KU LEUVEN

Solarproduktion von Wasserstoff

(Solar hydrogen production)

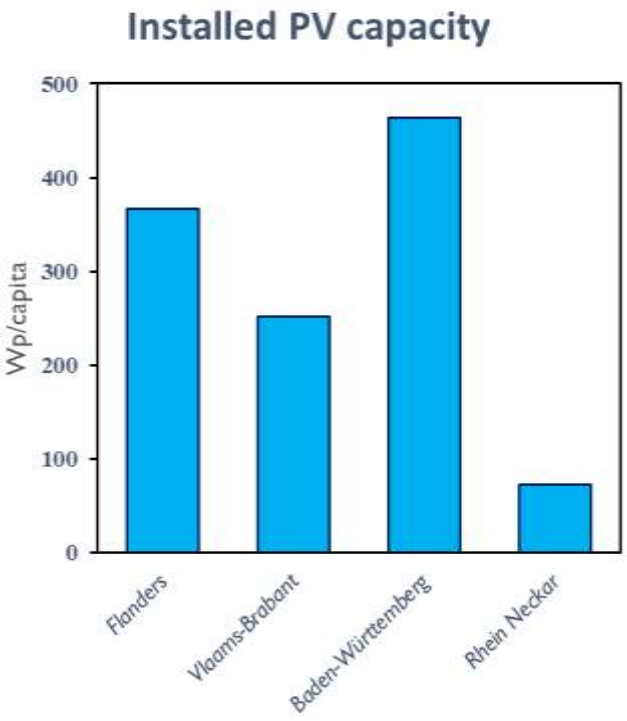
Dr. Jan Rongé

Dr. Tom Bosserez

Regionalkonferenz Energie & Umwelt

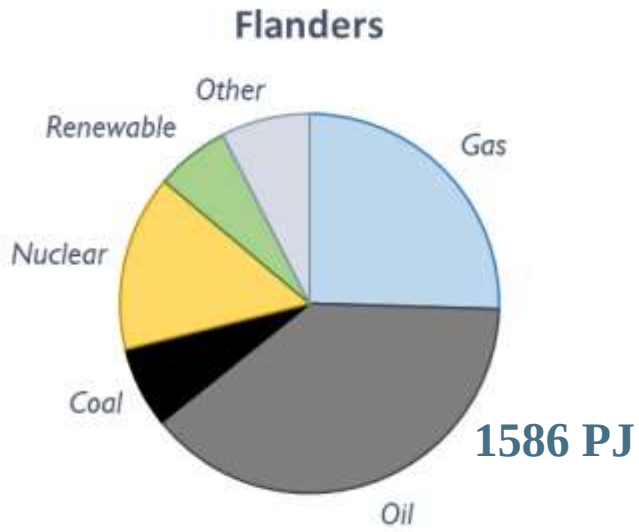
Mannheim, 14 November 2018

Energy picture

