



De rol van biobrandstoffen in de bio-based economy

*Ric Hoefnagels, Copernicus Institute of Sustainable
Development, Universiteit Utrecht*

Landelijk Biobased Kennisnetwerk: Energietransitie: de rol van biobrandstoffen
13 juni 2018, Aeres Hogeschool Dronten

The Copernicus Institute of Sustainable Development

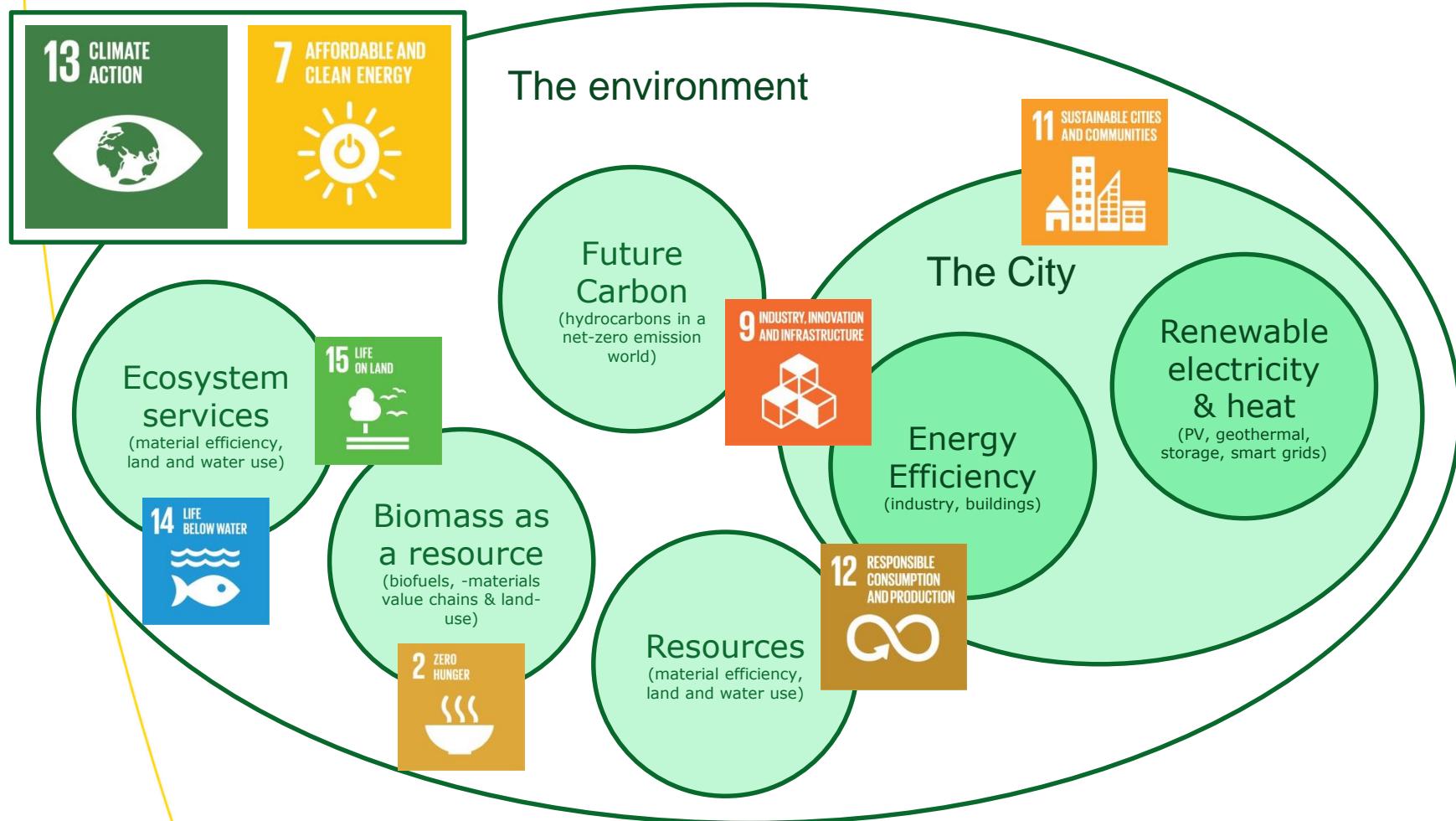
is the scientific institute for sustainability research and teaching of Utrecht University. We contribute to the transition to a sustainable society through scientific excellence in a multi-disciplinary environment.

We work in multi-disciplinary teams of four research groups:

- **Energy and Resources**
- Environmental Governance
- Environmental Sciences
- Innovation Studies



Topics within Energy & Resources



The BioBased Economy cluster

BBE cluster leader: Prof. Dr. Martin Junginger

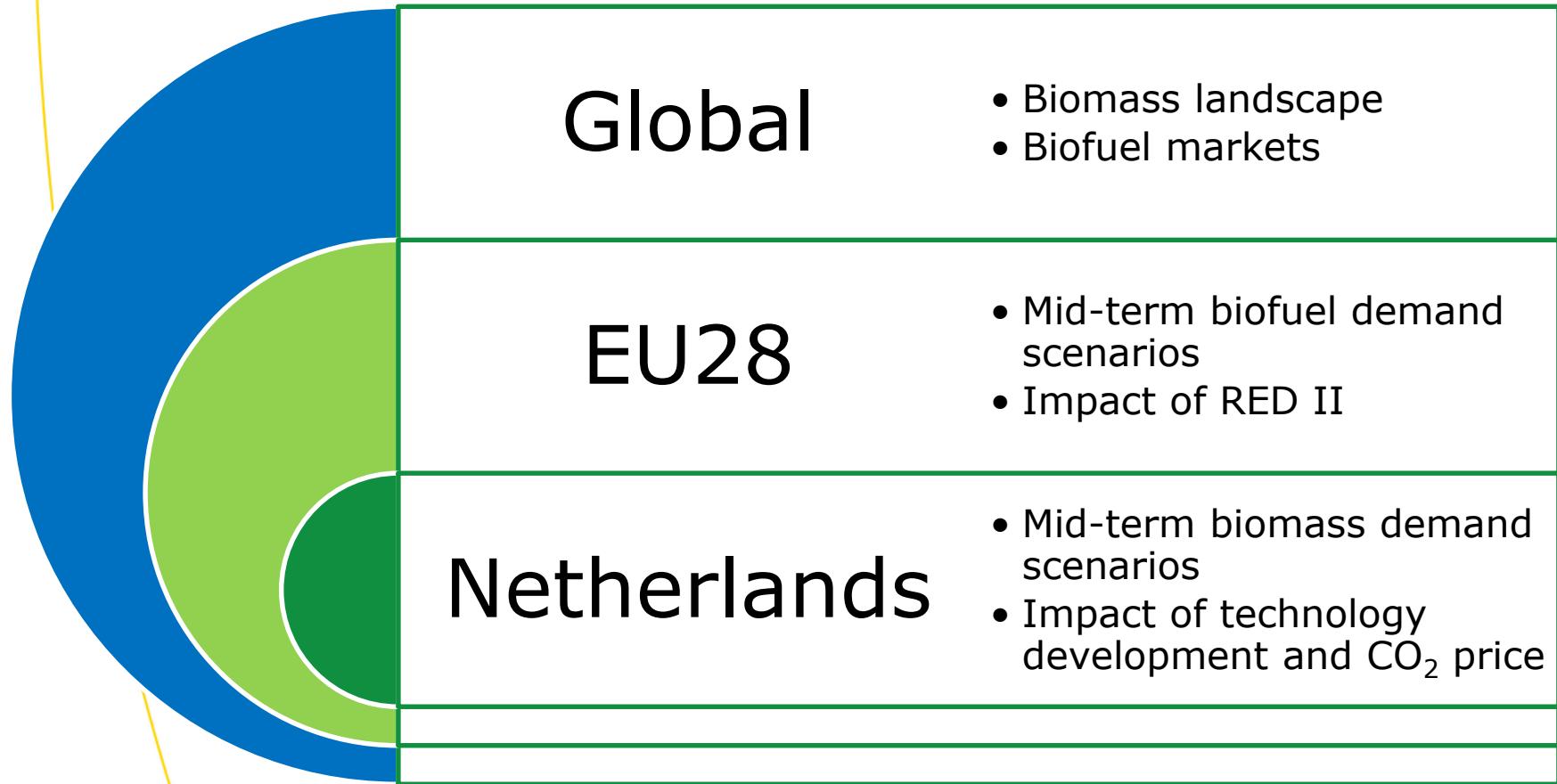
Senior researchers: Dr. Birka Wicke, Dr. Blanca Corona Bellostas, Dr. Floor van Hilst, Dr. Ioanna Mouratiadou, Dr. Iris Vural-Gursel, Dr. Li Shen, Dr. Marc Londo, Dr. Ric Hoefnagels



And about 15 PhD students & junior researchers

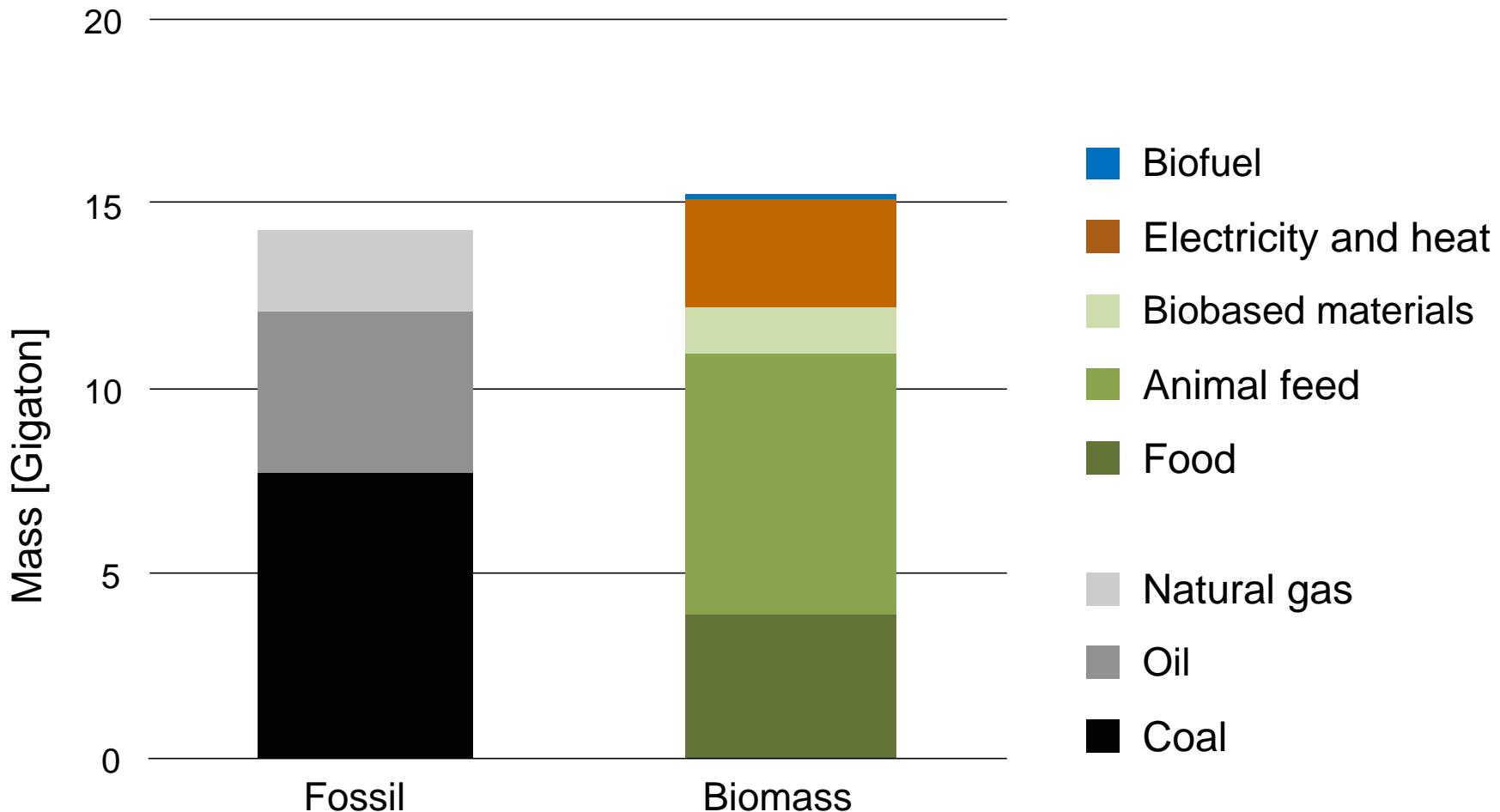


Contents





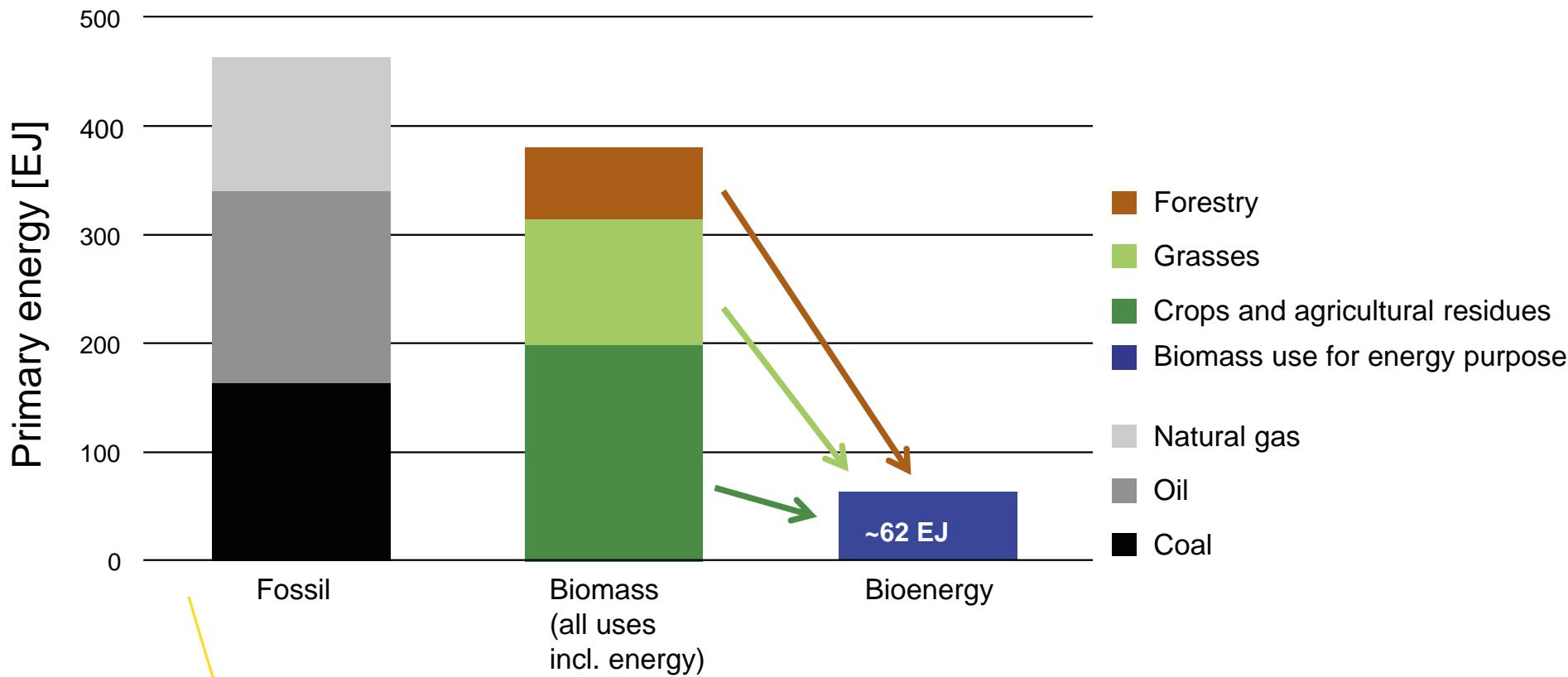
Global consumption of fossil energy and biomass [Mass basis]



