SLOVAK MINISTRY OF ECONOMY

Integrated National Energy and Climate Plan for 2021 to 2030

prepared pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action

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CONTENTS:

LIST OF ABBREVIATIONS:

PART 1 GENERAL FRAMEWORK 7

SECTION A: NATIONAL PLAN 7

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN 7

1.1. Executive summary *7*

DECARBONISATION DIMENSION 10

ENERGY EFFICIENCY DIMENSION 11

ENERGY SECURITY DIMENSION 13

INTERNAL ENERGY MARKET DIMENSION 13

RESEARCH, INNOVATION AND COMPETITIVENESS DIMENSION: 13

1.2. Overview of the current policy situation *17*

1.3. Consultations and involvement of national and Union entities and their outcome *36*

1.4. Regional cooperation in preparing the plan *37*

2. NATIONAL OBJECTIVES AND TARGETS 39

2.1. Dimension: decarbonisation *39*

2.1.1. GHG emissions and removal 39

2.1.2. Renewable energy 43

2.2. Dimension: energy efficiency *50*

2.3. Dimension: energy security *56*

2.4. Dimension: internal energy market; *66*

2.4.1. Electricity interconnectivity 66

2.4.4. Energy Poverty 78

2.5. Dimension: Research, innovation and competitiveness *80*

DRAFT STATE R&D PROGRAMMES FOR 2020-2024 WITH OUTLOOK TO 2029 (MATERIAL PREPARED FOR GOVERNMENT APPROVAL) 80

SLOVAK RESEARCH AND DEVELOPMENT AGENCY (SRDA) 82

National Centre for Research and Applications of RES *82*

Intelligent Network Research Laboratory *82*

Research and development targets *82*

3.1. Dimension: decarbonisation *84*

3.1.1. GHG emissions and removals 84

Agricultural land - *Slovak Government Regulation No 342/2014, laying down rules for granting support in agriculture in the context of decoupled direct payment schemes. The Regulation introduces the efficient use and appropriate timing of use of nitrogen doses from mineral fertilizers.* *88*

Agricultural land after 2015 - *Slovak Government Regulation No 342/2014, laying down rules for granting support in agriculture in the context of decoupled direct payment schemes. The Regulation introduces the efficient use and appropriate timing of use of nitrogen doses from mineral fertilizers after 2015.* *88*

D) SECTORAL POLICIES AND MEASURES IN THE LAND USE, LAND-USE CHANGE AND FORESTRY (LULUCF) SECTOR 88

3.1.2. Renewable energy 92

3.2. Dimension: energy security *108*

3.3. Dimension: energy security *130*

3.4. Dimension: internal energy market *133*

3.4.1. Electricity infrastructure 133

3.4.2. Energy transmission infrastructure 134

3.4.3. Market integration 134

3.4.4. Energy Poverty 136

3.5. Dimension: Research, innovation and competitiveness 138

SECTION B: ANALYTICAL BASIS 140

4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES 140

4.1. Projected evolution of main exogenous factors influencing energy system and GHG emission developments 140

4.2 Dimension: decarbonisation 146

4.2.1. GHG emissions and removals 146

Source: SHMI 149

4.5. Dimension: internal energy market 196

4.5.1. Electricity interconnectivity 196

4.5.2. Energy transmission infrastructure 201

5. IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES 225

5.1. Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals, including comparison to forecasts based on existing policies and measures (as described in section 4). 225

LIST OF PARAMETERS AND VARIABLES TO BE REPORTED IN SECTION B OF THE NATIONAL PLAN 252

List of abbreviations:

€	Euro
AM	Action Measure
AP	Action Plan
BOE	Barrel of Oil Equivalent
BSR	Bratislava Self-Governing Region
CEF	Connecting Europe Facility (EU financial tool)
CESEC	Central and South Eastern Europe Energy Connectivity
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
CPS	Compact-PRIMES model for Slovakia
CR	Czech Republic
DHS	District heating system
CETS	Czech energy transmission system
DS	Distribution system
EAP	Environmental Action Programme
EDEPI	European Domestic Energy Poverty Index
EED	Energy Efficiency Directive
EEX	European Energy Exchange
EC	European Commission
MPP	Mochovce power plant
NPP	Nováky power plant
ENTSO-E	European Network of Transmission System Operators
EP	European Parliament
EP SR	Energy Policy of the Slovak Republic (material approved by the Slovak Government in 2014)
ESD	Effort Sharing Decision
ESR	Effort Sharing Regulation
EST	Electric station
ESIF	European Structural and Investment Funds
ETS	Emissions Trading System
EU	European Union
EU ETS	EU Emissions Trading System
EUCO scenarios	Scenarios prepared by the European Commission
EUR	Euro
EURATOM	European Atomic Energy Community
GES	Guaranteed energy service
Gg	Gigagram
GWh	Gigawatt hour
H_2	Hydrogen
GDP	Gross Domestic Product
HU	Hungary
CH_4	Methane
InCT	Individual car transport
IEA	International Energy Agency
SMS	Intelligent measuring systems
IROP	Integrated Regional Operational Programme
SG	Smart Grids
IT	Information technologies
FEC	Final energy consumption
MWa	Municipal waste

CS	Compressor station
KTEE	Kiloton energy equivalent
CHP	Combined Heat and Power (Cogeneration)
kW	Kilowatt
LCA	Life Cycle Analysis
LNG	Liquefied natural gas
LULUCF	Land use, land-use change, and forestry
m^2	Square metre
m^3	Cubic metre
MTaC SR	Ministry of Transport and Construction of the Slovak Republic
ME SR	Ministry of Economy of the Slovak Republic
MAaRD SR	Ministry of Agriculture and Rural Development of the Slovak Republic
SME	Small and medium-sized enterprises
MSR	Market Stability Reserve
MESRS SR	Ministry of Education, Science, Research and Sport of the Slovak Republic
MTEE	Megaton energy equivalent
MW	Megawatt
MEnv SR	Ministry of the Environment of the Slovak Republic
N_2O	Nitrous oxide
NBS	National Bank of Slovakia
NECP	Integrated National Energy and Climate Plan
NEC	National emission ceilings
NFC	Non-repayable financial contribution
NH_3	Ammonia
NForC	National Forest Centre
NMVOC	Non-methane volatile organic compounds
NO_x	Nitrogen oxides
NRP	National Reform Programme
NC SR	National Council of the Slovak Republic
NSDS	National Sustainable Development Strategy
LCS SR	Low Carbon Strategy of the Slovak Republic
O_3	Ozone
OECD	Organization for Economic Cooperation and Development
CE	Circular economy
OP QE	Operational Programme Quality of Environment
OP II	Operational Programme Integrated Infrastructure
UN	United Nations
RES	Renewable energy sources
PCI	Projects of Common Interest
DSO	Distribution system operator
PEC	Primary energy consumption
PM	Particulate matter
POPs	Persistent organic pollutants
GSC	Gas-steam cycle
SS	Support services
TS	Transmission system
PSHPP	Pumped storage hydro power plants
R&D	Research & Development
SAS	Slovak Academy Of Science
SEnvA	Slovak Environmental Agency
SEA	Strategic Environmental Assessment
SET Plan	Strategic Energy Technology Plan
SHMI	Slovak Hydrometeorological Institute

SIEA	Slovak Innovation and Energy Agency
SR	Slovak Republic
SO_2	Sulphur dioxide
STI	Slovak Trade Inspection
ST R&D	State Plan for Research and Development
SO SR	Statistical Office of the Slovak Republic
t	tonne
TEN-T	Trans-European Transport Networks
TJ	Terajoule
SD	Sustainable Development
TYNDP	Ten-Year Network Development Plan
UA	Ukraine
UNFCCC	United Nations Framework Convention on Climate Change
RONI	Regulatory Office for Network Industries
V4	Visegrád Group (Slovakia, Czech Republic, Hungary, Poland)
HV	High voltage
LV	Low voltage
UNI	University
VHV	Very high voltage
WAM	'Additional measures' scenario
WEM	'Existing measures' scenario
WOM	'Without measures' scenario
ENV	Environment

Part 1 General framework

SECTION A: NATIONAL PLAN

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1. Executive summary

i. Political, economic, environmental and social context of the plan

The Slovak Republic (SR) became an independent state in 1993. It became a member of the Organization for Economic Cooperation and Development (OECD) in 2000, has been a member of the European Union (EU) since May 2004, and since 2007 has been a member of the International Energy Agency (IEA). The Slovak Republic adopted the joint European currency, the euro, in January 2009.

In November 2014, the Slovak Government approved an Energy Policy (EP SR), setting targets and priorities for the energy sector to 2035 with an outlook to 2050. The strategic objective of the EP SR is to achieve a competitive low-carbon energy industry sector ensuring the secure and efficient supply of all forms of energy at affordable prices, and taking customer protection and sustainable development into account.

The Slovak Republic takes air quality, reducing greenhouse gas emissions, mitigating climate change, the security of supplies of all energy types and their affordability, extremely seriously. In 2019, the SR committed to achieving carbon neutrality by 2050. The gross domestic consumption of the SR features balanced shares of nuclear and fossil fuels. The development of the power industry in the SR focuses on optimising the energy mix to reduce emissions of greenhouse gas and pollutants as much as possible while retaining or increasing energy security and the affordability of the individual energy types.

Pursuant to Section 88 of Act No 251/2012, on energy and on the amendment of certain other acts, as amended, the ME SR is responsible for preparing an energy policy for at least 20 years and for updating it in a five-year cycle. The Integrated National Energy and Climate Plan, prepared within the meaning of Art. 9 of Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, is an update of the Energy Policy approved through Resolution of the Government of the SR No 548/2014 of 5 November 2014.

The Energy Policy of the Slovak Republic (EP SR) originally featured four basic pillars - energy security, energy efficiency, competitiveness and sustainable energy. The EP SR also included science, research and innovation. This plan updates the existing Energy Policy while extending it to include decarbonisation.

The priorities of the EP SR are:

- an optimal energy mix;
- increase energy supply security;
- develop the energy infrastructure;
- diversify energy sources and distribution routes;

- maximum use of transmission networks and transit systems passing through the SR;
- application of the primacy of energy efficiency principle;
- reduce energy intensity;
- a functioning energy market in a competitive environment;
- high-quality energy supply at affordable prices;
- protect vulnerable customers;
- address energy poverty;
- a reasonable pro-export balance in the electricity system;
- promote high-efficiency cogeneration;
- promote the use of efficient district heating systems (DHS);
- promote the use of RES to produce electricity, hydrogen, heat and cold;
- use nuclear energy as a low-carbon electricity source;
- improve the safety and reliability of nuclear power plants.

Sustainable development must meet the current needs of the population without limiting future generations' ability to meet their own needs. It is therefore necessary to change technologies, processes and habits on both the generation and consumption sides.

The main quantified energy and climate targets for 2030 are, throughout the Union, to achieve a reduction in greenhouse gas emissions of at least 40% compared to 1990 (individual Member States have shares that take their local conditions into account), with the following binding targets at Union level: achieve an RES share in gross energy consumption of at least 32%, while the RES share in transport must be at least 14% in every Member State, a national energy efficiency contribution of at least 32% and electrical system interconnectivity of at least 15%.

The main quantified NECP targets for the SR by 2030 are to reduce greenhouse gas emissions for sectors not involved in emissions trading (non-ETS) by 20% (the share has been increased from the originally declared 12%). The RES share in final energy consumption has been set at 19.2% for 2030, together with meeting the required target of 14% of RES in transport. The elaborated measures to achieve the national contribution of the SR in energy efficiency show slightly lower values (30.3%) than the European target of 32.5%. Industry and buildings will be key to achieving the targets. The interconnectivity of the electricity grids is already above 50% and will remain so in 2030, so the target of at least 15% will be met.

Table 1 Europe-wide and national targets

EU and SR targets	**EU 2030**	**SR 2030**
Greenhouse gas emissions (compared to 1990)	**-40%**	**There are no national targets for individual Member States**
Emissions in the ETS sector (compared to 2005)	**-43%**	
Non-ETS greenhouse gas emissions (compared to	**-30%**	**-20%**

2005)		
Total share of renewable energy sources (RES)	**32%**	**19.2%**
Share of RES in transport	**14%**	**14%**
Energy efficiency	**32.5%**	**30.3%**
Interconnection of electricity systems	**15%**	**52%**

Source: EC, ME SR

The NECP proposal submitted to the European Commission in December 2018 included a proposed SR contribution to the RES target of 18%. Taking into account the need to increase RES ambitions, and based on the PRIMES-EUCO model scenario that shows the possibility of achieving an RES share of 19%, as well as taking into account other additional factors, the proposal for the final NECP was submitted for a public comments procedure with thorough processing for a scenario with measures for a target RES value of 19.2% in 2030. An increase in the ambition to 20% was compared to this scenario, with the additional required investment calculated at around EUR 700 million. Based on the comments from the interdepartmental consultation procedure, the target of 19.2% was chosen because 5 entities directly supported the reference target while no entity was in favour of the alternative 20% target.

In the electricity generation from RES sector, the NECP proposal from 2018 determined an indicative target of 25% for 2030, corresponding to 27.3% for the 19.2% target, which is at the limit of the technical possibilities of the Slovak electricity system. One alternative to increasing the overall share of RES in 2030 from 19.2% to 20% lies in heat generation. This would however require greater use of biomass, including the production of biogas and biomethane (mainly derived from waste from plant and animal production, from the biodegradable part of municipal waste, biodegradable kitchen and restaurant waste and waste from waste water treatment plants), heat pumps, solar panels and geothermal energy in DHS. The high level of national gasification, with over 90% of the population having access to natural gas, acts against the greater use of RES in the heat sector. The transition to biomass from natural gas in households is therefore problematic from the perspective of air quality, which could endanger compliance with EU legislation. One solution is to incorporate biomethane and hydrogen into the existing gas infrastructure.

Given current technology and price levels, the extensive use of geothermal energy in the 2020-2022 period is unlikely. The costs connected to the accelerated construction of geothermal equipment would lead to a significant increase in prices for heat consumers. It is unlikely that the significant input investments required for a large number of geothermal sources could be covered from public and private financing in such a short time period. Greater use of geothermal energy is more likely at a later date.

The planned RES target for 2030 in the NECP is 19.2%. The ME SR will take all possible steps to further accelerate RES development between 2021 and 2030, in particular in heat generation, to ensure that the SR will be able to approach the higher RES share in 2030.

Our calculations and expert estimates indicate that the achievement of the 24% RES target in 2030, as indicated by the EC based on the indicative formula in Annex II of Regulation (EU) 2018/1999 of

the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, is also not realistic. The regulation itself anticipates that this value will be modified to take national specifics into account.

From the perspective of the SR, account needs to be taken of the fact that after the as-yet unfinished blocks at the Mochovce nuclear power plant are put into operation, it will be difficult, even impossible, to increase the RES share above the proposed RES target in the electricity generation sector. Maintaining the reliability of the Slovak electricity system will require a sufficient level of flexible sources, even if the level of cross-border connections with neighbouring countries is higher than the EU average.

ii. Strategy relating to all five energy union dimensions

Building a competitive low-carbon economy directed towards carbon neutrality is a long-term priority of the SR's Energy Policy. The transition to a low-carbon economy is associated with additional costs that will be borne by consumers and/or taxpayers. For this reason, it will also be necessary to adopt measures that respect the primacy of energy efficiency principle, while RES should not be the main target but only one of the tools for such transformation. Maximising the use of new financial support mechanisms between 2021 and 2030 (Modernization Fund, Innovation Fund) will also be unavoidable, as these – with the proper setup of priority projects at national level – can make a significant contribution towards the transition to a low-carbon economy.

Measures to ensure environmental sustainability:

- provide financial mechanisms and use the proceeds for the SR from quota auctions under the emissions trading scheme to support the energy and industry sectors, focusing on priority areas in line with the sustainable development principles as outlined above;
- intensify activities to reduce CO_2 emissions, particularly in the transport sector;
- thoroughly assess the construction of new energy conversion resources in view of the possible negative impacts on environmental sustainability and on efficiency reduction;
- optimise the RES share, especially in heat generation;
- use natural gas and, in the long term, decarbonised gases and hydrogen;
- prepare measures to enable economic growth based on a low carbon, circular and a less energy- and material-intensive economy;
- ensure the timely implementation of the Integrated National Energy and Climate Plan (NECP);
- contribute towards achieving the environmental sustainability of the set targets through appropriate and targeted regulatory measures;
- use waste-to-energy.

Decarbonisation dimension

Building a competitive, low-carbon economy is a long-term priority of the Energy Policy of the SR. The optimal use of renewable energy sources, nuclear energy, decarbonised gases and innovative technologies, which contribute towards the effective use of energy resources, are key to achieving a

low-carbon economy. The use of waste gases and waste within the framework of the circular economy can also make a contribution.

Achieving Slovakia's future targets while increasing the RES share will be associated with significant financial costs. Therefore, the SR will implement support mechanisms that will meet the target of increasing the RES share on the one hand while on the other contributing towards meeting the targets of reducing greenhouse gas emissions and maintaining the "value for money" principle.

The SR has one of the lowest-emission energy sectors in the EU thanks to the high share of nuclear sources in its electricity generation and the high share of natural gas in the heating sector. There is only space for decarbonising the energy sector through the replacement of coal with low-emissions sources, respectively alternative fuel sources, in energy efficiency measures and in the decarbonising of transport. After the replacement of solid fossil fuels with renewable energy sources, the SR will have one of the lowest-emission energy sectors in the whole of the EU (specifically the seventh-least-energy-intensive energy sector in the EU from the perspective of the CO_2 intensity of electricity and heat generation) and thus any potential for increased RES implementation must be sought in the regions, where solid fossil fuels are used to a greater extent – RES and decarbonisation will be far more cost-effective there.

When projecting RES use, account was taken of the principle of minimising costs through an integrated approach to renewable energy sources and reducing greenhouse gas emissions. This means that the use of fossil fuels, and thereby greenhouse gas emissions, will be reduced through a suitable combination of RES and low-carbon technologies. In the upcoming period, the use of RES will be a priority – especially in transport, and in heat and cold production – while support for electricity generation will be limited.

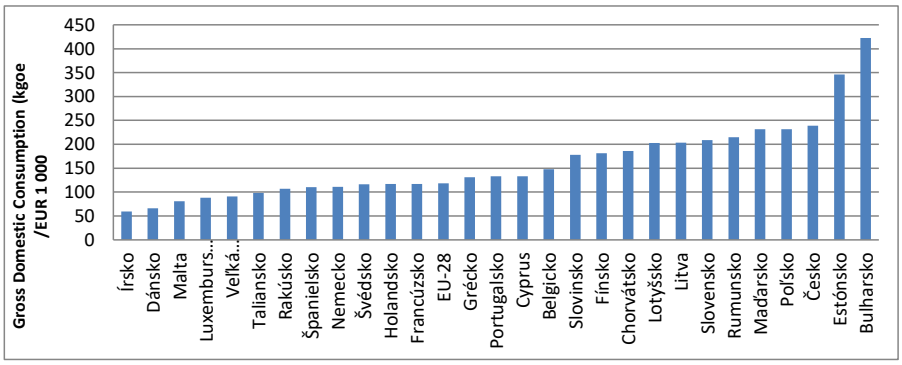
In the coming years the heating sector and, in particular, district heating, will be important for the transformation of the energy sector. Reducing the share of coal in heating to the benefit of renewables will improve the sustainability and security of heat supply. The high degree of centralisation of heat supply creates good technical preconditions for the use of biomass, biomethane and geothermal energy. The low-carbon electricity generation mix means that gradual electrification, in particular of public passenger transport, will be a challenge.

The acceptance of the more ambitious RES targets to 2030 (far over and above the scope of coal replacement) will significantly reduce the flexibility of a Member State to effectively reduce CO_2 emissions in other sectors from a technological and economic perspective.

Energy efficiency dimension

Energy efficiency synergistically contributes to reducing the energy intensity of the economy, contributes to increased energy security, has an impact on reducing the operating costs of energy companies and, last but not least, the savings on primary energy sources contribute to the mitigation of energy sector environmental impacts. Energy efficiency cuts across all dimensions of the Energy Policy.

Figure 1: Comparison of EU Member State energy intensity in 2017



Source: Eurostat (2019)

Key:

Hrubá domáca spotreba / HDP (kgoe/1000EUR):	**Gross Domestic Consumption (kgoe/EUR 1 000 EUR)**
Irsko	Ireland
Dánsko	Denmark
Malta	Malta
Luxemburg	Luxembourg
Veľká (Británie)	United Kingdom
Taliansko	Italy
Rakúsko	Austria
Španelsko	Spain
Nemecko	Germany
Švédsko	Sweden
Holandsko	Netherlands
Francúzsko	France
Grécko	Greece
Portugalsko	Portugal
Cyprus	Cyprus
Belgicko	Belgium
Slovinsko	Slovenia
Finsko	Finland
Chorvátsko	Croatia
Lotyšsko	Latvia
Litva	Lithuania
Slovensko	Slovakia
Rumunsko	Romania
Maďarsko	Hungary
Polsko	Poland
Česko	Czech Republic
Estónsko	Estonia
Bulharsko	Bulgaria

The energy intensity of the Slovak Republic has been falling in recent years. Significant progress in reducing energy intensity is evidenced by its development from 2000 to 2015 when, according to Eurostat data, the SR reduced its energy intensity by 50.8%. This positive development is, *inter alia*, a result of the successful restructuring of industry, the introduction of low-energy manufacturing processes in industry, improvements in building thermal and technical properties, and the replacement of appliances for more-energy-efficient ones. However, in spite of this, the Slovak Republic has the seventh-highest energy intensity in the EU-28 on a constant prices basis. This is mainly due to the structure of industry in the Slovak Republic, with high-energy-intensity industry having a major share, meaning that energy efficiency measures, including funding sources, will focus much more on industry and related services, including energy, in the future. The Slovak energy efficiency priority is a further reduction in the energy intensity of the SR economy with a view to achieving the European average.

The Slovak Republic has transposed the entire energy efficiency strategic and legislative framework of the European Union into its national strategic and legislative framework.

For energy efficiency, the key implementation tools to 2020 were energy efficiency Action Plans that assess energy efficiency measures and set out new measures to meet energy savings targets. This role will transfer to the NECP and two-year energy sector progress reports after 2020.

Energy security dimension

From the energy security point of view, there is support for an efficient energy architecture which creates, for the benefit and protection of consumers, conditions for increasing energy security through the utilisation of domestic energy sources, a favourable environment for the construction of low-carbon heat and electricity generation sources with the option of exporting electricity, and an optimal energy mix with low-carbon technologies in each sector.

The key areas are the diversification of transit routes and energy sources, increased nuclear safety and reliability, and energy supply security.

Internal energy market dimension

The Slovak Republic will strive to maximise its use of existing infrastructure in accordance with the rules adopted in new or amended EU documents that form part of the “Clean Energy for all Europeans” package. In this context, the deployment of smart energy systems and electricity storage systems is considered to be extremely important.

Research, innovation and competitiveness dimension:

The Implementation Plan of the Research and Innovation Strategy for Smart Specialisation of the Slovak Republic (IP RIS3) elaborates the procedures and processes for fulfilling the criteria in relation to thematic ex ante conditionality for the thematic objective entitled Strengthening Research, Technological Development and Innovation, and implementing the relevant investment priorities financed during the 2014-2020 programming period, as well as the measures to which the Slovak Republic has committed under the Operational Programme Research and Innovation (OP RandI).

As part of the EU’s climate change research programme, nearly EUR 6 billion has been earmarked for research into non-nuclear energy for the 2014-2020 period. In September 2015, the Commission adopted a Strategic Energy Technology Plan to help address the challenges needed to transform the EU’s energy system. This focuses on measures that will help the EU to become the world leader in renewable energy and develop energy efficient systems.

Establishing a technological lead in alternative energy and reducing energy consumption will create huge export and industrial opportunities. It will also support growth and jobs. Renewable energy sources will play an important role in the transition to a clean energy system.

The Slovak Republic has the potential to use knowledge and domestic expertise acquired through Big Data in the processing, analysis, prediction and visualisation of large volumes of data in real time, as well as to use artificial intelligence based on the extraction of historical data, with the objective of supporting future decisions, for example in environmental protection, the climate etc. These methods can be used to improve already tried and tested prediction models and to use modern technologies and developed algorithms for distributed and parallel data processing. This will allow, *inter alia*, the processing of analyses of various internal and external factors (for example weather effects) to predict the evolution of relationships within a selected ecosystem or power system, including the visualisation of Big Data and the virtualisation of various situations.

The "Draft State R&D Programmes for 2020-2024 with a View to 2029" is currently being prepared. This material is ready for approval by the Government (as of September 2019). The State R&D Programmes address key issues in developing and meeting the needs of society. They specify the science and technology fields on which research and development should focus or that should be intensified to achieve increased economic and social benefits and contribute towards their high standard and international recognition.

The objectives of the implementation of the State R&D Programmes are to develop key areas of the economy with a direct link to the application of R&D results and outputs in practice, to support improving the competitiveness of the SR economy and to support societal development, through targeted solutions for research and development projects supported from the State budget.

iii. Overview table with key objectives, policies and measures of the plan

Table 2: Key objectives, policies and measures

Strategy and policy	Key objectives	Measures
Economic Policy Strategy of the Slovak Republic to 2030 (Government Resolution No 300/2018)	Determine the strategic direction of the economic policy of the SR with a view to 2030. Improve the predictability and stability of public decisions.	The economic policy strategy has a supra-departmental nature; its defined scope commits the Office of the Government of the Slovak Republic and the Office of the Deputy Prime Minister for Investment and Informatics, in addition to the relevant ministries, to cooperate in its preparation. The draft measures were drawn up in cooperation with the relevant ministries and institutions. The measures set out in the document will be implemented through Action Plans in three-year cycles. There will be a review and possible modification of the strategy based on current needs in the middle of the period to which the document relates.
Strategic Plan for the Development of Transport of the SR to 2030	Reduce the negative environmental and negative socio-economic impacts of transport (including climate change)	Promote the use of alternative fuels and build the related infrastructure for road and water transport, replace

(Government Resolution No 13/2017)	through environmental monitoring, effective infrastructure planning/implementation and reducing the number of conventionally powered means of transport, potentially by using alternative fuels	obsolete marine propulsion units, including the use of low-emissions auxiliary power units, to protect water from pollution due to the discharge of waste from vessels on the Slovak Danube, renew the vehicle fleet by motivating citizens through direct financial support from the State, and potentially tax instruments, respectively exemptions from toll payment for freight vessels running on alternative fuels.
Strategy for the Adaptation of the Slovak Republic to Climate Change - Update (Government Resolution No 478/2018)	The main objective of the updated Strategy for the Adaptation of the SR to the Adverse Effects of Climate Change is to improve the readiness of the SR to face the adverse effects of climate change, to provide as much information as possible about the current adaptation processes in the SR and, based on its analysis, to establish an institutional framework and coordination mechanism to ensure the effective implementation of adaptation measures at all levels and in all areas, as well as to improve overall awareness of this issue.	General guidance for adaptation and examples of specific adaptation measures in the transport, energy and industry sectors, and for some other business areas.
Environmental Policy Strategy of the Slovak Republic until 2030 (Environmental Strategy 2030)	Nature protection Air protection Green economy	Improve biodiversity protection and limit the deterioration in the condition of species and habitats. The Slovak Republic will achieve good water condition and the green measures adopted will ensure improved protection from flooding. Water retention, improved landscape planning and more responsible water management will contribute towards reducing droughts and water scarcity. In the area of air protection, the main measures will focus on reducing the burning of coal, increasing ecological transport and more efficient and cleaner heating systems. The “polluter pays” principle will be applied more consistently, and environmentally harmful subsidies for coal or biomass from unsustainable sources should also be removed. Air quality will be improved in 2030 and will not have a significant negative impact on human health or the environment. In the field of climate change, the Slovak Republic will reduce greenhouse gas emissions in emissions trading sectors by 43%

		and by at least 20% outside such areas compared to 2005. Sustainable use criteria for all renewable sources will be developed by 2020. Circular economy principles will be gradually introduced in Slovakia. By 2030, the recycling rate for municipal waste will increase to a minimum of 60%, and the landfill rate will be reduced to less than 25% by 2035. At the same time, the use of preventive measures to prevent illegal dumps will increase. Slovakia will limit the production of food waste by 2030. Restaurants and supermarkets will be obliged to use their food in alternative ways, either by donating unspoilt food to charity or by composting or applying energy recovery for post-guarantee food. Green public procurement will cover at least 70% of the total value of all public procurement, and support for green innovation, science and research will increase significantly. The energy intensity of Slovakia's industry will approach that of the EU average. In the field of energy generation, renewable energy sources that, do not burden the environment by their nature, will be preferred.
National indicative energy efficiency targets and contributions to the European energy efficiency target	Primary energy consumption in 2020 16.38 Mtoe, 686 PJ, 20% Final energy consumption in 2020 (Eurostat) 10.39 Mtoe, 435 PJ, 23% National indicative contributions to the EU target 32.5% in 2030	Measures to increase energy efficiency, in particular in buildings and industry. Chapter 2.2. energy efficiency dimension
Low-carbon strategy for development of the SR	Strategy objectives: • Provide a coherent long-term (30-year) strategic overview for the transition to a low-carbon economy • Ensure consistency with other strategic documents and Action Plans in the national economy (energy, industry, transport, agriculture and forestry, waste) • Introduce binding and indicative targets for individual areas • Ensure consistency with the targets of the Paris Agreement,	To be specified in the Low-Carbon Development Strategy of the SR

	primarily the carbon-neutrality target • Provide a list of measures and their funding possibilities • Evaluate the impacts of the strategy and its measures on macroeconomic indicators	
National Policy Framework for the Development of the Alternative Fuels Market (Government Resolution No 504/2016)	• To promote the development of the alternative fuels market in the transport sector and the development of the relevant infrastructure through the determined measures	The document defines the measures to meet the national targets and objectives of the national policy framework, measures to promote the introduction of infrastructure for alternative fuels in public transport services, and to evaluate the placement of filling stations for liquified natural gas in ports not part of the basic TEN-T network, and to evaluate the need to install electricity-supply equipment for the needs of aircraft at stands at airports. Fuels included in the national policy framework will be eligible for Union support measures and national support measures for alternative fuels infrastructure so that State aid focuses on the coordinated development of the internal market directed towards mobility, with the use of transport means running on alternative fuels, as well as on a whole range of regulatory and non-regulatory incentives, in close cooperation with private sector entities that could play a leading role in promoting the development of infrastructure for alternative fuels.
Action Plan for the Development of Electromobility in the Slovak Republic (Government Resolution No 110/2019)	• promote low-emissions mobility	The measures have the nature of direct support for the purchase of highly environmentally friendly low-emissions vehicles, support for the construction of infrastructure, as well as incentive support such as differing vehicle identification, access to low-emissions zones and the use of car parks intended for a restricted group of users.

1.2. Overview of the current policy situation

On 11 December 2018, the European Commission (EC) approved the Regulation of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action. The

creation of an energy union is one of the EC's ten political priorities, and this regulation is an important element in the strategic energy union framework.

i. National and Union energy system and policy context of the national plan

The Ministry of Economy is the central state administration authority for energy, including the management of nuclear fuel and the storage of radioactive waste.

The priorities of the Slovak Republic in the energy sector are to ensure synergy between sub-policies, cost efficiency, enforcement of the principles of sovereignty in the energy mix, preservation of competitiveness and energy security. In this context we consider the replacement of high-emissions energy sources for low-emissions ones, as well as the development of renewable energy sources (RES) and measures to increase energy efficiency as a means of achieving emissions targets. In Slovakia, as well as in several other Member States, safe and sustainable nuclear power will play a very important role in the transition to a low-carbon economy. Extending the service life of existing nuclear sources is an effective tool for achieving climate targets (with a minimal impact on the final electricity prices).

The energy sector is also very closely related to industry competitiveness, and is something to which we are paying more attention in view of high international competition and the emergence of the technologically revolutionary Industry 4.0 concept. We have committed to finding ways to reduce the final price of electricity for industrial customers.

The Slovak Republic constantly emphasises improving energy security and the security of energy supply, as evidenced by the continuation of work on individual Projects of Common Interest (PCI).

In the field of renewable energy sources (RES), efforts are being made to promote forms that can replace fossil fuels in a way that ensures reliable electricity or heat generation and supply without major additional costs. Conditions will be created for the optimal use of renewable energy sources in the energy mix in order to meet the SR's targets from EU legislation.

In October 2018, Parliament approved an amendment to Act No 309/2009, on the promotion of renewable energy sources, in line with the philosophy of gradually reducing support for this source, with the priorities being to ensure cost-effectiveness and to minimise the impact on final energy prices.

The highly developed transport and distribution networks mean that the use of existing gas infrastructure provides the prerequisites for further decarbonisation of the economy.

The Ministry of the Environment of the Slovak Republic is the central state administration authority for environment creation and protection, and is responsible for the creation of the environmental policy and the climate change policy. Within the scope of its competence, the ministry establishes special professional organisations, which are budgetary and contributory organisations, unless otherwise determined in a separate regulation, and establishes other legal persons.

ii. Current energy and climate policies and measures relating to the five dimensions of the Energy Union

The Slovak Republic has taken all necessary steps to improve its mechanisms for monitoring, evaluating and streamlining instruments and measures to fulfil its commitments under the United Nations Framework Convention on Climate Change (UNFCCC). All relevant policies and measures at EU level are being strengthened to meet the 2020 targets under the agreement in the Climate and Energy Package. This includes legislation introduced in the EU to reduce greenhouse gas emissions by at least 20% by 2020 compared to 1990, with a conditional shift to a 30% reduction provided that other developed countries commit themselves to comparable emissions reductions. In addition, the EU has committed to achieving a 20% share for renewable energy (as a share of gross final energy consumption in the EU) by 2020, complemented by a target of an at least 10% share of renewable energy sources in the transport sector. The EU is also committed to achieving a 20% reduction in overall primary energy consumption by 2020 compared to projections in 2007.[1] As can be seen from the recent greenhouse gas inventory results, the Slovak Republic is well on track to meet its commitments.

The overall policy framework in the Slovak Republic consists of national conceptual and strategic sectoral documents as well as European climate strategies and policies.

Policy context at EU level

a) The Europe 2020 Strategy - Europe 2020 is a ten-year growth strategy and builds on lessons learned from the Lisbon Strategy. The main objective of Europe 2020 is to ensure "smart, sustainable and inclusive growth" through greater coordination between national and European policies. Three priorities are outlined in the Europe 2020 Communication[2]:

- Smart growth – developing an economy based on knowledge and innovation.
- Sustainable growth – promoting a low-carbon, resource-efficient and competitive economy.
- Inclusive growth – fostering a high-employment economy delivering social and territorial cohesion.

b) Climate and energy package - In December 2008, the European Parliament and the Council agreed on the EU Climate and Energy Package which, for the first time, provided an integrated and ambitious package of policies and measures to combat climate change together with renewable energy sources and energy efficiency elements. The Climate and Energy Package was formally adopted in 2009, and includes the following 20-20-20 goals:

- A cut of at least 20% in greenhouse gas emissions (from 1990 levels), with a firm commitment to increase this target to 30% if a satisfactory international agreement is reached.
- To achieve 20% renewable energy (as a share of total EU gross final energy consumption) by 2020, complemented by a target of an at least 10% share of renewable sources in transport.

[1] The EU's 20% energy efficiency target was legally defined in the Energy Efficiency Directive in such a way that energy consumption in the EU (at that time the EU-27) in 2020 cannot exceed 1 474 Mtoe of primary energy consumption and 1 078 Mtoe of final energy consumption.
[2] COM (2010) 2020 Final

- To save 20% of total primary energy consumption by 2020 compared to the unchanged reference scenario.

In order to meet the key objectives, the Climate and Energy Package includes four pieces of complementing legislation[3]:

  - A Directive revising the EU Emissions Trading System (EU ETS), which covers some 40% of EU greenhouse gas emissions;
  - An "effort-sharing" Decision setting binding national targets for emissions from sectors not covered by the EU ETS;
  - A Directive setting binding national targets for increasing the share of renewable energy sources in the energy mix;
  - A Directive creating a legal framework for the safe and environmentally sound use of carbon capture and storage technologies - the Carbon Capture and Storage Directive.

c) Climate and Energy Framework 2030 - This framework was agreed by EU leaders in October 2014 and is based on the Climate and Energy Package 2020 mentioned above. It sets three main objectives for 2030:

- At least 40% cuts in greenhouse gas emissions (from 1990 levels). To achieve this reduction, EU ETS sectors should cut emissions by 43% (compared to 2005) – to this end, the EU ETS is to be reformed and strengthened. Non-EU ETS sectors should cut emissions by 30% (compared to 2005) – this target needs to be translated into individual binding targets for Member States.
- At least 27% of EU energy consumption from renewable energy sources.
- An at least 27% improvement in energy efficiency.

New, stricter objectives were agreed in November 2018 through a revision of the Energy Efficiency Directive and the RES Promotion Directive:

  - Energy efficiency in the EU should increase by 32.5% by 2030.
  - The share of energy generated from renewable sources in gross final energy consumption should reach at least 32% in the same period.
  - Both targets should be reviewed in 2023, however if they are to be changed then only to make them stricter – no reduction in the targets will be possible.

d) Roadmap 2050 - In 2011, the European Commission launched three plans to support the debate on a long-term framework for climate and energy policies in Europe:

  - A Roadmap for moving to a competitive low-carbon economy by 2050;[4]
  - A Roadmap for a Single European Transport Area – the creation of a competitive and resource-efficient transport system;[5]
  - A 2050 Energy Roadmap.[6]

[3] http://europa.eu/rapid/press-release_IP-09-628_en.htm

[4] COM(2011) 112 final.

[5] COM(2011) 144 final.

In February 2011, the European Council reaffirmed that the EU's goal is to reduce greenhouse gas emissions in the EU by 2050 by 80% to 95% compared to 1990 levels as part of the developed countries' efforts as a group to reduce their emissions by a similar amount. Although the EU has already committed itself to reducing greenhouse gas emissions by at least 20% by 2020 compared to 1990 levels as part of the Climate and Energy Package, longer-term policies are now needed to achieve an ambitious reduction target by 2050. The European Commission has therefore published the notice "A Roadmap for Moving to a Competitive Low-carbon economy by 2050", providing guidance on how the EU can decarbonise its economy.

e) 7th Environmental Action Programme - Since the 1970s, environmental action programmes have provided the basis for the development of EU environmental policy. The 6th Environmental Action Programme expired in July 2012. Political agreement on a new General Union Environment Action Programme to 2020 (entitled Living well, within the limits of the planet) was reached between the European Commission, the European Parliament and the Council in June 2013. The Seventh EAP,[7] as proposed by the European Commission in 2012, provides an overarching framework for environmental policy (without any specific climate policy objectives, as this policy is currently a separate policy area) over the next decade, identifying nine priority objectives for the EU and its Member States:

- To protect, conserve and enhance the Union's natural capital.
- To create a resource-efficient, green and competitive low-carbon economy from the Union.
- To safeguard the Union's citizens from environment-related pressures and risks to health and well-being.
- To maximise the benefits of Union environment legislation by improving implementation.
- To improve the knowledge and evidence base for Union environment policy.
- To secure investment for the environment and climate policy and address environmental externalities.
- To improve environmental integration and policy coherence.
- To enhance the sustainability of the Union's cities.
- To increase the Union's effectiveness in addressing international environmental and climate-related challenges.

g) EU Circular Economy Action Plan - In December 2015, the European Commission approved the EU Circular Economy Action Plan as a tool to achieve the goals of the 2030 Agenda for Sustainable Development and, in particular, Objective No 12 "Sustainable consumption and production". This Action Plan focuses on:

- Production
- Consumption
- Waste management
- Support for the market in secondary raw materials and water reuse

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[6] COM(2011) 885/2.

[7] Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of the planet';

The priority areas of the Action Plan include plastics, food waste, key raw materials, construction and demolition waste, biomass and organic products.

Policy context at national level

a) **The Energy Policy of the Slovak Republic**

The Energy Policy was adopted through Resolution of the Government of the Slovak Republic No 548/2014. The Energy Policy of the Slovak Republic (Energy Policy) is a strategic document defining the primary objectives and priorities of the energy sector for the period to 2035 with an outlook to 2050. The Energy Policy is part of the national economic strategy of the Slovak Republic, because securing sustainable economic growth is conditional on a reliable supply of affordable energy. The aim of the Energy Policy is to ensure the sustainability of the Slovak energy sector to contribute towards the sustainable growth of the national economy and its competitiveness. The priorities from this point of view are to ensure the reliability and stability of the energy supply, efficient use of energy at optimal cost, and to ensure protection for the environment. The Energy Policy signals certain measures to reduce final electricity prices, including the phasing out of electricity tariffs for renewable electricity by 2020, focusing on the use of renewable energy sources for heat, electricity and transport, and on some efficiency-related changes in energy tariffs in connection with cogeneration.

b) The National Reform Programme (NRP)

The NRP is a national, regularly updated programme with the main objective of meeting the Europe 2020 strategy's structural policy objectives. It also contains an Action Plan with sector-specific target policies, including dedicated financial allocations.

c) **The Slovak Republic National Strategy for Sustainable Development (NS SD)**

The National Strategy for Sustainable Development is the cross-sectional document for sustainable development in the Slovak Republic, approved through Resolution of the Government of the SR No 978/2001. It integrates the key strategies and concepts of all the ministries into one resulting document. According to the national strategy, the basic orientation of the SR should be a long-term, targeted and comprehensive focus on the creation of a society founded on the principles of sustainable development and their practical application. To achieve this orientation it is necessary, throughout society, to apply sustainable development principles and criteria and focus on the long-term priorities (integrated targets) of sustainable development in the SR. 28 strategic objectives have been defined as part of this focus on setting long-term priorities, including reducing the use of non-renewable natural sources with the concurrent rational use of renewable sources; reducing the environmental burden; mitigating the impacts of global climate change, ozone depletion and natural catastrophes; and improving the quality of the environment in the regions.

d) **Strategy for Adaptation of the Slovak Republic to Climate Change**

The update was adopted by Resolution of the Government of the Slovak Republic No 478/2018. The main objectives of the updated national adaptation strategy are to improve Slovakia's preparedness to face the adverse impacts of climate change; to provide the widest possible information on current adaptation processes in Slovakia; and to establish an institutional framework and coordination mechanism to ensure the effective implementation of adaptation measures at all levels and in all areas to improve general awareness of this issue.

Figure 1 Interconnection of component areas in the context of adaptation to climate change

Key:

Adaptation Strategy of the SR for the Adverse Effects of Climate Change
Rock environment and geology State Programme for the Remediation of Environmental Burdens (2016-2021) Programme for the Prevention and Management of Landslide Risks (2014-2020)
Natural Environment and Biodiversity Updated National Strategy for Biodiversity Protection to 2020 and Action Plan for the National Strategy for Biodiversity Protection
Water Regime in the Landscape, Water Management Orientation, Principles and Priorities of the Water Management Policy of the SR to 2027 Water Plan of Slovakia Management Plans for Flood Risks to the SR
Residential Environment Urban Development Concept of the Slovak Republic
Population Health Action Plan for the Environment and Population Health SR IV. (NEHAP IV.)
Agriculture Concept for the Development of Agriculture of the SR 2013-2020
Forestry

National Forestry Programme (NFP) and NFP SR Action Plan for 2015-2020
Transport Strategic Plan for the Development of Transport Infrastructure to 2020 Development Strategy for Public Personal and Non-motorized Transport of the SR to 2020
Recreation and Tourism Development Strategy for Tourism to 2020
Industry, Energy Energy Policy of the Slovak Republic Research and Innovation Strategy for the Intelligent Specialization of the Slovak Republic Intelligent Industry Concept for Slovakia
Management of Emergencies and Population and Environment Protection National Strategy of Security Risks Management of the SR

Source: MEnv SR, Strategy for the Adaptation of the SR to Climate Change

e) Environmental Policy Strategy of the Slovak Republic "Greener Slovakia"

The Environmental Strategy Policy of the Slovak Republic to 2030 (Environmental Strategy 2030), approved by the Government of the Slovak Republic in February 2019 through Resolution No 87/2019, defines the vision to 2030, taking into account possible, likely and desired future development, identifies fundamental systemic problems, sets targets for 2030, proposes framework measures for improving the current situation, and also contains basic result indicators that allow verification of the achieved results. The basic vision of Environmental Strategy 2030 is to achieve a better quality of environment and a sustainable circular economy based on the consistent protection of environmental components using as few non-renewable natural resources and hazardous substances as possible, leading to improvement in population health.

For the preparation of this strategy, several studies were carried out, stakeholders were consulted, and the public had an opportunity to influence the strategy content.

f) Low-Carbon Development Strategy of the SR until 2030, with a View to 2050 (LCDS SR)

The MEnv SR completed a cooperation project with the World Bank in 2019. The main output of the project is a document entitled "A Low-Carbon Growth Study for Slovakia : Implementing the EU 2030 Climate and Energy Policy Framework". This study is the principal material for the preparation of the LCDS SR. The LCDS SR will include effective and cost-effective measures in the industry, energy, energy efficiency, transport, agriculture, forestry and waste management sectors. Representatives of the professional and lay public (relevant ministries, departmental organizations, and other interest organizations and institutions) are involved in the LCDS SR preparation process.

g) European Greenhouse Gas Emission Trading Scheme (EU ETS)

The EU ETS was established through Directive 2003/87/EC and has undergone several revisions to strengthen its implementation during its three trading periods (2005-2007, 2008-2012 and currently 2013-2020).

The first phase (2005-2007) was a three-year pilot period to learn from practical situations as preparation for the second phase, when the EU ETS was to work effectively to help ensure that the EU and its Member States meet their emissions targets under the Kyoto Protocol.

Before the start of the first phase, the Slovak Republic had to decide on the numbers of quotas to allocate to each EU ETS operation in its territory. This was done through the first National Allocation

Plan, which the Slovak Republic prepared and published on 1 May 2004. The European Commission Decision on Phase I of the National Allocation Plan of the Slovak Republic was approved on 20 October 2004.

Statistics from Phase I of the EU ETS:

- 175 facilities;
- 38 facilities closed their accounts;
- a permit was cancelled for 1 facility.

Table 3: Statistics from Phase I of the National Allocation Plan (in tonnes)

Year	**2005**	**2006**	**2007**
Allocation	30 299 021	30 357 450	30 357 404
Verified emissions	24 892 813	25 200 029	24 153 151

Source: Ministry of the Environment of the Slovak Republic

The second phase of the EU ETS was the five-year 2008-2012 period and corresponded to the first mandatory period of the Kyoto Protocol. The Decision of the European Commission on Phase II of the National Allocation Plan of the Slovak Republic was approved on 29 November 2006 and amended by the decision of 7 December 2007.

Statistics from Phase II of the EU ETS:

- 193 facilities;
- 30 facilities closed their accounts;
- a permit was cancelled for 1 facility.

Table 4: Statistics from Phase II of the National Allocation Plan (in tonnes)

Year	2008	2009	2010	2011	2012
Allocation	32 166 094	32 140 581	32 356 123	32 617 164	33 432 258
Verified emissions	25 336 706	21 595 209	21 698 625	22 222 534	20 932 903

Source: Ministry of the Environment of the Slovak Republic

The third phase of the EU ETS started on 1 January 2013 and introduced several changes. It brought in harmonised rules for the free allocation of emission allowances, introduced auctions as the main instrument to meet the emissions reduction target, added other sectors to its scope (*inter alia* civil aviation and aluminium) and set an annual reduction target of 1.74%. The Slovak Republic notified the Commission of the list of facilities covered by the Directive in its territory on 17 August 2012.

Table 5: Statistics from Phase III of the National Allocation Plan (in tonnes)

Year	2013	2014	2015	2016	2017	2018
Allocation	16 466 336	15 821 315	15 029 434	14 522 533	13 849 714	13 658 304
Verified emissions	21 829 374	20 918 069	21 181 280	21 264 045	22 063 225	22 193 396

Source: Ministry of the Environment of the Slovak Republic

In July 2015, the Commission presented a legislative proposal for reform of the EU ETS for the post-2020 period (i.e. Phase IV). This was followed by several consultations on this proposal, including expert meetings, to discuss the technical aspects of the proposed emission allowance free allocation rules and carbon leakage and independent stakeholder consultations on the newly proposed Innovation Fund.

Final agreement on the legislative proposal was reached in November 2017. The revised Directive was published in the Official Journal of the European Union in March 2018[8]. The main elements for the 2021-2030 period are: continued free allocation, continuation of safeguard measures to prevent carbon leakage, a linear emissions reduction factor at -2.2%, low-carbon support mechanisms (Innovation Fund, Modernisation Fund and exceptions for electricity generators) and a revision clause.

- New Entrants Reserve

  A maximum of 5% of the volume of EU allowances for the 2013 to 2020 period will be reserved for new entrants. The Slovak Republic has so far registered three official requests.

- New Entrants Reserve 300

  No carbon capture and geological storage project or innovative renewable energy project from the Slovak Republic participated in the first or second call of the New Entrants Reserve 300 initiative.

- Auction

  The auction is a new way of allocating allowances in Phase III. Interim auctioning began in 2012 with an auction of 120 million EUA, of which the Slovak Republic's share was 1.8 million EUA. The auctions are held on the European Energy Exchange (EEX) every Monday, Tuesday and Thursday. From 2015 onwards, the entire proceeds of the auction are income for the Environment Fund of the Slovak Republic. The auction share of the Slovak Republic was 14.9 million EUA in 2018.

Table 6: Revenues of the Slovak Republic from auctions 2012-2018

Period	2012	2013	2014	2015	2016	2017	2018
	EUR						
Revenue (EUA)	12 193 290	61 702 620	57 590 625	84 312 060	64 991 430	87 007 265	229 635 710
Revenue (EUAAs)	-	-	44 590	197 300	55 815	57 205	178 950
Overall revenue	12 193 290	61 702 620	57 635 215	84 509 360	65 047 245	87 064 470	229 814 660

Source: Ministry of the Environment of the Slovak Republic

- Backloading

Backloading is a term used to describe the process whereby a larger number of auction allowances will be temporarily withdrawn from auctions in 2014-2016 and returned to auction in 2019-2020. The main objective is to eliminate the current surplus of emission allowances in the EU ETS and to ensure an increase in carbon prices in the market.

According to Decision (EU) 2015/1814 on the establishment and functioning of a market stabilization reserve (see below), 900 million emission allowances deducted from auction volumes in the 2014-2016 period will not be added to the volumes to be auctioned in 2019 and 2020 but will instead be put in reserve. Directive 2009/29/EC lays down provisions that allow the EU ETS to be linked to other greenhouse gas trading systems, i.e. interconnection with other similar systems set up at regional or national levels outside the EU. Negotiations are ongoing on the interconnection of the EU and Swiss systems.

[8] Directive (EU) 2018/410

- MSR

The Market Stability Reserve (MSR) was introduced as a long-term solution to combat existing quota surpluses within the EU ETS. This is an automated mechanism to reduce the volume of auctioned allowances if there is a significant surplus in the market. If additional allowances are needed, the MSR will be used to increase the auction volume. The MSR will be operational from 2019 and all temporarily withdrawn allowances will become part of this reserve. This will cause a continuous increase in the price of carbon in the EU ETS and a stable investor environment for the next decade. On 15 May 2018, the Commission published the total number of allowances in circulation in 2017, approximately 1.65 billion. In accordance with MSR rules, 264 731 936 emission allowances will be placed in the reserve during the 8 months from January 2019. In accordance with the MSR rules, 397 178 358 emission allowances will be placed in the MSR over a period of 12 months (from 1 September 2019 to 31 August 2020). Further publication will be made in May 2020 to determine the reserve for September 2020 to August 2021.

h) Effort Sharing Decision (ESD)[9]

The ESD sets out the annual greenhouse gas emission targets of the Member States for the 2013-2020 period – these are legally binding and cover only greenhouse gas emissions not covered by the EU ETS, i.e. transport (excluding aviation), buildings, agriculture (excluding LULUCF) and waste. Each Member State must define and implement national policies and measures to reduce emissions of the greenhouse gases included in the Effort Sharing Decision. These include promoting public transport, building energy efficiency standards, more efficient farming practices and the conversion of animal waste into biogas. The emission limit values for the Slovak Republic are set at +13% by 2020 compared to 2005 levels.

Table 7: Evaluation of EU ETS and ESD greenhouse gas emissions in 2016

Category	Unit	Total emissions	EU ETS emissions	ESD emissions	EU ETS/ESD share in%
GHG emissions	Gg CO_2 equiv.	41 037.12	21 264.05	19 773.07	51.82/48.18
CO_2 emissions	Gg	38 984.26	21 136.23	17 848.03	54.22/45.78
N_2O emissions	Gg CO_2 equiv.	2 046.37	121.33	1 925.04	5.93/94.07
PFC emissions	Gg CO_2 equiv.	6.49	6.49	0.00	100/0

Source: Slovak Hydrometeorological Institute

Table 8: Evaluation of EU ETS and ESD greenhouse gas emissions in 2017

Category	Unit	Total emissions	EU ETS emissions	ESD emissions	EU ETS/ESD share in%
GHG emissions	Gg CO_2 equiv.	43 316.45	22 063.23	21 253.22	50.93/49.07
CO_2 emissions	Gg	41 344.21	21 949.62	19 394.59	53.09/46.91
N_2O emissions	Gg CO_2 equiv.	1 963.61	104.98	1 858.63	5.34/94.66
PFC emissions	Gg CO_2 equiv.	8.62	8.62	0.00	100/0

[9] Decision 406/2009/EC

Source: Slovak Hydrometeorological Institute

According to current emissions projections, the Slovak Republic should meet its individual 2020 targets for sectors not covered by the EU ETS with the current setup of national policies.

Table 9: Progress made in meeting the GHG targets under the Effort Sharing Decision (ESD) based on projections

2020 Target under ESD (% vs 2005)	+13.0%
2015 ESD emissions (% vs 2005)	-23.2%
2020 ESD WEM projections (% vs 2005)	-23.0%
2020 ESD WAM emissions (% vs 2005)	-26.0%

Source: MEnv SR

The most important sectors falling under the ESD from the perspective of emissions are transport and domestic heating. Transport and domestic heating are the most-focused-on sectors covered and regulated under the ESD. Total aggregate GHG emissions in transport are at the same level as in the base year of 1990 even though emissions have fallen in other sectors. This is the result of an increase in traffic intensity and the number of kilometres travelled, which cannot be offset by the increased energy efficiency of the vehicles (thanks to European legislation on CO_2 standards for cars and light commercial vehicles). Transport currently contributes 16.3% to total GHG emissions (CO_2 equivalent) and its share of total emissions has more than doubled since 1990. CO_2 emissions have fallen from 184 gCO_2/km to the current 133 gCO_2/km since 2000, and are expected to drop to 95 gCO_2/km for passenger cars by 2020, a fall of about half. The obligation for engine manufacturers to reduce their CO_2 emissions means that cumulative GHG and pollutant emissions over the last 15 years have not increased in direct proportion to the increase of 45% in vehicles, but have remained at the same level as in 2000. This indicates that engine manufacturers have improved their operational and environmental efficiency by up to 50%. As the transport sector is one in which reducing greenhouse gas and pollutant emissions is a challenge, attention still needs to be paid to the implementation of effective policies and measures that have real potential to reduce them, including taking their business environment and social impacts into account.

The Effort Sharing Decision, effective in stimulating new national policies and measures, has led Member States to become more proactive in considering new measures, as well as leading to better coordination between national, regional and local governments. This positive progress led to a new legislative proposal on an Effort Sharing Regulation (ESR) presented by the European Commission in July 2016. The Regulation lays down binding annual targets for greenhouse gas emissions for Member States for the 2021-2030 period, retaining binding annual greenhouse gas emission limit values for each Member State. Emission limit values will be set for each year in the 10-year period to 2030 on a falling linear trajectory.

The main changes proposed by the current ESR include the retention of flexible mechanisms under the Effort Sharing Decision and the addition of two new flexibilities.

These are:

- one-off flexibility to transfer a limited volume of allowances from the EU ETS: this covers some emissions in non-ETS sectors with EU ETS allowances that would normally be traded through auction;

- a new flexibility to transfer a limited volume of credits from the land use, land-use change and forestry (LULUCF) sector: to stimulate additional measures in the land use sector. The proposal will allow Member States to use up to 280 million credits throughout the 2021-2030 period from certain land use categories to meet their national targets.

j) Biofuel use policy

The basic framework for biofuel use was Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, as well as Directive (EU) 2015/1513 of the European Parliament and of the Council, amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. It has now been replaced by Directive 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast).

The body responsible for the implementation of the two directives is the Ministry of Economy of the Slovak Republic. The Ministry of the Environment is responsible for meeting the sustainability criteria for biofuels and bioliquids, for calculations to determine the impact of biofuels and bioliquids on greenhouse gas emission volumes, and for calculating greenhouse gas emissions during the life cycle of fossil fuels under Art. 7a of Directive 2009/30/EC and Council Directive (EU) 2015/652 of 20 April 2015 laying down calculation methods and reporting requirements under Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels.

In relation to sustainability criteria, the Slovak Republic has implemented Articles 17, 18 and 19 of Directive 2009/28/EC and the essentially similar Articles 7b, 7c and 7d of Directive 2009/30/EC, Art. 7a of Directive 2009/30/EC, Directive 2015/652 and the relevant Articles of Directive 2015/1513 through Act No 309/2009, on the promotion of renewable energy sources and high-efficiency cogeneration, as amended, and Decree of the Ministry of the Environment of the Slovak Republic No 271/2011, laying down sustainability criteria and targets for the reduction of greenhouse gas emissions from fuels, as amended.

This law deals, *inter alia,* with the core roles and responsibilities of the competent authorities and economic operators in a context that demonstrates the meeting of sustainability criteria for biofuels and bioliquids, which are the preconditions for meeting the national greenhouse gas reduction target as well as targets for renewable energy sources.

Decree of the Ministry of the Environment of the Slovak Republic No 271/2011, as amended, in force since 2011, establishes a national system for demonstrating compliance with the sustainability criteria for biofuels and bioliquids.

Voluntary schemes have been established to assess compliance with sustainability criteria throughout the biofuel and bioliquids production chain. These schemes are subject to approval by the European Commission and are therefore not subject to national approval and national control, and each Member State must accept the results of these schemes without reservation.

Decree of the Ministry of Agriculture and Rural Development No 295/2011, determining a detailed declaration by the producer and supplier of biomass for the production of biofuels or bioliquids, has

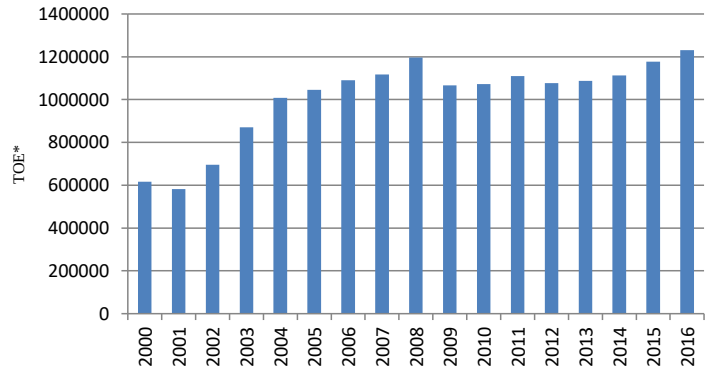
been in force since October 2011. Since 2011, the Slovak Republic has been operating a national system for demonstrating compliance with the sustainability criteria for biofuels and bioliquids. This system is based on independent verifiers whose training is organised and who are subject to mandatory examination and registration by the Ministry of the Environment of the Slovak Republic

k) Taxation of energy products and electricity

The tax on mineral oils is the most important tax in terms of tax revenue creation. The revenue from electricity, coal and natural gas is relatively low. The Slovak Republic generates relatively low revenue from environmental taxes (Figure 2) and the implicit tax rate (Figure 3) on energy is low. There is considerable scope for environmental tax reforms. Heating and energy use in industrial processes make up the highest share of total energy use and CO_2 emissions in the Slovak Republic. As a result, a more harmonised tax regime in these areas would increase tax revenues and provide incentives to reduce CO_2 emissions. This could be achieved by raising taxes on all fuels used for heating and manufacturing at a standard rate per unit of energy for natural gas. Unit-linked consumption taxes could also be indexed for inflation to avoid a decline in environmental tax revenues in real terms over time. We might also consider abolishing the tax differential between petrol and diesel. A gradual increase in diesel taxes could also be used to reduce the direct tax burden, although there may be limited scope for such an increase in the short term without similar increases in rates in neighbouring countries to avoid fuel tourism.

Support for electricity generation from coal and lignite will be abolished in accordance with the Action Plan for the Transformation of the Upper Nitra Coal Region approved by the Slovak Government on 3 July 2019. The potential for increasing electricity consumption taxation could be analysed, together with the full application of the Directive – meaning the application of a preferential tax rate on electricity used for industrial and energy purposes. The reduced household income could be compensated by the government using targeted tax or support measures.

Figure 2: Tax revenue from taxation of energy products 2005-2017[10]

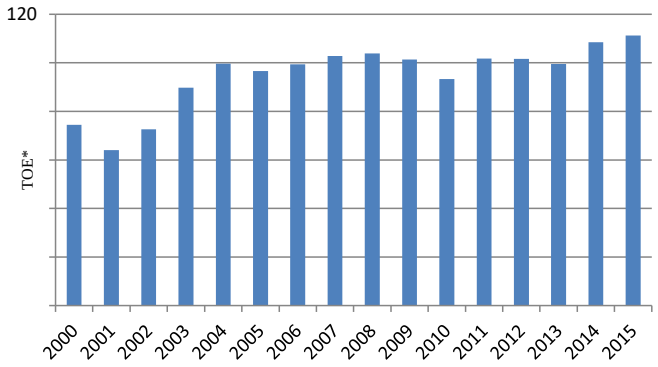


* TOE - Energy taxes in EUR per tonne of oil equivalent

Source: Directorate-General for Taxation and Customs Union (DG TAXUD), based on Eurostat data

[10] http://ec.europa.eu/taxation_customs/tedb/taxDetails.html?id=4148/1496928576#tax_revenueTitle1

Figure 3: Trend in the implicit tax rate on energy products in the Slovak Republic 2000-2017



* TOE - Energy taxes in EUR per tonne of oil equivalent, base year = 2010

Source: Directorate-General for Taxation and Customs Union (DG TAXUD), based on Eurostat data

I) National emission ceilings (NEC)

The current Directive 2001/81/EC on national emission ceilings was replaced from 1 July 2018 by the revised Directive 2016/2284 on NEC. Its main objective is to reduce the adverse impacts of air pollution on health, including reducing the annual number of premature deaths from air pollution by over half. This revised Directive contains the national emission reduction commitments for each Member State for the period to 2030 (with interim targets set for the period to 2025) for five specific pollutants: NO_x, SO_2, NMVOC, NH_3, and $PM_{2.5}$. The NEC Directive is transposed into national legislation in Act No 137/2010, on air protection.

2) Analysis of interactions with policy in air quality and air emissions

In connection with the adoption of Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, the Slovak Republic is intensively working on the preparation of the National Emissions Reduction Programme - which is currently at the end of the Strategic Environmental Assessment process - and the top-level document on air protection, the comprehensive Air Protection Strategy of the Slovak Republic to 2030, which will include, in addition to the emissions reduction programme, an Air Quality Improvement Strategy.

Integration with other policies is a key aspect in terms of promoting air protection objectives. Many air protection measures cannot be implemented alone, without coordination with the affected sectors while, at the same time, many targets and tools of other policies have great potential to contribute towards meeting air protection targets. Coordination and cooperation are essential to ensure the affected policies are consistent with air protection targets (in particular air quality requirements) and to maximise synergy effects. In accordance with the above, the relevant sectoral plans and programmes were taken into account during the preparation of the National Emission Reduction Programme and the selection of measures to ensure the achievement of reduction commitments, in particular in the fields of climate change and energy, transport, industry and agriculture. Integration and synergies are also essential for the NECP and all the named contact points are important for all the areas concerned.

The climate change and energy policy are among the main areas where potential to achieve synergies in achieving common objectives can be identified. The tools and measures for achieving the targets of the indicated policies provide significant space for the integration of air protection requirements, yet also include potentially risky areas such as contradictory targets (e.g. in the promotion of biomass as a renewable energy source), and so communication and coordination are particularly important in this area.

The described Low-Carbon Study analyses and describes a reference scenario as well as four possible scenarios for reducing emissions to 2050. In the reference scenario prepared based on current policies, the share of natural gas in cogeneration significantly increases, both before and after 2030. In the reference scenario, electricity sector investments focus on combined heat and power (CHP) and solar energy. CHP primarily uses natural gas as fuel. This also applies for four decarbonising scenarios before 2030, however the gas is subsequently replaced with biomass, wind and solar energy. Nuclear power will dominate electricity generation until 2050. Almost all the proposed measures, apart from the increase in biomass combustion, will also provide synergy effects in air quality. Specific figures will be provided through modelling, which is currently under way in cooperation with the World Bank, including the same scenarios.

The strategy of the Slovak Republic's adaptation to the adverse effects of climate change, as acknowledged in the EC opinion, also defines measures that can contribute towards improving air quality, in particular measures to preserve biodiversity and strengthen ecosystem services related, *inter alia*, to maintaining good air quality. These measures have not yet been quantified in terms of air protection.

The main framework document in the energy sector of the SR is the Energy Policy of the Slovak Republic (EP SR). The EP SR defines a competitive low-carbon energy sector ensuring the secure, reliable and efficient supply of all forms of energy at affordable prices, taking consumer protection and sustainable development into account. Among other things, it defines objectives for transport, which it identifies as a serious future problem also in terms of air pollution, especially in view of the increasing trend of final energy consumption by motor transport. The energy policy objectives in transport relate to the greening of transport through the introduction of green fuels, strengthening the position of public transport, achieving a share of at least 10% RES in fuel consumption in transport, and applying the "polluter pays" principle. The measures consist in promoting the development and wider use of public transport, in particular rail, promoting the use of green fuels, biofuels, CNG, LPG, electromobility, and non-motorized transport (cycling). The EP SR also defines instruments to promote the use of CNG in transport, which include reducing the tax burden on this fuel or tax credits for means of transport using this fuel (road tax), and the creation of compulsory quotas for the number of CNG vehicles for government and public administration operating locally (waste collection, state and municipal police, customs, etc.). The adoption of measures to further reduce greenhouse gas emissions could significantly complement existing and planned air quality measures, thus achieving a significant reduction in air pollution.

On 3 July 2019, the Slovak Government adopted Resolution No 336/2019 on the Action Plan for the Transformation of the Upper Nitra Coal Region.

The submitted material proposes solutions to the situation related to the reduction in the general economic interest in electricity generation in the Nováky power plant and the subsequent fall in coal

mining due to the planned reduction in mining activity, and the impact on employment in the Upper Nitra region.

The material also seeks to prevent a decline in the region and to address its development through a conceptual approach to structural change in the function of the economy and its associated impacts, similar to how the reduction in coal mining was - and is - addressed in developed countries in the context of European Union social cohesion, regional development and economic growth policies.

With regard to the transformation of the Upper Nitra region and maintaining the continuity of heat supply in this region, it is appropriate to use the existing heat and electricity generation infrastructure in accordance with the Action Plan for the Transformation of Upper Nitra with a minimal impact on the environment, price competitiveness, and long-term sustainable growth in the region.

Incentives for research and development

The objective of providing R&D incentives is to support the growth of research and development in the business sector in Slovakia, to support increased cooperation with the academic sector (universities, SAS organisations), and to support the growth of research and development cooperation between business sectors in the Slovak Republic and in the EU, with the aim of increasing the competitiveness of the Slovak business sector in international markets by enhancing product quality and applying all kinds of innovation in manufacturing and other business processes.

R&D incentives also encourage close cooperation between enterprises and the academic sector, thus qualitatively increasing the leading-edge nature and excellence of the R&D. In this context, R&D incentives are perceived as promoting and developing the best outcomes of systematic creative work, raising awareness and creating new applications.
This will create conditions for the creation of new jobs for highly qualified employees, thus supporting development of the research base, improvements in the education system, and the development of cooperation between academic workplaces and the business sector.
One important aspect of providing incentives for research and development is the expansion of existing research and development workplaces, or the creation of new workplaces in enterprises, thus creating new jobs for highly qualified R&D staff. Under the terms of the incentives, these workplaces and related jobs must remain active for at least 5 years after the end of the incentives. Another important aspect is that incentive beneficiaries are obliged to invest their own funds in research and development at a stipulated level and for at least the monitored five-year control period after the end of the incentives.

In 2018, the Government of the Slovak Republic adopted the Economic Policy Strategy of the Slovak Republic to 2030, which defines the measure “O 2.10 Increase in R&D expenditures so that the Slovak Republic gradually catches the top five EU countries in terms of the share of R&D expenditure in GDP by 2030”.

In the past, R&D incentives were provided to address projects in the field of materials and energy – Development of a Technological Complex for Processing Municipal Waste for Material and Energy Purposes - and in nuclear energy, namely nuclear decommissioning – Conditional Release of Materials from Nuclear Decommissioning.

In the upcoming period, the Ministry of Education, Science, Research and Sport of the Slovak Republic will focus, through research and development incentives, on promoting the following fields: research and development into highly efficient energy sources and technologies for transport

systems using Industry 4.0 principles; and research and development into biodegradable plastics, including composite materials, using renewable energy sources for the automotive industry.

The EURATOM (European Atomic Energy Community) Treaty was created to set up a European Atomic Energy Community that, among other things, helps coordinate Member States' research programmes into the peaceful use of nuclear energy. It is currently one of the frameworks for sharing knowledge and infrastructure, and for nuclear energy financing. It ensures the security of nuclear power supplies through a centralized monitoring system.
Since another main objective is to bring together the nuclear industries of the Member States, its competence includes those entities (Member States, public and private institutions, enterprises and natural persons) that carry out their business or part thereof in one of the areas the treaty regulates, and hence the special fissile materials, raw materials and the ores from which these raw materials are obtained. The powers granted by the EURATOM Treaty exclusively relate to civilian and peaceful uses of nuclear energy.

Specific EURATOM missions include:

- promoting research and ensuring the dissemination of technical knowledge,
- developing and ensuring the use of uniform safety standards to protect workers and the general public,
- simplifying access to investment and ensuring the construction of the basic facilities necessary for the development of nuclear energy in the EU,
- overseeing regularity and uniformity in the supply of ores and nuclear fuels to users in the EU,
- guaranteeing that nuclear material is not misused, in particular for military purposes,
- exercising title to the specific fissile materials assigned to it,
- contributing towards progress in the peaceful use of nuclear energy in cooperation with third countries and international organisations,
- establishment of joint ventures.

Euratom is a complementary research programme for nuclear research and training under the Horizon 2020 programme. Its role is to contribute, in a safe and efficient manner, to the long-term plan for decarbonising the energy system. As such, it reinforces three important Horizon 2020 priorities: scientific excellence, industrial leadership and changes in society.

Two areas form the core of EURATOM

- nuclear fission and radiation protection,
- the development of magnetic nuclear fusion as an energy source

iii. Key issues of cross-border relevance

The Slovak Republic is highly dependent on imports of primary energy resources. It is therefore necessary to reduce its high dependence on fossil fuel imports through systematic measures in energy efficiency and RES that meet sustainability criteria. The location of the Slovak Republic in Central Europe means that the diversification of transport routes is more than usually important.

Facilities enabling reverse gas flow from the Czech Republic and Austria were put into operation following the natural gas supply problems of 2009. A north-south connection between Poland and Slovakia is currently being built. In the electricity sector, the connection with Hungary is being strengthened and an intelligent connection with the Czech Republic (ACON) is being built.

The national intentions and targets for securing primary energy sources and diversifying transport routes are detailed in Article 2.3. Dimension: energy security.

iv. Administrative structure for implementing national energy and climate policies

The Ministry of Economy of the SR is primarily responsible for the energy sector, and the Ministry of the Environment of the SR is primarily responsible for atmospheric protection and climate change.

The SR has a systematised mechanism for the management, planning, monitoring and evaluation of energy efficiency, arising from the requirements of European and national strategic documents and legislation. The Ministry of Economy of the SR is the general coordinator of the energy efficiency agenda, primarily focusing on energy savings in all sectors of the economy, and has an interdepartmental working group for this purpose involving all relevant central state administration bodies.

The Ministry of Economy assesses the compliance of an application for a certificate to construct an energy facility with the Integrated National Energy and Climate Plan, which replaces the Energy Policy within the meaning of Section 88 of Act No 251/2012, on energy and on amendments to certain other acts, as amended. The plan can only be assessed after the submission of an application containing all the stipulated particulars within the meaning of the Energy Act. The ME SR will assess whether the application is in line with EP priorities.

If the application complies with the statutory requirements and is in accordance with the above priorities, the ME SR will issue a certificate of compliance of the investment plan with the Energy Policy of the SR.

The Ministry of the Environment of the Slovak Republic (MEnv SR) is responsible for the development of the national environmental policy and the creation of the national climate policy. The preparation and subsequent coordination of the implementation of all strategic and legislative proposals in the specific sectoral policies of other ministries also falls within the competence of the MEnv SR.

The main units dealing with climate change at the MEnv SR are the Climate Change Policy Department and the Emission Trading Department, which come under the Directorate for Climate Change and Air Protection.

Based on Government Resolution No 821/2011, the Climate and Energy Package Commission was replaced at state secretary level by the Climate Coordination Policy Commission (the Commission).

The Commission was set up on 15 January 2012 at state secretary level and is chaired by the State Secretary of the Slovak Ministry of the Environment. Other members are the state secretaries of the Ministry of Economy, the Ministry of Agriculture and Rural Development, the Ministry of Transport and Construction, the Ministry of Education, Science, Research and Sport, the Ministry of Health, the Ministry of the Interior, the Ministry of Finance, the Ministry of Foreign and European Affairs, and the Chairman of the Network Regulatory Office.

The Commission's main objectives are effective coordination in the development and implementation of mitigation and adaptation policies and the selection of appropriate measures to meet international commitments. The Commission plays the major role in inter-ministerial decision-making.

There are two special working groups under the Commission: one focusing on the preparation of the Adaptation Strategy of the Slovak Republic for the Adverse Effects of Climate Change, while the second is responsible for the Slovak Republic's Low-Carbon Strategy.

1.3. Consultations and involvement of national and Union entities and their outcome

i. Involvement of the national parliament

The relevant committees of the National Council of the SR (NC SR) have been working with the draft "Clean Energy for All Europeans" package since its publication. The regular preliminary opinion of the Slovak Republic on the draft regulation on the management of the energy union was the subject of an interdepartmental commentary procedure in May 2017, and was then discussed by the National Council Committee on Economic Affairs (6 June 2017) and the National Council Committee on European Affairs (15 June 2017).

Representatives of the Slovak Republic actively participated in the discussion of the draft regulation on the management of the energy union within EU units - as part of the Council's energy working group as well as within the Technical Working Group on National Energy and Climate Plans at the Commission. All interested state administration bodies were kept up to date on the progress and results of these negotiations.

ii. Involvement of local and regional authorities

Local and regional authorities have the option to participate in the development of strategy papers in accordance with the procedures outlined in section 1.3. iii.).

For regional projects, involvement of regional and local authorities is usual in the preparatory phase. For example, the Upper Nitra Development Action Plan, for one of the three pilot regions of the new Platform for Coal-Mining Regions in Transformation launched by the European Commission, was approved by the Slovak Government in July 2019. It was prepared by the Office of the Deputy Prime Minister of the Slovak Republic for Investment and Informatisation in cooperation with the Trenčín self-governing region, the Association of Towns and Municipalities of Upper Nitra and interested parties from the region concerned.

iii. Consultations of stakeholders, including the social partners, and engagement of civil society and the general public

In accordance with the rules for the preparation of materials for meetings of the Slovak Government, preparation includes discussions with all ministries and stakeholders as well as with the public. Within the standardised process for material submitted for discussion by the Government, an intra-departmental commentary procedure is then followed by an inter-ministerial commentary procedure (MPK). The material is published in the MPK via the publicly accessible website Slov-Lex, operated by the Slovak Ministry of Justice. On the website one may familiarise oneself with the proposed documents and, via an electronic form, comments may be raised on the submitted material not only by representatives of state and public authorities but also by natural persons or legal entities from the public. After a specified publication period (at least 15 days, for materials of a non-legislative nature this may be shortened to 5 days), the submitter of the material must evaluate the comments made and, if necessary, incorporate them. If the material submitted relates to an activity for which a government advisory body has been established, it must be assessed in that advisory body prior to submission for discussion by the Government. Accepted comments of the government advisory body are incorporated by the submitter into the material; any failure to accept comments must be justified.

Under the current legislation, the approval of strategic materials is also subject to an evaluation process under Act No 24/2006, on environmental impact assessment and on changes and additions to certain acts. If a strategic environmental assessment is required, the material is submitted for

Government discussion only after the public discussion of the strategic document and the Report on the Evaluation of the Strategic Document and the preparation of the final opinion from the evaluation of the strategic document. This procedure was used by the Slovak Government to discuss the documents mentioned in Chapter 1.2.ii.)

As part of the process of assessing the draft Energy Union Regulation, NECP content and preparation issues were also consulted with other ministries, and an inter-ministerial working group was set up which, in addition to reviewing the draft Regulation, mapped out the data sources needed to prepare the NECP across various ministries.

