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Renewable Methanol: An Enabler for Carbon Neutrality in the Chemical & Liquid Fuel Sectors

WEDNESDAY, 9 JUNE 2021 • 14:00-14:30 CEST

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SPEAKERS

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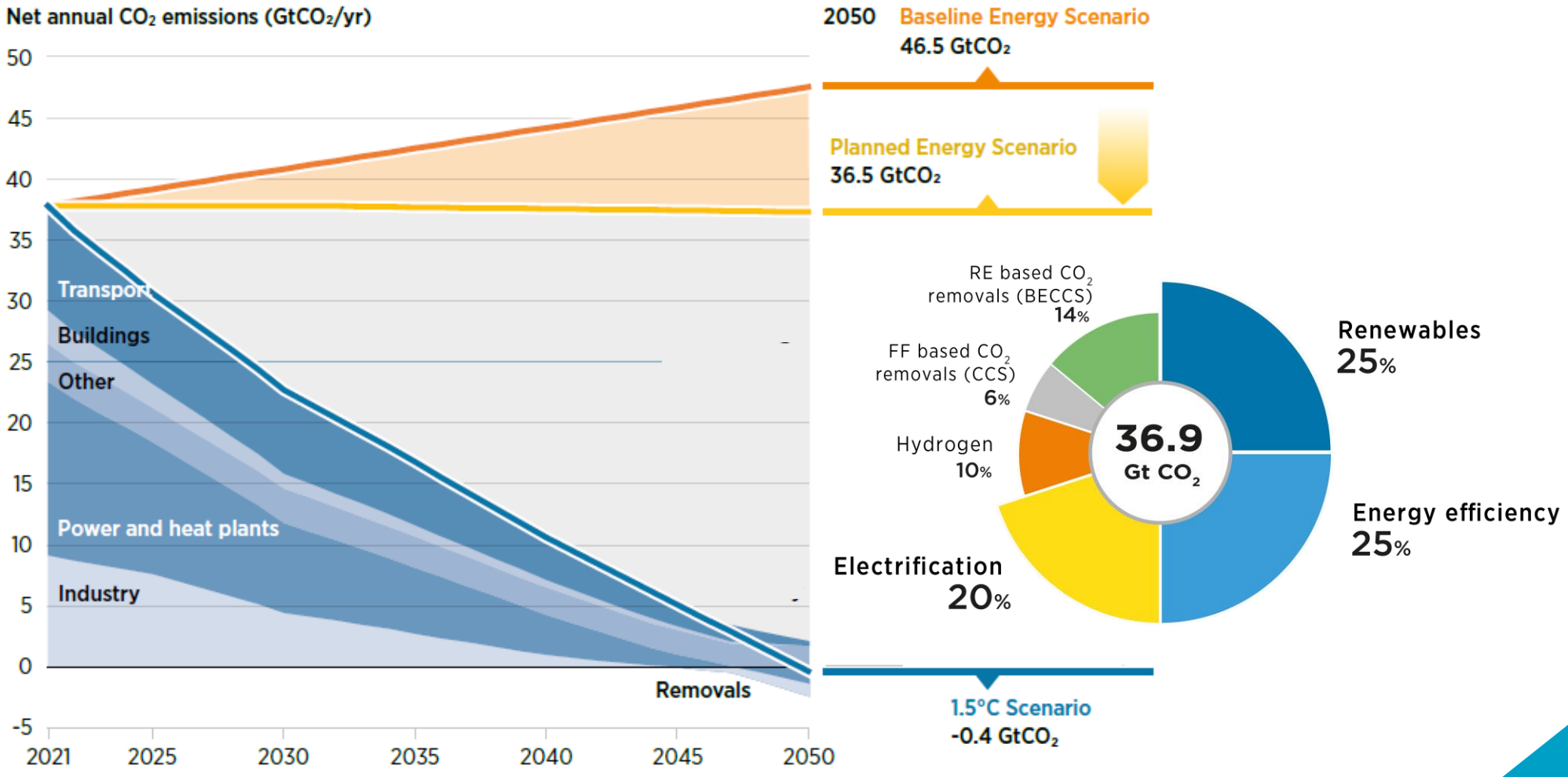
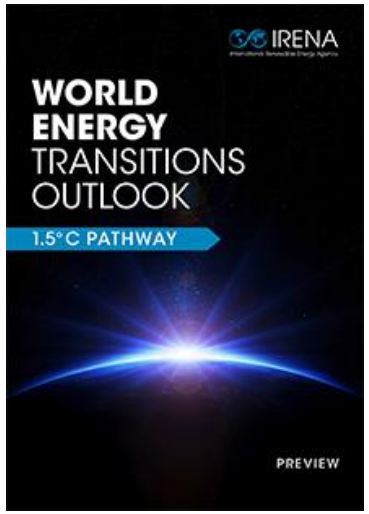
Net-zero goal – requires a daunting pace of change





IRENA's 1.5°C Scenario: Transition to net-zero emissions by mid-century

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90% of all decarbonisation in 2050 will involve renewable energy through direct supply of low-cost power, efficiency, electrification, bioenergy with CCS and green hydrogen.

IRENA analysis of leading scenario studies shows robustness of renewables-based solutions: https://energypost.eu/18-energy-transition-scenarios-to-watch-where-they-agree-and-disagree/

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In a 1.5°C pathway

Hydrogen

demand needs to grow from

120 Mt to 613 Mt

in 2050

Requires: 160 GW electrolysers added every year till 2050; installed capacity in 2020 was 0.3 GW.

Hydrogen and its derivatives will account for 12% of final energy use by 2050.

