

Uhde innovate 2024

Biomass gasification & sustainable value chains in the chemical industry

06 June 2024 | Frédéric Balligand, Dr. Guido Daniel, Karsten Radtke
Joint Presentation: Axens & thyssenkrupp Uhde

engineering.tomorrow.together.



thyssenkrupp

Agenda

Part 1: Sustainable biomass-based value chains at thyssenkrupp Uhde

Dr. Guido Daniel

Part 2: Our Pathway to BioTfuel: Biomass Gasification and its development:

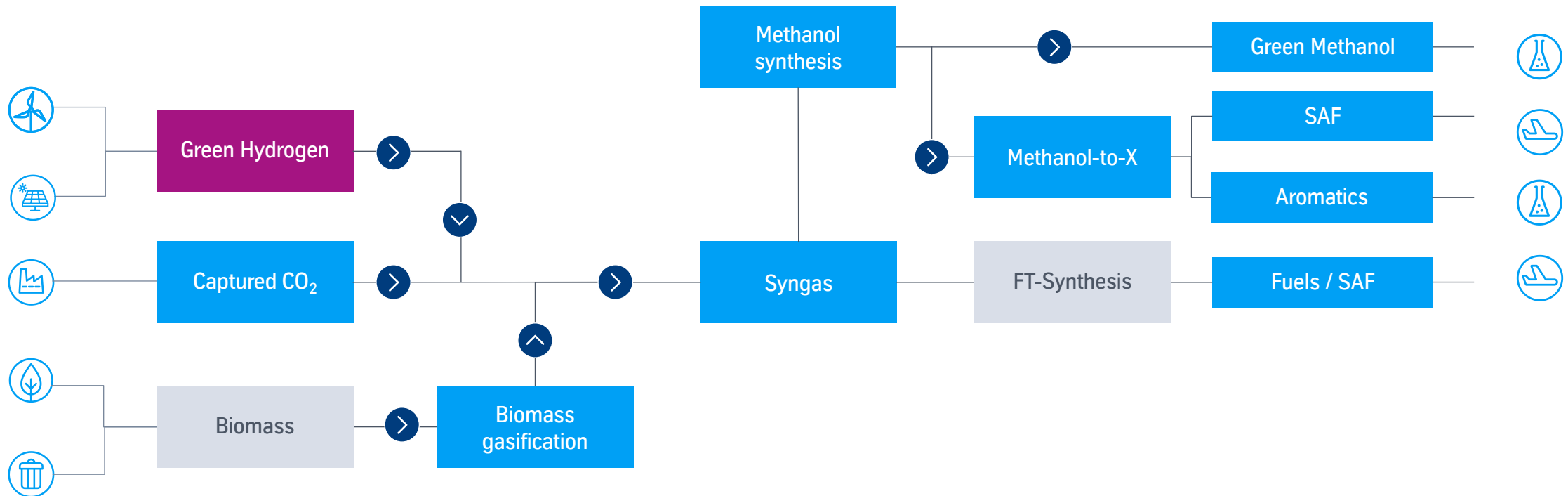
Karsten Radtke

Part 3: Project BioTfuel: a successful demonstration of biomass-to-liquid fuels:

Frédéric Balligand (Axens)



Uhde is a prime technology licensor for biomass gasification, green methanol and methanol-to-X technologies



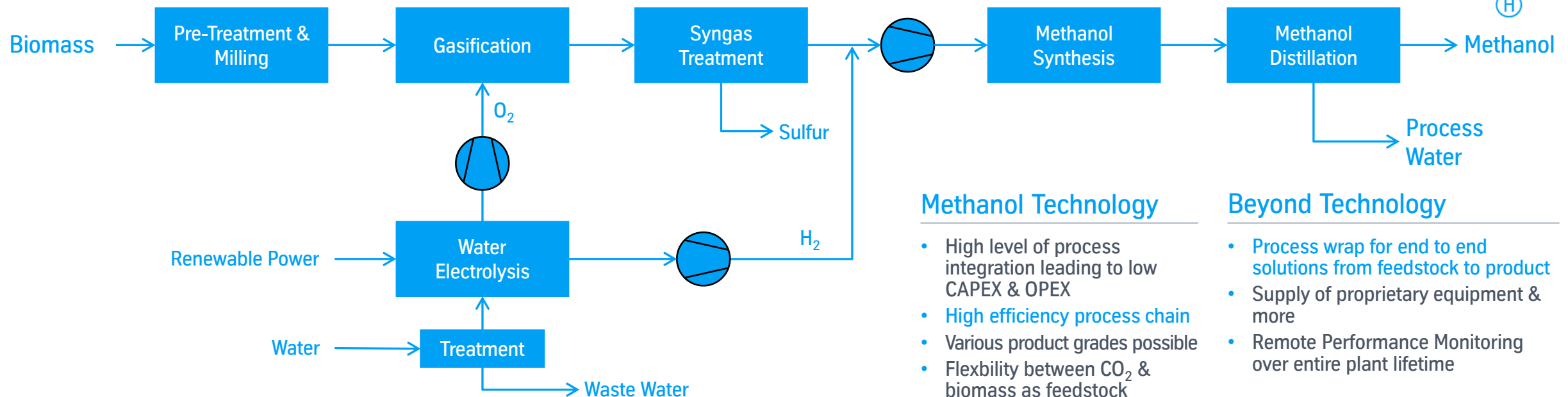
FT-Synthesis: Fischer-Tropsch-Synthesis

Biomass-to-Methanol – uhde® Green Methanol

Advanced plant configuration with renewable hydrogen

PRENFLO - ideal biogenic carbon conversion process

- Referenced technology with competitive CAPEX & OPEX
- Ready to go technology
- Proven & robust gasifier
- High carbon conversion rate & throughput
- Multiple burner concept
- Feedstock flexibility
- Water cooled membrane wall



