HYDROGEN

FLEXIBLUE®

HYDROGEN

HyPURE

HyPURE, a collaboration between Casale and Technip Energy,
is the go-to solution for large-scale, low-carbon Hydrogen plants

T.EN TECHNIP ENERGIES

CASALE

We are a global partner
in the chemical industry,
offering **integrated technologies,**
engineering, contracting
and construction solutions
for over a century.

Our mission

Contribute to shape a new sustainable planet with our plants for the production of fertilizer, methanol, hydrogen, melamine and derivatives, and help our customers creating value respecting the environment.

We are a global company front leader in the energy transition: a key player in the sustainable transformation of the chemical and energy industry, from a social, economic and environmental point of view.

Our values

INNOVATION PEOPLE CARE **PROFESSIONAL EXCELLENCE**
QUALITY **SAFETY** ETHIC **SUSTAINABILITY**

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The process is based on autothermal reforming (ATR) of either natural gas or off-gases with pure oxygen and a standout feature is its very carbon capture efficiency, exceeding 99%.
The scheme is extremely flexible, and it can be customized to meet specific Client's needs for steam and power as well as be easily integrated in any downstream unit.

Capacity

- Best suited up to **600.000 Nm³/hr** in a single train

Performances

- Best suited up to 600.000 Nm³/hr of hydrogen in a single train
- Natural Gas consumption:
  < 14.5 MJ NG/Nm³ H_2 on Low Heat Value (LHV) basis (LHV basis)
- Net Energy (Natural Gas + El. Power) efficiency: **> 70-75%+**

Benefits

- Low Energy Consumption
- Reduced NG specific consumption
- The steam production can be optimized from nil to maximum export.
  The excess steam can be utilized for power generation
- Single train arrangement, up to very high capacities
- Compact and simple lay-out
- Low Levelized Cost of Hydrogen (LCOH)

Enviromental Impact

Carbon capture higher than 99%
Total emissions to atmosphere:
- less than 0.1 kg CO_2 / kg H_2
- Less than 140 mg/Nm³ of NOx or even lower than 50 mg/Nm³ installing the SCR in fired heater's convection section.

Casale and Technip Energies technical assets

- Design of ATR Fired Heater
- ATR reactor and burner
- Axial-Radial® Pre-Reformer
- High temperature, Axial-Radial® water gas shift converter
- Low temperature, Axial-Radial® water gas shift converter
- Technip Large Scale Vortex (LSV®) burners

PROCESS OUTLINE

The HyPURE is designed to efficiently produce syngas rich in H_2 and CO, while limiting the CO_2 content and the methane slip. At its core, the process integrates Casale's pre-reforming and Casale's O_2-blown ATR.

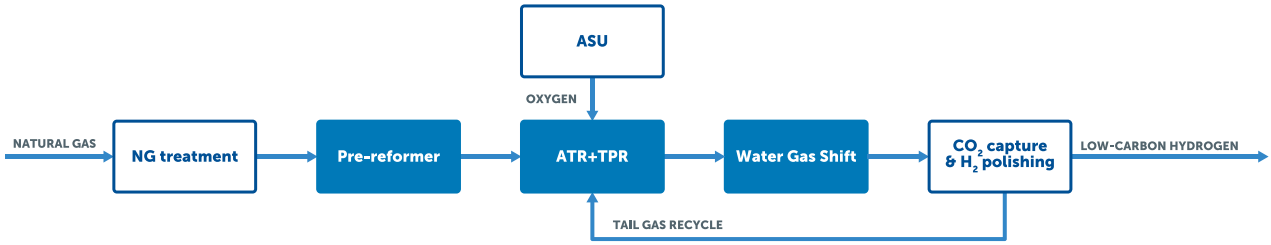
Operating at high pressure with a low Steam-to-Carbon ratio (S/C), this dual-reforming approach is characterized by an enhanced efficiency, reduced environmental impact, and significant cost savings.

More in particular:
- reduced size of ATR
- minimized fired duty for process purposes, which results in lower CO_2 emissions, contributing to a more sustainable operation
- reduced natural gas usage: lower methane slip translates to decreased reliance on natural gas feedstock, thereby reducing carbon usage.
- reduced plot area required, with significant savings in both bulk material and erection costs
- reduced CAPEX and OPEX

Factors such as S/C ratios, effluent temperature, and oxygen ratios are adjusted to minimize methane slip, leading to notable benefits:
- reduced natural gas usage: lower methane slip translates to decreased reliance on natural gas feedstock, thereby reducing carbon usage
- lower carbon emissions: by mitigating methane slip, the process yields lower overall carbon emissions.

Furthermore, taking a small portion of the produced hydrogen as fuel for the Large-Scale Vortex® (LSV) burners instead of natural gas significantly diminishes the carbon footprint by up to 99%, underscoring the process's environmental stewardship.

