IEA Bioenergy
Technology Collaboration Programme

Success stories and learned lessons in Germany

Workshop - Guidelines to overcome barriers for commercialization of advanced biofuels

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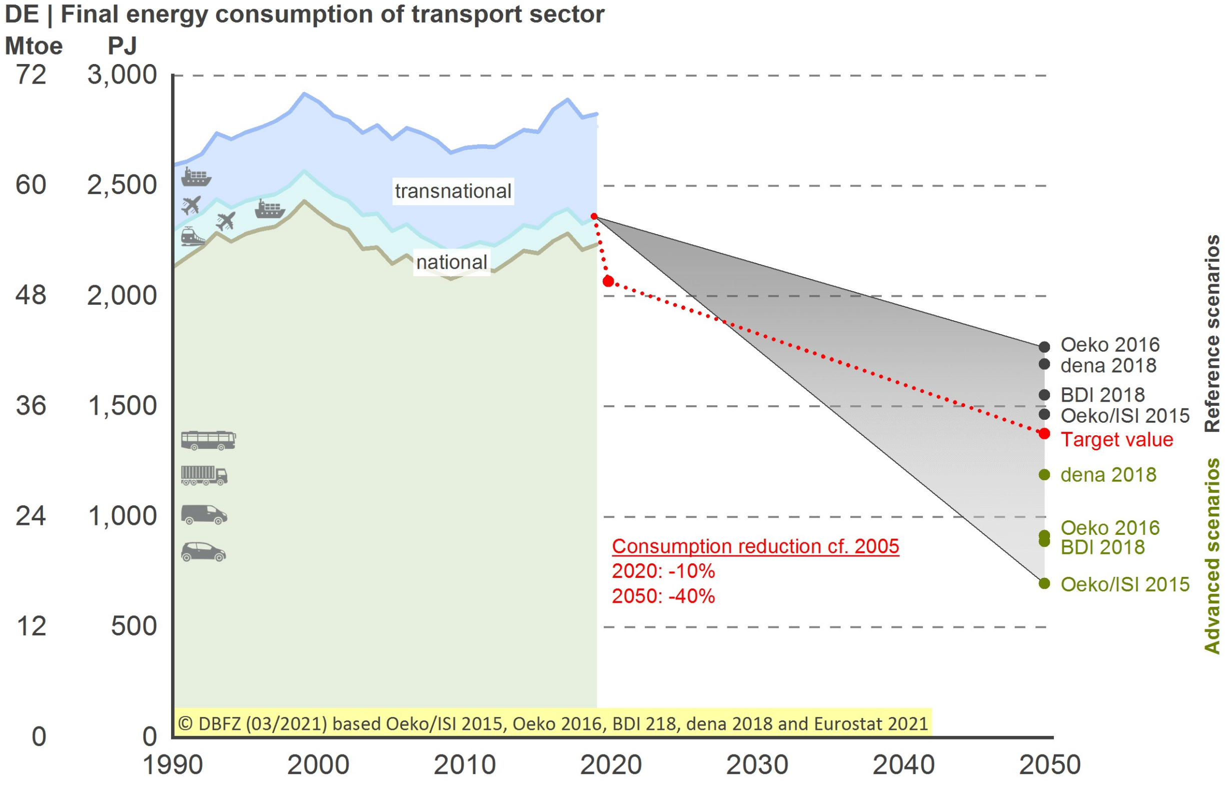
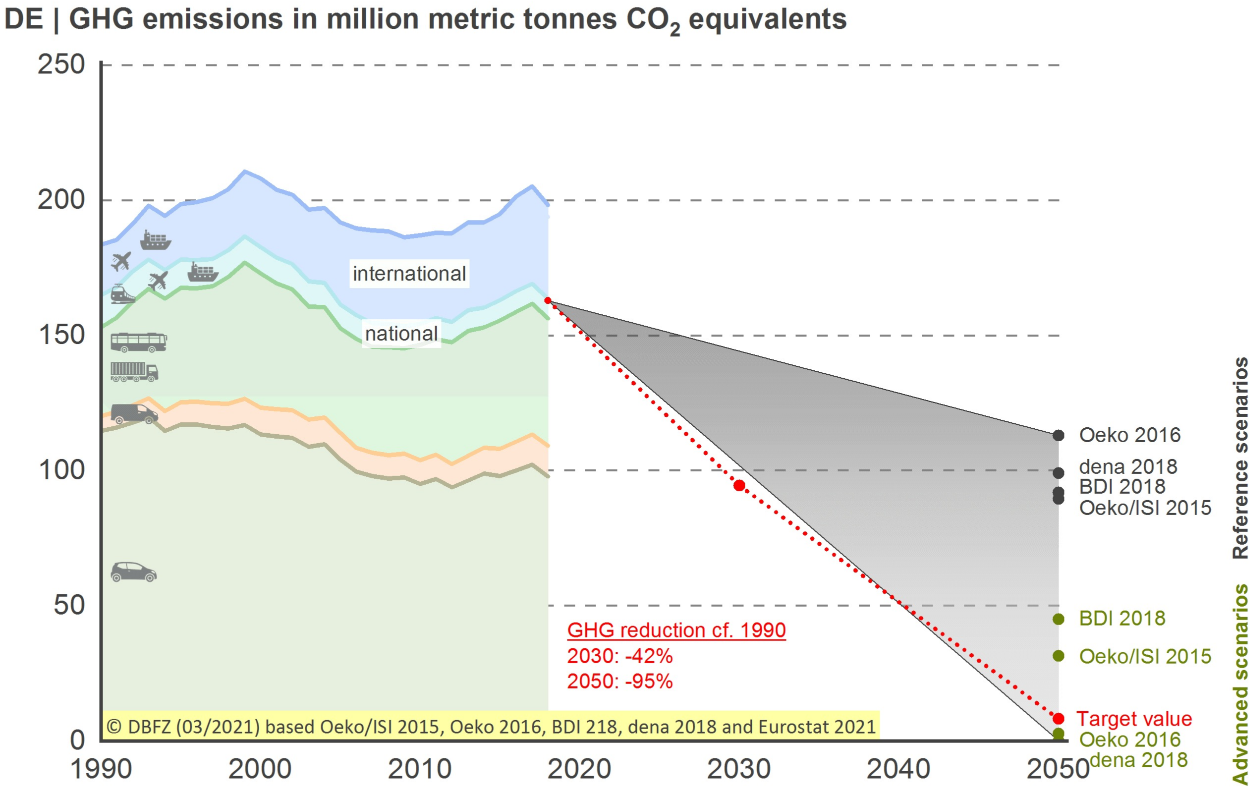
Agenda

