

Evaluation of biomass derived transport fuels in Germany

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Questions

- How much biomass for energetic use is available in Germany?
- How should this biomass be used to reduce CO₂ in an economical point of view?

Agenda

- Biomass potentials in Germany
- Optimizing the energetic use of biomass
- Key findings



Agenda

- Biomass potentials in Germany



Political goals

German Biofuel Quota Act

Quota	2008	2009	2010	2011	2012	2013	2014	2015
Diesel	4,4 %	4,4 %	4,4, %					
Gasoline	2,0 %	2,8 %	3,6 %					
Overall	-	6,25 %	6,75 %	7,0 %	7,25 %	7,5 %	7,75 %	8,0 %

Other biofuel goals

	2010	2020
Biofuel percentage on fuel	10%*	20 %**

*Proposal for a directive of the European Parliament and of the council on the promotion of the use of energy from renewable sources, Brussels, 23.01.2008

**Eckpunkten für ein integriertes Energie- und Klimaschutz-Programm für Deutschland, Meseberg 2007

Biomass potential – energy crops

Area for energy crops in Germany

In 2005: ca. 2 Mio. ha

Premises: Per capita crop land constant in Germany

Decline in population (81 Mio. in 2010, 78 Mio. In 2030)

Crop efficiency keeps rising (FAO)