Methanol Technology

- High level of process integration leading to low CAPEX & OPEX
- High efficiency process chain
- Various product grades possible
- Flexibility between CO₂ & biomass as feedstock

Beyond Technology

- Process wrap for end to end solutions from feedstock to product
- Supply of proprietary equipment & more
- Remote Performance Monitoring over entire plant lifetime



The addition of electrolytic hydrogen means that virtually all of the biogenic carbon can be converted into methanol!



What is Gasification?

Combustion is full oxidation:



Heat

Gasification is partial oxidation:



Chemical
Products

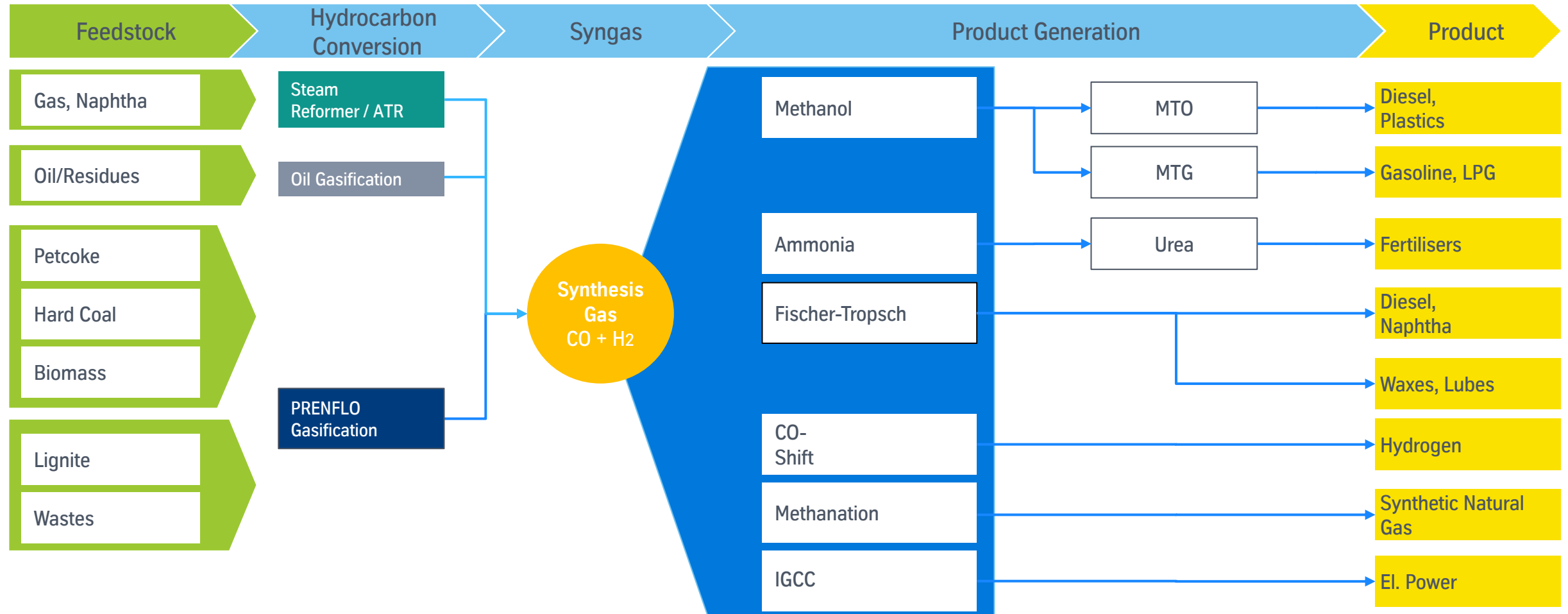


In contrast to combustion, gasification is the **chemical utilization** of hydrocarbon feedstocks



Synthesis Gas is the central intermediate product:

Nearly all hydrocarbons can be converted to syngas – by very different means



MTO: Methanol to Olefins | MTG: Methanol to Gasoline | IGCC: Integrated Gasification Combined Cycle



