



# Decarbonization Solutions to Support Industry Facing Energy Transition

Cécile Plain



# Agenda

## 1. Axens Horizon Overview

## 2. Decarbon'us – Decarbonization consulting services

- New Energy case studies
- Energy Efficiency

## 3. Take-Away



# Agenda

## 1. Axens Horizon overview

## 2. Decarbon'us – Decarbonization consulting services

- New Energy case studies
- Energy Efficiency

## 3. Take-Away

# Partnering for Success

## Strategic Positioning

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

20 years  
in master  
planning

>200  
References of  
successful  
projects

## DeCARBON'us

- Decarbonization studies
- Technical studies for decarbonization (scope 1, 2, 3)
- CO<sub>2</sub> emissions

>30  
References  
in Energy  
Transition

## Plant Optimization

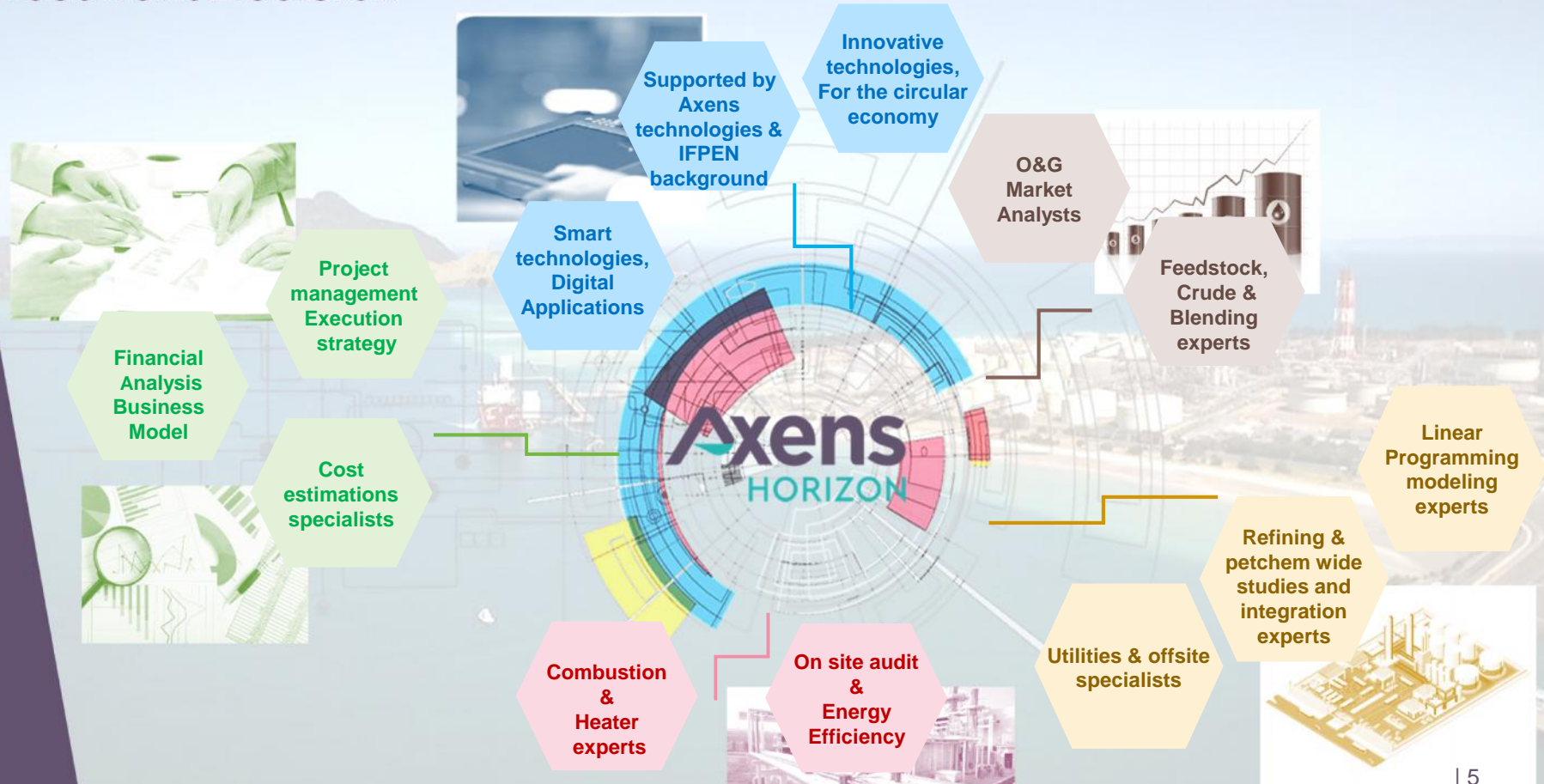
- Hydrogen Management
- APC & model based optimization
- Linear Programming Management
- Energy Efficiency and heaters optimization
- Crude Management
- Margin Improvement

## Audits

- Energy efficiency audits
- Overall Processing scheme review
- Energy and heaters performance assessment
- Due diligence and site rehabilitation
- Water management



