

Biomass Based Hydrogen Economy

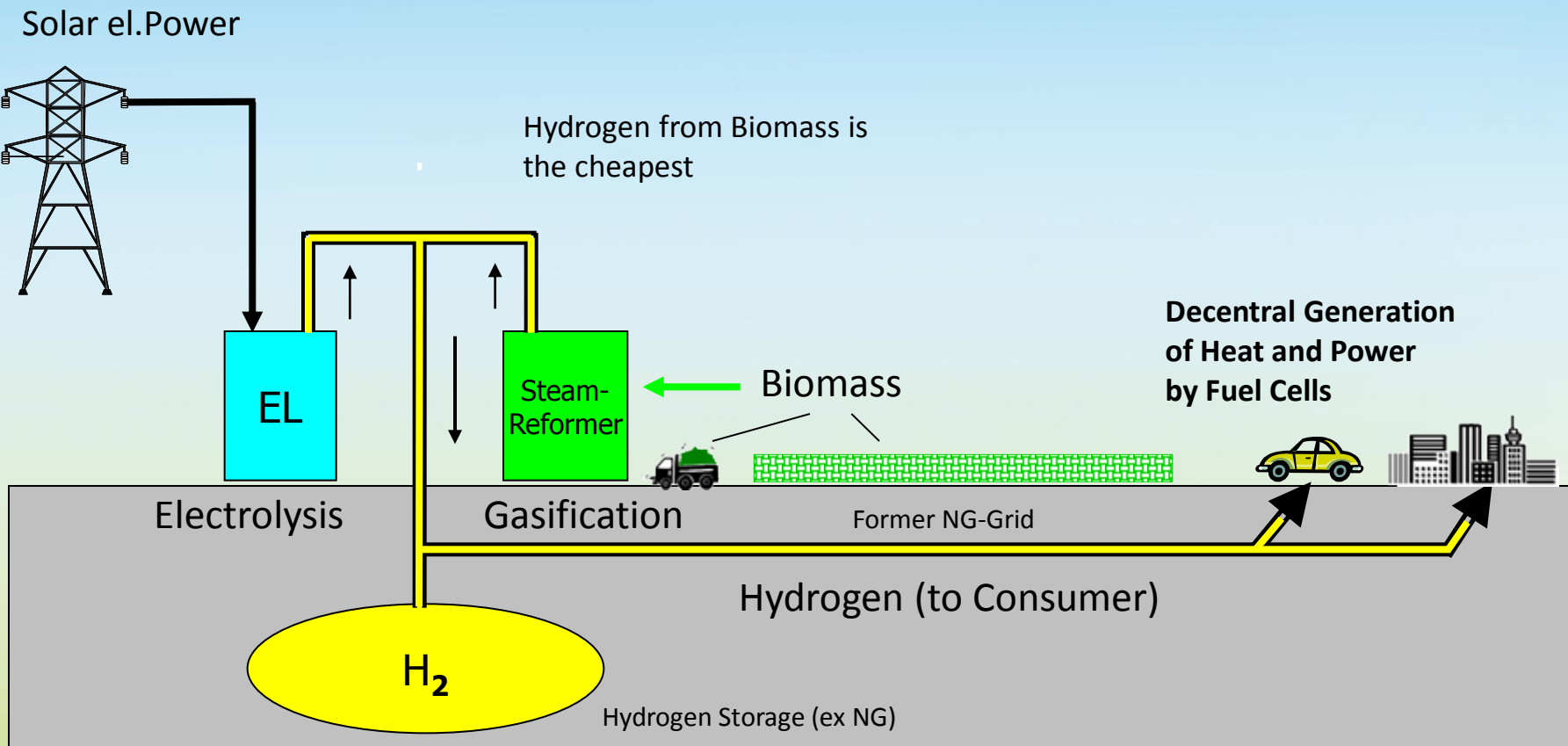
Italy

Karl-Heinz Tetzlaff
tetzlaff@h2-patent.eu
Fon +49 6195 960813

Rome, 4th Sept. 2009



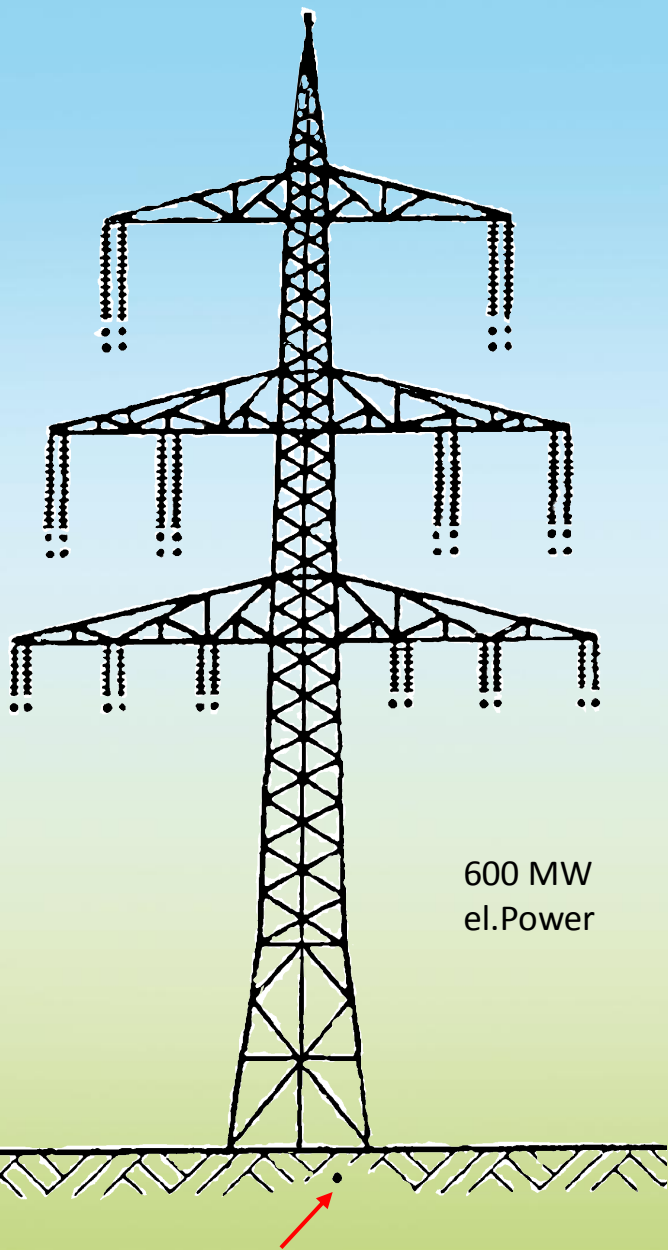
Green Hydrogen Economy



Heat guided Energy Economy: lossless on consumer's side



Energy Distribution



600 MW
el. Power

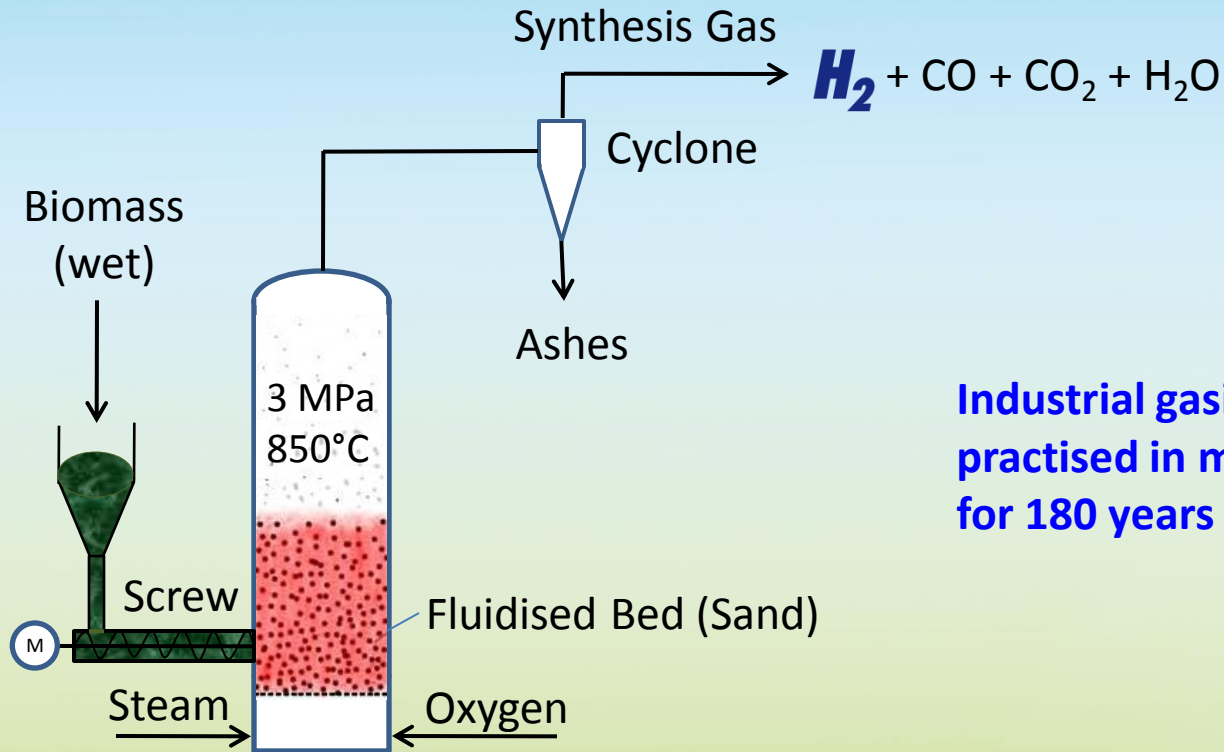
