

Biomass Based Hydrogen Economy

An Alternative to our Energy Economy

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The Roots of Technology



- Robust
- Affordable
- Available
 - By day and night
 - Irrespective of weather
 - Summer und winter
- High Potential
 - Replaces all nuclear and fossil energy
 - Applicable worldwide
 - Secures supply of food
 - Secures clean water supply

All energy is brought to your home
by pipeline just when you need it



The Recipe

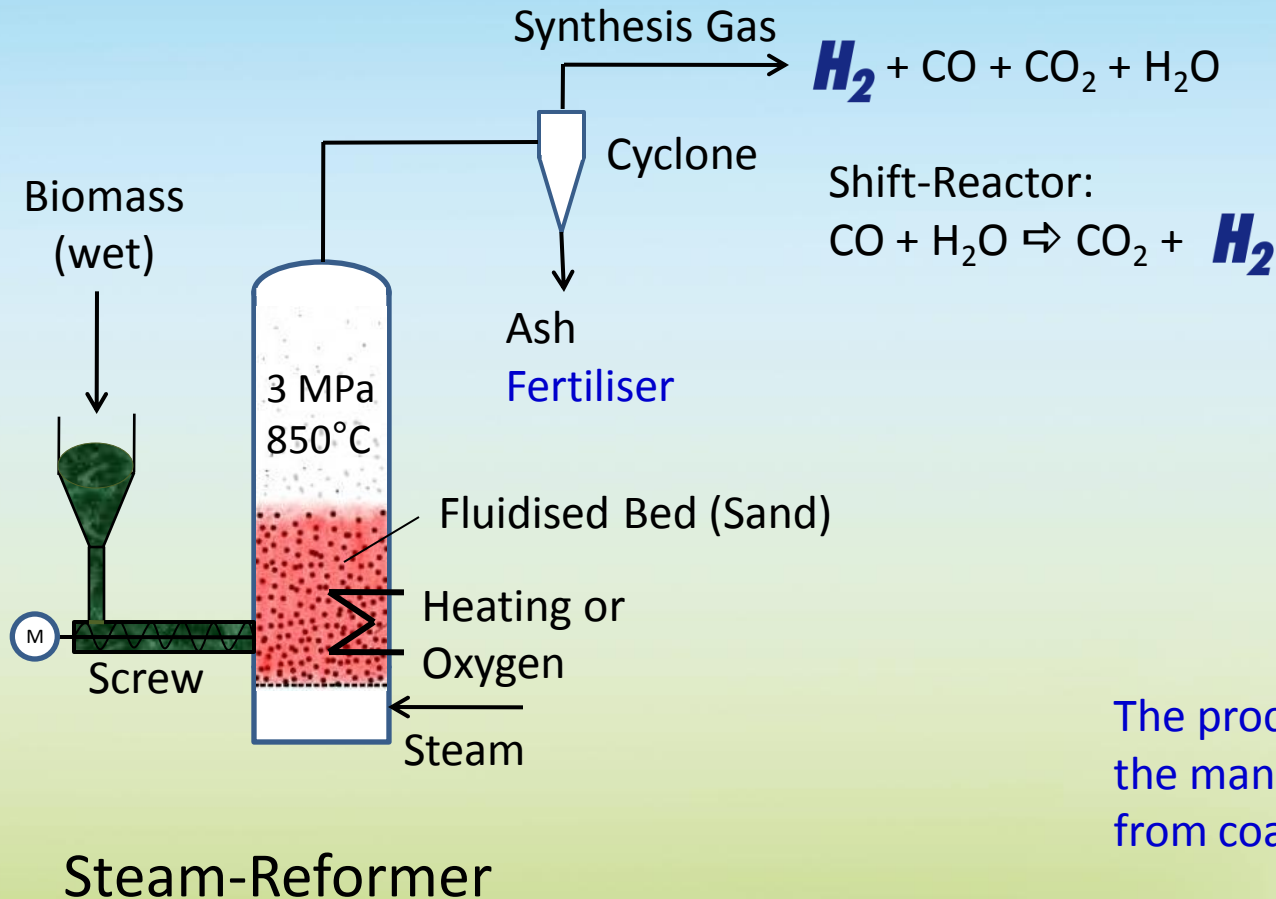


300-1000°C

The charm of the process is the endothermic enthalpy.
Therefore, the process is in principle lossless.

