

Technological Solutions to Accelerate the Energy Transition in the Oil&Gas Industry

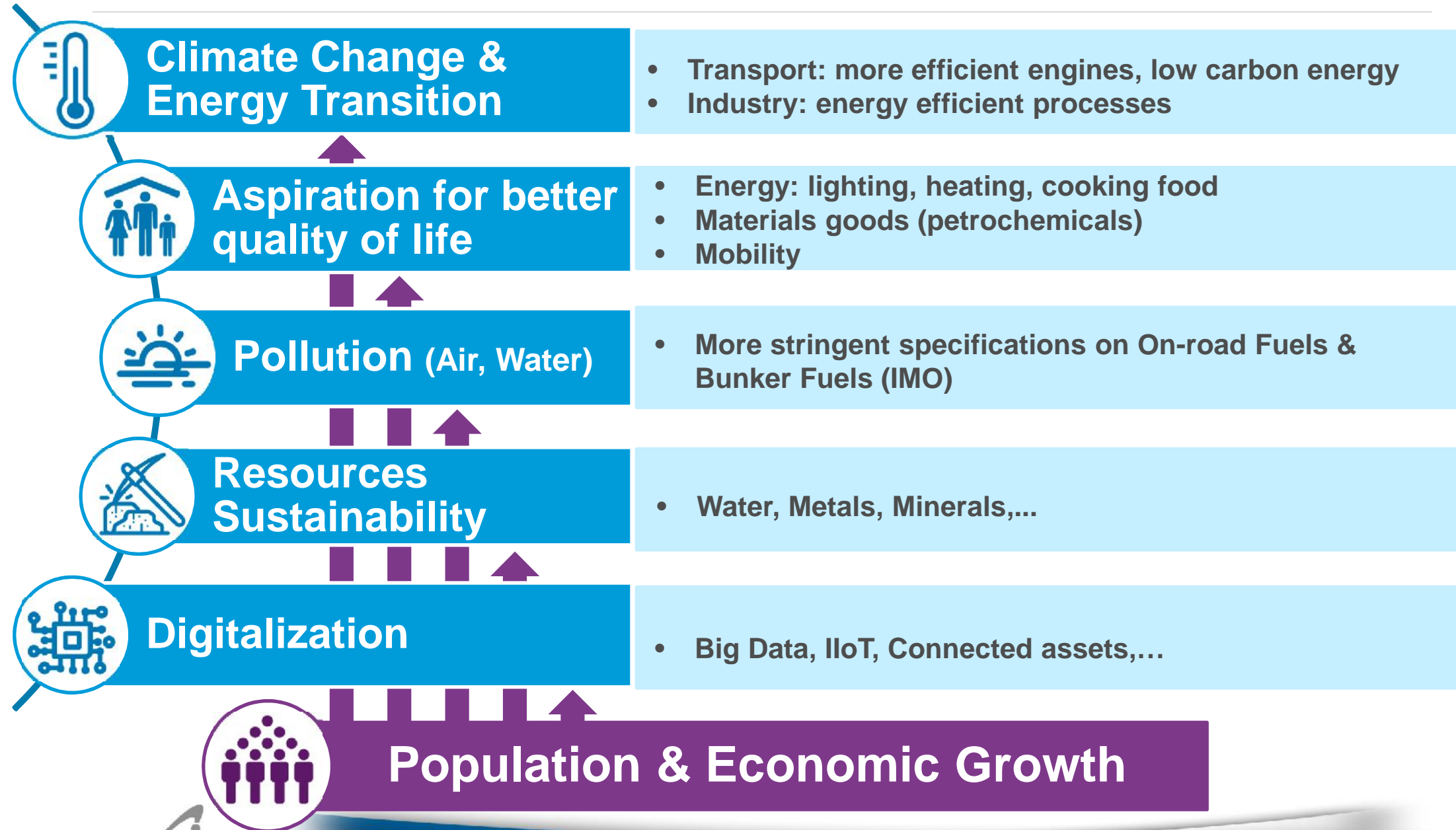


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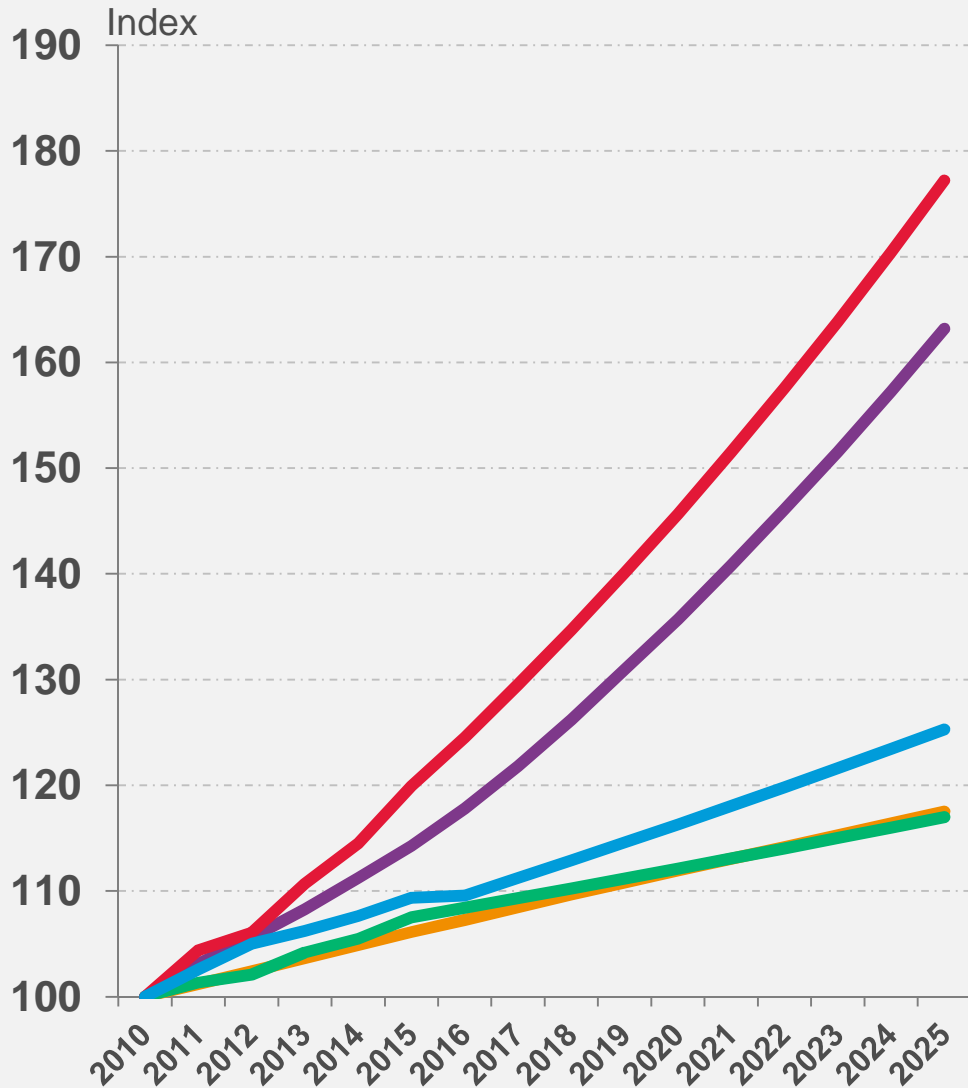
Tomorrow Megatrends

Main Stakes



Fuels, Gas, Chemicals - Axens Commitment

MARKET DRIVERS GROWTH (Base 100: Year 2010)



Petrochemicals*

+4.0%/y

