

A stylized, low-poly illustration of an industrial facility, including tall distillation columns, storage tanks, and piping, rendered in various shades of purple and teal. The illustration serves as a background for the title text.

Axens Strategy to Decarbonize Existing Assets

Stephane WERMESTER

Agenda

- Axens Horizon Overview: Pathways to Industrial Decarbonisation
- Axens Decarbonisation Consulting Services
 - ▶ Methodology
 - ▶ Examples
- Take-Away

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Axens Group Insights



Offices in
15 countries



Over
3,000
industrial units
under license



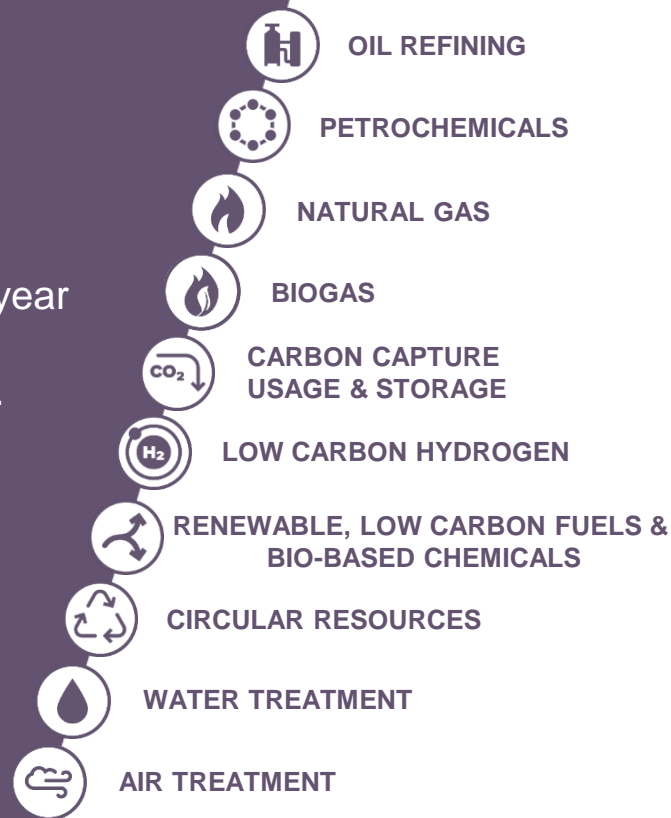
Over
500
modular units
references



Over
70,000
tons of catalysts
and adsorbents each year
coupled with
catalysts services, inc.
regeneration



