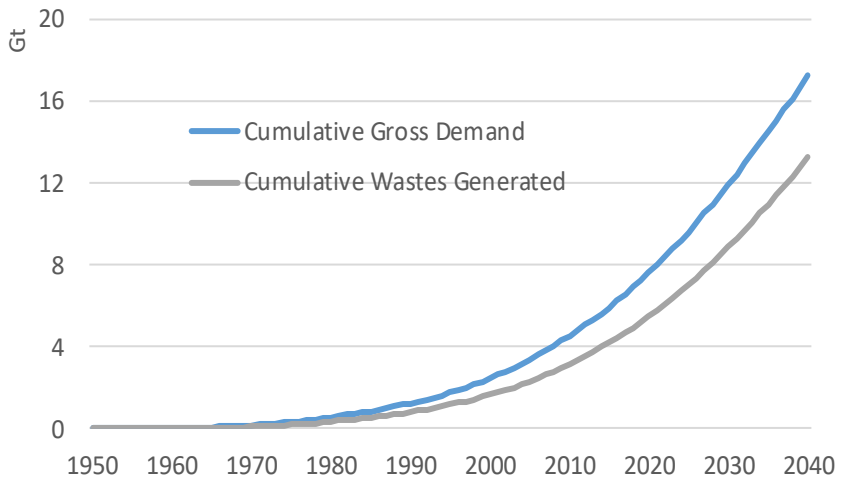
Integrating plastic recycling in petrochemical and refining assets

ERTC 2020, 16-19 November

PLASTIC, What is the main issue?



Only **7%** of plastic waste is recycled.

Plastic delivers outstanding benefits.
However end-of-life mismanagement impairs its acceptability.

Need for sustainable solutions to curb the growth of untreated polymer waste.

