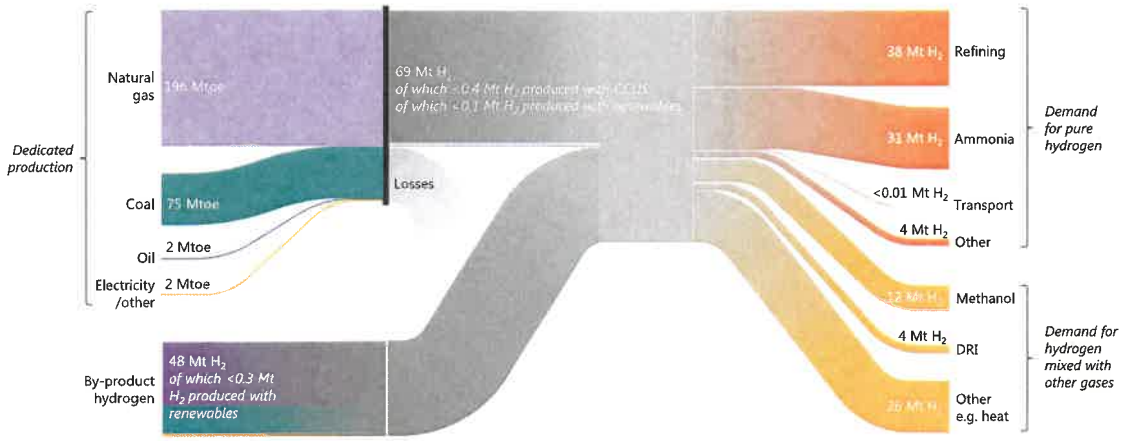
Overall, less than 0.7% of current hydrogen production is from renewables or from fossil fuel plants equipped with CCUS. In total, hydrogen production today is responsible for 830 $MtCO_2$/yr. In general, demand for pure hydrogen that is supplied from dedicated facilities is the most straightforward to replace with alternative sources of low-carbon hydrogen.

**Figure 6. Today's hydrogen value chains**




Notes: Other forms of pure hydrogen demand include the chemicals, metals, electronics and glass-making industries. Other forms of demand for hydrogen mixed with other gases (e.g. carbon monoxide) include the generation of heat from steel works arising gases and by-product gases from steam crackers. The shares of hydrogen production based on renewables are calculated using the share of renewable electricity in global electricity generation. The share of dedicated hydrogen produced with CCUS is estimated based on existing installations with permanent geological storage, assuming an 85% utilisation rate. Several estimates are made as to the shares of by-products and dedicated generation in various end uses, while input energy for by-product production is assumed equal to energy content of hydrogen produced without further allocation. All figures shown are estimates for 2018. The thickness of the lines in the Sankey diagram are sized according to energy contents of the flows depicted.

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**Today's hydrogen industry is large, with many sources and uses. Most hydrogen is produced from gas in dedicated facilities, and the current share from renewables is small.**

Chapter 2 provides more detail on the processes and costs of hydrogen production. It concludes that production costs are highly dependent on factors such as electricity costs and taxes, grid fees, natural gas prices, the availability and price of CCUS services, and the capacity utilisation rates of electrolysers. The price of hydrogen varies widely between regions and end uses (different end uses require different volumes, pressures and purity levels of hydrogen); it also varies according to the way that hydrogen is transported.

## What does it mean to be a chemical energy carrier and not an energy source?

Hydrogen is not an energy source but an energy carrier, which means that its potential role has similarities with that of electricity. Both hydrogen and electricity can be produced by various energy sources and technologies. Both are versatile and can be used in many different applications. No greenhouse gases, particulates, sulphur oxides or ground level ozone are produced from the use of either hydrogen or electricity. If the hydrogen is used in a fuel cell, it emits nothing but water. However, both hydrogen and electricity can have a high $CO_2$ intensity upstream if produced from fossil fuels such as coal, oil or natural gas. This disadvantage can only be overcome by using renewables or nuclear as the initial energy input, or equipping fossil fuel plants with CCUS.



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