Biomass

supply needs to sustainably grow from

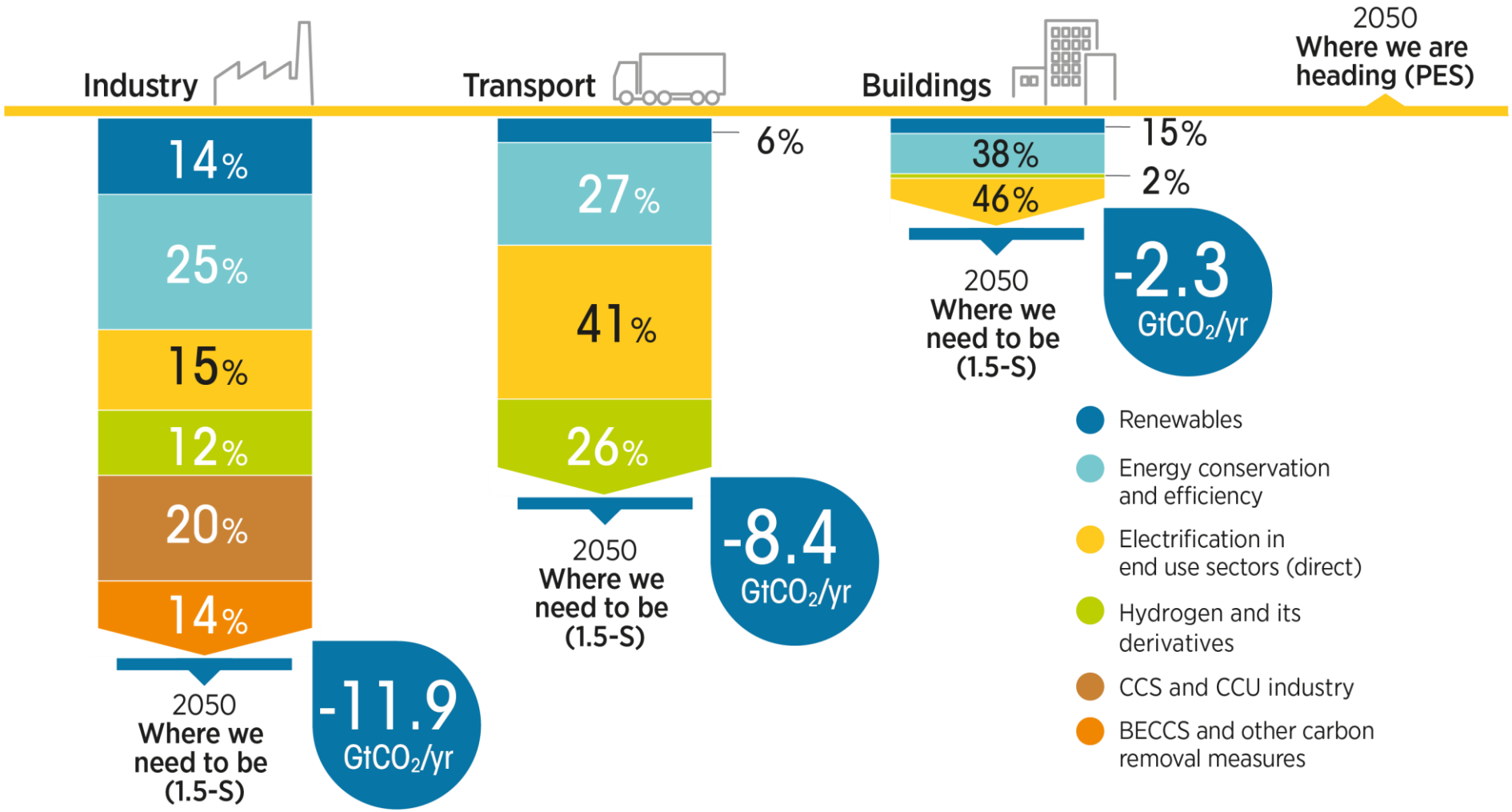
54 EJ to 153 EJ

in 2050

Requires: a tripling of supply and careful management & control to ensure sustainability.

Biomass and its derivatives will account for 18% of final energy use by 2050

Electrification and green hydrogen offer CO_2 reduction solutions for end-use



- In transport, two-thirds of CO_2 reductions come from electrification and hydrogen. In industry, hydrogen and electricity combined contribute to over one-quarter of emission reductions. Direct-use of renewables and energy efficiency remain important in all sectors.

IRENA's Analysis & Networking – Renewable Fuels & Feedstocks

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Analysis

Networks

- Collaborative Framework on Green Hydrogen
- Green hydrogen trade arrangements, standards and certification.
- Collaborations with associations including Methanol Institute & Ammonia Energy Association
- Collaboration with other global institutions: World Economic Forum – enabling frameworks for green hydrogen; UNIDO on industrial decarbonization; Mission Innovation on Bioenergy & Industry.

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Innovation outlook : Renewable methanol

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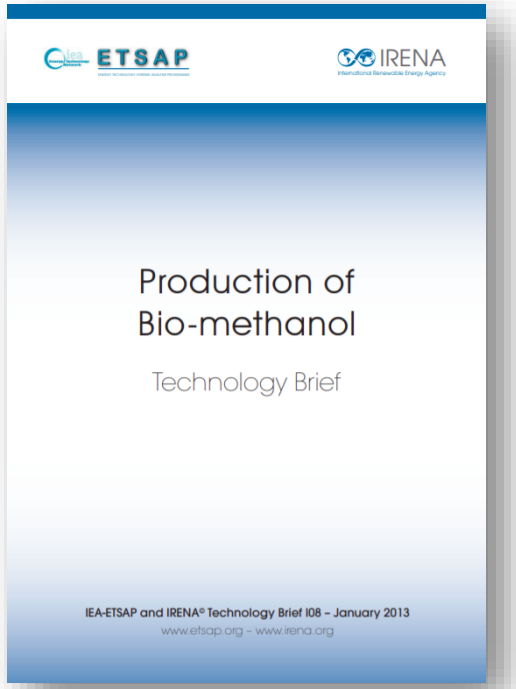
2013: Bio-methanol technology brief