	2010	2020	2030
Mio. ha	2,36	2,52	2,86

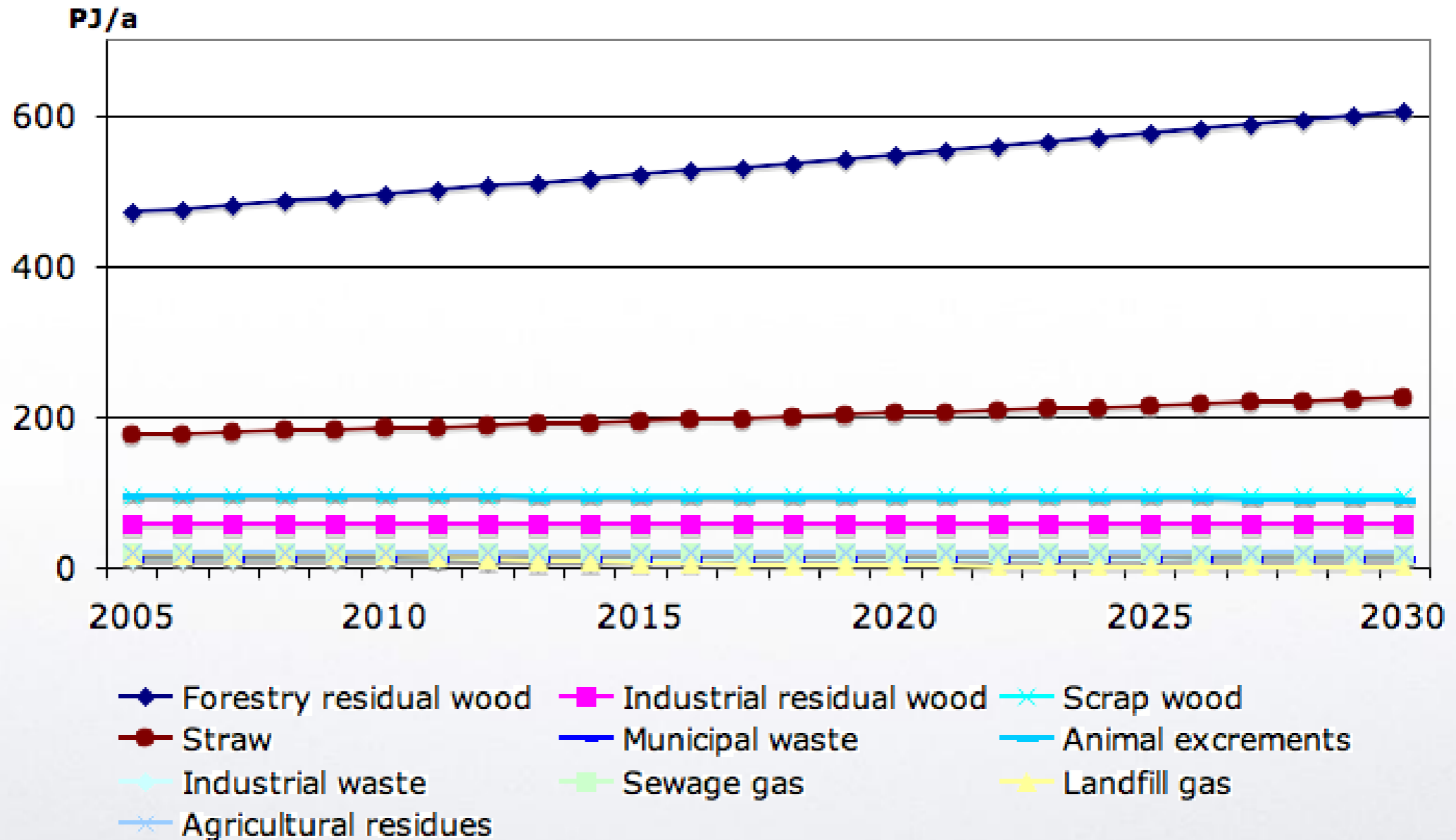
Energy crops

