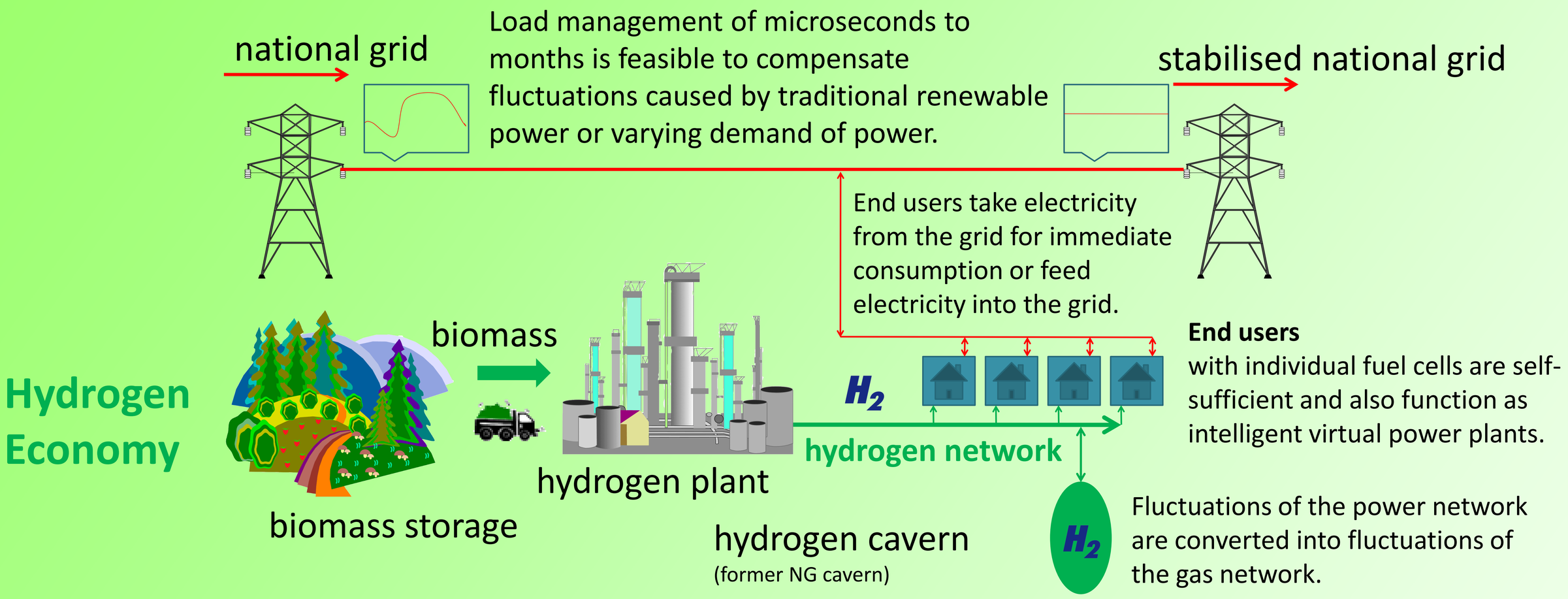
POWER GRID STABILISATION BY HYDROGEN PIPE NETWORK

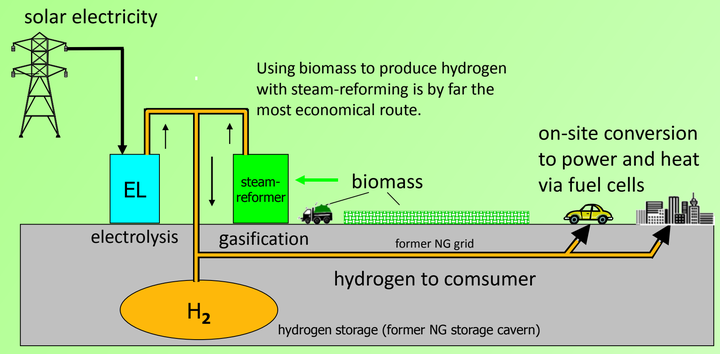
A new Idea



Stabilisation of the national grid - a synergy effect of a biomass-based hydrogen economy