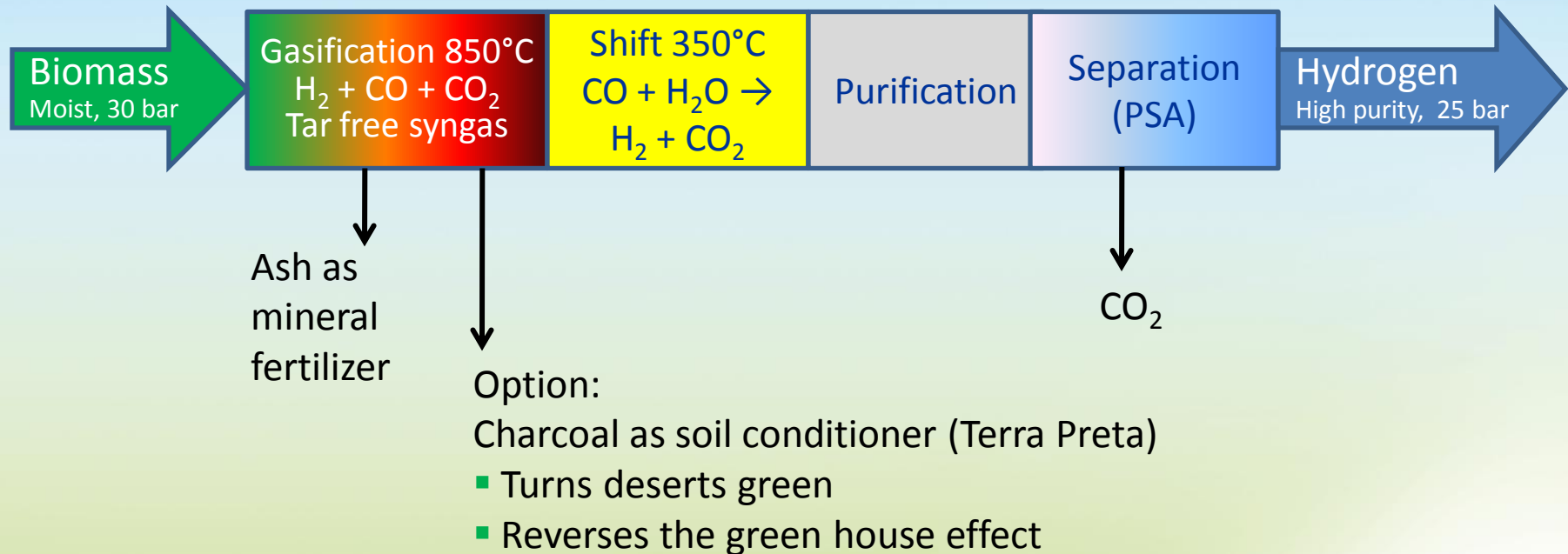


The Basic Process



The process was well known for the manufacture of town gas from coal

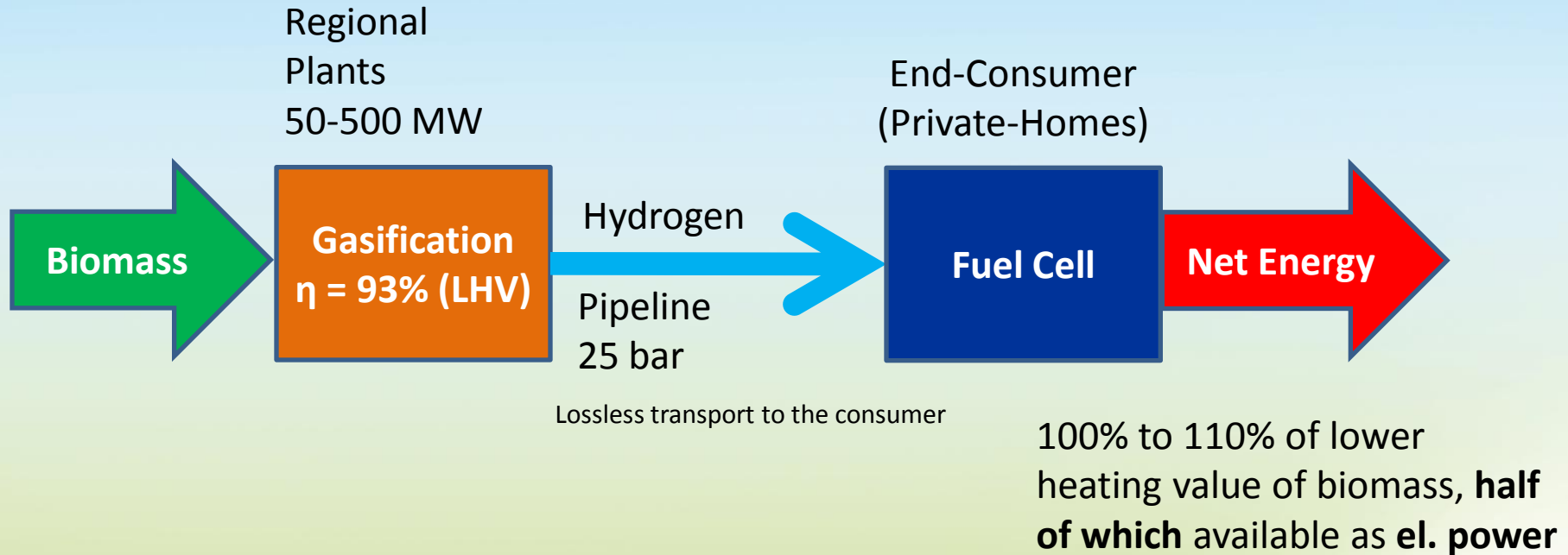
Industrial Production of Hydrogen in Pressurised Cascaded Fluidised Bed Reactors