*Ethylene, Propylene, Butadiene, BTX, Methanol



GDP

+3.7%/y



Natural Gas Demand

+1.5%/y



Population

+1.1%/y



Fuels Demand

+1.0%/y

- Oil to Chemicals
- Bio-based Chemicals
- Plastics Recycling
- Energy Efficiency

- A unique supplier for Natural Gas Processing technologies
- Energy Efficiency

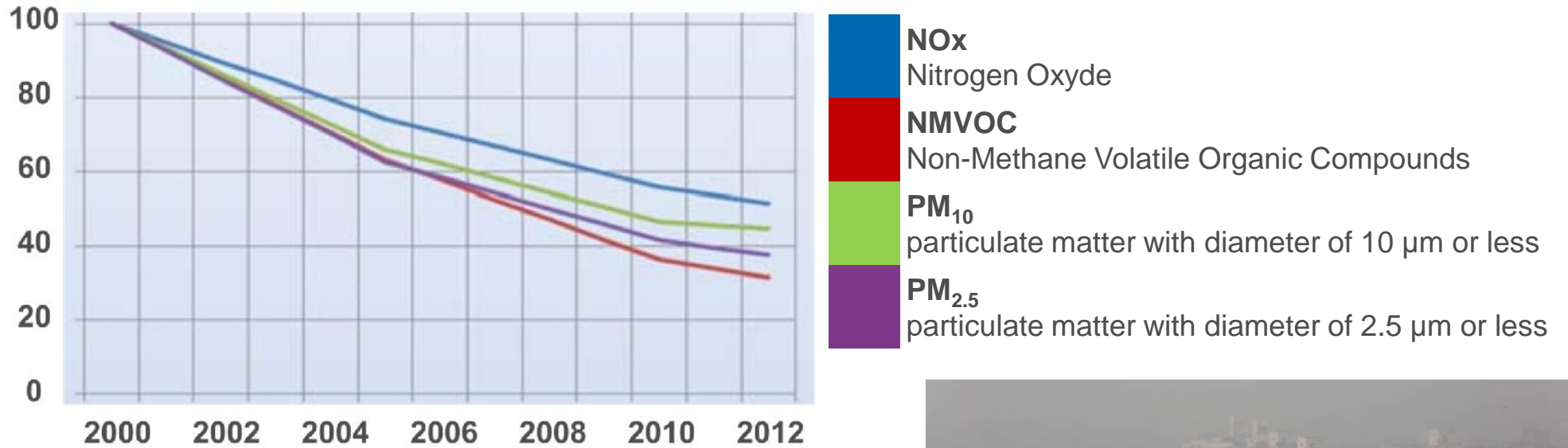
- Clean Fuels Production
- Energy Efficiency
- Biofuels

