Pilot-SBG

Renewable methane as a building block for a sustainable transport sector

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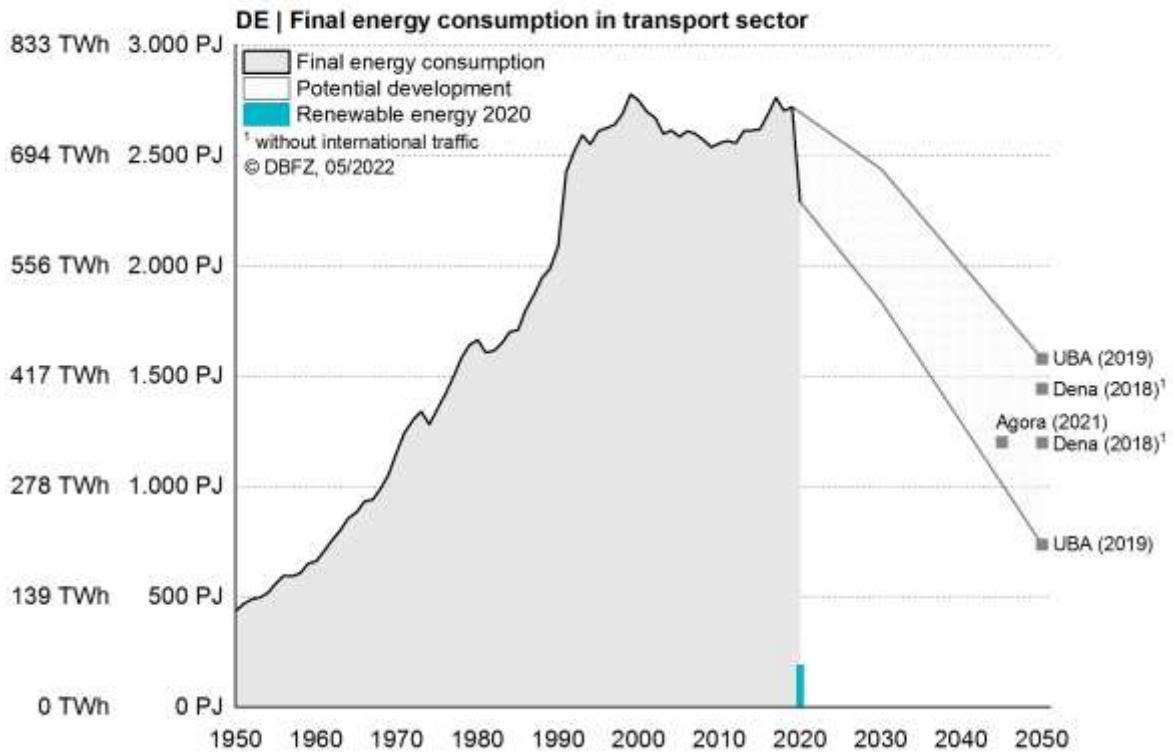
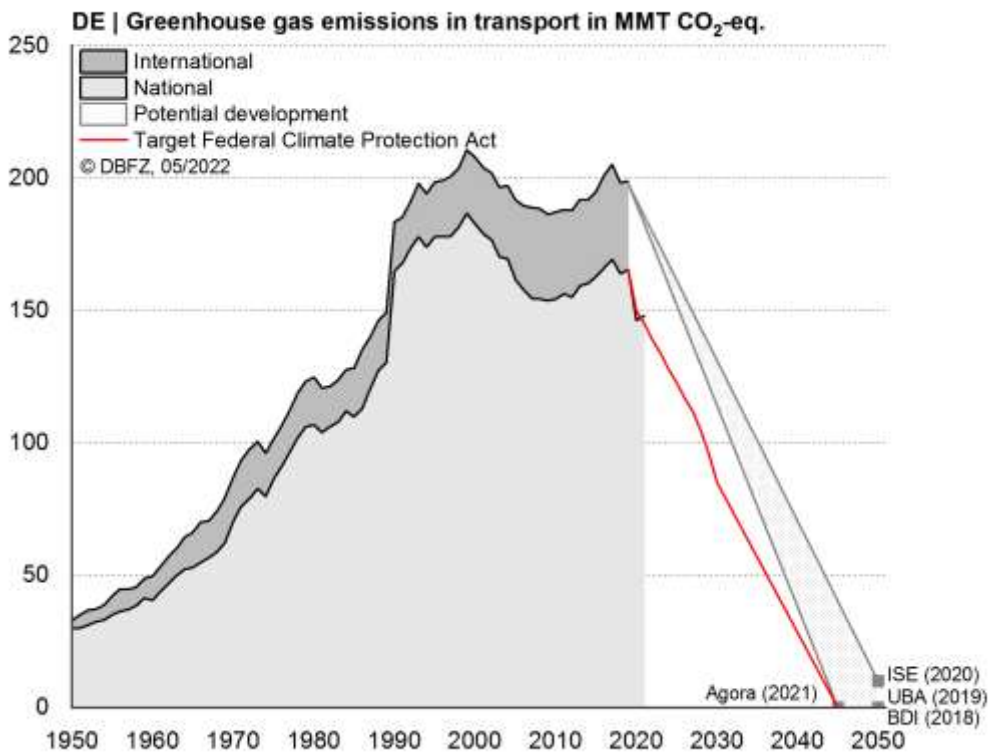
Fuels of the Future, January 24, 2023 | Session 5B: Biomethane as a fuel

Financed by
Federal Ministry for Digital and Transport

Massive gap between trends and targets in transport





GHG quota as part of the energy transformation: 6% in 2020/21 > 7% in 2022 >> 25% (2030)

