



High-Return Revamps: Hydrocarbon separation with modular membrane solutions



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The petrochemical industry's trilemma & opportunity

- 
- *Feedstock Price & Availability*
 - *High Energy Costs*
 - *Regulations*

**Competitiveness through
highly-efficient
separation solutions**

Over 10% of the world's energy is used for separation and purification

Energy-intensive thermal gas separation in steam cracking system

35%
of energy is needed
for separation

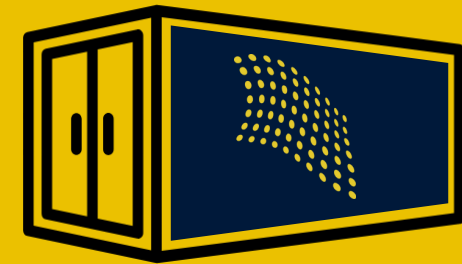
65%
rest

**11 million GJ/y
for distillation**



Avoiding thermal energy with membranes

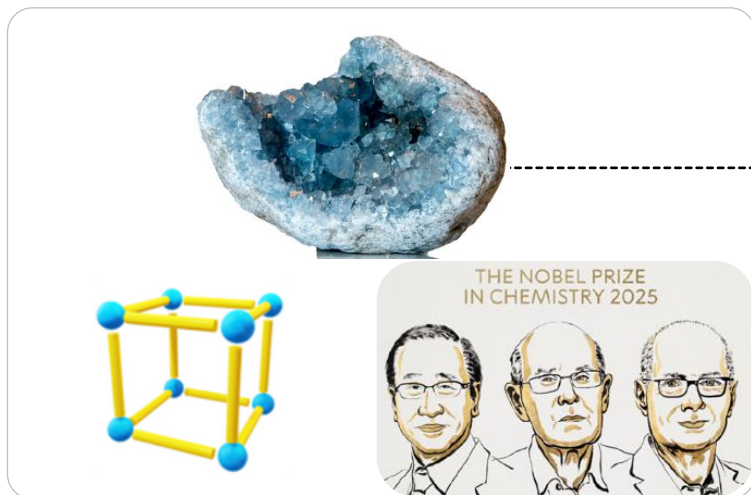
- Reduce energy needs by up to 90%
- Increase capacity with simple add-on
- Recover currently burned hydrocarbon
- Electrify & reduce GHG emissions



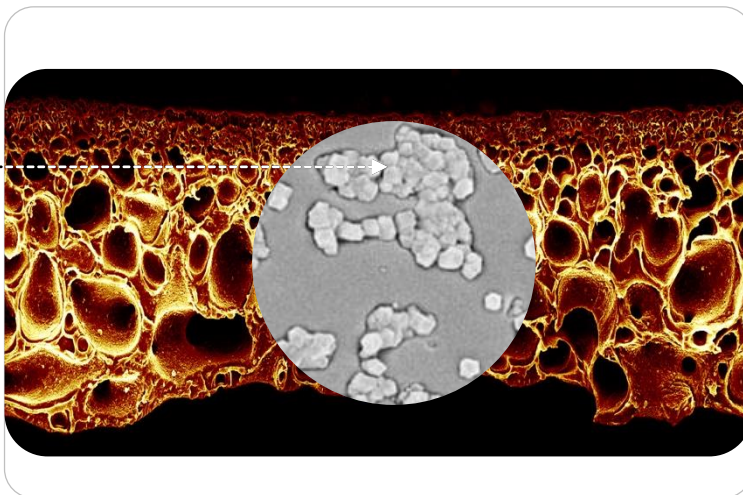
Membrane separation increases competitiveness

High-precision crystal membranes unlocking separation efficiency

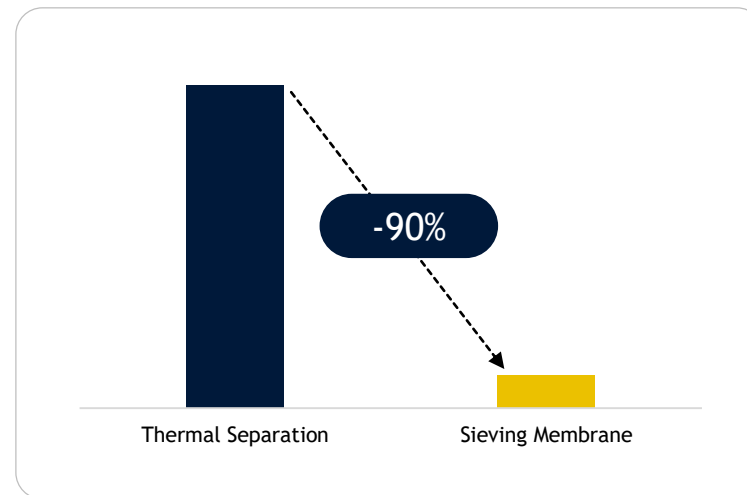
Nobel-Prize winning high-precision molecular sieving crystals



