Deutsches Biomasseforschungszentrum

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Department Biorefineries

BTx and PTx as competitors or companions – a systemic assessment

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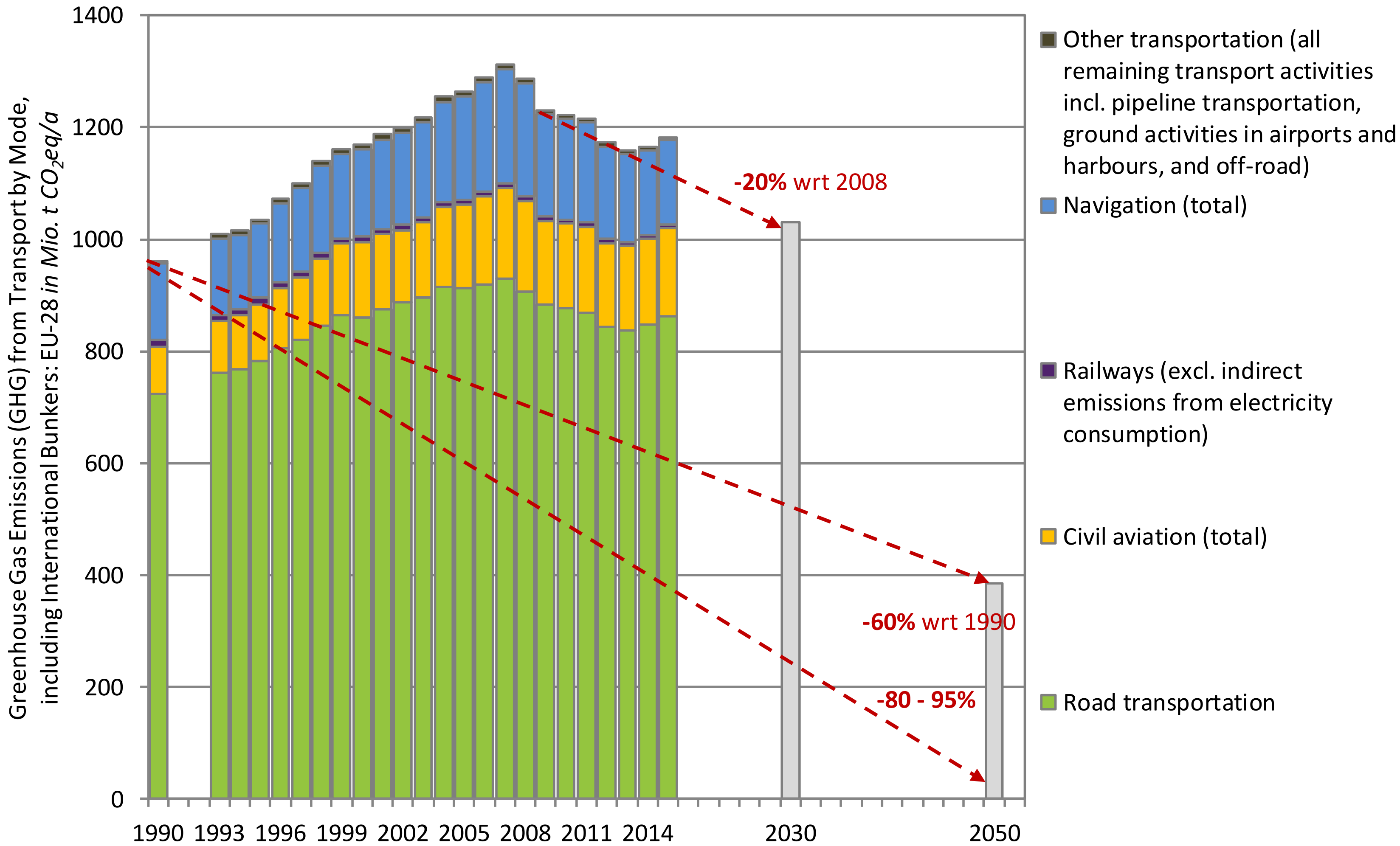
Background

