global-e





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Give Power to Hydrogen for a Green Future

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Roland Benedikter and Ingrid Kofler make a compelling argument for "Re-Globalization," offering a five-fold menu of options. Indeed in my view we must first and foremost *reframe* globalization as we know it. This is because the global energy question in relation to the environment and more generally to nature, the only truly global whole, will create a new framework for all other questions that are important for the world's future. It creates a new point of reference and shifts the scale of problems, making some appear bigger and some smaller than we perceive them now. Energy sustainability will be one decisive transformer of globalization practices, and increasingly influence the theory of globalism, too. This essay argues that hydrogen energy can and will be one of the main drivers of globalization's sustainable renewal. It should be used to reframe global energy priorities, at least for those who deal strategically with them. Why?

Energy is the basis of life and of everyday life. The world of microbes, plants, animals, humans, and human societies all need energy in a variety of forms. There are five global problems that need to be solved, all of which are fundamentally linked to the energy issue: 1) Climate change requires technologies without greenhouse gases; 2) Renewable energy sources will only be able to replace fossil energy sources if they are available 24/7; 3) Mobility without fossil fuels demands fundamental changes in transportation logistics; 4) Regionalization to balance borderless (and sometimes ruthless) globalization needs better and more systematic use of regional and local resources; 5) Recycling presents a huge challenge to save raw materials for a sustainable globalization.

These five crucial global problems have not been taken into account sufficiently by

the globalization project we have known over the past 30 years. All five are related to a reorientation of our existing energy concepts. The demand for energy of all kinds is increasing rapidly, at the same time that global population growth and its negative effects are also on the rise. Action is required, starting at the applied regional level. Hydrogen power can be part of this regional solution.

The challenge can be elucidated by looking at a satellite image of the earth at night. The points of light show the places of maximum energy consumption, namely the areas of large population density with strong technological development. Every single point of light is fed by a primary power source—almost exclusively with fossil fuels, whose finite availability is slowly becoming common knowledge. The technical efficiency of each light source with respect to its energy source is considerably less than 1% and, while we are proud of the technical mastery of energy supply, in reality this is an enormous swirling drain as more than 99% of the energy is lost in the form of radiated heat, which contributes significantly to the warming of the earth’s atmosphere.

A complicated network controls this system of energy production, distribution, and consumption, involving an unbelievably high consumption of raw materials to keep the system going. Digitization is becoming the biggest consumer of energy, and the countries that want to achieve a level of technological development equal to the most developed societies have the highest birth rate—all future energy consumers. This development is anything but sustainable.

Experts are looking for solutions and thinking about technical improvements to the existing system. Everything they propose is based on the existing structures, with the aim of achieving improvements in three stages: reducing energy consumption, improving the efficiency of equipment and machines, and finally replacing fossil fuels with those from renewable sources.

These three steps, taken in this order, are correct. Nevertheless, there is no doubt that they still involve serious challenges that need to be addressed. These include:

• Less consumption means less revenue for energy producers and less tax revenue for governments; the easiest way to compensate for this is through higher taxation.

• As more energy-efficient appliances replace the older, still mostly functional appliances, it boosts technical development and therefore the overall economy, but at the same time the manufacture of these appliances consumes more raw materials, including new raw materials such as rare earths. Recycling old equipment is still in its infancy.

• Replacing fossil fuels with renewable sources of energy reveals the fact that they are not eligible for baseload[1] if they are not available for use 24 hours a day, 365 days a year.

Modern societies cannot handle the pending necessary changes in these and other areas with our conventional systems. We must look for new ways—yet we do not want to forgo our quality of life, because this would lead to increased social tensions (not easy!).

Production and Storage Issues

The production of electricity by coal-fired power plants cannot be adjusted to the rapidly fluctuating demand in the course of a day since their output is not controllable as required, which has necessitated the intermediate storage of the surplus by pumped storage plants and the re-flow of cached energy. However, pumped storage power plants are dependent on corresponding differences in altitude in mountain areas, where water is pumped into production facilities using surplus electricity and, leveraging gravity and the local gradient, is converted back into electricity. Such facilities only become profitable for installations above 500 MW. They also need strong power lines for the supply and transportation of electricity. Significant interference with local habitats and high raw material consumption are the weak points of this technology. Coal-fired power plants are phasing out. Electricity production can be better controlled by gas-fired power plants and adapted to demand, which means that pumped storage power plants have become less important.