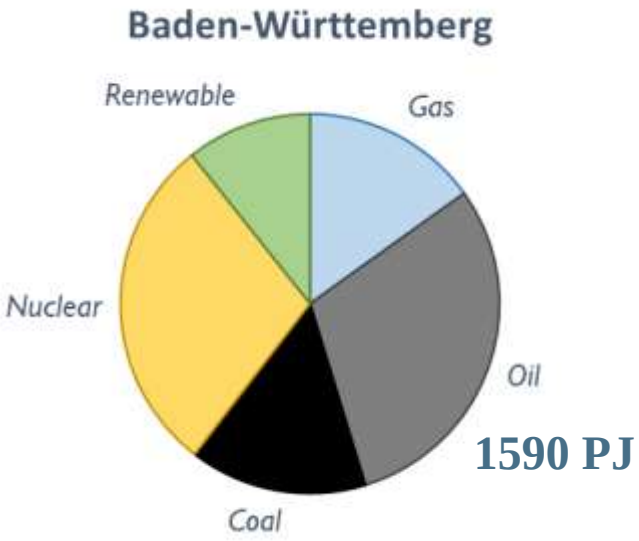


VL
1080
kWh/m²

B-W
1130
kWh/m²



1586 PJ



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Our Team

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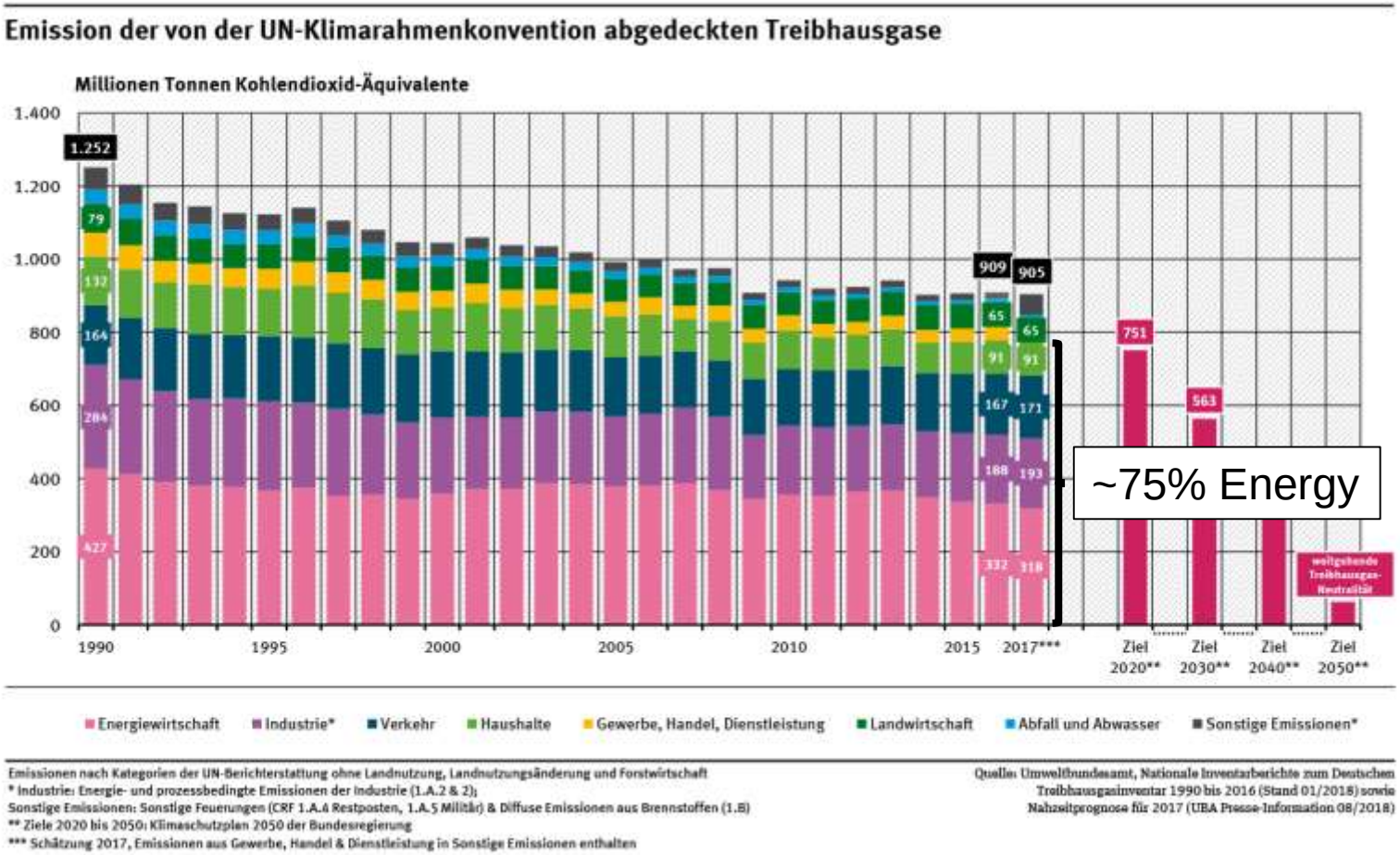
Gino Heremans

Robin Peeters
Barbara Thijs

Why hydrogen?

