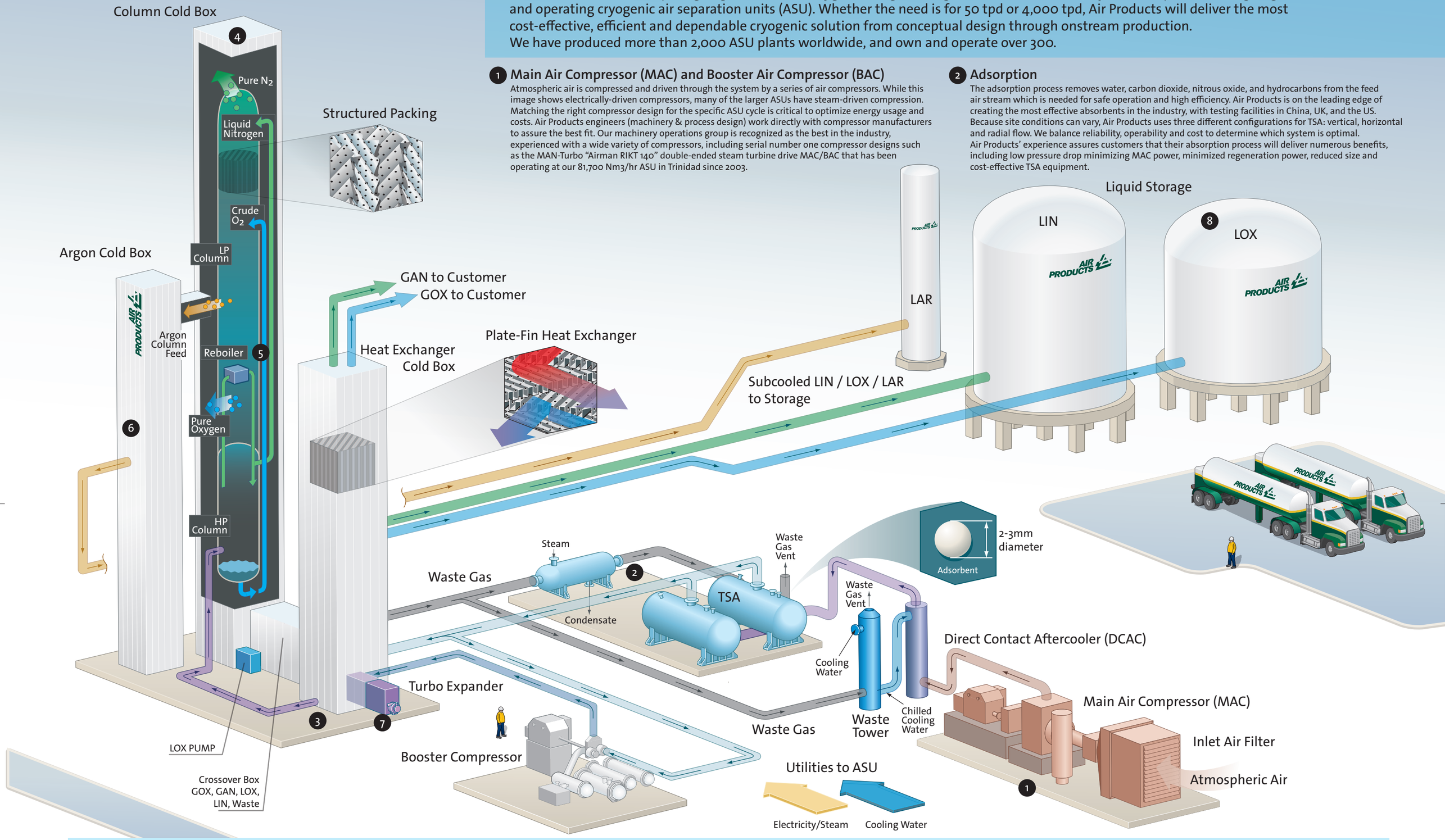
Air Products Air Separation Plants—Unique Technology & Unparalleled Experience

Worldwide customers requiring large amounts of oxygen, nitrogen or argon trust Air Products' 70 years of experience designing and operating cryogenic air separation units (ASU). Whether the need is for 50 tpd or 4,000 tpd, Air Products will deliver the most cost-effective, efficient and dependable cryogenic solution from conceptual design through onstream production. We have produced more than 2,000 ASU plants worldwide, and own and operate over 300.



