

Original Paper

Hydrogen H₂ Is the Solution to Global Overheating—But It Still Takes Time

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Abstract

Purpose: *In the overall context of global overheating (belittling it as “climate change”), hydrogen H₂ is the core of the solution to be sought. Although this is recognized in professional circles and now even by most politicians, progress towards the global hydrogen economy is still small and progress is too slow.*

Design/methodology/approach: *The goal was to find out why the implementation towards the acceptance and implementation of H₂ in the application, mainly in Germany, is progressing much too slowly. Germany stands here as an example for most industrialized countries.*

Findings: *Most people have understood that anthropogenic global overheating can only be solved by new technologies (which cost money, time and behavioral changes) in production and application. Hydrogen H₂ seems to be an essential part of the desired solution. Nevertheless, the state, economy and society are slowing down, or at least hurdles are being built up that contribute to a slowdown in implementation.*

Affected countries: *The situation described here, which is largely based on Germany, should be relatively easy to transfer to most EU countries because the situation there is comparable or at least similar.*

Research/Future/Practical Implications: *Yes, there are various hurdles to introducing hydrogen H₂. Responsible ministers and heads of government may not want too many changes too quickly themselves, the economy sees it as an immense cost factor (not to mention technical changes) and private individuals act according to their own motivation factors. Finally, it can be assumed that the possibility of making money using H₂ applications can be the fastest accelerator in the introduction of H₂. This can then be achieved using simple “out-of-the-box” solutions.*

Originality/value: *Currently there are practically no scientific books on the use or rejection of e-mobility. Therefore, only current surveys, market quantities and obvious behaviors of users and challenges can be described here.*

Keywords

global overheating, Hydrogen H2, slowdown necessary changes, motivation/decision making for people to act

JEL codes: *D91, Q01, Q42, Q49, Q54, Q56, Q57, R41.*

1. Introduction

Hydrogen H2 seems to be the solution to all global problems related to stopping greenhouse gases and the energy transition, which has been published countless times by the author of this paper as well as numerous other experts. Anthropogenic overheating of the earth, which is unfortunately always completely downplayed as climate change, can only be stopped permanently by using carbon-free methods. The use of, essentially green, H2 appears to be the key to success in order to stop global overheating in good time, albeit later than politically (COP meetings) aspired to. Despite this, the expansion of the H2 economy is obviously still not progressing fast enough. So the question arises, what is the reason for this and what needs to be changed? In the following, causes and possible solutions will be discussed, without claiming final completeness.

2. Politics Slowing Down H2

Katherina Reiche (DTS, 2022), Chairwoman of the German Federal Government's Hydrogen Council, criticizes the steps taken by the current Federal Government to implement the hydrogen strategy. It's about acting faster. The rest of the world doesn't sleep. Other nations were faster than the technology-oriented Germany and in some cases also much more goal-oriented in the concrete implementation of the H2 strategy in functioning results. Reiche considers the regulation to be insufficient for reducing electricity costs for the production of hydrogen using electrolysis. Companies that want to make massive long-term investments in hydrogen electrolysis therefore need a reliable and long-term commitment that will significantly reduce electricity costs compared to today.

The German federal government has set itself the goal of becoming the "hydrogen world champion". If you want to move fast, you shouldn't be on the brakes at the same time. Reiche is convinced that the political plans for implementing the hydrogen strategy are not sufficient to master the transformation process in the affected sectors. Industrial companies are not helped by government investment grants (CAPEX) alone. Rather, they also need a binding commitment from politicians that they will be supported over the years with the running costs (OPEX). The use of green hydrogen will be significantly more expensive than the use of conventional, carbon-based energy carriers and raw materials for a long time to come. The German federal government must therefore quickly develop a functioning system with

binding commitments. This effort is overdue. The danger is that the hoped-for investments in the H2 sector will otherwise not materialize.

But other market players also seem to be systematically slowing down the necessary changes towards H2. From the point of view of the hydrogen industry and the mineral oil industry, the matter is clear: if politicians pave the way for the use of green hydrogen in the refinery process, they will kill three birds with one stone. On the one hand, the CO₂ balance of the refinery process, the processing of crude oil, is significantly improved because the hydrogen displaces the fossil fuel natural gas. On the other hand, incentives are created for investments in hydrogen electrolysis. In addition, dependence on Russian natural gas is decreasing. You can hardly achieve more with a single measure. “Everything speaks in favor of creating the legal framework for the use of green hydrogen in refineries as quickly as possible. But the German Federal Environment Ministry has been avoiding taking the decisive step for years,” says Werner Diwald, Chairman of the Board of the German Hydrogen and Fuel Cell Association (Stratmann, 2022).

