IEA Bioenergy
Technology Collaboration Programme

Task 33 Country report The Netherlands

June 2021

Berend

Online via Teams

Opportunities for gasification

- The Netherlands is steering away from use of biomass for heat and power, but has identified it as crucial for the production of fuels and chemicals
- Horizon Europe has a clear theme on biofuels and biochemicals
- Circularity will depend heavily on gasification based technologies
- Hydrogen is being pushed a lot, provides opportunitees for gasification as well

Gasification locations in the Netherlands

TNO, Petten
R&D center on gasification

Mavitec, Heerhugowaard
Technology provider

ESKA, Hoogezand
Active CFB Gasifier

Torrgas, Groningen
Technology provider
EF gasifier demo site

SCW, Alkmaar
Technology provider
Super critical gasifier demosite

BEN, Amsterdam
Active Fixed Bed Gasifier

G.I. Dynamics, Amsterdam
Waste to Chemicals project

Enerkem, Rotterdam
Waste to Methanol project

Synova, Maassluis
Technology provider

Stercore, Emmen
Manure gasification project

Amer, Geertruidenberg
Idle CFB Gasifier

Brightsite, Geleen
Gasification platform
Biomass to hydrogen (Torrgas)
Waste to chemicals (RWE)

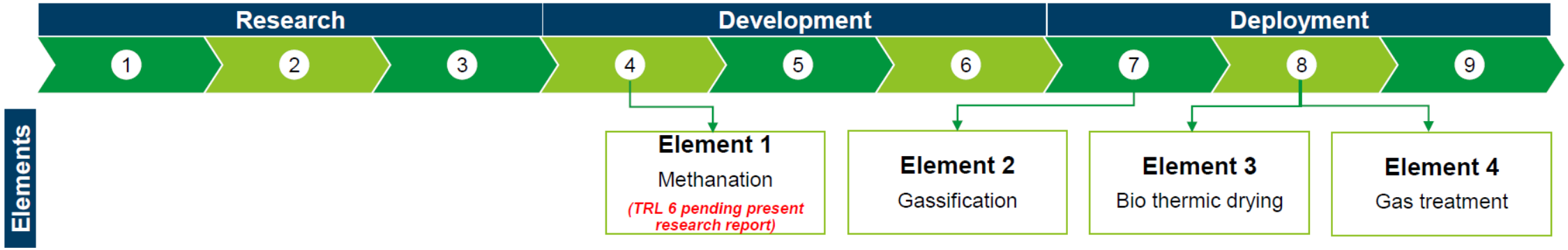
Stercore

- Economic Due Dilligence finished (KplusV)
- Technical Due Dilligence finished (DNV)
- Technical detailed design and building design finished together with Emmtec Engineering as EPC
- Off take agreement for the Bio-LNG with a UK/NL oil major agreed upon as a fuel guarantee not depending on the SDE++ scheme
- Court-ruling expected to be finalized in September

Stercore

Technical Due Diligence

Technology Readiness Level (TRL) STERCORE



Description

- STERCORE's production process consists of several individual elements which can operate independent of each other and have a TRL of 7+
- Only a single element of the methanation process has a relatively lower TRL. This element has been well-tested but is not yet operating on industrial scale resulting in the lower TRL level
- STERCORE works together with well known suppliers with a good track record to get maximum support
- STERCORE is a system integrator who combines proven technology with an innovative twist to get maximum results
- The management of STERCORE is highly experienced in the field of expertise its active in