600 MW Hydrogen Pipeline
(drawn to scale!)

Single grid meets the demand for heat and el. Power (incl. Transportation).

Energy distribution per electric grid is 10 times as expensive as per pipeline



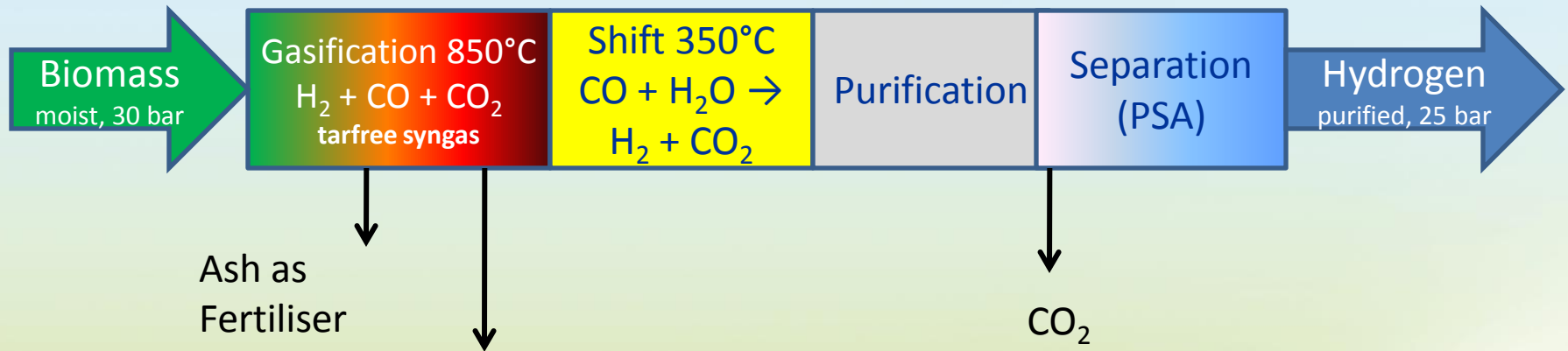
Hydrogen Production



Steam Reformer

Industrial gasification has been practised in most industrial countries for 180 years (town gas from coal).