Luc Gar é from the French hydrogen supplier Lhyfe is even clearer in his statements and demands (Gar é 2022). The federal government plans to achieve an electrolysis capacity of at least ten gigawatts by 2030. However, the old regulations and goals are no longer sufficient for this. Now a drastic and ambitious update of the national and, in the future, European hydrogen policy is needed. However, this must not mean directing the billions in funding to international partner countries (preferably sunny developing and emerging countries) and thus passing on the responsibility for the necessary expansion of the production of green hydrogen through the use of renewable energies. Instead, a new, comprehensive hydrogen strategy is needed that clearly focuses on European production, provides the required amounts of electricity and takes them into account and promotes them in the expansion goals. To do this, all parts of the production chain and, even more holistically, the value-added network, must be taken into account and broadly included in the specifications of the Ministry of Climate and Economics: from the expansion of renewable energies to research funding and the development of competitive large-scale industrial electrolyzers to the optimized and mandatory application in industry and transport. A hydrogen strategy 2.0 can specifically address this and means less focus on imports and more support for the European energy transition and structural change.

It is also questionable that the delegated legal act now presented, which specifies the future rules of the game for European hydrogen production, will unnecessarily shackle the ramp-up of the hydrogen economy. The draft of the delegated act provides that after a short transitional period until the end of 2026, only electricity from newly built and unsubsidized wind power and solar systems should be permitted for the production of green hydrogen. Even if planning and approval procedures for new wind power and solar systems are to be accelerated in the future, the production of green hydrogen in large quantities would not be possible before 2030. With the current proposal, a good plan is thwarted by the specific regulation: Europe needs regeneratively produced gases more today than tomorrow, to achieve climate protection goals and for more independence from Russia in primary energy. Also problematic is

the suggestion that electrolyzers may only produce hydrogen if electricity is also being generated from these new wind farms and solar systems at almost the same time. This temporal correlation causes electrolyzers to stand still whenever there is a prolonged lull. This makes the operation and thus the hydrogen unnecessarily expensive and a continuous supply to the industry almost impossible. What is intended as acceleration becomes a brake pad. This type of direct coupling to the generation of H₂ from directly assigned plants that generate electricity from renewable sources does not exist for other areas such as electro mobility either (IWR, 2022).

3. The Economy Slowing Down H₂

The description of what the economy/industry is doing against (i.e., contra) hydrogen is difficult to assess. All that is known is that the Volkswagen Group, mainly under its former CEO Herbert Diess, tried by all means to get politicians to swear in electric drives and even wanted to legally ban H₂ drives. Ultimately, H. Diess was also fired because of this obstinate and radical attitude. From different sources one reads again and again that VW secretly researches and develops on the subject of H₂. Allegedly, an H₂ vehicle with a range of 2000 km has already been developed, but this is neither publicly admitted nor presented (Elektroauto-news, 2022). Standing by H₂ and marketing it publicly requires more intense activity. The Daimler-Benz group is also trying to keep quiet about the topic of H₂, although “secret” news about internal developments keeps leaking out from there too. However, real support for H₂ by the German auto industry definitely looks different. Of the German car manufacturers, only BMW seems to stand by H₂ and currently only half-heartedly, but at least they are planning to bring an H₂ model onto the market in the short term (Campbell, 2022).

In the field of aviation, Airbus is on the way towards H₂ propulsion by 2035 and is said to be investing a three-digit million euro amount every year just for this (FAZ.net, 2022). How the concrete progress looks like is so far unknown. And the American Boeing company isn't really pushing H₂ either—they obviously focus more on biofuels and SynFuels (IWR, 2021). The tests with H₂ for the aircraft engines, explicitly with the engine manufacturer Rolls Royce, are running in a joint program with Airbus. Even if it were to work, the entire infrastructure at all airports worldwide would have to be rebuilt or built at all, and the aircraft that have now been delivered will have a service life of at least 2050 anyway. Honestly, a short-term complete technological upheaval towards H₂ or SynFuels, not to be expected anyway, even if one is optimistic. Whether the focus is then only on pure H₂, on a mixture with SynFuels, or exclusively with SynFuels cannot be seriously assessed at the moment (Haas, 2022).