Motivation and targets

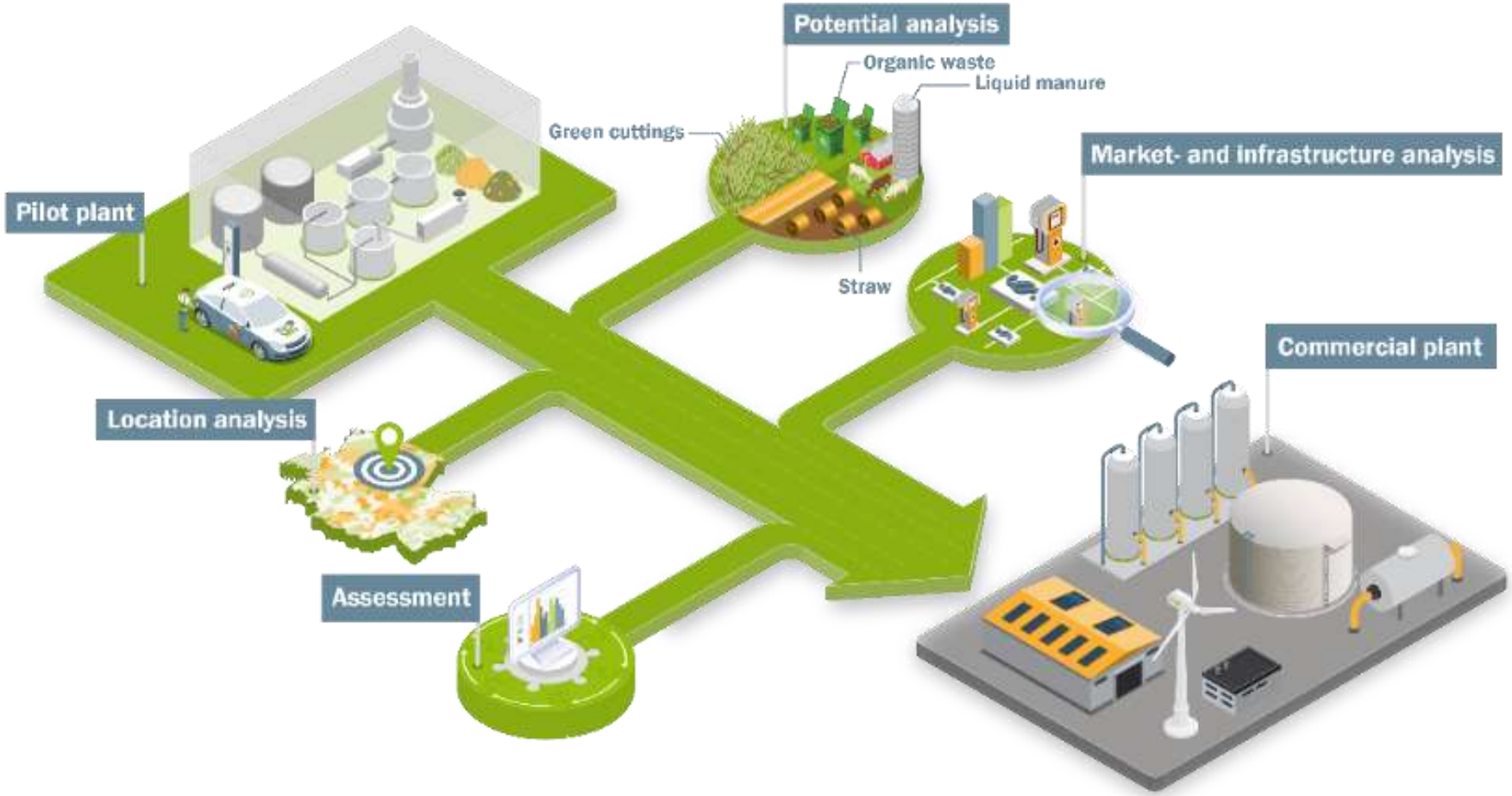
Climate-friendly, renewable methane as a fuel

