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5 minutes of reading

News

Innovation and Industry

Renewable energies | Hydrogen | Sustainable mobility

What are e-fuels, what substances does the term cover, how are they synthesized, for what usages and with what advantages and limitations? A summary note* and an online report address the questions associated with the properties and usages of e-fuels.

Video: the future of synfuels (in French)

E-fuels: summary note*

***he summary note is the fruit of the work of the EVOLEN Hydrogen and Industry committee, particularly the members of its working group dedicated to “e-fuels and synthetic substances”.*

See the full summary note

Synfuels, or **e-fuels**, are produced from renewable or low-carbon electricity, carbon dioxide or nitrogen in the case of e-ammonia, and hydrogen derived from electrolysis. In liquid or gas form, **their emergence alongside biomass-derived biofuels, offers a relevant alternative solution to defossilize transport and industry**, without creating conflicts of use with agricultural products, thereby enabling a reduction in the climate impact of these activities.

What are these substances? How are these substances produced and for what usages? What are the advantages and limitations associated with these substances? What potential production volumes can we expect and what are the barriers to their development? The summary note attempts to answer all these questions, with the aim of providing a comprehensive set of definitions and an insight into e-fuels and their future development.

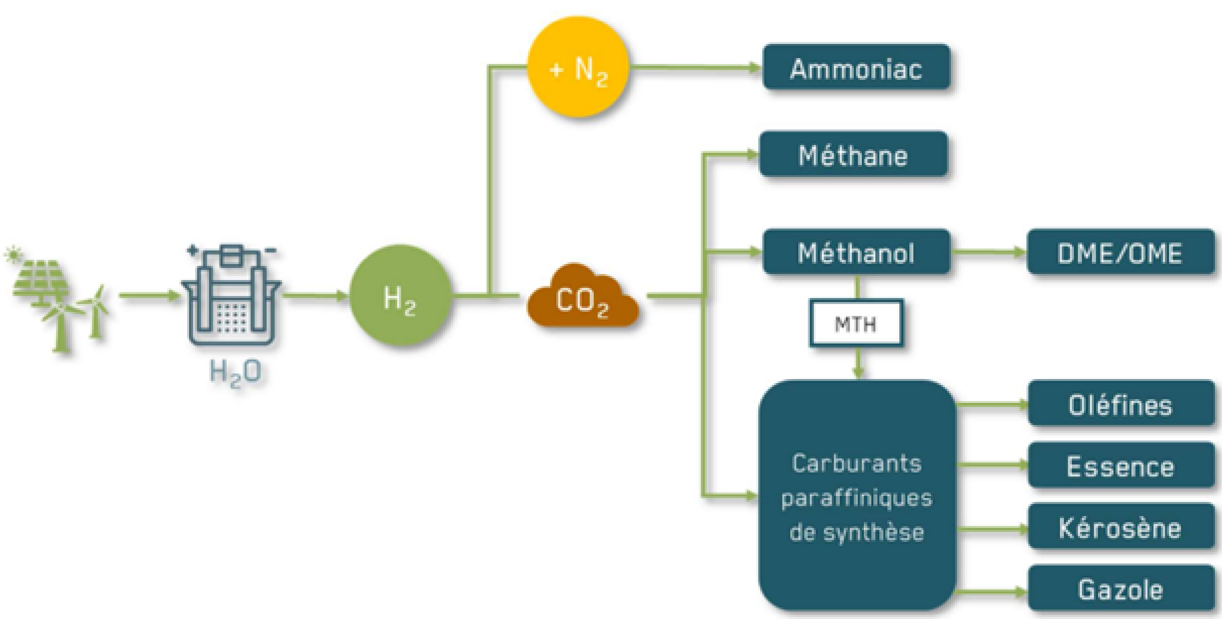
The document focuses on the uses of e-fuels as synfuels for mobility, concentrating on four e-fuels in particular: e-methane, e-methanol, the family of paraffin-based e-fuels including e-gasoline, e-diesel and e-kerosene, and e-ammonia.

E-fuels as alternative fuels

Water electrolysis makes it possible to convert renewable or low-carbon electricity into hydrogen, which is easier to transport, stock and distribute than electricity. Other than traditional usages reserved for industry and fertilizer chemistry, hydrogen can be used in mobility to power an electric motor via a fuel cell, or directly as a fuel in an IC engine.

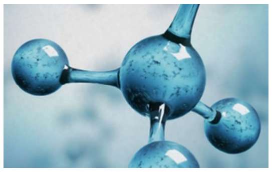
Hydrogen, a gas at atmospheric pressure, has a high energy density by mass, but a very low energy density per unit volume. As a result, to be stored in reasonable-sized tanks, it has to be compressed at very high pressure, between 300 and 700 bar, or liquefied at -252°C. Both these options require high energy consumption and there are major technical and technological challenges associated with onboard equipment.

