



PROFU - AVFALL I FOKUS

**Industriell pyrolysmetod för att göra ny
plast av blandat plastavfall**

Presentasjon - 14 Mars 2023
Geir Langeland – CEO

EMPOWERING THE CIRCULAR ECONOMY



SVT – NEWS: LARGE EMISSIONS OF GREENHOUSE GASES (IN SWEDISH)

svt NYHETER



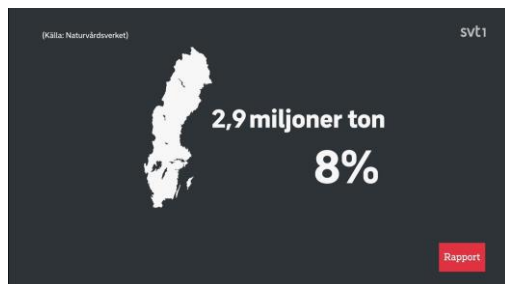
"90 percent of the plastic thrown away in Sweden is never recycled, instead it is incinerated. Something that leads to large emissions of greenhouse gases"

SVT News – 08.01.2023



"The plastic we collect must be circulated on a better set "

Jon Nilsson-Djerf
Material recycling advisor Avfall Sverige



- *"Large emissions of greenhouse gases that we have said must be reduced to zero"*
- *"A total of 2.9 million tonnes, which corresponds to 8% of Sweden's total carbon dioxide emissions"*
- *"We consume huge volumes of a raw material that is pumped up from the earth, something that is not sustainable"*

Åsa Stemmark
Material flow expert The Swedish Environmental Protection Agency

The Swedish Plastic Market

Total amounts of plastic:

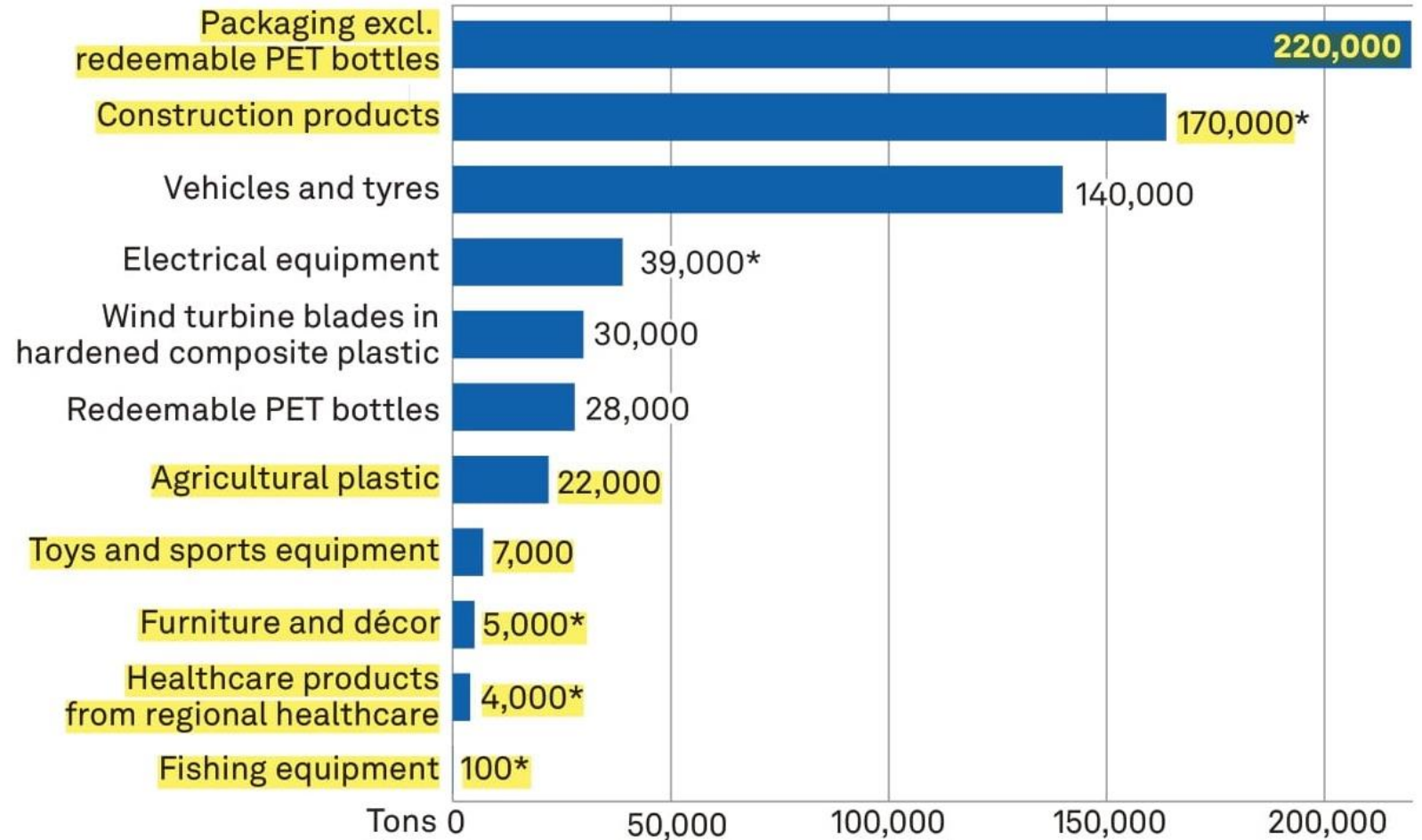
665 100 Tonnes

Waste plastic tested by Polyfuels
(highlighted)

= Potentials for chemical recycling:

- **428 100 Tonnes**
- **64 % of total market**

Plastic that entered the market in 2019 (tons)



*Minimum amounts that entered the market

TAKING THE CHALLENGE > POLYFUELS SOLUTION

Polyfuels have industrialized, and quality assured - proof of concept - method for making pyrolysis oil from mixed fractions of plastic waste in the production of new plastic:

- Billingsfors plant(Bengtsfors) – chemical recycling of plastic waste. From 2 to 24 tonnes per day from 2023 – 2026
- Feedstock and customers for pyrolysis oil secured through agreements with Borealis.
- All feedstock is first tested and analyzed with approved labs, following Borealis criteria for circular economy.
- The pyrolysis oil is then created in a thermochemical sealed process.
- The reactors are set up with a flexible modular system and can process different feedstocks simultaneously.
- The pyrolysis oil is further processed in a cracking process by our partner Borealis.