Source: Martin Junginger, Naar een bio-based economy: tussen panacee en pandemonium (8 September 2017)



Global consumption of fossil energy and biomass [Energy basis]



Source: Martin Junginger, Naar een bio-based economy: tussen panacee en pandemonium (8 September 2017)
Bioenergy: REN21 (2017)



Global land use

29% land
149 million km²

71% sea
361 million km²

71% Habitable land
104 million km²

29% deserts,
glaciers, mountains etc.
43 million km²

50% Agriculture
52 million km²

34% (semi-)
natural forest
36 million km²

1% Urban +
1% Freshwater
2 million km²

3% plantations
3.4 million km²

11% marginal land
12 million km²

77% meat & diary
40 million km²

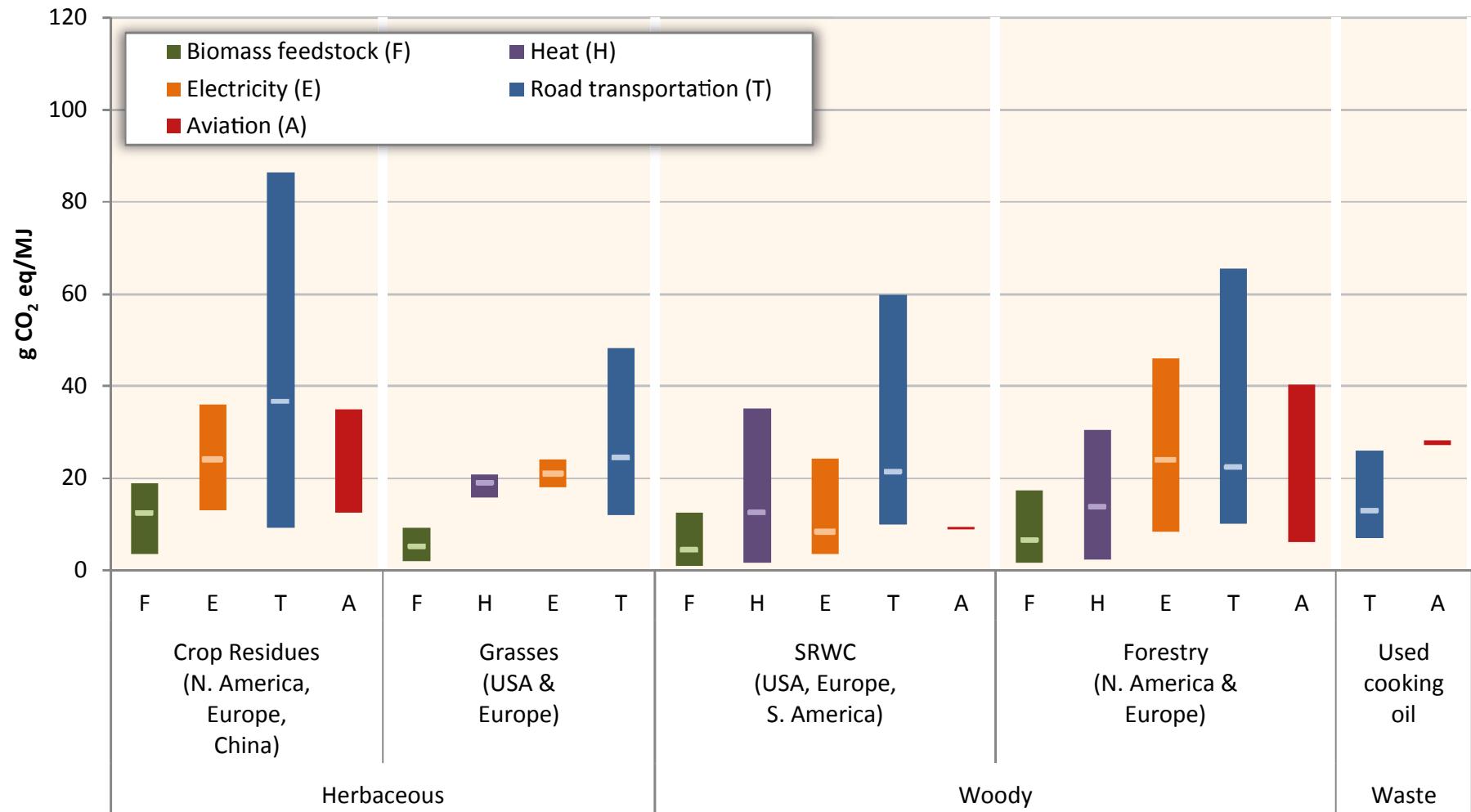
23% other food
(grains, vegetables, vegetable oils, etc.)
12 million km²

<1% Liquid biofuels
0.24-0.3 million km²

Source: Martin Junginger, Naar een bio-based economy: tussen panacee en pandemonium (8 September 2017)



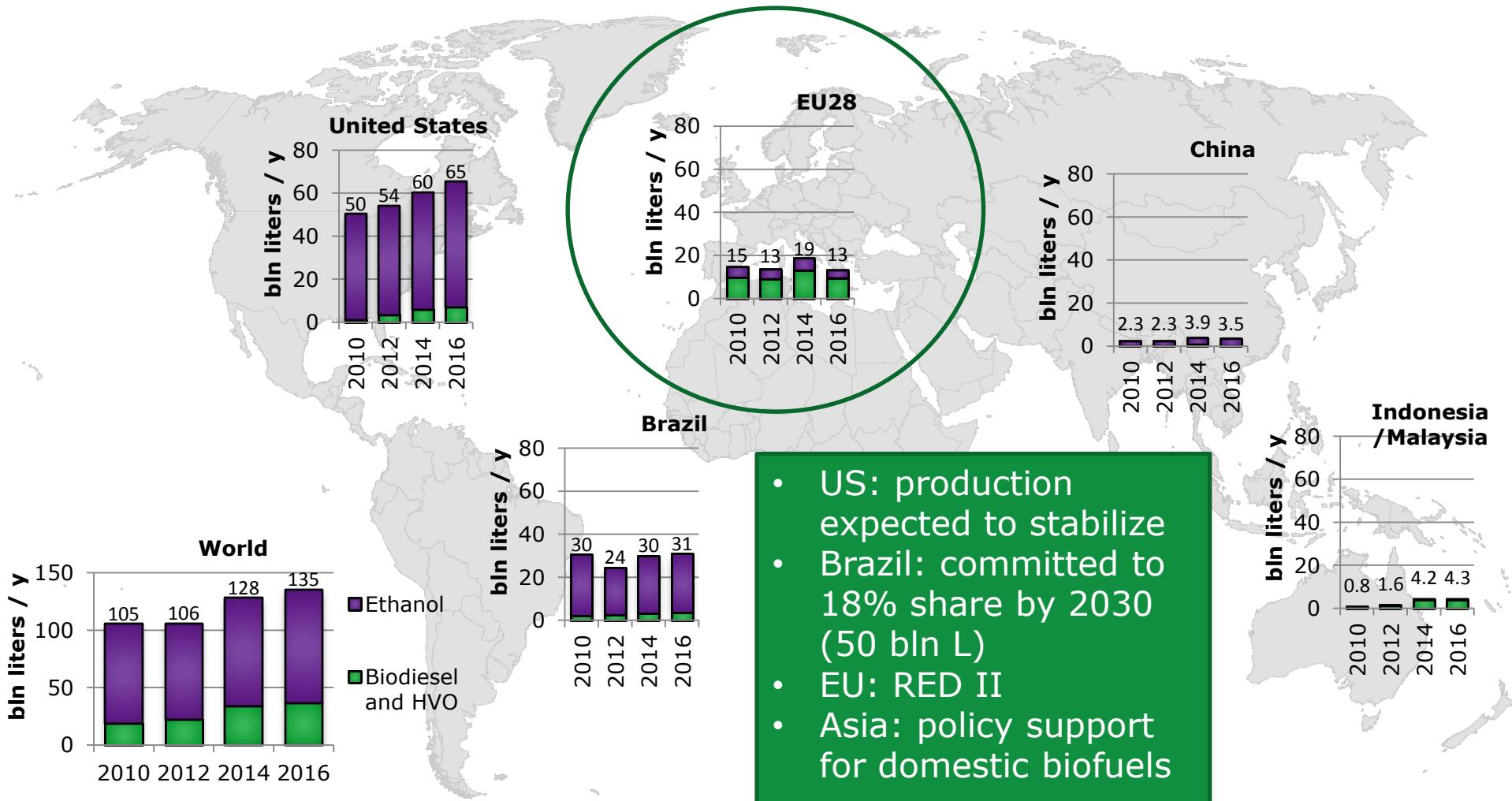
Variation in GHG emissions of biofuel production systems



Attributional, excl. market mediated effects

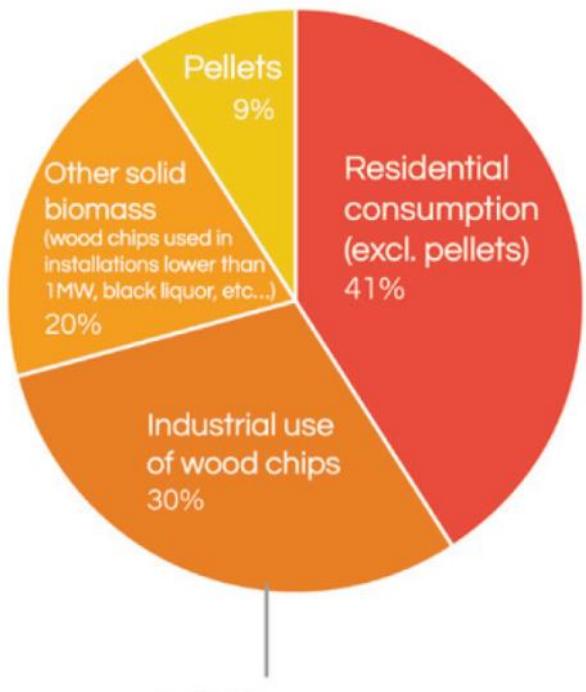


Global: biofuel production and key production regions

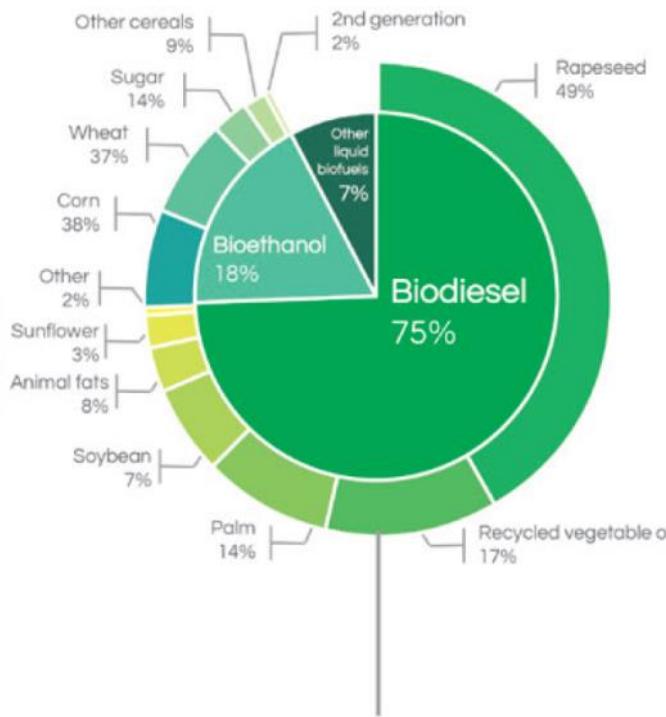




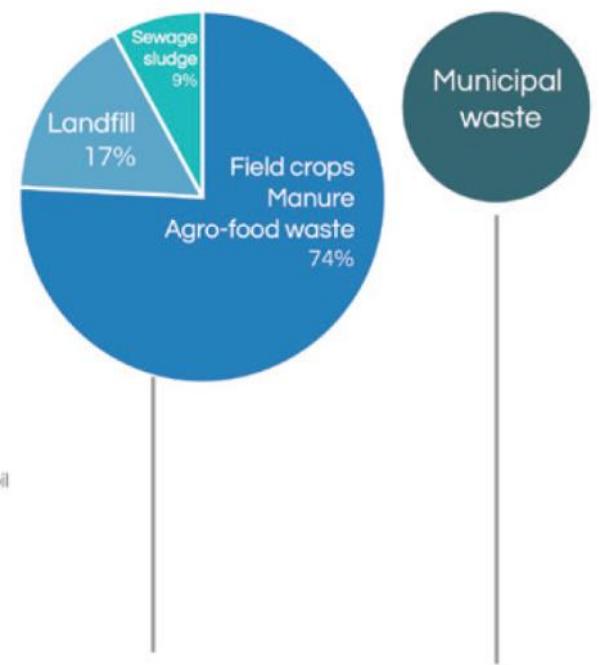
EU: Bioenergy landscape (2015)



