Interreg
Danube Transnational Programme
DanuP-2-Gas

Deliverable D.T2.2.1

Infrastructure Report (Slovakia)

Activity A.T2.2: Infrastructure analysis

March, 2022

Project co-funded by the European Union funds (ERDF, IPA)
www.interreg-danube.eu/danup-2-gas

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Short Description
The potential for exploitable organic residue for each participating country listing key aspects such as location, amount, transport options and costs.

Document Details	
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CONTENT

1. METHODOLOGY

The presented material is based on available information on the electricity market, natural gas market, water. The mentioned commodities are subject to regulation in Slovakia according to Act No. 250/2012 Coll. on regulation in network industries.

The Infrastructure database covered extensive amount of data within the Energetic infrastructure in Slovakia. The first sheet is dedicated for Renewable energy plants overview in Slovakia with addresses of the owners, the amounts of electricity, heat and in some cases biomethane power, production or consumption, and connection points to the nearest gas and electricity grid. The most difficult part was to get exact locations of the solar electric plants. There is no register of such plants with locations and no institution could provide it. Finally, the task was completed by detailed online map search with the satellite layer. Another types of REP contained wind turbine parks, hydro energy plants and biomass plants.

The second set of sheets provides information on Industrial plants with the information on power and production, localisation and nearest grid connections.

The third set of sheets provide information on Transport hubs in Slovakia, specifically the intermodal terminals where water-rail-road or at least two of these meet. The source can be found here http://www.intermodal.sk/intermodalna-infrastruktura/3s.

The fourth set of sheets describes the exact location of connection points to electrical and gas grid. These were especially hard to recognise, as the grid operators refused to provide them regarded that they are the components of critical infrastructure. Finally, the gas grid operator provided the information after several meetings and explaining the relevance of the project. The electrical grid connection points were found with the help of online mapping and satellite layer.

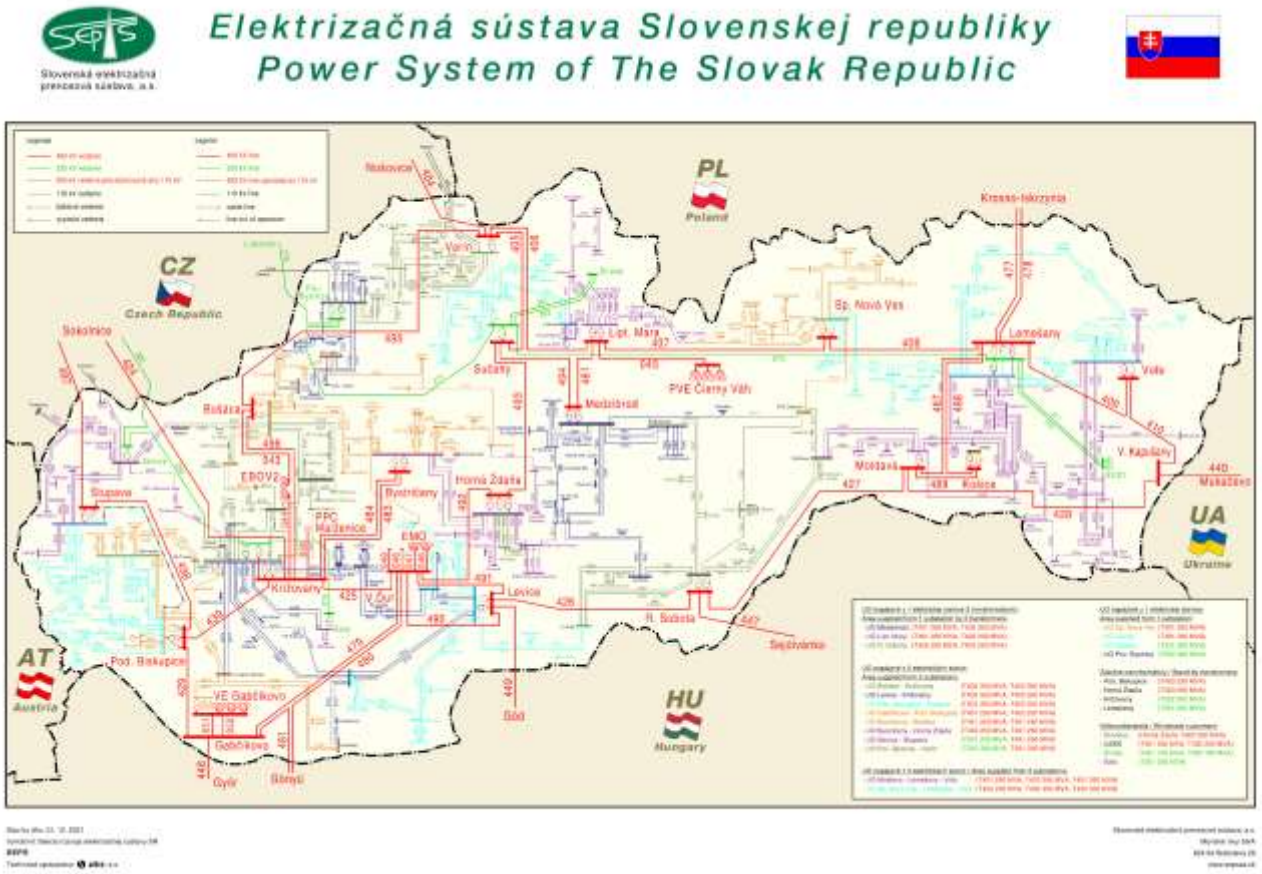
The last set of sheets represents the transnational links, where the electrical and gas grid precede the Slovak border with its neighbouring countries. This task was as well partly elaborated with the help of internet satellite localisation.