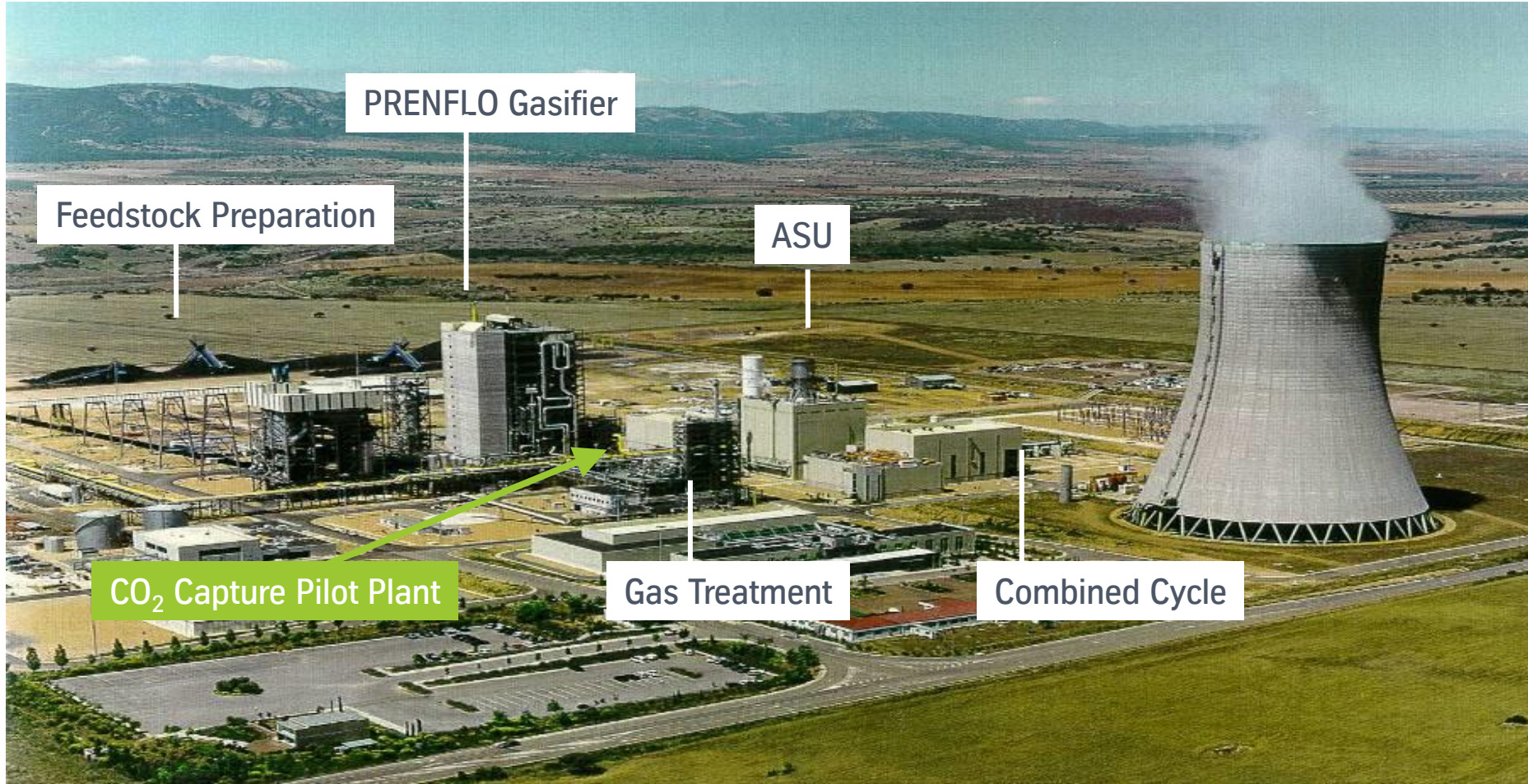
Leading the Way: Our Firsts in Gasification Achievements

- 1909: **first** Koppers Gas Generators (a total of 536 built)
- 1941: Invention of **first** **Entrained-Flow Gasification**:
 - **Koppers-Totzek**: dry-fed, membrane wall, multiple burners
- **Development, Design and Construction of**
 - **first** Koppers-Totzek Coal Gasification Plant
 - **first** Rummel-Otto Slag Bath Gasification Plant
 - **first** Saarberg-Otto Gasification Plant
 - **first** Texaco (GE) Coal Gasification Plant
 - **first** HTW Gasification Plant
 - **first** Shell-Koppers Gasification Plant
 - **first** PRENFLO Gasification Plant



World's largest single-train IGCC: PRENFLO Gasification Elcogas, Puertollano, Spain

Feedstock: petcoke / coal **with addition of biomass** - over 15 years of commercial operation



- IGCC Power Plant (318 MW)
- 2,600 t/d petcoke + coal feed
- upto 10 % biomass co-feed
- Single gasifier (770 MWth)