During discussion on the content of the Regulation on the Management of the Energy Union, the Slovak Ministry of Economy cooperated with the major companies and professional associations in the energy sector. Inputs from some experts from these companies and associations have also been used in the discussions on the final version of the Regulation and hence on the content of the Integrated National Plan for Energy and Climate. Organisations dealing with the production, transmission and supply of electricity, petroleum products, distribution companies, heat supply companies and employers' associations were addressed.

iv. Consultation with other Member States

The assessment of cross-border impacts is also included in the assessment process under Act No 24/2006 (the Act on Environmental Impact Assessment and on changes and additions to certain other acts). All cross-border connections are implemented in accordance with conventions with the relevant neighbouring Member States, international connections are on the current list of PCI projects.

v. Iterative process with the Commission

Several consultations with relevant EU bodies were conducted during the preparation of the national energy and climate plan. Representatives of the Slovak Republic participated in the discussions of the Energy Working Group in preparation of the text of the Regulation on the Management of the Energy Union and in the discussions of the technical group for the preparation of the NECP, where aspects of the preparation process for the plans were discussed. Issues related to the preparation of NECPs were also the subject of bilateral and multilateral talks with EC representatives at various levels during their visits to Slovakia, respectively during meetings as part of international energy and climate conferences. At meetings in Brussels (at the Energy Council working group from February 2017, in the technical group for the preparation of the NECP at the EC from April 2017, and via teleconferencing in July 2019), there was consultation with DG ENER regarding recommendations from the EC on the working version of the NECP, especially with regard to the ambitions of the SR in RES and energy efficiency.

1.4. Regional cooperation in preparing the plan

i. Elements subject to joint or coordinated planning with other Member States

On 20 November 2018, a joint meeting of experts from the V4 countries (the Czech Republic, Hungary, Poland and Slovakia) and Austria was held in Bratislava, where aspects of the preparation of NECPs in individual countries, as well as their basic objectives, policies on renewable energy, climate protection, energy efficiency, the internal market and the security of energy supply were discussed.

As part of regional cooperation, representatives of the Slovak Republic participated in the presentation of the German NECP in Berlin in April 2019 and, together with the hosting Austria, the Czech Republic and Germany, in the presentation of the content of the NECPs of the participating countries in Vienna in June 2019.

In August 2019 the SR commented on the draft Polish NECP and in October 2019 responded to a call for comments on the Czech Republic's draft NECP.

ii. Explanation of how regional cooperation is considered in the plan

Since the draft plan is based on previously approved materials that have been consulted in the preparation process, it reflects the requirements and opinions of the countries concerned.

2. NATIONAL OBJECTIVES AND TARGETS

2.1. Dimension: decarbonisation

2.1.1. GHG emissions and removal

i. The elements set out in Article 4(1)(a)

Binding targets at EU level resulting from EU legislation:

- Reduce greenhouse gas emissions: 40% in 2030 and 80-85% in 2050 compared to 1990;
- Reduce CO_2 emissions in the EU ETS: 43% in 2030 and 90% in 2050 compared to 2005, but this results from the EU ETS carbon trajectory as a result of EU ETS market regulations, including the market stabilization reserve, as adopted;
- Reduce greenhouse gas emissions outside the EU ETS: 30% in 2030 compared to 2005, with country-specific obligations;
- RES share: 32% of gross final energy consumption in 2030;
- Energy efficiency: reduce primary energy by 32.5% in 2030 compared to the 2007 baseline.

The revised EU ETS Directive sets a target for the reduction in greenhouse gas emissions in EU ETS sectors by 43% in 2030 compared to 2005. This represents an average annual reduction of 2.2% over the 2021-2030 period.

Greenhouse gas emissions from sectors outside the EU ETS are covered by the Effort Sharing Regulation (ESR). The ESR covers emissions from all sectors outside the EU ETS , except for emissions from international maritime transport, domestic and international aviation (incorporated into the EU ETS from 1 January 2012) and emissions and capture under land use, land-use change and forestry (LULUCF). This includes a wide range of small pollution sources in a wide range of sectors: transport (cars and lorries), buildings (mainly in connection with heating), services, small industrial installations, fugitive emissions from the energy sector, fluorinated gas emissions from equipment and other sources, agriculture and waste. These sources make up about 55% of total EU greenhouse gas emissions.[11]

The ESR target has been subdivided into national targets that have to be met by Member States individually. Under the Effort Sharing Regulation, national emissions targets for 2030 are set as a percentage change from 2005. For the Slovak Republic this is a 12% reduction compared to 2005. The maximum greenhouse gas emissions for non-EU ETS sectors for each year from 2021 to 2030 is expressed in the quantity of annual emission allowances (AEA) allocated to each Member State for the year in question.

The Environmental Strategy 2030 strategic document set a more ambitious national target for Slovakia in sectors outside the EU ETS, namely to reduce greenhouse gas emissions by 20% by 2030 compared with 2005.

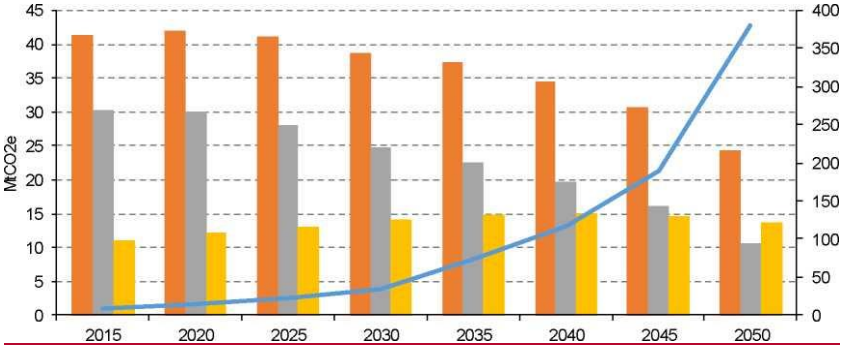
Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land-use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU, was adopted in 2018.

This Regulation establishes the obligations of the Member States concerning the LULUCF sector, through which contributions are made to meeting the objectives of the Paris Agreement and the EU's greenhouse gases emissions reduction plan for the 2021-2030 period. This Regulation also lays down

[11] European Commission. Commission Staff Working Document - Accompanying the document: Report from the Commission to the European Parliament and the Council on evaluating the implementation of Decision No 406/2009/EC pursuant to its Article 14. (SWD(2016) 251 final) 2016 https://ec.europa.eu/transparency/regdoc/rep/10102/2016/EN/10102-2016-251-EN-F1-1-ANNEX-1.PDF

rules for setting off emissions and their capture from the LULUCF sector and for verifying whether Member States are meeting their obligations.

Figure 4 Emissions quantity and price



Total emissions (Gg CO_2 equiv.) Energy and industry (Gg CO_2 equiv.)

Other emissions (Gg CO_2 equiv.) ETS price (EUR/tCO_2, RHS)

Source: MEnv SR

ii. Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable to the contribution to the overall Union commitment of reducing GHG emissions, other objectives and targets, including sector targets and adaptation goals, if available.

Addressing climate change as a global as well as a national problem requires the implementation of mitigation and adaptation measures. Preventing or at least minimising the risks and negative impacts of climate change can be achieved by combining measures to reduce greenhouse gas emissions with measures that reduce vulnerability and to increase the adaptive capacity of natural and man-made systems against the actual or anticipated negative impacts of climate change.

The first more comprehensive document to provide basic strategic guidance for Slovakia's adaptation to climate change and to give examples of proactive adaptation measures was the Slovak Republic's Strategy for Adaptation to the Adverse Effects of Climate Change (NAS) from 2014. In 2018, the national adaptation strategy was updated, taking into account the latest scientific knowledge in the field of climate change. The updated Strategy for Adaptation to the Adverse Effects of Climate Change was approved on 17 October 2018 by Resolution of the Government of the Slovak Republic No 478/2018. The strategy assesses the current state of adaptation and planned activities in key areas and sectors, defines a general vision for the adaptation of selected areas and sectors, a set of adaptation measures, and a framework for their implementation. It examines the consequences of climate change and proposes adaptation measures in multiple sectors. It proposes priority actions, an institutional framework for the coordination and implementation of adaptation activities, as well as a proposal for monitoring and evaluation, and identifies potential sources of funding.

The main objectives of the updated National Adaptation Strategy are to improve Slovakia's preparedness to face the adverse impacts of climate change, to provide the widest possible information on current adaptation processes in Slovakia, and to establish an institutional framework and coordination mechanism to ensure the effective implementation of adaptation measures at all levels and in all areas, as well as increase the general level of awareness about this issue.

The fulfilment of the following partial objectives should contribute towards the achievement of the main adaptation objectives: ensuring active development of the national adaptation policy, implementing adaptation measures and monitoring their effectiveness, strengthening the projection of objectives and adaptation strategy recommendations as part of multilevel public governance and entrepreneurship support, improving public awareness of the climate change issue, promoting synergies between adaptation and mitigation measures, use of the ecosystem approach in implementing adaptation measures, and supporting the reflection of objectives and recommendations of the 2030 Agenda for Sustainable Development, the UN Framework Convention on Climate Change and the Paris Agreement.

Based on the latest scientific knowledge, the National Adaptation Strategy combines scenarios and the possible impacts of climate change over the widest possible range of sectors with proposals for appropriate adaptation measures. Achieving these goals requires effective implementation and monitoring of the adaptation measures, the promotion of synergies between adaptation and mitigation measures, as well as raising public awareness and building a knowledge base. The updated NAS applies the proactive principle of adaptation and seeks to link scenarios and the possible consequences of climate change to the widest possible range of areas and sectors with proposals for appropriate adaptation measures, is aimed at assessing the current state of adaptation and planned activities in key areas and sectors, defining a general vision of adaptation in selected areas, and updating the set of adaptation measures and frameworks to implement them. In implementing adaptation measures, the NAS supports the use of an ecosystem approach and proposes a set of adaptation measures in the following areas: mining and geology, soil environment, natural environment and biodiversity, the water regime within the country and water management, the residential environment, population health, agriculture, forestry, transport, energy, industry and some other areas of business, recreation and tourism.

Adaptation measures will be further assessed and prioritised in the national adaptation Action Plan, currently in preparation. It is being prepared under the auspices of the Ministry of the Environment of the Slovak Republic in cooperation with the Prognostic Institute of the Slovak Academy of Sciences. Adaptation measures will be prioritized in the Action Plan based on qualitative and quantitative analyses. This prioritization will be based on the results of a participatory process involving all the relevant actors. Short-term measures for the 2020-2022 period and medium-term measures for the 2022-2025 period will be identified. The Action Plan should contribute towards better reflection of the adaptation measures in the sectoral policies of the relevant ministries. It should also include a proposal for a mid-term evaluation system for the adaptation process in Slovakia, including cost-benefit monitoring and a proposal for a platform for publishing and sharing positive experiences.

Circular economy

The linear economy model produces significant greenhouse gas emissions, mainly from energy-intensive production processes, but also at the end of product life cycles. A circular economy (CE) seeks to minimize and optimize energy materials and flows. The following sectors have the greatest potential for GHG reductions:

- Materials (especially plastics, but also metals and cement)
- Agriculture and food production (reducing losses and recycling nutrients)

- Construction (material replacement, modular design, intelligent crushers, space sharing, extended lifespans)
- The waste management sector
- The automotive industry (vehicle sharing, durability, extended lifespans)

Around 80% of Europe's greenhouse gas emissions come from energy generation and use, while efforts to mitigate climate change tend to focus on improving energy efficiency and moving towards low-carbon energy sources. Circular economy measures such as optimizing the use of resources, optimizing the use of products and increasing the number of material cycles can also lead to energy savings (indirect) and thus reduce emissions.

The circular economy affects all aspects of resource use, from product design, resource extraction and production to distribution, use and disposal. Too often, the CE is only seen as improving waste management and increasing recycling rates, yet the circular economy concept goes far beyond this.

The circular economy affects not only the use of material resources, but also the use of energy resources. Our economy is largely dependent on the energy system, as it consumes electricity and fuels during the production and use of materials and products. The transition to a 'regenerative' economy therefore also includes a transition to a system based on renewable energy sources (RES).

Climate change mitigation and circular economy measures overlap. However, circular economy measures can reduce greenhouse gas emissions other than through measures focusing on energy efficiency and renewable energy sources. For example, reducing the amount of raw materials needed to produce a product indirectly reduces emissions from production by reducing the demand for raw materials.

Our increasing prosperity has led to a continuing increase in consumption, resulting in increased pressure on the environment. This translates into air, water and soil pollution, increasing greenhouse gas emissions and degradation of natural capital and biodiversity. Much of the potential of the circular economy lies in the consumption phase. There is considerable potential in changing consumer behaviour and the way products are used.

It is important to note that the production of materials and products is responsible for a significant part of our total energy consumption. Therefore, measures aimed at optimizing these production processes to minimize the demand for energy and materials can also have a major impact on greenhouse gas emissions.

Measure 3.1. of the Economic Policy Strategy 2030 imposes "Adopt a document for the implementation of the circular economy in the Slovak Republic and its subsequent implementation with the aim of developing a green economy based on mutually supporting economic, environmental and energy policy aspects, promoting innovation and reducing the energy, material and emission intensity of the Slovak economy."

2.1.2. Renewable energy

i. The elements set out in Article 4(2)(a)

The European Union's binding target for the share of energy from renewable sources in gross final energy consumption is at least **32%** by 2030**.** In order to achieve this binding target, Member States' contributions for 2030 to this target from 2021 are in line with the indicative trajectory of this contribution. The directional trajectory reaches a reference point of at least

a) 18% by 2022

b) 43% by 2025

c) 65% by 2027

of the total increase in the share of energy from renewable sources between that Member State's binding 2020 national target and its contribution to the 2030 target.

The Slovak Republic proposes a target of 19.2% in 2030, which is an increase of 5.2 percentage points compared to the target set for 2020. Based on the requirements in Article 4(2) of the Regulation, the reference points in the indicative trajectory for 2022, 2025 and 2027 are set at 14.94%, 16.24% and 17.38% for the 19.2% target.

The total investment costs to achieve the RES targets are estimated at EUR 4.3 billion. These investment costs include the electricity and heating sectors. They are based on the estimated increase in installed capacity for generating electricity and heat from RES and the investment intensity per unit of output.

ii. Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sector

By 2030, the indicative trajectory will reach at least the Member State's planned contribution. The indicative trajectory for Slovakia starts at 14% in 2020.

Table 10 Estimated RES trajectories

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RES – heat & cold generation (%)	13.0	14.3	14.6	15.2	16.1	16.7	17.5	18.1	18.5	19.0
RES – electricity generation (%)	22.4	23.4	23.9	24.4	24.8	25.9	26.4	26.7	27.0	27.3
RES – transport, including multiplication (%)	8.9	9.2	9.5	9.7	9.8	10.4	10.7	11.2	12.3	14.0
Overall RES share (%)	**14.0**	**15.0**	**15.4**	**15.8**	**16.4**	**17.1**	**17.8**	**18.2**	**18.7**	**19.2**

Source ME SR

iii. ***Estimated*** *trajectories by renewable energy technology that the Member State projects to use to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030 including anticipated total gross final energy consumption per technology and sector in Mtoe and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW*

Table 11: Renewable energy contribution of each sector to final energy consumption (ktoe)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
(A) Anticipated gross final consumption of RES for heating and cooling	685	721	780	788	810	844	868	898	913	924	937
(B) Anticipated gross final consumption of electricity from RES	597	621	655	675	698	717	756	778	794	812	830
(C) Anticipated final consumption of energy from RES in transport	175	175	175	175	175	176	181	182	185	190	205
(D) Anticipated total RES consumption	1 457	1 517	1 597	1 638	1 683	1 737	1 805	1 858	1 892	1 926	1 972

Source: ME SR

Table 12: Estimate of the total anticipated contribution (installed capacity, gross amount of electricity generated) of individual renewable energy technologies in the Slovak Republic for electricity generation in the 2021-2030 period

	2021		2022		2023		2024		2025	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
Pumped storage power plant (PSPP)	916	420	916	420	916	420	916	450	916	450
Hydro	1 627	4 467	1 628	4 470	1 629	4 473	1 630	4 476	1 641	4 507
<1MW	36	104	37	107	38	110	39	113	40	116
1 MW – 10MW	60	168	60	168	60	168	60	168	70	196
>10 MW	1 531	4 195	1 531	4 195	1 531	4 195	1 531	4 195	1 531	4 195
Geothermal	0	0	0	0	0	0	4	28	4	28
Solar - *photovoltaic*	680	714	730	767	790	830	850	893	870	914
Wind - onshore	30	60	100	200	150	300	200	400	250	500
Biomass: solid	190	1 045	200	1 100	200	1 100	200	1 100	200	1 100
Biogas/biomethane	130	936	150	1 080	160	1 152	170	1 224	180	1 296
TOTAL (without PSPP)	**2 657**	**7 222**	**2 808**	**7 617**	**2 929**	**7 855**	**3 054**	**8 121**	**3 145**	**8 344**

	2026		2027		2028		2029		2030	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
Pumped storage power plant (PSPP)	916	450	916	450	916	450	916	500	916	500
Hydro	1 731	4 754	1 742	4 785	1 753	4 816	1 754	4 819	1 755	4 822
<1MW	41	119	42	122	43	125	44	128	45	131
1 MW – 10MW	80	224	90	252	100	280	100	280	100	280
>10 MW	1 610	4 411	1 610	4 411	1 610	4 411	1 610	4 411	1 610	4 411
Geothermal	4	28	4	28	4	28	4	29	4	30
Solar - photovoltaic	900	945	950	998	1 000	1 050	1 100	1 155	1 200	1 260
Wind - onshore	300	600	350	700	400	800	450	900	500	1 000
Biomass: solid	200	1 100	200	1 100	200	1 100	200	1 100	200	1 100
Biogas/biomethane	190	1 368	200	1 440	200	1 440	200	1 440	200	1 440
TOTAL (without PSPP)	**3 325**	**8 795**	**3 446**	**9 051**	**3 557**	**9 234**	**3 708**	**9 443**	**3 859**	**9 652**

Source: ME SR

Table 13: Estimation of total contribution (final energy consumption) anticipated from each renewable energy technology in the Slovak Republic in heat and cooling generation 2010-2020 (ktoe)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Geothermal excluding heat pump applications	7	13	12	15	30	35	46	47	48	50
Solar:	14	17	20	23	26	29	32	35	39	43
Biomass:										
Solid	600	620	625	630	635	640	645	650	650	650
Biogas/biomethane	65	75	80	85	90	95	100	100	100	100
Renewable energy from heat pumps:										
of which aerothermal	16	18	22	25	28	31	34	37	40	44
of which geothermal	12	15	18	20	22	24	26	28	30	32
of which hydrothermal	7	9	11	12	13	14	15	16	17	18
TOTAL	721	767	788	810	844	868	898	913	924	937

Source: ME SR

Table 14: Estimation of total contribution anticipated from each renewable energy technology in Slovak Republic in transport

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Bioethanol/bio-ETBE	50.0	50.0	50.0	50.0	50.0	55.0	55.0	55.0	55.0	55.0
of which advanced biofuels according to Annex IX.A	3.0	6.0	10.0	10.0	13.0	13.0	15.0	15.0	18.0	18.0
Biodiesel	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	130.0
of which advanced biofuels according to Annex IX.A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	15.0	22.0
of which biofuels according to Annex IX.B	35.0	35.0	35.0	35.0	34.0	33.0	31.0	25.0	23.0	21.0
Hydrogen from renewable sources	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.6	1.0	2.0
Electricity from renewable sources	12.3	13.2	13.8	14.6	15.4	16.8	17.9	19.2	20.2	22.0
of which road transport	0.7	0.8	1.0	1.2	1.5	1.8	2.4	2.9	3.8	5.2
of which rail transport	10.3	11.0	11.4	12.0	12.4	13.2	13.7	14.1	14.6	15.0
Biomethane/RCF*	0.0	0.0	0.0	0.0	0.5	1.0	2.0	5.0	10.0	20.0
Total	**187.3**	**188.3**	**188.8**	**189.7**	**191.1**	**198.1**	**200.3**	**204.8**	**211.2**	**229.0**

Source: ME SR
*RCF - recycled carbon fuels

The RES Directive also sets an indicative target of 1.3% as the annual average for the 2021 to 2025 and 2026 to 2030. This indicative value is reduced to 1.1% if waste heat and cold is not used. The following table shows the fulfilment of the indicative target for heating and cooling, where the numerator is heat from RES and the denominator an estimate of the need for heat for heating and cooling. The indicative values reach an average annual level of 1.3% and 1.4% respectively. We consider achieving higher growth or calculating the total heat consumption in technological processes in industry to be very problematic from the perspective of the annual installation and replacement of renewable energy installations.

Table 15 Estimated total anticipated contribution of individual technologies from renewable sources in the SR in the heat and cooling sector

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RES for heat generation (ktoe)	685	721	768	788	810	844	868	898	913	924	936
Estimate of the need for heat for heating and cooling (ktoe)	3 344	3 284	3 224	3 164	3 104	3 044	2 984	2 924	2 864	2 804	2 744
Share of RES in heating	20.5%	22.0%	23.8%	24.9%	26.1%	27.7%	29.1%	30.7%	31.9%	33.0%	34.1%
Annual increase		1.5%	1.9%	1.1%	1.2%	1.6%	1.4%	1.6%	1.2%	1.1%	1.2%
Average over 5 years		1.4%					1.3%				

Source: ME SR

iv. ***Estimated*** *trajectories of bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink*

The main sources of fuel wood biomass are forest land, long-term non-managed agricultural land with forest growth and residues from wood processing in the wood-processing, furniture and pulp and paper industry.

The area of forest land increased between 2000 and 2017 to 2.019 million ha[12]. Standing volume over 7 cm thick without bark increased from 410.0 to 480.3 million m^3,[13] while the annual increase in volume of this dimension grew from 11.2 to 12.0 million m^3. Actual annual felling ranged from 6.2 to 9.8 million m^3. The share of calamity felling in total felling accounted for 35% to 65%. Carbon stocks in living above-ground tree biomass rose from 166.3 to 187.6 million tonnes and in living underground biomass from 36.1 to 40.5 million tonnes. Carbon stocks in dead biomass increased from 35.7 to 39.4 million tonnes.

The effects of climate change and the consequent growth of calamity felling have meant that the share of conifers in the total recorded standing volume decreased from 41.0% to 37.2% between 2000 and 2017, while the share of broad-leaved trees increased from 59.0% to 62.8%. Changes in the species composition of forests are causing a deterioration in the qualitative structure of volume. The share of roundwood in total coniferous felling is 54% on average and 37% for broad-leaved trees. These changes in the qualitative structure of wood and the development of volume influence the production possibilities for forest fuel biomass. Between 2020 and 2030, planned annual felling will reach 8.9 to 9.0 million m^3 of wood thicker than 7 cm, which represents 11.2 to 11.4 million tonnes of above-ground tree biomass (including bark and wood with thickness up to 7 cm). A forecast for the development of the exploitable potential of fuel wood biomass on forest land taking into account biological constraints and current legislation to 2030 is presented in Table 16.

Table 16 Forecast of the annual usable potential of wood fuel biomass on forest land to 2030 ('000 tonnes)

Year	2020	2025	2030
Conifer fuel biomass	754	718	693
Broad-leaved fuel biomass	2 020	2 108	2 182
Total	2 774	2 826	2 875

Source: NFC Zvolen

The development of forest fuel wood biomass supplies between 2009 and 2018 is shown in Table 17.

Table 17 Annual supplies of forest fuel wood biomass between 2009 and 2018 ('000 tonnes)

Year	Wood chips	Firewood and other	Total
2009	220	695	915
2010	250	695	945
2011	270	700	970
2012	530	750	1 280
2013	620	820	1 440
2014	620	830	1 450
2015	615	835	1 450
2016	610	830	1 440
2017	580	845	1 425
2018	560	850	1 410

[12] Green Report 2018, Report on Forestry in the Slovak Republic for 2017. http://www.mpsr.sk/index.php?nav/D=123

[13] Proposal for Sustainable Biomass Utilization Criteria in Slovakian Regions for SR Programmes for the 2014-2020 Period Co-financed by the ESIF, NFC Zvolen, 2017.

Source: NFC Zvolen

In 2017, 9.36 million m^3 of fuel wood biomass supply was recorded, with a volume of 0.66 million m^3, meaning 7% of total production, while the remainder of the supplies were thin wood, felling residues and bark. The current exploitation rate of available forest fuel biomass resources has reached 51%[14] of the exploitable potential (*comparing supplies in Table 16 and forecasts in Table 17*).

The balances of annual greenhouse gas emissions and capture on forest land in the 2010-2017 period according to LULUCF categories are shown in Table 18.

Table 18 Balances of annual greenhouse gas emissions and capture between 2010 and 2017 on forest land (Gg)

Year	2010	2011	2012	2013	2014	2015	2016	2017
Emissions and capture balance	-3 756.0	-4 255.9	-5 842.9	-6 686.9	4 466.3	-4 786.7	-4 573.2	-4 448.8

Source: NFC Zvolen

Even a potential increase in the supply of forest fuel biomass should not have a significant negative impact on emission and capture balances to 2030. The forecast for the development of exploitable supply potential to 2030 assumes a substantial increase in the share of broad-leaved tree felling, hence a larger share of lower quality wood, small wood pieces and felling residues. The wide scope of calamities affecting mainly coniferous stands is causing the postponement of felling of broad-leaved tree stands to a later period and thus deterioration of wood quality. However, no increase in the total annual volume of planned production is anticipated.

The area of forest stands on long-term unmanaged forest land increased from 273 000 to 288 000 ha between 2006 and 2016 and wood stock over 7 cm thick without bark from 38 to 46 million m^3.[15] The average annual increase in timber of this dimension was 2.07 million m^3 and annual extraction was 0.5 million m^3. The stock of above-ground tree biomass reached 61.5 million m^3 in 2016.

The development of the exploitable potential, taking into account biological constraints and current legislation with an outlook to 2030 is presented in Table 19.

Table 19 Anticipated development of the annual usable potential of wood fuel biomass on non-forest land to 2030 ('000 tonnes)

Year	**2006**	**2020**	**2025**	**2030**
Fuel biomass	704	852	942	1 031

Source: NFC Zvolen

Annual supplies of wood fuel biomass, mainly in the form of chips, is currently around 0.45 - 0.55 million tonnes.

According to an assessment in 2016, the carbon stock in living above-ground tree biomass was 15.1 million tonnes and living underground biomass 4.4 million tonnes. Dead wood stock was 1.2 million

[14] Šebeň, V., 2017: National Forest Inventory and Monitoring for the Slovak Republic 2015-2016, NFC-FRI Zvolen, 256 p., ISBN 978-80-8093-234-3

tonnes. The annual production of solid wood residues in the wood processing industries used for energy purposes was, according to 2016 data, 1.694 million tonnes. Producers' own energy consumption was 669 000 tonnes and supplies to market 1.025 million tonnes. Pulp and paper industry companies annually produce around 520 000 t of so-called black liquor for their own energy use. The production of wood processing residues used for energy purposes to 2030 will be affected by:

- the development of domestic processing capacities,
- the cascade timber utilization rate,
- the competitiveness of wood compared to other raw materials,
- the development of the fuels and energy markets.

In the 2020-2030 period, annual production of solid residues from wood processing is anticipated to be 1.6 - 1.7 million tonnes. The trajectories of the contributions to electricity (Table 9), heat and cold (Table 10) generation, solid biomass part, are used to determine the fuel wood biomass supply trajectories. The trajectory of the demand for fuel wood biomass supply in the 2020-2030 period is valid provided that all solid biomass consumption is covered by wood biomass (Table 20).

Table 20 Fuel wood biomass supply trajectory between 2020 and 2030, broken down into cogeneration and heat and cold generation ('000 tonnes)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cogeneration	1 630	1 630	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800
Heat and cold generation	1 530	1 630	1 660	1 600	1 650	1 700	1 740	1 740	1 740	1 740	1 740
Total	3 160	3 260	3 400	3 400	3 450	3 500	3 540	3 540	3 540	3 540	3 540

Source: NFC Zvolen

Note: Electricity generation using the condensation principle is not anticipated.

The annual exploitable potential of fuel wood biomass on forest and non-forest land and solid residues after wood processing will be in the range of 5.1 to 5.5 million tonnes to 2030.

v. Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, communities generating energy from renewable sources and renewables self-consumers, which are also consumers, energy recovered from the sludge acquired through the treatment of waste water)

National trajectories and plans regarding this point have not yet been approved.

2.2. Dimension: energy efficiency

i. The elements set out in Article 4(b)

1. ***the indicative national energy efficiency contribution to achieving the Union's energy efficiency targets of at least 32.5% in 2030 as referred to in Article 1(1) and Article 3(5) of Directive 2012/27/EU, based on either primary or final energy consumption, primary or final energy savings, or energy intensity.***

In connection with the indicative national contribution in energy efficiency to achieving the Union's energy efficiency objectives, the Slovak Republic has created two scenarios - realistic and ambitious. When developing these scenarios, the starting point was the Low Carbon Growth Study for Slovakia: Implementation of the EU Climate and Energy Policy Framework by 2030. The main characteristics of the scenarios are:

- As growth slows, some sectors and subsectors will expand while others shrink. Export-oriented production sectors, such as the motor vehicle subsector, are undergoing sustained expansion driven by external demand. Other sectors are slowing.
- Continuous improvements in energy efficiency are taken into account.
- The ETS will remain a major influence on the choice of energy form to 2050. The carbon price in the reference scenario will push energy consumption in industry towards lower-carbon fuels. The ETS will also bring energy savings, which should also contribute.
- Industry demand for energy is anticipated to fall in parallel with the use of new efficient technologies in investments into industrial production.
- The demand for electricity will increase during the outlook period.
- Nuclear energy will play a key role in the electricity mix of the Slovak Republic.
- In the reference scenario, steam-gas cycles will replace coal-fired power plants.
- The construction of new nuclear power generation capacities in Slovakia is included, maintaining the importance of nuclear energy in the energy mix.
- Demand for heat and steam will decrease thanks to continuously increasing energy efficiency.

Based on the current trends in energy consumption, and also taking into account the predicted main characteristics affecting consumption trends to 2030, it can be stated that the achievement of the 32.5% target by Slovakia by 2030 is very improbable.

Final energy consumption fell between 2010 and 2014. In 2014, however, this trend changed quite significantly, resulting in a level of final energy consumption reaching approximately the 2011 level as early as in 2017. Primary energy consumption showed a similar trend. In order to achieve the set national targets for 2030, whether in terms of final or primary energy consumption, it will be essential to ensure the consistent implementation of all the energy efficiency measures outlined in this Roadmap.

However, achieving this ambition will be much more expensive than in the previous period given the very short-lived potential of measures with short payback periods.

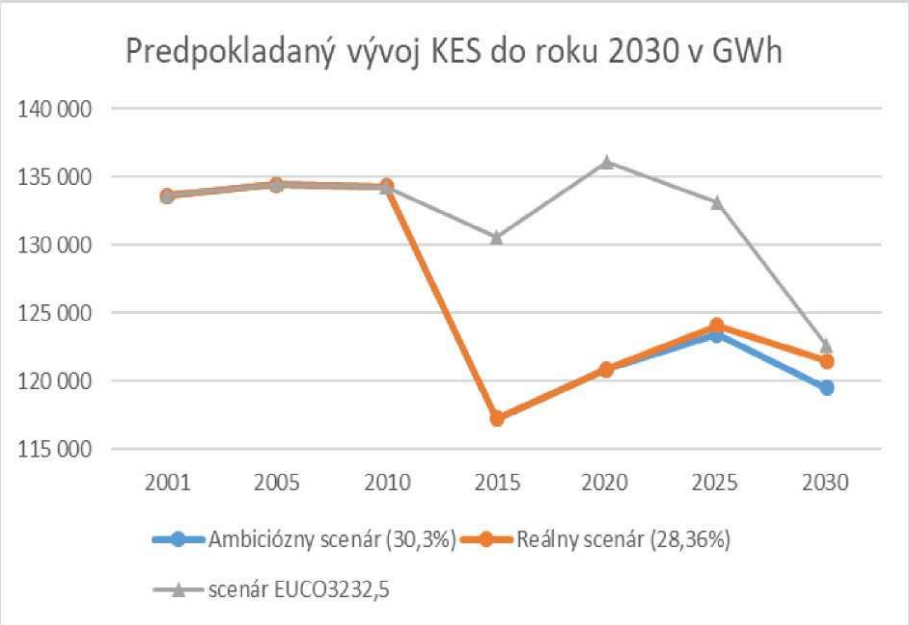
Table 21 National indicative energy efficiency targets for 2020 and national indicative contributions to the EU energy efficiency target for 2030

National indicative energy efficiency targets and contributions to the EU energy efficiency target	[Mtoe]	[GWh]	[%]
Primary energy consumption in 2020	16.2	188 666	20%
Final energy consumption in 2020	10.38	120 833	20%

		(Eurostat)	
Realistic primary energy consumption scenario in 2030	16.15	187 863	28.36%
Realistic final energy consumption scenario in 2030	10.44	121 448	
Ambitious primary energy consumption scenario in 2030	15.7	182 623	30.32%
Ambitious final energy consumption scenario in 2030	10.27	119 457	

Source: ME SR

Figure 5 Forecast for final energy consumption to 2030 (in GWh)



Source: ME SR

Key:
Anticipated FEC development to 2030 in GWh
Ambitious scenario (30.3%) Realistic scenario (28.36%)
EUCO32 32.5 scenario

Figure 6 Forecast for primary energy consumption to 2030 (in GWh)

Source: ME SR

Key:
Anticipated PEC development to 2030 in GWh
Ambitious scenario (30.3%) Realistic scenario (28.36%)
EUCO32 32.5 scenario

2. cumulative amount of end-use energy savings to be achieved over the 2021-2030 period under Article 7(1)(b) on energy saving obligations pursuant to Directive 2012/27/EU;

The cumulative final energy savings from 2021 to 2030 is **47,877.5 GWh**, or **870.5 GWh** per year. This target is calculated in accordance with Article 7(1)(b) EED, which states that Member States shall achieve cumulative energy savings with the final consumer corresponding at least to annual new savings from 1 January 2021 to 31 December 2030 of 0.8% of the annual final energy consumption, to be determined as the average for the three most recent years before 1 January 2019. As official Eurostat data on final energy consumption for 2018 were not officially published at the time of the preparation of this NECP, the baseline period for calculating the target is 2015 to 2017. Eurostat data from "Energy balance sheets 2017 DATA" were used to calculate the target value.

Table 22: Energy balance sheets 2017 DATA

FEC 2015 (GWh)	FEC 2016 (GWh)	FEC 2017 (GWh)	TOTAL (GWh)	Average (GWh)	0.8% of the average (GWh)
115 172.204	107 295.345	103 968.444	326 435.993	108 811.997	870.5

Source: EUROSTAT

Table 23 Cumulative energy savings for 2021 to 2030 (GWh)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
2021	870.5										870.5
2022	870.5	870.5									1741
2023	870.5	870.5	870.5								2611.5
2024	870.5	870.5	870.5	870.5							3482
2025	870.5	870.5	870.5	870.5	870.5						432.5
2026	870.5	870.5	870.5	870.5	870.5	870.5					5233
2027	870.5	870.5	870.5	870.5	870.5	870.5	870.5				6093.5
2028	870.5	870.5	870.5	870.5	870.5	870.5	870.5	870.5			6964
2029	870.5	870.5	870.5	870.5	870.5	870.5	870.5	870.5	870.5		7834.5
2030	870.5	870.5	870.5	870.5	870.5	870.5	870.5	870.5	870.5	870.5	8705
TOTAL	8705	7834.5	6964	6093.5	5223	4352.5	3482	2611.5	1741	870.5	47877.5

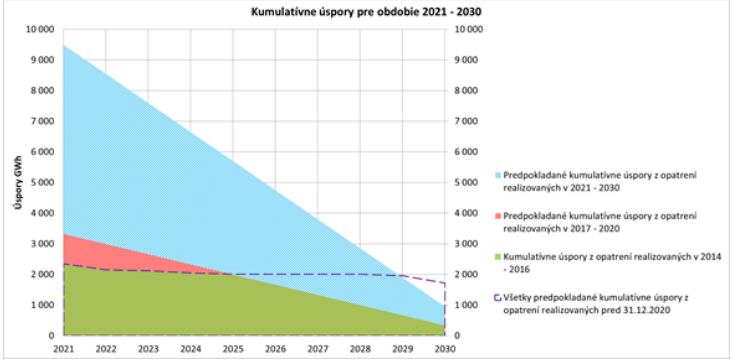
Source: ME SR

Pursuant to the amendment to the Energy Efficiency Directive 2018/2002, Member States will only be able to count energy savings resulting from policy measures introduced before 31 December 2020, or after that date provided that measures will result in **new** individual measures carried out after 31 December 2020. This implies that Member States will not be able to count the energy savings achieved from individual measures or projects implemented before 2021, which is one of the barriers to the development of energy efficiency, and which also artificially created a reduction in the ambition to achieve the 2020 target. In practical terms this change means that the lifespan of measures implemented before 2020 is irrelevant from the perspective of achieving the target after 2020.

In Figure 7, the red and green colours indicate the volume of savings calculated pursuant to the original Energy Efficiency Directive for the purposes of achieving the target pursuant to Art. 7.

Pursuant to the amendment to this Directive, such energy savings will have to be replaced with savings from new individual measures.

Figure 4: Current state of fulfilment of the cumulative target through existing measures



Key:	
Kumulatívne úspory pre obdobie 2021-2030	Cumulative savings for the 2021-2030 period
Úspory GWh	Savings GWh
Predpokladané kumulatívné úspory z opatreni realizovaných v 2021-2030	Estimated cumulative savings from measures implemented in 2021-2030
Predpokladané kumulatívné úspory z opatreni realizovaných v 2017 – 2020	Estimated cumulative savings from measures implemented in 2017-2020
Kumulatívné úspory z opatreni realizovaných v 2014 – 2016	Cumulative savings from measures implemented in 2014-2016
Všetky predpokladané kumulatívné úspory z opatreni realizovaných pred 31.12.2020	All anticipated cumulative savings from measures implemented before 31 December 2020

Source: ME SR

3. the indicative milestones of the long-term strategy for the renovation of the national stock of residential and non-residential buildings, both public and private, the roadmap with domestically established measurable progress indicators, an evidence-based estimate of anticipated energy savings and wider benefits, and the contributions to the Union's energy efficiency targets pursuant to Directive 2012/27/EU in accordance with Article 2a of Directive 2010/31/EU;

The text for this chapter will be part of the Long-term Strategy for the Renewal of the Residential and Non-Residential Building Fund in the Slovak Republic, which will be submitted to the Commission in accordance with Art. 53 of the Regulation on the Governance of the Energy Union by 10 March 2020.

4. the total floor area to be renovated or equivalent annual energy savings to be achieved from 2021 to 2030 under Article 5 of Directive 2012/27/EU on the exemplary role of public bodies' buildings;

The text for this chapter will be part of the Long-term Strategy for the Renewal of the Residential and Non-Residential Building Fund in the Slovak Republic, which will be submitted to the Commission in accordance with Art. 53 of the Regulation on the Governance of the Energy Union by 10 March 2020.

ii. *The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-supported estimate of anticipated savings and other benefits, and their contributions to achieving the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU*

The text for this chapter will be part of the Long-term Strategy for the Renewal of the Residential and Non-Residential Building Fund in the Slovak Republic, which will be submitted to the Commission in accordance with Art. 53 of the Regulation on the Governance of the Energy Union by 10 March 2020.

iii. *Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling*

Table 24: Other national objectives

Other national objectives	**Key objectives/measures**
National Traffic Information System	Using a unified system environment for collecting, processing, sharing, distributing and using traffic information in specific information, control and telematics applications to create the conditions for reducing negative environmental impacts and reducing the energy intensity of transport.
Transgeer Project	Planning of large-scale infrastructure projects as well as nature protection. An integrated approach to the development of a safe transport system in the Carpathian region that is environmentally friendly
Methodological guide on assessing the impacts of climate change on large projects in the transport sector	Analysis of climate change scenarios, possible impacts on individual monitored areas as presented in the present strategy
Working Group on the Low-Carbon Development Strategy of the Slovak Republic	Emissions planning (ENVISAGE, CGE, TREMOVE and COPERT models)
Strategy for Adaptation of the Slovak Republic to Climate Change - Update	General Adaptation Guidelines and examples of specific adaptation measures in the construction, transport, energy, industry and some other areas of business, increasing the resilience of these sectors.
Interdepartmental commission to ensure implementation of the Framework Convention for the Protection and Sustainable Development of the Carpathian Mountains (Carpathian Convention)	Implementation of the Carpathian Convention in the Slovak Republic, implementation of the Protocol on the Conservation and Sustainable Use of Biological and Landscape Diversity
Low-emission zones working group	Preparing legislation to define low-emission zones in cities
Informal interdepartmental circular economy working group	Creating conditions for the functioning of the circular economy, resolving cross-cutting themes when drawing up Slovak strategic documents and opinions for EU negotiations
Membership of EIONET (European Environment Information and Observation Network)	Providing background information when preparing environmental reports in Europe, updating information and commentary on materials
Membership of IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services)	Commentaries on regional assessments of biodiversity and ecosystem services

A material guarantor for scientific and research tasks	Processing of monitoring and analysis of the environment in transport, transition from the Kyoto Protocol to the Paris Agreement and its specifics for the transport sector in the Slovak Republic

Source MTC SR

2.3. Dimension: energy security

i. The elements set out in Article 4(c)

At present, the obligations and responsibilities for safeguarding the security of the electricity supply in the Slovak Republic are set out in Act No 251/2012 (Act on Energy and on the amendment and supplement of some other acts).

Electricity supply

The main state authority for supply security policy is the Slovak Ministry of Economy. In accordance with Section 88 of the Energy Act, the Ministry of Economy ensures the monitoring of the security of the electricity supply; it determines the application of measures to ensure the security of the electricity supply if the safety and reliability of the electricity system is compromised.

Current legislation relating to the security of the electricity supply is based on the transposition of the Third Energy Package for an EU internal market, which consists of Directive 2009/72/EC (Article 4) and Directive 2005/89/EC (Article 7). At present, this EU legislation is being replaced by new legislation that was part of the "Clean energy for all Europeans" package and will therefore need to be significantly updated in the short term.

National procedures for the prevention and management of emergencies are included in the Energy Act of 2012 (Act No 251/2012, on energy) and in Decree of the Slovak Ministry of Economy No 416/2012, laying down details on the procedure during a state of emergency in the electricity and gas sectors, and Decree of the Ministry of Economy of the Slovak Republic No 80/2019, which from 1 April 2019 amends and supplements Decree No 416/2012, reflecting, *inter alia*, the requirements of Commission Regulation (EU) 2017/2196 of 24 November 2017, establishing a network code on electricity emergency and restoration.

The ENTSO-E Operational Handbook (Operational Handbook RG CE, in particular Policy 5 – Emergency Operations) determines reference rules for the operation of the system by the national transmission system operator SEPS.

The transmission system (TS) operator has measures available to deal with and prevent states of emergency. The TS operator has a defence plan to prevent major malfunctions, measures for emergency changes of frequency and voltage, as well as a plan to restore the system after any full or partial state without voltage (blackout).

If, during operation, there is a change in the system that causes a sudden overload, in order to remove such overload the TS operator

a) will activate purchased support services,
b) will use contractually agreed emergency reserves,
c) will change the connection of electrical power equipment in the transmission and distribution systems.

Great attention is paid by the TS operator to the issues of safety and reliability. To safeguard these, the following are performed within the Electricity System of the SR:

- preventive measures - analysis of network performance calculations and short-circuit calculations, setup of protection systems, optimisation of the switch-off plan, regular maintenance of transmission equipment and the preparation of emergency response measures. Furthermore, there are measures to prevent the spreading of major system failures and measures to eliminate the consequences of major system failures (Defence Plan), measures on operational preparations, and measures to optimise TS maintenance and development,
- dispatching measures - emergency assistance, discontinuation of work on TS equipment in coordination with distribution system (DS) operators, use of support and system services, use of emergency response measures, TS reconfiguration,
- technical measures - protection system settings, use of support services, the effects of frequency characteristics and automatic voltage regulation.

In addition to the aforementioned emergency measures and their removal, restrictive measures are laid down in the legislation:

- a plan to reduce consumption,
- an emergency cut-off plan,
- a frequency cut-off plan.

The electric power dispatching of the TS operator annually updates the Frequency Cut-off Plan in accordance with RG CE ENTSO E Standards and Recommendations.

Future plans and procedures for security of the electricity supply will be based around, *inter alia*, the implementation of Regulation (EU) 2019/941 of 5 June 2019, on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC, including the responsibility of the competent authority to prepare a risk-preparedness plan after consultation with stakeholders in order to ensure a common approach to crisis prevention and management.

Gas supply

In regard to gas supply security, market participant obligations are addressed in the Energy Act, in Regulation (EU) No 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010 (the Regulation). Other relevant documents are the Preventive Action Plan and the Emergency Plan, the 2nd revision of which was approved in April 2017.

Gas supply standard

A distribution system operator who, based on a ministry decision, performs gas supply control tasks in a defined area, a gas supplier and a protected customer who ensures the supply of gas from the European Union or from third countries shall, for the purpose of addressing emergencies, comply with the gas supply standard for protected customers.

The gas supply standard means ensuring gas supplies for protected customers within the scope pursuant to the Regulation.

Article 6(1) of the Regulation determines the cases in which natural gas undertakings are to ensure the supply of gas to protected customers. These are:

a) extreme temperatures during a 7-day peak period occurring with a statistical probability of once in 20 years,
b) any period of 30 days of exceptionally high gas demand, occurring with a statistical probability of once in 20 years;
c) a period of 30 days in the event of disruption of the single largest gas infrastructure under average winter conditions.

The gas market participants concerned will ensure the above-mentioned gas supply standard using gas inventory in storage facilities by making gas supplies from such storage facilities available in emergencies to a network in the defined territory or through contracted supplies of gas produced in the defined territory. They may also provide up to 50% of the gas volume needed to ensure the gas supply standard using cross-border network capacity through contractually arranged auxiliary emergency gas supplies available in the defined area.

A distribution system operator who, based on a ministry decision, performs gas supply control tasks in a defined area, a gas supplier and a protected customer who ensures the supply of gas from the European Union or from third countries, shall submit a proposal for the method for complying with the gas supply standard to the ministry every year by 28 February for the following period from 1 November to 31 March. The ministry, after discussing the submitted proposals with the Regulatory Office for Network Industries (RONI) and the distribution network operator which, based on a decision by the ministry, performs gas supply control tasks in the defined area, will decide on the method for complying with the gas supply standard by 31 March. The relevant meeting of the Ministry, the RONI and the gas supply control took place on 27 March 2019. The distribution network operator who, based on a ministry decision, performs gas supply control tasks, a gas supplier and a protected customer who ensures the supply of gas from the European Union or from third countries shall submit to the ministry information about compliance with the gas supply standard for the following period from 1 November to 31 March every year by 31 August. If compliance with the gas supply standard is insufficient, the Ministry will impose measures by decision.

The Energy Act also laid down the conditions for the management of gas networks. The distribution network in the defined territory of the Slovak Republic is managed by the “gas supply control”, which is responsible for the operational management of the distribution network. The tasks of the gas supply control in the defined area are fulfilled, based on decision of the Ministry, by the dispatching centre of the distribution network operator, SPP - distribúcia, a. s.

The national secondary legislation regulating the conditions for the operation of gas supply control and the procedures in the event of a declaration of emergency, is provided through Decree No 416/2012.

Gas supply control performs the following functions in the defined territory of Slovakia:

a) it operatively manages its own distribution network and the distribution of gas to the connection points of connected distribution networks,
b) it manages interconnected transmission networks and distribution networks in the defined territory during a gas industry emergency and during activities to prevent such an occurrence,
c) it technically manages the allocation of gas sources at entry points to connected distribution networks,

d) it declares and cancels an emergency in the gas industry and its level according to the Regulation,
e) it declares and cancels restrictive measures in the gas sector pursuant to Section 21 of the Act,
f) it lays down measures to remedy an emergency in the gas sector,
g) it submits to the Ministry, weekly for the period from 1 November to 31 March and daily in the event of an emergency: for each day, a calculation of the capacity of other infrastructure in the event of a disruption to the largest independent gas infrastructure, including a calculation taking into account appropriate market measures on the consumption side in accordance with a special regulation.

An emergency in the gas sector and its level in the defined territory or part of the defined territory is declared and cancelled by the distribution network operator which, based on the Ministry's decision, performs gas supply control tasks in the defined territory, in public mass information systems and using control management resources. Such distribution system operator shall notify the Ministry without delay of

a) the declaration and cancellation of an emergency and its level,
b) information about any restrictive measures it plans to adopt,
c) additional information, upon request, relating to the declaration of emergency and its level or the restrictive measures,
d) information as to whether the emergency may result in the submission of a request for assistance from the European Union and its Member States.

A distribution system operator who, based on a decision from the Ministry, performs gas supply control tasks in a defined territory, shall immediately cancel an emergency upon request from the Ministry.

Where an emergency has been declared, gas market participants shall contribute to the elimination of its causes and consequences.

In connection with the gas supply standard, regulated at European level by the Regulation, so-called risk groups have been determined that associate Member States according to their natural gas sources. The Regulation determines that a Common Risk Assessment will be prepared for the individual risk groups, from which regional chapters relating to regional cooperation or potential coordination procedures during an emergency should be transferred to national plans. Slovakia has been classified in 4 risk groups, while 3 groups are currently active in view of the available transmission infrastructure.

At the same time, each Member State will draw up national documents – Risk Assessment, Preventive Action Plan and Emergency Plan. The Regulation sets out templates for the areas that should be captured in the individual plans as well as the frequency of their preparation. The Risk Assessment will map the risk factors that may affect gas supply to that Member State. In accordance with the identified risks, the Preventive Action Plan will elaborate measures that should mitigate the level of individual risks. The Emergency Plan presents the procedures and processes that need to be followed after the declaration of one of the gas supply emergency levels.

The Regulation also introduces the obligation for solidarity between Member States based on bilateral agreements. However, the conclusion of the relevant agreements between the individual states remains problematic due to several factors. Agreements are regularly discussed at the level of the Gas Coordination Group, as the deadline set by the Regulation for their conclusion has already expired, while the legal form of the agreement, the implementation of a request/offer for/of solidarity assistance, the price and terms of payment in the event of the provision of solidarity and other issues remain problematic. Germany has made most progress in this process, and has also provided its proposals for solutions to other states.

In connection with the application of the Regulation, a working group was set up under the aegis of the Slovak Gas and Oil Association and the Slovak Gas Agency, members of which were representatives of the Slovak Ministry of Economy; the Network Regulation Office; SPP, a.s.; SPP - distribúcia, a.s.; NAFTA, a.s.; and eustream, a.s. The aim of the working group was to propose the application of solidarity measures under Article 13. The working group prepared material that included proposals for the resolution of this issue, especially from the perspective of legislation. The material has been submitted to the Ministry of Economy of the Slovak Republic.

ii. National objectives with regard to increasing: the diversification of energy sources and supply from third countries the resilience of regional and national energy systems

Oil

Oil deliveries to Slovakia and transit across its territory take place reliably and smoothly in line with the volumes agreed in contracts concluded between Slovak and Russian companies. The continuity of oil supplies is ensured in accordance with the Agreement between the Government of the Slovak Republic and the Government of the Russian Federation on Cooperation in Long-term Supplies of Crude Oil from the Russian Federation to the Slovak Republic and the Transit of Russian oil through the Territory of the Slovak Republic, which entered into force on 1 January 2015 and expires on 31 December 2029.

The strategic geographical location and the relatively high transport capacity of the Druzhba pipeline in Slovakia are realistic prerequisites for its connection to European transit routes.

The Druzhba pipeline connects to the Adria pipeline in Šahy. Adria is currently used to supply oil brought in by tanker to the port of Omišalj. The maximum annual capacity is 3.8 million tonnes. After the eventual renovation of the Százhalombatta pumping station and the repair of pipeline defects on the Šahy - Százhalombatta section, the capacity will be 4.5 million tonnes. In Hungary, annual transport capacity of 6.9 million tonnes is currently available on the Százhalombatta - Croatia border. This capacity is calculated based on the pump capacity at the pumping station in Százhalombatta, while the capacity of the oil pipeline itself is 14 million tonnes per year. The capacity of the Adria oil pipeline (in the Omišalj to Šahy direction) in the event of a loss of supplies through Druzhba is currently sufficient to cover Slovakia consumption. In such a case, the annual transit volume would be between 3 and 3.5 million tonnes of oil.

Negotiations are currently under way to find an optimal solution for the Druzhba pipeline link with the Schwechat refinery to minimize possible environmental impacts.

Based on the latest survey, an oil pipeline route of 12.814 km with a connection point at a Slovnaft a.s. refinery and ending on the Slovak-Austrian border near Kittsee was recommended.

On the Austrian side, a project for a pipeline that would connect to the Slovak part of the pipeline near Kitsee is currently in its final phase. The necessary building permits have been issued, except for those subject to the demonstration of the purchase of a "Right of Way" (RoW) through the land concerned, however the Austrian side will also reach a conclusion in this regard. About 98% of the land concerned has been contracted, and intensive negotiations are underway regarding the remainder. The implementation of the pipeline project will ensure strategic interconnection with pipelines in Western Europe. With this step, if reverse pumping from Austria is made available, oil supplies from non-Russian sources will be possible and thus our dependence on oil from the Russian Federation reduced. The importance of the project was taken into account when it was included in the EU list of Projects of Common Interest (PCI).

Natural gas

The Slovak Republic is an important transit country for natural gas moving from east to west and west to east. There is also a need to complete connections in the north-south direction to retain the Slovak Republic's position in the pipeline transit of gas.

In order to secure gas supplies, both the State and the gas companies are taking steps to better prepare the Slovak Republic for potential gas supply problems to avoid any repeat of the situation that meant limiting gas supplies to Slovak consumers during the gas crisis of 2009. These measures address the options for transporting emergency gas supplies from other directions/countries, including securing auxiliary supplies of gas through reverse flow from the Czech Republic and Austria. These medium-term and long-term measures are mainly aimed at building interconnections between transport networks, providing opportunities for diversification of gas supplies and building or, more exactly, expanding gas storage facilities in Slovakia in suitable geological structures currently available.

Since 2009, the Slovak Republic has clearly declared its support for specific projects to increase gas supply security or, more exactly, aimed at finding solutions to interconnect Slovak networks with the networks of neighbouring countries in cases where such an interconnection does not yet exist. Discussions have also been held to make maximum use of EU funds.

Slovakia has supported interconnection projects with Poland and Hungary, as well as reverse-flow projects from the Czech Republic and Austria (these are being implemented only on the territory of the Member States referred to but directly impact the possibility to use reverse gas flow in Slovakia). It has also supported a project for technical modifications to enable reverse flow in the Slovak transport network operated by eustream, a.s., and the NAFTA a.s. project, which will enable increasing the volume of gas supplies from storage facilities to the transport network during emergencies.

As part of the Slovakia/Hungary interconnection project, the gas pipeline was placed on a standard commercial footing on 1 July 2015 after successful construction and test operations.

Diversification of natural gas routes and sources

"Polish-Slovak interconnection of gas networks" project

In September 2018, the construction of an interconnection between Slovakia and Poland was started based on the respective agreements between the transmission system operators - eustream, a. s. and GAZ-SYSTEM S.A. It should be put into operation in 2021.

This project is part of the North-South Gas Corridor and forms an important element in the transit pipeline chain linking Eastern Europe from the Polish LNG terminal at Świnoujście to the planned Croatian LNG terminal on the island of Krk. The Innovation and Network Executive Agency (INEA), GAZ-SYSTEM S.A. and eustream, a.s. signed a grant agreement in December 2017 for the Poland-Slovakia interconnection pipeline, approximately 106 kilometres of which will be in Slovakia. The grant agreement will enable the Polish and Slovak network operators to use European Union financial support from the Connecting Europe Facility (CEF) totalling EUR 104.5 million, while eustream has allocated EUR 52 million for the construction of the Slovak part.

The "Eastring" project

The Eastring pipeline should pass through Slovakia, Hungary, Romania and Bulgaria. On 20 September 2018, the transmission system of the SR operator eustream, a.s. presented the results of the feasibility study for the Eastring gas pipeline, for which it received a CEF grant of 50% of the eligible costs up to EUR 1 million. Based on this, a 1 208 km long pipeline route between Veľke Zlievci (Slovakia/Hungary border) and Malkoçlar (Bulgaria/Turkey border) was evaluated as the optimal pipeline option.

In terms of the concept to connect Western European markets with the countries of south-eastern Europe in particular, the Eastring gas pipeline project is a solution to achieve the strategic goal of maintaining or even increasing the volume of gas transported through the Slovak transport network. Implementation of the project would significantly contribute towards increasing the importance of Slovakia's role as a crossroads for gas connections and its ability to ensure reverse flow gas transport throughout the region. The pipeline, which is designed to be bi-directional, can therefore be considered a route for new potential suppliers, especially from the Caspian region, or from the possible Turkish gas hub, allowing them to access European markets and increase the level of security through diversification of sources.

Trading Region Upgrade (TRU) service

When forecasting future developments, the eustream, a.s. transmission system operator also monitors long-term trends and estimates for gas consumption throughout the EU. When considering the suitability of projects for implementation, it thus takes into account the security of supplies not only for the Slovak Republic but also for vulnerable regions, such as South-East Europe and Ukraine. Another criterion taken into account is the effort to contribute towards integrating gas markets in the most efficient way, in particular by using existing infrastructure as much as possible. One positive example is the implementation of the TRU service, which connects the Austrian and Czech gas markets through the existing Eustream transmission infrastructure. Thanks to this service, the European Union's efforts to integrate markets in a simple and cost-effective way without unnecessary investment are being put into practice. The first phase of the TRU project was concluded in September 2019.

iii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

Transit routes and their diversification are described in point ii.

Domestic gas extraction

Slovakia has its own domestic gas extraction, providing up to 2% of its total gas consumption. Over the long-term, we can anticipate the continuation of natural gas extraction from existing sources but with a falling trend. Only the discovery of new sources might cause any eventual changes to this trend, however extraction volumes would depend on the scope, character and location of such new deposits. Another vital factor would be the financial aspect of extraction from such deposits. The company NAFTA, a.s. is drilling several exploration wells in various parts of the country.

Underground gas storage facilities

Slovakia has several suitable geological structures that are used or that can be used as underground storage facilities for natural gas.

We consider underground storage facilities to be the most important tool to ensure gas supply security and therefore the resilience of energy systems. Two companies operate underground storage facilities in Slovakia - NAFTA a.s., Bratislava and POZAGAS a.s., Malacky. The total storage capacity of such facilities in the Slovak Republic is 42 547 GWh (meaning almost 4.01 billion m^3) (data from the operators as of 1 August 2019), while the maximum daily fixed withdrawal capacity is almost 465 GWh (almost 44 million m^3) (the maximum daily withdrawal capacity including interruptible capacity is over 515 GWh (48.5 million m^3), while the maximum daily fixed injection capacity is over 410 GWh (38 million m^3).

The Dolní Bojanovice underground storage facility (in the Czech Republic) operated by the company SPP Storage s.r.o., Prague, with a capacity of 6 944 GWh (0.65 billion m^3) and a maximum daily withdrawal capacity of around 95 GWh (8.8 million m^3) is also used to supply Slovakia. This storage facility is connected to the Slovak gas network and is independent from the connection equipment used by NAFTA a.s. and POZAGAS a.s. It also has a high degree of flexibility and can switch from injection to withdrawal and back relatively quickly.

Projects to convert other suitable geological structures into underground gas storage facilities, respectively to use them in another way for energy-related purposes (CCS), are also under way.

The NAFTA a.s. project to build the Veľké Kapušany Underground Gas Storage Facility is linked to gas infrastructure projects. The underground gas storage facility at Veľké Kapušany aims to enhance the security of the natural gas supply in the region and accelerate the integration of the markets of EU Member States - Poland, Slovakia and Hungary – including the neighbouring Ukrainian market. In terms of technical characteristics, the project envisages the creation of 340 million m^3 of new storage capacity with an estimated withdrawal capacity of 3.75 million m^3/day and injection capacity of 3.75 million m^3/day.

The project will support the European Union's priority gas corridor (NSI East Gas) and will have a significant cross-border impact on neighbouring states. The project is strategically located on the eastern border of the European Union in close proximity to one of the natural gas entry gates to the EU – the compressor station at Veľké Kapušany – at a point where 3 existing and 2 planned pipeline routes meet. There is currently no storage capacity in this part of Slovakia. By building an underground storage facility with a direct connection to the compressor station at Veľké Kapušany, the position of the Veľké Kapušany gas hub will be strengthened and the intensification of business activities and the gradual transformation of the node into a gas hub are anticipated.

The possibility of using waste heat from existing compressors at the Veľké Kapušany station to drive the storage compressors is also being considered (assuming gas transit from east to west or sufficient

waste heat capacity at the Veľké Kapušany compressor station), which would have a positive environmental impact and would not result in an additional increase in greenhouse gas emissions.

In addition, the project envisages the possibility of energy storage in the form of a mixture of natural gas and hydrogen. The storage of hydrogen in a mixture with natural gas has the potential to accelerate the use of renewable energy sources, as such storage eliminates the disadvantages of these energy sources (volatility of the amount of energy obtained from renewable sources) and will allow the long-term storage of energy from renewable sources.

iv. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

Electricity sector

In terms of ensuring the **flexibility of the energy system**, one of the Slovak Republic's objectives is to provide sufficient **flexibility** for market participants, primarily for entities with variable generation sources such as renewable energy sources. The basis for this flexibility is trading as close as possible to the moment of physical supply, as variable generation cannot be accurately planned over an extended period of time. Attention will therefore be paid to the development of trading opportunities and their rules, particularly through intra-day and balancing markets.

In connection with increasing the flexibility of the electricity system, it is the intention of the Slovak Republic – in line with the aforementioned European legislation – to create conditions for the provision of support services which, based on clearly defined rules, will allow the **aggregation** of collection facilities, energy storage facilities and electricity generating facilities for the purpose of offering regulatory services. Rules and appropriate conditions will also be established for the owners of the collection facilities, third parties and owners of conventional and renewable energy sources, as well as the owners of energy storage facilities, to become regulatory service providers. The aim is to ensure full and equal access for all technologies and suppliers, including renewable sources, to balancing markets. At the same time, the Slovak Republic is interested in supporting a shortening of the currently used **trading intervals** on daily, intraday and balancing markets. Shortening trading intervals will make it possible to contribute towards better management of the interconnected electricity system as well as towards the integration of a higher proportion of intermittent sources in total production. From the point of view of system power regulation, the Slovak Republic supports a shortening of the activation period of balance support services by 2023, which will lead to an increased management dynamic and grid flexibility.

A problem for the SR in terms of providing flexibility in electricity generation is the installed capacity of its power plants, which are able to flexibly react to current system requirements. The increasing share of volatile renewable sources in electricity generation means that the transmission system operator is encountering problems in managing the electricity system due to failure to meet the required support service volumes in some months of the year. The operation of photovoltaic and wind power plants creates increased demands on support services and it will be necessary to ensure the operation of sources with adequate regulatory capacities for their further development.

In the regulatory area in the SR, electricity consumption control is also used to ensure sufficient supply volumes – this is tertiary regulation by reducing the power consumption of a selected electricity consumer and tertiary regulation by increasing the power consumption of a selected electricity consumer.

Participation in the Grid Control Cooperation (e-GCC) cross-border exchange project at the start of 2012 improved the security of the electricity system operation, and in particular reduced the need to activate the Secondary Power Regulation and the number of Tertiary Power Regulation activations.

Gas sector

It is necessary to create an appropriate environment to ensure the flexibility of energy storage and accumulation operators. It is necessary to exploit the advantages of the underground storage facilities in the SR and the centralised heat supply system to the greatest possible extent.

Slovakia has underground gas storage facilities in the southwestern part of the country that play an important role in balancing disparities between gas supply and demand, and during peak demand. Gas storage facilities can be considered the most important tool in terms of gas supply security. Their operators currently provide natural gas storage services for several foreign gas companies.

The company NAFTA a.s. has two projects to develop underground storage facilities prepared. One of these is a new facility in the east of Slovakia – the Ptrukša geological structure (anticipated technical parameters: working volume 0.34 billion m^3, withdrawal and injection capacity 3.75 million m^3/day) at Veľké Kapušany. The other project is the expansion of the existing Láb complex (anticipated technical parameters: working volume 0.55 billion m^3, increase in withdrawal capacity by 10 million m^3/day and injection capacity by 8 million m^3/day). However, the implementation of these projects will depend on the situation in the natural gas storage market as well as on obtaining financial support from European Union sources.

Linking sectors

The development of energy storage will ensure the integration of variable RES into the system. Such a system will allow the storage of locally produced energy and its consumption according to demand. Integrating local energy storage in accumulation appliances, energy storage facilities and electric vehicles or in the gas distribution network with its storage capabilities is therefore an important element of the smart grid. In addition to energy storage, local power consumption management concepts are being developed based on good mapping and analysis of the ratios in the system so that electricity is not transformed to a higher voltage at the generation site and then back to a lower voltage at a remote location. Ensuring a flexible, low-carbon and sustainable electricity generation base will require first and foremost maintaining and supporting the existing capacity and operation of pumped-storage power plants, and possibly assessing the possible increase in storage capacity by building a new pumped-storage power plant.

Heating sector

In the heating sector there will be support for efficient district heating systems with heat supplied from RES, waste heat from industrial processes making cost-intensive use of RES, especially locally available biomass/biomethane and waste, including support for multi-fuel systems as well as heat pumps, which, as a form of RES, make it possible to significantly save on heat generation costs. The option to create conditions for the use of heating plants to supply electricity in emergencies will be considered. District cogeneration heating systems will be preferred over the generation of electricity from fossil fuels without the use of heat. Their operation is necessary so that they can be used for the provision of regulatory electricity as much as possible. It is necessary to use heating plant infrastructure for the integration of RES into district heating systems in the form of electricity and heat generation from biomethane (coming primarily from waste from plant and animal production,

from the biodegradable part of municipal waste, the biodegradable part of kitchen and restaurant waste, and waste from waste water treatment plants), energy recovery from municipal waste as part of the circular economy, and energy efficient equipment using RES that meet sustainability criteria.

2.4. Dimension: internal energy market;

2.4.1. Electricity interconnectivity

i. The level of electricity interconnectivity that the Member State aims for in 2030 in consideration of the electricity interconnection target for 2030 of at least 15%, with a strategy with the level from 2021 onwards defined in close cooperation with affected Member States, taking into account the 2020 interconnection target of 10% and the following indicators of the urgency of action:

The SR will fulfil the 10% target for EU Member States' transmission interconnection level by 2020 adopted by the EU Council in 2002, as well as the 15% interconnectivity level by 2030 set by the EU Council in 2014 as the share of net import transmission capacity to total installed electricity generation capacity in the Member State. Based on the Commission communication on Strengthening Energy Networks[16], the Slovak Republic achieved a 43% transmission system interconnection level in 2017, and in 2020 – according to the 2016 ten-year pan-European network development plan (TYNDP 2016) – it will reach a 59% interconnection level in 2020. In 2030, according to the TYNDP 2016 assumptions, the level of SR interconnection will decrease to 52%, mainly due to the projected increase in installed electricity generation capacity.

The **Slovak Republic will also fulfil the indicative indicators of the target for interconnection of the transmission systems of the Member States of the European Union to 2030,** according to the Commission report[17] of November 2017, which states that the nominal transmission capacity, i.e. the thermal capacity of a Member State's cross-border interconnection, should amount to at least 30% of the maximum load in the import direction and 30% of the installed renewable energy output in the export direction, while the average annual difference in the marginal cost of trading zones should be no greater than EUR 2/MWh.

According to the TYNDP 2018 analysis[18], in the first two criteria the Slovak Republic achieves a level of interconnection of over 60% for all the considered scenarios, i.e. a thermal import capacity at 230% to 250% of the assumed maximum load and a thermal export capacity at the level of 160% to 282% of the projected installed RES output. The difference between the average annual marginal cost and the neighbouring trading zones except the Czech Republic is over EUR 2/MWh. The average annual marginal cost in trading areas is represents variable costs, and thus is dependent on the variable costs of the Member State's source mix. The price difference in neighbouring areas indicates the degree of market deformity caused by restricted transmission. If there is sufficient capacity on all profiles, the average annual marginal price difference should not be higher than EUR 2/MWh.

[16] https://ec.europa.eu/energy/sites/ener/files/documents/communication_on_infrastructure_17.pdf

[17] https://ec.europa.eu/energy/sites/ener/files/documents/report_of_the_commission_expert_group_on_electricity_interconnection_targets.pdf

[18] https://tyndp.entsoe.eu/Documents/TYNDP%20documents/TYNDP2018/consultation/Main%20Report/TYNDP2018_Executive%20Report.pdf

According to analyses by the TSO (SEPS) presented in the Ten-Year Plan of the Transmission System for 2020 to 2029, by 2030 the implementation of cross-border interconnection projects with Hungary (see Chapter 2.4.2) will increase the maximum transmission capacities on the Slovak-Hungarian profile compared to the present situation in the export direction by approximately 85% to 3 489 MW and in the import direction by approximately 47% to 2 610 MW.

The implementation of cross-border pipeline projects with the Czech Republic will increase the maximum transmission capacity on the Slovak-Czech profile in the import direction by 35% to 2 862 MW by 2030. There will be no significant increase in capacity in the export direction, which will thus remain at approximately the current 2 950 MW.

2.4.2. Energy transmission infrastructure

i. Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects, that are necessary for the achievement of objectives and targets under the five dimensions of the Energy Union Strategy

As regards the electricity transmission infrastructure, the priority of the Slovak Republic is to complete the construction of **new Slovak-Hungarian cross-border interconnections** (2x400 kV Gabčíkovo (SR) – Gönyű (HU) – Veľký Ďur (SR) and 400 kV R. Sobota (SR) - Sajóivánka (HU)). On the Slovak side, both lines have been completed. In cooperation with the Czech TS operator (ČEPS), the TS operator (SEPS) requested the inclusion of the planned 1x400 kV Ladce (SR) - Otrokovice (CZ) connection on the list of projects of common interest (PCI). This is a link that would replace the 220 kV transmission system (TS) which is gradually being replaced on both sides of the SR/CZ border. This strengthening also includes a planned increase in the transmission capacity of the V404 Varín (SR) - Nošovice (CZ) line as part of planned renewal at both SEPS and ČEPS. The project was not included in the 4th PCI list.

As regards gas transport infrastructure, the Slovak Republic's priority projects are the completion of the Slovak-Polish interconnection, which was started in September 2018, and the implementation of the Eastring gas pipeline, included on the list of projects of common interest and for which the results of a feasibility study giving its optimal route were presented in September 2018.

Gabčíkovo (SR) - Gönyű (HU) - Veľký Ďur (SR) 2 x 400 kV line

The subject of this project is the construction of a 2x400 kV line between the Gabčíkovo (SR) – Gönyű (HU) - Veľký Ďur (SR) electric stations from the Veľký Meder locality where the existing 2x400 kV Gabčíkovo - Veľký Ďur line will be dismantled, creating a 2x400 kV Gabčíkovo (SR) - Gönyű (HU) - Veľký Ďur (SR)) cross-border interconnection.

The aim of the project is to increase transmission capacity between the transmission systems of Slovakia and Hungary as well as to increase the security and reliability of the operation of the transmission system of the Slovak Republic on the highly exposed cross-border transmission profile in the eastern region of Central Europe.

The justification and importance of construction of this project was demonstrated through the acquisition of PCI status. At the request of SEPS, at the beginning of 2016 the project was awarded a financial contribution from the Connecting Europe Facility (CEF) of 50% of the requested amount for engineering and project activities for the part of the line inside Slovakia (around EUR 0.46 million, which was drawn in 2019).

Rimavská Sobota (SR) - Sajoivánka (HU) 2 x 400 kV line

This project is for the construction of 2 x 400 kV lines between the Rimavská Sobota (SR) and Sajoivánka (HU) electric stations. As the line on the Hungarian side will temporarily only have one branch, there will one double line branch on the Slovak side before entering field No 3 at the Rimavská Sobota electric station and connected to the second branch at the last anchor mast.

The aim of the project is to increase transmission capacity between the transmission systems of Slovakia and Hungary, as well as to increase the security and reliability of the operation of the transmission system of the Slovak Republic on the highly exposed cross-border transmission profile within the eastern region of Central Europe.

The justification and importance of construction of the project was demonstrated by the acquisition of PCI status. At the request of SEPS, at the beginning of 2016 the project was awarded a financial contribution from the Connecting Europe Facility (CEF) of 50% of the requested amount for engineering and project activities for the part of the line in the territory of Slovakia (around EUR 0.64 million, which was drawn in 2019).

ACON smart grid project

The main objective of the ACON (Again COnnected Networks) cross-border smart grid project between the Slovak Republic and the Czech Republic is to strengthen the integration of the Czech and Slovak electricity markets and to effectively unify the behaviour and activities of the users of the electricity systems in order to create an economically advantageous, sustainable electricity system with small losses and high quality and security of supply.

In November 2017, the project was included in the third list of EU Projects of Common Interest (PCI). The project implementer for the SR is Západoslovenská distribučná, a.s., and on the Czech side E.ON Distribuce, a.s. The estimated project costs are EUR 221 million and the anticipated implementation period is 2018-2024.

Západoslovenská distribučná (ZSD) and E.ON Distribuce, together with their project partners, received EUR 91.2 million in co-financing from the European Commission for the international ACON Smart grid project.

This is the first ever project in Slovakia to feature massive deployment of state-of-the-art smart technologies that will enable the emergence of “new energy” based on local renewable sources.

The project will not only modernize existing infrastructure, but also build new infrastructure. Examples are the new power station in Borský Svätý Jur and the digitization of over 200 kilometres of 22kV lines. The benefits of the ACON project include a significant improvement in grid performance parameters, in particular the failure rate and maintenance downtime, as well as the reduction of electricity transmission losses.

The ACON project is implemented in the border regions of western Slovakia, but its benefits will have an impact both throughout Slovakia and in neighbouring states. The implementation of smart elements will provide adequate capacity for all grid users and allow for better monitoring. Easier identification of potential failures will reduce the time it takes to clear them. This will provide customers with a more stable distribution system with minimum downtime and high supply quality.

The possibility of co-financing the development of the distribution system from EU sources is an opportunity to significantly contribute towards the digitization of the Slovak distribution system and to offer new technological solutions to network users. The total value of the supported ACON project

is around EUR 182 million, while co-financing from European sources is EUR 91.2 million, meaning 50% of the project value, and the costs of each project partner account for 50%.

Projects of common interest are key cross-border EU energy infrastructure projects necessary for the creation of a single energy market and to achieve affordable, secure and renewable energy.

The ACON project, one of the most important Slovak-Czech energy projects and one that also promotes European energy goals, is supported by Peter Žiga, Minister of Economy of the SR, and Karel Havlíček, Minister of Industry and Trade of the Czech Republic. Both ministers, together with the project partners, signed the Declaration of Support for the ACON project in Bratislava on 24 June 2019 to ensure the smooth implementation of the individual project objectives.

The ACON project has several smart and innovative features and is one of the first smart grid projects on the PCI list. Intelligent technologies will provide new communication features as well as intelligent load management with automatic algorithms, which will increase awareness, ensure better interconnection, and allow the future use of distribution systems for the wider deployment of renewable sources as well as access to digital infrastructure.

Work on the ACON project will involve several activities, namely: a new cross-border 22kV connection between Holič and Hodonín; a new transformer station and the modernisation of existing transformer stations; cabling; and the installation of IT equipment and smart solutions.

Danube InGrid smart grid project

ZSD has initiated another similar project, this time in cooperation with a Hungarian company from the E.ON group and the national transmission system operators SEPS and MAVIR.

The main goal of the Danube InGrid (Danube Intelligent Grid) project is to increase the integration of renewable energy sources into the grid through the use of intelligent technologies at transmission and distribution level, including their smart management.

While ACON will mainly be implemented in the Trenčín and Trnava regions, Danube InGrid should primarily cover the Nitra region and part of the Trnava region. The inclusion of the project in the upcoming list of PCI projects was also supported by the EU Member States.

Slovak-Polish gas interconnection

The project has received support from the CEF for the implementation of the project itself of approx. EUR 57 million, and pipeline construction is currently under way in the Slovak Republic.

The project envisages a transfer capacity of about 5.7 billion m^3/year towards the Republic of Poland and 4.7 bn. m^3/year towards the Slovak Republic. The total length of the interconnection should be 165 km (in Slovakia a maximum of 106 km and in Poland 59 km). The project involves building a compressor station in Strachocine, Poland, and modifying an existing compressor station in Veľké Kapušany. This project represents a major part of the North-South Gas Corridor, linking LNG terminals in Poland and Croatia. Its implementation will contribute towards increased security of supply and will support market integration through diversification of sources and routes not only in the Slovak Republic and the Republic of Poland, but also in the whole region of Central and South-Eastern Europe.

Eastring

Eastring is a project for a new gas pipeline for central and south-eastern Europe, which represents an important step towards achieving a single European gas market, a common vision of the European

Union. Eastring is a project for a two-way gas pipeline between the Slovak Republic and the south-east European border (Black Sea or more exactly Turkey) with an annual capacity of 208 000 GWh to 416 000 GWh (about 20 billion to 40 billion cubic m^3). Eastring will connect existing gas infrastructure across Slovakia, Hungary, Romania and Bulgaria.

