

Conferencia Magistral Ruta Tecnológica ATJ

Jetanol™

Rosario - August 19th, 2025

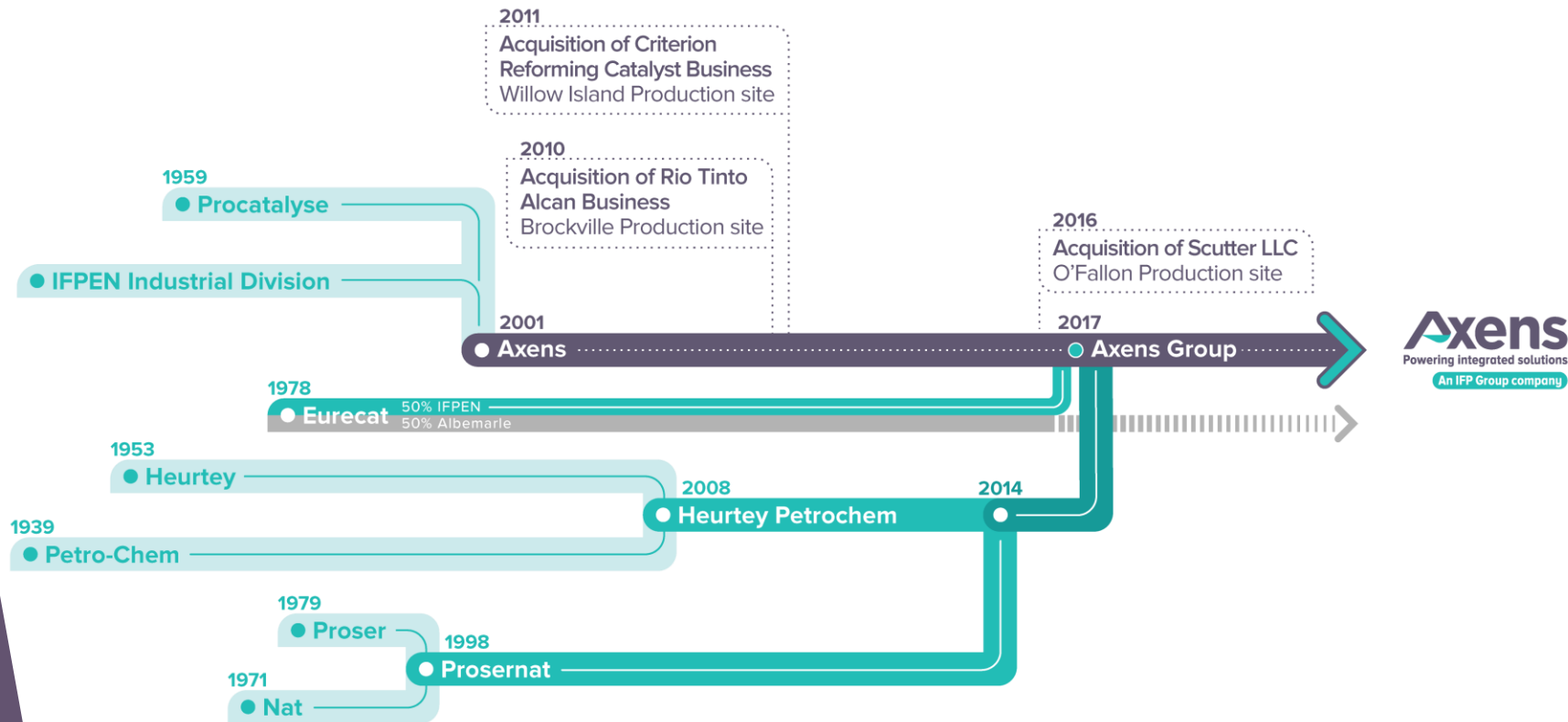


Coalición
Panamericana
de Biocombustibles
Líquidos

Rodrigo TEIXEIRA-PINTO
Latin America Account Manager

Axens
Powering integrated solutions

Axens: Built on Solid Foundations



IFPEN: Our Research Center, our Mother Company

IFPEN – France

- 100+ pilot units
- 1 000+ people
- 10 000+ active patents
- 300 Mi US\$ Budget R&D