# Multi-discipline Team Focused on Supporting You Taking the Right Investment Decision





# Agenda

## 1. Axens Horizon overview

## 2. Decarbon'us – Decarbonization consulting services

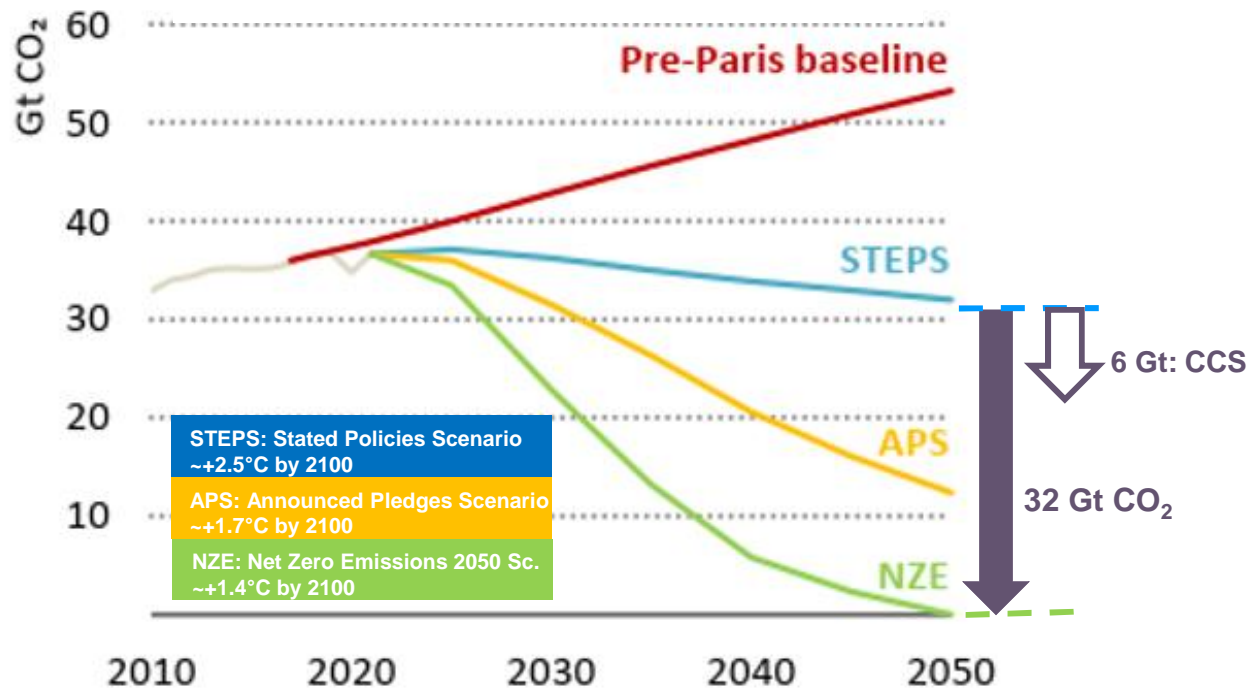
- New Energy case studies
- Energy Efficiency

## 3. Take-Away

# GHG Emissions - Insights from 2022 WEO (IEA)

## Energy-related CO<sub>2</sub> Emissions

## Several levers to reach targets



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

- Power
- Industry
- Transport
- Buildings

# Which Strategies are Currently On-going?

Focus on O&G companies' commitment...



From IHS market

**For Scope 3 targets:** three type of business models\* have emerged as

- **Big energy** Massive investment into renewables
- **Carbon as a service** Aggressive expansion into CCS projects
- **Sustainable fuels** Low carbon fuels