The European dimension of the project has been highlighted through its multiple inclusion in the PCI project list.

ii. Where applicable, main infrastructure projects envisaged other than Projects of Common Interest (PCIs)[19]

Electricity

The phase-out of the 220 kV transmission system (TS) by about 2026 is a long-term strategic objective of the TS operator. New TS equipment is already being built for a voltage of 400 kV. The phased-out 220 kV equipment is cancelled either without replacement or is replaced with new 400 kV equipment - depending on the agreement with the TS operator. Major 220 kV TS phase-out projects include the replacement of 220/110kV transforming in the Senica, Bysričany and Považská Bystrica electric stations and the creation of a 400/110kV connection at the Sučany electric station.

Regarding the construction of new power stations, or the reconstruction of existing 400 kV substations (R), the TS operator is switching to a uniform technical solution concept, including the transition to the remote control of electric stations without the presence of a permanent operator. This also relates to the replacement of 220 kV electric stations with 400 kV electric stations. The major projects to 2030 include the reconstruction of R400 kV Sučany, Varín and Liptovská Mara (including switching to remote control and, if necessary, the replacement of the transformers) and the replacement of end-of-life transformers, potentially increasing their installed capacity (in agreement with the respective DS operator). In terms of the construction of new power lines, the TS operator does not plan to build new interconnections except those intended to connect the new electric stations (after the switch from the 220 kV voltage level) to the grid and except for those mentioned above (connections to Hungary and Czech Republic). However, cross-border lines will only be built after a bilateral agreement with the neighbouring TSO. This means that it is an ongoing process and the situation may change.

Gas sector

In the gas sector we anticipate several measures to strengthen the internal gas market with the aim of, for example:

a) enabling and facilitating a liquid and competitive environment in the internal gas market,
b) enabling and strengthening the diversification of routes and sources, thereby increasing the security of gas supply through increased gas network flexibility,
c) contributing towards improving sustainable development in Europe, as natural gas plays a key role in the European Union's energy mix, in particular with regard to economic development and environmental protection.

2.4.3. Market integration

[19] In accordance with Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009 (OJ L 115, 25 April 2013, p. 39).

i. National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met

The national intentions of the Slovak Republic in connection with building the **single electricity market** within the EU are primarily determined by directly applicable European legislation (i.e. the relevant market network regulations and decrees).

The prospective targets and target values for market integration are conditional in particular on Commission Regulation (EU) 2015/1222 laying down guidelines for capacity allocation and congestion management (CACM Regulation), supplemented by Regulation (EU) 2019/943 of the European Parliament and of the Council on the internal market in electricity.

Within the **daily and intraday market** time frames this is mainly about the full integration of the Slovak Republic as part of a unified solution based on the principles of the implicit allocation of inter-area capacities, Single Day Ahead Coupling (SDAC) and the unified interconnection of intra-day markets based on the principle of continuous allocation of inter-area capacities, or Single Intraday Coupling (SIDC).

For the time frame of the daily electricity market, a project was launched at the turn of 2018/2019 for the timely implementation of the merger of the interconnection of Slovakia, Czech Republic, Hungary and Romania (4M MC) with the connected Western Europe MRC region (DE-AT-PL-4MMC project) based on the Net Transmission Capacity (NTC) method[20]. At the same time, all the project stakeholders, including the Slovak parties and the national regulatory authority, confirmed their commitment to implementing the European target solution and methodologies resulting from legally binding EU legislation on the principle of coordinated flow-based capacity calculation.

The intraday electricity market could be unified within the European Union by 2021. The basis for the target solution for the integration of the intraday electricity market should be the XBID project, which sets up the accession process and also includes the Slovak Republic. Slovak stakeholders are currently considering the position of Slovakia in relation to the XBID project with probable accession in the third wave after 2020.

With regard to **balancing markets,** it is assumed that at the turn of 2021/2022 the Slovak Republic will become an integral part of the unified centralised European platforms for the provision of performance balancing services. The involvement of the Slovak Republic in these platforms, based on current European legislation, is a response to the needs for increased flexibility in managing the interconnected electricity system, increased liquidity of the balancing market and transparent pricing for performance balancing services. Under the appropriate conditions set by the relevant legislation, it is possible to anticipate an increase in the liquidity of European platforms through the promotion of new technologies and entities delivering performance balancing services.

In terms of wholesale market integration and **increasing tradable capacity,** the Slovak Republic and Slovak parties will act in coordination with other Member States and stakeholders in the CORE region

[20] http://www.urso.gov.sk/?q=node/598

when implementing the principles of capacity allocation and congestion management under Regulation (EU) 2019/943 of the EP and of the Council on the internal electricity market (Article 16).

An important contribution to the integration of wholesale electricity markets in terms of reducing the price differential between market areas (Chapter 2.4.1 in connection with interconnection indicators, an indicative threshold of EUR 2/MWh) will be the implementation of **two new cross-border interconnections between Slovakia and Hungary** included in projects of common interest (PCI) with anticipated completion by the end of 2020 (Chapter 2.4.2). The aim is to increase cross-border transmission capacity on the Slovak-Hungary profile, which has long been a structural bottleneck and a significant barrier to market integration in the region.

The plans and form of the national legislation in the field of increasing the **flexibility of the Slovak electricity system**, including the management of consumption and aggregation, energy storage, consumer participation in the energy market and the benefits of own energy generation arise *inter alia* from the method of the transposition of Regulation (EU) 2019/944 of the EP and of the Council into Slovak legislation within the transposition deadline of the end of 2020, and the related provisions of Regulation (EU) 2019/943 of the European Parliament and of the Council, the "Clean energy for all Europeans" package.

One basic condition for the integration of flexibility sources in the future will be, in addition to effective nationwide SMS deployment, the creation of a suitable regulatory and legislative framework for the flexibility market, *inter alia* enshrining a new market entity – an aggregator – that will enable market access for distributed flexibility sources and the creation of a technological model for the development of distribution systems from the perspective of flexibility utilisation.

The national plans of the Slovak Republic in terms of building a single gas market will concentrate, in addition to supporting the implementation of infrastructure projects, on promoting the proper and timely implementation of network systems in gas transport. For example, the transmission system operator is currently able to sell transit capacities at cross-border transmission points through all existing platforms (PRISMA, RBP and GSA). Looking ahead to 2030, it will be necessary to focus on the anticipated internal gas market package that should, in addition to integrating the gas markets, significantly strengthen the sustainability aspect.

ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for when the objectives are to be met

Since the autumn of 2019, there has been intensive debate with market players on how to implement the new electricity market design (in particular Directive 2019/944 of the European Parliament and of the Council on common rules for the internal market in electricity and Regulation 2019/943 of the European Parliament and of the Council on the internal market), which will fundamentally regulate relations between market players and will need to be implemented by the end of 2020. The rights and obligations of individual market participants, including non-discriminatory RES participation, demand-side response and aggregation will, after the results of the negotiations with the stakeholders, be regulated through the Energy Act and related legislation.

Installed capacity of 43 MW for 2019 and 34 MW for 2020 has been stipulated for renewable energy sources, including a local source. At the same time, the Ministry of Economy is planning to launch an auction for new sources using renewable energy sources, where additional capacity will be released for the construction of the least costly facilities.

It is assumed that after the construction of a new cross-border transmission line between Slovakia and Hungary in 2021, there will be no reasons to limit the connection of sources in terms of security and reliability of electricity system operation, and the ME SR will be able to determine higher capacities for both local sources and auctions.

iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation of energy and from new technologies, including smart meters;

The plans and form of national legislation with regard to **ensuring the participation of consumers in the energy system** and the benefits of own electricity generation and new technologies, including smart meters, will arise, *inter alia*, from the transposition of Directive (EU) 2019/944 of the EP and of the Council into Slovak legislation with a transposition deadline of the end of 2020, in particular the provisions on active consumer participation in the market in Chapter III (Dynamic price contract - Article 11, Active customers - Article 15, Citizen Energy Communities - Article 16, Consumption management through aggregation - Articles 13 and 17 and smart meters - Articles 19 to 21 and Annex II) and other related EU legislation on the "Clean Energy for All Europeans" package, in particular Directive (EU) 2018/2001 of the EP and of the Council on the promotion of the use of energy from renewable sources.

The Slovak Republic has implemented legislation promoting own electricity generation by introducing the "**local source**" institute through an amendment to Act No 309/2009 on the promotion of renewable energy sources and high-efficiency cogeneration (Act No 309/2018).

The main measures in the development of **smart metering systems** (SMS) and **smart networks** (SN) are summarized in the Energy Policy of the Slovak Republic, 2014 (section 3.5.10). The SR is in the initial construction phase of basic SN infrastructure. It has fully transposed the provisions of Directive 2009/72/EC of the European Parliament and of the Council in the area of SMS (Annex I point 2). The SR is currently focusing primarily on the selective implementation of SMS pursuant to the relevant Decree of the Ministry of Economy No 358/2013 with a schedule to 2020 (offtake points with annual consumption over 4 MWh with anticipated penetration of about 23% low voltage OP by the target year 2020). Further SMS development steps will be reviewed after 2020 following the transposition of the related provisions of Directive 2019/944 of the European Parliament and of the Council on common rules for the internal electricity market (Articles 19 to 21 and Annex II), the "Clean Energy for All Europeans" package.

An important contribution towards the development of smart networks in view of the future development of distributed and renewable energy sources will be the implementation of the cross-border **ACON smart grid project** between Slovakia and the Czech Republic (Chapter 2.4.2), which has been placed on the Projects of Common Interest list and has obtained support from the Union through the Connecting Europe tool (CEF Energy). The project will improve the efficiency and security of the distribution system and the readiness to integrate distributed renewable sources, especially in the common border regions of the Czech Republic and Slovakia. The project is anticipated to be completed by 2024. At the same time, a joint Slovak-Hungarian **smart grid project called Danube InGrid** is being prepared.

Intelligent measuring systems are essential parts of intelligent networks. The introduction of smart measuring systems in the electricity sector is currently in the mandatory selective implementation phase within the meaning of the procedure and conditions of the Decree of the ME SR. As of 30 June 2019, a total of 273 862 SMS out of a final number of 390 849 devices that should be installed by 31

December 2020 were installed by regional distribution systems operators (a further several thousand SMS were installed under MDS conditions). Further steps in SMS implementation in the SR will continue until 2020 according to the schedule and conditions determined in Decree No 358/2013. Smart grids are bringing about changes to help strengthen the position of the customer, facilitate greater integration of renewable energy sources into distribution systems, enable and support the development of electromobility and electricity storage, increase energy efficiency and reduce losses, while also making significant contributions towards environmental protection, supporting technological development and creating new jobs. These networks are able to manage direct interaction and communication between consumers (households and enterprises), network operators, energy producers and suppliers. An intelligent network can flexibly respond to the distribution of electricity generation and consumption, even in environments where electricity flows in both directions. Better and more targeted management will mean the network is characterised by higher operational safety, higher efficiency, lower losses and lower operating costs.

IN deployment is anticipated to manage distribution networks optimally and more accurately, allowing multiple consumers to be connected without the need to invest in new network construction. The input of electricity into the electricity system by a large number of decentralised generation sources through different distribution systems cannot be regulated without the use of modern telecommunication technologies, which make operation more efficient.

An intelligent network, continuously monitored by SMS, should be able to respond optimally to the current distribution of generation and consumption capacities at all times. Experience from European countries with widespread use of SMS technology, the cornerstone for building smart grids, shows that the scale of interruptions in electricity supply to customers has diminished and that system losses have also fallen.

Another way to safely integrate green energy into the system is to develop energy storage. Such a system allows the storage of locally produced energy and its consumption based on demand. Integrating local energy storage in accumulation appliances, energy storage facilities and electric vehicles with their storage capabilities is therefore an important element of the smart grid. In addition to energy storage, local power consumption management concepts are being developed based on good mapping and analysis of the ratios in the system so that electricity is not transformed to a higher voltage at the generation site and then back to a lower voltage at a remote location.

It is anticipated that a detailed understanding of consumption will lead to changes in the behaviour of SMS-enabled customers and, together with the development of IN, will become a tool for more efficient consumption management, which should lead to general benefits and to a smoothing of system loads, impacting in turn the variation and volume of support services needed to regulate any uncompensated balance of electricity generation and consumption.

An important prerequisite for intelligent network support is the standardisation of suitable technologies for Slovak conditions and the option for interchangeability of its main components to allow the integration of solutions and equipment from different manufacturers.

iv. National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy generation, including a timeframe for when the objectives shall be met

The Slovak Republic's **goals and plans** for ensuring the **adequacy of the electricity system** are defined by the **Slovak Energy Policy** (see point 1.2 ii.).

To ensure the **adequacy of the electricity system** or, more exactly, to ensure the safe and reliable operation of each Member State's system, an appropriate and balanced source mix in terms of both sufficient generation capacity (quantity) and generation technology (quality) is an important prerequisite. **It is the intention of the SR to create the necessary conditions to ensure the adequacy of the electricity system in meeting climatic and energy objectives and respecting the conditions of the single European market.**

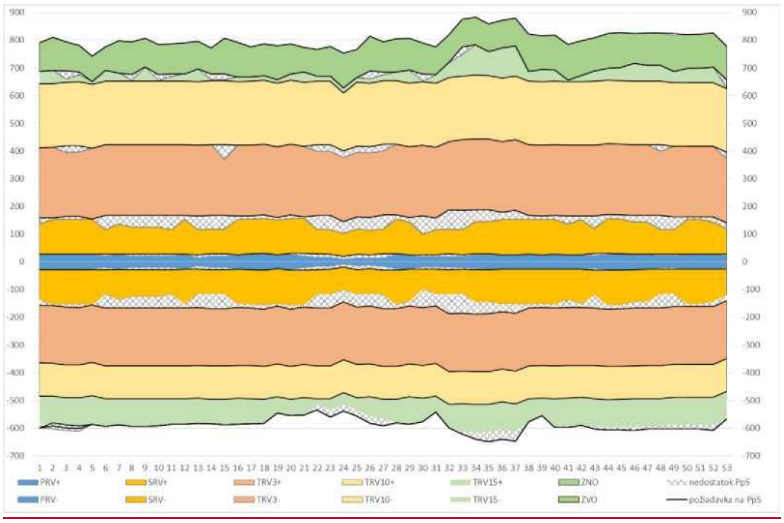
By 2030, the SR expects the export balance of the system to be 5% to 10% of projected electricity consumption[21] assuming the Mochovce nuclear power plant (Mochovce NPP - EMO 3,4) is commissioned, the operation of the Malženice gas-steam power plant (Malženice PP) and the possibility of terminating operations at the Nováky thermal power plant (Nováky PP - ENO). In this development scenario, the SR will have no difficulty in covering the assumed load. Based on current knowledge, to ensure the availability of support services there may be - on rare occasions - a power shortfall of 17% to 26% that the TS operator is able to import from abroad if the required power and transmission infrastructure are available at that moment.

Measures to increase support service availability carried out by the TS operator over the last few years have been directed towards seeking reserves that can be activated by modifying the rules for providing support services (virtual blocks) and the ability to procure some support service types from abroad (PRVs). The Strategy to Secure a Sufficient Volume of Support Services for the Provision of System Services and the Safe and Reliable Operation of the electricity system of the SR for 2019 to 2021 (the Strategy) was completed in 2018, and was subsequently subject to a public consultation process. Based on the conclusions and recommendations for the Strategy, a multi-annual tender was conducted, in which all types of support service were procured for 2019 to 2021. After an evaluation of the multi-annual tender results, we can say that for 2019 to 2021 the required support service volumes are secured at an average level of over 70%. No support service bids for TRV3MIN- and TRV10MIN- were submitted for 2019 and 2020 during the multi-annual tender, but we expect these to be procured through other tenders (annual, monthly, and daily). The TS operator has identified other options to ensure the availability of regulatory reserves through the creation of space for the emergence of "virtual blocks" consisting of multiple small sources and consumption points that behave as a single source vis-à-vis the transmission system operator's control management system, thereby expanding the supply of regulatory reserves. The TS operator is also seeking technical and commercial solutions for the provision of support service abroad through international cooperation. International cooperation as regards support services is the subject of a number of international projects, but it is important to note that there are a significant number of issues to be resolved (cross-border capacities, joint platforms), while finding solutions to them is time-consuming. At the same time, it should be understood that while it is possible to procure support services abroad based on international cooperation, this also means that support service providers in the Slovak Republic will also be able to supply their regulatory reserves abroad.

The evaluation of the anticipated support service availability in the cross-sectional year 2023 broken down by support services valid for 2018 is based on an analysis of the results of the optimisation of the likely deployment of available production units based on technical-economic assumptions and limitations for covering the anticipated load in an hourly resolution – a market simulation.

Figure 8 Estimated support service availability in the cross-sectional year 2023

[21] https://www.mhsr.sk/uploads/files/TZINde4d.pdf



Based on the indicated analysis of individual support service availability, it is clear that the required volume of support services to cover all anticipated requirements over 53 weeks will not be 100% available.

In real operation, it would probably be possible to compensate for the lack of support service availability by activating them at another certified facility operating on the electricity market, as well as by using foreign assistance, either by importing the support service in question or by purchasing NREs. All these options could help reduce the support service shortfall.

Within the meaning of the Parliament and Council Regulation on the internal electricity market[22] each Member State must have in place **a reliability standard** for the application of a capacity mechanism, which transparently states the required level of security of the electricity supply. To establish such a reliability standard, national regulatory authorities should, based on the ACER-approved ENTSO-E methodology, set an estimate of the **Value of Lost Load** (VoLL) in EUR/MWh. The reliability standard is to be expressed as the **estimated Energy Not Served** (ENS) in MWh/year, which should, *inter alia*, be taken into account when assessing the adequacy of sources.

According to the currently valid European legislation (Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity), the preparation of a ten-year European Network Development Plan (TYNDP ENTSO-E) includes an assessment of adequacy based on probable access. The assessment of adequacy on a medium-term basis (Mid-Term Adequacy Forecast (MAF)) is carried out in an annual cycle based on ENTSO-E transmission system operators' data, focusing on sensitivity analyses of the impacts of sudden changes in fluctuating RES production, climate conditions, market conditions (commodity and emissions pricing) and so on.

22 https://eur-lex.europa.eu/resource.html?uri=cellar:d7108c4c-b7b8-11e6-9e3c-01aa75ed71a1.0001.02/DOC_1&format=PDF

The probability processing of the pan-European adequacy outlook[23] also includes the already-mentioned indicatively calculated reliability standard, the Energy Not Served (ENS) in MWh/year, and Loss of Load Expectation (LLE) in h/year. Non-zero values in the results indicate a problem with the adequacy of the Member State's system.

The SR does not yet have a defined reliability standard (VoLL, ENS, LLE) and **does not apply a capacity mechanism** to ensure source adequacy. To determine these parameters, account must be taken of the socio-economic and national economic interest in energy self-sufficiency, i.e. the cost of non-supply of energy based on a presumed source mix in accordance with climate and energy objectives, and also based on the technical limits on interconnection of national and pan-European systems.

In the event of the establishment of a national supply reliability standard (following the application of a capacity mechanism) in accordance with European legislation under preparation, the Slovak Republic may, in the future, set or update its strategic objectives for ensuring electricity system adequacy and energy system flexibility in relation to generation from RES in accordance with climate and energy targets, respectively may ensure that the system has sufficient import capacity (in which case it is necessary to take into account the risk of generation shortfalls in the neighbouring systems and also an interest in ensuring an adequate level of security of supply on its own territory).

v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

Pursuant to Section 19(1)(2)(e) of Act No 250/2007 on consumer protection and on amendments to Act of the Slovak National Council No 372/1990 on offenses, as amended, the Ministry of Economy of the Slovak Republic informs consumers about their rights and obligations within the scope of its competence in the area of consumer protection.

For this purpose, the Ministry of Economy of the Slovak Republic publishes on its website a current list of Advisory Centres focused on consumer rights protection and an informative list of legal persons engaged in consumer protection.

The Network Regulatory Office, as the State authority for the regulation of network industries with nationwide competence, handles comments from electricity, gas, heat and water consumers, mainly concerning compliance with the rights and obligations of suppliers and operators of distribution networks and systems. A proposal for alternative dispute resolution may also submitted to the Office in an effort to arrange an agreement between customer and supplier acceptable to both parties to the dispute.

The Slovak Trade Inspectorate (STI) is the State authority for control of the internal market in consumer protection matters with a nationwide competence. In fulfilling this role, the STI supervises the sale of products and services to consumers, provides State supervision and control of the energy sector pursuant to special regulations, and market surveillance pursuant to a special regulation.

The legal regulation defining STI competencies is Act No 128/2002, on state inspection of the internal market in consumer protection matters and on amendments and supplements to certain laws, as amended. This Act defines the rights and obligations of the STI on a general level, but also in relation to specific rules governing consumer protection in specific areas.

[23] https://docstore.entsoe.eu/Documents/SDC%20documents/MAF/2018/MAF%202018%20Executive%20Report.pdf

In 2018 the European Commission presented a comprehensive package of measures for the benefit of European consumers, enabling Europeans to better cope with modern-day challenges and be better protected from widespread fraud or unfair commercial practices.

2.4.4. Energy Poverty

Measures of the Government of the Slovak Republic in the social area, primarily aimed at addressing social poverty, also contribute towards addressing energy poverty.

The foundations for addressing the issue of energy poverty from the perspective of the energy sector are set out in legal acts relating to the internal market in electricity and gas, through which the European Union obligates Member States to take measures to protect end customers and, in particular, to ensure there are sufficient guarantees to protect vulnerable customers. According to an opinion of the European Economic and Social Committee on Energy Poverty in the context of liberalization and the economic crisis (2011/C 44/09), the European Union must take action to establish common rules so that all Member States act in a united way to tackle energy poverty.

In this context, each Member State – including the Slovak Republic – is to develop a vulnerable customer protection concept covering energy poverty.

Energy poverty is often a consequence of poverty itself and must therefore be treated as a social policy issue. It is necessary to identify the difference between social poverty and energy poverty and to specify how energy poverty differs from the definition of a vulnerable customer. It is very important to look for solutions to eliminate poverty at government, ministry, self-government and private sector levels. Eliminating unemployment is key to tackling a range of related problems, in particular poverty and social exclusion. The Slovak Republic has exceeded its plan to eliminate the risk of poverty or social exclusion. The EU SILC 2017 survey showed that it has rescued 255 000 people from the risk of poverty or social exclusion. The measures adopted have had a major impact on the achievement of this objective, in particular in the employment policy, social policy and economic policy measures of the State.

In any case, these must be comprehensive approaches, because energy poverty is not only a financial problem, but also has its human dimension, which affects with all areas of society and significantly influences the whole social atmosphere. Therefore, any solutions must be preceded by a debate across the whole of society and a quantification of impacts, since proposed solutions should not unduly burden other energy market participants. Subsequently, an appropriate combination of proposed measures and a regular evaluation of their effectiveness can be adopted in order to optimise them so as to reduce the energy poverty limit while minimising the number of people affected by this phenomenon.

Measures taken by all interested parties must be directed towards meeting the goals of combating energy poverty, but they must in any way discriminate against other parts of the population or cause distortion of the liberalised energy market.

The principle of solidarity must be applied, as in other cases, but must be acceptable not only for the beneficiaries but also for providers.

The Slovak Republic has adopted national programmes and strategies that are secondarily aimed at addressing the problems of energy poverty:

- The National Reform Programme (NRP) – a document based on the Europe 2020 strategy, presenting national policies and measures to sustain growth and employment;
- The National Employment Strategy of the Slovak Republic to 2020 – an interdepartmental document that, with contributions from social partners, local governments and the civil society, identified mechanisms promoting increased employment;
- The National Framework Strategy for Promoting Social Inclusion and Combating Poverty;
- Networking and the Development of Public Employment Services.

At its meeting on 8 March 2016, the Regulatory Council adopted a regulatory policy for the 2017-2021 regulatory period. A major difference from the previous regulatory policy is the emphasis on vulnerable customers in the electricity, gas and heating sectors, and also on the energy poverty issue. The Regulatory Office for Network Industries (RONI) will actively cooperate with the relevant authorities in areas relating to network industries when transposing European laws into Slovak legislation, and will also ensure active cooperation with European Commission bodies in drafting European energy legislation.

In this respect, the RONI has set objectives and priorities in the legislative area as follows:

- Create conditions, in cooperation with other European Union Member States, to improve electricity and gas supply security;
- Ensure appropriate pricing for all customers through appropriate regulatory methods, with an emphasis on protecting vulnerable customers and ensuring the competitiveness of industrial customers;
- Optimize support for electricity generation from renewable energy sources and high-efficiency cogeneration, taking into account new criteria to reduce the financial burden and to ensure the adequacy of the impact on final energy prices;
- Achieve a proper perception of regulation, emphasizing that regulation is done in accordance with European Union rules and always ensures all costs are covered with a reasonable profit;
- Promote the introduction of smart metering systems to ensure energy consumption until a financial limit is reached;
- Develop mutual cooperation among the V4 countries to achieve a leading position and encourage other EU Member States to address common interests in the area;
- Help address energy poverty through appropriate regulatory methods.

Based on complete analyses and long-term preparation, the RONI submitted a proposal for a new concept for the protection of customers meeting the conditions of energy poverty for an interdepartmental comments procedure on 26 April 2019.

This material is supplemented and updated in cooperation with the Ministry of Economy of the Slovak Republic, the Ministry of Finance of the Slovak Republic and the Ministry of Labour, Social Affairs and Family of the Slovak Republic. After the evaluation of the comments, the material will be discussed by the Government of the Slovak Republic and all ministries concerned will participate in the implementation of the approved concept.

However, the competences of the RONI do not cover the whole scope (e.g. social policies or improving energy efficiency in the housing sector) of the energy poverty issue. The concept therefore strictly distinguishes between possible tools for a solution at governmental level and those at the level of the national energy regulator, as the creator of possible energy sector price measures

intended for socially vulnerable groups in the population. It explicitly states the impossibility of addressing energy poverty solely from the position of the national energy regulator as an isolated state administration body and emphasises the necessity of addressing this social issue by an integrated approach from all the public authorities concerned, which could be coordinated at government level. The concept has the ambition to translate the proposed measures into the programme of the Government of the Slovak Republic through the partial policies and programmes of the relevant ministries.

2.5. Dimension: Research, innovation and competitiveness

i. National objectives and funding targets for public and, where available, private research and innovation relating to the Energy Union, including, where appropriate, a timeframe for when the objectives are to be met

The Slovak Ministry of Education, Science, Research and Sport annually performs an In-depth Analysis of the Energy Technology Development, Development and Innovation in the Slovak Republic for the International Energy Agency, working with the OECD.
In order to obtain relevant information on the financing of energy research in Slovakia, the Ministry of Education, Science, Research and Sport of the SR approaches relevant institutions (the Slovak Academy of Sciences, the Research and Development Agency, the Research Agency, the Slovak Innovation and Energy Agency, the Statistical Office of the SR, the Ministry of Economy of the SR, the Ministry of the Environment of the SR, the Ministry of Agriculture and Regional Development of the SR, National Centre for Research and Applications of RES, the National Forestry Centre - Forest Research Institute in Zvolen, the National Agricultural and Food Centre, Horizon 2020, etc.), which have up-to-date information on R&D projects financed from the state budget, from European Union sources and from private sources.

The analysis of other years shows that within the Slovak Republic, EUR 20.351 million were spent on research and development in 2014; 2015 - EUR 2.944 million; 2016 - EUR 18.451 million; and 2017 – EUR 1.02 million.

Draft State R&D programmes for 2020-2024 with outlook to 2029 (material prepared for government approval)

The proposal assumes funding for R&D in key areas of the Slovak economy, which include the following areas: Improving the transmission capabilities and security of the Slovak electricity grid; Smart grids and renewable energy sources and nuclear energy. In the 2020-2024 time-scale, R&D support for these areas is indicated in Table 25.

Table 25: Energy security of the Slovak Republic with emphasis on optimal multi-sourcing, energy efficiency and the environment

State programme: Energy security of the Slovak Republic, emphasising multiple sourcing, energy efficiency and the environment (mil. EUR*)						
year	2020	2021	2022	2023	2024	**Total***
State Budget	17.9	21.0	21.6	18.9	4.6	**84.1**
of which current expenditure	5.7	13.4	21.6	18.9	4.6	**64.2**
of which capital expenditure	12.2	7.7	0.0	0.0	0.0	**19.9**
indicatively non-budget resources	6.0	7.3	7.5	6.5	1.6	**28.8**
total eligible expenditure	23.9	28.3	29.0	25.4	6.2	**112.8**

Source Ministry of Education, Science, Research and Sport of the Slovak Republic

Table 25 shows as assumption of indicative extra-budgetary resources of approx. EUR 28.8 mil. for 2020-2024 as a result of private sector R&D investments in the area concerned, with additional

research and development expenditure indicated in the 2025-2029 outlook as indicated in the following Table 26.

Table 26: Indicative additional R&D expenditure

Year	2025	2026	2027	2028	2029	Total
State Budget	16.819	17.155	17.498	17.848	18.205	87.525

Source Ministry of Education, Science, Research and Sport of the Slovak Republic

Slovak Research and Development Agency (SRDA)

In 2018, the SRDA launched a public call for applications to address R&D projects in individual groups of science and technology fields. The agency's primary objective is to increase the quality of R&D through competition from all applicants in a competitive environment, taking into account the priorities of the government-approved R&D Strategy "Knowledge for Prosperity - Research and Innovation Strategy for Smart Specialisation of the Slovak Republic".

The total amount of funding earmarked for the entire period of projects supported under this call is EUR 33 million. These funds were allocated according to the requirements of individual groups of science and technology fields. The total value of funds provided by the Agency to address any one project is limited to a maximum of EUR 250 000 for the whole period.

Information on approved R&D projects in individual areas as well as information on the value of the subsidy granted for R&D projects in the energy sector is available at: https://www.apvv.sk/grantove-schemy/vseobecne-vyzvy/vv-018.html?tab=promoted_projects

National Centre for Research and Applications of RES

In the field of RES there is the National Centre for Research and Applications of RES at the Slovak Technical University (STU). The Slovak Technical University has received support for this from the European Regional Development Fund under the Operational Programme Research and Development. Four STU faculties are involved in the project of the National Centre for RES Research and Application: the Faculty of Chemical and Food Technology, the Faculty of Electrical Engineering and Informatics, the Faculty of Mechanical Engineering, the Faculty of Civil Engineering. The focal points of the National Centre's research are biomass, solar energy and hydropower

Intelligent Network Research Laboratory

There is interest in setting up a laboratory for smart grid research. The role of the laboratory would be testing new network, consumption, production and interoperability technologies. The laboratory should also be a representative centre for public awareness.

Research and development targets

The priority of research and development in the energy sector is to ensure sustainable energy in Slovakia.

The objectives of energy research and development are in line with the "Research and Innovation Strategy for Smart Specialisation of the Slovak Republic." (2013).

Research and development in this area will focus on new and renewable, environmentally-friendly energy sources, the rationalisation of energy consumption in all sectors of the economy and on energy distribution, such as:

- exploration of domestic deposits of energy raw materials, geo-thermal energy and their efficient use;

- development of technologies for the generation of electricity and heat from RES (water, sun, wind, biomass and geothermal energy);
- development of energy storage and energy conversion technologies (POWER to X) to interconnect sectors;
- nuclear energy research focusing on safety and the disposal of spent fuel;
- research into fourth-generation reactors and the problems of nuclear fusion (participation of SR in the global ITER and DEMO projects);
- development of new energy transmission systems (power cables without dispersive electrical and magnetic fields);
- development of technologies to increase energy efficiency and reduce energy intensity.

ii. Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives, including long-term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy and carbon-intensive industry sectors and, where applicable, for related carbon transport and storage infrastructure

The promotion of clean technologies to 2050 is under development.

iii. Where applicable, national objectives with regard to competitiveness

The aim is to reduce the costs of high energy-intensive enterprises in relation to electricity payments that are used to finance the production of electricity from renewable sources.

The aim of the compensation is to reduce costs for electricity-intensive enterprises arising from high electricity payments.

Pursuant to Section 6a(1)(a) of Act No 309/2009 and Annex No 1 of the Ministry Decree, compensation may be granted to an authorized legal person or natural person - entrepreneur that meets the criteria set out in the above-mentioned legislative framework.

Until 31 August 2019, enterprises meeting the statutory criteria and included in the list of eligible industries could apply for compensation from the Ministry of Economy of the Slovak Republic for the system operation tariff (SOT).

The granting of compensation for the system operation tariff to eligible energy-intensive enterprises was subject to a notification process, and the aid itself – the provision of funds – will be implemented after the issue of the European Commission decision through which the Commission confirmed the compliance of this measure with the relevant State aid rules in September 2019.

With this partial refund, the ME SR is trying to reduce the costs of electricity-intensive enterprises arising from high electricity payments. Compensation has been requested by 77 enterprises operating, for example, in the metallurgy and steel sector, in the manufacture of various metals, stationery, cement, plastics, dyes, refined petroleum products, etc.

The ME SR has at its disposal EUR 40 million for this purpose in 2019. It will divide this amount into the total amount of supported electricity identified after the aggregation of all applications from enterprises meeting the set criteria. These include, in particular, annual electricity consumption over

1 GWh, a share of gross value added through the eligible activities of at least 50% of the total value of the enterprise, the proper payment of the SOT, etc.

3. POLICIES AND MEASURES

3.1. Dimension: decarbonisation

3.1.1. GHG emissions and removals

*i. Policies and measures to achieve the target set under Regulation **(EU) 2018/842** as referred in point 2.1.1 and policies and measures to comply with Regulation **(EU) 2018/841**, covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a **low emission** economy and achieving a balance between emissions and removals in accordance with the Paris Agreement*

This chapter provides information on the most important policies and measures for reducing greenhouse gas emissions with a base year of 2016. It describes both existing and planned measures.

a) **Sectoral policies and measures in the energy sector -** In addition to the legislative instruments on the trading of greenhouse gas emission allowances, an important role is played by Act No 137/2010, on air protection, as amended, which serves to control and regulate emission limits through the introduction of emission limits for basic air pollutants. This Act is supplemented by Act No 401/1998, on air pollution charges, which serves as an economic tool to reduce emissions.

Improving energy efficiency - Measures on the energy consumption side, pursuant to which energy savings are seen as a reduction in final energy consumption. These measures are broken down by sector (buildings, industry, public sector, transport and appliances). The measures set minimum requirements as regards the energy performance of new and existing buildings, and the renovation of buildings, the most important sources of potential energy savings to 2030.

Greenhouse gases affected: CO_2
Type of measure: regulatory
Condition: in force since 2014
Implemented in scenario: WEM

Implementation of the EU Winter Package - The Winter Package, part of the implementation of the Energy Union, promotes the transition to clean energy and takes into account the impact of RES on heat and electricity generation. It is anticipated that the RES Directive will need to be revised and concrete recommendations will be prepared to meet the EU target of a 32% share of renewable energy in total consumption by 2030.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: in force since 2016
Implemented in scenario: WEM

National Action Plan for Renewable Energy, Government Resolution No 677/2010 - The RES Action Plan sets out Slovakia's national targets for the percentage of renewable energy consumed in the transport, electricity and heat and cooling sectors in 2020, the trajectories of anticipated growth in the use of RES in each sector in the 2010-2020 period, the measures to achieve the objectives, support systems, and the total anticipated contribution of measures for individual technologies to produce renewable energy and to achieve binding efficiency and energy savings targets. The RES Action Plan set RES targets (including for biomass, support for fast-growing tree species, and regulatory measures for technological innovation in timber felling, etc.). The Slovak Republic has an obligation to increase the use of renewable energy sources in relation to gross final energy

consumption from 6.7% in 2005 to 14% in 2020, which means partial targets of a 14.6% share of RES in heat and cold production, a 24% share of RES in electricity generation and a 10% share of RES in energy demanded in the transport sector.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: in force since 2011
Implemented in scenario: WEM

Implementation of the European Greenhouse Gas Emissions Trading Scheme - the EU ETS stimulates the use of biomass in the fuel mix of energy producers and motivates technological innovation. It also motivates the energy-efficient use of industrial waste gases. This policy is an economic and regulatory measure with a high positive impact on reducing greenhouse gas emissions.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: in force since 2013
Implemented in scenario: WEM

District heating optimization - District heating optimization will be implemented by installing cogeneration units with combined heat and power (CHP) in district heating systems. Industrial cogeneration plants produce industrial steam, which can also be used for district heating. Other measures are also taken into account (e.g. improving the efficiency of district heating systems (DHS), installing innovative district heating technologies, and improving heat supply from combined heat and power plants).

Greenhouse gases affected: CO_2
Type of measure: regulatory
Condition: in force since 2015
Implemented in scenario: WEM

Termination of heating plants after 2025 - Gradual decommissioning of solid fossil fuel heating plants after 2025.

Greenhouse gases affected: CO_2
Type of measure: regulatory
Condition: in force since 2015
Implemented in scenario: WEM

EU ETS carbon price increases - The EU ETS carbon price affects both the energy sector and energy-intensive industries and is a major driver for reducing emissions. Electricity producers will have to exert pressure to raise the price of emission allowances to facilitate their own conversion from coal to gas.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: in force from 2020
Implemented in scenario: WAM

Transformation of solid fossil fuel power plants – the termination of electricity generation in Nováky in the general economic interest in accordance with the Action Plan for the Transformation of the Upper Nitra Coal Region and Transformation of the Fuel Base at the Vojany power plant.

In accordance with the Action Plan for the Transformation of Upper Nitra, the Nováky power plant, after its transformation from solid fossil fuels, can remain the primary heat source for the region.

The Vojany plant is being considered for transformation into a facility to use secondary fuels to free it from dependence on imported primary energy sources and to support the circular economy in the region.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: anticipated after 2023
Implemented in scenario: WAM

Decarbonisation of electricity generation - Decarbonisation of electricity generation will be achieved through nuclear power plants and renewable sources, which will gradually replace electricity generation from fossil fuels. The suitable renewable energy technologies are solar photovoltaic power plants, onshore wind turbines and biomass.

Greenhouse gases affected: CO_2
Type of measure: regulatory
Condition: anticipated after 2020
Implemented in scenario: WAM

Increase the share of nuclear energy in the Slovak Republic energy mix - Increase the share of nuclear energy in the medium term (2020-2025) through the commissioning of two new nuclear reactors in Mochovce.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: anticipated after 2025
Implemented in scenario: WAM

Continuation of the reduction in final energy consumption in all sectors - This measure emphasizes policies supporting faster renovation of old buildings compared to historical trends, and energy insulation for renovated buildings. Energy efficiency policies also include high standards for new buildings, support for heat recovery, best available techniques in industry (BAT including waste gas use), infrastructure as well as soft measures for greater efficiency in the transport sector.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: anticipated after 2020
Implemented in scenario: WAM

b) Sectoral policies and measures in transport

Environmental design and use of products - The aim of this measure is to reduce the environmental impact at all stages of the product life cycle. The measure lays down regulations for household appliances, motors and other electrical equipment with a negative environmental impact throughout the energy-using product life cycle (e.g. boilers, computers, cars, household appliances (white goods, black goods)). The automotive industry will be forced to take the entire life cycle of a vehicle into account. In addition to reducing fuel consumption and emissions, the actual production as well as the end-of-life phase of a vehicle must be taken into account. Ecodesign as a product development process identifies key environmental areas with an environmental impact throughout the product life cycle. It examines and evaluates all the activities, materials and substances associated with the sourcing of raw materials, and the production, distribution, use and final disposal of the product.

One challenge in the application of ecodesign in the automotive industry is the complex interactions between various, partly conflicting factors. The use of vehicles produced in this way will reduce CO_2 emissions in the transport sector.

Greenhouse gases affected: CO_2
Type of measure: regulatory
Condition: in force since 2010
Implemented in scenario: WEM

CO_2 emission standards for passenger cars and light commercial vehicles, efficiency standards for trucks, together with transport electrification - Increasing vehicle efficiency and reducing greenhouse gas emissions from cars, light commercial vehicles and trucks. A reduction in fuel consumption in trucks is anticipated from increased engine and production efficiency.

Greenhouse gases affected: CO_2
Type of measure: regulatory
Condition: in force since 2007
Implemented in scenario: WEM

Promoting biofuels in road transport - Slovakia intends to accelerate the implementation of second-generation biofuels made from non-food crops such as wood, organic waste, waste from food crops and specific biomass crops. Operators must mix biofuels with a minimum energy content as follows:

a) 5.8% in 2017,
b) 5.8% in 2018,
c) 6.9% in 2019,
d) 7.6% in 2020,
e) 8.0% in 2021,
f) 8.2% between 2022 and 2030.

The energy share from advanced biofuels must be at least:

a) 0.1% in 2019;
b) 0.5% between 2020 and 2024,
c) 0.75% between 2025 and 2030.

Greenhouse gases affected: CO_2, CH_4
Type of measure: regulatory and economic
Condition: in force since 2010
Implemented in scenario: WEM

Electrification of transport - Increase the share of electric vehicles and fuel cell vehicles to replace vehicles with internal combustion engines.

Greenhouse gases affected: CO_2
Type of measure: regulatory and economic
Condition: anticipated after 2020
Implemented in scenario: WAM

c) Sectoral policies and measures in agriculture

New fertiliser management - Slovak Government Regulation No 342/2014, laying down rules for granting support in agriculture in the context of decoupled direct payment schemes. New measures on fertiliser handling and processing and the introduction of a new animal feeding policy.

Greenhouse gases affected: N_2O
Type of measure: economic and regulatory
Condition: in force since 2015
Implemented in scenario: WEM

Implementation of a new animal feeding policy - Slovak Government Regulation No 342/2014, laying down rules for granting support in agriculture in the context of decoupled direct payment schemes. The measures include a reduction in the number of dairy cows and intensive feeding with active substances.

Greenhouse gases affected: CH_4
Type of measure: regulatory and economic
Condition: in force since 2015
Implemented in scenario: WEM

Agricultural land - Slovak Government Regulation No 342/2014, laying down rules for granting support in agriculture in the context of decoupled direct payment schemes. The Regulation introduces the efficient use and appropriate timing of use of nitrogen doses from mineral fertilizers.

Greenhouse gases affected: N_2O
Type of measure: economic and regulatory
Condition: in force since 2010
Implemented in scenario: WEM

Agricultural land after 2015 - Slovak Government Regulation No 342/2014, laying down rules for granting support in agriculture in the context of decoupled direct payment schemes. The Regulation introduces the efficient use and appropriate timing of use of nitrogen doses from mineral fertilizers after 2015.

Greenhouse gases affected: N_2O
Type of measure: economic and regulatory
Condition: in force since 2015
Implemented in scenario: WEM

d) Sectoral policies and measures in the land use, land-use change and forestry (LULUCF) sector

Rural Development Programme for 2014-2020 – A financial support system programme for selected thematic rural development priorities. The programme will improve the competitiveness of agriculture and forestry (by supporting investment on 1 250 farms and in 400 food enterprises). It contains 56 framework objectives for specific policies and measures in this sector with positive environmental impacts. It will ensure adequate management of natural resources and promote climate-friendly farming practices. About 20% of agricultural land will be managed in a way that protects biodiversity, soil and water resources.

Greenhouse gases affected: NO_2
Type of measure: regulatory and economic
Condition: in force since 2015
Implemented in scenario: WEM

e) Sectoral policies and measures in waste management

Waste Management Programme of the Slovak Republic for 2016-2020 – The Waste Management Strategy is a set of measures setting national targets. These include:

- Reducing the amount of mixed municipal waste by 50% compared to 2016 by 2025;
- Reducing the amount of biodegradable waste in mixed municipal waste by 60% compared to 2016 by 2025;
- Reducing the municipal waste landfill rate to a maximum of 10% by 2035.

When evaluating the specific measures for the objectives of the Waste Management Programme 2011-2015, it was found that most of the original objectives were not achieved.

Greenhouse gases affected: CH_4
Type of measure: regulatory
Condition: in force since 2016
Implemented in scenario: WEM

Waste Prevention Programme for 2019-2025 – The Waste Prevention Programme of the Slovak Republic for 2019-2025 was approved by the Government of the Slovak Republic in January 2019. The objectives of this programme are to minimise waste generation and strict adherence to the waste hierarchy. The new waste management information system will help improve control of waste flows. The system will focus on monitoring waste from generation to recovery, respectively disposal.

Greenhouse gases affected: CO_2, CH_4
Type of measure: regulatory
Condition: in force since February 2019
Implemented in scenario: WAM

ii. Where relevant, regional cooperation in this area

Pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council, which obliges Member States to reduce greenhouse gas emissions, in the event of an excess of allocated allowances the Slovak Republic may apply flexibility instruments through borrowing, banking and transferring allocated emission allowances to other Member States.

iii. Without prejudice to the applicability of State aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable

Financing measures:

a) Financing measures from EU funds:

Operational Programme Quality of Environment (OP QoE) **-** The OP QoE is the SR programming document for drawing assistance from the EU Structural Funds and the Cohesion Fund in the programming period 2014-2020 for the sustainable and efficient use of natural resources, ensuring environmental protection, active adaptation to climate change and promoting an energy efficient low-carbon economy.

The global objective of the OP QoE is to promote the sustainable and efficient use of natural resources, ensuring environmental protection, active adaptation to climate change and promoting an energy efficient low-carbon economy.

In order to achieve this global objection, three core thematic objectives were included in the investment strategy of the OP QoE, namely:

- Supporting the shift towards a low-carbon economy in all sectors (TC4);
- Promoting climate change adaptation, risk prevention and management (TC5);
- Preserving and protecting the environment and promoting resource efficiency (TC6);

Of the five priority axes, three are devoted to climate change and energy:

- Priority axis 2: Adaptation to the adverse impacts of climate change with a focus on flood protection (EUR 419.3 mil. from the Cohesion Fund, 13.36% of the OP QoE allocation). Promoting investment in adaptation to climate change, including ecosystem-based approaches.
- Priority axis 3: Promoting risk management, emergency management and resilience to exceptional events affected by climate change (EUR 260.9 mil. from the European Regional Development Fund, 8.31% of the OP QoE allocation). Promoting investment to address specific risks, ensuring disaster resilience and developing disaster management systems.
- Priority axis 4: Energy-efficient low-carbon economy in all sectors (EUR 938.88 million from the European Regional Development Fund, 29.92% of the OP QoE allocation). Promoting energy efficiency and renewable energy use in enterprises. Promoting energy efficiency, smart energy management and the use of renewable energy in public infrastructures, including public buildings and the housing sector. Promoting low-carbon strategies for all types of territories, especially urban areas, including the promotion of sustainable multimodal urban mobility and adaptation measures to mitigate climate change. Encouraging the use of high-efficiency cogeneration based on the demand for usable heat.

Slovak Investment Holding (SIH) is a national development institution responsible for the implementation of financial instruments from EU sources in the current and previous programming period. The financial instruments are repayable forms of EU funding, and these are also used in the field of energy efficiency. SIH provides, *inter alia*, financial instruments to improve energy efficiency in apartment buildings in the current programming period, while preparing financial instruments to improve energy efficiency in public buildings and small and medium-sized enterprises. The financial instruments in question are financed from the OP QoE as well as from the Integrated Regional Operational Programme (IROP). Given the economic effectiveness of financial instruments compared to non-repayable financial assistance, the use of financial instruments through SIH is anticipated to continue in the next programming period.

b) Financing measures from other sources:

SlovSEFF III - The SlovSEFF III programme is a credit line to promote the development of energy efficiency and renewable energy sources in Slovakia. The programme is aimed at supporting projects:

- which include the purchase and installation of equipment, systems and processes using renewable energy sources for the production of electricity and/or heat and/or cooling and/or any other form of energy replacing fossil fuel sources;
- which include equipment, systems and processes enabling the reduction of primary energy consumption, final consumption of electricity, fuels or other forms of energy for the production of goods and/or the provision of energy services related to the production of goods or the provision of services related to industry;

- measures in residential buildings, which are comprehensive, large projects for the reconstruction of the thermal ratios of apartment buildings, consisting of the thermal insulation of the external casing (external walls, roofs, cellars), together with additional measures.

The programme consists of a combination of loans provided by the European Bank for Reconstruction and Development with a grant component co-financed by funds obtained from the sale of AAUs to Spain.

State Environmental Protection Aid Scheme for the Reduction of GHG and Pollutants in the Manufacturing Industries (Industries Scheme) - The State aid scheme was prepared in accordance with Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty . The purpose of the aid is to encourage enterprises, as part of their activities, and in compliance with 36(2)(a) of the Block Exemption Regulation to increase the level of environmental protection by going beyond the applicable Union standards, by supporting projects aimed at reducing greenhouse gas emissions and pollutants to air by introducing the best available technologies.
The scheme was approved by the Slovak Competition Office by letter No 104/2017/OŠP-3471/2017 of 7 July 2017 and was published on 17 July 2017 in Official Journal 135/2017 under number G000019. On 11 August 2017, the scheme was also registered in SANI2 under number SA.48924. The scheme is valid until 2020, the implementation of projects is possible up to the end of 2023. The scheme may be funded from funds raised from the sale of emission allowances at auction, no call for proposals had been issued by November 2019.

State aid scheme for enterprises in sectors and subsectors deemed to be exposed to a significant risk of carbon leakage due to EU ETS allowance costs passed on in electricity prices (Compensation Scheme) - The state aid scheme has been prepared in accordance with the Commission Notice - Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012. The objective of the State aid is to prevent a significant risk of carbon leakage due to greenhouse gas allowance costs passed on in electricity prices borne by the beneficiary, if its competitors from third countries do not face similar CO_2 costs in their electricity prices and the beneficiary is unable to pass on those costs to product prices without losing significant market share.

The purpose of this aid is to avoid the significant risk of carbon leakage in connection with the transfer of the costs of greenhouse gas emission allowances into electricity prices borne by the aid beneficiary, if its third-country competitors need not include similar CO_2 costs in their electricity prices and the aid beneficiary cannot transfer these costs into product prices without losing significant market share. This aid will be reviewed based on the profitability of these enterprises and a realistic assessment of the risk of departure to third countries. Priority is given to funding projects to reduce greenhouse gas emissions and environmental pollution in general.

State aid is intended to compensate for the rise in electricity prices in connection with the passing on of greenhouse gas emission costs to those prices following the introduction of the EU ETS. The scheme was approved by Commission Decision C (2015) 9479 final of 14 December 2015 (case SA.43509 (2015/N) - Compensation of indirect CO_2 -related costs in Slovakia).

The scheme was published in the European Commercial Bulletin on 22 April 2016, as well as in the Commercial Bulletin of the Slovak Republic No 74/2016 issued 19 April 2016 under G000007. The scheme is valid until 2021, the compensation can still be provided in 2021 (for 2020). The scheme is funded from funds raised from the sale of emission allowances at auction.

Amendment No 1 has been prepared for the Compensation Scheme in order to update the national legislation in the area of State aid and extend the term of the scheme from the original 22 April 2016

to 31 December 2020 to the new 22 April 2016 to 31 December 2021. The modifications to the Compensation Scheme in Amendment No 1 did not need to be notified to the European Commission as neither the substance nor the conditions for the provision of the aid through the Scheme had changed. The Scheme, as amended by Amendment No 1, was published on 6 August 2018 in Commercial Bulletin No 150/2018 with ID: 1933496 – State aid and other support programmes - under number G000027.

3.1.2. Renewable energy

i. Policies and measures to achieve the national contribution towards the binding 2030 Union target for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in point 2.1.2, including sector- and technology-specific measures[24]

Existing policies and measures

The RES policy and the follow-up measures follow up on previous strategic documents approved by the Government of the SR (Energy Security Strategy (2008), National Renewable Energy Action Plan (2010) and Energy Policy of the SR (2014)). These documents promoted increasing the share of renewable energy sources in energy consumption and reducing the share of fossil fuels. These policies thus enabled a reduction in the share of coal in the energy mix.

Table 27: Existing policies and measures

Seq. No	Name and reference of the measure	Type of provision	Anticipated outcome	Targeted group and/or activity	Start and end dates of the measure
1.	Mandatory blending of bio-components into transport fuels	regulatory	Maintaining a share of 7% of biofuels from food crops after 2020	manufacturers of motor fuels	2006 →
2.	Mandatory blending of advanced biofuels into transport fuels	regulatory	Achieving 3.5% of advanced biofuels by 2030	manufacturers of motor fuels	2019 →
3.	Promoting electricity generation through redemption prices (up to 500kW)	legislative, regulatory	New sources - electricity generation 0.5 TWh in 2020-2030	investors	2009 - 2030
4.	Promoting electricity generation through the auction system	legislative	Support for electricity generation 1.5 TWh in 2020-2030	investors	2019 - 2030

[24] When planning those measures, Member States shall take into account the end of life of existing installations and the potential for repowering.

5.	Support for decentralised electricity generation	legislative	New sources - electricity generation 0.5 TWh in 2020-2030	investors	2019 →
6.	Support for business use of renewable energy	financial	RES heat and electricity generation	investors	2014 →
7.	Support for household use of RES	financial	Increasing the use of renewable energy sources	households	2015 →
8.	Support for the renovation of heat distribution pipes	financial	energy saving, promotion of district heating	investors	2014 →

In some of the existing electricity generation measures, the anticipated contribution from the individual electricity generation technologies of Chapter 2.1.2 was included in the anticipated result.

Policies and proposed measures to achieve the national contribution

The principle stated in the Energy Policy of the Slovak Republic which, when projecting RES use, took into account the principle of cost minimization in an integrated approach to the use of renewable energy sources and the reduction of greenhouse gas emissions, remains valid for the upcoming period. Maintaining this principle will mean setting up support for RES will ensure the objectives set are achieved in a cost-effective way and will prevent significant negative effects on electricity prices. In order to achieve the RES objectives, it is essential to exploit all available options, one of the greatest potentials being in the development of waste recovery in the production of biomethane and energy recovery from waste that cannot be recycled and that would thus end up in landfill. In district heating systems, the energy potential of geothermal and solar energy, biomass and biomethane will be used in particular.

The policy of increased RES use will be directed to the following areas:

1. **Support for the introduction of low-power electricity and heat generation installations in family houses and apartment buildings**

One sustainable approach is to encourage the installation of small-scale power generation equipment, whereby aid recipients are motivated to consume as much of their own electricity as possible and to minimise their supply to the grid. This approach addresses their energy self-sufficiency and reduces the impact of variable RES on the electricity grid. As part of support for small sources, support for the installation of heat generation facilities using RES will continue. A reduction in local emissions will be achieved not only through the promotion of proven technologies, but it is also appropriate to promote new fuel cell technologies with reduced carbon footprint in the case of natural gas or zero carbon footprint in the case of biomethane or pure hydrogen.

2. **Develop the use of 2nd generation biofuels**

The priority for RES in the transport sector is the development of biofuels with high greenhouse gas emission savings. These are advanced biofuels (the term defined in the RES Support Act, also called 2nd generation biofuels) made from raw materials pursuant to Annex No IX part A, and biofuels made from raw materials according to Annex No IX Part B of the RES Directive. At the same time, given the existing biofuel production capacity from food and feed crops, this policy will maintain the maximum possible share of these biofuels, which is counted towards meeting the targets for transport.

3. **Continue the promotion of support for electricity generation from RES**

Support for electricity generation from RES will continue, mainly based on operating aid as set up after the reform of support effective from the start of 2019. The basic form of support for installations with installed power of over 500 kW will remain a surcharge, while the electricity producer is responsible for selling the electricity on the market and for any deviation caused. Auction success is a prerequisite for providing support in the form of a surcharge. This system is complemented by a system of support through purchase prices set in advance (FIT support system), which applies to new producers with an installed capacity of up to 500 kW. Installations with an installed capacity of up to 250 kW have the possibility, in the FIT system, to obtain support in the form of the purchase of electricity and take responsibility for any deviation. This form of support for equipment up to 250 kW will be provided until 2033, when the activity of the buyer who carries out the above activities will terminate. Existing aid for electricity generation is in accordance with Commission Regulation No 651/2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty. It is estimated that the largest new installed capacity will be in solar (600 MW) and wind power plants (500 MW).

4. **Creation of a support mechanism to increase the RES share in the heating sector and in district heating systems, also through generation from RES in high-efficiency cogeneration**

Slovakia considers heating and cooling to be a key sector for meeting the RES target for 2030. There are two options for decarbonising the heating supply in buildings through the use of environmentally friendly and highly efficient equipment and technologies saving primary energy:

- at the level of each building separately; or
- at the level of existing district heating and cooling systems supplying several buildings at once.

All the analyses comparing the two alternatives favour the latter, given its lower costs and economies of scale.

The existing district heating infrastructure is an ideal base for building an intelligent city energy system and has all the prerequisites to fulfil the role of integrator of individual RES solutions in its territory. District heating systems already play an important role in cities in maintaining favourable air quality, as these systems can deliver environmentally friendly heat that meets the strictest legal standards and emission limits. Individual heat sources are virtually uncontrolled in terms of emissions, do not have to meet such strict standards, and therefore pose a greater risk to the population from air pollution.

Local governments are currently facing major changes connected with their efforts to ensure sustainable growth based on a low-carbon economy. They are therefore looking for intelligent or “smart” solutions.

The developed district heating infrastructure, which is already largely modernized, is gradually integrating new intelligent solutions. District heating systems will be irreplaceable for future Smart Cities. The deployment of these modern intelligent solutions aims to build so-called 4th generation

district heating systems that create efficient and intelligent systems in cities. Such systems can flexibly interconnect production and consumption, store energy at times of surplus, integrate the various forms of energy generated in the city, including renewable energy, and utilize waste heat from industrial processes or the tertiary sector (e.g. data centres and hospitals) that otherwise escapes in the form of air emissions and contributes to global warming. It is more acceptable for citizens to have a minimum number of chimneys in the city under constant monitoring and not hundreds or thousands of non-monitored ones.

District heating systems already use cogeneration of electricity, heat and cold, renewable energy sources, emission-reducing technologies, energy storage facilities, etc. District heating is no longer just heat generation, but also combined heat and power (CHP), which uses about 20% less fuel than producing the same amount of electricity or heat alone. CHP enables the provision of support services in electricity systems and the storage of energy in the form of heat. Last but not least, by reducing the purchasing of fossil fuels, which are predominantly imported from abroad, funds remain for their purchase in the region in question and thus support the development of the local economy.

In existing buildings (classic prefabricated apartment buildings), the supply of cold from district heating systems is a dream for the future, however this solution is already starting to be successfully implemented in new buildings. Projects for the absorption generation of cold have been successfully implemented in Bratislava and for industrial customers in the towns of Žilina and Levice, with more projects in preparation.

In developed countries, district heating systems are considered to be the most efficient and environmentally friendly way of generating heat and tools for decarbonising the energy sector. New trends in the energy sector are bringing new challenges and opportunities for the heating industry. Slovakia has all the prerequisites for building and developing 4th generation CHP systems. District heating systems are suitable for the integration of RES in the form of biomethane mainly derived from plant and animal production waste, the biodegradable part of municipal waste, biodegradable kitchen and restaurant waste, and waste water treatment plant waste.

Table 28 Individual types of waste in relation to biomethane

Waste type	Annual production in tonnes	Biomethane quantity	Quantity ktoe
Excrement from livestock	10.1 million tonnes*	155 mil. m3 – 205 mil. m^3 (methane content of biogas 55%)	141 – 187 ktoe
Biodegradable component of municipal waste (BDMW)	1 million tonnes (50% of total volume of MW*)	65 mil. m^3	60 ktoe
Biodegradable component of kitchen and restaurant waste (canteens, hotels, schools etc.)	0.35 million tonnes	42 mil. m^3	38 ktoe
	Energy potential of agricultural biomass = 115.2 PJ (2 750 ktoe) The waste component (grass silage and straw phytomass) represents approximately 40% of the stated volume (1 100 ktoe) *		

* SIEA - National roadmap for development of biomethane production and use in Slovakia

In addition to increasing the use of RES, the heating and cooling policy aims to actively participate in the smart cities concept and thus contribute towards creating quality living conditions for urban citizens, exploiting and developing the energy thermal infrastructure to ensure energy savings, ensure healthier air, recycle waste and use energy recovery from waste. CHP systems are a response to the current global issues and challenges of modern, rapidly developing cities where clean air is a key quality of life indicator.

5. Support for biomethane and hydrogen production

Biomethane and hydrogen are very promising fuels that also allow energy storage. Biomethane will be preferentially used in transport and high-efficiency cogeneration. A realistic target is more than 300 mil. m^3/year of biomethane by 2030.
Biomethane can be obtained from

- the transition from biogas to biomethane
- energy recovery from biodegradable municipal waste (BDMW), kitchen and restaurant waste
- energy recovery from waste from plant and animal production for biomethane production

The objective of supporting hydrogen from RES is 100% coverage of the consumption of hydrogen filling stations and the partial replacement of hydrogen from fossil fuels in industry (2030).

Proposed legislative and regulatory measures:

In order to implement measures aimed at increasing the RES share in the heating and cooling sectors, the following legislative and regulatory measures will need to be adopted. This will include regulatory measures, in addition to the transposition of Directive (EU) 2018/2001 and Directive (EU) 2018/2002. The aim will also be to introduce incentive mechanisms for district heating and cooling system operators aimed at increasing the RES share in the fuel mix (for example, a more favourable calculation of reasonable profit for operators using RES in their fuel mix, regardless of other economically justifiable costs and the maximum cost of heat, and increasing the importance of energy efficiency indicators when calculating fuel costs if RES is used for heat generation).

Support from public sources will be allowed for projects in district heating, where cost and environmental efficiency will be demonstrated. District heating systems are also suitable for the integration of RES in the form of biomethane, mainly from waste from plant and animal production, the biodegradable part of municipal waste, biodegradable kitchen and restaurant waste, and waste water treatment plant waste. While the potential for geothermal energy to generate heat is sufficient, its use must be adequately supported, which will require an overall increase in support. One example of unused potential is Geoterm Košice, where the RES Action Plan for 2011-2020 developed in 2009 envisaged the use of geothermal energy in heat generation.

The conditions of the regulatory periods after 2022 in the area of thermal energy will take into account the obligation to increase the RES share in district heating systems. They will also take into account the connection of own-consumption/energy communities producing RES to the district heating system.

Table 29 Overview of measures for the heating and cooling sector

Measure name	Measure type / concise measure description	Anticipated result	Target group	Measure start and end dates
1. Mandatory quantity of RES in district heating systems	regulatory / the obligation of district heating and cooling systems to contribute towards increasing the RES share in district heating and by connecting RES suppliers to district heating systems	increasing the RES share by one percentage point per year[25]	DHS	2021 →
2. Mandatory connection to district heating from RES	regulatory / physical integration of RES energy for heating and cooling through the use of district heating and cooling systems	more efficient use of heat from RES	CPM and new or reconstructed buildings	2021
3. Information obligation	regulatory / an obligation for heat suppliers to inform	increase in customer	DHS	2021 →

[25] within the meaning of Article 24(4)(a) of Directive (EU) 2018/2001

	their customers on a regular basis of the RES share in the supply of heat through a district heating and cooling system;	acceptance		
4. Supporting consumption of own heat	legislative / facilitating the installation of equipment to produce heat from RES for the own needs of consumers of energy from RES and renewables energy communities for heating for their own use, the storage of RES energy and the sale of excess generation through connections to district heating and cooling systems	Integration of decentralized sources of heat into the district heating system	DHS and consumers	2021 →
5. the right to disconnect	legislative / the right for a consumer connected to a district heating system to disconnect if it does not fulfil the condition of efficient district heat supply	Installation of own heating equipment	Consumer consuming their own heat or heat community generating heat from RES	2026
6. use of waste and waste heat	providing improved conditions for building biomethane production facilities (mainly from plant and animal production waste, the biodegradable part of municipal waste, biodegradable kitchen and restaurant waste and waste from waste water treatment plants) and waste heat from industrial and energy sector processes	reduction in fossil fuel consumption	waste recovery sector, nuclear power plants, industry	2021

Broader description of the measures

Measure 1: Mandatory quantity of RES in district heating systems
For the district heating and cooling sector, a binding target of at least one percentage point, expressed as an annual average over the periods 2021 to 2025 and 2026 to 2030 will be set. This binding target will not be set for individual district heating and cooling operators, but for the entire district heating sector so that the real contributions of the operators can be calculated. District heating and cooling system operators will be able to contribute towards the achievement of this mandatory target by changing their own fuel base by connecting suppliers of RES heat under Article 24(4)(b) of Directive (EU) 2018/2001 or by connecting self-consumers and RES-producing communities.

The connection of suppliers of heat from RES will be ensured through a mandatory heat take-off mechanism based on non-discriminatory criteria and, in order to meet the demand of new customers, by replacing existing heat and cooling capacity or by extending existing capacity under Article 24(5) of Directive (EU) 2018/2001. Non-discriminatory conditions and reasonable charges shall be applied to the connection of RES energy suppliers to district heating and cooling systems ensuring that a reasonable proportion of the fixed costs associated with the operation of the district heating system are met and the storage of the necessary capacity by the district heating system operator to meet the heat demand due to insufficient capacity of the RES heat supplier's equipment.

Measure 2: Mandatory connection to efficient district heating using RES

Another measure to increase the RES share in the heating and cooling sector will be connecting new buildings and existing buildings which are undergoing major renovation to district heating and cooling systems that fulfil the condition of efficient district heat supply and use RES, where the site has such a district heating and cooling system and where there is sufficient capacity to connect the building and supply it with heat or cold. For existing buildings that were not connected to the district heating and cooling system prior to their major renovation, connection will only be required if this

leads to a higher level of energy performance of the buildings compared to the operation of individual equipment for self-consumption of energy from RES or renewables energy communities.

Measure 3: Information obligation

Suppliers from district heating and cooling systems will be obliged to notify at regular intervals (at least once a year) the RES share in the heat supply in the district heating and cooling system and whether the system meets the condition of an efficient district heat supply or is in the process of transition to an efficient district heat supply system.

4. Supporting consumption of own heat

In accordance with Articles 21 and 22 of Directive (EU) 2018/2001, renewables self-consumers and renewables energy communities will be entitled to install their own equipment to produce heat from RES to provide heat for their own consumption, enable the storage of heat produced from RES and the sale of excess production. In districts with district heating and cooling systems, it will only be possible to install heat generation equipment for renewables self-consumers and renewables energy communities by connecting it to the district heating and cooling system, except for equipment of renewables self-consumers or renewables energy communities in existing buildings not connected to the district heating and cooling system and that do not have an obligation to connect to carry out a major renovation of an existing building.

Renewables self-consumers and renewables energy communities will only be subject to non-discriminatory fees and payments ensuring the payment of a reasonable part of the fixed costs associated with the operation of the district heating system and the storage of the necessary capacity by the district heating system operator to meet the heat demand due to insufficient capacity of the equipment of the renewables self-consumers and renewables energy communities.

The right of renewables self-consumers and renewables energy communities to set up a heat generation plant in a building to cover their own heat consumption, energy storage and the sale of excess heat generation will only be exercised at the level of the whole building and, for family houses with multiple dwellings and apartment buildings, only at the level of the whole family house with multiple dwellings or apartment building (Article 24(7) of Directive (EU) 2018/2001).

5. The right to disconnect

An end-user of a district heating and cooling system which does not become an efficient district heating and cooling system by 31 December 2025 will be entitled to disconnect from that system if they install equipment to produce heat exclusively from RES, under the conditions laid down in Article 24(2) and (3) of Directive (EU) 2018/2001. To this end, the competent national authority will approve a plan for a switch to an efficient district heat supply for individual district heating and cooling system operators. Except in the event of serious deficiencies in the fulfilment of contractual obligations which the district heating and cooling operator has not remedied within a reasonable period after receipt of the customer's notice, customers will not be allowed to disconnect from the district heat supply systems otherwise than based on an agreement with the operator of an efficient district heating system. This will not preclude the right of the final customer to install their own heat generation equipment as a renewables self-consumer or renewable energy community generating heat under conditions applicable to self-consumers and energy communities.

6. Recovery of waste and waste heat

This measure will support the integration of RES (favouring the construction of production facilities for biomethane mainly derived from plant and animal waste, the biodegradable part of municipal

waste, biodegradable kitchen and restaurant waste and waste water treatment plant waste), as well as the integration and use of waste heat in district heating systems, including waste heat generated as a by-product in industrial and energy sector facilities.

ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in point 2.1.2

The use of voluntary statistical transfer of RES to another Member State is not anticipated. The Slovak Republic will primarily seek to fulfil its contribution towards the European objective, set out in Chapter 2.1.2. This contribution is designed so that it can be fulfilled. If Slovakia exceeds its target, it will consider the use of statistical transfer.

In the event of suitable projects, Slovakia will participate in projects of common interest (PCI) in RES or in projects supported by the Connecting Europe Facility (CEF). The SR welcomes the creation of an EU financial mechanism for RES and will consider participation in this mechanism depending on the conditions.

iii. Specific measures on financial support, where applicable, including Union support and the use of Union funds, for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

Financial support measures to achieve the objectives - operating aid.

In order to implement measures aimed at increasing the RES share, increasing energy efficiency, reducing primary energy consumption, replacing fossil fuels with renewable energy sources, and implementing the best available technologies to reduce greenhouse gas and pollutant emissions in the heating and cooling and electricity sectors, the use of investment aid instruments is also proposed. It is anticipated that the support mechanism for the construction of new plants for the generation of electricity and heat from renewable energy sources will be retained through a tendering procedure, while in the case of plants using biomass and its processing products, there is a legal requirement for electricity and heat generation through cogeneration with the preferential placement of heat in district heating and cooling systems. An amendment to Act No 309/2009, on the promotion of renewable energy sources and high-efficiency cogeneration, which governs the operating aid rules for electricity generation, is therefore anticipated. A more comprehensive form of operating aid will only be granted if a less extensive form is not sufficient for these purposes.

1. **Operating aid for heat generation from RES**

Currently, in 2019, RES support is linked to electricity generation, while the heating sector has access to it only for cogeneration technologies, and only for biomass and biogas technologies. In order to achieve RES targets by 2030, it will also be necessary to consider operating aid that will allow separate operating aid for the production of heat from RES linked to the construction of new plants for the production of heat from biomass, biogas, biomethane, geothermal and solar energy and aerothermal, geothermal and hydrothermal energy used in heat pumps.

Operating aid may be granted in the form of a surcharge or green bonus on an annual basis in accordance with the rules resulting from Article 43 of Regulation (EU) 651/2014 and Chapter 3.3.2.2 of the State Aid Guidelines on Environmental Protection and Energy 2014-2020 (2014/C 200/01) (or

its future changes) until the full depreciation of the investment in RES according to the usual accounting principles. The aid will be limited to the construction of installations whose operators have built a new district heating and cooling system (with preference for sites with deteriorated air quality) or have approved a plan to switch to an efficient district heat supply (Article 24(2) of Directive (EU) 2018/2001) and who, precisely based on the installation of the supported equipment, will meet the conditions for an efficient district heat supply. This form of operating aid will also be financed from the proceeds from the auctioning of emission allowances.

2. **Operating aid for electricity generation in CHP plants using RES technology with installed capacity up to 1 MW**

Act No 309/2009, on the promotion of renewable energy sources and high-efficiency cogeneration and amending certain other acts, as amended, currently allows support for electricity generation in new cogeneration plants (irrespective of the use of RES) in the case of plants with an installed capacity of up to 1 MW_e, of which at least 60% of the heat produced is used to supply heat through a district heat supply and the primary energy saving is at least 10%.

In order to increase incentives for investors into technologies to generate electricity and heat from RES, it will be necessary to modify this form of aid to cover new cogeneration plants installed together with plants generating heat from RES. The aid should be provided in the form of a guaranteed feed-in tariff in accordance with the rules resulting from Article 43 of Regulation (EU) 651/2014 and Chapter 3.3.2.2 of the Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01) (or its future changes) for the period until full depreciation of investments in cogeneration and RES technology according to normal accounting principles. The aid will be limited to the construction of installations whose operators are building a new district heating and cooling system (with preference for sites with deteriorated air quality) or have a plan to switch to an efficient district heat supply approved by the competent national authorities (Article 24(2) of Directive (EU) 2018/2001 and who, precisely because of the installation of the supported equipment, meet the conditions for an efficient district heat supply.

3. **Operating aid for electricity generation in modernized combined heat and power plants using RES technology**

Act No 309/2009, on the promotion of renewable energy sources and high-efficiency cogeneration, currently allows aid for electricity generation in modernised cogeneration plants (irrespective of the use of RES) with an installed capacity of up to 125 MW_e, provided that the overall cogeneration efficiency is at least 80% in the case of combined cycle combustion turbines and condensation steam turbines with steam extraction, or 75% for other cogeneration plants, at least 60% of the heat produced in the cogeneration plant will be supplied through a district heat supply, and at least 60% of the total heat supply by district heat supply will be heat supply to the public. Aid for electricity generation is provided through a guaranteed feed-in tariff.

To increase incentives for investors into electricity and heat generation from RES technologies, it would be necessary to modify this form of aid so that it only applies under existing conditions to cogeneration facilities that will be modernised, provided the modernisation also includes the installation of equipment to produce heat from RES, or where the district heating plant operator concludes a long-term contract for the supply of biomethane. Aid should be provided through a

guaranteed feed-in tariff in accordance with the rules laid down in Article 43 of Regulation (EU) 651/2014 and Chapter 3.3.2.2 of the Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01) (or its future changes) for the period until full depreciation of investments in cogeneration and RES technology according to normal accounting principles.

4. **Operating aid to maintain the combined production of electricity and heat from biomass**

This will be a new form of operating aid, the provision of which is allowed under the Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01) in point 3.3.2.3. Operating aid will be granted to biomass cogeneration plants to offset the differences between the plant's operating costs and the market prices of electricity and heat. Aid will be provided through a feed-in tariff for a period of three years, with the possibility of extending the aid period if, after the expiry of the previous aid period, the differences have not been offset. Operating aid for the cogeneration of electricity and heat from biomass will only be provided in air quality management areas if it complies with stricter technological requirements.

5. **Operating aid for new CHP plants using renewable energy sources with an installed capacity exceeding 1 MW**

The existing system of aid for electricity generation in CHP plants using renewable energy sources through transparent tendering (auctions) will be maintained, with an increased emphasis on supporting such facilities that will place the bulk of their heat output into district heating and cooling systems. If installations from renewable energy sources, which allow the use of usable heat to be technologically supported, will receive aid, the heat output will have to be placed in district heating and cooling systems.

6. **Using waste and waste heat**

This measure will support the integration of renewable energy sources (favouring the construction of production facilities for biomethane mainly derived from plant and animal waste, the biodegradable part of municipal waste, biodegradable kitchen and restaurant waste and waste water treatment plant waste), as well as the integration and use of waste heat in CHP systems, including waste heat generated as a by-product in industrial and energy sector facilities.

Financial support measures to achieve the objectives - investment aid

To implement measures aimed at increasing the RES share, the use of investment aid instruments is also proposed:

1. EU funds
2. The Modernisation Fund consisting of the sale of emission allowances and other instruments linked to the EU ETS
3. The Environment Fund.

As part of the preparation of the new programming period for the use of EU funds for 2021 to 2027, the EC Report on Slovakia identified, in connection with the use of renewable energy sources, investment priorities related to support for the deployment of decentralized capacities as part of small RES projects and the transfer to RES for heating and cooling (in accordance with sustainability criteria).

In line with the Initial Proposal for the Priorities of the Slovak Republic for the Cohesion Policy for the Programming Period 2014-2020, the priorities for increasing energy efficiency, promoting RES and reducing greenhouse gas emissions in the programming period 2021-2027 will be:

- increasing energy efficiency and renewable energy use in enterprises, including the energy sector, and improving the energy performance of buildings,
- promoting renewable energy sources and efficient district heating systems (DHS) in heat and cold supply and smart energy systems, energy storage,
- promoting sustainable mobility by increasing the share of alternative greener propulsion systems in transport.

The programming period 2021-2027 will focus, as regards the use of RES, in particular on:

- support for meeting RES targets and increasing the RES share in district heating and cooling systems, including increasing the efficiency of the generation and distribution of heat in district heating systems and the use of RES in energy carriers to provide heating and cooling,
- providing support for plants using RES, energy distribution and storage facilities (including smart management systems) to increase the efficiency of existing installations, and the installation of new plants using RES (business, public and households sectors),
- exploiting geothermal energy and supporting the development of local heat supply systems,
- supporting transport infrastructure for charging electric vehicles and for refilling hydrogen-powered vehicles, as well as for the electrification of public passenger transport (electrification of railway lines, construction of new tram and trolleybus lines instead of bus transport).

The Environment Fund accumulates funds raised from the auctioning of emission allowances, and at least 35% of revenues will also be used for projects in the energy generation sector with support for efficient and sustainable district heating, cogeneration and the development of renewable energy sources. The aim will be to support the projects of district heating and cooling system operators for switching to efficient district heating and cooling by constructing new or upgrading existing heat and CHP plants using renewable energy sources.

Continued support for households after 2023

To promote the development of household appliances, it is proposed to continue support through subsidies for the purchase and installation of equipment using RES. Experience from the currently running Green for Households II subsidy programme has so far been positive. This is the National Project of the Slovak Innovation and Energy Agency (SIEA), in which family houses and apartment buildings can apply for aid through a voucher for small installations using renewable energy sources. The project is financed from the Operational Programme Quality of Environment. The aid is set up to give households an incentive to buy quality systems with reasonable performance, longer life and higher energy conversion efficiency, and not to underestimate the need for installation expertise. The aid may not exceed 50% of the eligible expenditure.

The following are devices supported through the programme:

- small power plants with an output of 10 kW or less
    - photovoltaic panels

- wind turbines (these devices cannot yet be supported)

- heat plants covering the energy needs of a family house or residential building
  - solar panels
  - biomass boilers
  - heat pumps

- micro fuel cell cogeneration installations.

Concurrence of investment and operating aid

In order to reduce operating aid, the possibility of concurrent investment and operating aid will be ensured in such a way as to ensure the condition of proportionality from the point of view of State aid and to comply with the requirements for deducting possible investment aid from the total investment amount when calculating the average cost of energy generation (LCOE).