Source: World Bank, CEH, IEA, Axens and other sources

Clean Fuels Production

Motor Fuel & Air Quality

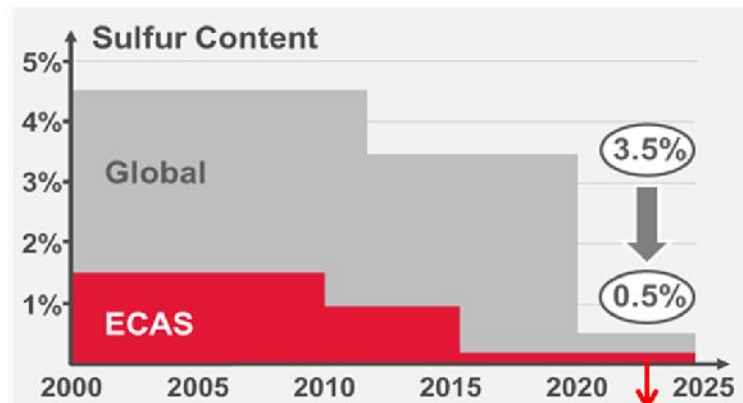
Atmospheric Pollutant Emissions (100 Basis in 2000)



Source: Air Parif Report (Dec. 2015)

Source : The Guardian

December 2015: « New Delhi considered by World Health Organization as the world's most polluted city »

