

A hand is shown in the foreground, holding a small amount of white, irregular plastic granules. The background is a grayscale image of a large landfill or waste site, with mountains visible in the distance under a cloudy sky. The text is overlaid on the left side of the image.

# Advanced Recycling

## Challenges & Opportunities

VKG Environmental Day

# Speaker

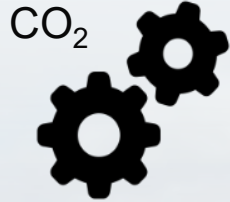


## Romain ROUX Axens Decarbonization & Consulting Vice President

Romain is in charge of Axens Horizon Consultancy since 2022 and has over 20 years of experience in Energy Transition and Decarbonization.

He joined Axens in 1999 and served before his current position as Advisor to Chief Technology Officer leading Business Innovation on **Digital, Plastic Recycling and Hydrogen**

# Hurdles to Advanced Recycling Projects



Technology



Industrial &  
Operational resources



Feedstock



Off-take & Market



Regulations



Financing

# Our today discussion



1 EU Policy and Regulation

2 Feedstock and Off-take

3 Industrialisation

4 Axens – Techno Licensor

5 Pyrolysis & Purification

# EU Policy & Regulation

Driving more demand

Unlock feedstock

25% recycled content for bottles

**2025**  
SUPD

**2025**  
WFD

Solid Municipal Waste recycle obligation  
>55% by weight by 2025  
>65% by weight by 2035

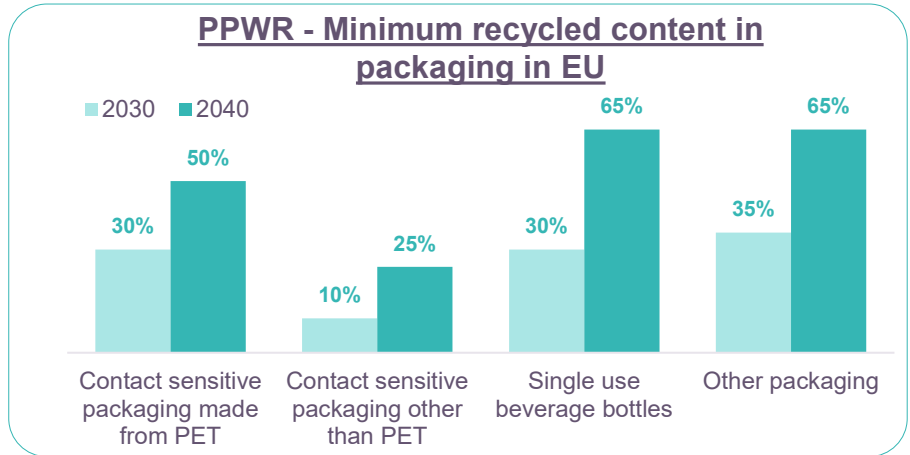
**End 2026**  
Waste export ban  
non OCDE countries