Overall, there were several sources of information. Most of it was provided by the external expert from energy sector, who elaborated the lists of REP, IP, CP and TL with the additional information. Some information were found on the internet from available sources. Some were obtained from personal meetings with the representatives of the electrical and gas distribution grid operators. Representatives of several involved

Ministries were contacted and internal experts were directed to affected offices (e.g. Regulatory Office for Network Industries, Intermodal graduation centre etc).

2. BRIEF DESCRIPTION OF SLOVAK INFRASTRUCTURE LANDSCAPE

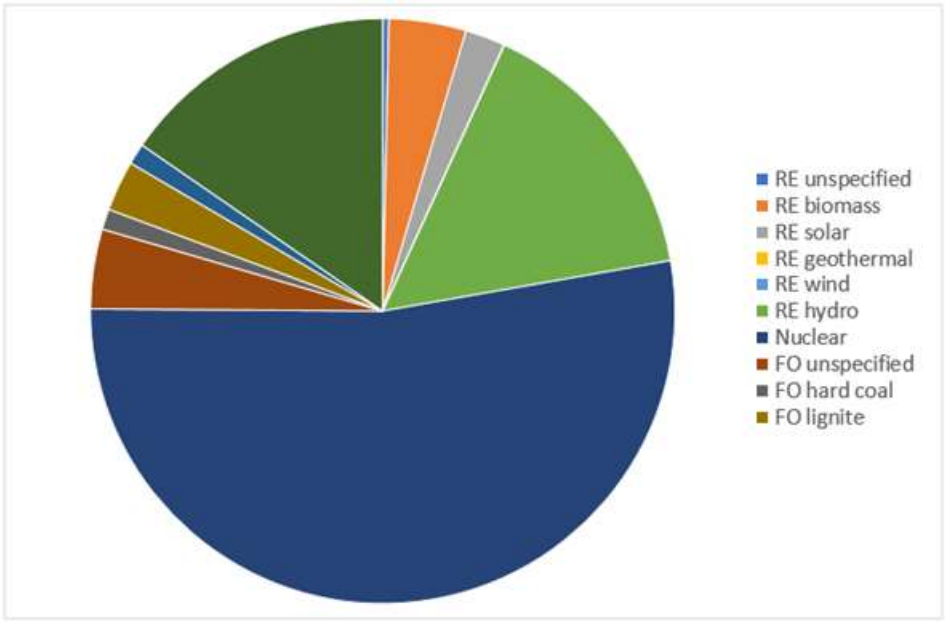
The infrastructure condition and distribution in Slovakia is well developed. Both the electrical and the gas grids cover most of Slovak inhabited areas and Industrial areas.