(95.285 ktoe)



(15.482 ktoe)



(15.612 ktoe)



(9.690 ktoe)

Source: AEBIOM, EPC, Eurostat, USDA

(136.204 ktoe)



EU: a revised energy directive RED-I

Targets

- 10% biofuels in 2020,
applying to each MS
- 0.5% voluntary target
advanced biofuels

Caps

- 7% on food-based
biofuels

Sectors

(In the nominator)

- Road and rail

GHG threshold

- - 50%
- - 60% post 2015
installations
- Fossil fuel: 83.8 CO_{2eq}/MJ

RED-II

(proposal)

- 1.7→6.8% for cat. 1-5
fuels, *applying EU-wide*
- Subtarget: 0.5→3.6% for
cat-1 (advanced) biofuels)

- 7.0→3.8% for cat-6
(food-based) biofuels
- 1.7% for cat-2 fuels

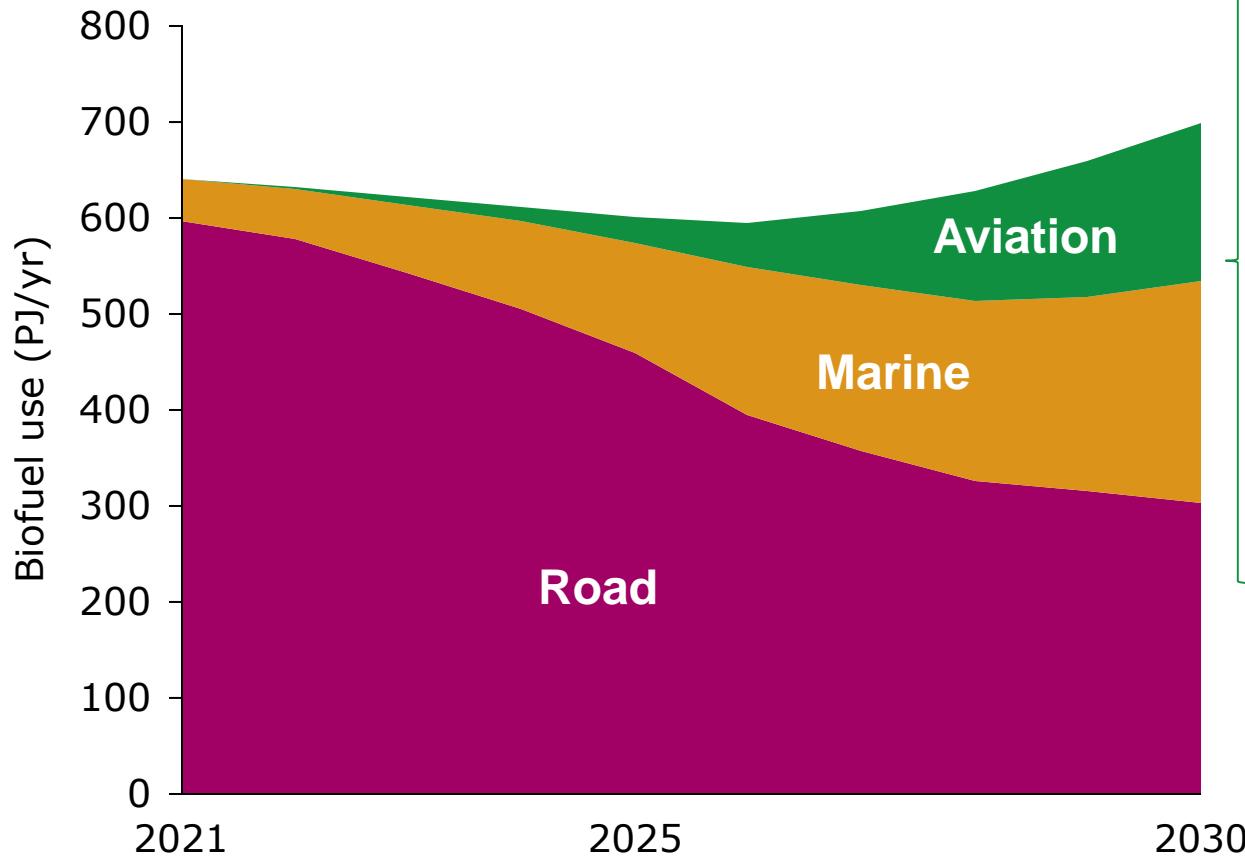
- Road, rail
- Aviation and marine with
a 1.2 multiplier

- -50% for pre-2015,
- -60% for post 2015
- -70% for post 2021
- Fossil fuel: 94 CO_{2eq}/MJ
(iLUC factors remain the same)



EU: Biofuel use projections in transport sector 2021-2030

Marine and aviation biofuels driven by multiplier and cost of fossil fuels (jet-A, marine gasoil)



Implications in 2030

- ▶ 160-260 PJ (3.8-6.1 Mt) RJF
- ▶ 6-9% of total EU jet fuel consumption
- ▶ 12-19 Mt CO₂-eq reductions

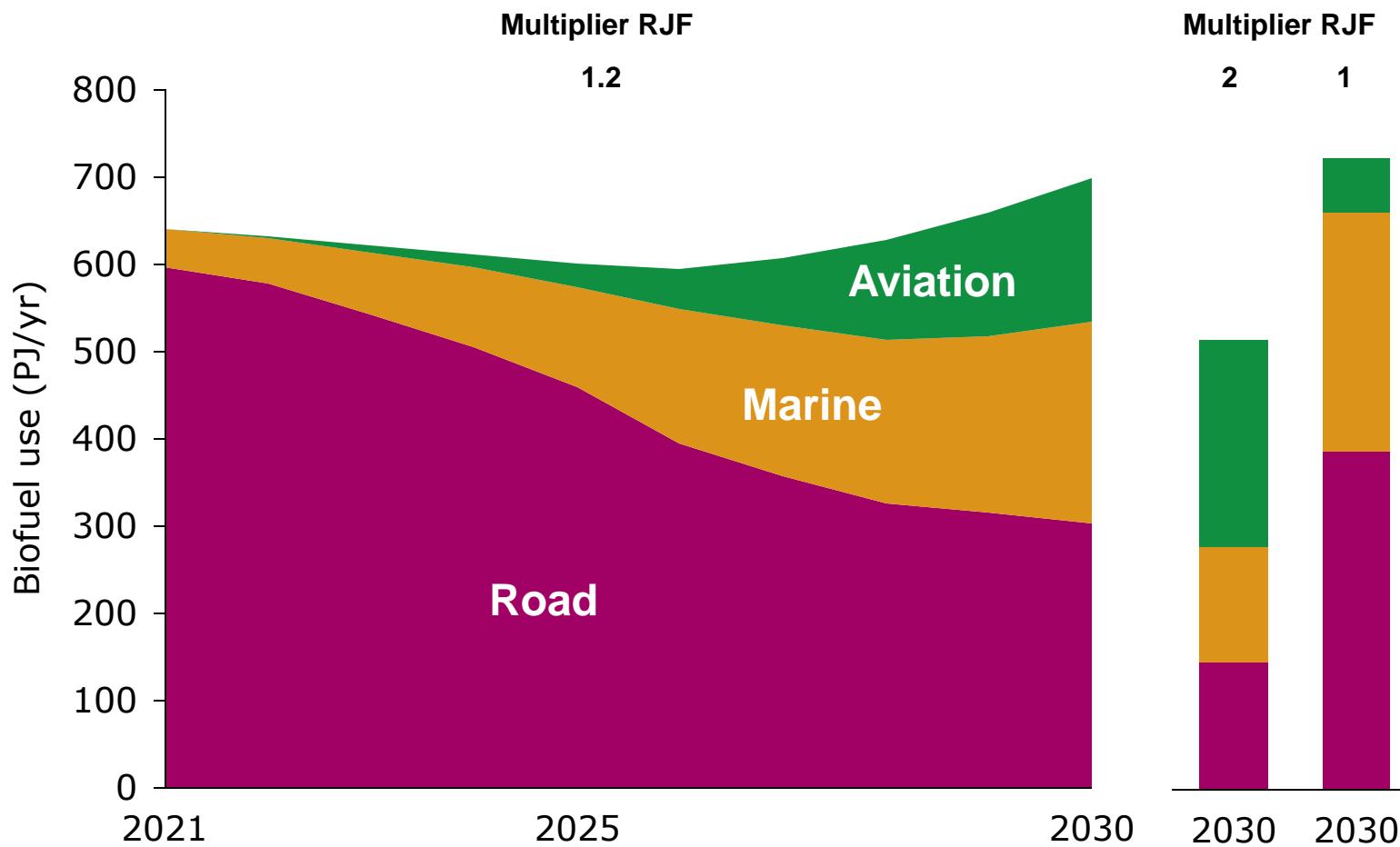
Additional cost RJF over 2021-2030

- ▶ 7.7-11 B€ over 10 years
- ▶ 1.0-1.4 €/departing intra-EU passenger



EU: The multiplier mechanism affects the distribution among end use sectors and the total biofuel production

Biofuel use projections in EU transport sector 2021-2030

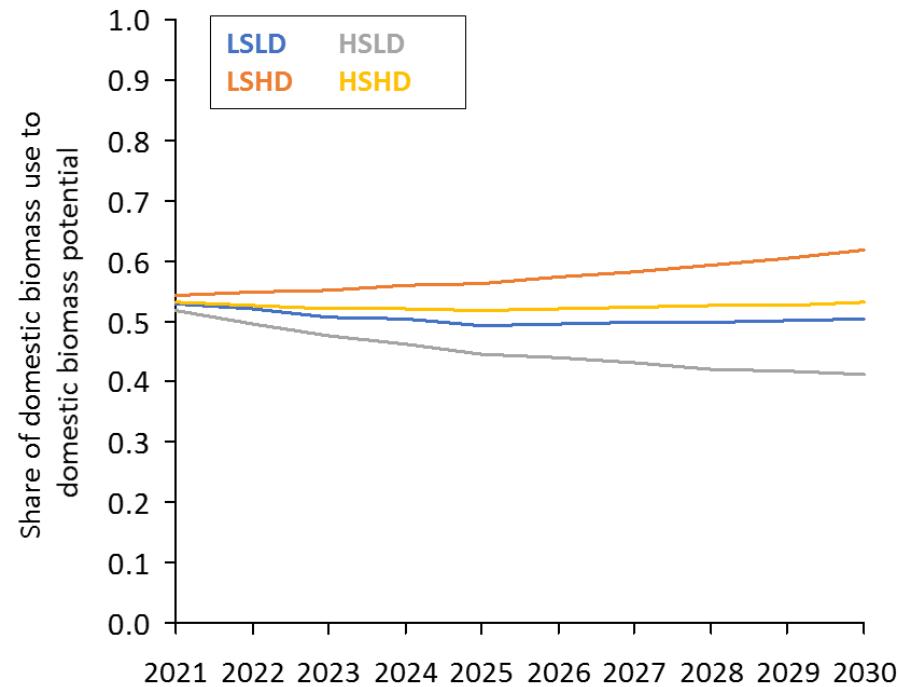


Forthcoming publication: De Jong et al. (2018), please do not cite, as preliminary



EU: biofuel imports could still grow substantially

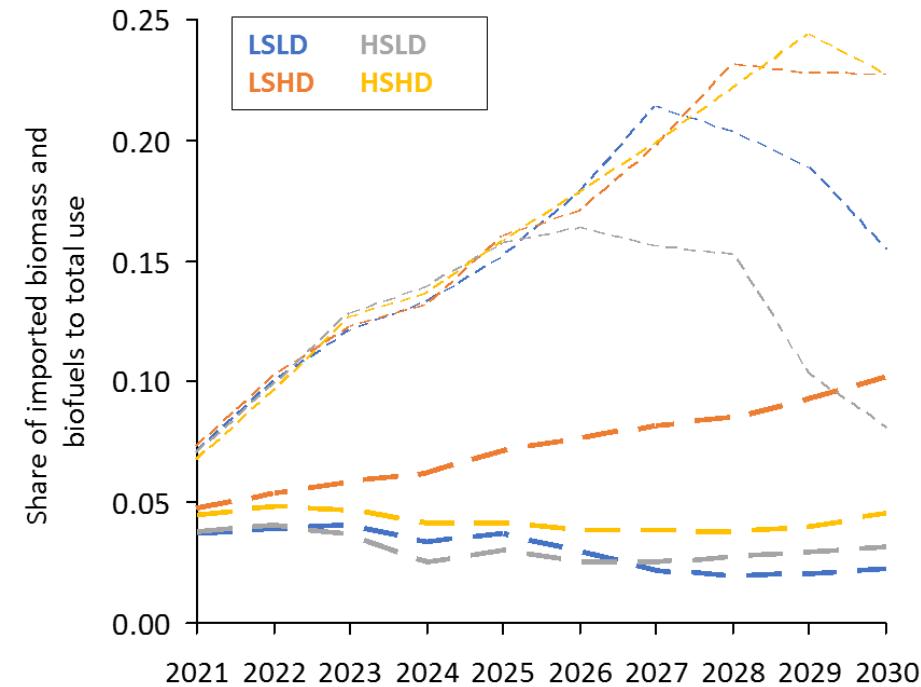
Domestic biomass



— Domestic biomass use to domestic biomass potential

De Jong et al. (2018)