**2028-30**  
ETS  
on landfill and  
WtE

**2030**  
PPWR  
Enforced

**2035**  
LandFill  
Directive  
Reduced to 10%

**2040**  
PPWR  
higher content



# Our today discussion



1 EU Policy and Regulation

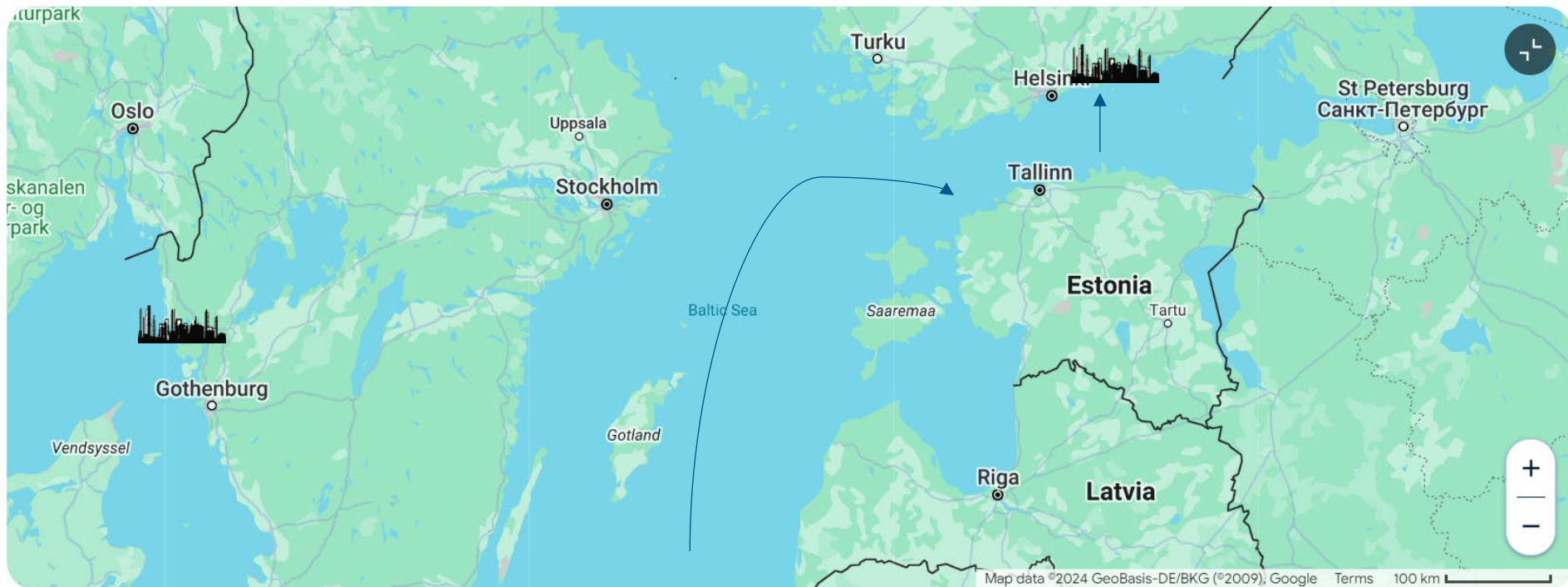
2 Feedstock and Off-take

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# Geographical competitive advantages



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# Plastic pyrolysis oil projects worldwide



**~40**

Plastic pyrolysis Running plants (worldwide)

**11 kta**

average feed capacity



**~60**

Plastic pyrolysis plants in project (worldwide)

**50 kta**

average feed capacity



Total announced capacity

**~4 Mta**

(Pyrolysis projects) by 2028

# Plastic Pyrolysis projects status



~40

Plastic pyrolysis Running plants (worldwide)



~60

Plastic pyrolysis plants in project (worldwide)



Total announced capacity

~4 Mta

(Pyrolysis projects)

# Plastic pyrolysis oil projects capacity vs installed naphtha Steam Cracking capacity



Average feed capacity

1.4 Mta

(Naphtha SC world)



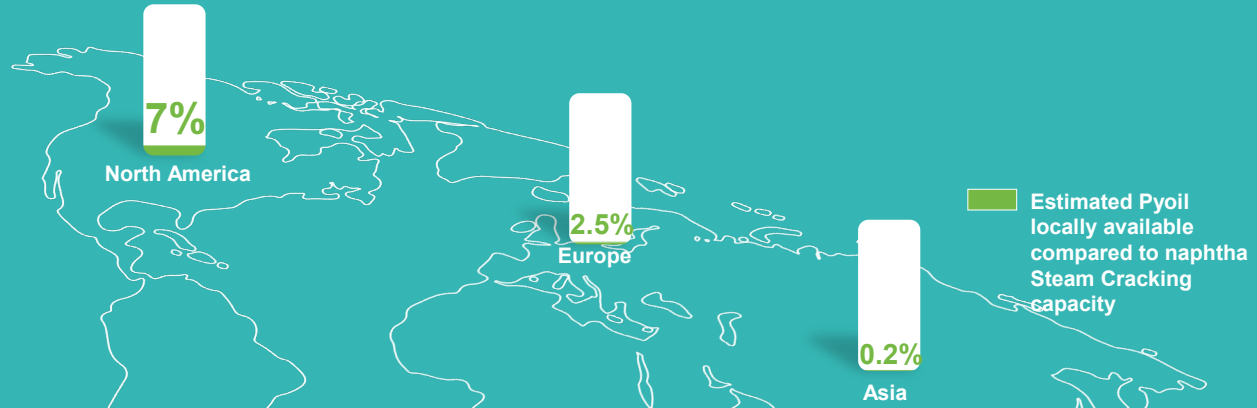
Average prod capacity

40 kta

(Pyrolysis projects)



x35



- Complicated to feed 1 existing Steam Cracking with 100% Pyrolysis Oil
- **Co-Processing with fossil is (at least on short term) necessary : Mass Balance is required**

