POWER GRID STABILISATION BY HYDROGEN PIPE NETWORK

Karl-Heinz Tetzlaff and Dr. Wolfgang Wendel ~ H_2-Patent GmbH ~ Post Box 1361 ~ 49182 Bad Iburg ~ Germany ~ info@h2-patent.eu

Power grid stabilisation becomes elaborate and costly as the fraction of fluctuating power fed increases. In Germany, the common practice of employing fossil back up power stations for stabilisation purposes reaches limits. This approach and other methods suggested so far of solving this problem are expensive und lossy.

For this reason an alternative solution is presented which incurs little additional cost and no loss of energy. It is suggested to amend the power grid by interlinking fuel cells to an additional hydrogen grid. This permits CHP to be established converting half of the hydrogen energy to heat and half to power. In private homes the subsequent excess of power thus produced could be utilized for heating via immersion heaters. The fuel cells in this setting must be designed to meet the maximum heating performance.

The hydrogen grid in question already exists: it's the natural gas grid. This can be adapted to a hydrogen grid without essential modifications.

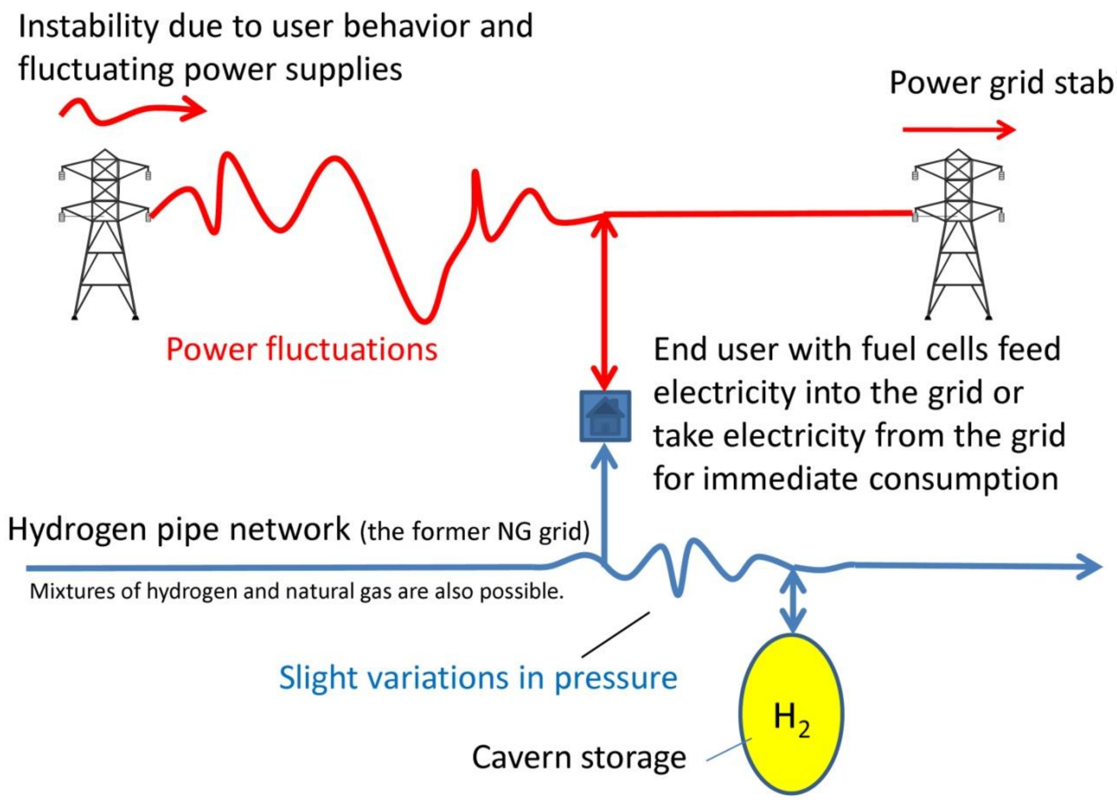

Fig. 1 Grid stability by adding a hydrogen pipe network with lot of fuel cells

If the grid power decreases the end user can supply electricity produced by fuel cells to boost the grid. Temporarily, FCs can produce up to ten times the nominal FC performance. The power available to stabilize the grid equals the total heat performance of all end users. Because the latter is normally a multiple of the power demand, more than the nominal grid performance can be made supplied.

In case of excess of power in the grid the end user could utilize it to meet his energy demand including heating.

In contrast to fuel cells requiring preceding fuel reformation, hydrogen fed fuel cells are extremely swift as they are able to increase or reduce their performance within microseconds. The concept presented can therefore level out both momentary disturbances as well as supply power over months and years. Although part of the hydrogen required for this could be provided by hydrogen stored in the grid itself or in caverns the major contribution would have to come from capacity reserves of hydrogen plants. This is much cheaper. The storage medium in that case is biomass i.e. stored sun energy. With a hydrogen grid existing, there is no necessity to level out major long-term disparities to the split of a second. There is weeks of time for this. For stabilizing the power grid, few hydrogen producing regions in the country suffice.