Industrial Production of Hydrogen in Pressurised Cascaded Fluidised Bed Reactors



Option:

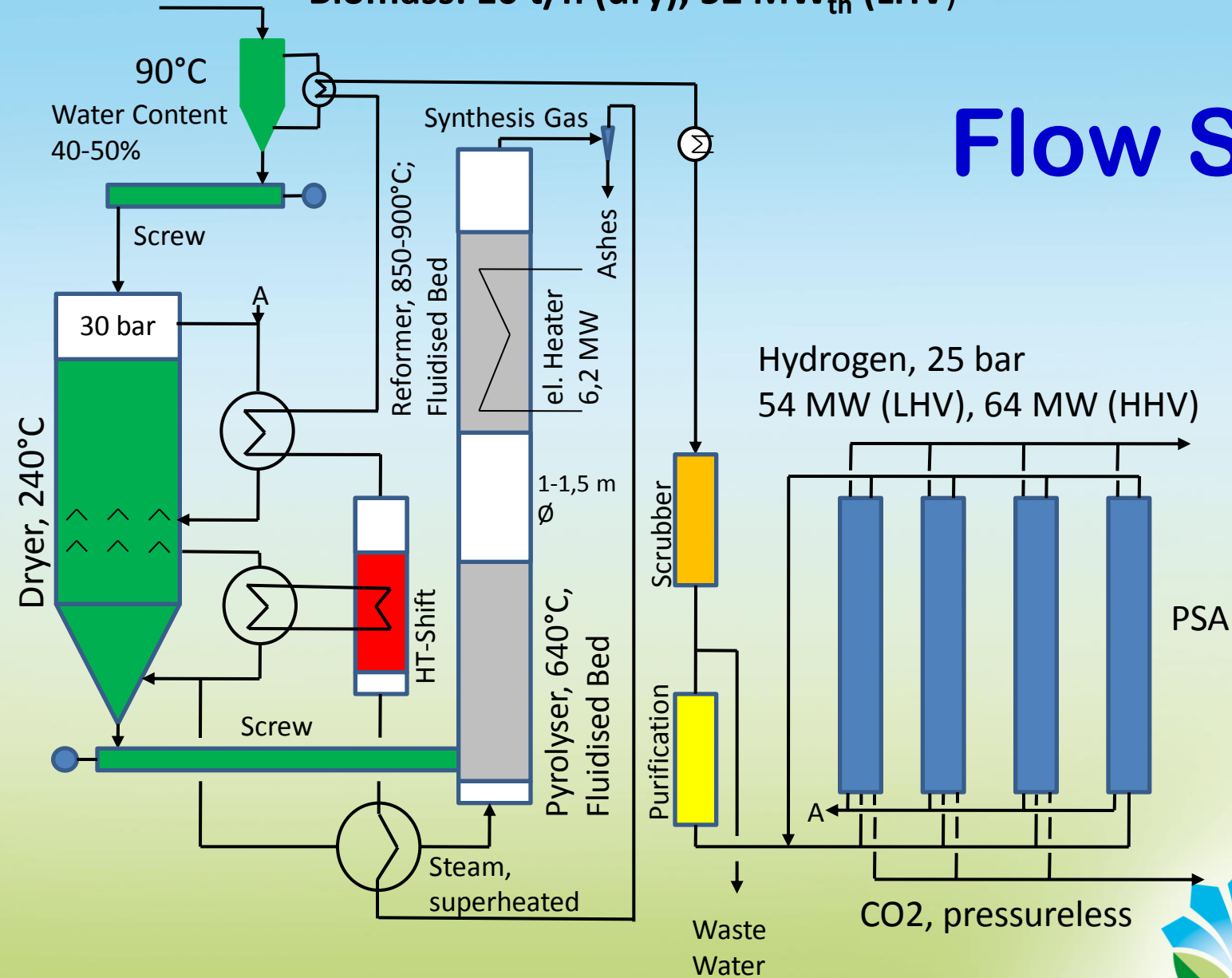
Charcoal to Improve Soil (Terra Preta)

- Turns Deserts Green
- Reverses Greenhouse Effect

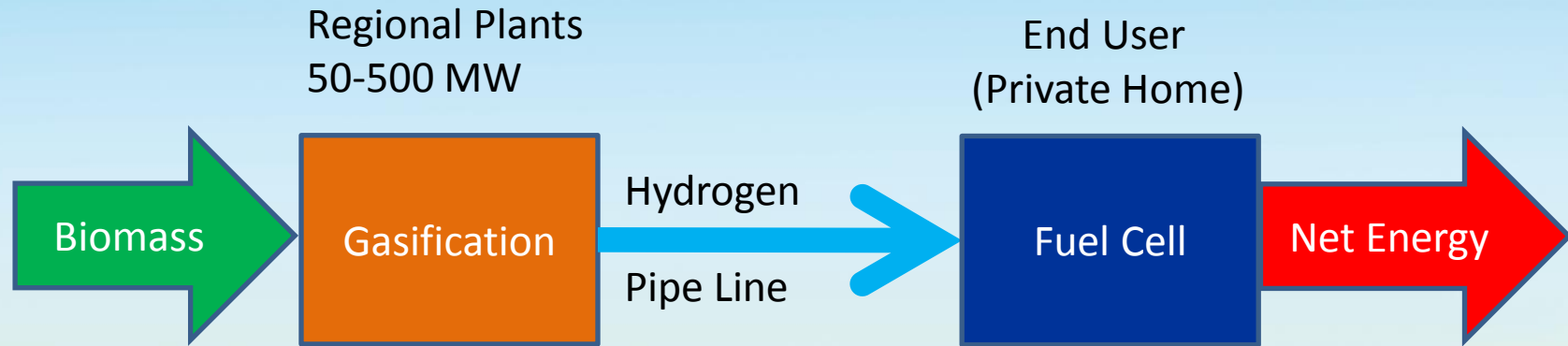


Biomass: 10 t/h (dry), 52 MW_{th} (LHV)