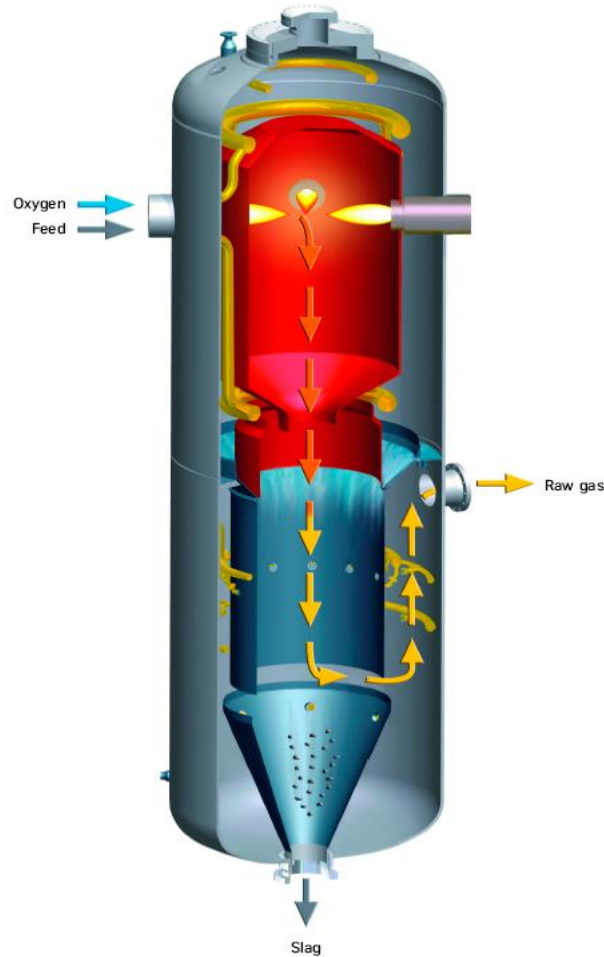
ASU: Air Separation Unit
IGCC: Integrated Gasification Combined Cycle



PRENFLO PDQ Gasification

Principle PDQ Features

- Dry powder feed (coal/biomass)
- Multiple horizontal co-annular burners
- Membrane wall
- Direct water quench
- Operation pressure flexible to requirements (25 - 42 bar)
- Raw gas temperature outlet of quench (200 - 250 °C)
- Compact gasification system with low plant investment



PDQ: Prenflo with Direct Quench



PRENFLO Gasifier - erection of gasification chamber / membrane wall (Puertollano)