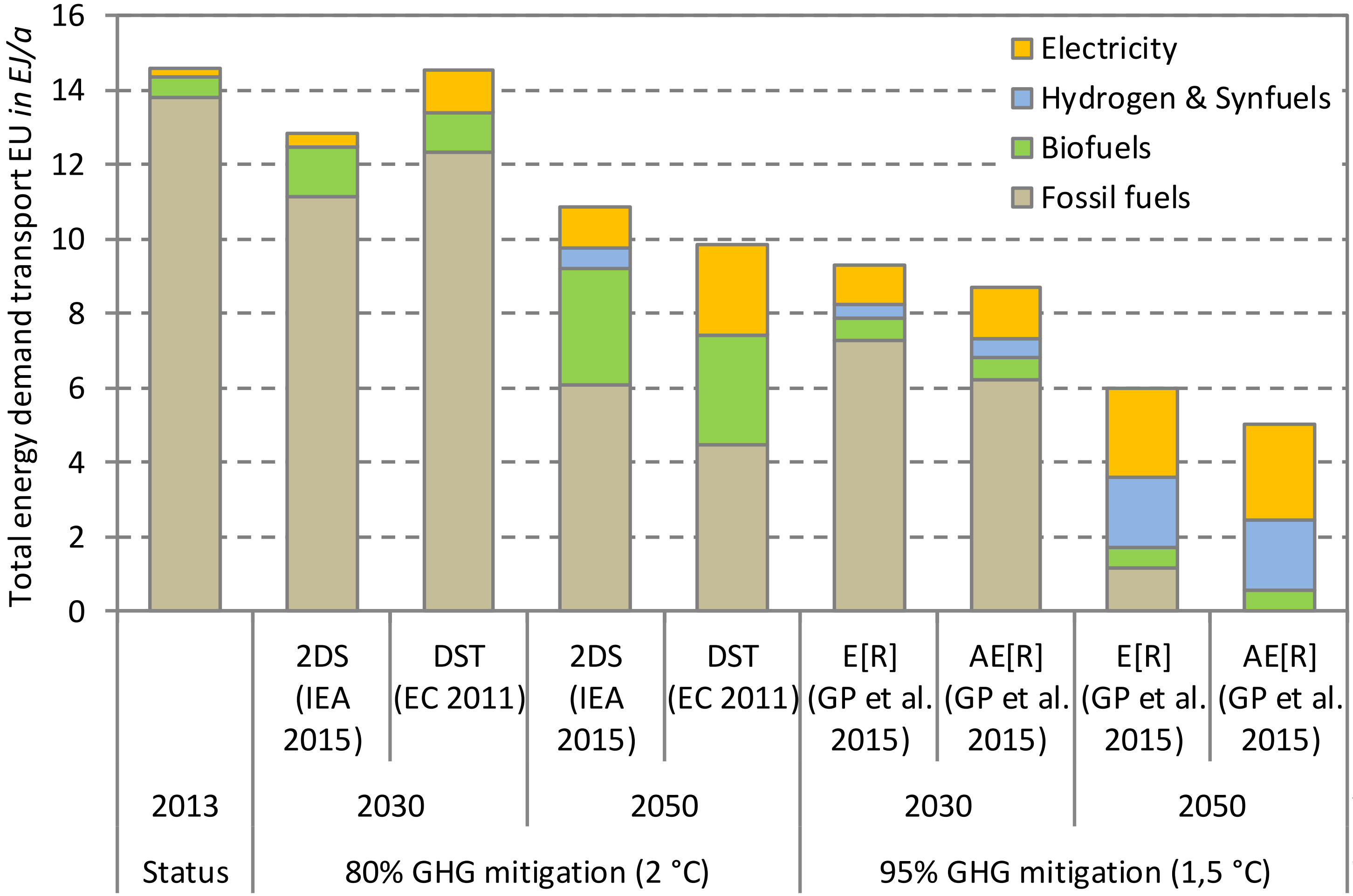
EU | GHG emissions from transport



Total transport energy demand: 358 Mtoe 340 Mtoe 355 Mtoe

Background

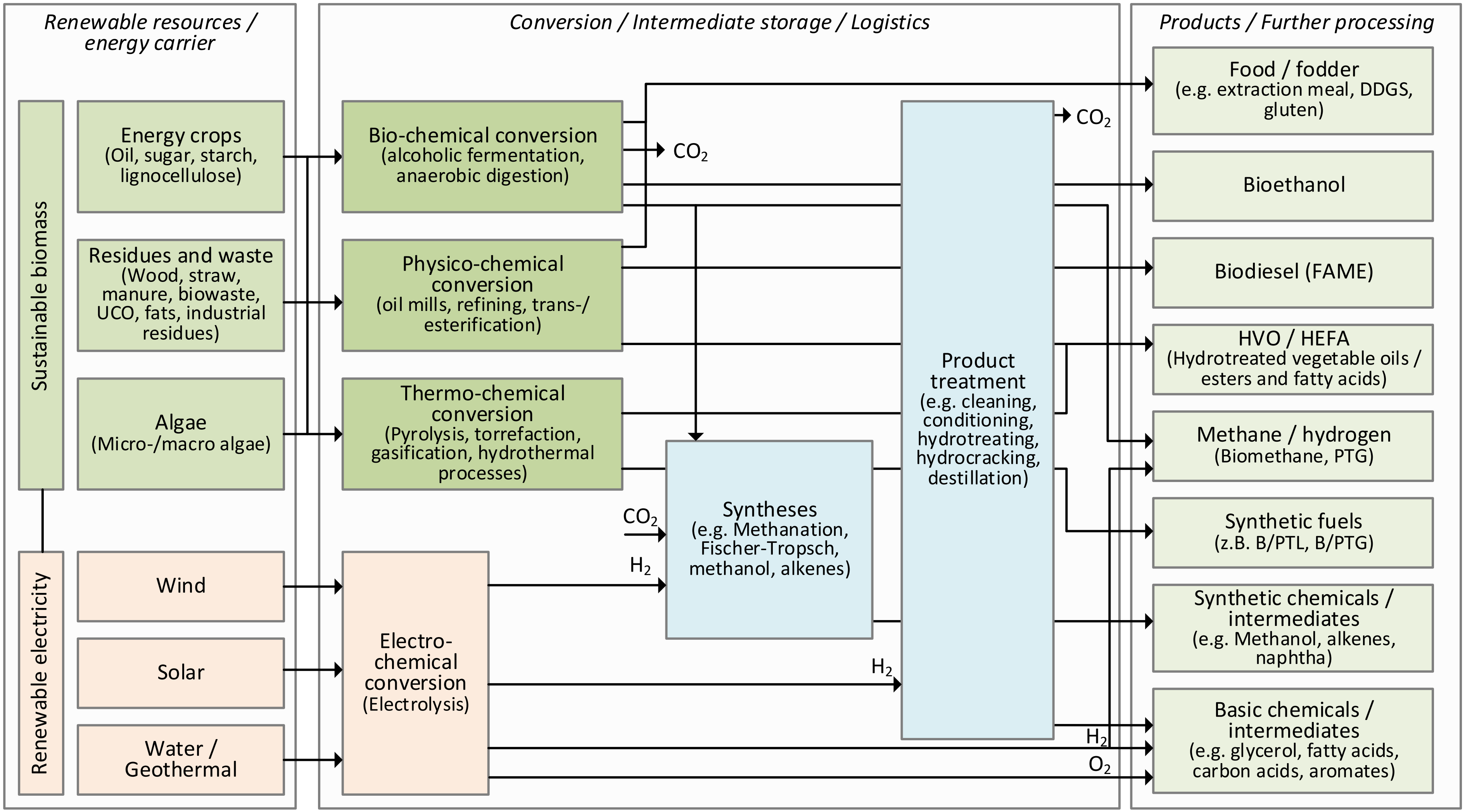
EU | Scenarios on transport energy demand



Frame scenarios.
2DS – 2° C-Szenario (EU 28);
DST - Diversified supply technologies (EU 27);
E[R] - Energy revolution (OECD);
AE[R] - Advanced energy revolution (OECD)

Sources: (IEA 2015) Energy Technology Perspectives 2015; (EC 2011) Energy roadmap 2050; (GP et al 2015) energy [r]evolution a sustainable world energy outlook 2015; Fig. presented in Mueller-Langer et al. 2016, FVEE Conference proceedings

BTx and PTx routes and synergies



SynBioPTx © DBFZ 08/2016 (w/o entitlement of completeness)
B/PTG – Biomass-/Power-to-Gas, B/PTL – Biomass-/Power-to-Liquids, DDGS - Dried Distillers Grains with Solubles, FAME – Fatty acid methy ester