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# Our DNA: Develop/Derisk/License Technologies to Face the Energy Transition

TRL\*

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9



**Chemical Experiments**



**Process Experiments, Design & modeling**



**Design & Build DEMO plants (Optional) / Industrialization**

Over  **11,000** active patents in IFPEN Group portfolio globally

Over  **100** Technologies in Axens portfolio

Over  **50 years** of experience

 **4,000** IFPEN & Axens researchers, engineers technicians, support services

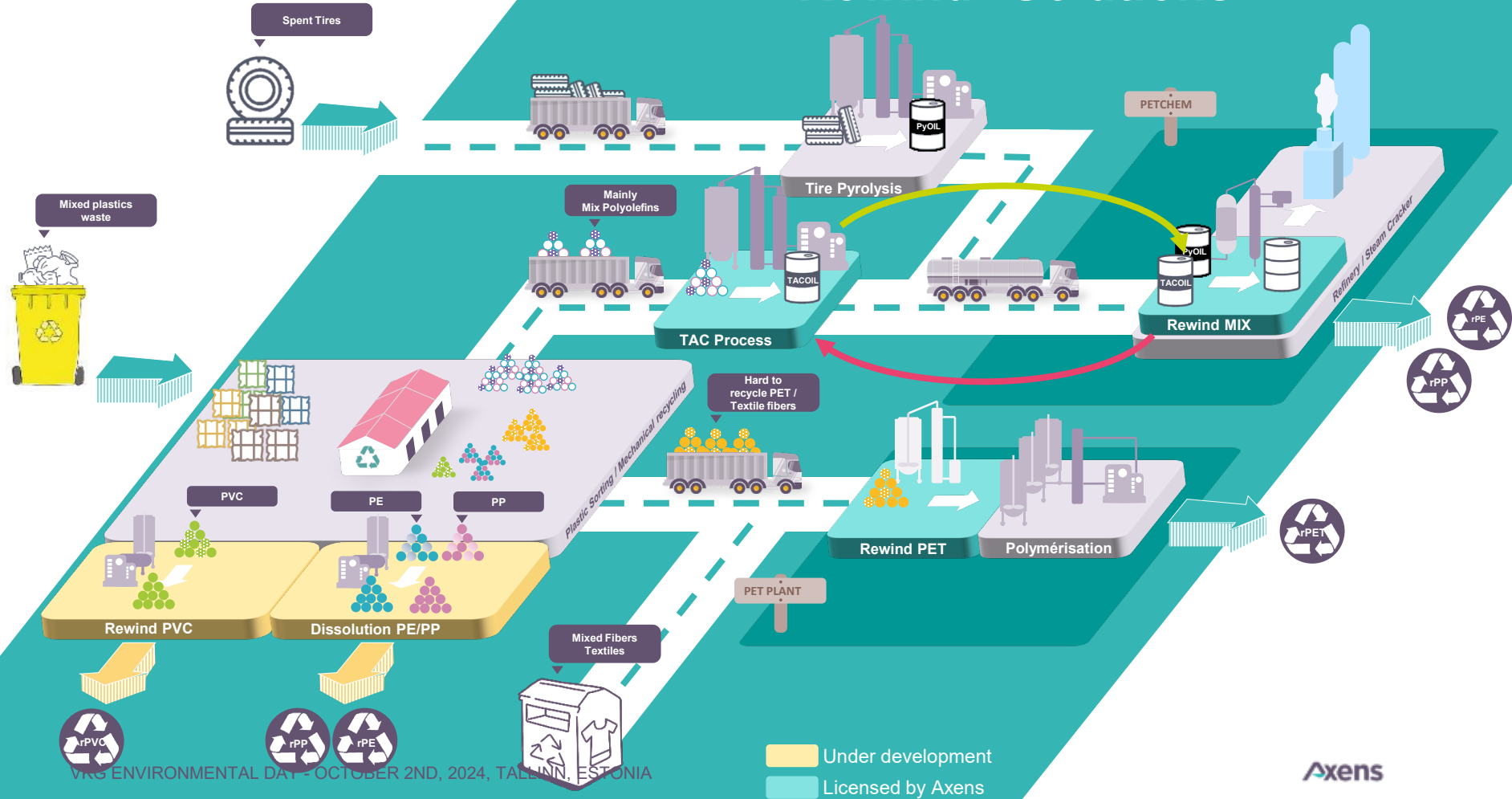
- Clean & Renewable Fuels
- PetChem Building Blocks
- SAF (EtJ, BTL, E-Fuels)
- H2, CCUS, Batteries
- Bio & Circular Plastics