“With a well documented Proof of Concept, Polyfuels main target is to be in forefront - becoming one of the Nordic marketleaders in chemical recycling of plastic waste”

LONG TERM AGREEMENT WITH ONE OF THE LARGEST PRODUCER OF POLYOLEFINS GLOBALLY

Signed MOU between Polyfuels Group and Borealis, to establish chemical recycling plants at specific locations in Sweden and Norway.

A common new cooperative approach and business model:

- Cooperation on 2 tonnes Demo-Plant in Billingsfors . scalable to 24 tonnes per day.
- Gaining vital knowledge in the development of new standards of chemical recycling of plastic waste.
- REACH and ISCC+ certification process with Borealis advisory support.



“Polyfuels Group is a key partner for Borealis as we have common ambitions to increase material recycling of plastics through innovative technologies and processes”

Quote; Director of Excellence, Anders Froberg - Borealis, Stenungsund.

2022-06-02

Green Ideas Group AB - Polyfuels™
C/O Abelco Investment Group AB
Nybrogatan 6
114 34 Stockholm

Letter of support for investment in Green Ideas Group AB - Polyfuels™ first chemical recycling plant for plastic waste in Billingsfors, Bengtsfors Municipality.

With this letter, Borealis expresses its support for Polyfuels™'s investment for a pyrolysis plant in Billingsfors. Borealis intends to negotiate a purchase agreement for the volume produced at the demo plant, as long as it meets Borealis' pyrolysis oil specification.

Planned start of production for the demo plant in April 2023. Over a two-year period until 2025, the estimated production of pyrolysis oil is up to 990 tons.

Borealis is Europe's second largest polyolefin producer. We are constantly working to find new solutions to maximize the climate benefits of our products. Borealis in Stenungsund also plans to build a chemical recycling plant partly financed by "Industriklivet" (Swedish Energy Agency), 51956-1, with planned start-up in 2025. Borealis then wants to use the pyrolysis oil from Polyfuels™ to produce high-quality polyolefins that meet the same quality requirements as are imposed on existing products.

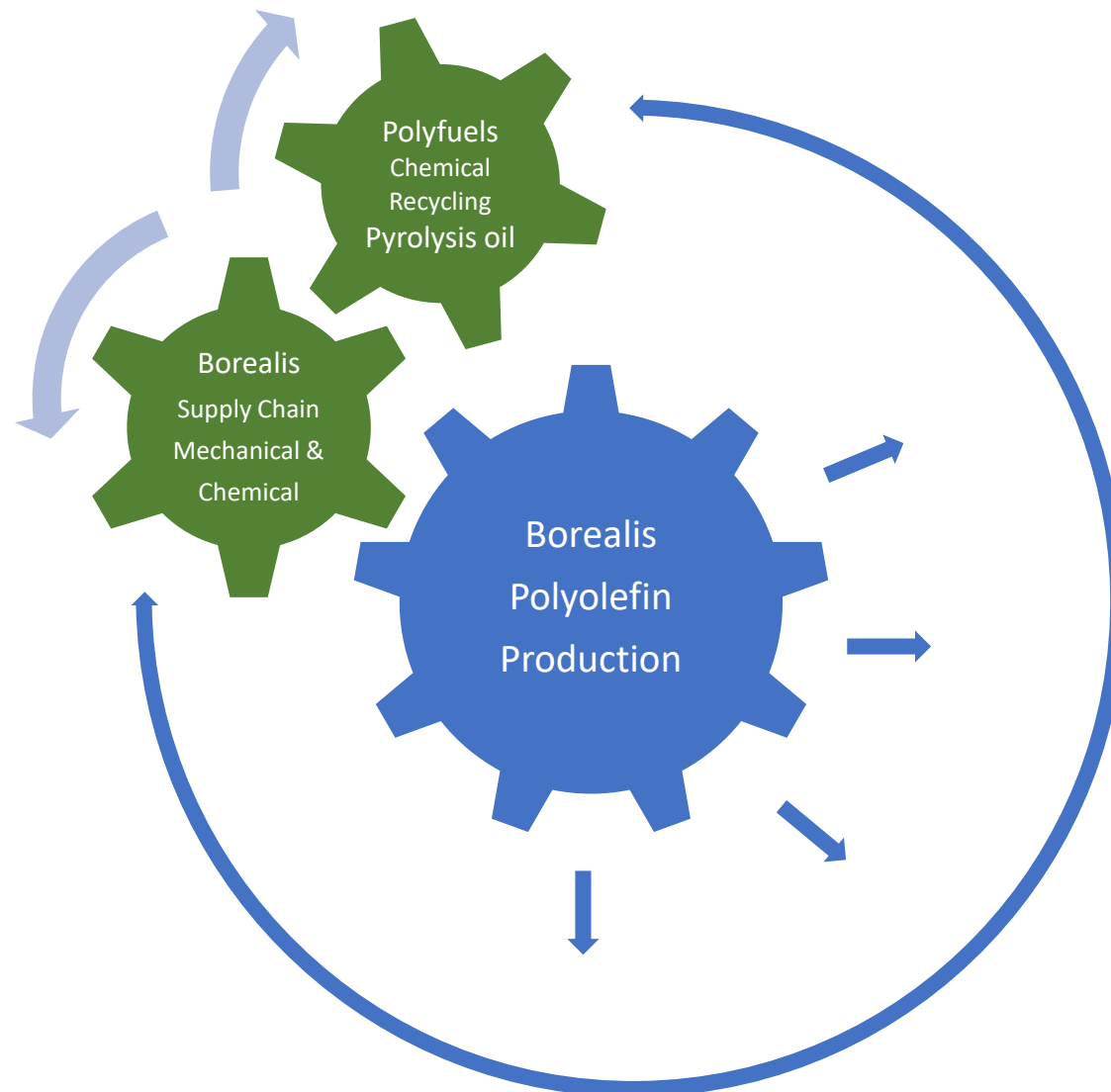
Borealis sees Polyfuels™ as a key partner as we have a common ambition to increase the recycling of plastics through innovative technologies and processes.