Systemic assessment

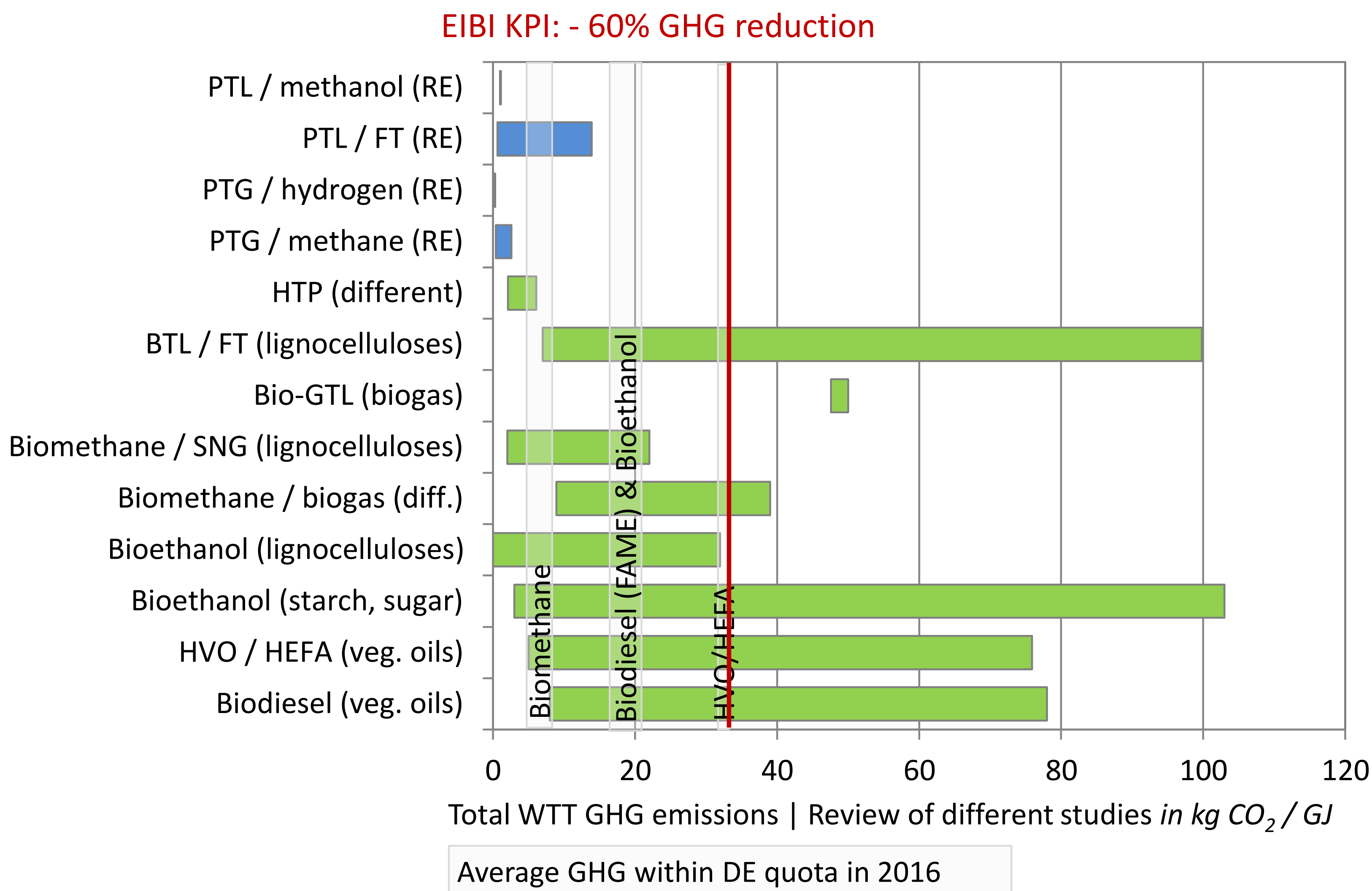
State of development & SynBioPTx potentials

Fuel option	Typical (by-)products[a]	State of development (TRL, FRL)[b]	Current capacity / production EU [kt/a]	SynBioPTx potential, examples[c]
Biodiesel (FAME)	press extraction meal, glycerine	Commercial, TRL/FRL 9	18,600 / 10,800	PT-methanol for trans-/ esterification
Hydrotreated veg. oils or esters/fatty acids (HVO / HEFA)	(press extraction meal), propane, gasoline fractions, jet fuel, diesel	Commercial, TRL 9 for HEFA diesel, TRL 4 for algae etc.	2,600 / 1,900	PT-H_2 for hydroprocessing
Bioethanol (sugar, starch)	sugar: bagasse/vinasse; starch: gluten, stillage for DDGS, fertiliser, biogas	Commercial, TRL/FRL 9	6,400 / 4,018	Bio-CO_2 about 8,800 kt/a
Bioethanol (lignocellulosic)	lignin-products, pentoses, from stillage for fertiliser, biogas	Commercial demo plants, TRL/FRL 7-9	48	Bio-CO_2 about 55 kt/a
Biomethane / Biogas	digestate, electricity	Commercial, TRL/FRL 9	882	Bio-CO_2 about 1,151 kt/a
Biomethane / Synthetic Natural Gas (SNG)	electricity and heat	Demonstration plants, TRL/FRL 6-7	0.2	Common synthesis RD&D, H_2 integration
Synthetic biomass-to-liquids (BTL), mainly FT, methanol/DME, OME	Jet fuel, diesel, gasoline / naphtha, electricity and heat	Pilot / demo plants, TRL/FRL 3-5	0.08	Common synthesis RD&D, H_2 integration
Synthetic power-to-liquids PTL, same like BTL	Jet fuel, diesel, gasoline / naphtha or methanol	Pilot plants, TRL 8-9 components, FRL 2 (methanol 8)	4 (methanol), 0.003	Use of Bio-CO_2, common synthesis