Other measures with similar effects to investment and operating aid

To implement measures aimed at increasing the RES share in the heating and cooling sector, fiscal measures, e.g. a reduced VAT rate on heat from district heating and cooling using RES, may be introduced.

Measures in the transport sector

Table 30 Measures in the transport sector

Measure name	Measure type/concise measure description	Anticipated result	Target group	Measure start and end dates
1. increasing the minimum share for fuel suppliers	regulatory / in line with the indicative trajectory, to achieve a 14% share of RES in fuels in 2030	Achieving the 14% RES target in transport	fuel suppliers	2022-2030
2. increasing the contribution of advanced biofuels	regulatory / increasing the share of advanced biofuels under Annex IX, Part A as a share of final energy consumption in transport	Share of advanced BP: 2022: 0.2% 2025: 1.0% 2030: 3.5%	fuel suppliers	2022-2030
3. increasing the share of biofuels in transport	prepare an analysis of the need to introduce fuels with a higher content of biofuels for the purpose of meeting the RES objectives in transport	Achieving the 14% RES target in transport	fuel suppliers biofuel suppliers ME SR MEnv SR	by 2022

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Measures in the biomethane and hydrogen sectors

Table 31 Measures in the biomethane and hydrogen sectors

Measure name	Measure type/concise measure description	Anticipated result	Target group	Measure start and end dates
1. introduction of guarantees of origin for biomethane	legislative / the introduction of guarantees of origin of biomethane for the purpose of developing the market for	market for biomethane guarantees	biomethane producers	2022

	biomethane marketed in the EU			
2. promoting the transition from biogas to biomethane	regulatory / support for the transition from biogas to biomethane to be used in transport or high-efficiency cogeneration	production of 250 mil. m3 (200 ktoe) of biomethane	biomethane producers	2022
3. support for the recovery of waste from plant and animal production	regulatory / support for the recovery of waste from plant and animal production for the production of biomethane	Production of 60 mil. m3 (50 ktoe) of biomethane	biomethane producers	2022
4. support for the recovery of waste from the biodegradable part of municipal (BDMW), industrial, kitchen and restaurant waste	regulatory / support for waste recovery	Production of 30 mil. m3 (25 ktoe) of biomethane landfilling less than 10% of generated municipal waste	processors of BDMW, industrial, kitchen and restaurant waste	2022
5. Promoting the production of hydrogen from RES or low-carbon hydrogen *	promotion of the production of hydrogen to be used in transport, industry or high-efficiency cogeneration	100% coverage of hydrogen pumping station consumption and partial replacement of hydrogen from fossil fuels	hydrogen producers	2022

* for this measure, low-carbon hydrogen means hydrogen whose carbon footprint is 60% lower (e.g. with the capture or use of carbon or CO_2) compared to hydrogen production in the process of natural gas reformation

iv. *Where applicable, the assessment of the support for electricity from renewable sources that Member States are to carry out pursuant to Article 6(4) of Directive (EU) 2018/2001*

The Slovak Republic will review the effectiveness of its support systems for electricity from RES and their significant distributional effects on different groups of consumers and investments every five years and by the end of 2024 at the latest. This assessment will take the impact of possible changes to the support systems into account. The results of this assessment will be taken into account within the framework of indicative long-term planning governing aid decisions and proposals for new aid. This assessment will be included in the progress reports in accordance with Regulation (EU) 2018/1999.

v. *Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements*

A summary of policies and measures under the enabling framework that Member States must implement under Article 21(6) and Article 22(5) of Directive (EU) 2018/2001 to promote and facilitate the development of energy self-consumption and renewable energy communities.

The contact point referred to in Article 16(1) will be the Slovak Innovation and Energy Agency (SIEA). The Ministry of Economy of the Slovak Republic will authorize the SIEA as its organization to establish one or more locations within its four branches to guide applicants throughout the entire administrative process of the application for and issue of permits to build, modernise and operate

facilities using RES and the equipment needed to connect them to the grid. The Ministry of Economy of the SR will promote more efficient administrative procedures by optimizing the setting of boundaries for environmental impact assessment to ensure that installations using renewable energy sources have a significantly lower administrative burden compared to fossil fuels.

Awareness of RES is already provided through the SIEA. The training of installers of RES equipment is provided through accredited training through which installers are certified. Upon completion of the professional training, the installer has the skills required to install the appropriate equipment and systems to meet the consumer's performance and reliability needs, to perform quality work, and to comply with all relevant regulations. The professional training course is completed with an examination based on which a certificate is issued free of charge by the Ministry of Economy of the SR. Such certificate is valid for 5 years and is automatically renewed once by another 5 years if the certificate holder participates in an update of their professional training.

In preparing this plan, existing unjustified barriers and the potential for self-consumption of energy from RES were assessed. The result of the assessment is that there are no regulatory or other legislative obstacles for such self-consumers. The only real barrier for over half of households is the costly installation of the equipment. The cost of installing the equipment as an additional or replacement heat source in terms of return on investment results in a low level of interest in these sources. The situation changes if there is a subsidy for such equipment. One example is the Green for Households programme, which provides supports for such equipment to provide a reasonable payback period. The interest in installing devices has thus increased several fold. It is therefore proposed to continue subsidies for households through the existing Green for Households programme also in the period after 2021. The measure under Article 22(6) of the RES Directive is a financial subsidy for households and apartment buildings.

vi. Assessing the need to build new infrastructure for district heating and cooling using renewable sources

To implement measures aimed at increasing the RES share in the heating and cooling sector and to improve air quality in locations with increased emission burdens (mainly due to particulate matter emissions), the construction of new district heating and cooling systems based on facilities for the production of heat from RES appears necessary (in particular geothermal energy, biomass, biogas, biomethane, solar energy and aerothermal, geothermal and hydrothermal energy used in heat pumps), potentially in combination with high-efficiency cogeneration facilities. In the event of insufficient interest from heat and cold market participants in building new district heating and cooling systems under market conditions, the competent authority will launch a call for tenders for new district heating and cooling capacities with the possibility of participation in any of the above-mentioned investment or operating aid programmes.

Another challenge is to build infrastructure to generate and supply cold using new or existing district heating infrastructure, absorption cooling technology and heat pumps. Projects for such infrastructure will be able to participate in investment and operating aid programmes provided they use renewable energy sources, potentially in combination with high-efficiency cogeneration technology.

vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation:

The preparation of special measures within the competence of the Ministry of Agriculture and Rural Development of the Slovak Republic is anticipated to increase the availability of biomass sources focused mainly on the cultivation of fast-growing trees.

3.1.3. Other elements of the dimension

i. Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS

Table 32 below shows the effects of mitigation measures. The overall impact of policies and measures was determined as the difference between scenarios after defining the impact of a specific measure.

Table 32 Effects of mitigation measures and policies

Mitigation measure name	Policy impact on EU ETS or ESD emissions	Reduction of greenhouse gas emissions for 2020 (Gg CO2 equiv.)			Reduction of greenhouse gas emissions for 2025 (Gg CO2 equiv.)		
		EU ETS	ESD	Total	EU ETS	ESD	Total
Environmental design and use of products	ESD		21.99	21.99		47.33	47.33
Increasing energy efficiency	EU ETS ESD	257.36	109.16	366.52	489.32	207.54	696.85
Implementation of the EU Winter Package	EU ETS ESD	225.80	51.97	277.78	238.83	54.97	293.81
District heating optimization	EU ETS ESD				337.40	56.10	
Decommissioning of fossil fuel power plants	EU ETS ESD				494.15	82.17	
Decarbonisation of electricity generation	EU ETS ESD	277.71	63.92	341.64	286.38	65.92	352.30
Continued reduction of final energy consumption in all sectors	EU ETS ESD	477.07	89.62	636.68	675.3	286.42	961.72
Environmental design and use of products	ESD		55.23	55.23		69.85	69.85
Increasing energy efficiency	EU ETS	879.37	372.98	1252.35	995.73	422.33	1418.07
Implementation of the EU Winter Package	ESD	256.1	58.95	315.05	301.73	69.45	371.18
District heating optimization	EU ETS	389.17	64.71	453.88	634.26	105.47	739.72
Decommissioning of fossil fuel power plants	ESD	768.59	127.8	896.39	631.88	105.07	736.95
Decarbonisation of electricity generation	EU ETS	559.13	128.69	687.82	611.79	140.81	752.6

Continued reduction of final energy consumption in all sectors	ESD	1405.55	596.15	2001.70	1507.13	639.24	2146.36

Source: https://cdr.eionet.europa.eu/Converters/run_conversion?file=sk/eu/mmr/art04-13-14_lcds_pams_projections/pams/pams/envxrmnra/SR_mmr-pam_report_2019_ETC_NEW.xml&conv=565&source=remote

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ii. Policies and measures to achieve other national targets, where applicable

On 17 October 2018, Government Resolution No 478/2018 approved the updated Strategy for the Adaptation of the Slovak Republic to Climate Change. The main objective of the updated adaptation strategy is to increase resilience and improve the readiness of the Slovak Republic to face the adverse effects of climate change and to establish an institutional framework and coordination mechanism to ensure effective implementation of adaptation measures at all levels and in all areas.

The fulfilment of the following partial objectives should contribute towards the achievement of the main adaptation objective: ensuring the active development of the national adaptation policy, implementing adaptation measures and monitoring their effectiveness, strengthening the projection of objectives and recommendations of the adaptation strategy in multilevel governance and promoting entrepreneurship, improving public awareness of climate change, promoting synergies between adaptation and mitigation measures and using an ecosystem approach in implementing adaptation measures, and promoting the projection of the objectives of the 2030 Agenda for Sustainable Development, the UN Framework Convention on Climate Change and the Paris Agreement.

The strategy seeks, within as wide a scope of areas and sectors as possible, to link scenarios and the possible consequences of climate change with proposals for appropriate adaptation measures. In terms of adaptation to the adverse effects of climate change, key areas and sectors are considered to be: the rock environment and geology, soil environment, natural environment and biodiversity, landscapes and water management, residential environment, population health, agriculture, forestry, transport, tourism, industry, energy, and other areas of business and risk management.

The preparation of an adaptation Action Plan, which began in 2018, is managed by the Ministry of the Environment of the Slovak Republic in cooperation with the Prognostic Office of the Slovak Academy of Sciences. Adaptation measures will be prioritized in the Action Plan after qualitative and quantitative analysis. This prioritization will be based on the results of the participatory process, involving all the relevant actors. Short-term measures for the 2020-2022 period and medium-term for the 2022-2025 period with a view to 2028 will be identified. Measures will be prioritized by importance, feasibility and the availability of financial resources. The Action Plan should contribute towards better translation of adaptation measures into the sectoral policies of the relevant ministries. It should also include a proposal for a system for monitoring vulnerability, a proposal for a system of mid-term evaluation of the adaptation process in Slovakia, including the monitoring of cost-benefit linkages, and a proposal for a platform for publishing and sharing positive experience. As a basis for the preparation of the Action Plan, the strategy defines six objectives that should be addressed as a priority. These are:

- setting specific objectives, priority measures and instruments for selected areas and sectors,
- formulating specific tasks for fulfilling selected priority AMs,
- determining coordinators, timetables and deadlines for tasks,
- quantifying economic costs for the implementation of tasks,
- mapping legislative, organisational and financial obstacles to implementation,

- defining selected indicators for priority AMs and monitoring.

iii. Policies and measures to achieve low emission mobility (including electrification of transport)

The Ministry of Economy of the Slovak Republic has prepared the "Draft Action Plan for the Development of Electromobility in the SR", which follows on from the conclusions and recommendations of the GEAR 2030 High Level Group of 18 October 2017, as well as the EC strategy document "Europe on the Move" and the adopted Clean Mobility Package. The Action Plan contains 15 measures which are direct support for the use of low-emission vehicles and the possibility for a financial mechanism to support the development of charging infrastructure, as well as incentive support. The current incentive to purchase vehicles is supported by benefits such as distinctive vehicle identification, the possibility of using lanes reserved for public transport, entry into low-emission zones, and using parking spaces reserved for a specific group of users.

In July 2019, the ME SR announced the first ever call for the construction of AC charging stations for municipalities and local government (planned volume EUR 500 000). The second round of the call (with the same financial volume) is planned to be announced by the ME SR in early 2020.

The ME SR plans to launch a call for the purchase of battery and plug-in hybrid electric vehicles (planned volume of EUR 5 million) at the end of 2019.

Support from the Ministry of Economy of the Slovak Republic is implemented based on Section 2(h) - construction of infrastructure for alternative fuels, and (i) - use of new vehicles powered by alternative fuels of Act No 71/2013, on the provision of subsidies within the competence of the Ministry of Economy of the Slovak Republic.

iv. Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

On 3 July 2019, the Slovak Government adopted Resolution No 336/2019 on the Action Plan for the Transformation of the Upper Nitra Coal Region. More detailed information on the Action Plan can be found in section 1.2. For an overview of the current political situation, see point ii, letter g.

3.2. Dimension: energy security

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2, including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

i. Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU and to be prepared in accordance with Annex III to this Regulation

After thorough analysis, the Slovak Republic has decided to implement energy savings exclusively through policy measures, i.e. without introducing mandatory schemes. The most significant influence as regards this decision was from the projected increase in final energy prices, which would ultimately have a negative impact on the business environment, which would then have reduced the competitiveness of the economy as well as possibly increasing unemployment.

For the implementation of the proposed measures it will be necessary to maximise synergies between the various measures in order to subsequently maximise the overall contribution towards meeting the energy efficiency and other energy and climate objectives.

Alternative policy measures are applied to achieve energy savings in line with Art. 7 of the Directive. The most important policy measures and financial mechanisms that have contributed, and may contribute, towards the fulfilment of the objective under Art. 7 of Directive 2012/27/EU include:

- The obligations on energy efficiency laid down by generally binding legislation beyond the obligations imposed by EU regulations
- State Housing Development Fund – energy efficiency programmes
- Operational Programme Quality of Environment, ESIF 2014-2020
- Operational Programme Integrated Infrastructure, ESIF 2014-2020
- Integrated Regional Operational Programme, ESIF 2014-2020
- Slovseff III programme
- Subsidies under the ME SR
- Environment Fund
- Subsidies through the Ministry of Transport and Construction of the Slovak Republic
- Voluntary agreement
- Future programmes involving the promotion of energy efficiency measures under the new Cohesion Policy 2021-2027
- Modernisation Fund

Table 33: Overview of the most important policy measures to achieve the objective of Art. 7 of Directive 2012/27/EU

Measure	Funding source
1. Apartment building renovation, 2. Renovation of social services facilities, 3. Subsidy for the elimination of systemic defects in residential buildings	SHDF
Support for measures to improve energy efficiency in apartment buildings, public buildings, small and medium-sized enterprises	Slovak Investment Holding
- Ensuring energy audits in SMEs and implementing energy audit measures, - Improving the energy performance of public buildings, - Developing, approving and implementing sustainable energy plans and reducing greenhouse gas emissions, - Implementing energy management systems, including energy audits and environmental management, - Supporting the development of energy services at regional and local levels, supporting so-called ESCO companies as energy service providers with guaranteed savings for the public sector, - Construction, reconstruction and modernisation of heat distribution, - Construction, reconstruction and modernisation of high-efficiency cogeneration facilities with a maximum heat input of 20 MW, - Raising energy efficiency awareness among children and young people,	Operational Programme Quality of Environment, ESIF 2014-2020, sources after 2020, MunSEFF

- Information campaign on energy efficiency, - Monitoring and Information System - linking to the majority of energy efficiency support mechanisms,	
- Renewal and modernisation of the public passenger transport fleet, - Building and upgrading transport infrastructure, - Supporting the development and use of public passenger transport, including support for the creation of integrated transport systems;	Operational Programme Integrated Infrastructure, ESIF 2014-2020
- Supporting the development of non-motorized transport, in particular cycling, - SHDF - Insulation of residential building from EU funds (see above),	Integrated Regional Operational Programme, ESIF 2014-2020
- Improving the thermo-technical properties of apartment buildings, - Improving energy efficiency in industry,	SlovSEFF Green Programme III
- Implementing energy audit measures in SMEs in BSR, - Increasing energy efficiency of heat distribution in BSR, - RES	Subsidies through the Ministry of Economy
- Improving the thermo-technical properties of public buildings,	Environment Fund
- Contribution towards family house insulation - Contribution towards the elimination of systemic defects in apartment buildings	Subsidies through the Ministry of Transport and Construction of the SR
- Implementing energy efficiency measures for entities, particularly in industry and the energy sector, with a view to achieving agreed energy savings or providing information.	Voluntary agreement
Measures listed in Annex No 2 of the Integrated National Energy and Climate Plan	The proposed sources of funding are listed for specific measures

Some of the aforementioned support programmes that will generate further measures to 2023 also fall into the 2021-2030 period. This applies in particular to the following measures

- Operational Programme Quality of the Environment, ESIF 2014-2020
- Operational Programme Integrated Infrastructure, ESIF 2014-2020
- Integrated Regional Operational Programme, ESIF 2014-2020

Further measures are continuous and will continue throughout the 2021-2030 period

- The obligations on energy efficiency laid down by generally binding legislation beyond the obligations imposed by EU regulations
- SHDF - programmes focused on the renovation of residential buildings, social services facilities
- The SlovSEFF III programme and its successor
- Subsidies under the ME SR
- Environment Fund
- Subsidies for family houses
- Voluntary agreement
- Measures to support energy efficiency and the use of RES supported through ESIF funds in the new programming period 2021-2027

Plan of Measures for 2021 to 2030 by sector to meet the energy saving end-user target (pursuant to Article 7 EED).

1. **Private sector buildings (excluding public sector buildings)**

The buildings sector will continue to be a very important one after 2020 in terms of the potential for achieving energy savings. New legislation adopted in accordance with the transposition of Directive 2018/844 will introduce new requirements for building renovation with an emphasis on increasing the number of buildings that have undergone comprehensive renovation, additional requirements

for technical building systems (installation of self-regulating equipment, control of heating and cooling systems, etc.) and implementation of building automation and management systems.

The adoption of measures to improve the energy performance of a building is intended to reduce the overall energy demand of such building, which in turn will be covered to the greatest extent possible by energy supplied from renewable sources.

A total of 64.7% of apartment buildings and 48.9% of family houses had been renovated in Slovakia, by the end of 2018 thanks to properly configured mechanisms from the State, operating in the field of thermal insulation in Slovakia for over 25 years. Measures that have the greatest impact on achieving energy savings have been carried out for a large part of these, namely the renovation and thermal insulation of the building structures (cladding, roof, the ceiling above unheated basements) and the replacement of opening structures (windows, doors).

Meeting the minimum requirements for almost passive buildings during renovation after 2020 will require thorough renovation that will entail higher financial costs; and a subsequent renovation (at the end of the building elements' life) of a building already renovated in the past will bring lower energy savings than in the case of the first renovation of that building.

The climate changes observed over the last ten years in Slovakia and across the EU will result in greater demand for building cooling and ventilation, which will also translate into a change in energy consumption patterns in buildings. The above-mentioned measures in the buildings sector apply only to privately-owned buildings, that is to say only to non-State and non-public buildings. Measures concerning State and public buildings are described in the "Public sector" chapter.

Improving the thermal and technical characteristics of family houses

There are over one million family houses in Slovakia. The statistical data on family houses date from 2011 and monitor the extent of thermal insulation and reconstruction of family houses, but not the technical standard of the work performed. Most homes were built in the 1960s, and so the majority are between 30 and 70 years old. The number of dwellings in family houses account for over half the total number of dwellings in Slovakia and they are privately owned. This fact is fundamental for the State's approach to motivating the population to carry out the renovation of family houses.

At the end of 2018, the share of renovated family houses (at different stages of renovation) in Slovakia was 48.97% of occupied dwellings in family houses, while the renovations carried out so far have been almost exclusively financed from the owners' private resources, possibly in combination with loans from the building savings system or commercial banks. Renovation costs per m^2 are known to be higher for family houses than for apartment buildings. In an effort to motivate family house owners, the State introduced support in the form of a State contribution towards the insulation of family houses to improve their energy efficiency in 2016. This allows the owner to cover up to 40% of incurred eligible renovation costs, subject to meeting the conditions laid down for the subsidy. In the light of practical experience, the contribution was revised upwards, the scope of activities covered by the contribution broadened, and the administrative requirements simplified to make the support mechanism more attractive to owners. The amendment to the Strategy for Residential and Non-Residential Building Fund Renovation states that, at the current rate of renovation, all occupied family houses will be renovated by 2043. It should be noted that a large proportion of family houses were previously renovated using inappropriate materials, often by the owners themselves, without expert knowledge of the technological process of thermal insulation. Repeated renovation will not only be much more costly due to the stricter minimum energy

performance requirements of buildings after 2020, but especially due to the need to improve the necessary training and incentives for owners to renovate. The construction of new family houses to the energy standard of almost passive buildings has been supported since 2018 through a State contribution towards almost passive family houses.

EU funds have supported technical equipment in family houses in the form of a subsidy for the installation of RES in family houses. Family houses and apartment buildings can apply for aid in the form of a voucher for small installations using renewable energy sources through the national project of the Slovak Innovation and Energy Agency (SIEA) called Zelená domácnostiam (Green for Households). In the new programming period, it is planned to continue the Green for Households project, also in connection with the objective of increasing the share of renewable energy sources in heating and allowing the energy savings thus achieved to be set against the 35% exemption from the energy efficiency target under Art. 7.

A key measure to 2030 will continue to be improvements in the thermal and technical properties of family houses, which will mainly be financed privately and through commercial banks. However, financial incentives remain an essential part of funding as the main incentive tool for continued renovations.

Improving the thermal and technical characteristics of apartment buildings

The renovation of apartment buildings in various forms has a long tradition in Slovakia. The proportion of renovated apartment buildings in Slovakia was over 64% of the total number at the end of 2018. The amendment to the Strategy for Residential and Non-Residential Building Fund Renovation 2017 shows that at the current renovation rate, all apartment buildings where renovation is possible will have been upgraded by 2030. Therefore, it is important to continue to support the renovation of apartment buildings in the upcoming period at least at the same rate. However, we need to take into account the fact that apartment buildings renovated more than twenty years ago will need to be renovated again in view of the gradual end of the lifetimes of the building materials and structures used, which will mean higher financial costs for thorough renovation of an apartment building to the stricter energy level of near-passive buildings after 2020.

The most important financial mechanism providing motivation to renovate apartment buildings is the building renovation programmes of the State Housing Development Fund and their combination with the use of EU structural funds. Their continuation into the 2021-2030 period is also anticipated to be a key factor for meeting energy efficiency targets to 2030. Other important support programmes are Slovseff and Munseff and support for project preparation through JESSICA projects and financial tools managed by Slovak Investment Holding.

Technical equipment in apartment buildings has been subsidised through EU structural funds in the form of subsidies for the installation of renewable energy sources in apartment buildings. As with family houses, the continuation of the Green for Households project is anticipated to continue in the new programming period.

Improving the thermal and technical characteristics of non-residential buildings

Non-residential buildings in the private sector are supported through various financial mechanisms. European funds are very important for this type of building. Renovation measures have the greatest potential for the renovation of buildings with the lowest energy efficiency. In this context, this primarily means hospitals and medical facilities. This measure could also potentially accelerate renovation for those categories of buildings that have financed their renovation exclusively from

their own resources. These are mainly shops, wholesalers, hotels and restaurants. The introduction of a suitable form of aid for this category of building will certainly be one of the decisive factors in the issue of building renovation, whether it be for owners or investors. The determination of a realistic projected value for the potential energy savings depends directly on the value of the aid.

The guaranteed energy service can also make a significant contribution towards achieving energy savings in this category, especially as it is a mechanism that, in most cases, does not depend on investment by building owners. Since these are private sector buildings, the basic rules for the use of the guaranteed energy service set out in the Energy Efficiency Act can be applied.

The new building requirements will require more funding to meet the set objectives and, in the case of repeated renovation, there will also be lower benefits in terms of energy savings. With an anticipated 20% share of energy savings from the total estimated savings from the measures implemented in the 2021-2030 period, this represents EUR 3 billion (including measures for public buildings), but this may not be the final value.

2. Industry

Due to its structure, industry in Slovakia is one of the most energy-intensive of all the EU Member States. According to data from the Statistical Office of the Slovak Republic for 2017, industry in Slovakia accounted for approximately 35% of final energy consumption. Between 2000 and 2015, the Slovak Republic reduced energy intensity by approximately 51%, while in the 2006-2012 period this reduction was over 27%, the largest reduction among EU countries in the given period. This achievement was a result, in particular, of implementing cost-effective measures with a sufficiently reasonable payback period to reward enterprises to pursue them solely from their own resources without public support. Given the limited potential of cost-effective measures, efforts to maximise the energy savings potential in relation to the achievement of the objective of Art. 7 of the Energy Efficiency Directive will be a major challenge in particular.

A prerequisite for successfully tackling this challenge will be to create an environment that will motivate enterprises to implement energy-saving measures as much as possible while minimizing the burden on public resources. The expenditure needed to reduce energy intensity in industry will be significantly higher than in the 2011-2020 period. Reducing the administrative burden and simplifying processes related to the drawing of public funds to promote energy efficiency will be at least as important in this context as ensuring the financing of such projects. It will be important to continuously raise enterprises' awareness of existing and planned instruments for State support of energy efficiency in industry. The State will endeavour to contribute towards creating an environment that promotes the exchange and sharing of information between enterprises, sectors and associations with the aim of reducing energy intensity. It will be necessary to introduce systematic data collection, verification, evaluation and subsequent reporting to continuously update and configure measures to promote energy efficiency, prioritise and subsequently implement them.

Slovakia's ambition towards the fulfilment of the objective ensuing from Art. 7 of the Energy Efficiency Directive is currently limited by the fact that the energy saving potential in Slovakia currently mapped through energy audits does not correspond to the anticipated contribution of enterprises towards meeting this objective.

The potential for energy savings in industry, calculated from currently available data, in particular from energy audit summary sheets, is around 2 780 GWh, or an average of 278 GWh per year to 2030. It is assumed that this value is in fact higher, as the potential in the summary sheet is a

recommendation by the auditor and does not always include the overall potential of the enterprise. Moreover, the number of large enterprises from which this data originates does not correspond to the total number of large enterprises in Slovakia legally obliged to carry out an energy audit. Also, there are no data from enterprises with energy management systems in place, or data from small and medium-sized enterprises. On the other hand, account should be taken of the fact that part of the measures relating to the identified potential may already have been, and probably have been, implemented. These facts are an example of the importance of ensuring systematic data collection in the process of meeting the objectives, with an emphasis on their quality.

However, the payback period is decisive for the implementation of the measures. Data available from energy audits show that the potential of measures with a return within 2 years, i.e. cost-effective measures, is around 28%. Given the continuing pressure to reduce costs, there is a strong assumption that this potential will decrease very rapidly and relatively significantly in the coming period, which will directly and proportionately increase the need for support from public funds for energy efficiency projects.

Measures

Measures to promote energy efficiency in industry for the 2021-2030 period are a combination of proven measures, activities from the Slovak energy efficiency action plans prior to 2020, and newly proposed measures and activities. The proposals for new measures reflect the SR's need to increase the rate of energy savings in industry, while also drawing on the experience of other countries where they proved very beneficial.

Increasing energy efficiency and reducing emissions in enterprises through competition

This measure is aimed at supporting the implementation of investment projects to reduce energy intensity and CO_2 production. It aims to provide support for projects only to the extent necessary for their implementation, which will in turn result in significant savings of public funds. One prerequisite will be to respect the principle of the primacy of energy efficiency, according to which energy efficiency improvements must be made whenever they are more cost-effective than equivalent solutions on the supply side. This means that, in addition to projects to improve energy efficiency, bidders will also be able to submit offers related to the installation of renewable energy sources. The main criterion for evaluating bids will be the cost in EUR per MWh saved, respectively MWh produced from RES. It is anticipated that if this measure is properly configured, is consistently implemented and properly funded, it could contribute 116.3 GWh per year towards meeting the target. The total estimated annual cost of this measure is EUR 103.7 million. In view of the need to implement the measure and ensure all the activities related to its effective functioning, an increase in funds of around 5% is anticipated. The contribution of the measure towards achieving the objective will directly depend on how its financing is set up. In this context, setting up the conditions for providing support to those involved in the project will be an important element. Their simplification compared to the current conditions for granting subsidies will certainly be an important incentive for companies to engage in this form of energy saving while, on the contrary, if they are left in their existing form or made even stricter, the result will be failure to realise the potential of the measure.

Support for improving energy efficiency in enterprises through an operational programme or implementation mechanism

The aim of this measure is to support the implementation of investment projects in industrial enterprises to reduce energy intensity with a payback period of over 2 years. The anticipated average annual benefit of this measure (48.2 GWh) is very ambitious given the experience to date. Achieving this contribution is conditional on reducing the administrative burden and simplifying the processes related to the provision of assistance from the relevant support mechanisms, as in the case of the "Increasing energy efficiency and reducing emissions in enterprises through competition" measure – this means everything from the submission of the application and its evaluation, to the publication of the results and subsequent monitoring of fulfilment. These factors are barriers with a major impact on the decision-making process of enterprises when considering applying. The total average annual investment costs are around EUR 42.9 million.

Support for energy audits for SMEs

This measure aims to support energy audits for small and medium-sized enterprises. Given the low projected energy savings potential of SMEs, the projected average contribution towards the target is only 2.9 GWh per year. The average total estimated annual expenditure is approximately EUR 0.6 million. In the Bratislava Region, this support is implemented through Act No 71/2013 on the provision of subsidies within the competence of the ME SR.

Voluntary energy saving agreements

This is the measure that contributed most towards the target under Art. 7 EED in the 2014-2020 period. In this period it has proved to be the most cost-effective instrument for meeting this objective among all the measures notified in the energy efficiency action plans. The objectives of the measure in the 2021-2030 period are to continuously increase the number of actors that will actively contribute towards the achievement of the objective, and also to involve industry or other relevant associations and societies in this scheme. Experience from Member States with years of experience in its implementation has shown that the measure as such not only contributes towards meeting energy efficiency objectives, but also brings about other positive effects, such as more effective collaboration between industry associations and societies with the State, or the sharing of ideas on energy efficiency projects between enterprises to reduce costs. The estimated annual contribution towards the objective under Art. 7 EED is 110.6 GWh at an average annual cost of about EUR 99.4 million, of which the maximum anticipated expenditure from public sources is about 1% to 2%.

Voluntary agreements will gradually be applied to other sectors of the national economy, with a strong emphasis on the application of the primacy of energy efficiency principle. In the context of voluntary agreements, the application of this principle will entail an obligation – for entities using any public resources (state budget, structural funds, etc.) to co-finance their projects – to commit to contributing towards the achievement of energy efficiency objectives through accession to a voluntary agreement. The level of commitment of stakeholders in the voluntary agreement, whether this is to develop a plan for implementing energy efficiency measures, implementing cost-effective measures (but also measures with a longer payback period), taking energy efficiency into account in planning and purchasing, staff training, meeting requirements relating to reporting and achieving agreed energy savings, etc., should be one of the important parameters in assessing applications for co-financing projects.

The measure will also include the creation of an information platform to provide information and news on energy efficiency in industry. The platform will also serve as a supporting tool for the exchange of experience and knowledge between enterprises.

Voluntary agreements, together with the 'Regional Energy Centre' measure, will make a decisive contribution, in particular through data collection, towards improving energy efficiency in industry in the future. It is also anticipated that these two measures have the greatest potential to help Slovakia achieve the objective of Art. 7 EED. With the consistent implementation of voluntary agreements, as well as other measures to promote energy efficiency in industry, it is anticipated that industry's contribution towards meeting energy efficiency targets may be higher than envisaged in this plan.

3. Public sector

Despite the many energy efficiency measures to improve energy efficiency undertaken in the past, the public sector still has considerable potential for energy savings. This assumption is based on the fact that recently the key barriers that prevented greater use of energy services in the public sector have been removed. New financial instruments used in the public sector should facilitate the achievement of the potential.

One of these instruments is the guaranteed energy service according to Eurostat rules. With regard to the anticipated decrease in the allocation of structural funds for the SR in the future programming period, the area of guaranteed energy services has extraordinary potential throughout the SR. A key factor for the development of this sector will be the provision of non-repayable EU financial assistance to improve the energy efficiency of public buildings in combination with repayable funding. Public buildings and public lighting are key areas for public sector energy savings. Recent developments in this segment would imply the expansion of guaranteed energy services in the public sector. The 2019 Eurostat Guideline, technical assistance options for government and public authorities, training requirements for professionals, in particular for the provision of GES, public procurement and energy audits aimed at restoring public buildings and public lighting, as well as information programmes for state and public authorities, including simple conversion tools enabling rapid identification of suitable projects, have been implemented and introduced.

From an analytical and energy savings monitoring point of view, it is necessary to establish comprehensive and interconnected lists of government and public buildings with information on their condition, renovation options and the possibilities of using GES or other funds, or combinations thereof, for these buildings. This information will also need to be disseminated for public lighting and green public procurement, integral parts of the public sector.

Measures

Provision of energy services for the public sector

Reducing energy consumption will be achieved through the implementation of guaranteed energy service projects by providers of guaranteed energy services for the public sector under energy efficiency contracts with guaranteed energy savings for the public sector. Repayment of the investment is anticipated from sources the GES beneficiary would use to cover energy costs in the future.

The concept for the development of guaranteed energy services in the public sector elaborated by the Slovak Ministry of Finance in cooperation with the Slovak Ministry of Economy and related legislative, conceptual and support measures for public sector entities, i.e. State and public administration, can be considered a significant incentive in this respect. Guaranteed energy services can be used primarily for the renovation of public buildings and public lighting. The evaluation of public sector buildings will show the real potential for this support scheme, as well as the possibilities

for its further development through combining different financial mechanisms to make the most efficient use of funds.

The opening up of options for public sector use of guaranteed energy services has been made possible by the Eurostat methodological guidelines of 27 September 2017 and the methodological guide to these guidelines issued on 8 May 2018. Based on these, Slovakia has prepared a change to the legislative framework enabling the use of the new Eurostat rules for GES in an amendment to the Energy Efficiency Act No 4/2019 and, on its basis, has also prepared a model contract for the public sector, which has been assessed by Eurostat to ensure it meets the parameters necessary for the public sector use of guaranteed energy services without any impact on public debt. The model contract was subsequently published on the ME SR website in April 2019. The measure is not notified separately but is part of the financial mechanisms of selected measures in this document.

Improving the thermal characteristics of public buildings

This measure is a continuation of existing ones aimed at renovating public buildings through investment. The most important financial mechanisms that have contributed towards the growth in public building renovation are Environment Fund, Munseff and the structural funds. To ensure the continuity of energy savings through the renovation of public buildings, it is necessary to continue with existing funding possibilities but, in particular, to also set up new financial mechanisms in combination with guaranteed energy services that could adequately cover the financial requirements for the renovation of public buildings and the fulfilment of the public buildings renovation target.

The current measures and funding for the renovation of public buildings and objective achievement are not sufficient. Support programmes and new sources of funding (such as GES) are essential to further enhance the renovation of public buildings. The total estimated amount of funding for public sector measures for the 2021-2030 period is EUR 1.24 billion.

Modernisation of public lighting

Comprehensive investment in the energy and telecommunications infrastructure of towns and municipalities is a prerequisite for supporting the development of public lighting. In addition to replacing the original luminaires with ones with lower energy consumption, intelligent control systems that ensure optimum operation of individual lights and, ultimately, optimal operation of the whole system at city or municipal level, will also significantly contribute towards energy savings. In addition, support for the development of the local energy infrastructure will significantly contribute towards increasing the number of charging stations in cities and municipalities. Therefore, it is desirable – if technically and economically feasible – to take as many aspects as possible into account in the implementation of the new local energy infrastructure, with the objective of contributing not only towards increasing safety and comfort for residents but also towards reducing energy consumption and, last but not least, reducing the operating costs of those towns and municipalities. In this context, great emphasis will need to be placed on ensuring that the newly installed intelligent systems are universal in terms of compatibility with systems and equipment from other manufacturers and brands. The estimated cost of modernizing public lighting is around EUR 600 million. It is assumed that energy savings in public lighting have the potential to contribute towards the objective of Art. 7 EED by approximately 8.1 GWh per year. The already-mentioned guaranteed energy services are an effective model for implementing measures in this area.

Promotion of green public procurement

Green public procurement is a specific form of public procurement with specific requirements to ensure the subject matter of the contract, including activities related to its delivery, assembly, installation and operation, is more environmentally friendly than other products with comparable functional or performance parameters for which environmental impact is not normally taken into account. The aim is primarily to take into account aspects contributing towards the achievement of energy and climate objectives, including final and primary energy consumption, and not just the lowest possible purchase price.

Based on legislative and technological changes and the development of green public procurement in the EU and in Slovakia, the National Action Plan for Green Public Procurement in the SR for 2016-2020 (NAP GPP III) was prepared and approved by the Government of the Slovak Republic on 14 December 2016 through Resolution No 590/2016.

The main indicator currently monitored, which is at the same time the strategic objective set out in NAP GPP III, is to reach a share of 50% green contracts concluded by public authorities out of the total volume of contracts concluded by them for selected priority product groups. In view of the very ambitious energy efficiency targets, it will be necessary to set up a system to monitor green public procurement so that indicators that directly contribute towards Slovakia's energy efficiency targets are also monitored and evaluated.

At the same time, measures will need to be introduced to significantly increase the involvement of contracting authorities and other authorities in providing the data needed to evaluate green public procurement in terms of the contribution towards meeting energy and climate objectives. One of these measures is Government Resolution No 478/2019, which approved the "Concept of Development and Implementation of Green Public Procurement in the Slovak Republic".

To this end, it will be necessary, in particular, to introduce a system to educate contracting authorities and other authorities so they take into account the environmental aspects of the subject of the contract as early as at the tender documents creation stage through the use of the LCC approach (a cost-effectiveness approach that takes into account all successive stages of a product, building or service provision, such as research and development, industrial development, manufacturing, repair, upgrading, adjustment, maintenance, logistics, training, testing, withdrawal and disposal).

Regional Energy Centre

The Regional Energy Centre measure is one of the most important in terms of meeting energy efficiency objectives. Although it will primarily focus on supporting and increasing energy efficiency in State and public administration, its overall nature will be cross-sectional and will extend into the private sphere. It is in line with the forthcoming Vision and Strategy for the Development of Slovakia to 2030 which states, as one of the means to significantly reduce the energy and carbon intensity of the Slovak economy and to transform to clean and low-carbon energy, the need to build capacity for quality energy planning at the strategic planning level for regions, towns and municipalities.

The main objectives of the measure are to promote energy efficiency improvements and RES development in regions, districts, self-governments and higher territorial units. Activities related to the fulfilment of this objective will be implemented through regional energy managers whose main tasks at the level of the allocated territorial unit will be:

1. Monitoring the energy-consumption condition of public and State buildings in the regions
2. Supporting the identification of energy savings potential and RES development potential

3. Supporting the design of measures to support energy efficiency improvements and RES development
4. Supporting the implementation of measures through consultation
5. Supporting the implementation of legislative requirements related to energy efficiency and RES
6. Supporting the implementation of actions plans for the development of sustainable energy of the strategic planning regions aimed at strengthening energy self-sufficiency, while respecting smart energy principles
7. Managing data in the energy efficiency monitoring system as one of the major sources of the Integrated Support Data System for decision-making based on accurate and verified data at all levels of government
8. Disseminating: energy legislation and the obligations arising from it for individual target entities
9. Administrating voluntary agreements
10. Promoting joint procurement for the purchase of energy and other goods and services in relation to reducing energy intensity.

Support for increasing energy efficiency and RES development will also be implemented through this measure in large, small and medium-sized enterprises in the region, including logistics and freight transport enterprises, as well as at the level of apartment buildings located in the region. However, this support will be limited for the public sector in view of the priority provision of services. The estimated total costs for the 2021-2030 period are EUR 24 million. The achieved savings will be, for the purpose of fulfilling Art. 7, reported primarily through other notified measures to eliminate the risk of the double counting of energy savings.

Support for energy audits, implementation of energy management, environmental management and EMAS systems for public administration, state administration and self-government

The aim of this measure is a systematic approach towards energy management at the level of individual State and public administration entities. In addition to the potential to make a significant contribution towards the systematic collection of the data needed to comply with Art. 7 EED, a positive shift in end-user behaviour in terms of their approach to energy use is also anticipated.

4. Transport

Transport has the fastest-growing energy consumption of all national economy sectors. In addition to the energy and climate objectives, the proposed measures must contribute in particular towards meeting the objectives of the Strategic Roadmap for Transport Development to 2030. These objectives include in particular:

- increasing the share of public passenger transport, in particular passenger rail transport, by transferring journeys from individual passenger transport,
- increasing the share of rail freight by transfer from road freight,
- improving the efficiency of rail transport operations.

The main measures to achieve these objectives from the perspective of energy efficiency are:

- Renewal and modernisation of the vehicle park – rail transport,
- Promotion of transport by bicycle,
- Promotion of public passenger transport,
- Promotion of energy-efficient individual transport.

The Slovak Ministry of Transport and Construction will implement the majority of these measures in particular through the Operational Programme Integrated Infrastructure (OPII), which supports the construction and reconstruction of energy-efficient infrastructure and public passenger transport through the purchase of energy-efficient public transport vehicles. The anticipated annual energy savings through these measures is 95.6 GWh.

As part of the support for vehicles with low specific energy consumption and lower or zero CO_2 emissions, the Slovak Ministry of Economy has prepared an Action Plan for the Development of Electromobility in the Slovak Republic based on the National Policy Framework for the Development of Alternative Fuels (Government Resolution No 504/2016). The Action Plan is a package of support measures which aims to ensure that consumers perceive low-emissions mobility as unproblematic, while accelerating the deployment of the relevant infrastructure. The measures have the character of direct support for the purchase of highly eco-friendly, low-energy and low-emission vehicles, support for infrastructure construction, as well as the character of incentive support, such as distinguishable vehicle designation, access to low-emission zones and the use of car parks for restricted groups of users.

The ME SR plans to continue its support for the replacement of cars with lower-emission ones and to provide subsidies for vehicles whose operation will contribute towards meeting energy and climate goals. Funding for infrastructure development will be available, in particular, under the Connecting Europe Facility (CEF) which, for example, builds CNG and LNG filling stations and charging stations.

As part of the promotion of non-motorised transport, strategic and conceptual projects are being implemented in support of non-motorised transport, such as the National Platform for Support of Non-motorised transport, National Cycling Strategy, a study of cycling development, etc. Already existing projects include bike sharing in Slovak cities, the Going to Work by Bicycle programme, etc.

Given the lack of data enabling us to quantify the energy savings potential in transport and the problem of defining selected attributes resulting from the requirements of the Energy Union Regulation and the Energy Efficiency Directive, Slovakia is only notifying part of the measures in this document. Measures that will actually deliver energy savings through OPII but cannot be used for Art. 7 EED for the above reasons are as follows:

- Support for the completion of a coherent network of higher road infrastructure (motorways and expressways included in TEN-T), 2nd class and 3rd class roads,
- Modernisation of the main TEN-T railway tracks,
- Removal of transport bottlenecks and critical high-accident-rate locations,
- Support for the creation and deployment of integrated transport systems,
- Modernisation of transport infrastructure, including intermodal freight terminals,
- Increasing energy efficiency in freight transport,
- Various soft measures aimed at driver behaviour to reduce energy consumption and energy intensity.

The MTC SR also cooperates with regions in the preparation and approval of Regional Integrated Territorial Strategies, which are implementation documents for NFP drawing from IROP, the preparation of sustainable mobility plans, and the harmonisation and coordination of public passenger transport between suburban bus, rail and water transport, and strengthening the central role of rail.

Current measures and funding to support energy efficiency measures in transport are lagging behind the rapid pace of transport development. In order to reverse the unfavourable trend in energy consumption growth, it is necessary to set up a system for the creation and updating of measures to promote energy efficiency in transport. Such a system must be based on effective data collection supported by active communication with relevant entities as well as their active involvement in the process of preparation of measures. In the pilot phase, these activities will be provided by regional energy managers as well as project managers providing activities related to the implementation of voluntary agreements.

5. Planned appliance measures

In the 'appliances' sector, the only notified measure will be white goods replacement. In this sector, in addition to replacing white goods, the installation of energy-saving lighting and the tightening of the minimum technical requirements by the EC in the framework of ecodesign and labelling legislation are anticipated to continue.

In the future, the Slovak Ministry of Economy and the SIEA plan to monitor other types of appliances in the white goods segment (i.e. not just refrigerators and freezers, but also washing machines, vacuum cleaners, dishwashers, etc.). It will also be necessary to introduce monitoring of other appliances (e.g. electrical goods) and support for the monitoring of discarded appliances for energy efficiency purposes.

It is anticipated that the replacement of white goods will be associated with total costs of approx. EUR 109.5 million per year. These costs should generate annual energy savings of about 36.7 GWh.

6. **Planned measures in the energy transforming, transmission and distribution ('TTD') sectors**

The planned measures are described in the chapter "Description of measures to develop measures to utilise the energy efficiency potential of gas and electricity infrastructure".

ii. Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU

The text for this chapter will be part of the Long-term Strategy for the Renewal of Residential and Non-Residential Buildings in the Slovak Republic, which will be submitted to the Commission in accordance with Art. 53 of the Regulation on the Governance of the Energy Union by 10 March 2020.

iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

Since 1 December 2014, energy services have legislative support in Act No 321/2014 on energy efficiency and on amendments to certain other acts (Act No 321/2014 on Energy Efficiency). This Act introduced, in Sections 15 to 20, an entire system for the definition and support of energy services. Energy services are divided into support energy services and guaranteed energy services - energy services with guaranteed energy savings, which are further specified when they are guaranteed energy services for the public sector.

Support energy service

Support energy services are specified in Section 15 and involve in particular advice, education and provision of a similar kind of service to improve energy efficiency.

Guaranteed energy service (GES)

On its website[26] the Slovak Ministry of Economy maintains GES provider lists as well as a list of professionally qualified persons performing guaranteed energy services. The method for enrolling on the list is addressed through Decree No 99/2015 of the Slovak Ministry of Economy on providers of support and guaranteed energy services. A GES is an energy service provided under an energy efficiency contract with guaranteed energy savings, i.e. energy efficiency contracts. The providing of an energy service with guaranteed energy savings is a regulated trade. The Act also lays down the mandatory content of an energy efficiency contract if the provision of the energy service relates to the public sector. The Slovak Innovation and Energy Agency also supports and promotes public awareness of energy service development. It also provides training and retraining for professionally people qualified to provide guaranteed energy services and advises public entities on the options for implementing measures to improve energy efficiency within its competence. Energy service providers are required to send energy service data for the preceding calendar year to the energy efficiency monitoring system. A GES is a contract between a GES provider and GES beneficiary, as defined by Act No 321/2014 on Energy Efficiency.

Table 34: Energy savings achieved through energy services in the Slovak Republic

Energy savings achieved through energy services	**2014**	**2015**	**2016**	**2017**
	[TJ]	**[TJ]**	**[TJ]**	**[TJ]**
Provision of energy services in the buildings sector (except public buildings)	5.67	4.22	70.61	22.23
Provision of energy services for the public sector	22.64	40.64	14.93	1.1

Prepared according to: Energy Efficiency Monitoring System, SIEA 2018

Obstacles and barriers:

Barriers to the development of energy services in the Slovak Republic were identified in 2012 to 2014, such as poor awareness of GES, a low level of confidence in GES providers, and the lack of a basic regulatory framework. Some of these barriers were removed by Act No 321/2014 on Energy Efficiency, which introduced the basic system for energy service provision, established the institute of a professionally competent person for the guaranteed energy service provision and the content of the energy efficiency contract for the public sector, as well as information obligations for the Slovak Innovation and Energy Agency. The fundamental political and regulatory barriers to energy services have thus largely been removed. However, removing barriers in particular in terms of demand flexibility, regulation and the setting up of appropriate support schemes, remains a challenge.

One of the key barriers to GES was the issue of private sector capital expenditure on public buildings under a GES contract which, according to the Eurostat until recently, increased public debt. Any financing secured by a GES provider was thus counted as a loan provided to the public sector,

[26] http://www.economy.gov.sk/energetika/energeticka-efektivnost/poskytovanie-energetickej-sluzby

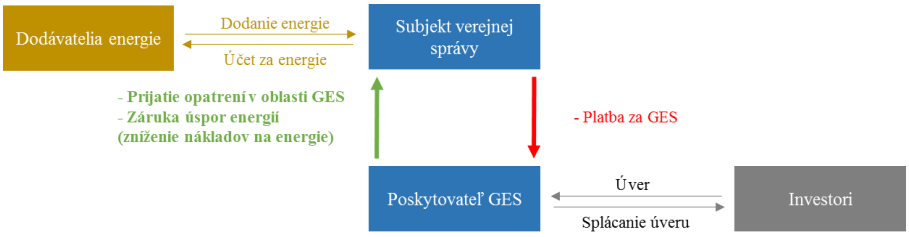
thereby increasing public debt and deficits. In the context of assessing the priorities that can be financed within the limits of public sector debt, GESs have generally been put to the back of the queue. This was not limited to the SR – the same problem also applied to other EU Member States. As a result of discussions at European Commission level, to which Slovakia has also significantly contributed, Eurostat's methodological guidance of 19 September 2017 was published and allowed for a system of energy service use in the public sector that does not lead to an increase in public debt. In the user manual of 8 May 2018, Eurostat, in cooperation with the European Investment Bank, subsequently detailed requirements to be met by GES contracts in order for them to be recorded outside the public finance sector, i.e. without any impact on public debt.

Policies and measures

The new methodology and user manual have significantly improved the conditions for the use of GES in the public sector. Based on this, a Concept of Development of Guaranteed Energy Services in the Public Administration of the Slovak Republic was created and approved by the Government of the Slovak Republic on 10 July 2018. Thereafter, a modification was prepared to the legislative framework, allowing the use of GES under Eurostat rules. The amendment to Act No 321/2014 on Energy Efficiency contains the necessary adjustments for the use of GES in the public sector in accordance with the Eurostat methodological manual and amendments to other related legislation concerning the management of State, municipality, town and local authority assets. A model contract approved by Eurostat is also available. The SIEA is preparing a project entitled Technical Assistance and Support for State and Public Administration to identify, in particular, building and public lighting renovation projects suitable for the application of GES in the public sector.

A simple schematic representation of the provision of guaranteed energy services is presented in Figure 2.

Figure 2 A simple schematic representation of the provision of guaranteed energy services



Key:

Dodavatelia energie	Energy suppliers
Dodanie energie	Energy supply
Účet za energie	Energy bill
- Prijatie opatreni v oblasti GES	- Adoption of GES measures
- Záruka úspor energii (zníženie nákladov na energie)	- Guarantee of energy savings (reduction in energy costs)
Subjekt verejne správy	Public administration body
Poskytovateľ GES	GES provider
Platba za GES	GES payment
Úver	Loan
Splácenie úveru	Loan repayment
Investori	Investors

In the area of demand flexibility, it is important to set up policies and measures that enable end consumers to buy, produce or store energy to maximise energy efficiency. To this end, it is important to involve end consumers directly through the installation of smart metering systems, and also to set up a system to motivate them sufficiently to use energy as efficiently as possible, e.g. by supporting the purchase of batteries for energy storage, respectively building central batteries in towns and municipalities. Another important motivating factor is the continuation of support for the installation of renewable energy sources and possible extension of the Green for Households project to apartment buildings and other categories of buildings.

The regulatory framework will have to comply with the primacy of energy efficiency principle, according to which improvements in energy efficiency must be made whenever they are more cost-effective than equivalent solutions on the supply side.

Equally important will be the effective configuration of support schemes, i.e. public and state bodies should be encouraged, as far as possible, to spend their resources economically to achieve the best possible result in particular. Given the need to increase the rate of renovation of buildings and public sector lighting, it will be desirable to enable providers of guaranteed energy services, in addition to public and State entities, to directly apply for support.

Last but not least, in the next programming period it will be necessary to prevent distortions in the market for guaranteed energy services through the provision of purely non-repayable EU financial assistance to public authorities to improve energy efficiency in public buildings and to modernize public lighting. The use of non-repayable financial assistance in this area has potential, but non-repayable financial assistance needs to be combined with repayable assistance from financial instruments under the same operation.

iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems[27], consumer information and training measures[28], and other measures to promote energy efficiency[29])

Slovakia meets its energy efficiency objectives through cross-sectional measures whose nature impacts several sectors of the national economy. There are several such measures, but the most important ones are:

- Continuation of “Energy Auditor” training courses
- Promoting activities to share and exchange energy-efficiency experience with other Member States
- Raising the awareness of children and young people in energy efficiency
- Supporting information campaigns focusing on energy efficiency
- Enlarging the energy efficiency monitoring system
- Energy consulting - providing information on energy efficiency with the objective of reducing the energy share in household expenditure

- Analyses focused on the impact of energy efficiency on selected aspects, areas of the national economy
- Introducing qualification schemes in energy efficiency and energy use
- Introducing accreditation and certification systems

Other measures

- Measures to be taken on an ongoing basis as a result of the progressive implementation of the priority for energy efficiency principle in national strategies, laws and policies
- Measures that will be notified on an ongoing basis depending on the pace at which all conditions for their proper notification can be met, such as the methodology for calculating energy savings, a system for collecting and evaluating data, and others. These are mainly measures in transport, but also exist in other sectors
- A gradual extension of voluntary agreements to other sectors outside industry

Planned measures in the heating and cooling sector

In close cooperation with measures to support RES development in the heating and cooling sector (Chapter 3.1.2), the following measures are also planned to improve the energy efficiency of the production and distribution of heat and cooling in district heating and cooling systems:

Measure: Construction of new district heating and cooling systems and conversion of existing district heating and cooling systems to efficient district heating and cooling systems

This measure will be implemented through the construction of new district heating and cooling systems meeting the conditions of efficient district heating and cooling (preferentially in locations with reduced air quality) and through the Roadmap for the transfer to efficient district heating and cooling, the approval of which will allow existing district heating and cooling systems to switch to efficient district heating and cooling. The construction of new efficient district heating and cooling systems and the approval of the Roadmap for existing systems will be preconditions for participation in one of the investment or operating aid programmes specified in Chapter 3.1.2., meaning through the installation of high-efficiency cogeneration systems using RES. If an existing district heating and cooling system has not implemented effective district heating and cooling technologies by 31 December 2025, the provisions of Article 24(2) and (3) of Directive (EU) 2018/2001 will apply.

Measure: Construction and modernisation of district heating distribution

As in previous periods, support for the construction of new and the reconstruction of existing district heating distribution systems will continue. Reducing the energy intensity of heat distribution (for heat and cold supply purposes) is an important element in the energy efficiency improvement policy, so investment aid (EU funds, the Modernisation Fund and the Environment Fund) will be used for this purpose. Where projects for the construction of new district heating and cooling distribution systems (preferentially in locations with reduced air quality) are combined with projects for the construction of new RES heat generation facilities, possibly in conjunction with high-efficiency cogeneration, a combination of investment aid and operating aid from the programmes listed in Chapter 3.1.2. may be considered (subject to the restrictions on the cumulation of investment and operating aid). The Slovak Republic will do everything it can to ensure the individual support programmes enable such combination in real time and that they are compatible with each other.

It will be necessary to allocate additional funding to implement these and other measures anticipated to fulfil the ambition for Art. 7 of the Energy Efficiency Directive. Their amount will be

calculated as the product of the specific investment intensity of the measures for which there has been an additional increase in energy savings and the assumed absolute value of these 'additionally identified' savings.

v. Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii, iii and iv

The SR is creating local information centres on the use of energy through the SIEA. These services are generally free of charge. Strengthening capacity at the level of self-government in the field of energy and energy efficiency, increasing professional education for staff and strengthening instruments and measures at both national and local levels are also important.

As part of the ŽIŤ ENERGIOU (LIVE ENERGY) project, consultants from the Slovak Innovation and Energy Agency (SIEA) provide free energy advice to households, enterprises and the public sector on energy efficiency measures and the use of renewable energy sources in four advisory centres in Slovakia (Bratislava, Trenčín, Banská Bystrica and Košice). The project is co-financed by the European Regional Development Fund under the Operational Programme Quality of Environment.

As part of support for the least developed districts, activities for coordinated development of the energy sector and waste management were also created through the individual Action Plans in the districts.

vi. Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure[30]

Description of measures to the utilise energy efficiency potential of gas and electricity infrastructure

An assessment of the energy efficiency of the electricity and gas infrastructure is introduced in the form of an obligation for individual market participants who do business in accordance with the requirements of Act No 251/2012 on the energy sector in the field of electricity and gas, and who operate electricity or gas infrastructure.

Electricity sector

In the electricity sector, the energy efficiency potential of the transmission system operator and the distribution system operators was assessed. The assessment was carried out by entities involved in the operation of the transmission system and distribution systems.

The main contributors towards increasing energy efficiency in the electricity sector include the transmission system operator, Slovenská elektrizačná prenosová sústava, a. s. (Slovak Electric Transmission System (SEPS)) and the distribution system operators.

The primary objectives of SEPS are to ensure the security and reliability of electricity supplies within the defined territory and to meet international obligations arising from ENTSOE membership. At the same time, however, it proposes and implements measures contributing towards reducing system losses and thus decreasing energy intensity. This includes building new lines and restoring older ones to ensure a decrease in transmission impedance, and a gradual phase-out of the 220 kV system and its replacement with a 400 kV system. Specific projects are listed in the Ten-Year Plan for the

30 In accordance with Article 15(2) of Directive 2012/27/EU.

Development of the Transmission System for 2020-2029, which sets out investment plans over the next 10 years for the needs of electricity transmission, load management and network interoperability. The energy efficiency of electricity transmission is assessed based on annual balancing data for the transmission system.

In the Slovak Republic, electricity distribution is currently provided by three regional distribution systems (eastern, central and western Slovakia) and about 150 district (local) distribution systems. The evaluation of the energy efficiency of distribution systems is carried out in accordance with the requirements of Act No 321/2014 on Energy Efficiency, and Slovak Ministry of Economy Decree No 88/2015, laying down the scope of evaluation, method of calculation and the value of energy efficiency of sources and distribution, which replaced Decree No 428/2010.

Under current Slovak legislation, distribution system operators are responsible, in terms of increasing energy efficiency, for:

- calculating the energy efficiency of the distribution system and sending this to the energy efficiency monitoring system,
- introducing smart metering systems in line with Decree No 358/2013,
- installing HV/LV transformers in line with Commission Regulation No 548/2014, implementing Directive 2009/125/EC on ecodesign, with regard to small, medium and large power transformers,
- a plan for the development of the distribution system which, under the Energy Act, must be sent each year to the Slovak Ministry of Economy by distribution system operators with over 100 000 supply points,
- implementation of the Regulatory Office for Network Industries (RONI) methodological guideline No 05/12/2015 of 11 June 2015.

The main measures by which distribution system operators contribute towards increasing energy efficiency:

- replacement and modernisation of existing equipment, in particular the replacement of transformers
- installation and deployment of smart metering in systems
- reconstruction of electrical sub-stations
- optimisation of the operation and number of transformers depending on the projected electricity consumption in a given system
- introduction of system control and diagnostic processes
- reactive power compensation and implementation of automatic compensation control
- replacement of very high voltage, high voltage and low voltage cables
- distribution mapping and upgrading of distribution cabinets
- replacement of lights with LED lighting and installation of motion sensors for lighting
- installation of remote data collection devices
- improving the energy efficiency of the buildings in which these devices are located.

Of the above-mentioned measures, the replacement of transformers has the most significant impact on reducing primary energy consumption. Particularly because of the long payback period, it is clear that the rate of reduction of primary energy consumption through the replacement of transformers will be directly dependent on support for these investments from public funds. The less resources

spent on investment, the greater the need will be to increase investments into operating costs to maintain existing transformers. This will contribute towards extending their lifespan and safety but not to primary energy consumption target under Art. 3 EED. Part of the planned measures are described in more detail in Chapter 4.5.2.

Gas industry

As regards gas, the assessment was carried out by the transmission system operator, by the gas distribution network operators and by the gas storage operators. The necessary investments identified in the gas industry are about EUR 30 million for the entire ten-year period, to which the large investment projects of cross-border interconnections referred to in the Ten-Year Network Development Plan for Gas Transport (TYNDP) need to be added.

The transmission system operator eustream, a.s. performed most of the key measures between 2005 and 2015. This was mainly optimising the operation of the transmission network and optimising the compressor technology.

The major projects contributing to reducing energy demand, the implementation of which planned for the future, include the modernisation and reconstruction of gas transportation technology:

- modernisation of the compressor station control system
- redesign of RENet compressor stations
- further improvements to the accuracy and objectivity of measuring systems
- increased operational safety
- increased flexibility of the transport network associated with new cross-border interconnections that have been opened in the last three years, or are planned.

Gas distribution is provided by approximately 50 distribution network operators. An assessment of the energy intensity of gas distribution has been performed in accordance with Slovak Ministry of Economy Decree No 88/2015.

Among the most important planned measures are:

- introduction of a switch-off, switch-on regime for the heating of natural gas volume flow depending on the size of distribution
- replacement of gas heating boilers
- optimisation of compressor performance, data and network pressure measurement and remote transmission
- insulation of heat conduits and exchangers
- improved energy efficiency of heating in control stations
- control of gas conversion and preheat and gas heating control, control of route closure, gas pipeline tightness and additional insulation of pipelines
- introduction of smart metering systems in gas distribution and supply

The potential for energy savings is very limited, primarily due to how the gas facilities are operated and maintained. The technical losses are approximately 300 GWh. Even employing maximum effort and sufficient resources to ensure energy efficiency measures, this potential can be reduced by a maximum of about 10%, which represents about 3 GWh savings per year.

Gas storage operators have identified their key measures to be optimisation of tank operations, modernisation of the system for monitoring and controlling the productivity of equipment and technological units, and the possibility of using process heat in operations.

Energy efficiency criteria in network tariffs and regulation (EED Article 15)

Description of planned or adopted measures to ensure the removal of those incentives in transmission and distribution tariffs that are detrimental to the overall efficiency of the generation, transmission, distribution and supply of electricity (Art. 15(4) EED).

Under Section 11(1), access to the transmission system and electricity transmission (point d) and access to the distribution system and distribution of electricity (point e) are also subject to price regulation. The method of calculating the maximum price is set out in the RONI Decree.[31]

Description of planned or adopted measures to incentivise operators to improve efficiency in infrastructure design and operation (Article 15(4) EED).

Under Section 9(1)(j) of Act No 250/2012, the Regulatory Office for Network Industries will organise a bidding procedure for a contractor for technology to increase the energy efficiency of systems or to reduce electricity consumption, and a contractor to prepare for the construction of, and construct, new power-generating facilities for which economic incentives are provided.

A description of the measures planned or adopted to ensure that tariffs allow suppliers to improve consumer participation in system efficiency, including demand response (Article 15(4) EED).

For individual tariff rates, the RONI Regulation on Price Regulation in Electricity favours individual electricity end-users directly connected to the transmission system.

In this context, regulatory policy also needs to take sufficient account of the primacy of the energy efficiency principle within the meaning of Directive 2018/2002 of the European Parliament and of the Council amending Directive 2012/27/EU on energy efficiency, for example by introducing incentives that would, to the maximum extent possible, encourage energy suppliers and distributors to achieve energy savings on the part of end consumers.

vii. Regional cooperation in this area, where applicable

The Slovak Republic is one of the founding members of the international CESEC (Central and South Eastern Europe Energy Connectivity) association. The original aims of the group were to coordinate efforts to facilitate the swift completion of cross-border and trans-European projects to diversify gas supply to the region and to develop regional gas markets and implement harmonized EU rules to ensure optimal infrastructure functioning. At the 4th CESEC Ministerial Meeting in Bucharest in September 2017, energy ministers signed a Memorandum of Understanding extending the scope of CESEC cooperation including, among other things, energy efficiency and renewable resources.

viii. Financing measures, including Union support and the use of Union funds, in the area at national level

A list of financial mechanisms, including measures, is provided in Chapter 3.2. in Table 33. Union funds are also an important part of them, with European investment and structural funds anticipated to deliver the most important benefit. Co-financing from the funds will focus primarily on increasing energy efficiency and the use of RES in enterprises and buildings, promoting renewable energy sources, efficient district heating and cooling systems, smart energy systems and energy storage, and promoting sustainable mobility by increasing the share of alternative greener fuels in transport. At

[31] e.g. Decree of the Regulatory Office for Network Industries No 17/2017, providing for price regulation in the electricity sector and certain conditions for the implementation of regulated activities in the electricity sector.

national level, a significant contribution of the Modernisation Fund is envisaged in addition to the mechanisms listed in Table 33, in particular in the area of enterprise support.

3.3. Dimension: energy security[32]

i. Policies and measures related to the elements set out in point 2.3[33]

Diversification of sources and transport routes is necessary to ensure stability in terms of securing primary energy sources. Thanks to economy measures and industrial restructuring in Slovakia, energy consumption has been growing at a slower pace despite relatively strong economic growth. Such developments help increase energy security and independence on energy imports.

ii. Regional cooperation in this area

Energy security is an important part of the EU's position in the debate in regional fora. Slovakia is a member of the Visegrad Group. In addition, energy security, infrastructure development and market integration are being discussed by the CESEC (Central and South Eastern Europe Energy Connectivity) group.

In terms of energy security, the maintenance of the gas transit corridor through Ukraine remains an absolute priority for the Slovak Republic. We consider this crucial for ensuring energy security not only for the Central European region, but also for economic development, political stability and security in Ukraine, which is an EU priority.

It is important for the Slovak Republic to find a solution for gas transit through Ukraine after 2019, when the agreements on gas transit, respectively supply, signed in January 2009 will expire.

Slovak-Hungarian interconnection

The pipeline connection between Slovakia and Hungary connects high-pressure transmission systems between Veľké Zlievce on the Slovak side and the Hungarian municipality of Vecsés in the suburbs of Budapest. The bi-directional pipeline with an annual capacity of 4.38 billion m3 will be 110.7 kilometres long (of which 92.1 kilometres in Hungary and 18.6 in Slovakia). The Slovak-Hungarian gas pipeline will provide new business opportunities while being of strategic importance for the whole region. It will provide Slovakia with access to the planned southern gas corridors or to the LNG terminal in Croatia. Hungary will gain new access to Western European gas networks. The project, part of the planned European North-South Corridor, will contribute towards European energy security and diversification of transport routes.

The interconnection of the transmission systems of the Slovak Republic and Hungary is a priority not only for eustream and its Hungarian partner, but also for national governments and the European Commission.

Slovak-Ukrainian interconnection point at Budince

The Memorandum of Understanding signed on 28 April 2014 between Ukrtransgaz and eustream related to the operation of a gas pipeline to allow reverse gas supply to Ukraine. The implemented

[32] Policies and measures shall reflect the energy efficiency first principle.

[33] Consistency shall be ensured with the preventive action and emergency plans under Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010 (OJ L 280, 28.10.2017, p. 1) as well as the risk preparedness plans under Regulation (EU) 2018/.... [as proposed by COM(2016)0862 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC]

solution consisted in the quick commissioning of the unused Vojany-Uzhgorod (Budince border point; the so-called small reverse) gas pipeline. It was put into commercial operation on 2 September 2014 in the presence of the Prime Ministers of Slovakia and Ukraine as well as the High Representative of the European Commission. This solution is optimal from the point of view of security of gas supply for Slovakia and the EU, and also in terms of technical, legal, temporal and full compatibility with the EU legislative framework.

The pipeline can provide transport capacity of 40 million m3 per day (of which 27 million m3 is provided on a fixed basis), while in annual terms there is the possibility to transport 14.6 billion m3 of natural gas to Ukraine.

From 1 April 2016, the Budince border point became a two-way point, with entry capacity to the eustream transmission network from Ukraine, with a maximum fixed entry transmission capacity of 17 million m3/day. The Ukrainian Ukrtransgaz expects that the launch of bi-directional transit will increase interest in the use of underground gas storage facilities in Ukraine.

Slovak-Polish gas interconnection

The project to interconnect the transmission networks of Slovakia and Poland proceeded according to the mutual agreements between the transmission system operators eustream, a.s. and GAZ-SYSTEM S.A.

The list of projects was approved through Commission Delegated Regulation (EU) No 1391/2013, amending Regulation (EU) No 347/2013 of the European Parliament and of the Council of 14 October 2013 on the Trans-European Energy Infrastructure Guidelines on the list of projects of common interest for the Union (PCI). The Slovak-Polish interconnection project was also included under point 6 “Priority corridor North - South gas pipeline interconnections in Central and South-East Europe (NSI Gas East). The project was also included in the second list of PCIs as defined by Commission Delegated Decision (EU) 2016/89 of 18 November 2015 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council (Commission Decision 2016/89). PCI status was awarded to the project for the third time when it was included in the list of projects of common interest issued by Commission Delegated Regulation No 2018/540 of 23 November 2017 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council.

On 22 November 2013, an Agreement was signed in Bratislava between the Government of the Slovak Republic and the Government of the Republic of Poland on cooperation in the implementation of a gas pipeline project connecting the Polish transmission network and the Slovak transmission network. The working group set up under this intergovernmental agreement (involving the relevant ministries and regulatory authorities, as well as the operators) will hold consultations when necessary to address issues related to the project. On 18 September 2018, the ceremonial launch of construction took place at the Velké Kapušany compressor station with the symbolic signature of the Prime Minister of the Slovak Republic, Minister of Economy, Polish Government Plenipotentiary for Strategic Energy Infrastructure, the Chairman of the Board of GAZ-SYSTEM, the CEO of eustream and a representative of INEA. The pipeline is expected to be put into operation in 2021.

Eastring

In August 2017, Eustream, a.s. concluded a contract to carry out a feasibility study for the planned Eastring gas pipeline linking the countries of Central and South-eastern Europe with the Hungarian consulting and design company Euroil. The feasibility study was intended to define the necessary

technical, economic, financial and environmental aspects of the future pipeline, including its optimal routing, as well extensive market research.

On 20 September 2018, the feasibility study was presented in Bratislava in the presence of EC Vice-President M. Šefčovič. A new pipeline route of 1 208 km between Velke Zlievce (SR/HU border) and Malkoçlar (BG/TR border) was proposed as a result of the study.

The European importance of this project has been confirmed through its multiple inclusion in the PCI list.

Nuclear energy

Under Article 2d of the Euratom Treaty, nuclear fuel diversification falls within the competence of the Community. For the purpose of implementing this Article, the Euratom Supply Agency has been established to ensure that Member States are not unduly dependent on a single third-country supplier and that regular and fair supplies of nuclear fuel are ensured.

In 2018, Slovenské elektrárne, a.s., under the supervision of the Euratom Supply Agency, conducted an international tender for the supply of nuclear fuel, to which all relevant suppliers around the world signed up. Based on the results of the international tender, Slovenské elektrárne, a.s., TVEL and Euratom Supply Agency signed a contract for the supply of nuclear fuel for nuclear power plants in Slovakia in 2019. The fuel will be used in blocks in the Mochovce and Bohunice power plants, including two recently completed blocks in Mochovce. The contract is valid for the 2022-2026 period, with the option extension to 2030, and allows programmes for the introduction of nuclear fuel from alternative suppliers.

iii. Where appropriate, national funding measures in this area, including support from Union resources and use of Union funds

Slovak-Hungarian interconnection

Financial support under the European Energy Programme for Reconstruction (EEPR) was EUR 30 million. The total investment costs amount to about EUR 170 million (of which about EUR 21 million on the Slovak side).

Slovak-Polish interconnection

The operator of the Slovak transmission network, eustream, a.s., and the operator of the Polish transport network, GAZ-SYSTEM S.A., signed a trilateral agreement with the European Commission Innovation and Networks Executive Agency (INEA) in 2015 on EU financial assistance for the project "Elaboration of project documentation and execution of engineering activities for Polish-Slovak gas interconnection". Under this agreement, the project received financial support from the European Union of EUR 4.6 million from the fund entitled Connecting Europe Facility (CEF).

On 18 December 2017, INEA, GAZ-SYSTEM S.A. and eustream, a.s. signed a grant agreement for construction work for the Poland-Slovakia Interconnector.

In 2019, an amendment to the grant agreement for the construction of the interconnector in question entered into effect, based on which the grant agreement enabled both the Polish and transmission system of the SR operators to obtain financial support from the European Union from CEF funds totalling EUR 104.5 million.

Eastring

The EU Innovation and Network Executive Agency and eustream, a.s. signed a grant agreement in May 2017 under which eustream can draw a subsidy for a feasibility study on the planned pan-European Eastring pipeline. Based on this, the European Union supported up to 50% of the eligible costs of the study (up to a maximum of EUR 1 million) from CEF funds. The results of the study were presented on 20 September 2018.

3.4. Dimension: internal energy market[34]

3.4.1. Electricity infrastructure

i. Policies and measures to achieve the targeted level of interconnectivity as set out in Article 4(d)

As mentioned in point 2.4.1 NECP, the targets for the interconnection of European electricity networks at the level of the Member States are also met in the context of the current and planned transmission capacities of the Slovak Republic in the event of a conservative approach to the envisaged load and development of RES by transposing the National Action Plan to 2030. However, the trend in these two parameters influencing the size of the import and export capacity of the Slovak TS depends on a number of factors reflecting the socio-economic development and the national economic orientation of the SR, which can to a certain extent be created by national policy and goals set at national level.

ii. Regional cooperation in this area[35]

To support the preparation and implementation of cross-border investment projects in the field of electrical infrastructure, bilateral cooperation in particular is carried out at the level of the TS operators concerned. Wider regional cooperation to support cross-border transmission projects and other key electricity infrastructure projects is not currently needed. Discussions on future cross-border connections are taking place within the ENTSO-E System Development Committee.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The financing of any SEPS transmission infrastructure projects is secured through the payments of system users for electricity taken. The principles and rules are determined by the Slovak Regulatory Office for Network Industries. National support mechanisms (financial) to support the construction of transmission infrastructure are not in place. Selected key infrastructure projects (e.g. the set of buildings for the "400/110 kV Bystričany Transformer" project) are co-financed by the BIDSF support fund, managed by the European Bank for Reconstruction and Development, to reduce the impact of the early shutdown of the V1 nuclear power plant at Jaslovské Bohunice.

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34 Policies and measures shall reflect the energy efficiency first principle.

35 Other than the PCI Regional Groups established under Regulation (EU) No 347/2013.

3.4.2. Energy transmission infrastructure

i. Policies and measures related to the elements set out in point 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

To support the smooth implementation of PCI projects, Slovak legislation has adopted the relevant legislation (the Energy Act, Construction Act, etc.) as a "one-stop-shop" approach in the sense of Art. 8(3)(c) of Regulation of the European Parliament and of the Council (EU) No 347/2013. This enables the Slovak Ministry of Economy to monitor the PCI project authorisation process in the Slovak Republic and to effectively accelerate the issue of relevant permits.

ii. Regional cooperation in this area[36]

See the previous section, point 3.4.1 ii.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

See the previous section, point 3.4.1 iii.

3.4.3. Market integration

i. Policies and measures related to the elements set out in point 2.4.3

The objectives of the Slovak Republic in integrating the electricity market in all timeframes, increasing the flexibility of the energy system and related projects are based on and in line with the requirements of the aforementioned European legislation that is directly applied in the conditions of the Member States (i.e. the relevant market network regulations). Therefore, these objectives, as defined today, do not result from conceptually set goals at national level, nor from national policies and official government decisions in the area concerned.

Promoting gas market integration is aimed primarily at projects that increase the flexibility of the transport service under optimal operating conditions and maximise the use of existing infrastructure. The result should be end-user access to secure and affordable gas supplies. The implementation of network regulations in the gas sector based on transnational legislation created conditions for integrating gas markets and increasing their liquidity. In the coming period, measures that will contribute towards their further development by reducing the administrative burden on the entities concerned will be put into practice.

ii. Measures to increase the flexibility of the energy system with regard to renewable energy generation such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

See previous sections, point 2.4.3 iv. and v.

Measures in the development of smart metering systems and smart grids (Energy Policy of the Slovak Republic, Chapter 3.5.10):

[36] Other than the PCI Regional Groups established under Regulation (EU) No 347/2013.

- to incentivise an electricity system operator to actively monitor the development of smart grid technologies in order to apply relevant technologies where this is cost-effective from the point of view of system security and securing energy supplies cost-effectively;

- to continuously review the scope of SMS deployment and increase the penetration of SMS in a cost-effective way, to maximise the full-scale benefits of deploying SMS and developing intelligent networks while taking into account technological progress;

- to ensure that SMS technical parameters meet the requirements of European energy efficiency legislation, in order to create the conditions for informing consumers so they can effectively manage their consumption;

- to ensure that SMS technical parameters support solutions for SN construction and development by ensuring interoperability of SMS components and adequate communication capabilities;

- to support local or broad testing of the SN and, in the time horizon to 2035, the development of intelligent cities, municipalities and regions, the development of system management in the direction of the construction of the SN at the level of the Slovak distribution systems and transmission system;

- to create the conditions for building local smart grids with almost equilibrated balance with minimum flows in or out;

- to make use of SMS and SN to support electromobility;

- to increase the number of households equipped with smart appliances and SMS with the possibility of remote supervision of the electricity consumption pattern of households;

- to develop the conditions for storing electricity as close as possible to the point of consumption.

iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

RES and storage measures are contained in the "Clean Energy for All Europeans" package and are the subject of the transposition of Directive of the EP and Council (EU) No 2018/2000 on promotion of renewable energy sources, published in December 2018, and EP and Council Regulation (EU) No 2019/944 on common rules for the internal market in electricity, published in June 2019.

iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

Act No 251/2012, on Energy, defines vulnerable and protected customers. A vulnerable household electricity consumer is a household electricity consumer whose life functions are dependent on electricity or is heavily disabled and uses electricity for heating and has reported and demonstrated this fact himself or through his electricity supplier to the operator of the distribution system to which his/her point of sale is connected, in the manner given in the market rules; a vulnerable household

gas consumer is gas customer in a household that is vulnerable to household gas is a household gas user who is heavily disabled and uses gas for heating and who has reported and demonstrated this fact himself or through his gas supplier to the operator of the distribution network to which his/her point of sale is connected, in the manner given in the market rules.