Premises: Data for 2005: KTBL

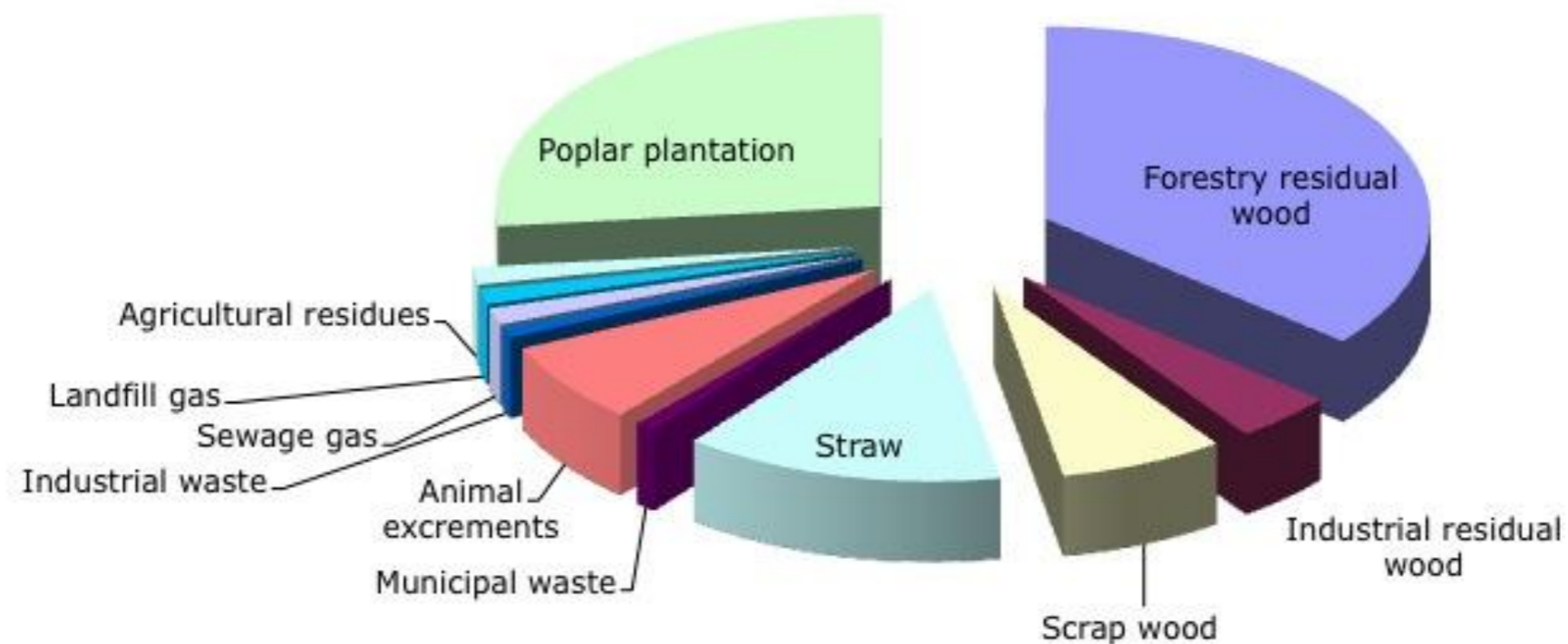
Efficiency augmentation: 1,0 % p.a.