Pic.1 Electricity system of Slovakia

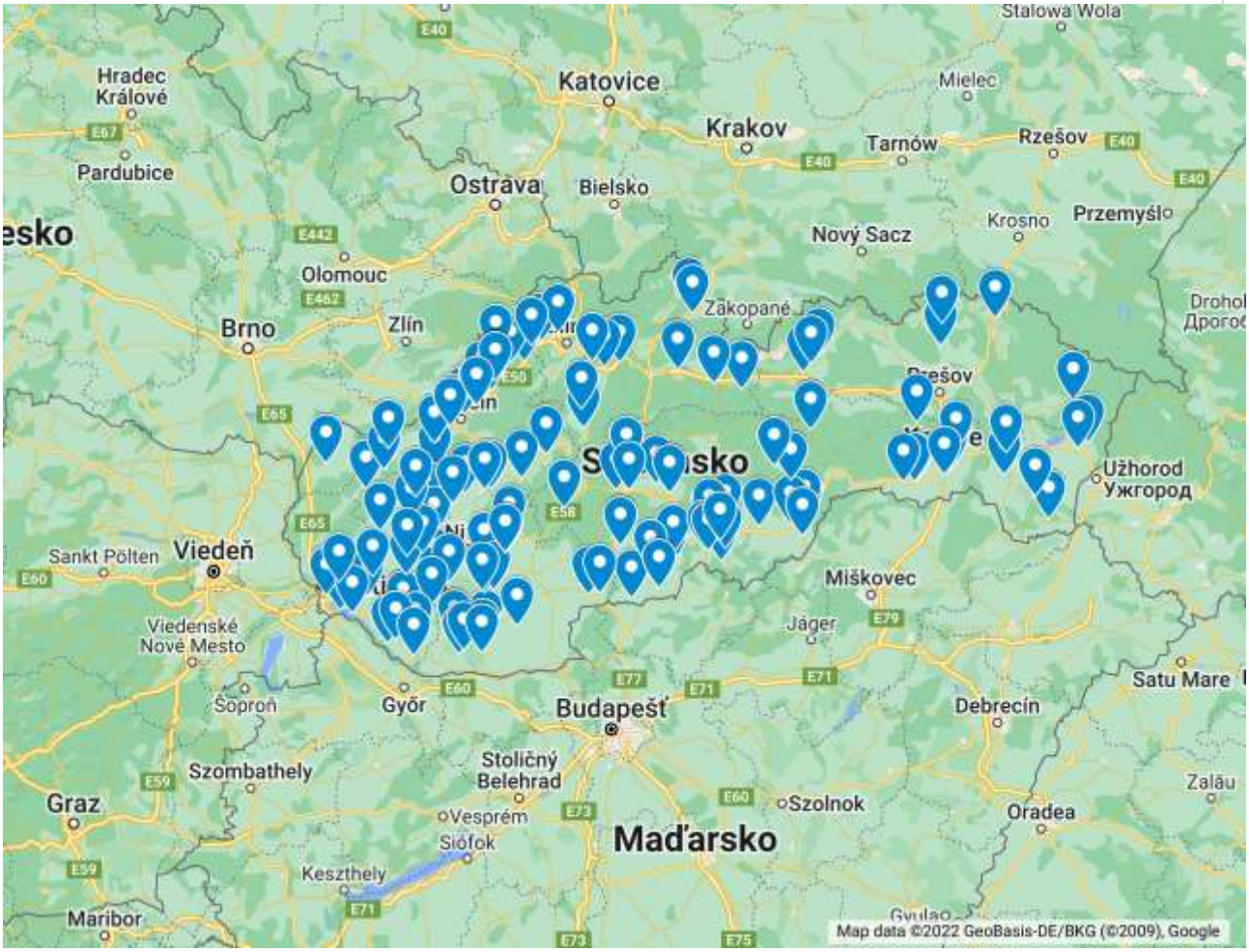
Pic.2 Gas distribution network map

To elaborate on the situation with REP in Slovakia, we can state that the amount of electricity produced with REP is still low. Majority comes from hydroelectric plants, some amount comes from solar plants and the wind power is represented with only one running park. There is still huge potential to increase the share of production from renewable sources. The statistics from OKTE from 2021 shows that the majority of electricity is still produced from the nuclear plants.



Production Mix 2021	2021
Volume [TWh]	27,73
RE unspecified	0,34%
RE biomass	4,27%
RE solar	2,21%
RE geothermal	0,00%
RE wind	0,02%
RE hydro	15,40%
Nuclear	52,88%
FO unspecified	4,40%
FO hard coal	1,13%
FO lignite	2,79%
FO oil	1,16%
FO gas	15,40%

Pic.4 and table: Source https://www.okte.sk/en/guarantees-of-origin/statistics/national-energy-mix/



Pic. 3 Mix of all types of the REP over 1MW imported from the Infrastructure database

The trends, however are in line with the rest of EU to move from fossil fuels to renewable sources. According to Integrated energy and climate plan for the years 2021-2030, In 2019, the Slovak Republic signed up to the commitment to achieve carbon neutrality by 2050 SR has balanced share of nuclear fuel and fossil fuels in gross domestic consumption. Development of the SR energy sector is aimed at optimizing the energy mix so that greenhouse emissions decrease as much as possible gases and pollutants during preservation, or increase in energy security and price the availability of individual types of energy.

In the best alternative, the Slovak Republic proposes a target of 19.2% of renewables in 2030, which is an increase of 5.2 percentage point compared to the target set for 2020 which proposes total investment difficulty in achieving goals in the area of RES in the amount of 4.3 billion euros for 19.2%.

The Slovak Republic implemented legislation supporting its own production of electricity by introducing an institute "local source" through the amendment to Act no. 309/2009 Coll. on the support of renewable energy sources and highly efficient combined production (Act No. 309/2018 Coll.). This act is supported by introduction of measures in the field of development of intelligent metering systems (IMS) and intelligent networks. SR is in the phase of initial construction of basic IS infrastructure.

