METHANOL

CENTRAL BUILDING BLOCK OF A SUSTAINABLE ENERGY FUTURE

Franz Josef Radermacher

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STARTING POINT

Germany focuses too much on national goals in the fight against climate change (climate nationalism). However, these are of little relevance in the global context. This focus leads to unfavorable strategies, for example in the areas of green electricity, green hydrogen and synthetic fuels. All considerations are dominated by scarcity and exorbitant costs because we want to produce in Germany by oneself what actually and rationally should be imported, just as we currently import 70 % of our energy.

The issue of climate protection is extremely complex. Global CO_2 emissions continue to grow. The Paris Agreement contains ambitious targets but no matching commitments and measures. The negative momentum on climate results from the understandable economic aspirations of many poorer countries toward a catch-up in prosperity.

China is leading the way but is subsequently emitting one third of the world's CO_2 emissions, with a rising trend. Simultaneously, the world's population is growing apace. By 2050, some 2.5 billion people will add to it, i.e. an increase of the population the size of Germany every year.

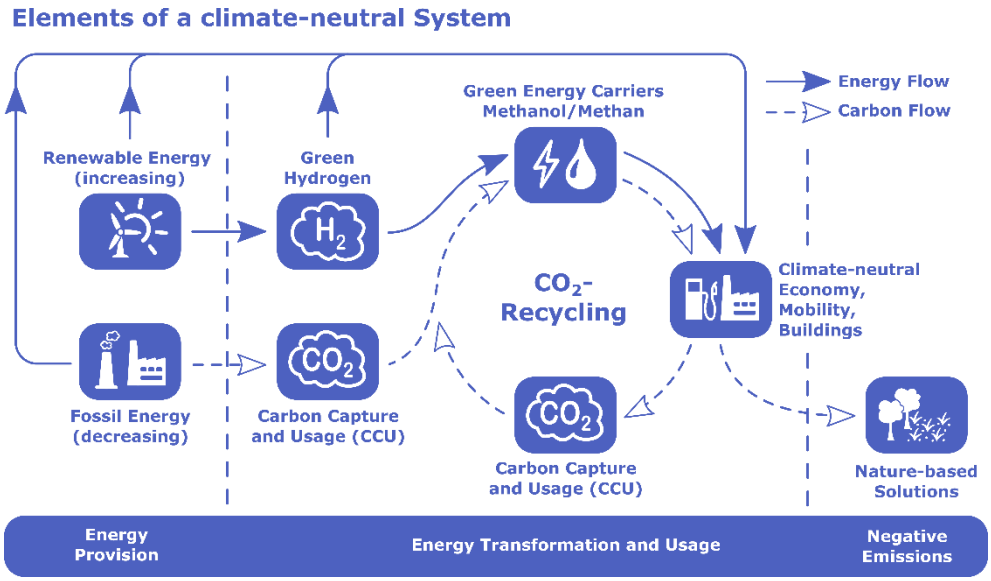
German and European climate policy pays little attention to these issues. We are primarily concerned with reducing our own CO_2 emissions. This is of little relevance to the global climate but it demands all our attention and enormous financial and intellectual resources. We are fully committed to electromobility, not to climate-neutral synthetic fuels for passenger cars, including the existing global fleet with internal combustion engines. Nuclear power is rejected across the board, as is the capture and use of CO_2 from industrial plants and coal-fired power plants.

SYNTHETIC ENERGY SOURCES ARE AN ALTERNATIVE

Are there alternatives? Yes, because Germany is a high-tech country and the world needs new technological solutions. Huge amounts of cheap green electricity from the great solar deserts, green hydrogen as a derived product from these regions, and derived synthetic energy sources such as methanol and methane for use anywhere in the world would totally change the situation.

Siemens Energy and Porsche are currently pursuing this path in the "Haru Oni" project in Chile. Also interesting in this context is the recycling of CO_2 from power

plants and industrial facilities and their conversion to climate-neutrality using green methanol and methane as energy sources. In summary, there would be a three-step approach, leading from green electricity via green hydrogen to synthetic fuels, especially methanol.



GREEN ELECTRICITY

Over the last decades, the possibilities to produce green electricity, i.e. renewable energy in electric form, have greatly improved, especially via large installations of photovoltaic systems and via large onshore and offshore wind power. Of particular interest – also from a development perspective – are the potentials in the world's large solar deserts. Germany is not a good location for green electricity. Despite very high subsidies via the federal Renewable Energy Act (EEG), green electricity still makes up only seven percent of final energy consumption. High production volatility raises electricity costs to very high levels, from a total-cost-of-ownership perspective. This prohibits the widespread use of green electricity for a variety of downstream productions, in particular green hydrogen.

The world needs cheap green electricity in huge quantities if a climate catastrophe is still to be prevented. The author has calculated that up to 400,000 TWh will be needed for the whole world in 2050. This includes the further growth of the world population, the hoped-for, further increase in prosperity (especially in poorer countries) and the lower energy efficiency in poorer countries. Also taken into account are the energy losses when green electricity is transferred to other forms of use (e.g. e-fuels). Total electricity production in Germany today, including electricity

from coal, is about 700 TWh. German Federal Research Minister Anja Karliczek wants to meet about 800 TWh of Germany's energy needs from green hydrogen by 2040. She recently presented the "Atlas of Green Hydrogen Generation Potentials in Africa", which shows a potential for 165,000 TWh of green electricity per year in West Africa alone.