Innovative integration of crystals into flexible membranes



Sieving saves energy



cm CHEMISTRY OF MATERIALS

Forbes

\sifted/

Featured in

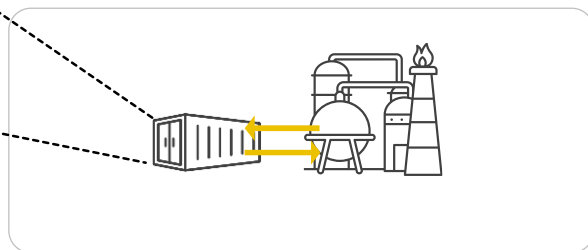
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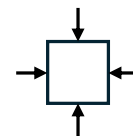
TC TechCrunch

High efficiency enables lower cost and emission separations across applications

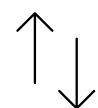
Modular and containerized units for flexibility during fast changing times



Up to 90% energy savings for hydrocarbon separations



Compact and plug & play



Highly modular to fit different scales and applications

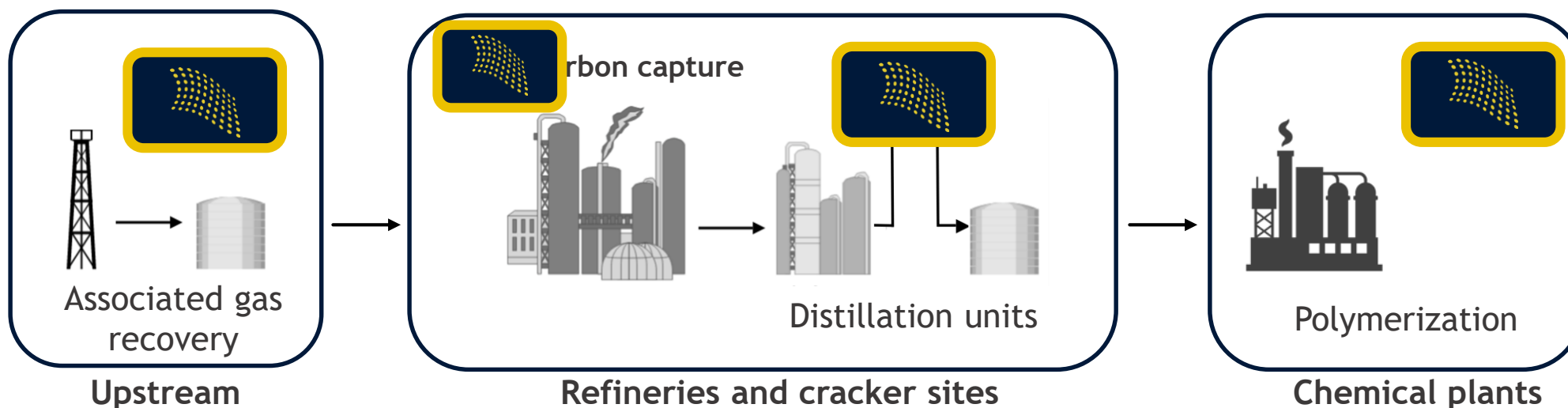


Online monitoring to optimize performance



