Interreg
EUROPEAN UNION
Danube Transnational Programme
DanuP-2-Gas

Deliverable D.T2.2.1

Infrastructure Report (Bulgaria)

Activity A.T2.2: Infrastructure analysis

June, 2022

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

DOCUMENT CONTROL SHEET

Project reference	
Full title of the project	Innovative model to drive energy security and diversity in the Danube Region via combination of bioenergy with surplus renewable energy
Acronym	DanuP-2-Gas
Programme priority	Priority 3
Programme priority specific objective	SO 3.2 Improve energy security and energy efficiency
Duration	01.07.2020 – 31.12.2022
Project website	www.interreg-danube.eu/danup-2-gas
Project coordinator	TZE

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	
Title of document	Infrastructure Report (Country)
Action	WP T2 Transnational Infrastructure and Biomass assessment & Pre-feasibility Studies
Deliverable	D.T2.2.1
Delivery date	June 2022

Version	Date	Author	Organization	Description
V1	March 2022	Teodor Vuchkov	BSERC	1st version
V2	June 2022	Kiril Raytchev	BSERC	Final version

IMPRINT

This document is issued by the consortium formed for the implementation of the DanuP-2-Gas project by the following partners:

- LP Technology Centre Energy - University of Applied Sciences Landshut (DE)
- ERDF PP1 Energy Agency of Savinjska, Koroška and Šaleška Region (SI)
- ERDF PP2 Tolna County Development Agency Nonprofit Public Ltd.(HU)
- ERDF PP3 Energy Institute at the Johannes Kepler University Linz (AT)
- ERDF PP4 Black Sea Energy Research Centre (BG)
- ERDF PP5 URBASOFIA SRL (RO)
- ERDF PP6 Deggendorf Institute of Technology (DE)
- ERDF PP7 National Recycling Agency of Slovakia (SK)
- ERDF PP8 Institute of Technology and Business in České Budějovice (CZ)
- ERDF PP9 MAHART-Freeport Co. Ltd (HU)
- ERDF PP10 International Centre for Sustainable Development of Energy, Water and Environment Systems (HR)
- ERDF PP11 Energy Institute Hrvoje Požar (HR)
- ERDF PP12 University of Zagreb Faculty of Electrical Engineering and Computing (HR)
- IPA PP1 Regional Agency for Socio – Economic Development – Banat Ltd (RS)

Responsible Partner for the compilation of this document

LP Technology Centre Energy - University of Applied Sciences Landshut (DE)
ERDF PP1 Energy Agency of Savinjska, Koroška and Šaleška Region (SI)

CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

Bg	Biogas (REP)
Bm	Biomass (REP)
CP	Connection point
IP	Industrial plant
H	Hydro (REP)
O	Other (REP)
P	Photovoltaic (REP)
P2G	Power-to-gas
REP	Renewable energy plant
SEDA	Sustainable Energy Development Energy
TH	Transport hub
TL	Transnational link
TPP	Therma power plant
W	Wind (REP)

1. METHODOLOGY

For the needs of the infrastructure analysis, information about five types of infrastructure assets was collected:

- Renewable energy plants (REPs)
- Industrial plants (IPs)
- Connection points (CPs)
- Transport hubs (THs)
- Transnational links (TLs)

Data specification for each of the infrastructure assets, assumptions made, along with the data sources used are presented in the following paragraphs.

1.1 DATA SPECIFICATION AND DATA SOURCES FOR RENEWABLE ENERGY PLANTS

REP data was collected according to the specification in the table below:

Table 1 REP Data Specification

	Category	Description
Identification	REP-Number	For counting and reference purposes.
	Type	REPs are considered as candidates for P2G colocations. P, W and Bm plants of over 1 MW power are of interest. Bg > 500 kW, and H > 10 MW. O type plants could be for production of biochar etc. REP types: Photovoltaic, Hydro, Wind, Biomass, Biogas, Other
	Owner Address	Company address of plant owner.
	Name	Short name of the REP (location or plant name)
	Location long	Longitude coordinate
	Location lat	Latitude coordinate
Electri	Power	Power [kW]. Eligible for: P, H, W, Bm, Bg, O
	Production	Average annual production [MWh]. Eligible for: P, H, W, Bm, Bg, O
Heat	Power	Heat power [MW_t]. Eligible for: Bm, Bg, O
	Production / Consumption	Average annual heat production (+) / consumption (-). In case the REP consumes - the number should be negative and vice versa. [MWh_t]. Eligible for: Bm, Bg, O
	Price	[€ / MWh_t]. If the REP consumes - the price should be negative and vice versa. In case it is a waste heat - the price should be set to 0.
Biomet	Capacity	Power [kWh/h] Eligible for: Bg, O
	Production	Average annual production [kWh]. Eligible for: Bg, O
Bio	Production	Average annual production [tons]. Eligible for: Bm, O