CO_2 ➔ Energy ➔ Renewable energy



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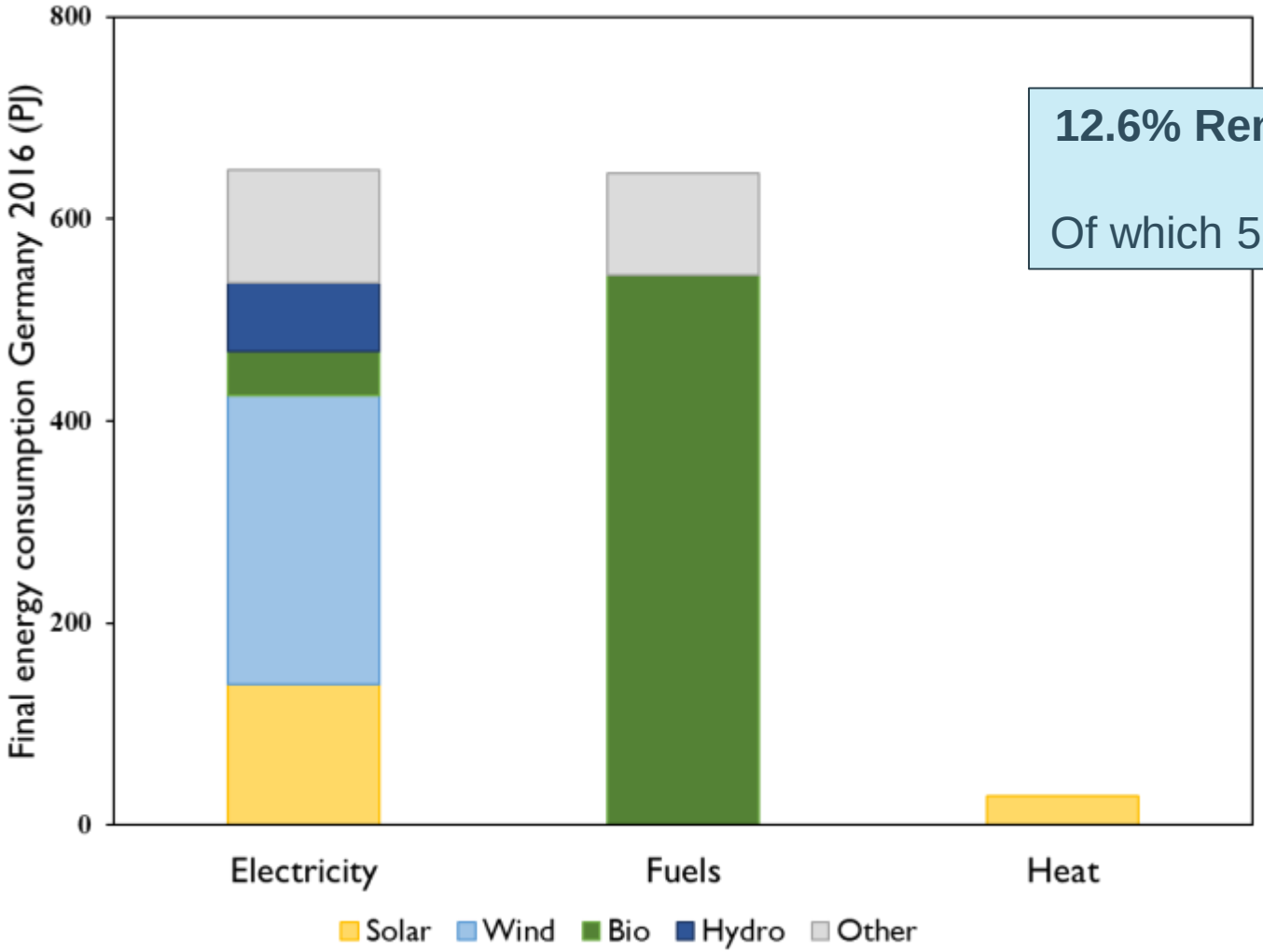
Why hydrogen?