Axens Group



Offices in
15 countries



More than
3,000
industrial units
under license



More than
75,000
tons of catalysts
and adsorbents per year



More than
3,500
heaters sold



7 Manufacturing
Sites



More than
500 modular
unit references



OIL REFINING



PETROCHEMICALS



NATURAL GAS



BIOGAS & LANDFILL



CARBON CAPTURE
UTILIZATION & STORAGE



LOW CARBON HYDROGEN



RENEWABLE, LOW CARBON FUELS
& BIO-BASED CHEMICALS



CIRCULAR RESOURCES

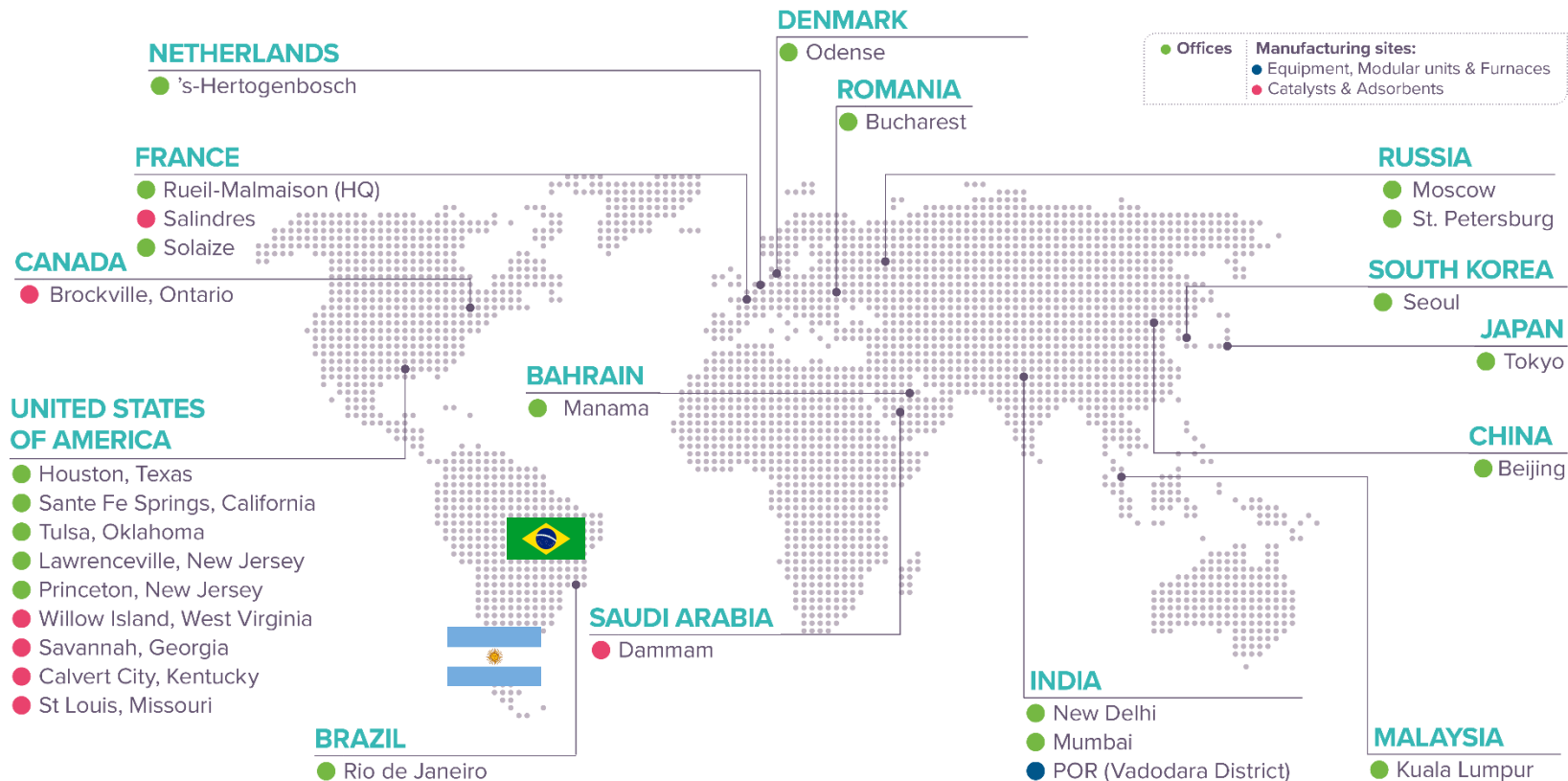


WATER TREATMENT



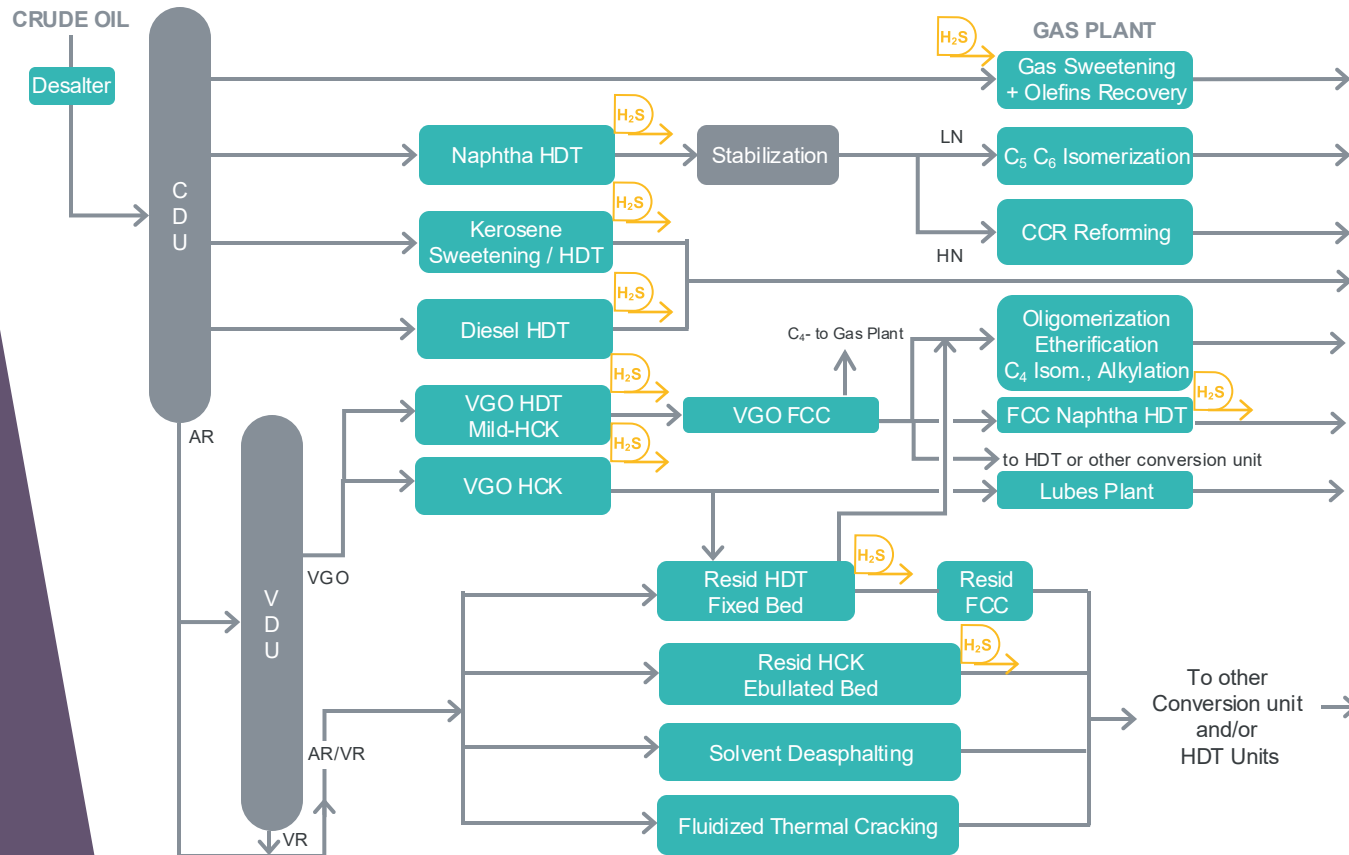
AIR TREATMENT

A worldwide network: 2300 employees in 4 continents



Axens Refining Offer

SULFUR PLANT



- ▶ (LPG) Propane/Butane
- ▶ Propylene
- ▶ Naphtha for petrochemicals
- ▶ Aromatics Complex
- ▶ Gasoline
- ▶ Jet Fuel
- ▶ Diesel
- ▶ Lubes, Waxes, Paraffins
- ▶ Marine Bunker Fuel
- ▶ Bitumen
- ▶ Coke
- ▶ Sulfur