[a] depending on process design; [b] according to technology readiness level (TRL) of the European Commission, fuel readiness level (FRL) according CAAFI , [c] here rough estimation based on process related CO_2, Distiller's Dried Grains with Solubles, DME Dimethylether, FT – Fischer-Tropsch, OME – Oxymethylethers; ©DBFZ 2018 bassd on Naumann et al. 2016; Gain Report 2016; European Biogas Association, 2016; CRI 2017

Systemic assessment

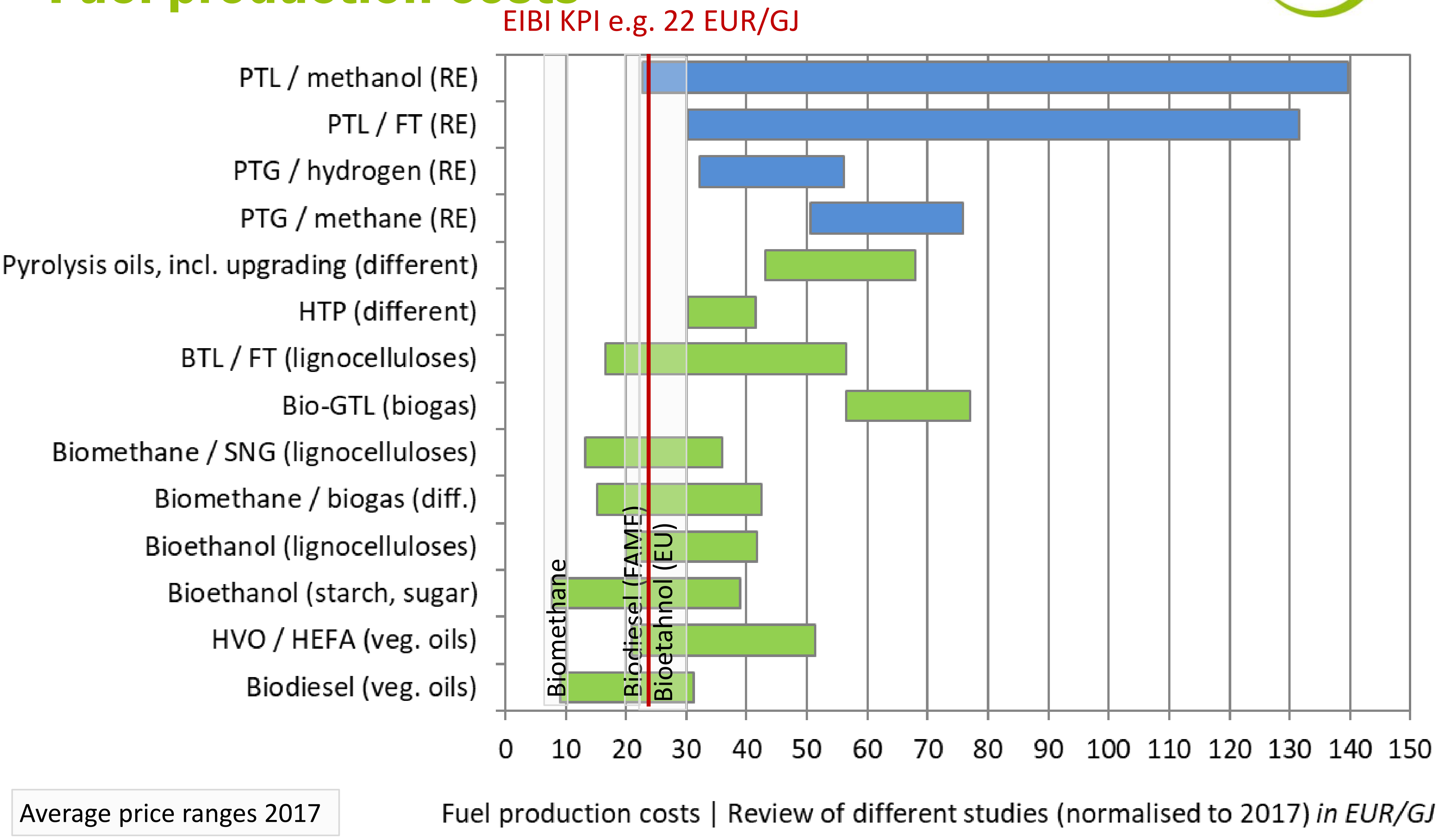
GHG emissions WTT



©DBFZ 2016 based on e.g. Moreira 2015; LBST 2010, JEC 2013, LBST 2014, DBFZ 2012-2015, Gröngröft 2014, Stratton 2010, Frank 2013, Liu 2013, Sills 2013, Schmied 2015, MKS 2013, Jones 2015, BLE 2015, Naumann et al 2016, BLE 2017