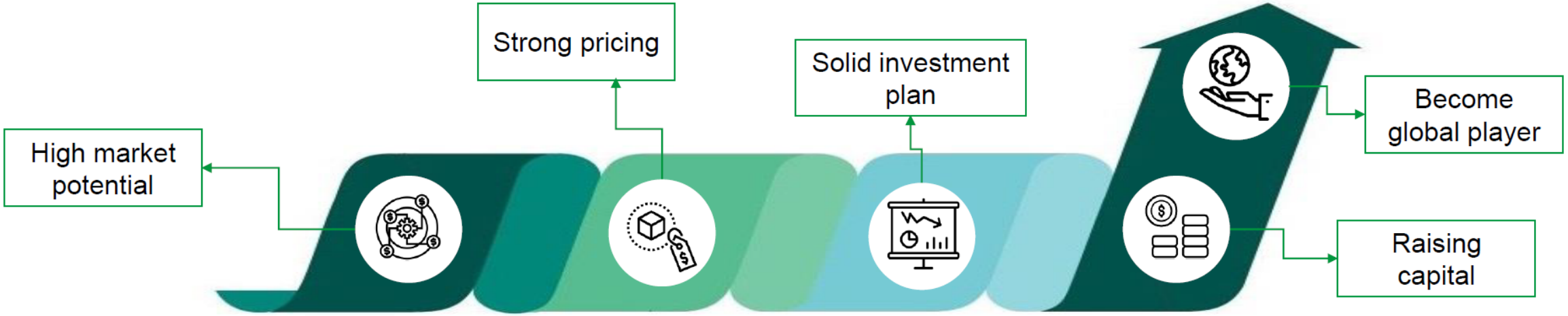
Results Technical Due Dilligence DNVGL

- Elements have a high technology readiness level, however that will not guarantee success for using the elements as a whole, the combined technique is new
- Full TDD report is available upon request
- Opportunities and threats are listed in the following slides, as well as their implications and proposed actions.

No	Low	Medium	High
No material risk identified and no action required	Risk identified that has been mitigated or where the risk level is low	Identified risk to be mitigated, risk can be material	Potentially big impact, mitigation is required