Innovative process concept following a **zero waste approach**

Utilization of **residues and waste materials for advanced fuels production**

Integration of **electricity & green hydrogen**

Selected results of the first project phase



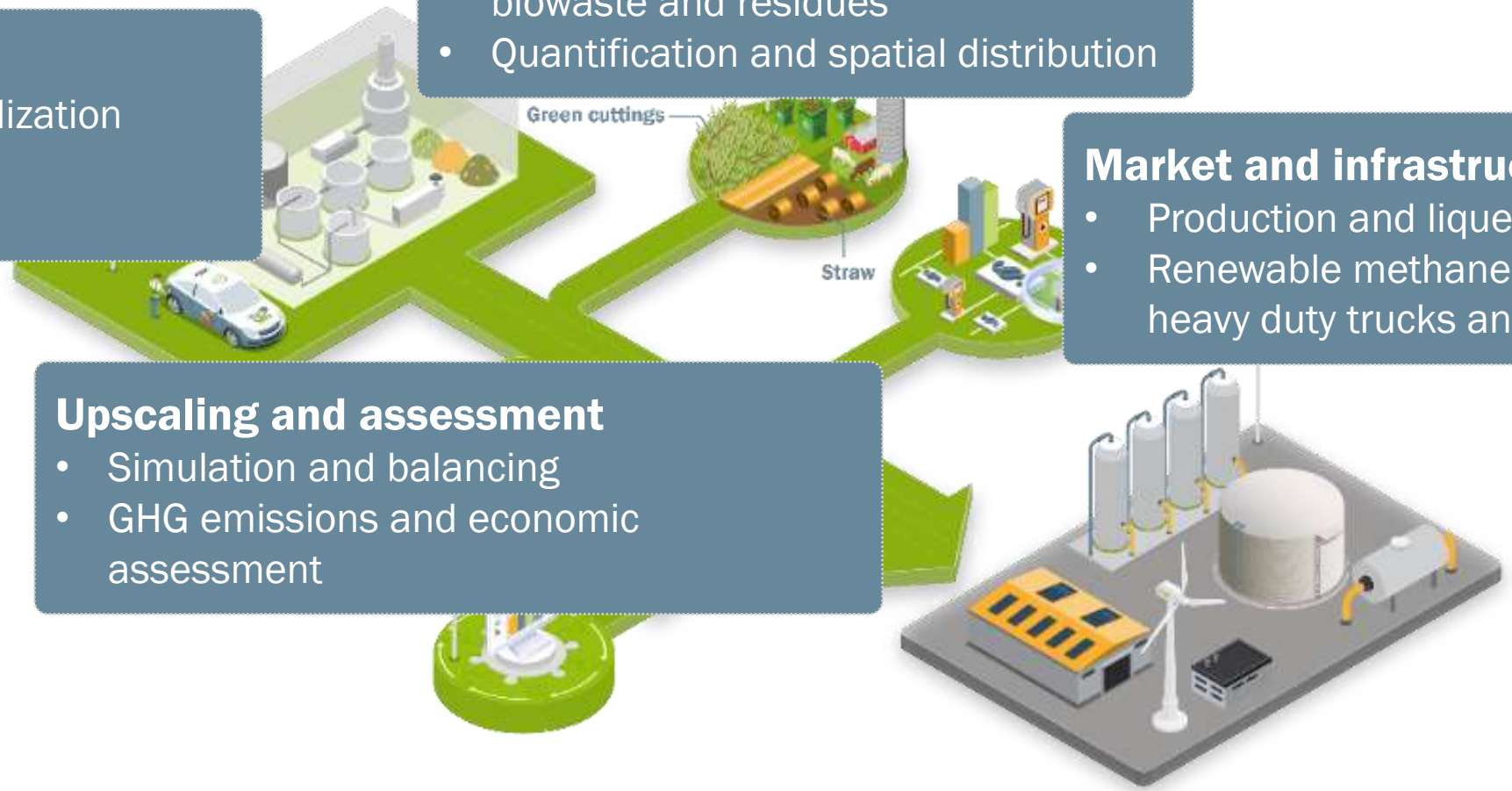
Selected results of the first project phase

Ressource potential
- of selected agrarian and urban biowaste and residues
- Quantification and spatial distribution

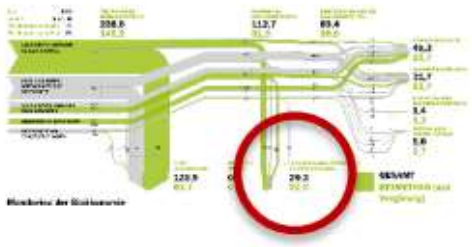
Pilot plant
- Conceptualization
- Realization
- Pretests

Market and infrastructure
- Production and liquefaction
- Renewable methane as fuel in heavy duty trucks and shipping

Upscaling and assessment
- Simulation and balancing
- GHG emissions and economic assessment