1 Main Air Compressor (MAC) and Booster Air Compressor (BAC)

Atmospheric air is compressed and driven through the system by a series of air compressors. While this image shows electrically-driven compressors, many of the larger ASUs have steam-driven compression. Matching the right compressor design for the specific ASU cycle is critical to optimize energy usage and costs. Air Products engineers (machinery & process design) work directly with compressor manufacturers to assure the best fit. Our machinery operations group is recognized as the best in the industry, experienced with a wide variety of compressors, including serial number one compressor designs such as the MAN-Turbo "Airman RIKT 140" double-ended steam turbine drive MAC/BAC that has been operating at our 81,700 Nm3/hr ASU in Trinidad since 2003.

2 Adsorption

The adsorption process removes water, carbon dioxide, nitrous oxide, and hydrocarbons from the feed air stream which is needed for safe operation and high efficiency. Air Products is on the leading edge of creating the most effective absorbents in the industry, with testing facilities in China, UK, and the US. Because site conditions can vary, Air Products uses three different configurations for TSA: vertical, horizontal and radial flow. We balance reliability, operability and cost to determine which system is optimal. Air Products' experience assures customers that their absorption process will deliver numerous benefits, including low pressure drop minimizing MAC power, minimized regeneration power, reduced size and cost-effective TSA equipment.

3 Main Heat Exchanger

The heat exchanger promotes heat transfer between fluids. Air Products offers unique design capabilities to optimize the heat exchanger's energy efficiency and integration with the process cycle. The ability to customize the equipment for each customer's ASU comes from a highly experienced engineering staff and long-term working relationships with leading heat exchanger manufacturers.

6 Argon Distillation

Argon removal systems depend on distillation for purification. Air Products' *Integrated Argon Removal* system eliminates the need for a separate column for argon removal. It produces a crude argon stream (90% Ar and 10% O_2) out of the main column that results in 3–4% power savings. If pure argon is required, further purification of the crude argon stream occurs in a separate distillation column, or in a proprietary Air Products Argon PSA, which can be added later. Proprietary packing technology allows for a shorter argon column size versus competitive technologies. The smaller column results in production efficiencies and dramatically lower shipping and installation costs.

4 Air Distillation System

Choosing the optimal configuration of distillation column components is not only important in air separation, but vital to minimize capital and operating costs. Air Products was the pioneer in structured packing in 1984—now the accepted industry standard. Structured packing provides a large surface area per volume, which maximizes mass transfer performance and creates lower pressure drop versus conventional distillation trays. Air Products' proprietary structured packing delivers a higher capacity and lower pressure drop, resulting in lower energy consumption. Combined with our patented liquid and vapor distributors, the Air Products air distillation system offers unequaled distillation performance. Site conditions can vary, so all designs are tested to assure optimal efficiency and reliability before installation.

7 Turbo Expander

Turbo expanders are used to expand air or nitrogen from a higher pressure to a lower pressure, providing refrigeration to produce liquids in the distillation column system. Proper design is critical. Air Products has nearly 50 years of in-house design and manufacturing expertise producing more than 1,300 turbo expanders. This hands-on knowledge assures customers they will receive the highest thermodynamic performance, improved operability, reduced maintenance, and a better integration with the process design.

5 Main Reboiler

The reboiler is the heat integrator of the low pressure and high pressure distillation columns. Air Products offers proprietary technology to enhance the operation and safety of the two industry accepted reboilers used in ASUs today; downflow and thermosyphon reboilers. The downflow reboiler is preferred as it allows for higher heat transfer coefficients, resulting in less power usage.

8 Backup Systems

On the rare occasion when a gasifier needs to safely shut-down on backup oxygen, a backup system has to start fast and maintain the line pressure within tight limits. Designing these systems and making them work reliably is a real challenge. Air Products' instantaneous backup system for high pressure oxygen applications is recognized as the best in the world, providing needed confidence to customers.