OUR AMBITION:
LEADING THE WAY TO PLASTIC RECYCLING

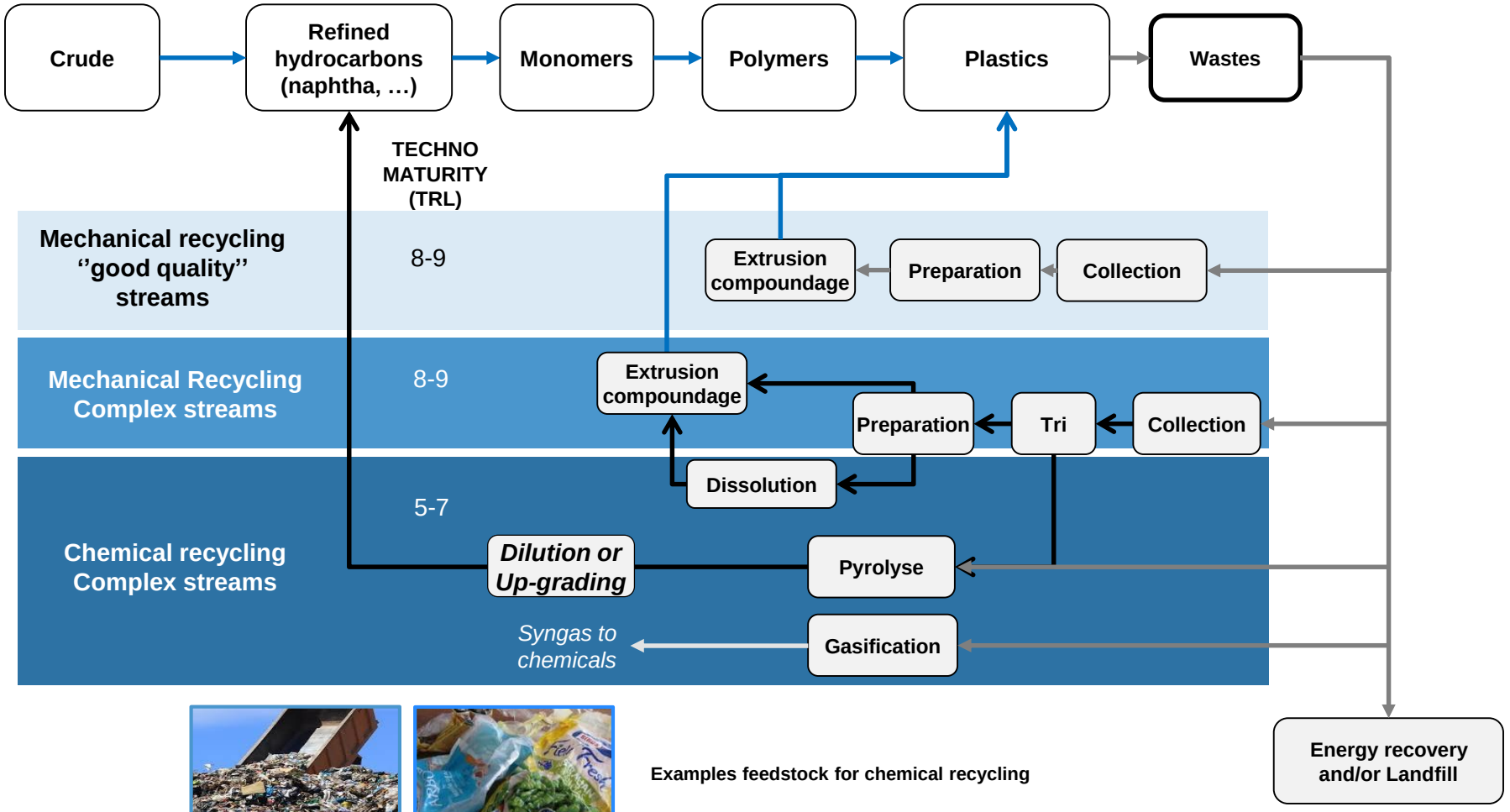
30%

RECYCLED POLYMERS

by 2030

PLASTIC RECYCLING: A DEVELOPMENT PRIORITY FOR TOTAL R&C

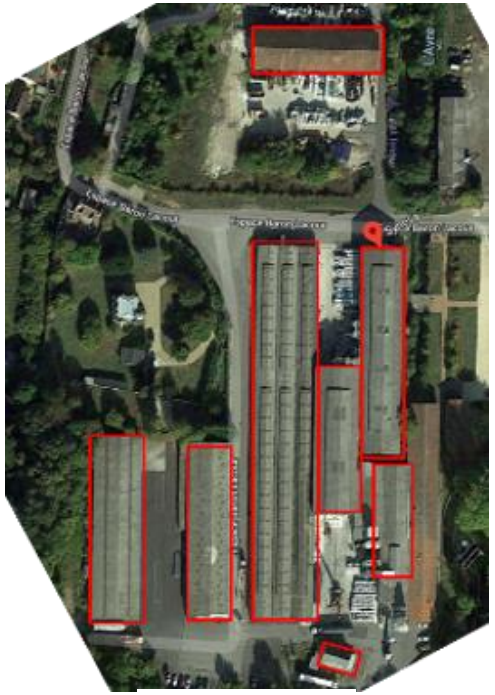
RECYCLING ROUTES

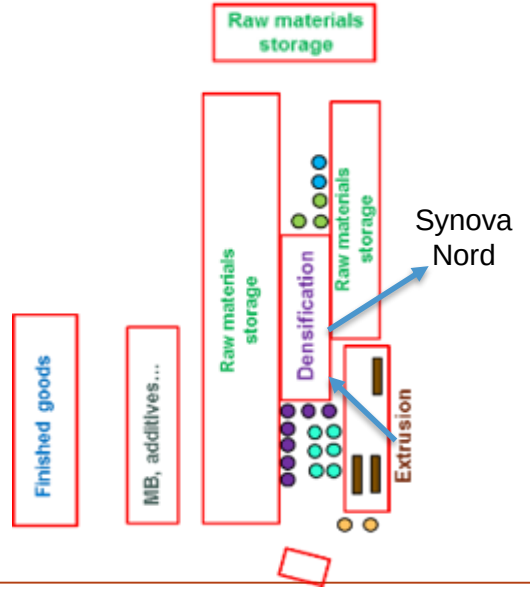


MECHANICAL RECYCLING: SYNOVA

LEADER IN THE PRODUCTION OF HIGH QUALITY RPP, MAINLY FOR THE AUTOMOTIVE SECTOR

- Acquisition by TOTAL in February 2019
- Extension of annual production from 25kT to 45kT by June 2021 for 12M€
- Creation of 15 FTE - jobs