Over
3,500
furnaces sold



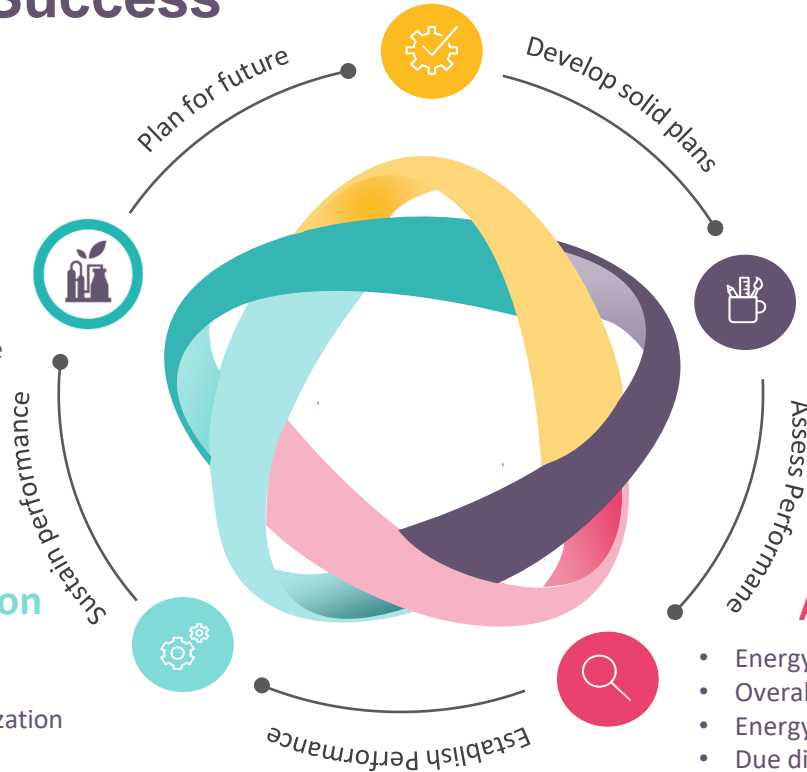
Partnering for Success

DeCARBON'us™

- Technologies pathway screening
- Decarbonization solutions mapping
- Circular Economy: waste less, thrive more
- Carbon footprint & LCA
- Regulatory Monitoring and Market Surveys
- Technical & economical studies for decarbonization on full value chain

Plant Optimization

- Margin Improvement
- Molecular Management
- APC & model-based optimization
- Feedstock Management
- Linear Programming Management
- Energy Efficiency and heaters optimization
- Hydrogen Management



Strategic Positioning

- Market studies
- Site location & infrastructure studies
- Project Appraisal

20 years
in master
planning

>250
References of
successful
projects

Master Planning

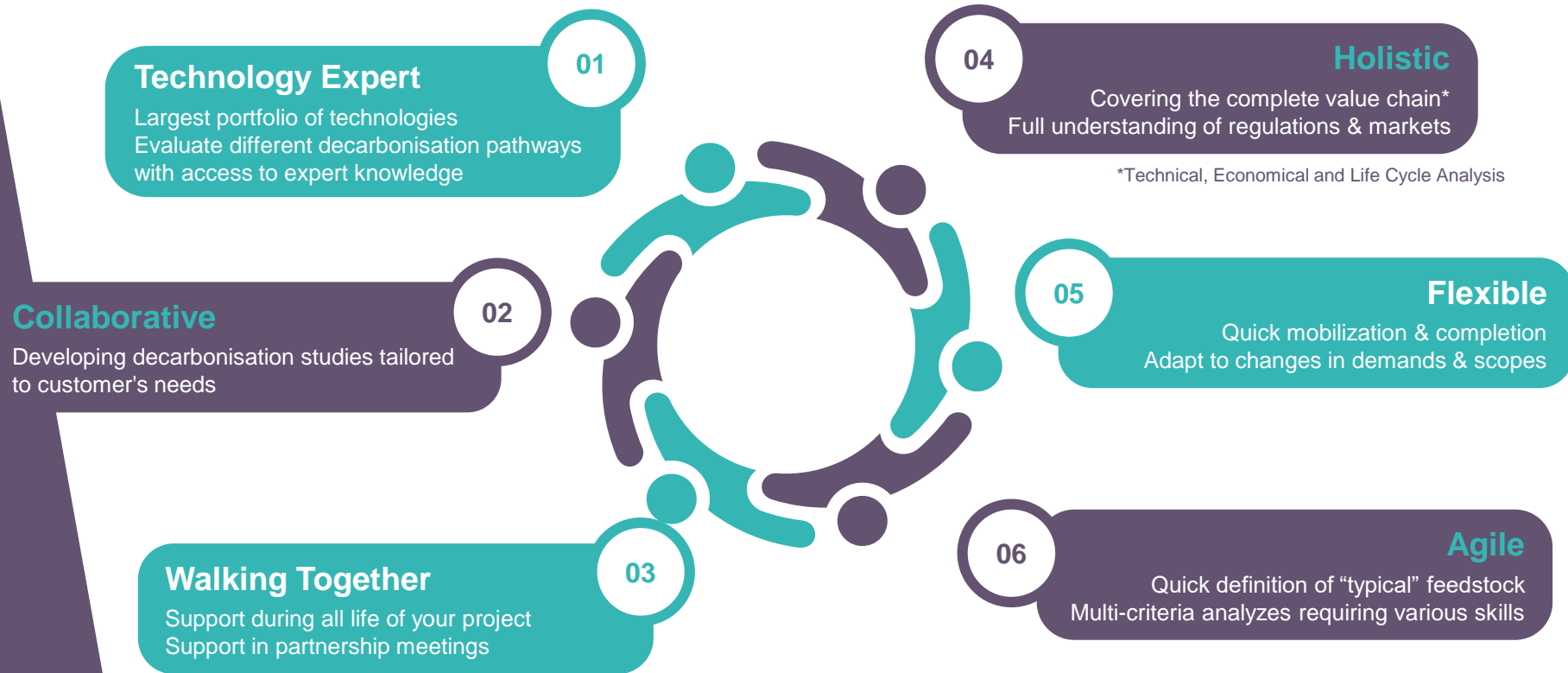
- Grassroots & expansion
- Scheme development
- Repurposing and relocation
- Staged investment
- Innovative project management
- Support to financing