12.6% Renewable energy

Of which 58% is bio energy

IEA; Eurostat; IRENA

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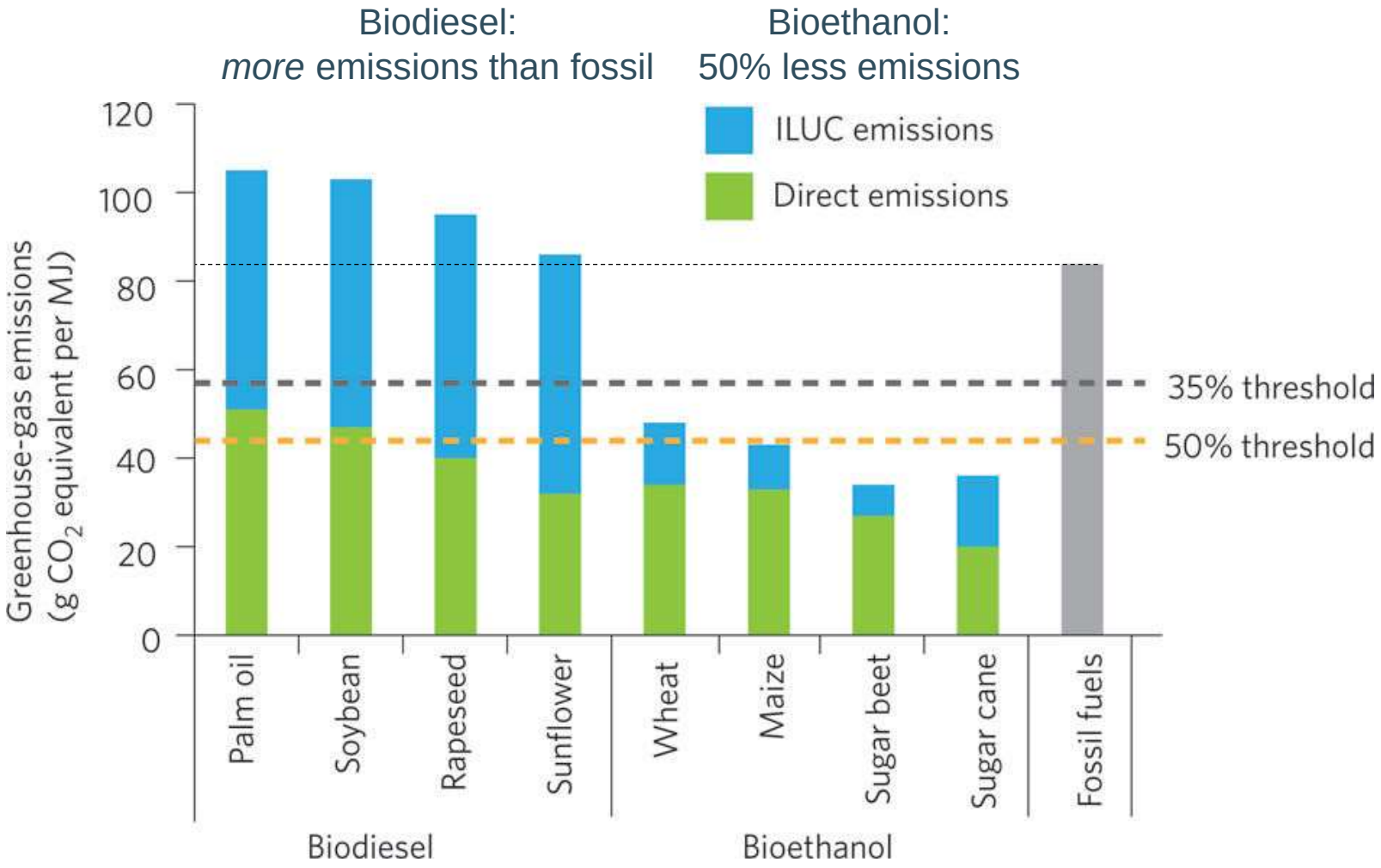
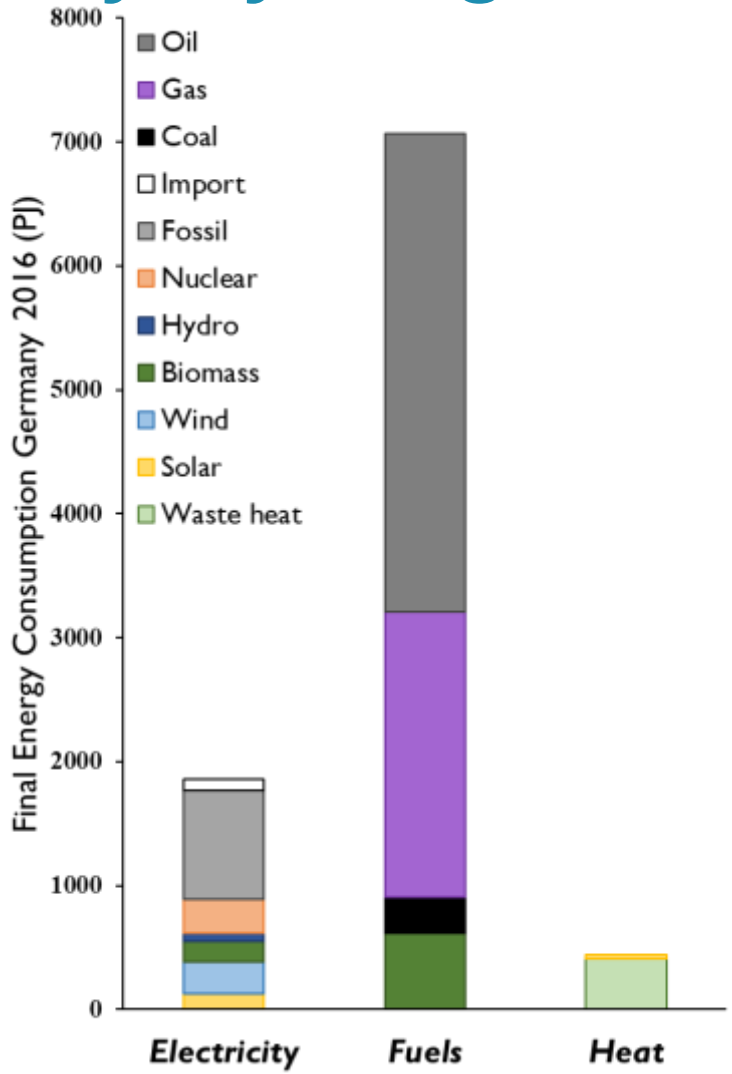


Nature Clim. Change **1**, 389

Why hydrogen?



There is no alternative yet for fossil *fuels*

- Biofuels: limited / not sustainable
- Electrification?