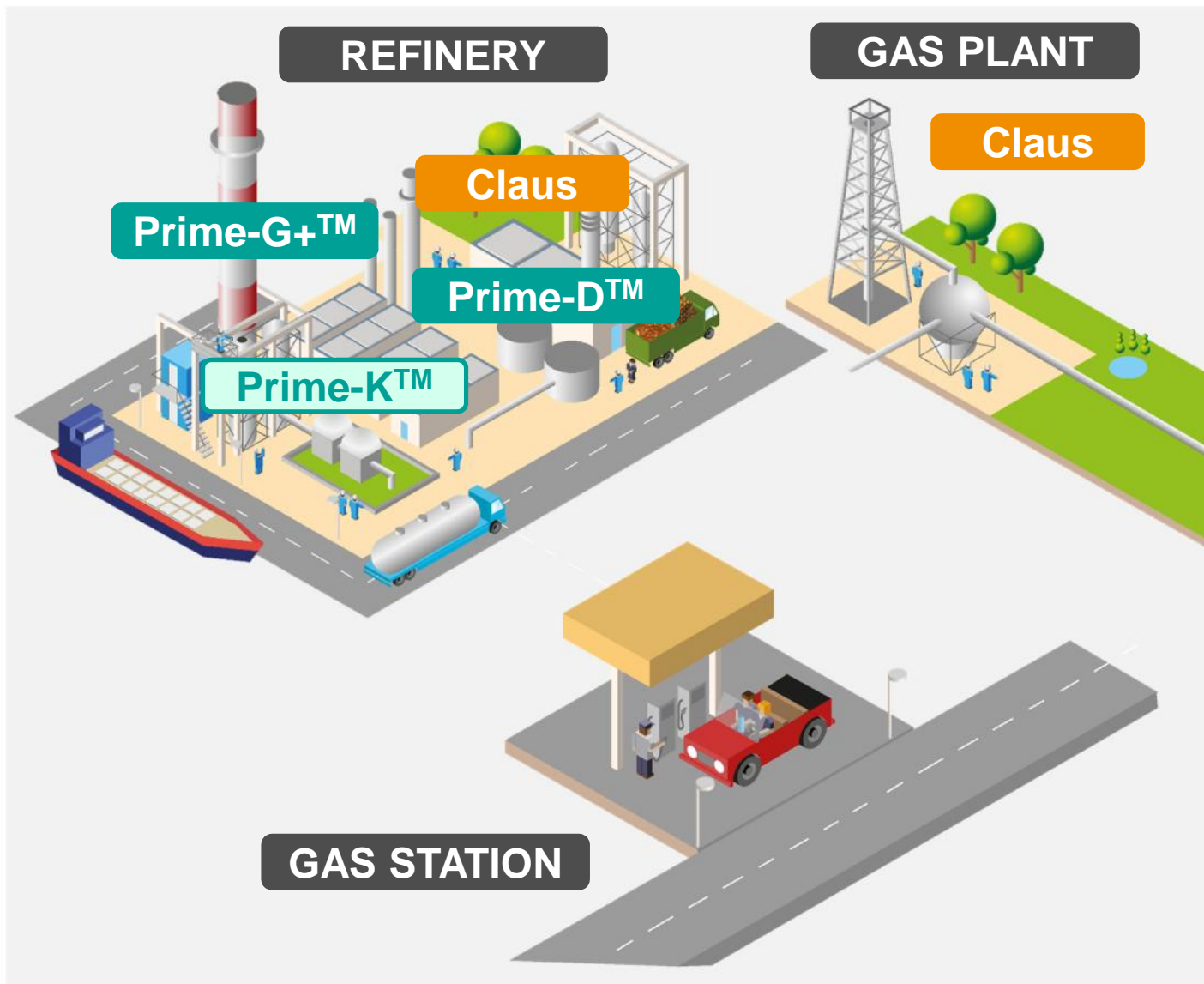


Source: IMO

2016: IMO announces 0.5%wt sulfur cap for 2020

Clean Fuels Production

Fuels Hydrodesulfurization & Sulfur Recovery



~20% of worldwide **low sulfur Gasoline & Diesel** consumption (<50 ppm) comes from **Axens' Prime-D™ & Prime-G+™** units out, representing a cumulated production of 7.0 Mb/d (or 320 Mt) in 2016