The main steps of the HyPURE process:
Autohermal reforming - The feed natural gas undergoes desulfurization before entering first in the Casale Axial-Radial® pre-reformer and then in the O_2-blown ATR.
Heat recovery - The hot effluent from ATR is sent to the waste heat recovery package for high pressure steam generation and then is treated in the Casale Axial-Radial® water gas shift section, where the CO present in the gas is converted to hydrogen.
CO_2 recovery - All CO_2 in the gas stream is extracted and recovered for either definitive sequestration or alternative applications. The final purification of the hydrogen is accomplished using an appropriate unit, guaranteeing the production of high-purity, low-carbon hydrogen suitable for a wide range of applications.



Block flow diagram of HyPURE process

Casale and Technip Energies: a renewed partnership

Technip Energies and Casale have a long relationship, going back to the 1980s, with numerous achievements in the syngas and hydrogen fields. A new partnership is formed to jointly license oxidative reforming-based technologies. As part of this collaboration, Technip Energies and Casale are co-licensors of the technology and Process Design Packages (PDP's), the associated proprietary equipment, or entire plants on an EPC basis. Technip Energies and Casale together bring unique strengths for improved project performance.

CASALE T.EN TECHNIP ENERGIES

PLANTS FOR
A NEW PLANET.
SINCE 1921.

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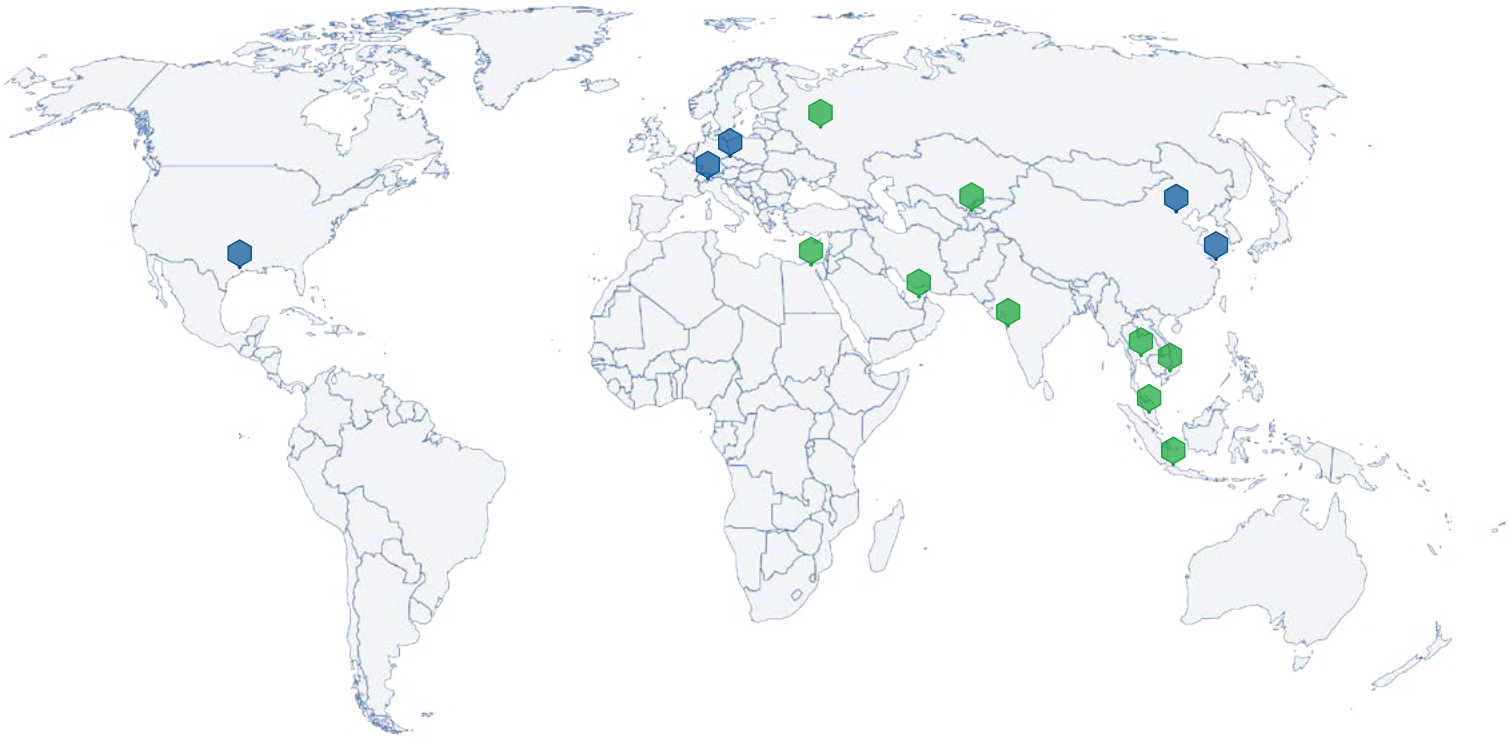
Casale in the world



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