No heat, no chemicals, and no water required

High-value use-cases along the hydrocarbon value-chain



Flare & off-gas recovery

→ Recover burned or vented gas to gain value and comply with regulations

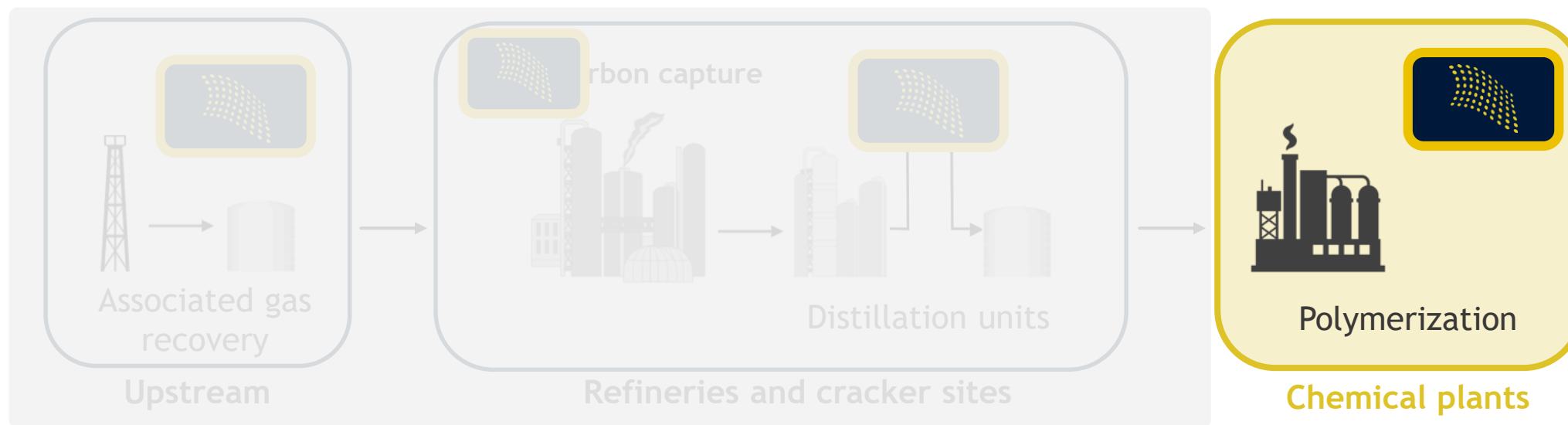
Feedstock flexibility

→ From chemical grades to polymer grades via simple add-on units

Modular capacity increase

→ Extend capacity with light CAPEX investment

Focusing on membrane solutions for polymerization plants



Flare & off-gas recovery

→ Recover currently burned or vented streams to gain value and comply with flaring regulations

Feedstock flexibility

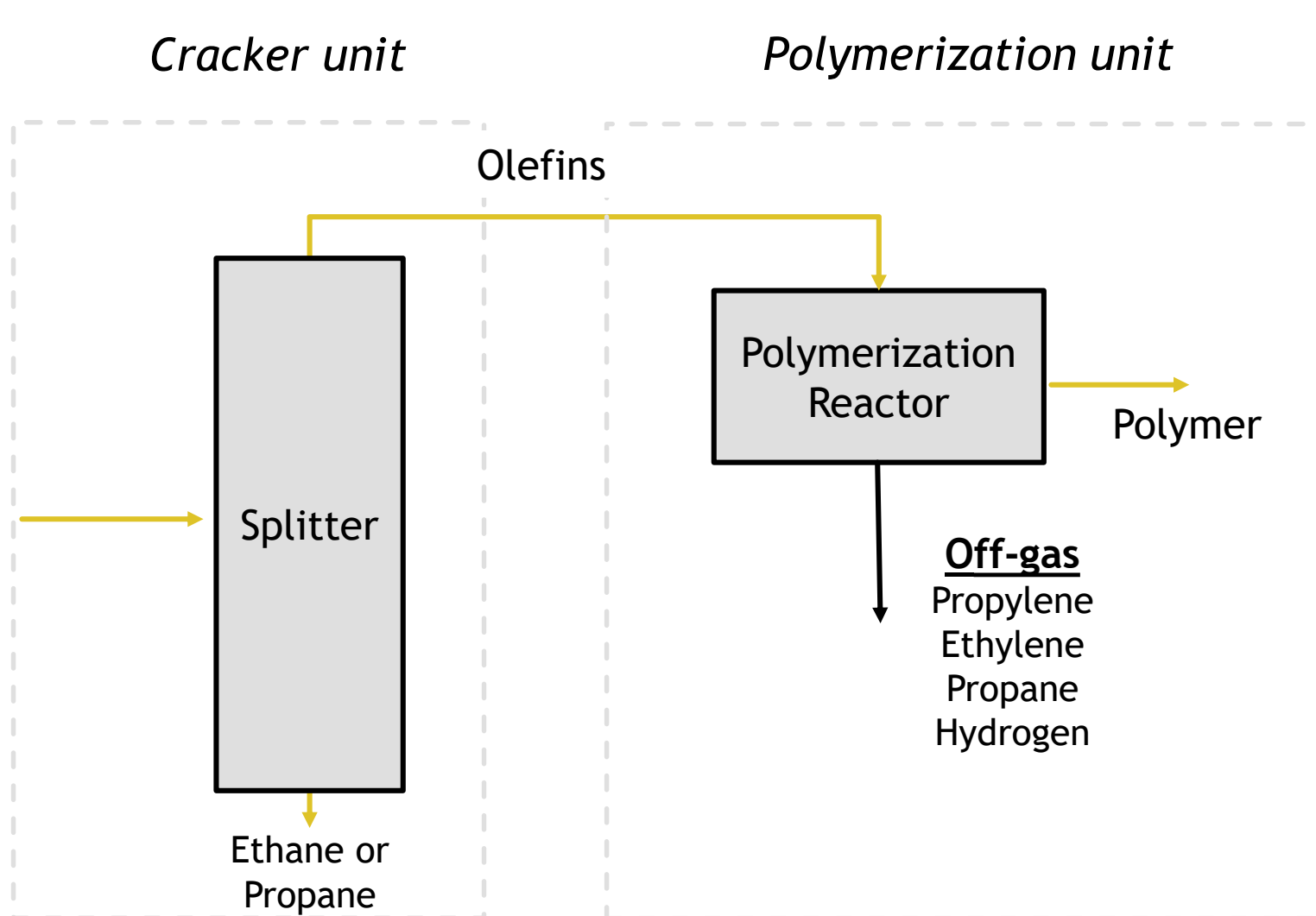
→ From chemical grades to polymer grades via simple add-on units