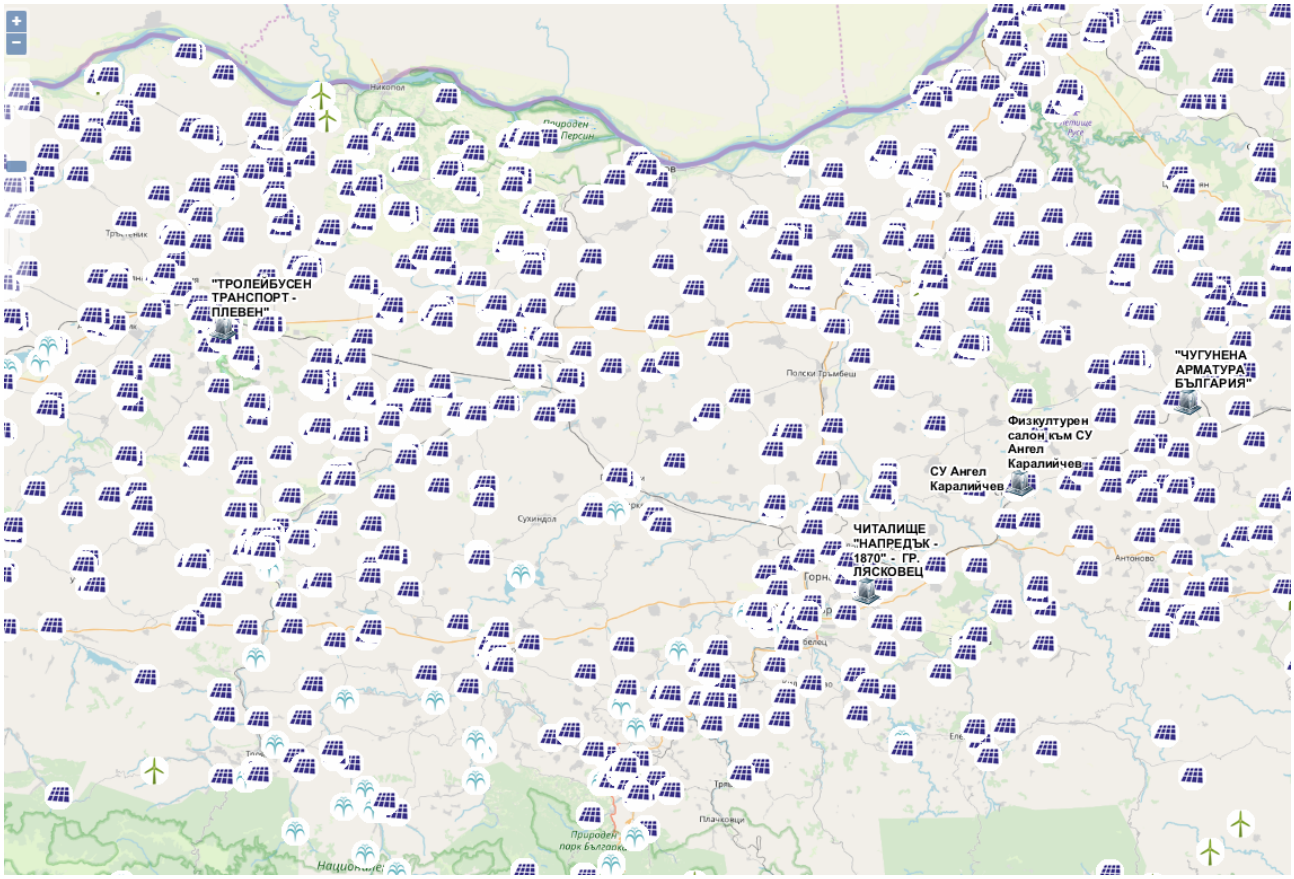
	Price	[€ per ton]
Connection	CP 1	Reference to the Connection points table [CP-Number] e.g. electrical grid; substation availability
	CP 2	Reference to the Connection points table [CP-Number] e.g., natural gas grid
	CP 3	Reference to the Connection points table [CP-Number] e.g. water grid: rivers, lakes, town water system, drill well, etc.
Transpo	TH 1	Reference to the Transport hub table (e.g. sea port) [TH-Number].
	TH 2	Reference to the Transport hub table (e.g. train station) [TH-Number].

REPs data was segmented into seven groups:

- Identification group
  Identification segment combines information about REP's type, name, owner's info, and geocoordinates. The owner information field uses the name of the REP's owner company instead of an address. The data was collected from the Sustainable Energy Development Agency (SEDA) database[1] and the web site yurukov.net. SEDA's database representation as a map can be seen on the figure below.

