Autothermal Reforming

To produce low-carbon hydrogen at scale

Autothermal Reforming (ATR)

What is it?

ATR is a **process** for producing **hydrogen** at scale. ATR can transform natural gas or other feedstocks into syngas in a **highly energy efficient** process. **Hydrogen** can be extracted from the syngas or the syngas can be converted to various chemicals such as **Ammonia and Methanol**. In the ATR process, natural gas (i.e. methane) is **converted with oxygen and steam** into syngas molecules at high temperature. The reaction with oxygen generates the heat required to "break" the methane molecules. With a further simple shift reaction step, hydrogen and carbon dioxide are obtained.

What are the advantages?

Combined with carbon capture, ATR enables industrial scale **low-carbon hydrogen production**, with key advantages:

- **high carbon capture rate** of up to 99% based on scope 1,
- **high energy efficiency**,
- **cost-effective solution and ease of operation**.

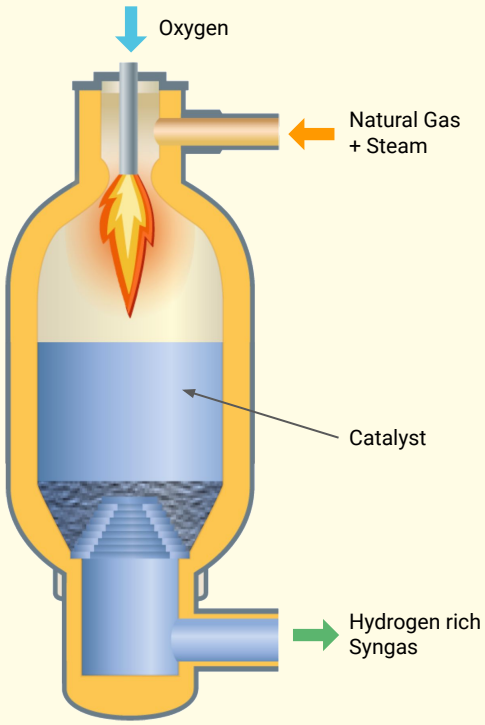
ATR and SMR: what differences?

Both technologies convert hydrocarbons to hydrogen, but:

ATR converts methane **with steam and pure oxygen** to syngas. The addition of oxygen into the reactor provides the energy required for the conversion without external firing. **SMR** converts methane to syngas **with steam** only, but requires external heating.

ATR is particularly suitable for **large capacities**, whereby smaller capacities tend to favor **SMR**.

However, the most suitable selection also depends on the **projects requirements and setting**, for example location, capacity requirements, availability and cost of electricity and natural gas.



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AIR LIQUIDE Track Record

Successful integration and operation of ATR plants at large scale, producing syngas for methanol, ammonia and other industrial gases.

One of the **leading companies**

LOW-CARBON HYDROGEN

A key enabler of a successful energy transition

With its mastery of hydrogen, Air Liquide is actively contributing to its development

> Sales in hydrogen x3: our hydrogen revenues will at least triple in size, increasing from 2 billion to more than 6 billion euros by 2035.

> 8 billion euros: ~ 8 billion euros will be invested in the low-carbon hydrogen supply chain by 2035.

Supporting the development of a first demonstration project in Japan

In January 2023

Air Liquide announced that it will deploy its ATR technology to a pilot project for the production of low-carbon hydrogen and ammonia for **INPEX CORPORATION**.

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Air Liquide