1. Background
2. Development in Germany
3. Exemplary case studies
   – KIT (bioliq®)
   – Clariant (Sunliquid®)
4. Conclusion

Background

Massive gap between trends and targets in transport





Background

Regulatory frame with strong market impact

European Commission

European Council

European Parliament

Strategies

§

Directives with guideline character:
e.g. AFID, CVD, ETD, FQD, RED/REDII/III

Regulations with binding character:
e.g. ESR, ECL, CO_2 FR

Standards, norms, guidelines: e.g. ISO, EN, DIN, VDI

Transposition in EU member states

Specification in EU member states

Directly binding

Federal Government Parliament

Federal Council

Strategies

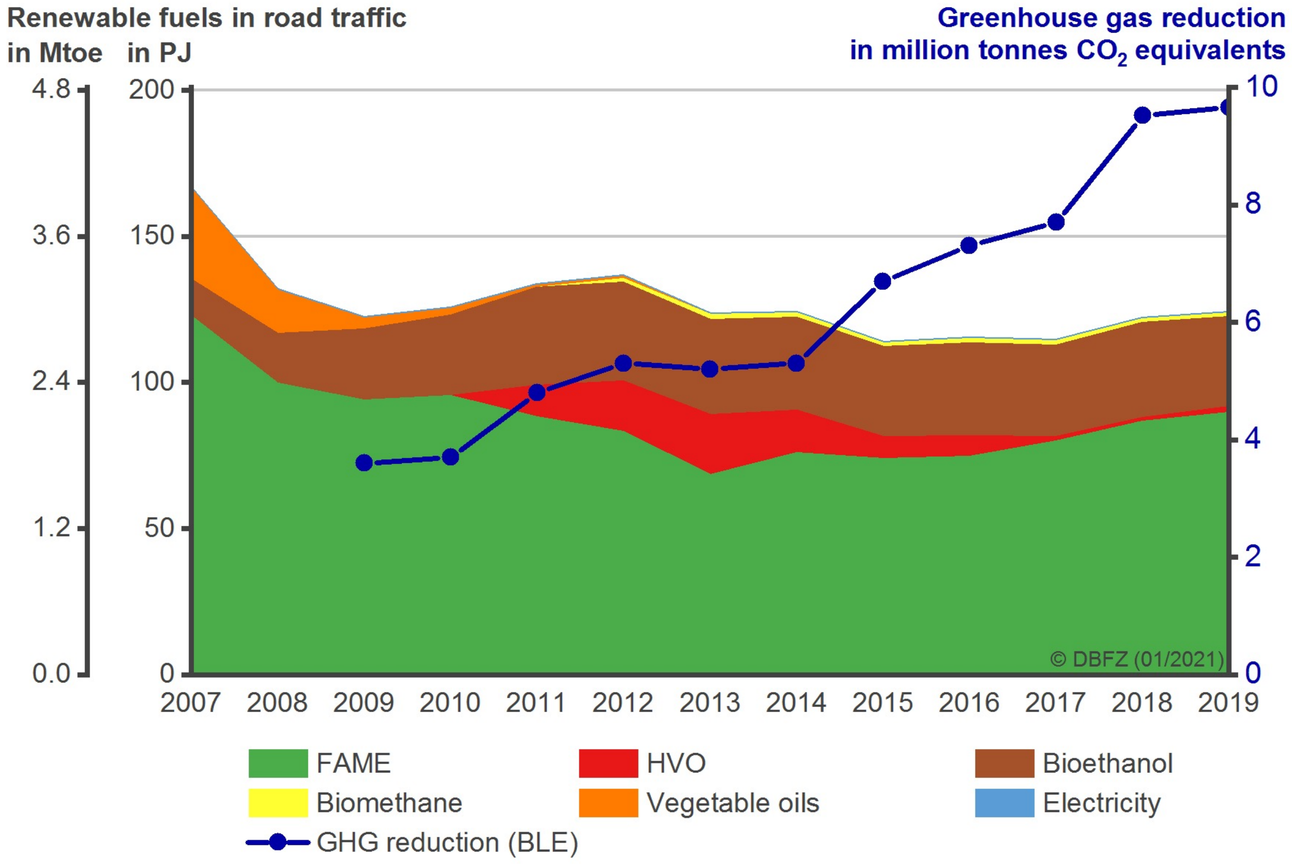
§

National laws and ordinances:
e.g. KSG, BEHG, EnergieStG, BImSchG, BImSchV