\*From Wood Mackenzie report 2022

All these decarbonization strategies rely on innovative technical solutions



# Decarbonization – Complex Subject

*A wide portfolio of solutions...*



*Existing asset optimization*



*Bio & Alternatives*



*Circular Economy*



*Carbon Capture Use & Storage*



*Hydrogen*

*Beyond technical solutions...key parameters to be adressed*



## Markets

- Changing
- Incentives/taxes
- Expansion

## Assets

- Existing configuration
- Core business

## Regulations

- Carbon taxes
- ETS

## Solutions

- Multiple paths
- Technologies
- Maturity

## Level of change

- Quick Wins
- Deep transformation

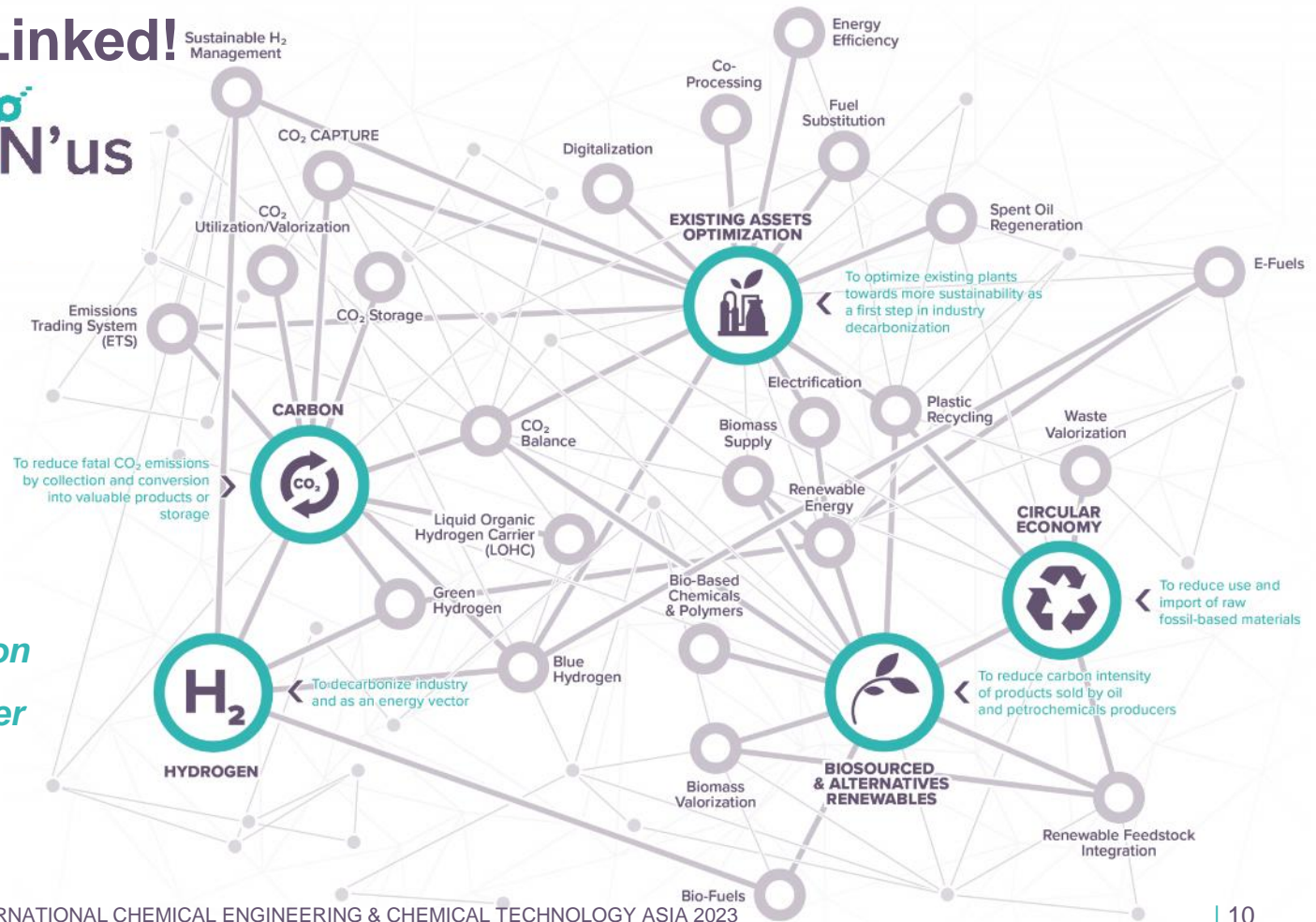


# Everything is Linked!

## DeCARBON'us



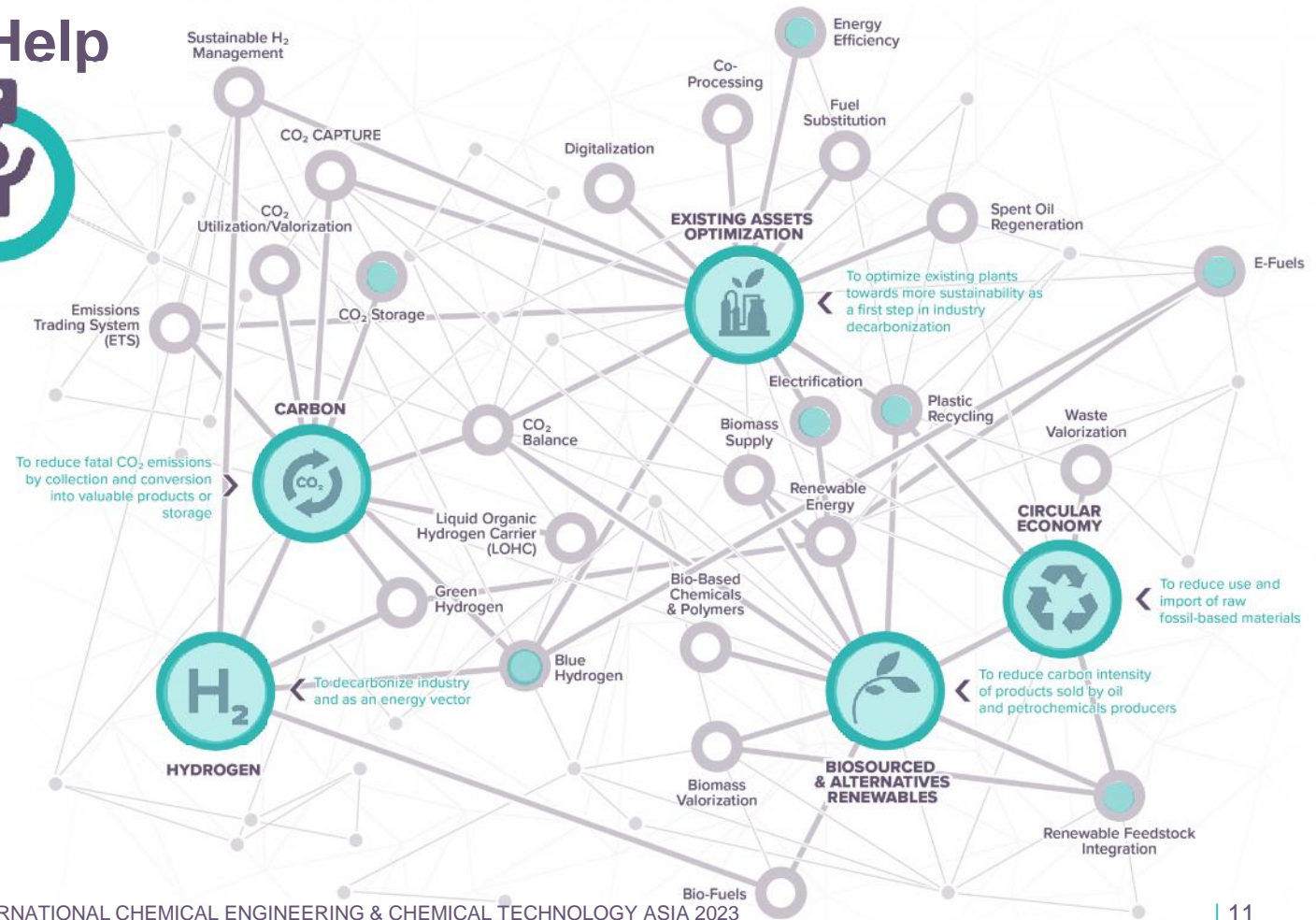
*A dedicated  
decarbonization  
consulting offer*



# How We Can Help



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



## Decarbonization screening & road map



- Collaborative workshop with Industrial company
- Support of Axens experts



- CO<sub>2</sub> assessment,
- CO<sub>2</sub> baseline,



- Screening of all potential solutions: short term to long term
- Qualification (CAPEX, OPEX)
- Decarbonization roadmap with phased implantation planning

