NEXTCHEM | STAMICARBON

# LEADING THE WAY IN NITRIC ACID TECHNOLOGY.

## TOTAL RECYCLE CONCEPT

LESS IN.
MORE OUT.
MORE PROFIT.

# RETHINKING NITRIC ACID PRODUCTION

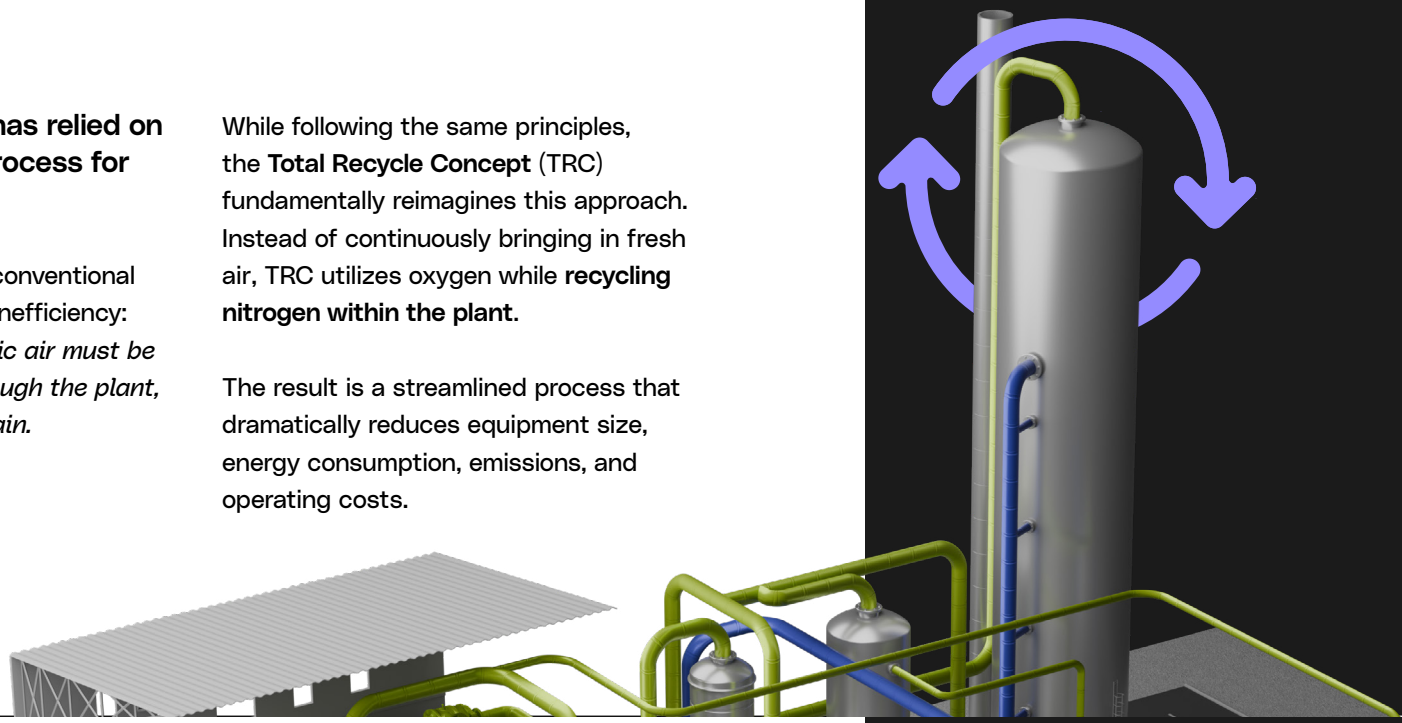
**Nitric acid production has relied on essentially the same process for more than a century.**

Despite being reliable, the conventional design carries an inherent inefficiency: *vast volumes of atmospheric air must be compressed, conveyed through the plant, and ultimately released again.*

While following the same principles, the **Total Recycle Concept** (TRC) fundamentally reimagines this approach. Instead of continuously bringing in fresh air, TRC utilizes oxygen while **recycling nitrogen within the plant.**

The result is a streamlined process that dramatically reduces equipment size, energy consumption, emissions, and operating costs.

Put simply, the plant no longer breathes in a straight line, it breathes in a circle.




