Why Bio-Methanol?

May 28, 2020

0900 UTC -04 |1500 UTC +2 |2100 UTC +8

METHANOL INSTITUTE

NextChem
Maire Tecnimont for Energy Transition

SÖDRA

METHANOL INSTITUTE

Why Bio-Methanol?

Tim Chan

Manager, Government Relations and Business Development
Asia & Middle East

MI History

- The Methanol Institute (MI) was established in 1989
- Three decades later, MI is recognized as the trade association for the global methanol industry
- Facilitating methanol's expansion from our Singapore headquarters and regional offices in Washington DC, Brussels, and Beijing

Members

METHANOL INSTITUTE

Tier 1

MHTL · methanex the power of agility · سابك sabic · OCI

Tier 2

Qatar Fuel Additives Company Limited · MITSUBISHI GAS CHEMICAL · ATLANTIC METHANOL · MITSUI & CO., LTD. · PETRONAS · Oman Methanol Company S.A.O.C.

Tier 3

Eni Ecofuel · Sipchem EXCELLENCE everywhere · G2X ENERGY · OQ · Mitsubishi International Corporation · JM Johnson Matthey Inspiring science, enhancing life

Tier 4

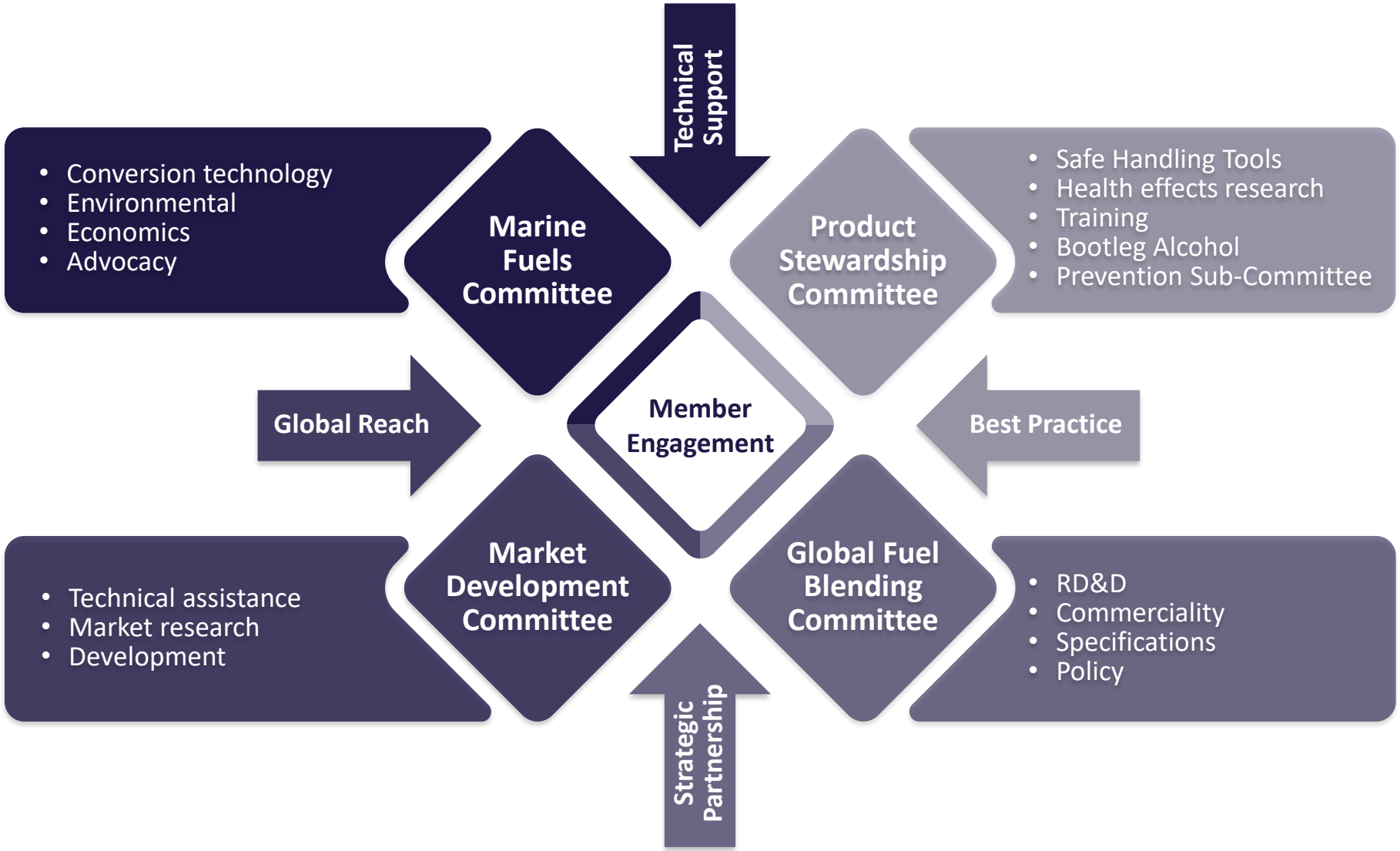
FiTech · Advent · HELM PROMAN METHANOL · OMAN TRADING INTERNATIONAL · MOL Mitsui O.S.K. Lines · Blue World Technologies · CARBON RECYCLING INTERNATIONAL

Element 1 Powering Innovation · SCC Southern Chemical Corporation · bse engineering · YCI METHANOL ONE · FUELSAVE GREEN TECHNOLOGY · GasTechno ENERGY AND FUELS · mmsa · neo-H2

IMTT · Palcan · NW INNOVATION WORKS · VITUSA PRODUCTS INCORPORATED · TRICON ENERGY · quantiam technologies inc. · Gane Energy

OLAHMOTORS · IGPMethanol · CLARIANT · CoogeeChemicals · HALDOR TOPSOE · solvadis we do chemistry · Nebraska Public Power District

Committee Structure

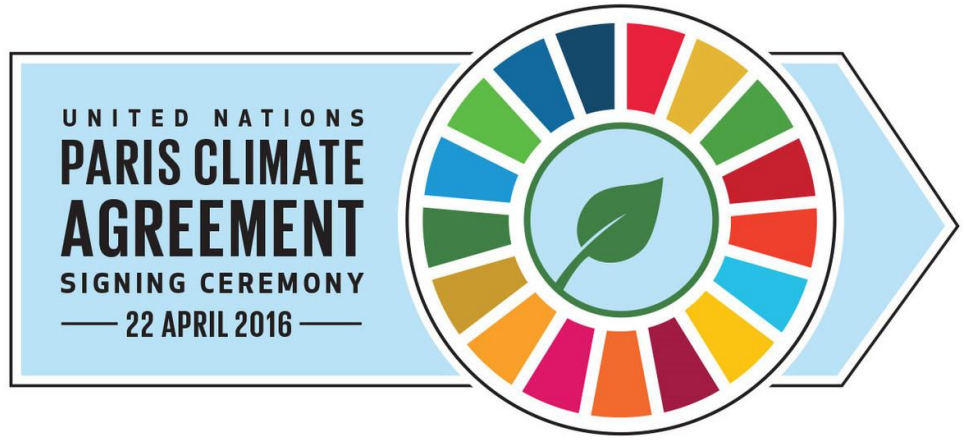


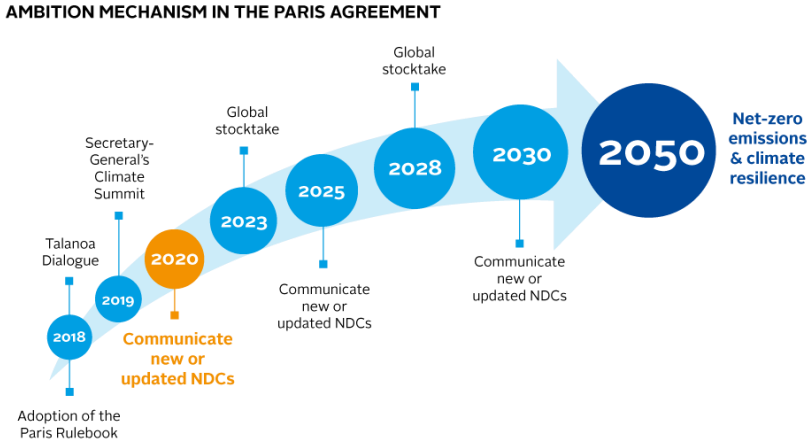
Facilitating increased Sustainability

- MI supports the spirit enshrined in the UN Sustainable Development Goals (SDGs) and UN Paris Climate Agreement by
  - Acknowledging the need for public-private partnerships that foster sustainability of environments, economies, and societies;
  - Advocating for the recognition of alternative fuels as well as their commercial viability driven by government policy to "*level the playing field*"
  - Support technological developments that enable sustainable production of methanol

- Renewable and bio-methanol production:
  - Lowers greenhouse gas emissions through carbon capture;
  - Diversifies waste management by diverting waste from landfills and incinerators; and
  - Increases the value of waste

- Methanol is largely produced from natural gas, an important starting point for the transition to clean and sustainable fuels for marine and land transport, as well as feedstock for petrochemicals in the circular economy.





EU RED II Changes and Implications

But the devil is in the details…

- Food/feed crops capped at **7% or 2020 level**, whichever is lower
- High ILUC risk feedstocks (e.g. palm oil) to be reduced to **0%**
- Waste feedstocks in Annex IX Part B (e.g. UCO) capped at **1,7%**
- Minimum share of advanced biofuels (Annex IX A) of **3,5%**

Consequences for Methanol

- **Conventional methanol** volume at risk from potential lower share of conventional FAME and impact of E10 (MTBE, M3)
- Waste based **bio-methanol** benefits from Advanced minimum sub-target
- E-methanol not considered an Advanced renewable fuel

Contacts

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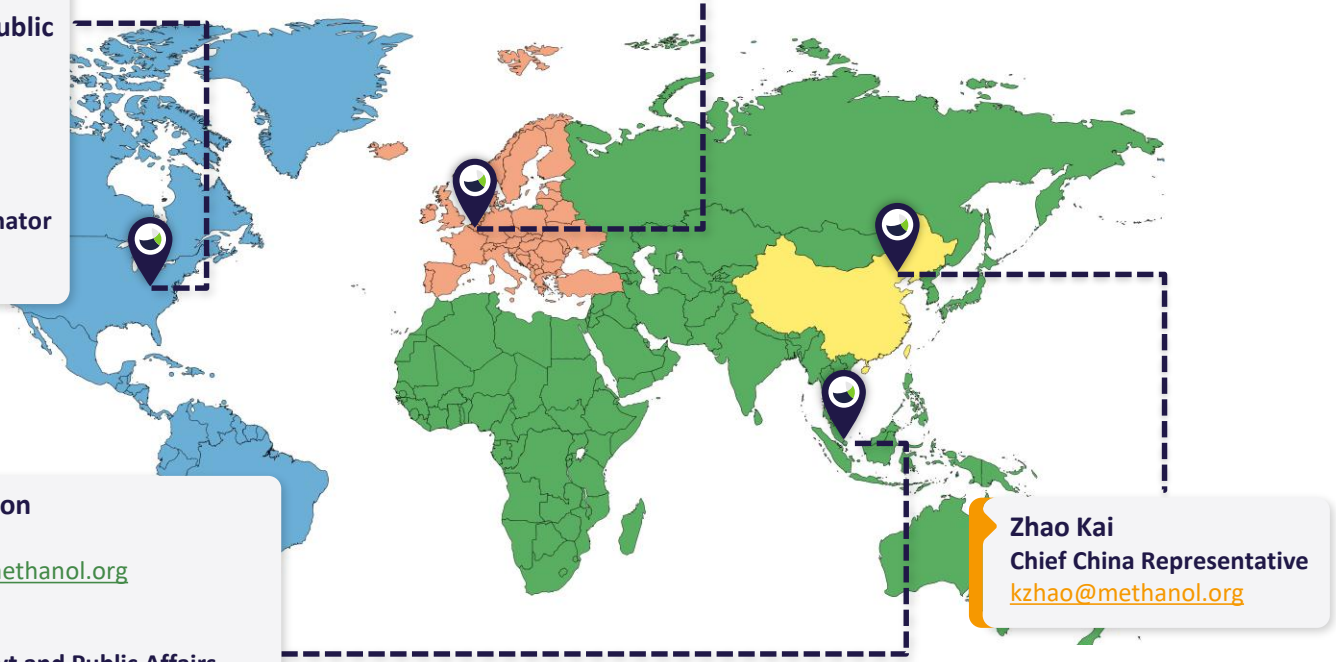