[1] https://portal.seea.government.bg/bg/Map

Figure 1 SEDA Database Representation as a Map



- Electricity, Heat, Biomethane, Biochar groups
  Depending on the REP type information, different segments can be filled-in. In the case of Bulgaria, there is a feed-in tariff for production of electricity. This is the reason why all REPs in the database are used for that purpose.
- CPs and THs groups
  These groups contain references to the CPs and THs tables, which are separate from the REP table in the Infrastructure database.
  In all the cases, there is a power connection point available on the REP that can be used by a P2G (Power-to-gas) hub. These CPs were recorded in the CPs table. Water connection point was always assumed to be present due to the possibility of capturing it below the ground (by drilling).

1.2 DATA SPECIFICATION AND DATA SOURCES FOR INDUSTRIAL PLANTS

IP data was collected according to the specification in the table below:

Table 2 IP Data Specification

Category	Description

Identification	IP-Number	For counting and reference purposes.
	Type	IPs are considered as candidates for P2G colocations. Plants with power > 1 MW are of interest; Top 3-5 biggest natural gas consumers in the country. IP types: Refinery, Chemical, Other
	Owner Address	Company address of plant owner.
	Name	Short name of the IP (location or plant name)
	Location long	Longitude coordinate
	Location lat	Latitude coordinate
Electrici	Power	Power [kW].
	Consumptio n	Average annual consumption [MWh].
Heat	Power	Heat power [MW_t].
	Price	[€ / MWht] If the IP consumes - the price should be negative and vice versa. In case it is a waste heat - the price should be set to 0.
	Production / Consumptio n	Average annual heat production (+) / consumption (-). In case the IP consumes - the number should be negative and vice versa. [MWh_t].
(Natural	Power	[kWh/h]
	Consumptio n	Average annual consumption [kWh]
Connection	CP 1	Reference to the Connection points table [CP-Number] e.g. electrical grid
	CP 2	Reference to the Connection points table [CP-Number] e.g., natural gas grid
	CP 3	Reference to the Connection points table [CP-Number] e.g. water grid
Transpor	TH 1	Reference to the Transport hub table (e.g. sea port) [TH-Number].
	TH 2	Reference to the Transport hub table (e.g. train station) [TH-Number].

IP data was segmented into six groups:

- Identification group
  Identification segment combines information about IP's type, name, owner's info, and geocoordinates. The owner information field uses the name of the IP's owner company instead of an address. The data base includes the sixteen largest consumers of natural gas, according to articles published in the media[2]. Sofia Thermal Power Plant (TPP) consumes nearly 30% of the annual demand for natural gas in Bulgaria and takes the first place. The Lukoil refinery and a producer of

[2] https://www.economic.bg/bg/a/view/koi-sa-naj-zavisimite-ot-gaz-predprijatija-v-bylgarija; https://www.banker.bg/upravlenie-i-biznes/read/kolko-e-zavisima-bulgariia-ot-ruskiia-gaz

artificial fertilizers are following the Sofia TPP. Next come producers from the glass industrial sector, mining, and the heavy industry.

- Electricity, Heat, and Natural gas groups
  Natural gas consumption data was collected from the annual environmental reports of Lukoil refinery, Amilum, BA Glass, Biovet, Stomana Industry, and Sviloza. In some of the cases the figures were used as representative for the sector: BA Glass, Alkomet, Biovet, and Sviloza.
- CPs and THs groups
  These groups contain references to the CPs and THs tables which are separate from the IP table in the Infrastructure database.
  In all the cases, there is an electricity as well as a natural gas connection point available at the IP that can be used by a P2G (Power-to-gas) hub. These CPs were recorded in the CPs table. Water connection point was always assumed to be present due to the possibility of capturing it below the ground (by drilling).

1.3 DATA SPECIFICATION AND DATA SOURCES FOR CONNECTION POINTS

CP data was collected according to the specification in the table below:

Table 3 CP Data Specification

	Category	Description
Identification	CP-Number	For counting and reference purposes.
	Type	Electricity, Water, Natural gas
	Owner Address	Company address of connection point owner.
	Name	Short name of the CP (location or other relevant name)
	Location long	Longitude coordinate
	Location lat	Latitude coordinate
Electricity	Type	Can be of either Transmission or Distribution type [Transmission | Distribution]
Natural gas	Type	Can be of either Transmission or Distribution type [Transmission | Distribution]
Water	Flow rate	[m^3/h]. Should be over 1 m^3/h.