Flow Sheet

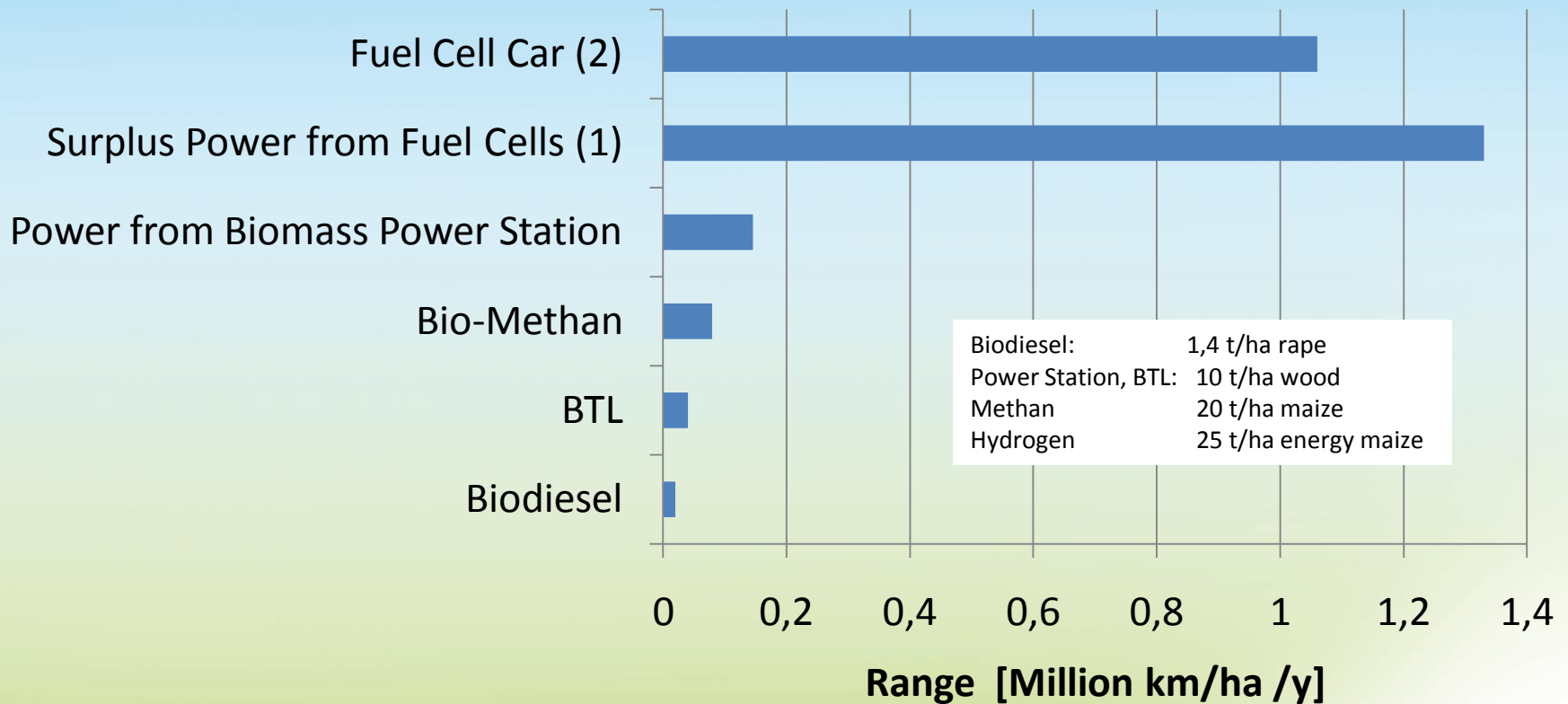


Energy Efficiency



100% to 110% of
Heating Value of
Biomass, ca. 50% as El.
Power

Efficiency of Technologies



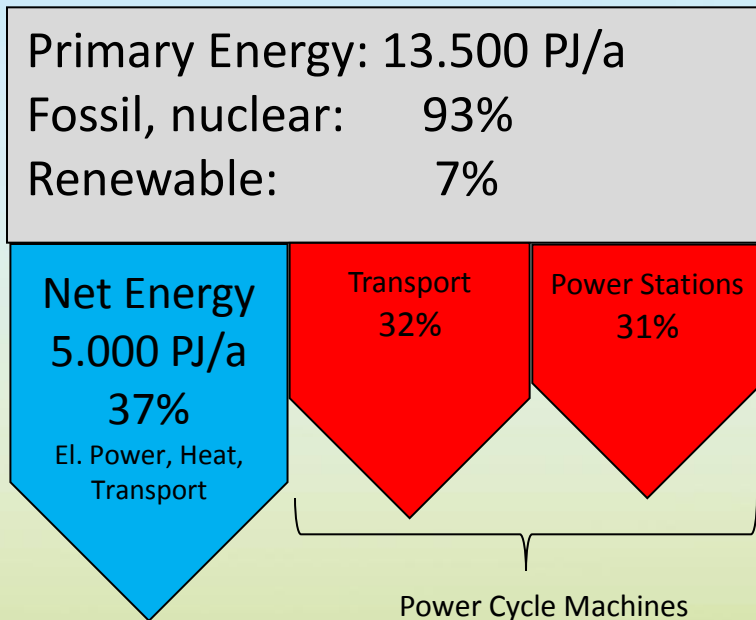
(1) Based on stored Hydrogen, the efficiency will be about 70 and 110% (NEFZ) for cars later 2020