Act No 250/2012, regulating network industries defines the following categories as vulnerable customers:

1. a household electricity consumer,

2. a household gas consumer,

3. a small enterprise.

v. Description of measures to enable and develop demand response including those addressing tariffs to support dynamic pricing[37]

In the context of the modernisation of power stations, transmission and distribution networks, new possibilities for communication between energy companies and their customers are gradually being introduced through smart energy networks, smart home households, and smart meters.

This modernisation will also be reflected in time in the tariffs that will be an offer tool for energy suppliers. Their principal benefit is energy saving.

An indispensable requirement for the use of dynamic tariffs is that a household must have an intelligent electricity meter installed and a smart home controller that controls smart sockets, as well as heating, the hot water boiler, air conditioning and other smart home appliances.

The open questions are the forms of communication with the supplier operator, or in the form of an information SMS when the supplier sends information about cheaper electricity in a certain time interval, without the personal involvement of the customer, and direct communication of the supplier with an installed smart meter.

3.4.4. Energy Poverty

i. Where applicable, policies and measures to achieve the objectives set out in point 2.4.4

The elimination of energy poverty is a long-term process of adopting legislative adjustments, inter-ministerial measures, and setting up support mechanisms and systemic and operational solutions. This process is ongoing in Slovakia.

As regards legislation, there are several generally binding legal norms in force in Slovakia that create the conditions to address energy poverty:

- Act No 321/2014 on energy efficiency and on amendments to certain Acts, set out measures to promote and improve energy efficiency and contribute towards reducing energy poverty
- Act No 250/2012 on regulation in network industries, implementing the EU Third Energy Package for the Internal Market in Electricity and Gas of 2009
- Act No 443/2010 on subsidies for the development of housing and on social housing, providing subsidies for the elimination of systemic defects in apartment buildings

[37] In accordance with Article 15(8) of Directive 2012/27/EU.

- Act No 150/2013 on the State Housing Development Fund, which provides loans for the insulation of existing apartment buildings
- Act No 417/2013 on assistance in material need and on amendments to certain Acts, as amended, on the basis of which it is possible to provide a housing allowance, which is part of the total assistance provided in material need
- Decree No 18/2017, laying down price regulation in the electricity sector
- Decree No 248/2016, laying down price regulation in thermal energy
- Decree No 223/2016, laying down price regulation in the gas sector

As part of the economic policy measures to support economic growth approved by Government Resolution No 227 of 15 May 2013, a number of tasks were imposed with direct or indirect impact on energy poverty issues, such as:

- Assessment of the subsidy programme to support energy efficiency and to secure funds for the implementation of the measure in relation to the possibilities of the State budget,
- Assessment of the implementation of the subsidy programme to support renewable energy sources and to secure funds for the implementation of the measure in relation to the possibilities of the State budget, preparation of a Memorandum of Understanding on not increasing the tax, levy and fee burden on entrepreneurs; in this context, the role can be understood as adopting laws that will not result in rising energy prices,
- Provision of loans for thermal insulation of existing apartment buildings (State Housing Development Fund),
- Creating employment programmes, including providing investment incentives to increase employment.

Consistent implementation of the set legislative framework will lead to a reduction in the energy intensity of households and thus to a reduction in the number of people suffering from energy poverty. Despite the effective implementation of these measures, there is a high probability that there will still be energy-poor households. Therefore, operational solutions are being prepared in Slovakia that should contribute towards consumer protection:

- A clearly defined procedure for energy companies for when a household finds itself in a situation where it cannot pay for energy. Such households may be offered the option of a repayment calendar, or the possibility of installing a special electricity meter that limits consumption to a certain value (credit meters)
- The use of appropriate mechanisms to motivate energy consumers to manage their consumption
- New housing allowance legislation is in a late development stage. Housing costs include expenditure on rent, energy, water and other housing-related services. The introduction of a housing allowance under new legislation will contribute towards reducing the housing burden on low-income households and will consequently reduce the risk of poverty.

The actual housing allowance should be a directed, direct, financial support by the state for households in apartment buildings, intended in particular to cover, or more exactly, reduce that portion of apartment household costs, for legal forms of housing, that have a direct impact on the retention of accommodation and which an apartment household typically cannot afford to pay for in part or in total because of the value of those costs or the low income of the household members. So this will not be a flat-rate benefit, the accommodation allowance will be paid only for apartment households that meet the statutory requirements.

Some systemic solutions have been elaborated in government departments in relation to energy poverty:

- Development and support of information systems for the collection and integration of data on the population and the subsequent use of this data in the assessment of energy poverty in the population

- Prioritize support for job creation in sectors and regions whose renewal, restructuring and development will create the preconditions for increasing their contribution towards economic growth and hence employment growth

In April 2018, the National Reform Programme of the Slovak Republic 2018 was adopted, describing the structural measures that the Government of the Slovak Republic plans to implement, especially in the next two years. This programme is being implemented and continuously updated with the aim of reducing unemployment, reducing poverty and material need as such, and thus reducing energy poverty.

3.5. Dimension: Research, innovation and competitiveness

i. Policies and measures related to the elements set out in point 2.5

Basic climate change signs and greenhouse gas emission reduction requirements bring with them the need for a basic awareness in the population of energy sectors and of technologies that reduce negative environmental impacts. The greatest prerequisites for awareness raising and support for public information are in the areas of RES support, energy efficiency and energy savings. These are the cross-sectional areas of the energy industry that can help developments across the economy. Basic information on sustainability and its associated energy and RES savings should be part of the tuition as early as at elementary school, bringing into people's lives these ideas on sustainable lifestyles.

In this respect, it would be advisable to develop a National Strategy for raising awareness in the field of energy efficiency, targeting the public from children to specialists and manufacturers. The strategy should support the development of awareness and education for the lay and professional public on energy efficiency, support the implementation of information campaigns on energy efficiency and support the implementation of consultancy and training projects for state and local government employees in the field of energy efficiency, with the aim of monitoring and evaluating energy savings, as well as the design of measures for the efficient use of public funds in the field of energy efficiency. Education in basic funding and the available financial instruments will help to improve energy efficiency and RES development. The national strategy should assume smart metering systems that are the basis for information about consumption, or about generation from customers' own distributed sources.

ii. Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context (SET Plan)

Slovakia is widely involved in international activities in research, development and innovation through bilateral agreements on scientific and technological cooperation with EU countries and outside the EU. Slovakia is a member of the IEA, through university and SAS workplaces, it participates in scientific and technological cooperation within the EU through the 7th EU Framework

Programme (7th EU FP) and EURATOM. Promoting science and research is one of the priorities of the EU 2020 Strategy.

The European Commission has adopted the strategic document "Strategic Energy Technology Plan" (SET Plan), which represents the technological pillar of the EU's energy policy. Through one of the industrial initiatives related to nuclear energy, Slovakia is involved in the Allegro project (cooperation in nuclear energy between Slovakia, Hungary and the Czech Republic and France).

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

These financing measures in this area at national level, including Union support and the use of Union funds were included in earlier chapters.

Table 35 Proposal of costs for individual years of the solution and the whole period of the solution (EUR million)

Year	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
State Budget	17 940	21 038	21 599	18 916	4 600	**84 093**
Of which current expenditure	5 741	13 370	21 599	18 916	4 600	**64 225**
Of which capital expenditure	12 199	7 668	0	0	0	**19 868**
Indicative non-budget resources	5 953	7 253	7 450	6 515	1 580	**28 751**
Total eligible cost	**23 893**	**28 291**	**29 049**	**25 431**	**6 180**	**112 844**

Source: MESRS SR

The indicative budget for the ENERGETIKA SRDP is EUR 84.093 million for the 2024-2028 period. The proposed budget below takes into account projected GDP growth and includes all three SRDP sub-programmes. The data are in millions of euros. If required, the budget will be increased by 35%

Table 36 Indicative budget for the state project R&D Energy between 2024 and 2028

Year	**2024**	**2025**	**2026**	**2027**	**2028**	**Total**
State Budget	16.819	17.155	17.498	17.848	18.205	**87.525**

Source: MESRS SR

Estimated financial provision for the implementation of the outlook plan. The indicative budget for the SRDP Energy between 2024 and 2028 is EUR 87.525 million tonnes. The proposed budget below takes into account the projected GDP development and covers all three sub-programmes of the SRDP programmes

SECTION B: ANALYTICAL BASIS[38]

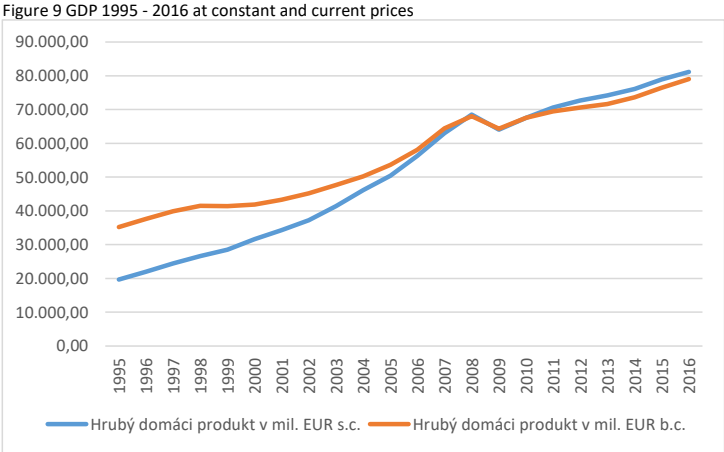
4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES[3940]

4.1. Projected evolution of main exogenous factors influencing energy system and GHG emission developments

i. Macroeconomic forecasts (GDP and population growth)

The Slovak Republic is one of the fastest growing countries in the EU and OECD (measured by GDP). Between 1995 and 2016 real GDP growth in Slovakia increased 2.24 times and the nominal increase was more than 4. The average annual growth rate of real GDP was therefore approximately 3.74% (nominal 6.65%).

Figure 9 GDP 1995 - 2016 at constant and current prices



Key

Hrubý domácí product	GDP
s.c.	constant prices
b.c.	current prices

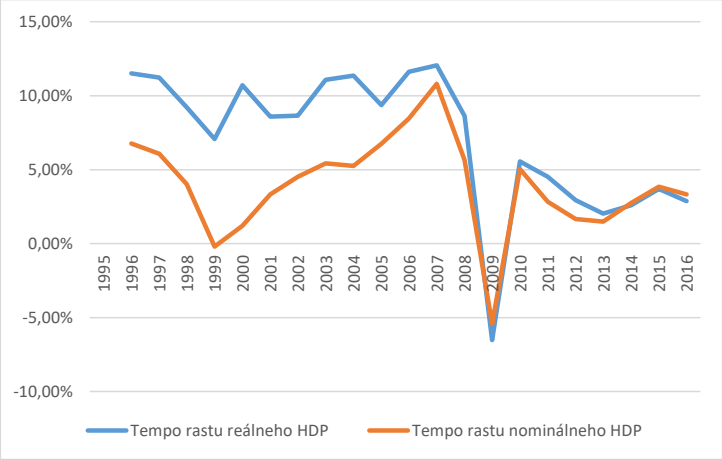
Source: Statistical Office of the Slovak Republic; 2018

38 See Part 2 for a detailed list of parameters and variables to be reported in Section B of the Plan.

39 Current situation shall reflect the date of submission of the national plan (or latest available date). Existing policies and measures encompass implemented and adopted policies and measures. Adopted policies and measures are those for which an official government decision has been made by the date of submission of the national plan and there is a clear commitment to proceed with implementation. Implemented policies and measures are those for which one or more of the following applies at the date of submission of the national plan or progress report: directly applicable European legislation or national legislation is in force, one or more voluntary agreements have been established, financial resources have been allocated, human resources have been mobilized;

40 The selection of exogenous factors may be based on the assumptions made in the EU Reference Scenario 2016 or other subsequent policy scenarios for the same variables. Besides, Member States specific results of the EU Reference Scenario to 2016 as well as results of subsequent policy scenarios may also be a useful source of information when developing national projections with existing policies and measures and impact assessments.

Figure 9 GDP growth rate in individual years



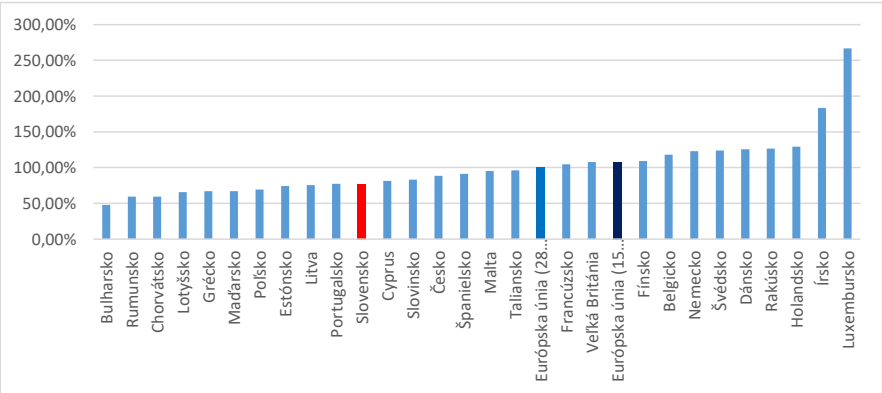
Key

Tempo rastu reálneho HDP	Growth rate for real GDP
Tempo rastu nominálneho HDP	Growth rate for nominal GDP

Source: Statistical Office of the Slovak Republic; 2018

Gross domestic product per capita rose 2.21 fold between 1995 and 2016. Only in 1999 and 2009 was there a decrease in this indicator. In 2016, the per capita GDP was EUR 14 900 at current prices and EUR 22 300 (data available for 2015) at purchasing power parity (Eurostat). Thus, against the of the EU28 country average it reaches 51.38% at current prices and 77.24% at purchasing power parity. A positive trend is the gradual real convergence of Slovakia to the EU average.

Figure 11 GDP at purchasing power parity as% of EU average (for 2016)



Source: Eurostat; 2017

Key:

Bulharsko	Bulgaria
Rumunsko	Romania
Chorvátsko	Croatia
Lotyšsko	Latvia

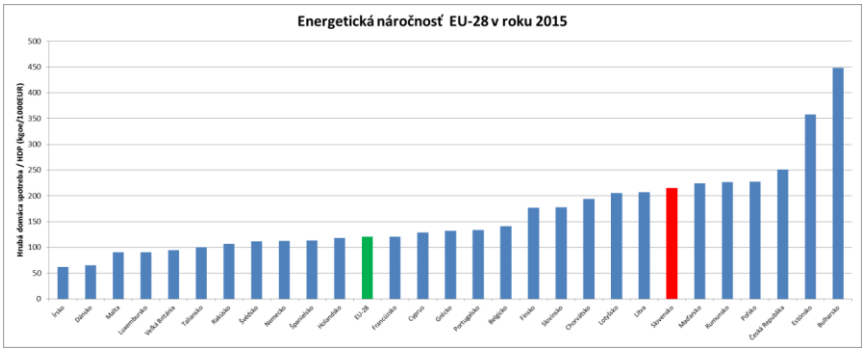
Grécko	Greece
Maďarsko	Hungary
Polsko	Poland
Estónsko	Estonia
Litva	Lithuania
Portugalsko	Portugal
Slovensko	Slovakia
Cyprus	Cyprus
Slovinsko	Slovenia
Česko	Czech Republic
Španelsko	Spain
Malta	Malta
Taliansko	Italy
Evropská únia (28)	EU-28
Francúzsko	France
Veľká (Británie)	United Kingdom
Evropská únia (15)	EU-15
Finsko	Finland
Belgicko	Belgium
Nemecko	Germany
Švédsko	Sweden
Dánsko	Denmark
Rakúsko	Austria
Holandsko	Netherlands
Irsko	Ireland
Luxemburg	Luxembourg

GDP growth was due to a gradual increase in all components of GDP, but was more pronounced due to an increase in final consumption and foreign trade results. Final government consumption grew faster than household consumption after 2010, influenced by the government's drive to revitalise the economy and implement investment projects (especially infrastructure).

Slovakia is an industrial country - industry accounts for a quarter of real GDP: 27.93% in 2016, of which industrial production 24.12% (in nominal terms 24.34% and 20.45% respectively). In nominal terms, the gross added value of industry represents more than a quarter of the total value added of Slovakia's economy (26.93% in 2016). Sectoral GDP also indicates that the second most important sector is services[41] . This also applies to the creation of added value. From the point of view of GDP growth and added value growth, there is now a decline in the share of industry and an increase in the share of services.

Figure 12 Energy intensity of the Slovak economy compared to the EU-28

[41]) Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation activities.



Source: Eurostat; 2017

Key:

Energetická náročnosť EU-28 v roku 2015	Energy intensity EU-28, 2015
Hrubá domáca spotreba / HDP (kgoe/1000EUR):	Gross Domestic Consumption (kgoe/1000 EUR)
Irsko	Ireland
Dánsko	Denmark
Malta	Malta
Luxemburg	Luxembourg
Veľká (Británie)	United Kingdom
Taliansko	Italy
Rakúsko	Austria
Španelsko	Spain
Nemecko	Germany
Švédsko	Sweden
Holandsko	Netherlands
EU-28	EU-28
Francúzsko	France
Cyprus	Cyprus
Grécko	Greece
Portugalsko	Portugal
Belgicko	Belgium
Finsko	Finland
Slovinsko	Slovenia
Chorvátsko	Croatia
Lotyšsko	Latvia
Litva	Lithuania
Slovensko	Slovakia
Maďarsko	Hungary
Rumunsko	Romania
Polsko	Poland
Česko	Czech Republic
Estónsko	Estonia
Bulharsko	Bulgaria

As at 1 January 2017, the Slovak Republic had 5 435 343 inhabitants[42] , of whom 2 783 659 were women. The average age of the population is 40.36 years; the mean life expectancy at birth for men is 73.71 years and for women 80.41 years (all data for 2016). The trend in the age structure over the long run is not favourable, and Slovakia is ageing - there is an increasing number of people past their productive age.

[42]) Source: http://www.infostat.sk/vdc/sk/index.php?option=com_content&view=category&layout=blog&id=13&Itemid=58

Demographic developments in the case of the Slovak Republic will, according to the SAS, mean a population increase over the next few years. By 2025 to 2030, an increase from the current 5.43 million (2016) to 5.48-5.55 million is anticipated. A population decline over several decades will follow. By 2060, the population is anticipated to fall to just above the 5 million mark. In the area of mitigation of the consequences of the demographic forecast, it is necessary for the Slovak Republic to conceptually and emphatically address the issue of support for young families and the birth rate, as well as creating the conditions for young people not to be motivated to emigrate.

The ageing of the population and its increasing economic burden will pose a challenge for the pension system. In the second half of the 20th century, when the on-going pension systems performed their missions without difficulty, about 1 person at a post-productive age accounted for about 10 people of working age. At present, this ratio is 1:4.8 and in 2060 it will be only 1:1.6. As early as 2030, there will be only 3 people of working age per person past productive age. On the other hand, however, one may observe that a large group of people of a post-productive age continues to work. These facts will necessarily have to be reflected in the whole set-up of the social system, in particular in pensions and health care.

ii. Sectoral changes expected to impact the energy system and GHG emissions

At present it can be said that the source of economic growth and development of the Slovak Republic, which is cost competitiveness based on low wages and other production costs, is gradually being exhausted and in essence will not form the basis of future economic policy.

Dynamic technological changes, new forms of entrepreneurship, an emphasis on sustainable growth, environmental solutions, innovation, science and research, as well as regional development, are the current challenges that the Slovak Republic will have to be able to face and develop in order to maintain and strengthen its competitiveness and secure its development in all areas affecting the living standards of the population.

Changes related, for example, to the introduction of the Industry 4.0 concept, represent pan-societal changes across a range of areas beginning with industry, security, technical standardisation, science and research, the labour market, the education system and ending with the legal framework.

The new nature of competitiveness for the Slovak economy is therefore determined by five key areas, namely: **development of human capital, technological changes, ecological and energy efficiency of the economy, development of the business environment and regional development along with the area of agriculture.**

An effective economic policy will require a stable political environment with clear responsibility for its implementation, the establishment of support mechanisms and measures for innovative and environmentally sound solutions based on the Value for Money principle and a significant reduction in the administrative burden for the entities concerned.

iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

Table 20: EU ETS carbon prices considered

	2015	2020	2025	2030	2035	2040
EU ETS carbon prices (EUR/t of CO_2)	*7.5*	*15.0*	*22.5*	*33.5*	*74.0*	*117.0*

Source: 2015-2030 EU Reference Scenario 2016, 2035-2040 Slovak Republic low-carbon study

Table 38: Recommended international fossil fuel prices (values set in 2017 with updated deflators, exchange rates, US inflation and price index)

	Constant 2016 price in EUR/boe			Constant 2016 price in EUR/GJ			Constant 2016 price in EUR/toe		
	EUR/boe	EUR/boe	EUR/boe	EUR/GJ	EUR/GJ	EUR/GJ	EUR/toe	EUR/toe	EUR/toe
	Oil	Gas (GCV)	Coal	Oil	Gas (GCV)	Coal	Oil	Gas (GCV)	Coal
2015	51.77	41.68	12.32	8.90	7.17	2.12	372.72	300.09	88.74
2016	60.36	43.72	12.95	10.38	7.52	2.23	434.60	314.75	93.25
2017	65.90	45.67	13.57	11.33	7.85	2.33	474.49	328.81	97.69
2018	71.66	47.66	14.18	12.32	8.20	2.44	515.95	343.15	102.07
2019	76.25	49.75	14.78	13.11	8.56	2.54	548.97	358.22	106.39
2020	80.58	51.84	15.37	13.86	8.91	2.64	580.18	373.23	110.65
2021	84.57	53.84	16.26	14.54	9.26	2.80	608.93	387.63	117.04
2022	85.95	54.01	16.75	14.78	9.29	2.88	618.85	388.89	120.58
2023	88.61	54.88	17.21	15.24	9.44	2.96	638.03	395.16	123.90
2024	90.45	55.57	17.78	15.56	9.56	3.06	651.26	400.12	128.01
2025	91.47	56.08	18.36	15.73	9.64	3.16	658.59	403.80	132.21
2026	93.75	56.97	19.07	16.12	9.80	3.28	675.04	410.19	137.28
2027	95.82	57.80	19.77	16.48	9.94	3.40	689.91	416.17	142.33
2028	97.23	58.72	20.50	16.72	10.10	3.52	700.02	422.81	147.57
2029	99.43	59.65	21.23	17.10	10.26	3.65	715.89	429.46	152.86
2030	100.77	60.99	22.04	17.33	10.49	3.79	725.51	439.13	158.67
2031	102.04	61.84	22.24	17.55	10.63	3.82	734.67	445.26	160.09
2032	102.66	62.81	22.52	17.65	10.80	3.87	739.17	452.25	162.14
2033	103.38	63.68	22.82	17.78	10.95	3.92	744.36	458.52	164.29
2034	104.20	64.47	23.09	17.92	11.09	3.97	750.22	464.20	166.27
2035	105.12	65.14	23.34	18.08	11.20	4.01	756.83	469.00	168.02
2036	106.15	65.77	23.49	18.25	11.31	4.04	764.30	473.52	169.14
2037	107.33	66.28	23.68	18.46	11.40	4.07	772.80	477.20	170.53
2038	108.62	66.77	23.91	18.68	11.48	4.11	782.03	480.78	172.12
2039	109.94	67.33	24.15	18.91	11.58	4.15	791.60	484.75	173.87
2040	111.30	67.34	24.32	19.14	11.58	4.18	801.36	484.81	175.13

Source: EC

one barrel of oil is equivalent to 5 815 GJ

1 barrel of oil equivalent corresponds to 0.138889 t of oil equivalent

iv. Technology cost developments

The evolution of technology prices is estimated in terms of the reference data provided by the European Commission in May 2017.

4.2 Dimension: decarbonisation

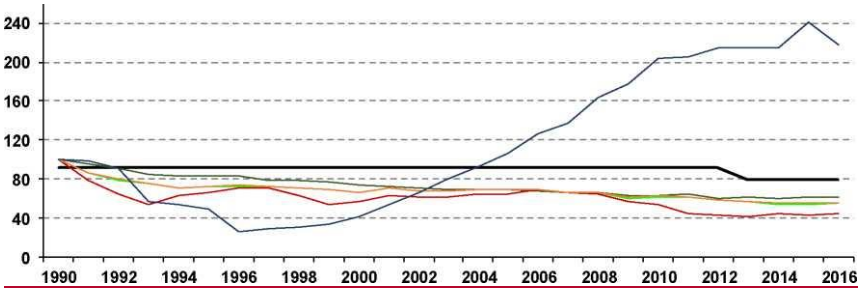
4.2.1. GHG emissions and removals

i. Trends in current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors

Total GHG emissions were 41 037.12 Gg CO_2 (without LULUCF) in 2016. This represents a reduction of 44.5% compared to the 1990 reference year. Compared to 2015, emissions increased by 0.3%. Total GHG emissions in the Slovak Republic increased in 2016 compared to the previous year, caused by an increase in the industrial processes sector, in the agricultural sector, as well as in response to economic growth in Slovakia. This trend was slightly corrected by a year-on-year increase in capture in the LULUCF sector. The greatest changes in the national emission inventory (submitted in 2018) are due to a recalculation of the emissions in the transport, agriculture, LULUCF (and KP LULUCF) and in the waste sector for individual years or whole time series.

Emissions without LULUCF increased slightly in 2016 compared to 2015. In the 1991-2016 period, total greenhouse gas emissions in the Slovak Republic did not exceed the 1990 level. Figure 13 shows - in an assessment relative to 1990 (100%) – trends in gases in relation to the Kyoto Protocol target without LULUCF. The consumption of HFCs, PFCs and SF_6 gases in industry result in emissions collectively called F-gases. Despite the decline, PFCs from aluminium production show a rising trend.

Figure 13 Trends in greenhouse gas emissions (relative as %) relative to the KP target



Source: SHMI

Key:

Kyoto Protocol target
CO2
CH4
N2O
GHG
F-Gases

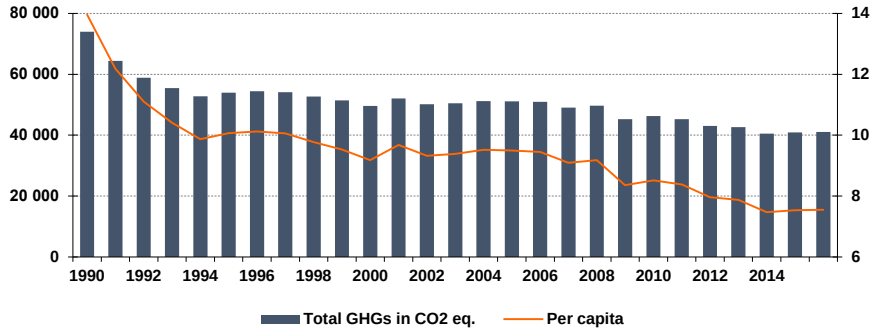
The Slovak Republic reduced its emissions by approximately 17% between 2008 and 2016. According to emission projections (2017), Slovakia is on track to exceed its 2020 target compared to 2005 by 17%. The reduction in emissions to 2005 was thanks to several impacts, starting with industrial and technological restructuring linked to the transition from fossil fuels from coal and oil to natural gas

(the main driver has been legislation on air pollution since 1991). After 2005, emissions reduction has been mainly achieved by restructuring the economy in a less-energy-intensive direction and also temporary changes in production intensity (in relation to global and EU markets). The transport sector (especially road transport) is showing ever-increasing emissions.

In Slovakia, the transition to a less carbon-intensive economy through the implementation of new technologies will take longer, especially in combination with the high dynamics of energy-intensive industry. There is continued pressure to develop effective strategies and policies to achieve a further reduction in emissions. One example is a combination of regulatory and economic instruments (tolls for trucks based on their environmental characteristics in combination with fuel and emission standards for new vehicles).

The trends observed in energy consumption can be partly explained by the economic crisis. Besides this, structural changes in the manufacturing industry towards less-energy-intensive industries such as engineering and the automotive industry can explain why after 2009 energy consumption did not grow at a similar pace as in the previous year, leading to a significant reduction in primary consumption. The trend recorded mainly in primary energy consumption is therefore mainly due to other factors, although some improvements in energy efficiency were made, primarily in the 2005-2008 period.

Figure 14: Total GHG emissions (in Gg of CO_2 equiv.) per capita



Source: SHMI

As of 31 December 2016, the population of the Slovak Republic was 5 435 343. The average population density is 110.8 inhabitants per km². The population is concentrated in towns and lowlands and basins, while the hills and mountains are thinly populated. The average unemployment rate in the Slovak Republic was 5.8% in the first half of 2019 (based on data from the SO SR). The City of Bratislava is the largest city in the Slovak Republic with a population of 425 932 (as at 31 December 2016).

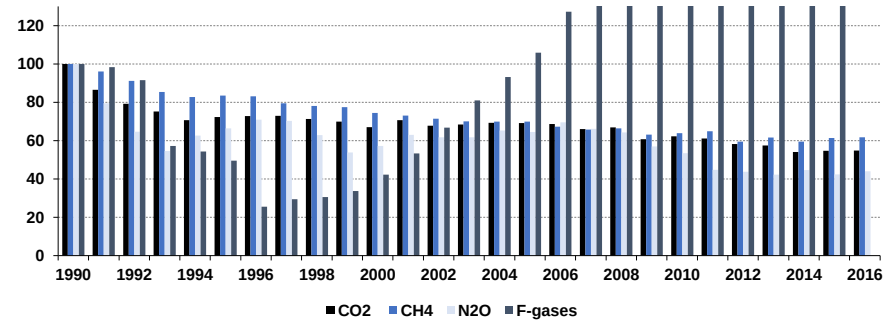
Total anthropogenic carbon dioxide (CO_2) emissions without LULUCF fell by 45.2% in 2016 compared to the baseline year (1990). In 2016, total CO_2 emissions were 33,996.77 Gg without LULUCF. Compared to 2015, this is a 1% increase. The reason for the increase in CO_2 emissions in 2016 was mainly the increase in CO_2 emissions in industrial processes and waste as a result of increased economic output. In 2016, CO_2 emissions, including LULUCF, were comparable to the previous year and had dropped by 48.3% compared to the baseline year.

Total anthropogenic emissions of methane without LULUCF decreased by 39.1% compared to the baseline year (1990) and currently their value is 4 383.52 Gg CO_2 equiv. In absolute terms, CH_4 emissions were 175.34 Gg without LULUCF. Methane emissions from LULUCF represent 0.76 Gg, caused in particular by forest fires. This trend has been relatively stable over the last five years, with a slight decline in 2014 due to an increase in emissions from the energy sector. CH_4 emissions reached a new maximum in 2002 (since 2000) and have been declining since then thanks to the implementation of new legislation on waste.

Total anthropogenic emissions of N_2O without LULUCF decreased compared to the baseline year (1990) by 56.0% and currently their value is 1 971.15 Gg CO_2 equiv. Emissions of N_2O in absolute value reached 6.61 Gg without LULUCF. N_2O emissions from LULUCF were 0.12 Gg. Emissions rose by 1% compared with 2015 due to increased activity in the industrial processes sector. The trend is related mainly to the production of nitric acid. The overall decrease in these emissions is related to the decline in agricultural production due to the decreasing number of animals and use of fertilisers.

Total anthropogenic emissions of F-gases were 673.37 Gg HFC, 6.49 Gg PFC and 5.82 Gg SF_6 in CO_2 equiv. Since 1995, HFC emissions have increased as a result of increased consumption and substitution of PFCs and CFCs. Since that year, it has declined for the first time in the last inventory year (2016). This decrease applied to all F-gases and is a consequence of the implementation of F-Gas EU legislation. The PFC emission trend is decreasing and SF_6 emissions increased slightly due to an increase in industrial consumption.

Figure 15: Trends in GHG emissions between 1990 and 2016 by gas relative to 1990 levels (100%)



Source: SHMI

The energy sector, including transport, was the main contributor to greenhouse gas emissions with a 67% share in 2016. The share of the transport sector (16%) in total emissions decreased by 1% compared to the previous year (2015). In addition to combustion in stationary pollution sources, pollution from small sources and residential heating systems as well as fugitive emissions of methane from transport, and the processing and distribution of oil and natural gas, significantly contribute towards total greenhouse gas emissions.

Next in order of importance is the Industrial Processes and Product Use (IPPU) sector, accounting for 23% of total greenhouse gas emissions in 2016. This sector mainly produces technological emissions

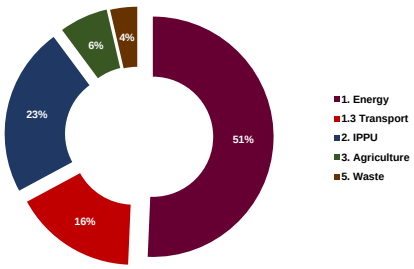
from raw materials processing, chemicals production and steel and iron production. Reducing emissions from technological processes is very costly, partly due to the existence of specific technical limits, so emissions from the reference year have not changed as significantly as in other categories. The fastest growing emissions in the IPPU sector are emissions of HFCs and SF_6 due to industrial demand and the use of these substances in the construction, insulation, electrical and automotive industries.

In 2016, the share of the agricultural sector in total greenhouse gas emissions was 6%. The trend in emissions has remained relatively stable since 1999. The most significant reduction in emissions from agriculture was achieved in the early 1990s as a result of a reduction in livestock breeding combined with reduced use of fertilizers.

In 2016, the waste sector contributed 4% of total greenhouse gas emissions. Utilizing a more accurate methodology for assessing methane emissions from solid waste in landfills and the inclusion of the older layer in the calculation resulted in a continuous increase in emissions of over 100% compared to the 1990 base year. A similar trend is anticipated in the coming years, although this increase should not be as significant as before. The amounts of emissions from landfills depend largely on the applied methodology for landfill assessment, as well as on the extent to which landfill site operators use energy recovery from landfill gases.

The share of individual sectors in total greenhouse gas emissions has not changed significantly compared to the 1990 base year. However, an increase in transport emissions and a decrease in the share of stationary sources of pollution in the energy sector are noticeable. Combustion of fossil fuels, which account for approximately 75% of total CO_2 emissions in the Slovak Republic (excluding LULUCF), is the most important anthropogenic source (see Figure 16).

Figure 16: Share of individual sectors in total GHG emissions



Source: SHMI

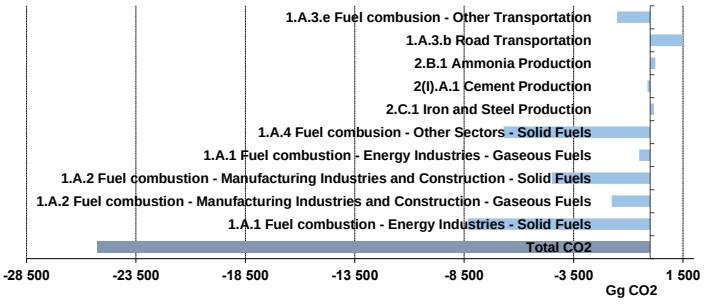
Key categories are defined as emission sources or capture that have a significant impact on inventory as a whole, in terms of absolute emission levels, the trend or both.

CO_2 emissions from category 1.A.3.b - Road transport - diesel are the largest key category, responsible for 24% of total CO_2 emissions without LULUCF in 2016. Between 1990 and 2016,

emissions in road transport increased by 1.5 Mt CO_2, an increase of 30% due to the increase in fossil fuel consumption in this key category (Figure 17). Since 1990, the largest increase in CO_2 emissions has been identified as related to road transport. Figure 17 below shows that solid fuels from category 1.A.1 Fuel combustion is the second largest key category without LULUCF (17%), although between 1990 and 2016 emissions in this category dropped by 35% The main factors explaining this decrease in emissions are improvements in energy efficiency and the transition from coal to gas.

CO_2 emissions in category 2.C.1 - Iron and steel production is the largest key source without LULUCF in the industrial process and product use (IPPU) sector and accounts for 16% of total CO_2 emissions in 2016. CO_2 emissions from category 1.A.2 in the energy sector are the third largest source in the Slovak Republic, accounting for 17% of total greenhouse gas emissions in 2016. Between 1990 and 2016, emissions from this category dropped by 50%

Figure 17: Absolute change in CO_2 emissions for key categories between 1990 and 2016



Source: SHMI

Methane emissions account for 9% of total GHG emissions in 2016 and have fallen by 39% since 1990 to 175.34 Gg CH_4. The two largest key sources (5.A Solid Waste Disposal with 22% and 3.A Enteric fermentation with 22% of total CH_4 emissions in 2016) account for 50% of CH_4 emissions in 2016. Figure 18 shows that the main causes of the decline in CH_4 emissions, the reduction in the enteric fermentation category due mainly to the declining number of animals and reduced emissions in the categories of fugitive emissions from coal mining. Figure 18 also shows a significant drop in categories 3.A and 3.B and an increase in Category 5.A - Solid waste landfills (due to the change in IPCC methodology used for landfills, considering the time layer since 1960.

Figure 18 Absolute change in CH_4 emissions for key categories between 1990 and 2016

5.D Wastewater Treatment and Discharge
3.D.1 Direct N2O Emissions From Managed Soils
2.B.2 Nitric Acid Production
3.B Manure Management
3.D.2 Indirect N2O Emissions From Managed Soils
5.B Biological Treatment of Solid Waste
2.G Other Product Manufacture and Use

Total N2O

Gg CO2 equiv.

Source: SHMI

N_2O emissions account for 4.9% of total GHG emissions and have fallen by 56% to 6.61 Gg N_2O in 2016 (Figure 19). This trend was caused by a decline in the two largest key sources: 3.D.1 - Direct N_2O emissions from agricultural soils with a 52% share and 3.D.2 - Indirect N_2O emissions from agricultural land with a 16% share of total N_2O emissions in 2016. The main reason for the large reductions in N_2O emissions was the application of reduction measures in nitric acid production processes and a slowdown in agricultural activities (Figure 19). N_2O emissions increased in category 5.B - Biological waste treatment. This increase was due to increased operations and output.

Figure 19 Absolute change in N2O emissions for key categories between 1990 and 2016

5.D Wastewater
3.D.1 Direct N2O Emissions From Managed Soils
2.B.2 Nitric Acid Production
3.B Manure Management
3.D.2 Indirect N2O Emissions From Managed Soils
5.B Biological Treatment of Solid Waste
2.G Other Product Manufacture and Use
Total N2O

Gg CO2 equiv.

Source: SHMI

Emissions of fluorinated gases account for 1.7% of total greenhouse gas emissions. In 2016, emissions were 679.86 Gg CO_2 equiv., which was 146% higher than 1990 levels. The largest key source is category 2.F.1 - Cooling and Air Conditioning and accounts for 93% of fluorinated gas emissions in 2016. HFC emissions from the use of halogenated hydrocarbons have grown significantly between 1990 and 2016. The main cause was the elimination of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in cooling, air conditioning, foam production and as aerosol propellants). On the other hand, PFC emissions have decreased significantly. The decline began in 1996 and was strongest in 1999 and 2000.

The area of forest land reached 2.019 million ha, of which stands covered 1.946 million ha. Since 1990, the area of forest land has increased by 42 700 ha and stands by 24 600 ha. The timber stock on forest land increased from 348.5 to 480.3 million m3 raw wood without bark. The area of forest stands on non-forest land increased from 273 000 to 288 000 ha and timber stocks from 38 to 46 million m3. The total forested area of the Slovak Republic, calculated from stands, is 45.1%. At present, due to the current age composition, wood reserves are at the highest they have been for at least the last century. The same statement applies to non-forest land.

Dead wood is an important component of forest ecosystems to promote biodiversity, and should be kept in forests to an extent appropriate to its functional focus. There is currently 87.0 million m3 of

dead wood on forest land and 6.8 million m3 in stands on non-forest land. Converted per hectare, these figures are significantly higher than the European average. This situation is mainly due to the deteriorated condition of forests after a wide range of calamities and insufficient stand hygiene. The decomposition of dead wood is also a source of greenhouse gas emissions.

The state of forest stands has an impact on the balance of greenhouse gas emissions and capture. The significant scope of calamities and the rapid aging of the remaining stands have reduced the capture possibilities after 1990 from approx. 8 500 Gg to the current 4 500 to 5 500 Gg per year. The most important carbon storage in forest stands is living biomass, the amount of which depends on the maintenance of or increase in the production capacity of the forests. With regard to the impact of climate change, it is also necessary to improve the age structure of the forests by gradually decreasing the area of older stands with decreasing production capacity.

In 2015, the Ministry of the Environment of the Slovak Republic drew up and submitted to the Government of the Slovak Republic the Waste Management Programme 2016-2020 (WMP SR), which is prepared in accordance with the requirements laid down in the legislation of the Slovak Republic and the European Union (EU), especially in Act No 223/2001 on waste and on amendments to certain other Acts, as amended, and Directive of the European Parliament and of the Council No 2008/98/EC of 19 November 2008 on waste and repealing certain Directives. The WMP SR defines the objectives for individual waste streams resulting from EU legislation as well as the legislation of the Slovak Republic. On 5 December 2018, the MEnv SR submitted to the Government of the SR information on the ongoing fulfilment of WMP SR objectives and measures for the 2016-2020 period, in which it evaluated the fulfilment of the set strategic goals and targets in the recycling of individual waste streams, stating that in 2017 the objectives relating to the landfilling of all waste, the landfilling of municipal waste and the landfilling of biodegradable municipal waste were not met, and will not be met in the coming years. These waste streams are an important source of energy that is being landfilled today. It is therefore desirable to set up State policies and regulatory mechanisms to limit landfilling so that part of the waste will be recycled and part for energy recovery in accordance with waste management priorities.

ii. Projections of emissions sectoral developments with existing national and EU policies and measures at least until 2040 (including for 2030) – scenario with measures - WEM

ii-a) Description of the scenario with measures (WEM) - GHG emission projections were prepared according to the WEM scenario, which is **equivalent to the EU 2016 reference scenario (EU 2016 RS)** for 2015-2040 (with a view to 2050). 2016 was designated as the reference year for the modelling of greenhouse gas emissions for all scenarios for which verified data sets from the national greenhouse gas emission inventory were available. **The scenario is based on the logic of the EU 2016 RS and includes policies and measures adopted and implemented at EU and national level by the end of 2016, including measures needed to achieve the renewable energy and energy efficiency targets in 2020**. Policies included in the EU 2016 RS also include amendments to three directives agreed at the beginning of 2015 (ILUC - Renewable Energy Directive, FQD - Fuel Quality Directive and the EU ETS Market Stability Reserve Decision), but do not take into account the results of the negotiations relating to the “Clean Energy for All Europeans” legislative package, or the measures taken at national level after 2016 (including the decision to phase out support for electricity generation from domestic coal by 2023). The scope of the EU 2016 RS includes currently known policies and any additional measures necessary to achieve binding energy and climate targets to 2020. After 2020,

other policy measures are excluded from the EU 2016 RS, except for the EU ETS. The pricing trajectory for EU ETS quotas draws on the EU 2016 RS quota price outlook.

Despite the absence of new policies after 2020, the reference scenario is not a frozen efficiency outlook. Energy efficiency improvements in all sectors will continue in the future, albeit at a slower pace than would be the case with the enactment of new policies. EU energy efficiency directives already in place and regulations for the ecological design of household appliances, motors and other electrical equipment will have an increasing impact. Most importantly, market forces are the drivers for efficiency gains. In industry, progress in energy efficiency is part of the pursuit of productivity growth, which is part of sustained growth in added value. In the building and transport sectors, energy efficiency improvements are achieved through the commercialisation of equipment and vehicles with increasing efficiency, as industry considers operating cost reductions to be a marketing factor that can increase sales. Therefore, the decoupling of energy consumption from economic growth will continue in the future as a result of technological progress (included in the values corresponding to the parameters of the model chosen to reflect market forces, set below the values that would be adequate for technological progress related to the policy).

ii-b) Description of models used

The Compact Primes Model (CPM) is a mathematical system implemented in the General Algebraic Modelling System (GAMS) environment. This is a model for high-level mathematical programming. The energy model is designed to support the development of an energy strategy, including an assessment of policy instruments, energy demand and energy supply planning, and the assessment of climate-change-mitigation policies. The main metric of the model is the energy sector at a detailed level:

- energy demand by sector and fuel,
- modelling of energy efficiency options,
- technology capacities,
- a mix of electricity generation, cogeneration and other energy supply technologies,
- fuel prices and system costs,
- investments by sector and energy-related CO2 emissions.

The energy model for Slovakia captures details about energy supply and demand that are critical when designing a low-carbon path. The country-level energy model called Compact-PRIMES for Slovakia (CPS) provides a technology-rich upward analysis for key energy sector elements and was designed to assess low-carbon options for the energy sector. The CPS is a partial country equilibrium model for the energy sector that balances energy supply and demand. As it is a hybrid model with details of technology and engineering along with microeconomic and macroeconomic interactions and dynamics, CPS sectoral decisions consider technologies and costs. On the supply side, it captures the supply of electricity and heat as well as that of biomass. Energy demand modelling assesses the energy needs of industry (and 10 subsectors), households, transport and the services sector. The CPS model proposal is suitable for quantifying long-term energy planning and policies to reduce energy-related greenhouse gas emissions.

ENVISAGE Slovakia - a macroeconomic model for Slovakia that complements the energy model while using the detailed results of the CPS energy model and assessing influences and impacts on the whole economy. It has all the features of a standard general computable equilibrium model with

additional specialisation in energy, electricity generation and emissions, so is useful for assessing climate policies. The macroeconomic model called the ENVISAGE Slovakia Applied General Equilibrium Model (Slovak-CGE) is tailored to reflect the specific characteristics of the Slovak economy. One important feature is that the demand for energy commodities in households and enterprises is sensitive to the price of the commodity, which makes it possible to analyse the various options for electricity generation. Compared to the CPS energy model, the aim of the Slovak-CGE model is to simulate the wider economic effects of moving towards a low-carbon economy. A detailed description of the models is given in the Final Report on the Low-Carbon Study of Slovakia Project, which is available on the website of the Ministry of the Environment of the Slovak Republic.

ii-c) Emissions projections in the energy sector (excluding transport) – the energy sector produces greenhouse gas emissions from the combustion and conversion of fossil fuels. It was necessary to focus on methodological improvements due to the complexity of greenhouse gas emission projections in energy and industry. For this reason, the new model for the energy and large industry sector has replaced the originally used MESSAGE model. This approach is in line with the prepared study of low-carbon growth for Slovakia entitled "Implementation of the EU Framework for Climate and Energy Policies by 2030" and also with the methodology for the preparation of the National Low-Carbon Strategy of the Slovak Republic.

The modelling of emission projections was performed based on the results of the new CPS model. The CPS model is still not fully calibrated for the CRF categorisation of greenhouse gas emissions to meet reporting obligations, so the model results had to be adjusted according to the GHG inventory. The modelling outputs were determined based on the potential of the greenhouse gas reduction measures. Projections of greenhouse gas emissions in the energy sector are modelled in the WEM scenario, which includes the following policies and measures at EU level:

- Ecodesign Framework Directive (Directive 2005/32/EC);
- Directive on the energy labelling of products (Directive 2010/30/EU);
- The Energy Performance of Buildings Directive, the Energy Efficiency Directive (Directive 2012/27/EU);
- Completion of the internal energy market, including provisions of the 3rd package (Directive 2009/73/EC, Directive 2009/72/EC), Regulation (EC) 715/2009, Regulation (EC) 714/2009;
- Directive on the promotion of the use of energy from renewable sources - Directive on renewable energy sources - including the ILUC amendment (Directive 2009/28/EC as amended by Directive (EU) 2015/1513);
- EU ETS Directive 2003/87/EC amended by Directive 2004/101/EC (international credits), Directive 2008/101/EC (air transport), Directive 2009/29/EC (revision of the climate and energy package to 2020), Regulation (EU) 176/2014, Decision (EU) 2015/1814 (market stabilisation reserve) and implementing decisions, in particular 2010/384/EU, 2010/634/EU, 2011/389/EU, 2013/448/EU, 2011/278/EU, 2011/638/EU (benchmarking and carbon leakage list);
- Regulation of the European Parliament and of the Council on car emission standards, Regulation (EC) 443/2009, as amended by EU Regulation 333/2014, EURO 5 and 6 Regulations;
- Regulation 715/2007 of the European Parliament and of the Council on the type-approval of motor vehicles;

- Regulation 510/2011 setting emission standards for new light commercial vehicles as amended by Regulation 253/2014.

In addition to the above-mentioned EU-level policies and the national policies needed to implement the 2020 commitments, the WEM scenario includes the following national specific measures:

- Optimisation of district heating systems - transition from fossil fuels to biomass and natural gas;
- Gradual decommissioning of solid fuel heating plants from 2025;
- Subsidies to promote alternative-fuel vehicles - EUR 5 000 for BEV and EUR 3 000 for PHEV to 2020.

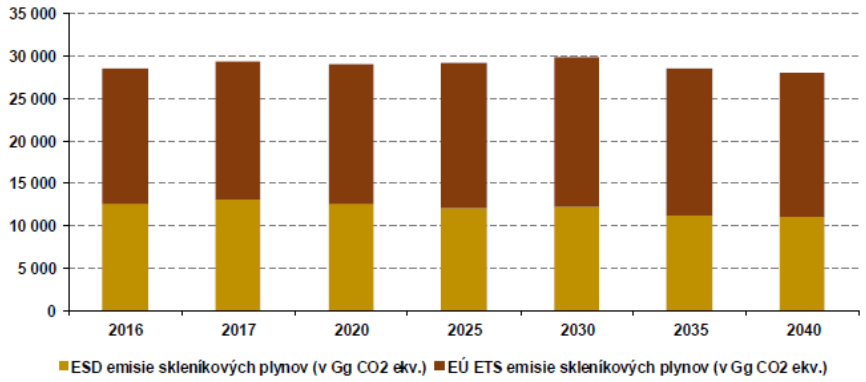
The development of greenhouse gas emission projections in the energy sector expressed as CO_2 equivalent is shown in Table 39 and Figure 20.

Table 39 Projections of greenhouse gas emissions from the energy sector under the WEM scenario

Total greenhouse gas emissions in the energy sector (in Gg CO_2 equiv.)							
Year	2016	2017	2020	2025	2030	2035	2040
Total emissions without LULUCF	**42 154**	**43 316**	**42 355**	**42 046**	**41 399**	**39 526**	**38 521**
Total emissions with LULUCF	**35 427**	**36 727**	**36 210**	**37 006**	**36 965**	**35 370**	**34 290**
1. Energy	28 483	29 442	29 000	29 268	29 890	28 507	27 997
1.A.1. Energy sector	7 540	7 487	7 113	6 828	7 058	6 252	6 465
1.A.2. Manufacturing sector	6 710	7 136	6 817	6 642	6 791	6 546	6 158
1.A.3. Transport	*7 536*	*7 660*	*7 772*	*8 525*	*8 797*	*8 778*	*8 583*
1.A.4. Other sectors	4 942	5 357	5 387	5 369	5 360	5 239	5 051
1.A.5. Other	66	66	66	64	67	64	63
1.B. Fugitive emissions from fuels	1 689	1 737	1 845	1 840	1 816	1 628	1 678

Source: MEnv SR

Figure 20 Projections of greenhouse gas emissions from the energy sector broken down into EU ETS and ESD by WEM scenario



Key:

ESD emisie skleníkových plynov (v Gg CO2 ekv.)	ESD greenhouse gas emissions (in Gg CO2 equiv.)
EÚ ETS emisie skleníkových plynov (v Gg CO2 ekv.)	EU ETS greenhouse gas emissions (in Gg CO2 equiv.)

Source: SHMI, 2016 and 2017 are real

ii-d) Projections of fugitive CH_4 and CO_2 emissions from coal mining and mining activities 2017-2040

The assumptions of the WEM scenario are based on old dates for the decline of coal mining in the SR, prepared based on the following data:

- Data on coal mining in 2017 from individual underground mines were obtained from official sources – from the company HBP, a.s., and the Statistical Office of the Slovak Republic;
- Data on expected coal mining were obtained from sources of the Ministry of Economy of the Slovak Republic - "Energy Policy of the Slovak Republic for 2014".

The WEM scenario envisages a decline in mining in 2030, but the actual date for the end of coal mining support in the Slovak Republic has been shifted to 2023. Thus, the total emissions calculated based on the WEM scenario will be lower than shown in Table 39 for 2025-2040.

ii-d) Projections of fugitive greenhouse gas emissions from the extraction, transport and distribution of natural gas and oil in the Slovak Republic for the 2017-2040 period

The input data were obtained from the following sources:

- Statistical Office of the Slovak Republic (for 2017);
- CPS Model.

For the calculation of fugitive emissions (and projections) of methane from the extraction, transport and distribution of natural gas and oil in the Slovak Republic, emission factors from the following sources were used:

- IPCC 2006 Guidelines for National Greenhouse Gas Inventories - Chapter 4: Fugitive Emissions (IPCC 2006 GL);
- IPCC Guidelines on best practices and unpredictability management in national greenhouse gas inventories (IPCC 2000 GPG).

Projections of fugitive methane emissions from the extraction, transport and distribution of natural gas and oil in the Slovak Republic were estimated based on the following assumptions:

- Oil production in the Slovak Republic is anticipated to cease after 2020;
- Natural gas production will only decline slowly;
- Consumption/distribution of natural gas and oil in Slovakia will remain unchanged;
- Redirecting the supply of natural gas through the Nord Stream pipeline will reduce the amount of gas transported to other countries by pipelines in Slovakia, resulting in a reduction in fugitive CH_4 emissions.

Table 40 Activity data projections for the preparation of projections for 2017-2040 under the WEM scenario

Activity	Units	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Oil production	t	8 000	10 254	0	0	0	0
Oil processing	t	5 587 000	5 749 078	5 664 604	5621 146	5 458 604	5 282 346
Long distance transmission of	9 582 252	9 727 295	9 454	9 181	8909 180	8 636	9 582

oil			590	885		475	252
Natural gas production	10^6 m^3	140 000	110 605	114 095	100 413	85 417	75 361
Long distance transmission of natural gas	10^6 m^3	64 200 000	69 069 617	67 882 186	67 036 012	66 102 132	68 622 506
Natural gas distribution	10^6 m^3	5 248 000	4 871 149	5 556 479	5 466 016	5 267 342	5 355 552

* real values; Source: ME SR

The projections for greenhouse gas emissions in category 1.B.2 - Fugitive emissions from the extraction, transport and distribution of oil and natural gas, are shown in Table 41.

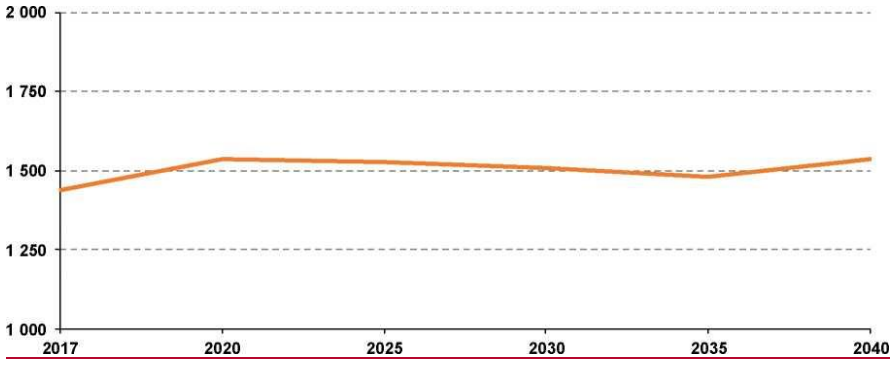
In addition to projections of fugitive CH_4 emissions from the extraction, transport and distribution of natural gas and oil in the Slovak Republic, projections of CO_2, NMVOC and N_2O emissions were also calculated, but their importance for the overall projections of greenhouse gas emissions in this category is negligible. The calculations used the same methodology and conditions as for methane.

Table 41 Fugitive emissions projections from oil and gas for 2017-2040 under WEM scenario

Year	**CH_4**	**CO_2**	**NMVOC**	**N2O**
		tonnes		
2017*	57 543	1 317	8 747	0.0116
2020	61 355	1 330	9 043	0.0126
2025	61 088	946	8 868	0.0037
2030	60 262	892	8 771	0.0032
2035	59 239	827	8 771	0.0028
2040	61 310	807	8 292	0.0024

* real values; Source: ME SR

Figure 21 Projections of fugitive greenhouse gas emissions from oil and natural gas



Key:

CO2 ekv. (t) scenár WEM	CO2 equiv. (t) WEM scenario

The values for 2017 are real; Source: SHMI

ii-f) Transport emissions projections

Transport emissions projections are based on the CPS energy model and its scenarios. The prediction of energy consumption in the transport sector was determined as the percentage shares of fuels in total consumption in the energy sector. Road transport emissions projections were calculated based on the following data and activities:

- Aggregation of data transmitted from the COPERT 5 road transport model for the 2000-2017 period, as the current COPERT version uses a total of 382 road vehicle categories. The aggregation took into account the mode of transport, the fuel used and the EURO emission standard.
- Update of data on new registrations and scrapped vehicles from the EVO IS.
- Allocation of new vehicle registrations to vehicle categories based on their energy consumption forecasts.
- Distribution of scrapped vehicles into categories of older vehicles so that their number gradually decreases to zero through the ongoing renewal of the Slovak Republic vehicle fleet.
- The estimated number of vehicles for each year (2018-2040) based on new vehicle registrations and the number of vehicles scrapped.
- Aggregation of annual mileage according to COPERT calculations for the 2000-2017 period into defined vehicle categories and the assumption of mileage development for 2018–2040.
- Transfer of 'implied' emission factors from COPERT and their appropriate breakdown for vehicle categorisation in the design model.
- Calculation of future transport performance for the 2018-2040 period for the given vehicle categories.
- Calculation of emission projections by multiplying performance and emission factors.

Greenhouse gas emission projections in category 1.A.3.b - Road transport, in the scenario with measures were prepared according to EU 2016 RS (WEM). CO_2, CH_4 and N_2O emissions projections under the WEM scenario will fall to 2040. This trend is explained by the measures outlined and applied in the scenario (Table 40). Emissions from biomass are not calculated separately in emission projections, but increasing the share of biofuels in petrol and diesel affects CO_2 emission factors and, consequently, CO_2 projections.

The Slovak Republic and other countries are implementing various policies and measures to reduce the environmental burden of the transport sector. All policies and measures described in the previous chapters for the transport sector are in line with the prepared Low-Carbon Study of the Slovak Republic. Of these measures, only those for which emission reduction effects could be calculated in the WEM scenario were evaluated and used.

Table 42 Overview of policies and measures in the transport sector

PAM	Name	What was changed
PAM 01	Biofuels promotion	CO_2 emission factors due to increased biomass share
PAM 02	Regulation on CO_2 emission standards for new passenger cars	CO_2 emission factors for new passenger cars (95 g / km average)
PAM 03	Regulation on CO_2 emission standards for light commercial vehicles	CO_2 emission factors for new light commercial vehicles (147 g / km average)
PAM 04	ICAO agreement to reduce CO_2 emissions from aircraft	No changes compared to 2016
PAM	Changing traffic distribution	Reduction of road freight transport for journeys over 300 km, of

05		which 30% should be transferred to rail.
PAM 06	Economic and tax instruments	Changing the projected energy consumption, ecological fuels will predominate and should be subject to lower tax.
PAM 07	Road tolls	Demand for road freight transport varies based on price.

Table 43 Anticipated fuel consumption in transport under the WEM scenario to 2040

Fuel	unit	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Petrol	TJ	22 034.4	21 747.6	22 536.0	26 506.8	29 343.6	28 670.4
Diesel	TJ	74 694.6	56 314.8	59 245.2	62 582.4	65 685.6	64 396.8
LPG	TJ	1 944.1	3 506.4	3 297.6	3 283.2	2 988.0	2 894.4
Natural gas	TJ	223.2	752.4	792.0	1 076.4	1 339.2	1 587.6
Biogas	TJ	0.0	3.6	25.2	43.2	54.0	79.2
Conventional biofuels	TJ	6 481.6	7 437.6	7 675.2	8 337.6	8 928.0	8 794.8
Advanced biofuels	TJ	0.0	0.0	0.0	0.0	3.6	14.4
Kerosene	TJ	45.0	2 268.0	2 768.4	3 409.2	3 852.0	3 956.4
Hydrogen	TJ	0.0	0.0	0.0	7.2	151.2	464.4
Electricity	GWh	0.2	707.0	860.0	991.0	1 160.0	1 241.0

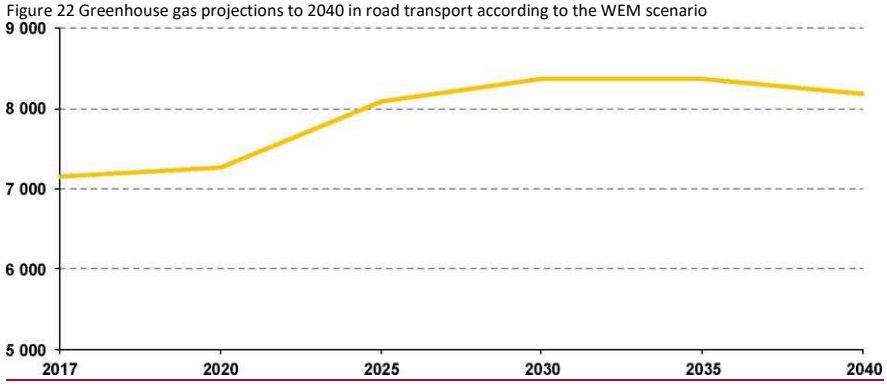
* real values; Source: SHMI

Table 44 Road transport emissions projections for 2017*-2040 under the WEM scenario

Year	CO_2	CH_4	N_2O
	kt	tonnes	
2017*	7 151.18	318.34	262.02
2020	7 261.43	182.04	237.96
2025	8 093.57	150.04	272.55
2030	8 373.25	130.25	284.17
2035	8 365.98	112.91	285.87
2040	8 173.54	99.32	280.80

* real values; Source: SHMI

Figure 22 Greenhouse gas projections to 2040 in road transport according to the WEM scenario

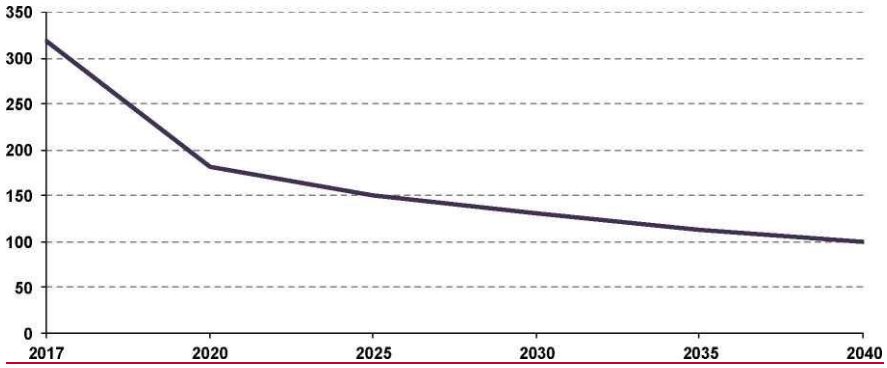


real values for 2017; Source: SHMI

Key:

CO2 ekv. (Gg) scenár WEM	CO2 equiv. (Gg) WEM scenario

Figure 23 Projections of methane emissions to 2040 in road transport according to the WEM scenario



real values for 2017; Source: SHMI

Key:

CH4 (t) scenár WEM	CH4 (t) WEM scenario

In addition to projections of greenhouse gas emissions in road transport, projections of emissions from non-road transport in the Slovak Republic were also calculated, but their share in total emissions from transport is minimal. Non-road emission projections were calculated in a simpler way using AutoRegressive Integrated Moving Average (ARIMA) modelling. Only a scenario with WEM measures was prepared for these projections.

Table 45 Projections of emissions in non-road transport for 2017-2040 under the WEM scenario

Emission	Sector	unit	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2	Air transport	kt	3.42	4.55	4.88	4.87	4.87	4.87
	Rail		84.35	94.45	97.87	100.99	104.44	108.09
	Transport by ship		4.69	3.01	2.64	2.25	2.06	1.87
CH_4	Air transport	tonnes	0.07	0.07	0.07	0.07	0.07	0.07
	Rail		5.07	5.27	5.47	5.67	5.87	6.07
	Transport by ship		0.45	0.30	0.30	0.30	0.30	0.30
N_2O	Air transport		0.09	0.09	0.09	0.09	0.09	0.09
	Rail		34.96	36.57	37.87	39.07	40.47	41.88
	Transport by ship		0.13	0.06	0.06	0.06	0.06	0.06

*real values; Source: SHMI

ii-g) Industrial process and product use (IPPU) emission projections

The projections of greenhouse gas emissions from the IPPU sector (large industrial enterprises) integrated into the EU ETS are modelled together with the energy sector. The scenario with measures is based on the EU 2016 RS (WEM) scenario. The projections of greenhouse gas emissions from the IPPU sector that are not included in the EU ETS have been modelled using the trend in value added in the industry segment and productivity trends. The CO_2 emissions projection in category 2.A.2 - Lime production also included CO_2 projections in the category "Food, beverages and tobacco", mainly due to the use of limestone in the sugar industry.

The N_2O and CH_4 emission projections in categories 2.B.1 - Production of ammonia and hydrogen, and 2.B.2 - Nitric acid production, took the trend in natural gas consumption in the chemical industry category into account, while the nitric acid projections took the productivity trend in the chemical industry, fertilizer production and petrochemistry into account.

The CH_4 emissions projections in category 2.C.2 - Ferroalloys and CO_2 emissions from category 2.C.5 - Lead production took the development of productivity in the basic processing of non-ferrous metals into account. CO_2 emissions projections in category 2.D - Lubricants, paraffins and solvents took the productivity trend in the non-energy use of liquid fuels for projections in the lubricants category into account. The trend in CO_2 emissions from paraffin production has been constant over the last 10 years and has also been used in projections. The productivity trend in the textile production category was taken into account in the projections of CO_2 emission from solvents.

F-gas emission projections - F-gas emission projections were calculated based on the limits set by Regulation (EU) 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) III (Table 46).

Table 46 Restrictions on the marketing of F-gases referred to in Article 11(1)

Products and equipment		Date of prohibition
Where appropriate, the GWP of mixtures containing fluorinated greenhouse gases will be calculated in accordance with Annex IV within the meaning of Article 2(6).		
1. Disposable fluorinated greenhouse gas containers used for servicing, maintaining or filling refrigeration and air-conditioning equipment, heat pumps, fire protection systems or switchboards or for use as solvents		4 July 2007
2. Non-sealed direct evaporation systems containing HFC and PFC as refrigerants		4 July 2007
3. Fire-fighting equipment	containing PFC	4 July 2007
	containing HFC-23	1 January 2016
4. Windows for apartment buildings containing fluorinated greenhouse gases		4 July 2007
5. Other windows containing fluorinated greenhouse gases		4 July 2008
6. Footwear containing fluorinated greenhouse gases		4 July 2006
7. Tyres containing fluorinated greenhouse gases		4 July 2007
8. Single-component foams containing fluorinated greenhouse gases with a GWP of 150 or more, unless their use is necessary to meet national safety standards		4 July 2008
9. Aerosol dispensers sold and intended for sale to the general public for amusement and decorative purposes within the meaning of point 40 of Annex XVII to Regulation (EC) 1907/2006 and acoustic warning devices containing HFC with a GWP of 150 or more		4 July 2009
10. Household refrigerating and freezing equipment containing HFCs with a GWP of 150 or more		1 January 2015
11. Commercial refrigeration and refrigeration systems (hermetically sealed equipment)	containing HFCs with a GWP of 2 500 or more	1 January 2020
	containing HFCs with a GWP of 150 or more	1 January 2022
12. Stationary refrigeration equipment containing HFCs with a GWP of 2 500 or more or that is dependent on such HFCs for operation, other than equipment intended for the cooling of products to temperatures below -50°C		1 January 2020
13. Clustered centralized refrigeration systems for commercial use with a nominal capacity of 40 kW or more that contain or that depend on fluorinated greenhouse gases with a GWP of 150 or more for operation, except for the primary refrigeration circuit of cascade systems in which fluorinated greenhouse gases can be used with a GWP of less than 1 500		1 January 2022

The projections under the WEM scenario directly followed the above-mentioned EP and Council Regulation 517/2014, Annex III.

The SF_6 emission projections in category 2.G under the WEM scenario followed the extrapolation of the base year (taking into account time series consistency) with the assumption of a gradual exclusion of obsolete installations. N_2O emission projections in category 2.G were taken into account mainly due to the use of N_2O as propellant in aerosol containers.

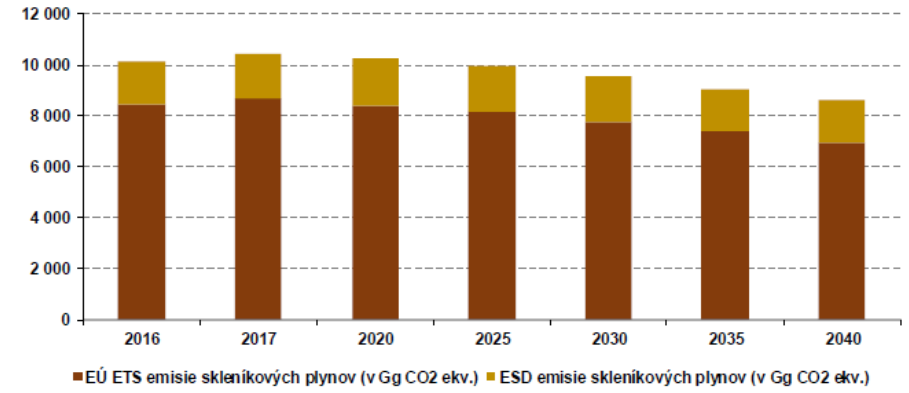
The development of greenhouse gas emission projections in terms of CO_2 equivalent under the scenario with measures (WEM) from the industrial processes sector, including F-gases, is presented in Table 47 and Figure 24.

Table 47 Projections of greenhouse gas emissions from the industrial processes sector including F-gases under the WEM scenario

Total greenhouse gas emissions in the industrial processes sector (in Gg CO_2 equiv.)							
Year	**2016**	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
Total emissions without LULUCF	**42 154**	**43 316**	**42 355**	**42 046**	**41 399**	**39 526**	**38 521**
Total emissions with LULUCF	**35 427**	**36 727**	**36 210**	**37 006**	**36 965**	**35 370**	**34 290**
2. Industrial processes *	9 378	9 647	9 414	9 063	8 098	7 663	7 194
2.A Production of cement and lime	2 183	2 277	2 023	1 972	1 817	1 748	1 670
2.B Chemical industry	1 471	1 535	1 509	1 481	1 443	1 374	1 271
2.C Manufacture of metals	4 851	4 906	4 912	4 710	4 494	4 322	4 043
2.D Non-energy use of fuels	124	113	114	112	111	105	99
2.F Use of F-gases	673	739	785	719	168	49	49
2.G Manufacture of products and their use	75	77	72	69	67	64	61

*Small differences in the total may be due to rounding values

Figure 24 Projections of greenhouse gas emissions from the industrial processes sector including F-gases broken down into EU ETS and ESD according to the WEM scenario



Key:

EU ETS greenhouse gas emissions (in Gg CO2 equiv.)	ESD greenhouse gas emissions (in Gg CO2 equiv.)

Real values for 2016 and 2017, Source: SHMI

ii-h) Projections of emissions from agriculture

The potential for reducing greenhouse gas emissions in agriculture is related to manure management, in particular to the handling and storage of manure and slurry and to changing animal feed plans. These measures have been incorporated into the Rural Development Programme 2014-2020. The current legislation is in line with Good Agricultural Practice and the Common Agricultural Policy (CAP) at national level. The CAP is divided into two pillars:

- direct subsidies per hectare of farmed land and livestock payments,

- the Rural Development Programme (RDP), which supports rural development projects, in particular the promotion of resource efficiency, and support for the transition to low-carbon agriculture that is climate-resilient and self-sufficient in food.

The Slovak Republic uses RDP funds to modernize storage capacities for manure and slurry, to improve animal living conditions and modernize animal housing facilities. Some measures also have an impact on reducing not only greenhouse gas emissions but also ammonia from the rearing of cattle and pigs. It is essential to minimize nitrogen losses in the form of emissions through effective control of the nitrogen cycle in agriculture. Low-emission techniques for manure and slurry storage are used on large and medium-sized farms characterized by intensive and semi-intensive farming. Small farmers are not currently included in the RDP mechanism due to their limited livestock numbers.

The time series of the input data for the preparation of the emission projections were of different length (longest for the 1970-2016 period, shortest for the 2003-2016 period) and were obtained from various sources as follows:

- Statistical Office of the Slovak Republic (SO SR) - statistical database, number of livestock. The most important parameter is the number of livestock used to estimate CH_4 emissions from enteric fermentation and CH_4 and N_2O emissions from fertilizer management. The results were used in the WEM scenario.
- National Agricultural and Food Centre - Research Institute of Agriculture and Food Economics (NAFC - RIAFE). Status and forecast reports analysed the new available legislation and national strategies for the future development of animal rearing. This showed that no legislation or strategies have been taken into account.
- National Agricultural and Food Centre - Animal Production Research Institute (NAFC - APRI) - information on animal feeding. Information on animal feeding is important for estimating CH_4 emissions from enteric fermentation used in the WEM scenario.
- Central Control and Testing Institute in Agriculture (CCTIA) - statistical database of inorganic nitrogen fertilizers, lime utilisation and urea consumption. The consumption of nitrogen fertilizers, lime and urea was taken into account in the WEM scenario.

Projections of livestock numbers to 2040 assume a further significant decline in inventory, which is not in accordance with the Concept of Agricultural Development of the Slovak Republic. More details on activities and projected parameters are given in Table 48.

Table 48 Parameters for preparing emission projections in the WEM scenario to 2040

Source/years	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
1 000 pcs						
Cattle	439.83	420.26	409.24	406.00	405.04	404.76
Sheep	365.34	349.25	344.12	354.48	372.33	394.32
Pigs	614.384	524.34	475.22	445.51	427.54	416.66
Goats	37.067	37.25	37.60	37.71	37.75	37.76
Horses	6.145	6.06	5.40	4.75	4.11	3.46
Poultry	13 353.837	12 112.59	11 921.31	11 733.78	11 549.95	11 369.73
tonnes						
Inorganic N-fertilizers	122 541.15	124 614.67	134 062.06	143 509.45	152 956.83	162 404.22
Urea	44 288.01	50 203.48	57 178.88	61 676.1	64 575.71	66 445.10
Application of lime	20 052.68	20 931.13	22 543.14	24 362.83	26 420.44	28 751.38

*real values; Source: SHMI

The forecasts for livestock numbers for the 2018-2040 period were made by the RIAFE in Bratislava using the exponential balancing model in SAS 9.3 software. These are adaptive time series forecasting methods, which means that the model parameter values change over time. The forecast is based on balancing weights that give different observations different meanings. The most recent observations have the highest weighting, and this decreases exponentially towards the past. Weighting values are optimized by the statistical software itself. The calculations were based on analyses of the historical time series of individual forecasted indicators, assuming the current state of affairs for other external factors. These may affect the forecasted parameters in different intensities and directions, but their future development is often unpredictable. For example, CAP measures have significant impacts on both animal and plant production. Negotiations on its direction beyond 2020 are still ongoing, and the final version of the reform for the 2021-2028 period will only be known in three years' time. In addition to the CAP, a number of other factors – whether economic (supply, demand, prices of agricultural inputs and outputs, etc.), political or accidental (natural disasters, climate change, etc.) – can influence the indicators in question.

Although current projections may differ from actual values achieved in the future due to a number of external factors, the forecasts reflect current trends and expectations for the future relatively well. In particular, the continuing decline in livestock production in Slovakia could lead to a gradual decline in the numbers of most livestock (cattle, pigs, poultry, horses and, to some extent, sheep). This may also result in an increase in the consumption of industrial fertilizers, which will have to replace the lack of organic fertilizers in the soil.

The emission projections were then calculated using the methodology given in IPCC 2006 GL. The Slovak Republic does not use a specific model to estimate trends in emissions. The calculation of methane is based on the estimation of specific parameters from animal food rations. Methane emissions from enteric fermentation and manure management are estimated consistently in the common model due to the common parameters used, in particular the gross intake of energy (Charts 25 and 26).

The basis for estimating nitrogen emissions is the analysis of the nitrogen cycle in agriculture. The emission balance took into account national specific parameters as well as an analysis of the nitrogen cycle, which is the basis for the accurate estimation of emissions and projections in agriculture in Slovakia.

Emissions projections from the agricultural land category were prepared using the WEM scenario (identical to the WAM scenario). The projections have a rising trend due to the projected increase in urea and limestone consumption. The application of limestone to soil is important – it is used to increase soil fertility. Urea consumption is also anticipated to increase – this is used as an inorganic nitrogen fertilizer, and the increase in inorganic nitrogen fertilizer consumption is related to the lack of organic nitrogen in the soil because of the decline in livestock numbers (Figure 27) and its compensation with inorganic fertilizers.