CPs data was segmented into four groups:

- Identification group
  Identification segment groups information about CP's type, name, owner's info, and geocoordinates. The owner information field uses the name of the owner of the CP instead of an address. Data was manually collected from the maps of ESO and Bulgartransgaz shown below.

Figure 2 ESO Substations Map

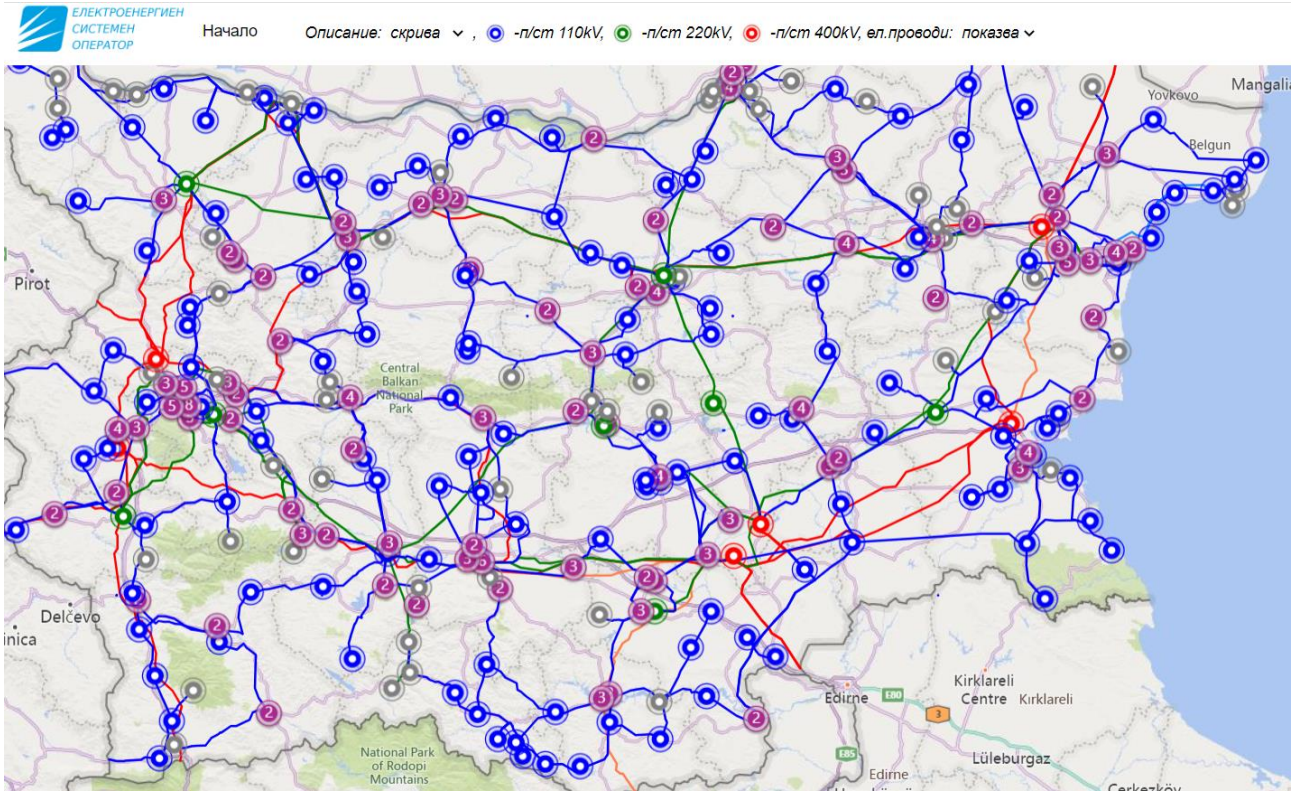


Figure 3 Bulgartrasngaz Gas Grid

- Electricity, Natural gas, and Water groups
  In the case of ESO and Bulgatransgas, CPs are always of type "Transmission" as they represent the backbone of the national electricity and gas systems. REPs and IPs provide "Distribution" type of CPs. Water is assumed to always be accessible by drilling.

1.4 DATA SPECIFICATION AND DATA SOURCES FOR TRANSPORT HUBS

TH data was collected according to the specification in the table below:

Table 4 TH Data Specification

	Category	Description
Identificatio	TH-Number	For counting and reference purposes.
	Type	TH types: Water-rail, Water-road, Rail-road, Water-rail-road, Other
	Water Codes	"01" for Danube river; "02" for Adriatic sea; "03" for Black sea
	Owner Address	Company address of transport hub owner.