It is important for Borealis that the Polyfuels™ demo plant is realized.

We also see an opportunity to receive up to 5,940 tonnes of pyrolysis oil per year from Polyfuels™, in the event of a future scale-up of the process at Polyfuels™ Billingsfors.

Yours sincerely,

Anders Fröberg
VD Borealis Sverige AB



THE BOREALIS & POLYFUELS GROUP PARTNERSHIP: A COMMON PROTOCOL OF ANALYSIS – STANDARDISING PYROLYSIS OIL QUALITIES

STEP 1

- Destillation Curve
- PIONA

STEP 2

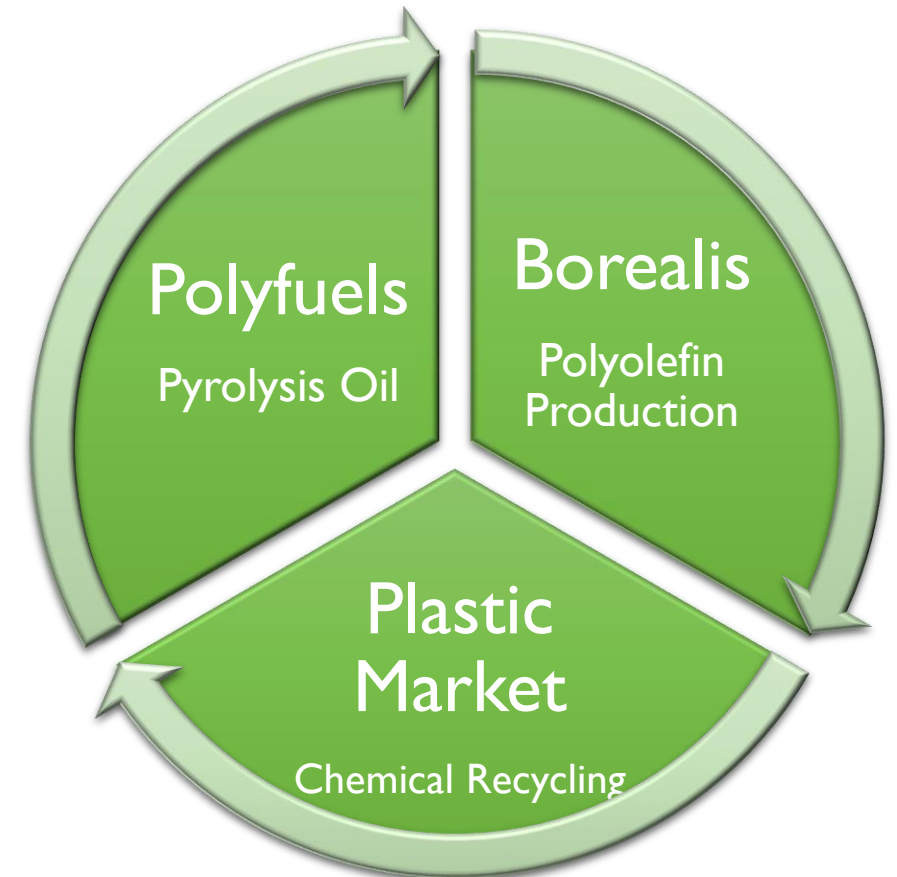
- Total Sulfur
- Total Oxygen
 - Total Nitrogen
 - Halogens

STEP 3

- Si P
- Total metals and Hg, Zn, Pb, As

Pyrolysis oil qualities

I. Direct Cracker	Pyoil can be fed directly into the Borealis cracker.
I. Blending Quality	Pyoil will have to be blended with crude oil to reach necessary quality.
I. Hydrotreatment	Pyoil will be processed in the hydrotreatment platform for removing impurities.
I. External Refinery	Pyoil will be processed at external refinery, to reach expected cracker quality.



PLASTIC TESTING ON INDUSTRIAL SCALE PLANT IN JAPAN INDUSTRIAL SCALE

- 3 types of plastic samples (HD500, MIX HD-PP and LDH) was sent from Norway to Japan.
- The 3 samples (a total of 1400 kg) were pre-washed and cut with shredder into 10 and 40mm pieces, to be preparer for pyrolysis tests at Nagata's facility.
- The purpose was to start testing of plastic waste from a major Norwegian supplier, and to further analyze both the process and end-results on an industrial scale.
- Results gave pyrolysis oil of a clear visual quality and a production yield (input of plastic – output of pyrolysis oil) of up to 95 %. Oil samples were sent to Norway for further analysis.



