AMMONIA

FLEXIBLUE®

AMMONIA

HyPURE-N

Casale's pure ATR-based process for large-scale Blue Ammonia plants

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**

AMMONIA

HyPURE-N

Casale has embraced the energy transition challenge focusing on developing sustainable technologies for the production of various base chemicals, including blue ammonia from Natural Gas resources. Drawing upon proprietary technologies, HyPURE-N represents the latest step forward for the large-scale production of ammonia with a greatly reduced environmental impact thanks to the optimization of the energy consumption, the reduction of the natural gas required thus generating, as a consequence, a lower amount of emissions. All CO_2 is captured, and it is sent to sequestration or to other utilizations.

Capacity

- Best suited from **3500 MTD and above**, but can be applied also for lower capacities

Performances

- Energy consumption: as low as **7.4÷7.6 Gcal/MT LHV basis**, including utilities and final CO_2 compression at Battery Limits
- CO_2 recovery: **as high as 99%**

Benefits

- Low energy consumption
- Reduced LCOA (Levelized Cost of Ammonia)
- No steam/power import or export is required

Casale technical assets

- Auto Thermal Reformer (ATR) including burner
- Casale Axial-Radial® prereformer
- Casale Axial-Radial® HT and LT shift converters
- Casale ammonia washing unit
- Casale Axial-Radial® ammonia converter, with proprietary nozzle-to-nozzle connection between the pressure vessel and the downstream waste heat boiler
- Advanced waste heat recovery train in the synthesis loop
- Amomax®-Casale ammonia synthesis catalyst

Enviromental Impact

Total CO_2 emissions per ton of ammonia produced:

- from 0.08 to 0.02.

PROCESS OUTLINE

HyPURE-N is a single-train process optimized to produce ammonia on a large scale with very low carbon intensity. Virtually all CO_2 generated in the front-end is captured and compressed up to (for instance) 200 bar g for sequestration or other utilization purposes (e.g. Enhanced Oil Recovery).
Such high level of decarbonization is achieved through the adoption of a pre-reformer and pure O_2-blown Auto-Thermal Reforming (ATR) front-end, operated at high pressure and with a low Steam to Carbon ratio.
This peculiar and patented reforming scheme is central to obtaining large capacities, high energy efficiency whilst reducing the generation of high temperature heat (limited only to pre-heating purpose), which is the main responsible for the high carbon emissions through the stack in traditional "grey" processes.

The main steps of the process are:

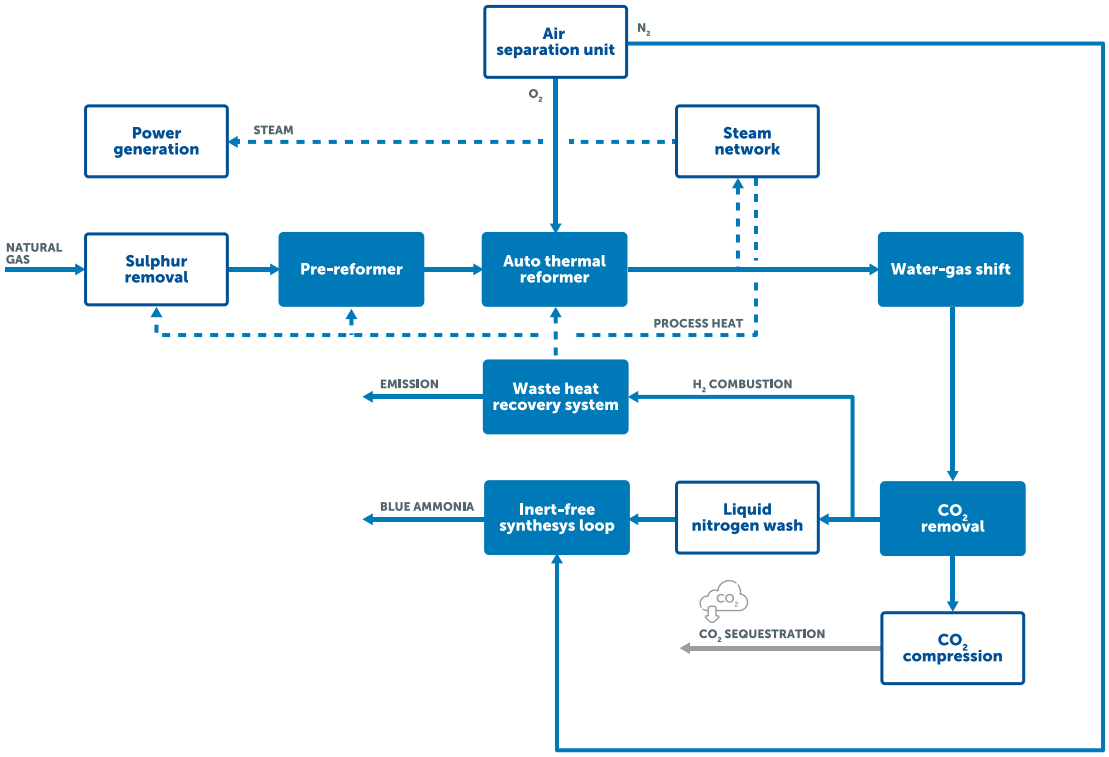
Auto thermal reforming - The feed natural gas is first desulphurized in a conventional cobalt-molybdenum unit and, after subsequent preheating, it is transferred in a Casale Axial-radial® prereformer reactor.
The partially reformed gas is mixed with O_2 and the routed to the autothermal reactor (ATR) where it is catalytically converted into a mixture of H_2, CO and unconverted methane.
The O_2 necessary is obtained with a conventional Air Separation Unit, which also generates the N_2 required by the synthesis of ammonia in the back end of the plant.