~50 million tons of **SO₂** are **not emitted** to the atmosphere thanks to **Claus Plants loaded with Axens' Claus Catalyst** representing **~40%** of the Sulfur recovered from refining and gas processing operations in 2016

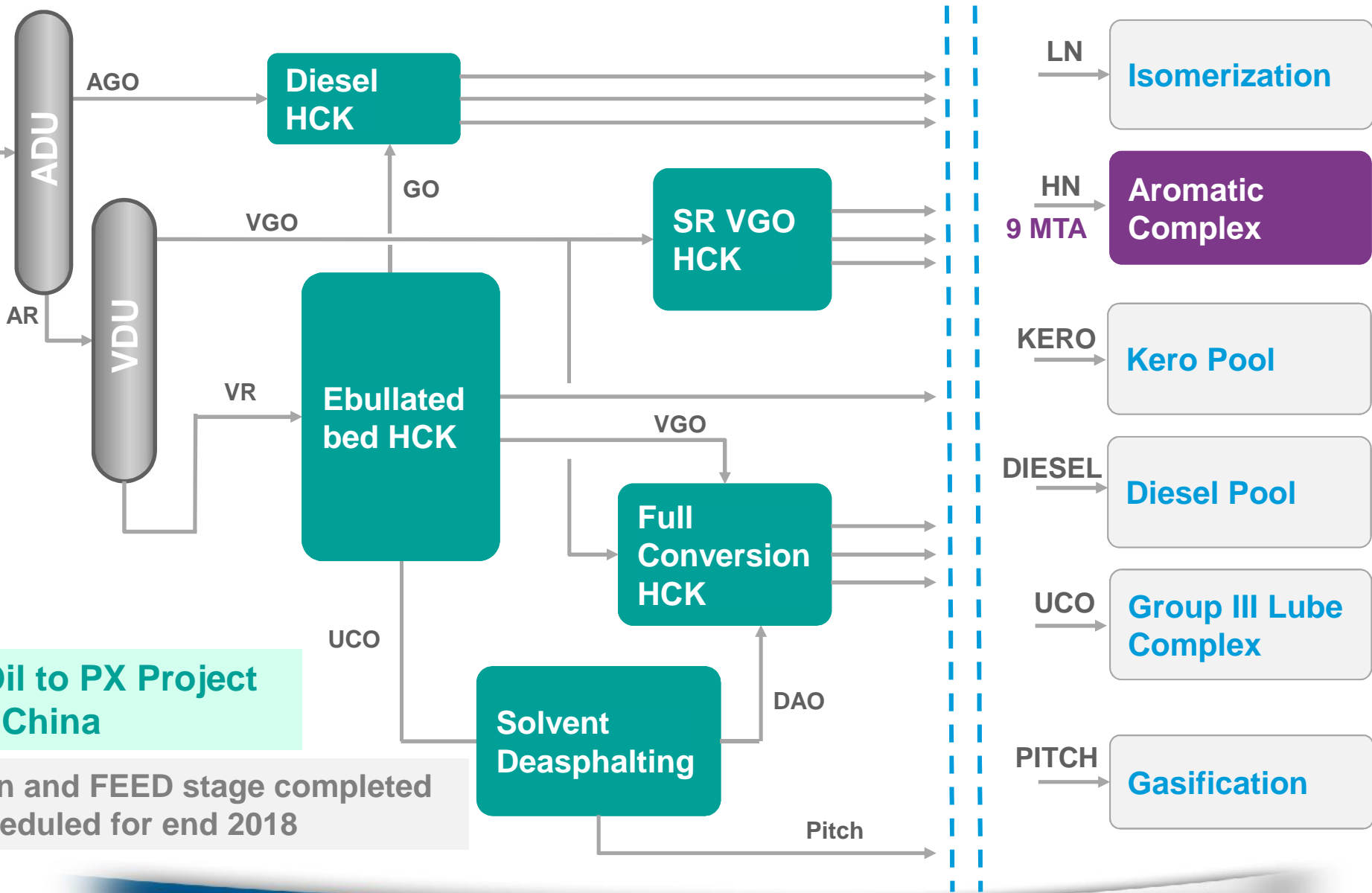
If not recovered, this could increase yearly worldwide SO₂ emissions (all sectors) by **50%**