Imported biomass and imported biofuel



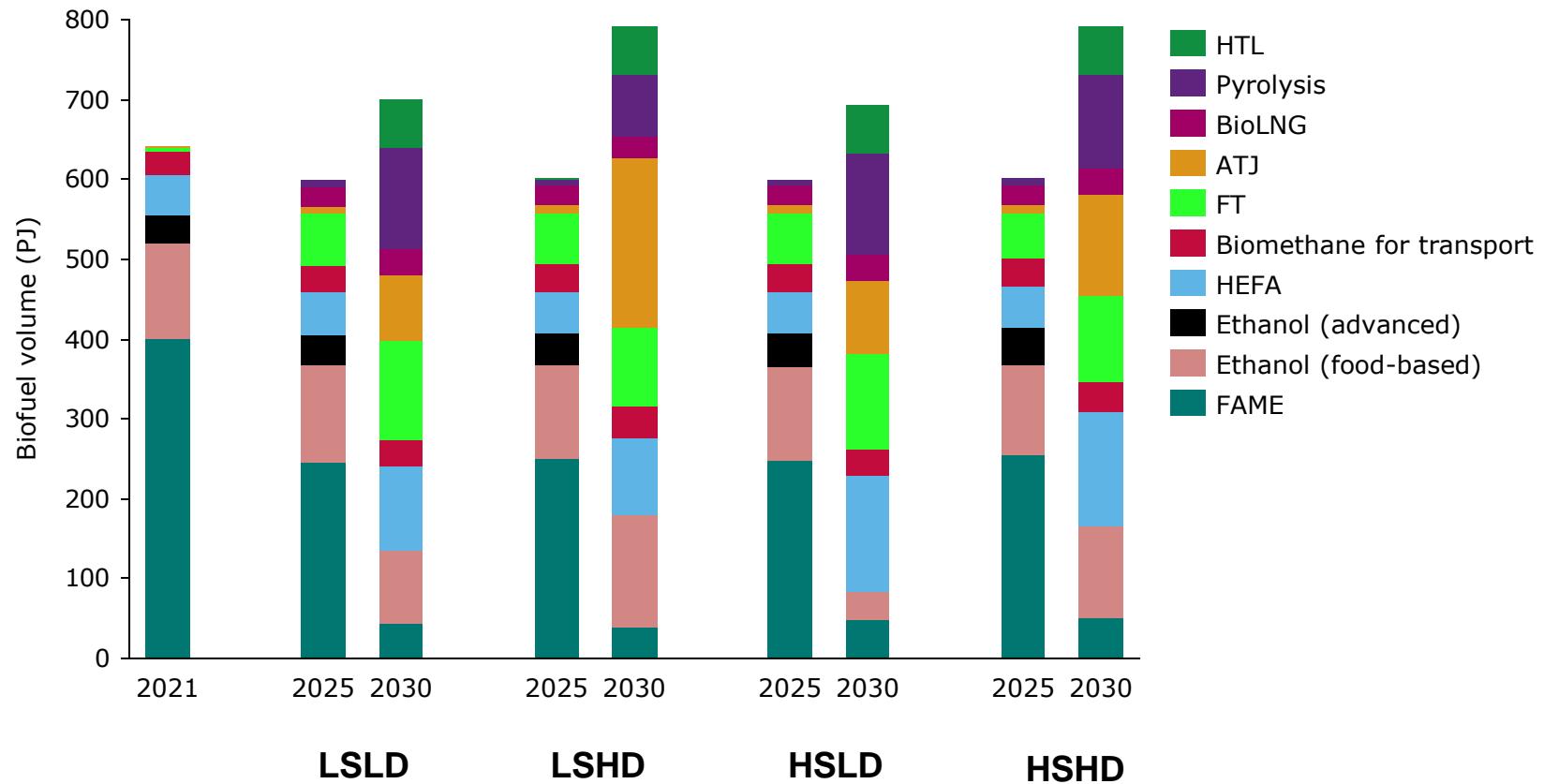
— Share of imported biomass to biomass use

--- Share of imported biofuel to biofuel use

Biofuel imports could increase up to 25% of gross inland consumption



EU: Biofuel mix by conversion technology and feedstock type

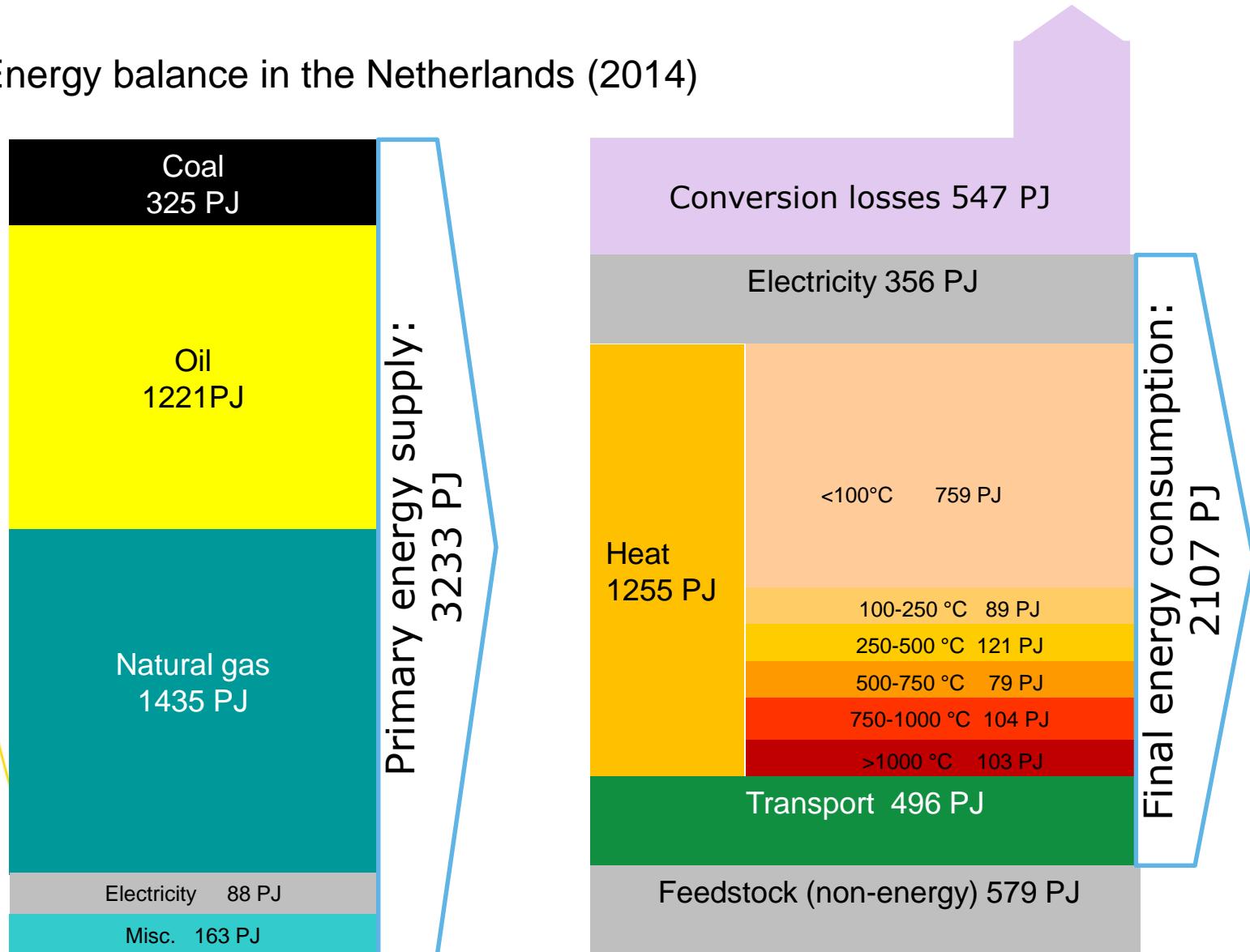


De Jong et al. (2018)



Challenging sectors to decarbonise

Energy balance in the Netherlands (2014)





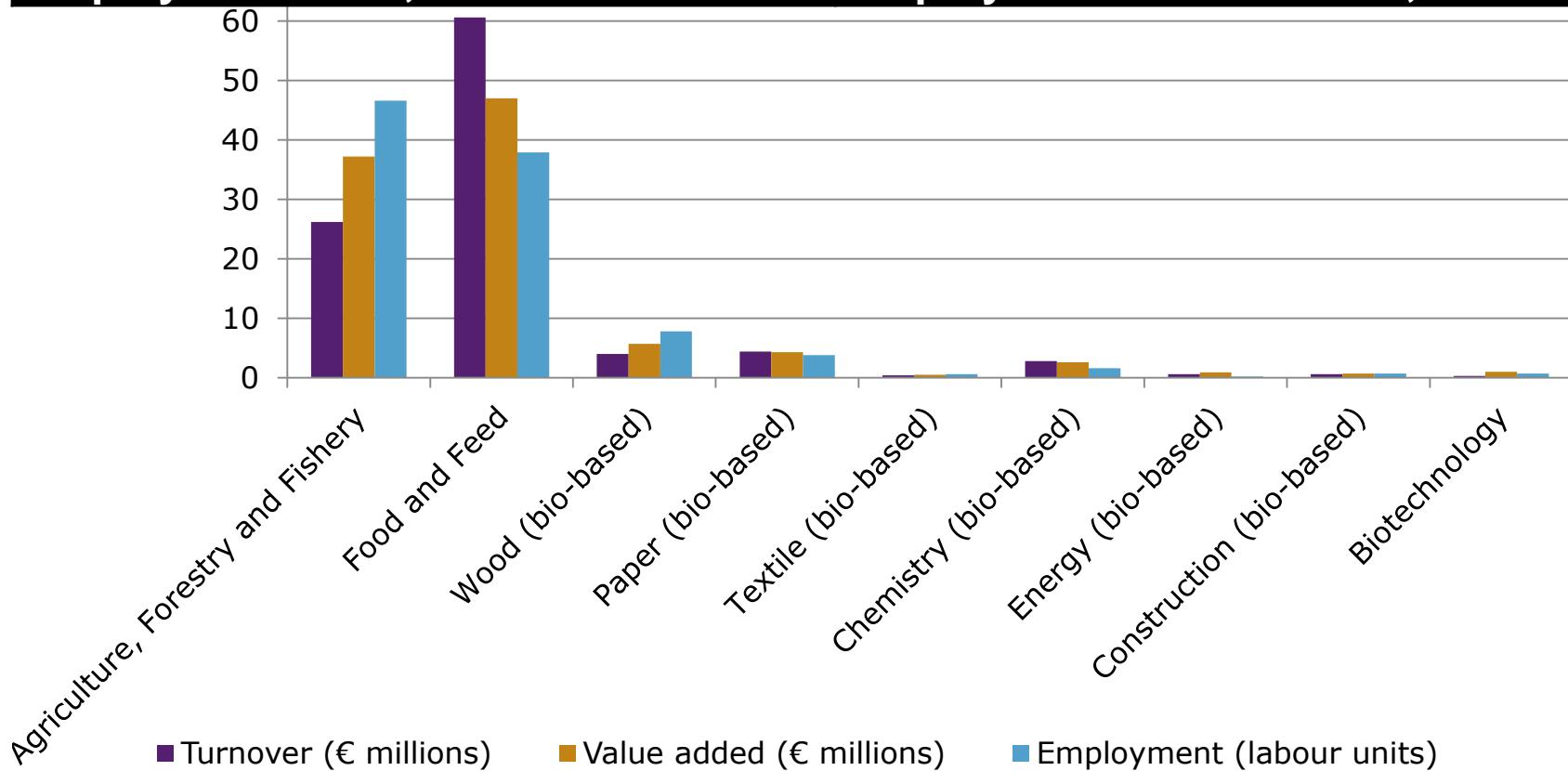
The Dutch bio-based economy in 2013

Direct share total bioeconomy in total economy 2013

Turnover: 7,7%
Value added: 4,9%
Employment: 4,9%

Indirect share total bioeconomy in total economy in 2013

Turnover: 12%
Value added: 9,5%
Employment: 9,8%





The future of the Dutch bio-based economy

Macroeconomic outlook of sustainable biorenewables innovations in the Netherlands

This is a publication of TKI-BBE /BE-Basic



Universiteit Utrecht



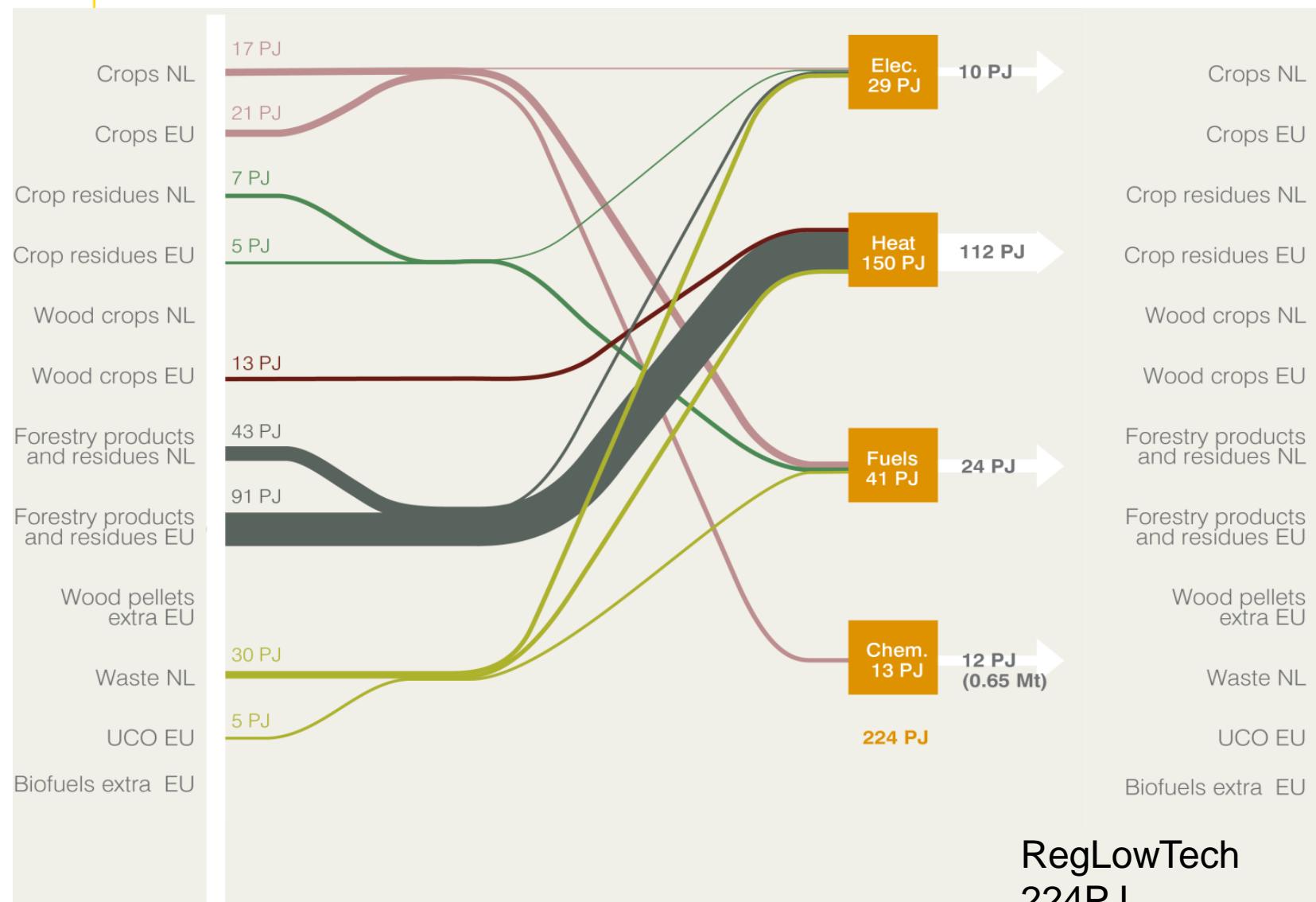


Future outlook

- Macro-economic outlook of sustainable energy and biorenewables innovations (MEV II)
- Biobased economy scenarios for the Netherlands to 2030
- **RegLowTech:** slow rate of technology development, limited to intra-EU biomass imports
- **GlobHighTech:** high rate of technology development, intra-EU and extra-EU imports of biomass
- **-NP:** CO₂ price 26 €/tonne CO₂ (IEA New Policies Scenario)
- **- 450:** CO₂ price 69 €/tonne CO₂ (IEA 450 Scenario)