	Name	Short name of the TH (location or other relevant name). Should be able to process bulk loads. Should have facilities for covered storage. Of main interest are TH near assets, e.g., REPs, IPs, CPs, Biomass sources etc.
	Location long	Longitude coordinate
	Location lat	Latitude coordinate

THs data was contained into just one group:

- Identification group
  The Identification group consists of TH's type, name, owner's info, and geocoordinates. The owner information field uses the name of the owner of the TH instead of an address. Data was manually collected from the Bulgarian Integrated Transport Strategy till 2030 and National Railroad Company[3].

1.5 DATA SPECIFICATION AND DATA SOURCES FOR TRANSNATIONAL LINKS

TL data was collected according to the specification in the table below:

Table 5 TL Data Specification

	Category	Description
Identification	TL-Number	For counting and reference purposes.
	Type	TL types: Electrical link, Gas link
	Owner Address	Company address of transnational link owner.
	Name	Short name of the TL (location or other relevant name)
	Location long	Longitude coordinate
	Location lat	Latitude coordinate

TLs data was contained into just one group:

- Identification group
  The Identification group consists of TL's type, name, owner's info, and geocoordinates. The owner information field uses the name of the owner of the TL instead of an address. Data was manually collected from the ESO and Bulgartransgaz maps (see 1.3).

[3] https://www.rail-infra.bg/upload/996/Prilojenie%2028_15032018.pdf

2. BRIEF DESCRIPTION OF BULGARIAN INFRASTRUCTURE LANDSCAPE

It is the cost for energy and energy supporting systems which is of major interest in reference to the Bulgarian infrastructure landscape. These will constitute an important part of the Atlas platform (being built as part of the current project), on the basis of which inputs will be provided for the needs of the Optimization tool calculations used for the development of a P2G pre-feasibility study in Bulgaria. The Optimization tool and Pre-feasibility are also part of the P2G project.

The following energy prices are discussed in the next sections:

- Grid investment prices
  - Electrical grid
  - Natural gas grid
  - Water grid

Figure 4 Grid Investment Prices

	Grid investment prices
Electrical grid	Unit cost for electrical transmission grid connection [€/(kW km)]
	Unit cost for electrical distribution grid connection [€/(kW km)]
	Capacity cost for electrical transmission grid connection [€/kW]
	Capacity cost for electrical distribution grid connection [€/kW]
Gas grid	Unit cost for gas transmission grid connection [€/(kW km)]
	Unit cost for gas distribution grid connection [€/(kW km)]
	Capacity cost for gas transmission grid connection [€/kW]
	Capacity cost for gas distribution grid connection [€/kW]
Water grid	Unit cost for water grid connection [€/(m^3/h)/km]
	Capacity cost for water grid connection [€/(m^3/h)]

- Electricity price and its components

Figure 5 Electricity Price

	Electricity prices
	Start time of day tariff [hour]
	End time of day tariff [hour]
	Start time of weekend tariff [hour]
	End time of weekend tariff [hour]
Day tariff	Electricity price without grid or operator fees, including taxes [€/kWh]
	Grid/operator fees of the transmission system, including taxes [€/kWh]
	Grid/operator fees of the distribution system, including taxes [€/kWh]

Night tariff	Electricity price without grid or operator fees, including taxes [€/kWh]
	Grid/operator fees of the transmission system, including taxes [€/kWh]
	Grid/operator fees of the distribution system, including taxes [€/kWh]
Weekend tariff	Electricity price without grid or operator fees, including taxes [€/kWh]
	Grid/operator fees of the transmission system, including taxes [€/kWh]
	Grid/operator fees of the distribution system, including taxes [€/kWh]
	Monthly peak power price [€/kW]
	VAT percentage applicable to electricity business [%]

- Natural gas price and its components

Figure 6 Natural Gas Price

	Gas prices
	Start of winter period
	End of winter period
Winter period	Gas price without grid/operators fees, including taxes [€/kWh]
	Gas supply fee, including taxes [€/kWh]
	Transmission system fee for consumption, including taxes [€/(kWh/day)]
	Transmission system fee for injection, including taxes [€/(kWh/day)]
	Distribution system fee for consumption, including taxes [€/kWh]
	Distribution system fee for injection, including taxes [€/kWh]
Summer period	Gas price without grid/operators fees, including taxes [€/kWh]
	Gas supply fee, including taxes [€/kWh]
	Transmission system fee for consumption, including taxes [€/(kWh/day)]
	Transmission system fee for injection, including taxes [€/(kWh/day)]
	Distribution system fee for consumption, including taxes [€/kWh]
	Distribution system fee for injection, including taxes [€/kWh]
	VAT percentage applicable to gas business [%]

- Water price and its components

Figure 7 Water Price

Water price
Price for water supply, excluding sewerage and wastewater cleaning costs, including operators/grid fees and taxes [€/m^3]

- Biochar transport price

Figure 8 Biochar Price

Biochar transport prices
Unit transport cost via waterway [€/(t km)]
Unit transport cost via railroad [€/(t km)]
Unit transport cost via road [€/(t km)]

The full data that was submitted for the needs of the Atlas platform can be seen in Appendix II.