Oil to Chemicals / Aromatics

Maximize Paraxylene Production

High VR content crude mixture:
60% Arabian Heavy
30% Arabian medium
10% Marlim

20 MTA



1st Crude Oil to PX Project In China

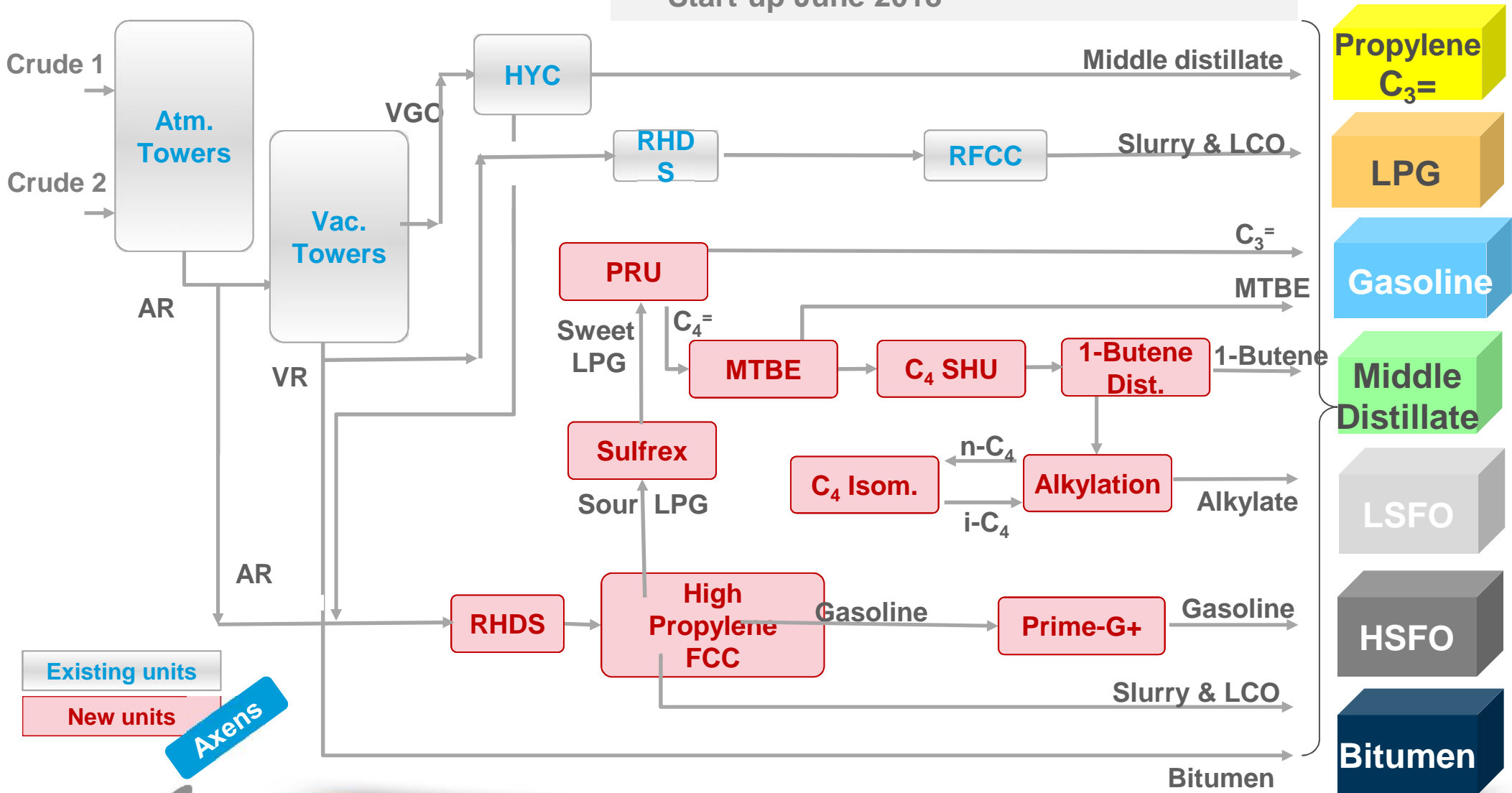
- Basic Design and FEED stage completed
- Start up scheduled for end 2018