2021: Renewable Methanol Innovation Outlook

- **Methanol** is a **key building block** in the chemical sector
- IRENA assessed the potential of **bio-methanol in 2013**
- Significant **developments** since then
- In 2020 **IRENA and Methanol Institute** partnered to provide the energy community with the latest information and outlook for renewable-methanol

Available at:
www.irena.org/publications

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Rapid growth in global methanol market

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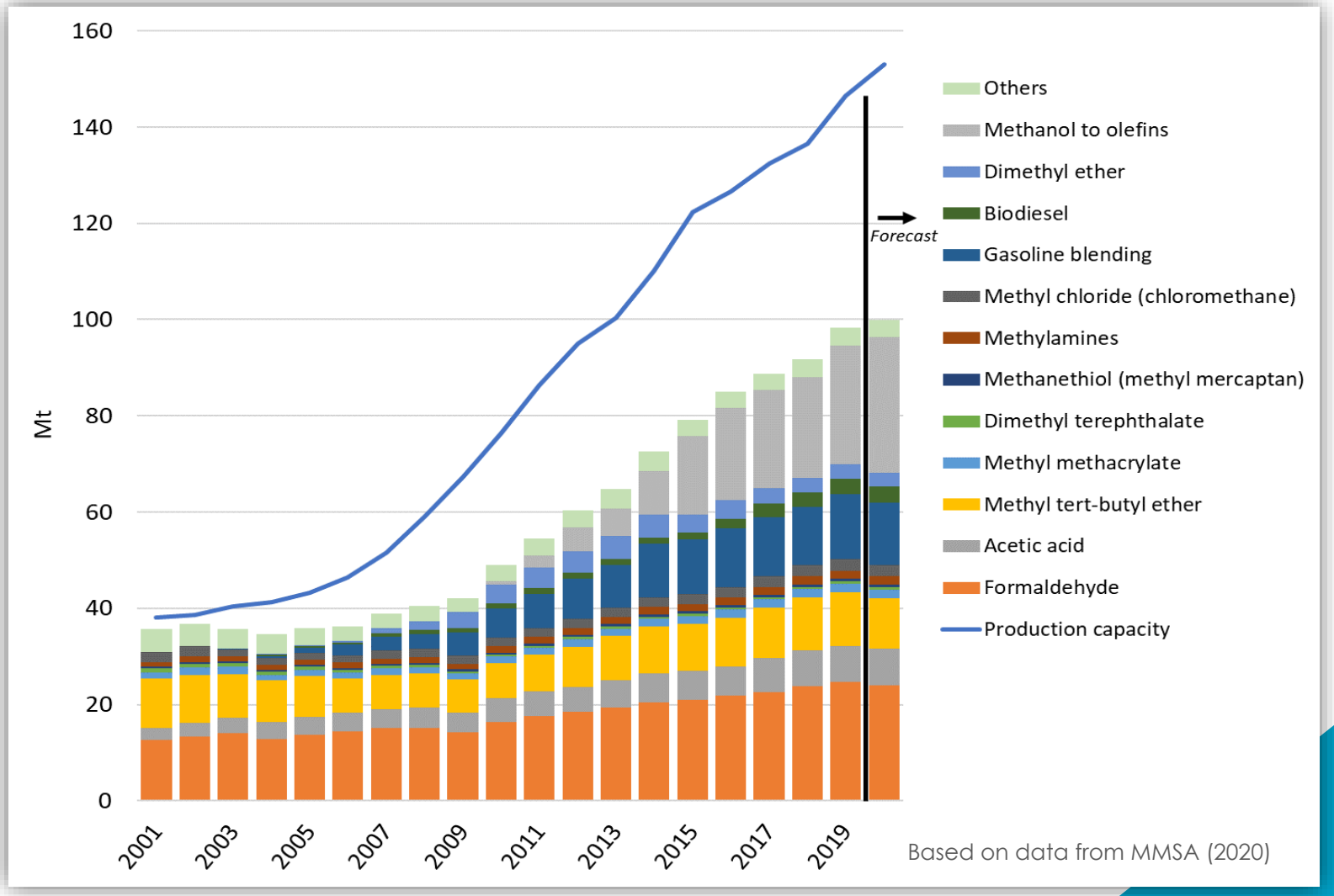
- In the **last 10 years** methanol production capacity and **use has more than double**, from 40Mt in 2009 to **100Mt in 2019**
- Around 2/3 is used in the production of **chemical products** and 1/3 in the production of **fuels**
- Recent applications, such as Methanol-to-Olefins (MtO) for **plastic products are growing even faster**