Allocation through integrated area optimization

Development of residuals until 2030



Biomass potential in Germany in 2010



↳ ≈ 10 % of the German energy demand in 2007

Poplar is used on the whole available area.
Source: Own calculations

Agenda

- Optimizing the energetic use of biomass



Possible biomass use

Synthetic fuels production

- 3 types of gasification:
 - entrained-flow gasification
 - Flash pyrolysis and entrained-flow gasification
 - fluidized bed gasification
- 2 types of synthesis:
 - Fischer-Tropsch-Synthesis
 - Methanol synthesis and MtSynfuel

Other bioenergy production

Fuel production:

- Fermentation
- Oil mill / esterification
- enzymatic fermentation
- Hydrogen production

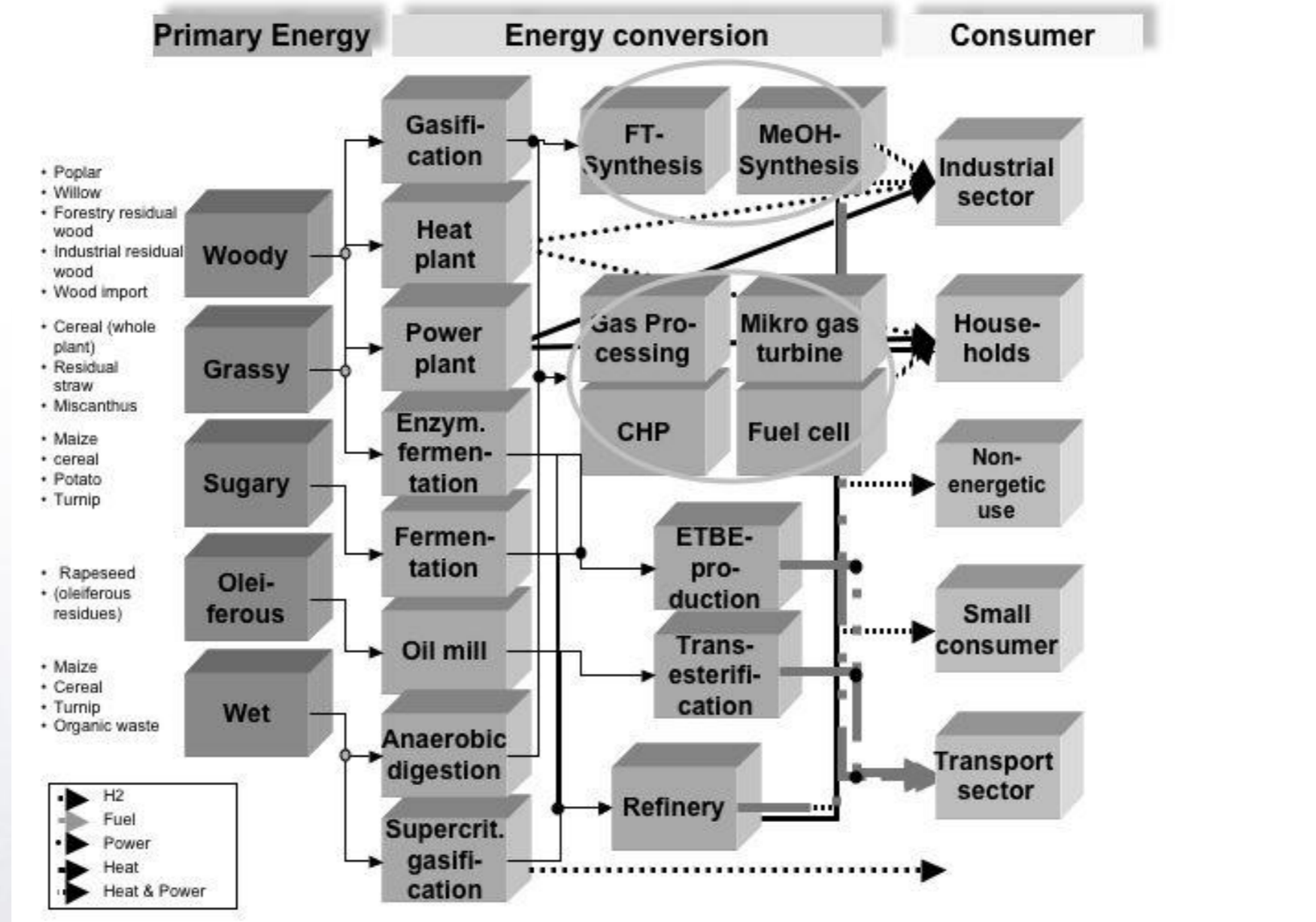
Heat and power production:

- Anaerobic digestion
- CHP with biogas/synthesis gas
- Micro gas turbines with biogas/synthesis gas
- Power plants
- Heating stations

IKARUS - functionality

- (Instrumente für **Klimagasreduktionsstrategien**)
- maps the German energy system
- cross-linked processes from primary energy supply to energy services
- Demand driven
- bottom-up model
- Specific energy fluxes, emissions and costs mapped for the whole energy system
- dynamical linear optimization
- Optimizing criteria: minimization of system costs
- Time steps: 5 year steps until 2030 , myopic view

IKARUS – Biomass use structure



Case scenarios

- Reference scenario (with biofuel quota)
- Without biofuel quota
- CO₂-price – global and in the transport sector
- Fossil fuel price scenarios (high/low)
- Competition with food crops
- Sensitivities on area for biomass, import of biomass and biomass prices

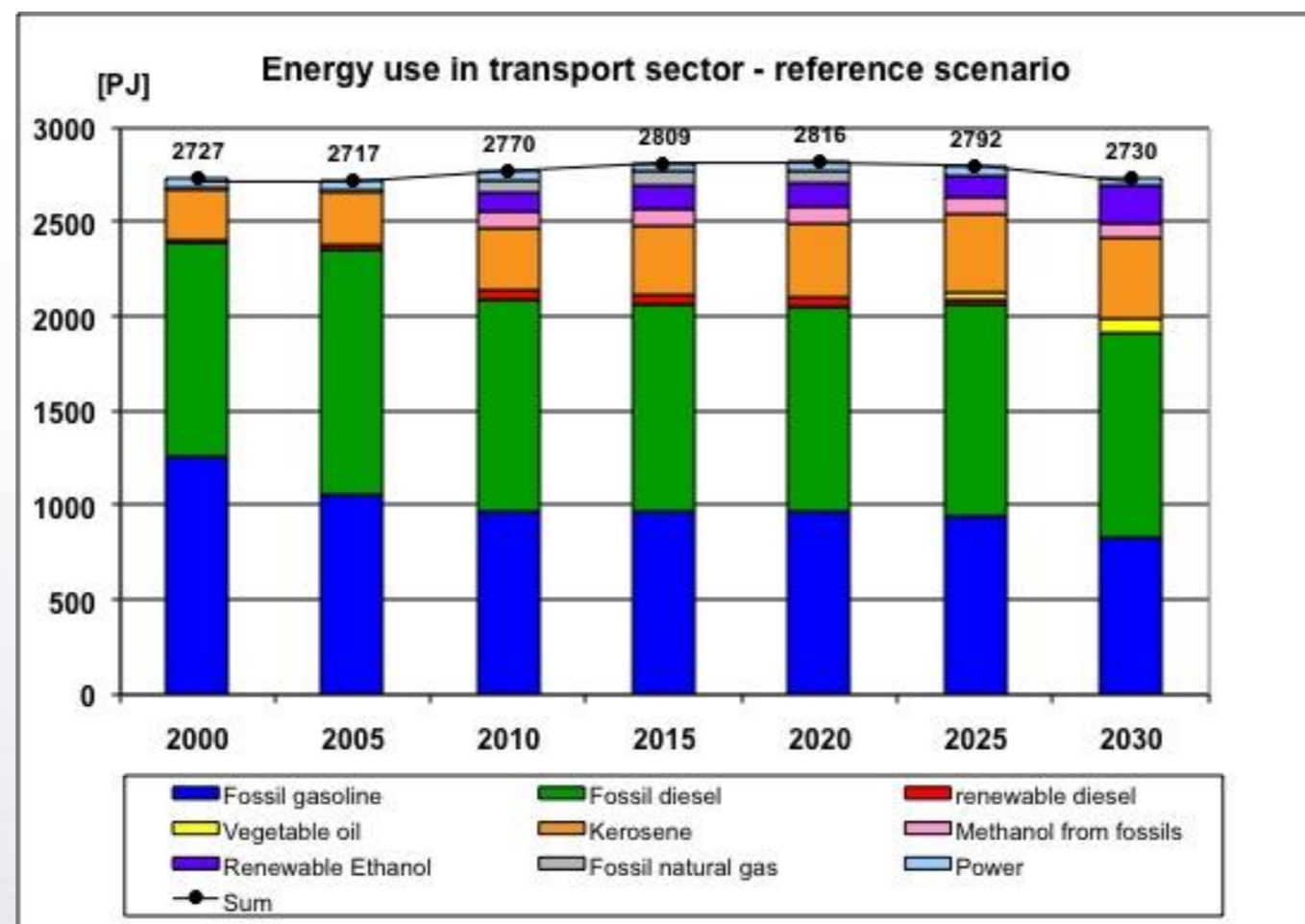
Agenda

- Key findings



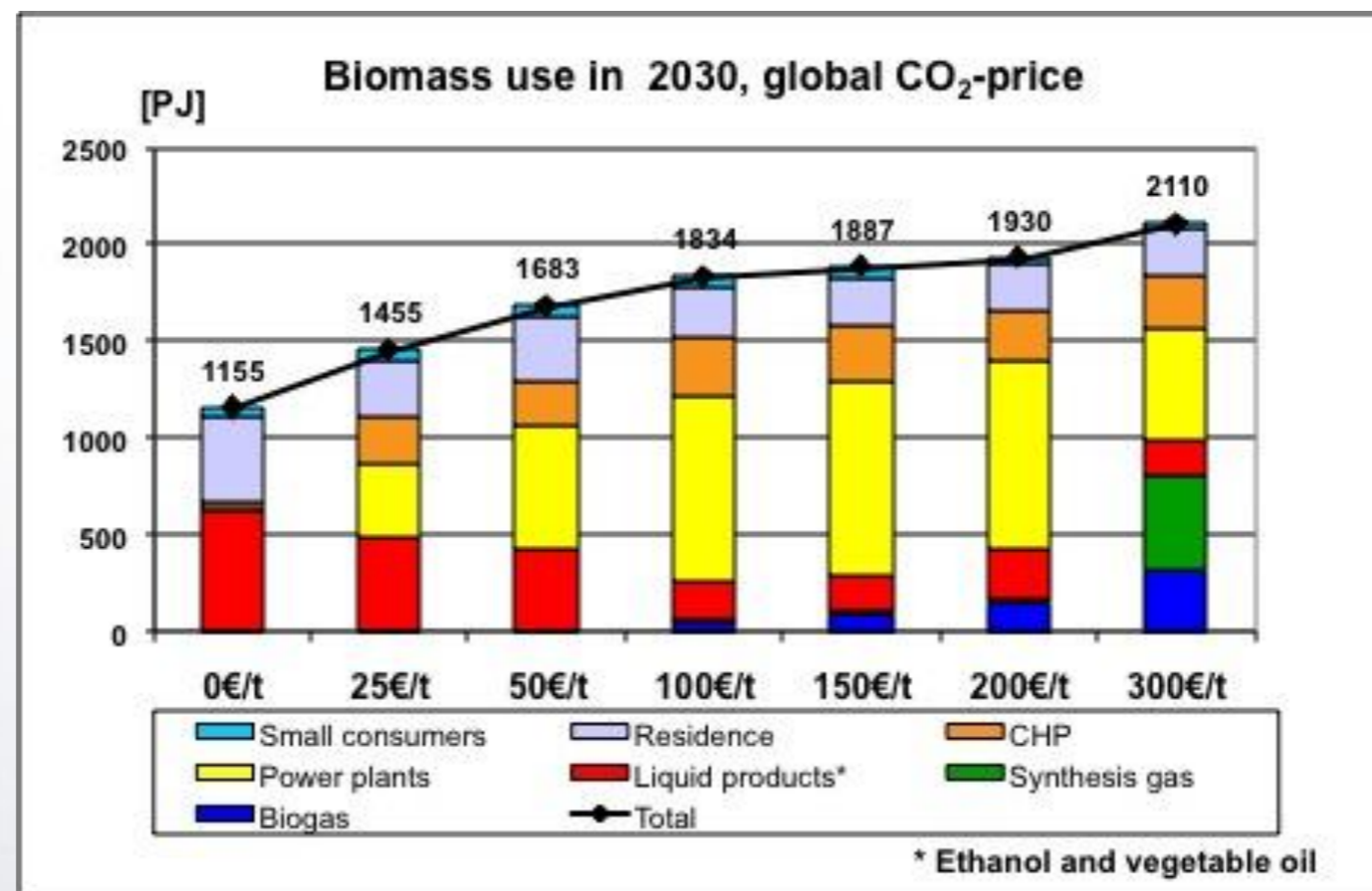
Key findings – reference scenario

- In the reference scenario due to the biofuel quota 10 % renewable fuels are used in 2030
- Mainly ethanol and biodiesel, synthetic biofuels are not chosen