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WASTE TO CHEMICAL TECHNOLOGIES: BIO-METHANOL FROM WASTE

WASTE TO CHEMICALS TECHNOLOGIES

BIO-METHANOL FROM WASTE

28 Maggio 2020

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Maire Tecnimont for Energy Transition

AGENDA

1. Waste to Chemical Technologies
2. Waste to Methanol
3. Conclusion

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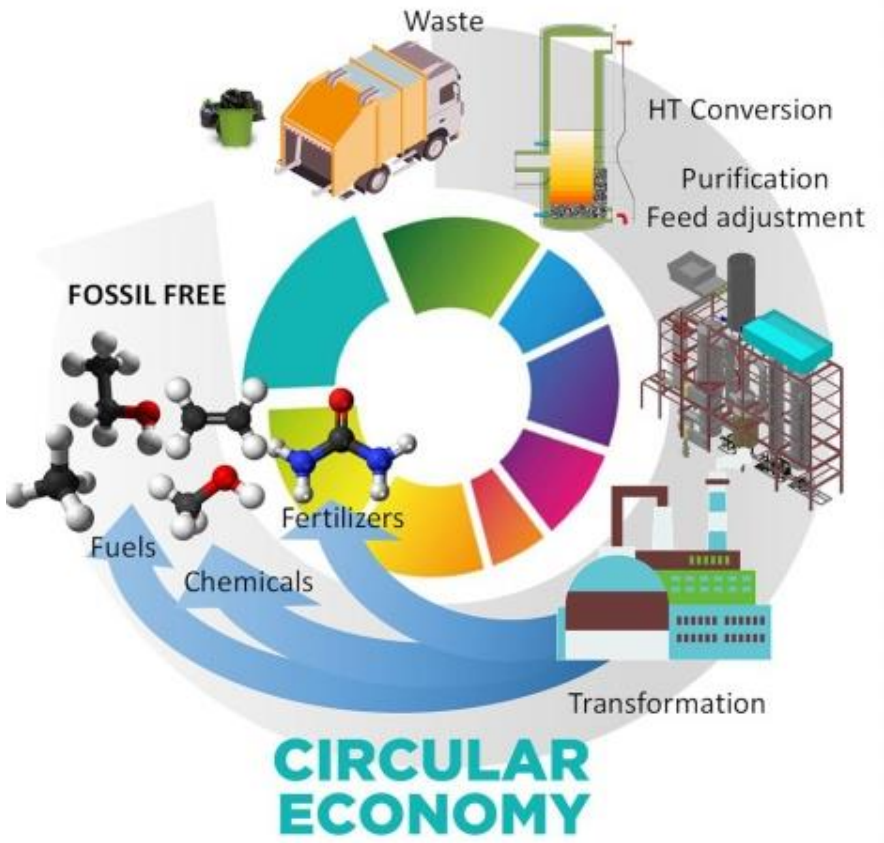
WASTE TO CHEMICALS TECHNOLOGIES

Waste to chemical technologies to give carbon a second chance of life.

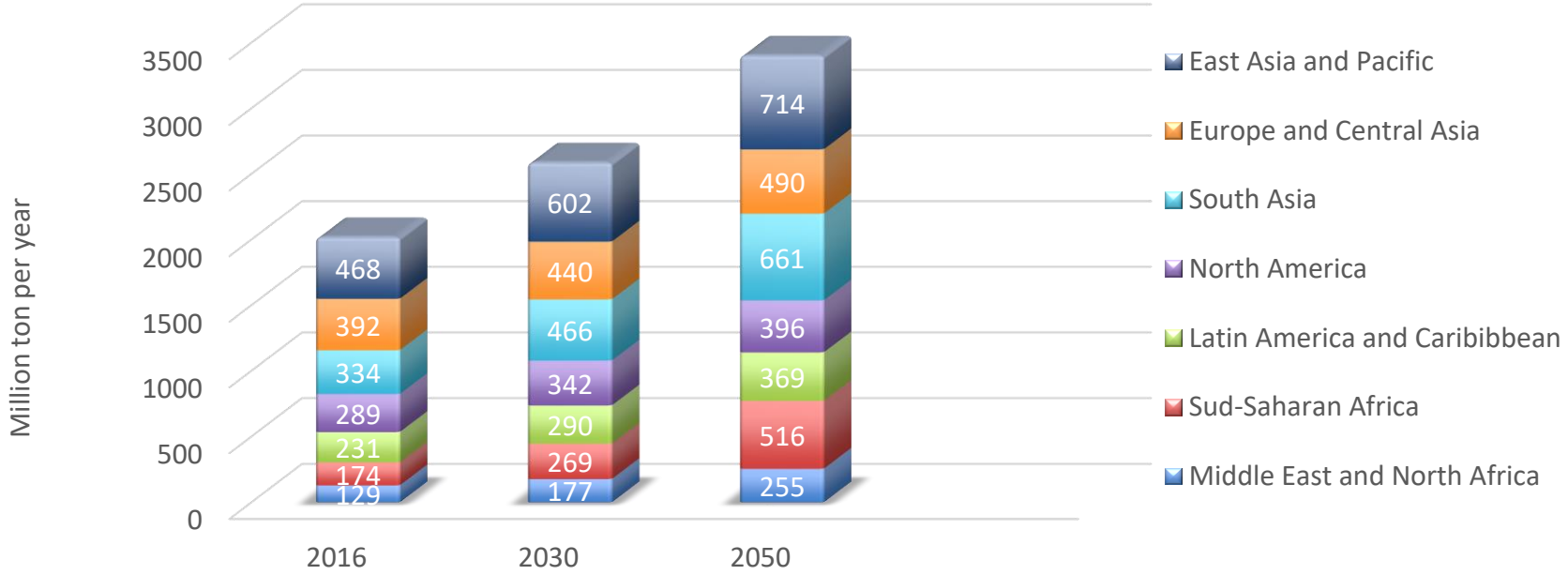
- ❑ ***Waste to Hydrogen***
- ❑ ***Waste to Methanol***
- ❑ ***Waste to AdBlue/Urea***
- ❑ ***Waste to Methane***
- ❑ ***Waste to Ethanol***
- ❑ ***Waste to Syngas***
- ❑ ***Waste to Acetic Acid***
- ❑ ***Waste to Nitric Acid***



WASTE AS A SOURCE OF CARBON AND HYDROGEN

30%-50% (w-wet) of waste is **CARBON**

5%-10% (w-wet) of waste is **HYDROGEN**



What-a-waste. World data bank. https://dataviz.worldbank.org/authoring/what-a-waste/final

HIGH TEMPERATURE WASTE CONVERSION MAIN REFERENCES

2001 - Chiba
- Capacity: 80.000 t/y (2 lines)
- Status: In operation
- Feed : Industrial waste and sludge
- Use: Power

2003 - Mutsu (Aomari - JP)
- Capacity: 45.000 t/y (2 lines)
- Status: In operation
- Feed : Industrial waste
- Use: Power

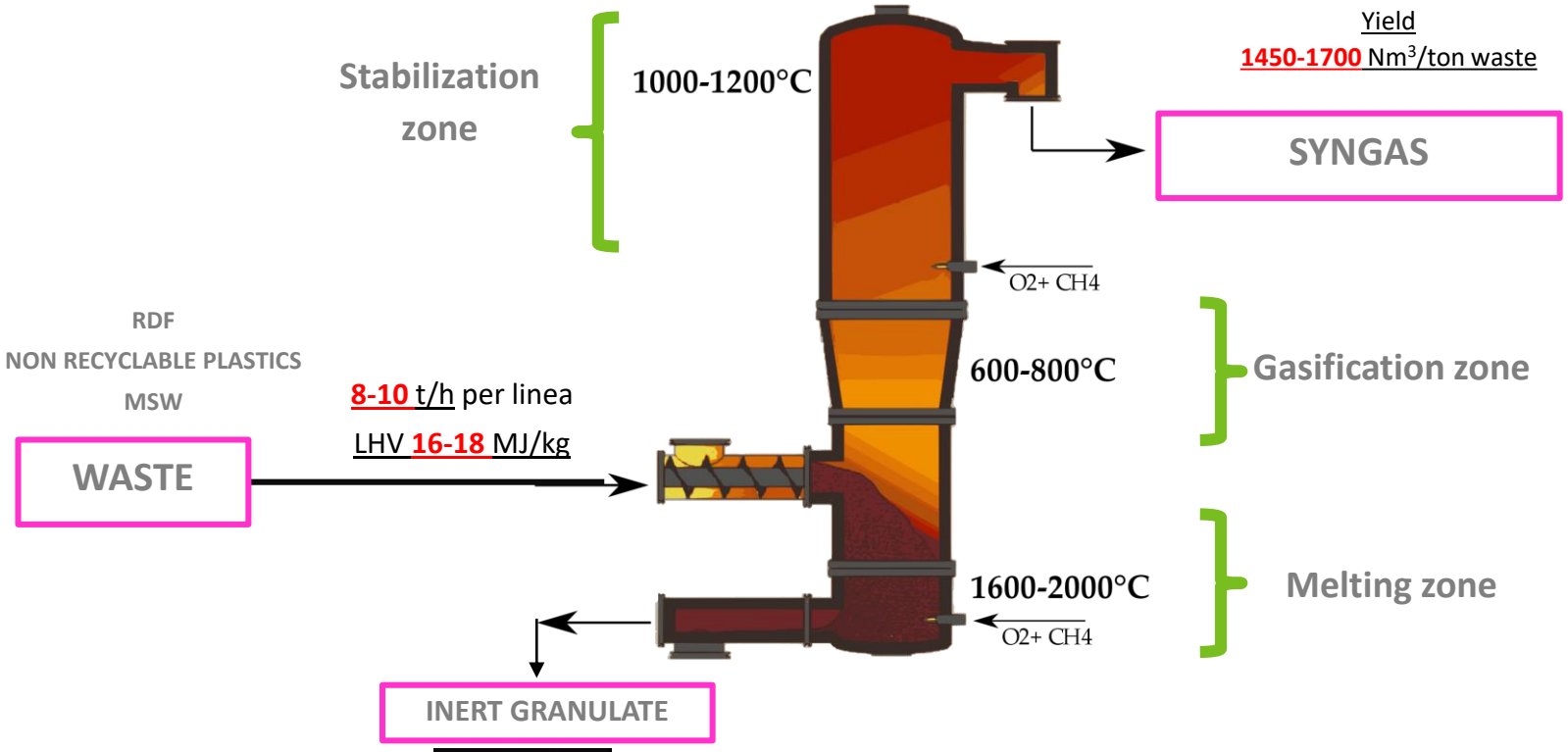
2004 - Osaka (Osaka - JP)
- Capacity : 28.000 t/y (2 lines)
- Status: In operation
- Feed : Municipal and Industrial solid waste
- Use : Power

2005 - Tokushima (JP)
- Capacity: 36.000 t/y 2 lines)
- Staus: In operation
- Feed: Municipal solid waste
- Use: Power

