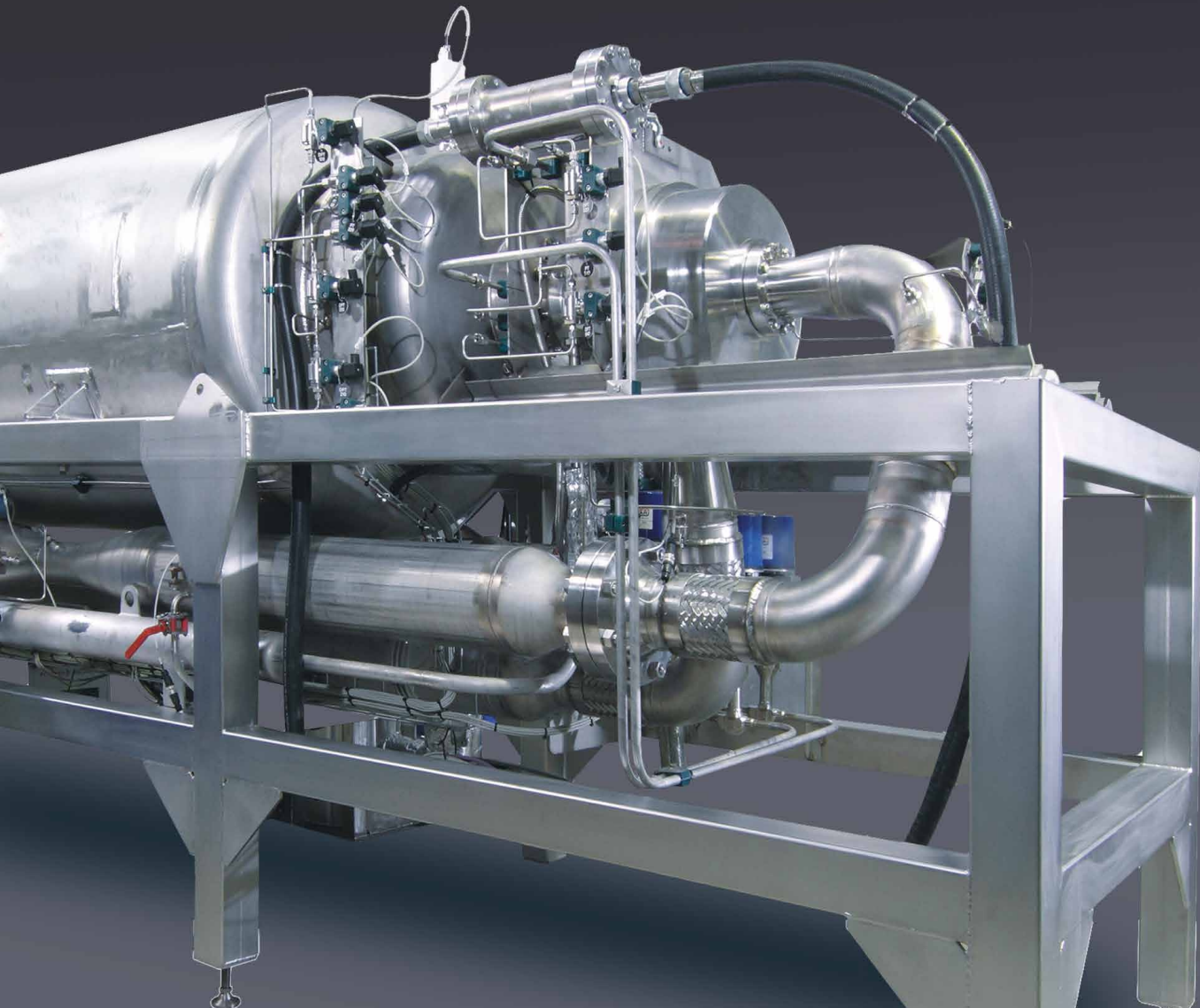


Turbo-Brayton cryogenic systems

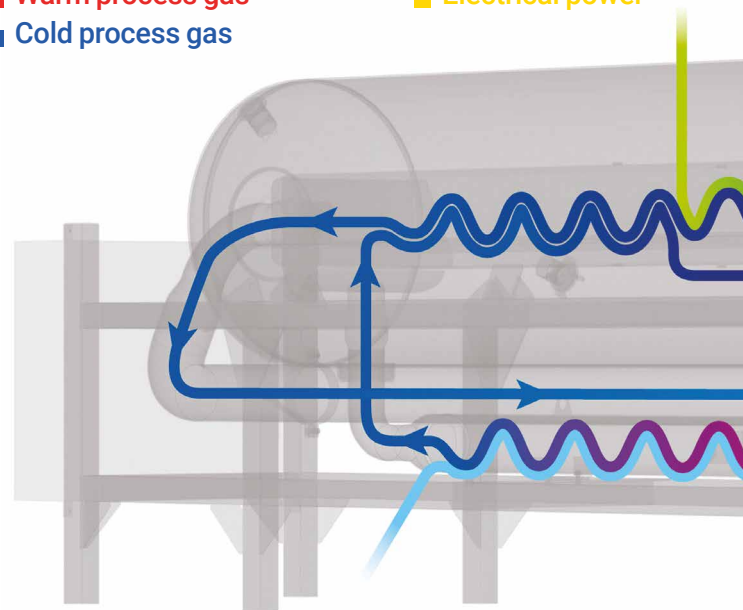
An innovative solution for refrigeration and liquefaction
from 25 K to 200 K





Reverse Turbo-Brayton principle

- Gas from/to customer
- Water
- Warm process gas
- Electrical power
- Cold process gas



Thanks to the development of several technological bricks, Air Liquide designs and manufactures innovative Turbo-Brayton cryogenic systems.