Due to the heat recovery of the tar-free syngas and the electrical heating equipment, the process is highly efficient ($\eta = 93\%$)



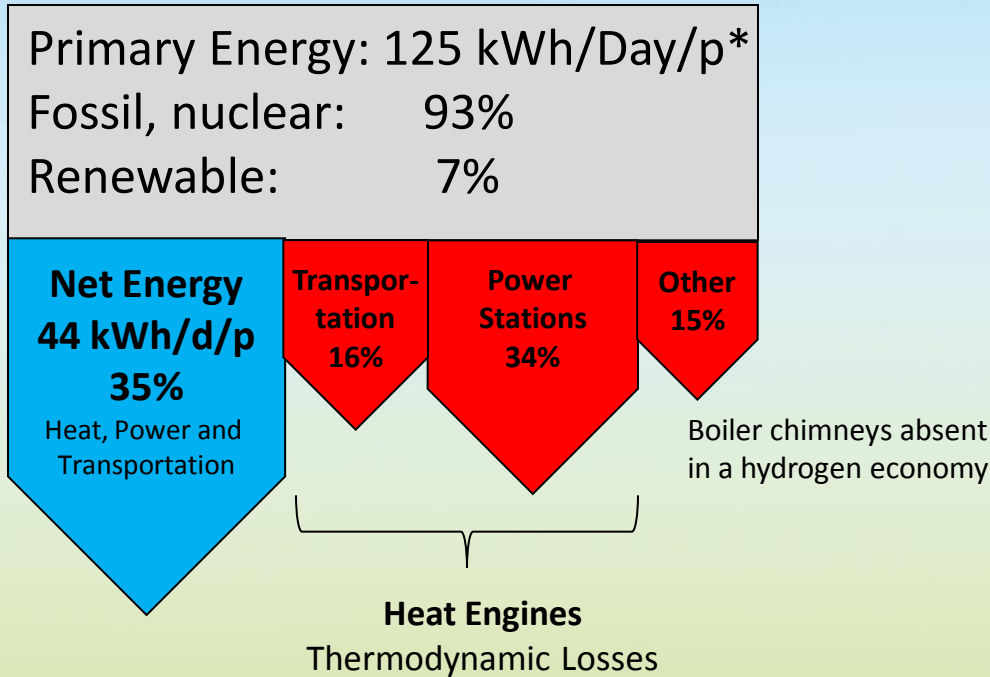
Efficiency



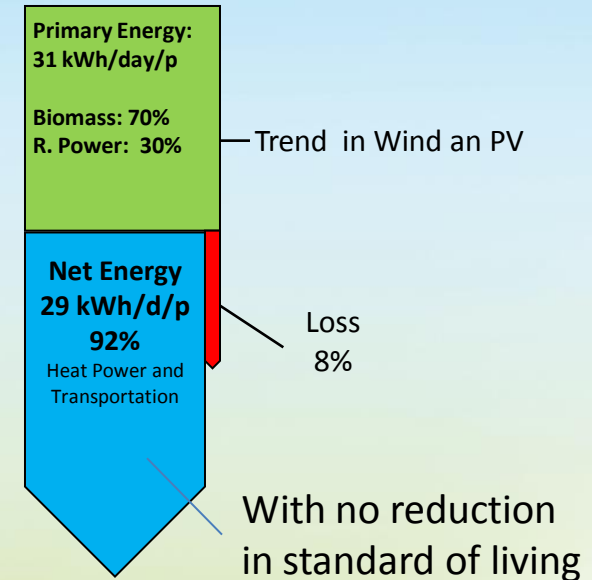
There is a big surplus of power, that will be lead to a lossless heat constrained economy

Energy Economy Today and Tomorrow in Germany

Energy Economy 2007



Hydrogen Economy 2030



Reduction of primary energy to a quarter improves energy costs and the biomass potential

*13,000 PJ/a equals 125 kWh/day among 80 million Germans
[Nutzenergie aus BWK61,6(2009) mit Korrektur: Strom=Nutzenergie (4.400+200=4.600 PJ)]