RegLowTech-NP, 2030

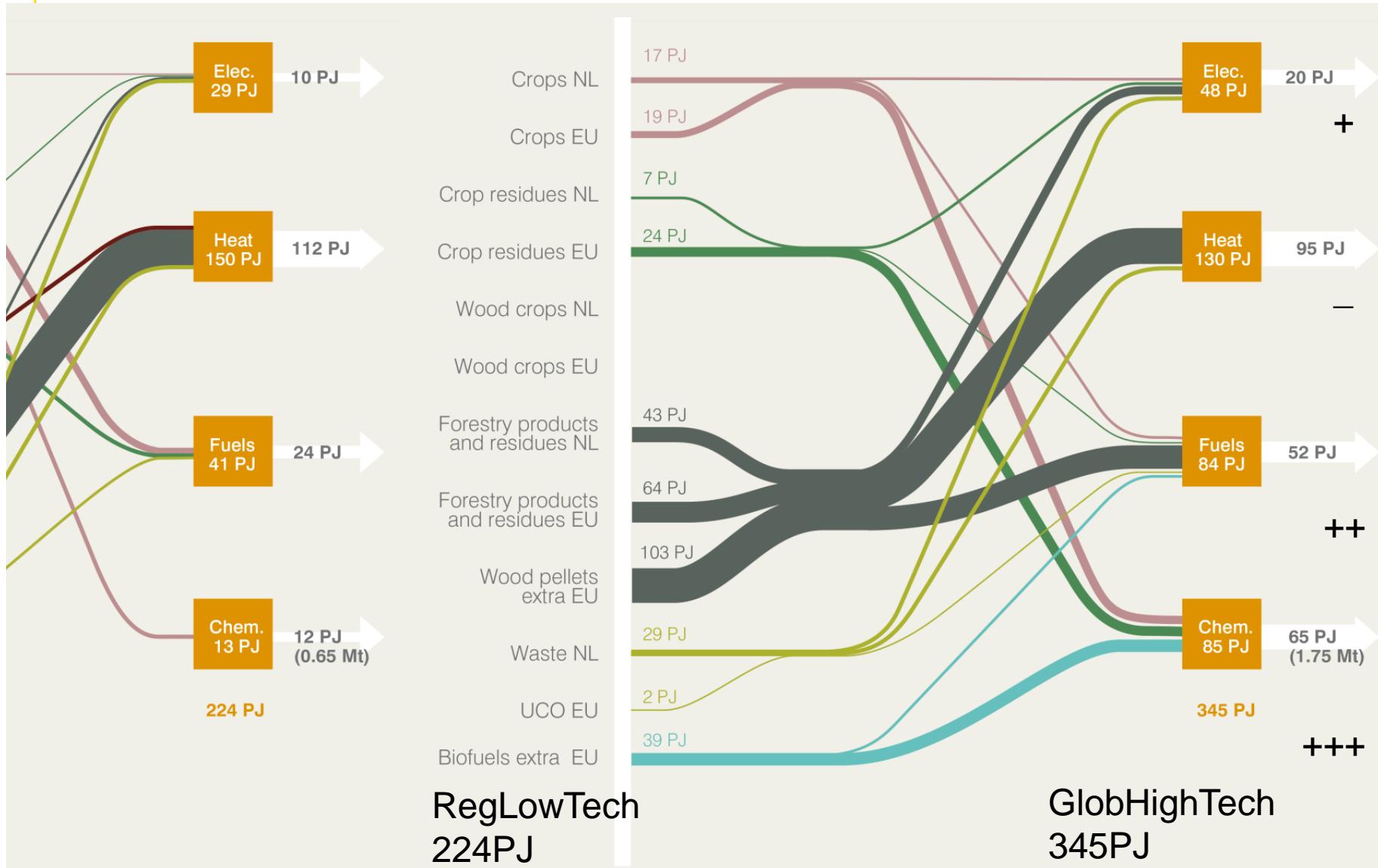


RegLowTech
224PJ

Macro-economic outlook of sustainable energy and biorenewables innovations (MEV II)



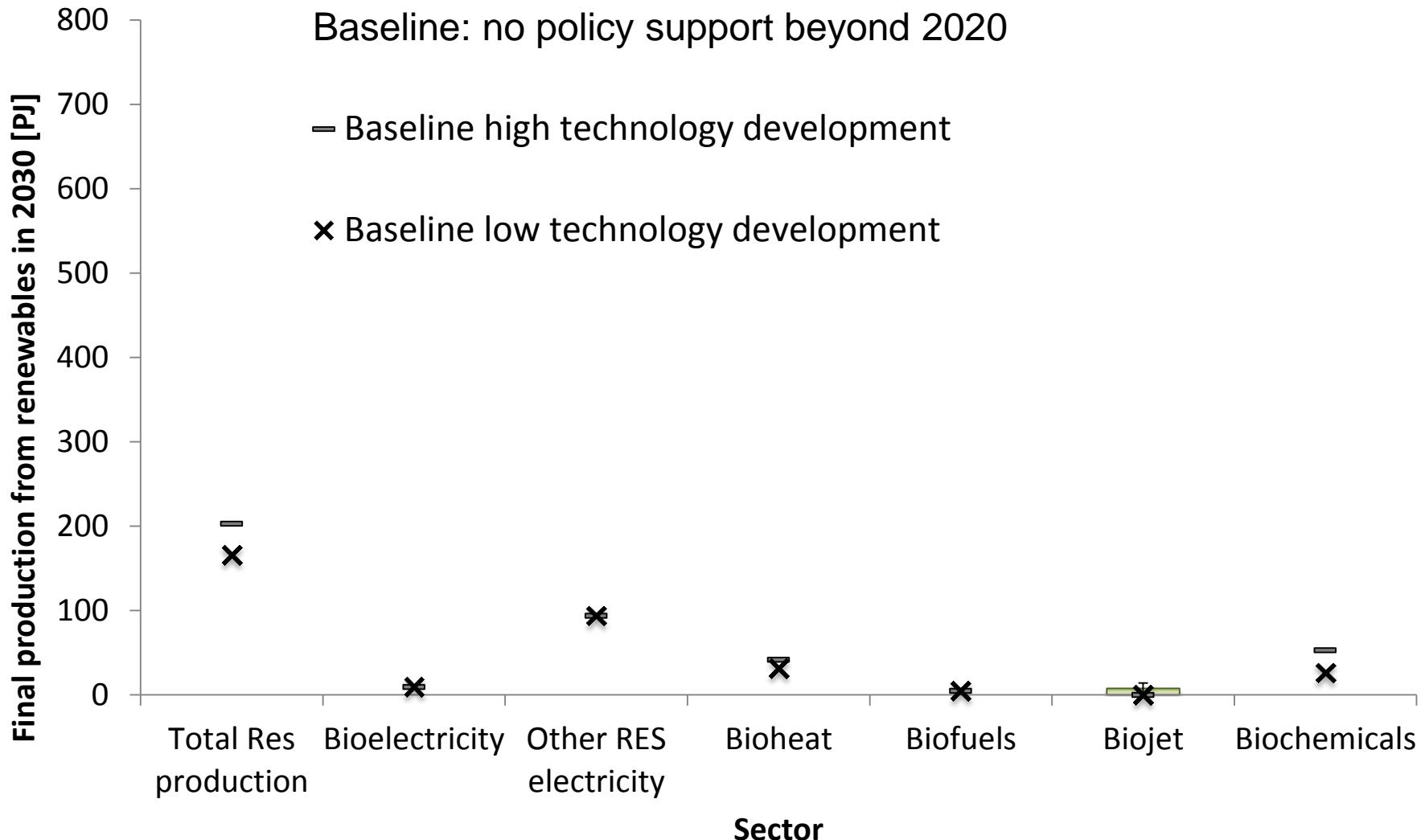
GlobHighTech-NP, 2030



Macro-economic outlook of sustainable energy and biorenewables innovations (MEV II)