Air Liquide's teams answers to customer's specific needs with a global approach, using a procedure that combines advice, solution design, test, risk and cost control, to propose the most fitting liquefaction or refrigeration solution.

Applications

Refrigeration

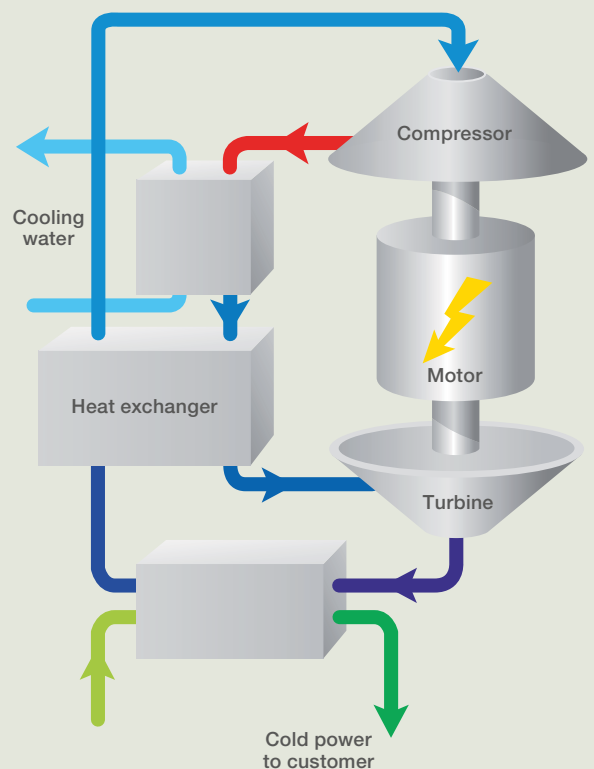
- Specific refrigeration between 25 K and 200 K adapted to customer's applications
- HTS (High Temperature Superconductivity) cooling: FCL (Fault Current Limiter), coil, motor, generator, cable, etc.
- Cryogenic gas purification and/or separation