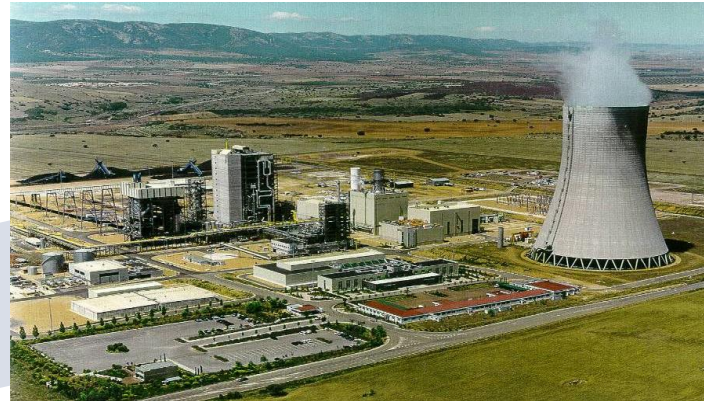


Sourcing of Carbon and Hydrogen via Gasification

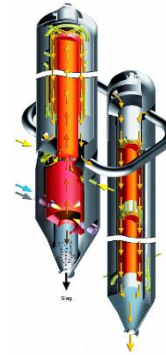
almost 100 years in Gasification



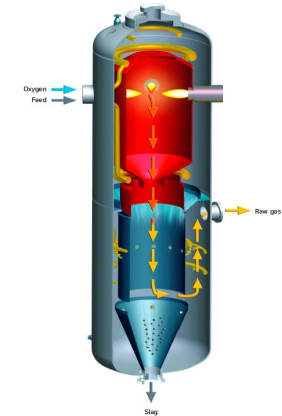
1925 First Uhde gasification order



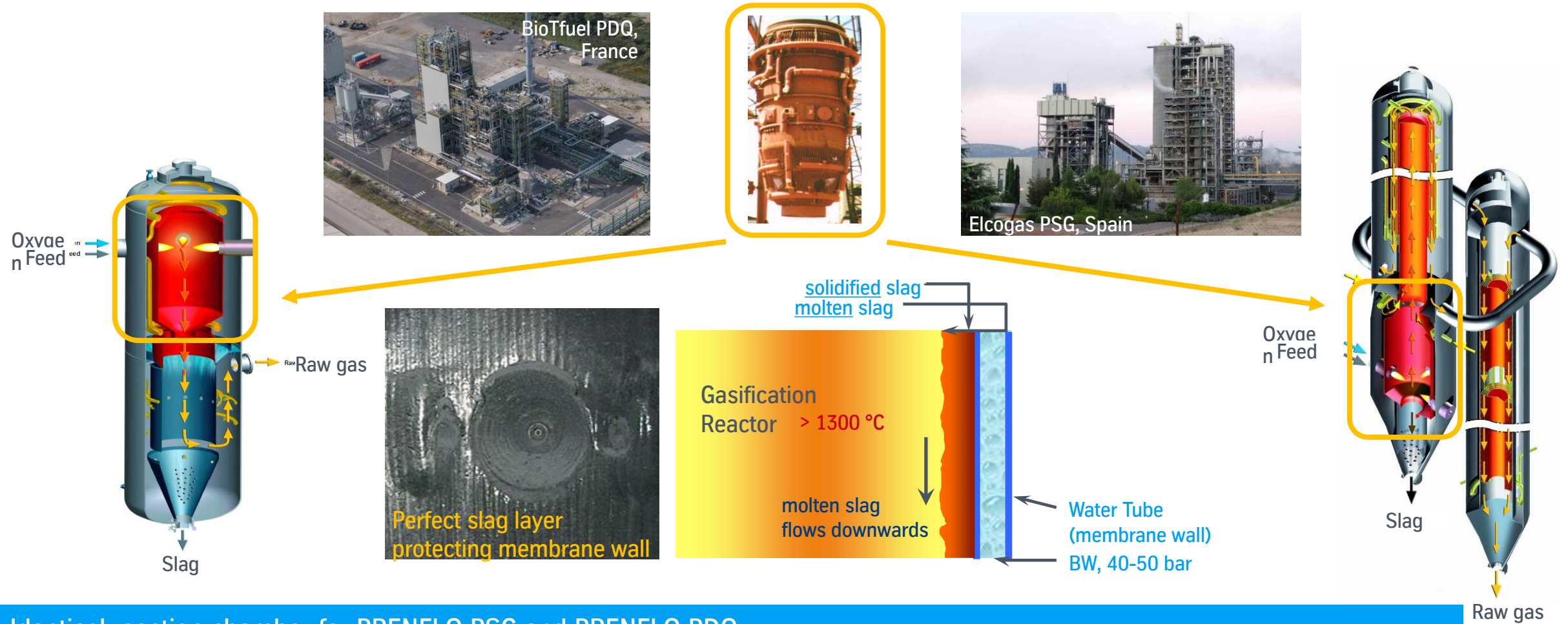
1998 Elcogas, Puertollano, Spain



2022 BioTfuel® plant, Dunkirk, France



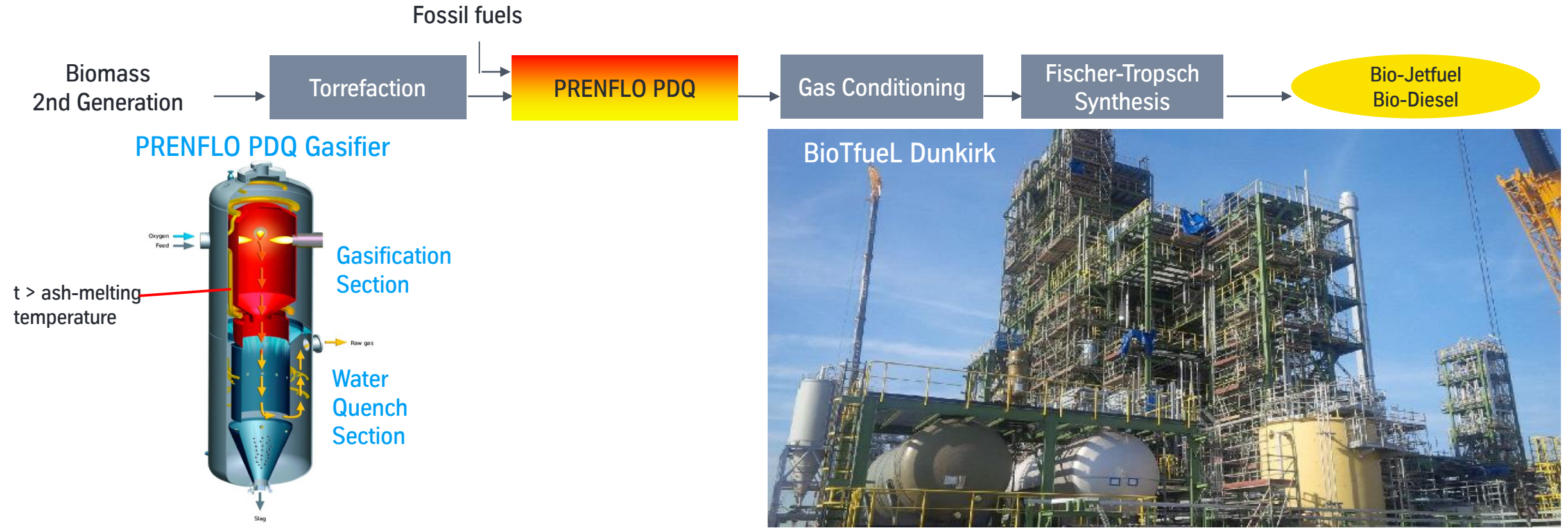
PRENFLO with Steam Generation (PSG) or with Direct Quench (PDQ)