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With greater reliance on renewable energy sources, their use for electricity production depends on different kinds of external factors: without sunshine,

photovoltaic production does not work; without wind, wind turbines do not produce. On the other hand, existing primary resources such as sun or wind can often generate too much power, which is then lost unless it can be stored and used on an ad hoc basis. These losses are up to 80 percent for PV systems and up to 50% for wind turbines.[2] Pumped storage tanks are not the solution here, because wind turbines are most efficient in lowlands or near the sea, while PV systems are most efficient in locations of high solar radiation. New and larger power lines do not solve the problem either because they are not storage media.

In this situation, hydrogen offers itself as an efficient solution to power storage, because it has the following characteristics:

• It can store electricity in any dimension, from a few kW to the GW range, stabilizing the power lines.

• The electrolysis systems are flexible, efficient, and feasible on any scale.

• Storage facilities can be installed anywhere, preferably directly at the production site; therefore they do not need a new power grid and can be back-flown at the site. They can also be installed at the point of consumption, which stabilizes the power load at the consumption site.

• None of these facilities imply any considerable interference with local natural habitats.

• Excess hydrogen can also be used for stationary installations and for transportation systems.

• Capillary installation of any size increases the efficiency of renewable energy sources and reduces their losses to a minimum.

• Such systems can work in the daily rhythm like pumped storage, but hydrogen can also serve as a buffer for the long term, even in the annual cycle, thus opening up new application possibilities.



Enel hydrogen power plant in Fusina, Italy.

Besides these purely technical considerations, economic factors must be taken equally into account. Hydrogen must come from renewable energy sources, first and foremost to capture and use the surplus. Renewable energy sources are present everywhere in some form, but especially outside the large human settlements. This also means that energy production on the basis of hydrogen power will be highly decentralized; not just large-scale, but many medium-sized and small plants will be possible, with potentially profound economic and social implications. For example, outside the large settlements, new energy suppliers are emerging and new skilled jobs are being created in peripheral and rural areas. This will reduce the necessity to move to cities for qualified jobs. With hydrogen production, the value added remains in the domestic economy as no money is spent on the purchase of fossil fuel-based energy and the absolute dependence on politically unstable oil countries is reduced. Regional added value and purchasing power increase, leading to stronger regional

integration. New applications will be cheaper, even for developing countries, helping them avoid repeating the same energy economy mistakes we made. Finally, and not least, CO_2 emissions no longer accumulate, leading gradually to a strong overall reduction in negative climatic effects.

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By solving the question of the efficient use of renewable energy sources in all of its facets through the development of hydrogen power, we see solutions to the above-mentioned global problems. First, climate change is reduced by using technologies that produce no greenhouse gases—no CO_2, no CH_4, no toxic substances, and no production-related energy / heat losses. The needed renewable energy sources are available 24 hours a day, while excess production is stored in the short and long term, and thus is not lost (recycling!). Mobility is given a new orientation away from fossil fuels, providing opportunities for changing traffic logistics and for moving society from private to public transportation. Regionalization gains value by harnessing regional and local resources, becoming an equal partner in globalization. Finally, hydrogen can also be considered as a form of recycling, a by-product of surplus electricity, thus making a major contribution to saving raw materials.

Overall, in the coming years globalization will be decisively reframed through the lens of future energy needs and supply in an increasingly crowded and energy-hungry world. A new technology such as hydrogen power can provide efficient solutions to the global energy crisis, and has the potential to reframe globalization’s perspectives in decisively forward-oriented ways. Why wait until globalization as we know it breaks down due to unsustainable energy consumption and the irresponsible energy use of the past decades?

Notes

1. Baseload means electricity available 24 hour/day. Renewable energies usually are still not working all day long, e.g. photovoltaic works only during sunshine, overproduced electricity during daytime and storage can be used during nighttime. The same is valid for wind- produced electricity later applicable during wind calm periods. With intermediate storage they became so-called baseload electricity.

2. Tractebel-Engie and Hinicio. “Study on early business cases for H2 in energy

storage and more broadly power to H2 applications.” Final Report June 2017; funded by FCH JU (Fuel Cell Hydrogen Joint Undertaking), supported by the European Commission, Brussels.

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