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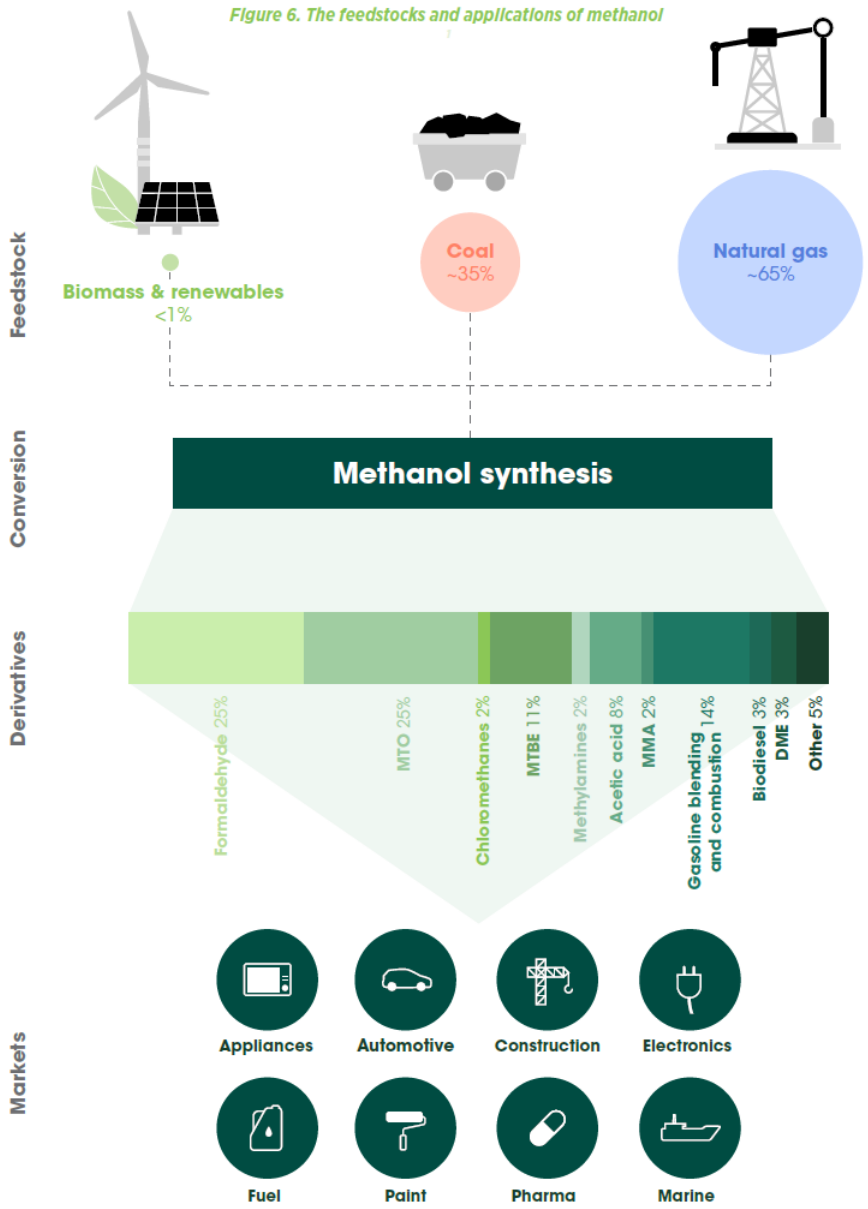
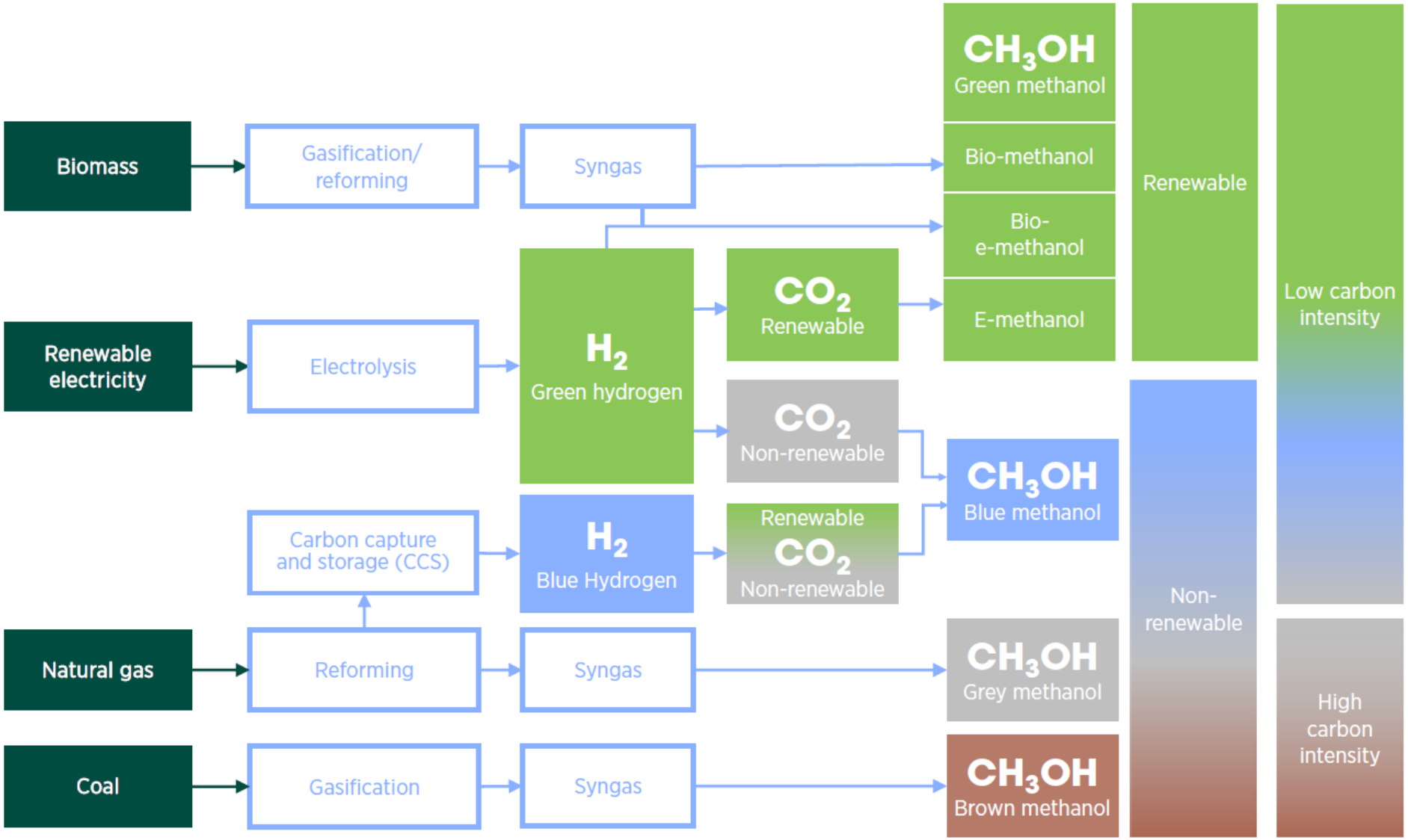
Applications for methanol



