EU Communication

EU HYDROGEN STRATEGY

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KEY ISSUES

Objective of the Communication: The Commission wants a fast-paced increase in the production and use of carbon-free and low-carbon hydrogen so that the EU can become "climate neutral" by 2050.

Affected parties: Energy producers and distributors, manufacturers of electrolysers, current users of fossil-fuel-based hydrogen, steel production and sectors where electrification is difficult such as long-distance transport by air, sea and truck.

Pro: In order to create a market for carbon-free and low-carbon hydrogen, it is crucial that hydrogen be subject to standard EU-wide certification based on its life-cycle carbon emissions.

Contra: Subsidies, particularly those for demonstration projects and for investment in hydrogen technologies, harbour the risk that – instead of economic competition – a competition for funds will develop resulting in permanent subsidies. There are better alternatives.

Proposal: Options for crediting hydrogen as an alternative fuel, or targeted quotas, will trigger an increase in the production of "clean" hydrogen whilst retaining economic competition between hydrogen providers.

The most important passages in the text are indicated by a line in the margin.

CONTENT

Title

Communication COM(2020) 301 of 8 July 2020: **A hydrogen strategy for a climate-neutral Europe**

Brief Summary

- **Context and objectives**
  – By 2050, the EU wants emissions and removals of greenhouse gases (GHG) such as CO_2 to reach a zero balance ["Climate Neutrality"; Commission Proposal COM(2020) 80, see cep**PolicyBrief** 2020-03].
  – Low-carbon hydrogen (H_2), which does not give rise to any carbon emissions when used – particularly when burnt – can contribute to a large-scale CO_2 reduction in the economy ("decarbonisation") as [p. 2]
  - storage and buffering for fluctuating electricity production from renewable energy such as wind and solar;
  - fuel for fuel cells or raw material for synthetic fuels used in transport by air, sea and truck.
  - an alternative to fossil fuels in high-carbon industrial processes such as steel making.
  – The EU is a world leader in electrolysers, H_2 refuelling stations and fuel cells [p. 17].
  – In 2018, 26 Member States signed up to the "Hydrogen Initiative"; some – e.g. Germany, France, Netherlands – have already adopted national hydrogen strategies [p. 2].
  – In its hydrogen strategy, the Commission sets out how, in order to decarbonise the economy, it aims to achieve a fast-paced increase in the production and use of hydrogen from carbon-free or low-carbon sources ("hydrogen economy") and to coordinate the national hydrogen strategies of the Member States [p. 3, 9 and 12].

- **Hydrogen (H_2): H_2 production methods and their CO_2 emissions**
  Hydrogen can be produced in a variety of ways. The total volume of CO_2 emissions ("life-cycle CO_2 emissions") and resulting costs depend on the technologies and energy sources used [p. 3 et seq.].
  – **H_2 production methods**
  - "Fossil-based" hydrogen is produced from fossil fuels – natural gas and coal [p. 4].
    - The primary method of producing H_2 by way of steam reforming gives rise to high levels of CO_2 ("grey hydrogen").
    - H_2 production by way of steam reforming combined with "carbon capture" (CC) can keep up to 90% of the CO_2 out of the atmosphere ("blue hydrogen").
    - In the case of H_2 production by way of methane splitting ("methane pyrolysis") – currently still in the pilot phase – no additional CO_2 is produced ("turquoise hydrogen").
  - "Electricity-based" hydrogen [p. 3] is produced from water. In the production of H_2 by way of electricity-powered electrolysis using special facilities ("electrolysers"), no additional CO_2 is produced.
  - "Biogenic" hydrogen is produced from sustainable – "renewable" – biomass or from the biogas obtained from it [p. 3 et seq.]. H_2 production by means of the biochemical conversion of biomass or the steam reforming of biogas, releases CO_2 previously bound up in plants.

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– **H_2 classification depends on life-cycle CO_2 emissions**
  - A "low-carbon" classification encompasses "fossil-based" hydrogen with carbon capture and "electricity-based" hydrogen when in both cases life-cycle CO_2 emissions are "significantly reduced" as compared with current H_2 production [p. 4].
  - "Clean" or "renewable" means [p. 4 et seq.]
    - "electricity-based" hydrogen if it is produced with renewable electricity ("green hydrogen");
    - "biogenic" hydrogen where – yet to be developed – "sustainability requirements" are met.