Axens Natural Gas Offer



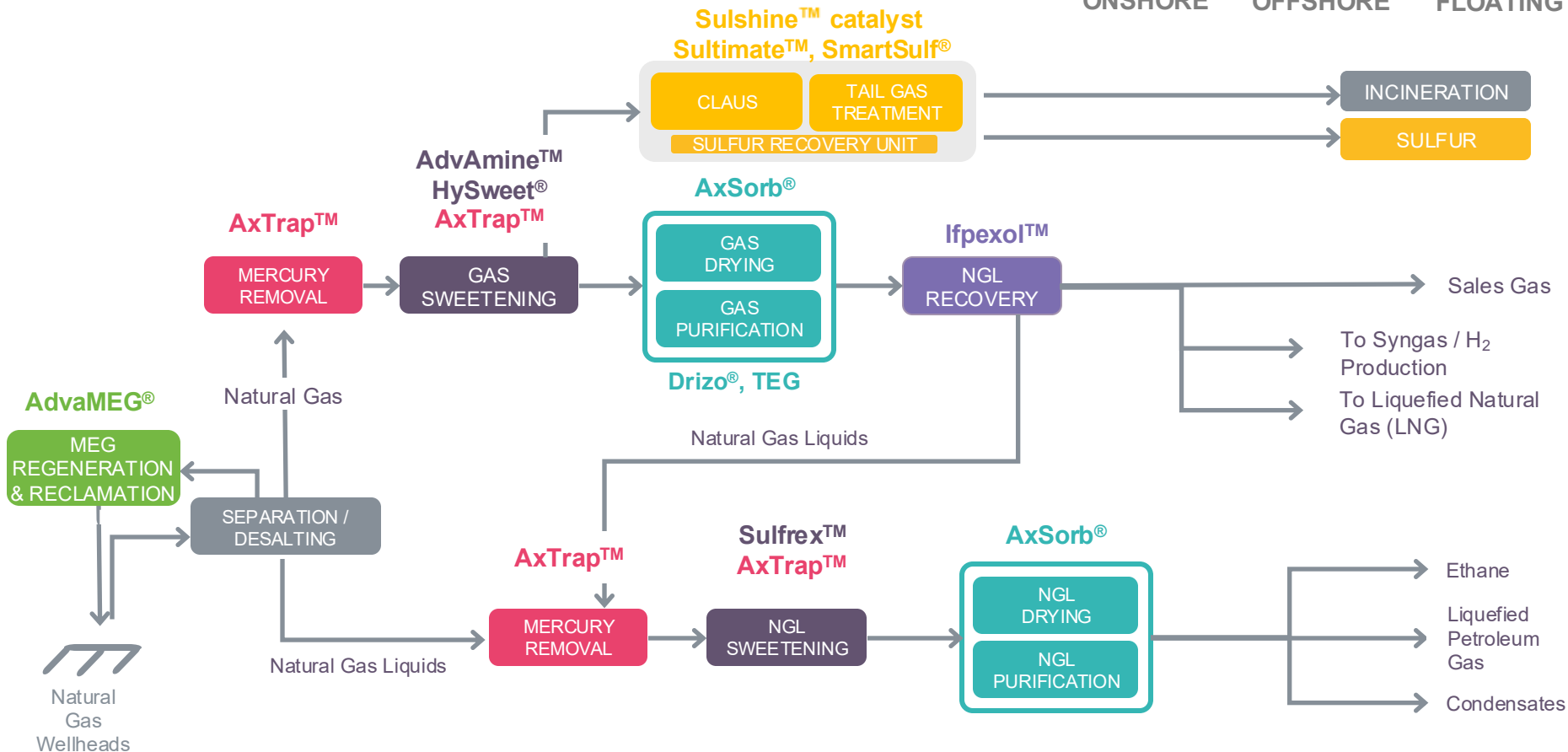
ONSHORE



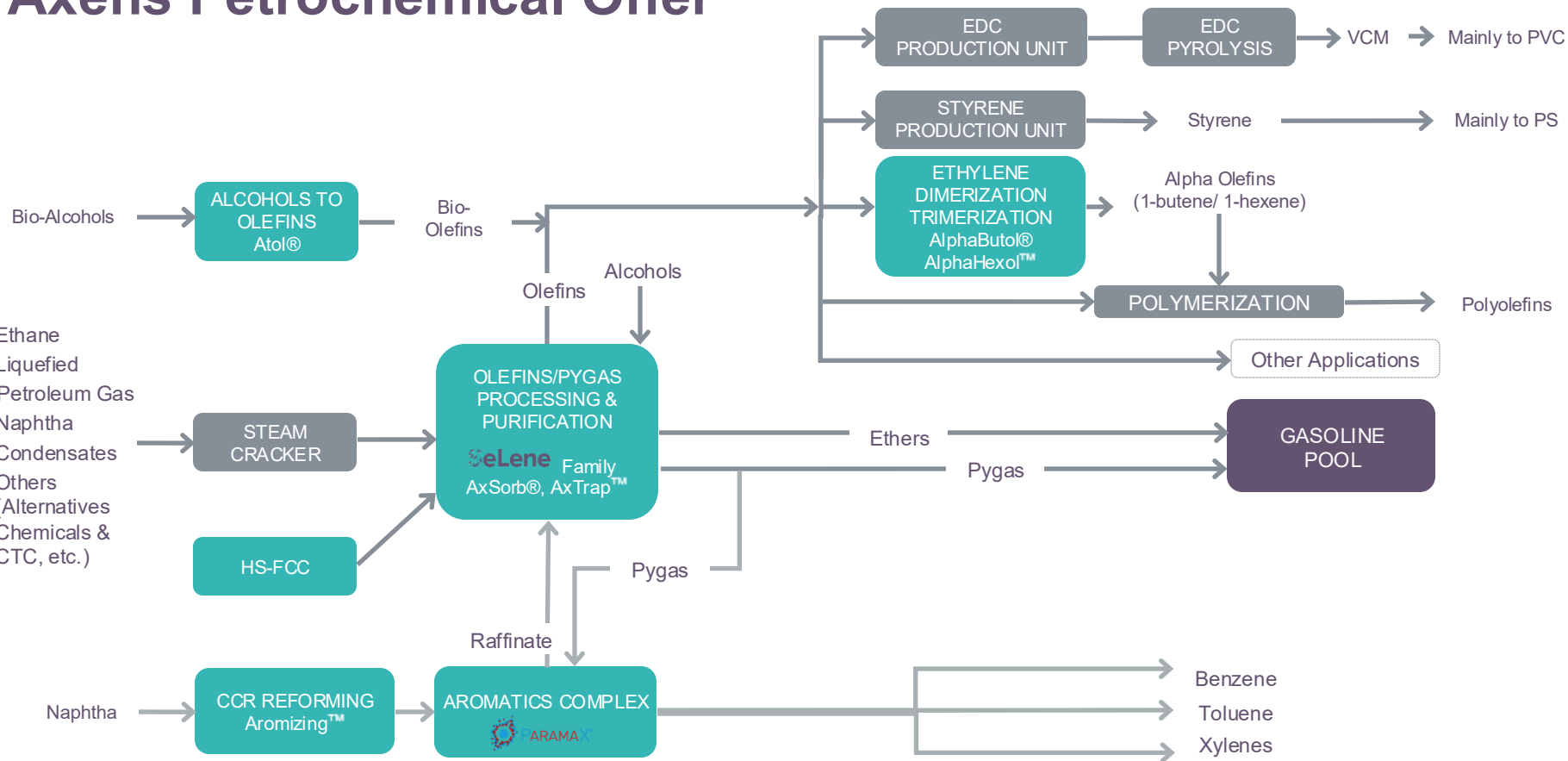
OFFSHORE



FLOATING



Axens Petrochemical Offer



Business Model

Axens, backed by several **decades of reliable technology commercialization**,

and together with IFPEN & other partners,
self-invest in **technology development and de-risking**

to provide **performance guarantees** to the market.

Transition to the Low Carbon Economy: a large range of solutions

ENERGY EFFICIENCY, LOW CARBON FUELS, H₂ and CO₂ CAPTURE



Energy Efficiency

- Energy Efficiency & Low-Carbon Site Audit
- Consulting Offer for Decarbonization
- High Efficiency Equipment
- Electrical Heaters
- Optimized Heater Efficiency
- Digitalization
- CEED, Custom & Efficiency Early Design



Renewable, Low Carbon Fuels & Bio-Based Chemicals

Low Carbon Fuels

- Co-Processing
- Vegan® (HEFA)
- BioTfuel® (gasification & FT)
- Jetanol™ (ATJ)

Petrochemicals Intermediates

- Futurol® (Advanced Ethanol)
- AtoI® (bio-ethylene)
- BioButterfly™ (bio-butadiene)
- Bio-TCat™ (bio-aromatics)
- 2G Sugars



Low Carbon Hydrogen

- Blue Hydrogen: Grey Hydrogen & CO₂ Capture
- Hydrogen Purification
- Hydrogen Transportation (LOHC)



Carbon Capture Utilization & Storage

- Pre-Combustion: Advamine™
- Post-Combustion: DMX™
- e-Fuels



RECYCLING

Circular Resources

- Plastic Recycling

- TAC  
- Tire Recycling
- Metal Recycling
- Battery Recycling
- Catalyst Pool Management

- Spent lube-oil reprocessing


AIR, BIOGAS, WATER



Biogas & Air Treatment

- Air Pollution Control

- Water Purification with a Large Portfolio of Adsorbents
- Industrial Waste Water Treatment