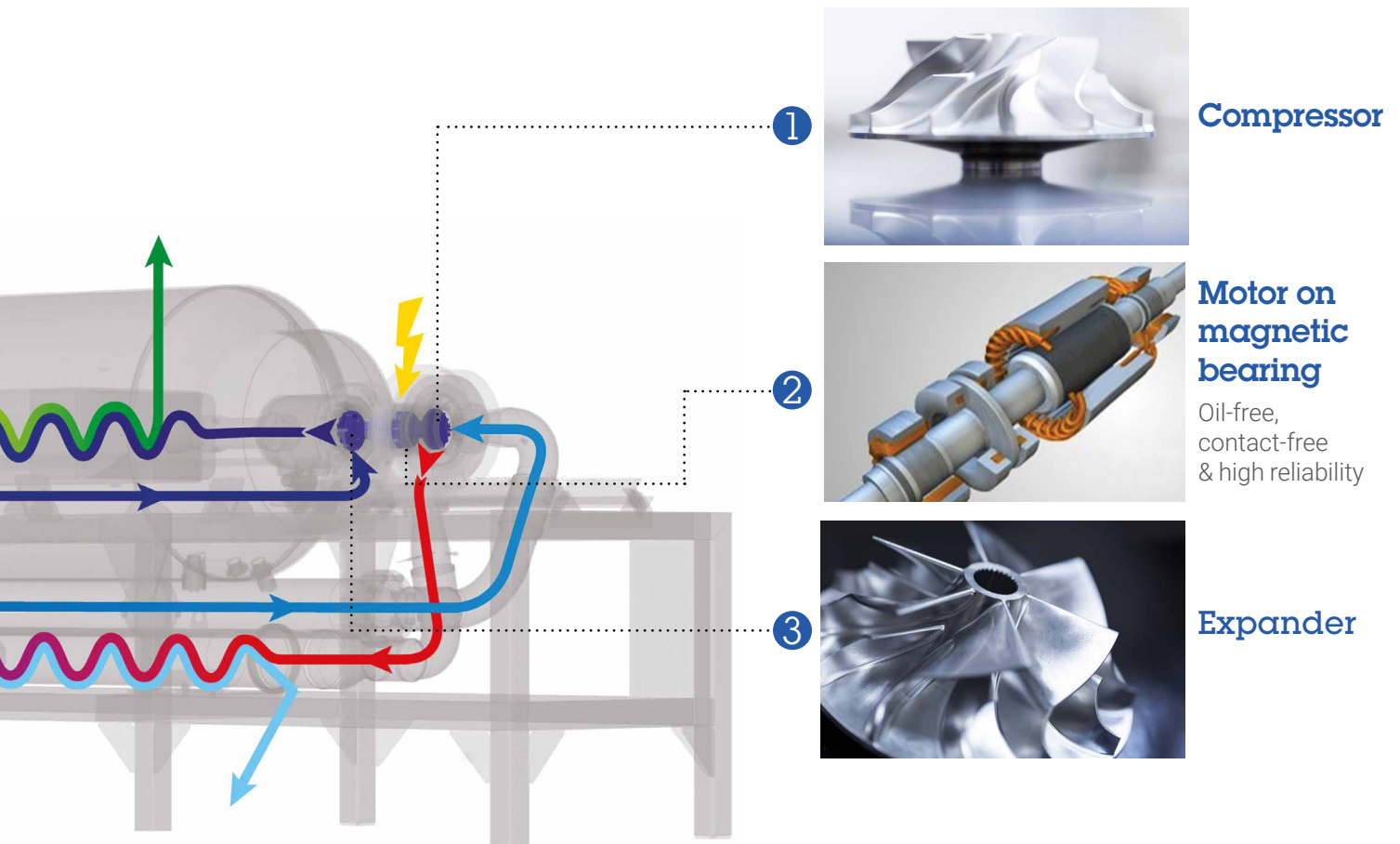
Liquefaction

- Air, nitrogen, oxygen, methane, argon, xenon...
- Biogas
- Boil off reliquefaction: CnHm, LNG, LN₂, Ar, O₂...

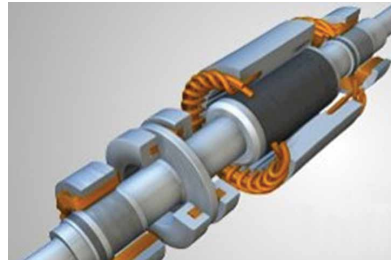
Innovation

Air Liquide's innovative reverse Turbo-Brayton process essential innovation concerns the assembly of all active elements on a single shaft.