It is expected that the deployment of intelligent networks will enable optimal and more precise management of distribution networks, which will enable connection of several subscribers without the need for investments in new network construction. Electricity input to of the electricity system from a large number of decentralized production sources through different distribution systems cannot be regulated without the use of modern telecommunications technologies that make operations more efficient.

Renewable sources of electricity

Of the total installed capacity of hydropower plants of 2542 MWe, 1626 MWe are in run-of-river power plants and 916 MWe are in pumping power plants. The largest hydroelectric power plant is Gabčíkovo Hydropower Plant with an installed capacity of 720 MWe. Its annual production (2200 GWh) represents almost half of the total electricity production of hydropower plants in Slovakia.

Photovoltaic power plants experienced the greatest development between 2011 and 2013, when 530 MWe of installed capacity were put into operation, which represents a total of 530 GWh of produced electricity with an annual utilization of 1000 hours. There are currently 5 wind turbines in operation in the Slovak Republic with a total installed capacity of 3.1 MW and an annual production of approximately 5.5 GWh of electricity. Wind power plants cannot compete with other sources of electricity in Slovakia. Since the end of 2013, the so-called stop status for connecting new RES sources to the system, which limited the connection of variable RES sources larger than 10 kWe. In connection with the amendment of Act no. 309/2009 Coll. on the support of renewable energy sources and highly efficient combined production and on the amendment and supplementation of some laws, the Ministry of the Interior of the Slovak Republic determined for the years 2019 and 2020 the connectable volume of new equipment with a total installed capacity of 89 MW. It concerns equipment for the production of electricity from RES and VÚ KVET with support, as well as installed power in local sources without the obligation to pay a tariff for operating the system. By 2030, it will be necessary to solve the replacement for the existing photovoltaic power plants with a capacity of approximately 530 MWe, which were connected to the grid between 2010 and 2012. These power plants are covered by contracts with a guarantee of a feed-in

subsidy for 15 years, which means that between in the years 2025-2027, there will be a loss of financial support, and it is therefore possible to expect their disconnection from the system.

Biomass is currently represented in the energy mix with an installed capacity of 272 MWe and annual production at the level of 1731 GWh.

Characteristics of the SR Transmission System The SR transmission system is primarily a set of 400 kV, 220 kV and selected 110 kV technological devices connected to each other, through which electricity is transmitted from its producers to individual customers from the SR transmission system (hereinafter referred to as "PS SR") , as well as cross-border transmission of electricity. These are mainly: • national and cross-border 400 kV, 220 kV and selected 110 kV lines, • 400/220 kV, 220/110 kV and 400/110 kV transformers, • 400 kV, 220 kV and selected 110 kV substations, • compensation devices.

Electric lines Individual electric stations ("ESt") in PS SR are galvanically connected to each other by means of forty-six 400 kV transmission lines with a developed 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. From the total number of 400 kV and 220 kV transmission lines, PS SR has eight 400 kV and two 220 kV cross-border electric lines, together with a total length of approx. 444 km on the territory of the Slovak Republic, which connect PS SR with the neighboring transmission systems of CZ on the respective cross-border profiles. HU, PL and UA.

2.1 ELECTRICAL ENERGY SECTION

The operator of the transmission system in Slovakia is called the Slovak Electricity Transmission System (SEPS).

The Slovak transmission system is primarily a set of 400 kV, 220 kV and selected 110 kV technological devices connected to each other, through which electricity is transmitted from its producers to individual customers from the Slovak transmission system, as well as cross-border transmission of electricity. These are mainly:

- national and cross-border 400 kV, 220 kV and selected 110 kV lines,
- 400/220 kV, 220/110 kV and 400/110 kV transformers,
- 400 kV, 220 kV and selected 110 kV substations,
- compensation devices.

Electric lines Individual electric stations in Slovakia are galvanically connected to each other by means of forty-six 400 kV transmission lines with a developed 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. From the total number of 400 kV and 220 kV transmission lines, PS SR has eight 400 kV and two 220 kV cross-border electric lines, together with a total length of approx. 444 km on the territory of the Slovak Republic, which connect PS SR with the neighbouring transmission systems of CZ on the respective cross-border profiles. HU, PL and UA.

In the Slovak Republic, electricity distribution is currently ensured by three regional distribution systems (east, center and west of Slovakia) and approx. 150 local distribution systems.