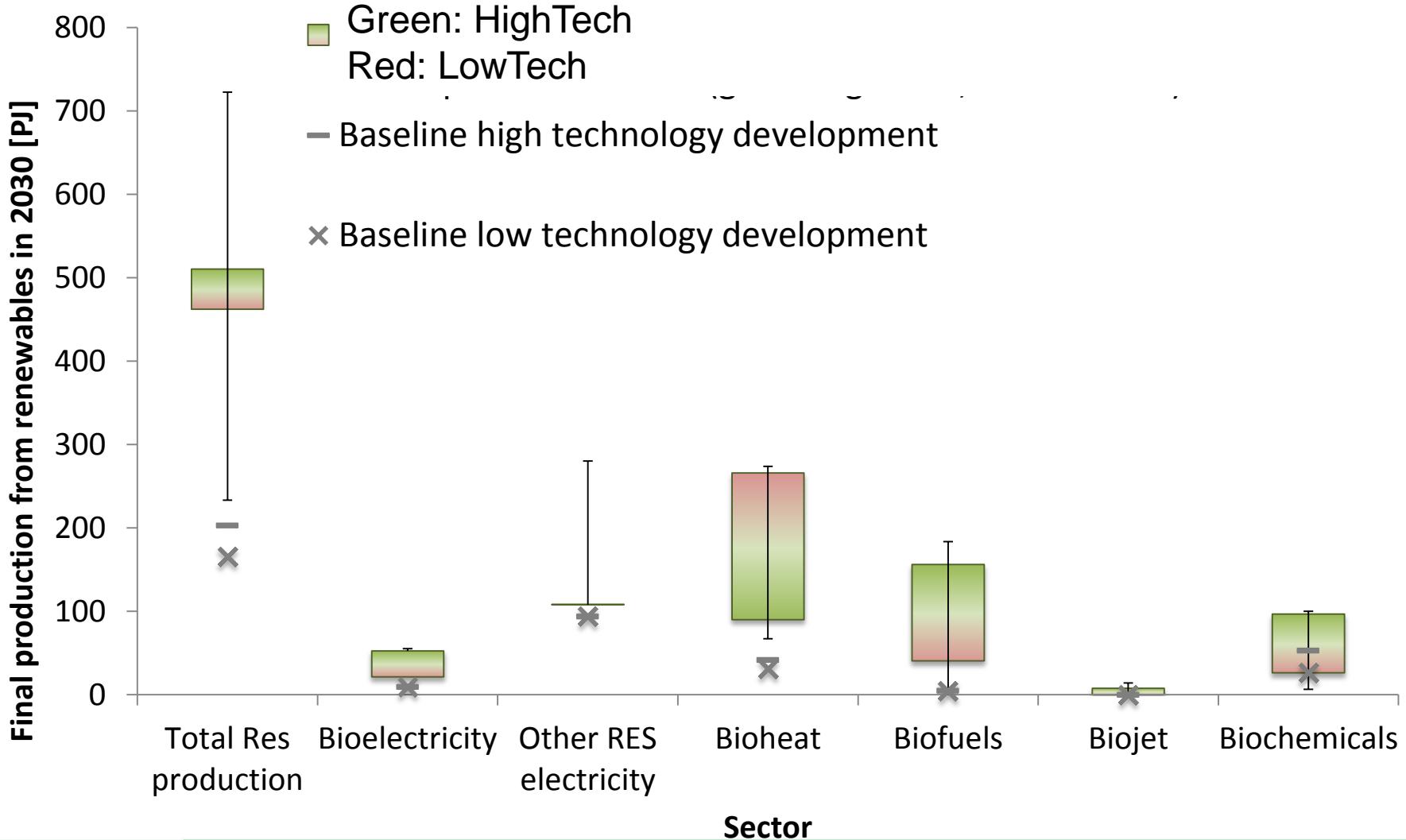


Without policy support, biobased sectors will decline



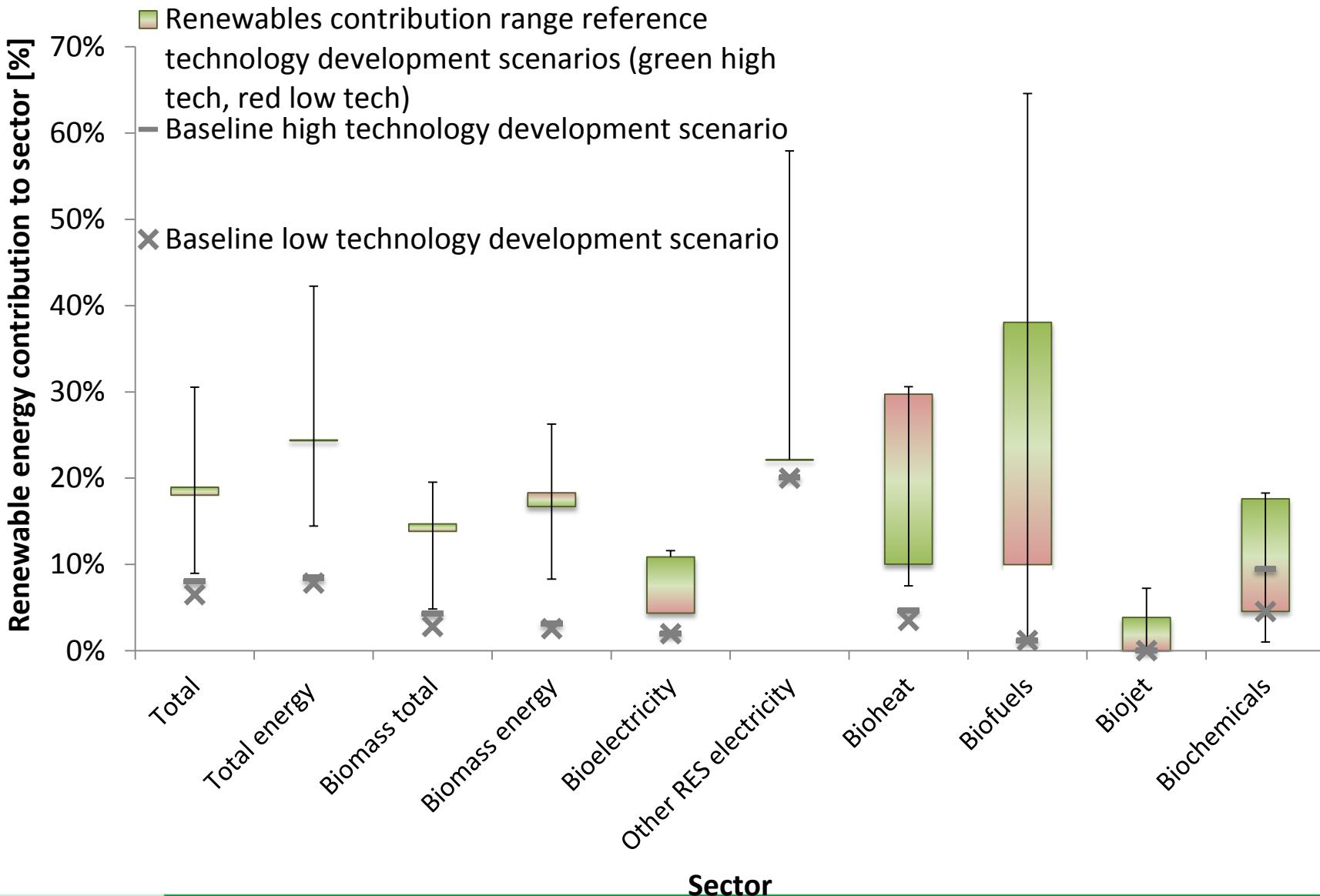


Final biomass consumption in the 450 scenarios (69 €/tonne CO₂)



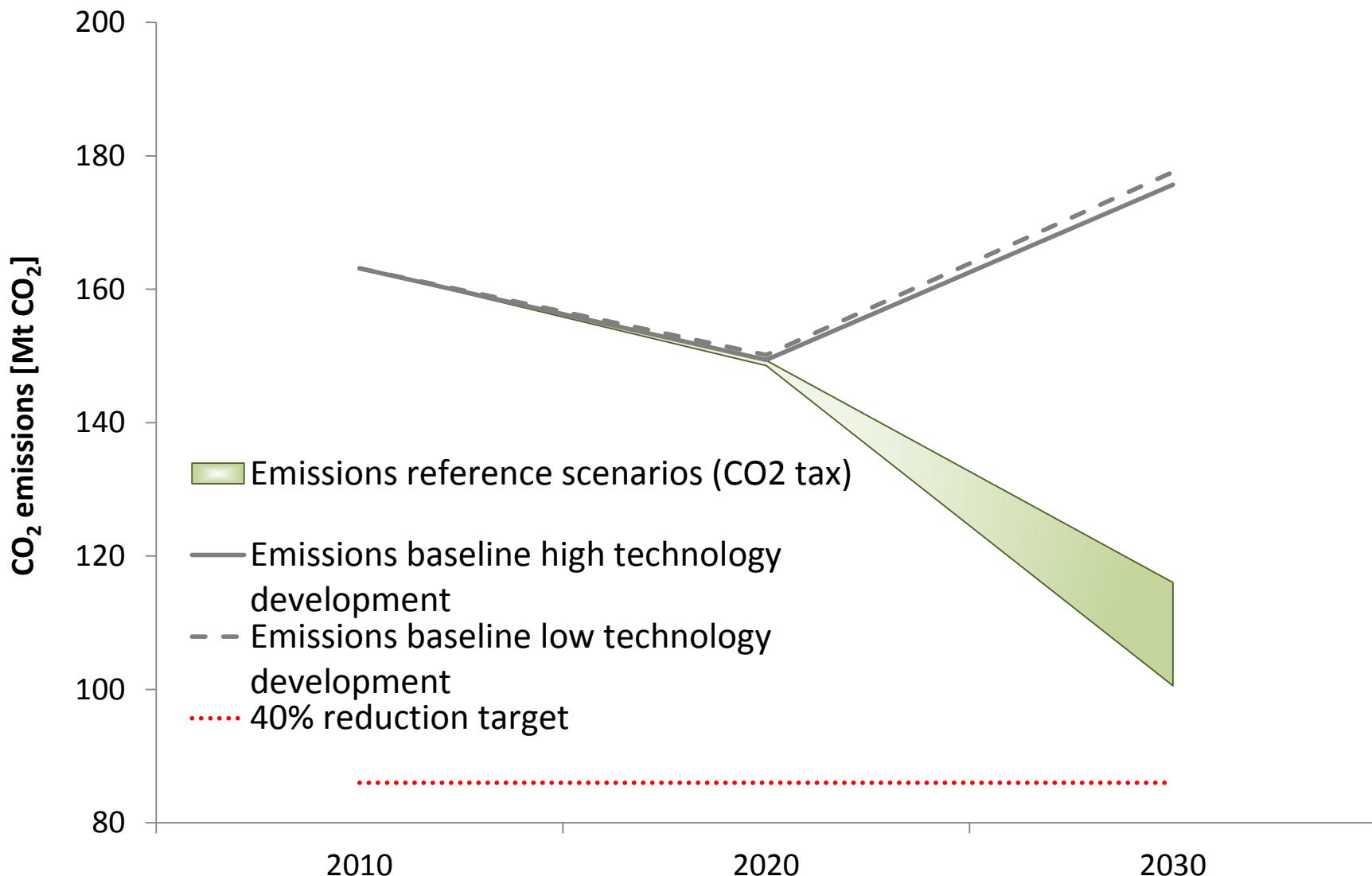


RES share per sector in the 450 scenarios



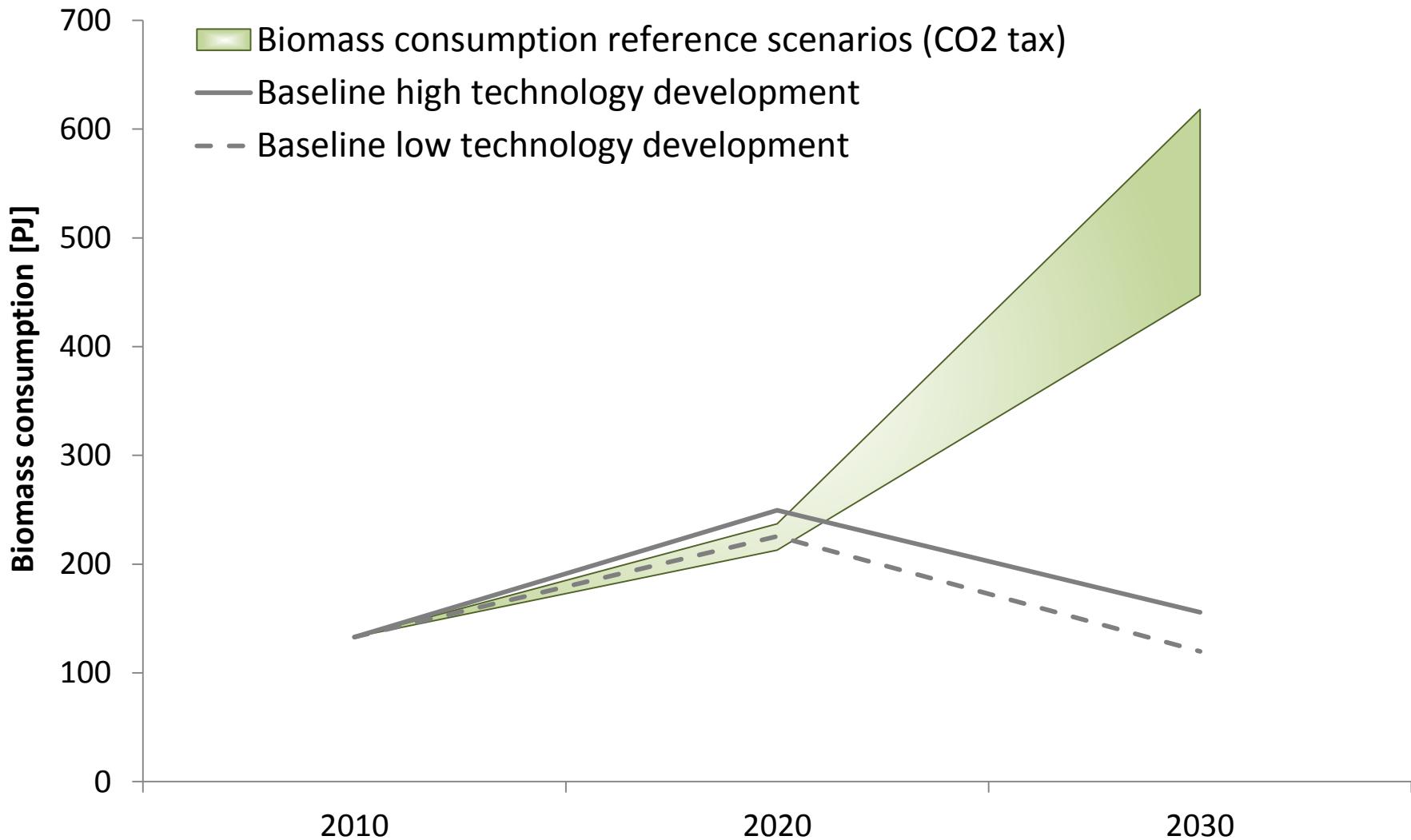


CO₂ emissions (excl. agriculture, other GHG emissions), 450 scen.





Biomass consumption, 450 scen.





Conclusion

- Low carbon liquid transportation will be needed still for many decades to meet long term climate targets and play a central role in sectors that have little alternatives for decarbonisation on the longer term including heavy duty transport, aviation and shipping.
- In the Netherlands, significant volumes of biobased chemicals could be produced by 2030 (5-20%), but remains uncertain (delayed retirement of steam cracker capacity, low fossil fuel prices and declined demand could reduce production substantially).
- Under enhanced technology development scenarios, renewable jet fuels and BECCS could become more prominent.



Thank you for your attention!

Ric Hoefnagels

Email: r.hoefnagels@uu.nl
Phone: +31-30-2537645

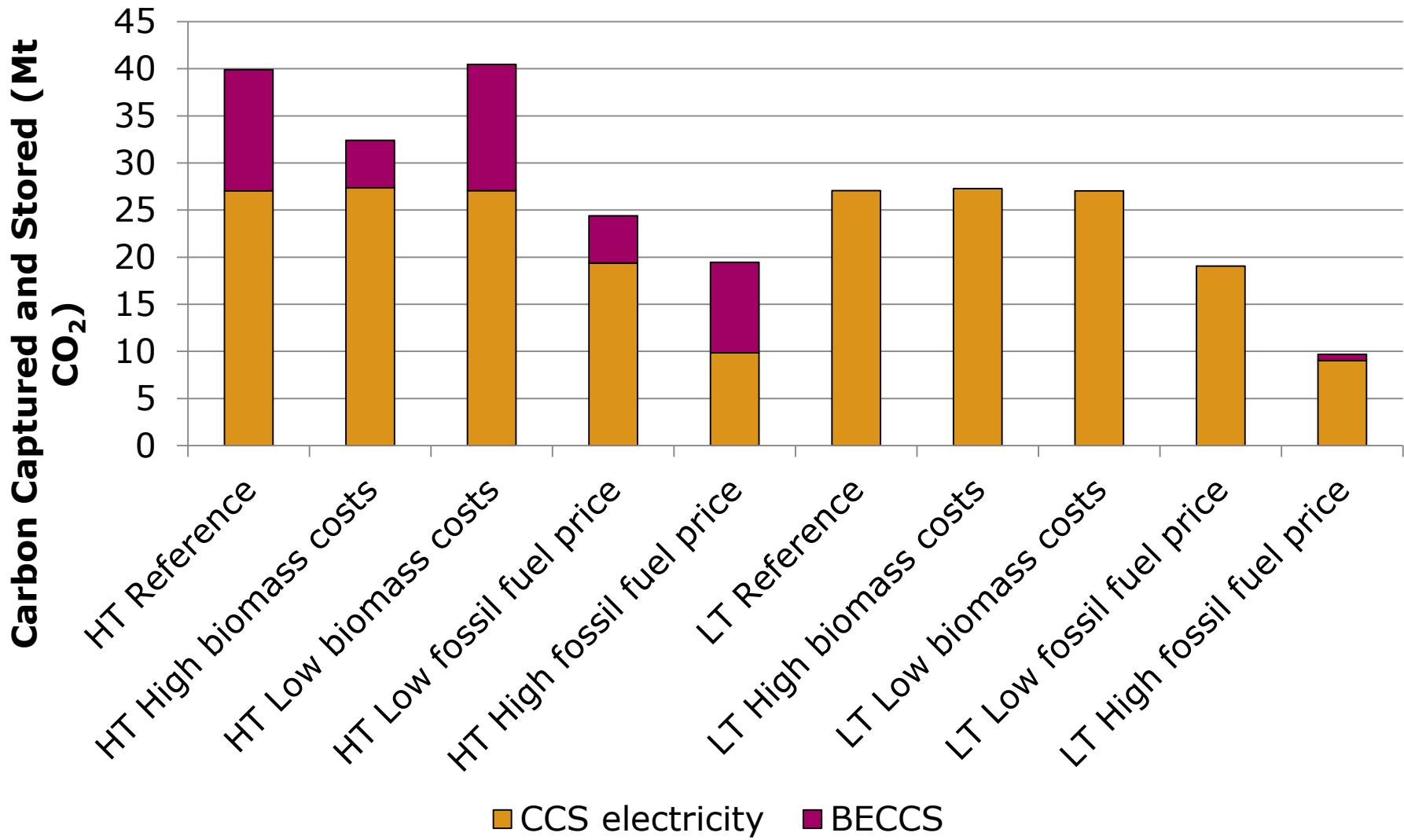
Copernicus Institute – Utrecht University

References

- de Jong, S., van Stralen, J., Londo, M., Hoefnagels, R., Faaij, A., & Junginger, M. **Renewable jet fuel supply scenarios in the European Union in 2021-2030 in the context of proposed biofuel policy and competing biomass demand.** GCB Bioenergy.Tsiropoulos, I., Hoefnagels, R., Broek, M., Patel, M. K., & Faaij, A. P. (2017). **The role of bioenergy and biochemicals in CO₂ mitigation through the energy system—a scenario analysis for the Netherlands.** Gcb Bioenergy, 9(9), 1489-1509.
- van Meijl, H., Tsiropoulos, I., Bartelings, H., Hoefnagels, R., Smeets, E., Tabeau, A., & Faaij, A. (2018). **On the macro-economic impact of bioenergy and biochemicals—Introducing advanced bioeconomy sectors into an economic modelling framework with a case study for the Netherlands.** Biomass and Bioenergy, 108, 381-397.