Oil to Chemicals / Olefins

Maximize Propylene and 1-Butene Production

- Mega Revamp Project in Korea
- Start-up June 2018

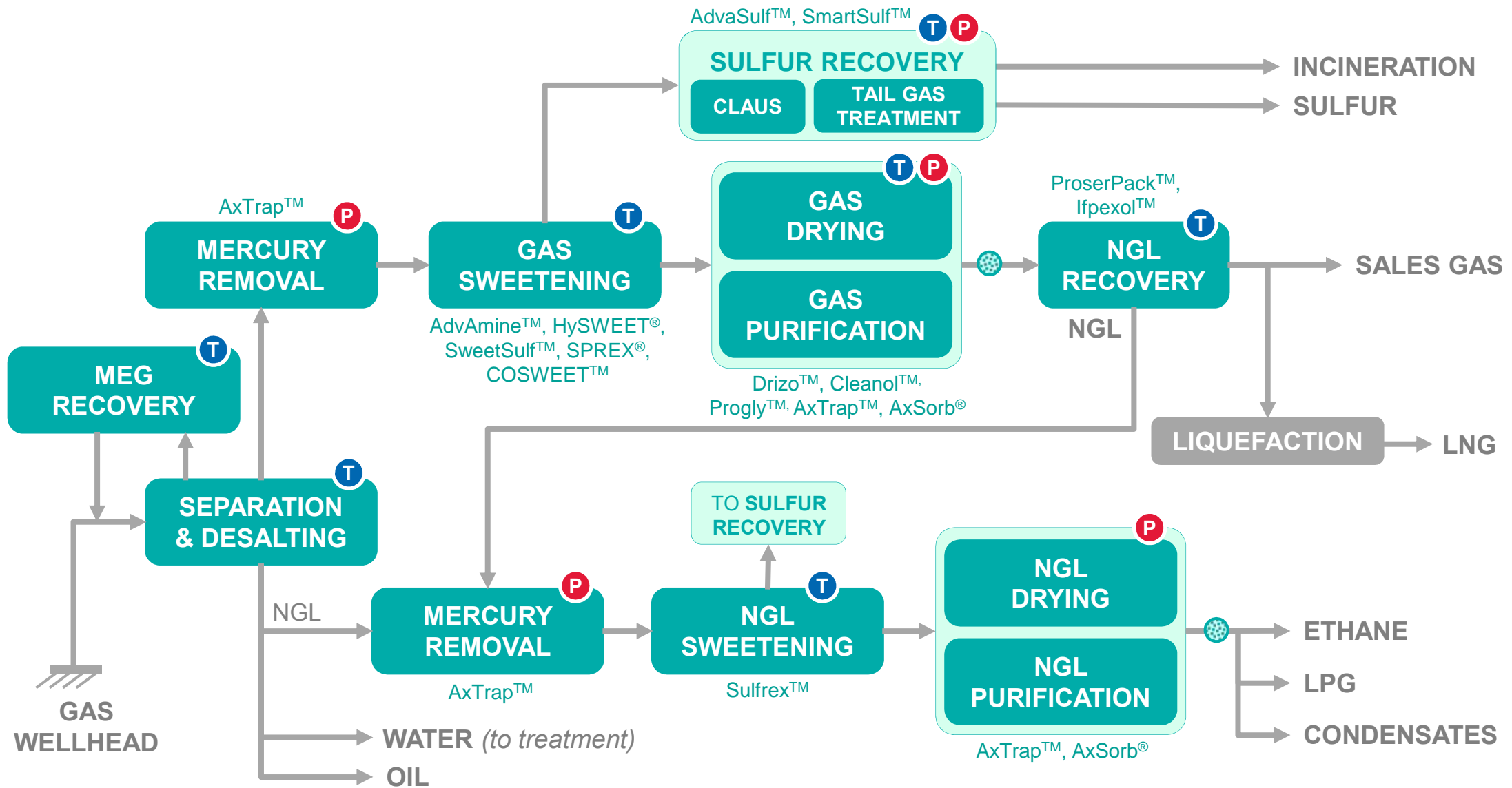


Existing units

New units



Maximize Value and Energy from the Natural Gas : Gas Processing Technologies



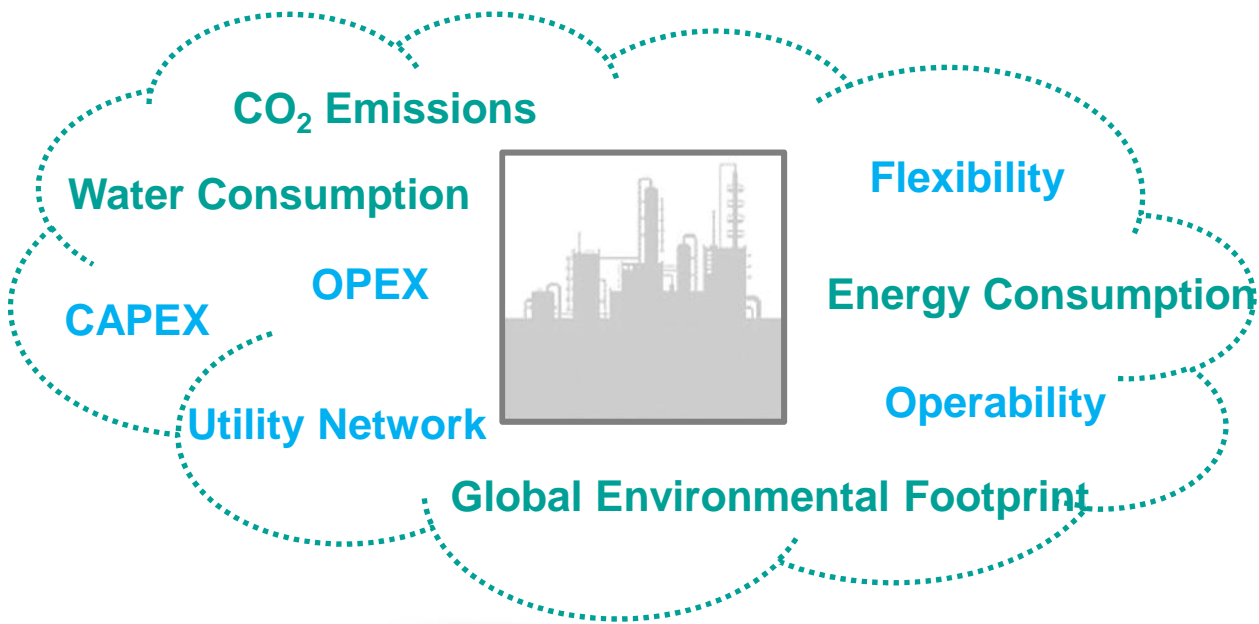
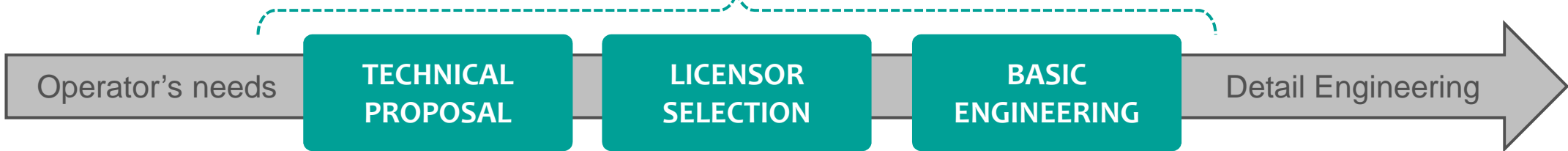
P Products
 T Technologies
 ⚙️ Alternative location of MRU
NGL: Natural Gas Liquids **LPG:** Liquefied Petroleum Gas **LNG:** Liquefied Natural Gas

Energy and Water Efficiency

Reducing Environmental Footprint is Profitable !