The structure of electricity prices in Slovakia consists of:

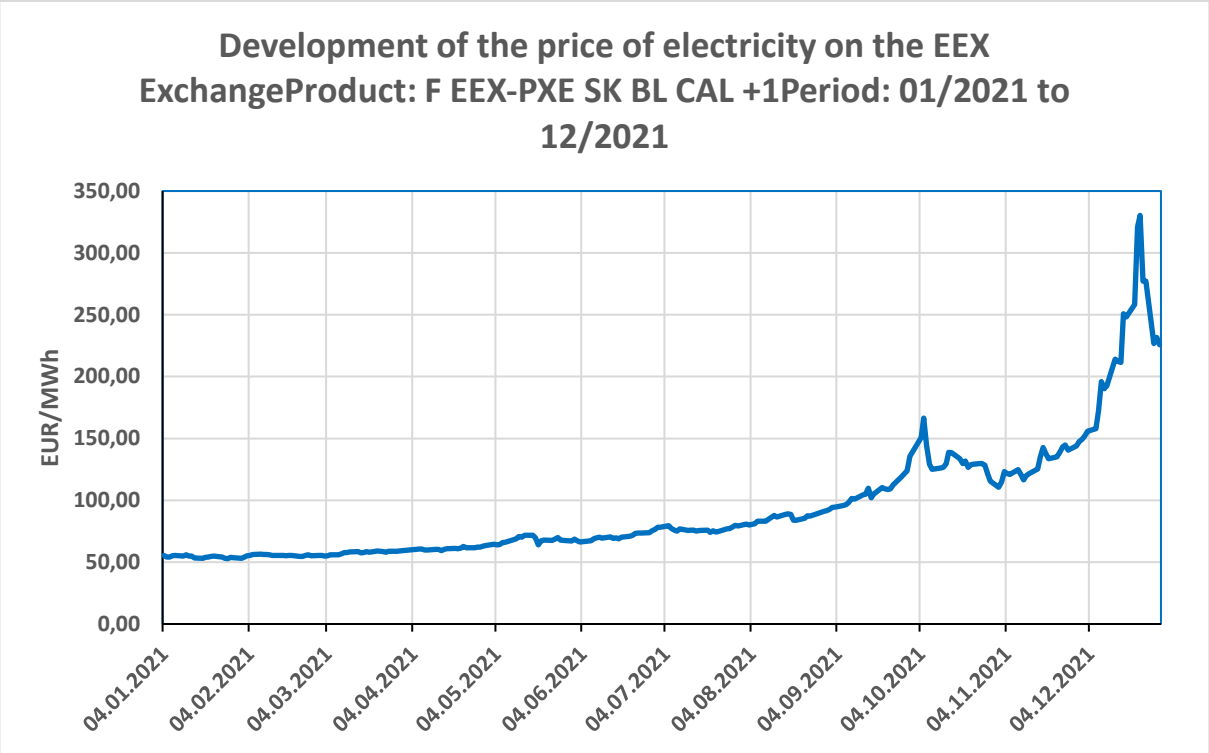
- commodity,
- distribution fees,
- tariff for system operation (TPS),
- tariff for system services (TSS),
- contribution to the National Nuclear Fund,
- excise duty on electricity.

2.1.1 OVERVIEW OF COMMODITY PRICES TRADED ON THE EEX EXCHANGE IN 2021 FOR SLOVAKIA:

Average 0.094 € / kWh

Maximum 0.330 € / kWh

Minimum 0.053 € / kWh



2.1.2 ELECTRICITY - DAILY MARKET OKTE, A.S. BRATISLAVA

OKTE's daily and intraday market provides electricity market participants with the opportunity to buy and sell electricity in order to balance their position and minimize their deviation.

Period	Base €/kWh	Off - peak €/kWh	Peak €/kWh
january	0,0558	0,0470	0,0646
february	0,0505	0,0435	0,0575
march	0,0537	0,0510	0,0564
april	0,0607	0,0606	0,0607
may	0,0598	0,0602	0,0594
june	0,0758	0,0749	0,0766
july	0,0864	0,0831	0,0898
august	0,0855	0,0824	0,0885
september	0,1327	0,1242	0,1412
oktober	0,1512	0,1272	0,1753
november	0,1853	0,1481	0,2225
december	0,2321	0,1798	0,2844
Year 2021	0,1028	0,0904	0,1151

2.1.3 ELECTRICITY DISTRIBUTION

Electricity distribution in Slovakia is provided by three distribution companies:

- Západoslovenská distribučná, a.s. Bratislava

- Stredoslovenska distribucna, a.s. Žilina

- Východoslovenská distribučná, a.s. Košice

Each distribution company has the amount of individual components of distribution fees determined by the Office for the Regulation of Network Industries.

Their tarrifs can be found on their web pages.