Over  **3,000** industrial units under license



# Rewind® Solutions



# Our today discussion



1 EU Policy and Regulation

2 Feedstock and Off-take

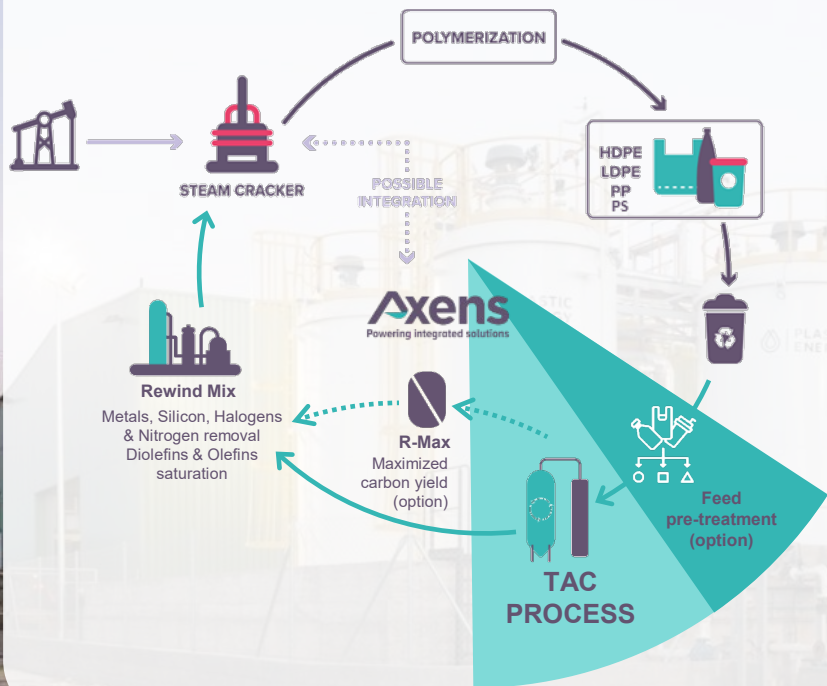
3 Industrialisation

4 Axens – Techno Licensor

5 Pyrolysis & Purification

# TAC Process & Rewind<sup>®</sup> MIX

The optimized **Pyrolysis Pathway**  
from feed to drop-in product



## TAC PROCESS



> 10 years of industrial experience



Innovative solutions patented



Simple and Robust Technology



Strong expertise in feedstock: origins, types, impurities impact...

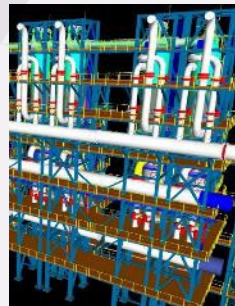


Modular design & supply by Axens



Integration of feed pretreatment working with partners

Fully demonstrated at industrial scale



Reaction section  
Modular Design  
By Axens



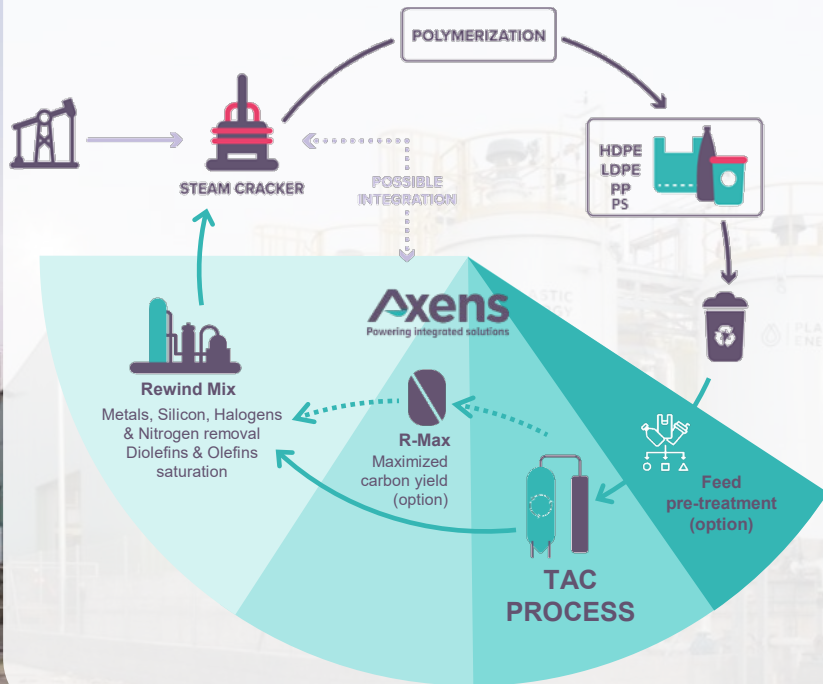
Almeria, Spain  
Capacity of 4 Kta  
(SU 2016)