Table 49 Agricultural emissions projections to 2040 under the WEM scenario

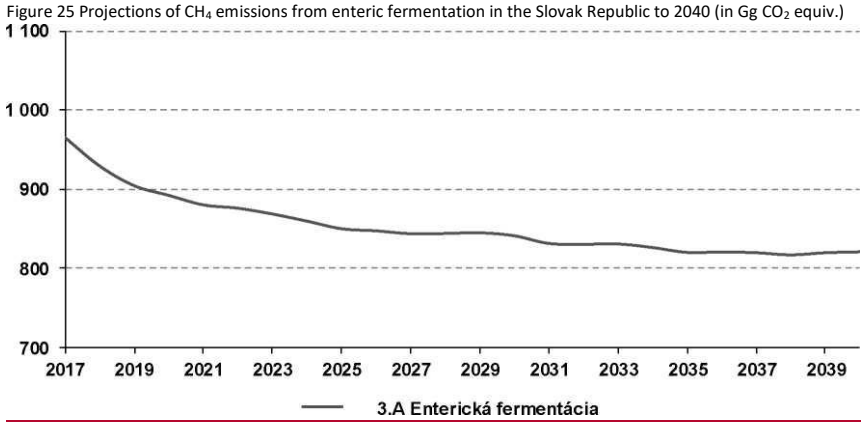
Year	Enteric fermentation	Fertilizer management	Agricultural land *	Agriculture Total
	Gg CO2 equiv.			
2017*	966	285	1 296	2 547
2020	893	267	1 217	2 376
2025	851	255	1 285	2 391
2030	842	251	1 327	2 420
2035	821	248	1 429	2 497
2040	821	247	1 501	2 570

*real values; Source: SHMI

The Slovak Republic and other countries apply various measures to reduce the environmental impact of agriculture. Table 50 describes the methods suitable for reducing emissions arising from these measures.

The Slovak Republic has prepared only one scenario for emission projections in agriculture, and this is the WEM scenario, which is identical to the WAM scenario. This includes measures in manure and slurry management, and policies for reducing emissions from agricultural land, which are included in the CAP and Act of the Government of the Slovak Republic No 488/2010. The following Figures show the results of modelling emissions projections from the agriculture sector.

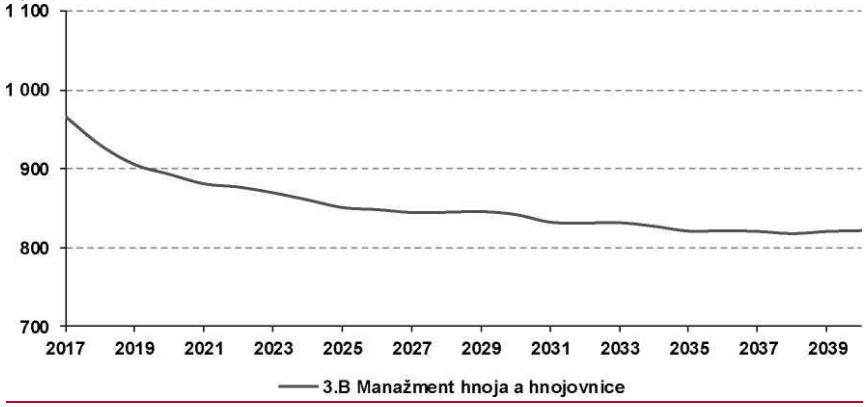
Figure 25 Projections of CH_4 emissions from enteric fermentation in the Slovak Republic to 2040 (in Gg CO_2 equiv.)



Key:

3.A Enterická fermentácia	3.A Enteric fermentation

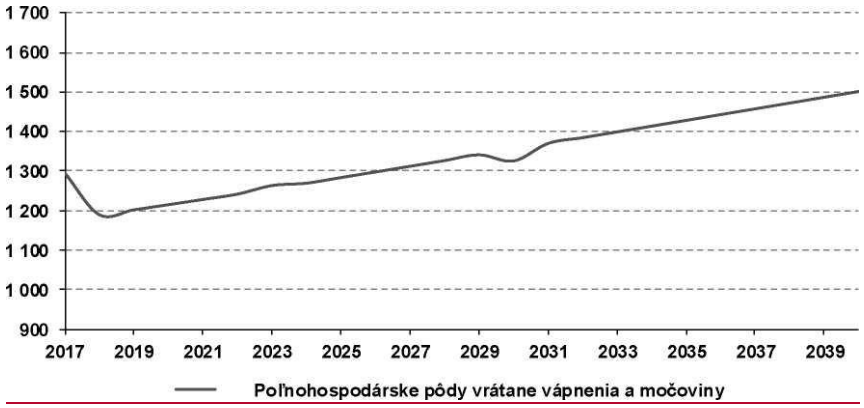
Figure 26 Projections of CH_4 and N_2O emissions from fertilizer management in the Slovak Republic to 2040 (in Gg CO_2 equiv.)



Key:

3.B Manažment hnoja a hnojovnice	3.B Manure and slurry management

Figure 27 Projections of N_2O emissions from agricultural land in the Slovak Republic to 2040 (in Gg CO_2 equiv.)



Key:

Poľnohospodárske pôdy vrátane vápnenia a močoviny	Agricultural land including liming and urea

Table 50 Potential of possible mitigation measures for greenhouse gas emissions

Mitigation measure	Greenhouse gas	Reduction potential	Description
Storage of liquids in tanks insulated from the environment	N_2O	100%	Sludges are stored in isolation, in tanks with oxygen access
Manure storage	N_2O	100%	Manure is stored without or with minimum addition of water to facilitate handling and is stored under a roof with a concrete floor
Interventions in animal feeding	CH_4	NA	Reduction in numbers of dairy cows, intensive feeding with active substances, in particular cereals

ii-i) Projections for emissions and capture in the Land use, land-use change and forestry sector (LULUCF)

The LULUCF emission and capture projections were based on the sector strategy document of the Rural Development Programme of the Slovak Republic for 2007-2013 and 2014-2020, taking into account the approved National Forestry Programme (NFP) of the Slovak Republic and the NFP Action Plans for 2009-2013 and 2015-2020. Projections for greenhouse gas emissions and capture assess all scenarios (without measures, with existing measures and with additional measures) and projection parameters (for managed forests). The baseline projection year was 2016.

The projections for greenhouse gas emissions and capture in the LULUCF sector were prepared based on the following input data:

- afforestation of unforested areas,

- grassing over of arable land,
- enhancement of protection from forest fires.

Without measures (WOM) – this scenario corresponds to the state of forestry and land use without the measures implemented before 2016, as well as the measures planned for the future. Forest development is estimated according to effective forest management plans without the introduction of specific measures.

With Existing Measures (WEM) – this scenario includes the impacts of the measures under consideration and implemented before 2016. From 2004 to 2006, only minimal specific mitigation measures were implemented in the LULUCF sector. During this period, afforestation of agricultural land was supported by the Rural Development Programme (RDP) and the Sectoral Operational Programme for Agriculture and Rural Development. The conversion of agricultural land into forest land (afforestation) has been approved under these programmes for 15 projects covering a total of 100 hectares. Between 2007 and 2016, afforestation of unforested areas and grassing over of arable land continued under the Regional Development Programmes for 2007-2013 and 2014-2020. The following mitigation measures were considered in the WEM scenario:

- afforestation of 800 ha of less productive land with rapidly growing tree species and the first afforestation of 600 ha of agricultural land by 2016;
- grassing over of 50 000 ha of arable land by 2016;
- the impact of Regulation No 2152/2003/EC on forest monitoring and environmental interactions in society; this legislation also focuses on forest fires and estimates the reduction in forest fire risk to 90% as compared to the 2000-2003 period.

Figure 28 Projections of CO_2 emissions and capture (in Gg) in category 4.A.1 - Forest land remaining forest land, WOM and WEM scenarios

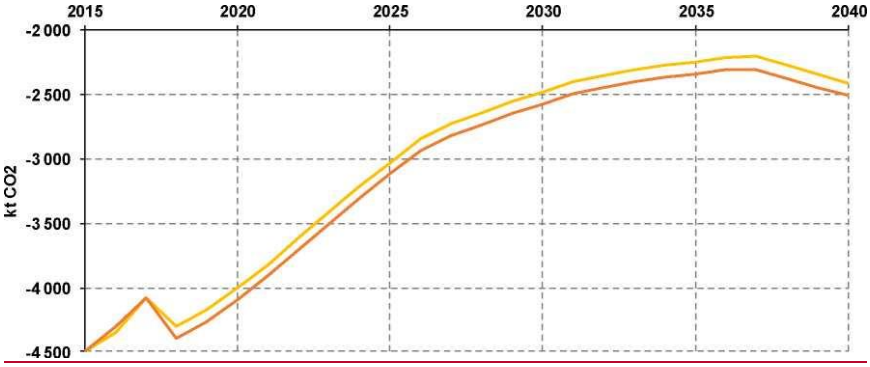


Figure 29 Projections of CO_2 emissions and capture (in Gg) in category 4.A.2 - Land converted to forest (afforestation), WOM and WEM scenarios

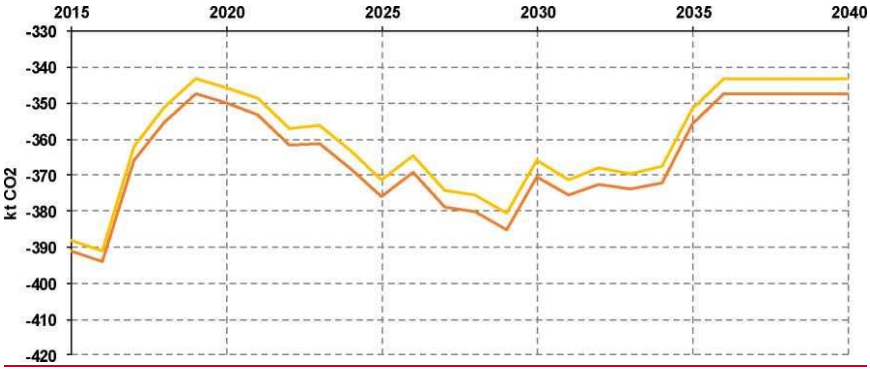


Table 51 presents the results from the modelling of projections of CO_2 emissions and capture from the LULUCF sector. The WOM and WEM scenarios are almost identical because measures to reduce emissions or increase capture had no significant impact on CO_2 trends in the LULUCF sector. As can be seen in Table 51, CO_2 capture is in the range of 4 600 to 9 000 Gg CO_2. The projections for CO_2 capture in the 2030-2037 period show a falling trend, the main factor of which is a decrease in biomass increments in managed forests as a result of a decrease in the relative age of forests with the highest wood biomass increment. Model results indicate this trend is anticipated to change after 2037.

Table 51 Projections of CO_2 emissions and capture in LULUCF (in Gg) under WOM and WEM scenarios to 2040

WOM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**-6 642.32**	**-6 101.13**	**-4 994.58**	**-4 386.66**	**-4 106.08**	**-4 181.18**
Forest land	-4 448.84	-4 345.20	-3 396.61	-2 849.51	-2 597.28	-2 754.38
Forest land remaining forest	-4 079.85	-3 999.56	-3 025.38	-2 483.59	-2 245.66	-2 411.29
Conversion of land to forest land	-368.99	-345.64	-371.23	-365.91	-351.62	-343.09
Arable land	-1 142.66	-1 056.55	-1 050.67	-1 027.82	-1 005.59	-985.34
Grassland	-165.25	-108.85	-68.37	-92.83	-126.00	-132.68
Settlements	98.38	102.65	111.08	103.86	101.85	102.25
Other land	92.98	132.74	143.03	146.52	132.43	133.19
Harvested wood products	-1 076.92	-825.92	-733.04	-666.88	-611.49	-544.22
WEM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**-6 642.32**	**-6 193.70**	**-5 090.25**	**-4 484.87**	**-4 206.56**	**-4 283.80**
Forest land	-4 448.84	-4 437.77	-3 492.28	-2 947.72	-2 697.75	-2 857.00
Forest land remaining forest	-4 079.85	-4 087.73	-3 116.26	-2 577.29	-2 341.83	-2 509.64
Conversion of land to forest land	-368.99	-350.05	-376.02	-370.43	-355.93	-347.35

Arable land	-1 142.66	-1 056.55	-1 050.67	-1 027.82	-1 005.59	-985.34
Grassland	-165.25	-108.85	-68.37	-92.83	-126.00	-132.68
Settlements	98.38	102.65	111.08	103.86	101.85	102.25
Other land	92.98	132.74	143.03	146.52	132.43	133.19
Harvested wood products	-1 076.92	-825.92	-733.04	-666.88	-611.49	-544.22

*real values; Source: SHMI

The same procedure was used to model emissions from forest fires. Forest fire emission projections are presented in the following tables.

Table 52 Projections of methane and N_2O emissions from forest fires (in Gg) under WOM and WEM scenarios to 2040

	CH_4					
WOM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**0.85**	**0.97**	**1.00**	**1.02**	**1.04**	**1.08**
Forest land	0.85	0.97	1.00	1.02	1.04	1.08
Forest land remaining forest	0.85	0.97	1.00	1.02	1.04	1.08
WEM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**0.85**	**0.70**	**0.73**	**0.75**	**0.76**	**0.80**
Forest land	0.85	0.70	0.73	0.75	0.76	0.80
Forest land remaining forest	0.85	0.70	0.73	0.75	0.76	0.80
	N_2O					
WOM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.13**
Forest land	0.05	0.05	0.06	0.06	0.06	0.06
Forest land remaining forest	0.05	0.05	0.06	0.06	0.06	0.06
WEM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**0.12**	**0.10**	**0.11**	**0.11**	**0.11**	**0.11**
Forest land	0.05	0.04	0.04	0.04	0.04	0.04
Forest land remaining forest	0.05	0.04	0.04	0.04	0.04	0.04

*real values; Source: SHMI

Slovakia has not yet defined emissions and capture from the wetlands category, where there is a lack of input data for modelling emission and capture projections for the reporting period.

The area of forest land reached 2.019 million ha, of which stands covered 1.946 million ha. Since 1990, the area of forest land has increased by 42 700 ha and stands by 24 600 ha. The timber stock on forest land increased from 348.5 to 480.3 million m3 raw wood without bark. The area of forest stands on non-forest land increased from 273 000 to 288 000 ha and timber stocks from 38 to 46 million m3. The total forested area of the Slovak Republic, calculated from stands, is 45.1%. At

present, due to the current age composition, wood reserves are at the highest they have been for at least the last century. The same statement applies to non-forest land.

Dead wood is an important component of forest ecosystems to promote biodiversity, and should be kept in forests to an extent appropriate to its functional focus. There is currently 87.0 million m3 of dead wood on forest land and 6.8 million m3 in stands on non-forest land. Converted per hectare, these figures are significantly higher than the European average. This situation is mainly due to the deteriorated condition of forests after a wide range of calamities and insufficient stand hygiene. The decomposition of dead wood is also a source of greenhouse gas emissions.

The state of forest stands has an impact on the balance of greenhouse gas emissions and capture. The significant scope of calamities and the rapid aging of the remaining stands have reduced the capture possibilities after 1990 from approx. 8 500 Gg to the current 4 500 to 5 500 Gg per year. The most important carbon storage in forest stands is living biomass, the amount of which depends on the maintenance of or increase in the production capacity of the forests. With regard to the impact of climate change, it is also necessary to improve the age structure of the forests by gradually decreasing the area of older stands with decreasing production capacity.

Table 53 Emissions projections in the land use and forestry sector under the WOM and WEM scenarios to 2040

WOM	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
4. Land use, land use changes and forestry (LULUCF) sector	-5983	-6142	-5840	-5672	-5587	-5662	-5793
4.A Forest land	-4466	-4786	-4440	-4307	-4213	-4290	- 4421
4.B Arable land	-795	-728	-760	-713	-713	-713	-713
4.C Grass lands	-184	-191	-215	-215	-215	-215	-215
4.E Habitation	84	92	114	114	114	114	114
4.F Other land	108	192	136	136	136	136	136
4.G Harvested wood products.	-731	-721	-675	-687	-695	-693	-693
WEM	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
4. Land use, land use changes and forestry (LULUCF) sector	-5983	-6143	-5829	-5661	-5575	-5650	-5781
4.A Forest land	-4466	-4786	-4429	-4296	-4202	-4279	-4410
4.B Arable land	-795	-728	-760	-713	-713	-713	-713
4.C Grass lands	-184	-191	-215	-215	-215	-215	-215
4.E Habitation	84	92	114	114	114	114	114
4.F. Other land	108	192	136	136	136	136	136
4.G Harvested wood products.	-731	-721	-675	-687	-695	-693	-693

ii-.i) Waste management emission projections

The projection of emissions from the waste sector to 2040 focuses on activities in the areas of municipal waste disposal and municipal waste water treatment. These two main sources of emissions account for over 80% of the estimated emissions in the waste sector. Emissions from composting, waste incineration, industrial waste disposal and industrial waste water treatment are dynamically estimated from an average of 10 years (2007-2017), while the constant value of 2017 is used throughout the projected 2018-2040 period only in the case of municipal waste composting.

Emissions from municipal waste disposal are affected by the amount of waste disposed of, which is regulated through the Waste Management Act; and landfill gas combustion, which is regulated by

the Air Pollution Control Act. The projections of emissions from municipal waste disposal are therefore divided into waste quantity modelling and landfill gas recovery modelling.

Projections of total municipal waste produced are based on projections of waste per capita and population growth. This procedure is in line with the Eunomia prediction[43] prepared in 2016. This waste generation prediction is used for all prepared scenarios. The amounts of separated recyclable materials (paper, plastics, glass, food waste, garden waste) are used as variables in the preparation of each scenario. After estimating gross landfill emissions, net emissions are estimated by subtracting the captured CH_4.

Municipal Waste Management (WEM scenario) – this is based on the expectation that trends in municipal waste management will continue as they have over the last decade. This development is characterized by the organisation of waste collection at municipal level and by increased separation of recyclable materials, with landfilling still the main waste disposal method. It is anticipated that both incinerators (Košice and Bratislava) will continue to operate in this scenario at their current output (200 kt/year).

Landfill gas is obtained only for profit from electricity generation, and electricity suppliers are reluctant to connect these new energy producers. The increase in methane recovery from landfill gas follows trends from the previous decade.

The main document defining the waste management strategy is the Waste Management Programme of the Slovak Republic 2016-2020. This document notes that the previous waste management plan (2011-2015) did not achieve its targets and notes that the 2013 target of reducing the disposal of biodegradable waste to 50% of the 1995 level has not been achieved – nor was the target of recycling 35% of municipal waste by 2015. The 2021-2025 roadmap is not yet available.

The main source of emissions from waste water treatment are retention tanks (septic tanks). CH_4 emissions projections from wastewater are based on the changing number of people using public sewerage systems and domestic wastewater treatment plants, with the aim of estimating reductions through tank counts. Nitrogen oxide emissions are based on estimates of protein consumption, while the characterisation of installations as WWTP is assessed as before.

Biogas recovery from anaerobic sludge digestion is not a factor affecting emissions, since wastewater legislation requires that all anaerobic treatment plants have combustion or biogas combustion systems. In addition, heat produced from biogas is an important element of the energy balance of wastewater treatment plants under the Slovak climate.

Waste water sector (WEM scenario) - Only one scenario has been prepared for the waste water sector. There are no quantified targets available to define alternative scenarios for the 2018-2040 period. The scenario with measures is based on the expectation that developments in waste management will continue as observed in the last decade. These can be characterized as the gradual development of sewage systems and the modernisation of wastewater treatment plants to meet the requirements of EU water sector strategies. The scenario assumes that the number of retention tanks will decrease as a result of the expansion of sewerage systems from the current 68% to 75% and the number of domestic waste water treatment plants from the original 2% to 5%.

[43] https://www.eunomia.co.uk/

The model for modelling the amount of waste is derived from statistical data on municipal waste published by the Statistical Office of the SR[44] and an analysis of waste composition published by Benešová[45]. The total amount of waste is estimated based on demographic forecasts and the percentage of waste per inhabitant. The waste produced is divided into mixed municipal waste, a group of separately collected fractions (separated waste) subject to waste composition analysis, and a group of other separately collected fractions not covered by waste composition analysis. The same division applies to landfilled waste. Total landfilled waste is estimated as the difference between the total waste produced and the sum of recovered and incinerated waste. The model uses a number of separated fractions as input variables. These variables are used to estimate the amount of mixed/residual waste as well as changes in the composition of the waste. An overview of the model parameters and their interdependencies is given in the following table.

Table 54 Overview of parameters used

Parameter	Waste produced	Landfilled / incinerated waste
Total	Population / waste	Total amount - recovered - (incinerated or mechanical-biological treatment)
Separated waste analysed	Sum of the separated fractions	Sum of separated landfilled fractions
Separated waste not analysed	Total waste produced 0.2	Separated waste produced not analysed 0.5
Residual waste	Total waste production - separated waste analysed - separated waste not analysed	Total waste production - separated waste analysed - separated waste not analysed

Table 55 Emissions projections under WOM and WEM scenarios to 2040

WOM	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total without LULUCF	**74460**	**54412**	**49863**	**51396**	**46560**	**41188**	**41819**	**42179**	**42790**	**43194**	**43269**
Total including LULUCF	**65469**	**45127**	**40144**	**45791**	**40547**						
1. Energy	56668	39568	36540	36759	32741	27627	28093	28563	28952	28957	28640
2. Industrial processes	9813	9383	8594	10258	9610	9080	9262	9355	9700	10157	10542
3. Agriculture	6587	4122	3379	3022	2813	3020	2977	2758	2673	2670	2676
4. LULUCF	-8991	-9284	-9719	-5605	-6013	-6 142	-5840	-5672	-5587	-5662	-5793
5. Waste	1393	1339	1351	1357	1395	1461	1488	1503	1465	1411	1411
WEM	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
1. Energy	56668	39568	36540	36759	32741	27546	26959	27168	27372	27248	26936
2. Industrial processes	9813	9383	8594	10258	9610	9073	8912	8945	9234	9611	9991
3. Agriculture	6587	4122	3379	3022	2813	3020	2977	2758	2673	2670	2676
4. LULUCF	-8991	-9284	-9719	-5605	-6013	-6143	-5829	-5661	-5575	-5650	-5781

[44] http://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/poh-sr-2016-2020_vestnik.pdf

[45] Benešová, Kotoulova, Černík: Základní charakteristiky komunálních odpadů http://www.mnisek.cz/e_download.php?file=data/editor/234cs_2.pdf&original=STANOVEN%C3%8D+PRODUKCE+ODPAD%C5%AE-P%C5%98%C3%8DLOHA.pdf

5. Waste	1393	1339	1351	1357	1395	1461	1488	1503	1465	1411	1411

ii-j) Projections of emissions from international transport

GHG emissions from international transport are not included in the national balance. Projections of greenhouse gas emissions from international aviation and international maritime activities were prepared for a scenario with measures - WEM. The data in Table 56 show that projected greenhouse gas emissions from these categories are negligible for Slovakia compared to other sources.

Table 56 Projections of greenhouse gas emissions (Gg CO2 equiv.) from international transport in a WEM scenario to 2040

WEM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
International transport	**185.06**	**185.06**	**185.06**	**185.06**	**185.06**	**185.06**
Aviation	166.39	166.39	166.39	166.39	166.39	166.39
Maritime	18.67	18.67	18.67	18.67	18.67	18.67

*real values; Source: SHMI

ii-k) Projections of total greenhouse gas emissions

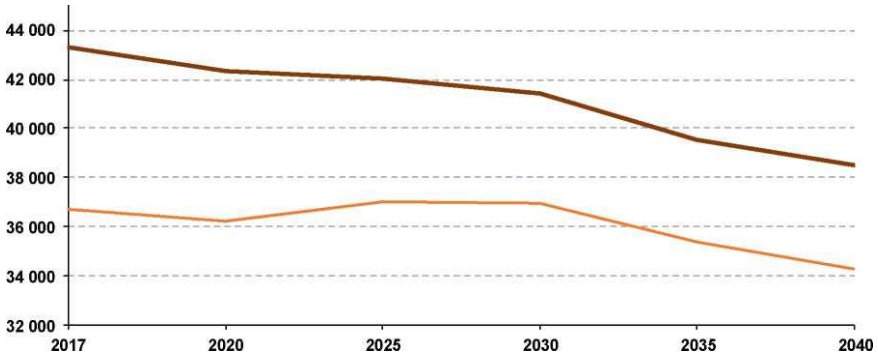
Projections of greenhouse gas emissions, converted to CO_2 equivalents according to current GWP values, have been developed for all defined IPCC sectors and years and relevant scenarios. Table 57 and Figure 30 show the results of model data in summary for a scenario with measures.

Table 57 Aggregated greenhouse gas emission projections (Gg CO_2 equiv.) in the monitored sectors

WEM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Total without LULUCF	**43 316.44**	**42 354.75**	**42 046.28**	**41 399.03**	**39 525.73**	**38 521.16**
Total including LULUCF	**36 727.13**	**36 209.70**	**37 005.84**	**36 965.02**	**35 369.89**	**34 290.00**
1. Energy	29 442.34	29 000.39	29 267.89	29 890.16	28 506.71	27 996.64
2. Industrial processes	9 646.59	9 414.10	9 063.39	8 097.59	7 663.02	7 193.88
3. Agriculture	2 546.79	2 376.24	2 390.66	2 419.79	2 497.09	2 570.24
4. LULUCF	-6 589.31	-6 145.05	-5 040.44	-4 434.01	-4 155.84	-4 231.16
5. Waste	1 680.72	1 564.01	1 324.34	991.49	858.90	760.40

*real values; Source: SHMI

Figure 30 Total GHG emissions projections under the WEM scenario (with and without LULUCF) (Gg CO_2 equiv.)



Key:

CO2 ekv. (Gg) scenár WEM bez LULUCF	CO2 equiv. (Gg) WEM scenario without LULUCF
CO2 ekv. (Gg) scenár WEM s LULUCF	CO2 equiv. (Gg) WEM scenario with LULUC

4.2.2. Renewable energy

i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

Table 58 Current share of renewable energy in gross final energy consumption

	2015	2016	2017
Renewable energy - heat and cold production[46] (%)	10.8	9.9	9.8
Renewable energy - electricity generation[47] (%)	22.7	22.5	21.3
Renewable energy - transport[48] (%)	8.5	7.5	7.0
Total share of renewable energy sources[49] (%)	**12.9**	**12.0**	**11.5**
Of which the cooperation mechanism represents[50] (%)	0	0	0
Surplus for the cooperation mechanism[51] (%)	0	0	0

ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to 2040)

Figure Indicative trajectory with respect to existing policies and measures

[46] Share of renewable energy in heat and cold production: gross final consumption of energy from renewable sources for heat and cold production (as defined in Article 5(1)(b) and Article 5(4) of Directive 2009/28/EC) divided by gross final energy consumption for heat and cold production. The same procedure as in Table 3 NREAP applies.

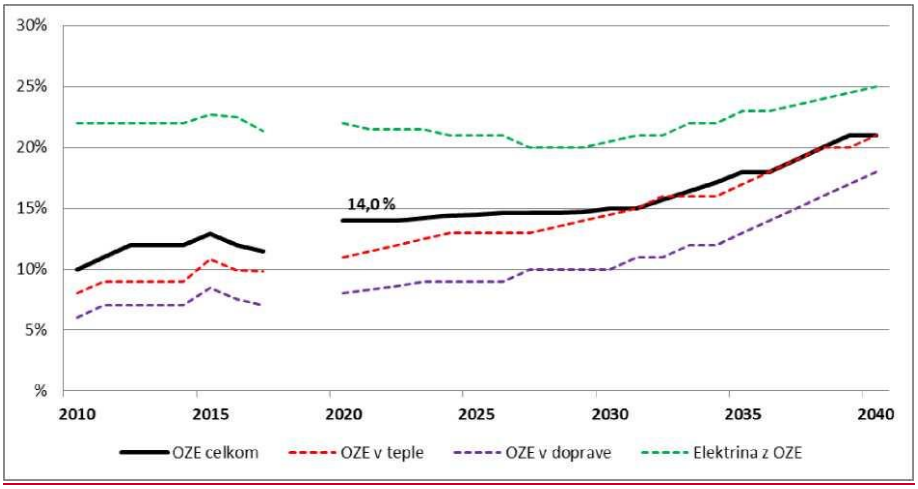
[47] Share of renewable energy in electricity production: gross final consumption of energy from renewable sources (as defined in Article 5(1)(b) and Article 5(4) of Directive 2009/28/EC) divided by total gross final energy consumption. The same procedure as in Table 3 NREAP applies.

[48] Share of renewable energy in transport: final energy from renewable sources consumed in transport (see Articles 5(1)(c) and Article 5(5) of Directive 2009/28/EC) divided by consumption in transport of 1. petrol; 2. diesel; 3. biofuels used in road and rail transport; and 4. electricity in land transport (as shown in row 3 of Table 1). The same procedure as in Table 3 NREAP applies.

[49] The share of renewable energy in gross final energy consumption. The same procedure as in Table 3 NREAP applies.

[50] In percentage points of the total share of renewable energy sources.

[51] In percentage points of the total share of renewable energy sources.



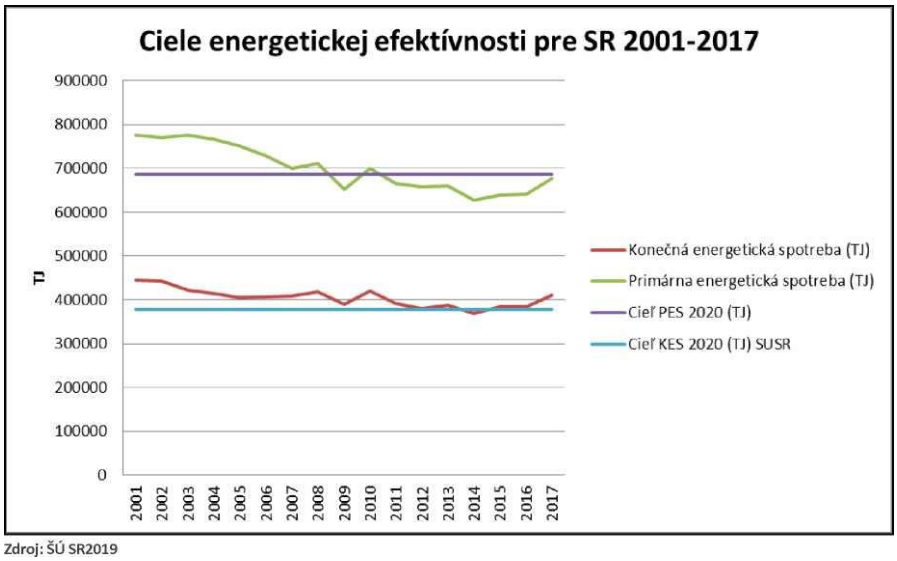
Key:

OZE celkem	RES total
OZE v teple	RES in heating
OZE v doprave	RES in transport
Elektrina z OZE	Electricity from RES

4.3 Dimension: energy efficiency

i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

Figure 31 Energy consumption in the SR 2001–2016



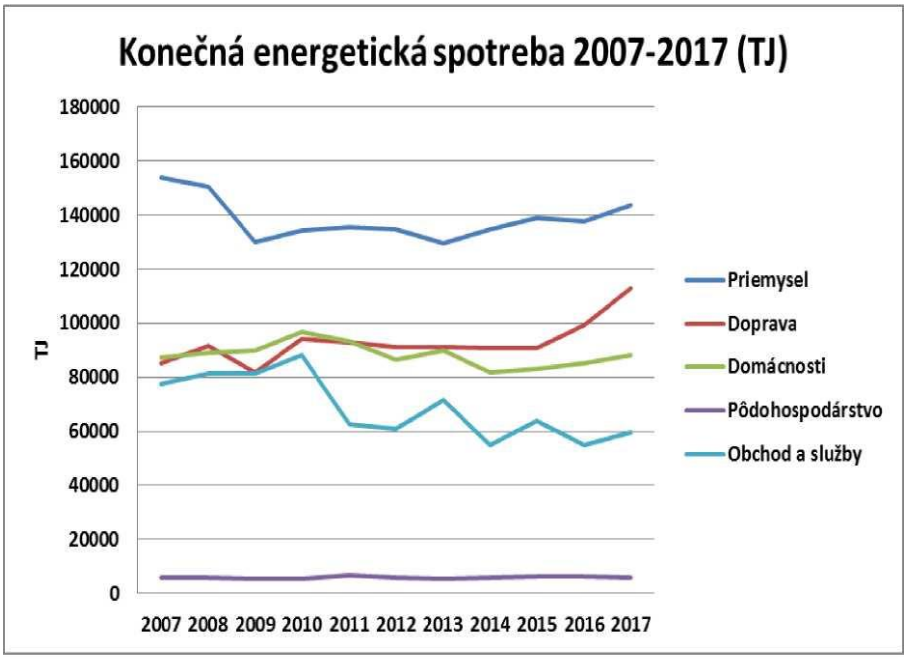
Zdroj: ŠÚ SR2019

Konecna energeticka spotreba (TJ)	**Final energy consumption (TJ)**
Primarna energeticka spotreba (TJ)	**Primary energy consumption (TJ)**
Ciel PES 2020 (TJ)	**Target PES 2020 (TJ)**
Ciel TES 2020 (TJ) SUSR	**Target FES 2020 (TJ) SO SR**

Source: Eurostat 2018

Primary energy consumption reached 676 PJ in 2017, 36 PJ (5.68%) more than in 2016. Final energy consumption in 2017 amounted to 410 PJ, an increase of 27 PJ (7.17%) compared to 2016.

Figure 32 Final energy consumption 2007-2017



Zdroj: ŠÚ SR (2019)

Key:

Priemysel	Industry
Doprava	Transport
Domacnosti	Households
Podohospodarstvo	Agriculture
Obchod a sluzby	Commerce and services

Source: SO SR (2019)

Energy consumption trends by sector

Industry

The industry sector is the largest energy consumer in the Slovak Republic. Energy consumption in industry declined until 2009, after which energy consumption in industry levelled out, with a moderate increase in 2015 and 2017. Final energy consumption in industry was 144 PJ in 2017, or

38% of final energy consumption in Slovakia. Year-on-year energy consumption in industry rose by 0.8% because of the economic recovery and production growth.

Transport

Consumption in the transport sector expressed as final energy consumption was 113 PJ in 2017. The largest year-on-year rise in energy consumption was in 2017, increasing by 13.8%. Between 2007 and 2017 it rose by up to 33%, making it the largest consumption increase in the monitored ten-year period.

In terms of the individual modes of transport, road transport in particular contributed to the high increase. Other modes of transport show a steady trend in energy consumption. The chief factors fuelling long-term energy consumption growth in transport include: the ever-growing numbers of registered motor vehicles and the accompanying rise in the numbers of people travelling by car, along with an expansion in road haulage as the carriage of goods switches from less-energy-intensive modes of transport to road transport. The comparable financial cost of road freight transport is an important factor, even if an enormous number of road vehicles are used.

Households

Households consumed 88 PJ of energy in 2017 with consumption increasing year-on-year by 3.7%. This shows that there is still considerable potential for the renovation of buildings, in particular for government and public buildings, but also for private sector buildings.

There are approximately 1 million apartment buildings and family houses (with 1.9 million dwellings) and over 15 000 public buildings such as schools, hospitals and offices. Based on expert estimates, buildings are responsible for 26% of CO_2 emissions.

Agriculture

Energy consumption in the agriculture sector does not show such significant fluctuations as in other sectors. In 2017, energy consumption in the agriculture sector amounted to 6 PJ and the sector recorded a year-on-year decline in consumption of 4.2%.

Commerce and services

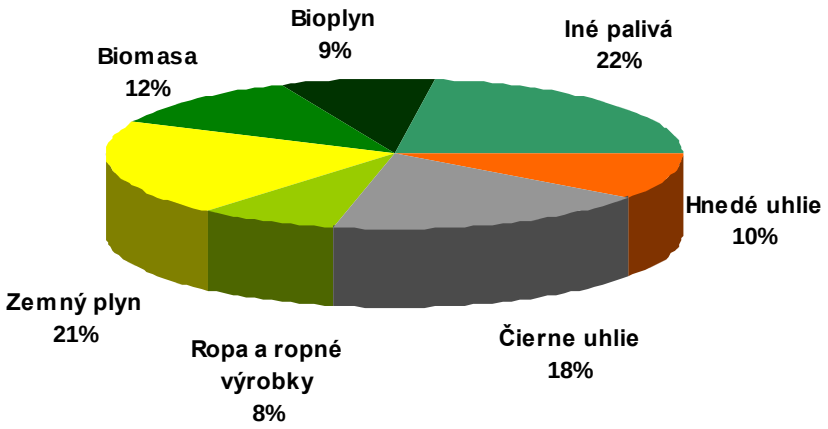
The commerce and services sector consumed 60 PJ of energy in 2017, a rise of 9% compared to the previous year. This variation can be explained by the break-up and merger of enterprises, changes in their sectoral classification and the resulting changes in terms of where their consumption is classified in the energy balance, and by the calculation method used for this item by the SO SR.

ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling[52]

In 2017, the total installed capacity for high-efficiency cogeneration was 1 241.85 MW, while the electricity generated was 2 545.28 MWh, representing 9% of total electricity generation in Slovakia. In terms of cogeneration technologies, the generation of electricity and heat in steam vapour condensing or backpressure turbines is currently predominant. The share of these installations in total installed power is 58.0%, and 83.0% of the total heat produced by high efficiency cogeneration.

52 In accordance with Article 14(1) of Directive 2012/27/EU.

Figure 33: Share of individual fuels in combined heat and power plants



Key:

Biomasa	Biomass
Bioplyn	Biogas
Iné palivá	Other fuels
Hnedé uhlie	Brown coal/lignite
Čierne uhlie	Black coal/anthracite
Ropa a ropné výrobky	Oil and petroleum products
Zemný plyn	Natural gas

In recent years, plants using combined heat and power technology have been rebuilding boilers to burn biomass with coal and building new boilers to burn biomass, and this trend will continue, although to a lesser extent than hitherto. Systematic measures to reduce subsidies and the consumption of fossil fuels through increasing energy efficiency and the use of RES that meet sustainability criteria need to be put in place.

For large sources with steam and gas turbines, only a slight increase in installed capacity is anticipated, which is achieved by the essential reconstructions of existing technology with combined heat and power technology. In this segment of electricity output through cogeneration, especially in the heat plants with condensing steam turbines, recently, in addition to the reconstruction and modernisation of these facilities, these technologies are being replaced by gas piston engines for natural gas with an electric motor power of up to 10 MW. The greatest potential for additional high-efficiency cogeneration is assumed for existing district heating systems, which supply heat to end users.

Table 59 Estimated economic potential of electricity generation using cogeneration

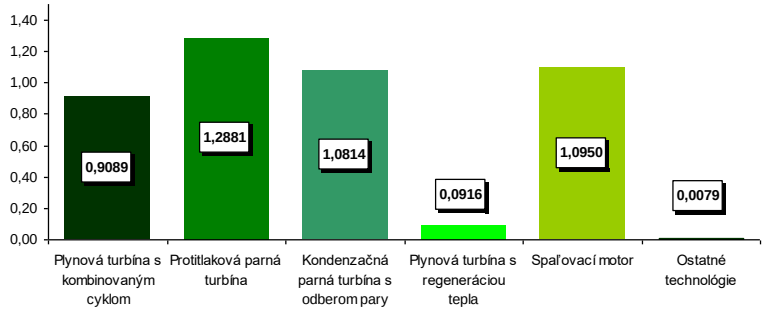
Year	Actual				Prediction			
	2011		2014		2020		2025	
CHP technology	Capacity Installed	Electricity generated	Capacity Installed	Electricity generated	Capacity Installed	Electricity generated	Capacity Installed	Electricity generated
	(MWe)	(GWh)	(MWe)	(GWh)	(MWe)	(GWh)	(MWe)	(GWh)
Combined cycle gas turbine.	394.9	874.0	394.9	908.9	394.9	947.8	394.9	967.6

Steam backpressure turbine	583.0	1370.6	577.0	1,288.1	582.8	1340.4	594.4	1,367.2
Steam condensing extraction turbine	1622.9	1299.9	1631.1	1,081.4	1647.4	1153.2	1663.9	1,164.7
Gas turbine with heat recovery	25.4	124.8	25.4	91.6	30.5	115.8	36.6	139.0
Combustion engine	47.1	231.5	187.1	1 095.0	261.9	1571.3	340.4	2 042.7
Other technologies	0.0	0.0	1.2	7.9	5.9	38.7	8.8	58.1
Total	2 673.3	3 900.8	2 816.7	4 472.8	2 923.3	5 167.2	3 039.1	5 739.2

Table 60 Estimated economic potential of heat generation by cogeneration

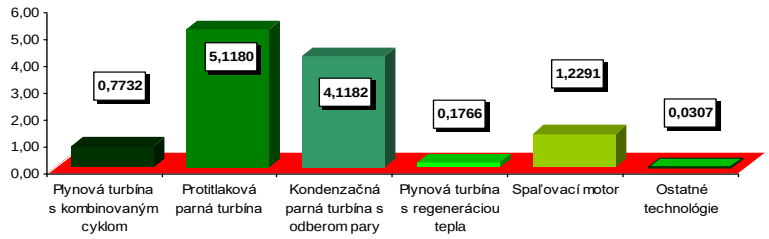
Year	Actual				Prediction			
	2011		2014		2020		2025	
CHP technology	Capacity Installed	Heat supplied	Capacity Installed	Heat supplied	Capacity Installed	Heat supplied	Capacity Installed	Heat supplied
	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)
Combined cycle gas turbine.	332.0	748.2	332.0	773.2	346.2	806.4	353.4	823.2
Steam backpressure turbine	1854.0	5359.2	1818.2	5118.0	1891.9	5325.8	1929.8	5 432.3
Steam condensing extraction turbine	4873.0	4760.1	4902.0	4118.2	5227.6	4391.8	5279.8	4 435.7
Gas turbine with heat recovery	83.4	262.9	83.4	176.6	105.4	223.2	126.5	267.9
Combustion engine	52.9	264.2	206.9	1229.1	296.9	1763.8	386.0	2 292.9
Other technologies	0.0	0.0	4.8	30.7	23.7	151.3	35.5	227.0
Total	7 195.3	11 394.6	7 347.3	11 445.9	7 891.7	12 662.2	8 111.1	13 478.9

Figure 34: Structure of electricity generation using cogeneration in 2014 (TWh/year)



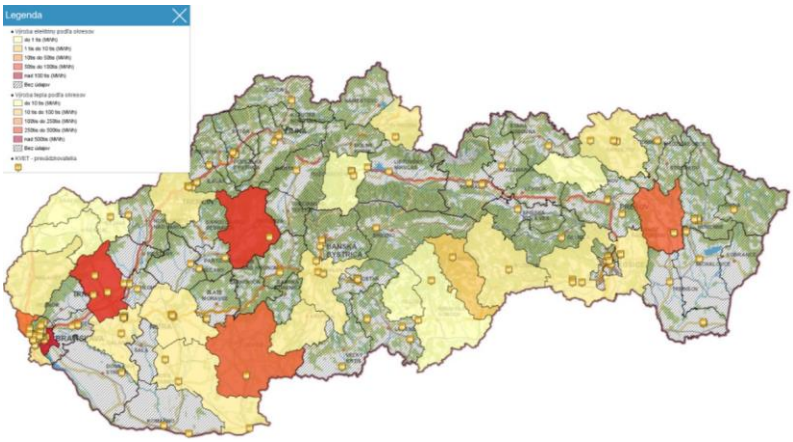
Combined cycle gas turbine. | Steam backpressure turbine | Steam condensing extraction turbine | Gas turbine with heat recovery | Combustion engine | Other technologies

Figure 35: Structure of heat generation using cogeneration in 2014 (TWh/year)



Combined cycle gas turbine. | Steam backpressure turbine | Steam condensing extraction turbine | Gas turbine with heat recovery | Combustion engine | Other technologies

Figure 3: Co-generators and the amount of electricity and heat produced by district



Heat supply from district heating systems is provided to approximately 16 000 apartment buildings, with a total of 650 620 apartments (more than 1.8 million inhabitants). Over the last 15 years, heat consumption in apartment buildings connected to the district heating systems has decreased by 26% to 1 800 GWh. This reduction followed the introduction of energy-efficiency measures (hydraulic regulation of heating systems and hot water distribution, insulation of circulating pipelines for hot water distribution, installation of thermoregulating valves, thermal insulation of building façades and replacement of windows) and depending on the number of degree-days, reflecting the climate conditions in different years. Slovakia will continue to support the continuation of the above measures.

The Slovak Innovation and Energy Agency, which operates the energy efficiency monitoring system, has created and operates a Thermal Map of the Slovak Republic. The Thermal Map serves in particular to identify those areas where heat can be efficiently and efficiently delivered through high-efficiency combined heat and power, through renewable sources, and through the use of heat from industrial processes for heating and cooling . The Thermal Map should help to provide potential investors with information on locations where it is advisable to think in the future about the introduction of district heating systems and hence the potential for the use of cogeneration.

More detailed information on the Thermal Map is available at www.siea.sk/tepelna-mapa/.

Table 61 Current heat supply in district towns of the SR and the potential for cogeneration for selected cities

District	Heat supplied			CHP potential		
				Total number (combustion motors)	Total Power	
	Heating	Hot water heating	Total		Heat	Electrical
	(GWh)			(-)	(kW)	(kW)
Banska Bystrica	184.95	79.94	264.89	27	7 617	6 591
Banska Stiavnica	9.82	5.21	15.03	6	560	447
Brezno	15.99	6.58	22.57	9	702	561
Detva	31.90	14.09	45.99	2	1 537	1 331
Krupina	12.61	6.32	18.93	2	677	541
Lucenec	45.10	18.08	63.18	14	1 829	1 463
Poltar	6.38	2.74	9.13	1	234	187
Revuca	35.75	11.90	47.64	7	907	725
Rimavska Sobota	47.95	16.32	64.27	4	452	361
Velky Krtis	36.24	13.36	49.61	3	524	420
Zvolen	104.20	52.66	156.86	10	795	636
Zarnovica	11.60	6.76	18.36	4	621	497
Žiar nad Hronom	88.02	40.31	128.33	1	80	64
Bratislava I.	175.56	32.07	207.63	24	2 717	2 173
Bratislava II.	449.70	143.21	592.92	14	1 392	1 113
Bratislava III.	869.88	77.11	946.99	17	2 119	1 695
Bratislava IV.	492.74	101.97	594.71	12	2 089	1 672
Bratislava V.	652.96	120.22	773.19	22	13 982	11 335
Malacky	72.13	17.46	89.59	9	1 943	1 555
Pezinok	17.08	1.01	18.09	4	675	540
Senec	18.63	0.01	18.64	3	712	570
Gelnica	9.70	4.00	13.70	3	448	359
Košice - surrounding area	16.58	6.58	23.16	3	185	148
Košice I.	168.52	66.52	235.04	4	208	167
Košice II.	148.84	74.17	223.01	1	0	0
Košice III.	44.57	28.24	72.81	0	0	0
Košice IV.	78.17	31.75	109.92	1	16	13
Michalovce district	60.69	30.75	91.44	19	3 659	2 929
Roznava	52.23	18.66	70.88	17	1 231	986
Sobrance	2.97	2.13	5.10	3	239	192
Spisska Nova Ves	79.84	31.85	111.69	27	3 592	2 874
Trebisov	42.69	18.55	61.24	13	1 932	1 547
Komarno	72.61	32.86	105.47	16	765	612
Levice	91.57	40.47	132.05	20	2 414	1 932
Nitra	195.16	54.34	249.50	27	4 735	3 792

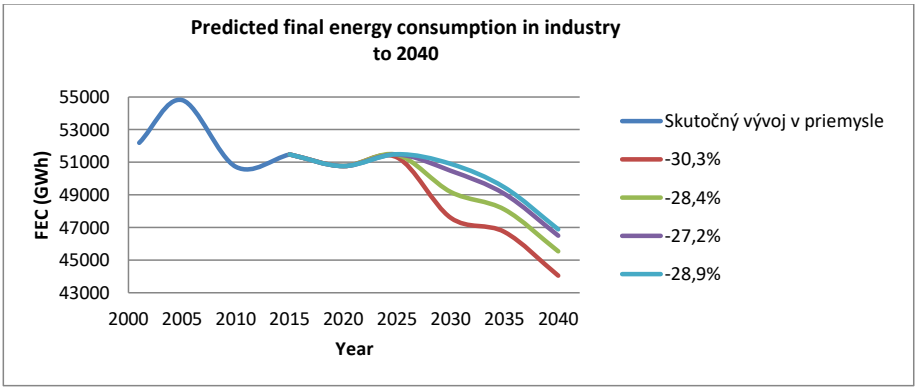
Nové Zámky	166.99	45.03	212.02	7	1 886	1 509
Šaľa	45.66	0.02	45.68	4	1 365	1 091
Topoľčany	106.93	18.06	124.99	1	1 949	1 754
Zlate Moravce	32.30	5.55	37.84	3	766	613
Bardejov	55.68	20.84	76.53	11	2 233	1 787
Humenne	109.20	47.67	156.87	0	0	0
Kezmarok	20.49	11.33	31.82	10	1 279	1 022
Levoca	14.41	6.05	20.46	6	400	320
Medzilaborce	10.10	4.82	14.92	2	489	391
Propad	104.01	49.72	153.73	35	4 649	3 720
Prešov	139.13	52.30	191.42	32	7 902	6 840
Sabinov	14.48	7.24	21.72	6	827	662
Snina	31.19	13.43	44.62	1	185	148

iii. Projections considering existing energy efficiency policies, measures and programmes as described in point 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)[53]

Forecasts in individual sectors of the national economy were based on outputs from a model developed by the World Bank, with 4 variants being created for each sector. The variants reflect the PEC decline forecasts for 2030 compared to the reference year 2007. The PEC prognosis values in 2030 for the following variants are as follows: -27.2%. -28.9%. -28.4%. -30.3%.

Predicted final energy consumption in industry

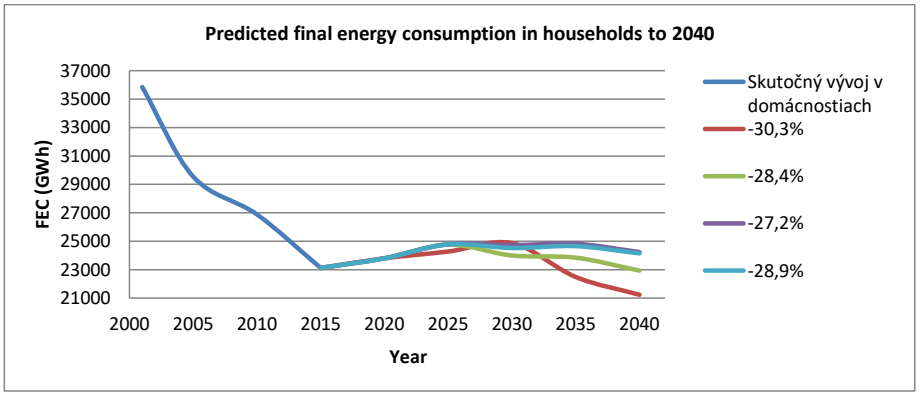
Figure 36 Predicted final energy consumption in industry



Key:
Skutočný vývoj v priemysle Actual trend in industry

Predicted final energy consumption in households

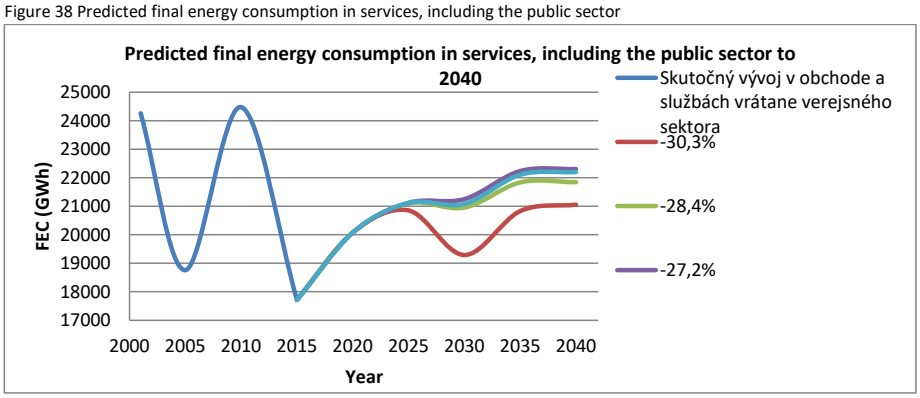
53 This reference business as usual projection shall be the basis for the 2030 final and primary energy consumption target which is described in 2.3 and for conversion factors.



Key:
Skutočný vývoj v domácnostiach Actual trend in households

Predicted final energy consumption in services, including the public sector

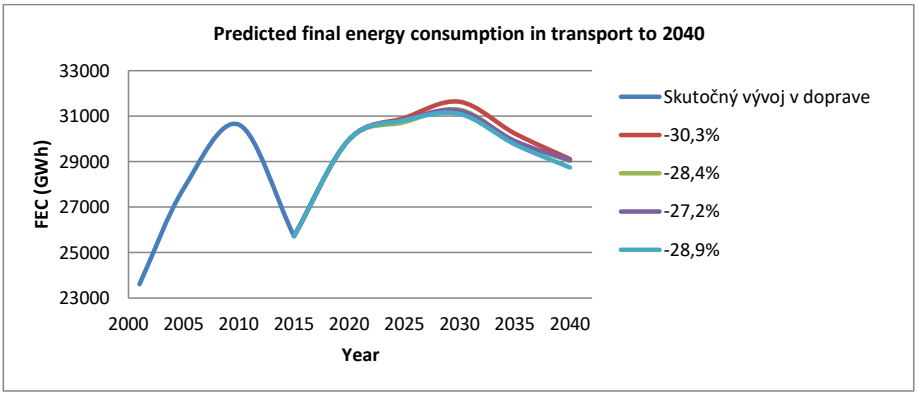
Figure 38 Predicted final energy consumption in services, including the public sector



Key:
Skutočný vývoj v obchode a službách vrátane verejného sektora
Actual trend in commerce and services, including the public sector

Predicted final energy consumption in transport

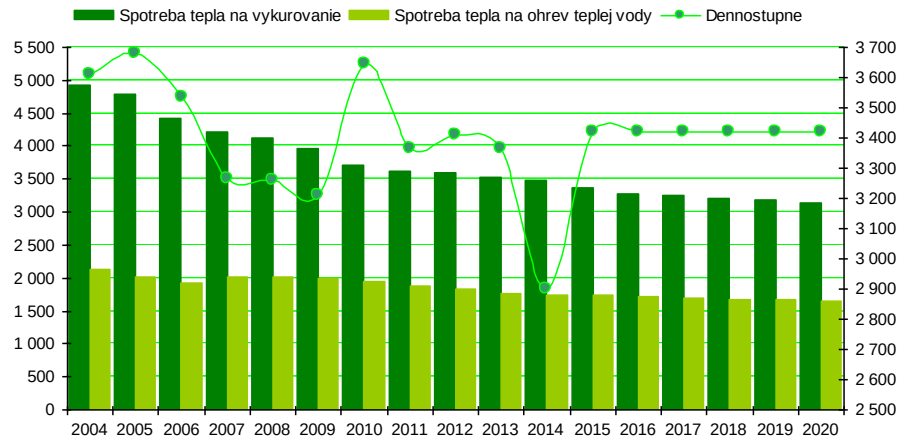
Figure 39 Predicted final energy consumption in transport



Key:
Skutočný vývoj v doprave Actual trend in transport

Predicted heat consumption

Figure 40: Actual and predicted trend in heat consumption in GWh in apartment buildings with heat supplied through district heating systems



Key:
Spotreba tepla na vykurovanie Heat used for heating
Spotreba tepla na ohrev teplej vody Heat used for heating hot water
Dennostupne Day degrees

It is assumed that the decline in heat consumption will continue, but not so markedly as in the last 15 years. Estimates and forecasts for 2020 provide for a decrease in heat consumption of 8.5%, that is, 450 GWh.

The forecast for heat consumption for the next few years was determined by analysing the potential for the energy efficiency of thermal plants, from which to a large extent the supply of heat from district heating systems and is covered and the anticipated development of heat consumption for heating, especially in apartment buildings supplied by heat from these systems. In addition to

reducing heat consumption in apartment buildings, it is anticipated that there will be significantly reduced heat consumption in public buildings supplied by heat from district heating systems. Consideration was also given to the assumed heat consumption in development areas (industry, housing construction). The potential increase in heat consumption will largely be covered by the anticipated reduction in the supply to existing heat consumers. According to the above, the anticipated heat consumption was modelled up to 2025.

Table 62 Real and projected heat consumption in Slovakia

		2010	2012	2014	2015	2017	2019	2021	2023	2025
Public and industrial heating plants, heating systems - district heating systems	(GWh)	24 002	22 089	19 063	20 864	20 790	20 453	20 669	21 162	21 666
Individual heat supply - local boilers (households, services)	(GWh)	19 370	18 783	15 790	18 279	17 647	17 484	17 617	17 911	18 214
TOTAL	(GWh)	**43 372**	**40 872**	**34 853**	**39 143**	**38 437**	**37 937**	**38 286**	**39 073**	**39 881**

Table 63 Real and projected energy mix with heat from district systems

Primary fuels and energy		2010	2012	2014	2015	2017	2019	2021	2023	2025
natural gas	(GWh)	12 551	11 001	8 361	9 875	9 686	9 285	9 497	9 983	10 479
Coal	(GWh)	5 519	3 177	3 015	3 230	3 221	3 157	3 095	3 033	2 973
wood and wood waste	(GWh)	1 293	2 643	3 068	3 059	3 183	3 311	3 378	3 446	3 515
nuclear	(GWh)	1 526	1 373	844	996	1 037	1 078	1 089	1 111	1 133
other fuel*	(GWh)	3 112	3 895	3 775	3 704	3 663	3 622	3 611	3 589	3 567
TOTAL	(GWh)	**24 002**	**22 089**	**19 063**	**20 864**	**20 790**	**20 453**	**20 669**	**21 162**	**21 666**

*oil and petroleum products, waste incineration, effluent, metallurgical gases, usable heat from chemical production

Planned measures in the heating sector

- Construction, reconstruction and modernisation of heat distribution systems
- Construction, reconstruction and modernisation of high-efficiency cogeneration plants with a maximum heat input of 20 MW to reduce the consumption of primary energy sources for electricity and heat generation
- Greening the heating industry and promoting the introduction of RES in the energy mix for heat generation with a view to moving to a low-carbon economy and reducing greenhouse gas emissions and pollutants

In the 2014-2020 programming period, Priority Axis 4 was established in connection with Operational Programme Quality of Environment. That was aimed at transitioning to a low-carbon economy by using renewable energy sources and improving energy efficiency (increasing heat and power from renewable energy sources, systematically reducing greenhouse gas emissions, and developing efficient district heating systems). The **Green for Households** national project was also established under this axis.

This project focuses on the use of the so-called small renewable sources in family houses and apartment buildings to increase the share of renewable energy use in households. By the end of

2018, 18 501 vouchers, worth more than EUR 41.19 million, were reimbursed as part of the Operational Programme Quality of the Environment, providing an installed capacity of 141.63 MW.

The plan for the new project, with a total budget of EUR 48 million, has already been approved. As part of the project, an additional 25 000 installations could be supported by 2023 in households outside the Bratislava autonomous region. It is planned to extend the original SIEA voucher system plans with an applications stack to allow households to demand vouchers on an ongoing basis. The project envisages an increase in the number of small renewable energy installations by 21 000 units and an increase in the capacity of renewable energy generation by 140 MW.

State environmental protection aid scheme for the reduction of GHG and pollutants in the energy sector

The scheme is intended to provide State aid to increase environmental standards by going beyond the applicable Union standards, in the form of a subsidy from the state budget, to support projects in the field of achievable and measurable greenhouse gas and pollutant emissions savings, reducing the use of primary energy sources, replacing fossil fuels with renewable energy sources, constructing, renovating and modernising heat distribution from district heating, construction or upgrading energy infrastructure, and introducing best available techniques to reduce greenhouse gas and pollutant emissions. The scheme may be financed by funds raised from the sale of emission allowances at auction, no call had been made as of November 2019.

Action Plan for the transformation of Upper Nitra - a new central heat source

As regards the transformation of the Upper Nitra region and maintaining the continuity of heat supply in this region, use of the existing heat and electricity generation infrastructure in accordance with the Upper Nitra Transformation Action Plan with minimal environmental impact will be appropriate, ensuring price competitiveness and promoting the long-term sustainable growth of the region.

iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

Cost-optimal levels of minimum energy performance requirements for buildings have been established according to the EC comparative methodology given by Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings, by establishing a framework for a comparative methodology for the calculation of cost-optimal levels of minimum energy performance requirements for buildings and building elements and guidelines accompanying Commission Regulation (EU) No 244/2012. By calculations and comparisons, it was to be demonstrated whether the current minimum energy performance requirements for buildings and building elements in Member States are not significantly lower than cost-optimal requirements. Comparison of the calculated cost-optimal levels with current minimum energy performance requirements for buildings The results of the comparison for the SR have revealed the justification for the tightening of requirements after 2015.

By selecting according to specified features (building category, construction period, size, availability of project data) using the database of residential and non-residential buildings based on statistical

analysis methods, 11 reference buildings were proposed. In addition to the set obligation to propose 2 reference buildings from the existing pool and 1 reference new building to represent the categories of apartment buildings, family houses and administrative buildings, 1 reference building representing school buildings and 1 reference building representing a sports building were proposed.

As part of the packages of measures, measures were applied complying with the applicable requirements set for low-energy construction, for ultra-low energy construction and for buildings with nearly zero energy requirement according to STN 73 0540-2+Z1+Z2 of 2019. All packages, including the package with the optimal building design properties being considered, were used to determine primary energy, life cycle costs, including net present value.

For each reference building, between 5 and 12 packages/variants of measures were used. One special package is the reference case characterised by the original state for existing buildings and a package characterised by current requirements for new buildings. Variant solutions have been proposed for individual thermal protection levels of buildings (e.g. 12 variants for thermal protection of the outer cladding with various thicknesses of thermal insulation varying from 40 mm to 240 mm in additional thermal protection in an additive thermal insulating contact system). The value of the heat transfer coefficient took into account the original quality of the cladding, the roof covering and the internal dividing structures between the heated and unheated spaces. For the variations in the change in the thermal properties of the opening structures, a selection was made of products characterised by the heat transfer coefficient of the frame and the glazing (U_f, U_g, U_w in W/(m^2.K)), solar energy transmittance g (-) and a linear loss coefficient for the glazing spacing frame. Variants were also considered for heat generation (7 variants, e.g. natural gas district heating, wood chips, combined heat and power generation, condensing gas boiler, wood pellet boiler, air - water heat pump, ground - air heat pump) , as well as variants for hot water production and cold production. For lighting, an analysis was independently conducted of the cost optimality of the measures when compared with the energy requirement. The option chosen was applied in all packages of proposed measures when determining the net value.

The results of the calculations show that global costs are different for the macroeconomic and financial aspects, but this does not change the optimum position. The national reference value that was considered for the SR to compare the calculated cost-optimal levels with the current minimum energy performance requirements is the financial (microeconomic) level, i.e. including VAT and without considering CO_2 costs.

Under Art. 4(1) of Directive No 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast), minimum energy performance requirements shall be reviewed at regular intervals which shall not be longer than five years.

The results of the calculation of the cost-optimal levels of minimum energy performance requirements for buildings in 2013 were compared with the established requirements (as recommended) from 1 January 2016 for the ultra-low energy level of construction. By an amendment to standard STN 73 0540-2+Z1+Z2 of 2019 standardised requirements were introduced for ultra-low energy construction, valid from 1 July 2019, which correspond to the results of the calculation of cost-optimal levels of minimum energy performance requirements for buildings.

When calculating cost-optimal levels of minimum energy performance requirements in 2018, the procedures used and results of the cost-optimal minimum level of 2013 calculations, introduced in the applicable legislation, have been respected. This means that the basic level of assessment are the current requirements for the ultra-low energy level of construction.

The calculation of the minimum requirements for the energy performance of buildings and at the same time the subject of the second phase of the assessment was the calculation of the cost-optimal level of minimum energy performance requirements for buildings with nearly zero energy needs. For the second phase of assessing the cost optimalities of the minimum building energy efficiency requirements, reference was made to the reference building categories: apartment buildings, family houses and administrative buildings.

Due to the introduced clarifications and adjustments to the entry conditions of calculations (e.g. taking into account the influence of thermal bridges, poor heat use, change of primary energy factors) and taking into account the supply of new construction products and changes in the parameters of construction products, a new assessment of reference buildings in the ultra-low energy level of construction had to be carried out.

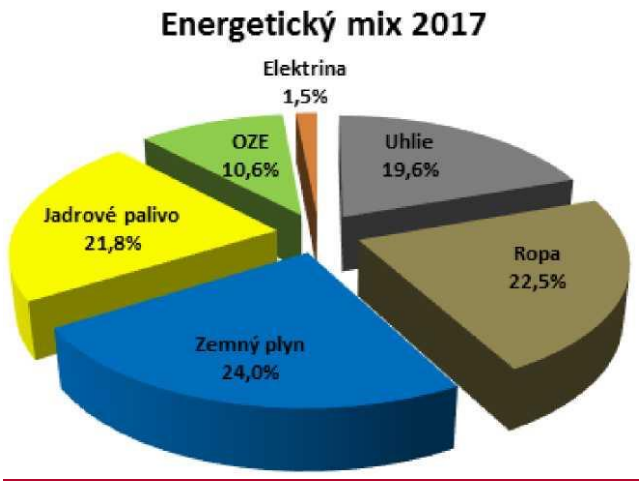
The material for 2018 is available at: https://ec.europa.eu/energy/en/content/eu-countries-2018-cost-optimal-reports

4.4. Dimension: energy security

i. Current energy mix, domestic energy resources, import dependency, including relevant risks

The main domestic sources of energy are renewables and brown coal. After 2023, when support for the production of electricity from coal is discontinued, we expect a significant decline in brown coal mining. The decarbonisation of the Slovak economy will also involve additional costs, and therefore its implementation will require the sensitive and gradual replacement of high-emission sources with low-emission affordable and cost-effective ones. RES are one of the decarbonisation tools, and therefore other low-emission energy sources will also have their places in the energy mix.

Figure 41: Energy mix SR 2017



Key:

Zemný plyn	Natural gas
Ropa	Oil
Uhlie	Coal
OZE	RES
Jadrové palivo	Nuclear fuel

The SR is almost 90% dependent on the import of primary energy sources: nuclear fuel 100%, natural gas 98%, oil 99% and coal 68%.

Oil

Oil deliveries to Slovakia and transit across its territory are reliable and smooth, in line with the volumes agreed in contracts concluded between Slovak and Russian companies. The continuity of oil supplies is ensured in accordance with the Agreement between the Government of the Slovak Republic and the Government of the Russian Federation on Cooperation in Long-term Supplies of Crude Oil from the Russian Federation to the Slovak Republic and the Transit of Russian Oil Through the Territory of the Slovak Republic, which entered into force on 1 January 2015 and expires on 31 December 2029.

Pursuant to the provisions of Council Directive 2009/119/EC of 14 September 2009, Member States are required to maintain minimum stocks of oil and/or petroleum products of at least 90 days of average daily net imports or 61 days of average daily domestic consumption, whichever is the higher. The SR implemented it by Act No 218/2013, on emergency stocks of oil and petroleum products and on the resolution of oil supply crises, and on a change and additions to certain laws.

Further to the aforementioned, the Slovak Republic currently maintains emergency stocks of oil and petroleum products in accordance with the valid legislation. Emergency stocks of crude oil and petroleum products are maintained by the Emergency Oil and Petroleum Products Agency, which was established on 13 September 2013; these stocks are currently maintained at 100.8 days of

average daily net imports. Total emergency stocks are approximately 883 000 tonnes (63% in the form of oil, 37% in the form of petroleum products by category).

The Agency owns emergency stocks of oil and petroleum products, arranges their procurement, maintenance and exchange and is responsible for the protection of the state in this segment in accordance with the requirements of Council Directive 2009/119/EC. Emergency stocks must be continually ready for prompt issue to resolve emergencies.

The emergency stocks minimum limit for the particular calendar year is determined by the Administration of State Material Reserves of the Slovak Republic based on data obtained within the state statistical survey. Emergency oil stocks are held within the Slovak Republic. The Administration of State Material Reserves cooperates with the European Union and the International Energy Agency on the prevention and management of oil emergencies.

The Petroleum Security Commission (NESO) is responsible for the security of oil and oil products supply and is an advisory body to the Chairman of the Administration of State Material Reserves. The Commission acts in accordance with the applicable legislation of the Slovak Republic and international agreements binding for the Slovak Republic. It monitors and analyses: the state of the oil market, the state of oil security and any imminent or acute state of oil emergency. Members of the NESO Commission are, in particular, important representatives of the petroleum industry, of the competent authorities in the state administration, as well as the Emergency Oil and Petroleum Products Agency.

The European Commission (EC) may, in coordination with the Member States, assess the emergency preparedness of individual EU Member States and, if deemed appropriate by the EC, verify the level of emergency stocks. In preparing such assessments, the EC takes account of the work carried out by other institutions and international organisations and consults the Oil Coordination Group set up to prevent crises. In the event of a serious interruption of supplies, a special meeting of this working group may be convened at short notice, or may take place as an on-line consultation.

Electricity

Balance of electricity generation and consumption

In terms of the electricity balance, since 2007 (after the shutdown of the EBO V1 nuclear power plant) Slovakia has been an importing country, however imports showed a downward trend until 2013. This trend then changed between 2014 and 2018. The trend of increasing import volumes will continue until the AE Mochovce 3 and 4 blocks are put into operation. After the commissioning of Mochovce, Slovakia will become a net exporter of electricity. The main motivation was the trend in electricity prices on the market, which are below the generation costs for some technology types.

Total electricity consumption in the Slovak Republic reached 30 947 GWh in 2018. Domestic sources produced 27 149 GWh, and so in 2018 imports were 3 797 GWh (12.3% of consumption in the SR). The main reason was the trend in electricity prices on the market, which are below the generation costs of some technology types in Slovakia.

Table 64 Generation, consumption and loading of the electricity grid of the SR 2009-2018

Year	Generation [GWh]	Total consumption [GWh]	Balance [GWh]	Average loading ** [MW]	Maximum loading [MW]
2009	26 074	27 386	-1 312	3 126	4 131

2010	27 720	28 761	-1 041	3 283	4 342
2011	28 135	28 862	-727	3 295	4 279
2012	28 393	28 786	-393	3 277	4 395
2013	28 590	28 681	-91	3 274	4 178
2014	27 254	28 355	-1 101	3 237	4 120
2015	27 191	29 548	-2 357	3 377	4 146
2016	27 451	30 103	-2 651	3 427	4 382
2017	28 027	31 056	-3 030	3 545	4 550
2018	27 149	30 947	-3 797	3 533	4 506

*Exports and imports are indicated using positive and negative values

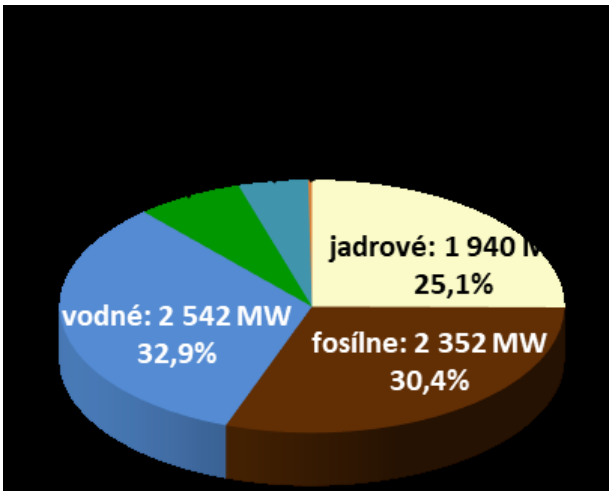
** Total consumption divided by the number of hours in the year in question

The maximum system load in 2018 of 4 506 MW was recorded at 9:00 am on 27 February, down 44 MW from the previous year. The minimum load (6:00 am on 29 July) was 2 368 MW.

Source base of electricity generation in Slovakia

The installed capacity of electricity generating plants in the electricity system of the SR reached 7 728 MW in 2018. The transmission system operator has registered no interest in the construction of a significant electricity source of over 50 MW either at present or in the past 5 years. Investors are focusing on the implementation of projects of local importance.

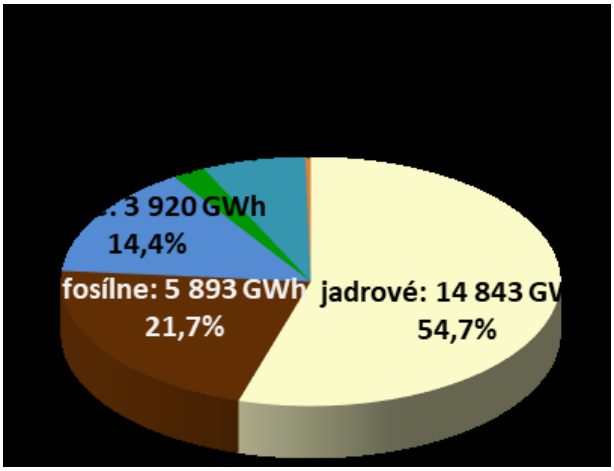
Figure 42 Structure of installed capacity in the electricity system of the SR in 2018



Key:

FVE	Photovoltaic power plant
OZE	RES
ostatne	Other
vodne	Hydro
jadrove	Nuclear
fosilne	fossil

Figure 43 Structure of electricity generation in the electricity system of the SR in 2018



Nuclear power plants

Nuclear power plants are the most important source in terms of their share of electricity generation (55%). Blocks 1 and 2 of Mochovce power plant were put into operation in 1998 and 1999. Technical modifications have since increased their output to the current 2x470 MWe. The anticipated lifetime of the blocks is 50 years, but if all safety conditions are met they can theoretically be operated until 2058 or 2059.

Blocks of the Bohunice V2 power plant were put into operation in 1985 and 1986. Technical modifications have since increased their output to 505 MWe. In addition to electricity generation, the Bohunice power plant supplies heat to Trnava, Leopoldov, Hlohovec and Jaslovské Bohunice. Their theoretical lifespan ends in 2045.

At present, block 3 of the Mochovce power plant with an installed capacity of 470 MW is nearing completion. Block 4 is planned to be commissioned after a one-year gap, thus giving the SR 6 nuclear blocks with a total installed capacity of 2 880 MW.

Fossil fuel power plants

Electricity generation from coal has been falling over the long term. In 2013, the EVO 2 power plant with an installed capacity of 4x110 MW was decommissioned, while since 2014, blocks 1 and 2 of the Vojany 1 power plant have not been operated. Blocks 3 and 4 of the Nováky power plant have been phased out due to technical obsolescence and non-compliance with emission limits. In 2016, another 2 blocks of the Vojany power plant and one block of the Nováky power plant were decommissioned. In total, therefore, 1 210 MW of output has been decommissioned.

Of the coal-fired power plants, 2 blocks of the Nováky power plant and 2 blocks of the Vojany power plant are currently in operation. The Nováky power plant with its annual gross electricity generation of approximately 870 to 1 100 GWh consists of Block A with an output of 46 MWe, which supplies heat to the Upper Nitra region, and Block B with an output of 2x110 MWe. The Vojany EVO 1 power plant with its output of 2x110 MW and annual gross electricity generation of approximately 460 GWh is deployed operatively based on electricity demand and market prices. The total share of these

power plants in electricity generation in the Slovak Republic is 7.5% (ENO - 5.9%, EVO 1 - 1.6%). In accordance with the Action Plan for the Transformation of Upper Nitra, the Nováky power plant – after its conversion from solid fossil fuels – can remain the primary heat source for the region.

In addition to heat generation, the heating plants in Bratislava, Košice, Žilina, Martin, Zvolen, Martin and Považská Bystrica account for over 3% of total electricity generation in Slovakia. Another activity is to provide support services for the electricity grid.

The Malženice gas-fired power plant (430 MWe) and Bratislava gas-fired power plant (218 MWe) did not generate electricity for a long period yet have combined potential generation of over 3 TWh. Malženice is now in operation. The Malženice power plant is one of the most modern sources of electricity of its type, especially in terms of power range. The Bratislava power plant currently only provides minimum-volume support services for the system.

Renewable electricity sources

Of the total installed capacity of hydro plants of 2 542 MWe, 1 626 MWe is in flow-through plants and 916 MWe in pumped-storage plants. The largest hydroelectric power plant is Gabčíkovo hydroelectric power plant with its installed capacity of 720 MWe. Its annual production (2 200 GWh) represents almost half the total electricity generation of hydropower plants in Slovakia.

Photovoltaic power plants expanded most between 2011 and 2013, when 530 MWe of installed capacity was commissioned, representing a total of 530 GWh of electricity generated through annual usability of 1 000 hours.

There are currently 5 wind turbines in operation with total installed capacity of 3.1 MW and an annual output of approximately 5.5 GWh of electricity. Wind power plants in Slovakia cannot compete with other sources of electricity.

Biomass is currently represented in the energy mix with an installed capacity of 224 MWe and annual generation of 1 185 GWh.

Security and reliability of the Slovak power system

As regards meeting the criteria and recommendations of the European Network of Transmission System Operators (ENTSO-E), good results have been reported in the past period and the security of electricity supply in Slovakia is at a high level. At the same time, the Slovak Republic is meeting all the objectives of the Commission communication on strengthening energy networks.

