



<https://www.sbs.com.au/news/australia-launches-world-first-coal-to-hydrogen-plant-trial>



Steam reforming of [natural gas](https://en.wikipedia.org/wiki/Natural_gas) is the most common method of producing commercial bulk hydrogen at about 95% of the world production[[1]](https://en.wikipedia.org/wiki/Steam_reforming#cite_note-Ogden_1999-1)[[2]](https://en.wikipedia.org/wiki/Steam_reforming#cite_note-2) of 500 billion m3 in 1998.[[3]](https://en.wikipedia.org/wiki/Steam_reforming#cite_note-3) Hydrogen is used in the [industrial synthesis of ammonia](https://en.wikipedia.org/wiki/Ammonia_production) and other chemicals.[[4]](https://en.wikipedia.org/wiki/Steam_reforming#cite_note-4) At high temperatures (700 – 1100 °C) and in the presence of a [metal](https://en.wikipedia.org/wiki/Metal)-based [catalyst](https://en.wikipedia.org/wiki/Catalyst) ([nickel](https://en.wikipedia.org/wiki/Nickel)), steam reacts with methane to yield [carbon monoxide](https://en.wikipedia.org/wiki/Carbon_monoxide) and hydrogen.

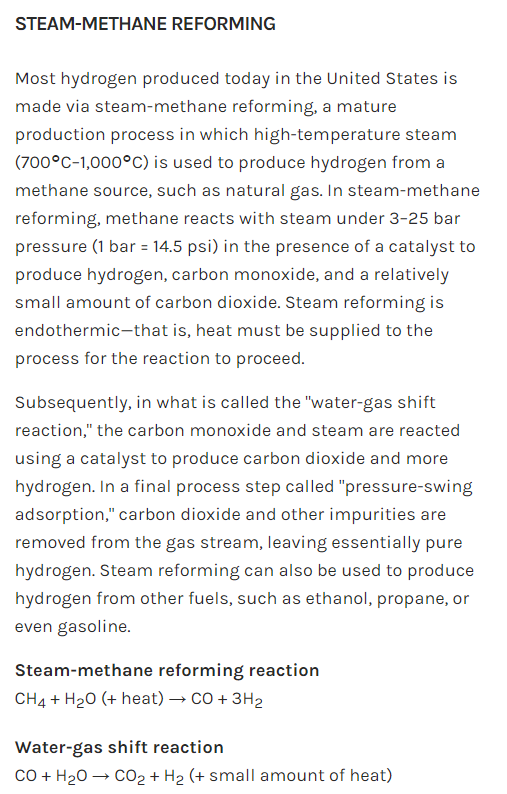
[CH4](https://en.wikipedia.org/wiki/Methane) + [H2O](https://en.wikipedia.org/wiki/Water) ⇌ [CO](https://en.wikipedia.org/wiki/Carbon_monoxide) + 3 [H2](https://en.wikipedia.org/wiki/Hydrogen)

Catalysts with high [surface-area-to-volume ratio](https://en.wikipedia.org/wiki/Surface-area-to-volume_ratio) are preferred because of [diffusion](https://en.wikipedia.org/wiki/Diffusion) limitations due to high [operating temperature](https://en.wikipedia.org/wiki/Operating_temperature). Examples of [catalyst](https://en.wikipedia.org/wiki/Catalyst) shapes used are spoked wheels, gear wheels, and rings with holes. Additionally, these shapes have a low [pressure drop](https://en.wikipedia.org/wiki/Pressure_drop)which is advantageous for this application.[[5]](https://en.wikipedia.org/wiki/Steam_reforming#cite_note-5)

Additional hydrogen can be obtained by reacting the [CO](https://en.wikipedia.org/wiki/Carbon_monoxide) with water via the [water-gas shift reaction](https://en.wikipedia.org/wiki/Water-gas_shift_reaction).

CO + H2O ⇌ [CO2](https://en.wikipedia.org/wiki/Carbon_dioxide) + H2

The first reaction is strongly [endothermic](https://en.wikipedia.org/wiki/Endothermic) (consumes heat, ΔHr= 206 kJ/mol), the second reaction is mildly [exothermic](https://en.wikipedia.org/wiki/Exothermic) (produces heat, ΔHr= -41 kJ/mol).



**Syngas**, or **synthesis gas**, is a [fuel gas](https://en.wikipedia.org/wiki/Fuel_gas) mixture consisting primarily of [hydrogen](https://en.wikipedia.org/wiki/Hydrogen), [carbon monoxide](https://en.wikipedia.org/wiki/Carbon_monoxide), and very often some [carbon dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide). The name comes from its use as [intermediates](https://en.wikipedia.org/wiki/Reaction_intermediate) in creating [synthetic natural gas](https://en.wikipedia.org/wiki/Synthetic_natural_gas) (SNG)[[1]](https://en.wikipedia.org/wiki/Syngas#cite_note-Beychok-1) and for producing [ammonia](https://en.wikipedia.org/wiki/Ammonia) or [methanol](https://en.wikipedia.org/wiki/Methanol). Syngas is usually a product of [gasification](https://en.wikipedia.org/wiki/Gasification) and the main application is [electricity generation](https://en.wikipedia.org/wiki/Electricity_generation). Syngas is combustible and can be used as a fuel of [internal combustion engines](https://en.wikipedia.org/wiki/Internal_combustion_engine).[[2]](https://en.wikipedia.org/wiki/Syngas#cite_note-2)[[3]](https://en.wikipedia.org/wiki/Syngas#cite_note-3)[[4]](https://en.wikipedia.org/wiki/Syngas#cite_note-4) Historically, syngas has been used as a replacement for gasoline, when gasoline supply has been limited; for example, [wood gas](https://en.wikipedia.org/wiki/Wood_gas) was used to power cars in Europe during [WWII](https://en.wikipedia.org/wiki/World_War_II) (in Germany alone half a million cars were built or rebuilt to run on wood gas).[[5]](https://en.wikipedia.org/wiki/Syngas#cite_note-5) Syngas, however, has less than half the [energy density](https://en.wikipedia.org/wiki/Energy_density) of [natural gas](https://en.wikipedia.org/wiki/Natural_gas).[[1]](https://en.wikipedia.org/wiki/Syngas#cite_note-Beychok-1)

Syngas can be produced from many sources, including natural gas, coal, biomass, or virtually any hydrocarbon feedstock, by reaction with steam ([steam reforming](https://en.wikipedia.org/wiki/Steam_reforming)), carbon dioxide ([dry reforming](https://en.wikipedia.org/wiki/Dry_reforming)) or oxygen ([partial oxidation](https://en.wikipedia.org/wiki/Partial_oxidation)). Syngas is a crucial intermediate resource for production of hydrogen, ammonia, methanol, and synthetic hydrocarbon fuels. Syngas is also used as an intermediate in producing [synthetic petroleum](https://en.wikipedia.org/wiki/Synfuel) for use as a [fuel](https://en.wikipedia.org/wiki/Fuel) or [lubricant](https://en.wikipedia.org/wiki/Lubricant) via the [Fischer–Tropsch process](https://en.wikipedia.org/wiki/Fischer%E2%80%93Tropsch_process) and previously the [Mobil](https://en.wikipedia.org/wiki/Mobil) [methanol to gasoline](https://en.wikipedia.org/wiki/Gas_to_liquids#Methanol_to_Gasoline_process_(MTG)) process.







