Interreg
Danube Transnational Programme
DanuP-2-Gas

Output T2.2

Pre-feasibility Study Germany

WP T2: Project main output

October, 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	Pre-feasibility Report (Country)
Action	WP T2 Transnational Infrastructure and Biomass assessment & Pre-feasibility Studies
Deliverable	Output T2.2
Delivery date	October 2022

Version	Date	Author	Organization	Description
V1	27.10.2022	Astrid Heindel	TZE	1st version
V2	13.12.2022	Astrid Heindel	TZE	2nd 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)

CONTENT

1. METHODOLOGY

The data for this pre-feasibility study was taken from the infrastructure and biomass reports and databases for Germany. The methods for data collection can be reviewed in the infrastructure and biomass reports. For the road distances and the transport prices, averages were calculated based on the price ranges provided in the infrastructure report.

The biomass content is divided in either dry (<15% moisture content) or wet (>15% moisture content), according to the moisture content given in the biomass database. If a result seems suitable according to the optimization calculation, it might be worth to have a look into the biomass database and calculate the exact dry mass content for more exact calculations.

The amounts of gas consumptions for the industrial plant case studies were provided by expert estimation. The location is also theoretical and does not rely on real industrial plants.

Three cases were considered for the placement of the P2G hub: At an existing industrial plant, at an existing renewable electricity plant and a greenfield investment. All cases will be calculated in four different ways: with current gas prices, 10 times the gas price; without subsidies and with 50% subsidies. Overall, 12 cases will be calculated.

2. CASE STUDIES

2.1 CASE STUDY 1: INDUSTRIAL PLANT

The second case study is an industrial plant in Lower Bavaria. It is assumed that the plant consumes around 54.000 MWh of gas and around 8.000 MWh of electricity per year. Price for selling heat was set to 0, assuming heat cannot be integrated in this area. For this case study, only surrounding sewage sludge sources were considered.

Case 0% subsidies, current gas prices (8.9 ct/kWh): No investment is economically viable.

Case 50% subsidies, current gas prices: No investment is economically viable.

Case 0% subsidies, 10 times higher gas price (72 ct/kWh): Investment in a methanation reactor is viable. With an investment of around 10 mio. €, the yearly operational costs can be reduced from 40 mio. € to 29 mio. €. Payoff period is 6 years. In this scenario, half of the consumed gas is substituted by biomethane.

Case 50% subsidies, 10 times higher gas price: The operation mode is the same as without subsidies, but the payoff time is reduced to 5.5 years.

Conclusion: It is only the economically viable to produce renewable natural gas from biogenic waste resources if the gas prices rise.

2.2 CASE STUDY 2: GREENFIELD INVESTMENT

For the greenfield investment, a location near Regensburg was chosen in the Atlas tool. Biogenic waste resources from Regensburg city, Regensburg county and Kelheim county were selected (municipal waste, household waste and sewage sludge).

Case 50% subsidies, current gas price: An investment in a biomass-to-biochar plant and an electrolyser is most viable. In case of restriction of not selling any biochar or hydrogen, the most viable option is to consume electricity in order to produce renewable natural gas that will be fed into the grid.

Case 0% subsidies, current gas price: Hydrogen production via electrolysis is most viable.

Case 0% subsidies, 10 times higher gas prices: Hydrogen production via electrolysis only is most viable. For the same case with **50% subsidies**, the investment prices are cut in half, the operation mode is the same. In case of restriction (no hydrogen and oxygen in bottles and no biochar sold), the optimal solution is to produce methane for feed-in into the gas grid. Even with **doubled gas prices in summer and four times higher gas prices in winter**, investment in a methanation unit to produce biomethane for injection is viable.

With current gas prices, the production of renewable natural gas to feed into the grid is not economically viable. However, the production of hydrogen is viable based on the current (autumn 2022) hydrogen prices of 12.85 €/kg. Slightly higher gas prices (2-4 times the current prices) might make investment in methanation units viable.

2.3 CASE STUDY 3: RENEWABLE ELECTRICITY PLANT (REP)

The REP chosen for this case study is a free-standing photovoltaic plant located in Froschham, 86551 Aichach. It provides a production capacity of 4,169 kWp and provided 4,311,543 kWh of electricity to the grid in 2020. Biogenic waste resources in the neighbourhood are the municipal and green waste as well as sewage sludge from the county Aichach-Friedberg.

Without subsidies and current gas prices, an investment in a P2G hub is not economically viable.

With 50% subsidies, the production of green hydrogen via electrolysis and production of biochar is economically viable.

With 10 times higher gas prices, methane production for feed-in is viable, while hydrogen is still produced.

In general, the tool would suggest biochar and hydrogen production over the production of natural gas, even with 10 times higher gas prices. Only due to restrictions, gas production is recommended, but not for the current gas prices.

3. RESULTS AND CONCLUSIONS

	0sub 1gas	0sub 10gas	50sub 1gas	50sub 10gas
IP				
REP				
GF				

No investment is economically viable

Investment in biomethane production economically viable

Investment in hydrogen production viable

The general conclusion is that current **gas prices are too low** to make investments in P2G hubs economically viable for production of biomethane as substitute for fossil natural gas. Even with subsidies, the production of natural gas is often not viable. With gas prices 10 times higher than current prices, the production of biomethane for both industrial purposes and for feed-in to the grid are both viable.

For current gas prices, **hydrogen and biochar production are most viable**. However, taking into account that the market for biochar might not be big enough to sell all the amount of biochar that could be produced, the production of only green hydrogen is probably the better option.

During different tests, it was shown that the rise of the CO_2 tax planned up to 2030 does not affect the investments and operational modes. Even higher taxes would not influence the results either.

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