What follows from this? The global community should ensure that a great deal of this green electricity is produced around the world in the right places, and at costs that are not much higher than today's final energy consumption costs (in international comparison). Ultimately, this green electricity and its downstream products (such as green hydrogen) must largely replace today's primary energy sources of coal, gas and oil.

Reasonably, such "green way" has to be made attractive primarily by its own cost-effectiveness and only secondarily by (temporary) public subsidies, so that the corresponding corporations, industries and public institutions based in the fossil energy sector no longer invest in the exploration of fossil energy sources (currently about 600 billion U.S. dollars per year) but produce large volumes of green electricity (and subsequently also green hydrogen) at suitable locations – especially in the solar deserts of the world –, for the simple reason that it pays off.

GREEN HYDROGEN

In many applications, energy is required in a form that is not electrical and detached from a pipeline system. Today, fossil fuels play a central role in this context, some of which are used to generate electricity but some of which are used in a completely different form (e.g. as fuels). Green hydrogen opens up new options in this context. It has therefore always been clear, and is becoming increasingly clear, that green hydrogen is urgently needed as a further component alongside green electricity, and in large quantities. This is now also the subject of debate in Germany.

With the view of the subject broadening, the path to a new energy future no longer solely relies on green electricity but also on green hydrogen even though very large quantities of green electricity are required to produce green hydrogen, not least because of the conversion losses (about 30%) compared to the direct use of green electricity. So green hydrogen is a downstream product of green electricity and especially a great energy storage. Many applications just need energy in a form other than electricity. This is how green hydrogen and its downstream products come into play.

From a German perspective, there is the problem of being unable to sufficiently supply ourselves with either green electricity or green hydrogen – just as we are currently unable to supply ourselves with fossil fuels locally. In addition, green hydrogen is far too expensive in our country to make it competitive globally. Politicians are addressing this problem in the German hydrogen strategy with support programs for green hydrogen (e.g. "H2 Global"), but also by promoting a green ramp-up in Germany.

From the author's point of view, the debate about green hydrogen in Germany and Europe is still far too much determined by the unrealistic idea of some to produce the renewable energy we use mostly in Germany or Europe. We have neither the space nor the right solar radiation for this. In the end, it is hard to understand why people are so fixated on producing energy sources locally. After all, oil, gas and coal are also imported – quite to our own advantage, because in return our technology is exported. As the world's leading exporter, our balance of payments has always included considerable surpluses. This is already hard enough for the world to bear.

SYNTHETIC FUELS (E-FUELS)

However, green electricity and green hydrogen alone cannot achieve a global climate-neutral future. With international production, transport problems remain which are serious in the case of hydrogen, especially concerning the transport across large oceans. That is why we need a third pillar in addition to green electricity and green hydrogen. This third pillar is to e-fuels or also reFuels (regenerative fuels).

Because of geographic and climatic conditions alone, we need this third component, and we need it as an energy carrier to be able to store and transport the energy. Synthetic fuels such as green methanol, green methane and green ammonia are suitable for a wide range of applications and can be produced from green hydrogen. Various synthesis processes exist for this purpose. For example, there is the direct synthesis route and the Fischer-Tropsch process.

For various reasons, the author considers the technology path via the direct synthesis of methanol and methane to be particularly attractive. Both substances are very good for energy storage and comparatively easy to transport. The methanol route in particular opens up a broad field of diverse applications. Like the methanol track, green methane can be used in gas applications, e.g. heating/cooling in houses or (coal) power plants, but in steel and cement production. The issue of heating/cooling is obviously of central importance and there are smarter, and above

all cheaper, solutions for this than exclusively focusing on the expensive energy refurbishment of buildings, namely the use of climate-neutral synthetic heating oil.

Starting from methanol, the pathways to synthetic gasoline, diesel, kerosene, marine fuel as well as heating oil are promising. It is these reFuels that help to transform our civilization towards climate-neutrality at a sustainable cost. The recycling of CO_2 from industrial plants and power stations and the use of CO_2 to produce the synthetic fuels plays a major role in this. This is a major merit of the path described here.

In particular, such reFuels offer a realistic option for rendering the global fleet of vehicles with combustion engines climate-neutral. Individual mobility plays a central role, just like individual heating and cooling. In the mobility sector, we face around 1.3 billion existing vehicles worldwide which release a total of about 5 billion tons of CO_2 into the atmosphere every year. That is almost twice the CO_2 emissions of the EU.

Overall, the path described above is embedded in a school of thought sometimes called "methanol economy" that has already been worked on for decades. At present, so-called black methanol is already the second most synthesized energy liquid worldwide. The world market leader is China. Methanol derived from coal is used there to reduce the demand for imported oil.

THE GLOBAL ENERGY SOLUTIONS E.V. ASSOCIATION

The Global Energy Solutions e.V. association addresses the topic in a very fundamental way. A lot of supplementary information can be found on the website www.global.energy.solutions.org, in particular a one-pager that presents the approach in its entirety.