Sevilla, Spain  
Capacity of 4 Kta  
(SU 2017)

# TAC Process & Rewind<sup>®</sup> MIX

The optimized Pyrolysis Pathway  
from feed to drop-in product



Production of **virgin-like naphtha**

Rely on industrially **proven technologies**

**Maximized yield** (up to 85% wt.) from  
plastic waste to Steam Cracker feed

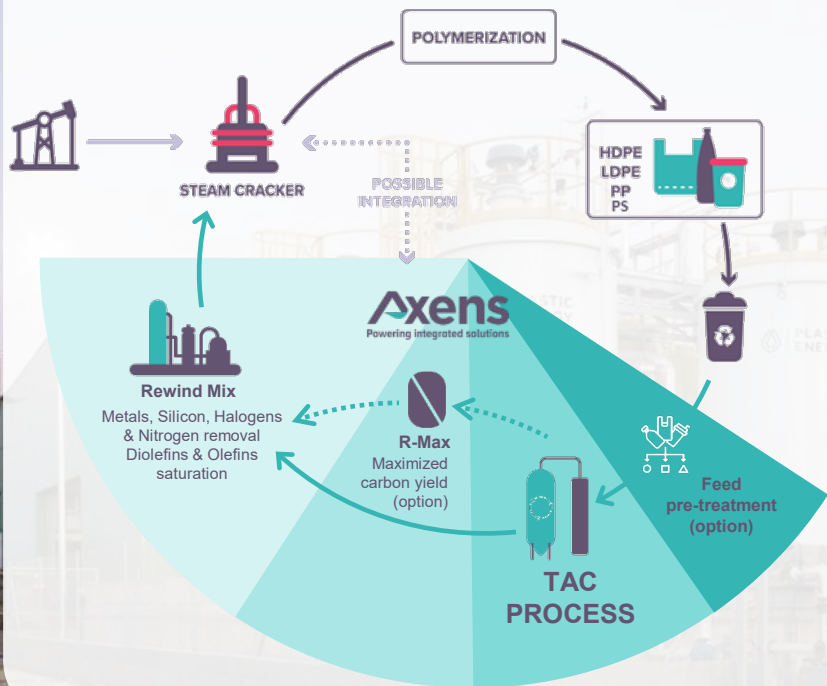
**CO<sub>2</sub> footprint: Circular PE < Virgin PE**  
(cradle-to-gate) without avoided incineration  
~2-3 T of CO<sub>2</sub> avoided by diverting PE  
wastes from incineration to circular PE \*

**one single technology supplier**  
& **set of guarantees** for the full chain



# TAC Process & Rewind<sup>®</sup> MIX

The optimized Pyrolysis Pathway from feed to drop-in product



# Major Companies Have Elected Our Solutions



> 550 kta

announced capacity

by 2025

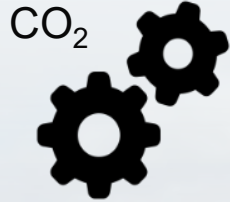


- >10 years technology development
- Industrially proven technology on post consumer mixed plastics with more than 10 years of track record

# Geleen plant



# Hurdles to Advanced Recycling Projects



Technology



Industrial &  
Operational resources



Feedstock



Off-take & Market



Regulations



Financing

**Axens**  
Powering integrated solutions



axens.net



Thank you

Axens.net  
a new digital  
journey