
ECFD

information

E-Fuels – Global production
volumes and future demands
in harmony

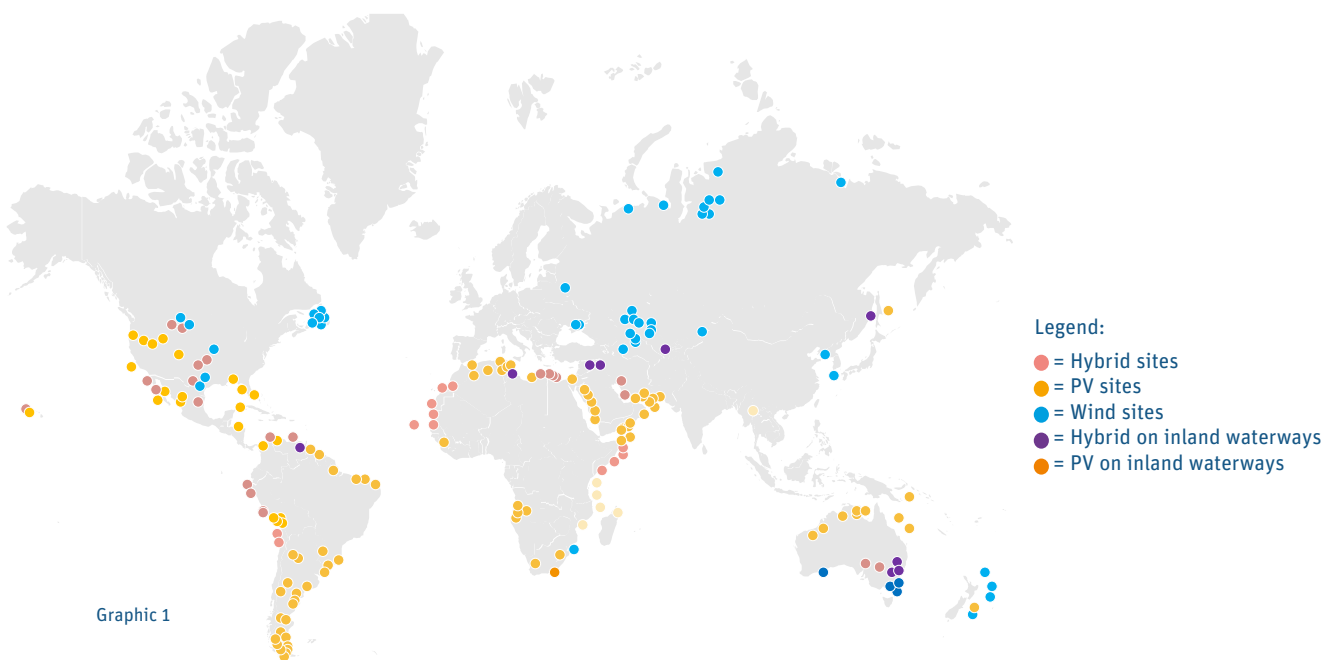


Sufficient renewable energies are available globally to replace the current demand for fossil fuels with CO₂-neutral synthetic fuels.

How high are the global generation potentials for PtX products?

The PtX Global Atlas of the Fraunhofer Institute for Energy Economics and Energy System Technology (IEE) shows which global locations have a particularly high potential for **renewable energies** from wind and solar power:

At these sites, green hydrogen and its derivatives can be produced in Power-to-X (PtX) plants. Possible hydrocarbon-based derivatives are either gaseous (Power-to-Gas (PtG), such as methane or ammonia) or liquid (Power-to-Liquid (PtL), such as e-methanol or synthetic crude oil (e-crude/syncrude) → e-fuels).



Vast quantities of renewable energy are available globally:

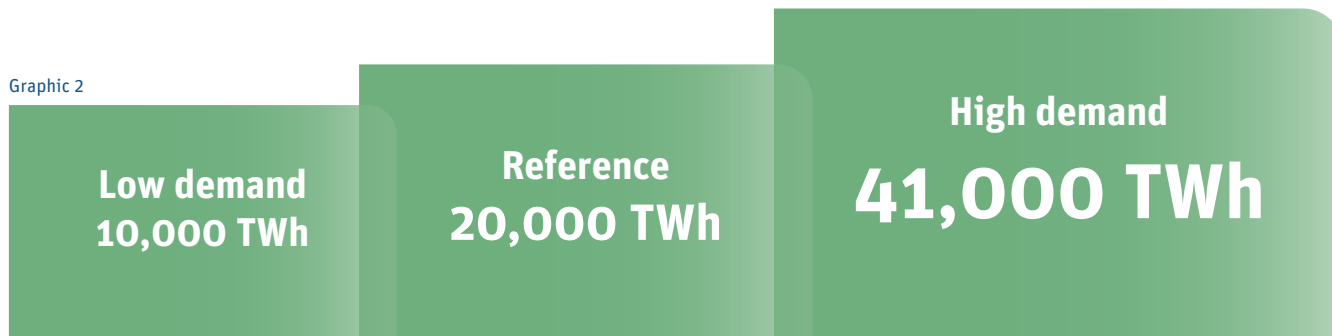
- PtX production regions **without nature conservation conflicts, water scarcity and land competition** are available in large numbers globally.
- Sustainable carbon dioxide (CO₂) for the production of PtG/PtL products can be extracted from ambient air using the direct air capture (DAC) process; PtX plants are thus independent of CO₂ point sources.
- Sites with high solar and wind power potentials enable **many full load hours** for generation plants, which can subsequently provide large amounts of electricity for further use. Sites with hybrid plants (wind and solar) near the coast perform best. A solar plant at an average location in Germany generates only about 40 percent of the amount of electricity per year that a comparable plant in North Africa produces.
- **Other particularly suitable locations for PtX generation** are available in North America, Asia, Australia and South America.