- › 3 to 12 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

# Case Study # 1: European Refiner - 2022

## Context

### Decarbonization screening

- Fast & Budget Friendly study
- Define Priorities, identify quick wins and more long-term solutions for Decarbonization (Scope 1 to 3)

### Client



- Mid-size European refiner
- Large industrial location
- Leading Port



### 2-days Brainstorming Workshop

Coached by 10 Axens experts (technology and process experts)



### 13 opportunities for decarbonization

#### 7 opportunities for scheme improvement, for each:

- › Preliminary technical evaluation (yields, CO<sub>2</sub> abatement...)
- › Raw investment figures (CAPEX, OPEX)
- › Comparison table

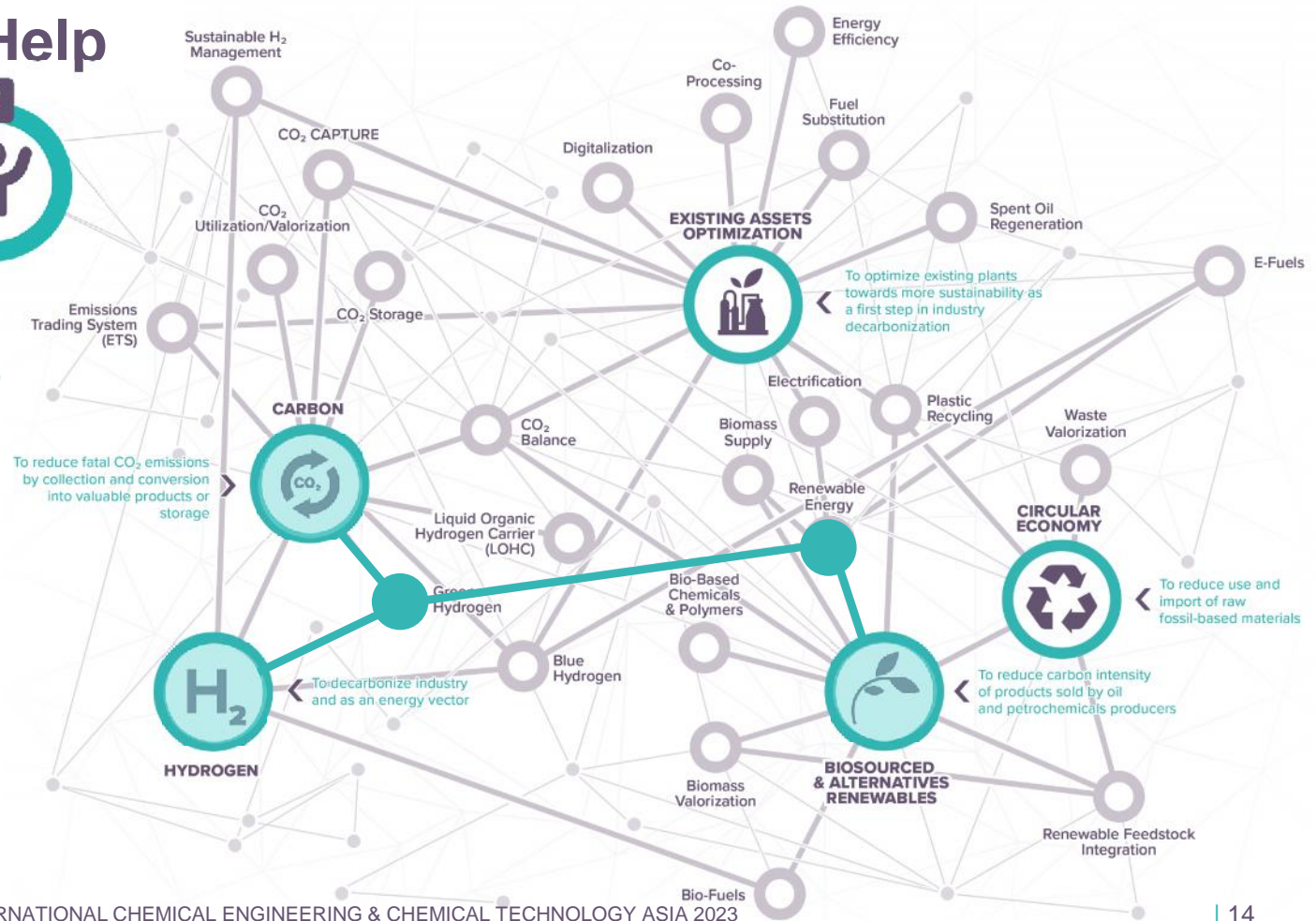
Solution	Performance & Margin Improvement	CO <sub>2</sub> Abatement Potential	Estimated CAPEX & OPEX	Maturity of Technology	Execution Considerations
Energy Efficiency	++	+	++	+++	+++
Spent Lube Oil Regeneration					
LOHC	+++		+	+++	+
Alcohol-To-Jet	+++	+++	++	++	-
Biomass to Ethanol	++	+++	++	+++	-
Extraction of Aromatics	++	--	+	+++	+
... 6 additional solutions					

✓ Achieved in a 3 weeks study!