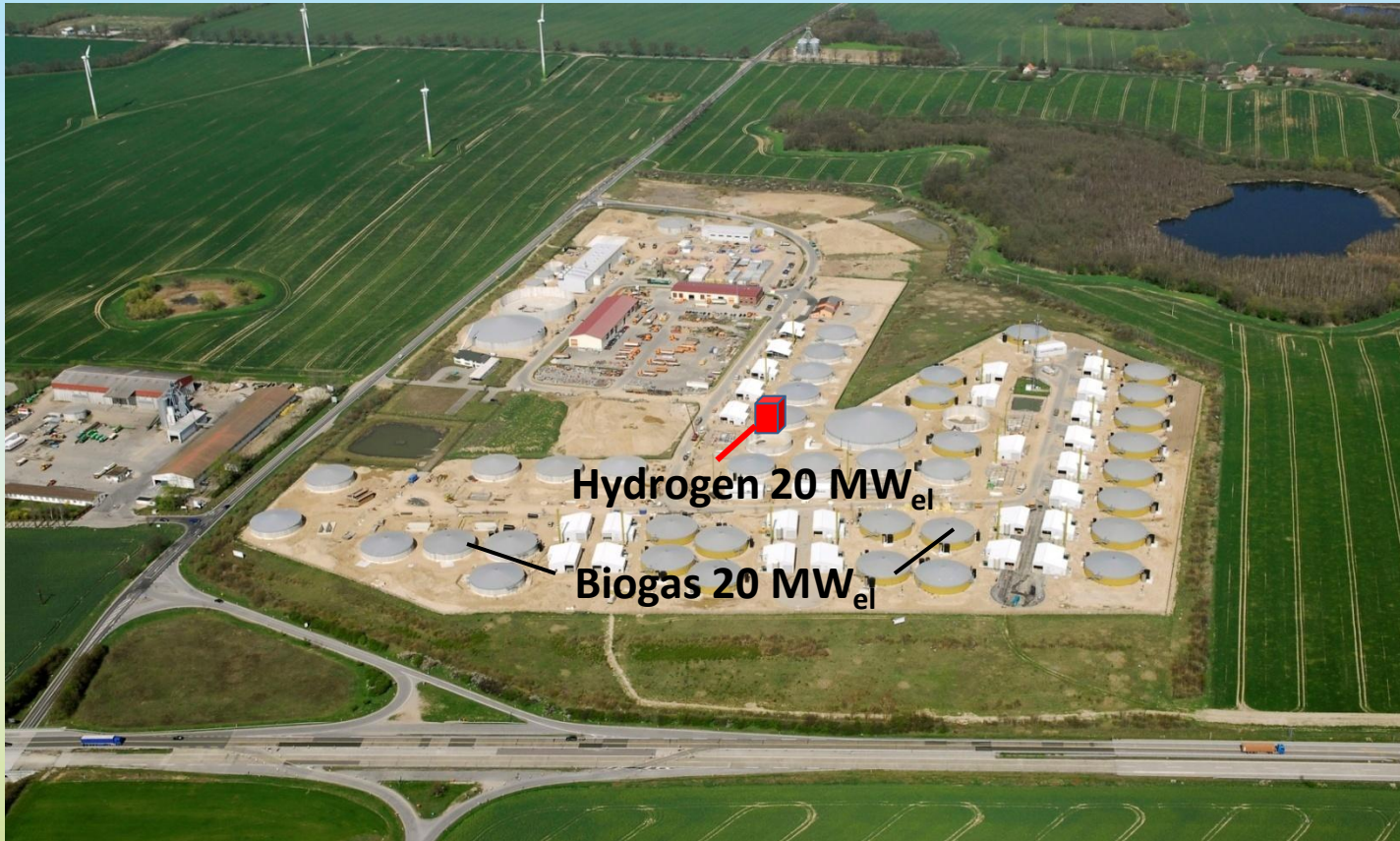
Potential of Biomass

The potential of biomass in Europe is high enough to feed everyone and also replace all nuclear and fossil energy!