► **Strategic plan – first phase: 2020 – 2024**
– The Commission wants to [p. 5]
  - create regulatory requirements for a "liquid and well-functioning hydrogen market";
  - incentivise supply and demand in lead markets by bridging the "cost gap" between "clean" and "low-carbon" hydrogen on the one hand and conventional solutions on the other;
– By 2024, the Commission is aiming for electrolyser capacity in the EU of at least 6 GW capable of producing up to 1 million tonnes (t) of "clean" hydrogen using renewable energy [p. 5].
– This would initially decarbonise current H_2 production and facilitate the use of hydrogen in industrial processes and for heavy-duty long-distance transport [p. 5].
– In order to ramp up production, also electricity-based "low-carbon" hydrogen will be needed [p. 5].
– Some existing production facilities for "fossil-based" hydrogen are to be retro-fitted with CC [p. 6].

► **Strategic plan – second phase: 2025 – 2030**
– By 2030, the Commission is aiming for electrolyser capacity in the EU of at least 40 GW capable of producing up to 10 million t of "clean" hydrogen using renewable energy [p. 5].
– A network of H_2 refuelling stations and larger-scale storage facilities will have to be established [p. 7].
– A basic EU-wide hydrogen grid needs to be planned by repurposing parts of the existing gas grid [p. 7].

► **Strategic plan – third phase: 2030 – 2050**
– H_2 technologies for the production and use of "clean" hydrogen should achieve maturity and reach all hard-to-decarbonise sectors – such as aviation, maritime transport and industrial buildings [p. 7].
– A massive increase in renewable energy is required as up to a quarter of renewable electricity will be needed for renewable hydrogen production by 2050 [p. 7].

► **Research and Development**
– Public funds for the research and development to bring H_2 technologies to market readiness, including by way of demonstration projects, will be provided by the ETS Innovation Fund as well as by InnovFin and InvestEU [p. 18].
– Important research areas are [p. 17]
  - larger size, more (cost)-effective electrolysers, hydrogen production from marine algae, solar water splitting and pyrolysis;
  - infrastructure solutions to distribute, store and dispense hydrogen in large volumes;
  - large scale end-use applications and associated safety standards.

► **Investment in hydrogen production**
– The InvestEU programme, which will have its capacity doubled by the Corona recovery programme [see cep**Adhoc** 07/2020], supports the expansion of hydrogen production by incentivising private investment [p. 9].
– A "European Clean Hydrogen Alliance" will coordinate investment between public authorities and industry, determine viable investment projects and set up a clear "investment pipeline" with them [p. 8].
– The Commission assesses the investment requirement up to 2030 at [p. 7]
  - € 24–42 billion for electrolysers;
  - € 220–340 billion to scale up 80-120 GW of solar and wind energy capacity for the electrolysers;
  - € 11 billion to retrofit half of the plants producing "fossil-based" hydrogen with CC;
  - € 65 billion for hydrogen transport, distribution and storage as well as H_2 refuelling stations.

► **Boosting demand and expanding supply**
– In order to "boost demand" for hydrogen, the Commission will
  - explore "policies" "building on the provisions" of the recast Renewable Energy Directive [(EU) 2018/2001; see cep**Input** 01/2019]; these include crediting "clean" hydrogen as an alternative fuel when it comes to meeting the requirements for fuel manufacturers, as is already the case for biofuels [p. 22];
  - consider quotas for blending "clean" hydrogen, or synthetic fuels produced from clean hydrogen, in special end-uses – such as chemicals or transport; a "quota" is a share of the total volume of fossil-based energy carriers even where there is no physical blending ("virtual blending") [p. 11].
– In order to expand production capacity (expand supply) of "clean" hydrogen [p. 9]
  - various forms of "support" are necessary before hydrogen can become competitive;

- investors require clarity and certainty in the transition to a "hydrogen economy" including by way of
  - an EU standard for the certification of "low-carbon" H_2 production based on life-cycle CO_2 emissions;
  - EU-wide criteria for certifying "low-carbon" and "renewable" hydrogen.