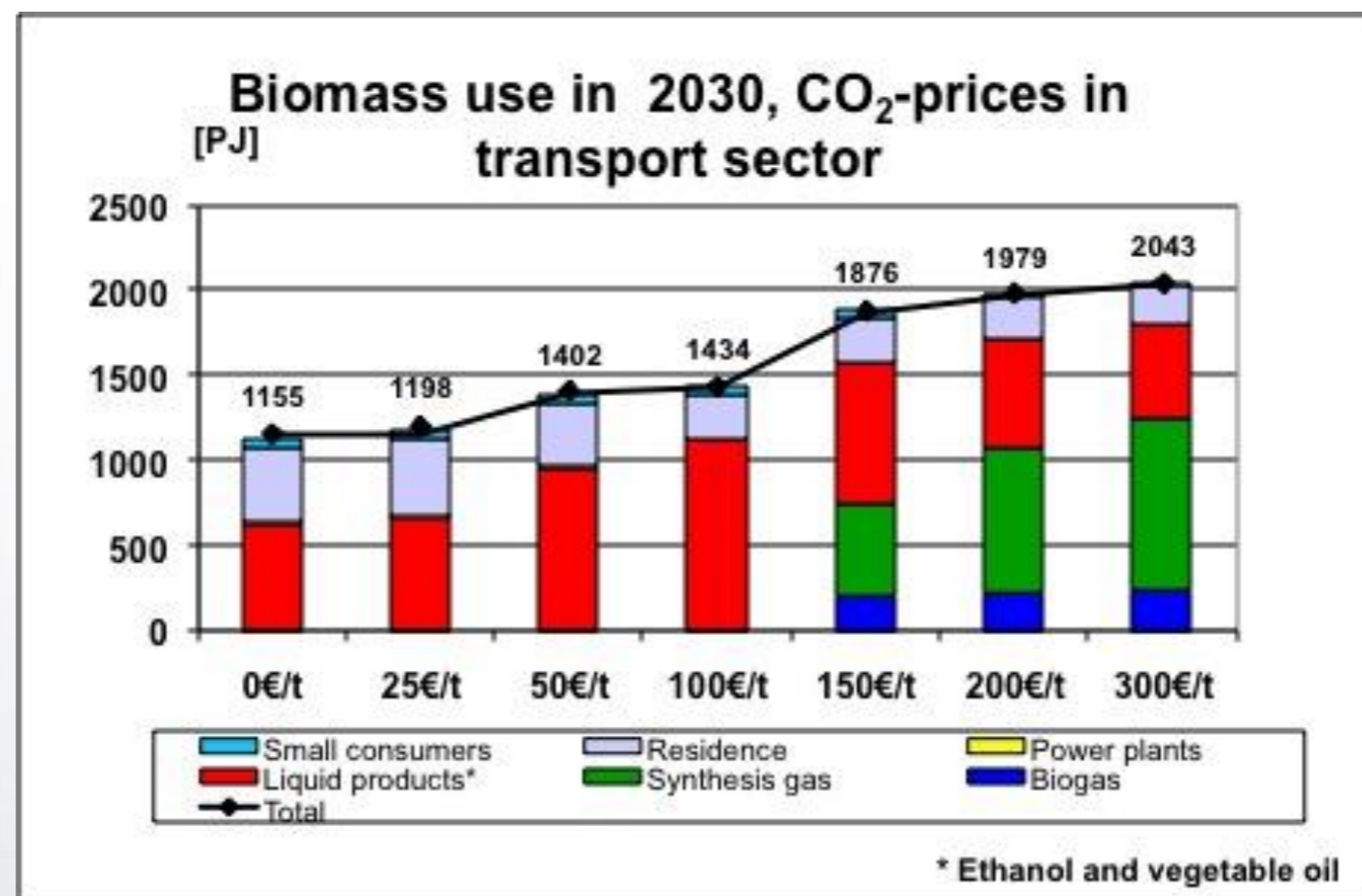
Key findings – global CO₂-prices

- If CO₂-prices are implemented globally, synthetic fuels are chosen only at very high prices
- Before biomass is mainly used in the stationary sector



Key findings –CO₂-prices in transport

- If CO₂-prices are implemented in the transport sector, first biomass is mainly used for liquid fuel production
- At higher prices 2nd generation biofuels are chosen



CO₂-Scenarios

Scenarios

€/t _{CO₂}	Global	Transport
	25 - 300	25 - 300

Synthetic are fuels chosen at CO₂-prices of:
300 €/t global or 150 €/t in the transport sector