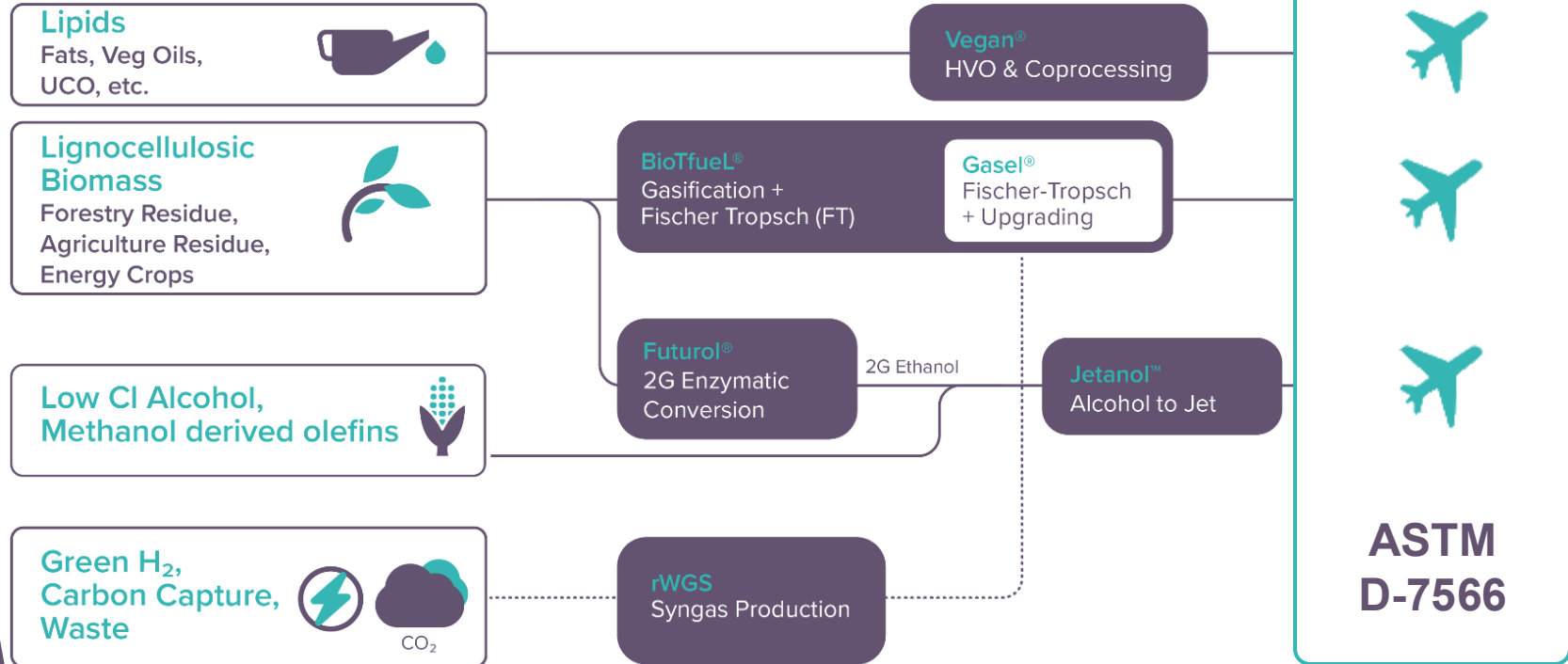



Water Treatment

- Sulfur recovery


Axens SAF Technologies

Sustainable Aviation Fuel



Axens ATJ Technology

Sustainable
Aviation
Fuel

Jetanol™



ASTM
D-7566

Jetanol™ journey: The beginning ...

- ▶ ASTM defined the steps to convert Ethanol to Jet ...

... all the required **technologies** were already **available** in Axens portfolio.

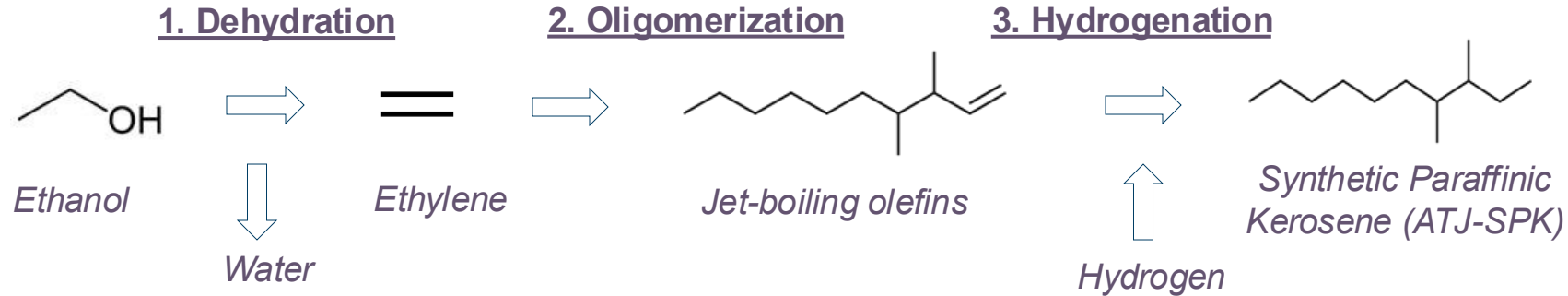


Alcohol-to-Jet: How do we do it?

Jetanol™

The Basics:

1. Remove ethanol oxygen by dehydration to form ethylene
2. Build carbon chains for jet fuel production
3. Total hydrogenation to remove olefins and reach ATJ-SPK properties



 **ATJ-SPK Pathway is validated by ASTM D-7566 Annex 5**

Jetanol™ journey: Existing technologies for new challenges

Ethanol
Dehydration
Atol®



 SUMITOMO CHEMICAL

HIGHLIGHTS



- Best-in-class technology & catalyst
 - High **activity** and market-leading product **selectivity**
 - Resulting in smaller reactor system
 - Regenerable and **long-life cycle catalyst**
 - Patented **energy-efficient** system
 - Lowest GHG emissions
- Tolerant to a **wide range of ethanol** feed qualities:
 - Corn ethanol, Sugarcane ethanol, 2G ethanol
 - Hydrous or anhydrous
- **Commercial experience**: 10 references worldwide

Jetanol™ journey: Existing technologies for new challenges



► Unique dual catalytic system oligomerization:

Homogeneous
Catalysis



Heterogeneous
Catalysis

Dimersol™

- Key for a controlled ethylene oligomerization & stable operation
- 1st plant in 1977  (USA)
- **> 80 commercial references**
- 2005 - Nobel Prize in Chemistry



Polynaphtha™

- Highly selective towards SAF
- Maximum Carbon retention
- 1st plant in 1986  idemitsu (Japan)
- **> 30 commercial references**
- 2023 - Best refining technology



Dimerization - Axens made a choice: homogenous catalysis



Homogenous Catalysis

Selectivity

- Low Temperature
- High conversion & selectivity

Liquid Catalyst

- Perfect feed/catalyst distribution
- No aging / no permanent poison

Operation

- Smooth reaction and temp. control
- Easy heat removal

High Yields

Stability

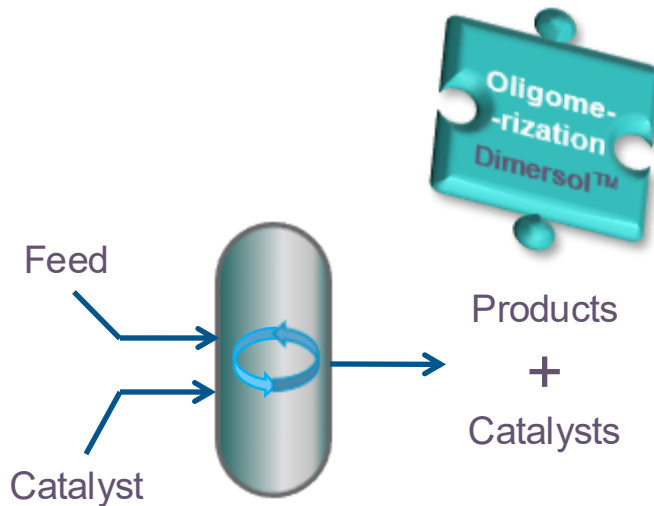


Nobel Laureate Yves Chauvin
IFPEN

Axens is the market leader with over 80 industrial references



Ethylene requires reaction control to reach high yields



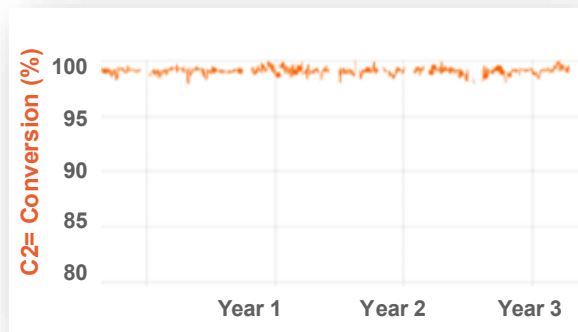
Jetanol™ journey: Existing technologies for new challenges