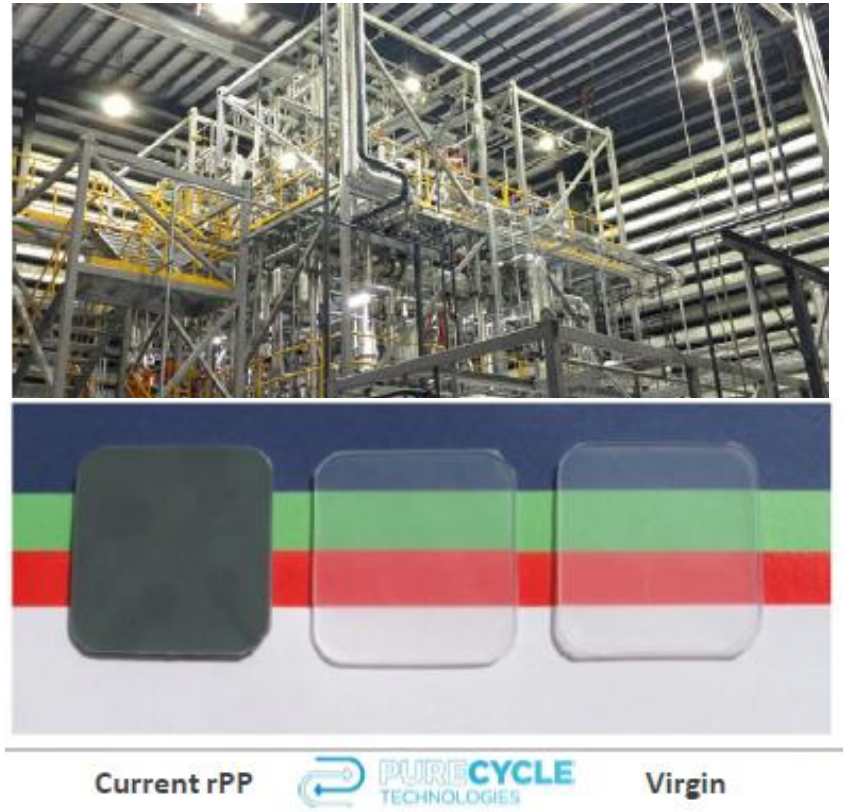
HIGH PURITY RECYCLED PP

TECHNOLOGY

- Efficient decontamination technology (Yield > 90%)
- Favorable dossier to obtain FDA (US Food & Drug Administration)
- 100% physical recycled content
- Market premium for virgin substitution

PROJETCS & PARTNERSHIPS

- 1st industrial project in Ohio ~ 50 kty rPP.
- Strategic partners: Total, P&G, L'Oréal, Nestlé, Milliken , Ravago, ….
- Total:
  - Product performance in depth testing
  - Regular off-take as from 2023
  - Study for a production line in Europe.