2005 - Isahaya (JP)
- Capacity: 90.000 t/y (3 lines)
- Status: In operation
- Feed: Municipal solid waste
- Use: Power

2005 - Kurashiki (JP)
- Capacity 150.000 t/a (3 linee)
- Status: In operation
- Feed: Industrial waste
- Use: Power

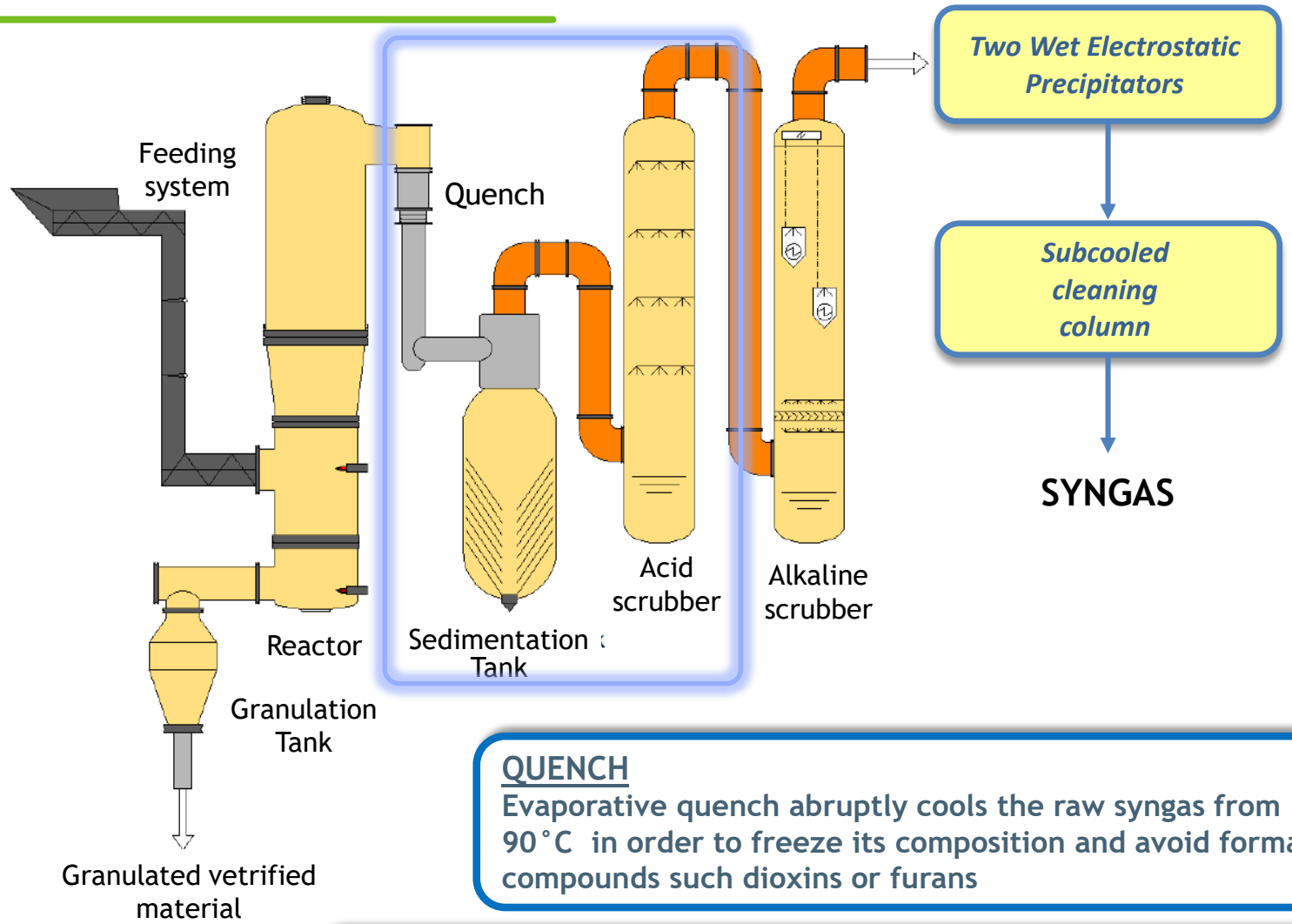
FOCUS – HIGH TEMPERATURE MELTING GASIFIER



High temperature gasifier reactor converts waste into:

- SYNGAS RICH IN H2 AND CO
- INERT GRANULATE

FOCUS – SYNGAS CLEANING



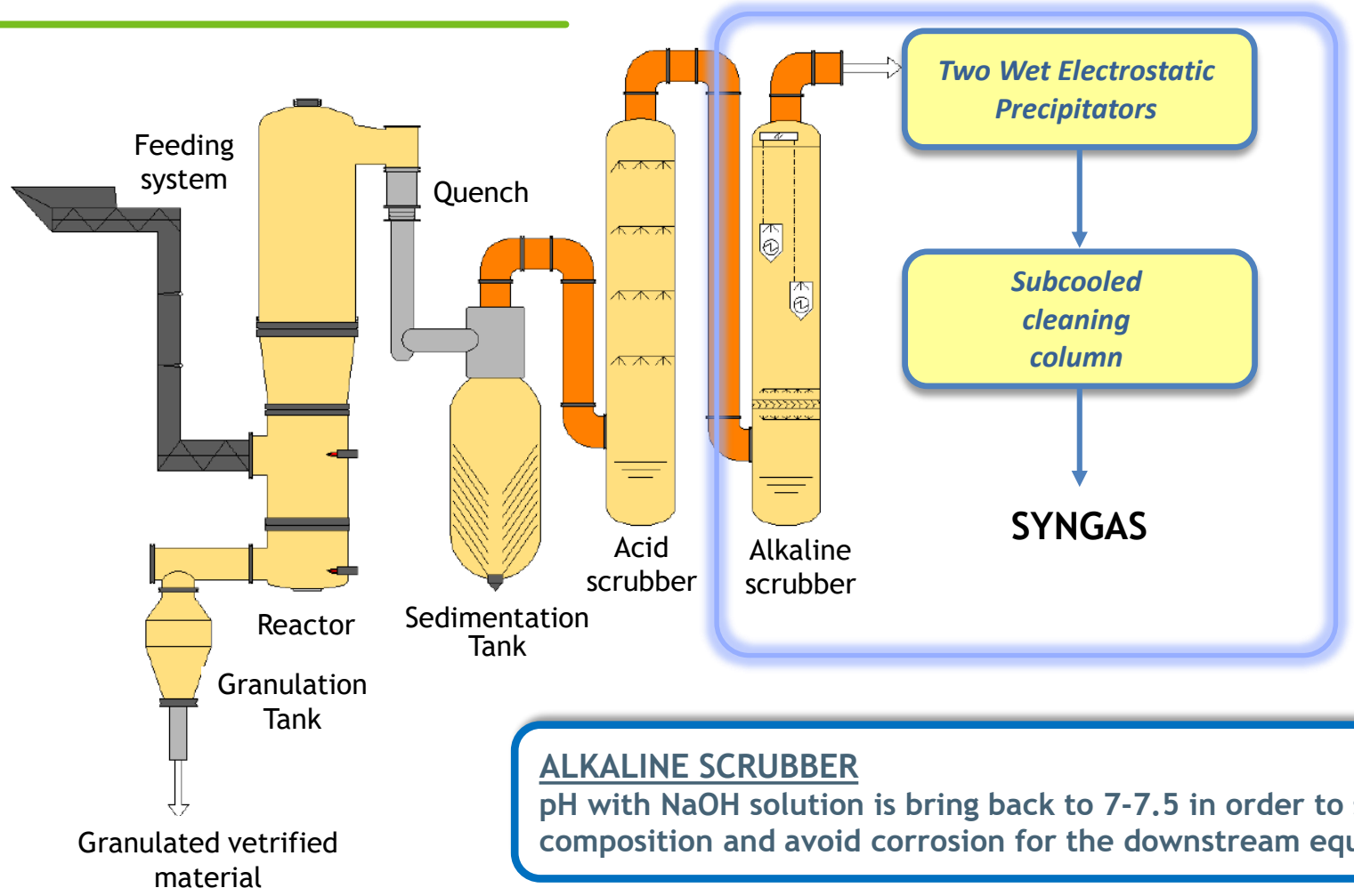
QUENCH

Evaporative quench abruptly cools the raw syngas from 1100 to near 90°C in order to freeze its composition and avoid formation of harmful compounds such dioxins or furans

SEDIMENTATION TANK AND ACID SCRUBBER

pH between 1.5-3 is controlled with HCl - NaOH addition in order to bring in solution heavy metals. Heavier particles are collected in the sedimentation tank. Temperature of syngas in the acid scrubber is reduced down to 50°C

FOCUS – SYNGAS CLEANING



ALKALINE SCRUBBER
pH with NaOH solution is bring back to 7-7.5 in order to stabilize the composition and avoid corrosion for the downstream equipment

WET ELETROSTATIC PRECIPITATORS
To remove the dust and residual metals

SUBCOOLED CLEANING
To ensure a deeper purification, syngas is cleaned with sub cooled water down to 15-20°C

HIGHLIGHTS GASIFICATION & CLEANING SECTION

- ❑ Waste fed to HT-gasifier **DON'T REQUIRE ANY SPECIAL PRETREATMENT**.
- ❑ Waste with **HIGH CLORINE CONTENT** (PVC) may be treated
- ❑ Multiple parallel HT-Gasification lines ensure a continuous operation during maintenance operation thus increasing **OVERALL PLANT RELIABILITY.**
- ❑ **No FLY ASH PRODUCTION** due to operating condition of the HT gasifier bottom section.
- ❑ **NO DIOXINE AND FURANS PRODUCTION** due to operating conditions.
- ❑ A robust cleaning section acoounts for a **DEEP ABATMENT OF CONTAMINANTS.**
- ❑ **BALANCING OF SYNGAS FLOWRATE FLUCTUATIONS** is achieved through a gas holder thus assuring stable operation.
- ❑ **SYNGAS IS RICH IN H2 AND CO** and free of TARS and hydrocarbons

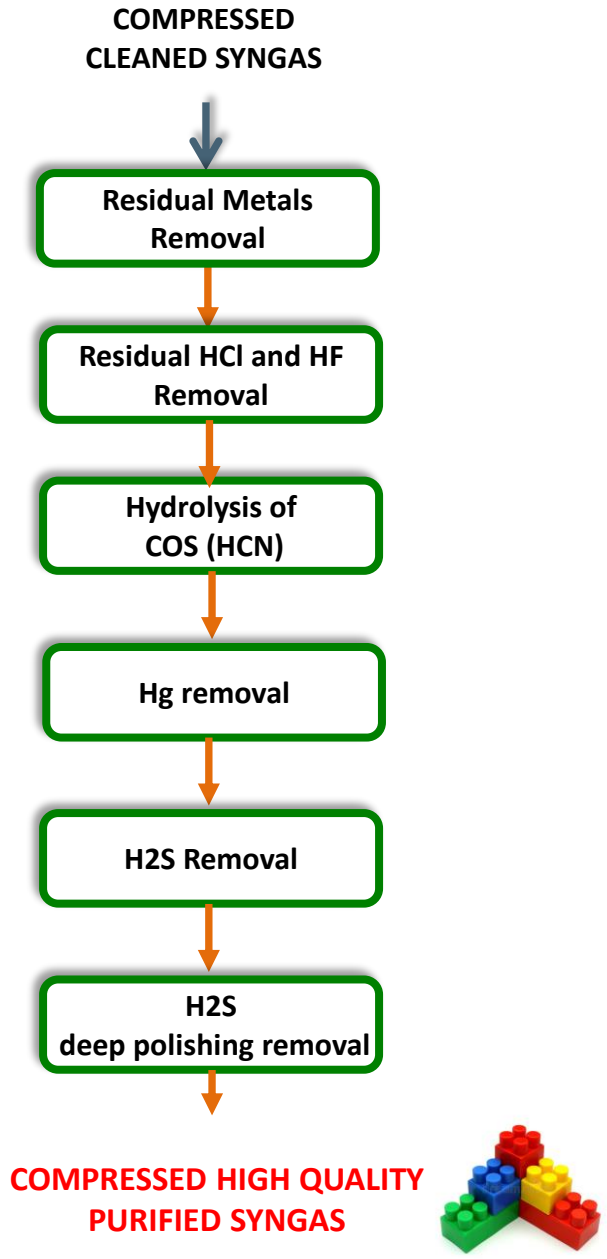
HIGHLIGHTS PURIFICATION OF WASTE DERIVED SYNGAS

❑ **TAILORED SYNGAS PURIFICATION ARCHITECTURE** accounts for a deep contaminants removal :