Stercore

Economic Due Diligence



Description

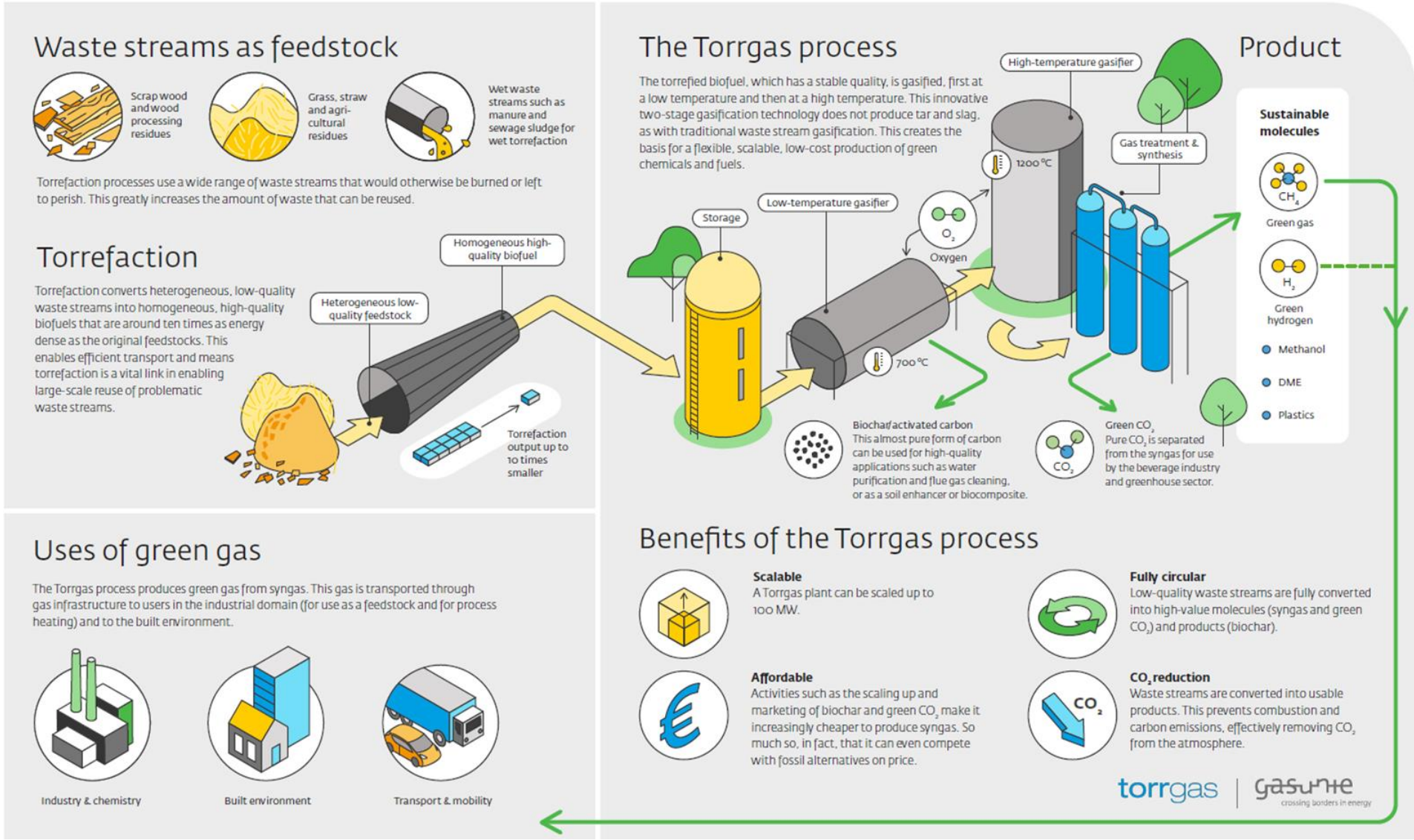
- Business economic analysis displays the financial forecast and describes the investment needs. All of STERCORE's financial assumptions are evaluated in this part.
- Commercial analysis: evaluates the way in which STERCORE puts the product on the market and the choices that STERCORE makes concerning product, pricing, promotion and location of the company. In addition, it describes the industry, the competition and the target group.