INITIAL ANALYSIS – SINTEF INDUSTRY

SINTEF Industri is the leading research & development organization in Norway and is certified and accredited internationally.

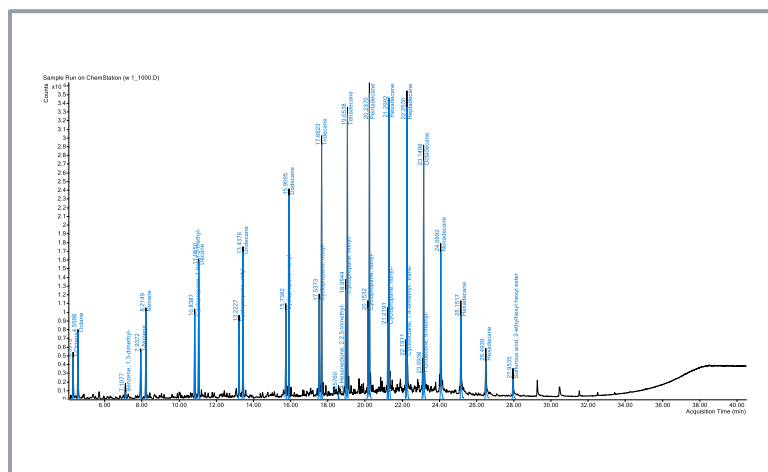
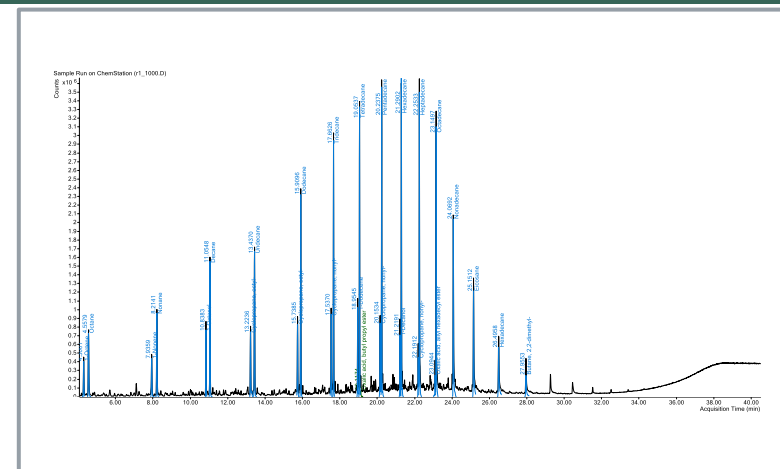
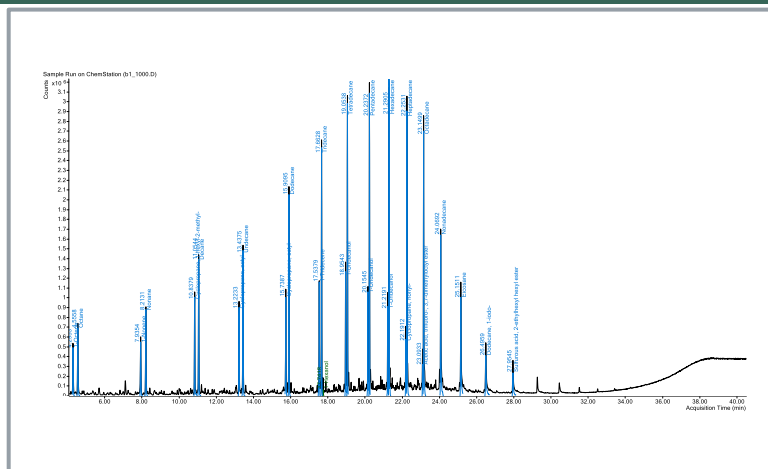
The first initial analysis of the pyrolysis oil from Nagata was done with the GS-MS Method (Qualitative Analysis).

Results were defined as follows:

“All three samples appear to be very similar in composition. Main components are hydrocarbons ranging from C8 to about C20. Main components seem to be linear alkanes and linear alkenes. Gasoline typically has hydrocarbons from C3-C9 with alkanes, alkene and aromatic compounds (benzene, toluene).”

The hydrocarbons in this sample shows most resemblance with the hydrocarbons found in kerosene and diesel (the diesel seems to have a bit higher carbon number).”

SINTEF Industri



Certify your wasteplastic for Chemical Recycling to new plastic

EMPOWERING THE CIRCULAR ECONOMY

- ✓ **The Goal** - We will receive your waste plastic, not mechanically recycled, then analyze the potential for chemical recycling into new plastic. The whole process will be ISCC certified and REACH classified according to EU regulations.
- ✓ **The Method** - In our LAB-Reactor, the waste plastic will undergo a thermochemical - pyrolysis - process, where a synthetic oil is produced. This operation is equivalent to larger industrial scale pyrolysis processes.
- ✓ **The Analysis** - Through certified laboratories, we will analyse the specific oil produced from your excess waste plastic. All our work is done in accordance to analysis & specifications for the oil to be utilized for new plastic production.