# How We Can Help



*Should one solution  
be selected, it  
needs more  
information before  
investing in*



# Decarbonization: How We Can Help

## Specific feasibility studies



- *Market studies*



- *Technical development (material balance, utility, plot area...)*
- *Site implementation study*



- *Cost estimation ISBL / OSBL, AACE Class 5 or 4*
- *Economical study (NPV, IRR...)*
- *Sensitivity study (feedstock or product prices...)*



- *Simplified Life Cycle Analysis (LCA)*

- › **8 to 16 weeks study** depending on the scope and level of details
- › **Full value chain assessment**
- › **Project viability assessment**

# Case Study # 2: United States - Refiner – 2022 – on going

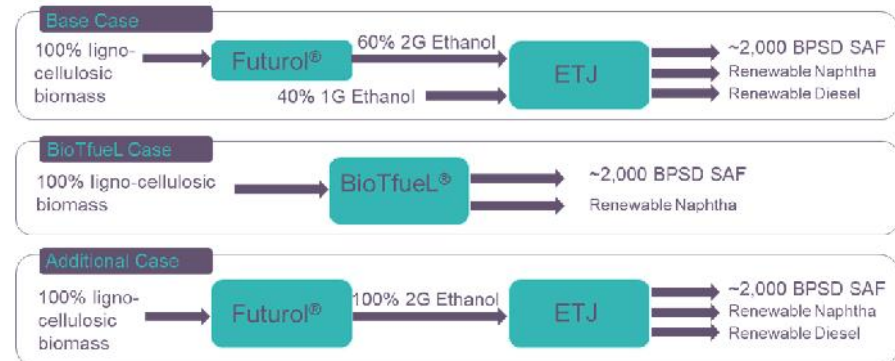
## Context

- American refiner / trader
- Availability of pine trees residues closeby
- SAF production to reduce fossil origin of sold products

## Objective

- Identification of best SAF pathway before investing
- 2000 BPSD of SAF product

## 2 SAF pathways / 3 options



Additional Case can be compared with staggered investment, with 1 Futuro!® @60% of ETJ capacity.

### Phase 1: Preliminary studies

- › Review of feedstock
- › Comparison of 3 options
- feeds requirement, products (SAF, naphtha and diesel), Carbon Index (CI), CAPEX (ISBL and OSBL) / OPEX, net production cost, plot area, flexibility...*

### Phase 2: Development of selected pathway(s)

- › Technical development (HMB, utilities, plot area...)
- › Economical development (CAPEX class 5, OPEX)
- › Economical analysis + sensitivity analysis



# Case Study # 2: United States - Refiner – 2022 – on going

★ ... 1<sup>st</sup> phase outcomes ★



- Ethanol 1G option discarded due to market issue
- Both SAF pathways meet client strategy:
  - BioTfuel® option: higher CAPEX
  - FuturoL™/ETJ option: higher net production cost, but possibility for stepwise investment
- **2 SAF pathways are being developed in 2nd Phase of the study**



... 2nd phase still ongoing with technico-economic development



# Case study # 3 - VICAT Carbon Capture & Methanol PFS (1/2)

## Context

Cement industrie: 2% of CO<sub>2</sub> emissions in France, 12% of industry emissions

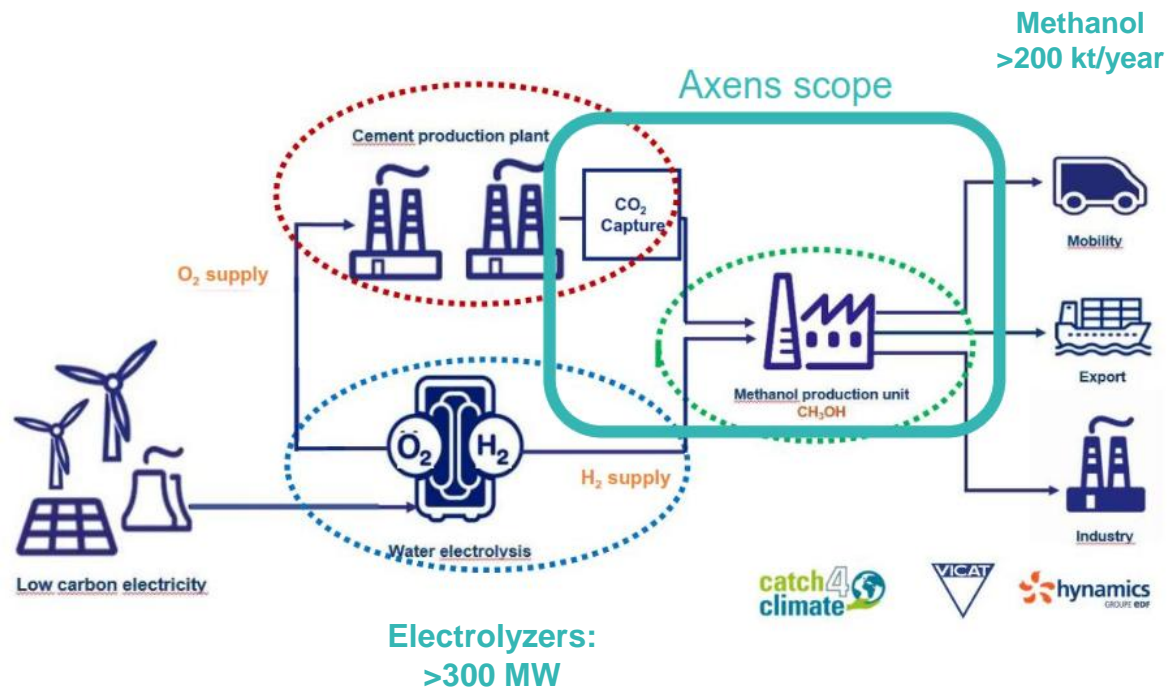
Vicat ambition: carbon neutral in 2050 throughout the entire value chain of its operations

## Project goals

- 40% reduction of CO<sub>2</sub> emissions at Montallieu site
- Methanol production from captured CO<sub>2</sub> and hydrogen produced in electrolyzers
- To use decarbonized electricity



Application to l'IPCEI financing



-> 500 000 t CO<sub>2</sub> / year avoided



# Case Study # 3- VICAT Carbon Capture & Methanol PFS (2/2)



## Phase 1

- › Market study on methanol
- › Review of existing distribution logistics for methanol in France, Rhône-Alpes area
- › Identification of technological blocks needed for carbon capture and methanol production
- › **Comparative assesment of carbon capture technologies and methanol production technologies (multi-criteria analysis)**
- › Quality review of flue gas and selection of flue gas collection point for carbon capture