Results Economic Due Diligence KplusV

- STERCORE can acquire a position in the market and meet its budget, however given the innovative nature of the project, the aimed equity/loan capital ratio is unbalanced.
- EDD report is available upon request
- The components of the analysis are criticized using the following method:

	Red light	Great risk - not or difficult to mitigate
	Orange light	Medium risk - can be mitigated
	Green light	Limited risk - no mitigating measures necessary

Torrgas - the process

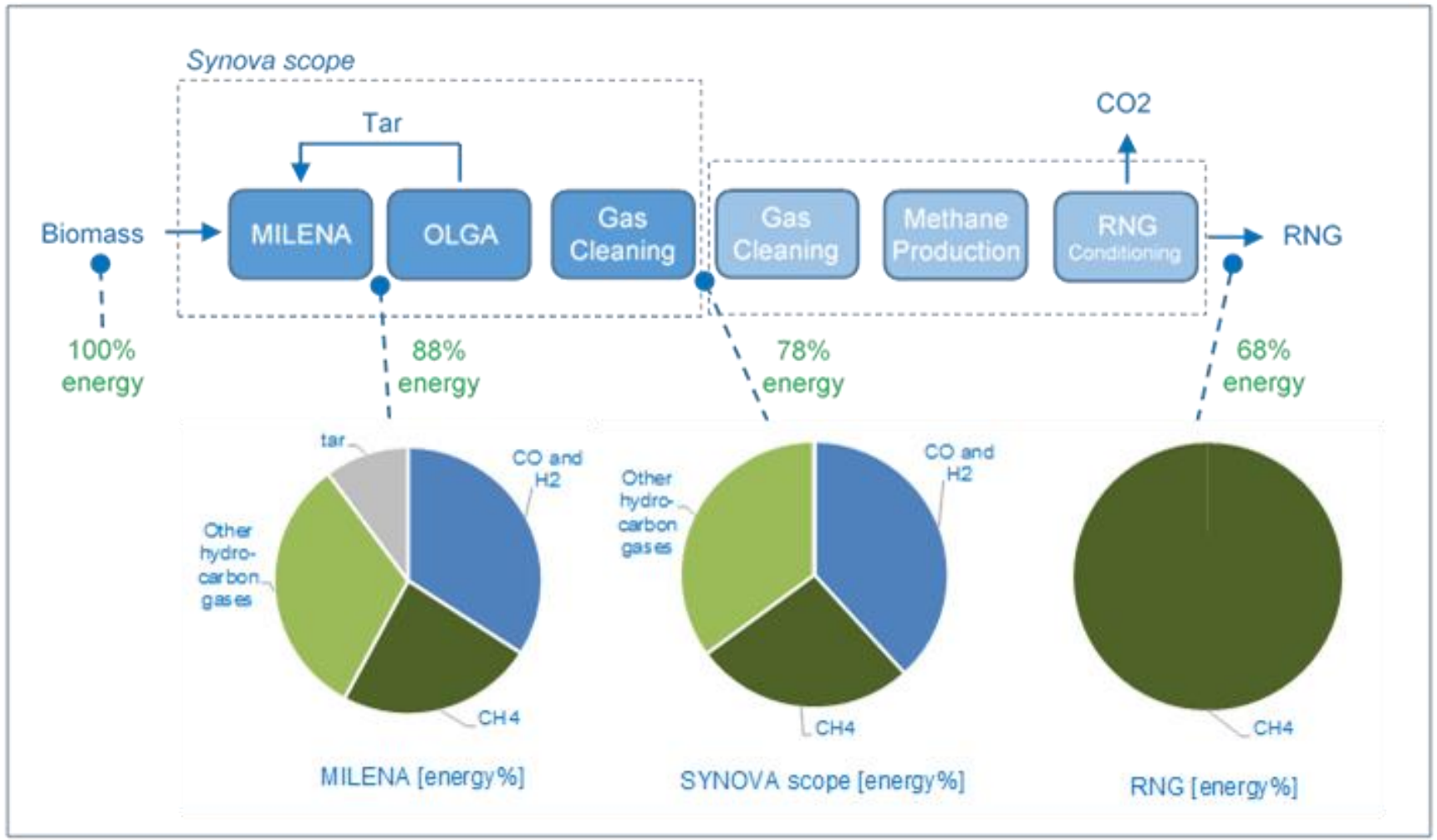


Torrgas projects

- 30 MW_{SNG} nearing financial close
- 50 MW_{H2} currently working on the funding
- Currently started 3 global MeOH project.

My observation: In the Netherlands it is very difficult to get projects realized, where abroad people see the need and are much more cooperative