- Potential **applications**
  - Chemical building blocks
  - Shipping
  - Fuel cells for road vehicles
- However, today close to 100% of methanol **production comes from fossil fuels** –natural gas and coal-
- **Renewable options**
  - Biomass based route: **Bio-methanol**
  - (now getting traction) Green hydrogen based route: **E-methanol**

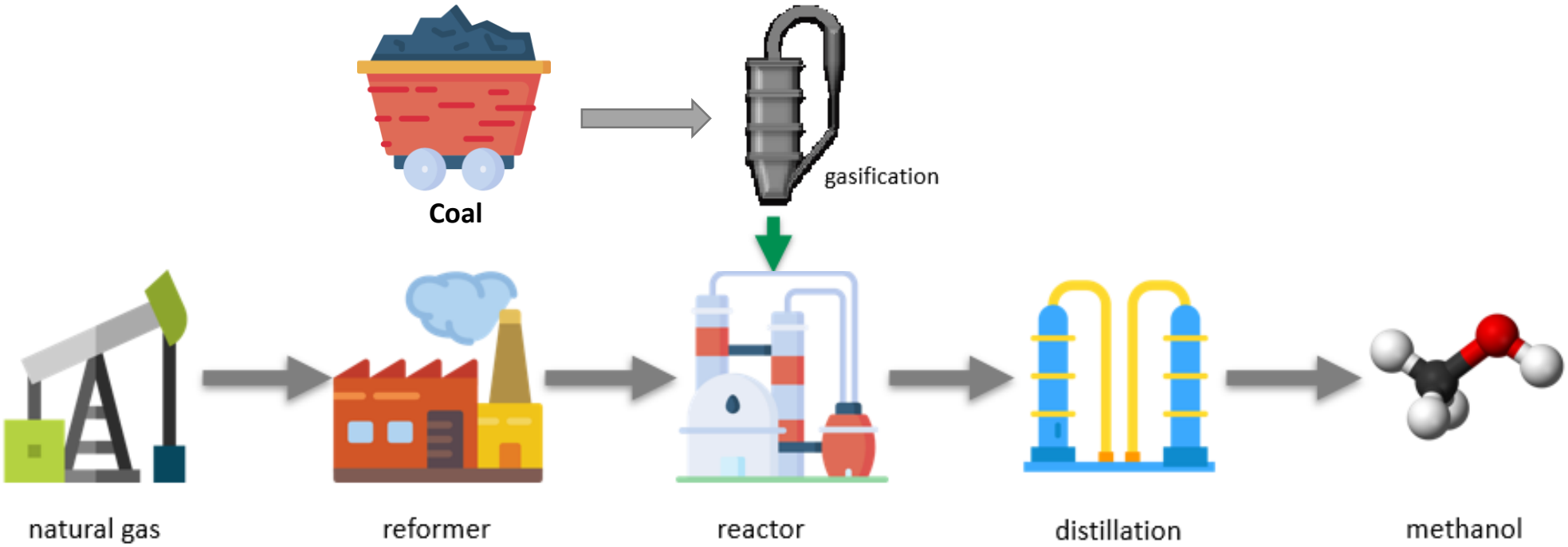
Source: IRENA and MI (2021) Innovation Outlook: Renewable Methanol

Methanol conversion pathways



Methanol from fossil fuels

- Close to 100% of methanol is being produced from fossil fuels : 65% from natural gas, 35 % from coal
- Production from natural gas is the norm in the rest of the world
- Most methanol production capacity using coal is located in China