Quantification of technical and mobilizable potentials



Biomethane

97–279 PJ

Substitution potential in the transport sector total

4–11 %

LNG-TRUCKS

13 - 39%

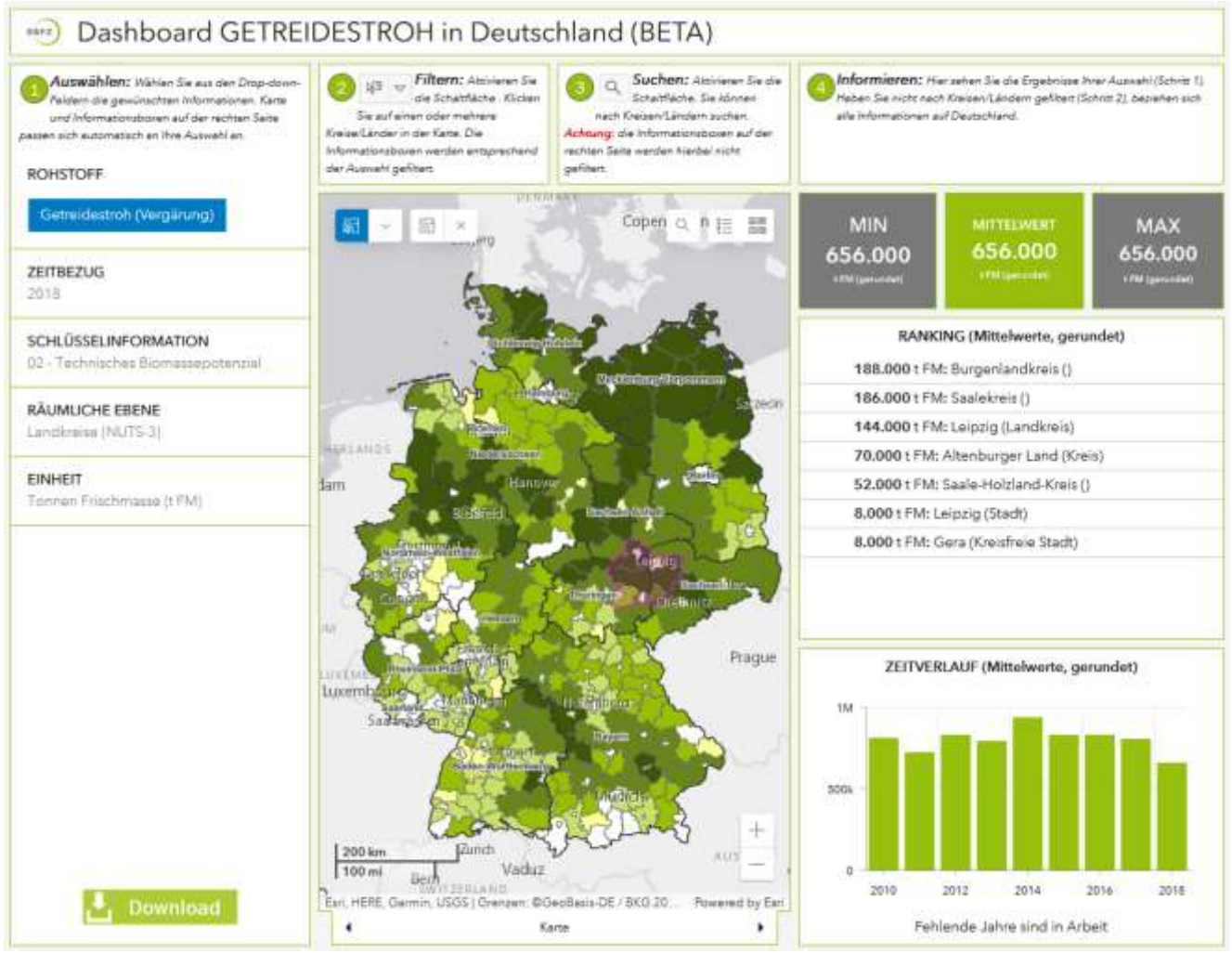
Capri23auto/pixabay

or

LNG-VESSELS (BUNKERING)

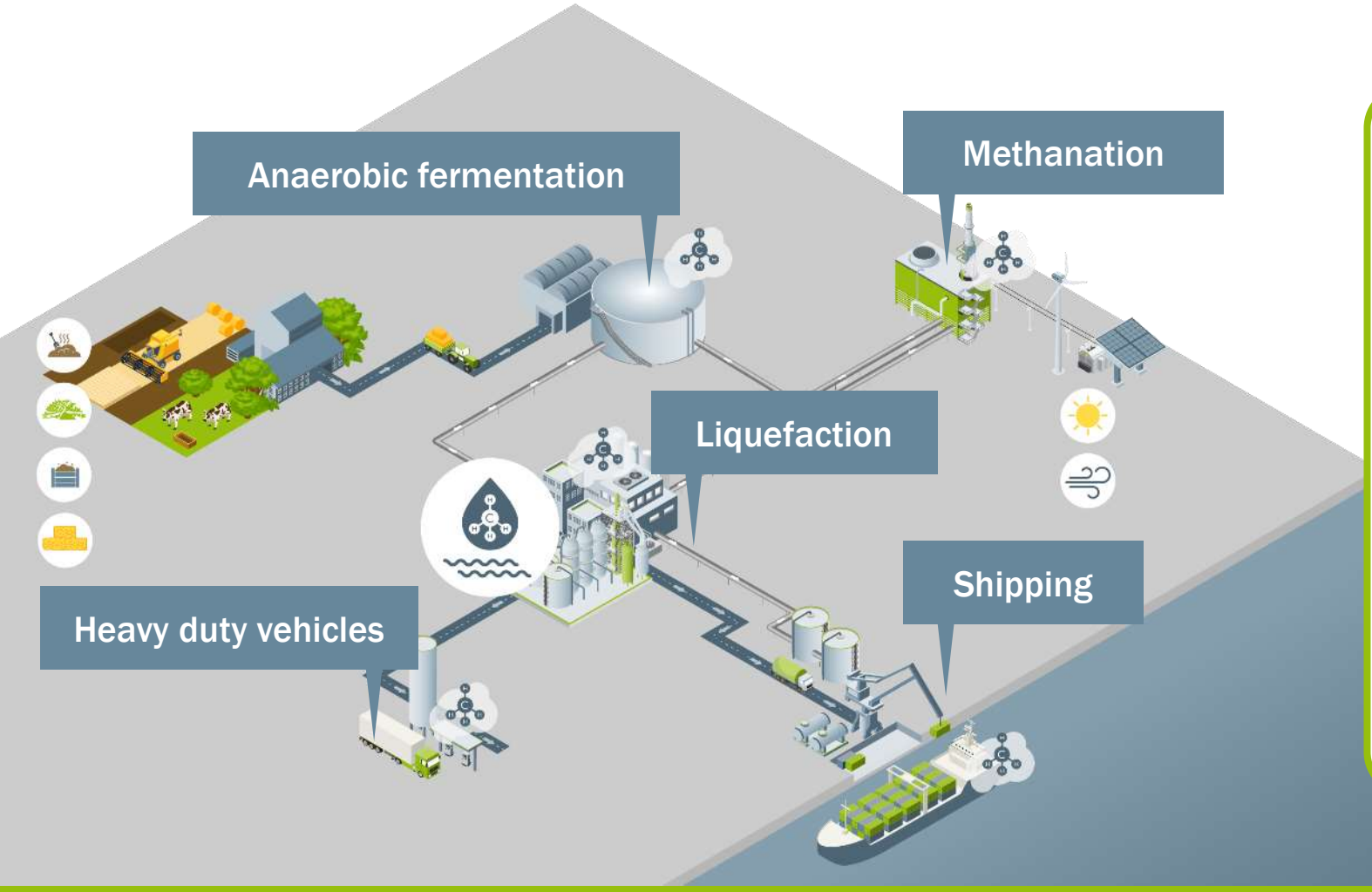
87 - >100%

127071/pixabay



Sources: www.webapp.dbfz.de 01/2021, https://datalab.dbfz.de 01/2023, Kalcher et al. (2021) | further information: https://www.dbfz.de/projektseiten/pilot-sbg/