- Unique dual catalytic system oligomerization :

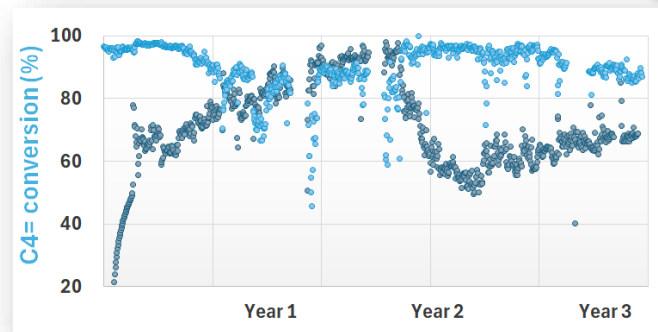


Homogeneous
Catalysis

Heterogeneous
Catalysis



C2= conversion
close to ~100%



C4= Conversion
close to ~100%

Jetanol™ journey: Existing tech for new challenges...

Hydro-
genation



> 700 Axens' Hydrogenation
references

HIGHLIGHTS



Hydrogenation

► Low Capex & Opex

- Mild operating conditions
- Efficient use of H₂
- Optimized recycle rate

► Compliant with ASTM

- Deep olefins hydrogenation
- Impurities removal
- Efficient fractionation

ATJ-SPK
sample production



Unhydrogenated
Jet fuel

Hydrogenated
Jet fuel



1. Scope*
1.1 This specification covers the manufacture of aviation turbine fuel that consists of conventional and synthetic blending components.
1.2 This specification applies only at the point of batch origination, as follows:
1.2.1 Aviation turbine fuel manufactured, certified, and released to all the requirements of Table 1 of this specification (DT566), meets the requirements of Specification DT567 and shall be regarded as Specification DT567 turbine fuel. Duplicate testing is not necessary; the same data may be used for both DT566 and DT567 compliance. Once the fuel is released to this specification (DT566), the single requirements of this specification are no longer applicable; any certification shall be done in accordance with Table 1 of Specification DT567.
1.2.2 Field blending of synthesized paraffinic kerosene (SPK) components, as described in Annex A1 (DT SPK), Annex A2 (DTFA SPK), Annex A3 (DT SPK), Annex A4 (synthesized paraffinic kerosene plus aromatics (SPK/A)), Annex A5 (ATJ), Annex A6 (catalytic hydroisomerization for (C10)), or Annex A7 (JRC-HEFA SPK) with DT567 fuel (which may be the whole or in part have originated as DT566 fuel) shall be considered batch origination in which case all of the requirements of Table 1 of this specification (DT566) apply and shall be evaluated. Short term performance test programs commonly used to ensure transportation quality are not sufficient. The fuel shall be regarded as DT567 turbine fuel after certification and release as described in 1.2.1.
1.2.3 Once a fuel is redesignated as DT567 aviation turbine fuel, it can be blended in the same fashion as the equivalent refined DT567 aviation turbine fuel.
1.3 This specification defines the minimum property requirements for aviation turbine fuel that contains synthesized hydrocarbons and lists appropriate additives for use in civil
operated engines and aircraft. Specification DT566 is directed at civil applications, and maintained as such, but may be adapted for military, government, or other specialized uses.
1.4 This specification can be used as a standard in describing the quality of aviation turbine fuel from production to the aircraft. However, this specification does not define the quality assurance testing and procedures necessary to ensure that fuel in the distribution system continues to comply with this specification after batch certification. Such procedures are defined elsewhere; for example in ICAO 9977, EIDG Standard 1590, ISO 1, ISO 2, API 1541, API 1585, and ASTM 101.
1.5 This specification does not include all fuels satisfactory for aviation turbine engines. Certain equipment or conditions of use may permit a wider, or require a narrower, range of characteristics than is shown by this specification.
1.6 While aviation turbine fuels defined by Table 1 of this specification can be used in applications other than aviation turbine engines, requirements for such other applications have not been considered in the development of this specification.
1.7 Synthetic blending components, synthetic fuels, and blends of synthetic fuels with conventional petroleum-derived fuels in this specification have been evaluated and approved in accordance with the principles established in Practice D4054.
1.8 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.
1.9 This standard does not purport to address all of the safety concerns that may be associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.
1.10 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

*1.4 Summary of 5 changes within appears at the end of this standard

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Standard D566-20a, 2020a, 2020a, 2020a