IEA; Eurostat; IRENA

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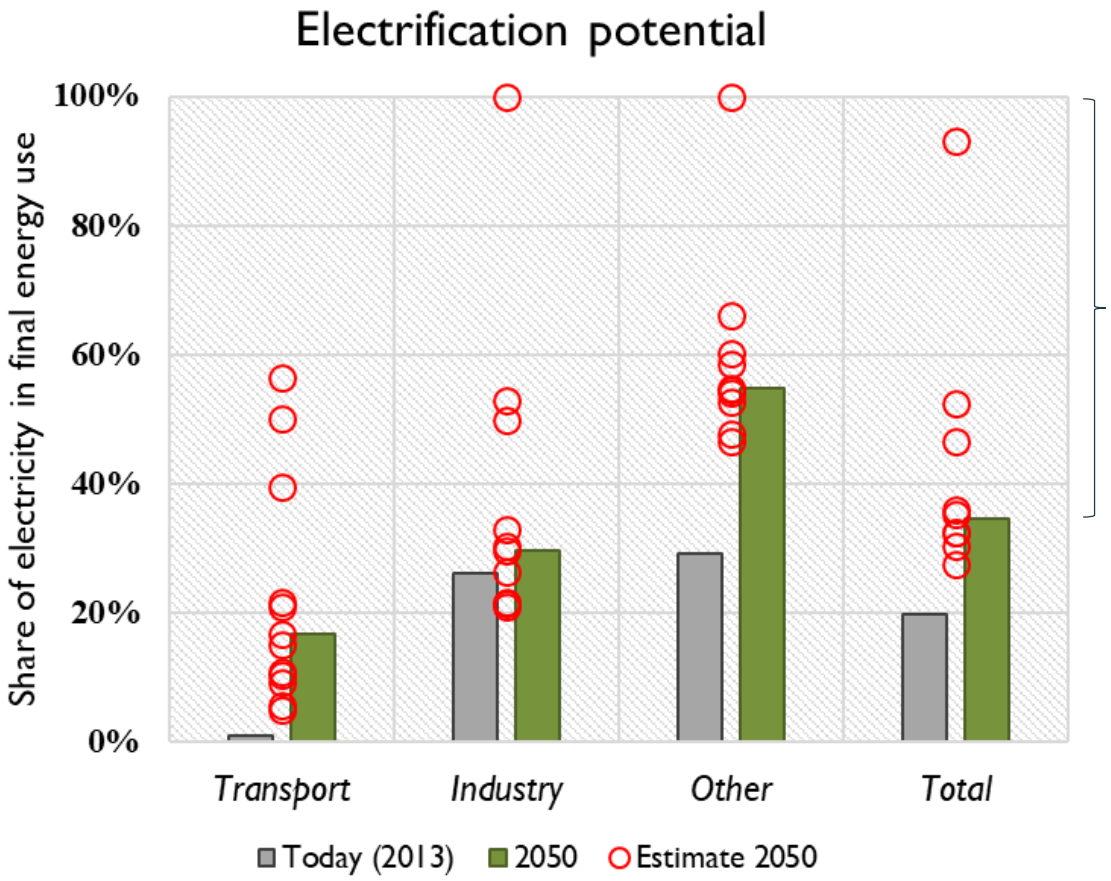
Why hydrogen?



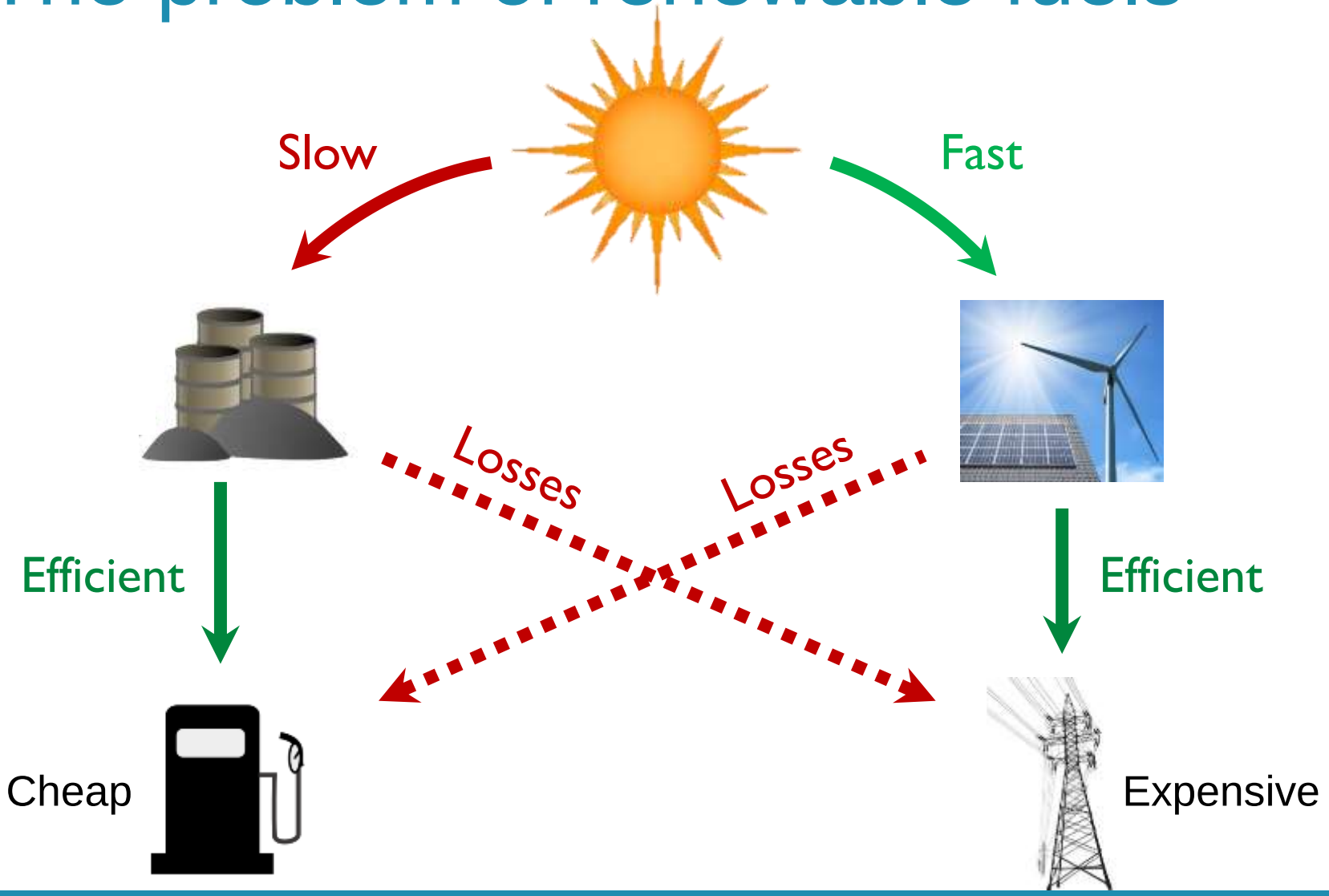
> 60% of fossil fuels can not be replaced by electricity