2.1.3.1 Prices for connection of the electricity producer to the distribution system

Reserved capacity agreed in the contract for the existing offtake point (offtake equipment) for the connection of the electricity producer, except for electricity generation facilities from renewable energy sources or cogeneration	Price per 1 kW of maximum reserved capacity up to the value of the current maximum reserved capacity for the existing offtake point, inclusive	5,15 - 6,02 €
Price per 1 kW of maximum reserved capacity above the value of the current maximum reserved capacity for the existing offtake point		10,30 - 12,04 €
For the connection of a producer of electricity from renewable energy sources or cogeneration	Price per 1 kW of maximum reserved capacity up to the value of the current maximum reserved capacity for the existing offtake point, inclusive	5,15 - 6,02 €
Price per 1 kW of maximum reserved capacity above the value of the current maximum reserved		10,30 – 12,04 €

capacity for the existing offtake point	

2.1.3.2 Other charges in the price of electricity

Tariff for the operation of the system (TPS) for the year 2021:

up to 1 GWh of electricity consumption - 15.90 € / MWh

over 1 GWh of electricity consumption - 11.90 € / MWh

over 100 GWh of electricity consumption - individually in € / MWh

Tariff for system services (TSS) for the year 2021 - 6.2976 € / MWh

Contribution to the nuclear fund - 3.27 € / MWh

Excise duty on electricity - 1.32 € / MWh

Value Added Tax (VAT) valid for electricity trade - 20%

2.1.4 SHARE OF RESOURCES IN ELECTRICITY GENERATION IN 2021

Production Mix 2021	**2021**
Volume [TWh]	**27,73**
RE unspecified	**0,34%**
RE biomass	**4,27%**
RE solar	**2,21%**
RE geothermal	**0,00%**
RE wind	**0,02%**
RE hydro	**15,40%**
Nuclear	**52,88%**
FO unspecified	**4,40%**
FO hard coal	**1,13%**
FO lignite	**2,79%**
FO oil	**1,16%**
FO gas	**15,40%**

2.1.5 DATA ON TOTAL ANNUAL ELECTRICITY IN 2020-2021

Data on electricity generation, consumption and imports in 2020 and 2021-preliminary estimate:

Electricity balance ES SR year 2020	
	GWh
Domestic production	29 010
Consumption of ES SR (without pumping)	29 328
Balance (imports)	-318

Electricity balance ES SR year 2021-preliminary estimate	
	GWh
Domestic production	30 085
Consumption of ES SR (without pumping)	30 859
Balance (imports)	-774

2.1.5.1 Overview of electricity production from renewable energy sources in 2020

	Distribution system	Method of production		Number of resources	Production
				pcs	MWh
1	Total balance area of the Slovak Republic	OZE	- biomass	11	317 731
2			- anaerobic biogas		510 777
3			- anaerobic biogas-other	3	13 862
4			- other RES and secondary fuel	2	62 607
5			- gas Wastewater Treatment Plant	8	10 005
6			- landfill gas	10	10 794
7			- sun energy	1 999	684 267
8			- wind energy	1	0
9			- hydropower	225	2 124 132

2.1.6 SUPPORT SERVICES FOR THE ELECTRICITY SYSTEM OF SLOVAKIA (ES SR)

The Office for the Regulation of Network Industries designates for SEPS, a.s. Bratislava, which is the operator of ES SR, maximum prices for the provision of individual types of support services (PpS):

- Primary frequency and power control
- Secondary frequency and power control
- 3 min. positive frequency and power control
- 3 min. negative frequency and power control
- 10 min. positive frequency and power control
- 10 min. negative frequency and power control
- 15 min. positive frequency and power control
- 15 min. negative frequency and power control
- Reduction of consumption
- Increased consumption

Support services	€/MW
Primary power and frequency control (within ± 26 MW)	40,61
Secondary power and frequency control (average range ± 145 MW)	13,39
3 min. tertiary regulation (+) of power and frequency (fast-starting backup service in the range of + 255 MW)	13,74
3 min. tertiary regulation of (-) power and frequency (service of fast-starting backup in the range - 135 MW)	9,85
10 min. tertiary (+) power and frequency control (on average + 215 MW)	11,15
10 min. tertiary (-) power and frequency control (on average - 100 MW)	9,42
15 min. tertiary (+) power and frequency control (on average + 120 MW)	7,34
15 min. tertiary (-) power and frequency control (on average - 120 MW)	5,01
reduction of consumption (on average - 70 MW)	4,41
increase in consumption (on average + 10 MW)	2,59

Regulatory energy	€/MWh
Price of the offered positive regulating electricity delivered upon activation of the support service (PpS) PRV +	135
Price of the offered positive regulating electricity delivered upon activation of the support service (PpS) PRV +	175
Price of the offered positive regulating electricity delivered when activating the support service (PpS) TRV15MIN +, TRV10MIN +, TRV3MIN +	189
The price of the offered positive regulating electricity delivered at the activation of the support service (PpS) reduction of consumption	189
The price of the offered negative regulating electricity delivered at the activation of the support service (PpS) PRV-	-25
Price of the offered negative regulating electricity delivered upon activation of the SRV support service (PpS)	-5
Price of the offered negative regulating electricity delivered upon activation of the support service (PpS) TRV15MIN-, TRV10MIN-, TRV3MIN-	-5
Price of the offered negative regulating electricity delivered at the activation of the support service (PpS) increase of consumption	-5