Standard D566-20a, 2020a, 2020a, 2020a

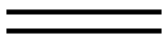
Standard D566-20a, 2020a, 2020a, 2020a

Jetanol™: Long track record industrial experience

8 references

Jetanol™

Dehydration

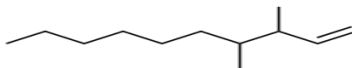


Atol®

- ▶ Since 2012
- ▶ 10 references



Oligomerization

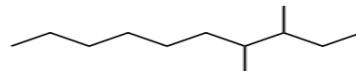


Dimersol™
Polynaphtha™

- ▶ Since the 1970's
- ▶ > 110 references



Hydrogenation



Hydrogenation

- ▶ Since the 1960's
- ▶ > 700 references



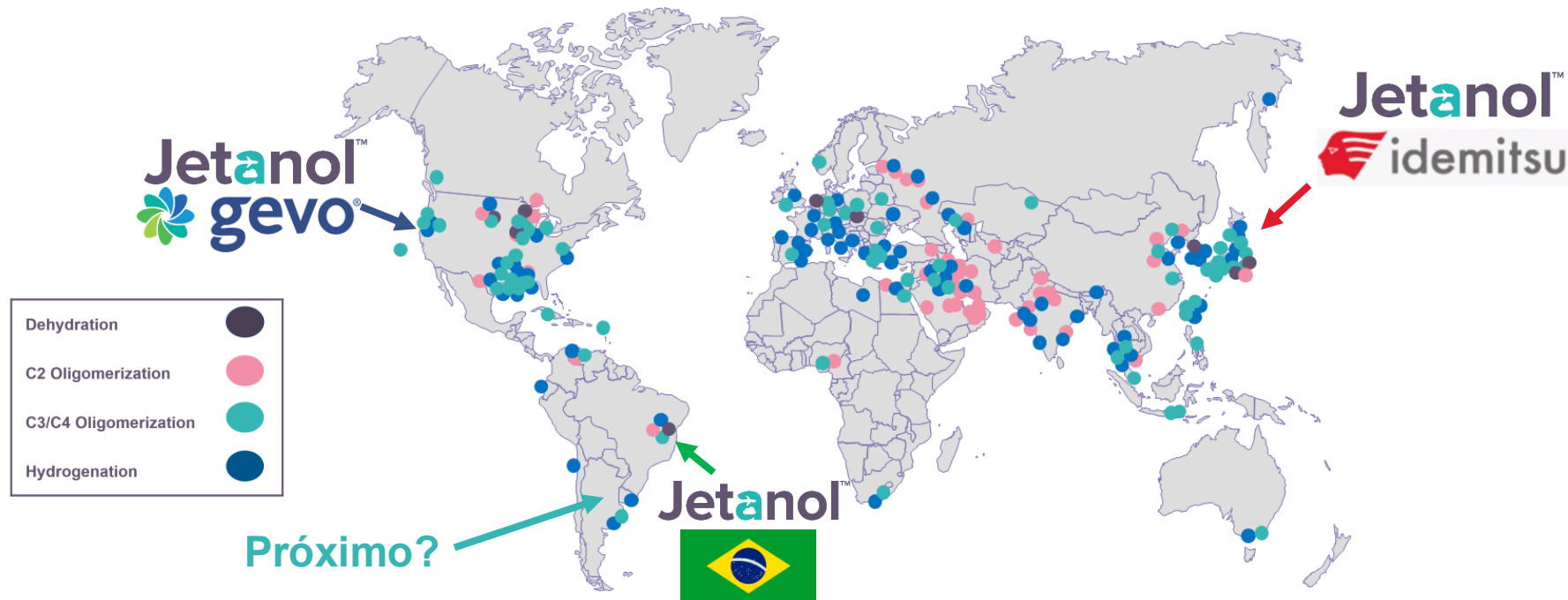
Existing in-house knowledge gathered in an end-to-end solution

All units in operation at industrial scale

Jetanol™: Unmatched Commercial Experience

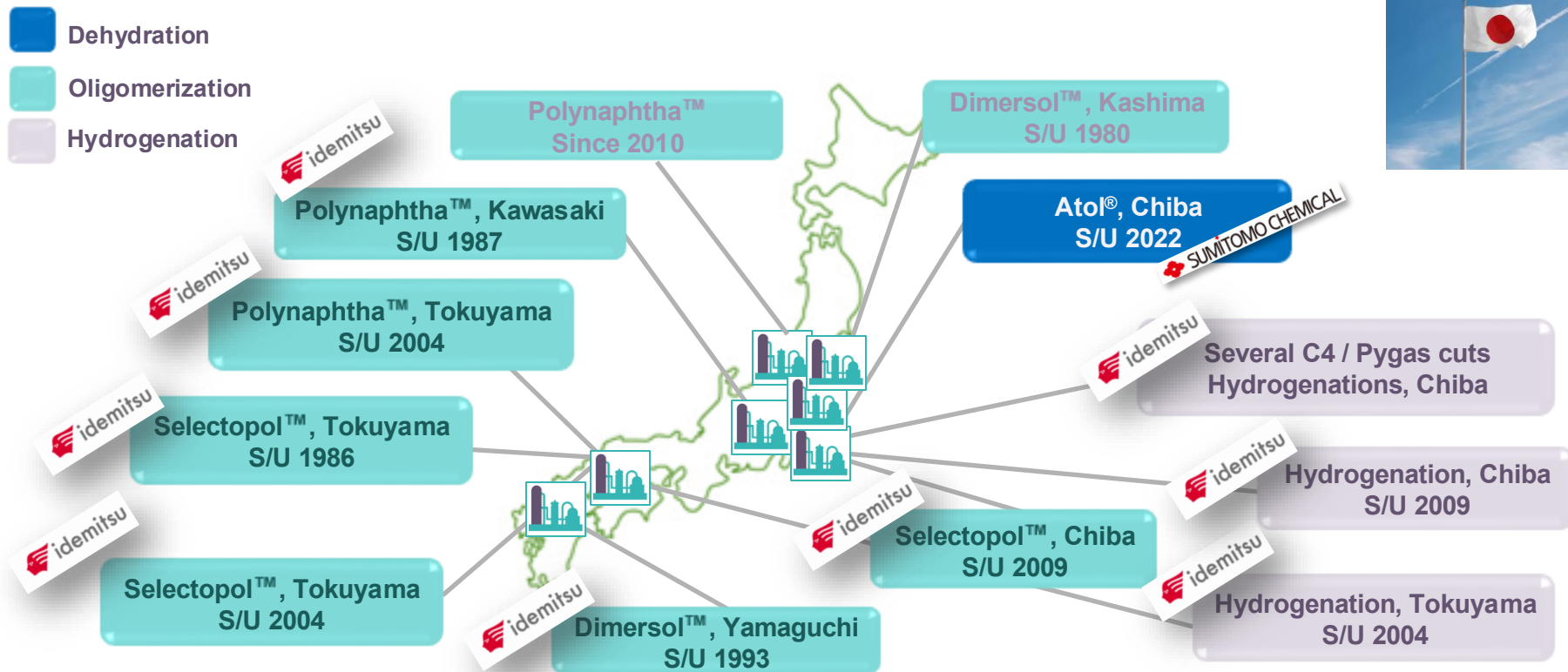
Decades of industrial experience in ATJ chemistry to develop a robust & end-to-end solution

100% of Performance Acceptance: Axens' technologies are trustable!