At all stages of preparation for operation, suitable solutions for the operation of the electricity system of the SR are proposed and the necessary space for maintenance, innovation and construction of power generation equipment is created to ensure the long-term reliable, secure and efficient operation of the system under economic conditions. To address or prevent emergencies, the TSO has a defence plan in place to prevent the occurrence of major disturbances, emergency frequency and voltage change response, and a black-out system recovery plan. Operational safety meets the requirements for electricity transmission and is checked at each stage of preparation for operation annually, monthly, weekly and daily. The release of TS installations is carried out in coordination with neighbouring TS operators at all stages of preparation for operation.

ii. Development projections in relation to existing policies and measures up to at least 2040 (including projections to 2030)

Source base forecast to 2030

The development of electricity consumption will depend on the success of energy efficiency measures, respectively energy savings, and speed of development of electromobility.

It is projected that sufficient electricity should be provided and that there is no need to build more larger sources before 2030. Under the anticipated scenario, the available capacity from the net installed capacity of electricity sources is positive to 2030. Upon completion of EMO 3 and 4, the system will be secure from the point of view of electricity generation even if the largest fossil electricity sources (Malženice, Bratislava, Vojany and Nováky) are not operated.

It is assumed that the total installed capacity will be 8 720 MW in 2030 (7 240 and 9 560 MW under extreme scenarios), of which RES (including the installed capacity of hydroelectric power plants) will be 3 790 to 4 630 MW. The maximum loading will increase in proportion, with a 1.2% year-on-year increase in consumption up to 5 250 MW.

The argument for the current operation of the Nováky power plant is to ensure a secure and reliable electricity supply for the region concerned. After the completion of the reconstruction of the Bystričany power plant in 2023 (conversion to the 400 kV voltage level), this reason will lapse and it will be possible to ensure electricity supply even without the operation of ENO. As ENO A supplies heat to adjacent municipalities and industrial enterprises, there will be a need to ensure the continuity of heat supply.

The long-term operation of the Vojany I power plant (2x110 MW) will only be considered if the return on the necessary investment costs to ensure safe and reliable power output from the power plant to the TS, respectively to the DS, will be acceptable to the facility operator. The Vojany power plant is deployed on a commercial basis and its future operation will remain dependent on the development of prices and market conditions.

Given the development of gas prices in the previous period, the economic efficiency of gas-fired power plants remains a question. A high market gas price and low electricity price would not allow them to operate profitably, and so their future is dependent on the trend in fuel prices and emission permit prices.

By 2030, it will be necessary to address the replacement of approximately 530 MWe of existing photovoltaic power plants that were connected to the grid between 2010 and 2012. These power plants are subject to contracts with a feed-in subsidy guarantee for 15 years, which means there will be a loss of financial support between 2025 and 2027 and we can therefore expect them to be disconnected from the system.

The hydropower potential of the SR is currently utilized at 71% and there is theoretically potential for the construction of new power plants with an installed capacity of 241 MWe and annual generation of 1 900 GWh. Given the investment intensity of construction, the demanding EIA and public opinion turning against such large-scale projects, no significant construction of new hydropower plants is anticipated.

In the preceding period, certificates of compliance of the investment plan with the energy policy were issued for potentially prepared new-source projects:

The Sereď Hydroelectric Power Plant project is aimed at exploiting the unused energy potential of the Váh River in the Sereď - Hlohovec section for generating electricity of around 180 GWh per year. A dam with a lock is a part of the Váh waterway project and its completion will create a fairway from Komárno to Hlohovec. The main obstacle to the implementation of the work is the long-term return on investment at current electricity prices.

The New Nuclear Source (NNS) at the Jaslovské Bohunice site with a total installed capacity of 1 200 MW would be one of the most promising prospective Slovak energy industry projects if implemented.
From the point of view of the overall balance of the Slovak Republic regulatory area, the construction of the NNS would be more effective if it was considered a substitute for the existing EBO V2 power plant. The simultaneous operation of EBO V2 and the NNS would place additional demands on the electricity system of the SR, and extensive investments on the transmission system of the SR side due to the large accumulation of installed power in practically a single point of the transmission system. To ensure the export of electricity abroad, the affected parts of the transmission system of the SR for electricity export would have to be significantly strengthened. The NNS with an installed capacity of 1 200 MW would require additional regulatory power in the defined territory of the Slovak Republic in case of the failure of this large electricity source to ensure compliance with common standards valid in the interconnected ENTSO-E system when the source is connected to the system. In view of the announced EBO V2 lifetime extension, confirmed through the implementation of specific technical and safety measures as required by the Nuclear Regulatory Authority of the SR, and also in view of the need to meet anticipated demand, the commissioning of the NNS will only be possible after 2035.

The construction of the New Nuclear Source would also be in accordance with the direction taken by the Slovak Republic, namely decarbonisation of the Slovak economy. The main parameter for assessing the justification for the construction of the source will be the future development of electricity consumption in the Slovak Republic. The construction of the New Nuclear Source must therefore be conditional on its sufficiency. The projections elaborated within the “Low-Carbon Study” project confirm the possibility of replacing end-of-life nuclear sources through the construction of the NNS after 2045. The New Nuclear Source will also be assessed in the given period with regard to the most modern existing technologies and its competitiveness (technical and economic).

The Ipeľ Pumped Hydropower Project, with a proposed installed capacity of 560 MW, represents significant potential for providing a wide range of support services. This is a weekly cycle pumped hydro source that is able to move weekend “surplus” energy from nuclear power plants to peak load on weekdays. It is also an optimum balancing factor for the output of wind and photovoltaic power plants. Implementation of the project will depend on the growth of the international electricity market and interest from a strategic investor.

It is also possible to assess the feasibility of using hydro energy potential within the comprehensive use of the Danube above Bratislava and increased production of bioethanol at Enviral Leopoldov, with installed capacity of 15 MW in the form of CHP from RES.

Even with the construction of relatively small local, widely distributed power sources with relatively limited installed power, an installed power increase of several tens of MW can be anticipated in the coming years. This generation is highly efficient especially through the use of the latest technologies, esp. CHP, and because of its proximity to the customer does not place increased demands on transmission capacity.

4.5. Dimension: internal energy market

4.5.1. Electricity interconnectivity

i. Current interconnection level and main interconnectors[54]

The current level of interconnection of the transmission system including the main interconnection lines is shown in the following Table 65, while Figure 44 documents the current actual transmission capability of main interconnectors.

Table 65 Transmission capacity of cross-border lines

Prenosové kapacity cezhraničných vedení

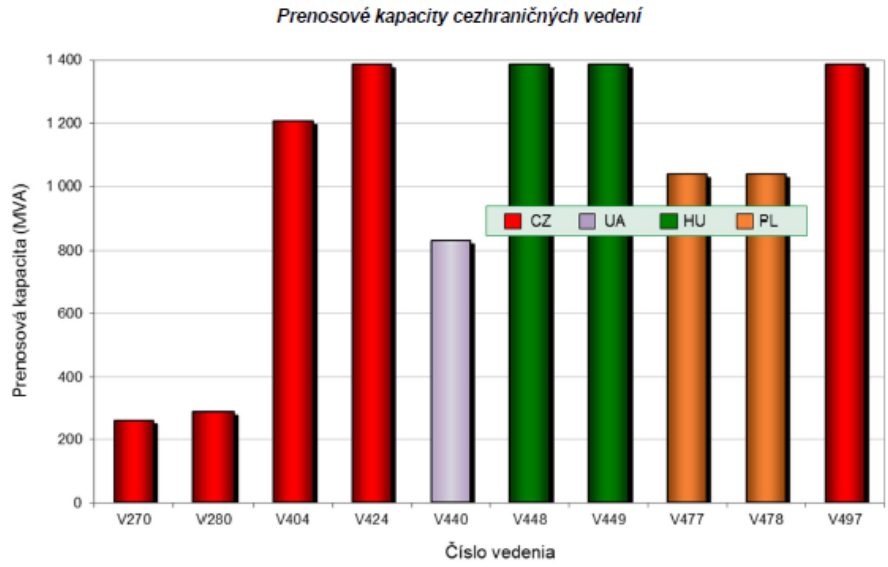
Vedenie	Elektrická stanica			Elektrická stanica SK		Napätie kV	I_{max} A	Limitovaná prenosová kapacita MVA
	krajina	názov	spoločnosť	názov	spoločnosť			
V270	CZ	Liskovec	ČEPS	Pov. Bystrica	SEPS	220	683	260
V280	CZ	Sokolnice	ČEPS	Senica	SEPS	220	755	288
V404	CZ	Nošovice	ČEPS	Varín	SEPS	400	1 740	1 206
V424	CZ	Sokolnice	ČEPS	Križovany	SEPS	400	2 000	1 386
V440	UA	Mukačevo	WPS	V. Kapušany	SEPS	400	2 000	1 386
V448	HU	Győr	MAVIR	Gabčíkovo	SEPS	400	2 000	1 386
V449	HU	Göd	MAVIR	Levice	SEPS	400	2 000	1 386
V477	PL	Krosno - Iskrzynia	PSE	Lemešany	SEPS	400	1 500	1 039
V478	PL	Krosno - Iskrzynia	PSE	Lemešany	SEPS	400	1 500	1 039
V497	CZ	Sokolnice	ČEPS	Stupava	SEPS	400	2 000	1 386

Key:

Vedenie	Line No.
Elektrická stanica	Sub-station
krajina	Country
názov	Name
spoločnosť	Company
Napätie kV	Voltage kV
I_{max} A	I_{max} A
Limitovaná prenosová kapacita MVA	Limited transmission capacity MVA

[54] With reference to overviews of existing transmission infrastructure by transmission system operators (TSO).

Figure 44 Transmission capacities of cross-border lines



Key:

Číslo vedenie	Line No.
Prenosová kapacita MVA	Transmission capacity MVA

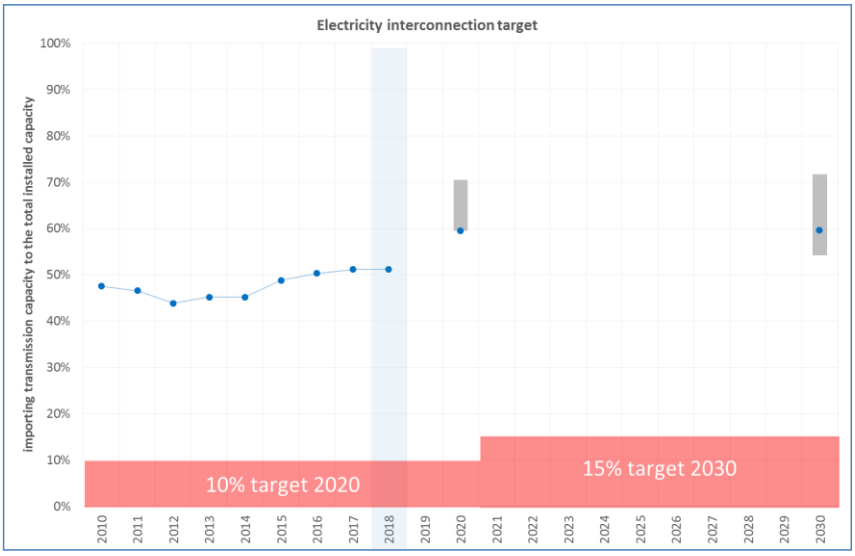
Note: Permissible current loads of the V440 V. Kapušany - Mukachevo (UA) and V449 Levice - Göd (HU) are seasonally adjusted. At present, the V440 line current load rating is 1609 A (summer 1200 A) and V449 is 2000 A (summer 1800 A).

ii. Projections of interconnector expansion requirements (including up to 2030)[55]

The total thermal capacity of the Slovak border crossings is now 10 200 MVA (9 306 MW); by 2030 this should reach 14 000 MVA (12 203 MW). The trend in the overall level of Slovak interconnection by 2030 and its dispersion with respect to trends in the source mix, i.e. the ratio of the assumed net import transmission capacity to the total anticipated installed electricity generation capacity in the SR is shown in Figure 45.

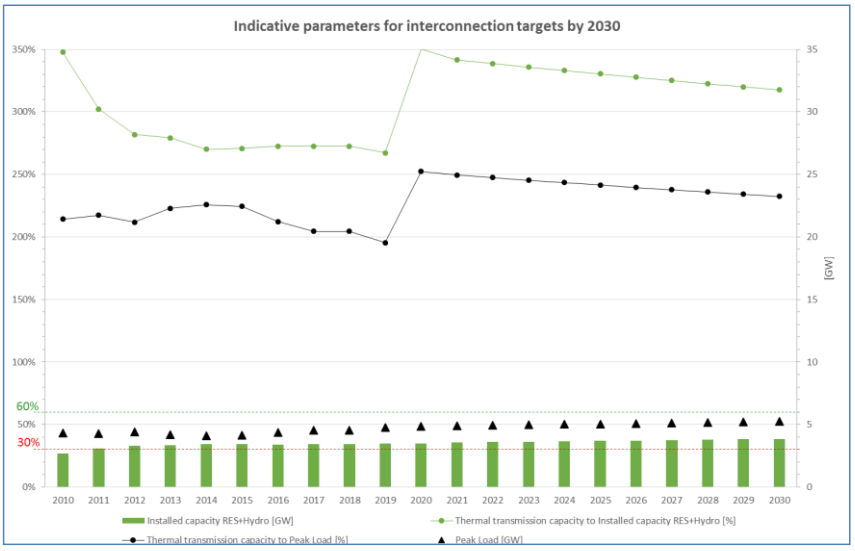
Figure 45: Indicative electricity interconnection targets

[55] With reference to national network development plans and regional investment plans of TSOs.



The anticipated trend in the indicative parameters for interconnection, due to achieve a minimum of 30% of import of the anticipated maximum load and 30% of export of installed RES output including hydroelectric power plants is shown in the following figure.

Figure 46 Estimated trend in indicative interconnection parameters



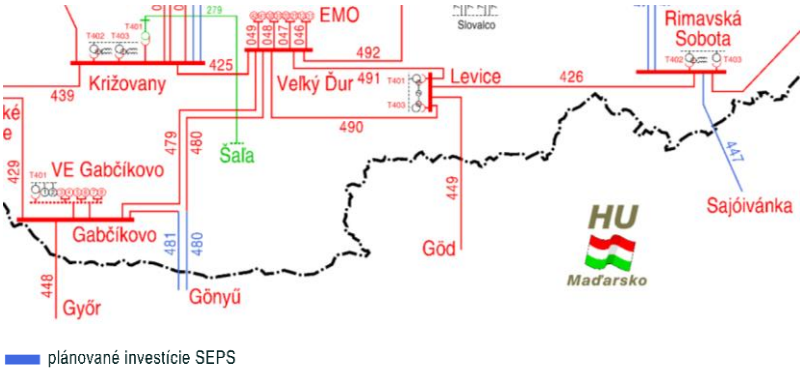
It is clear from this that the 15% target by 2030 will be met as well as the indicative parameters. The price difference between business zones will depend on the electricity market in 2030.

The values of the maximum transmission capacities on the individual cross-border profiles of the transmission system of the SR were calculated for the 2023 and 2028 development time horizons for the import and export directions of power flows on SR cross-border profiles with checks of the validity of the basic N-1 safety criterion only in the transmission system of the SR. The calculation of transmission capacity values at cross-border profiles depends in particular on the topology and system connection, the location and deployment of the electricity generating equipment, and the maximum permissible current loads on the TS lines.

The values of maximum transmission capacities on SR cross-border profiles are calculated for the basic network connection state, the production of electricity generating equipment and the loading of the electricity system of the SR considered for separate development time horizons (Y+5 and Y+10). The operating transmission capacities on SR cross-border profiles, determined for the current situation, maximum Y+1, are also calculated taking into account the current system connection, the deployment of electricity generating equipment (maintenance of power generation facilities and elements of the transmission system of the SR) and the loading of the electricity system of the SR at the given calculated hour. For the current state, respectively for the Y+1 horizons, tradable transmission capacities are also determined that already take into account the necessary safety provisions for unexpected events and for the large differences between trading and real power flows, so-called circular flows, the TS operator was able to meet the basic N+1 security criterion. Taking these states into consideration, which can only be estimated very poorly for the coming years, the tradable transmission capacity values for 2023 and 2028 would be lower than the maximum transmission capacity values.

Based on the results of calculations of transmission capacities on SR cross-border profiles in the 2023 and 2028 time horizons, we can state that the construction of new 2x400 kV cross-border lines Gabčíkovo (SR) - Gönyű (HU) - Veľký Ďur (SR) and 400 kV R. Sobota (SR) - Sajóivánka (HU) will significantly increase the maximum transmission capacity at the SR-HU cross-border profile – by about 85% in the export direction and about 47% in the import direction. The commissioning of the new SR-HU lines would have a minimum or even negligible influence on the maximum transmission capacity of other SR cross-border profiles.

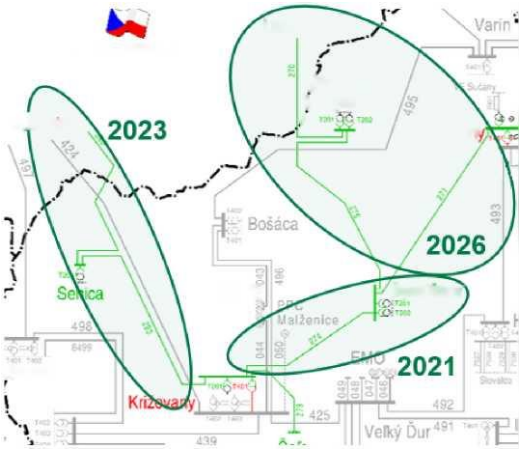
Figure 4: Schematic view of the planned investment project for the construction of new cross-border lines on the SR-HU profile



Planned SEPS Investment

The shutdown of the 220 kV system in central and western Slovakia, mainly the 220 kV cross-border lines on the SR-CZ profile, and the increase in the maximum current carrying capacity of the V404 Varín (SR) – Nošovice (CZ) line to 2 000 A, in comparison to the 2023 time horizon, namely the shutdown of the 220 kV cross-border line on the V280 Senica (SR) – Sokolnice (CZ) SR-CZ profile with the connection of the new R400 kV Senica to the existing V424 Križovany (SR) – Sokolnice (CZ) line, will increase the maximum transmission capacity on the SR-CZ profile in the import direction by 35%, while in the export direction the increase will be negligible. For the other cross-border profiles under consideration, the shutdown of the 220 kV system in the western part of the transmission system of the SR and the increase in the permissible current carrying capacity of the V404 line will have a minimum, respectively negligible, impact (maximum 3%).

Figure 5 Shutdown of the 220 kV cross-border lines on the SR-CZ profile



In the 2022 time horizon, SEPS intends to shut down the V280 Senica (SR) - Sokolnice (CZ) 220 kV cross-border line on the SR-CZ profile as part of the planned phase-out of the 220 kV part of the TS in central and western Slovakia. In the 2026 time horizon, SEPS is considering the shutdown of the V270 Považská Bystrica (SR) – Lískovec (CZ) 220 kV cross-border line. These topological changes mean that the total transmission capacity in the import and export directions on this profile may be reduced by approximately 10% of the current maximum value in both directions, as confirmed by the results of the SEPS and ČEPS joint study calculations. One of the main general recommendations of this study for both companies to achieve the greatest reduction in the period with reduced maximum transmission capacity on the CZ-SR profile due to the complete shutdown of the 220 kV cross-border lines, is synchronisation of the planned investment measures of both sides in both material and temporal terms. To eliminate the consequences of reducing the maximum transmission capacity on the CZ-SR profile, by 2025 at the V404 Nošovice (CZ) - Varín (SR) cross-border line the maximum permissible current carrying capacity will increase from 1 740 A to approximately 2 000 A, on the ČEPS side through the complete reconstruction of the line in 2018 and on the SEPS side through the building of a new single 400 kV line between 2024 and 2025. The above planned investments on both sides will not only compensate for the impact of the shutdown of the 220 kV cross-border lines, but will also present the possibility of further increasing the maximum transmission capacity on the CZ-SR profile. In the future, both SEPS and ČEPS aim to continue to synchronize, as far as possible, the planned investment actions in material and temporal terms to reduce the period with a reduced

maximum transmission capacity on the CZ-SR profile as much as possible resulting from the complete shutdown of the 220 kV cross-border lines.

These described topological changes in the 220 kV Slovak TS have a negligible impact on the TTC values of other SR cross-border profiles, and there is also no significant change in the maximum transmission capacities for the 2028 time horizon on these cross-border SR profiles.

All the above mentioned considerations and assumptions about the development of the TTCs of the individual cross-border SRS profiles in the 2023 and 2028 time horizons are based on the analyses and assumptions of SEPS and ENTSO E. The TTC values of the development horizons analysed for 2023 and 2028 should be understood as informative and non-binding annual values that apply exclusively to the analysed development variants for the Slovak TS. The NTC values for the next period are, or will be, specified by the SEPS electricity dispatching.

4.5.2. Energy transmission infrastructure

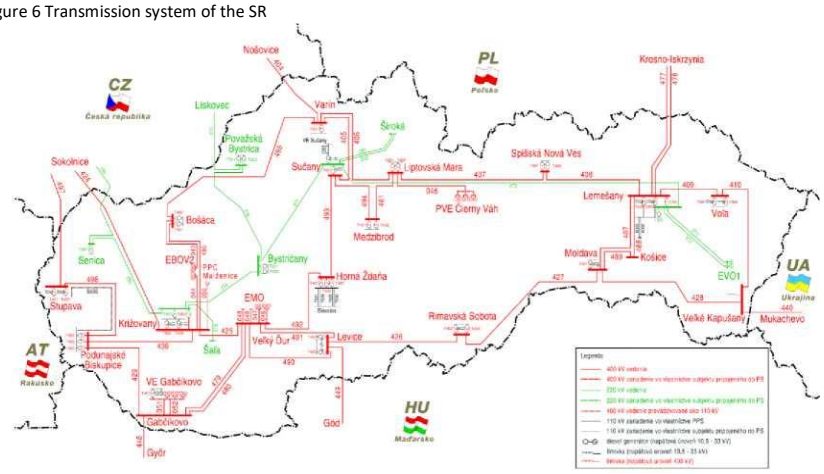
i. Key characteristics of the existing transmission infrastructure for electricity and gas[56]

Characteristics of the transmission system of the SR

The transmission system of the SR is above all a set of electrically interconnected 400 kV, 220 kV technology devices, 110 kV in selected equipment, via which transmission is achieved of electricity from its generators to individual customers for the transmission system of the SR (TS SR) as well as cross-border transmission of electricity. These are, in particular,

- national and cross-border 400 kV, 220 kV lines and selected 110 kV lines,
- 400/220 kV, 220/110 kV and 400/110 kV transformers,
- 400 kV, 220 kV substations and selected 110 kV substations,
- compensating devices.

Figure 6 Transmission system of the SR



56 With reference to overviews of existing transmission infrastructure by TSOs.

The TS SR also includes the relevant support, so-called secondary installations without which transmission and control of the Slovak electricity grid would not be possible. These are management information systems (MIS), commercial metering, protection and automation systems, telecommunication transmission devices, and so on. Users of the TS SR are also directly connected to the TS SR by means of their electrical equipment; these users are:

- three regional distribution system (DS) operators,
- five electricity customers,
- four electricity generators.

In addition, the TS SR is synchronously connected to adjacent transmission systems to the following extent:

- two single 220 kV interconnections and three single 400 kV connections to the Czech Republic (CZ),
- one double 400 kV link to Poland (PL),
- one single 400 kV link to Ukraine (UA),
- two single 400 kV connections to Hungary (HU).

Through these interconnections, the Slovak electricity grid is synchronously connected with TSs in Europe, the operators of which are together with SEPS part of ENTSO-E.

Electricity lines

The individual stations in the TS SR are galvanically connected by means of forty-six 400 kV transmission lines with a total length of 2,138 km, seventeen 220 kV transmission lines with a total length of 826 km and seven 110 kV transmission lines with a total length of 80 km. Of the total number of 400 kV and 220 kV transmission lines, the TS SR has eight 400 kV and two 220 kV cross-border lines, together with a total length of about 444 km in the SR, connecting the TS SR with the neighbouring CZ, HU, PL and UA transmission systems.

Further information - for example, on the number of masts, is published at the TSO SEPS web site (https://www.sepsas.sk/TechnickeÚdaje.asp?kod=16).

Characteristics of the gas transmission network

The transmission network is characterised in legislation as: 'A network of compressor stations and a network of high-pressure gas pipelines interconnected and serving to transport gas within the defined territory, without the extraction network and storage and high-pressure pipelines serving primarily to transport gas to a part of the defined area'.

One company is active in gas transmission in Slovakia – eustream, a.s. – the operator of the national transmission network. Based on the decision of the Government of the Slovak Republic of 28 November 2012, the form of separation was determined according to the requirements of European legislation using the Independent Transmission Operator (ITO) model.

In 2018 a total of 59.7 billion m^3 of natural gas was transported. This amount means eustream, a.s. continues to be one of the most important gas transporters within the EU, based on volume.

The transmission network is made up of parallel DN 1200 and DN 1400 pipes in four to five lines, the total length of the pipelines in the transport network is almost 2 270 km. The transmission network includes 4 booster stations (BS) – BS Veľké Kapušany, BS Jablonov nad Turňou, BS Veľké Zlievce and BS Ivanka pri Nitre – which ensure the pressure differential required for continuous gas flow with a total output of 600 MW. They are located about 110 km from one another. The total transmission deliverability is more than 90 billion m^3 annually. From the transmission network, natural gas within the defined area passes through the national interconnection stations into the distribution system and is transported to final customers.

The connection between Slovakia and the neighbouring countries at the transport networks level currently exists with Austria [Baumgarten crossing point], the Czech Republic [Lanžhot crossing point], Hungary [Velka Zlievce crossing point] and Ukraine [Velké Kapušany crossing point and Budinka crossing point].

Table 66: Interconnection capacities of the Slovak transport network and surrounding transport networks:

Border crossing point	**Output fixed capacity (GWh/day)**	**Input fixed capacity (GWh/day)**
Veľké Kapušany [SR/UA]	0	2 028.0
Budince [SR/UA]	280.8	176.8
Baumgarten [AT/SR]	1 570.4	247.5
Lanžhot [CZ/SR]	400.4	696.8
Veľké Zlievce [SR/HU]	126.9	0

ii. Projections of network expansion requirements at least until 2040 (including up to 2030)[57]

By 2040, the SEPS TS operator is considering the reinforcing the SR-CZ profile by 1x400 kV line from Ladce (SR) - Otrokovice (CZ). According to the information in point 2.4.2 ii, this is to minimise the impact of the planned shutdown of the 220 kV TS on the SR-CZ profile, or more exactly, on the TS SR and TS CZ. It is a realistic assumption that preparation of this project will begin after 2025 so that the line will be commissioned around 2032, with SEPS as well as ČEPS trying to shorten this term as much as possible. For this purpose SEPS and ČEPS have signed a Memorandum of Cooperation, where both companies have declared their willingness to coordinate cooperation on their operational and developmental plans on the SR-CZ profile. For the 2030-2040 timescale, SEPS is not considering building further cross-border connections. A 2x400 kV SR - PL line and a fifth line between SR and HU are at the consideration and potential planning stage. There are no discussions on this subject between SEPS and the neighbouring TS concerned.

After a long break, communication was established with the TSO operator in Ukraine, the company NPC Ukrenergo. The Slovak-Ukraine cross-border profile is often a bottleneck (as is the profile to Hungary) in cross-border electricity transmission and causes operational and management problems for electricity dispatching in Slovakia. The "Restoration of the 400 kV Mukacheve (UA) - Veľké Kapušany (SR) line" project was included in the PECI/PMI 2018 list, approved by the Energy Community Ministerial Council in November 2018. The anticipated deadline for the comprehensive

[57] With reference to national network development plans and regional investment plans of TSOs.

renewal of the V440 line in the Slovak Republic is 2030. However, this must be done using new calculations around 2023. Ukraine will have completed its plan to reconstruct this line on its side by that time.

Implementation of investment plans by the transmission system operator

Following the decision on the gradual phase-out of the 220 kV system, TS SR development is focused mainly on the development of the 400 kV system from the point of view of the transmission infrastructure (TS/DS lines and transforming). The controlled phase-out of the 220 kV TS is long-term, technologically and organisationally, a time- and cost-intensive task requiring repairs of TS 220 kV equipment to the extent necessary, via maintenance work or partial reconstruction to ensure the operation of some 220 kV systems until around the year 2025 when they will be at the limit of their technical and reasonable life, or beyond.

A significant impact on the development of the 400 kV TS comes in particular from the development of new generating capacities and the change in their structure both in the Slovak Republic and in neighbouring countries. Both factors have a direct or indirect impact on the loading of the Slovak energy grid, which implies a need to strengthen TS SR infrastructure. In addition, the strategic goal of the SR in electricity generation is directed towards an export balance for the Slovak Republic (EMO 3,4, decentralised production and RES, and also a New Nuclear Source around 2035), which has, or will have, an effect on the load on cross-border profiles through export flows. The enhancement, and associated strengthening of, the 400 kV TS , in addition to the aforementioned gradual phase-out of the 220 kV TS, are also conditional on no less important impacts, either in the form of existing investment plans, as well as potential new 400 kV TS users or indirectly impacting impulses from lower voltage level individual distribution systems (particularly in terms of decentralised production), as well as through external influences such as transit flows, typically from north to south. The TS operator has to respond flexibly to these impacts, which, in view of the TS operator's development plans, leads to necessary planning and implementation of both national and cross-border investment projects.

Information about the TSO's investment plans is provided every two years through the Ten-Year Plan for the Development of the Transmission System (the most recent document covers 2020 to 2029). Information on selected SEPS projects is also available in the ENTSO-E Ten-Year Network Development Plan, the current version of which is available at http://tyndp.entsoe.eu/.

Implementation of investment plans by the distribution system operator

The permanent objectives are to strengthen the critical points of the system, to renovate the system in terms of its physical condition, to comply with quality standards, to reduce electricity distribution losses and to connect new supply points. The investment activity reflects the actual development and quality needs of the distribution system, previous developments, as well as the legislative requirements on a distribution system operator. Quality of distribution and trouble-free operation of the distribution system is very important for customers. Planned activities and investments in the distribution system are aimed at achieving the expected quality of service, and SSE-D is making every effort to meet customer expectations. The investment process is divided into three basic chapters - new connections, quality and increase in the transmission capacity of lines and other investments related to distribution activity.

NEW CONNECTIONS

Under this investment chapter, development actions for the construction of the distribution system have been addressed because of the need to connect larger supply points to high voltage, such as industrial parks, multifunctional buildings and commercial premises, as well as the connection of new

supply points to low voltage, such as standard supply points (family houses, apartment developments, smaller business premises, and civic amenities). Under this chapter in 2017, 214 constructions were completed for low- and high-voltage and EUR 8.49 million invested.

QUALITY AND INCREASE IN TRANSMISSION CAPACITY

From the point of view of investment construction in the quality and increase in transmission capacity, in 2017 178 structures were built for low- & high voltage level and 21 structures for very high voltage at a total annual investment cost of EUR 23.74 million. The purpose of these investments was to ensure the reliability and continuity of electricity distribution. The continuing priorities of this construction were compliance with qualitative parameters, elimination of the unfavourable physical condition caused by external influences and the age of the equipment, reduction of the fault rate, modernisation of the facilities, deployment of elements with remote monitoring and control functions and improvement in the possibilities for electricity distribution. These contribute towards reducing the SAIDIP parameters, i.e. the planned downtime in client-minutes, and SAIFIP, i.e., the planned downtime frequency in client-downtime events.

MAIN ACTIVITIES AND INVESTMENTS FOR DISTRIBUTION SECTOR DEVELOPMENT

In order to ensure the development and stability of the distribution system, significant projects for the very high voltage distribution system were implemented in the year 2017 and prepared for the upcoming period. In particular, these were the construction of the new 110/22 kV substation Novaky, which will ensure safe and reliable supply of customers with regard to the needs of Slovenské elektrárne, a.s. in the plants of Elektrárne Nováky (power supply and supply of own requirements) and Fortischem, a.s., Nováky (supply from the transmission system), preparation for the application of European Commission regulations on Requirements for Generators (RfG) from the point of view of access and connection to the distribution system, preparation of connection conditions for nodal areas Liptovská Mara - Sučany and Liptovská Mara - Spišská Nová Ves to ensure higher operational reliability of electricity distribution and more.

The company VSD operates an extensive distribution system, which accounts for nearly 22 000 km of power lines at very high voltage, high voltage and low voltage. At very high voltage, the distribution system is powered by four higher-level transmission system power stations with a voltage level of 400 kV and 220 kV. At very high and high voltage, the company operates 57 electrical transformer and switching stations. Reliable and secure distribution of electricity to all company customers, independent of the voltage level of the connection, is ensured by VSD by the set-up of all internal processes such as planning for the renewal and development of the distribution system, setting up and overseeing compliance with technical standards in respect of distribution reliability quality, and increasing the overall efficiency of electricity distribution. Level of reliability of electricity distribution. In 2017 as well, VSD succeeded in maintaining the distribution network reliability index at a favourable level of 99.96% ASAI (Average Service Availability Index), also taking into account weather and distribution interruptions caused by third parties. A programme of systematic renewal and modernisation of networks in eastern Slovakia also made a significant contribution towards this result, with the help of which our company can ensure a high-quality electricity distribution for new investors and the growing economy. Investments in renovation and modernisation of the distribution system. It is in the long-term interests of VSD to have reliable and safe operation of the distribution system. It directs its decisions in proposing investment plans in line with this basic objective. In 2017, VSD invested EUR 44.1 million into its system (2016: EUR 43.7 million), with the largest amount of funds invested as usual in system renewal to further improve customer service.

Investments in automation and innovative technologies are an essential and natural effort on the part of VSD to increase the quality of services provided, not only in the area of electricity distribution but also in areas such as the provision of metered electricity values through the eVSD customer portal, but also for more comfortable communication with the customer. In 2017, VSD invested in innovative technologies in the field of communication and transmission of measured and monitored

data from the customer to VSD information systems, focusing on communication technologies related to the operation of smart metering, especially in the areas of: LoRa – (Long Range Radio Communication) and PLC – (Power Line Carrier).

4.5.3. Electricity and gas markets, energy prices

i. Current situation of electricity and gas markets, including energy prices

A problem of the current EU electricity market having an impact on the electricity market in the Slovak Republic and neighbouring markets is that the market is fundamentally distorted by various subsidies and grants in particular in the development of renewable energy sources. The increase in the volume of renewable sources (mostly photovoltaic and wind power) has been achieved through the introduction of support schemes in the form of direct operating subsidies, essentially throughout the EU, including the SR. Wholesale electricity prices are also negatively influenced by the existence of capacity mechanisms that are already in place or are being introduced in some countries. This caused low market prices, which have recently begun to grow. As a result of this is that the EU's energy system as a whole suffers from the shutting down of conventional and flexible resource capacities and insufficient investment in new capacities.

To address the challenges of the current EU electricity market, the European Commission has presented a proposal for EU Electricity Market Reform (a new electricity market design) under the "Clean energy for all Europeans" package. The third liberalisation package was not designed for the current and a future source base with a high proportion of decentralised and variable renewable resources. This package is a reflection of the Energy Union concept in concrete legislative proposals and should form the basis for implementing the EU's climate and energy targets by 2030 in the electricity sector. It represents a vision of the organisation of the market in the 2030 horizon.

The aim is to achieve better electricity market preparedness for a change the energy system (energy transformation). The aim is to provide the right investment signals as well as the market and energy market flexibility required for the market integration of new production sources, especially volatile renewable sources. At the heart of the energy transformation are end-users, who will get more rights and the option to choose their electricity suppliers as well as to produce electricity and supply it to the network.

From the perspective of the SR, it is particularly important that the future model of the EU electricity market does not jeopardise the security of electricity supply and does not lead to increased end-user electricity prices.

There have been no significant changes in gas supply for Slovak gas customers. Due to the size of the gas market in the Slovak Republic and the relatively stable natural gas prices that fell slightly during 2019, this trend should remain unchanged and neither a significant increase in the number of customers nor the entry of new suppliers into the energy market in Slovakia is anticipated.

The price of electricity and gas depends on a range of different supply and demand conditions, including the geopolitical situation, the national energy mix, diversification of imports, network costs, environmental protection costs, adverse weather conditions or excise rates and taxation, as well as government measures reducing energy prices.

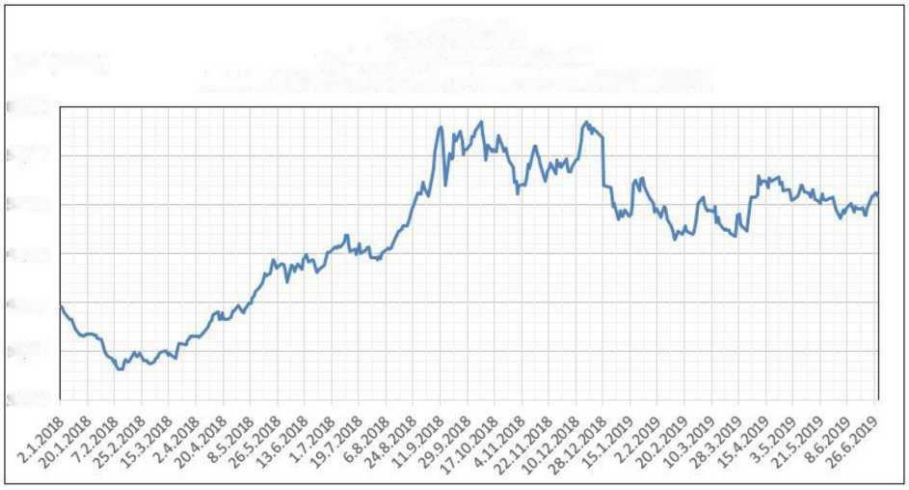
The Slovak Ministry of Economy has prepared measures to increase the competitiveness of enterprises in the form of compensation for the tariffs for the operation of the system for energy-intensive enterprises that meet the conditions specified in the amendment to the Act on the Promotion of Renewable Energy Sources.

Also, the reform of the system to support the production of electricity from renewable energy sources and cogeneration of electricity and heat will ensure the cost-effectiveness of the support system, while minimising the impact on end-user energy prices.

Electricity market

In the wholesale electricity market, the Authority's competences are only in the creation of legislative conditions and in compliance monitoring.

Figure 47 Electricity price trends in 2018-2019



The decisive participants in the electricity market in the Slovak Republic are:

- **Slovenské elektrárne, a.s.** - the major producer of electricity, which in 2018 provided 68.65% of electricity generation in the Slovak Republic from its own sources. Electricity generation in the amount of 18 638 GWh provided 60.22% of electricity consumption within the Slovak Republic. The installed capacity of Slovenské elektrárne, a.s. for electricity generation was 4 081 MW,

- **encouraging generators of electricity from renewable energy sources and high-efficiency cogeneration**. For 2017, the amount of electricity generated from renewable energy sources at a surcharge was estimated to be 2 780 GWh and the amount of electricity produced by high-efficiency cogeneration of electricity and heat at a surcharge was 2 316 GWh,

- **Slovenská elektrizačná prenosová sústava, a.s.** as the sole holder of a permit for electricity transmission , the transmission system operator, also fulfilling the tasks of energy dispatching (provided an equalised balance on the defined territory of the Slovak Republic),

- **OKTE, a.s.**, organiser of the short-term electricity market as an institution for evaluating and organising the short-term electricity market and ensuring the clearing, assessment and settlement of variances in the Slovak Republic,

- **Západoslovenská distribučná, a.s., Stredoslovenská distribučná, a.s. and Východoslovenská distribučná, a.s.** are the exclusive operators of the regional distribution systems in the relevant parts of the defined territory, to which more than 100 000 supply points were connected. In addition to these three distribution companies, 157 holders of permits to distribute electricity were also active in the electricity market. These were operators of local distribution systems in production and non-production facilities, to which less than 100 000 supply points were connected,

Currently, 439 entities have business licenses in the electricity sector.

Retail market

The adoption of Act No 250/2012, on regulation in network industries, introduced price regulation of the supply of electricity to vulnerable customers, which are household customers and small enterprises.

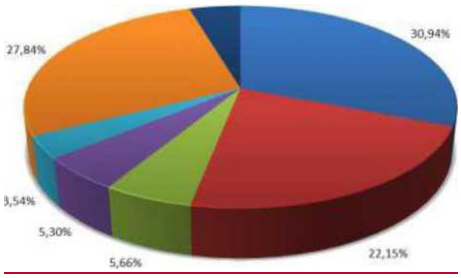
Price regulation in electricity supply covers:

- electricity supply to households
- electricity supply to small firms
- electricity supply by the supplier of last resort.

Electricity supply to households

Maximum electricity prices for households have two components and consist of a monthly payment per single supply point and of the price for electricity supplied in the low or high band. Electricity supply for households is divided into eight tariffs.

Figure 48 Structure of electricity prices for households



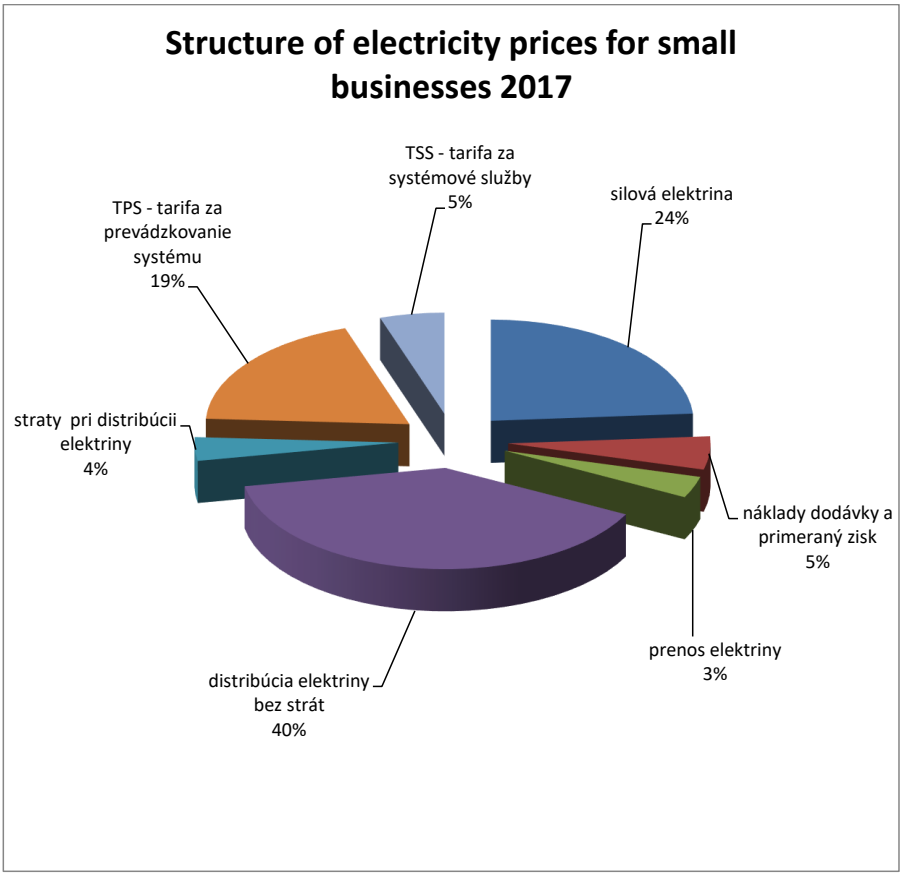
Key:

silová elektrina	power
tarifa za systémové služby	system services charge
prenos elektriny vrátane strát	electricity transmission including losses
straty z distribúcie elektriny	electricity distribution losses
tarifa za prevádzkovanie system	system operating charge
náklady dodávky a PZ	cost of supply and reasonable profit
distribúcia elektriny bez strat	electricity distribution without loss

Electricity supply to small enterprises

A small enterprise is considered to be an end-user of electricity with an annual electricity consumption for all its supply points of no more than 30 000 kWh in the year prior to the submission of the draft price. The supply of electricity to small enterprises has been divided into 11 tariffs.

Figure 49 Structure of electricity prices for small enterprises 2017



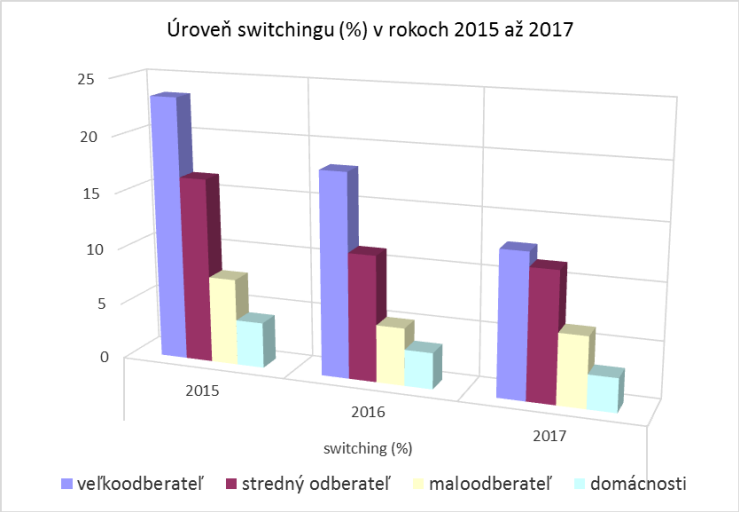
Key:

silová elektrina	power
TSS - tarifa za systémové služby	system services charge
prenos elektriny	electricity transmission
straty pri distribúcii elektriny	electricity distribution losses
SOT - tarifa za prevádzkovanie system	system operating charge
náklady dodávky a primeraný zisk	costs of supply and reasonable profit
distribúcia elektriny bez strat	electricity distribution without loss

Switching electricity supplier

In order to assess the level of liberalisation of the electricity and gas markets, a percentage coefficient is used, so-called switching, which expresses the ratio of the number of supply points with a change of electricity or gas supplier to the total number of supply points that year.

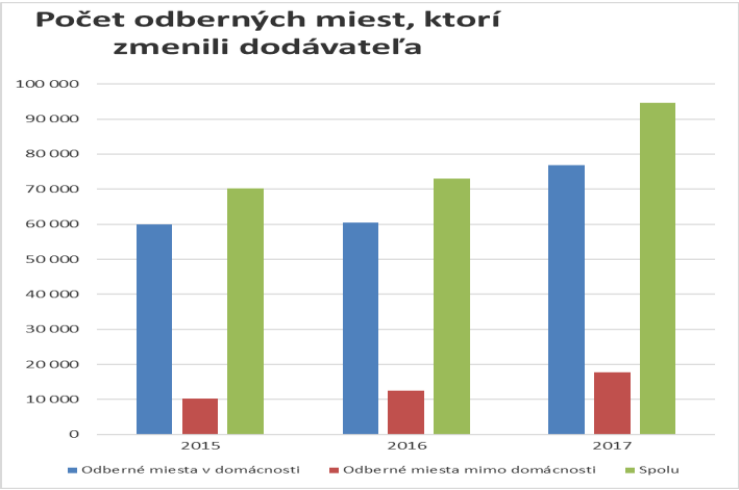
Figure 50 Ratio of the number of supply points with a change of electricity or gas supplier to the total number of supply points



Key:

Úroveň switching (%) 2015-2017	Incidence of switching (%) 2015-2017
veľkoodberateľ	major customer
stredný odberateľ	medium customer
maloodberateľ	small customer
domácnosti	households

Figure 51 Number of supply points with change of supplier



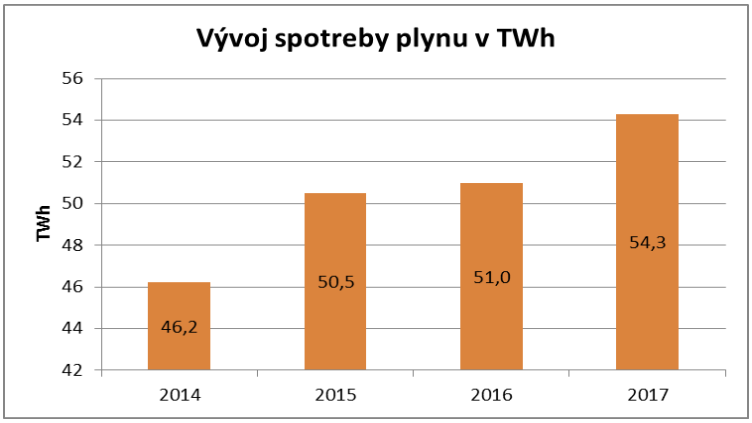
Key:

Počet odberných miest, ktori zmenili dodávateľa	Number of supply points with change of supplier

Odberé miesta v domácnosti	Household supply points
Odberé miesta mimo domácnosti	Non-household supply points
Spolu	Total

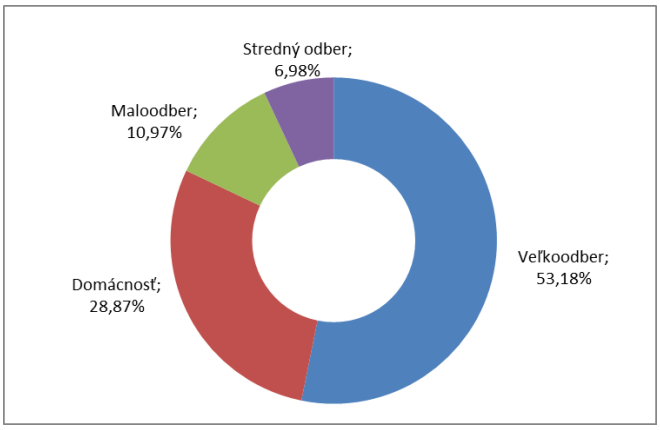
Gas market

Figure 52 Gas consumption 2014-2017



Key:
Vývoj spotreby plynu v TWh Gas consumption (TWh)

Figure 53 Gas consumption in 2017 broken down by customer category



veľkoodberateľ	major customer
stredný odberateľ	medium customer
maloodberateľ	small customer
domácnosti	households

The highest share of gas consumption in the SR, up to 53.18%, are traditionally industrial customers included in tariff groups for which annual gas consumption at the supply point reached more than 4 000 000 kWh. The share of households in total gas consumption in the SR is 28.87%

Gas market participants

- the transport network operator (eustream, a.s.),
- the distribution network operator on a defined territory of the Slovak Republic (SPP - distribúcia, a.s.),
- 40 operators of local distribution networks,
- two storage operators,
- 28 gas suppliers,
- gas customers.

Wholesale market

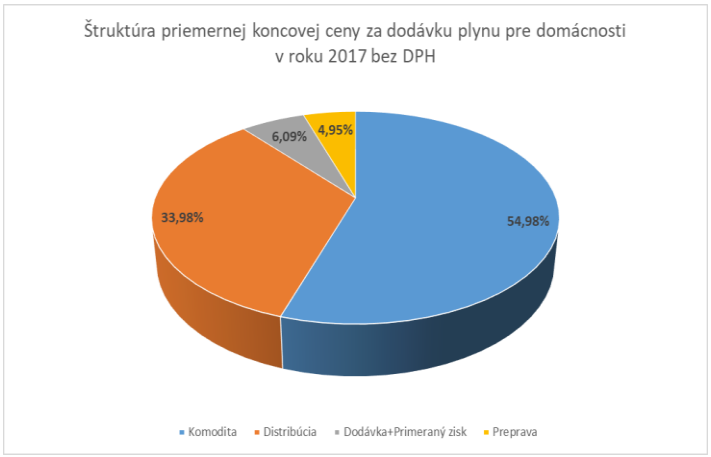
The wholesale gas market is characterised by:

- the purchase of gas based on long-term contracts,
- the purchase of gas on commodity exchanges,
- the purchase of gas from another trader - gas supplier
- trading at the virtual point of trade of the transport system operator
- trading, respectively. by a change in ownership of stored gas in underground storage facilities.

Retail market

Maximum gas supply prices for vulnerable customers were comprised of two components, a maximum fixed monthly rate and a maximum gas tariff for gas supplied. Consumer tariffs were divided into six tariff groups 1 to 6 according to the amount of gas consumed annually. A vulnerable gas consumer according to the Regulatory Act is a household gas customer or a gas subscriber in the small business category. A small business within the meaning of the Regulatory Act is a natural gas customer with an annual gas consumption at all supply points of up to 100 000 kWh in the previous year and is part of the vulnerable consumers group.

Figure 54 Structure of average end-price for gas supply to households 2017



Key:

veľkoodber	Major customer
stredný odber	Medium customer
maloodber	Small customer
domácnosti	Households

Table 67: Structure of supply points and switching

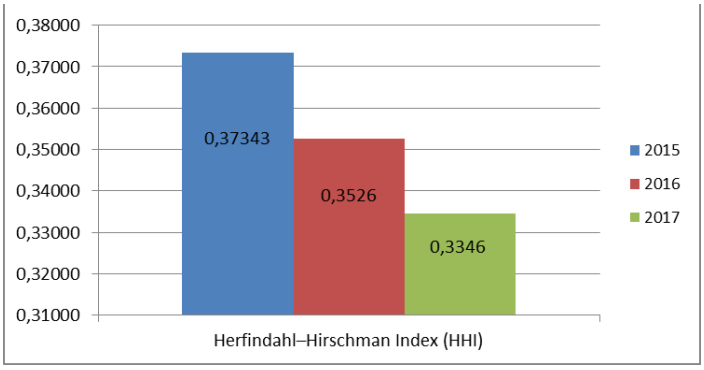
Kategórie odberných miest odberateľov	počet odberateľov plynu so zmenou dodávateľa plynu			switching (%)		
	2015	2016	2017	2015	2016	2017
veľkoodberateľ	174	130	93	23,39	18,06	12,72
stredný odberateľ	480	318	322	16,44	11,14	11,44
maloodberateľ	5 877	3 967	4 743	7,72	5,08	6,21
domácnosti	58 081	45 827	43 670	4,07	3,21	2,98
spolu	64 612	50 242	48 828	4,29	3,33	3,16

Key:

Kategorie odbernych miest odberateľov	Supply point customer category
Počet odberných miest, ktori zmenili dodávateľa	Number of supply points with change of supplier
switching (%)	switching (%)
veľkoodberateľ	Major customer
stredný odberateľ	Medium customer
maloodberateľ	Small customer
domácnosti	Households
spolu	Total

The concentration level on the gas market can also be measured by the HHI index (Herfindahl-Hirschman Index). The market is concentrated if the HHI is more than 0.1 and is highly concentrated at a value exceeding 0.2. Figure 55 shows the HHI trend between 2015 and 2017. There is a gradual decrease in the HHI value in the gas market, but it can be said that in 2017 this value was also above the high concentration threshold.

Figure 55 Herfindahl–Hirschman Index 2015–2017



ii. Projections of development with existing policies and measures at least until 2040 (including to 2030)

Stagnation rather than a slight increase in gas consumption is anticipated in the near future. In accordance with energy legislation, certificates for the construction of energy facilities were issued for various companies, while others published their intentions in this area (new sources for the generation of electricity and heat from gas). However, the implementation of investment plans is a decision for the companies themselves, while decision-making is influenced by several factors such as the market price of electricity, the market price of gas as the input commodity, etc.

Other factors that will affect the level of consumption include the average annual temperature and the continuation of various energy-efficiency-related measures, e.g. the thermal insulation of buildings and modern technological solutions for them. In the households segment, gas consumption as well as the availability of alternative fuels will influence consumption levels. Competition between different gas suppliers on the market can play a positive role in prices.

Table 68 Assumption for natural gas consumption with an outlook to 2023

Year	2019	2020	2021	2022	2023
Total consumption [billion m3]	4.8	4.9	5.0	5.0	5.0

Source: ME SR

Possible changes in projections will depend on decisions related to natural gas regarding meeting climate targets (Gas Package anticipated in 2020).

From the point of view of electricity generation, the Slovak Republic promotes nuclear energy and also cost-effective RES with the aim of achieving the set targets by 2030 and thus also fulfilling the Slovak priorities in this area as stated at the beginning of this document.

4.6. Dimension: Research, innovation and competitiveness

i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at Union or global level)

Since 2007, the SR has been a member of the International Energy Agency, which is also engaged in research into low-carbon energy technologies with a view to achieving long-term goals in globally reducing greenhouse gas emissions.

In 2016, the SR became the first country in Central and Eastern Europe to become a member of the IEA Solar Heating & Cooling Programme (SHC) technology cooperation programme. The participation of the SR in this programme will enable the development of scientific knowledge in the SR and improved involvement of Slovak scientists in the international research community.

ii. Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

Only data from the RDD IEA questionnaire are available; this looks at structured research and development funding for energy, which also provides information on R&D funding for low-carbon technologies for 2015-2017.

iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

Transparency of energy prices is guaranteed in the EU through the obligation of EU Member States to send EUROSTAT information on prices for different categories of consumers in industry as well as

data on market shares, sales conditions and pricing systems. Provision of prices for household consumers is voluntary.

Gas and electricity tariffs vary by supplier. They can result from agreed contracts, especially for large industrial consumers. In the case of smaller consumers, they are usually determined by the amount of gas consumed using other characteristics, most of which include some form of fixed charge. Therefore, there is no single price for natural gas or electricity. The information that is published in EUROSTAT statistics on natural gas prices is surveyed together for three different types of households, and information on electricity prices is surveyed for five different types according to individual annual consumption bands. In the case of industrial consumers, price information is surveyed for six different types of users in the case of gas prices, and for industrial consumers, information on electricity prices is collected for seven different types of users.

The legal basis for the statistical surveying of gas prices charged to consumers in industry is European Commission Decision (2007/394/EC) of 7 June 2007 amending Council Directive (90/377/EEC) with regard to the methodology to be applied for the collection of gas and electricity prices charged to industrial end-users. Directive 2008/92/EC of the European Parliament and of the Council of 22 October 2008 concerning a Community procedure to improve the transparency of gas and electricity prices charged to industrial end-users.

The natural gas price, or the electricity price for end-users within the meaning of Regulation (EU) 2016/1952 of the European Parliament and of the Council of 26 October 2016 on European statistics on natural gas and electricity prices and repealing Directive 2008/92/EC is the sum of three main components: “Energy and supply”, “network” (transport and distribution) and a component including taxes, levies and fees. The following items are included in the individual components:

Gas

Energy and supply include the commodity price of natural gas paid by the supplier or the price of natural gas at the point of entry into the transmission network and, where appropriate, storage costs and costs associated with the sale of natural gas to final customers.

Network charges include the following costs: gas transmission and distribution tariffs, transmission and distribution losses, network charges, after-sales service costs, system operating costs, and rental costs and consumption measurement.

Taxes, fees and charges are the sum of all taxes, fees and levies.

Electricity

Energy and supply include the following costs: electricity generation, storage, balancing energy, delivered energy costs, customer service, post-warranty service and other delivery costs.

Network charges include the following costs: electricity transmission and distribution tariffs, transmission and distribution losses, network charges, post-warranty costs, system operating costs, and costs of renting a meter and measuring consumption.

Taxes, fees and charges are the sum of all taxes, fees and levies.

iv. Description of energy subsidies, including for fossil fuels

Environment Fund

The Environment Fund was primarily established to provide State support for environmental care and environment creation on sustainable development principles. The main mission of the Fund is to provide funding to applicants in the form of subsidies or loans to support projects under actions

aimed at achieving the objectives of the State Environmental Policy at national, regional or local level. In addition, the Fund also provides funds for other activities and activities referred to in Section 4(1) of the Environment Fund Act (http://www.Environment Fund.sk/sk/o-nas).

An overview of funds provided through subsidies from the Environment Fund (http://www.Environment Fund.sk/sk/prehlady/dotacie/rozhodnute):

Call focused on the Development of energy services at regional and local level OPKZP-PO4-SC441-2019-53

Call focused on Reducing energy intensity and increasing the use of renewable energy sources in enterprises - OPKZP-PO4-SC421-2018-46

OPKZP-PO4-SC441-2019-53 - Development of energy services at regional and local level

OPKZP-PO1-SC111-2019-51 - Utilisation of biodegradable waste - construction of biogas stations used for combined production of heat and electricity

IROP-PO1-SC121-2019-48 - Increasing the attractiveness and competitiveness of public passenger transport

UPDATED CALL: OPKZP-PO1-SC111-2016-16 - Preparing for re-use and recovery of non-hazardous waste

OPKZP-PO4-SC421-2018-46 - Reducing energy intensity and increasing the use of renewable energy sources in enterprises

FUTURE CALL: Electricity and heat generation equipment with high efficiency cogeneration up to 20 MW

OPKZP-PO1-SC141-2015-7 - Reduction of emissions from stationary sources of air pollution

FUTURE CALL: Developing energy services at regional and local level

FUTURE CALL: Biodegradable waste assessment - construction of biogas stations used for combined heat and power generation power

FUTURE CALL: Improving the energy performance of public buildings

Information programmes on the adverse effects of climate change and opportunities for proactive adaptation

Green for Households

A scheme to support the construction of infrastructure for alternative fuels (de minimis aid scheme) - DM - 6/2019

Government Regulation No 426/2010, laying down the details of the deduction from electricity supplied to end customers and the method of its collection for the National nuclear fund for the decommissioning of nuclear installations and for the management of spent nuclear fuel and radioactive waste

State aid to cover part of the costs related to the decommissioning and management of spent nuclear fuel from nuclear power plants (A1 and V1) (No SA.31860 (N506/2010)) is implemented within the meaning of European Commission Decision C(2013) 782 of 20 February 2013. These costs are partially financed in the form of levies on transmission system operators and distribution system operators to the revenue budget account of the MEnv SR chapter and are transferred to the budget of the National nuclear fund for the decommissioning of nuclear installations and for the management of spent nuclear fuel and radioactive waste within the meaning of Government

Regulation No 426/2010, laying down the details of the deduction from electricity supplied to end customers and the method of its collection for the National Nuclear Fund.

State aid scheme for enterprises in sectors and subsectors expected to have a significant risk of carbon leakage in relation to the pass-through of emission allowances under the EU ETS to electricity prices, as amended by Appendix No 1 (Scheme No SA.51172 (2018/N))

State aid scheme to support international cooperation in industrial research and experimental development, as amended by Amendment No 1 (Scheme No SA. 427653)

State aid scheme for a loan instrument to promote the energy performance of buildings (apartment buildings) (Scheme No SA.48640)

State aid scheme for granting aid in the form of environmental tax relief, as amended by Amendment No 1

Call to submit applications for compensation **for the tariff for the operation of the system to eligible energy-intensive enterprises**, meeting the criteria laid down in Act No 309/2009 (the Call) from the Ministry of Economy of the Slovak Republic chapter (available funds for the Call for 2019: EUR 40 000 000).

Table 69 Tax measures

Measure	Legal basis	From	To (if applicable)
Exemption from excise duty on mineral oil - air transport	Act No 98/2004	May 2004	
Exemption from excise duty on mineral oil - water transport on the Danube	Act No 98/2004	May 2004	
Exemption from excise duty on mineral oil - electricity generation	Act No 98/2004	July 2008	
Exemption from excise duty on mineral oil – CHP	Act No 98/2004	July 2008	
Exemption from excise duty on mineral oil - all types of exemption	Act No 98/2004	May 2004	
Reduced rate of excise duty on mineral oil - Petrol containing a biogenic substance	Act No 98/2004	May 2004	
Reduced rate of excise duty on mineral oil - Gas oil containing a biogenic substance	Act No 98/2004	May 2004	
Exemption from excise duty on electricity – RES	Act No 609/2007	July 2008	
Exemption from excise duty on electricity – CHP	Act No 609/2007	July 2008	
Exemption from excise duty on electricity - energy-intensive industry	Act No 609/2007	July 2008	
Exemption from excise duty on electricity - transport	Act No 609/2007	July 2008	
Exemption from excise duty on electricity - households	Act No 609/2007	July 2008	
Exemption from excise duty on coal - electricity generation	Act No 609/2007	July 2008	
Exemption from excise duty on coal – CHP	Act No 609/2007	July 2008	
Exemption from excise duty on coal - rail and river transport	Act No 609/2007	July 2008	
Exemption from excise duty on coal - households	Act No 609/2007	July 2008	

Exemption from excise duty on coal - all types of exemption	Act No 609/2007	July 2008	
Exemption from excise duty on natural gas - electricity generation	Act No 609/2007	July 2008	
Exemption from excise duty on natural gas - CHP	Act No 609/2007	July 2008	
Exemption from excise duty on natural gas - households	Act No 609/2007	July 2008	
Exemption from excise duty on natural gas - rail transport	Act No 609/2007	July 2008	
Exemption from excise duty on natural gas - all types of exemption	Act No 609/2007	July 2008	
Reduced air pollution charge (for particulate emissions - large and medium-sized sources using domestic brown coal)	Act No 401/1995	May 2001	
Reduced air pollution charge (for sulphur oxide emissions - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for nitrogen oxide emissions - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for carbon monoxide emissions - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for emissions of organic substances in gas phase - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 1 - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 2 - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 3 - large and medium-sized sources using domestic brown coal)		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 4 - large and medium-sized sources using domestic brown coal)		May 2001	
Landfilling charge - municipal waste after sorting 4 components	Act No 17/2004	February 2004	
Landfilling charge - municipal waste after sorting 5 components	Act No 17/2004	February 2004	
Landfilling charge - municipal waste after sorting – all reduced rates	Act No 17/2004	February 2004	
Transfer to the National Nuclear Fund	Government Regulation No 426/2010	January 2011	
Max. transfer to the National Nuclear Fund per final electricity consumer	Government Regulation No 426/2010	January 2014	
Special-purpose subsidy to the National Nuclear Fund	Act No 238/2006	July 2006	

System operation tariff - RES	RONI Decree laying down price regulation in the electricity sector and certain conditions for carrying out regulated activities in the electricity sector (current Decree No 18/2017, as amended by No 207/2018 and No 178/2019.)	August 2007	annual update
System operation tariff - CHP		August 2007	annual update
Tariff for the operation of the system - production of electricity from domestic coal		August 2007	annual update
System operation tariff - OKTE		August 2007	annual update
System operation tariff - total		August 2007	annual update
Reduced tariff for system operation - stable consumption		July 2011	annual update
Reduced tariff for system services - stable consumption		August 2007	annual update
Regulated natural gas prices - households	Act No 250/2011	January 2005	
Regulated natural gas prices – small enterprises	Act No 250/2011	September 2012	
Regulated electricity prices – households	Act No 250/2011	January 2005	
Regulated electricity prices – small enterprises	Act No 250/2011	September 2012	
Contribution for family house thermal insulation	Act No 555/2005	January 2016	
Discounted loans for thermal insulation of residential and family houses	Act No 150/2013	January 2004	
Discounted loans for thermal insulation of social services homes	Act No 150/2013	September 2007	
Subsidies for the purchase of small RES (Green for Households)	SIEA	January 2015	
Bohunice International Decommissioning Support Fund (BIDSF)	International Agreement of the EBRD, SIEA	February 2002	
Contribution towards electric car purchase I.	ME SR	November 2016	June 2018
Contribution towards electric car purchase II.	MH CR	2019	
Color-coded vehicle registration numbers for electric vehicles (for using reserved lanes and parking lots)	ME SR, MV SR	from 2020 at the latest	
Exemption from motor vehicle tax - electric vehicle	Act No 361/2014	January 2015	
Reduced tax on motor vehicles - hybrids, CNG and hydrogen	Act No 361/2014	January 2015	
Environment Fund Subsidies, Area A - Air and Ozone Layer Protection	Act No 587/2004		
Environment Fund Subsidies, Area C – Waste management development	Act No 587/2004		
Environment Fund Subsidies, Area J - Electromobility	Act No 587/2004		
Environment Fund Subsidies, Area L - Improving the energy efficiency of existing public buildings, including thermal insulation	Act No 587/2004		
Public economic interest - production of electricity from domestic coal	Resolution of the Government (termination of public economic interest No 336/2019)	2005	to end no later than the end of 2023

State aid SA.52687 - Slovakia - electricity generation in Slovakia using domestic coal

The notified measure is financial compensation granted by the Slovak Republic to Slovenské elektrárne, a.s. for the fulfilment of the public service obligation to ensure the security and reliability of the electricity system in the Bystričany system node until the completion of investments in the transmission network. According to a valid resolution of the Government of the Slovak Republic, this State aid is to end no later than the end of 2023.

Slovenské elektrárne, a.s. owns and operates the Nováky thermal power plant located in Zemianske Kostoľany. The Nováky power plant uses brown coal as fuel, mined in Slovakia, and is essential for ensuring the security of supply at the Bystričany system node. The Nováky power plant produces and supplies a minimum of 870 GWh and a maximum of 1 100 GWh of electricity generated using domestic coal to the electricity system per year. Slovenské elektrárne, a.s. receives compensation for this public service obligation representing the difference between their revenues from the sale of the electricity and other services and the generation costs. These costs are compensated to Slovenské elektrárne, a.s. based on a mechanism established by the Regulatory Office for Network Industries pursuant to a decree setting price regulation in the electricity sector. Slovenské elektrárne, a.s. is entitled to a fixed price for each MWh of electricity supplied to the system and demonstrably generated from domestic coal. The total volume of electricity produced and delivered (870 to 1 100 GWh) represents approximately 0.5% to 0.6% of the total estimated demand for primary energy in Slovakia. The amount is estimated to be up to approximately EUR 100 million a year, depending on the real and transparently published costs and taking into account the 'polluter pays' principle.

State aid SA.39096 (2014/N) and SA.49270 (2017/N) - Slovakia - Aid to cover extraordinary costs associated with the Hornonitrianske bane Prievidza a.s. Cigeľ mine.

This aid – intended to cover extraordinary costs associated with the closure of the Hornonitrianske bane Prievidza a.s. Cigeľ mine and that are unrelated to normal production, such as extraordinary costs for workers who have lost or will lose their jobs, subsurface safety work resulting from the closure of coal production blocks, surface reclamation costs and other costs under Article 4 of Council Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of non-competitive coal mines – was notified through Commission Decision No SA.39096 (2014/N). This State aid, amounting to EUR 6 million, will end by 2020.

In connection with the adopted Government Resolution No 580 of 12 December 2018 on a proposal for the transformation of the Upper Nitra region in connection with the proposal of general economic interest in securing the electricity supply, and Government Resolution No 336 of 3 July 2019 on the Action Plan for the Transformation of the Upper Nitra Coal Region, the notification of State aid to facilitate the closure of the Baňa Handlová and Baňa Nováky mines of Hornonitrianske bane Prievidza a. s. within the meaning of Council Decision 2010/787/EU of 10 December 2010 is under way. The State aid for the closure of the Baňa Handlová and Baňa Nováky mines is anticipated to end by the end of 2027.

Table 70 Taxes, exemptions, fees and tariffs

Tax name		Payer, sector (if only selected sector applies)	From	To (if applicable)
Excise duty on mineral oil (petrol)	Act No 98/2004		May 2004	
Reduced rate of excise duty on mineral oil (petrol)	Act No 98/2004		January 2011	
Excise duty on mineral oil (petrol)	Act No 98/2004		May 2004	
Excise duty on mineral oil (medium oil)	Act No 98/2004		May 2004	
Excise duty on mineral oil (gas oil)	Act No 98/2004		May 2004	
Reduced rate of excise duty on mineral oil (gas oil)	Act No 98/2004		January 2011	
Excise duty on mineral oil (heating oil)	Act No 98/2004		May 2004	

Excise duty on mineral oil (liquefied gaseous hydrocarbons)	Act No 98/2004		May 2004	
Excise duty on mineral oil (liquefied gaseous hydrocarbons)	Act No 98/2004		May 2004	
Excise duty on mineral oil (lubricating oils and other oils)	Act No 98/2004		January 2012	
Excise duty on mineral oil (lubricating oils and other oils)	Act No 98/2004		January 2012	
Exemption from excise duty on mineral oil	Act No 98/2004	business sector	May 2004	
Exemption from excise duty on mineral oil	Act No 98/2004	business sector	May 2004	
Exemption from excise duty on mineral oil	Act No 98/2004		July 2008	
Excise duty on electricity	Act No 609/2007		July 2008	
Excise duty on coal	Act No 609/2007		July 2008	
Excise duty on natural gas	Act No 609/2007		July 2008	
Excise duty on natural gas	Act No 609/2007		July 2008	
Exemption from excise duty on electricity	Act No 609/2007		July 2008	
Exemption from excise duty on electricity	Act No 609/2007	Industry	July 2008	
Exemption from excise duty on electricity	Act No 609/2007	Business sector	July 2008	
Exemption from excise duty on electricity	Act No 609/2007	Households	July 2008	
Exemption from excise duty on coal	Act No 609/2007		July 2008	
Exemption from excise duty on coal	Act No 609/2007	Business sector	July 2008	
Exemption from excise duty on coal	Act No 609/2007	Households	July 2008	
Exemption from excise duty on natural gas	Act No 609/2007		July 2008	
Exemption from excise duty on natural gas	Act No 609/2007	Households	July 2008	
Exemption from excise duty on natural gas	Act No 609/2007	Business sector	July 2008	
VAT on mineral oils	Act No 222/2004		April 2004	
VAT on petrol				
VAT on medium oil				
VAT on gas oil (diesel)				
VAT on heating oil				
VAT on liquefied gaseous hydrocarbons				
VAT on lubricating and other oils				
VAT on electricity				
VAT on coal				
VAT on natural gas				
Air pollution charge (solid pollutant emissions - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (sulphur oxide emissions - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (nitrogen oxide emissions - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (carbon monoxide emissions - large and medium-sized sources)	Act 401/1995		January 2000	
Air pollution charge (emissions of organic substances in their gaseous phase - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (for emissions of other pollutants / Class 1 - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (for emissions of other pollutants / Class 2 - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (for emissions of other pollutants / Class 3 - large and medium sources)	Act 401/1995		January 2000	
Air pollution charge (for emissions of other	Act 401/1995		January 2000	

pollutants / Class 4 - large and medium sources)				
Reduced air pollution charge (for particulate emissions - large and medium-sized sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for emissions of sulphur oxides - large and medium-sized sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for nitrogen oxide emissions - large and medium-sized sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for carbon monoxide emissions - large and medium sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for emissions of organic substances in gas phase - large and medium sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 1 - large and medium sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 2 - large and medium sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 3 - large and medium sources using domestic brown coal)	Act 401/1995		May 2001	
Reduced air pollution charge (for emissions of other pollutants / class 4 - large and medium sources using domestic brown coal)	Act 401/1995		May 2001	
Landfilling charge - inert waste	Act No 17/2004		February 2004	
Landfilling charge - other, non-hazardous waste	Act No 17/2004		February 2004	
Landfilling charge - municipal waste after sorting less than 4 components	Act No 17/2004		February 2004	
Landfilling charge - municipal waste after sorting 4 components	Act No 17/2004		February 2004	
Landfilling charge - municipal waste after sorting 5 components	Act No 17/2004		February 2004	
Landfilling charge - hazardous waste	Act No 17/2004		February 2004	
Landfilling charge - other waste	Act No 17/2004		February 2004	
Landfilling charge - hazardous waste	Act No 17/2004		February 2004	
Payment for gas storage - natural gas	Government Regulation No 50/2002		January 2008	
Payment for mining – coal	Act No 44/1988		January 1992	
Payment for extracted minerals - coal	Government Regulation No 50/2002		January 2008	
Tariff for exploiting the hydroenergy	RONI Decree No		May 2016	

potential of watercourses (from 100 kW to 1 000 kW)	0002/2008/V			
Tariff for exploiting the hydroenergy potential of watercourses (from 1 001 kW to 10 000 kW)	RONI Decree No 0002/2008/V		May 2016	
Tariff for exploiting the hydroenergy potential of watercourses (over 10 000 kW)	RONI Decree No 0002/2008/V		May 2016	
Max. levy to the National Nuclear Fund per electricity end user	Government Regulation No 426/2010		January 2014	
Contributions from licensees for the operation of nuclear installations - fixed component	Government Regulation No 312/2007		July 2007	
Contributions from licensees for the operation of nuclear installations - variable component	Government Regulation No 312/2007		July 2007	
Contributions from licensees for the operation of nuclear installations - total	Government Regulation No 312/2007		July 2007	
Nuclear installation tax - municipalities within 1/3 of the radius of the threat zone	Act No 582/2004		December 2009	
Tax for nuclear installations - municipalities between 1/3 and 2/3 of the radius of the threat zone away	Act No 582/2004		December 2009	
Nuclear installation tax - municipalities over 2/3 of the radius of the threat zone away	Act No 582/2004		December 2009	
Registration fee for vehicles with engine power up to 80 kW / 86 kW/ 92 kW / 98 kW / 104 kW / 110 kW / 121 kW / 132 kW/ 143 kW / 154 kW / 165 kW / 176 kW / 202 kW / 228 kW / 254 kW / over 254 kW	Act 145/95		February 2017	
Reduced electric vehicle registration fee	Act 145/95		October 2012	
Motor vehicle tax - depending on engine volume (up to 150 cm^3 / up to 900 cm^3 / up to 1200 cm^3 / up to 1500 cm^3 / up to 2000 cm^3 / up to 3000 cm^3 / over 3000 cm^3	Act No 361/2014	Business sector	January 2015	
Exemption from motor vehicle tax - electric vehicle	Act No 361/2014	Business sector	January 2015	
Reduced tax on motor vehicles - hybrids, CNG and hydrogen	Act No 361/2014	Business sector	January 2015	
System operation tariff - RES	RONI Decree laying down price regulation in the electricity sector and certain conditions for carrying out regulated activities in the electricity sector (current Decree No 18/2017, as amended by No 207/2018 and No		August 2007	Annual update
System operation tariff - CHP			August 2007	Annual update
System operation tariff - production of electricity from domestic coal			August 2007	Annual update
System operation tariff - OKTE			August 2007	Annual update
System operation tariff - total			August 2007	Annual update

	178/2019)			
Reduced tariff for system operation - stable consumption	RONI Decree laying down price regulation in the electricity sector and certain conditions for carrying out regulated activities in the electricity sector (current Decree No 18/2017, as amended by No 207/2018 and No 178/2019)	industry	July 2012	Annual update
Reduced tariff for system services - stable consumption	RONI Decree No 225/2011 and RONI Decree No 18/2017, as amended by No 207/2018 and No 178/2019	industry	July 2012	Annual update

5. IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES[58]

5.1. Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals, including comparison to forecasts based on existing policies and measures (as described in section 4).