Pyrolysis Technologies : Back to Basics

Key components :

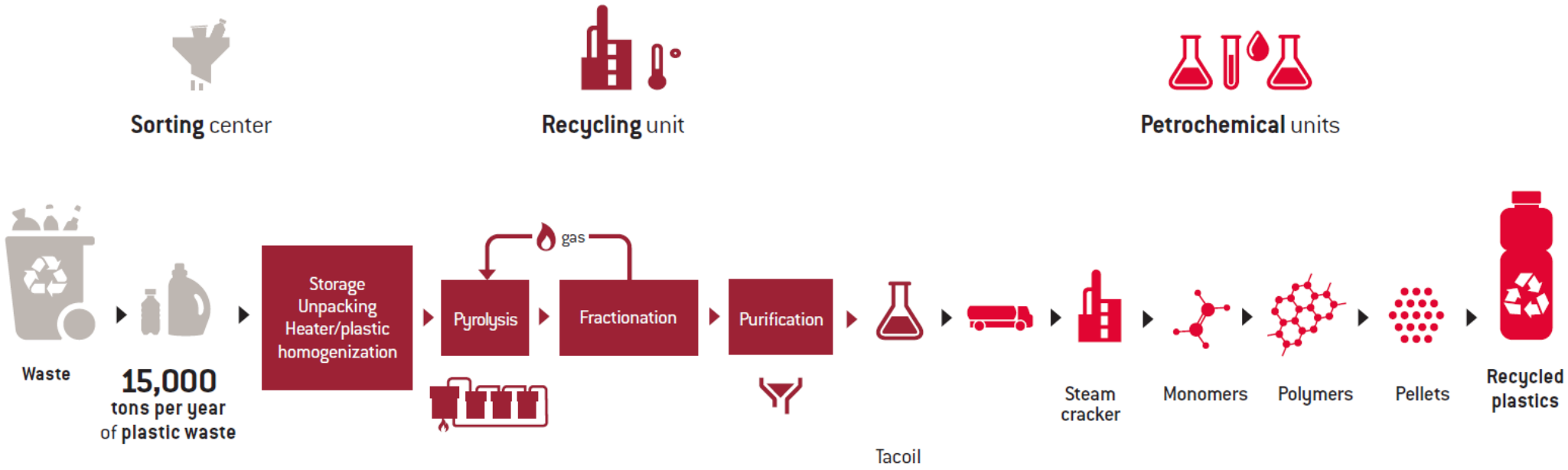
- Thermal cracking using inert atmosphere.
- Batch and continuous processes are available, several chemical engineering design.
- Heating transfer is the key : slow pyrolysis, fast pyrolysis, flash pyrolysis
- Yield & selectivity's could be different as combination of feedstock quality & temperature.
- The use of a catalyst is possible → thermo-catalytic cracking.
- Some processes use hydrogen, or solvent, or water, and some processes operate in vacuum conditions.

A	B	C	D	F	G
- Batch - Semi batch	Continuous - CSTR	Continuous - Fluidized bed or - Circulated bed	Continuous horizontal : - extruder - rotary kiln	Co-processing with water - hydrothermal	Co-processing with Solvent & cracking
- Robust - scale-up	- char blocking - Downtime	- efficient transfert of heat - no char as by product - downtime - Size	- char blocking - complex to operate - low throughput	- high temperature & pressure - cost of water treatment	- cost of solvent recovery

MAIN TAKE AWAYS :

- Assess the technology through factual methodology : Performance / Risks / Maturity
- Low maturity – only one techno at TRL 7 - Pyrolysis technology is based on know-how of operation.
- Feedstock preparation is key, on learning curve.

CHEMICAL RECYCLING PLANT AT GRANDPUITS REFINERY



Feedstock

Total will be constructing France's first chemical recycling plant with Plastic Energy (Total 60%, Plastic Energy 40%). The new unit will help Total meet its objective of producing 30% of its polymers from recycled materials by 2030

→ On waste streams unsuitable for mechanical recycling
→ To produce food contact polymer quality by closing the plastic loop