Audits

- Energy efficiency audits
- Overall Processing scheme review
- Energy and heaters performance assessment
- Due diligence and site rehabilitation
- Water management
- Air emissions & gas treatment

Axens Horizon's Strengths

Partnering for Success and De-Risking Investment

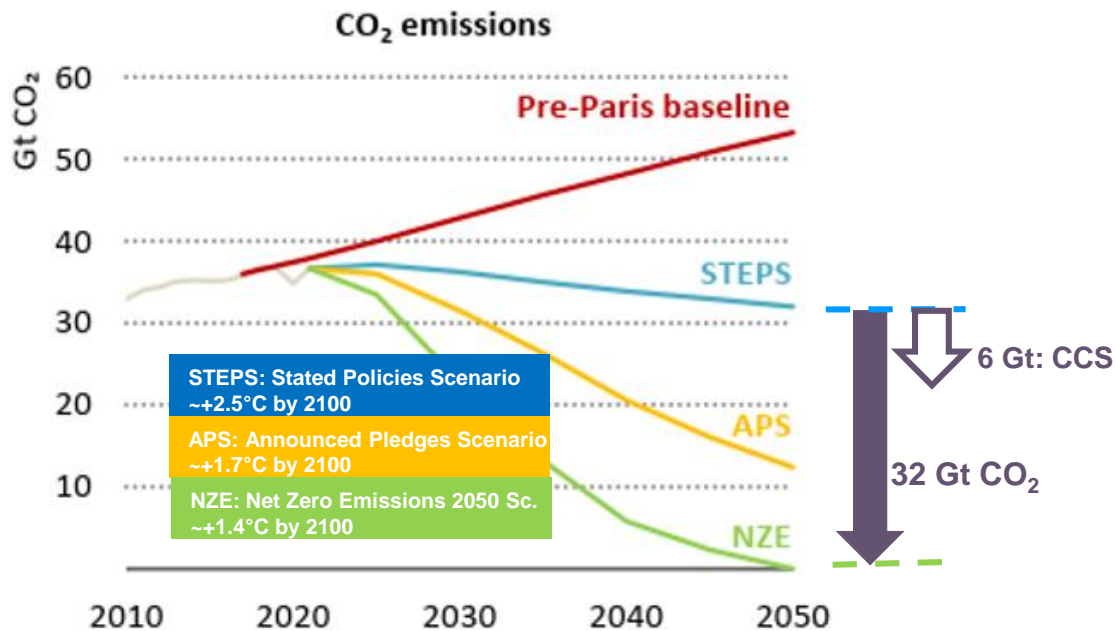


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GHG Emissions – Insights from 2024 WEO (IEA)

Energy-related CO₂ Emissions



Several levers to reach targets

CCS	●	●		
Energy Efficiency	●	●	●	●
Electrification		●	●	●
Biofuels			●	
Biofeedstocks		●		
Plastics Recycling		●		
Low Carbon Hydrogen	●	●	●	
E-Fuels			●	

● **Power**
● **Industry**
● **Transport**
● **Buildings**

Decarbonization – Complex Subject

A wide portfolio of solutions...