In Europe we have five times more bio energy than we need



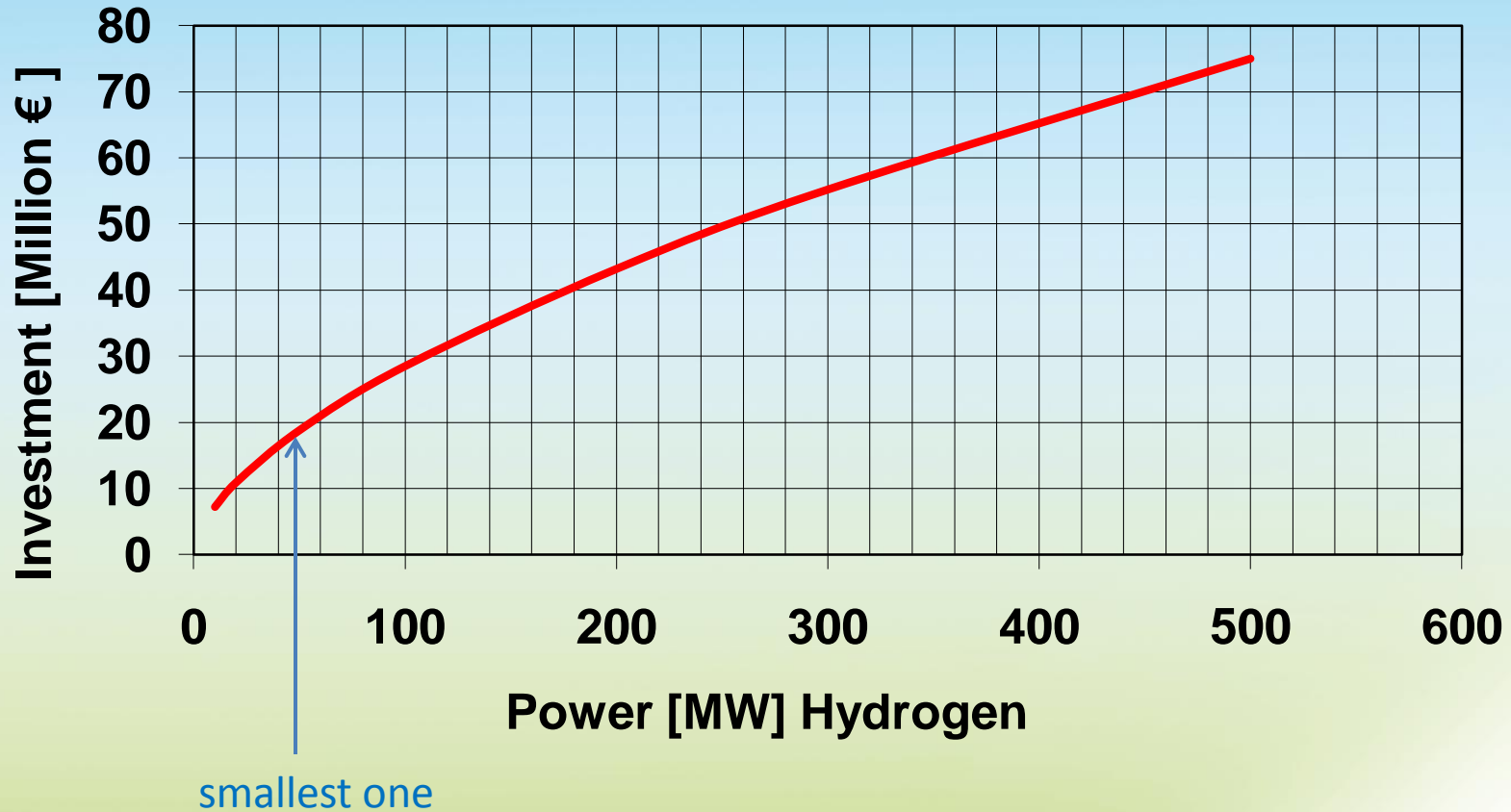
Anaerobic and Chemical Plants Compared



Projection