RECYCLE GAS
ATM
PROCESS WATER
STEAM EXPORT
BFW
ACID
OXYGEN
NITRIC ACID
LIQUID NH3
A Recycle compressor
B Burner
C Waste heat boiler
D Bleaching column
E Absorption column

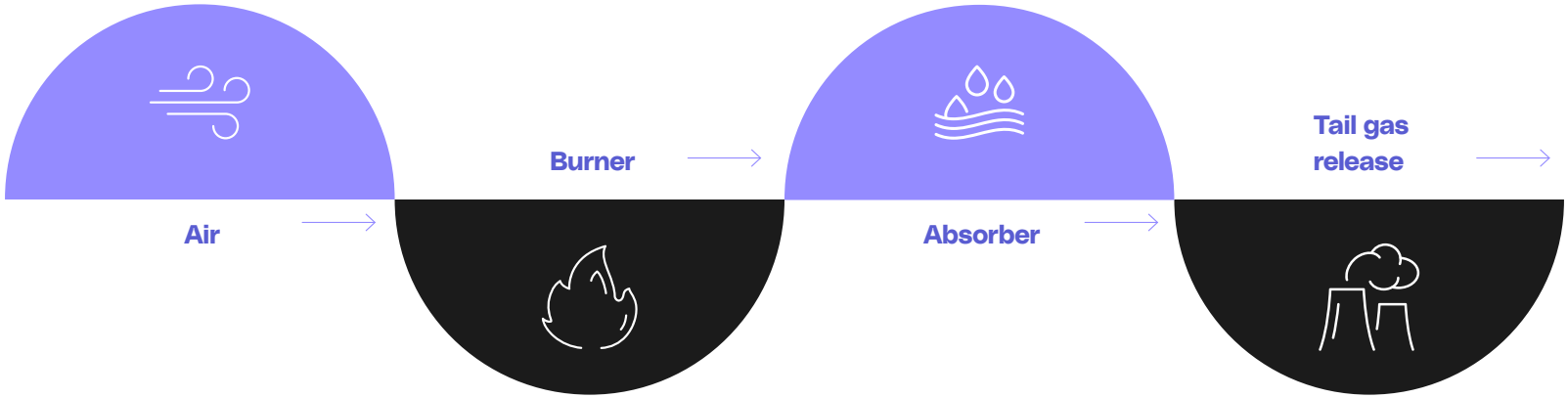
# THE CONVENTIONAL NITRIC ACID PROCESS

Traditional nitric acid plants rely on atmospheric air as the source of oxygen for ammonia oxidation. Because air contains only about 21% oxygen and 79% nitrogen, large volumes of inert nitrogen must be compressed and conveyed through the plant.

## In this design:

- Massive air compressors are required
- Nitrogen passes through once and is released

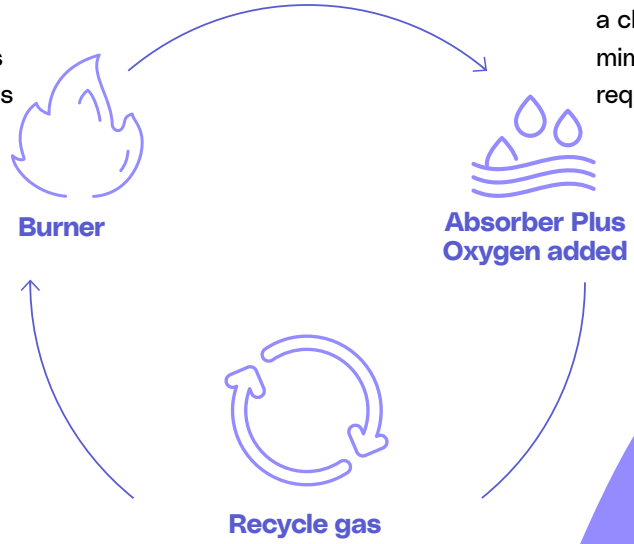
## Conventional Process Flow:



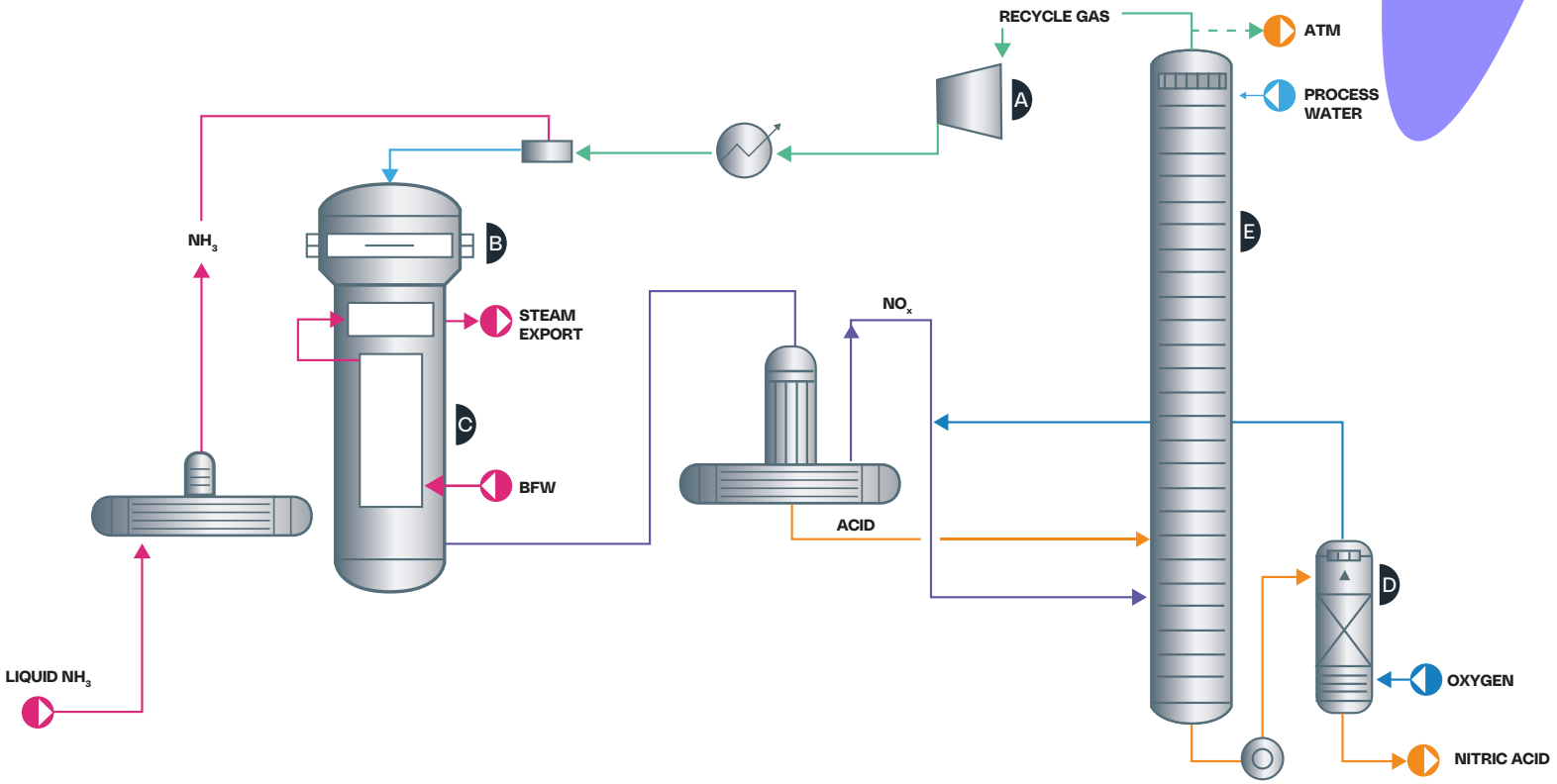
# THE TOTAL RECYCLE CONCEPT

The **Total Recycle Concept** takes a fundamentally different approach. Instead of introducing fresh air continuously, the nitrogen already present in the system is retained and recirculated. Oxygen is supplied separately, allowing the process to operate with a controlled synthetic gas mixture.

TRC Process Flow:

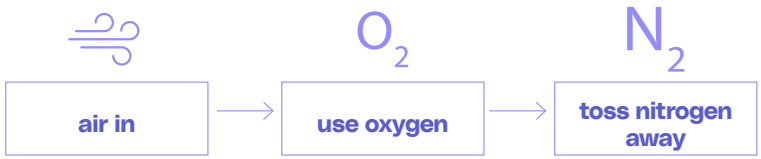



The gas leaving absorption section has controlled composition of oxygen and nitrogen, and is recycled and returned to the ammonia burner. This creates a closed-loop process gas circuit that mimics the composition of air without requiring continuous air compression.