Modular capacity increase

→ Extend capacity with light CAPEX investment

UniSieve provides solutions for polyethylene and polypropylene off-gas recovery

Millions lost through burning of olefins or recycling to cracker

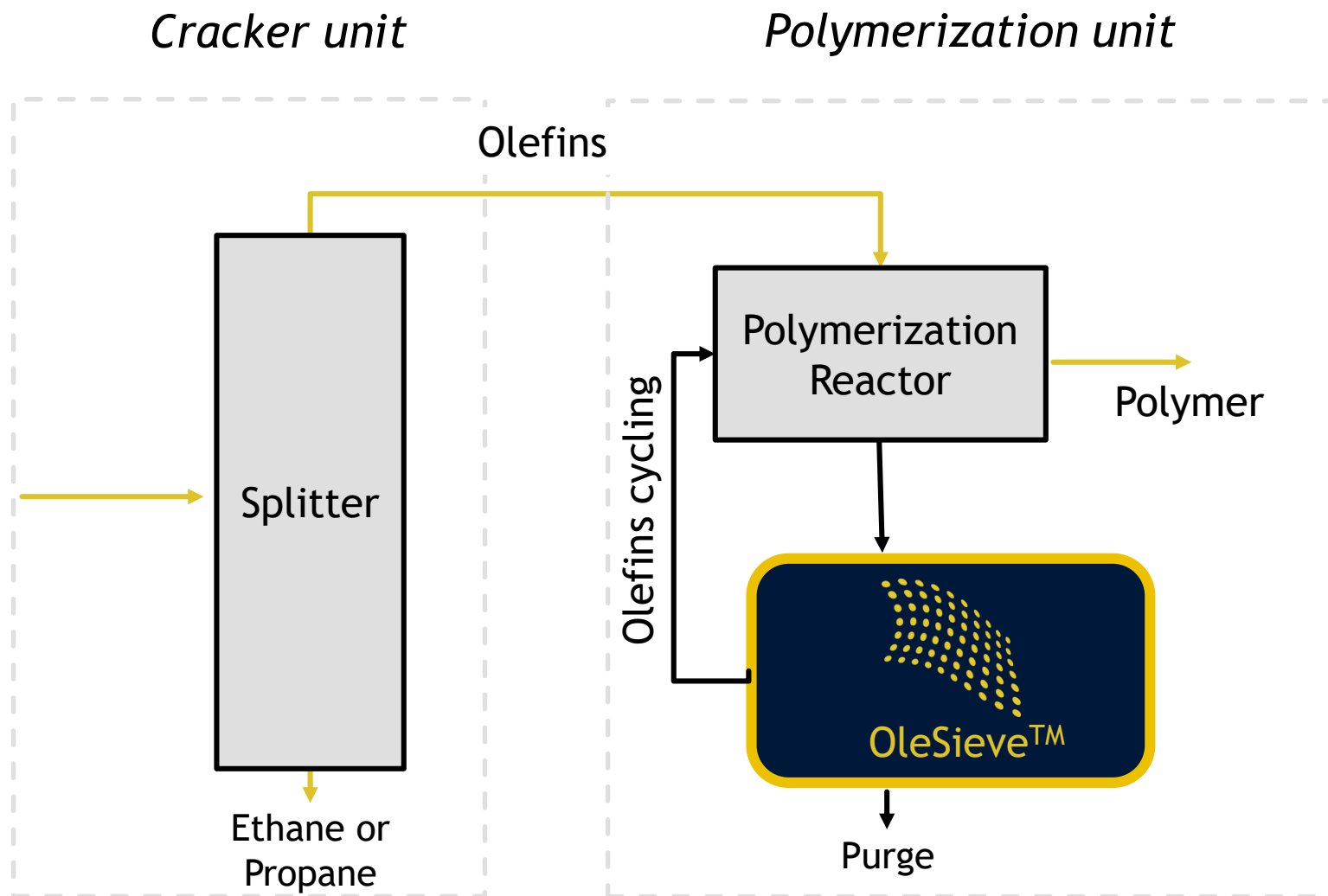


Currently available options:

A) Olefins are fed back to cracker: capacity reduction and high energy penalty

B) Olefins are burned: complete loss of olefin value

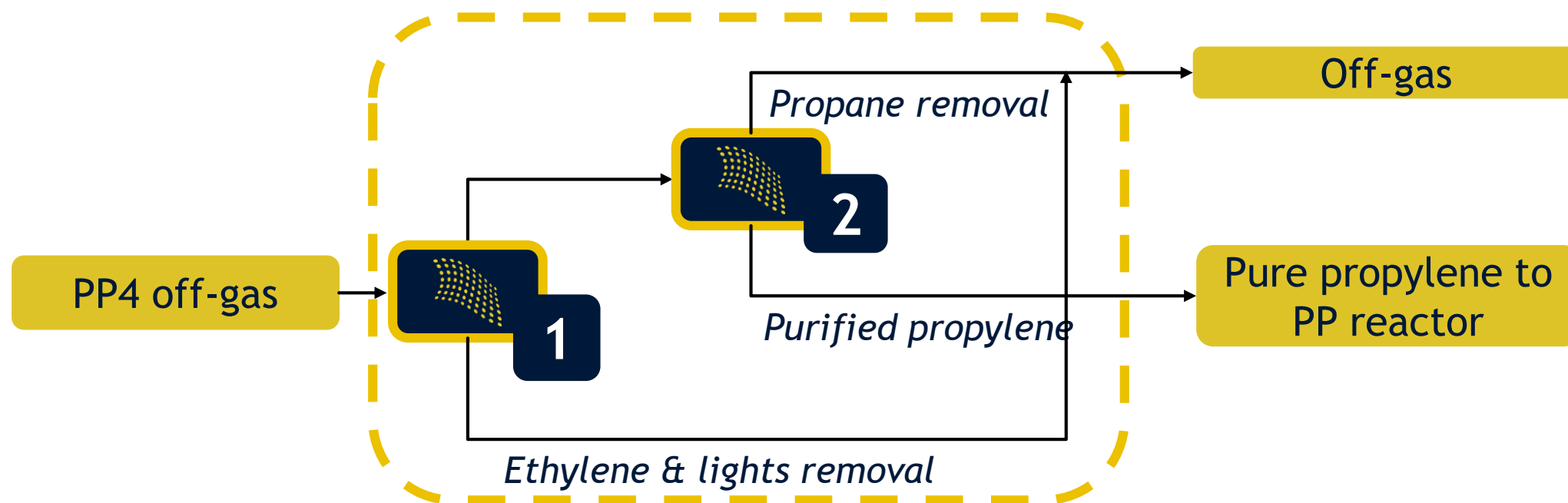
Simple recovery through OleSieve™ add-on membrane unit



UniSieve's high-return solution:

OleSieve™ uses advanced membranes to recover 95%+ of the reactive olefins at 99%+ purity

OleSieve™ solution is tailored to site specific conditions & specifications: Polypropylene

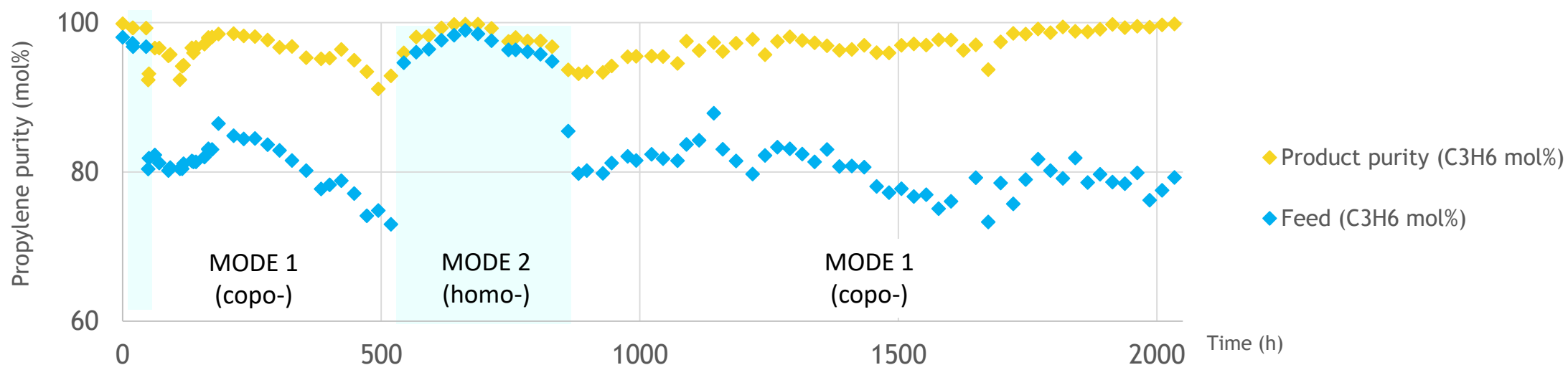


Stage 1 separates ethylene and lighter components (H₂, CH₄, N₂)