High-Temperature (HT) CO Shift – After cooling in a waste heat boiler generating high-pressure steam, the bulk of the carbon monoxide (CO) content of the synthesis gas is converted to CO_2 and H_2 by reaction with steam.

Low-Temperature (LT) CO Shift – After further cooling, the CO shift reaction is completed in a LT shift stage. Casale Axial-Radial® flow internals are used in both the HT and LT shift reactors.

CO2 removal – After cooling and condensing the surplus steam, the gas next passes into the absorption column of a highly-efficient regenerative CO_2 removal system. The CO_2 is recovered in a concentrated form and sent to other uses or final sequestration.

Syngas Purification – The traces of oxygenated compounds, other ammonia synthesis catalyst poisons, and inerts are removed through a suitable purification system, including for instance trough Liquid Nitrogen Washing. Nitrogen necessary for the ammonia synthesis reaction is also added at this stage.



Ammonia Synthesis - After adding with N_2, the purified, inert-free syngas is compressed and directed to a Casale ammonia synthesis loop, equipped with a Casale Axial-Radial® ammonia converter, where low-carbon, cold ammonia produced. The high efficiency of the converter and the reactivity of the inert-free gas ensure that equipment sizes in the synthesis loop and refrigeration section are within the limit of industrially proven references.

With the only exception of the syngas and the refrigeration compressors, which are driven by steam turbines, all other movers utilize electrical power generated within the plant.

Most importantly, HyPURE-N, process leverages a specific pre-combustion philosophy that utilizes part of the carbon-free syngas generated plus other off-gases for all fuel requirements and that is central to meet the distinctively low environmental impact target.

The process is extremely flexible and may be tailored to specific needs in terms of carbon capture requirements and energy consumption.

PLANTS FOR
A NEW PLANET.
SINCE 1921.

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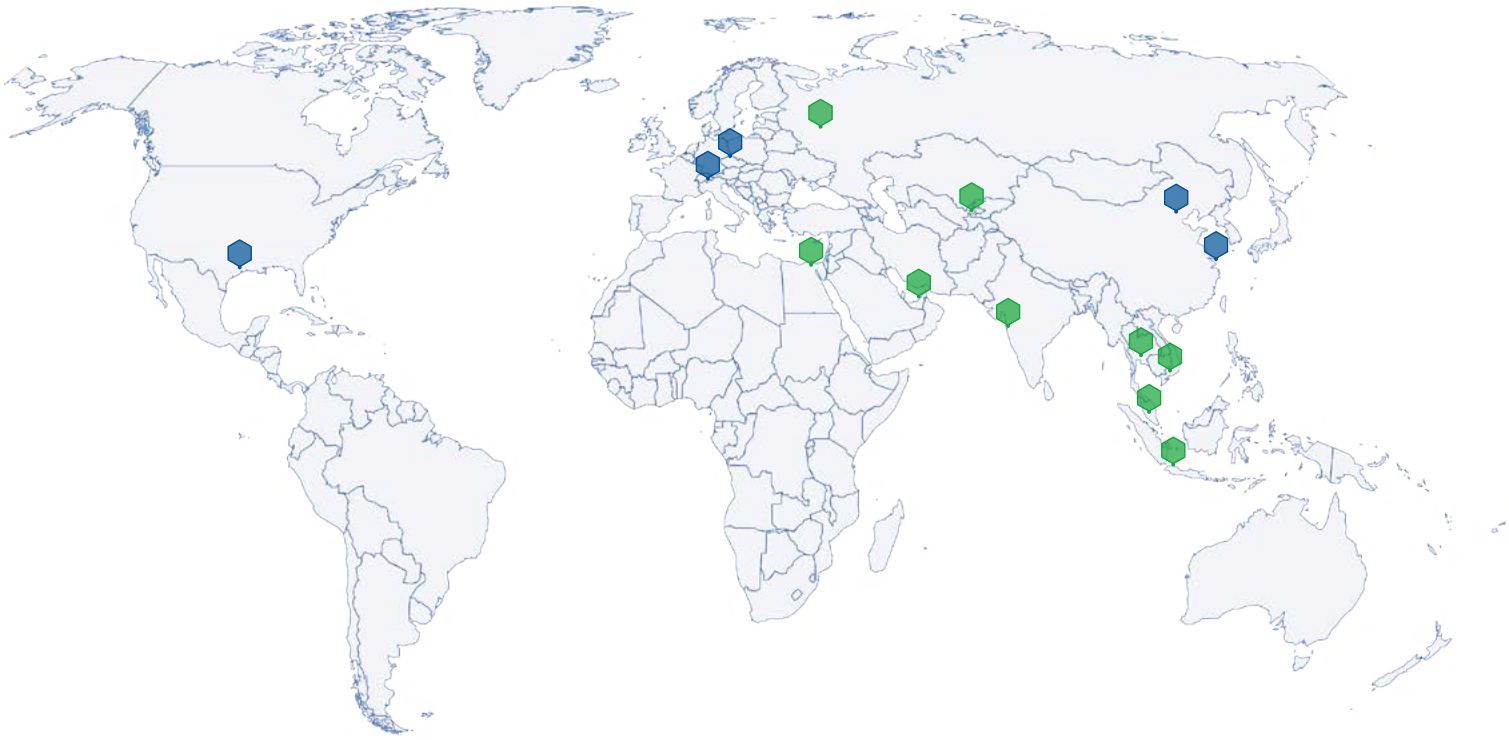
Casale in the world



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