2.1 ELECTRICAL ENERGY SECTION

Following is the list of figures obtained, along with the sources used.

- **Unit cost for electrical transmission grid connection [€/(kW km)]: 2.60**

  The data provided in the ESO map (see1.3) was used to obtain a required investment of EUR 130,000/km. If that investment is related to a power of 50,000 kW, we get the figure stated above.

- **Unit cost for electrical distribution grid connection [€/(kW km)]: 4.00**

  According to data provided by the biggest utility provider in Bulgaria on its web site[4], the costs will be EUR 30,000/km. If that investment is related to a power of 7,500 kW, we get the figure stated above.

- **Capacity cost for electrical transmission grid connection [€/kW]: 5.00**

  The data provided in the ESO map (see1.3) was used to obtain a required investment of EUR 250,000 for new zone in substation. If that investment is related to a power of 50,000 kW, we get the figure stated above.

- **Capacity cost for electrical distribution grid connection [€/kW]: 50.00**

  According to data provided by the biggest utility provider in Bulgaria on its web site[4]. The calculation was based on EUR 10,000 price for 200 kW.

- **Start time of day tariff [hour]: 7:00 (6:00 in winter period)**

  According to data provided by one of the biggest utility providers in Bulgaria on its web site[5]

- **End time of day tariff [hour]: 23:00 (22:00 in winter period)**

  According to data provided by one of the biggest utility providers in Bulgaria on its web site[5]

- **Start time of weekend tariff [hour]: Not applicable for Bulgaria**

- **End time of weekend tariff [hour]: Not applicable for Bulgaria**

[4] https://ermzapad.bg/bg/za-klienta/uslugi/prisedinyavaniya/prisedinyavane-na-potrebitel-km-elektrorazpredelitelnata-mrezha/
[5] Link

- **(Day tariff) Electricity price without grid or operator fees, including taxes [€/kWh]: 0.1043**

  According to data provided by the National Statical Institute (NSI)[6].

- **(Day tariff) Grid/operator fees of the transmission system, including taxes [€/kWh]: 0.0256**

  According to data provided by the National Statical Institute (NSI)[6] and the assumed ratio of costs between the transmission and distribution grid.

- **(Day tariff) Grid/operator fees of the transmission system, including taxes [€/kWh]: 0.0381**

  According to data provided by the National Statical Institute (NSI)[6] and the assumed ratio of costs between the transmission and distribution grid.

- **(Night tariff) Electricity price without grid or operator fees, including taxes [€/kWh]: 0.0835**

  A discount of 20% was assumed as seen in an offer to industrial clients (see5).

- **(Night tariff) Grid/operator fees of the transmission system, including taxes [€/kWh]: 0.0256**

  Assumed the same as for the day tariff.

- **(Night tariff) Grid/operator fees of the transmission system, including taxes [€/kWh]: 0.0381**

  Assumed the same as for the day tariff

- **(Weekend tariff) Electricity price without grid or operator fees, including taxes [€/kWh]: Not applicable for Bulgaria**

- **(Weekend tariff) Grid/operator fees of the transmission system, including taxes [€/kWh]: Not applicable for Bulgaria**

- **(Weekend tariff) Grid/operator fees of the transmission system, including taxes [€/kWh]: Not applicable for Bulgaria**

- **Monthly peak power price [€/kW]: Not applicable for Bulgaria**

- **VAT percentage applicable to electricity business [%]: 20**

2.2 NATURAL GAS ENERGY SECTION

Following is the list of figures obtained, along with the sources used.

- **Unit cost for gas transmission grid connection [€/(kW km)]: 1.30**

[6] https://nsi.bg/sites/default/files/files/data/timeseries/Energy-2.1.El_prices_Ind.xls

The figure is based on the parameters used in the project "Nish-Pirdop", found in Plan for Development of Bulgartransgaz (2021-2030). The cost provided there is EUR 346,483 / km for a capacity of 25,000 m^3.

- **Unit cost for gas distribution grid connection [€/(kW km)]: 2.17**

  The figure is based on the parameters used in a public announcement made by a gas utility company for a gas grid project[7]. The cost provided is EUR 30,000 / km for a capacity of 1,300 m^3.

- **Capacity cost for gas transmission grid connection [€/kW]: 1.15**

  The capacity cost is based on the parameters used for the IGB project, found in Plan for Development of Bulgartransgaz (2021-2030).