(2) In cold winters half of this range, because car heating comes from batteries

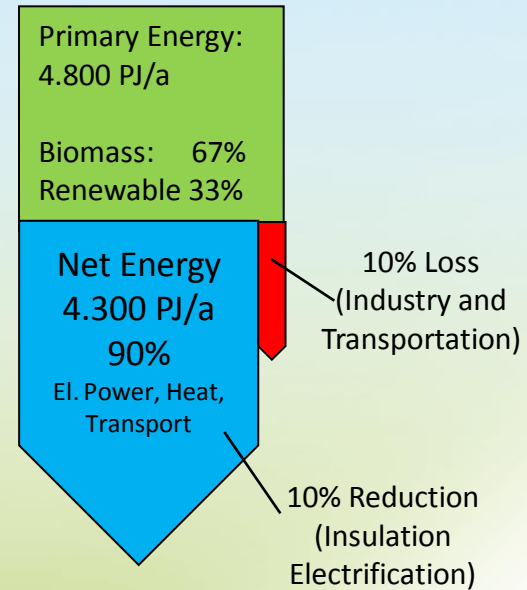


Reduction of Energy Demand, Germany for Example

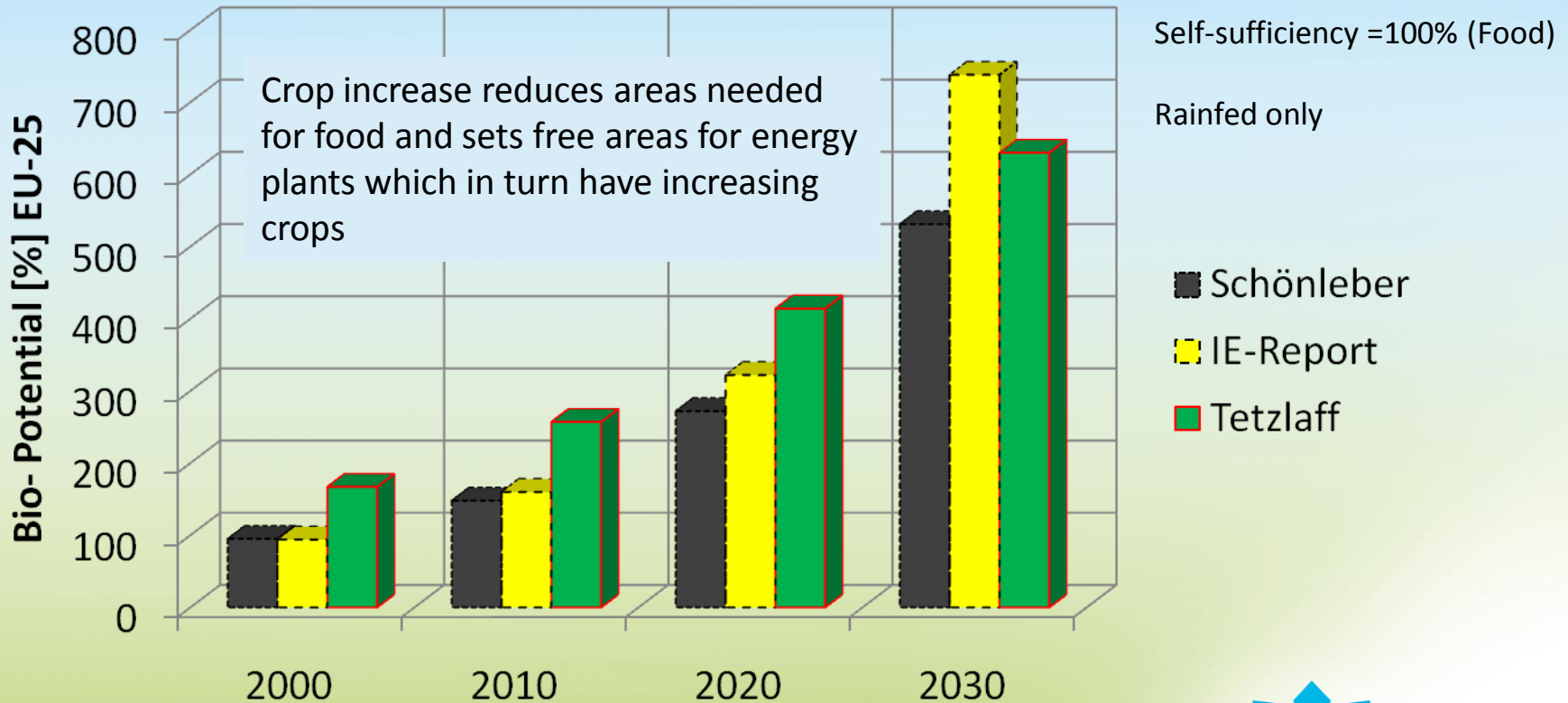
Energy Management 2007



Hydrogen Energy Management 2030



Estimation of Hydrogen Economy Potential



The biomass potential alone suffices to substitute all fossil and nuclear energies in Europe (without reducing energy consumption).



Water = Energy = Water

If you have water you can produce bio-energy.

If you have bio-energy you can produce much more water.