NEW PLASTIC TO OIL LAB IN BILLINGFORS

<https://polyfuels.se/certification/> - Password: Lab I 23

MINILAB REACTOR BILLINGSFORS –VIKEN

Commercial Plastic to Oil (PTO) testing

A fully operational Test-Lab for waste plastic to oil:

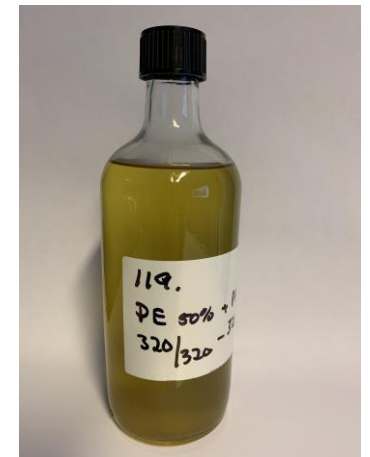
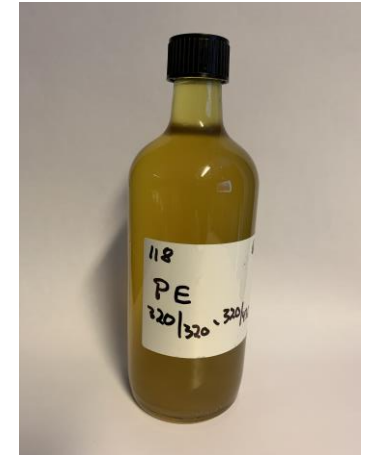
- PTO Testing
- Oil analysis

The test-lab operation will run until the PTO-2 tonnes demonstration plant is ready for launch Q1 2024, and will provide important indicators for the future demo plant operation.

For more information - follow link:

<https://polyfuels.se/certification/>

Password: Lab I 23



EXAMPLES OF PLASTIC TESTING



**Stena Recycling
PEX og Töva**



**Mölnlycke Healtcare
Medical supplies**



FIRST MOVER – CERTIFICATION OF CHEMICAL RECYCLING

The large percentages of plastic waste incinerated today, is causing massive amounts of CO₂ emissions into the atmosphere. A green shift towards new solutions are necessary – chemical recycling.

Polyfuels will be a first mover in certifying through the following standards, that today's incinerated plastic waste, will be the feedstock for new plastic production.



ISCC – International Sustainability and Carbon Certification (ISCC) is a certification system that offers solutions for the implementation and certification of sustainable and traceable supply chains of waste and residue raw materials, non-bio renewables and recycled carbon materials and fuels.

REACH is a regulation of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry.



The Waste Framework Directive sets the basic concepts and definitions related to waste management, including definitions of waste, recycling and recovery.

INVESTING IN PLASTIC TO OIL = ENVIRONMENTALLY PROFITABLE

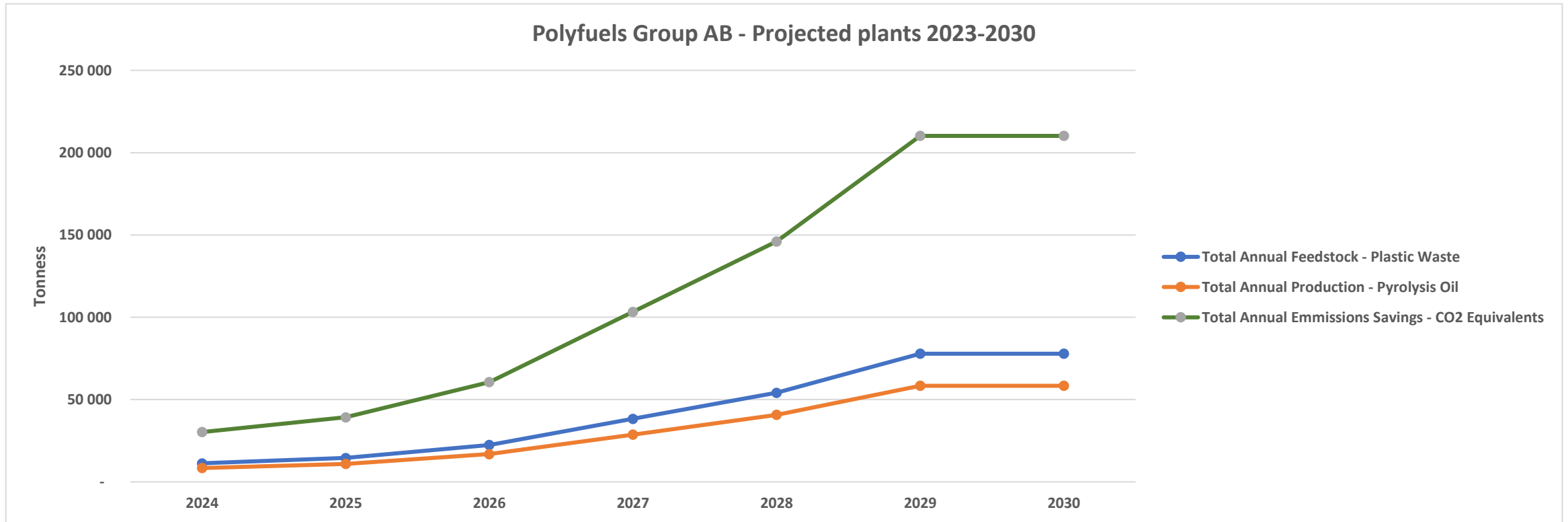
	2 tonnes per day plant	24 tonnes per day plant	Total production all plants 2030 – with partner Borealis
Annual plastic production input – Tonnes	660	7920	77 880
Annual pyrolysis oil production output – Tonnes	495	5 940	58 410
Annual CO² Savings – Tonnes	1 782	21 384	210 276

The largest part of waste incineration is plastic, with a high CO² content: 1 tonne of plastic waste = 2,7 tonnes of CO²

Plastic input = Plastic being incinerated today

- CO² savings: Plastic is not incinerated
- CO² savings: Chemical recycling greatly reduced the need for fossil fuels
- **Profitability: Chemical recycling profitability in ROI and environmental**, giving investors, shareholders and partners – an invested share in their ambitions to go carbon neutral.