Infrastructure integration of renewable methane



Europe

Biomethane capacity

- 1000 plants | 855,000 m³/h | 4.8 million t/a [1]

Liquefaction capacity (Bio-LNG)

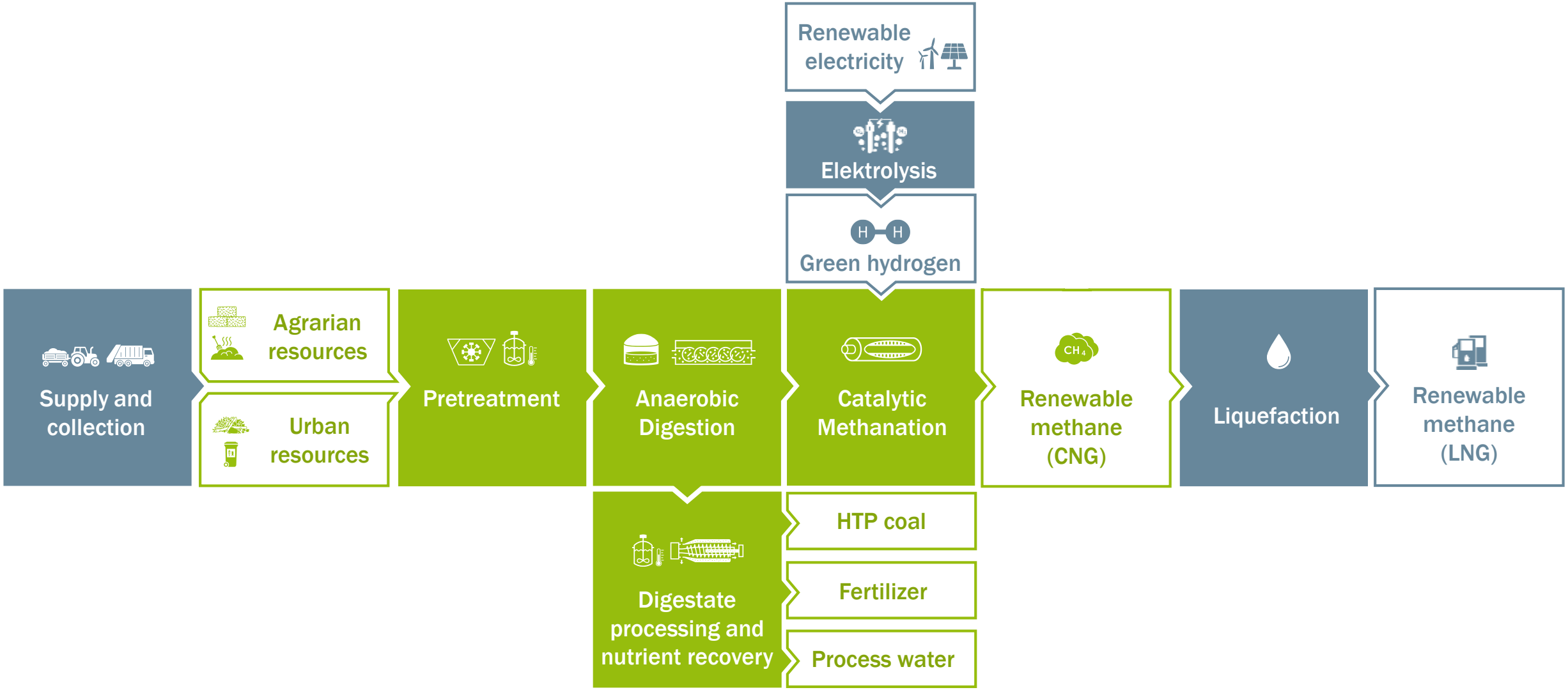
- 78 plants in operation, under construction or projected | 0,7 million t/a [2]

Filling stations

- 635 LNG stations [3]

[1] European Biogas Association und Gas Infrastructure Europe 2022) | [2] European Biogas Association 2021 | [3] https://www.ngva.eu/stations-map/
further information: https://www.dbfz.de/projektseiten/pilot-sbg/

Concept and system boundaries



Conceptualization and realization

Conceptualization and realization

Methodology

Preliminary tests
on laboratory scale

Simulation of process chain
(initial digital twin of pilot plant)