If you have water

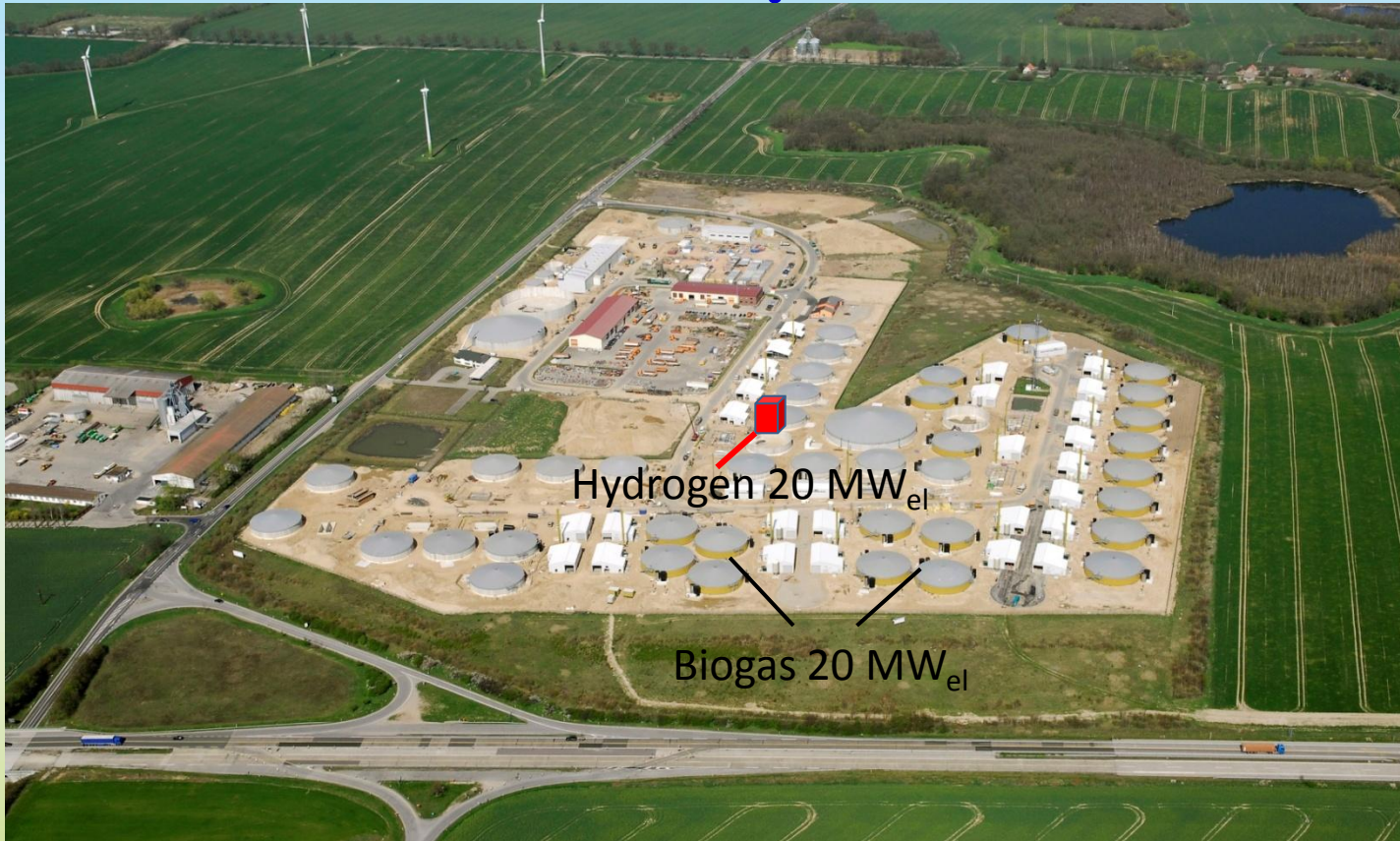


1 m³ of water produces 5 kg biomass
1,5 kg of biomass produces 1 m³ water by desalting ocean water ...