❑ Particles/metals
❑ HCl/HF
❑ COS hydrolysis (CS_2) to H_2S
❑ Hg
❑ H_2S
❑ H_2S deep polishing step → ppb

❑ Resulting syngas is **USEFUL TO BE USED FOR SYNTHESIS**

❑ Depending for selected end product, SYNGAS COMPOSITION MAY BE PROPERLY ADJUSTED to fit synthesis requirements



CHEMICALS PATHWAY FROM WASTE

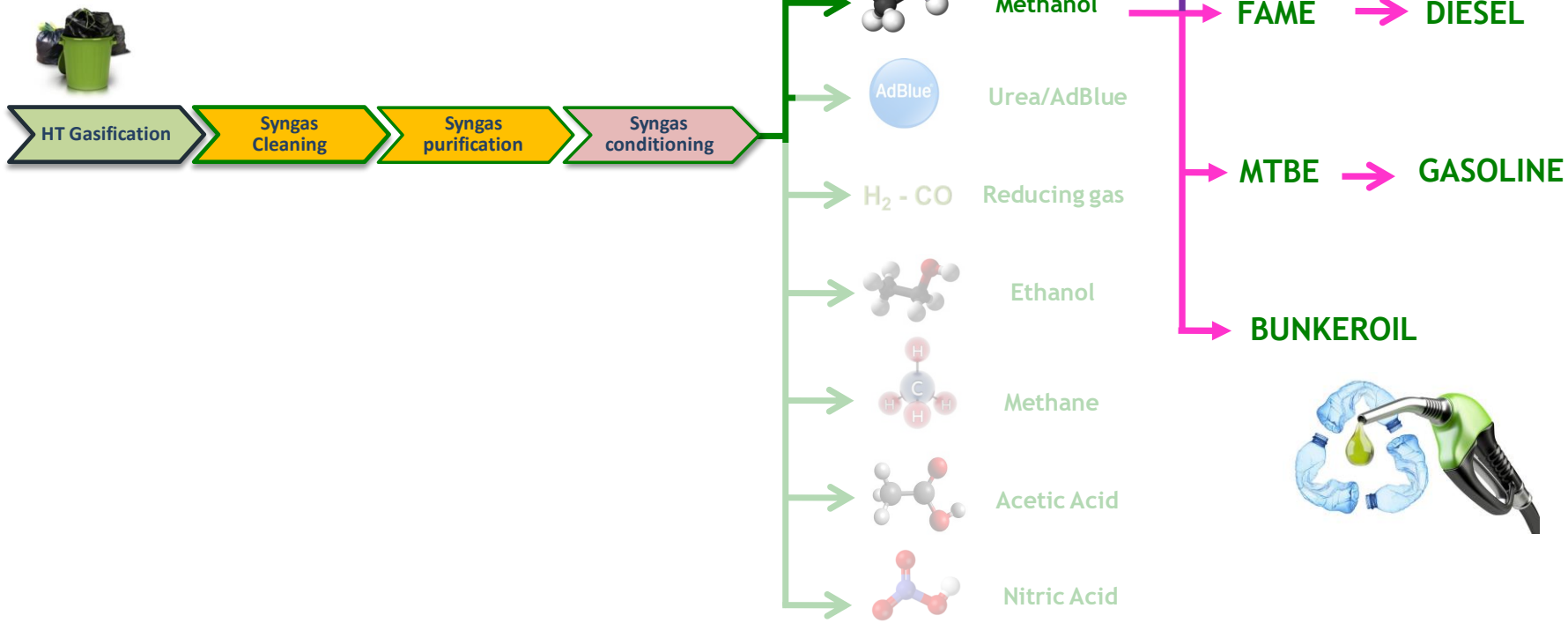
Waste feedstock can be converted into SYNGAS to be used as BUILDING BLOCK for the synthesis of chemicals and fuels.
A premium on final end product may be recognized.

HT Gasification → Syngas Cleaning → Syngas purification → Syngas conditioning

- Hydrogen
- Methanol
- Urea/AdBlue
- H_2 - CO — Reducing gas
- Ethanol
- Methane
- Acetic Acid
- Nitric Acid

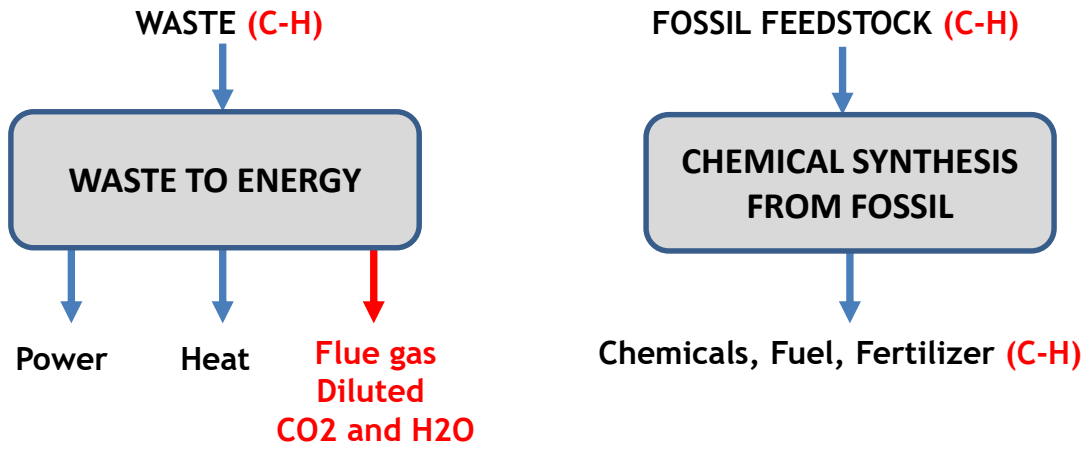
CHEMICALS PATHWAY FROM WASTE

The WASTE to METHANOL pathway….

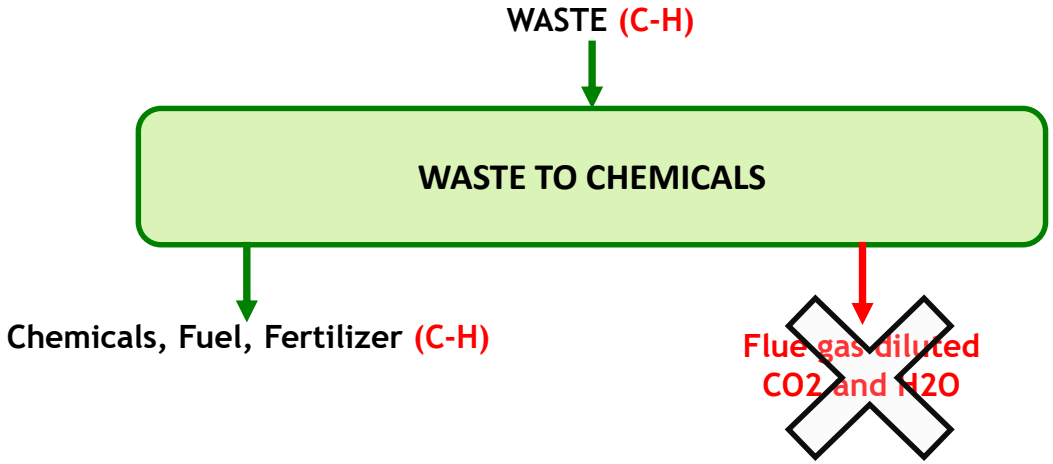


WASTE TO CHEMICALS – ENVIRONMENTAL BENEFIT

❑ CONVENTIONAL APPROACH



❑ WASTE TO CHEMICAL APPROACH



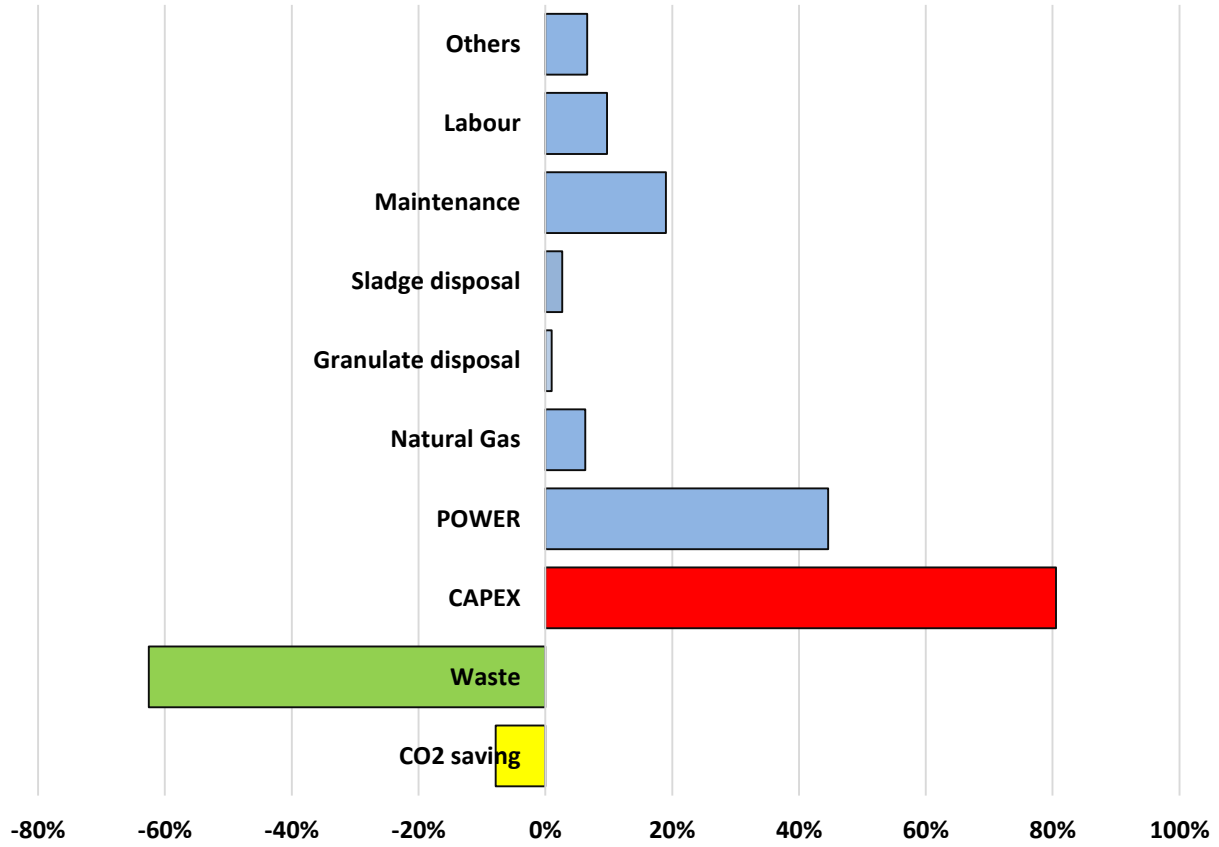
SAVING CO2

Carbon is fixed into chemicals or available as pure CO2 to be reused.