Plastic markets

CONVERT PYROLYSIS OIL AT ANTWERP

PLASTIC ENERGY

OBJECTIF

- Partial substitution of naphtha by pyrolysis oil to produce certified polymer

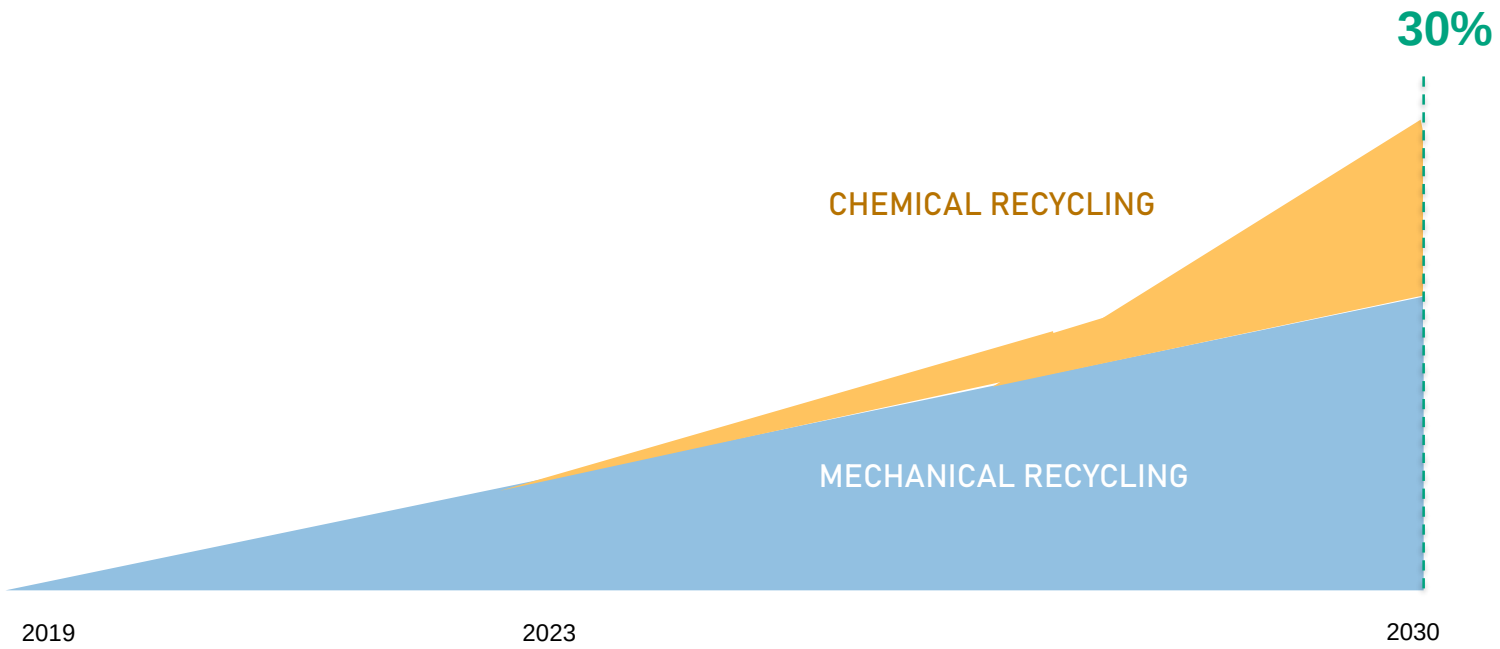
PARTENAIRES

- Plastic Energy, Customers & Brand Owners

Project: PISSARRO

- Inject pyrolysis oil in steam cracker by trucks coming from PE plants.
- Convert TACOIL over the next 6 months.
- Commercialized certified polymers.
- Secure access to large quantity of pyrolysis oil

TOTAL'S ROADMAP & PORTFOLIO OF DEVELOPMENTS



Acquisition of Synova & doubling capacities

Sourcing & recyclates compounding

Total Circular compounds®

50%+ recycled content with similar performances as virgin resins to meet customer demand

Partnership for recycled PP

Collaborate with partners to assess the interest of developing a new plant together in Europe.

Develop & Invest in chemical recycling

Collaborate with partners to experiment at various scale conversion technologies

Alliance To End Plastic Waste

Develop, accelerate and deploy solutions, catalyze public and private investment; and engage communities to help end plastic waste in the environment

THANK YOU