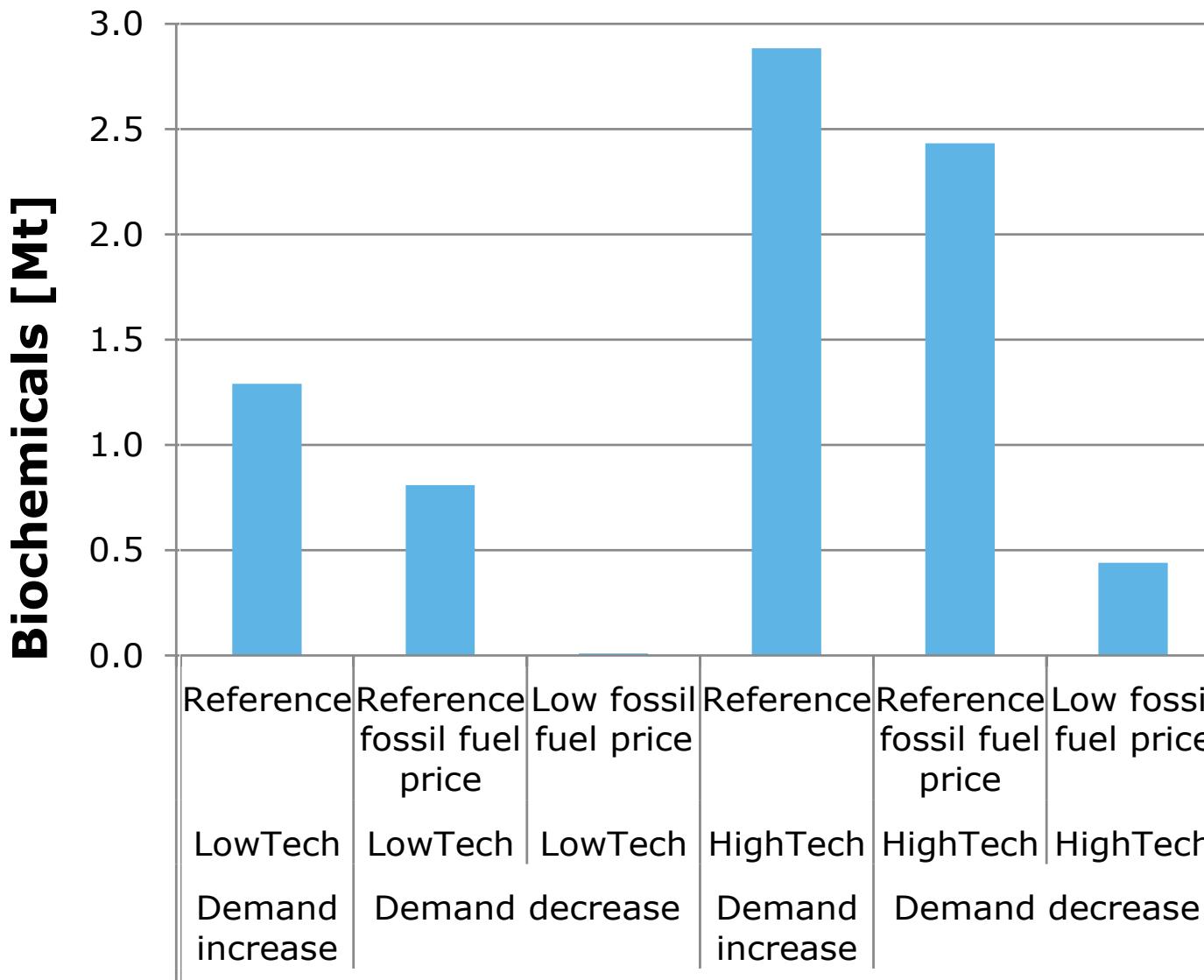


Carbon captured and stored (2030)





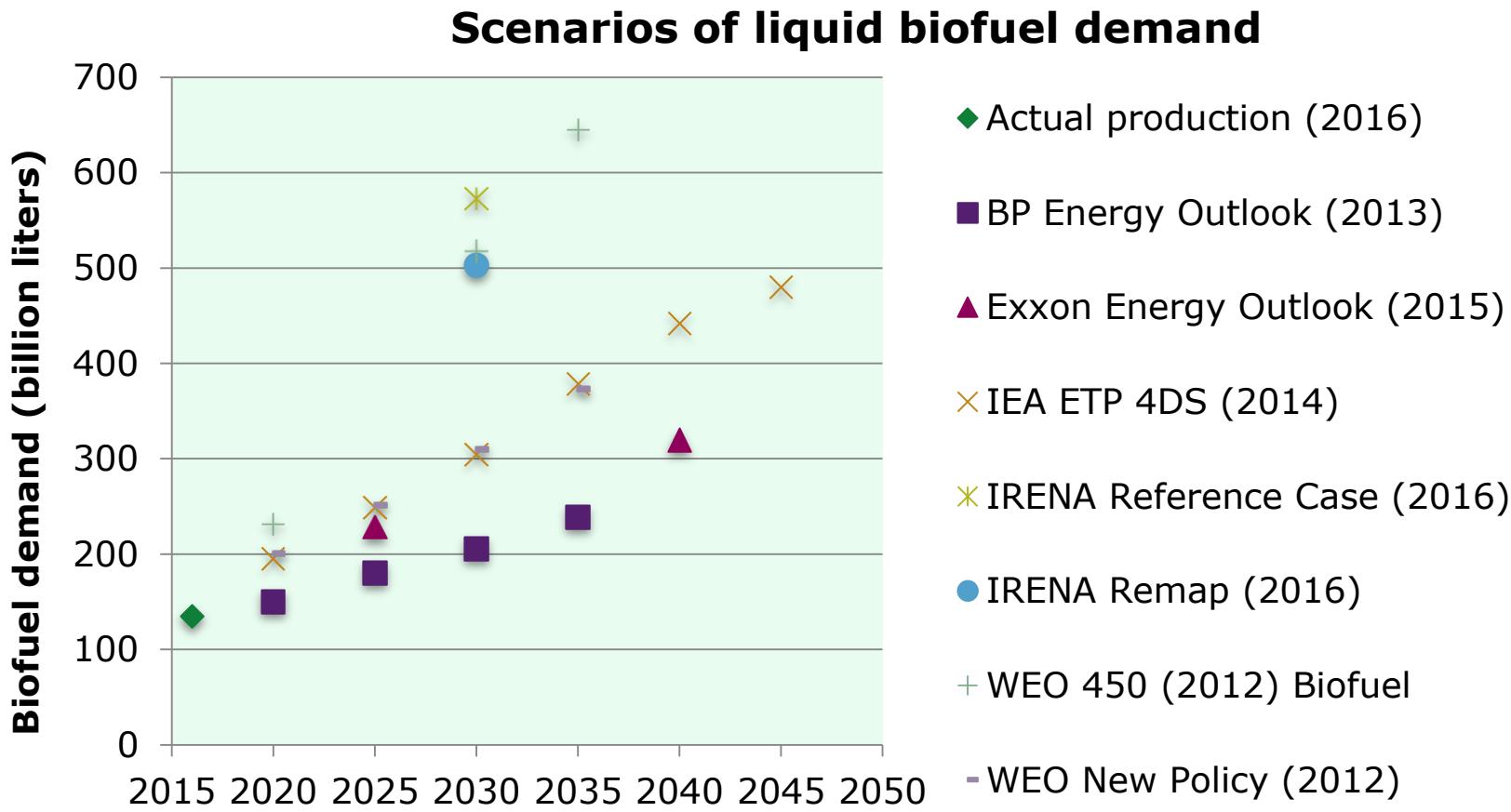
Biochemical output in the Netherlands (2030)





Global: future biofuel demand could still increase substantially

2035: 77-378% increase compared to 2016



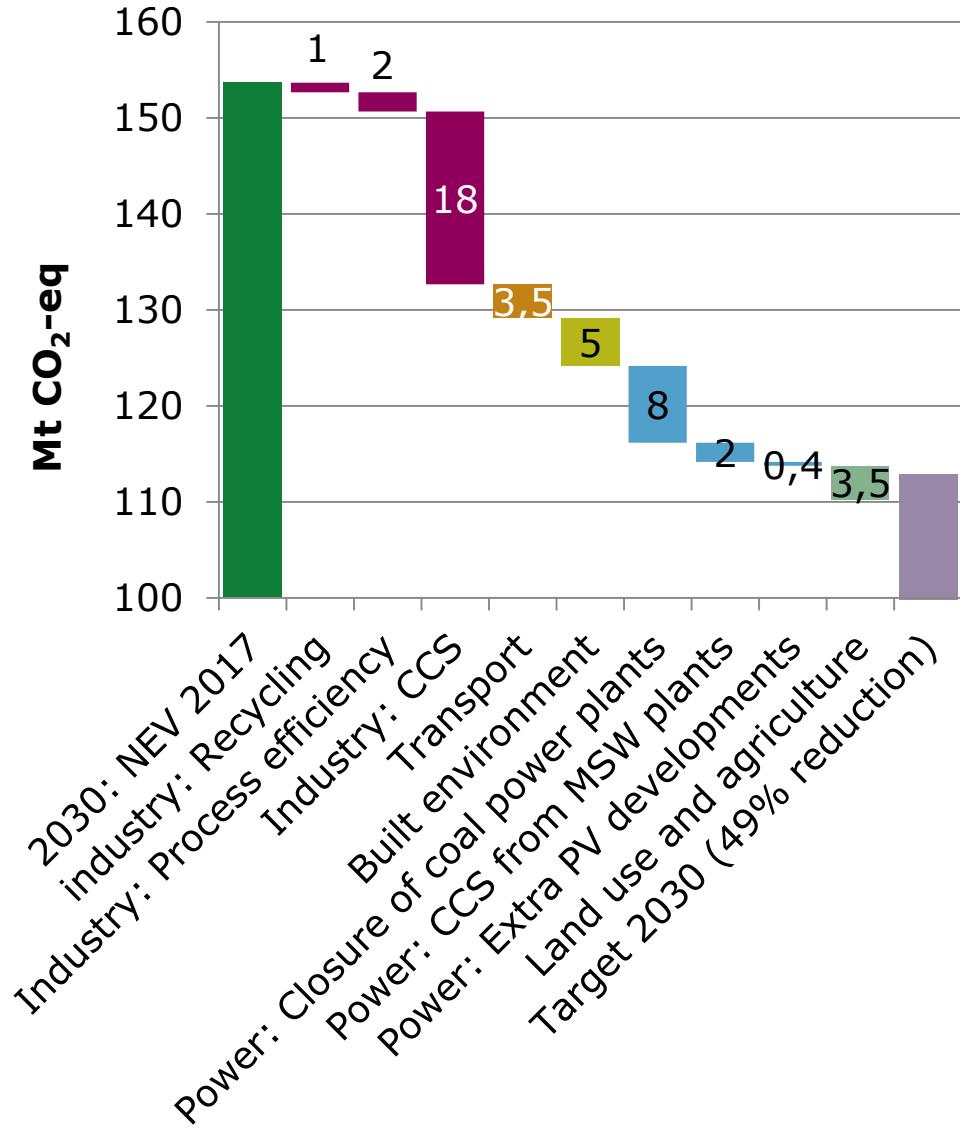
Source: IRENA (2016) INNOVATION OUTLOOK ADVANCED LIQUID BIOFUELS

Global projections provide limited insights in biofuel trade flows, technology development and regional (support) policies