Binding for industry, product supplier: e.g. CO_2 FR

Development in Germany

Biofuels in transport

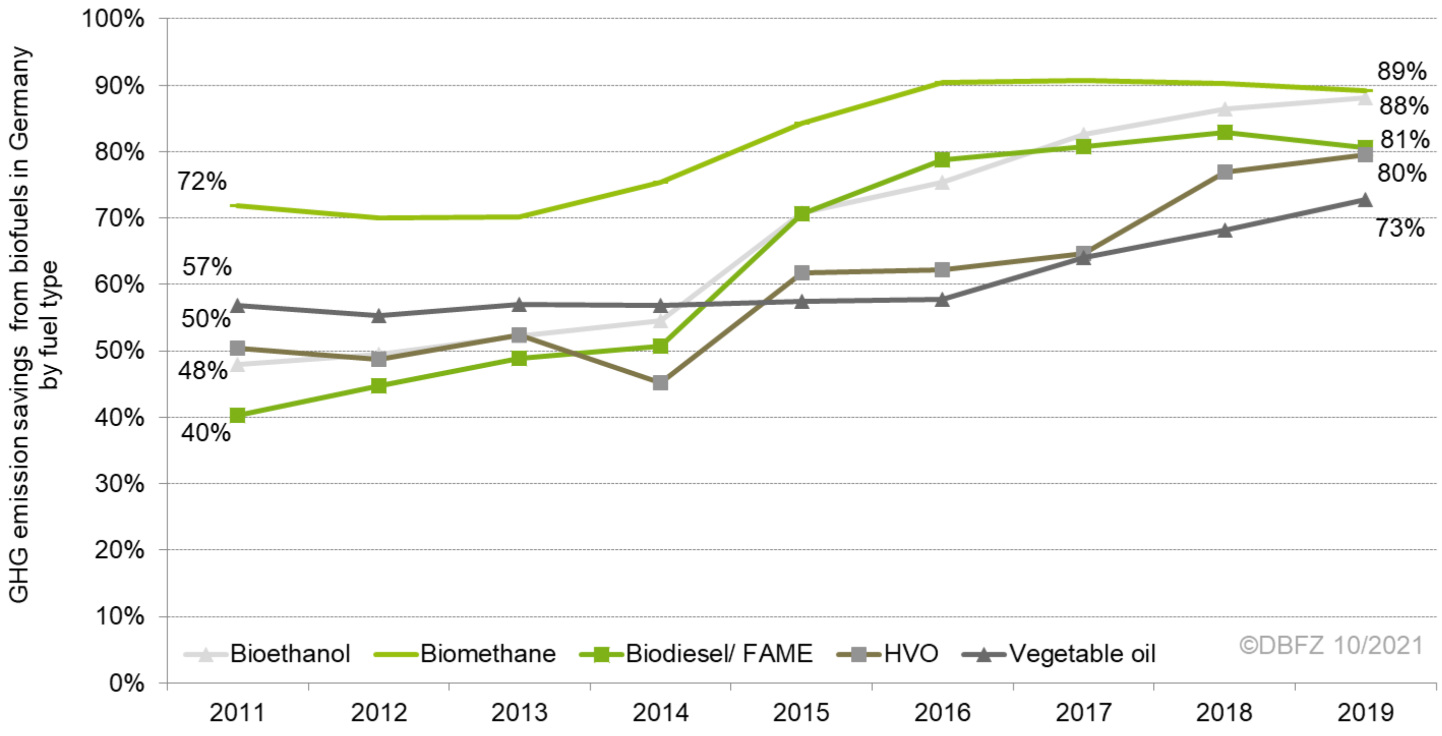


- GHG quota:
  3.5% from 2015, 4% from 2017 and 6% from 2020
- Until now GHG mitigation in transport mainly based on konventional biofuels >> 2019: ca. 9.7 Mio. t GHG mitigation through ca. 3.6 Mio. t biofuels (of which ca. 29% residues)
- All biofuels have been certified acc. BiokraftNachV >> 2019: average GHG mitigation against fossil reference 83%
- Biofuels are part of bioeconomy and produced in multi-product plants

Background paper GHG quota
(https://www.dbfz.de/fileadmin//user_upload/Referenzen/Statements/Background_Paper_GHG_Quota.pdf)

Development in Germany

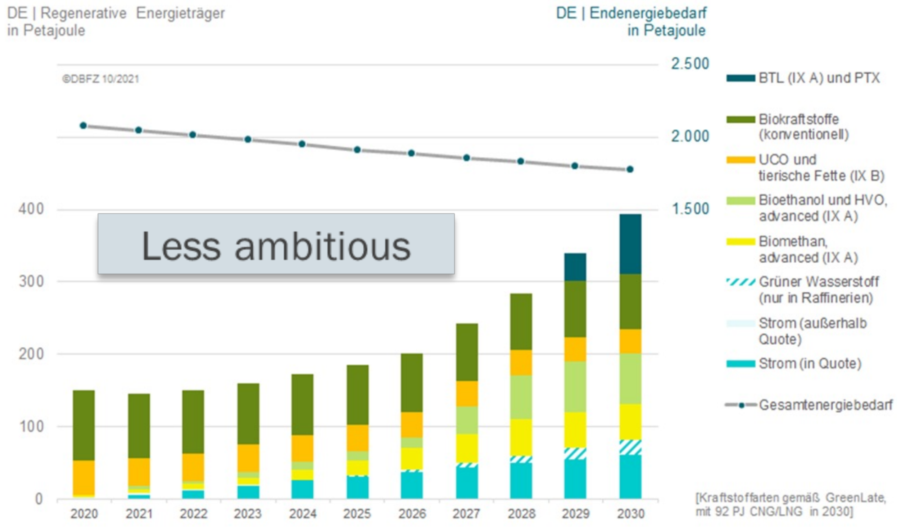
Improvement of specific GHG mitigation potentials