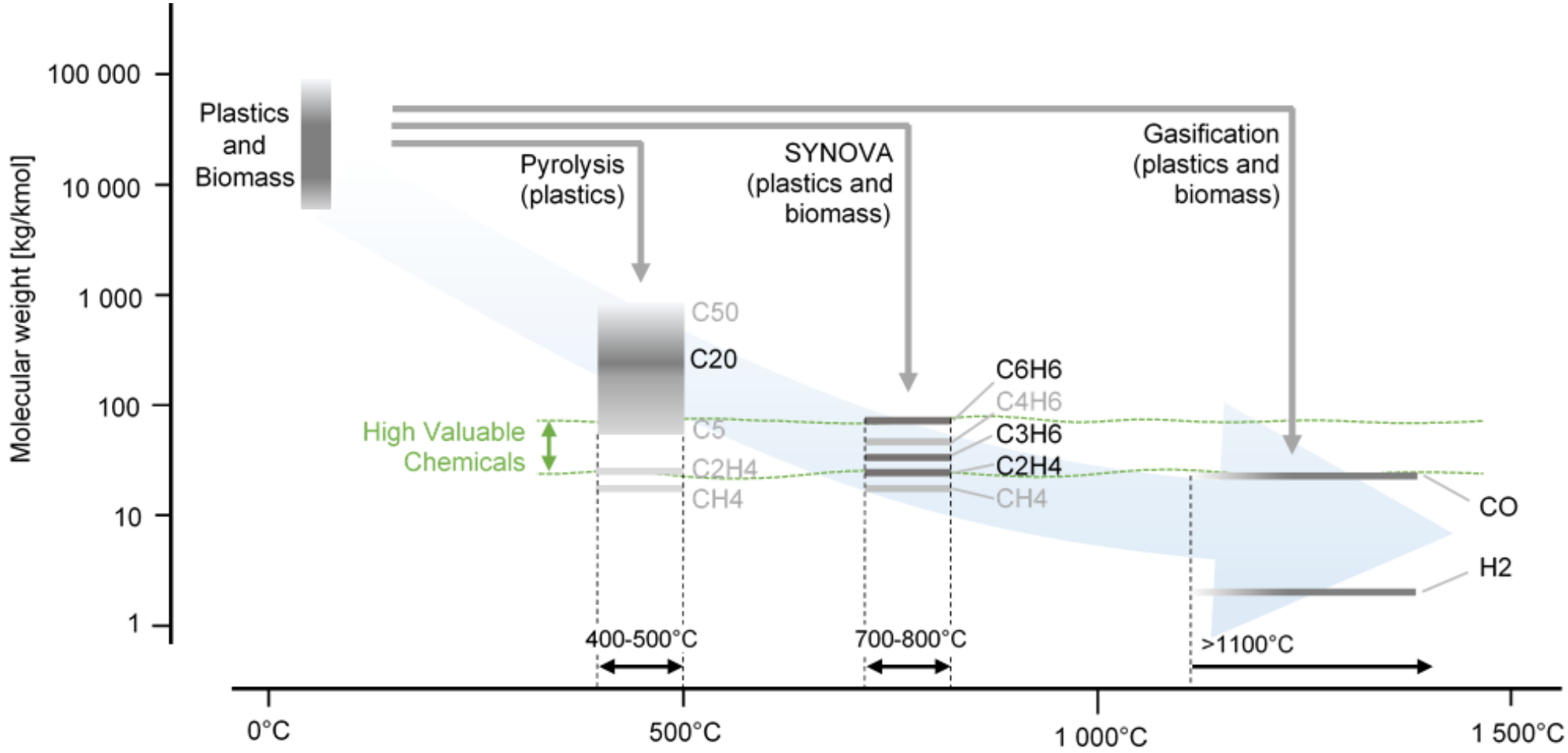
Synova scope



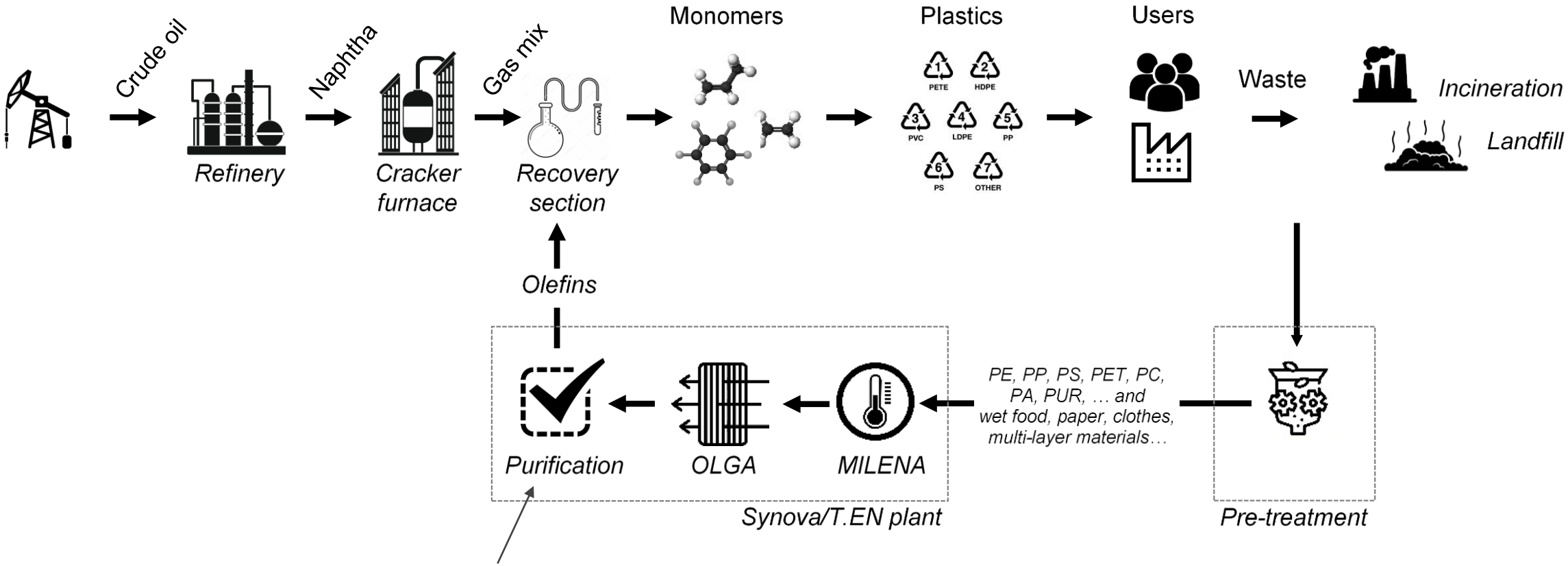
Opportunities

1. Plastic cracking and connecting to industry
2. Biomass gasification towards SNG
3. Waste to electricity

SYNOVA's SOLUTION
MEDIUM TEMPERATURE = DIRECT CHEMICALS



SYNOVA/T.EN's SOLUTION REPLACING THE CRACKER FURNACE



SYNOVA joins forces with Technip Energies (T.EN)
https://synovatech.com/?s=technip.html

BIOGENIC MATERIAL

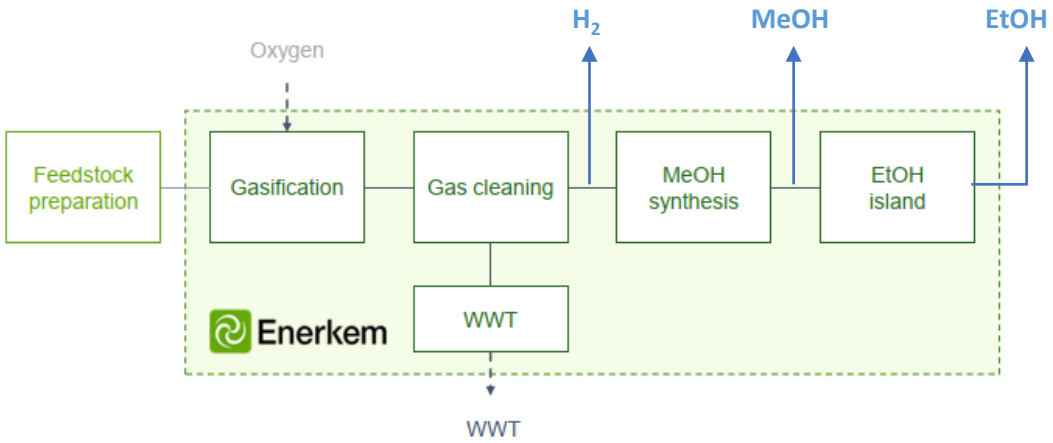
- No need to remove inseparable biogenic materials from waste plastic
- It offers important and unique benefits
  - Increases the output of high-value molecules
  - Improves the CO_2 reduction
  - Makes bio-plastics
  - Avoids expensive upstream separation
  - Keeps the losses low and circularity high
  - Keeps the feedstock cheap and highly available

This is not what it looks like!
40% of carbon is biogenic (C-14 dating)

ENERKEM

Technology Status:

- TRL9, commercial roll out
- > 25,000 hours of operation
- Feedstocks:
  - Pure plastics
  - RDF
  - Biomass
  - Construction & Demolition (C&D)
  - Industrial, Commercial, and Institutional (ICI)
  - Agricultural and forestry residues
- Commercial plant in Edmonton, Canada
  - 90 MWth producing IMPCA methanol and ASTM Ethanol
- Best of class carbon intensity
  - **Lowest carbon intensity on BC LCFS regime**
- Commercial syngas, hydrogen, methanol, and ethanol platforms