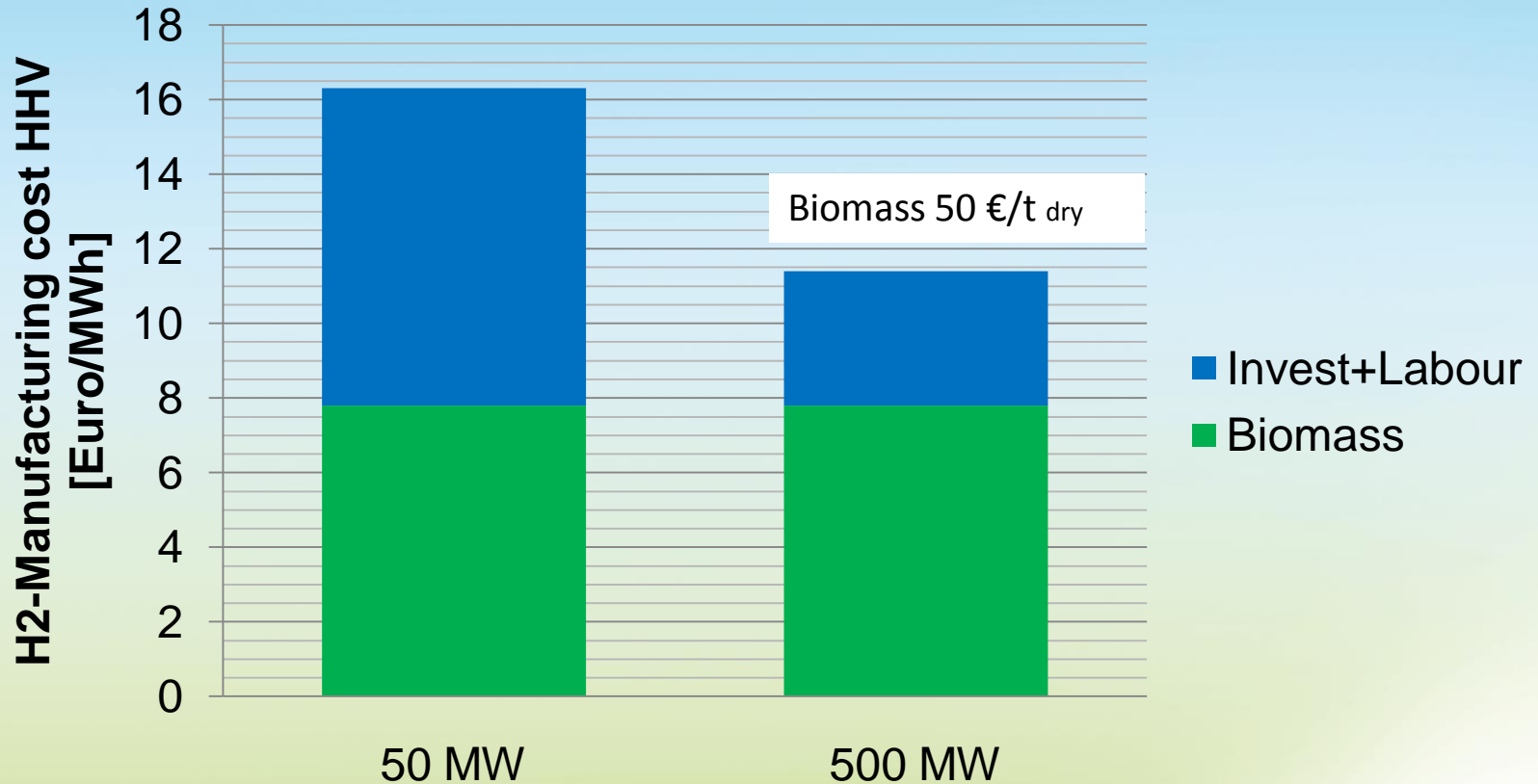
Cost of a Hydrogen Plant



To replace all fossil and nuclear energy in Germany with hydrogen facilities would cost approx €20 billion