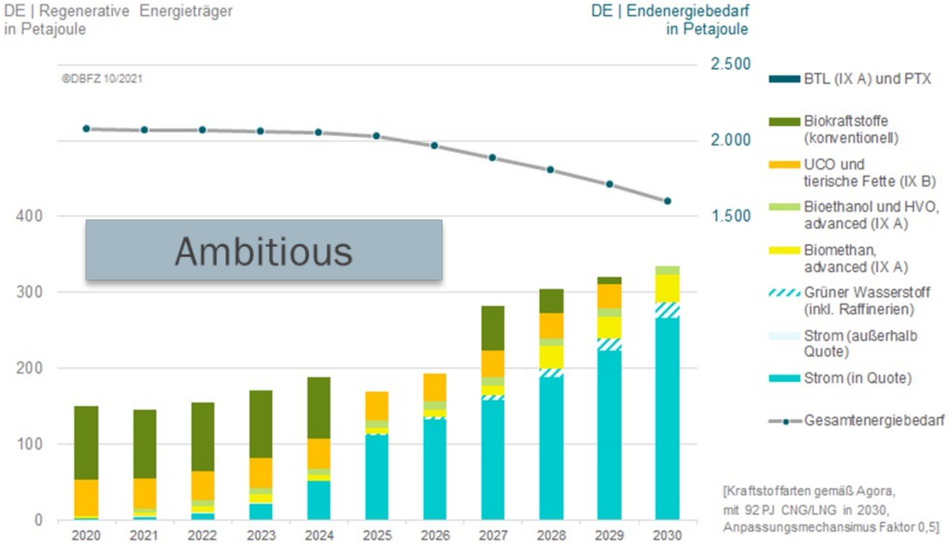


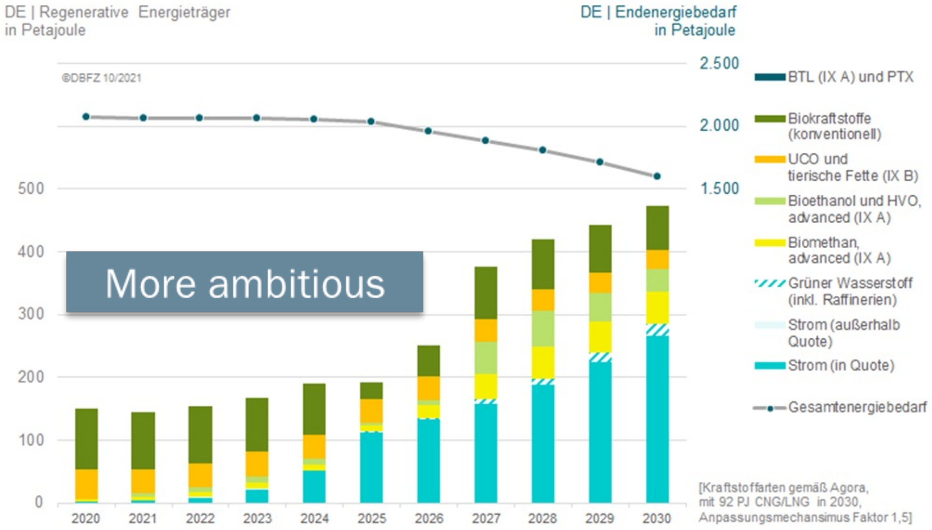
Average value for GHG emission savings from biofuels utilized in Germany by fuel type between 2011 and 2019 (No specificity from feedstock utilized). ©DBFZ based on BLE (2014,2015, 2017, 2018 and 2020)