Why hydrogen?

Hydrogen is the smallest fuel molecule that can be sustainably produced using renewable energy and materials

$$2\ H_2O \overset{E}{\leftrightarrow} 2\ H_2 + O_2$$

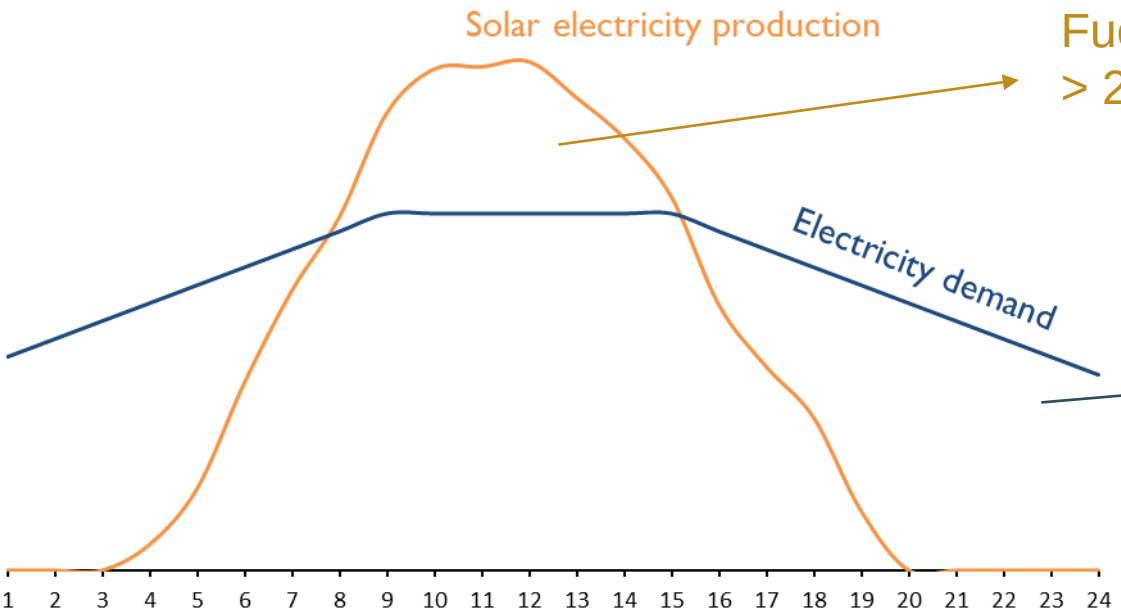
The problem of renewable fuels



Renewable fuel production

‘Peak shaving’