## ★ Key facts ★

- 5,5% methanol world consumption: wide range of application + renewable origin
- Decarbonized methanol locally produced vs today imported fossil-based methanol
- Carbon capture: DMX™ technology complies with IPCEI acceptance criteria
- Methanol production: preselection of heterogeneous catalysis technology preselected



## .....Phase 2



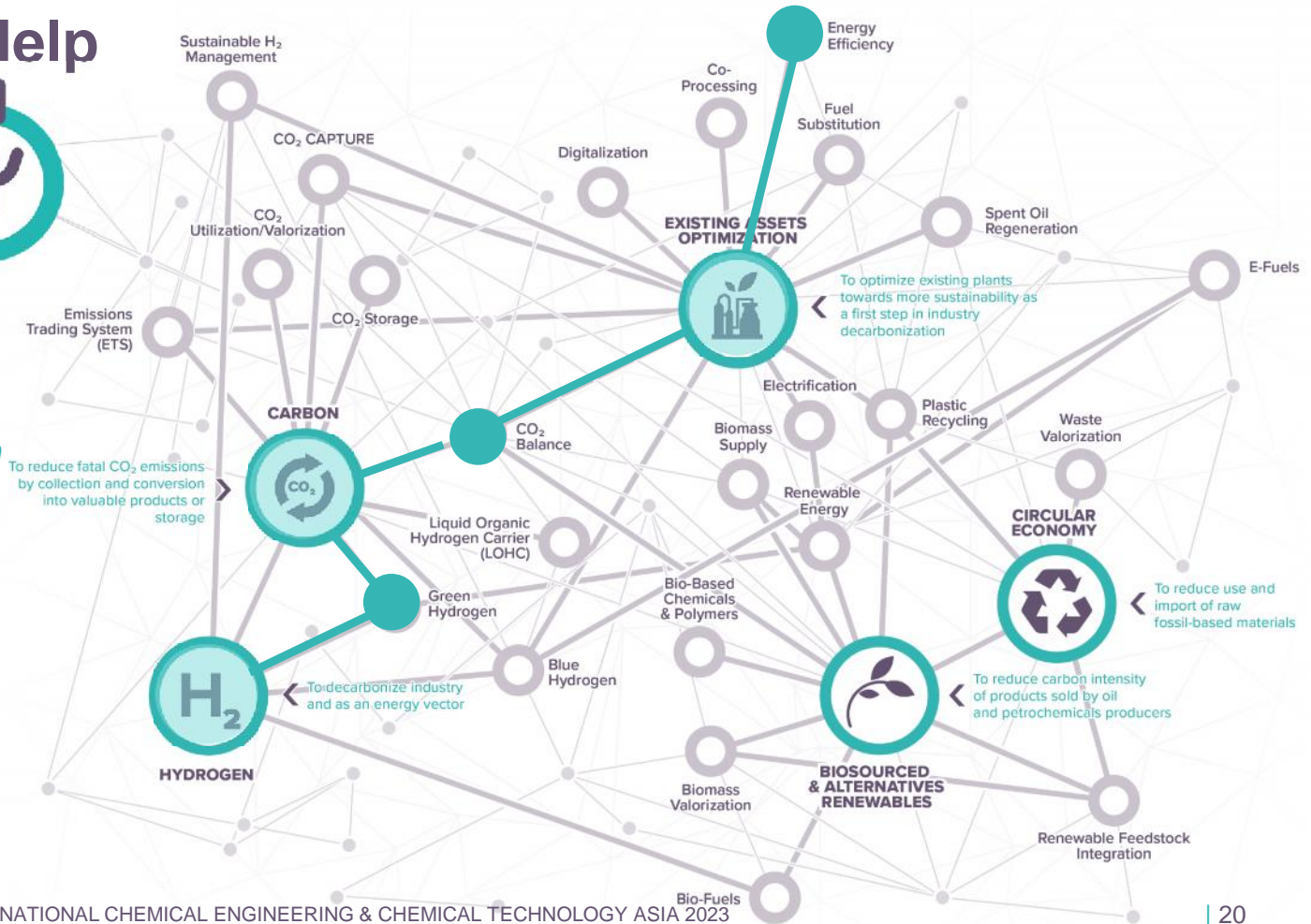
## ....Prefeasibility study development

- › Consolidated material balance, product yields, effluents, composition, operating conditions, utilities
- › Implementation of treatment facilities on site(required plot area, infrastructures and logistics aspects)
- › Total cost estimate, economic study, sensibility analysis on profitability parameters

# How We Can Help



*In terms of Energy Efficiency, quick-win solutions available*



# Energy Efficiency Offer: 20+ Years of Delivered Expertise

## @ Site Level



Energy Efficiency  
& Lower Carbon  
Site Audit

## @ Unit Level



Process & Catalysts  
Schemes Evaluation



Custom & Efficient  
Early Design

## @ Furnace Level



Air Preheaters (APH)  
& FAST  
(Fuel Advanced  
Savings Technology)