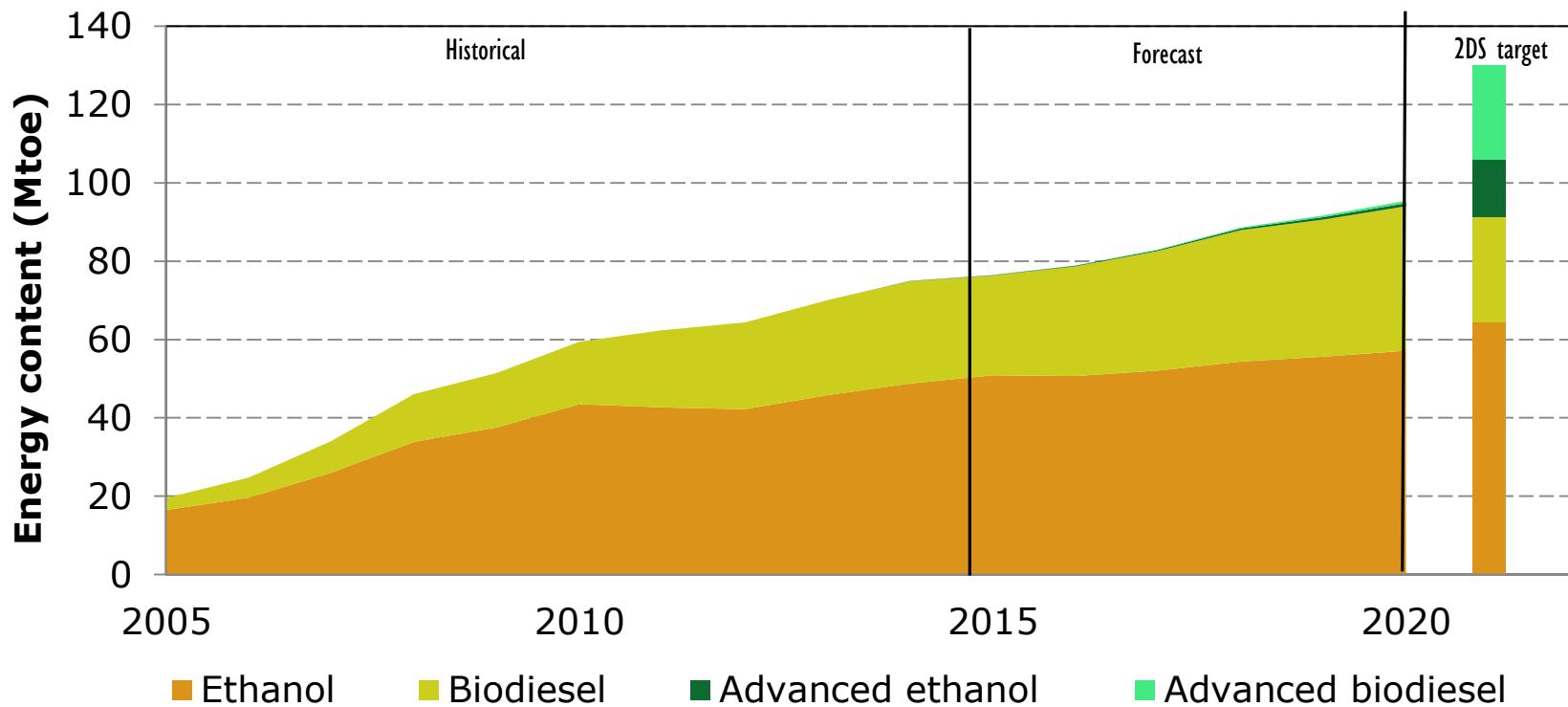
Impact of coalition agreement to reduce GHG emissions from NEV 2017

- Analyse regeerakkoord Rutte III
- 49% reductie t.o.v. 1990
- Belangrijkste maatregelen:
 - CCS in industrie
 - Sluiten kolencentrales
 - Minimum CO₂ prijs voor elektriciteitssector
 - ETS-prijs loopt op tot 43 €/t CO₂ in 2030





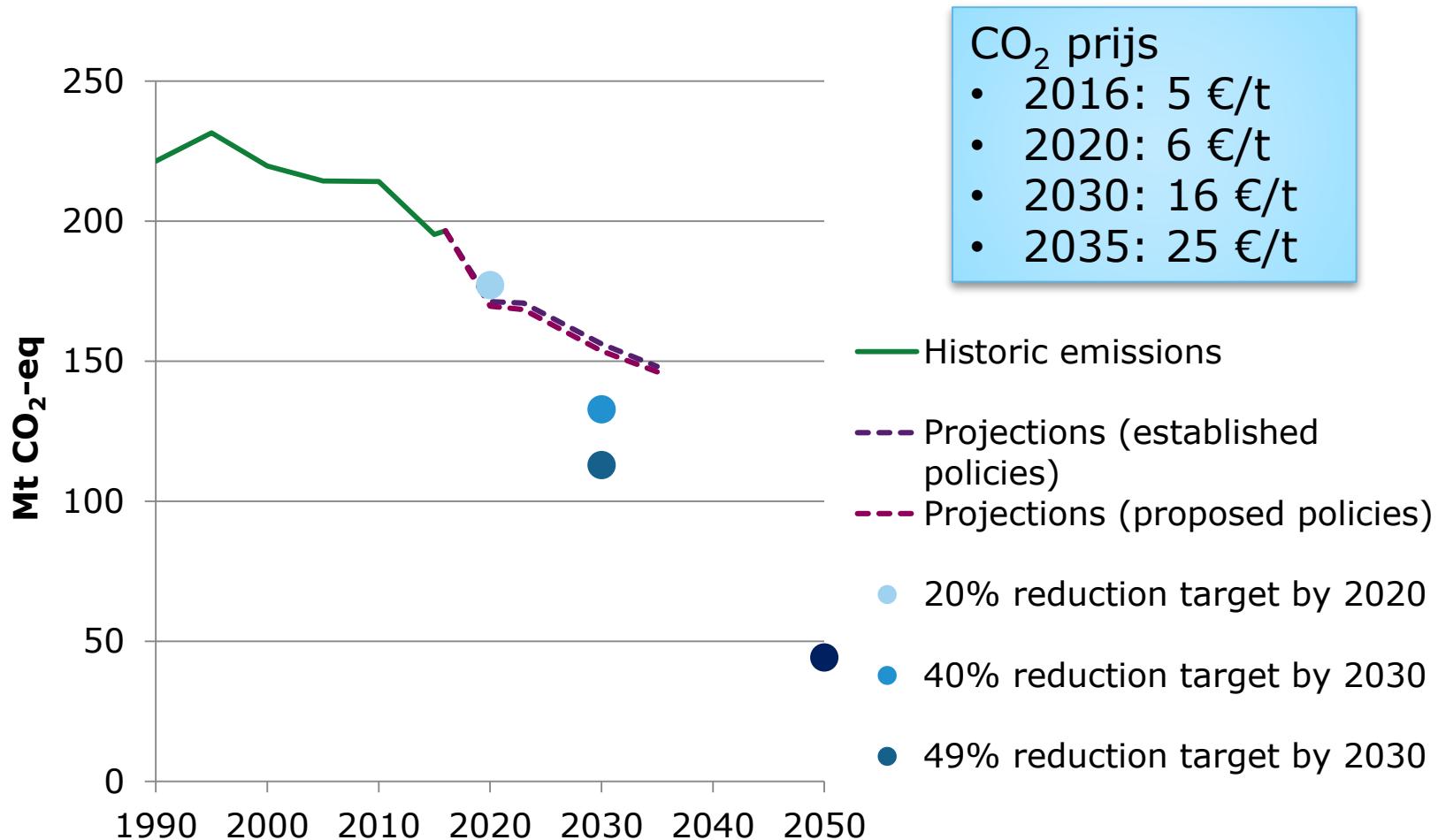
Global: biofuel production



International Energy Agency (2017), Tracking Clean Energy Progress 2017, OECD/IEA, Paris



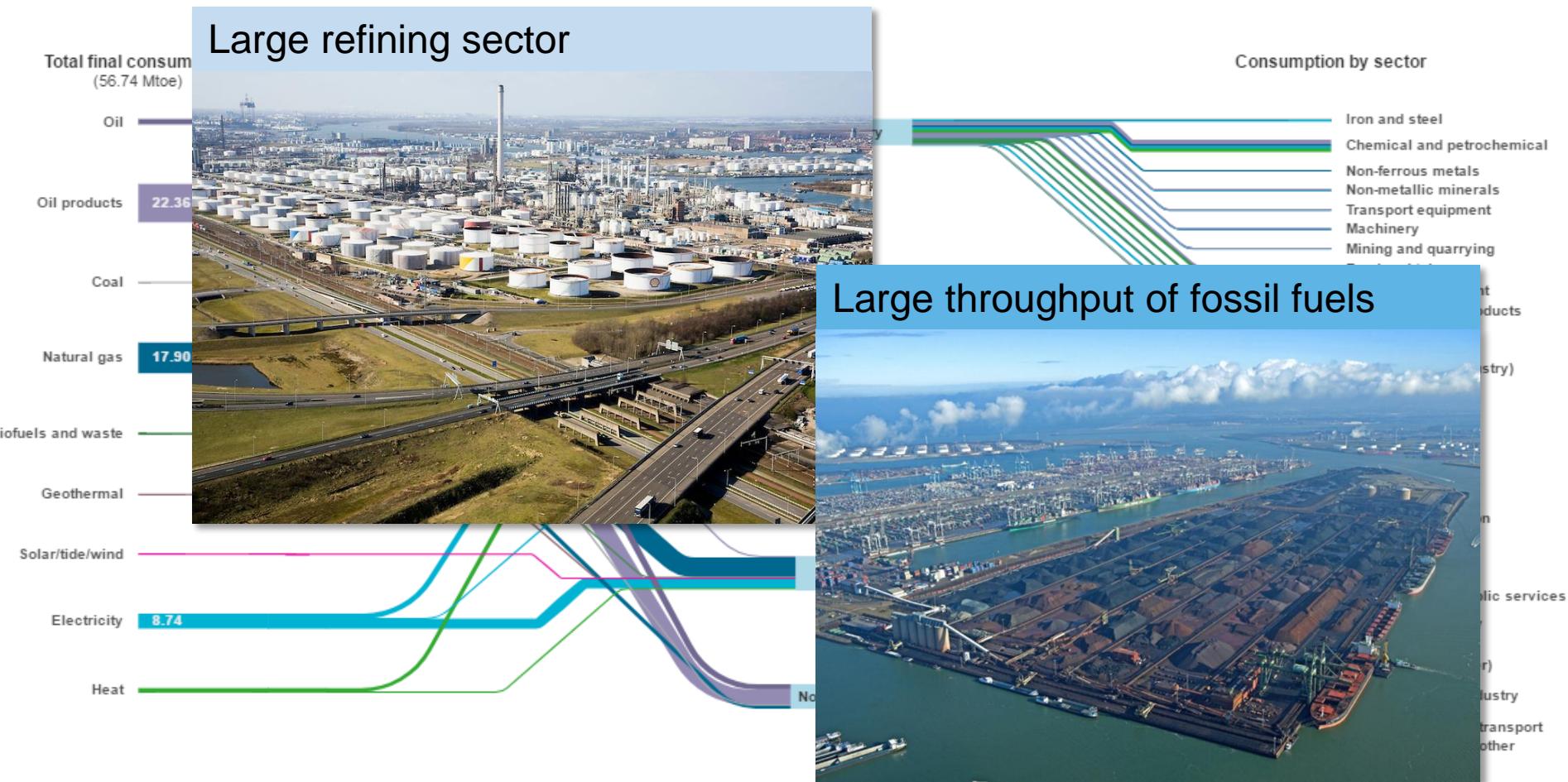
Total NL GHG emissions and projections (National Energy Outlook)



- **RES target of 2020 (14%) will probably not be met (12.5%)**
- **Slow down of GHG emission reduction beyond 2020**



The Netherlands: final consumption

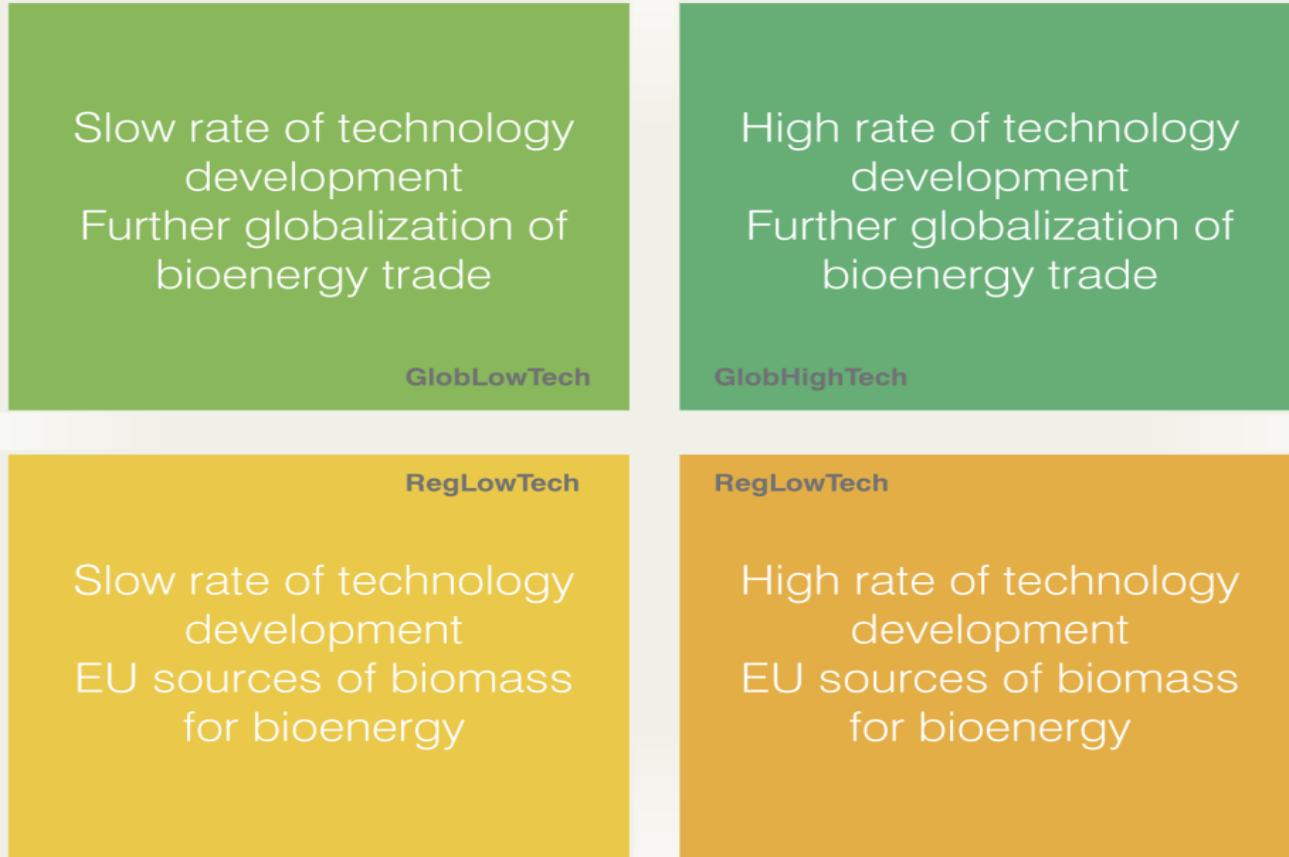


Overview of the four scenarios

Intra and extra European trade
Global orientation

Low technological development

High technological development



Regional orientation
Intra European trade