Presently, the production of hydrogen from atomic or fossil sources is not competitive. By far the most economic route is the generation of hydrogen by thermochemical gasification (850^0C) of biomass. The process is well understood, but some optimisation is still required.

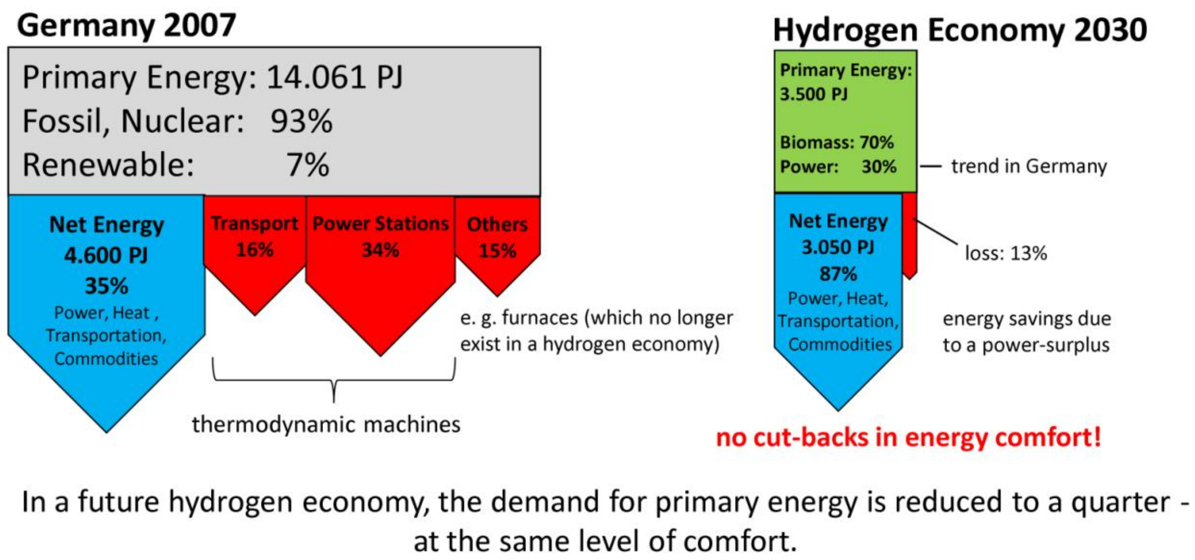

Fig. 2 Energy economy today and tomorrow in Germany

Since a biomass based hydrogen economy cannot be implemented over night, it is reasonable to continue to expand the renewable energies as hitherto. Assuming that in 2030 renewables account for 50% of power production, biomass would have to provide 70% of the country`s total energy supply (Fig. 2). This yields an energy economy featuring a portion of electric power of 60%. As we are dealing with a heat led system the subsequent excess of power this is neither lost nor expensive. The primary energy required will drop to about a quarter of its present value. Conversely, it follows that gasifying biomass to produce hydrogen and converting it in FCs increases the energetic potential of biomass by a factor of four compared to conventional combusting. This would allow all atomic and fossil energies to be substituted. Since biomass doesn`t cost more than fossil energies today, there is going to be a corresponding general decrease in the cost of energy. This holds for Europe and many countries in the world. In Europe in 2030 there could be ten times as much biomass available for energetic use than is going to be needed without the production of feed and food being affected. The year 2030 is chosen because it is estimated that a hydrogen economy would take that long to be implemented. The amount of biomass then available for energetic purposes is going to be higher than today because the harvest continues to increase allowing more biomass, the yields of which also augment, to be grown.

The effect of excessive availability of biomass in a hydrogen economy is that prices for food and biomass will not depend on the price of crude oil or NG. This would be the case by present methods of using biomass which only permit 15 -30% of the energy demand to be met. The extension of alternative renewable energies (wind turbines and photovoltaic's) to meet total energy demand within the next 10 – 20 years is unaffordable. The complete installation of a hydrogen economy in Germany is estimated to require an investment of 40 bn €. This sum is presently invested every year without being able to escape the oil-, climate- and cost-trap.

The biomass based hydrogen can be implemented without state subsidies. The stabilisation of the power grid is in this case only a synergy effect, no additional investment being necessary. Moreover, the stabilisation of the power grid incurs no loss of energy. The only requirement is an intelligent management of a multitude of fuel cells as a virtual power station.

For a transitional period it may be advantageous to blend hydrogen and natural gas. This could help in case of only a single hydrogen plant existing to permit falling back to the original system. Mixtures of NG and hydrogen can be charged to simple low temperature fuel cells (PEM) if NG is conditioned for FC application. The grid stabilisation is also achievable in this way.

The core idea of the concept presented is to show how an effective and cheap power grid stabilisation is achievable, thereby removing the greatest obstacle to further extension of alternative renewable energies without additional storage facilities having to be implemented.