Stage 2 removes propane to reach target propylene purity



Stable output during highly varying feed compositions

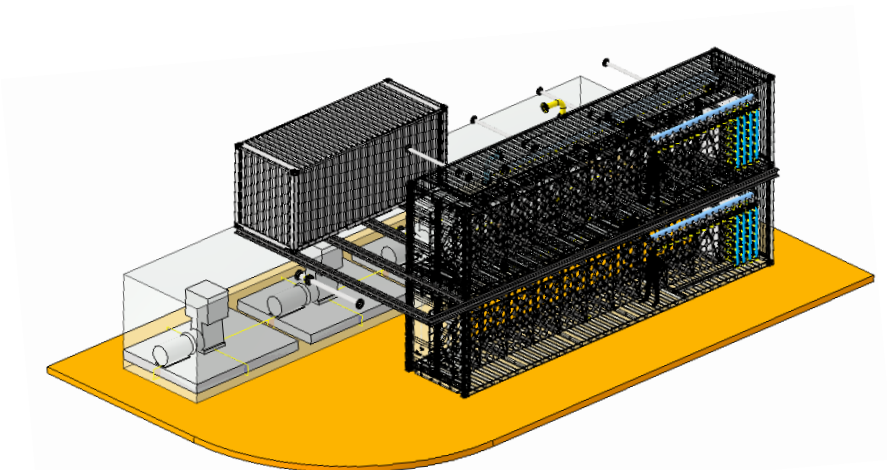


- **HOMO-polymer campaigns:** targets met (99% purity, 80% recovery) instantly
- **CO-polymer campaigns:** variable feed and lights required process optimizations to meet target specifications (99% purity, 80% recovery)

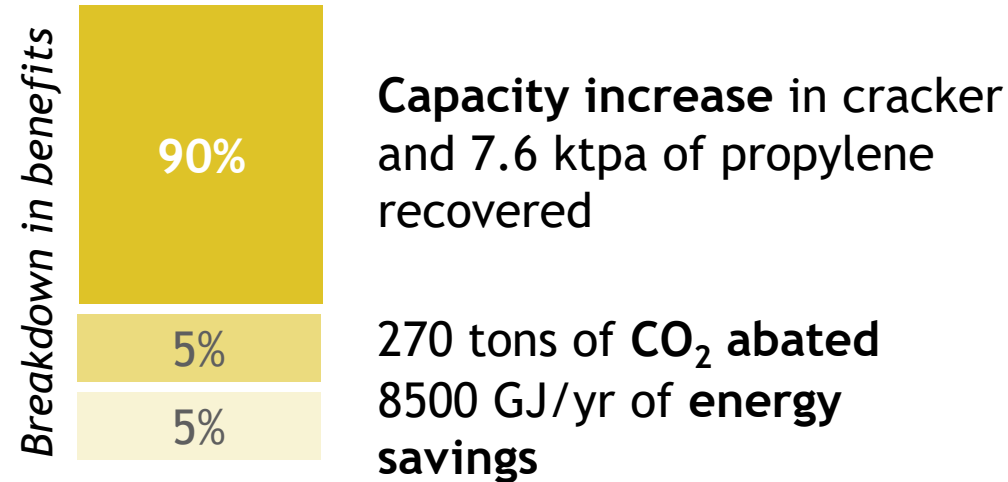
Technology is ready for full scale implementation

OleSieve™:

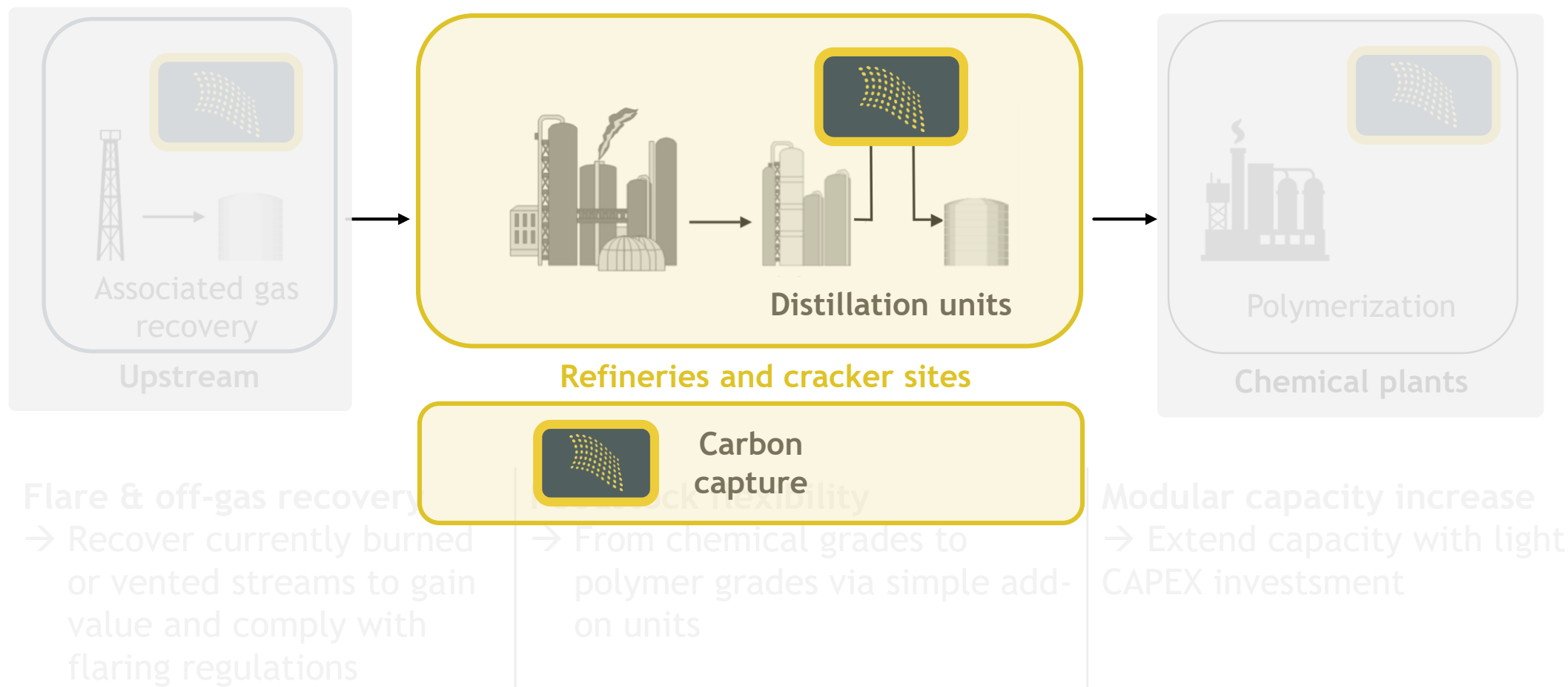
Modular system improving efficiency and reducing CO₂ emissions