Fraunhofer IEE has determined the following global PtX production potential:

1. Outside Europe, a total of 109,000 terawatt hours (TWh) of green hydrogen and 87,000 terawatt hours of synthetic fuels can be technically produced per year.
2. Fraunhofer IEE sees an annual utilisation potential of 69,100 terawatt hours of hydrogen or at least **57,000 terawatt hours** of PtL.

What is the projected global demand for PtX products in 2050?

The World Energy Council estimates that the demand for PtX products in 2050 will be between 10,000 TWh and 41,000 TWh annually (depending on the study scenario).



This means that even the projected maximum demand for PtX products can be covered with the globally available generation potentials.

Can e-fuels completely replace the fossil liquid fuel market?

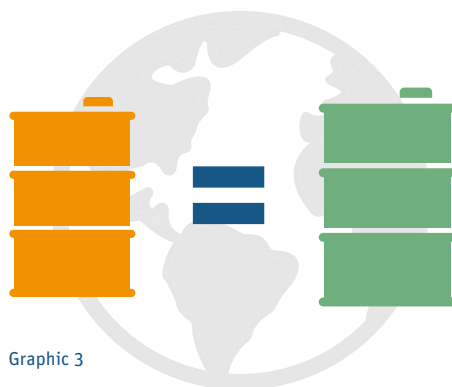
Reasons why e-fuels could replace fossil fuels and combustibles:

- E-fuels are also easy to transport at normal pressure and temperature and have a high energy density.
- In the future, they could completely replace fossil

mineral oil products in industry, transport and the heating sector.

- E-fuels can be used in all combustion engines without technical modifications.
- They can be distributed via the transport and distribution infrastructures that already exist globally.

In 2019, fossil oil with an energy content of approx. **53,600 TWh** was produced worldwide



Global utilisation potential of **57,000 TWh** of synthetic liquid fuels and combustibles

- A **complete substitution** of fossil mineral oil products used worldwide with synthetic PtX products such as e-fuels is possible in principle.
- Assuming the widespread use of **renewable energies in all forms** (electricity and green molecules) and the operation of efficiency effects, liquid synthetic fuels can make a decisive **contribution** to meeting **Germany's future energy needs**.
- International **energy partnerships** are the basis for technology and energy transfers.
- PtX products enable a **diversified energy system without fossil components** and at the same time contribute to **security of supply**, because they can store wind and solar energy over long periods without losses.

Conclusion and demands on policymakers

- The energy, industry, transport and heating sectors have a high demand for energy from renewable sources in all forms both now and in the future. This demand can only be fully covered by energy imports.
- Various regions lend themselves particularly well as PtL production locations. Currently, the first industrial PtL production plants are under construction, such as HIF Global (Highly Innovative Fuels) 'Haru Oni' in Chile. Other industrial projects in Europe, the USA and Australia are also either under construction or in the planning stage.
- Appropriate regulatory framework conditions (e.g. fleet regulations and volume quotas) can make the European Union a reliable partner in the global PtX market. For this to happen, e-fuels must be recognised as a climate protection solution and placed on an equal regulatory footing with other forms of renewable energy.
- Global energy projects require international cooperation in the form of energy partnerships that promote the rapid development of global renewable energy and PtX generation facilities via investment incentives.

Source:

Graphic 1: Source: Fraunhofer IEE, 2021; Graphic 2: Frontier Economics; Graphic 3: salim138, enigmanic – stock.adobe.com; Fraunhofer IEE (2021): PTX-ATLAS: GLOBAL POTENTIAL FOR THE PRODUCTION OF GREEN HYDROGEN AND CLIMATE-NEUTRAL SYNTHETIC FUELS; WEC – World Energy Council. (2018). International aspects of a Power-to-X roadmap – A report prepared for the world energy council Germany; Prognos, Fraunhofer-Institut UMSICHT and DBFZ (2018): 'Status und Perspektiven flüssiger Energieträger in der Energiewende' [Status and perspectives of liquid energy sources in the energy revolution]