

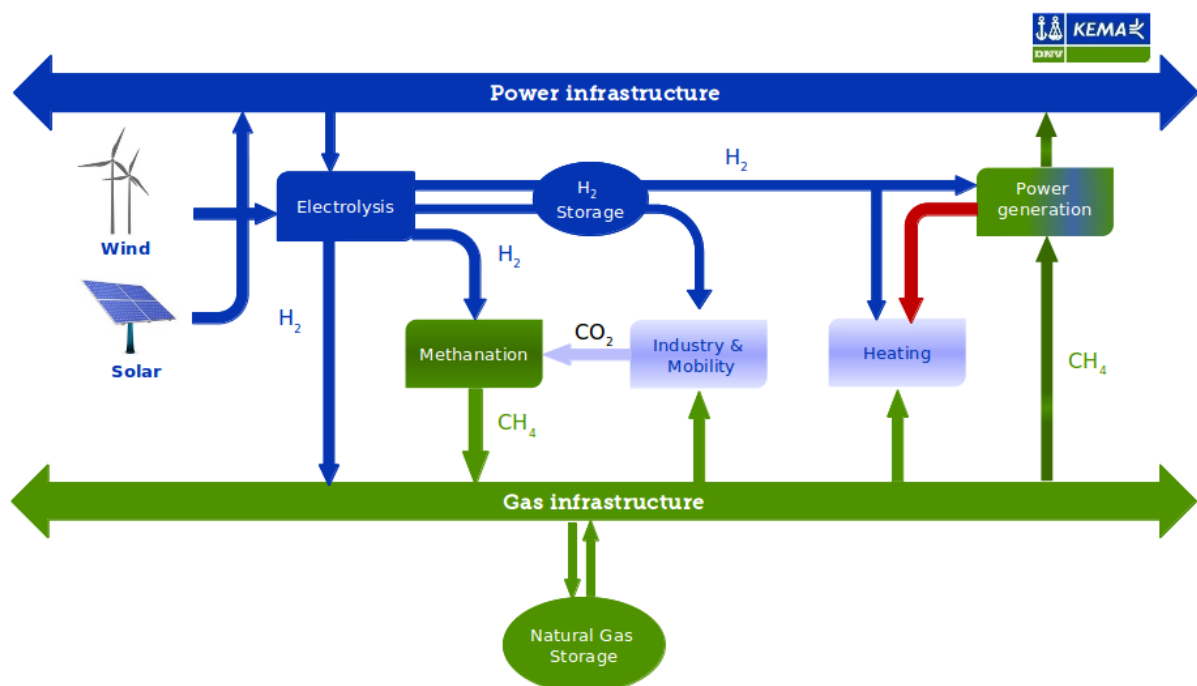
# Power-to-Gas Storage

## What is Power-to-Gas storage?

[Power-to-Gas \(P2G\) technology](#) involves converting electricity into a gas fuel using electrolysis. Electrolysis uses electrical power to split water molecules ( $\text{H}_2\text{O}$ ) into its components, oxygen and hydrogen.

The hydrogen is then used as a form of stored energy – it can be used directly as a transport or industry fuel source, combined with carbon dioxide to make methane or even injected directly into the natural gas grid.

P2G is a less efficient energy storage technology than pumped hydropower, lithium-ion battery storage and even thermal storage. If reversible solid oxide cells are used for electrolysis and waste heat from the process is recycled, however, [round-trip efficiencies of approximately 70%](#) can be achieved.



[Source: European Power to Gas](#)

## Power-to-Hydrogen

Hydrogen produced from electrolysis has a high energy density as a fuel with no pollution – when burned with oxygen, only thermal energy and water are produced. If the electricity used during the power-to-gas processing is from renewable sources, it is a carbon-neutral fuel.

Hydrogen produced in this way has primarily been used as fuel for transport or other industry. Until recently, grid-scale applications were not economically feasible considering the cheapness of natural gas and the high costs of electricity.

## Power-to-Methane

An additional step to the process converts hydrogen into methane. This lowers the round-trip efficiency by approximately 8%, and turns a clean-burning fuel into one that produces greenhouse gases.