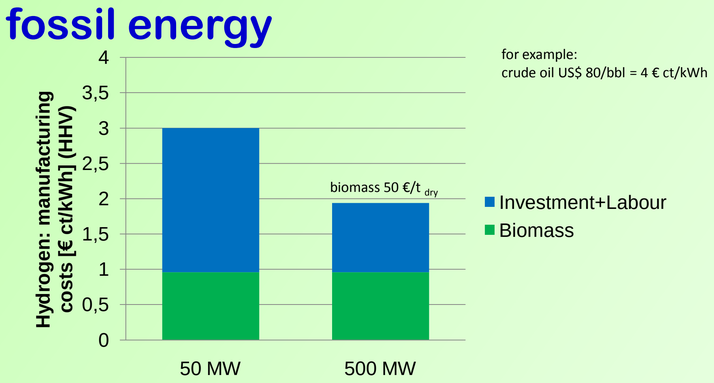
Hydrogen will be our future source of energy. The stabilisation of the power network is just one of many positive side-effects. No energy is lost and no additional costs are incurred. The system also works with mixtures of hydrogen and natural gas. Fuel cells can, with the right know-how, operate with these mixtures. A hydrogen economy itself is absolutely competitive to today's energy supply, even without subsidies.

Genuine hydrogen economy



- Systematic excess of power leads to a heat-guided economy without losses

Bio-hydrogen is cheaper than fossil energy

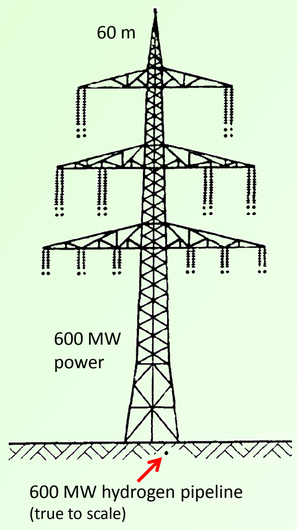


for example:
crude oil US$ 80/bbl = 4 € ct/kWh

Household tariffs would be 0.7 ct/kWh higher than the actual costs of production (well-to-door costs). **Power,** respectively heat will then cost 2.7-3.7 ct/kWh.

A 50 MW plant can fully serve more than 20.000 homes (heat and power).

Cost of delivery well-to-door (Germany)

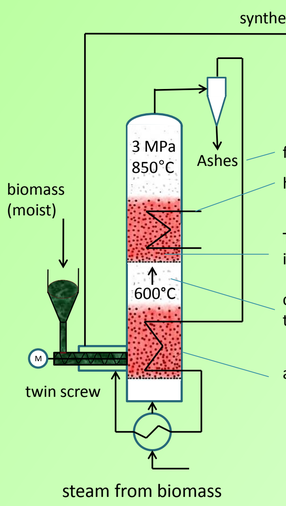


Hydrogen = 0.7 ct/kWh
Power = 9.3 ct/kWh (2009, Germany)

Examples for production plus delivery costs:
Power generated by individual fuel cells
= 3 + 0.7 = 3.7 ct/kWh

Power generated by existing nuclear stations
= 2.5 + 9.3 = 11.8 ct/kWh

Tar-free hydrogen



$H_2 + CO + CO_2 + H_2O$, tar free

The Shift-Reactor converted:

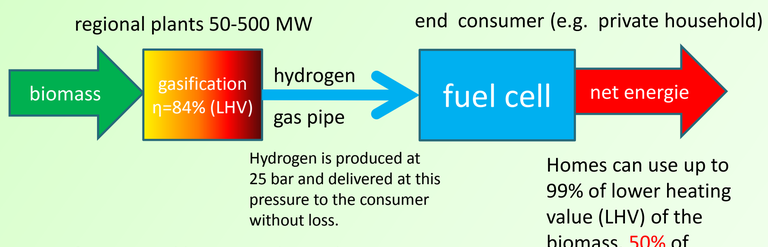
$CO + H_2O \Rightarrow CO_2 + H_2$

fertiliser ashes
heater or oxygen
Tar particles are destroyed in the hot bed of charcoal
charcoal particles move with the pyrolysis gas to the next level
about 1 m diameter for a 50 MW plant

Wood:
$C_6H_9O_4 + 8\ H_2O \rightarrow 6\ CO_2 + 12{,}5\ H_2$ (allotherm)
$C_6H_9O_4 + 1{,}1\ O_2 + 5{,}8\ H_2O \rightarrow 6\ CO_2 + 10{,}3\ H_2$ (autotherm)

This is an endothermic reaction with principally no energy losses.

Efficiency of the energy chain

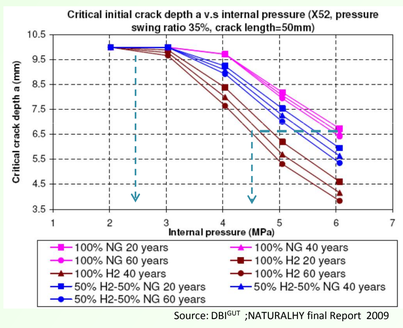


Hydrogen is produced at 25 bar and delivered at this pressure to the consumer without loss.

Homes can use up to 99% of lower heating value (LHV) of the biomass, 50% of which as power.

Price of power and heat are identical in a heat guided economy.

Hydrogen in natural gas pipelines



Consequences
Shorter inspection intervals or pressure drop by about 25%. Alternatively, the addition of <500 ppm oxygen.

A hydrogen economy is a regional gas economy. Pressures above 2.5 MPa (25 bar) are not needed. Therefore hydrogen embrittlement is not to be expected.

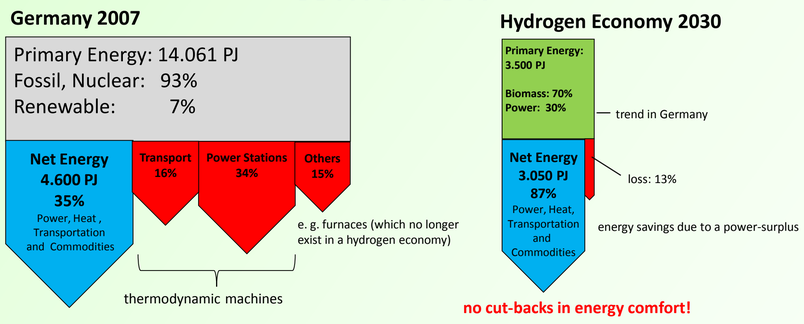
When switching from natural gas to hydrogen, the losses incurred by leakage will drop from 0.1% to 0.04% in relation to the transported amount of energy.

Investment for a hydrogen economy in Germany

The complete installation of an absolutely sustainable hydrogen economy for Germany would cost about € 40 billion*. This is a one-off investment! Please bear in mind that the same amount is at present being invested into our energy infrastructure year after year.

* Including full environmental and climate protection

Energy consumption today and tomorrow



In a future hydrogen economy, the demand for primary energy is reduced to a quarter - at the same level of comfort.

Biomass potential

Experts largely agree that, based on the present structures in Germany, biomass can in future contribute about 20% of the overall energy demand. The calculation thus is: 14,000 PJ x 0.2 = 2,800 PJ.

Note: as shown left, a biomass-based hydrogen economy would need approx. 2,500 PJ (70% of 3,500 PJ) to replace all nuclear and fossil energies.

In summary, there is sufficient potential of biomass and no threat whatsoever to food-producing agriculture.

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