Avoiding combustion Nox and SOx production is avoided

WASTE TO CHEMICALS – ECONOMIC BENEFIT

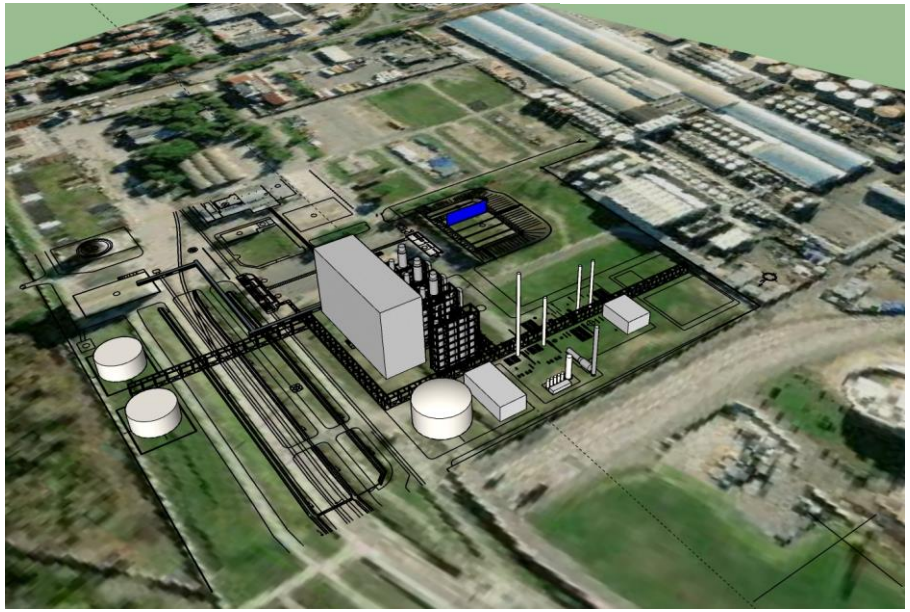
Altough Capex intensive, the WASTE TO CHEMICALS TECHNOLOGY accounts for competitive Cost Of Production (COP) thanks to the **NEGATIVE COST OF FEEDSTOCK** (WASTE GATE FEE).

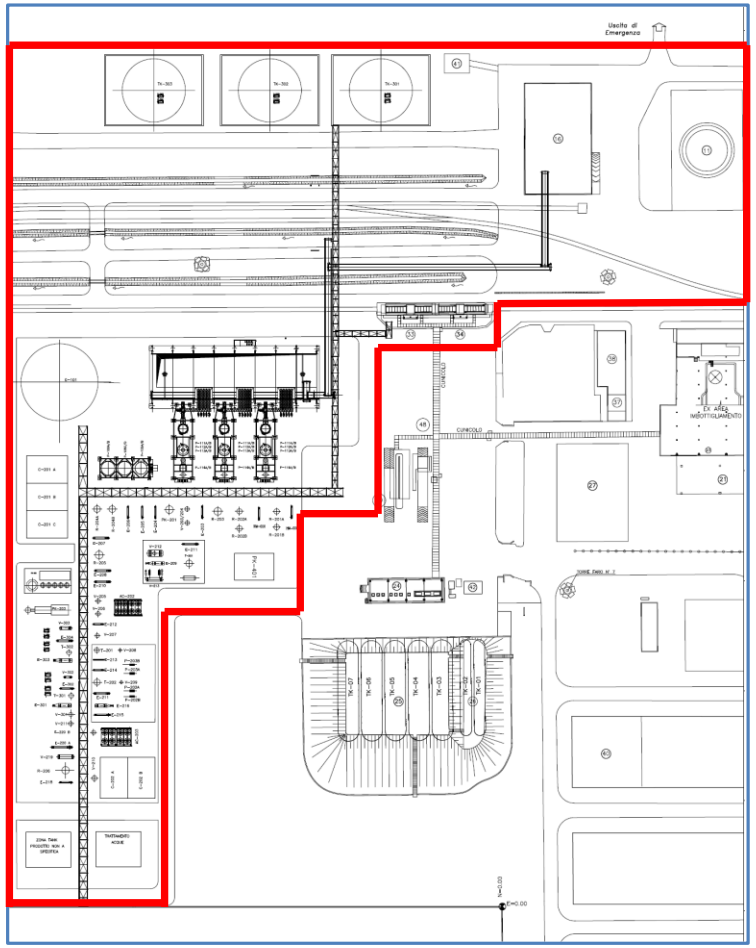


IMPACT ON COST OF PRODUCTION

WASTE TO METHANOL – ONGOING ACTIVITIES WITHIN ENI REFINERY IN LIVORNO

Eni and Maire Tecnimont sign agreement to introduce new technology that transforms non-recyclable waste into hydrogen and methanol





BASIC DESIGN PACKAGE: WASTE TO METHANOL
LOCATION: LIVORNO ENI REFINERY
FEEDSTCOKS: CSS-PLASMIX

CAPACITY: **METHANOL 340 MTPD**
WASTE 180.000-190.000 t/y

CASE STUDY - WASTE TO METHANOL

GREEN METHANOL PRODUCTION FROM WASTE (RDF-PLASTICS)

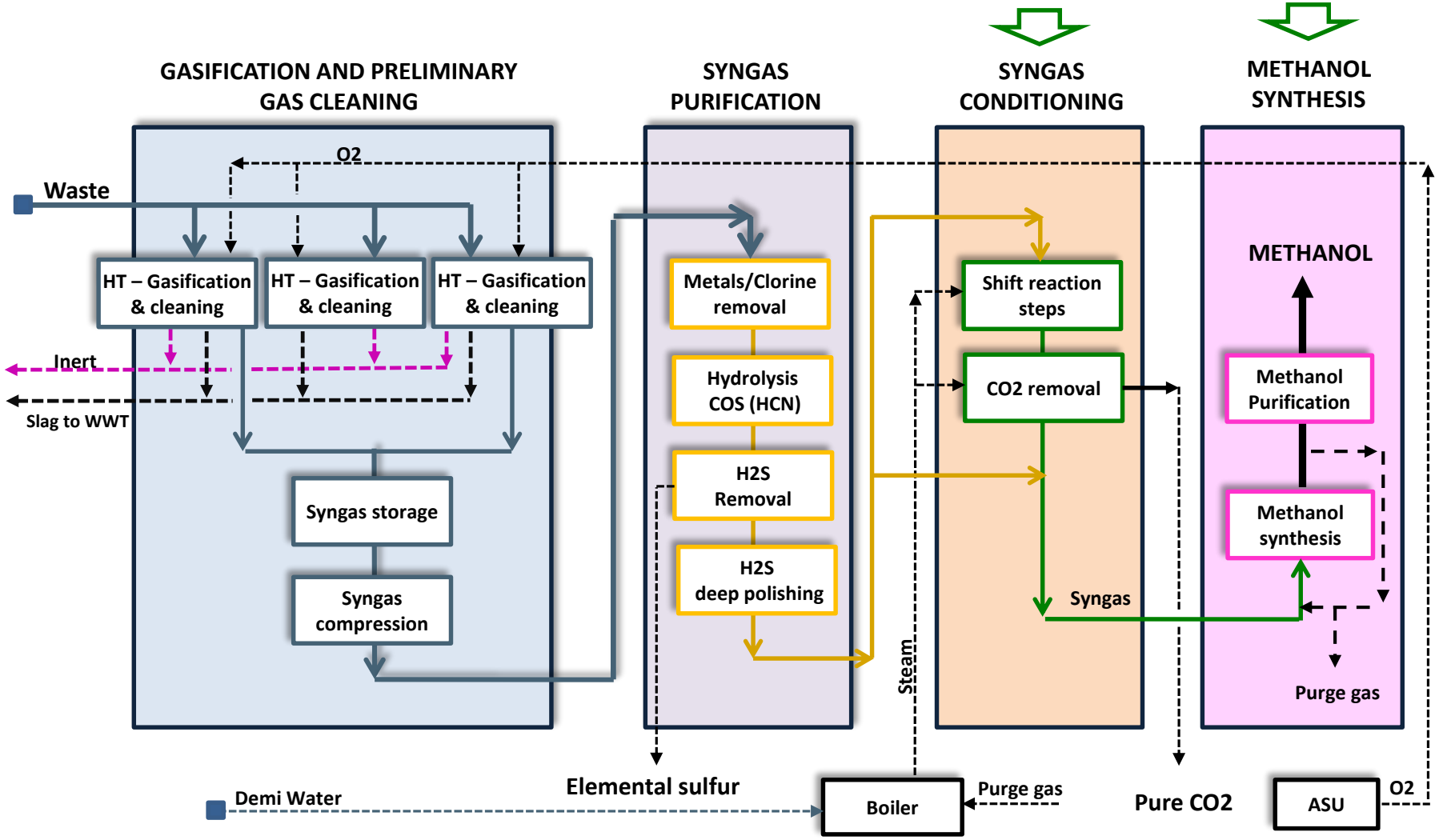
ACCORDING TO Renewable Energy Directive it may be considered an ADVANCED BIOFUEL

Refuse Derived Fuel (RDF-PLASTICS)

Methanol (Advanced biofuel)

CASE STUDY - WASTE TO METHANOL

Overall process scheme allowing to convert WASTE into METHANOL



CASE STUDY - WASTE TO METHANOL

PURIFIED COMPRESSED SYNGAS IS ROUTED TO CONDITIONING SECTION

- Syngas composition has to fit requirements for methanol synthesis defined by methanol module MM.

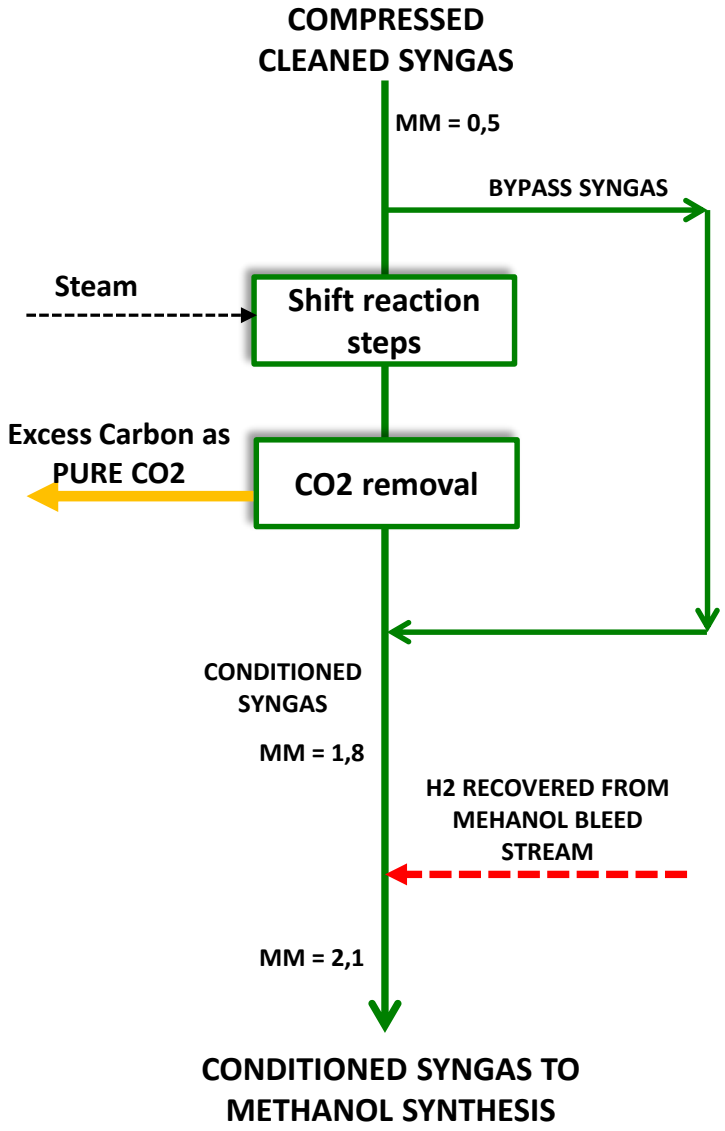
  $MM=(H2-CO2)/(CO+CO2) = 2.1$

- Syngas coming from RDF/plastics gasification has a MM=0,5 that means an excess of carbon exists or a defect of H2.