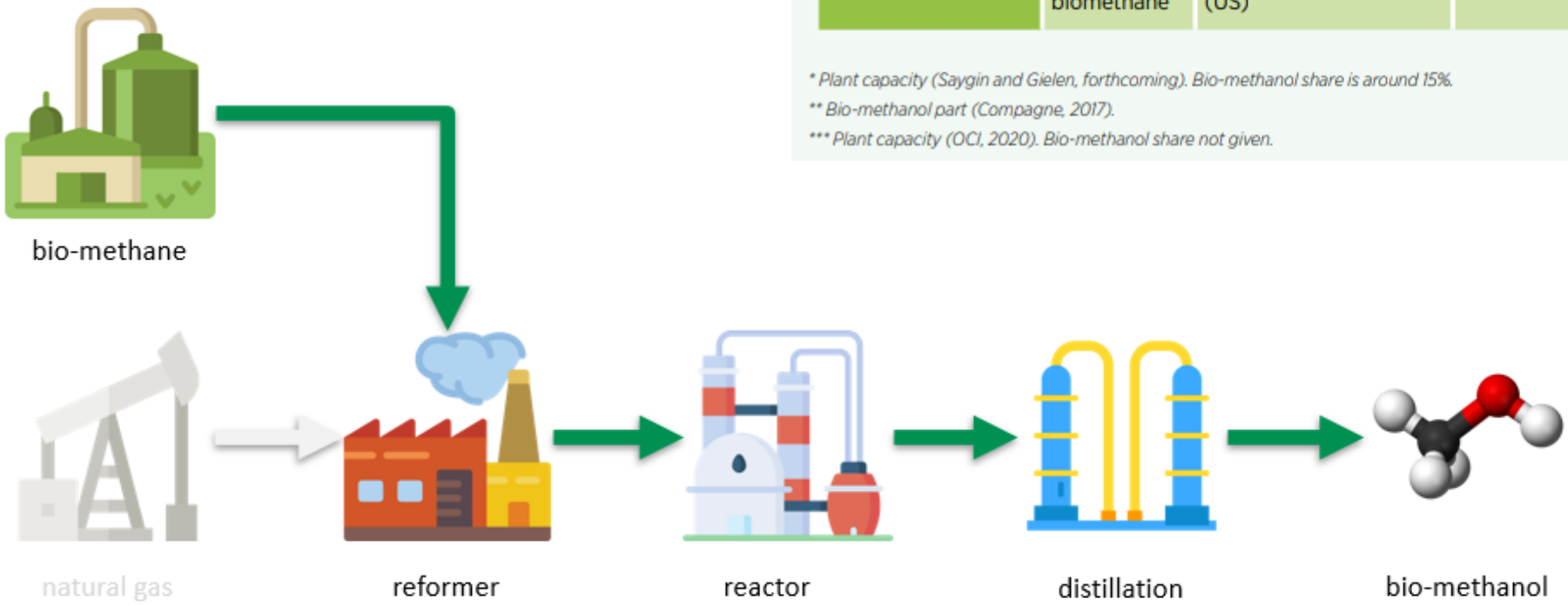
Methanol from biomethane

- Biomethane can be blended or co-feed with natural gas to produce methanol
- About 540 units produce biomethane out of 18 000 biogas units in EU (2019)
- Very little or no technical change need

Table 5. Methanol plants co-fed with a mix of natural gas and biomethane

Technology	Feedstock	Project, reference	Project phase	Product	Plant capacity
Steam reforming	Natural gas/ biomethane	BASF, Ludwigshafen (DE)	Operational	Methanol	480 kt/y* (2018)
Steam reforming	Natural gas/ biomethane	OCI/BioMCN Groningen (NL)	Operational	Methanol	60 kt/y** (2017)
Steam reforming	Natural gas/ biomethane	OCI Beaumont Texas (US)	Operational	Methanol	1 075 kt/y (2020)***

** Plant capacity (Saygin and Gielen, forthcoming). Bio-methanol share is around 15%.*
*** Bio-methanol part (Compagne, 2017).*
**** Plant capacity (OCI, 2020). Bio-methanol share not given.*



Methanol via biomass/MSW gasification

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- Gasification route enables a wide variety of biomass feedstock
- Technology is similar to commercial gasification technology
- Feedstock preparation is a key step for biomass/MSW