Simulation of supply chain on a
commercial scale,
technical assessment

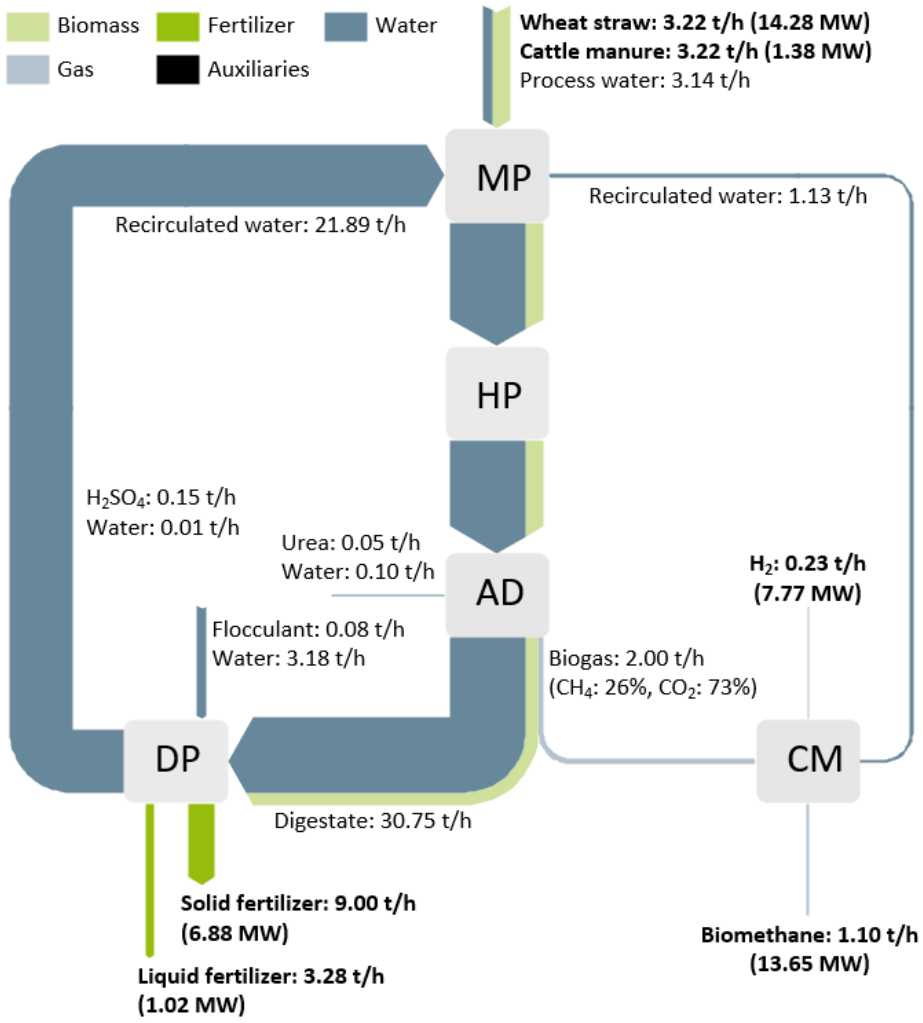
Mass and energy balance
of an exemplary concept on a commercial scale

Production costs
of renewable LNG

GHG emissions
from the supply
chain

Economic assessement of renewable methane
Marketing opportunities in the German GHG quota
(initial: advanced biomethane)

Mass and energy balance | commercial scale

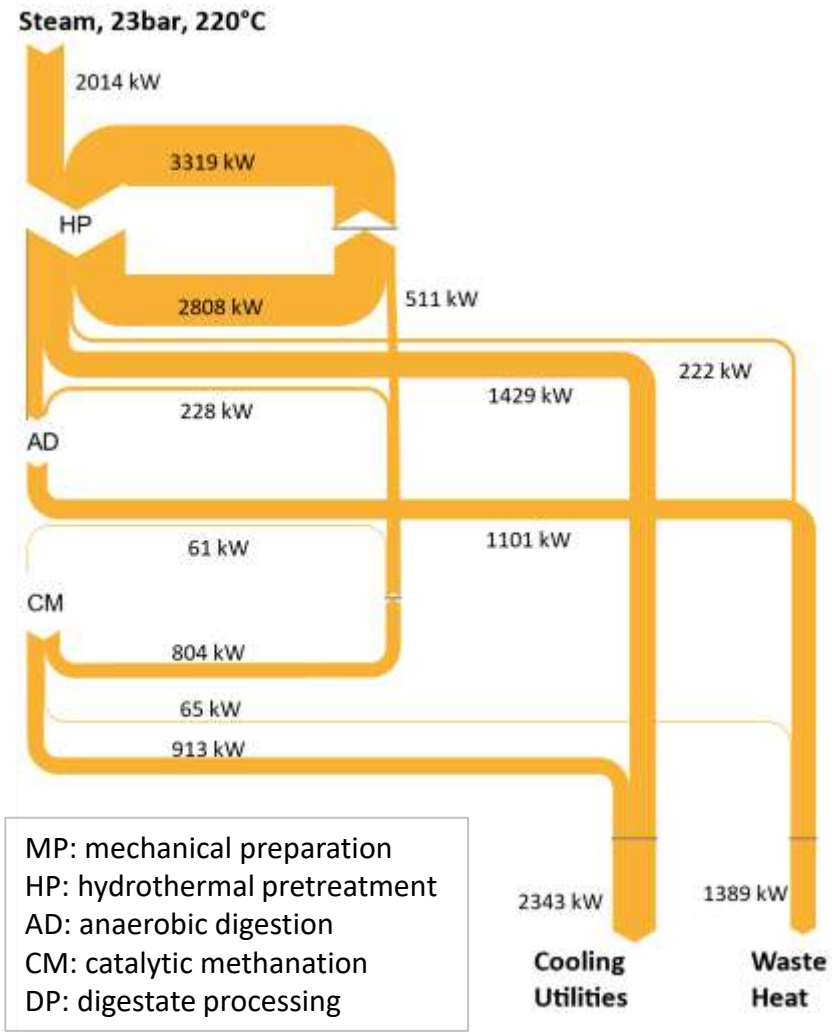


Input:

- 25760 t/a straw
- 25760 t/a manure
- 25120 t/a water
- 16 GWh/a heat (steam)
- 110 GWh/a electricity (and some auxiliaries)