PROJECTED PLANTS 2023 – 2030 – IN COOPERATION WITH BOREALIS UPSTREAM – DOWNSTREAM – CO2 SAVINGS

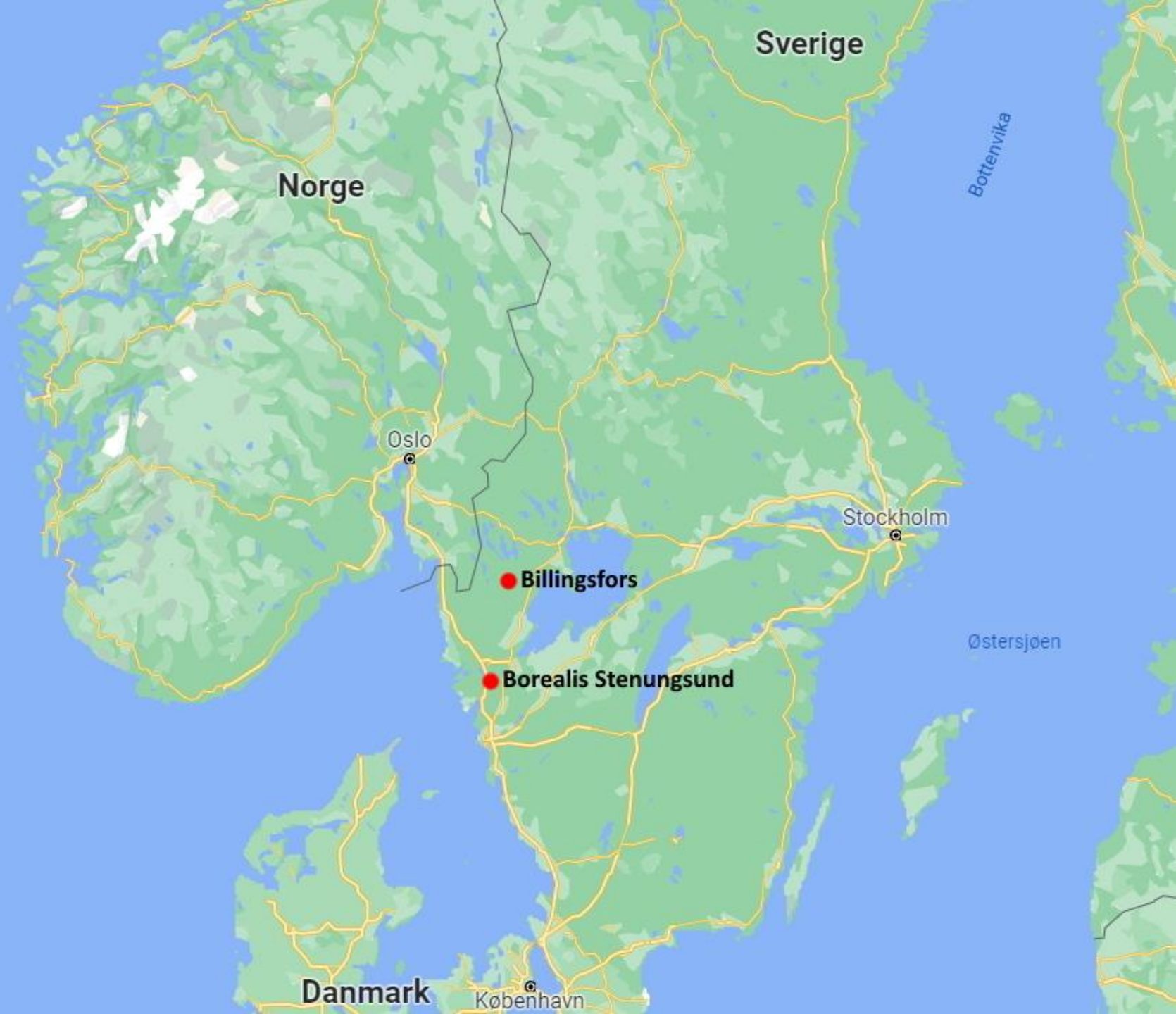


THE BILLINGSFORS PLANT

- Strategic location – Sweden and Norway
- Total area approx 330 000 m²
- Approved and regulated industrial area
- 5 companies operating at the plant area – possible synergy effects

Operational Highlights:

- 2022: Test-Lab operation
- 2024: 2 tonnes Demo Plant operation
- 2025: Full Scale 24 tonnes operation