Another option for using renewable or low-carbon hydrogen is to convert it into synfuels, or e-fuels, by reacting it with CO_2 or nitrogen. These fuels, which, like e-methane, can be in gas form in ambient conditions, but are generally liquids, are easier to transport, store and use than hydrogen; they represent a promising future option for air and sea transport - where pure hydrogen appears difficult to use over long distances for the reasons outlined above - as well as for some river and road transport.



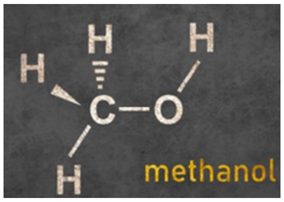
Principal e-fuel synthesis methods (in French)

Which e-fuels for which uses?



E-methane

In liquid form, one of the major advantages of e-methane is that it can be incorporated in LNG (liquefied natural gas) and thus benefit from existing infrastructures and regulations. In gas form, it can cover traditional natural gas usages (heating, electricity) and also be used in road (LNG) and sea transport.



E-methanol

E-methanol, which is already produced in small proportions on an industrial scale, particularly for the chemicals industry, is a promising fuel for the shipping sector. It is known to industry, energy-dense and liquid at ambient temperature. Easy to incorporate in gasoline for existing vehicle powertrains, and used in dual-fuel engines in the maritime sector, e-methanol can also be deployed rapidly. It is also an option for decarbonizing the production of chemicals (formaldehyde, acetic acid, etc.) and olefins (ethylene, propylene). However, methanol is associated with a degree of toxicity that requires specific precautions when used as a fuel.

Paraffin-based e-fuels

With properties similar to those of their fossil equivalents, the use of paraffin-based e-fuels in the road, maritime and aviation sectors is therefore a potential option.
- **E-diesel** is particularly aimed at road transport. With properties that are comparable with or even superior to those of conventional diesel, it can be used in its pure form or as a blend in commercial diesel.
- **E-kerosene** is aimed at the aviation sector. It is an example of a Sustainable Aviation Fuel (SAF).

E-ammonia

E-ammonia is a fuel under close scrutiny by the shipping industry, since it is an economical synfuel that is easy to produce; it is also the only one not to contain carbon. However its high toxicity and the dangers it represents for the environment remain an obstacle to its large-scale development as a fuel, particularly in confined spaces like ships. Further R&D efforts are required for safe use in these types of environments. E-ammonia is also an option for decarbonizing the production of chemicals (fertilizer, explosives).

To find out more, consult the summary note:

Decarbonisation of processes and production of synthetic fuels at the heart of IFPEN's work

Pilote Fischer-Tropsch sur la raffinerie ENI de Sannazzaro

IFPEN's teams are involved in the deployment of decarbonised processes through the use of decarbonised hydrogen, electricity and biomass, and through the recovery of CO_2.

Biomass and natural gas are converted into synthetic liquid fuels using **the Fischer-Tropsch process**. Although this technology dates back to the middle of the last century, IFPEN's work focuses on improving its efficiency, production costs and environmental footprint.

After more than 15 years of research in partnership with ENI, IFPEN has developed a new Fischer-Tropsch process marketed by Axens under the name Gasel®. Based on a Fischer-Tropsch synthesis and upgrading, it is characterised by a high level of productivity and the absence of sulphur, nitrogen and aromatic compounds in the synthetic fuel obtained, which improves the environmental performance of vehicles, particularly with regard to particles smaller than 23 nm.

Since July 2021, the European Commission's regulatory proposal for the Fit for 55 package, known as ‘ReFuelEU Aviation’, has proposed a minimum incorporation of 5% e-fuel in aviation fuels by 2035 and 28% by 2050. To meet these ambitions, we need reliable processes capable of high capacities. To support the emergence of the e-fuels market, IFPEN and **Axens have launched the development of a technology for producing CO from CO_2 and H_2 (the Reverse Water Gas Shift reaction).**

The development of the Reverse Water Gas Shift upstream building block and CO_2 capture, for example on industrial emitters via the DMX™ process, will complete this technology to provide a complete chain from CO_2 capture to the production of synthetic fuels.

YOU MAY ALSO BE INTERESTED IN

E-fuels: Axens, Paul Wurth (SMS group) and IFPEN sign an agreement for the co-development of the Reverse Water Gas Shift technology

Learn all about synfuels (e-fuels)

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Link to the web page :