Rotterdam, Netherlands: project undergoing a review

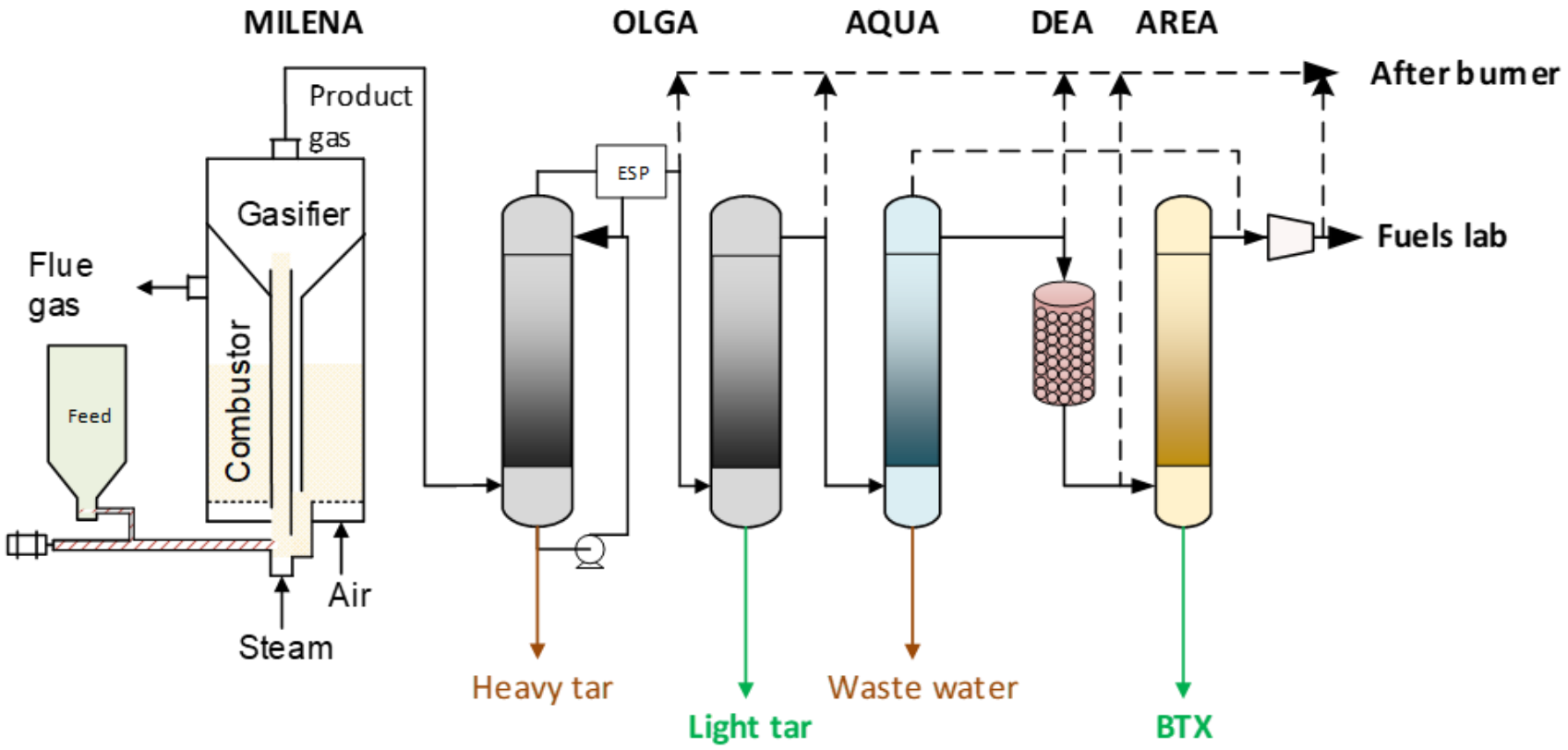
- 400,000 tons of non-recyclable municipal solid waste
- Original project was a 220,000 tons of methanol per year
- Project under-review to determine feasibility of drop-in fuels production; i.e. coupling syngas to drop-in fuels technology package

Other Project Status:

- **Varennes Montreal, Canada: project in construction**
  - Partners: Shell, Suncor, Proman
  - 200,000 tonnes per year of non-recyclable residual waste and wood waste
  - annual production of nearly 125 million litres of low carbon fuels
  - https://www.shell.com/energy-and-innovation/new-energies/new-energies-media-releases/shell-invests-in-quebecs-first-waste-to-low-carbon-fuels-plant.html
- **Tarragona Spain : project in engineering design**
  - Partners: Repsol, Suez
  - 400,000 tons of non-recyclable municipal solid waste from its surrounding regions
  - 220,000 tons of methanol, contributing to avoid 200,000 tons of CO2 and reducing the waste that ends up in the landfill
  - https://www.bioplasticsmagazine.com/en/news/meldungen/20210430-Repsol-to-join-Enerkem-and-Agbar-on-waste-to-chemicals-plant-project-in-Tarragona.php