Beyond technical solutions...key parameters to be addressed



Existing asset optimization



Bio & Alternatives



Circular Economy



Carbon Capture Use & Storage



Hydrogen

**So many solutions
to decarbonize the
activity, but which
one(s) to invest in?**



Markets

- Changing
- Incentives/taxes
- Expansion

Assets

- Existing configuration
- Core business

Level of change

- Quick Wins
- Deep transformation

Regulations

- Carbon taxes
- Subsidies
- Mandates

Solutions

- Multiple paths
- Technologies
- Maturity

○ Kickstart Creativity: Brainstorm Together!



- Collaborative workshop with customer
- Support of Axens experts



- Screening of all potential solutions: short term to long term
- Qualification (CAPEX, OPEX)
- Preliminary Execution plan

- › 3 to 16 weeks study depending on the scope and level of details
- › Access to all **Axens expertise**: new domains but also Oil & Gas for existing units optimization

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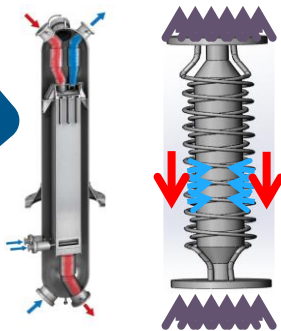


Increase Energy Efficiency

New Feed - Bttm/Effluent Heat Exchanger

New F/E exchanger

- **Spiral Tubes** Heat Exchanger
- **Welded Plate** Heat Exchanger
- HICO from ~ 65°C (~117°F)
to ~ 27°C (~48°F)



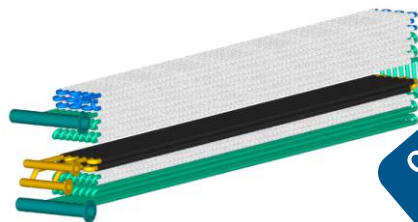
- 35% on Preheater duty
- 35% on Air cooler duty

Fired Heaters Revamp

1st option

Convection section optimization

New tube arrangement & increase of extended surface

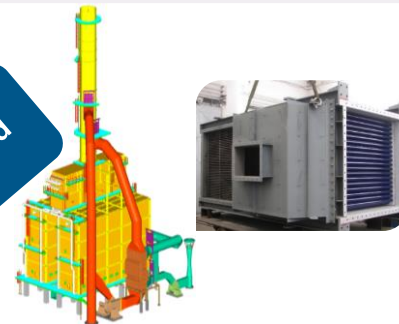


- + 3.5% fuel efficiency
- + 12% steam production
- Same fuel consumption

2nd option

Air Pre Heater (APH)

System implementation



- + 4.5% fuel efficiency
- 7% fuel consumption
- 7% for CO₂
- 6% steam production

Adopt e-Heater to Go Beyond Decarbonisation



High heater
Efficiency >95%

Enhanced
Operational
Flexibility

Zero emissions
(CO₂, So_x, No_x,
PM)



Longer run length

No combustion
safety hazards

Accurate and fine
heat flux controls



Reduced footprint

Several possible
services in the
same equipment

High reliability &
Reduced
maintenance

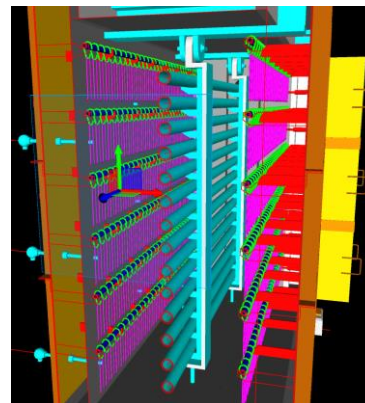


► Process coils & structure:

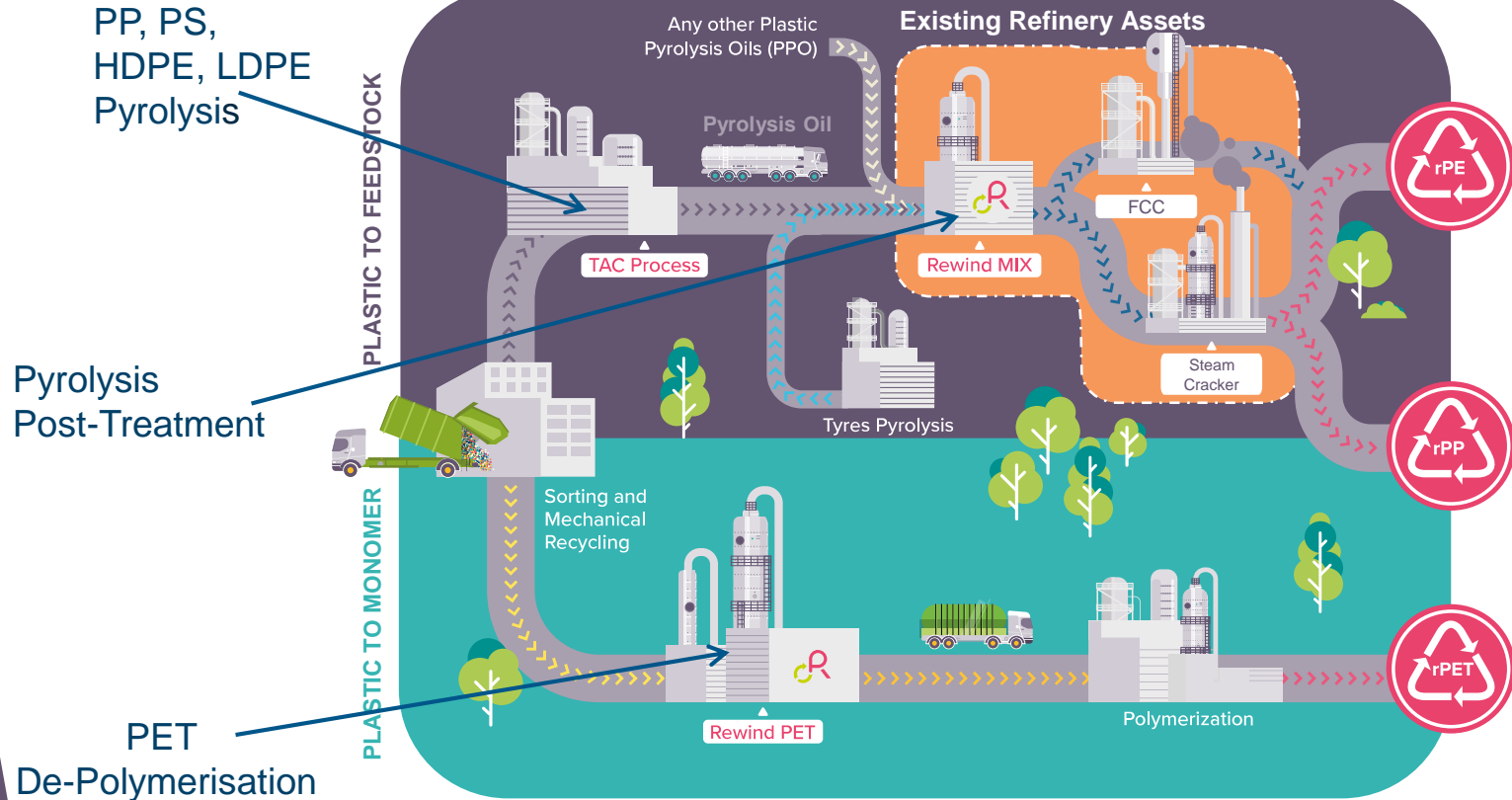
- › The capacity of an Electrical Tubular Radiant Heater is typically **up to 20/25 MW**, which can be extended using parallel cells of such duty.