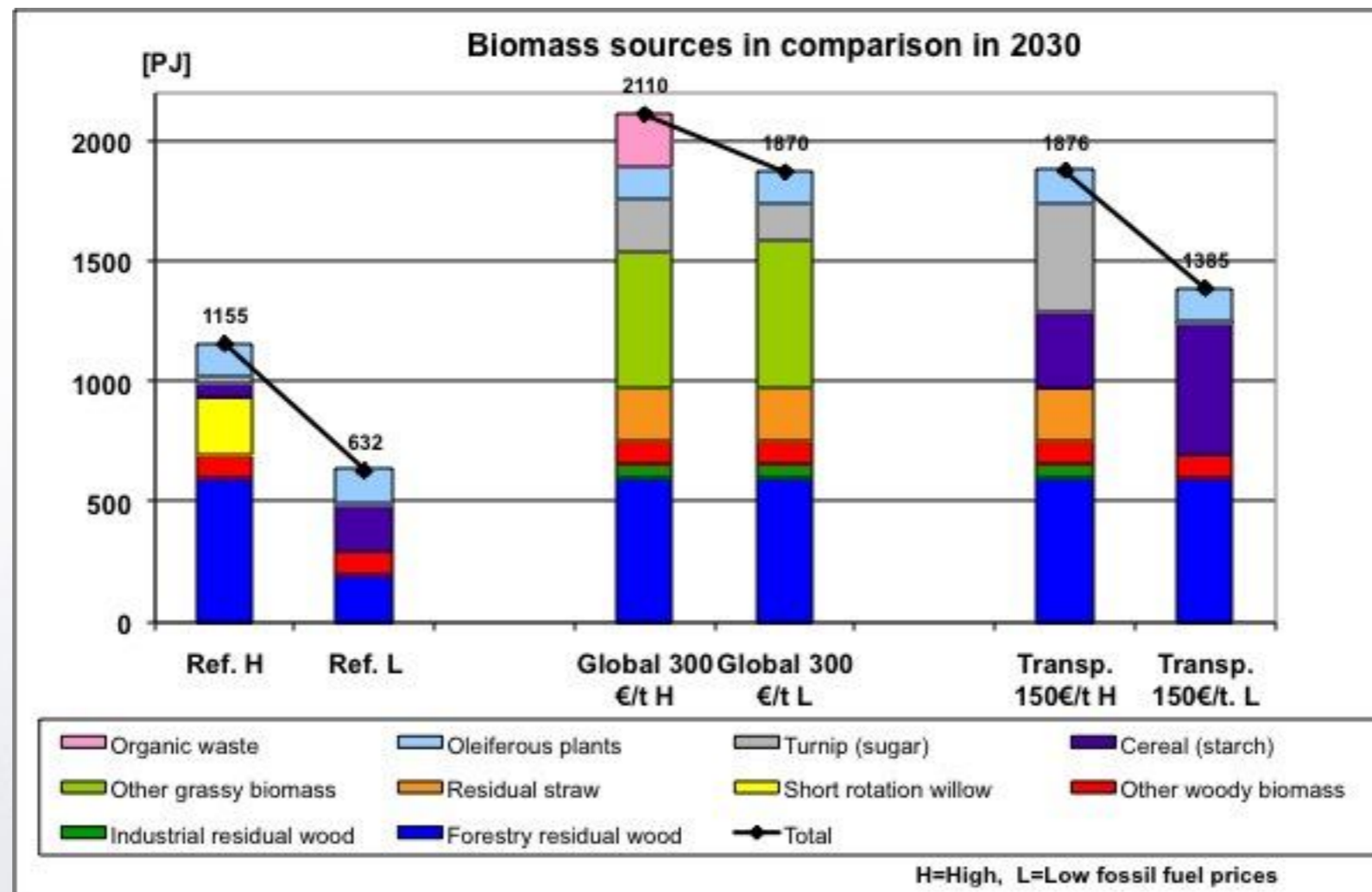
German tax rates

€/t _{CO₂}	Electricity	Natural gas*	Gasoline	Diesel
	10,28	68,95	277,33	177,51

* As LPG

Key findings – Biomass sources

- Biomass sources differ in magnitude and composition
- Wood is used in all cases to its maximum except low prices in the reference scenario



Conclusions

- Biomass is used mainly in the stationary sector.
- If global CO₂-prices are set globally, biomass is still mainly used in the stationary sector.
- Only with high CO₂-prices on transportation sector synthetic biofuels are used.
- Biofuel quota favours 1st generation biofuels until 2025
- If no food crops are used, less biomass is used in the system

Thank you for your attention



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