- A condItioning step to increase MM value is required through shift reaction. Only a fraction of syngas is fed to the shift section followed by CO2 removal.

- Final MM adjustment is achieved by adding H2 recovered from methanol loop bleed stream.

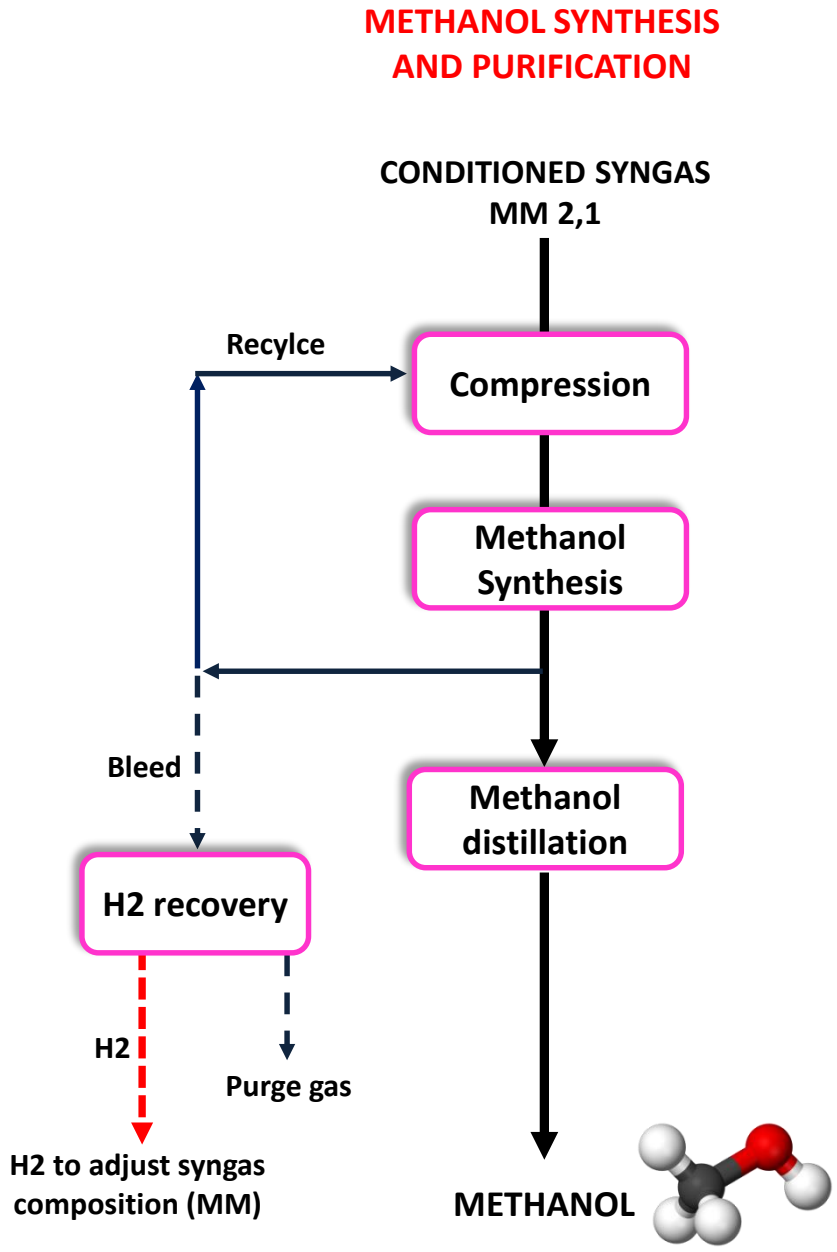
SYNGAS CONDITIONING



CASE STUDY - WASTE TO METHANOL

Methanol synthesis and purification

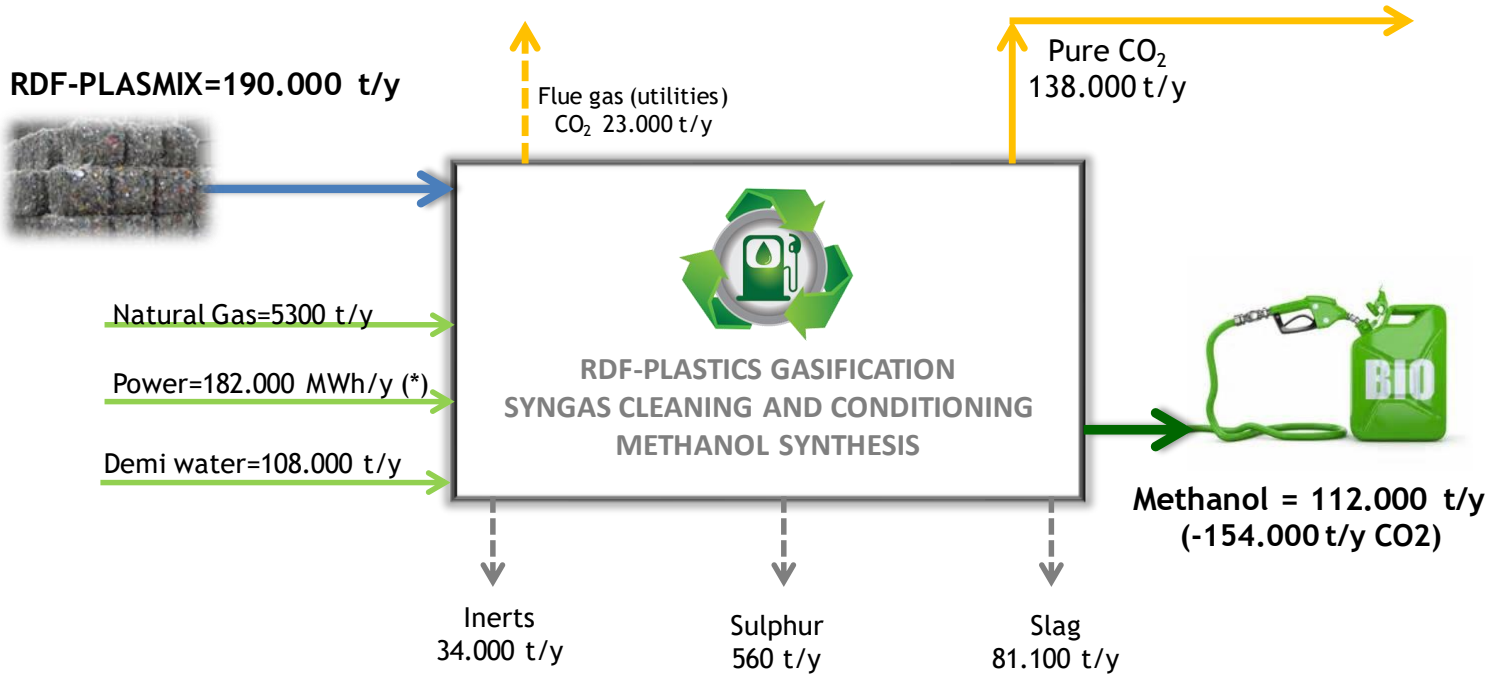
- Syngas composition once adjusted in order to fulfill MM=2,1, is routed to methanol loop.
- Bleed stream is fed to a PSA unit to recover H2 for adjustment of syngas composition (MM value).
- Raw methanol is sent to distillation in order to reach required purity.



CASE STUDY - WASTE TO METHANOL

OVERALL BALANCE FOR A METHANOL CAPACITY OF 340 MTPD

Overall yield	
Methanol yield	**0,58 kgMeOH/kgRDF**



Achievable COP is in the range 170-180 €/ton

(*) **Including power consumption of ASU for Oxygen production**

CONCLUSIONS

The NextChem technology Waste to Chemical represents an economically competitive process performing low carbon footprint

Waste represents a valid source of carbon for chemical production in substitution of fossil feedstock

Chemical conversion of solid waste is a valid alternative to conventional landfill or thermal valorization.

The proposed technology perfectly fits Circular Economic concept, which promotes the use of waste as feedstcok for the synthesis of new products.

Conversion of waste into Fuel and Chemicals results in a very profitable technology accounting for competitive cost of production and environmental benefit.