Optimized Heater  
Efficiency  
Digitalization  
Electrical Heaters

DeCARBON'us

Consulting Offer for  
Decarbonization

Connect'In

Technical Services and  
Process Optimization  
powered by Digital

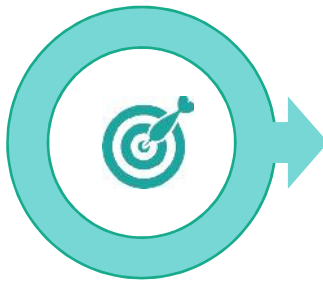
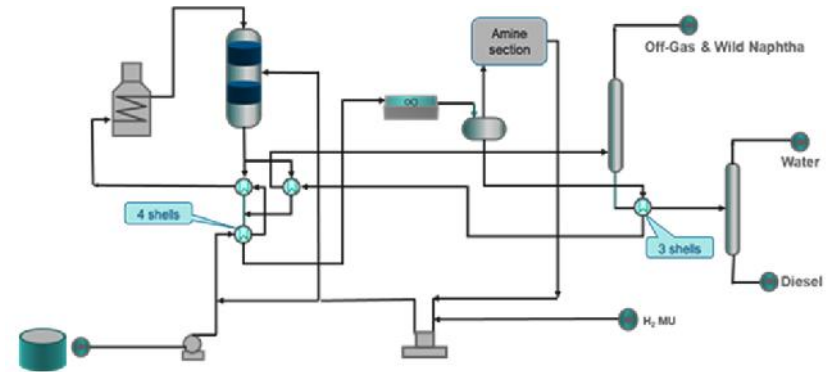


High Efficiency  
Equipment

Holistic evaluation at various levels to determine the  
**most optimized & advanced** solutions

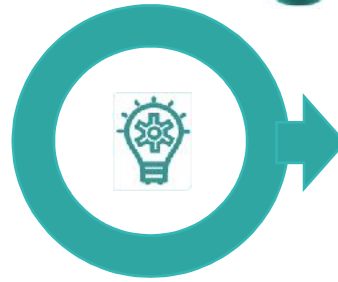
# Case Study #4 - Existing DHDT – South Europe

DHT  
Started 1996  
245 m<sup>3</sup>/h capacity  
Cold scheme  
60% SR diesel / 30% Cracked Feed / 10% VO



## Objectives

Reduce **OPEX**  
Reduce **CO2 emission**  
Improve **margin**



## Strategy

Review exist scheme,  
identify potential modification  
and benefits



## Results

**CO2 emission** has been  
reduced by **15%**

# Option Selection and Implementation



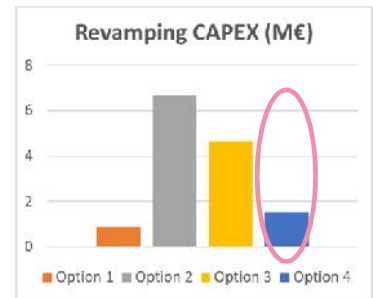
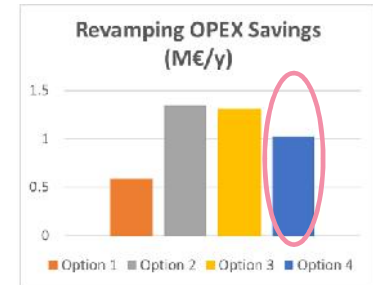
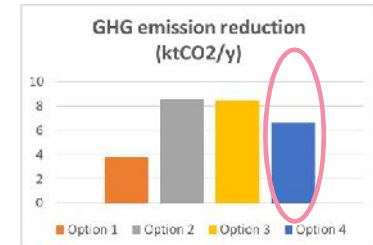
Option selected

- ❖ **Simple** Solution → 3 new LP Heat Exchangers shells + 1 HP Heat Exchanger
- ❖ **Efficient** Solution: Heater in shutdown 80% of catalyst cycle length and duty divided by 3 for the 20% remaining period in operation
- ❖ Low **payback time** (< 1.5 years)
- ❖ **-15%** of CO2 emissions
- ❖ **Easily implemented**

**Customer's feedback**

**"Thanks you for the CEED study you conducted. It really became reality"**

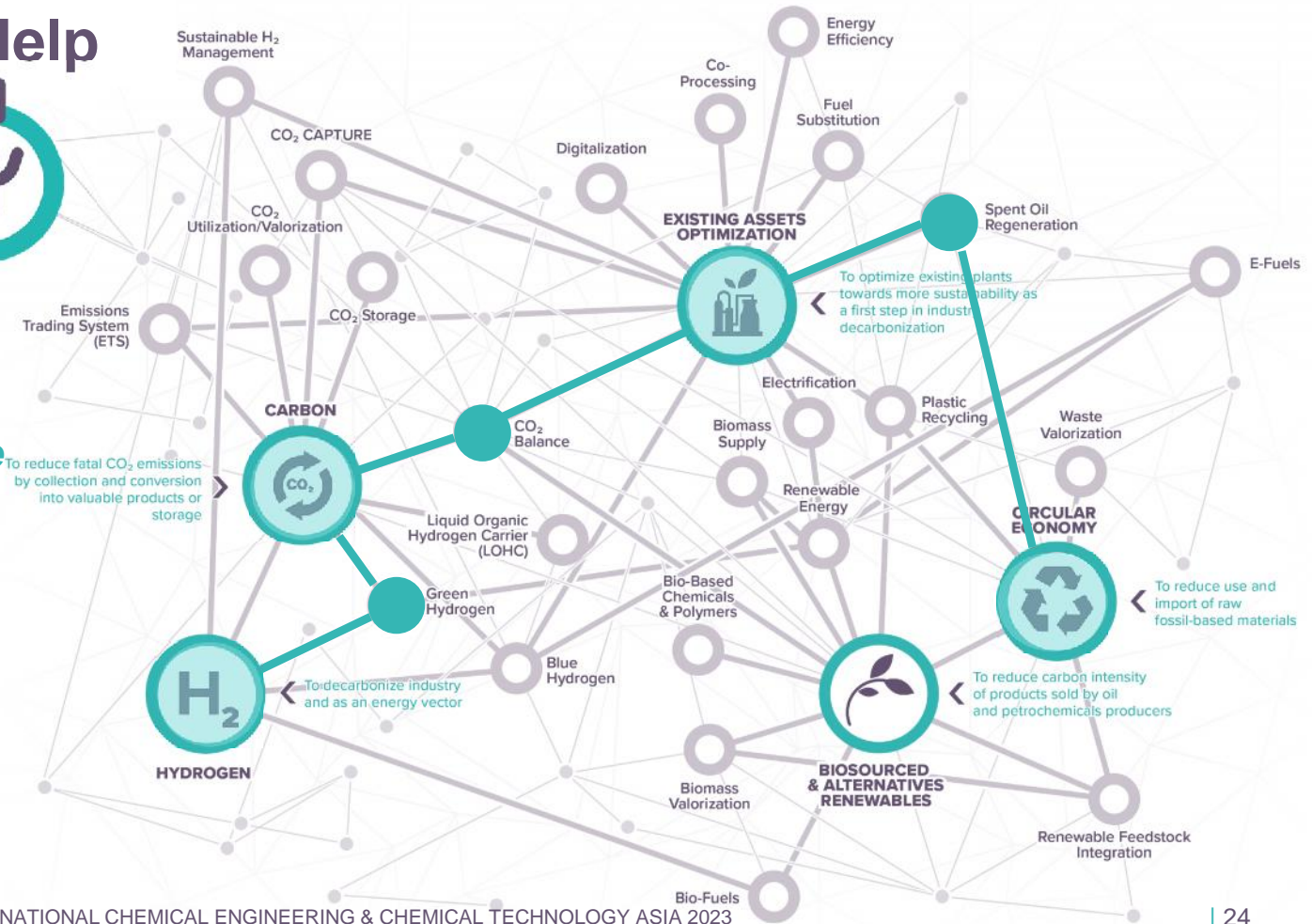
- **Tailor made** solution
- **Implementation** during Summer 2022
- **Operational** during study phase (heater in shutdown)



