

## SYNTHESIS GAS

**Syngas**, or **synthesis gas**, is a fuel gas mixture consisting primarily of hydrogen, carbon monoxide, and very often some carbon dioxide. The name comes from its use as intermediates in creating synthetic natural gas (SNG) and for producing ammonia or methanol. Syngas is also used as an intermediate in producing synthetic petroleum for use as a fuel or lubricant via the Fischer–Tropsch process and previously the Mobil methanol to gasoline process. Syngas is combustible and often used as a fuel of internal combustion engines. It has less than half the energy density of natural gas.

**Production methods include steam reforming of natural gas or liquid hydrocarbons to produce hydrogen, the gasification of coal, biomass, and in some types of waste-to-energy gasification facilities.**

### Production chemistry

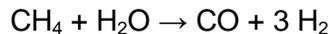
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The main reaction that produces syngas, steam reforming, is endothermic with 206 kJ/mol methane needed for conversion.

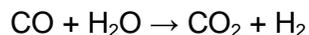
The first reaction, between incandescent coke and steam, is strongly endothermic, producing carbon monoxide (CO), and hydrogen H<sub>2</sub> (water gas in older terminology). When the coke bed has cooled to a temperature at which the endothermic reaction can no longer proceed, the steam is then replaced by a blast of air.

The second and third reactions then take place, producing an exothermic reaction - forming initially carbon dioxide - raising the temperature of the coke bed - followed by the second endothermic reaction, in which the latter is converted to carbon monoxide, CO. The overall reaction is exothermic, forming "producer gas" (older terminology). Steam can then be re-injected, then air etc., to give an endless series of cycles until the coke is finally consumed. Producer gas has a much lower energy value, relative to water gas, due primarily to dilution with atmospheric nitrogen. Pure oxygen can be substituted for air to avoid the dilution effect, producing gas of much higher calorific value.

When used as an intermediate in the large-scale, industrial synthesis of hydrogen (principally used in the production of ammonia), it is also produced from natural gas (via the steam reforming reaction) as follows:



In order to produce more hydrogen from this mixture, more steam is added and the water gas shift reaction is carried out:



The hydrogen must be separated from the CO<sub>2</sub> to be able to use it. This is primarily done by pressure swing adsorption (PSA), amine scrubbing, and membrane reactors.