This does not mean Power-to-Methane has no place supporting the grid – if waste carbon dioxide is used for the methanisation process, no additional emissions are produced. Producing methane also allows for continued use of existing natural gas infrastructure, reducing capital expenditure and supporting the transition from fossil fuel to renewable generation.

## Benefits of Power-to-Gas for the Grid

### Reducing renewable power generation curtailment

As wind and solar makes up a greater proportion of power generation assets, grid oversupply issues become problematic. Peak wind and solar output can be greater than grid transmission infrastructure can handle, forcing generation curtailment. Production capacity is lost both during the curtailment, and in the case of wind, during start-up as the wind turbines ramp up to full speed. This issue is particularly important in countries with unstable or aging grid infrastructure.

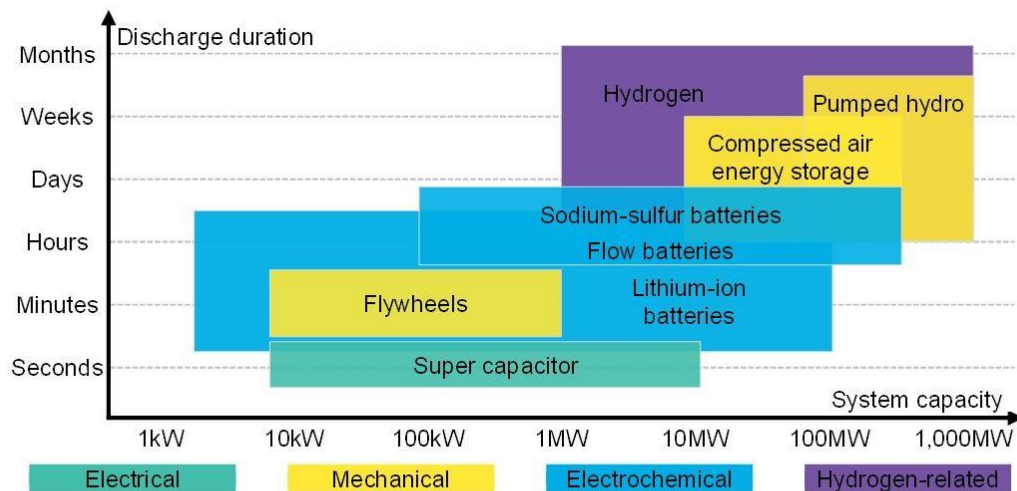
Power-to-gas allows this surplus energy to be soaked up at the source by producing hydrogen – no need to slow or stop peak production.

### Long-term, large-scale energy storage

A drawback of most energy storage technologies is that energy can only be stored for limited amounts of time. With the exception of pumped hydropower and seasonal thermal energy storage, energy storage systems can only hold onto their energy for days, hours or even less. Hydrogen and methane can be stored for months at a time without energy loss.

Hydrogen gas can also be used to store energy in enormous quantities, ideal for weeks and months of back-up power rather than merely hours or days.

## Size and discharge durations by storage technology



Source: Bloomberg New Energy Finance. Note: system capacities and discharge durations are based on general use, rather than technical limitations.

[Source: Bloomberg New Energy Finance](#)

### Use of existing natural gas infrastructure

While an entirely hydrogen-powered grid would need significant upgrades or new infrastructure, hydrogen gas can be [injected directly into the grid at 5-15% concentrations with no ill effects](#). It can also be converted to methane with an additional process for use as natural gas.

Many countries, such as the United Kingdom and Germany, have extensive existing natural gas infrastructure. Power-to-gas can play a crucial role in transitioning from a traditional fossil fuel powered grid to complete decarbonisation.

### Carbon-neutral (for hydrogen produced from renewables)

As more countries move to slash their carbon dioxide emissions, carbon-neutral forms of generation become more important. Hydrogen produces only thermal energy and water when burned, generating electricity emission-free. When surplus renewable energy is used to produce hydrogen, the resulting electricity is carbon-neutral – another step towards grid decarbonisation.