Custom & Efficient Early Design



Options

- A** Base Case
- B** Low Energy
- C** Low Water
- D** Optim

→ Select at early stage the most profitable option that fits all constraints

A large portfolio of technologies for Bio-based Fuels & Chemicals

High quality, drop-in Biofuels and Chemicals



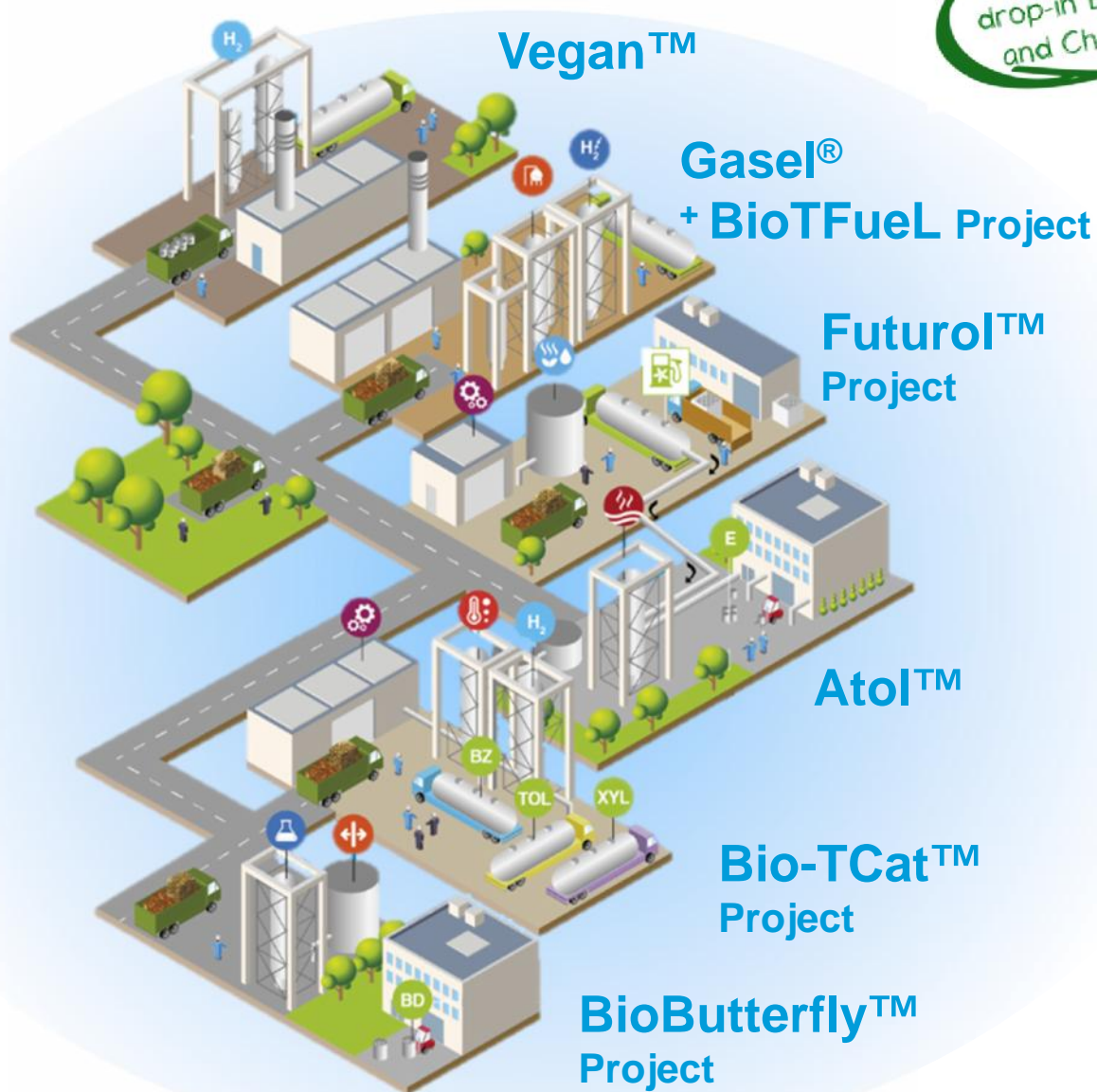
Renewable Oils & Fats








Lignocellulosic Biomass



Sugars



- ▶  Renewable Diesel & Jet
- ▶  Cellulosic Ethanol
- ▶  Ethylene
- ▶  Aromatics
- ▶  Butadiene

Prepare the Transition with Bio-Fuels

La Mède Biorefinery Project



Sept-2014

Sept-2015

Mid-2018



Scoping Study

Process Study
Pilot Tests

PDP

Unit start-up



Emplacement : Châteauneuf-les-Martigues, France
Activités : production de biodiesel, d'Avgas, d'AdBlue, plateforme de logistique et de stockage, école de formation

- **First Vegan[®] Industrial Reference**

- **Retrofit of two HDT Units into a Vegan[®] Unit**

- **Production of 500,000 t/y of Renewable Diesel**

Capacité : 500 000 t/y de RVO
Mise en production : mi-2018



New 2nd Generation Bio-Fuels

Futurol™ Project

Cellulosic Ethanol



BioTFuel Project

Renewable
Diesel & Jet



Axens commitment in the Energy Transition

➔ Make available the **technological solutions** to :

- Use clean fossil hydrocarbons where we need them :
➔ **Clean Fuels, Chemicals, Natural Gas (to-Power)**
- Avoid wasting of primary resources :
➔ **Energy & Water Efficiency, Plastics Recycling**
- Accelerate the Transition
➔ **Bio-based Fuels and Chemicals**

Thank you! And see you on Axens' Blog axens.net/blog