$$2\,H_2O \overset{E}{\leftrightarrow} 2\,H_2 + O_2$$

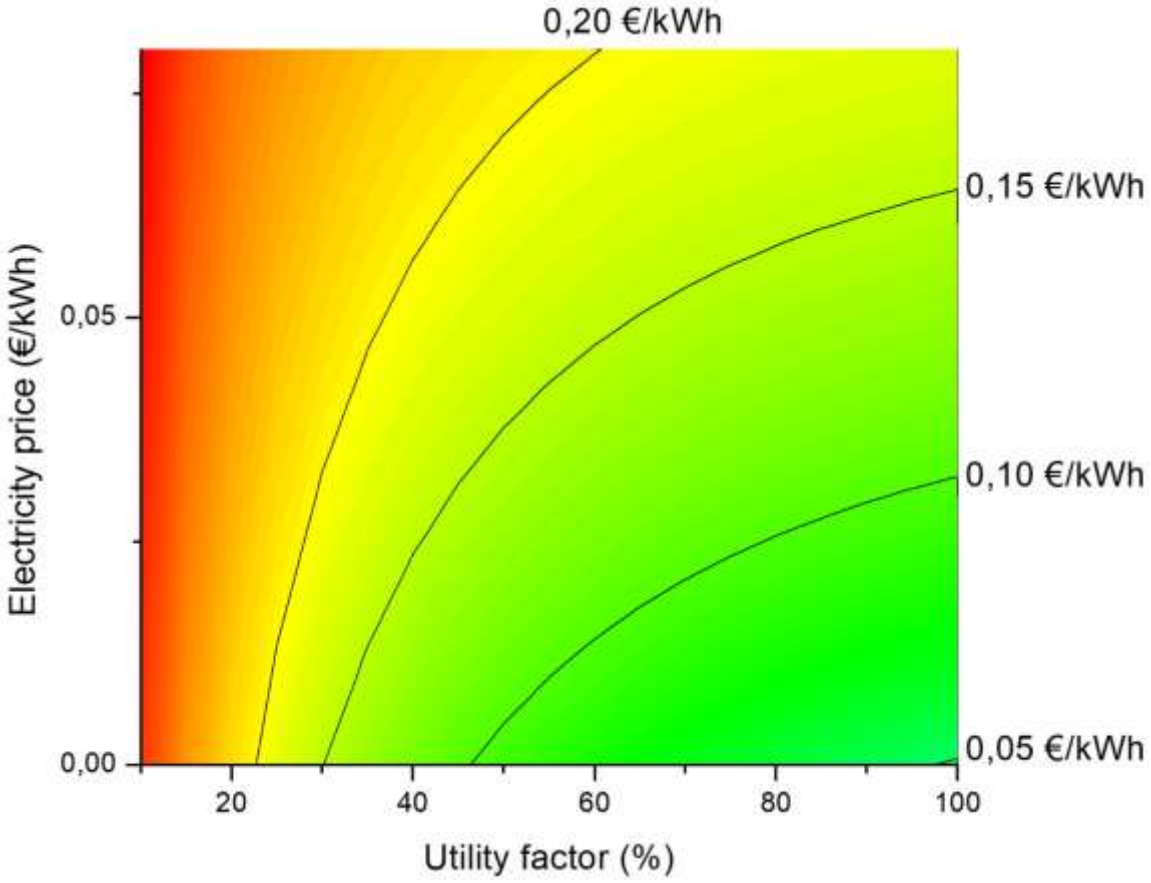


Fuel from peak shaving:
> 2/3 of energy demand …

Electricity:
< 1/3 of energy demand

Renewable fuel production

Dedicated hydrogen production by electrolysis

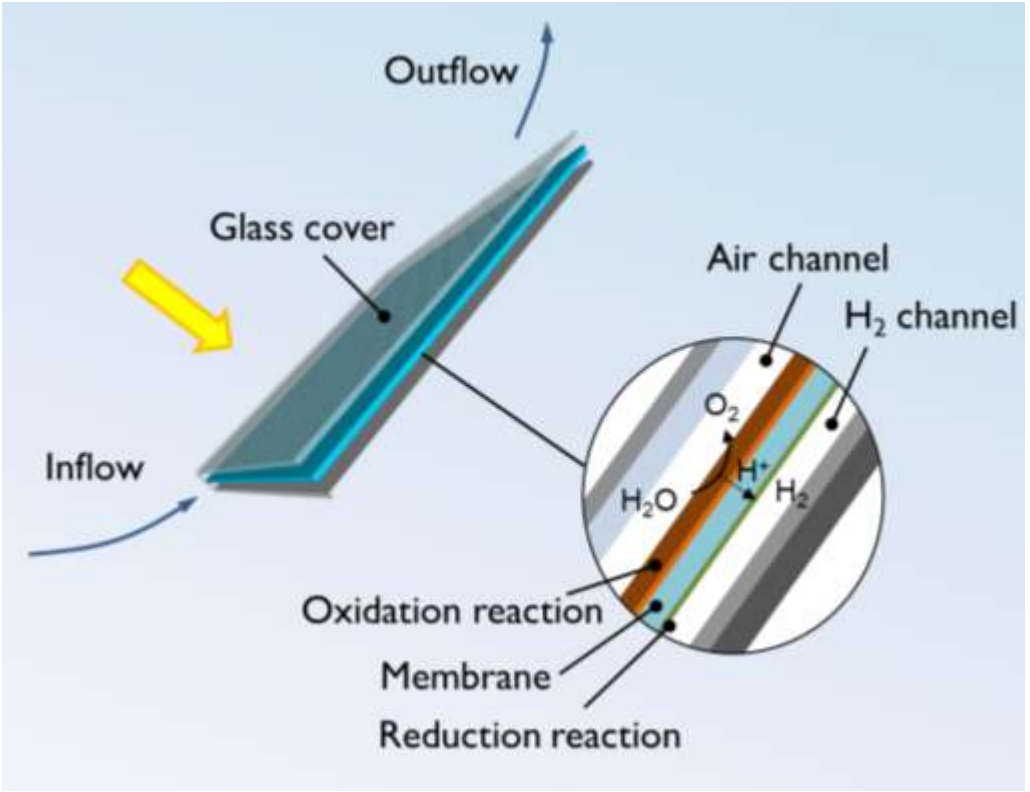


Natural gas: 0,03 €/kWh
Gasoline: 0,16 €/kWh

Electrolysis ('power to gas')
➔ Hydrogen: 0,18-0,30 €/kWh (today)