- **Capacity cost for gas distribution grid connection [€/kW]: 0.10**

  The capacity cost is based on the price list of one of the gas distribution companies[8].

- **Start of winter period: October**

- **End of winter period: March**

- **(Winter period) Gas price without grid/operators fees, including taxes [€/kWh]: 0.03**

  According to data provided by the NSI[9].

- **(Winter period) Gas supply fee, including taxes [€/kWh]: Not applicable for Bulgaria**

- **(Winter period) Transmission system fee for consumption, including taxes [€/(kWh/day)]: 0.002**

  The capacity cost is based on the price list of one of the gas distribution companies[8].

- **(Winter period) Transmission system fee for injection, including taxes [€/(kWh/day)]: Not applicable for Bulgaria**

  With the exception of Chiren storage facility and the border entry points of Bulgaria there are no other cases of injection of natural gas into the grid system.

- **(Winter period) Distribution system fee for consumption, including taxes [€/kWh]: 0.005**

  The distribution system fee is based on the price list of one of the gas distribution companies[8].

- **(Winter period) Distribution system fee for injection, including taxes [€/(kWh/day)]: Not applicable for Bulgaria**

  With the exception of Chiren storage facility and the border entry points of Bulgaria there are no other cases of injection of natural gas into the grid system.

- **(Summer period) Gas price without grid/operators fees, including taxes [€/kWh]: 0.03**

[7] https://sop.bg/sevlievogas-704/proceduri-20-2-zop/a2-0006266.html
[8] Link
[9] https://nsi.bg/sites/default/files/files/data/timeseries/Energy-2.3.Gas_prices_Ind.xls

The same price is used as for the winter period. There are no fluctuations up in prices for the winter period and down for the summer one for clients in Bulgaria. The general tendency throughout the years has always been up with a few exceptions. In addition, natural gas quantities form the Chiren storage facility are released in the winter period in order to keep the prices down. The facility is filled with natural gas in the summer period when prices of gas suppliers for Bulgaria are more competitive.

- **(Summer period) Gas supply fee, including taxes [€/kWh]: Not applicable for Bulgaria**
- **(Summer period) Transmission system fee for consumption, including taxes [€/(kWh/day)]: 0.002**

  Same as for the winter period. In general, no seasonal fluctuations are present.
- **(Summer period) Transmission system fee for injection, including taxes [€/(kWh/day)]: Not applicable for Bulgaria**

  With the exception of Chiren storage facility and the border entry points of Bulgaria there are no other cases of injection of natural gas into the grid system.
- **(Summer period) Distribution system fee for consumption, including taxes [€/kWh]: 0.005**

  Same as for the winter period. In general, no seasonal fluctuations are present.
- **(Summer period) Distribution system fee for injection, including taxes [€/(kWh/day)]: Not applicable for Bulgaria**

  With the exception of Chiren storage facility and the border entry points of Bulgaria there are no other cases of injection of natural gas into the grid system.
- **VAT percentage applicable to gas business [%]: 20**

2.3 BIOCHAR SUPPLY SECTION

Biochar has properties that resemble very much those of coal[10]. Taking into account that there is no history of biochar transportation in Bulgaria and that biochar is like coal from that perspective, it was prices for coal transportation that were investigated and stated below.

Following is the list of figures obtained, along with the sources used.

- **Unit transport cost via waterway [€/(t km)]: 0.020**

  Water transportation with barges is strongly influenced by the prices of Ukrainian companies due to the fact that Bulgaria intensively imports goods from Ukraine transported by Ukrainian water transport companies. The figure stated as unit transport cost is based on an interview with Ukrainian water transport service provider[11]. The assumptions are that the barge has an 800 tons capacity and the distance is 1,000 km.

[10] Hydrothermal carbonization of stabilized sludge and meat and bone meal (see Appendix I)
[11] https://latifundist.com/blog/read/2901-barzhi-zatori-i-pochatok-zernovogo-sezonu-u-rumuniyi-shcho-robiti-dunajskim-portam

- **Unit transport cost via railroad [€/(t km)]: 0.072**

  The price is based on the price of the National Railroad Transport Company[12].

- **Unit transport cost via road [€/(t km)]: 0.051**

  The price is based on a public procurement procedure issued by one of the TPPs in reference to transport of coal to the plant from its storage facilities[13].

2.4 WATER SUPPLY SECTION

Following is the list of figures obtained, along with the sources used.

- **Unit cost for water grid connection [€/(m3/h)/km]: 4,100**

  The figure estimation is based on an article in reference to investment in building a new water connection for the needs of a small village[14]. The main parameters are EUR 60,000 / km and capacity of 14.4 m^3.