► Electrical Hardware

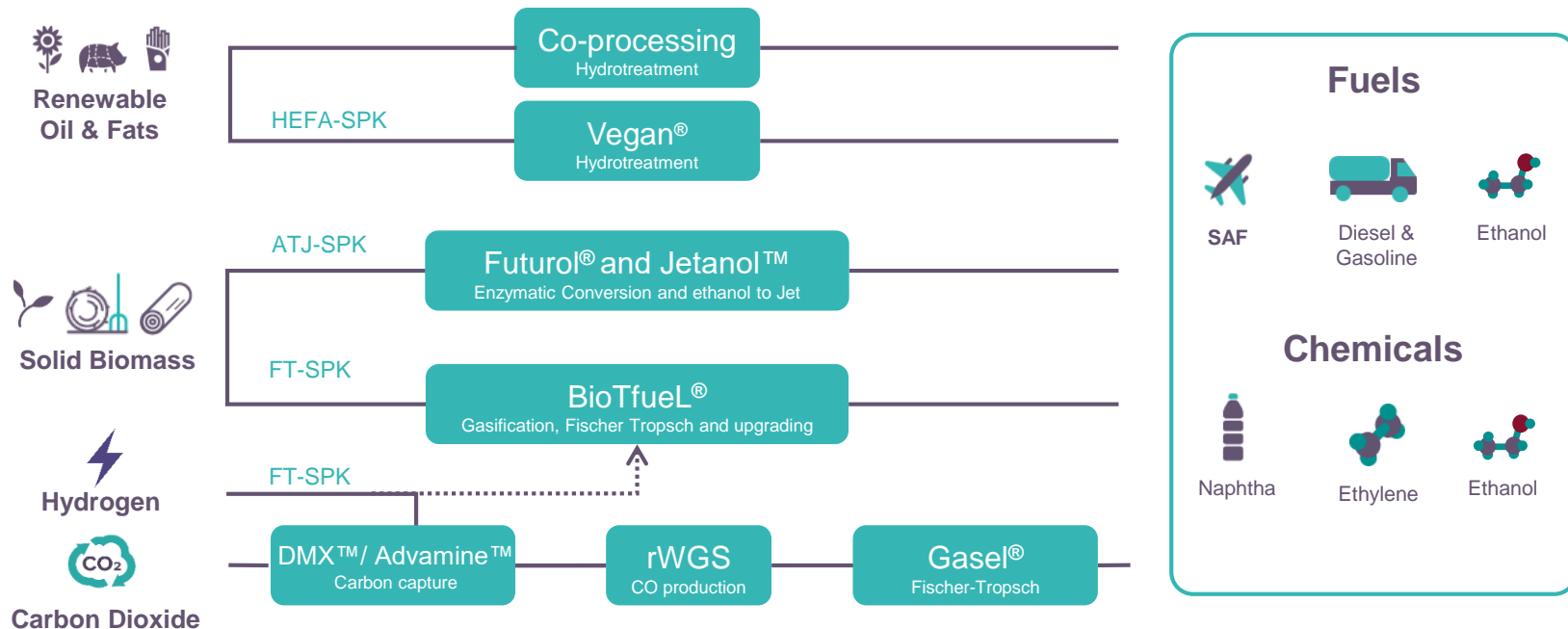
- › Made of electrical radiant resistances installed on the furnace walls, **powered and controlled by power control panels** installed in the electrical substation.



Include Circular Economy: Axens Plastic Recycling



Produce Low-Carbon Products: SAF



And What about CO₂ Capture Supported by Axens' Experience?

- **Solvent development** for gas treatment and CO₂ capture is in the **IFPEN group DNA**
- Gas Sweetening - Acid Gas / CO₂
Over 250 references since late 50s
Large AGR Units running worldwide



DMX™ Mini-pilot unit
IFPEN, Solaize
0.5 kg/h CO₂ capture

DMX™:
One technology, end to end support

- IFP Group expertise
- Mobile pilote
- Tailor-made carbon capture - Large-scale units
- Modular Solutions
- TechServices