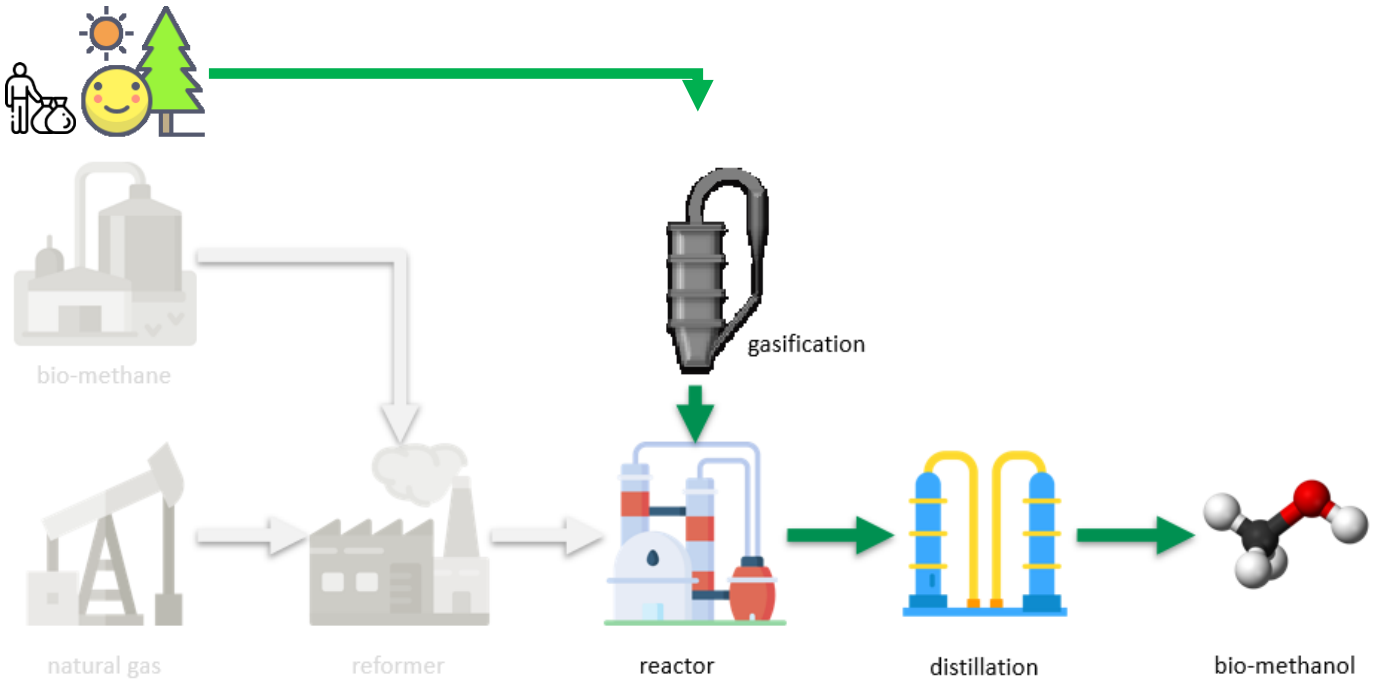


Table 4. Gasification technologies and their application

Gasification technology Name/owner	Heating principle	Type	Feedstock	Project, reference	Project phase	Product	Plant capacity (unit varies) kt/year
SES Gasification Technology (U-Gas)	DO_2	BB	Biomass/ MSW	Trans World Energy, Florida (US) (Trans World Energy, 2020)	FEED done, start-up Q2 2023	Methanol	875 kt/y
NextChem Technology	DO_2	UO_2	MSW	ENI Refinery, Livorno, Italian (IT) (NextChem, 2020b)	Basic engineering ready Q3 2020	Methanol	115 kt/y
			MSW/ waste wood	LowLand Methanol (NL) (LowLands Methanol, 2020)	Start-up early 2023	Methanol	120 kt/y
PDQ/ Thyssenkrupp	DO_2	EF	Biomass (torrefied)	BioTfueL Demo Project (FR) (BioTfuel, 2020)	Operational	FT products (slipstream based)	15 MWt of biomass
HTW/ Thyssenkrupp	DO_2	BB	Biomass	Värmlands-metanol (SE) (Värmlandsmetanol, 2017)	Planning	Methanol	100 kt/y
TRI	IH	BB	MSW	Fulcrum (US) (TRI, 2020)	Start-up Q4 2020	FT products	40 000 m^3/y
Bioliq/KIT	DO_2	EF	Pyrolysis oil from straw	Bioliq Demo project (DE) (KIT, 2020)	Operational	Gasoline via DME	5 MW_t of biomass
Chemrec	DO_2	EF	Black liquor	BioDME demo plant (SE) (Chemrec, 2020)	Idling	DME (via methanol)	4 t/d
Enerkem (Enerkem, 2020a)	DO_2	BB	MSW	Edmonton (CA)	Operational	Ethanol (via methanol)	30 kt/y
	DO_2	BB	MSW	Quebec (CA)	Announced construction	Ethanol (via methanol)	35 kt/y
	DO_2	BB	MSW	Rotterdam (NL)	Engineering	Methanol	215 kt/y
	DO_2	BB	MSW	Saragossa (SP)	Engineering	Methanol	215 kt/y
Sungas and GTI (U-Gas)	DO_2	BB	Biomass	GTI demo, Chicago (US) (SunGas Renewables, 2020)	Operational	Syngas	5 MW_t of biomass
TCG Global	IH	U-IH	Biomass	Red Rock Biofuels (Red Rock Biofuels, 2020)	Under Construction Start-up 2021	FT products	58 000 m^3/y

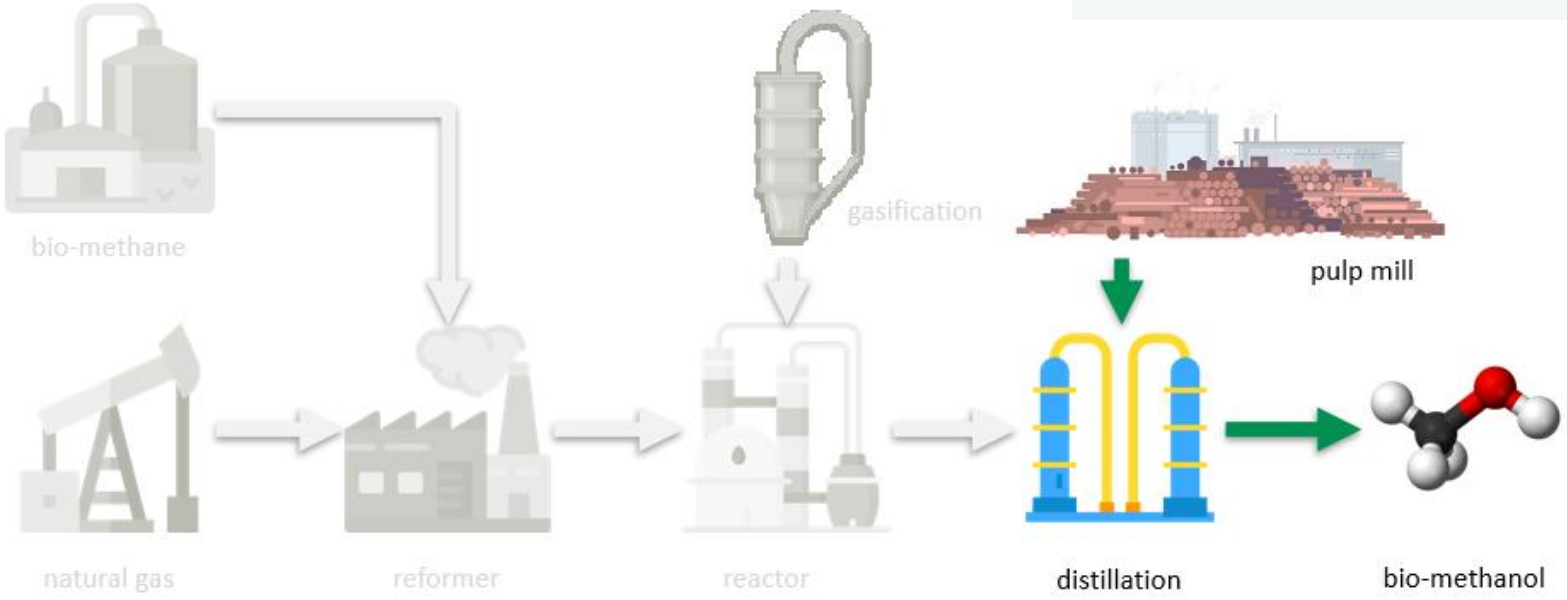
Notes: *FEED = front-end engineering design; FT = Fischer Tropsch; kt/y = thousand tonnes per year; MWt = megawatt thermal; t/d = tonnes per day.*

Methanol from pulping cycle

- Raw methanol is formed in the digester where wood chips react with the cooking chemicals
- Global estimate with pulp processing shows up to 1.2 Mt/yr of methanol