Systemic assessment

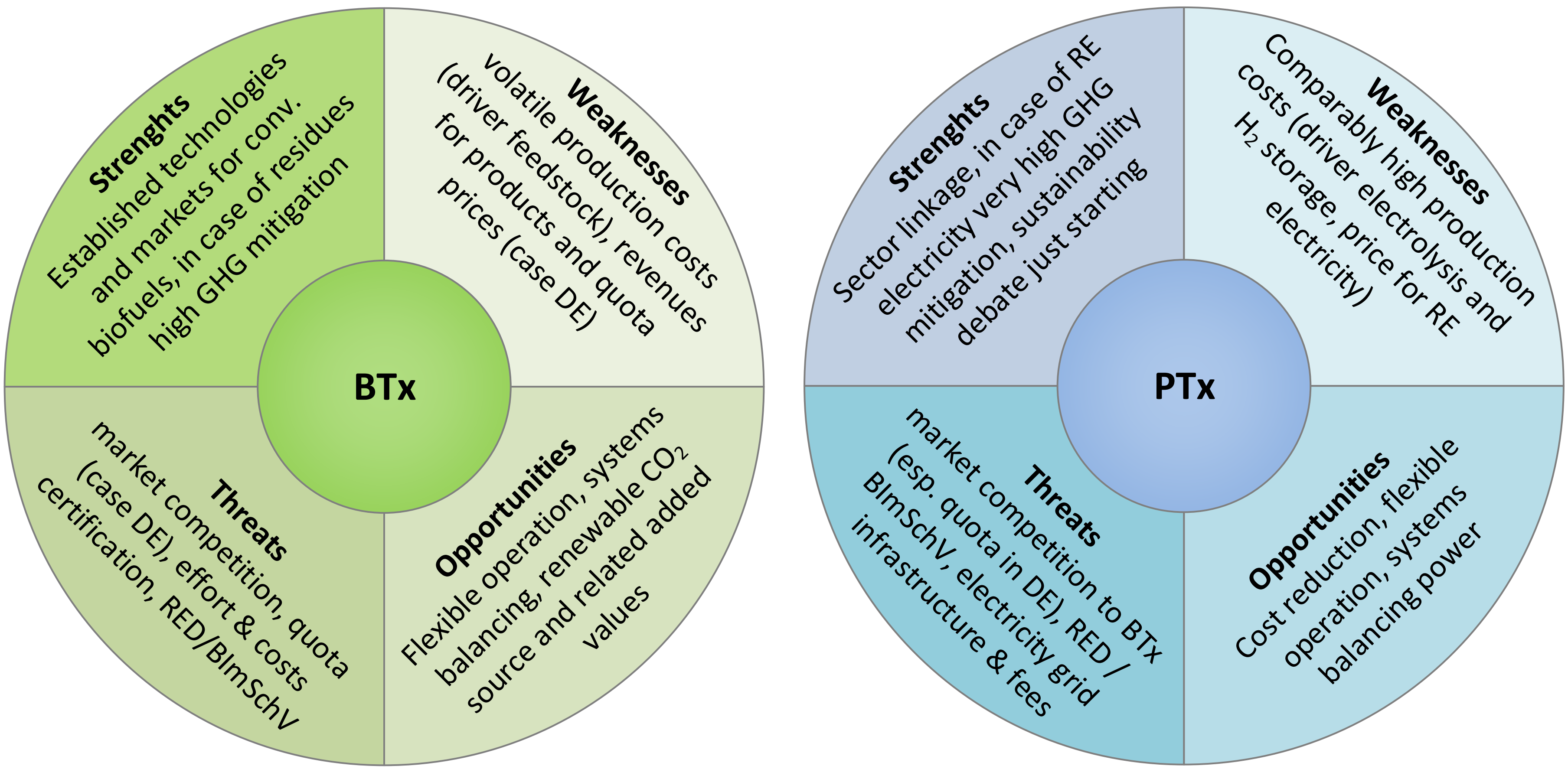
Fuel production costs



Fuel production costs | Review of different studies (normalised to 2017) *in EUR/GJ*