Cost of Manufacturing Hydrogen

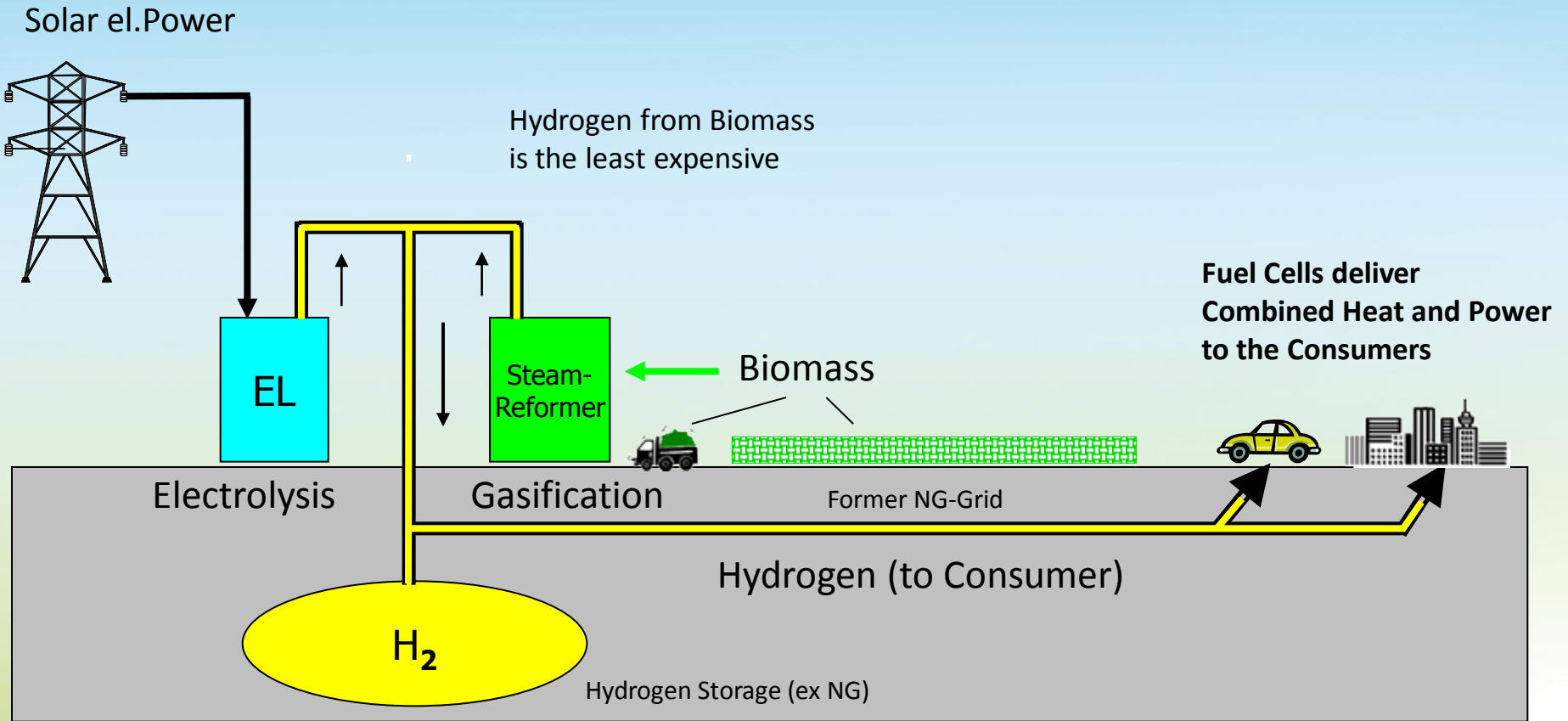


Please Note:

The manufacturing cost of the first pilot plant will be at least 30 €/MWh



Green Hydrogen Economy

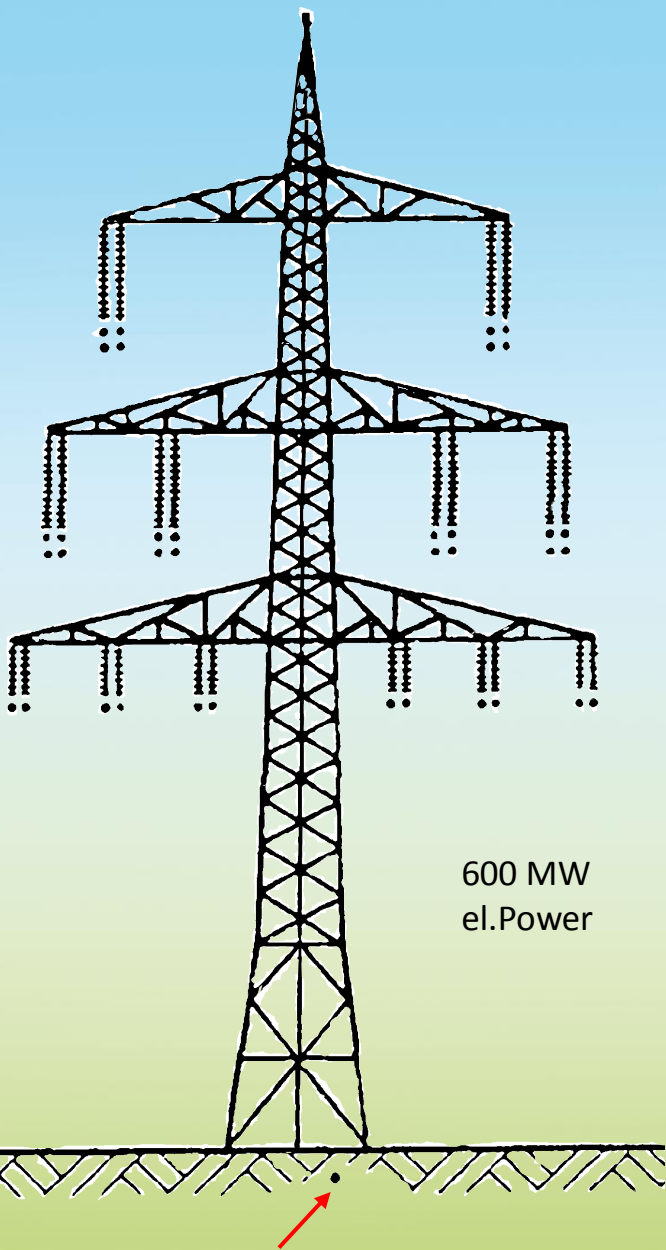


Because fuel cells deliver surplus electric power:

A hydrogen economy is more constrained by heat than power and is lossless at the consumer.