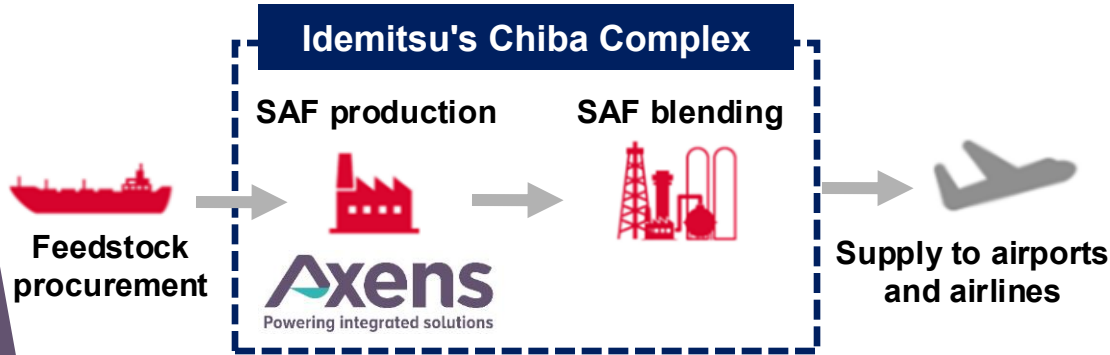


8 references of the complete Jetanol™ chain

Deep Industrial Deployment of Axens ATJ tech in Japan



Jetanol™ ATJ project in Japan with idemitsu



- Project timeline: Start-up 2028
- Capacity: ~26 MMGPY of SAF / ~100 MM liters SAF / ~80 KTY SAF
- Process: Axens Jetanol™ technology
 - Reliability of technologies
 - Support for customization
 - Continuous support during decades of operation



✓ Axens's partnership spirit

Axens Jetanol™ Solution: Built on Solid Foundations

Industrially Proven De-risked Technologies



- Hundreds of industrial references
- Decades of industrial operation

Best-in-class technologies



- > 60 related patents
- Based on a Nobel Prize in chemistry technology (Y. Chauvin, IFPEN)
- Leader in olefins upgrading and hydrogenation
- Near-complete carbon retention
- Industry-leading yields



Feedstock flexibility



- Impurity management for a wide range of alcohol sources
- Water management

SAF & co-products



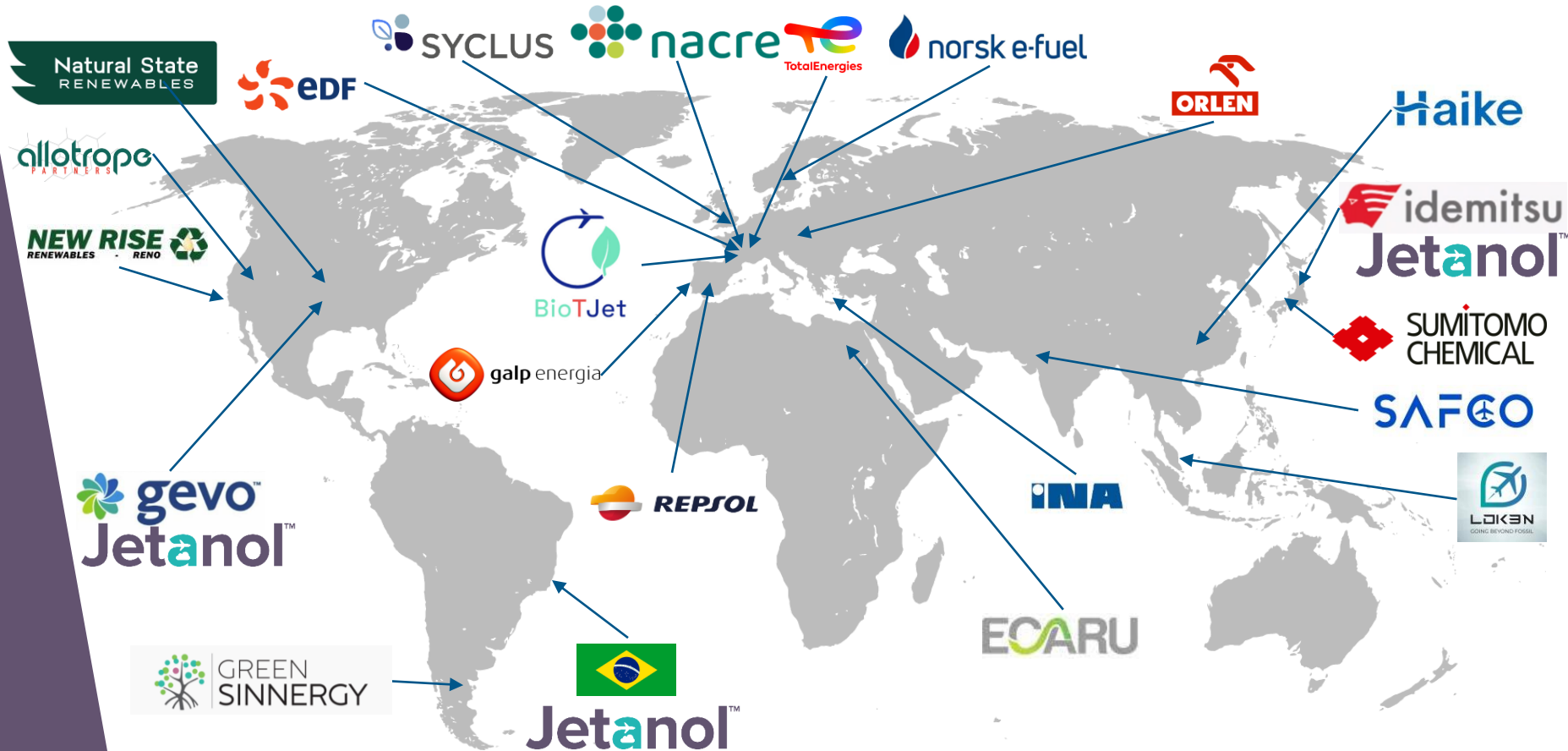
- Certified SAF ATJ-SPK as per ASTM 7566 Annex 5
- Final product slate maximized for SAF production
- Bio-naphtha as co-product
- Diesel as a potential co-product
- Immediate value from ethylene as platform molecule

Single Source Supplier



- Full technology and catalyst provider
- End-to-End Guarantees

Low Carbon Projects with Axens





axens.net

Muchas
Gracias