TNO lab infrastructure update / nearing completion

- Possibility to recover light tar components as products, roughly 200 gram/h (mostly naphthalene)
- Water scrubbing system, capable of dosing acid/caustic for additional impurities capturing
- DEA: conversion of olefins to aromatics to boost the yield of the BTX scrubber
- AREA: capturing 150 – 300 gram/h of BTX

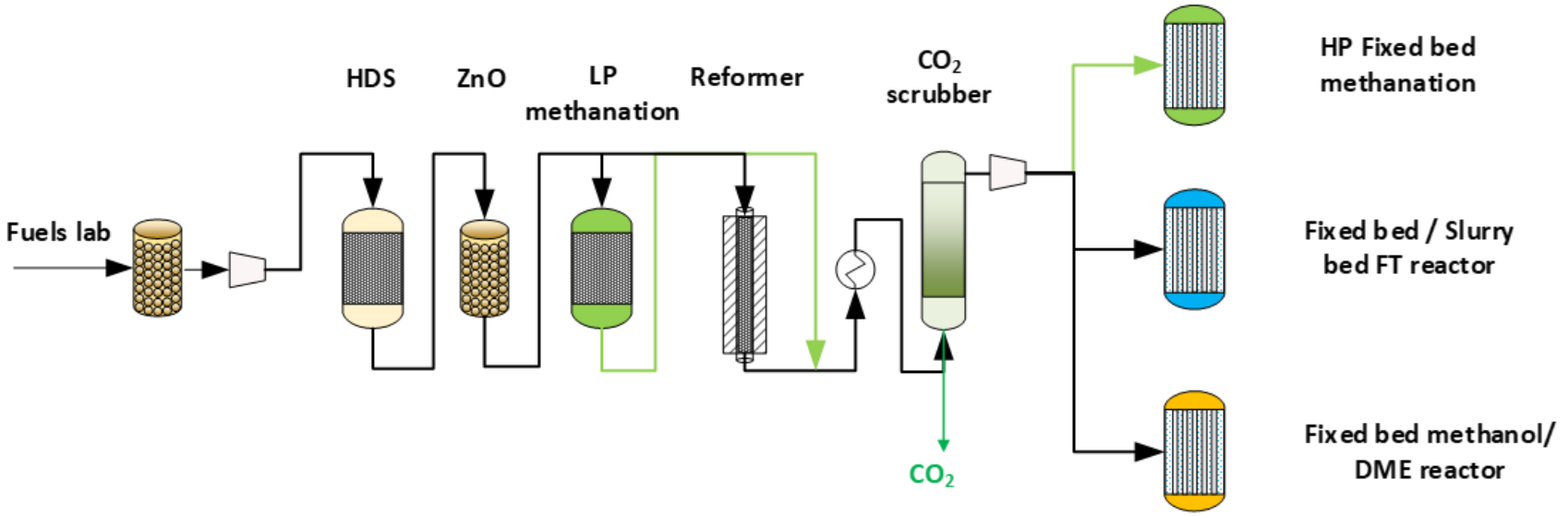


Some pictures

MILENA → OLGA Collector → OLGA Absorber/Stripper → AQUA → Dilute Ethylene Aromatization→ BTX removal

Slip stream possibilities

- Steam reformer to produce syngas
- Amine based CO_2 scrubber to fine tune the syngas composition
- Gas booster from 5 – 100 bar
- Fixed bed reactor setup
  1. Methanation
  2. Fischer Tropsch
  3. Methanol
  4. DME
- Slurry bed reactor setup for FT
- Wax upgrading and Catalyst screening unit



Some more pictures




HDS → Prereformer → Methanation → Reformer → CO_2 scrubber→ Compressor→ 3 HP catalytic reactors




Support tools: Analytical distillation unit / Large distillation unit / Wax upgrading / Catalyst screening

No update

- G.I. Dynamics (update coming soon)
- HoSt
- SCW
- BEN
- Mavitec
- ESKA

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