Bio-Hydrogen: a magic formula



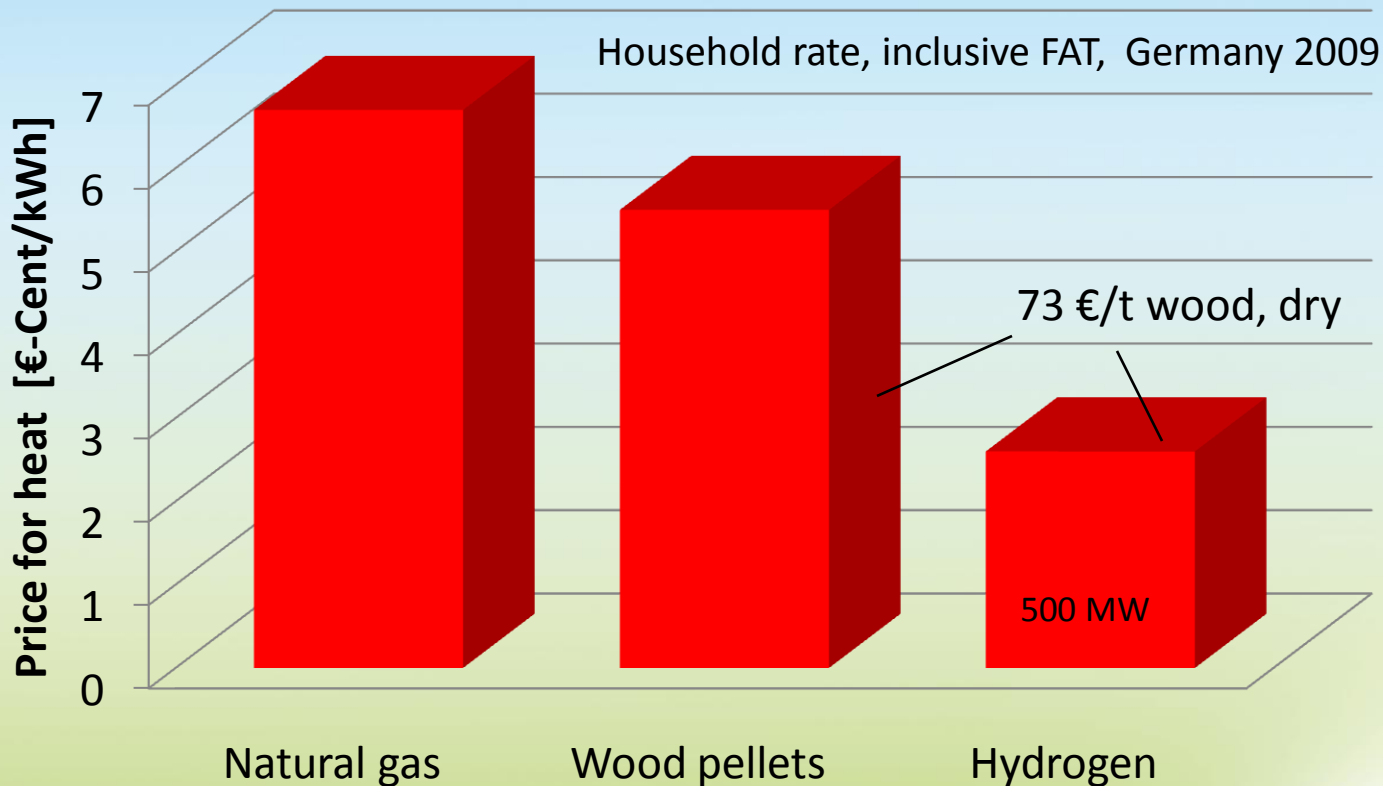
Digestive and Chemical Plants Compared



An initial assessment of investment



The Fairytale of the Expensive Hydrogen



Hydrogen: 2,6 ct/kWh for heat *and* power



How to Start

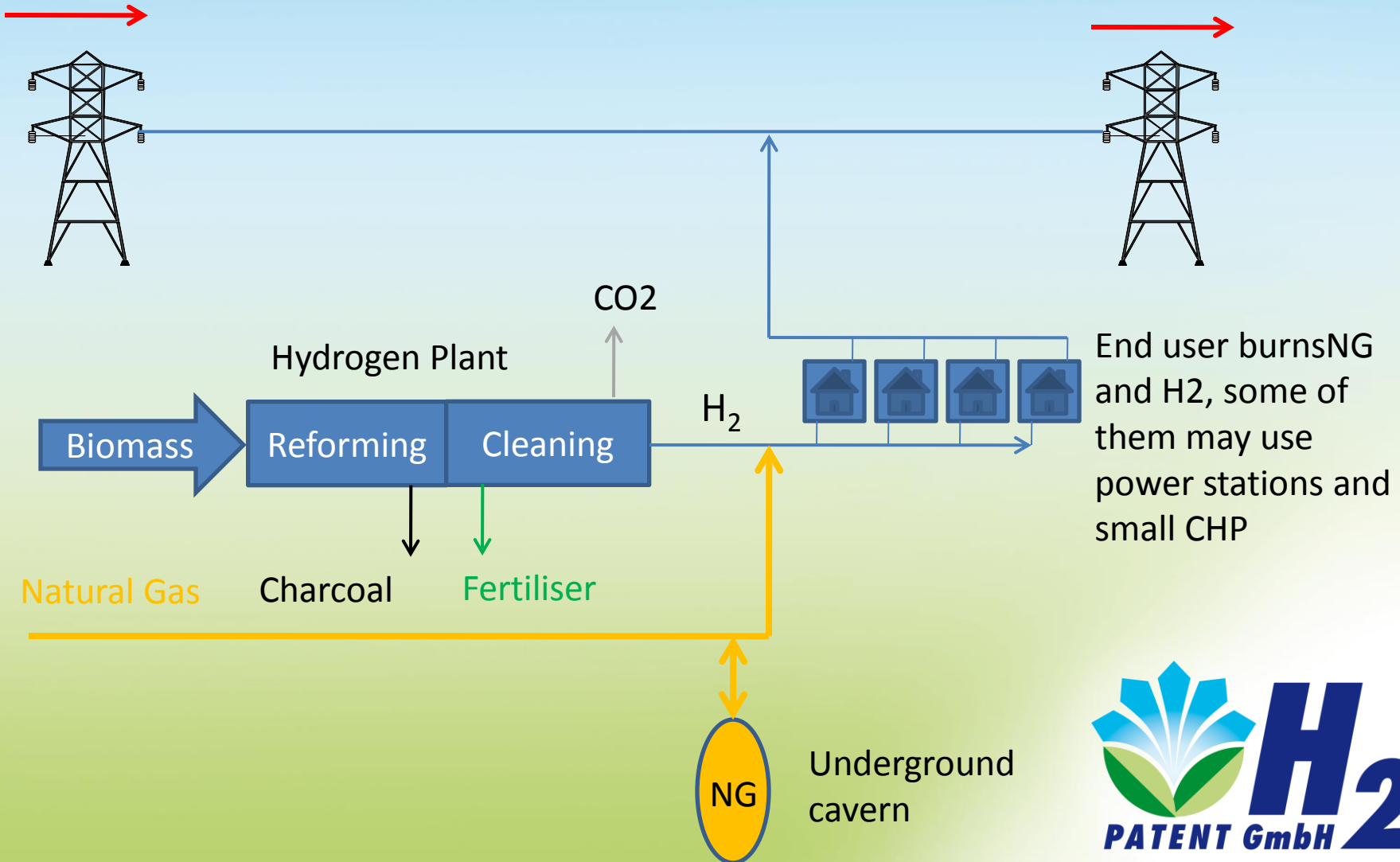
The smallest unit will be 50 MW hydrogen, sufficient for full service of a town of about 30.000 inhabitants

Two solutions:

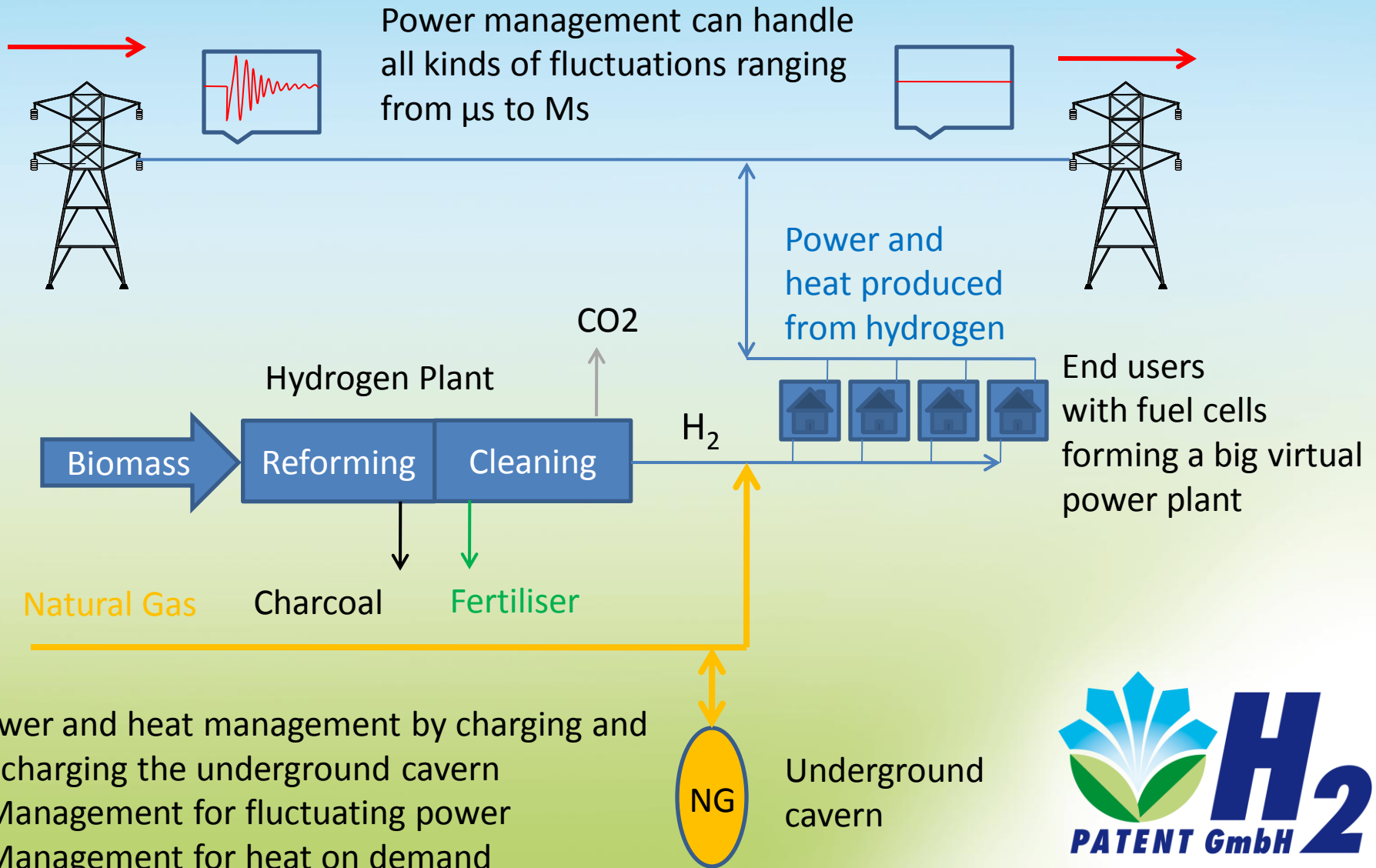
1. Hydrogen Island (Civita) with pure hydrogen pipelines working as a virtual power station with 1.000 fuel cells 25 kW_{el} each for example. In this case most of the heat will be lost, but the overall efficiency of about 50% is higher than the efficiency of a biomass power station. You need the power line if the hydrogen plant is shutting down.
2. Use of fuel cells in a pipeline network with contains hydrogen and natural gas as a mixture. In this way, a hydrogen economy can developed step by step. The loss of heating energy goes also step by step to zero. Your standby system is the power line and natural gas. This concept has several advantages to stabilize the power line in the transitional period.



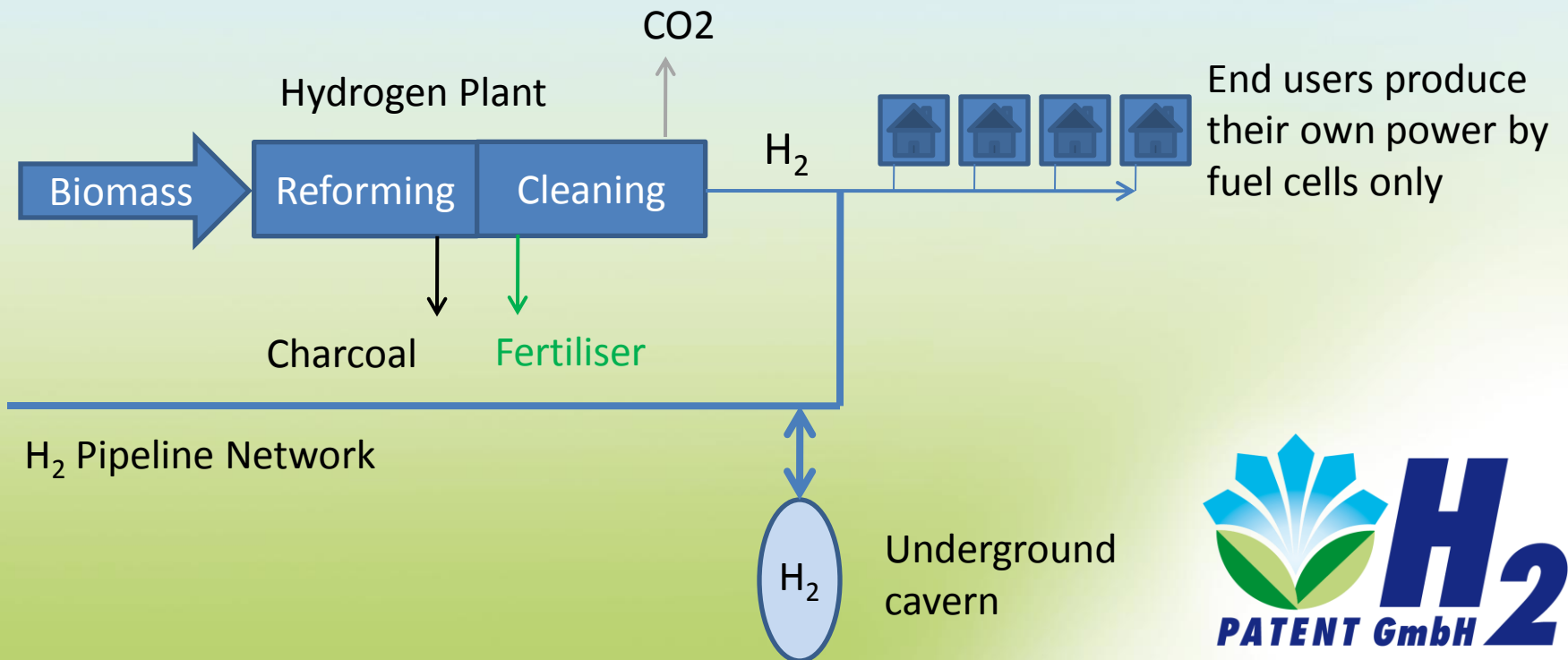
Mixed Use of Hydrogen



Advanced Power Management



Hydrogen Economy



Thank you for Attention



H₂-Patent GmbH
P. O. 13 61
Bad Iburg
Germany
www.h2-patent.eu

Karl-Heinz Tetzlaff