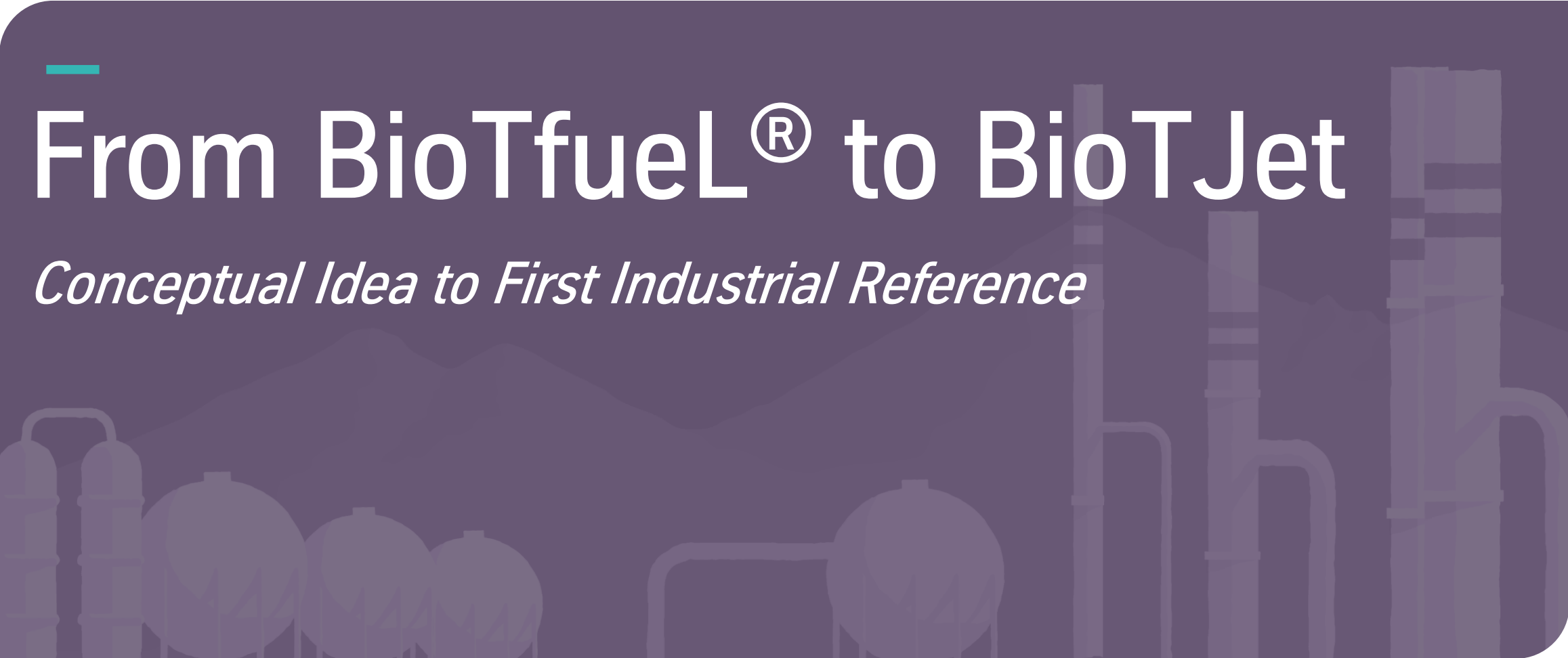
Identical reaction chamber for PRENFLO PSG and PRENFLO PDQ

PSG: PRENFLO with Steam Generation





- The BioTfuel demonstration project objectives are to develop, demonstrate and commercialize an integrated B-XTL chain for the production of advanced bionaphtha, biojetfuel, biodiesel from biomass
- Joint project by Avril, Axens, CEA, IFPEN, Total, thyssenkrupp Industrial Solutions



From BioTfuelL[®] to BioTJet

Conceptual Idea to First Industrial Reference

Frédéric BALLIGAND

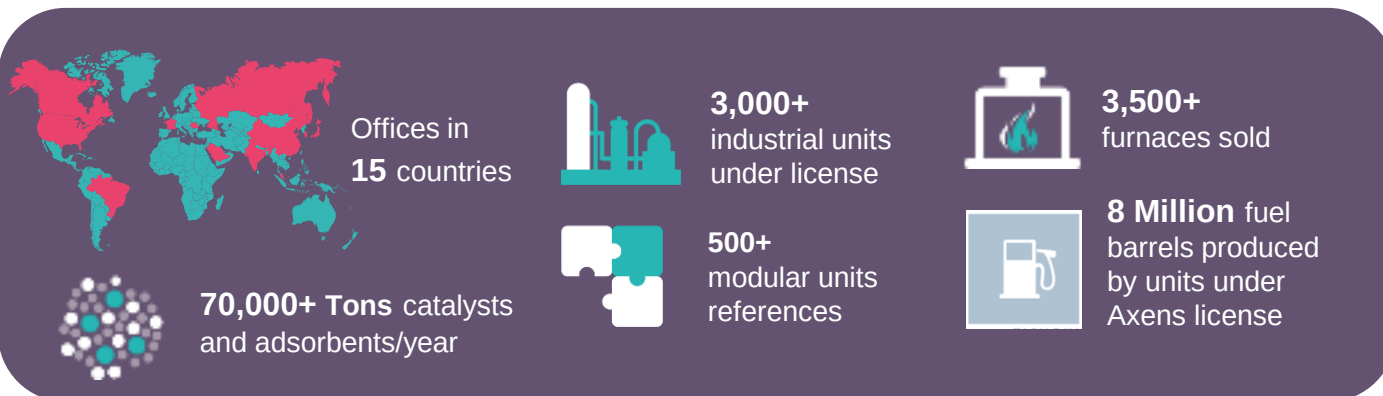
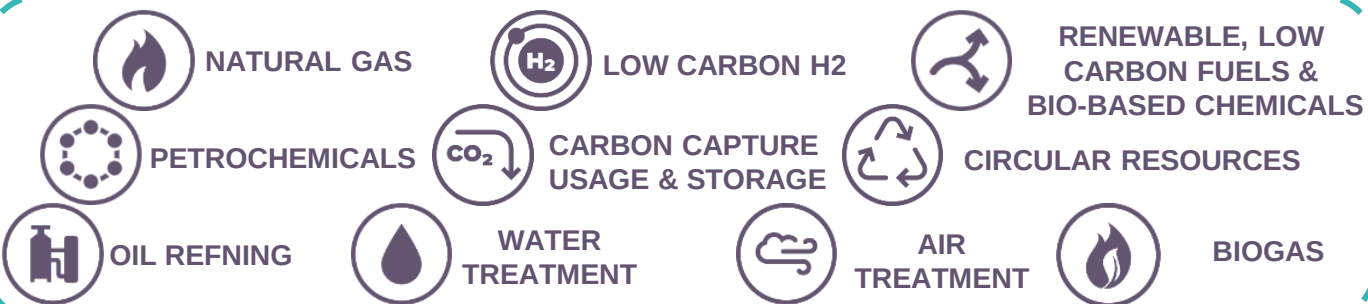