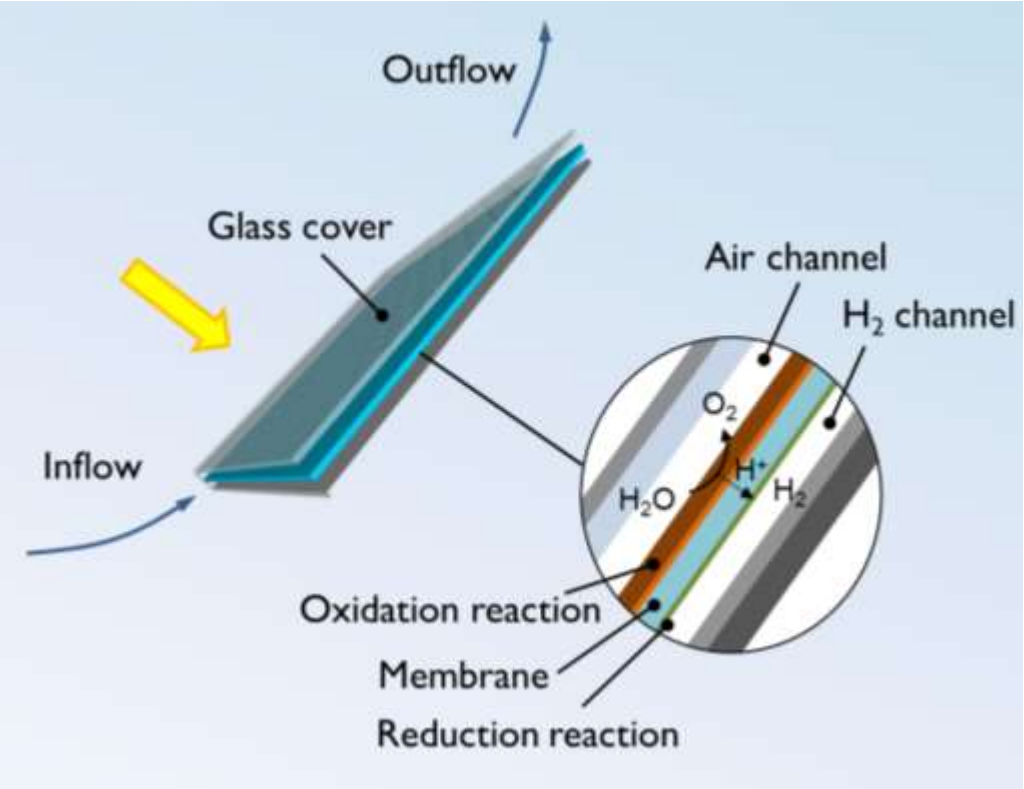
Solar hydrogen panels

40 g water vapour per m^2 per hour



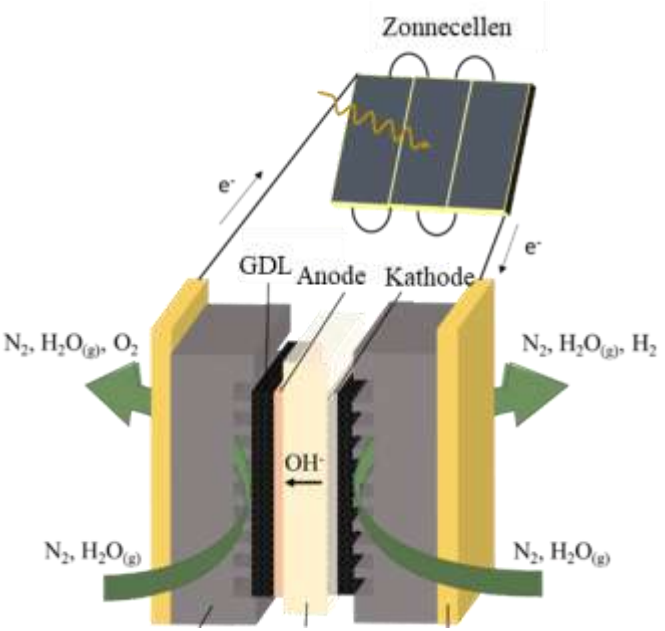
Solar hydrogen panels

- ‘Solid state’: no liquids
- ‘Black box’: hydrogen from air and sunlight
- Modular: from 0.2 kW
- Safe: low pressure, no liquid leakage
- Efficient and low cost: no grid power needed
- Predictable: no fluctuating power costs or taxes



Solar hydrogen panels

- Integrated solar electrolysis
- No noble metals
- More efficient than grid electrolysis



Efficiency (sun ➔ hydrogen)	15%
Efficiency (electrolysis)	$75\%_{LHV}$ ($89\%_{HHV}$) 4 kWh/Nm^3 H_2
Water consumption	0 l/Nm^3 H_2
'Power cost'	15 – 51 €/MWh 0,7 – 2,2 €/kg H_2
Hydrogen production	4-9 kg/m^2.year
Lifetime	?

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