Support services for SEPS, a.s. Bratislava provides, for example:

- Slovenské elektrárne, a.s. Bratislava
- SLOVNAFT, a.s. Bratislava
- SLOVINTEGRA, a.s. Levice
- Heating plant Košice, a.s.
- TEPLÁREŇ Považská Bystrica, s.r.o.
- CHEMES, a.s. Humenne
- Martinská teplárenská, a.s. Martin

2.2 NATURAL GAS SECTION

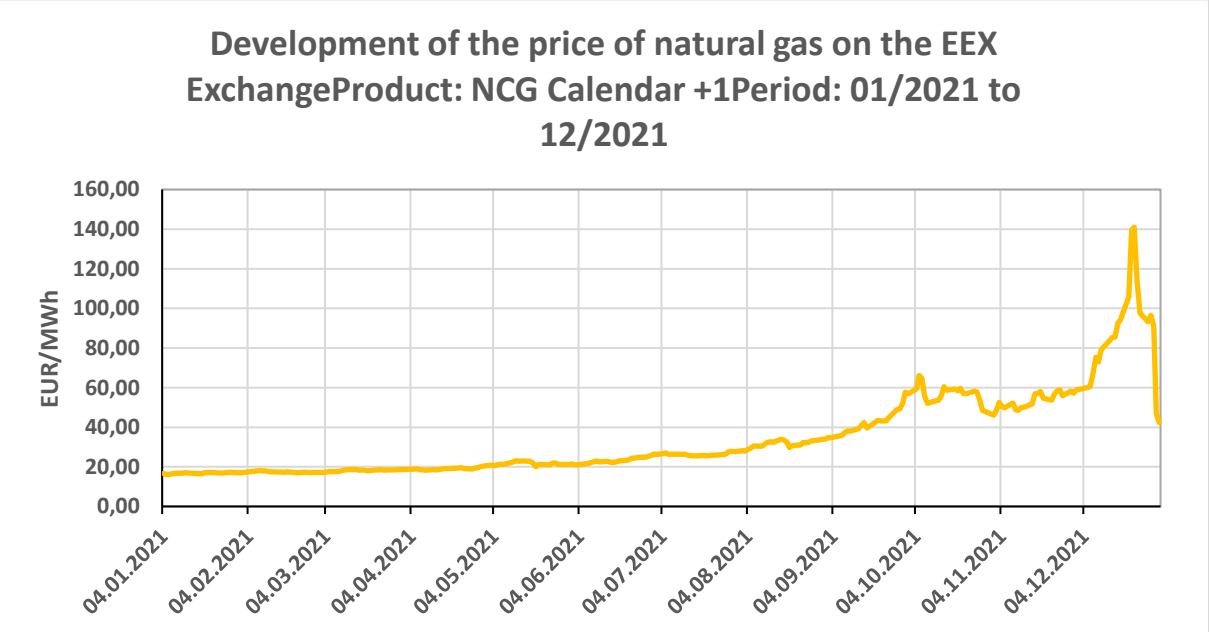
The gas transmision network is, in terms of the relevant legislation, characterized as: "a network of compressor stations and a network of mainly high-pressure gas pipelines, which are connected to each other and serve to transport gas in a defined area, in addition to the production network and storage and high-pressure gas pipelines, which serve primarily for transportation of gas to parts of the defined territory". The transport network consists of parallel pipelines DN 1200 and DN 1400 in four to five lines, the total length of gas pipelines of the transport network is almost 2,270 km. Part of the

transmission network are 4 compressor stations (KS) - KS Veľké Kapušany, KS Jablonov nad Turnňou, KS Veľké Zlievce and KS Ivanka pri Nitra - which ensure the pressure differential necessary for a smooth flow of gas with a total output of 600 MW. They are located at a distance of about 110 km from each other. The total transport capacity of the network is more than 90 billion. m3 per year. From the transmission network, natural gas in a defined area is delivered to the system of distribution networks through national discharge stations and transported to end customers. The connection between Slovakia and neighbouring countries at the level of transport networks currently exists with Austria (border point Baumgarten), the Czech Republic (border point Lanžhot), Hungary (border point Veľké Zlievce) and Ukraine (border point Veľké Kapušany and border point Budince).