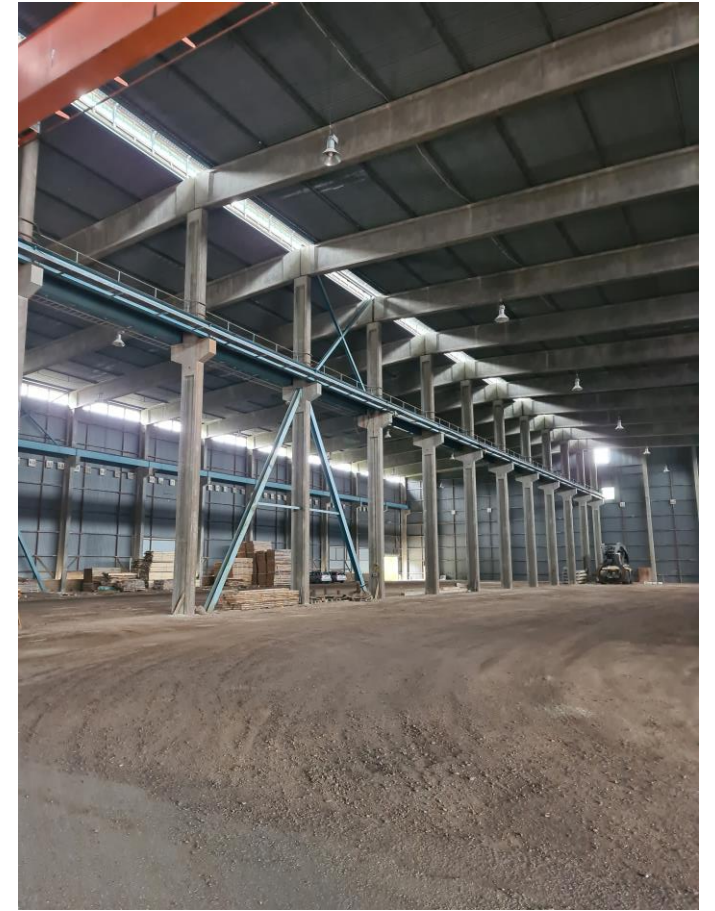






 **POLYFUELS BILLINGSFORS AB**

BILLINGSFORS PTO PLANT OVERVIEW



TREASURE will innovatively circulate by refurbishment, reuse and recycling currently burned, exported, landfilled or dumped plastic, batteries and biobased side and waste streams by deploying systemic circular economy (CE) solutions.

The systemic CE solutions will integrate the two main elements of TREASURE:

- Stakeholder engagement demonstrations
- Key value chain demonstrations.

Polyfuels Group's role in the project

1. Thermochemical testing of heterogenous mixtures of plastic waste
2. Analysing offtake products (Pyrolysis oil, syngas and Charcoal).
3. Developing new standards of chemical recycling processes that can be replicated into fully operative large-scale plants.

EU Horizon – The Treasure Project

Polyfuels Group granted 4th of February a total of EUR 1 004 325 (SEK 10 503 450)



EU Horizon-bidrag I I MSEK:

Polyfuels är projektledare i pyrolys-projektet bestående av 17 partners från 7 europeiska länder. Projektet kommer starkt att bidra till att etablera Polyfuels som marknadsledare i Norden.





CIRCULAR TIRES HOLDING AS

ELT Plants

End of Life Tires

Main Projects

Norway – Circular Tires Viken AS (UE)

Sweden – Circular Tires Billingsfors AB (UE)

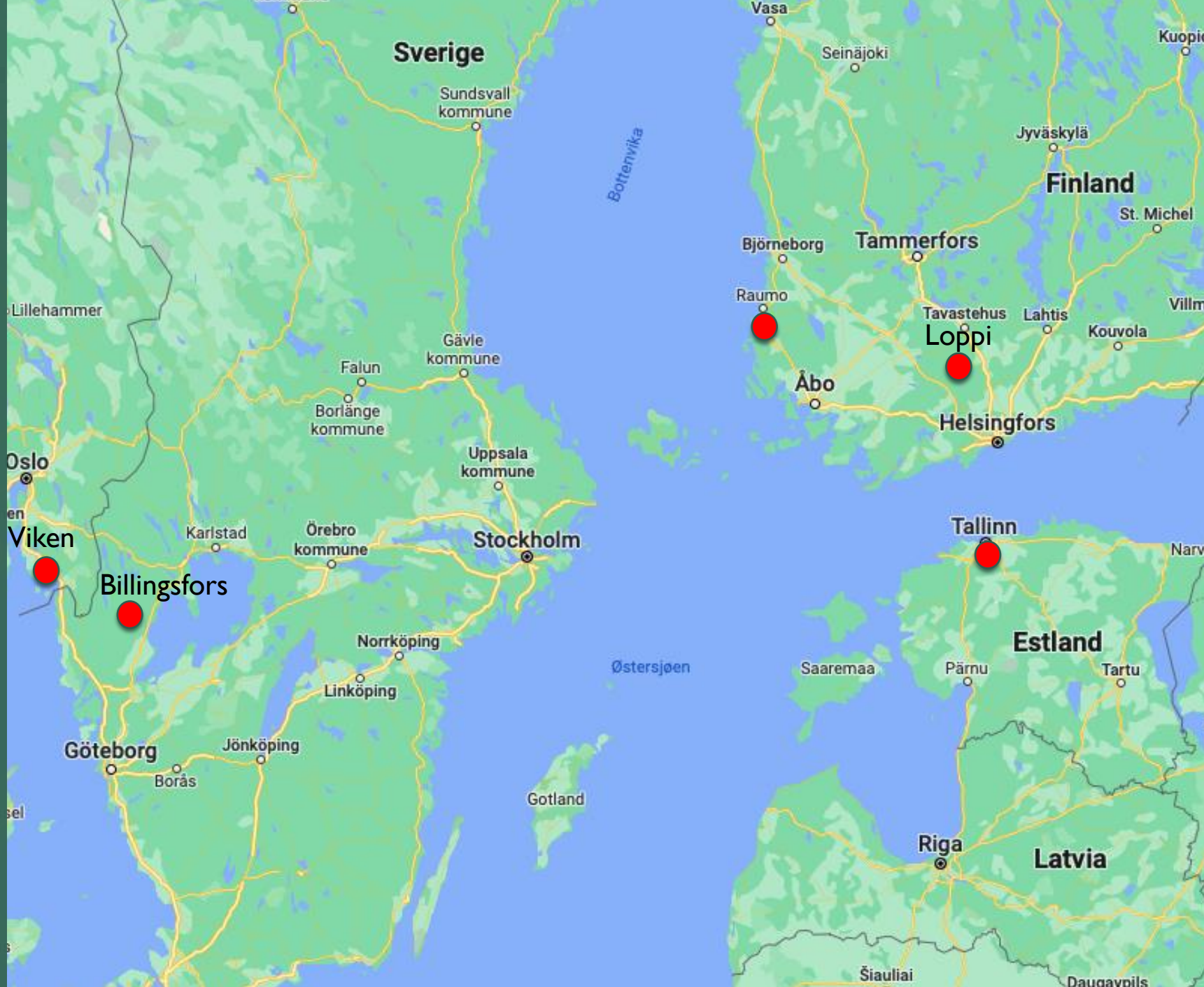
Includes pre-study for
Finland and Estonia