PRESENTATION TITLE | TITLE A

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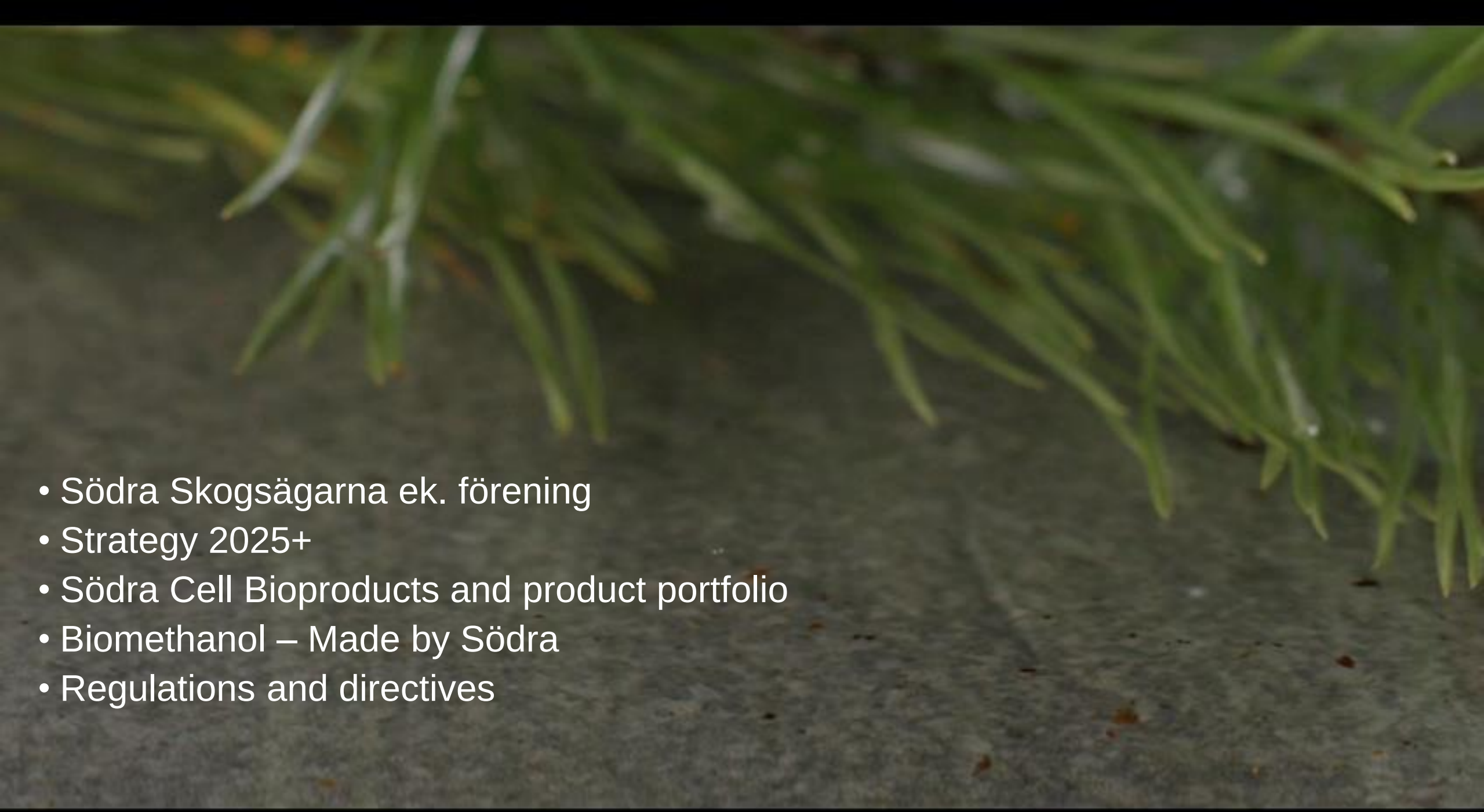
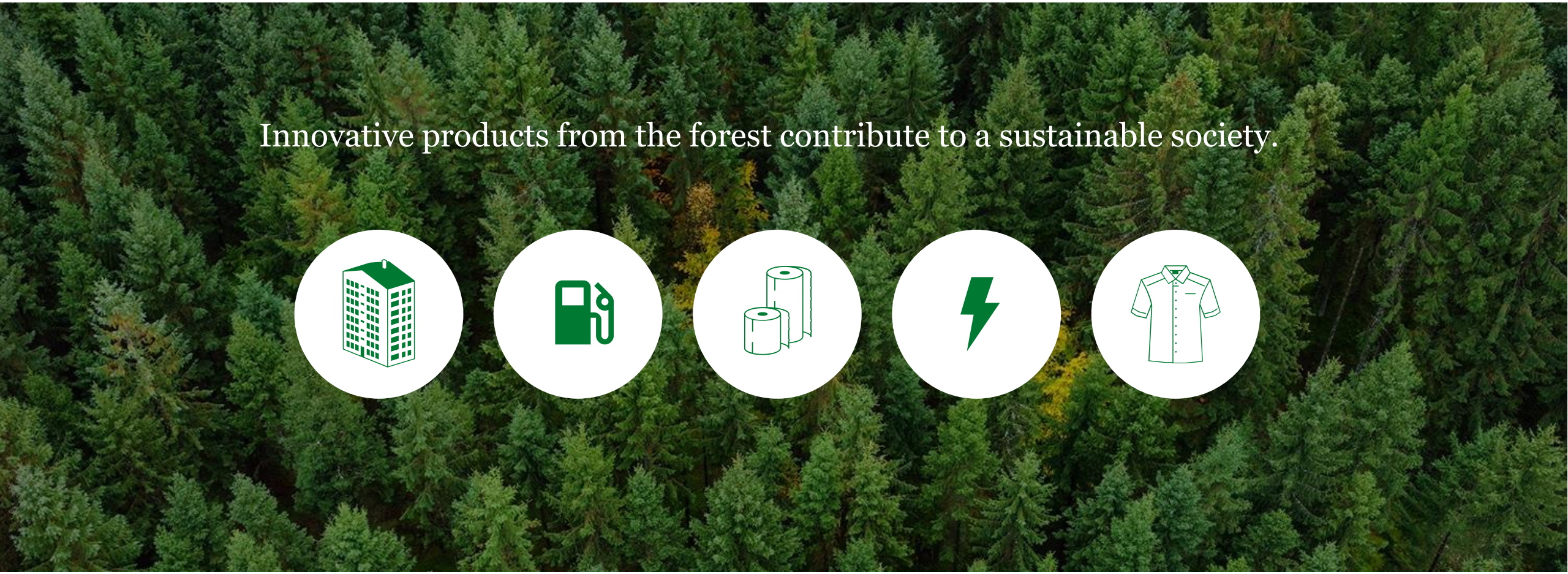
Södra shows the way!
The future is made of trees
SÖDRA

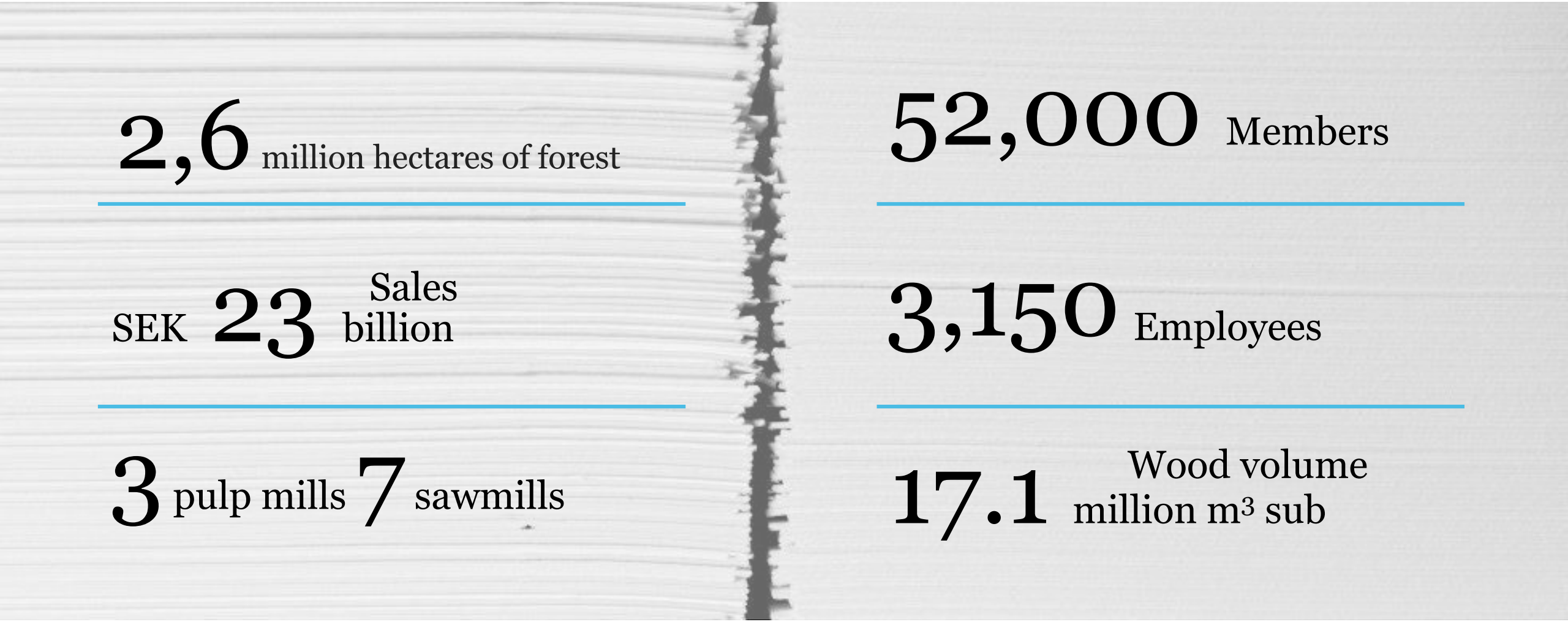


- Södra Skogsägarna ek. förening
- Strategy 2025+
- Södra Cell Bioproducts and product portfolio
- Biomethanol – Made by Södra
- Regulations and directives