In the area of rail transport, the first H₂ train in Germany is running in northern Lower Saxony and is being done very successfully by the manufacturer Alstom (Schaal, 2022). Further H₂ projects on the rails are in the concrete planning and implementation phase. Market leader Siemens (Werwitzke, 2022) also fought here for a long time and apparently slowed down rather than accelerated the development of H₂-based technology, although allegedly 60% of German railway lines are not electrified and diesel locomotives are used there, which due to their CO₂ emissions, have to be replaced anyway. Accordingly,

the *Siemens Mireo Plus H* should be ready by 2024 at the earliest, two years later than that of Alstom. Those two years of being slower than the competition must be counted as “light years” in R&D. It is not possible to judge why Siemens overslept.

Shipping traffic remains. Whether and if so, how H₂ should be used here still seems completely unclear at the moment. Since H₂ is a gas, the solution can be easily represented using gas engines. The operation of a fuel cell and an electric motor seems rather unlikely for the large overseas ships. Here, too, SynFuels, NH₃, CH₄O and partially also H₂ will probably be the main solution to replace the heavy fuel oil currently used (Wasserstoff-Kompass, 2022).

4. Society's Braking of H₂

Whether people do something is largely based on their motivation. This decides to do something or not. One of the most famous depictions of human motivation is the famous Maslow pyramid with its five levels (Maslow, 1943). However, this is not only a few days old, but also quite heterogeneous and cannot be used sensibly here.

If you look at how some states proceed to get their own population to behave in some way, from the point of view of this author only three rough concepts can actually be distinguished from one another: American, German and Russian. Since no relevant research results could be found in the scientific literature, the author has developed his own model, which is largely based on the obvious behavior of the respective governments towards their own peoples.

Ultimately, it is usually at least a matter of a state that its own population, which is usually very heterogeneous, does what the government/administration of the state wants (Bittner, 2005). The philosophy, which also includes behavior, names three main reasons: desire, opinion/principle and goal. If you now bring these theoretical approaches in the direction of people's behavior in relation to new needs and measures relating to renewable energies and the implementation by the population in your own country, you can come to the following logical and very easy to understand representation: The money-based method is described here as “*The American Way*” because in hardly any other country does money seem to be as common a cause of action as in the USA. The desire is presented as a desire for money, because money is the main means of providing for one's daily subsistence. At the same time, it is probably felt to be in short supply by most people worldwide (one would like more of it). Freedom is valued here with a maximum, because people decide for themselves whether they want to earn money with something or not. At the same time, time and effort are minimal, since everyone can decide for themselves immediately and without the state and its laws.

The opinion or principle as belief is part of the mindset of people. Not only in politics, but also in trade unions, associations and ultimately, of course, in religions, given attitudes are the measure of desired behavior. This attitude of mind, which is desired in public, can be achieved through various measures, including all kinds of opinion-forming via communication, argumentation, persuasion and ultimately also a kind of “talking to death” (talking at someone until they are forced to give up for the sake of peace

and/or agrees). This approach is referred to here as “*The German Way*” because it seems to be typical for Germany. The freedom here is partially much less than in the USA and lasts much longer, since there are numerous political steps and laws and convincing the population via the media can take years. At the same time, a process of awareness must also take place among people.

The goal is something that is aimed for in the short, medium and long term. Since, according to Freedom House, around 28% of all countries around the world are dictatorships and another around 32% are only partially free, lack of freedom in these countries can be described as a core characteristic. In this total of about 60% of all states, the goal of the people should be, at least not to suffer disadvantages through coercion, persecution and punishment. The people there will therefore be motivated to do what the state wants, without being/having to be convinced of it, as in the German way, and without being able to earn money, as in the American way. However, the risk of penalties may be considered so great that the implementation time and effort are very low. At the same time, however, freedom also tends towards zero. It is therefore called “*The Russian Way*” here.

It can be summed up: The ways in which a state can get its people to do something can be summed up as: money, or opinion/belief, or coercion/punishment. Since there is currently no simple diagram for this, the author developed one that clarifies the facts and presents them in a generally understandable way. The author could not determine whether another scientist had already published something similar, or comparable, before. Obviously, this presentation on this subject in diagram form is the first time.