The structure of the natural gas price in Slovakia consists of:

- Commodity, including trader's service
- distribution fees in the range of:
  - performance rate (DMM) in € / m3 / day
  - fixed monthly rate in € / month
  - rate for gas taken in € / kWh
  - rate for services related to gas transmission in € / kWh / day
- excise duty on natural gas

Commodity-natural gas is traded on commodity exchanges (PXE) and is not regulated for large customers. In 2021, its value developed as follows:



The regulated part of the natural gas price is the distribution of natural gas in the following range:

a) Tariffs for access to the high-pressure distribution network and gas distribution

aa) Annual rate in euros for access to the high-pressure distribution network:

Entry point	Annual rate of daily distribution capacity at the aggregate entry point
(€/kWh /day)	
home point, storage operator's storage facility, transfer point from the extraction network, transfer point of the biomethane producer (together also referred to as the "aggregate entry point").	0,123

ab) Tariff rates in euros for individual offtake points of the distribution network for gas distribution

Tariff group	Fixed rate per month	Annual rate for daily distribution capacity at the point of consumption up to 1 mil. m3 / day inclusive	Annual rate for daily distribution capacity at the point of consumption over 1 mil. m3 / day	Variable rate for 1 kWh
	(€/month) (€/m3/day)		**(€/m3/day)**	**(€/kWh)**
1	1,78			0,0206
2	4,76			0,0084
3	7,64			0,0081
4	12,36			0,0066
5	41,45			0,0059
6	50,78			0,0058
9	74,31	6,51	0,10	0,0022
10	93,20	6,49	0,10	0,0022
11	339,68	5,44	0,10	0,0022
12	403,01	5,44	0,10	0,0021
13	410,92	5,43	0,10	0,0021

14	2 363,97	5,13	0,10	0,0012
15	4 587,17	4,60	0,10	0,0006
16	5 028,17	4,51	0,10	0,0005
17	13 619,47	3,95	0,10	0,0004
18	17 237,73	3,69	0,10	0,0004
19	30 808,91	3,68	0,10	0,0003
20	49 270,73	3,30	0,10	0,0002
21	54 270,73	3,25	0,10	0,0002
22	55 000,00	3,00	0,10	0,0002
23	59 000,00	2,60	0,10	0,0002
24	58 000,00	2,00	0,10	0,0002
25	58 000,00	1,75	0,10	0,0002
26	60 000,00	1,60	0,10	0,0002

By its decision, the Office for the Regulation of Network Industries designates SPP distribúcia, a.s. Bratislava tariffs for natural gas distribution (0020/2017 / P, 0089/2017 / P, 0044/2021 / P).

The connection to the natural gas distribution network is individual and governed by the technical conditions of connection.

https://www.spp-distribucia.sk/odberatelia/stredni-a-velki-podnikatelia/nove-pripojenie/stredni-a-velki-odberatelia/

In Slovakia, the first biomethane station was connected to the natural gas distribution network near Jelšava (Banská Bystrica Region, Revúca District) in 2021, which converts biogas into biomethane, which is injected into the gas network. There are about 100 other biogas plants in Slovakia, of which at least half have the potential to replenish biogas plants for biomethane.

2.3 BIOCHAR SECTION

Biochar is not produced in Slovakia, nor do we have information on its use.

2.4 WATER SECTION

The water supply segment is a regulated area in Slovakia, the prices of water and sewerage are determined by the Office for the Regulation of Network Industries for individual regional water companies. Example of prices of selected water companies:

Distributor	Západoslovenská vodárenská **spoločnosť, a.s.**	Stredoslovenská vodárenská **spoločnosť, a.s.**	Východoslovenská vodárenská **spoločnosť, a.s.**
Maximum price for production and supply of drinking water by public **water supply € / m3**	1,0802	1,2119	1,4004
Maximum price for production and distribution of drinking water by public water **supply € / m3**	0,7550	0,6797	0,8530
Maximum price for drainage and wastewater treatment by public **sewerage € / m3**	1,1157	1,1615	1,0716

https://www.urso.gov.sk/21269-sk/cenove-rozhodnutia-2017-2022/

https://www.urso.gov.sk/21269-sk/cenove-rozhodnutia-2017-2022/

https://www.urso.gov.sk/21269-sk/cenove-rozhodnutia-2017-2022/

The availability of water supply networks is in all urban areas of cities and towns and connection prices depend on the location, but in general these costs for the establishment of a water connection are acceptable and do not form a significant part of the costs in the investment plan.

In the case of the implementation of its own well, the permission of the District Environmental Office is required and the estimated costs for its implementation are approximately 150 - 200 € / bm of well depth.

3. LITERATURE

- Úrad pre reguláciu sieťových odvetví – www.urso.gov.sk
- Ministerstvo hospodárstva SR – www.economy.gov.sk
- Slovenská elektrizačná a prenosová sústava, a.s. Bratislava – www.sepsas.sk
- Komoditná burza EEX – www.EEX.com
- Západoslovenská distribučná, a.s. Bratislava – www.zsdis.sk
- Stredoslovenská distribučná, a.s. Žilina – www.ssd.sk
- Východoslovenská distribučná, a.s. Košice – www.vsds.sk
- SPP – distribúcia, a.s. Bratislava www.spp-distribucia.sk
- Integrated national energy and climate plan for the years 2021 – 2030