► **International perspective**
– The Commission is endeavouring to achieve greater cooperation with neighbouring countries [p. 19].
– Installation of 40 GW of electrolyser capacity is planned for countries neighbouring the EU by 2030 [p. 19 et seq.].
– EU trade policy should prevent the emergence of market and trade barriers at an early stage [p. 20].

► **Infrastructure**
– For pure hydrogen to be sold across the EU irrespective of its production method ("interoperability of the market"), EU-wide quality standards and rules for cross-border grid operation are necessary [p. 15].
– With the decline in demand for natural gas after 2020, elements of the existing pan-European gas infrastructure could be repurposed for the cross-border transport of hydrogen [p. 15].

Policy Context

In the Paris UN Climate Agreement, the EU committed to comply with the 2-degree climate target (see cep**PolicyBrief** 2016-13). This gave rise to the target of EU climate neutrality by 2050 which is to be achieved by way of numerous EU measures. This hydrogen strategy is complemented by the parallel "Strategy for Energy System Integration" [COM(2020) 299] which envisages the large-scale electrification of all sectors or – if this is impossible or uneconomic – the use of renewable or low-carbon fuels [p. 3].

Options for Influencing the Political Process

Directorates General:	DG Energy (leading)
Committees of the European Parliament:	Industry, Research and Energy (leading)
Federal Ministries:	Economic Affairs and Energy (leading)
Committees of the German Bundestag:	Economic Affairs and Energy (leading)

ASSESSMENT

Economic Impact Assessment

The target of climate neutrality by 2050 envisaged by the EU, is a major technological and economic challenge. It **can be most effectively and efficiently achieved by means of emissions trading** for all sectors [see cep**PolicyBrief** 03/2020; cep**Study** Effective Carbon Pricing (2019)]: By limiting and reducing the number of emissions allowances, the target reduction in emissions can be reliably achieved and, with emissions trading, the market will find the most cost-effective reduction measures available e.g. by investment in technology to reduce emissions.

By contrast, other climate-policy instruments – such as subsidies to support certain technologies – are less effective and unnecessarily costly. Hydrogen, with its many advantages, may play an important role in decarbonising the economy. However, providing it with separate support amounts to technological bias and must be rejected in principle because, at this point in time, we cannot be sure how far other technologies will be able to achieve more cost-effective emissions reductions in the future. The Commission's detailed plans on the amount of "clean" hydrogen that is to be produced with what electrolyser capacity and by when, amounts to an undue presumption of knowledge.

Nevertheless, since almost all Member States have signed up to the Hydrogen Initiative of the Council of Energy Ministers and some are already pursuing national hydrogen strategies, a common EU-wide hydrogen strategy is basically appropriate. Since only on the EU level national hydrogen strategies can be coordinated and the regulatory requirements for an EU-wide "liquid and well-functioning hydrogen market" be set up in order to avoid disturbance and distortions of competition in the internal market.

However, even at EU level, public money should only be used to support basic research which would not otherwise be undertaken in the private sector. More far-reaching **subsidies – particularly for demonstration projects and investment in hydrogen technologies –** should be rejected as they **harbour the risk** that projects will only be planned in order to obtain support funds and then discontinued due to the lack of a viable business model. In addition, there is a risk **that – instead of economic competition – a competition for funds will develop** in which companies with the most promising funding applications will prevail **resulting –** at the expense of the general public **– in permanent subsidies** in order to maintain the profitability of investments that have already been initiated.

Besides, **there are better alternatives** for making "clean" hydrogen competitive: **Options for crediting hydrogen as an alternative fuel** pursuant to the Renewable Energy Directive, **or targeted quotas,** may close gaps between production costs and the willingness of potential customers – such as airlines or fuel manufacturers – to pay. The resulting increase in demand **may** then **also lead to an increase in the production of "clean" hydrogen but with** genuine **economic competition between providers** to service the demand.