Södra – where everything comes from the forest, and innovations grow on trees



Södra in figures



2,6 million hectares of forest

SEK **23** Sales billion

3 pulp mills **7** sawmills

52,000 Members

3,150 Employees

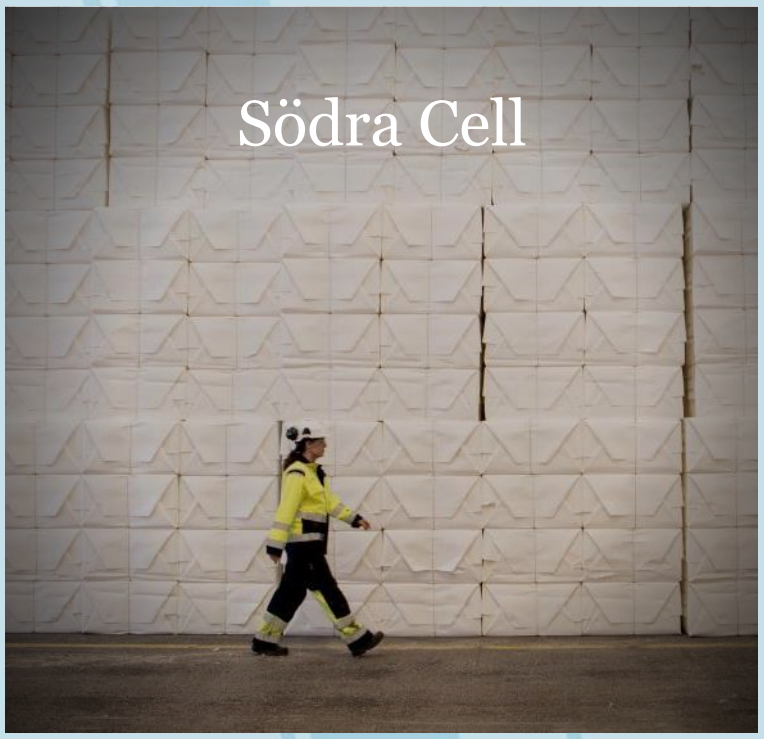
17.1 Wood volume million m³ sub

Södra's assignment from its 52,000 owners

Promote the profitability of forest estates

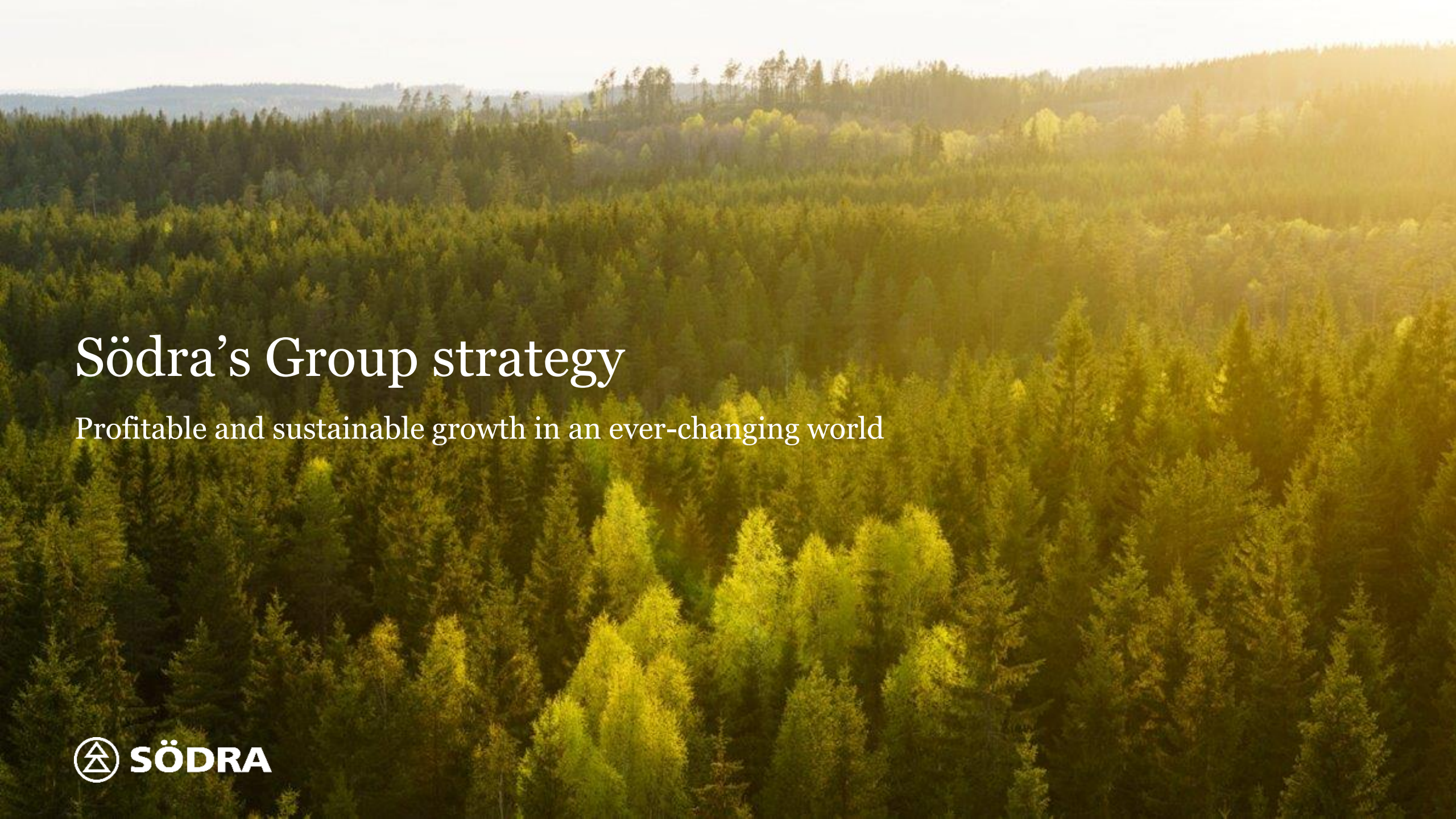
- Forest
- Industry
- Business policy

Three business areas



Values

Value-generating relationships and a long-term approach



Södra’s Group strategy

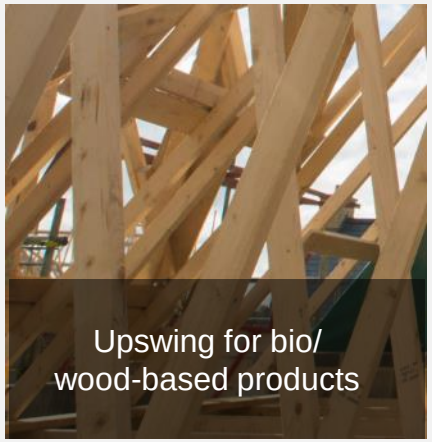
Profitable and sustainable growth in an ever-changing world

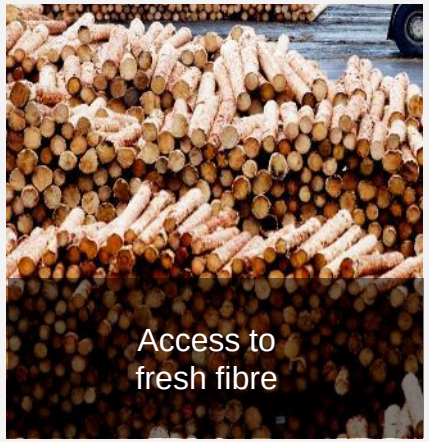
SÖDRA

A rapidly changing external environment

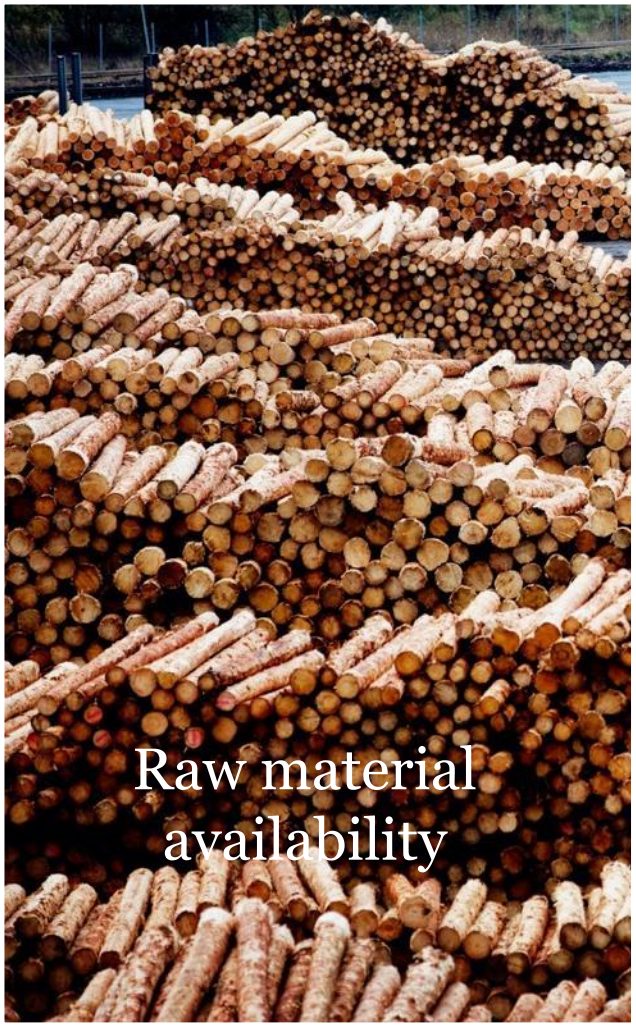
Macrotrends

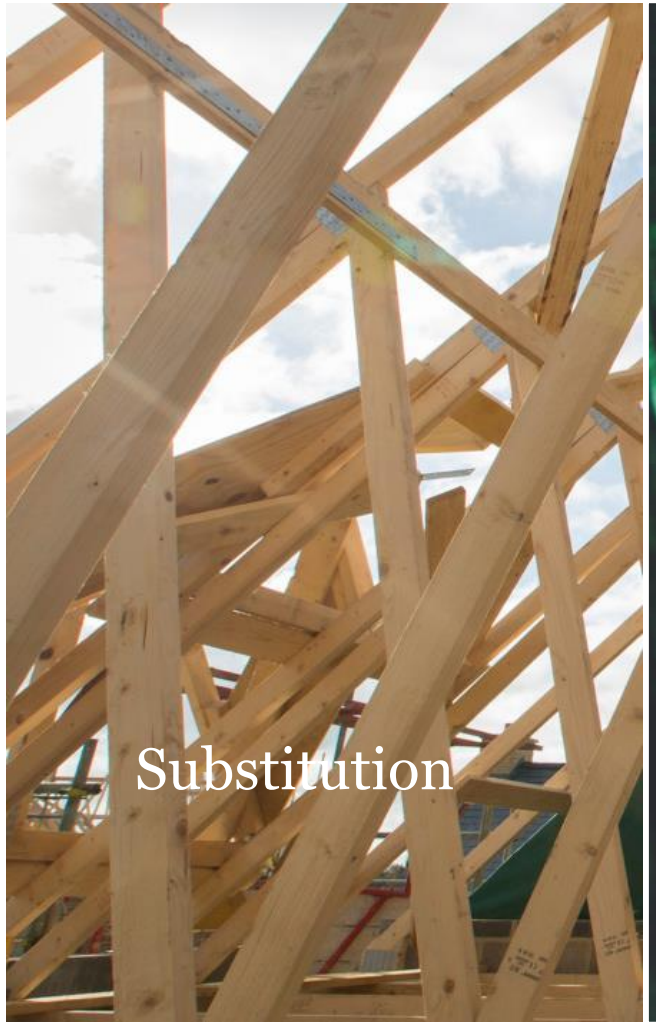
Consequences





How will the forest industry be affected?





Target scenario Södra's Group-strategic focus until 2025+

Increasing amounts of forest raw material in the products of the future

SÖDRA CELL BIOPRODUCTS

VP SÖDRA CELL BIOPRODUCTS

Johannes Bogren

SHARED FUNCTIONS WITH PAPER PULP

CRM, ANALYTICS, LOGISTICS, SUSTAINABILITY etc.

SALES DIRECTOR

Dag Benestad

SALES MANAGER

Viktor Odenbrink

SALES ADMINISTRATOR AND SUPPLY

Camilla Skagerlind

SALES ADMINISTRATOR AND SUPPLY

Christina Karlsson

TECHNICAL PRODUCT MANAGER

Catharina Fechter

Product portfolio

Biomethanol – Refuelling the future

DNV·GL

ISCC Certified Sustainability Certified GHG Savings

Certificate

according to the
Renewable Energy Directive (RED)

(Directive 2009/28/EC on the promotion of the use of energy from renewable sources amended through Directive (EU) 2015/1513)

Certificate Number: EU-ISCC-Cert-SE205-00000171

DNV GL Business Assurance Sweden AB,
Box 6046, Solna, Sweden

certifies that

Södra Skogsägarna Ekonomisk Förening
Nygård 402, 38391 Mönsterås, Sweden

complies with the requirements of the RED and the certification system
ISCC EU
(International Sustainability and Carbon Certification)
which is approved by the European Commission.

This certificate is valid from 07.04.2020 to 06.04.2021

The site of the system user is certified as:

Point of Origin, Processing Unit (Methanol Plant)

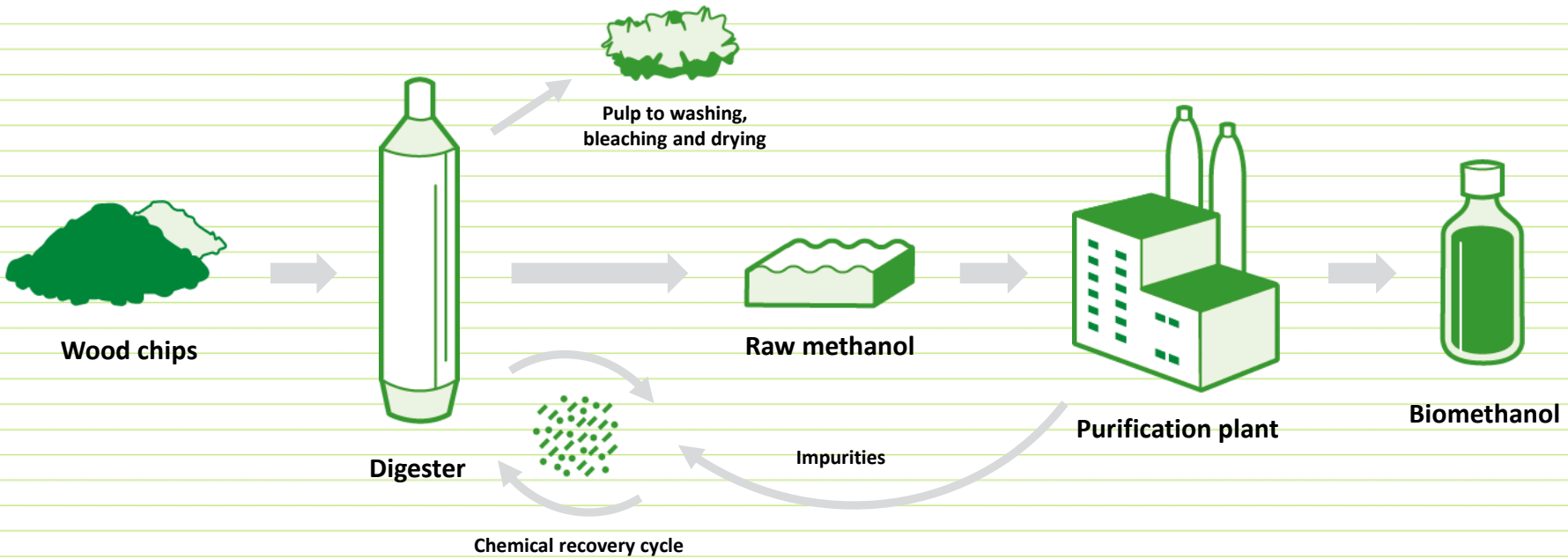
Stockholm 07.04.2020
Place and date of issue

DNV·GL

Stamp, Signature of issuing party

The issuing Certification Body is responsible for the accuracy of this document.
Version / Date: 1 (no adjustments) / 07.04.2020

The process



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Directives and regulations in the EU

- Globally
- EU – RED I & II
- National regulations

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Q&A

Thank you

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