# How We Can Help



*In terms of Circular Economy Spent lube regeneration is possible*





## Revivoil™ Partnership



Leader in refining technology

State of the art R&D facilities

Over 2,200 worldwide industrial [references](#)



Leader in spent lube re-refining

Forty years of experience

120,000 TPA production capacity  
of spent lubes [Group II & III](#) Production

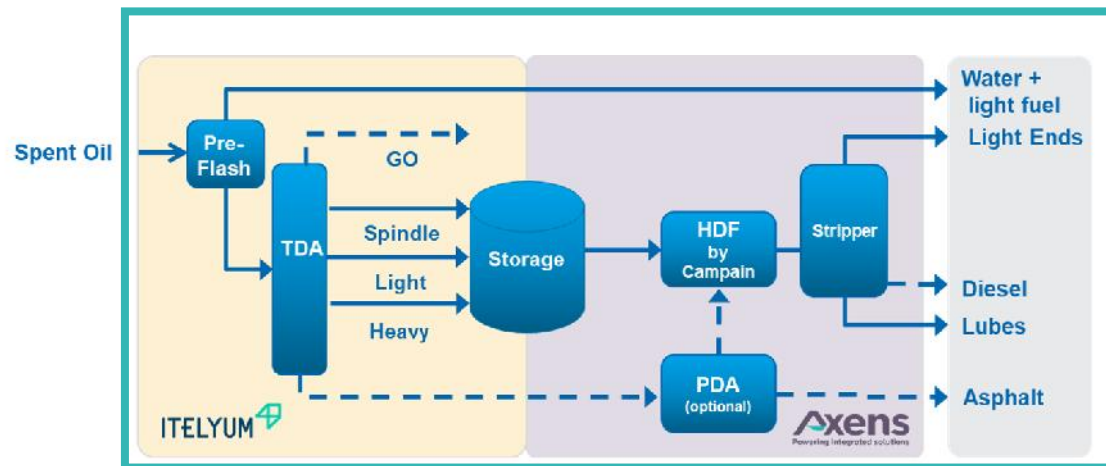
## Revivoil™

15 Global References + Catalyst Operating Experience  
Lube bases sustainable production

# Spent Oil Re-Refining - Circular Economy



Client: **ITELYUM** Italian Company specialized in circular Economy and **Axens**, partner In Revivoil Technology – Operator of several industrial factories -



## Revivoil™

**Project:** Axens Horizon studied the feasibility of producing Group II base oils from spent oil with an existing low pressure HDF unit together with minimizing the CAPEX & OPEX of the existing asset

**Challenge:** Reaching **S** < 300wppm, **VI** > 80, **Aromatics** < 10wt% with low pressure **HDF**

## Solution & Result

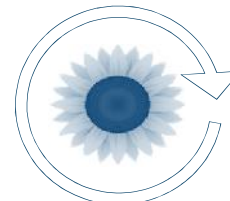


**Solution:** Working in close collaboration between both teams

- ▶ Operating Conditions review: Catalyst volume increase keeping main equipment (Compressor & Furnace)
- ▶ The feedstocks, products and byproducts characteristics have been defined on the **overall material and utilities requirement**, the impact on utility generation & distribution, offsite, and auxiliary units (in general OSBL) were preliminary designed.
- ▶ The **cost estimation** (AACE Class IV) and **project financial model** were established based on ITELYUM parameters. Then, feasibility was assessed **upon the different price scenarios** from Group I to Group II base oil productions

**Main Outcomes:** **Group II base oil production is possible with low pressure HDF unit**

- ▶ Fast track project: Study Executed in 2 months, PDP phase finished, EPC on-going, **S/U end of 2023**
- ▶ Lower CO<sub>2</sub> emission
- ▶ Blue H2 production through CCUS
- ▶ **Re-Refining complex financial results**
  - › **Double Digit IRR** by considering **current** price set





# Agenda

## 1. Axens Horizon overview

## 2. Decarbon'us – Decarbonization consulting services

- New Energy case studies
- Energy Efficiency

## 3. Take-Away



## Decarbonization in Action Conclusion



A unique opportunity



High profitability  
& Decarbonization



Let's work together!

**Axens**  
Powering integrated solutions



[www.axens.net](http://www.axens.net)

Thank  
you!