A Recycle compressor
B Burner
C Waste heat boiler
D Bleaching column
E Absorption column

Conventional plant:




VS

TRC plant:


In other words, traditional plants are dragging around **four times more nitrogen than oxygen.** The TRC allows the process to only take the oxygen needed and recycle the nitrogen already inside, where it's used for for process control, heat carrying and safety control

| CONSUMPTION | | |
|---|---|---|
| Operating range | % | 70-110 |
| $NH_3$ consumption | kg/ton 100% $HNO_3$ | 282 |
| Pt losses (incl. recovery) | g/ton 100% $HNO_3$ | 0.035 |
| HP steam export, 45 bar, 450°C | kg/ton 100% $HNO_3$ | 1200 |
| $NO_x$ | g/ton 100% $HNO_3$ | < 4-10* |
| $N_2O$ | g/ton 100% $HNO_3$ | < 5-15* |
| Cooling water | ton/ton 100% $HNO_3$ | 80 |

* Depending on quality of oxygen source.

# KEY ADVANTAGES

### Simplified Plant Design

TRC eliminates or reduces major equipment such as complex compressor train including tail gas expander, large absorption column, and $NO_x$ abatement reactor, resulting in a compact and efficient plant layout.

### Lower Capital Investment

By reducing equipment size and eliminating major machinery, capital expenditure can be reduced by up to approximately 40% compared to conventional nitric acid plants.

### Higher Steam Export

Because tail gas reheating is no longer required, more reaction heat can be recovered and used for high-pressure steam generation.

### Near-Zero Emissions

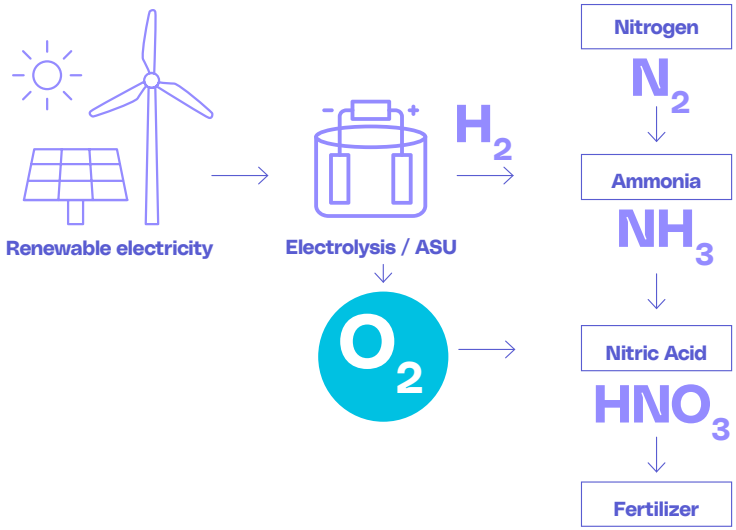
With recycling of tail gas stream, emissions of $NO_x$ and $N_2O$ are drastically reduced, creating a cleaner and more sustainable nitric acid production process.