Development in Germany

Possible scenarios under REDII / GHG quota until 2030



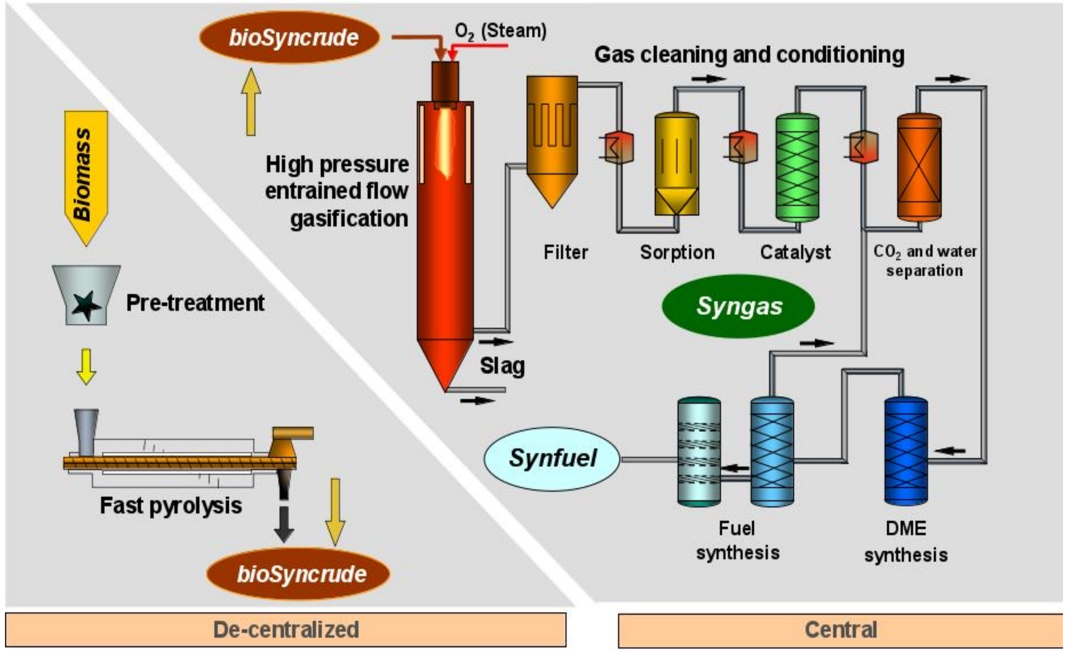




2030	Less ambitious	Ambitious	More ambitious
Renewable energies			
Share, real	20 %	15 %	23 %
Share acc. RED II (14%)	36 %	51 %	64 %
Emission reduction			
RED II revision (proposal: 13 %)	15 %	18 %	24 %
Emission budget (KSG)			
Target 2030 (80 Mio t CO_2 eq.)	+ 24	+ 14	+ 4
Total 2022-2030 (994 Mio t CO_2 eq.)	+ 110	+ 124	+ 85

Exemplary case studies

bioliq® | Karlsruhe Institute for Technology



The bioliq® process at KIT (© KIT)

The bioliq® demonstration plant at KIT (© KIT)

- **2005** Stage 1: Construction of the fast pyrolysis
- **2008** Start of operation of fast pyrolysis
- **2010** Stages 2,3,4: Construction of gasifier, gas cleaning and synthesis processes
- **2013** Start of operation and production of synthetic fuels
- **2014** Beginning of project Energy Lab 2.0
- **2015** Construction of the Power-to-Gas process
- **2018** Construction of the Power-to-Liquid process
- **2019** Operation and production of synthetic methan
- **2020** Operation and production of renewable fuels

Exemplary case studies

bioliq® | Karlsruhe Institute for Technology

- Bioliq ® process involves technologies for the production of synthetic gasoline via gasification of biomass, divided in a de-centralized and a centralized process;
- The drop-in fuels components produced by Bioliq® do not require technological changes/ adaptations and is flexible to produce different types of fuels depending on the process configuration;
- Fuel produced tested in other project (refuels);
- Technology successfully scaled-up to TRL 7;
- Partnership with other technology developments as producing syngas for PtL fuel production
- Driving factors for success:
  - Long term operation possible overcoming typical starting problems, room for various feedstock and process conditions optimization;
  - bioliq® process configuration successfully verified;
  - Fuels tested positively
- Lessons for other project: Pilot projects need sufficiently long life time for construction, commissioning, start-up operation and operation. Budget need to be planned accordingly.

Examplary case studies

Sunliquid® | Clariant

The demonstration plant sunliquid ® cellulosic ethanol plant in Germany (© Clariant)

The first commercial sunliquid ® cellulosic ethanol plant in Romania (© Clariant)

<2006
Laboratory development

2008
Pilot plant in Munich, Germany

2012
Demonstration plant in Straubing, Germany

2018
Beginning construction of first commercial plant

2019>
Commercialization technology licenses

2021
Finalization of constrution of first sunliquid cellulisic ethanol plant

Examplary case studies

Sunliquid® | Clariant

- Development of cellulosic ethanol technology from research in microorganisms and enzymes and further scale-up of process;
- Pilot plant constructed in Planegg;
- Demonstration facility in Straubing with capacity of 1 kt/y cellulosic ethanol in operation since 2012;
- Production of enzymes on-site, test of diverse feedstocks within the demonstration facility;
- Completion of building first-of-a-kind in Romania in 10/2021 and commissioning;
- Focus in selling licenses of its technology, other facilities planned in Europe and in China
- Driving factors for success:
  - Funding to projects focusing the technology development with industry/research
  - Policies focused in GHG reductions targets (e.g. REDII, perspective REDIII)
  - Expertise from institutions in the process development

Conclusion

- Massive gap between trends in transport and targets
- Regulatory frame with a strong impact on market development and competiviness between fuel options
- GHG mitigation in transport mainly based on conventional biofuels with increasing shares on residues as feedstocks
- GHG quota as instrument with good success: increased GHG mitigation at similar fuel amonts
- Role of biofuels until 2030 highly depend on development of fullfilling options for GHG quota
- Examples for liquid advanced biofuels

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