Courtesy of QatarGas



DMX™ demonstration plant
Arcelor Mittal, Dunkerque
500 kg/h CO₂ capture

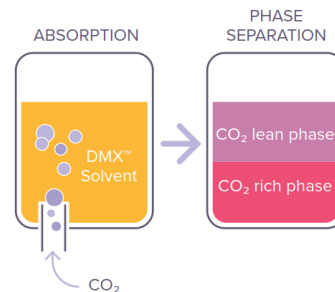
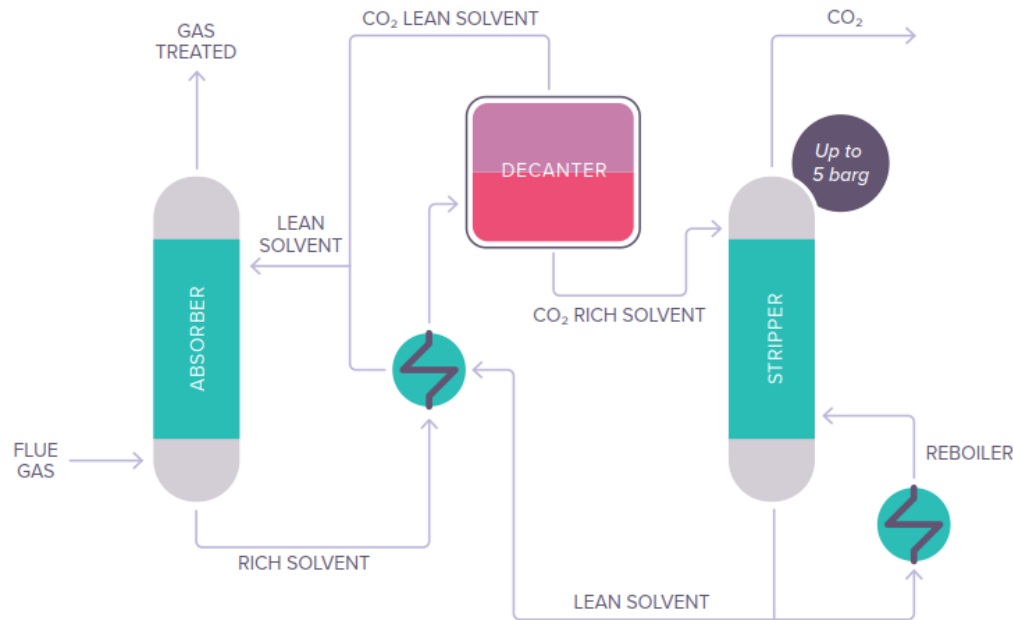


Successful demonstration of the technology

- Performances
- Operability
- Robust simulation tool

Flue Gas CO₂ capture - DMX™ Process

A new **demixing** solvent...



Benefits

- ✓ Low energy consumption
- ✓ Thermally stable solvent
- ✓ Low sensitivity to oxygen
- ✓ Optimized CAPEX
- ✓ High capture rate achievable
- ✓ High purity of CO₂ produced
- ✓ Easy to operate

...with low energy
consumption

AXENS Solutions Along the CCUS Value Chain



1

Pretreatment

2

Capture

DMX™



AxTrap™
AxSorb®
TEG CO₂

3

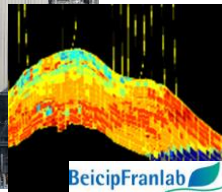
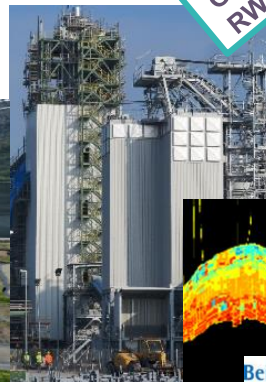
Conditioning

4

CO₂ Utilisation

CO₂ Storage

Gasel®
RWGS



Axens

Technologies and Expertise
Licence / Basic engineering
Modularization
Product
Support & Expertise
Services

IFP Group entities

Beicip Franlab
Storage site screening &
characterization, injectivity,
monitoring
IFPEN
R&I center

Partnerships

Compressors vendors
Liquefaction vendors
Engineering companies

CCS hub Alliance

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Take Away: Life Cycle Support for Your Decarbonised Project

Continuous support: From feasibility study to start-up



De-risked solutions built on long-standing experience and dedicated pre-commercial programs with solid experience



Strong & reliable partnership to provide continuous support all along your project and beyond.

Feasibility study support for project de-risking and customized

Digital twin with Axens high fidelity model





www.axens.net



Thank you!

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