With appropriate organisation, this would be enough e.g. to trigger a ramping up of electrolyser capacity in the EU for "clean" hydrogen and the associated cost reductions. In order to avoid unnecessary costs, end uses with greater willingness to pay for "clean" hydrogen – such as in aviation or refineries – and thus where the economic gap is smallest, should be deployed. The physical or "virtual" blending of "clean" hydrogen, or synthetic fuels produced from clean hydrogen, with fossil fuels could open up demand potential with a corresponding willingness to pay.
Such "support" would be required initially in order to help "clean" hydrogen to achieve a breakthrough because, in the foreseeable future, emissions trading alone will not trigger the anticipated cost reductions – arising from the expansion of production ("economies of scale") and the resulting learning opportunities – in the manufacturing of "clean" hydrogen. Thus, according to estimates from the Commission and the Zürich Federal Institute of Technology, ETH, based on current CO_2 prices, there is currently a significant profitability gap [see table below]. Depending on electricity prices, these "cost gaps" between "grey" and "blue" hydrogen would only be closed with an allowance price of € 55-90 [p. 4]; between "grey" and "green" hydrogen only at double the amount. Despite the rising cost of "grey" hydrogen due to higher CO_2 prices, "cleaner" or "low-carbon" hydrogen would remain unprofitable for a long time.

Table: Life-cycle CO_2 emissions and production costs

H_2 production method	Life-cycle CO_2 emissions [kg CO_2 / kg H_2]	Production costs [€ / kg H_2]	
		2020	2030
"fossil-based" hydrogen			
- Steam reforming ("grey")	9	1.5	1.5
- Steam reforming + CC 90% ("blue")	1	2	2
- Methane pyrolysis ("turquoise")	almost zero	Pilot phase	2 – 2.5
"electricity-based" hydrogen			
- Electrolysis – current electricity mix	14	6 – 12	3 – 6
- Electrolysis – renewable electricity ("green")	almost zero	2.5 – 5.5	1.1 – 2.4

In order to create a market for "clean" and low-carbon hydrogen, it is crucial that hydrogen be subject to standard EU-wide certification – based on the method of production – **according to its life-cycle carbon emissions.** This will create transparency regarding carbon emissions for hydrogen users and thus facilitate competition between all methods of H_2 production.
The EU-wide and also – through the inclusion of neighbouring countries – **international approach,** proposed by the Commission, increases cost-effectiveness as compared with national hydrogen strategies**.** This is because the electricity from renewable energy, necessary for the manufacture of "clean" hydrogen, cannot be manufactured everywhere in an equally cost-effective manner; thus, due to geographical conditions, the yield from photovoltaics is greater and more uniform in southern Europe and north Africa, whilst in northern Europe this is true of the yield from wind energy.
The advocated avoidance of technological bias in the production of "clean" and "low-carbon" hydrogen – notably by supporting "blue" hydrogen – contributes to cost efficiency because as a result of the initially more cost-effective steam reforming with carbon capture, for a longer time more CO_2 can be saved than with electrolysis using electricity from the current energy mix.

Legal Assessment

Legislative Competency

Unproblematic. The EU is authorised to take climate and energy policy measures (Art. 191 and Art. 194 TFEU). In this regard, the EU can – in supplement to the measures of its Member States – promote research and technological development (Art. 179-188 TFEU). In particular, the Commission can take initiatives to coordinate the research and technology policy of the EU and its Member States (Art. 181 TFEU).

Conclusion

The target of climate neutrality by 2050 can be most effectively and efficiently achieved by means of emissions trading. Subsidies, particularly those for demonstration projects and for investment in hydrogen technologies, harbour the risk that – instead of economic competition – a competition for funds will develop resulting in permanent subsidies. There are better alternatives: Options for crediting hydrogen as an alternative fuel, or targeted quotas, will trigger an increase in the production of "clean" hydrogen whilst retaining economic competition between hydrogen providers. In order to create a market for "clean" and "low-carbon" hydrogen, it is crucial that hydrogen be subject to standard EU-wide certification based on its life-cycle carbon emissions. The EU-wide and international approach increases cost-effectiveness.