Axens in Brief

Company Profile

- Technology provider for renewable fuels, bio-based chemicals, oil & gas, and petrochemical industries
- 40+ year experience in biofuels & biotech
- Ownership structure: 100% IFPEN

Business Areas



Axens Offer

Integrated solution
Covers entire value chain

Axens
HORIZON

Axens
SOLUTIONS

Heurtey
Petrochem
SOLUTIONS



The BioTfuelL[®] Project



MAIN FIGURES

- 190+ M€ investment
- Including Subsidies: 33 M€
- 10+ years of development
 - 6 World-Class Companies



ACHIEVEMENTS

- 2 Large Scale Demo Units
- Successful operation & tests results
- BioTfuelL[®] concept De-risked & validated
 - Production of FT Liquid from Biomass !



BioTfuelL[®] Project




BioTfuelL



Raw Wood



Torrefied Wood



FT Liquids

Sannazaro, Fischer-Tropsch Pre-Commercial Plant

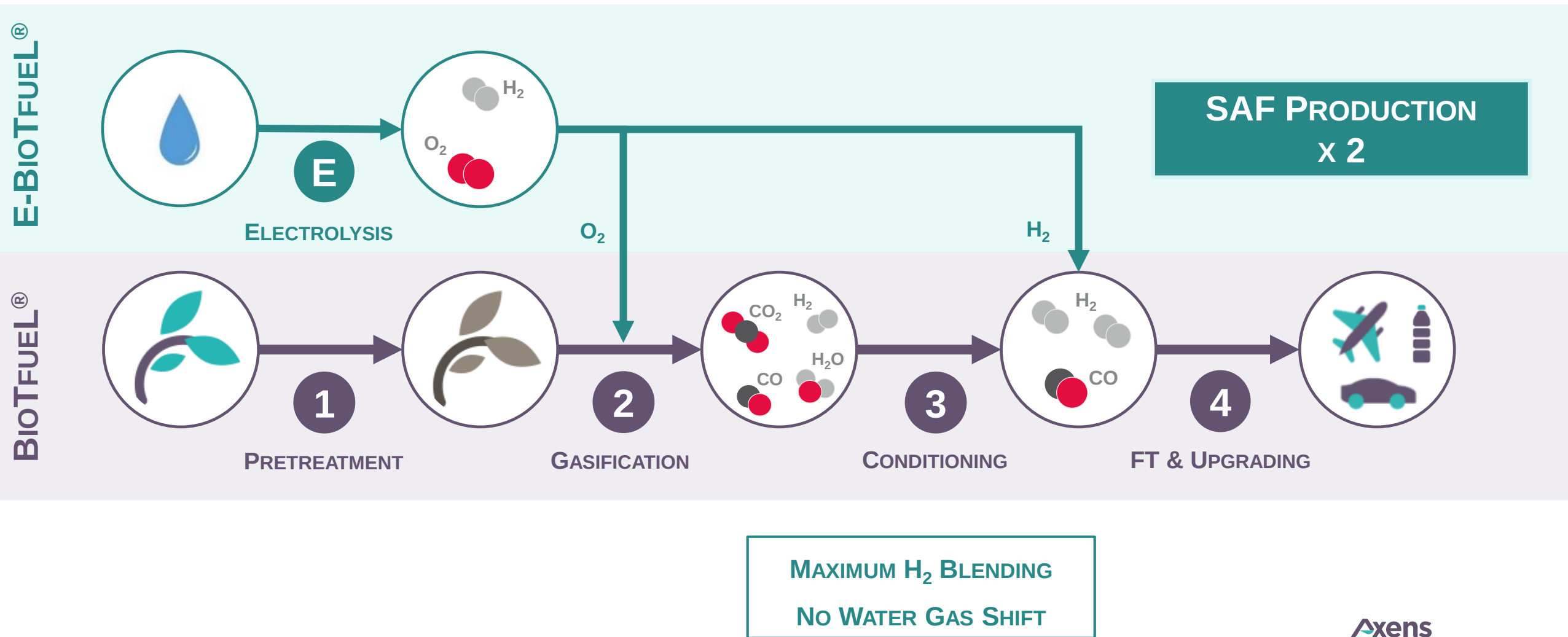


MAIN ITEMS TESTED AND PROVEN:

- DEMO PROCESS SCHEME = INDUSTRIAL PROCESS SCHEME
- FT CATALYST PERFORMANCES TESTED IN REAL SLURRY BUBBLE COLUMN REACTOR
- PRODUCED WAXES TESTED ON UPGRADING CATALYSTS



From BioTfuel[®] to E-BioTfuel[®]



E-BioTfuelL[®], the Best of Two Worlds



BTL

- CAPACITY DRIVEN BY BIOMASS AVAILABILITY
- ASU REQUIRED FOR O₂ SUPPLY
- CO AVAILABLE IN SYNGAS, LACK OF H₂
→ WGS REQUIRED
- ADVANCED BIOFUELS



E-BTL

- LESS CONSTRAINTS ON BIOMASS AND POWER
- O₂ AVAILABLE FROM ELECTROLYSIS
- H₂ AND CO AVAILABLE IN SYNGAS
→ NO WGS, NO R-WGS
- ADVANCED BIOFUELS & E-FUELS



E-FUELS

- CAPACITY DRIVEN BY POWER AVAILABILITY
- O₂ AVAILABLE FROM ELECTROLYSIS
- H₂ AVAILABLE IN SYNGAS, LACK OF CO
→ R-WGS REQUIRED
- E-FUELS

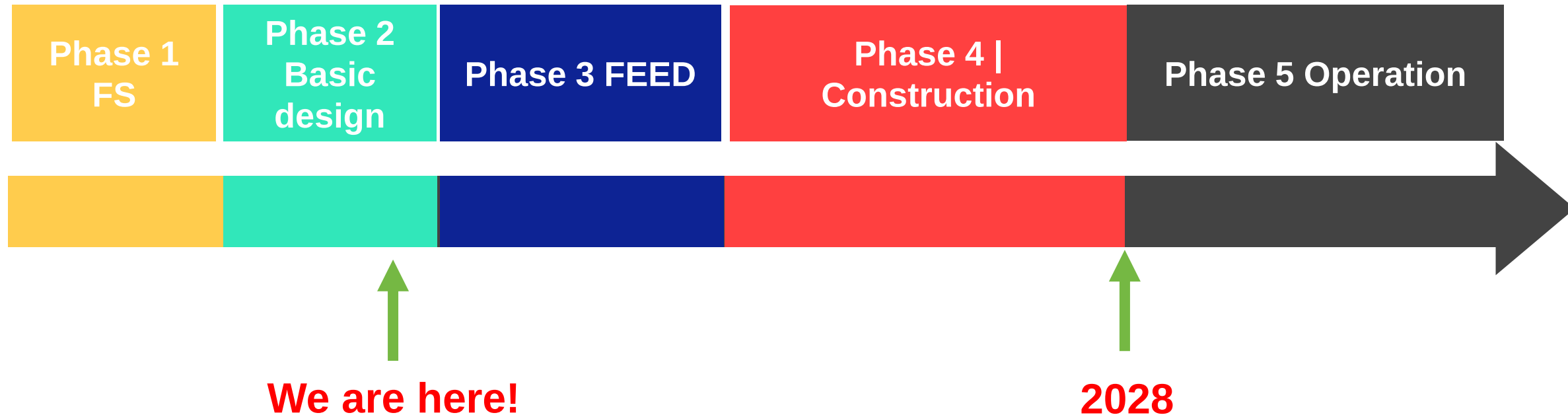
INCREASED PROFITABILITY DUE TO HIGHER SAF PRODUCTION

A First Reference on Track: BioTJet

- FRANCE, PARDIES (NEARBY PAU)
- FORESTRY RESIDUES AND ALTERNATIVE FEEDSTOCKS. LOCAL SOURCING
- 110 KT/YEAR SAF + RENEWABLE NAPHTHA
- E-BioTFUEL[®] CONFIGURATION SELECTED
- START-UP TARGET : 2028



Next steps : Project Timeline



BioTfuel[®] Advantages over Competition

AXENS/UHDE = UNIQUE LICENSOR

SINGLE CONTACT FOR COMPLETE CHAIN



END TO END GUARANTEE

FROM BIOMASS INTAKE TO FINAL FUELS



Axens



thyssenkrupp

FULL PROCESS INTEGRATION

*RELIABLE & FLEXIBLE TECHNOLOGIES
PROCESS EFFICIENCY & INTEGRATION*



MATURE TECHNOLOGY

*BIOTFUEL[®] IS VALIDATED AND BASED UPON
EXISTING COMMERCIAL TECHNOLOGIES*



Axens
Powering integrated solutions



—
axens.net



Thank you

Axens.net
a new digital
journey

Thank you for your attention

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