- Modest CAPEX
- Attractive project returns
- Finalizing detailed engineering



Beyond off-gas recovery



UniSieve provides solutions around C3 splitter and for Carbon Capture

Capacity increase for C3 splitter

Challenge:

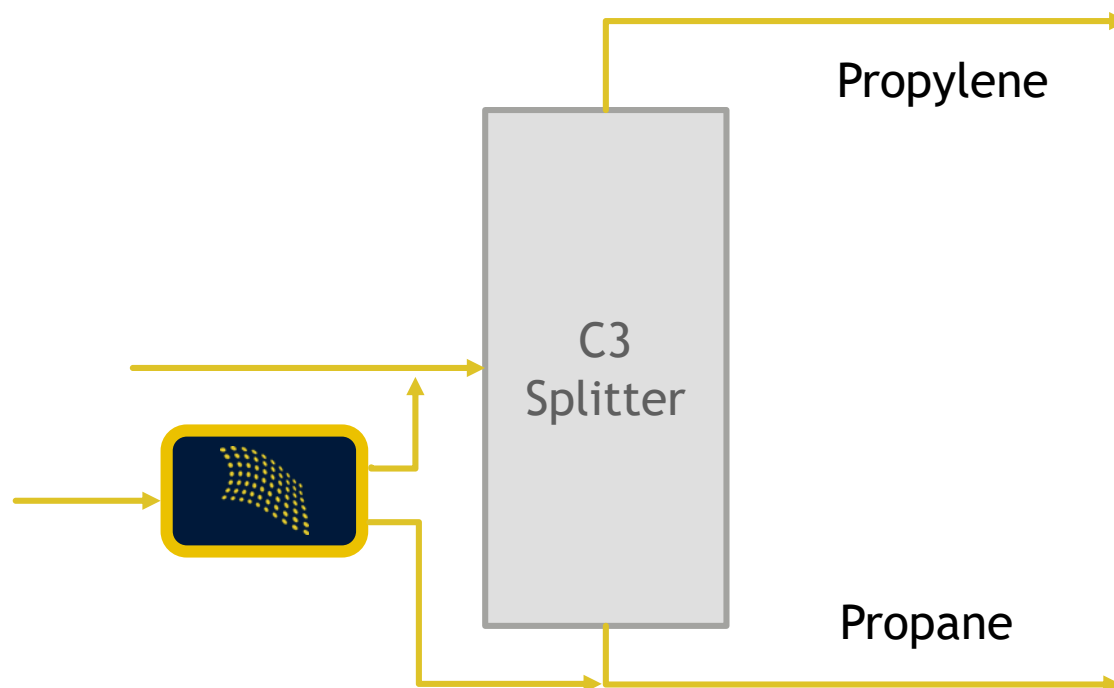
- Revamping a C3 splitter is costly due to its large diameter and the high number of trays required

Solution:

- OleSieve membranes increase throughput without need for new column

Benefits:

- 10-50% capacity increase



OleSieve solutions can also be used to improve recovery and reduce energy use of existing columns