Energy Distribution



600 MW hydrogen pipeline
(drawn to scale!)

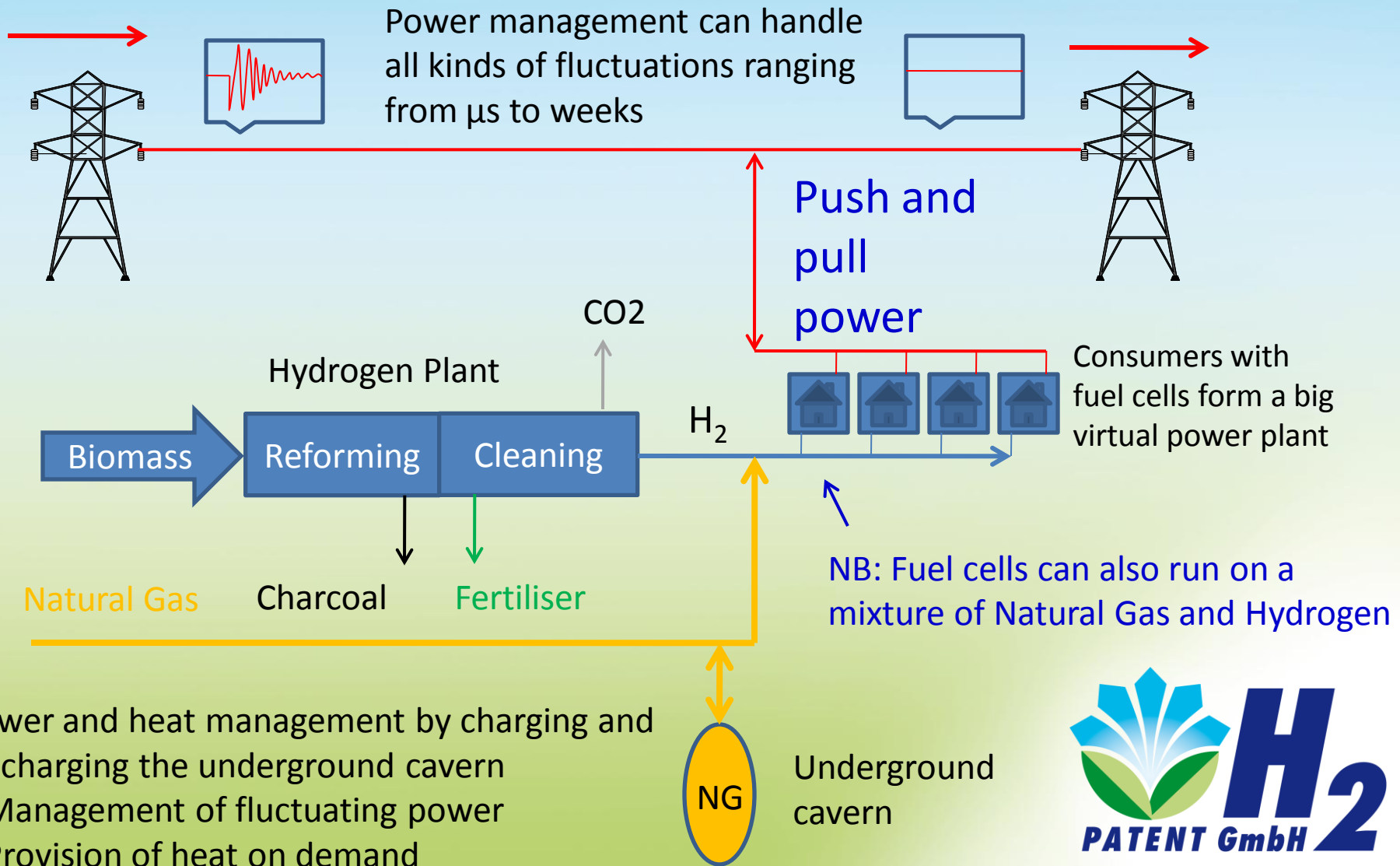
Single gas grid meets the demand for heat and power (incl. transportation).

Energy distribution by 'the grid' is 10 times more expensive than by pipeline

Pipeline transport to homes inclusive all services will be approx 7 €/MWh



Stabilising the National Grid by Hydrogen Pipeline



The Hydrogen Economy Offers



Swords into Ploughshares



Everlasting Energy

Solution of global warming to no cost

Peace and Prosperity for ever (!?)



Hydrogen Economy Offers

CO₂- Neutrality

Sustainability

Availability

Affordability

What are we waiting for?



**Thank You
for your
Attention**



Comparison

	H ₂ -Patent	D MacKay	How? Why? When?
Infrastructure	Gas	Electrical	Lower Cost
Source	Biomass	Sun +Sea +Wind +Nuclear	Energy store
Generation	Fuel Cells		Efficiency +CHP
Biomass Gasification	Huge Potential	Ignored	Forgotten?
Most Expensive?	Heat Biomass to H ₂ €11-17 /MWh	Power Offshore Wind £120-150 /MWh*	Electric Power Surplus!
Heat Pumps	Option	Yes	Efficiency
CO ₂ Sequestration	Option for cooling the planet	No	Greener!
START NOW?	H2 + Natural Gas	Build Elec.	NOW!

To replace all fossil and nuclear energy in Germany with hydrogen facilities would cost approx €20 billion



* Bourhill: www.guardian.co.uk/environment/2010/feb/22/aerogenerator-wind-turbine