- **Capacity cost for water grid connection [€/(m3/h)]: Not applicable for Bulgaria.**

- **Price for water supply, excluding sewerage and wastewater cleaning costs, including operators/grid fees and taxes [€/m3]: 0.069**

  Based on the price list of one of the water utility companies near Sofia (the capital of Bulgaria). It supplies the Pernik Industrial Zone with water for production needs.

[12] https://bdzcargo.bdz.bg/bg/vutreshni-prevozi/tarifi-za-tovarni-prevozi-na-teritoriiata-na-rbulgariia.html
[13] https://www.toplo-gb.com/docs/public-orders/1553061240_32_1_DOGOVOR.pdf
[14] https://www.24chasa.bg/bulgaria/article/11970348

APPENDIX I LIST OF REFERENCES

Annual Environmental Report of Amilum (2019), Ministry of Environment and Water Resources

Annual Environmental Report of BA Glass (2019), Ministry of Environment and Water Resources

Annual Environmental Report of Biovet (2019), Ministry of Environment and Water Resources

Annual Environmental Report of Stomana Industry (2019), Ministry of Environment and Water Resources

Annual Environmental Report of Sviloza (2019), Ministry of Environment and Water Resources

Bulgarian Integrated Transport Strategy till 2030, Ministry of Transport

Plan for Development of Bulgartransgaz (2021-2030), Bulgartransgaz

Hydrothermal carbonization of stabilized sludge and meat and bone meal, Department of Technological Equipment of Buildings, Faculty of Engineering, Czech University of Life Sciences Prague, Prague, Czech Republic

APPENDIX II ATLAS DATA SETUP

	Grid investment prices	
Electrical grid	Unit cost for electrical transmission grid connection [€/(kW km)]	2,60
	Unit cost for electrical distribution grid connection [€/(kW km)]	4,00
	Capacity cost for electrical transmission grid connection [€/kW]	50,00
	Capacity cost for electrical distribution grid connection [€/kW]	10,00
Gas grid	Unit cost for gas transmission grid connection [€/(kW km)]	1,30
	Unit cost for gas distribution grid connection [€/(kW km)]	2,17
	Capacity cost for gas transmission grid connection [€/kW]	1,15
	Capacity cost for gas distribution grid connection [€/kW]	0,10
Water grid	Unit cost for water grid connection [€/(m^3/h)/km]	4.100,00
	Capacity cost for water grid connection [€/(m^3/h)]	
	Electricity prices	
	Start time of day tariff [hour]	7
	End time of day tariff [hour]	23
	Start time of weekend tariff [hour]	
	End time of weekend tariff [hour]	
Day tariff	Electricity price without grid or operator fees, including taxes [€/kWh]	0,1043
	Grid/operator fees of the transmission system, including taxes [€/kWh]	0,2560
	Grid/operator fees of the distribution system, including taxes [€/kWh]	0,0381
Night tariff	Electricity price without grid or operator fees, including taxes [€/kWh]	0,0835
	Grid/operator fees of the transmission system, including taxes [€/kWh]	0,0256
	Grid/operator fees of the distribution system, including taxes [€/kWh]	0,0381
Weekend tariff	Electricity price without grid or operator fees, including taxes [€/kWh]	
	Grid/operator fees of the transmission system, including taxes [€/kWh]	
	Grid/operator fees of the distribution system, including taxes [€/kWh]	

	Monthly peak power price [€/kW]	
	VAT percentage applicable to electricity business [%]	20

	Gas prices	
	Start of winter period	
	End of winter period	
Winter period	Gas price without grid/operators fees, including taxes [€/kWh]	0,03
	Gas supply fee, including taxes [€/kWh]	
	Transmission system fee for consumption, including taxes [€/(kWh/day)]	0,002
	Transmission system fee for injection, including taxes [€/(kWh/day)]	
	Distribution system fee for consumption, including taxes [€/kWh]	0,005
	Distribution system fee for injection, including taxes [€/kWh]	
Summer period	Gas price without grid/operators fees, including taxes [€/kWh]	0,03
	Gas supply fee, including taxes [€/kWh]	
	Transmission system fee for consumption, including taxes [€/(kWh/day)]	0,002
	Transmission system fee for injection, including taxes [€/(kWh/day)]	
	Distribution system fee for consumption, including taxes [€/kWh]	0,005
	Distribution system fee for injection, including taxes [€/kWh]	
	VAT percentage applicable to gas business [%]	20

Water price	
Price for water supply, excluding sewerage and wastewater cleaning costs, including operators/grid fees and taxes [€/m^3]	0,069

Biochar transport prices	
Unit transport cost via waterway [€/(t km)]	0,02
Unit transport cost via railroad [€/(t km)]	0,07

Unit transport cost via road [€/(t km)]	0,05