*i. Projections of the development of the energy system and GHG emissions and removals as well as, **where relevant** of emissions of air pollutants in accordance with Directive (EU) **2016/2284** under the planned policies and measures at least until ten years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures.*

Effects of planned policies and measures described in Chapter 3 on the energy system and on greenhouse gas emissions and capture, including comparison with projections based on existing policies and measures (as described in Chapter 4.1.1.ii above).

The whole of this chapter, by national economy sector, follows on from Chapter 4.1.1.ii (WEM scenario), within the framework of which descriptions of the models, methodologies and implemented PAMs used in the preparation of greenhouse gas emissions projections, including sector descriptions (parameters, activity data, data sources, etc.) are provided.

iii-a Description of the scenario with additional measures

WAM - The scenario with additional measures (the so-called decarbonisation scenario) is identical to the DCarb2 scenario. When proposing the WAM scenario, the adopted 'Clean Energy for All Europeans' policy package, presented by the European Commission in November 2016, was also taken into account. The PRIMES model scenarios, named the EUCO scenarios, supported the impact assessment of measures and objectives proposed by the European Commission to 2030 and 2050. Other PRIMES model scenarios, called the EUCO scenarios to 2030 and 2050, supported the assessment of measures and objectives set out by the European Commission.

The WAM scenario includes ways to achieve different combinations of ambitious energy efficiency, renewable energy sources and emission reduction targets in 2030. The WAM scenario analyses the possibility of achieving the EU's 2050 emission reduction targets (carbon neutrality). The scenario includes Slovakia's participation in the EU ETS after 2020 and the intermediate renewable energy sources and energy efficiency targets and the construction of new nuclear power capacities, while maintaining its key role in the production mix.

The new governance process limits Member States' freedom to adopt national renewable energy sources, energy efficiency and overall greenhouse gas emission reductions targets. There is no freedom as regards non-ETS targets, but the target category specification is at the discretion of the Member State. As a substantial share of emissions that are not part of the EU ETS are not related to energy generation, it is possible to make choices between sectors.

- An overview of possible contributions has been prepared using several scenarios quantified for Slovakia using the PRIMES model (Table 71) to shape the possible contributions of the Slovak Republic towards the achievement of the EU 2030 targets.

Table 71 Objectives achieved by scenario

[58] Planned policies and measures are options under discussion and that have a realistic chance of being adopted and implemented after the date of submission of the national plan. The resulting projections under section 5.1.i shall therefore include not only implemented and adopted policies and measures (projections with existing policies and measures), but also planned policies and measures.

	Ref	Decarb1	Decarb2	Decarb3	Decarb4	EUCO
Total CO_2 emissions from combustion (% change from 2005)	-27.81	-39.02	-40.80	-40.59	-41.48	-38.94
Primary energy savings (%)	-24.91	-30.32	-28.36	-27.25	-28.88	-26.93
Total RES share (%)	14.34	16.33	18.91	19.83	21.85	19.0
RES— heating and cooling (%)	14.04	16.89	20.65	22.07	19.55	22.0
RES - electricity (%)	21.28	22.62	24.81	25.32	36.79	23.4
RES - Transport (%)	10.20	11.49	11.74	11.80	13.12	11.4

iii-b Description of individual models - Compact Primes, the Envisage Slovakia model was used in the preparation of greenhouse gas emission projections under the WAM scenario. For details, see Chapter 4.1.1.ii. DCarb2 was used under the WAM scenario for national reporting purposes.

iii-c Emissions projections in the energy sector (excluding transport) - The energy sector produces greenhouse gas emissions from the combustion and conversion of fossil fuels. The modelling of emission projections was performed based on the results of the new CPS model. The CPS model is still not fully calibrated for the CRF categorisation of greenhouse gas emissions, so the model results had to be adjusted according to the current greenhouse gas emission inventory. The WAM scenario specification depends on the EU scenario design logic, and in particular on the EUCO30[59] scenario, which sets the 2030 targets at EU level as follows:

- Reduce greenhouse gas emissions by 40% in 2030 and by 80-85% in 2050 compared to 1990;
- Reduce CO_2 emissions in the EU ETS by 43% in 2030 and by 90% in 2050 compared to 2005, however this is based on the EU ETS carbon trajectories resulting from EU ETS market regulations, including the market stability reserve, as adopted;
- Reduce greenhouse gas emissions in non-EU ETS sectors by 30% in 2030 compared to 2005, with country-specific obligations;
- Achieve a 27% RES share in gross final energy consumption in 2030;
- Energy efficiency expressed as a 30% reduction in primary energy consumption (1 321 Mtoe - excluding non-energy consumption of energy products) in 2030 compared to the 2007 baseline.

In addition to the above PAMs, the scenario includes the following national policies:

- The earlier decommissioning of solid fuel power plants. The decommissioning of the Vojany and Nováky power plants is anticipated in 2025 and 2023 in that order.
- A scheme to promote RES in electricity generation with anticipated RES technologies such as solar, onshore wind turbines and biomass. The scenarios assume 50 MW in the 2021-2025 period, followed an additional 500 MW through auctions.
- The continued development of nuclear energy is anticipated based on economic optimality.
- Carbon capture and storage is excluded.

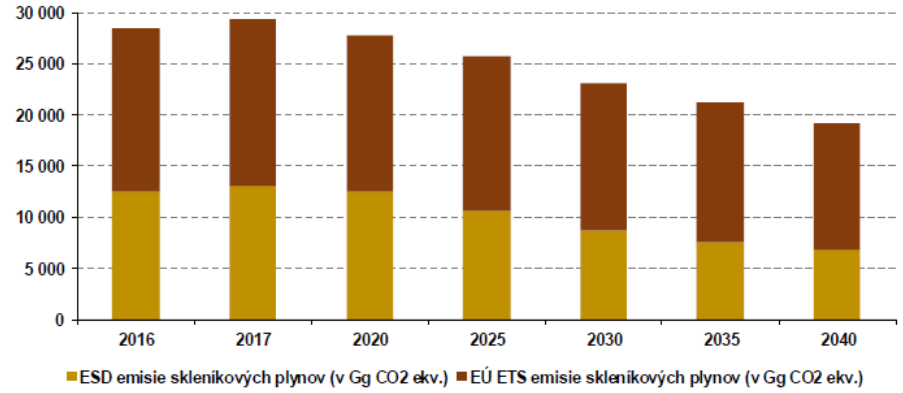
The development of greenhouse gas emission projections in terms of CO_2 equivalent under the decarbonisation scenario with additional measures (WAM-DCarb2) from the energy sector (transport projections are described in more detail in Chapter 4.1.1.iii-f) is shown in Table 72 and Figure 56.

Table 72 Projections of greenhouse gas emissions from the energy sector under the WAM scenario

[59] In 2016, the European Commission developed two basic policy scenarios, EUCO27 and EUCO30, using the PRIMES model, based on the EU 2016 Reference Scenario. EUCO scenarios include achieving the 2030 energy and climate targets and 27% or 30% energy efficiency targets. www.ec.europa.eu/energy/en/data-analysis/energy-modelling

Total greenhouse gas emissions (in Gg CO2 equiv.)							
Year	**2016**	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
Total emissions without LULUCF	**42 154**	**43 316**	**42 355**	**42 046**	**41 399**	**39 526**	**38 521**
Total emissions with LULUCF	**35 427**	**36 727**	**36 210**	**37 006**	**36 965**	**35 370**	**34 290**
1. Energy	28 483	29 442	27 845	25 802	23 152	21 320	19 261
1.A.1. Energy industry	7 540	7 487	7 118	5 634	4 444	3 986	4 211
1.A.2 Manufacturing industry	6 710	7 136	6 823	6 342	5 435	4 731	3 739
1.A.3 Transport	7 536	7 660	6 878	7 070	7 097	6 907	6 152
1.A.4 Other sectors	4 942	5 357	5 387	5 304	4 851	4 626	4 194
1.A.5 Other	66	66	66	61	52	49	48
1.B. Fugitive emissions from fuels	1 689	1 737	1 573	1 390	1 273	1 021	918

Figure 56 Projections of greenhouse gas emissions from the energy sector broken down by EU ETS and ESD under the WAM scenario



Key:

ESD emisie skleníkových plynov (v Gg CO2 ekv.)	ESD greenhouse gas emissions (in Gg CO_2 equiv.)
EÚ ETS emisie skleníkových plynov (v Gg CO2 ekv.)	EU ETS greenhouse gas emissions (in Gg CO_2 equiv.)

Source: SHMI, real data for 2016 and 2017

iii-d Projections of fugitive CH_4 and CO_2 emissions from coal mining activities – the projections of fugitive CH_4 and CO_2 emissions were calculated based on the following data and assumptions:

- Data on coal mining in 2017 were obtained for the individual underground mines from official sources – from the company HBP, a.s., and from the Statistical Office of the Slovak Republic.
- The anticipated termination of state coal mining subsidies for the mining company HBP, a.s. is anticipated in 2023;
- A gradual decrease in coal mining in connection with the closure of the Cígeľ mine (HBP, a.s.) in 2017.

The emission factors and methodology specified in Chapter 4.1.1.ii-d were used to calculate fugitive methane and CO_2 emissions. Table 73 shows the projected volume of coal mining between 2017 and 2040 under the WAM scenario. The possible continuation of domestic coal mining after 2023 will depend on its economic profitability after the end of state subsidies.

Table 73 Planned coal mining in Slovakia to 2040 under the WAM scenario

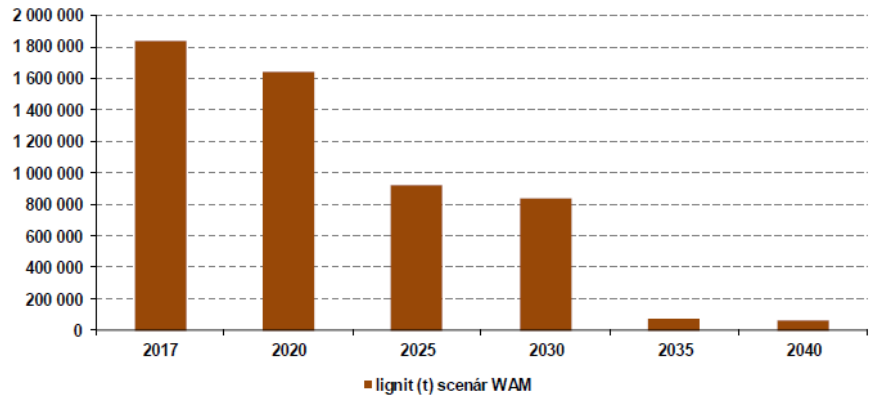
Mine	**Unit**	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
HBP, a. s.	kt	1 779	1 189	424	341	0	0

Cigeľ	kt	180	0	0	0	0	0
Handlová	kt	173	0	0	0	0	0
Nováky	kt	1 426	1 189	424**	341**	0	0
BD, a. s.	kt	0	0	0	0	0	0
BČ, a. s.	kt	56	450	500**	500**	73	62
Total production	**kt**	1 834	1 639	924	841	73	62

*real values; Source: ME SR

***The model counted on production decreasing to 2030, but according to a Slovak Government Resolution of July 2019, the notification of State aid to complete the closure of uncompetitive coal mines in Upper Nitra counts on the end of support for coal mining by 2023.*

Figure 57 Planned coal mining for the 2017*-2040 period under the WAM scenario



Key:

lignit (t) scenár WAM	lignite (t) under the WAM scenario

*real values; Source: ME SR

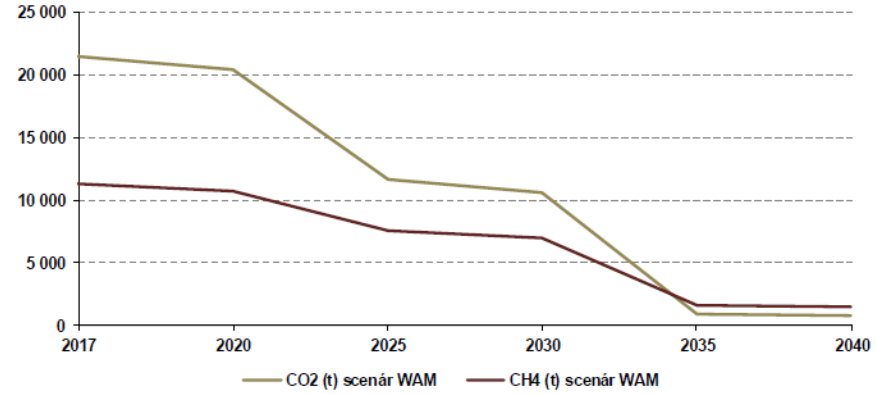
Table 74 Projections of fugitive methane and CO_2 emissions from coal mining and mining activities in the Slovak Republic to 2040 under the WAM scenario

Year	**Brown coal**	**CH_4**	**CO_2**	**CO_2 equiv.**
	tonnes			
2017*	1 834 000	11 297	21 398	303 823
2020	1 639 067	10 758	20 433	289 383
2025	924 341	7 524	11 622	199 722
2030	840 804	7 023	10 589	186164
2035	73 258	1 624	935	41 535
2040	62 061	1 431	792	36 567

*real values; Source: ME SR and SHMI

Figure 58 Projections of fugitive methane and CO_2 emissions from coal mining and mining activities in the Slovak Republic to 2040 under the WAM scenario

Key:



Key:

CO2 (t) scenár WAM	CO_2 (t) under the WAM scenario
CH4 (t) scenár WAM	CH_4 (t) under the WAM scenario

real values for 2017; Source: SHMI

iii-e) Projections of fugitive greenhouse gas emissions from the extraction, transport and distribution of natural gas and oil in the SR for the 2017-2040 period - prepared based on the following data and assumptions:

- Statistical Office of the Slovak Republic (for 2017);
- CPS model;

Emission factors from the following sources were used to calculate fugitive methane emissions (and projections) from the extraction, transport and distribution of natural gas and oil in the Slovak Republic:

- IPCC 2006 Guidelines for National Greenhouse Gas Inventories - Chapter 4: Fugitive Emissions (IPCC 2006 GL);
- IPCC Guidelines on Best Practices and Uncertainties for National Greenhouse Gas Inventories (IPCC 2000 GPG).

The projections of fugitive methane emissions from the extraction, transport and distribution of natural gas and oil in the Slovak Republic were estimated based on the following assumptions:

- Oil production in the Slovak Republic is anticipated to cease after 2020;
- Natural gas production will only decline slowly. There will be no significant changes to the consumption/distribution of natural gas and oil in Slovakia;
- The redirection of natural gas supplies through the Nord Stream pipeline will reduce the amount of gas transported to other countries through pipelines in Slovakia, resulting in a reduction in fugitive CH_4 emissions.

Table 75 Activity data projections for the preparation of projections for the 2017-2040 period under the WAM scenario

Activity	Units	2017*	2020	2025	2030	2035	2040
Oil production	t	8 000	10 254	0	0	0	0
Oil processing	t	5 587 000	5 749 078	5 664 604	5 621 146	5 458 604	5 282 346
Long-distance oil	t	9 582 252	9 727 295	9 454 590	9 181 885	8909 180	8 636 475

transport							
Natural gas production	10^6 m^3	140 000	110.605	114.095	100.413	85.417	75.361
Long-distance natural gas transport	10^6 m^3	64 200.00	56 000.00	51 000.00	46 000.00	41 000.00	36 000.00
Natural gas distribution	10^6 m^3	5 248 000	4 871.149	5 556.479	5 466.016	5 267.342	5 355.552

*real values; Source: ME SR

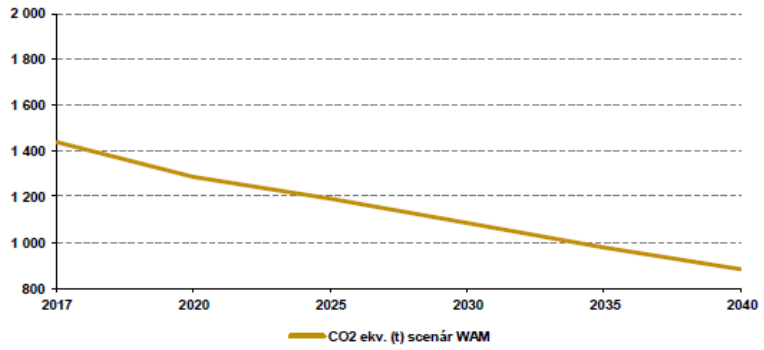
In addition to projections of fugitive CH_4 emissions from the transport and distribution of natural gas and oil in the Slovak Republic, CO_2, NMVOC and N_2O projections were also calculated, yet their importance for the overall greenhouse gas emission projections is negligible. The same methodology and conditions were used in the calculations, but the results of the negotiations on Directive 2018/2001 on the promotion of the use of energy from renewable sources were not taken into account.

Table 76 Fugitive emissions projections from oil and gas for the 2017-2040 period under the WAM scenario

Year	CH_4	CO_2	NMVOC	N_2O
		tonnes		
2017*	57 543	1 317	8 747	0.0116
2020	51 280	1 296	8 896	0.0126
2025	47 582	879	8 672	0.0037
2030	43 434	808	8 527	0.0032
2035	39 606	727	8 527	0.0028
2040	35 212	677	7 914	0.0024

*real values; Source: SHMI

Figure 59 Projections of fugitive greenhouse gas emissions from oil and natural gas to 2040 in the Slovak Republic under the WAM scenario



Key:

CO2 ekv. (t) scenár WAM	CO2 equiv. (t) under the WAM scenario

real values for 2017; Source: SHMI

iii-f Transport emission projections – these are based on the energy model and its arrangement as described in the previous Chapter 4.1.1.ii. CO_2 emission projections under the scenario with additional measures in category 1.A.3.b - Road transport were prepared under the DCarb2 scenario (WAM). The calculated projections show a clear downward trend in CO_2 and N_2O emissions to 2040,

but CH_4 emissions increase under the WAM scenario compared to the WEM scenario, the most likely reason being the rising trend in the consumption of natural gas and biogas in road transport and its increasing share in fuel consumption, which has been included under the WAM scenario.

The Slovak Republic, like other countries, implements various policies and measures to reduce the transport sector environmental burden. All policies and measures described in Chapter 3 for the transport sector are in line with the prepared low-carbon study of the Slovak Republic. Of these PAMs, only those for which emission reduction potential could be calculated and that relate to the Dcarb2 (WAM) scenario were evaluated and used for the preparation of projections.

Table 77 Anticipated fuel consumption in the transport sector for the 2017-2040 period under the WAM scenario

Fuel	**unit**	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Petrol	TJ	22 034.4	21 747.6	21 186.0	21 142.8	19 090.8	14 986.8
Diesel	TJ	74 694.6	56 314.8	57 020.4	56 844.0	50 464.8	35 082.0
LPG	TJ	1 944.1	3 506.4	3 204.0	3 358.8	3 168.0	3 834.0
Natural gas	TJ	223.2	752.4	784.8	1 080.0	1 400.4	1 638.0
Biogas	TJ	0.0	3.6	25.2	111.6	169.2	421.2
Conventional biofuels	TJ	6 481.6	7 437.6	7 326.0	7 938.0	3 214.8	2 836.8
Advanced biofuels	TJ	0.0	0.0	0.0	10.8	7 146.0	17 337.6
Kerosene	TJ	45.0	2 268.0	2 768.4	3 394.8	3 556.8	3 247.2
Hydrogen	TJ	0.0	0.0	0.0	10.8	327.6	2 365.2
Electricity	GWh	0.2	707.0	870.0	1 056.0	1 301.0	2 276.0

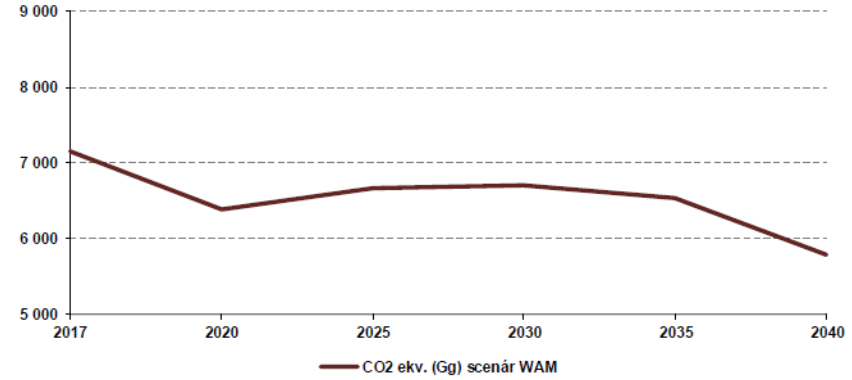
*real values; Source: SHMI

Table 78 Greenhouse gas emissions projections in road transport for the 2017-2040 period under the WAM scenario

Year	**CO_2**	**CH_4**	**N_2O**
	kt	tonnes	
2017*	7 151.18	318.34	262.02
2020	6 377.67	180.36	230.74
2025	6 657.64	148.84	263.71
2030	6 695.72	130.75	275.51
2035	6 523.17	119.64	272.11
2040	5 788.15	120.49	231.81

*real values; Source: SHMI

Figure 60 Projections of greenhouse gas emissions to 2040 in road transport under the WAM scenario

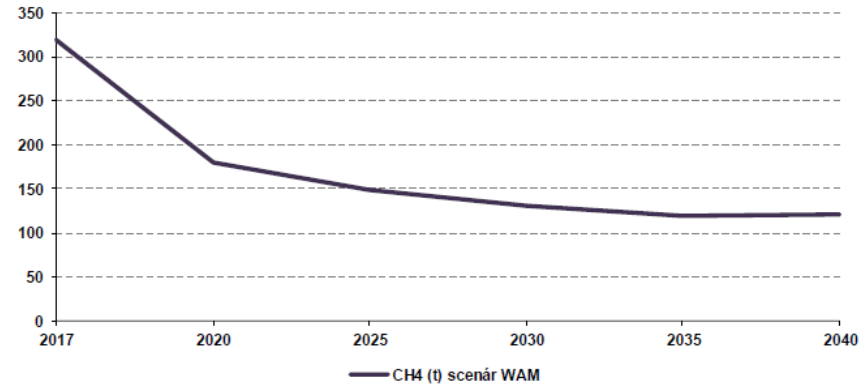


Key:

CO2 ekv. (Gg) scenár WAM	CO2 equiv. (Gg) under the WAM scenario

real values for 2017; Source: SHMI

Figure 61 Projections of methane emissions to 2040 in road transport under the WAM scenario



Key:

CH4 (t) scenár WAM	CH_4 (t) under the WAM scenario

real values for 2017; Source: SHMI

In addition to projections of greenhouse gas emissions in road transport, projections of emissions from non-road transport in the Slovak Republic were also calculated, but their share in total transport emissions is minimal. Non-road emission projections were calculated in a simpler way using AutoRegressive Integrated Moving Average (ARIMA) modelling. For these projections, only the WEM scenario was prepared, which is identical to the WAM scenario (Chapter 4.1.1.ii).

iii-g Emissions projections from the Industrial Processes and Product Use (IPPU) sector - a description of scenarios and methodology is given in Chapter 4.1.1.ii. The IPPU sector emissions projections incorporated in the EU ETS (large industrial enterprises) have been modelled together with projections from the energy sector (DCarb2 scenario), while IPPU sector emission projections that are not incorporated into the EU ETS have been modelled taking into account the trend in added value and the effect of the measures by product category.

The trend in greenhouse gas emission projections expressed as CO_2 equivalent under the scenario with measures (WAM-DCarb2) from the industrial processes sector, including F-gases, is shown in Table 79 and Figure 62.

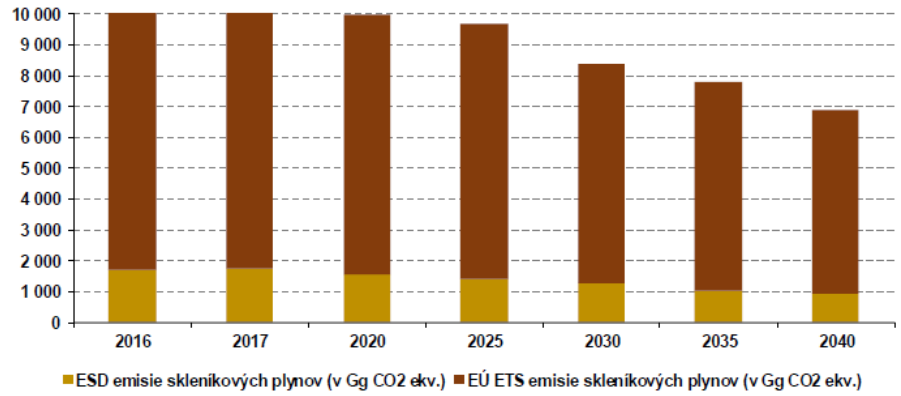
Table 79 Projections of greenhouse gas emissions from the industrial processes sector, including F-gases, under the WAM scenario

Total greenhouse gas emissions in the industrial processes sector (in Gg CO_2 equiv.)							
Year	**2016**	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
Total emissions without LULUCF	**42 154**	**43 316**	**42 355**	**42 046**	**41 399**	**39 526**	**38 521**
Total emissions with LULUCF	**35 427**	**36 727**	**36 210**	**37 006**	**36 965**	**35 370**	**34 290**
2. Industrial processes*	9 378	9 647	9 417	9 245	7 456	7 009	6 159
2.A Cement and lime production	2 183	2 277	2 023	1 992	1 636	1 544	1 343
2.B Chemical industry	1 471	1 535	1 509	1 518	1 348	1 333	1 281
2.C Metals production	4 851	4 906	4 914	4 849	4 185	3 949	3 367
2.D Non-energy use of fuels	124	113	114	112	111	108	103

2. E Electronics industry	NO	NO	NO	NO	NO	NO	NO
2.F Used F-gases	673	739	785	704	116	21	21
2.G Manufacture of products and their use	75.25	76.76	71.40	68.82	60.98	52.88	45.02

* Minor differences in the total may be due to rounding values.

Figure 62 Projections of greenhouse gas emissions from the industrial processes sector, including F-gases, broken down by EU ETS and ESD under the WAM scenario



Key:

ESD emisie skleníkových plynov (v Gg CO2 ekv.)	ESD greenhouse gas emissions (in Gg CO_2 equiv.)
EÚ ETS emisie skleníkových plynov (v Gg CO2 ekv.)	EU ETS greenhouse gas emissions (in Gg CO_2 equiv.)

Source: SHMI, real data for 2016 and 2017

iii-h F-gas emission projections - F-gas emission projections in category 2.F under the WAM scenario were prepared in accordance with EP and Council Regulation 517/2014 with the proviso that all refrigerants must be supplied from low-GWP gases (or supplementary gases). Projections of SF_6 emissions in category 2.G under the WAM scenario were prepared in accordance with the condition that the use of SF_6 gas in new installations is prohibited. Table 79 shows total aggregated data on projections of process gas and F-gas emissions in the industrial processes sector under the WAM scenario.

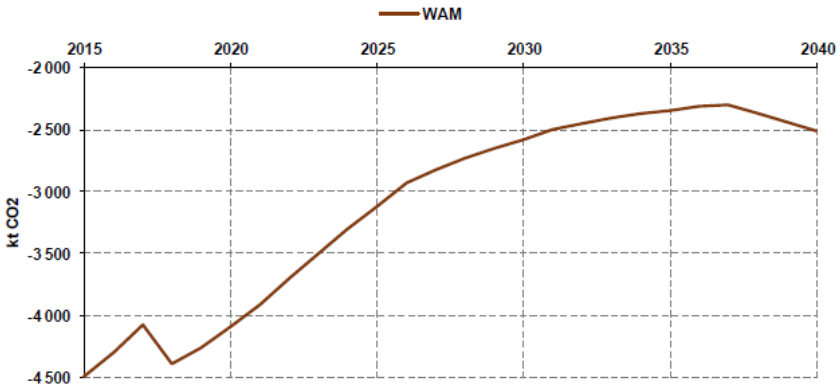
iii-i Emissions projections in the agricultural sector - only one scenario has been prepared in this sector, and this is described in detail in Chapter 4.1.1.ii.

Projections of emissions in the land use, land-use change and forestry (LULUCF) sector - projections of emissions and capture in the LULUCF sector were based on the sectoral strategic document of the Rural Development Programme of the Slovak Republic for 2007-2013 and 2014-2020 taking into account the adopted National Forest Programme (NFP) of the Slovak Republic, as well as the NFP Action Plans for 2009-2013 and 2015-2020.

The scenario with additional measures (WAM) shows the trend in emissions with afforestation of 23 000 ha of grassland by 2040 and the grassing of 50 000 ha of arable land after 2016. Based on this assumption, the scenario shows an increase in CO_2 capture in forests and arable land and a slight decrease in meadows and pastures, as well as increased emissions from populated areas and other land categories.

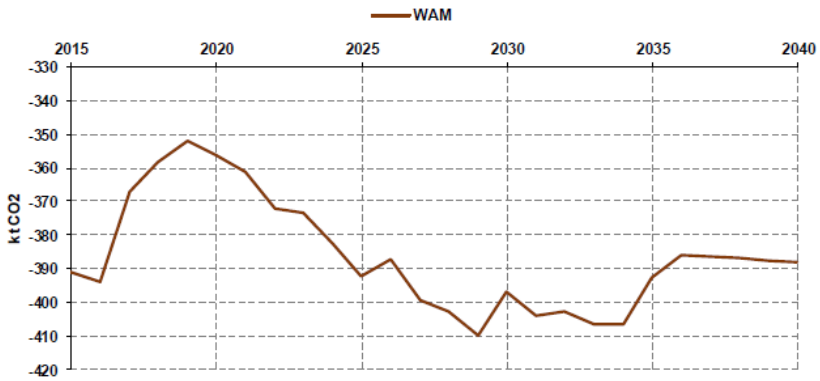
The measures planned after 2016 are included under the WAM scenario. The PRV (2014-2020) was adopted as the continuation of the previous document, with no new specific measures introduced. The WAM scenario took into account the afforestation of 23 000 ha of agricultural land for the 2020-2040 period. The greenhouse gas emission calculation was based on the methodological procedures and mathematical relationships defined in the IPCC Good Practice Guidelines for 2003 for the LULUCF sector (IPCC GPG LULUCF). The values of the emission and conversion/expansion factors used for the projections are consistent with the 2016 LULUCF GHG emission inventory. They are also published in the National Inventory Report of the Slovak Republic 2018.

Figure 63 Projections of CO_2 emissions and capture (in Gg) in category 4.A.1 - Forest land that remained forest land under the WAM scenario to 2040



real values for 2015; Source: SHMI

Figure 64 Projections of CO_2 emissions and capture (in Gg) in category 4.A.2 - Land converted to forest (afforestation) under the WAM scenario to 2040



real values for 2015; Source: SHMI

Table 80 shows the results from the modelling of CO_2 emission and capture projections from the LULUCF sector. The WAM scenario shows the trend in emissions with the afforestation of 23 000 ha of grassland to 2040 and the grassing of 50 000 ha of arable land after 2016. Based on this assumption, the scenario shows an increase in CO_2 capture in forests and arable land and a slight

decrease in meadows and pastures, as well as an increase in emissions from populated and other land categories.

Table 80 Projections of CO_2 emissions and capture in the LULUCF sector (in Gg) under the WAM scenario to 2040

WAM	2017*	2020	2025	2030	2035	2040
Land use, land-use change and forestry	**-6 642.32**	**-6 208.50**	**-5 122.03**	**-4 533.63**	**-4 272.30**	**-4 360.09**
Forest land	-4 448.84	-4 443.98	-3 508.66	-2 974.27	-2 734.49	-2 903.00
Forest land that remains forest	-4 079.85	-4 087.74	-3 116.28	-2 577.32	-2 341.87	-2 514.99
Conversion of land to forest land	-368.99	-356.24	-392.38	-396.95	-392.61	-388.01
Arable land	-1 142.66	-1 056.47	-1 050.48	-1 027.52	-1 005.19	-984.83
Grassland	-165.25	-117.53	-83.96	-115.33	-155.41	-163.48
Settlements	98.38	102.65	111.08	103.86	101.85	102.25
Other land	92.98	132.74	143.03	146.52	132.43	133.19
Harvested wood products	-1 076.92	-825.92	-733.04	-666.88	-611.49	-544.22

*real values; Source: SHMI

The same procedure was used to model emissions from forest fires. Outputs from CH_4 emission projections from forest fires are shown in Table 81 below.

Table 81 Projections of CH_4 and N_2O emissions in the LULUCF sector from forest fires (in Gg) under the WAM scenario to 2040

CH_4						
WAM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Land use, land-use change and forestry	**0.85**	**0.70**	**0.73**	**0.75**	**0.76**	**0.8**
Forest land	0.85	0.70	0.73	0.75	0.76	0.8
Forest land that remains forest	0.85	0.70	0.73	0.75	0.76	0.8
N_2O						
Land use, land-use change and forestry	**0.12**	**0.10**	**0.11**	**0.11**	**0.11**	**0.11**
Forest land	0.05	0.04	0.04	0.04	0.04	0.04
Forest land that remains forest	0.05	0.04	0.04	0.04	0.04	0.04

*real values; Source: SHMI

Slovakia has not yet defined emissions and capture from the wetland category; there is a lack of activity data to model emission and capture projections for the period under review.

iii-j Emission projections in the waste sector - emission projections from the waste sector to 2040 under the WAM scenario focus on municipal waste disposal and municipal waste water treatment. These two main emission sources account for over 80% of the sector's estimated emissions. Emissions from composting, waste incineration, industrial waste disposal and industrial waste water treatment are estimated for the preceding 10 years (2007-2017); the constant 2017 value is used throughout the 2018-2040 period only in the case of municipal waste composting.

WAM scenario description - Only the WEM scenario has been prepared for the waste water sector. There are no quantified targets available that would enable the definition of alternative scenarios for the 2018-2040 period. The Waste Prevention Programme 2019-2025 evaluates the specific objectives of the previous programmes and concludes that most of these objectives have not been achieved. The new programming document for 2019-2025 therefore defines new quantified targets for municipal waste that have been included under the WAM scenario:

- reduce residual municipal waste by 50% compared to the 2016 level by 2025,
- reduce biodegradable waste in residual municipal waste by 60% by 2025 at the latest,
- reduce landfill rates to 10% of total municipal waste by 2035.

To achieve the above objectives, it was assumed that existing incinerators would continue to increase their operation to achieve full capacity, meaning 285 kt/year (the Košice incinerator 70-80 kt/year and the Bratislava incinerator 135 kt/year). The model anticipated the creation of additional incinerators and a mechanical-biological waste treatment capacity of 560 kt/year.

iii-k International transport emission projections - these emissions are not included in the national balance. The data in Table 82 show that the projected greenhouse gas emissions from these categories make up a negligible share of total emissions, even for the WAM scenario.

Table 82 Aggregated data on projections of greenhouse gas emissions from international transport under the WAM scenario (in Gg CO_2 equiv.) to 2040

WAM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
International transport	**185.06**	**185.06**	**185.06**	**185.06**	**185.06**	**185.06**
Aviation	166.39	166.39	166.39	166.39	166.39	166.39
River transport	18.67	18.67	18.67	18.67	18.67	18.67

*real values; Source: SHMI

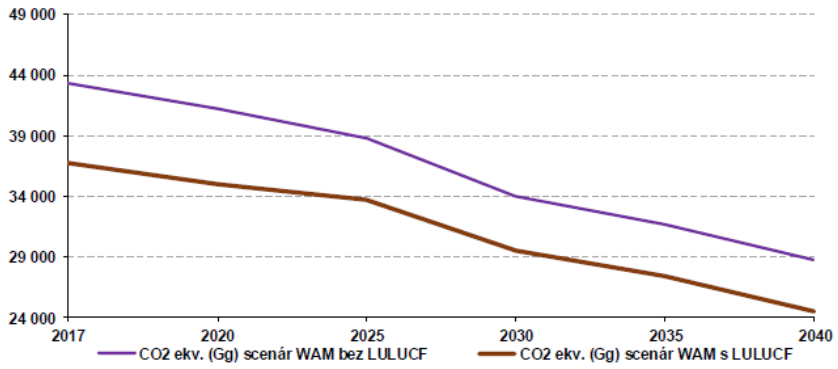
iii-j Total greenhouse gas emissions projections under the WAM scenario - Table 83 shows the trends in greenhouse gas emission projections to 2040 under the WAM scenario with and without LULUCF sector capture.

Table 83 Projections of total greenhouse gas emissions (in Gg CO_2 equiv.) under the WAM scenario to 2040 with and without LULUCF

WAM	**2017***	**2020**	**2025**	**2030**	**2035**	**2040**
Total without LULUCF	**43 316.44**	**41 202.63**	**38 761.08**	**34 019.06**	**31 684.66**	**28 750.82**
Total with LULUCF	**36 726.75**	**35 042.78**	**33 688.87**	**29 536.29**	**27 463.07**	**24 443.36**
1. Energy	29 442.34	27 845.20	25 801.56	23 151.76	21 320.05	19 260.82
2. Industrial processes	9 646.59	9 417.17	9 244.52	7 456.03	7 008.62	6 159.37
3. Agriculture	2 546.79	2 376.24	2 390.66	2 419.79	2 497.09	2 570.24
4. LULUCF	-6 589.69	-6 159.85	-5 072.22	-4 482.77	-4 221.59	-4 307.46
5. Waste	1 680.72	1 564.01	1 324.34	991.49	858.90	760.40

*real values; Source: SHMI

Figure 65 Aggregated greenhouse gas emissions projections (in Gg CO_2 equiv.) under the WAM scenario with and without LULUCF to 2040



Key:

CO2 ekv. (Gg) scenár WAM bez LULUCF	CO_2 equiv. (Gg) WAM scenario without LULUCF
CO2 ekv. (Gg) scenár WAM s LULUCF	CO_2 equiv. (Gg) WAM scenario with LULUCF

Real values for 2017; Source: SHMI

ii. Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency/energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply

The intention of the SR is to minimize the risk of stranded costs in existing energy facilities. For this reason, the completion of unfinished electricity sources and the gradual replacement of polluting sources using fossil fuels through reducing consumption and building RES-based sources remain priorities.

In the area of heat supply, the priority is the maximum utilisation of existing district heating systems and their gradual transformation into efficient district heating systems with the possibility of changing the fuel base to RES, taking into account decreasing heat consumption as a result of thermal insulation.

To optimize the decision-making and authorisation process, it is therefore necessary to take into account the interactions between the ETS, pricing, taxation and regulatory policies and the requirements for reducing environmental burdens. Aligning individual policies with investment objectives is a challenge for better regulation. Predictability and transparency in the decision-making process play important roles. This process will minimises the possibility of investment being thwarted and costs stranded.

iii. Assessment of interactions between existing policies and measures and planned policies and measures, and between those policies and measures and Union climate and energy policy measures

The SR is a leader in electricity generation using low-carbon technologies. Nuclear energy accounts for the largest share, contributing not only towards decarbonisation but also towards electricity supply security. The intention of the Slovak Republic is to use existing sources as long as possible, with regard to nuclear safety, and to continue to use such technology. This approach may seem restrictive in terms of meeting the EU's RES targets, but will achieve better results in terms of meeting the decarbonisation targets.

Natural gas is widely used for heat generation, and the Slovak Republic has one of the highest supply coverage rates. A gradual increase in the proportion of biomethane is in synergy with EU measures.

5.2. Macroeconomic and, as far as possible, the health, environmental, employment and education, skills and social impacts effects, including fair transition aspects (from the perspective of costs and benefits as well as cost-effectiveness), of the planned policies and measures described in Section 3 at least until the last year of the period covered by the plan, including a comparison with projections based on existing policies and measures

The whole of this chapter, by national economy sector (energy, industry, energy efficiency, transport), follows on from chapter No 4 (WEM scenario), which provides descriptions of the energy and macroeconomic model (CPS, Envisage Slovakia), prepared to allow Slovakia to address EU questions and policies relating to climate change and energy. Essentially, these analytical models differ in coverage and approach. On the other hand, together they represent a powerful tool for assessing climate policies and showing the impact of different policy packages. Both models draw on multiple data sources and are based on information used by the EU to develop scenarios (described in more detail in the introduction to Chapter 4).

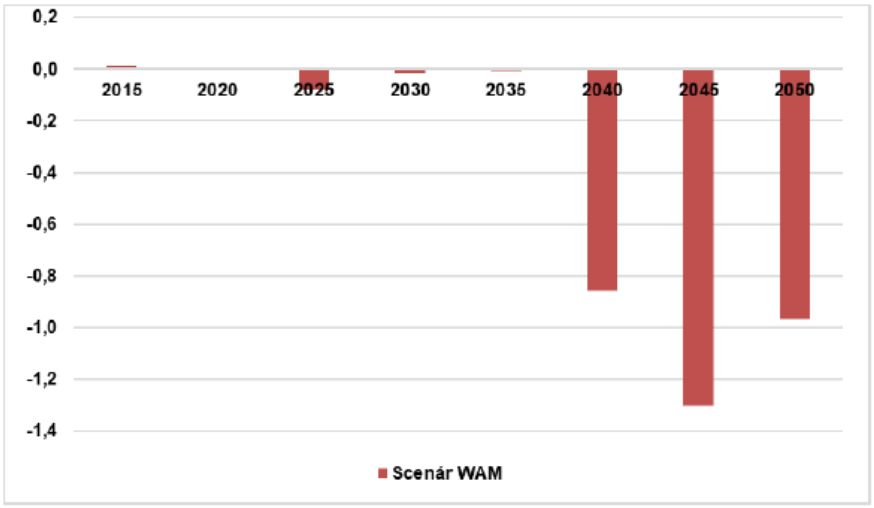
The macroeconomic model for Slovakia, which complements the energy model, uses the detailed results of the energy system from the CPS model and assesses impacts throughout the economy. It has all the features of a standard general economic equilibrium model but contains additional details on energy, electricity generation and emissions, so is also useful for assessing climate policies. The macroeconomic model is tailored to reflect the specific characteristics of the Slovak economy. Importantly, the demand for energy commodities in households and enterprises is price sensitive and captures the various options for electricity generation. Emissions are explicitly modelled. Various mitigation policies can be analysed using the Slovak-CGE model. Compared to the CPS energy model, the aim of the Slovak-CGE model is to simulate the wider economic effects of a shift towards a low-carbon economy.

5.2.1 Macroeconomic analysis of the WAM scenario – employment

Based on the results of the WAM scenario, changes in the structure of the economy will lead to a redistribution of the workforce in various industries. We anticipate that sectors expected to grow (mainly export-oriented industries and capital goods industries) will need additional labour, while sectors expected to decline (mainly consumer goods production industries) will release labour. However, not all workers made redundant will find work in the new growing sectors, which could lead to rising unemployment. Overall, structural economic change in response to decarbonisation policies (Dcarb 2 scenario) appears to be negative in terms of aggregate labour demand. In the short term (partly due to delayed wage adjustments), reduced demand for labour will mainly be reflected in lower employment. In the long run, it will result in downward pressure on wages, especially approaching 2050.

Figures 66 and 67 illustrate these developments.

Figure 66 Total employment by policy scenario, 2015-2050; % change compared to the reference scenario



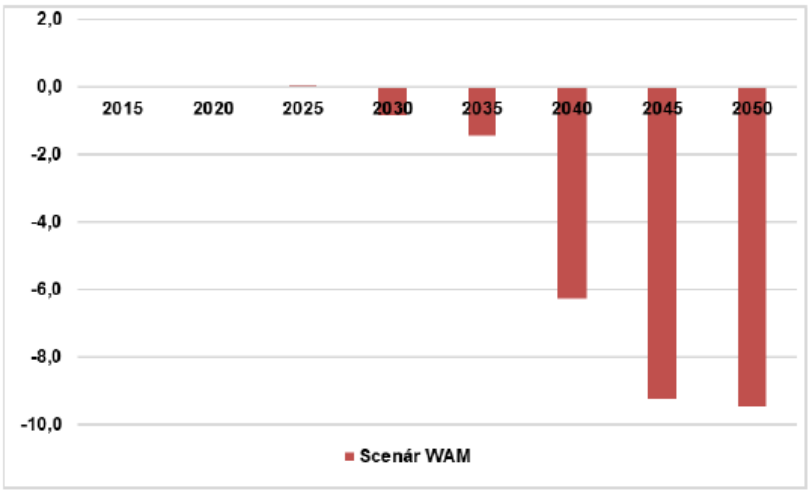
Key:

Scenar WAM	WAM scenario

Source: Results of the Slovak-CGE model

Wages fall in the long run in parallel with labour market adjustments

Figure 67 Real wages by policy scenario, 2015-2050; % change compared to the reference scenario



Key:

Scenar WAM	WAM scenario

Source: Results of the Slovak-CGE model

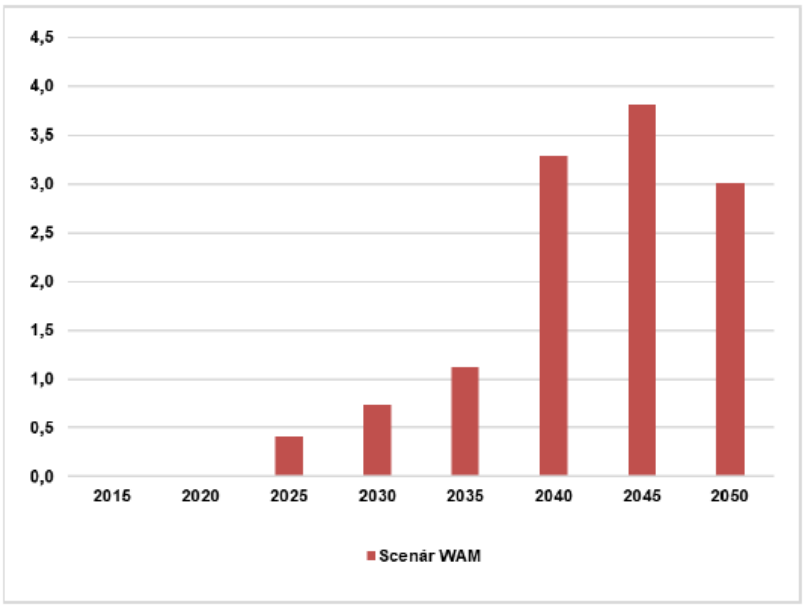
5.2.2 Macroeconomic analysis of the WAM scenario - impact on GDP

The transition to a low-carbon economy may potentially support GDP growth in the long run, but on the other hand may lead to lower household consumption.

Investments in energy efficiency will reduce energy costs and lead to long-term economic productivity gains. These investments need to be funded in the short to medium term. In industry and tertiary sectors, these energy efficiency investments will be passed on to consumers through higher product and service prices. Households will effectively finance the renovation of their buildings through energy savings. Households will also experience electrification costs in the transport sector, but this will not directly reduce consumption – they are expected to gradually replace their internal combustion engine (ICE) vehicles with alternative fuel or hybrid vehicles (section 5.3, Table 85). Household consumption will however be affected by the higher product and service prices charged by enterprises to offset the costs of their energy efficiency investments, in particular investments in electricity generation. Based on the results of the WAM scenario, GDP growth is anticipated to rise by around 0.5% to 1.0% in the 2025-2035 period and by 3% to 4% in the 2040-2050 period (Figure 68), and household consumption to decline by 0.7% to 1.02% in the 2025-2035 period, and by 5% to 6% in the 2040-2050 period (Figure 69).

Based on Figure 68 below, we can state that the GDP impact is favourable for the Dcarb2 (WAM) scenario in the long run

Figure 68 GDP by policy scenario, 2015-2050, as the % change compared to the reference scenario

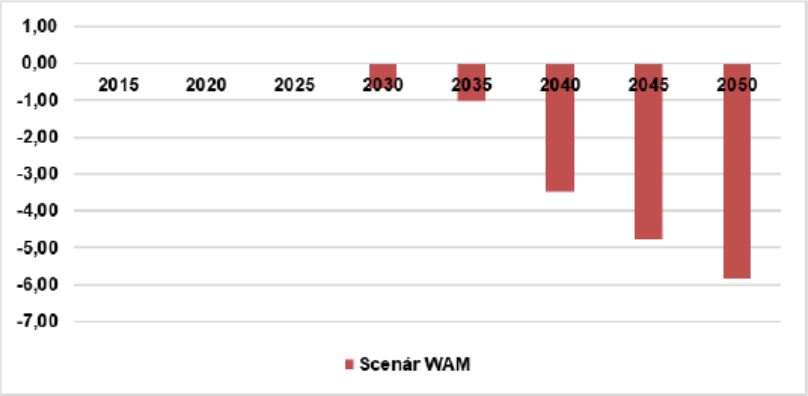


Source: Results of the Slovak-CGE model

Key:

Scenar WAM	WAM scenario

Figure 69 Private consumption by policy scenario, 2015-2050, % change compared to the reference scenario



Source: Results of the Slovak-CGE model

Key:

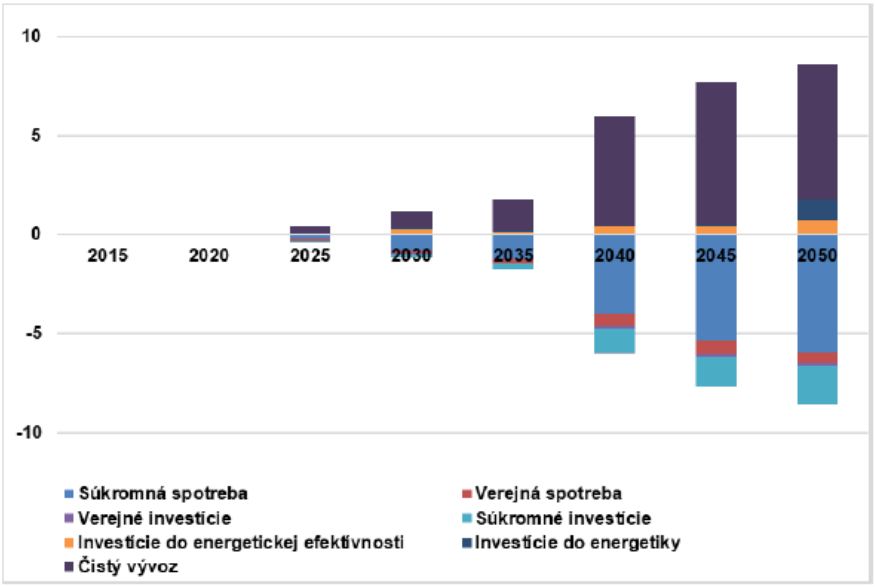
Scenar WAM	WAM scenario

According to the MEnv SR, reduced demand for fossil fuels will reduce Slovakia's import expenditures but, on the other hand, modelling indicates a deterioration in trading conditions. The deteriorated trading conditions will mean that, from a macroeconomic point of view, when exporting, more factor resources will need to be exchanged for a given quantity of imported goods. Consequently, imports will decline while exports rise. The increase in net exports in the context of deteriorated trading conditions will 'consume' GDP gains stemming from productivity improvements (energy efficiency) and contribute towards a decline in private consumption.

If Slovakia focuses on investing in decarbonisation, non-energy investments may be squeezed out to some extent. Investments in energy efficiency and in the energy sector are significant - from 0.3% to over 2.0% of GDP in all years. The increasing prices resulting from enterprises offsetting their energy efficiency investment costs will lead to a decrease in Slovakia's competitiveness, with a subsequent impact on enterprises' profitability. In addition, the decline in household consumption will reduce demand, thereby also impacting profitability. Decreasing profitability will discourage foreign investors from investing in the Slovak economy. Similarly, investments in electricity generation will squeeze out some non-energy investments.

As shown in the following Figure 70, net exports will increase by more than needed to merely offset reduced consumption in the long run.

Figure 70 Percentage of GDP expenditure by policy scenario, 2015-2050, % change compared to the reference scenario



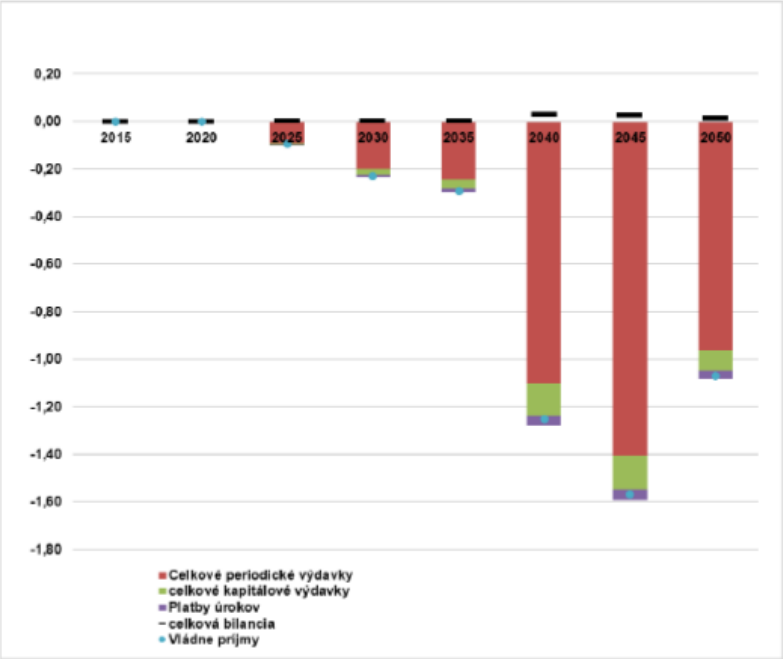
Key:

Sukromma spotreba	Private consumption
Verejne investicie	Public investment
Investicie do energetickej efektivnosti	Investment into energy efficiency
Cisty vyvoz	Net exports
Verejna spotreba	Public consumption
Sukromne investicie	Private investment
Investicie do energetiky	Investment into the energy sector

Source: Results of the Slovak-CGE model

It is also anticipated that the government will increase taxes or reduce transfers to ensure government budget sustainability during the transition to a low-carbon economy. As a result, the general government budget balance will remain broadly unchanged under all scenarios. Another option for the government would be to finance any shortfall through deficits, but this option was not modelled. In any event, an increase in public debt would ultimately have to be repaid through higher taxation or lower expenditure. The shift to a low-carbon economy will lead to lower revenue collection from indirect taxes (such as VAT) and direct taxes (including social security contributions). Indirect tax revenues will decrease due to the fall in household consumption, while direct tax revenues will decrease due to lower wages. The model does not define what specific change in taxation or the transfer system will be introduced to neutralize the budgetary impact, except that it is (or is almost) a non-distorting instrument (lump sum). (Figure 71)

Figure 71 General government budget balance by budget component and policy scenario (Dcarb2 (WAM)), 2015-2050, GDP change, % compared to the reference scenario



Key:

Celkove periodicke vydavky	Total periodical expenditures
Celkove kapitalove vydavky	Total capital expenditures
Platby urokov	Interest payments
Celkova bilancia	Total balance
Vladne prijmy	Government revenues

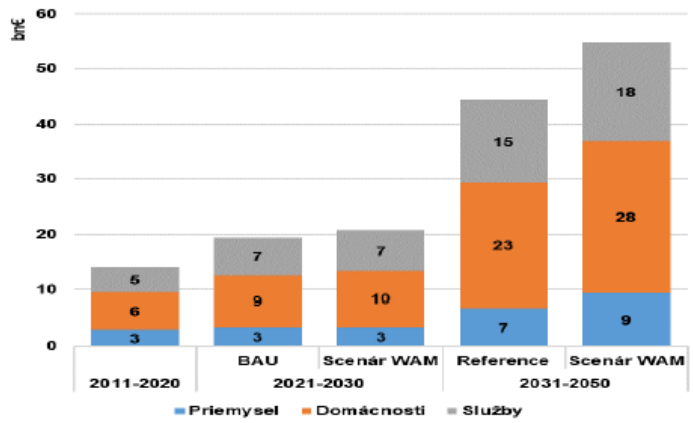
Source: Results of the Slovak-CGE model

5.3. Overview of investment needs

i. Existing investment flows and forward investment assumptions with regard to the planned policies and measures

Increases in energy efficiency and extensive RES development will lead to higher investment spending as consumers shift to buying higher-efficiency energy products, equipment, appliances and vehicles. According to the following Figure 72, we can state that investment in energy efficiency by households and enterprises will increase rapidly after 2030.

Figure 72 Investments in energy efficiency by sector, by policy scenario, 2011 to 2050, in EUR billions



Priemysel	Industry
Domacnosti	Households
Sluzby	Services

Source: E3-Modelling, CPS Technical Report

As noted above, the analysis revealed a positive impact on GDP, particularly in the long term, and that the decline in consumption is largely stimulated by emission-mitigation policies outside Slovakia. The GDP formula follows the size of the investments in energy efficiency, where higher energy efficiency investments lead to lower consumption but ultimately to higher overall GDP. This impact is stimulated by crowding out private investment in energy efficiency. Lower private investment will distort the capital in the economy, leading to lower overall production. Household consumption will fall as households reduce consumption to pay energy efficiency investments, in particular building renovation. Investments in energy efficiency will grow. Towards the end of the period, investments in electricity generation will increase as Slovakia will build a new nuclear power plant in the model scenario. Exports will shrink because of the loss of competitiveness as efficiency investment costs are passed on to consumers, and also because of the lower production capacity of the economy due to the reduced capital. Importantly, the macroeconomic impact on Slovakia will not solely be due to its own domestic policies – over half the fall in consumption will be due to decarbonisation policies in the rest of the EU (modelled as a carbon tax in both the ETS and non-ETS sectors). Policies in the rest of the EU will lead to lower imports from Slovakia. For example, only about 50% to 60% of the decline in consumption in Slovakia between 2040 and 2050 will be due to domestic policies (including the pricing of ETS emissions in Slovakia), the balance being due to lower demand from the rest of the EU as a result of the deteriorated trading conditions.

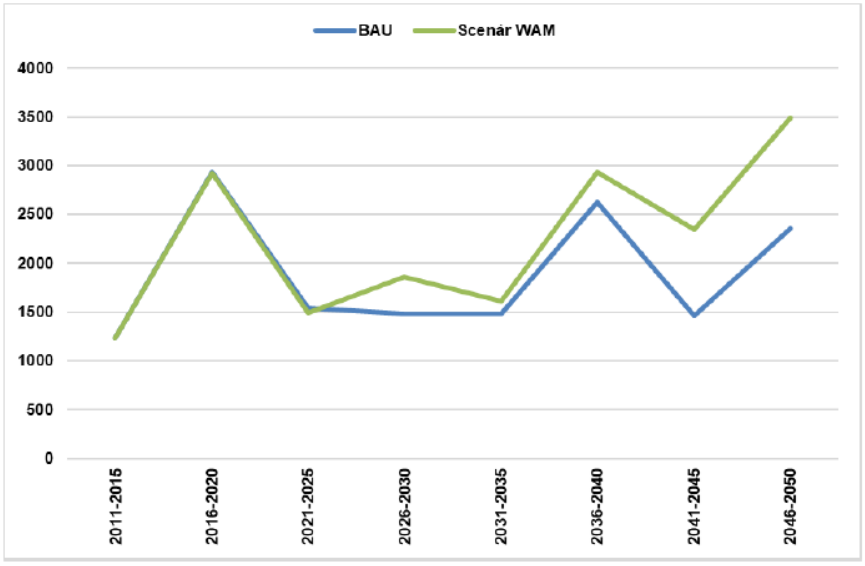
The following Table 84 and Figure 73 show the necessary investments in the industry sector by production branch (in EUR millions over 5-year periods).

Table 84 Necessary investments in the industry sector

INVESTMENT EXPENDITURE (IN EUR MILLIONS OVER 5-YEAR PERIODS)								
Industry	**2011-2015**	**2016-2020**	**2021-2025**	**2026-2030**	**2031-2035**	**2036-2040**	**2041-2045**	**2046-2050**
Steel industry	514.73	1114.75	820.15	872.17	914.30	1826.69	1501.54	2076.10
Metallurgy of non-	59.64	146.28	95.70	160.11	87.34	88.92	37.46	61.13

ferrous metals								
Chemical industry	53.66	489.76	58.15	87.02	81.75	100.48	117.40	138.23
Building materials	34.00	98.75	65.33	108.30	97.05	102.50	141.99	156.77
Paper industry	428.17	689.13	170.21	213.08	133.89	341.11	234.01	591.49
Manufacture of food, beverages and tobacco	25.61	66.85	68.32	129.03	76.25	135.45	93.01	129.17
Engineering	59.18	153.09	123.50	142.64	121.36	224.03	124.78	173.81
Textile industry	6.74	8.62	7.11	8.08	6.82	15.87	8.40	11.70
Other industries	54.46	155.62	87.78	140.17	92.63	100.91	93.43	155.92
Total	1236.18	2922.85	1496.23	1860.60	1611.39	2935.96	2352.02	3494.32

Figure 73 Total investment in the industry sector



Source: E3-Modelling, CPS Technical Report

The following Table 85 shows the investments that need to be made per national economy sector, and Table 86 shows the need for investments for the policies and measures analysed:

Table 85 Investments by subsector or type, by scenario, 2015, 2030 and 2050 (EUR millions and thousands of vehicles)

	2015	2030		2050	
		Reference scenario	Dcarb2 scenario (WAM)	Reference scenario	Dcarb2 scenario (WAM)
Investments (EUR millions)					

Heat recuperation	-	114.76	291.82	125.60	984.23
Processing	969.61	1 555.49	1 470.10	1 956.95	2 196.82
Equipment and appliances	3 429.05	7 811.45	7 855.16	9 811.00	9 698.20
Renovation of buildings by households	-	205.25	829.09	222.76	2 794.54
Renovation of buildings in the service sector	-	257.14	832.00	285.45	1 510.87
Passenger cars (thousand vehicles)					
Electric cars	-	37	56	211	1 646
Fuel cell cars	-	0	0	73	350
Plug-in hybrid cars	-	69	99	2623	370
Cars with internal combustion engines	1 754	2 409	2 357	2 561	1 211

Source: E3-Modelling, CPS Technical Report

Table 86 Investments by selected (analysed) policies and measures

Name of policy, measure	Anticipated costs (in EUR)			Description (addition) of estimates when calculating costs
	Absolute costs per year	Year(s) for which the investments were calculated	Reference year for price determination	
Increasing energy efficiency	2 247 000 000.00	2020-2035	2015	Capital costs (annual equivalent)
Implementation of the EU Winter Package	1 171 000 000.00*	2035	2015	Total costs of electricity generation (energy supply)
National Action Plan for Renewable Energy, Government Resolution 677/2010	1 483 000 000.00	2030	2015	Investment expenditure for energy generation plants
Implementation of the European Greenhouse Gas Emissions Trading Scheme	61 000 000.00*	2035	2015	Investment expenditure only for energy generation plants (five year period)
CO_2 emission standards for cars and light commercial vehicles, efficiency standards for trucks, together with electrification of transport	34 561.00	2020-2035	2015	Capital costs (annual equivalent)
Increasing energy efficiency in industry	544 000 000.00	2035	2015	Capital costs (annual equivalent)
District heating optimisation	103 000 000.00	2035	2015	Investment expenditure in connection with the installation of CHP units in district heating systems. (five year period)
Heating plant restructuring after 2025	109 572 219.00*	2019-2027	2015	Costs of closing and liquidation of the Handlová and Nováky mines

Increasing carbon prices in the EU ETS	74.00*	2035	2015	EU ETS carbon price (EUR / tonne CO_2)
Decarbonisation of electricity generation	1 051 000 000.00	2035	2015	Investment expenditure related to the penetration of RES into electricity generation (only for power plants, especially photovoltaic power plants)
Increasing the share of nuclear energy in the energy mix of the Slovak Republic	5 190 000 000.00*	2020	2015	Capital expenditures on the construction of new nuclear reactors in Mochovce (five-year period)
Continued reduction of final energy consumption in all sectors	30 000 000.00	2035	2015	Revenue related (in tonnes of CO_2/EUR)

Source: CPS Energy Model - E3 Modelling
*absolute costs

When processing the estimated costs related to the achievement of the currently planned target of a 19.2% RES share in 2030, the ME SR calculated the investment costs related to decarbonisation of electricity generation at EUR 180 000 000 and to decarbonisation of heat generation (RES) at EUR 250 000 000 per year.

Table 87 Investments in the transport sector (by type)

	2015	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Investment costs (EUR million)	28 948	55 315	56 684	64 804	72 980	100 671	114 241	113 127
Personal transport	24 838	47 592	50 157	58 163	66 096	92 533	106 468	104 807
Public road transport	840	1 628	1 357	1 302	1 254	1 998	1 581	1 409
Individual road transport	20 687	40 661	43 329	50 791	59 538	84 753	98 963	97 006
Rail transport	2 644	3 814	4 001	4 150	3 618	3 716	4 064	4 110
Air transport (incl. international)	667	1 488	1 470	1 920	1 685	2 066	1 859	2 281
Inland navigation	-	-	-	-	-	-	-	-
Freight	4 110	7 723	6 528	6 641	6 884	8 137	7 773	8 320
Road transport	3 112	5 650	4 665	4 733	5 224	6 663	5 694	6 289
Rail	960	1 969	1 770	1 810	1 570	1 396	1 991	1 904
Inland navigation	38	104	93	97	89	79	88	127
International freight	-	-	-	-	-	-	-	-

Source: CPS Energy Model - E3 Modelling

Figure 74 below presents the estimated investments across all analysed sectors (transport, industry, services, households) in terms of costs

Figure 74 Estimated investments in industry, transport, services and households by policy scenario, 2020 to 2050, EUR billions

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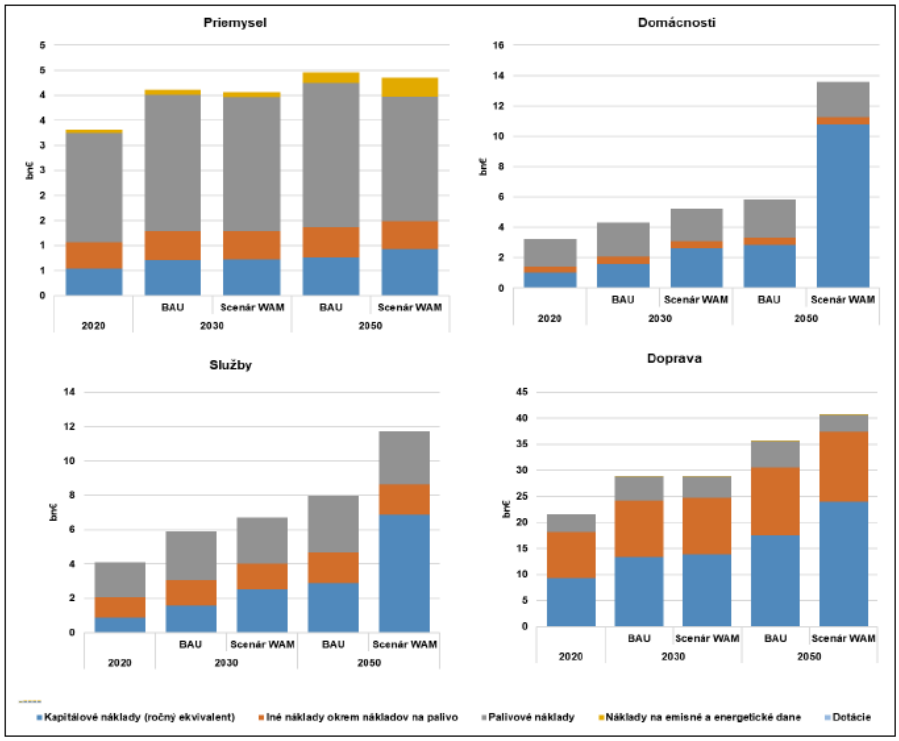

Key:

Priemysel	Industry
Domacnosti	Households
Sluzby	Services
Doprava	Transport
Kapitalove naklady (rocny ekvivalent)	Capital costs (annual equivalent)
Ine naklady okrem nakladov na palivo	Other costs except fuel
Palivove naklady	Fuel costs
Naklady na emisne a energeticke dane	Emissions and energy taxes

Source: E3-Modelling, CPS Technical Report

ii. Sector or market risk factors or barriers in the national or regional context

It is important for future economic development in this field to develop sector-specific measures, as it is very difficult to develop a successful universal industry or scientific-research policy in a time of specialisation. This is increasingly related, *inter alia*, to support for scientifically excellent teams and their cooperation with practice and the relevant sectors, support for an educational focus on practice, or streamlining and significantly reducing administrative demands.

The high energy intensity of industry as well as the share of industry in the country's GDP are key challenges for the economic policy in the future in connection with the digital transformation and innovative technologies.

In research and innovation, the problem is a fragmented and in particular undercapitalized production sphere. Expenditure on research and development by enterprises in the Slovak Republic is low. There is only weak collaboration between universities and enterprises on R&D for innovation. Another problem is the lack of motivation for researchers to stay and work in Slovakia.

The ambition of the SR in terms of competitiveness is to support investments that increase added value, emphasising business research and innovation. The limiting factor is the low share of public investment outside European structural and investment funds.

iii. Analysis of additional public finance support or resources to fill identified gaps identified under point iii)

As an EU Member State, Slovakia accepts the strengthening of the strategic approach in the cohesion policy with a view to further developing a coordinated and harmonized implementation of Union funds, which will be implemented based on the so-called general - shared governance, in particular for the European Regional Development Fund (ERDF), the European Social Fund plus (ESF+), the Cohesion Fund, measures financed under shared governance for the European Maritime and Fisheries Fund (EMFF), the Asylum, Migration and Integration Fund (AMIF), the Internal Security Fund (ISF) and the Border and Management and Visa Instrument (BMVI), while simplifying and defining five clear cohesion policy objectives for the 2021-2027 period:

1. A smarter Europe - innovative & smart economic transformation;
2. A greener, low-carbon Europe;
3. A more connected Europe - ICT mobility and regional connectivity;
4. A more social Europe - implementation of the European pillar of social rights;
5. A Europe closer to citizens - sustainable and integrated development of urban, rural and coastal areas through local initiatives.

This simplification will enable synergies and flexibility between the different components within a given objective and will eliminate the artificial differences between the different policies contributing towards the same objective, while providing a basis for thematic concentration for the ERDF and the ESF+. At the same time, synergies between the various EU instruments will be fostered through a strategic planning process that identifies common objectives and common areas for action under different programmes, such as the Common Agricultural Policy (CAP), European Horizon, Connecting Europe Facility (CEF), Digital Europe Programme, Erasmus+, InvestEU Programme and LIFE.

5.4. Impacts of planned policies and measures described in Section 3 on other Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

i. Impacts on the energy system in neighbouring and other Member States in the region to the extent possible

The interconnections below contribute towards improving energy security and reliable supply in all the states concerned.

In particular, bilateral cooperation at the level of the TSOs concerned is under way to support the preparation and implementation of cross-border investment projects in electricity infrastructure. Broader regional cooperation to support cross-border transmission projects and other key electricity

infrastructure projects is currently shown not to be needed. Discussions on future cross-border interconnections are taking place within ENTSO-E in the System Development Committee.

As regards the electricity transmission infrastructure, the Slovak Republic's priority is to complete the construction of new Slovak-Hungarian cross-border connections (2x400 kV Gabčíkovo (SR) - Gönyű (HU) - Veľký Ďur (SR) and 400 kV R. Sobota (SR) - Sajóivánka (HU)). On the Slovak side, both lines are in the contractor procurement phase, while building permits for both projects have been issued.

In cooperation with the Czech TSO (ČEPS), the TSO (SEPS) is considering submitting an application to include the planned 1x400 kV Ladce (SR) - Otrokovice (CZ) interconnection on the list of projects of common interest (PCI). This is an interconnection that would replace the gradually decommissioned 220 kV transmission system (TS) on both sides of the SR/CZ border. This reinforcement also includes a planned increase in the transmission capability of the V404 Varín (SR) - Nošovice (CZ) line as part of the upcoming renewal work by SEPS and ČEPS.

Steps are being taken both by the State and the gas companies to secure gas supplies, based on which the Slovak Republic will be better prepared for possible gas supply problems. The Slovak Republic has supported interconnection projects with Poland and Hungary, as well as reverse flow projects from the Czech Republic and Austria.

The pipeline for the Slovakia and Hungary interconnection project was put into standard commercial operation on 1 July 2015 after the successful completion of construction and testing.

The Slovak-Polish gas interconnection project is part of the North-South Gas Corridor and forms an important element in the gas pipeline transit chain that will connect Eastern Europe from the Polish LNG terminal of Świnoujście to the planned Croatian LNG terminal on the island of Krk.

The Eastring gas pipeline project, in the sense of the concept to interconnect Western European markets with the countries of south-eastern Europe in particular, is a solution for strategic goal of maintaining or even increasing the volumes of gas transported through the Slovak transmission network. The implementation of the project would greatly contribute towards increasing the importance of Slovakia's role as a crossroads for gas interconnections and its ability to ensure gas transit using reverse flow to the whole region. The gas pipeline, designed to be bi-directional, can therefore be considered a way for new potential suppliers – especially from the Caspian region or the potential so-called Turkish gas hub – to access European markets and increase the level of security through source diversification.

The strategic geographical location of the Slovak Republic and the relatively high transport capacity of the Druzhba pipeline on Slovak territory create realistic conditions for its connection to European transit routes.

The Druzhba-Adria project addresses the issue of oil transport by pipeline from the Russian Federation through Belarus, Ukraine, Slovakia, Hungary and Croatia. In 2015, the expansion of the Adria-Friendship 1 pipeline section between the Slovak city of Šahy and the Hungarian city of Százhalombatta was completed and put into operation. This expansion and reconstruction almost doubled the original transit capacity. This project was included in the original PCI list.

The project for an oil pipeline in the direction of Schwechat is considered a strategic investment, and since 2013 has been considered a strategic corridor and project of common interest at EU level. The implementation of the oil pipeline project will ensure strategic interconnection with oil pipelines in Western Europe. With this step and if reverse pumping from Austria is ensured, oil supplies from non-Russian sources will be possible, thus reducing our dependence on oil from the Russian Federation.

At present, the suitability of routing the above-mentioned pipeline across the Slovak Republic is being analysed. Based on the latest survey, an oil pipeline route of 12.814 km with a connection point at the Slovnaft a.s. refinery was recommended, ending on the Slovak-Austrian border near Kittsee.

ii. Impacts on energy prices, utilities and energy market integration

Binding European Community regulations are the decisive starting point for the regulatory policy. These are reflected into the setting of reasonable energy prices for consumers to maintain transparent and non-discriminatory regulatory principles. Energy prices are anticipated to rise due to higher demand, system costs, deregulation, implementation of European measures, as well as increased environmental protection costs.

The activities of the Agency for the Cooperation of Energy Regulators (ACER) towards developing a coordinated governance system for the construction of a functioning single European gas and electricity market from the perspective of energy security and reliability in individual EU Member States, or framework guidelines to serve as a basis for the preparation of network regulations, are also reflected in cooperation with the Regulatory Office for Network Industries (RONI). The cooperation between the national regulator and ACER is also enshrined in the regulatory policy developed by the Regulatory Council (a RONI body), which defines regulatory policy priorities for the relevant regulatory period with the ambition to apply regulatory tools and regulatory methods that ensure the transparent and non-discriminatory performance of activities in network industries, including monitoring mechanisms for compliance with competition rules, compliance with transparency obligations, possible abuse of a dominant market position and, last but not least, consumer rights protection, with an emphasis on the most vulnerable consumer groups.

iii. Where relevant, impacts on regional cooperation

When forecasting future developments, the transmission system operator eustream, a.s. also monitors long-term trends and estimates of gas consumption across the EU. When considering the suitability of projects for implementation, it takes into account the need for secure supplies, not only for the Slovak Republic but also for vulnerable regions such as south-eastern Europe and Ukraine in particular. Another criterion taken into account is the desire to contribute towards the integration of the gas markets in the most efficient way, in particular by using existing infrastructure to the greatest extent possible. One positive example is the implementation of the TRU service, which connects the Austrian and Czech gas markets through the existing Eustream transmission infrastructure. Thanks to this service, the European Union’s efforts to integrate markets in a simple and cost-effective way without unnecessary investment are being put into practice.

Part 2

List of parameters and variables to be reported in Section B of the National Plan[60] [61] [62] [63]

A list of parameters and variables to be reported in Section B of the NECP is provided in the table in Annex No 1.

[60] For the plan covering the period from 2021 to 2030: For each parameter/variable in the list, trends over the years 2005-2040 (2005-2050 where appropriate) including for 2030 in five-year intervals shall be reported both in section 4 and 5. Parameters based on exogenous assumptions vs. modelling output shall be indicated.

[61] As far as possible, reported data and forecasts shall build on and be consistent with Eurostat data and methodology used for reporting European statistics in the relevant sectoral law, as European statistics are the primary source of statistical data used for reporting and monitoring, in accordance with Regulation (EC) No 223/2009 on European statistics.

[62] Note: all projections are to be performed on the basis of constant prices (2016 prices used as the base year)

[63] The Commission will provide recommendations for key parameters for projections, at least covering oil, gas, and coal import prices as well as EU ETS carbon prices.