Point Source Carbon capture

CO₂ Source



Cement/concrete, 20%



Biomass, Waste to energy, 9-11%



Aluminum & Steel, 1-4%



Soda ash, 20-25%



Power plant, 4-5%



H2 Production (SMR), 20%



Refineries (FCC), 15%

CarboSieve™ Capture Solution



Up to 99+%

Utilization

Use



Storage



Benefits of CarboSieve™

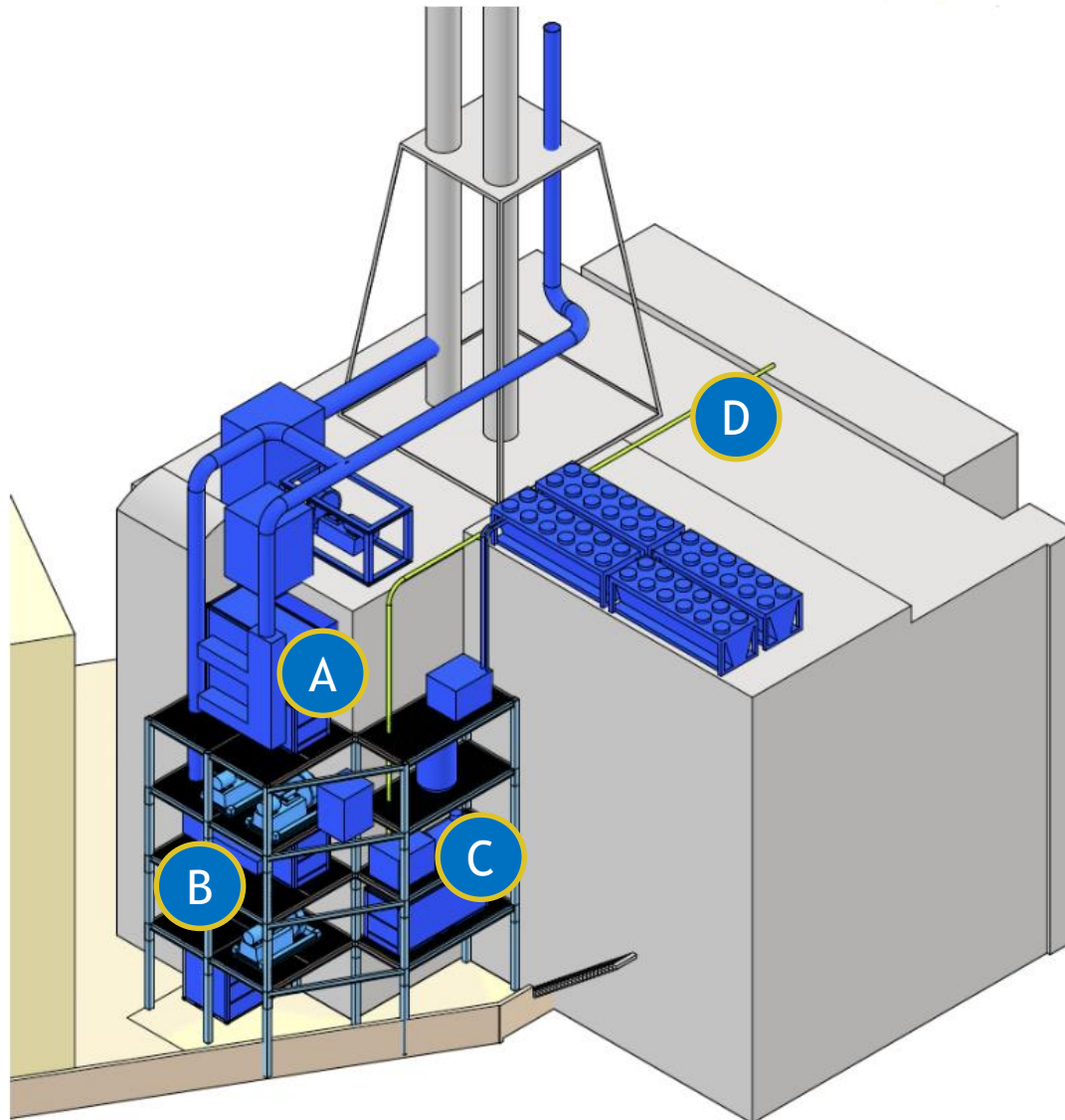
Low Energy Demand

No Hazardous
Chemicals & no VOCs
emissions

Compact & Highly
Modular

Simple & passive
system

CarboSieve™: Example of a 45'000 tonnes of CO₂ captured per year



- A Membrane stages
- B Vacuum compressors
- C Liquefaction
- D CO₂ Product

UniSieve solutions provide high-value opportunities

- Recover valuable olefins
- Increase capacity and energy-efficiency
- Reduce flaring & CO₂ emissions



Meet us after the presentation!



About UniSieve Ltd.:

UniSieve accelerates decarbonization of heavy-emitting industries with sieving membranes. The UniSieve separation solutions enable highly-efficient recovering and purifying hydrocarbons, affordable point-source carbon capture, and many more applications. UniSieve's membranes allow size-based purification that is up to 90% more energy-efficient than alternative solutions.

<https://www.unisieve.com>

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