Output

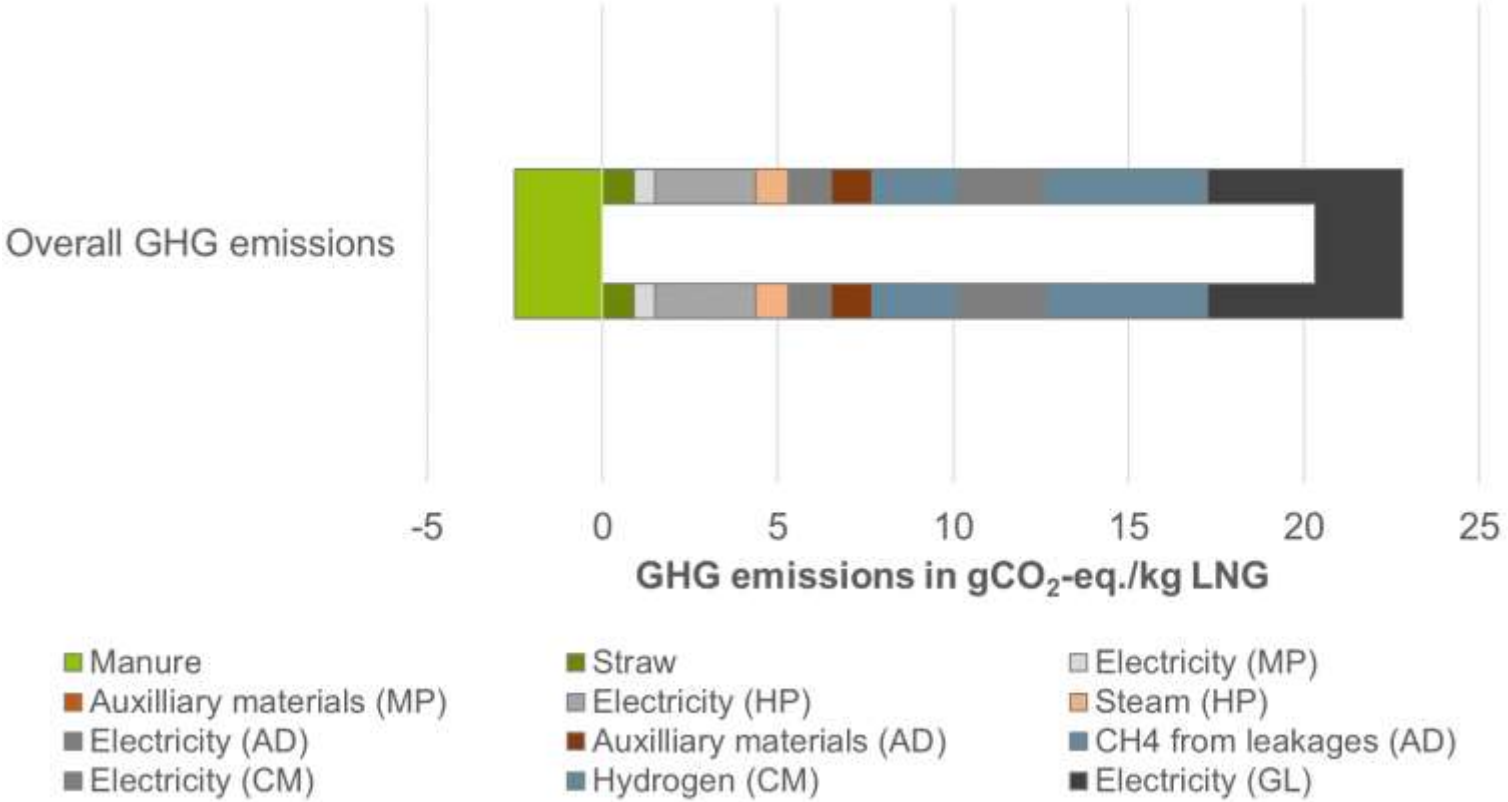
- 8800 t/a methane
- 98240 t/a fertilizer



MP: mechanical preparation
HP: hydrothermal pretreatment
AD: anaerobic digestion
CM: catalytic methanation
DP: digestate processing

Source: Etzold H. Röder L, Oehmichen K, Nitzsche R: Technical design, economic, and environmental assessment of a biorefinery concept for the integration of biomethane and hydrogen into the transport sector (in submission)

GHG emissions



Overall GHG emissions

in g CO_2-eq./kg:

- 14.7 advanced biomethane
- 20.3 advanced Bio-LNG

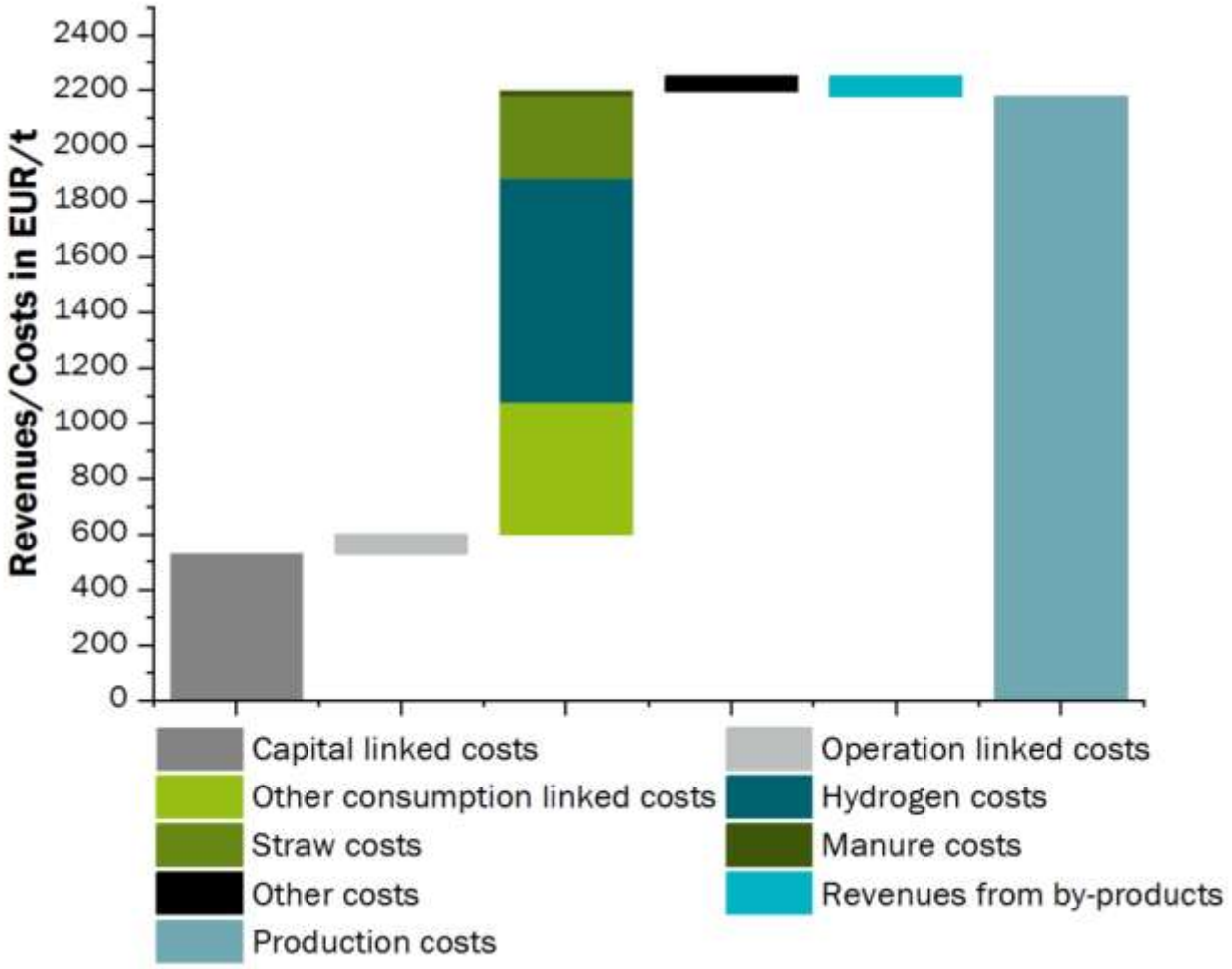
➢ 78 % GHG saving

(compared with 94.1 g CO_2-eq./kg)

➢ Green hydrogen from 100% renewable electricity (emission factor 9.1), further process electricity from the grid

Source: Etzold H. Röder L, Oehmichen K, Nitzsche R: Technical design, economic, and environmental assessment of a biorefinery concept for the integration of biomethane and hydrogen into the transport sector (in submission)

Production costs



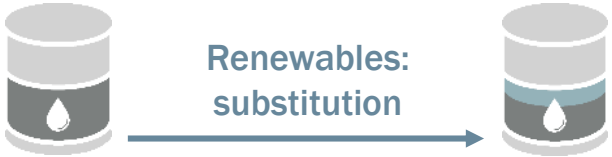
- High costs for the supply of hydrogen (despite optimistic assumption for hydrogen price: 3.80 EUR/kg)
- Other consumptions costs mainly driven by electricity (especially for HTP, methanation, digestate processing and liquefaction)
- Production costs approx. 2200 EUR/t
- Current LNG price 2300-2500 EUR/t [4]

➢ Additional revenue required from GHG quota

[4] https://www.liqvis.com/startseite.html
Source: Etzold H. Röder L, Oehmichen K, Nitzsche R: Technical design, economic, and environmental assessment of a biorefinery concept for the integration of biomethane and hydrogen into the transport sector (in submission)

Economic assessment and GHG quota

Petrol and diesel
(counted in the denominator)



Emission reduction:
comparator (Comp.)
94,1

Natural gas
(**not** counted in the denominator)

Emission reduction:
decreasing comparator
94,1 - quota

- Current quota price approx. 420 EUR/t CO_2-eq.[5]
- ➢ Plus up to 80 % for advanced biofuels (750 EUR/t CO_2-eq.)
- Missing quantities (penalty): 600 EUR/t CO_2-eq.

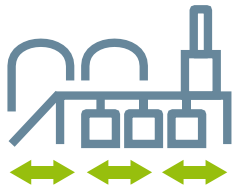
	GHG quota	Comp.	Emission reduction (ER)	Comp.	ER in g CO_2-eq./MJ CH_4	ER in t CO_2-eq./t CH_4	Current revenue from quota	Max. revenue from quota
2023	8 %	94,1	73.8 (78%)	86.6	66.3 (77%)	3,3	1392 EUR	1988 EUR
2026	12 %	94,1	73.8 (78%)	82.8	62.5 (75%)	3,1	1313 EUR	1875 EUR
2028	17.5 %	94,1	73.8 (78%)	77.7	57.4 (74%)	2,9	1206 EUR	1723 EUR
2030	25 %	94,1	73.8 (78%)	70.6	50.3 (71%)	2,5	1056 EUR	1508 EUR

[5] https://equota.de/thg-quote-treibhausgasminderungsquote/ | KW1 2023

Conclusions | Renewable methane as transport fuel

- Resource potentials offer a great opportunity for significantly more climate protection in transport sector
- Continuous development of necessary infrastructure already underway in europe
- Integrated concepts for the use of biogenic and non-biogenic resources enable high efficiency
- RED II and GHG quota set the decisive framework in the coming years

  (final contents of delegated acts for renewable fuels of non-biologic origin are crucial for such concepts)



Pilot SBG contributes to many aspects

contact

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https://www.dbfz.de/projektseiten/pilot-sbg/