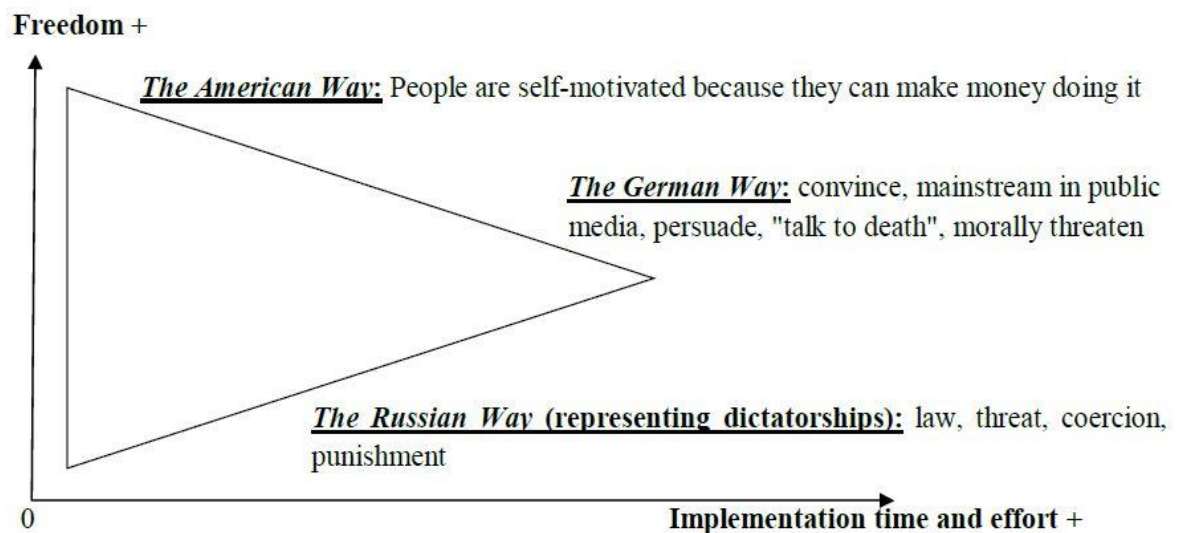


Figure 1. The Source: Was Derived by the Author D. Novak on the Basis of Scientific Knowledge, Which Is Why It Is Now Referred to as the Novak Model or Novak Triangle, since There Are Obviously no Comparable Representations to Date

When making or implementing climate protection solutions such as H2, especially since the global temperature is increasing faster and faster, the time factor is obviously crucial. As the title of the paper

suggests, the changeover is still progressing too slowly. So the question arises, how can a process be accelerated? From the author's point of view, only simple "out-of-the-box" solutions that 1). are easy to understand, 2). are technically easy to implement and are therefore 3. inexpensive. So: The supplier can explain it to the potential customer in a simple way, who will then understand it immediately; the provider can easily install and activate the solution at the customer's; the customer can afford it because it is inexpensive and, ideally, even earn money with it. These "out-of-the-box" solutions must be standardized and certified in advance and then only require standardized approval by official control bodies.

5. Conclusion and Possible Solutions

So the question for the decision-makers is what the solution looks like. If the dictatorial solution, here called *The Russian Way*, is to be abandoned; only the other two ways remain. Since *The German Way* has the massive disadvantage that it takes far too long and the population does not always have or live by the same opinions and principles, the only alternative is actually *The American Way*. People should therefore be brought to the right behavior in the implementation/transformation towards renewable energies by being able to earn money with it themselves. So money is probably the only decisive factor that works worldwide and where the people who are supposed to implement it themselves do not have to be persuaded to do anything, nor do anything just out of fear of punishment. Referred to as a win-win situation (for the population and the climate) in management parlance.

In concrete terms, this means that the political mandate holders (desired solution: end the braking by politics) must change the legal situation in their area of responsibility (municipality, district, federal state, state, international community such as the EU). The situation must be changed in such a way that the production, transport, sale and use of H₂ allows those affected (whether companies or private individuals) to earn money by either selling H₂ to others for a profit, or alternatively by using it themselves reduce their own private costs themselves and thus indirectly contribute to their own livelihood (solution: breakthrough through economic advantages for users).

Final insight: The energy transition, which must be achieved worldwide as part of climate protection efforts, including COP 27 (UN, 2022), can only really succeed if the states create framework conditions that are legally clear to the people. In addition, they must be easy to implement (desired solution: end society's braking).

States and providers should develop practicable "out-of-the-box" solutions and market them pro-actively so that the speed of production, transport and use of H₂ really multiplies in the short term.

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Note

Figure 1: The source itself was created by the author D. Novak based on scientific findings, which is why it is called the Novak model or Novak triangle.