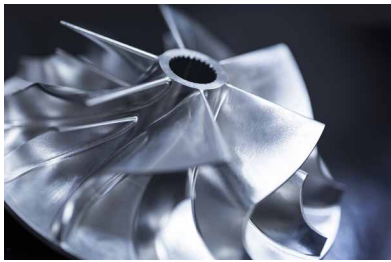


Compressor



Motor on magnetic bearing

Oil-free, contact-free & high reliability



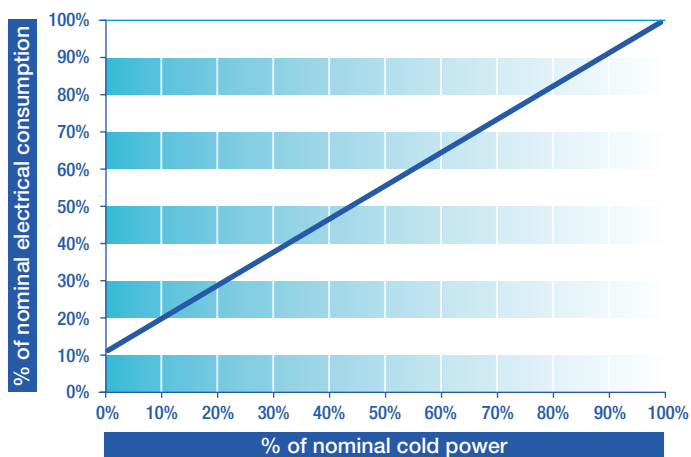
Expander

Benefits

High efficiency solution

Air Liquide's Turbo-Brayton cryogenic systems are designed to be both **energy efficient** and **flexible**.

- Cryogenic expander power recovery
- Centrifugal compressors and expanders
- Direct drive motors
- Motor's speed adjusts automatically to match the load and operating conditions



Care free systems

One of Air Liquide's key concern is to deliver a product that guarantees ease of installation, a high availability as well as a high reliability in order to keep your production up and running.

High availability and reliability

- Designed to be maintenance free
- 100% oil free
- 100% contact free
- No downtime
- Factory tested before shipping

Ease of installation and operation

- Plug & play
- Packaged system
- Small footprint
- Remote control
- Low noise level
- No compressed air required

Low life cycle cost

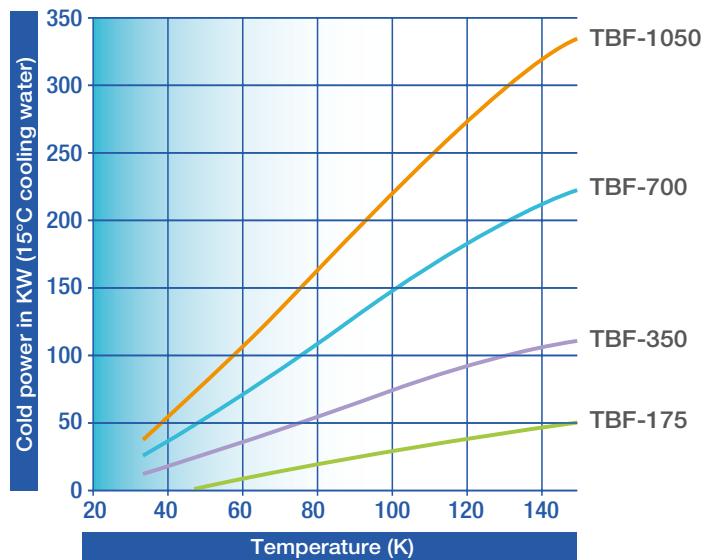
All Air Liquide's solutions are developed to set costs at their lowest level, taking into account all phases of the product's life cycle:

- Installation
- Operation: energy saving
- Maintenance-free for 5 years
- Fast payback



From standard to on-demand systems

Turbo-Brayton range



On-demand

- Specific architectures
- Extension of the temperature range down to 20 K

Options

Options can be added to fully satisfy customer's need:

- Cryogenic circulator LN₂, GH₂, GN₂, GHe integrated on the refrigerator
- Liquefaction and refrigeration of fluids up to 70 bars
- Containerized system
- Air-cooled system
- Heat recovery (building heating, customer process needs,...)

Some references of the Turbo-Brayton application

- Onboard the International Space Station (ISS), 2006
- HTS cable supraconductivity, 2017 (TBF-175)
- HTS cable supraconductivity, 2016 (TBF-350)
- LNG reliquefaction offshore, 2015-2017-2018 (TBF-350)
- LNG reliquefaction offshore, 2016-2018 (TBF-1050)



Contacts

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A world leader in gases, technologies and services for Industry and Health, Air Liquide is present in 73 countries with approximately 67,100 employees and serves more than 3.9 million customers and patients.