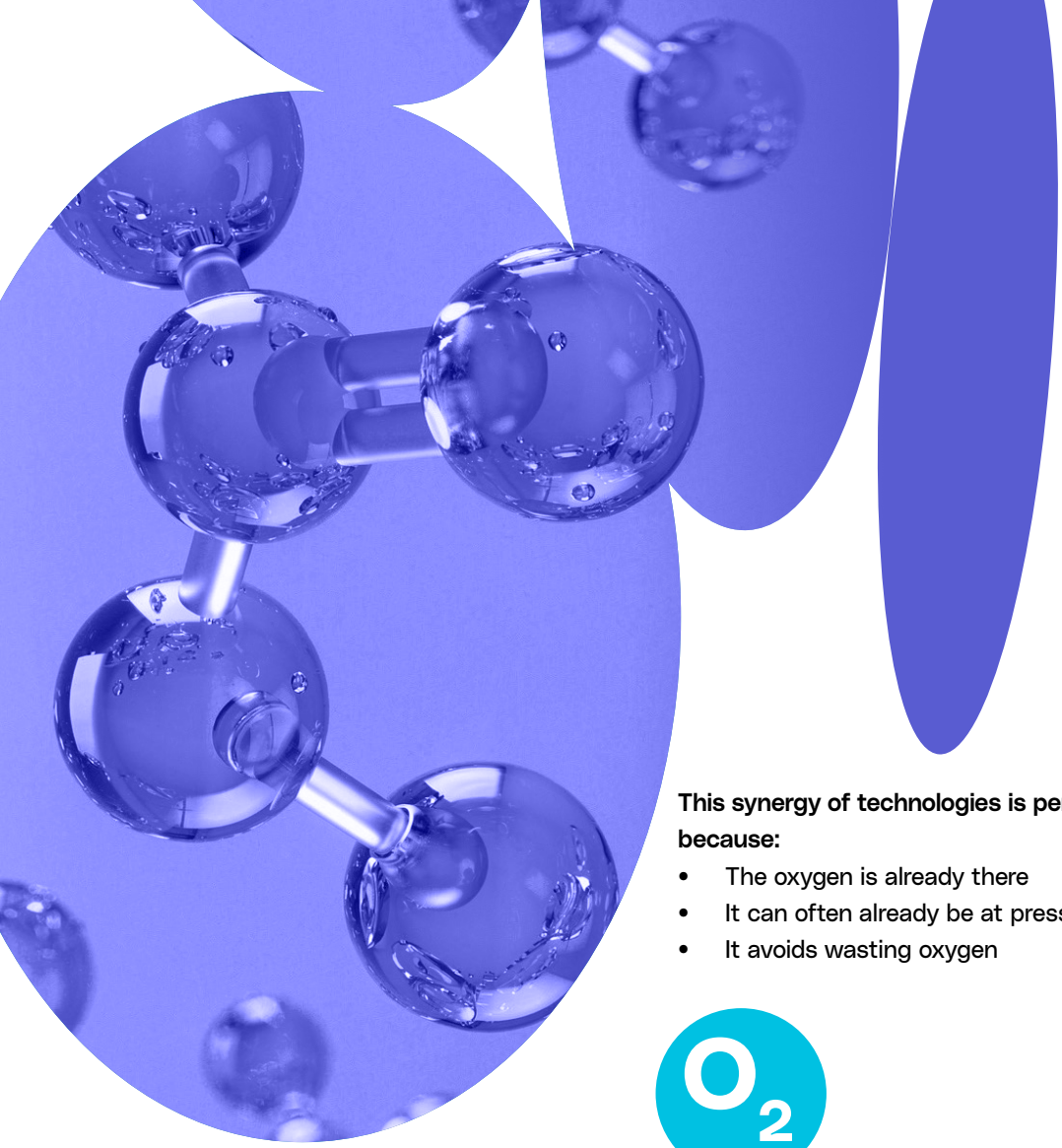

$CO_2$
NET/NEAR
ZERO
0%

This synergy of technologies is perfect because the oxygen is already there

# PERFECT SYNERGY WITH GREEN AMMONIA

The **Total Recycle Concept** fits naturally within green ammonia complexes. Electrolyzers used to produce green hydrogen generate pure oxygen as a byproduct, which can be directly utilized in the TRC nitric acid process, and so avoids wasting oxygen. Also Air Separation Units used to generate nitrogen required for green ammonia production, generates oxygen as side product.





**This synergy of technologies is perfect because:**

- The oxygen is already there
- It can often already be at pressure
- It avoids wasting oxygen

$O_2$

A technology ready for the future of sustainable fertilizers.

# A NEW GENERATION OF NITRIC ACID TECHNOLOGY

The Total Recycle Concept represents a step change in nitric acid plant design. By transforming a traditionally open process into a closed-loop system, TRC delivers lower CAPEX, lower OPEX, reduced energy consumption, near-zero emissions, and a simplified plant configuration.

A smarter process.
A cleaner process.

# WE ARE STAMICARBON

## WHAT CAN WE DO FOR YOU?

Stamicarbon, the nitrogen technology licensor of NEXTCHEM (MAIRE Group), designs and licenses fertilizer plant technologies, specializing in urea, green ammonia, and nitric acid. As part of NEXTCHEM, Stamicarbon leverages the capabilities and expertise of a world-leading engineering group. In total, Stamicarbon has licensed more than 260 plants and realized more than 100 revamping and optimization projects. Applying more than 75 years of knowledge and experience, Stamicarbon offers customers tailored solutions and services to maintain, improve and optimize plants in every stage of their life cycle, with a focus on sustainable fertilizer production. As pioneers with a higher purpose, Stamicarbon has a vision to help enable the world to feed itself and improve the quality of life. Stamicarbon is headquartered in Sittard, The Netherlands, and operates worldwide.

Questions?
Like to know how we can help you make the switch to sustainable, futureproof fertilizer production? We are here for you. Contact our experts at **www.stamicarbon.com.**

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