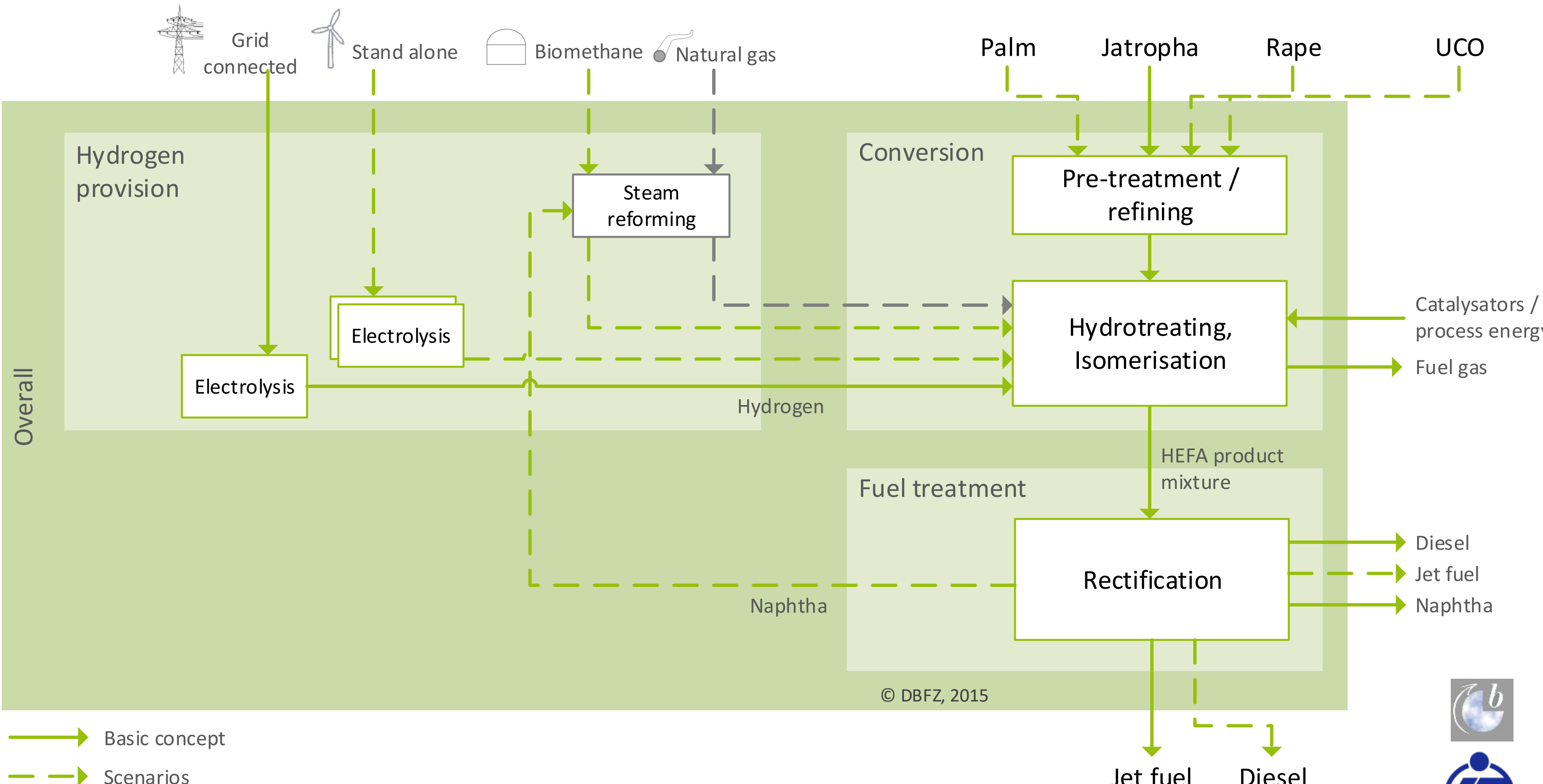
Systemic assessment

Simplified SWOT



Example PTG-HEFA hybrid refinery

Feasibility of different plant concepts



- Focus region: Germany
- Selected RE favoured regions: Sweden, Spain, Namibia

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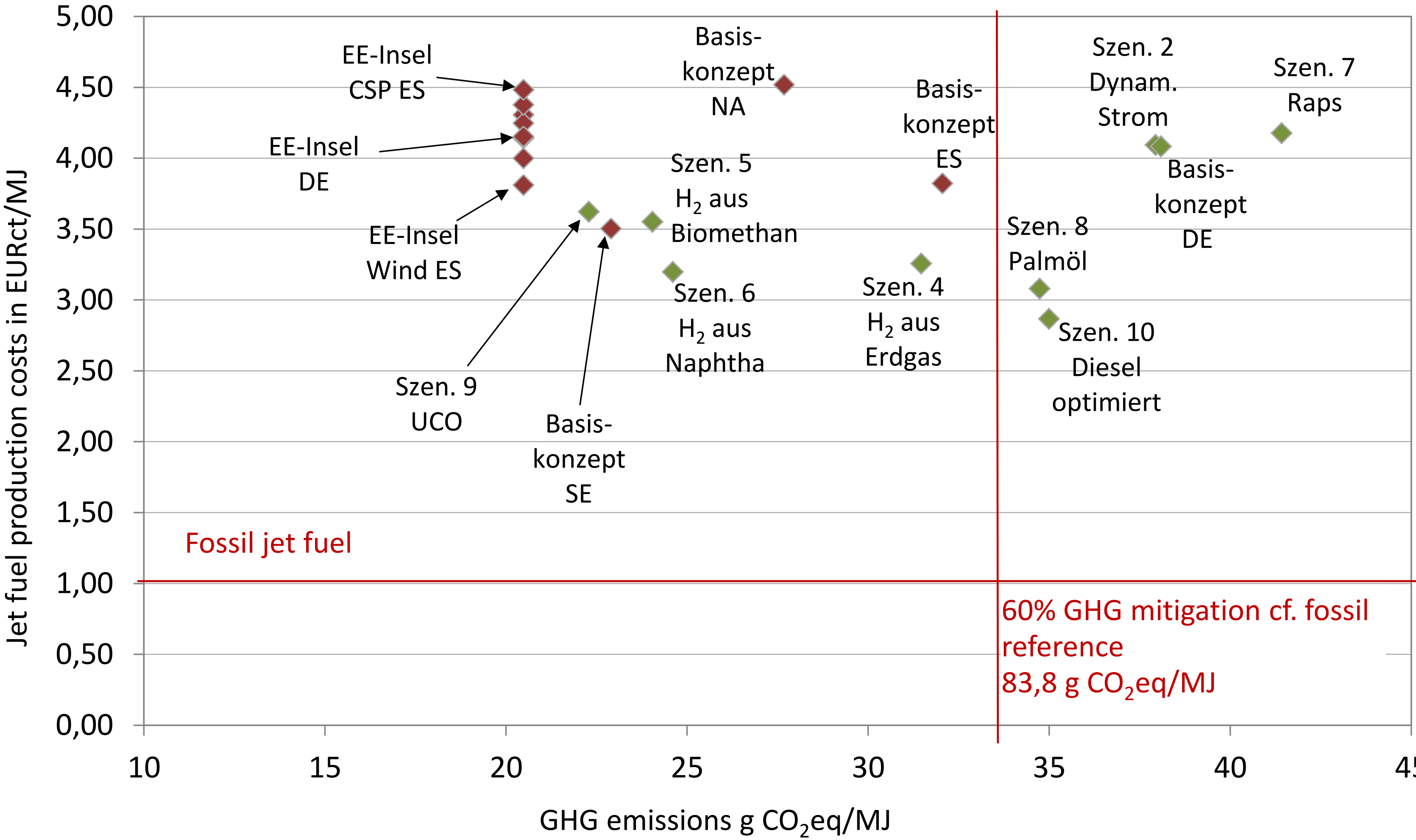
Summary of results



- Mitigation costs | comparison with favoured regions (red)
  Base scenario: Alternative regions well below DE (approx. 65-85%)
  Stand-alone scenario (“EE-Insel”): comparable with DE (+/- 7%)

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Conclusion

- For reaching future targets all sustainable renewable fuels required
- Considering BTx and PTx as multi product plants addressing different sectors
- Synergies for biofuels and PTL/PTx: e.g. biobased CO_2 for PTx, hydrogen for HVO/HEFA, for fuel and chemical synthesis, biogas methanation >> SynBioPTx allows expanding existing value chains
- Comparably higher costs for PTL (esp. electrolysis, electricity) >> competitiveness of input / feedstocks, annual load and flexible operation cost drivers
- PTL with GHG benefits only if 100% renewable electricity is used >> with increasing RE share in electricity mix also biofuels improve GHG balance further
- Comparable GHG reduction for biofuels and PTL >> for use within GHG quota in Germany PTL not competitive
- Challenge: fuel availability, market competition of educts/products and related operability of control mechanism

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Smart Bioenergy – Innovations for a sustainable future

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