STRATEGIC LOCATIONS

NORWAY:
MAIN PROJECT
VIKEN PARK
CT PLANT CO-
LOCATED
WITH POLYFUELS
VIKEN AS

SWEDEN:
MAIN PROJECT
BILLINGSFORS
CT PLANT CO-
LOCATED WITH
POLYFUELS
BILLINGSFORS AB



FINLAND:
PRE-STUDY
LOPPI, ON
SILMÄNANNON
INDUSTRIAL AREA
WITH
FINNISH TYRES
RECYCLING OY
OR
RAUMO, CITY-HARBOUR

ESTONIA:
PRE-STUDY
MUUGA
HARBOUR OF TALLINN

TWO PARALLELL ELT-PLANTS IN NORWAY AND SWEDEN IN ADDITION TO PRE-STUDIES FOR NEW PLANTS IN FINLAND AND ESTONIA

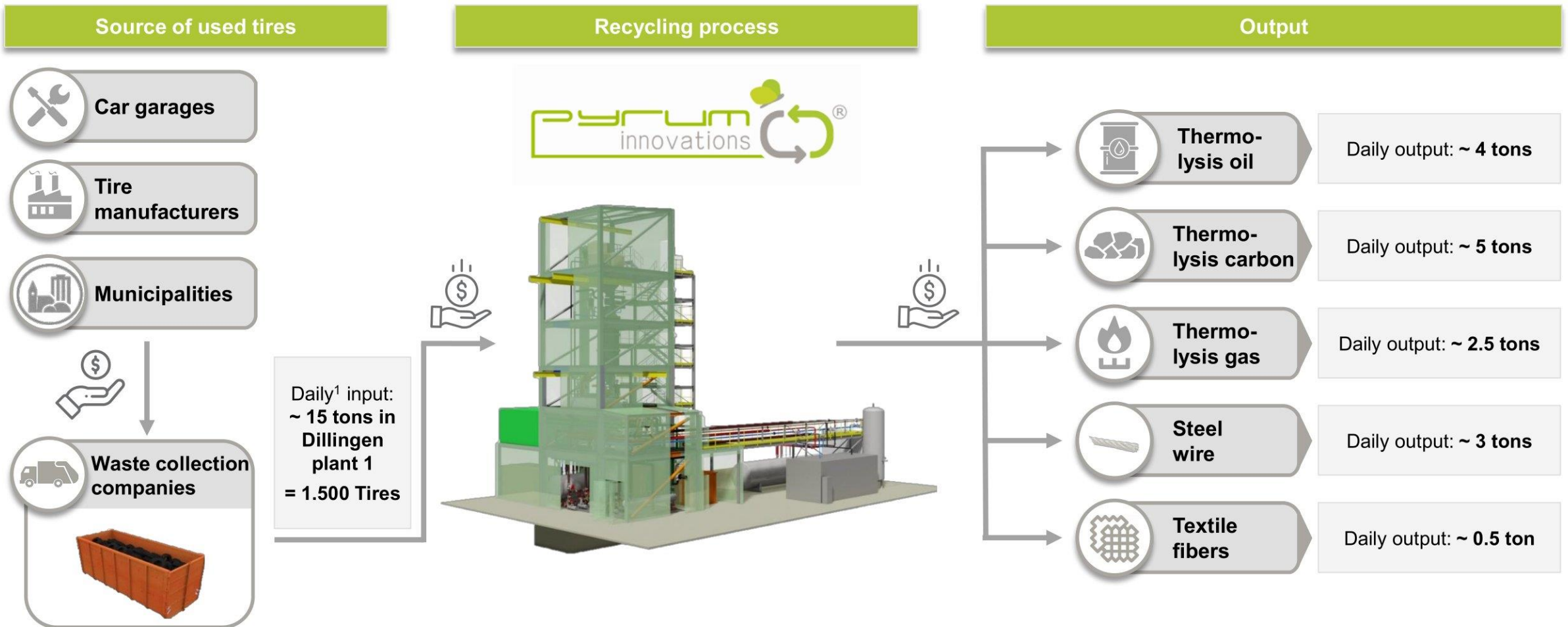
- Polyfuels Group AB have now signed partnership agreements with Norsk Dekkretur, Svensk Däckåtervinning and Finnish Tyre Recycling, in addition to Rehvinglus in Estonia
- Pyrum Innovation AG, BASF SE and the feedstock partners offers a strong support team for Polyfuels Group AB in the initial project phase and pre-studies conducted by subsidiary Circular Tires Holding AS.
- Polyfuels Group AB & Circular Tires Holding AS has a cooperation with Pyrum and BASF, building new plants in Viken and Billingsfors, and in parallell pre-studies for Finland and Estonia will be conducted.
- Based on this stakeholder platform, and two projects to be developed, it will be established 40 000 tonnes capacity plants in total in Norway and Sweden as first priority. There will be a parallell pre-study of two projects to secure feedstock of 40 000 tonnes in total, from local sources in Finland and Baltics. Timeline for investing in these projects, will be six to nine months after the investments in the first two projects.



Value chain provides favourable economics ...

... as Pyrum is being paid both for receiving their feedstock and sales of products

Sources and operation output from used tires



Sources: Company info | Notes: (1) Management view on a typical daily input/output



ROLLOUT PLAN FOR PYRUM ELT PLANTS IN THE NORDICS: Q2 2024 – Q4 2028