Table 6. By-product bio-methanol from wood pulping

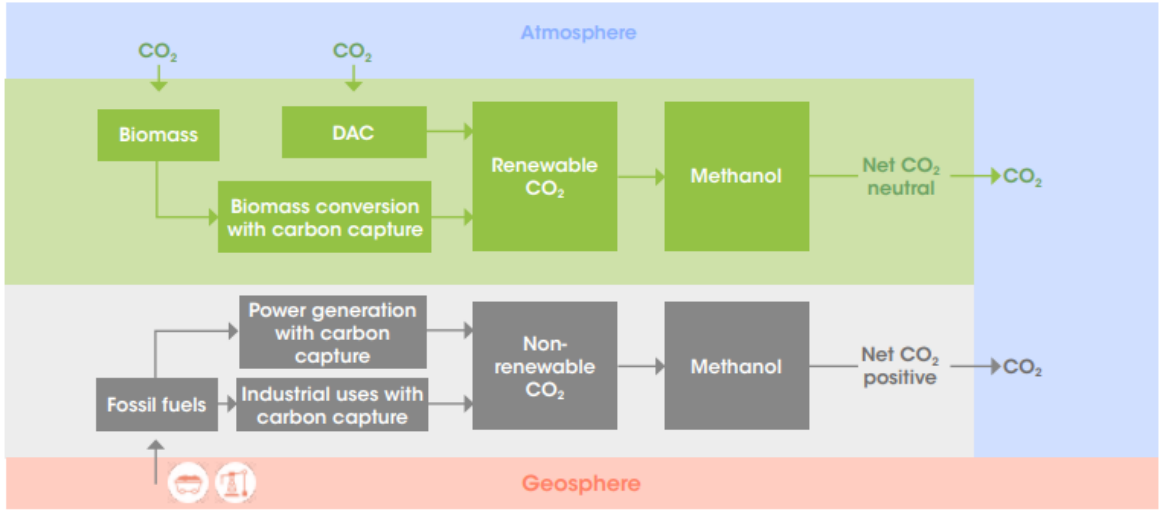
Technology	Feedstock	Project	Project phase	Product	Plant capacity
Andritz	By-product from wood pulping	Södra Mill, Mönsterås (SE)	Operational	Bio-methanol	5.25 kt/y
Not known	By-product from wood pulping	Alberta Pacific (CA)	Operational	Bio-methanol	3 kt/y

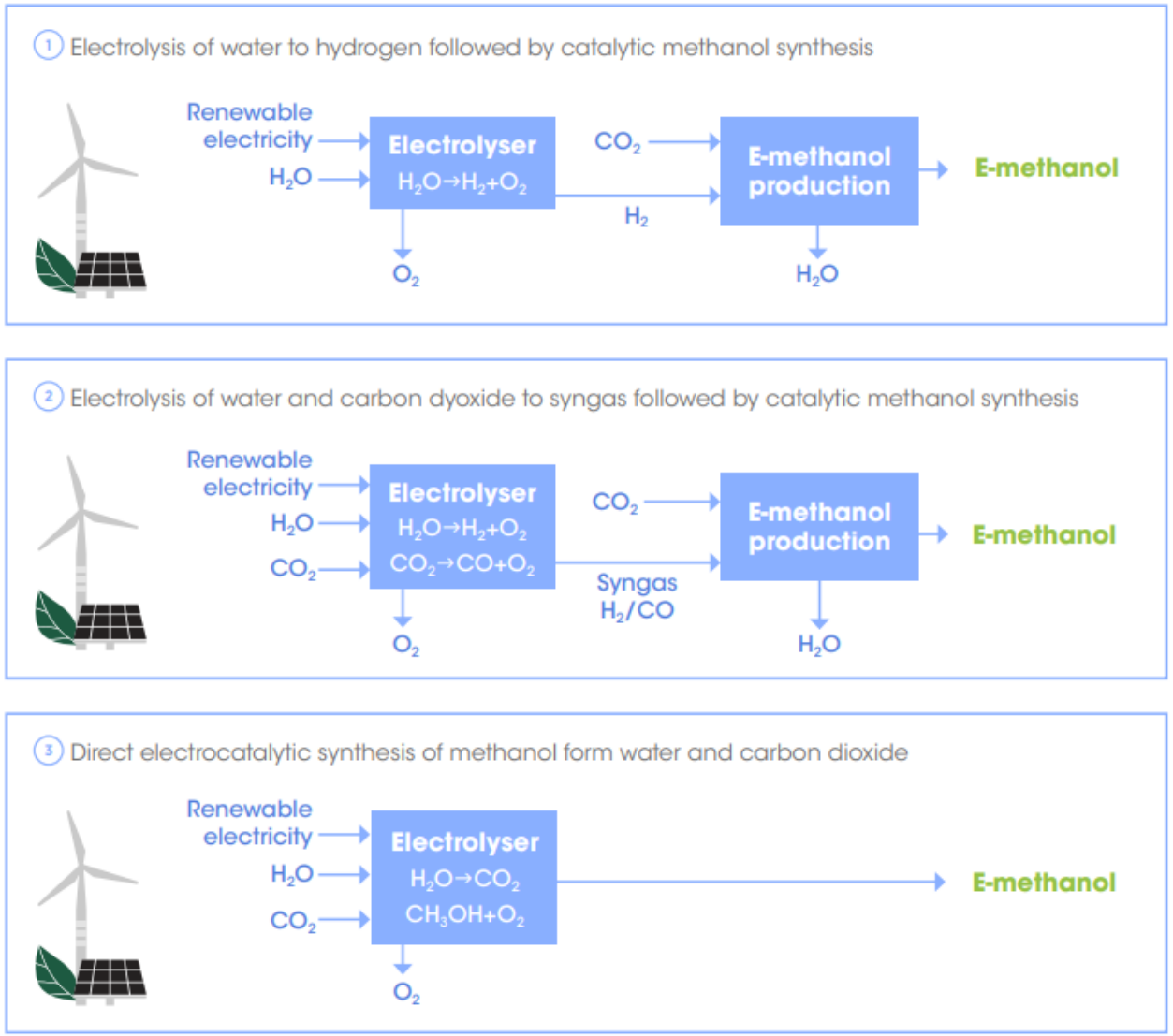


E-methanol - PtX

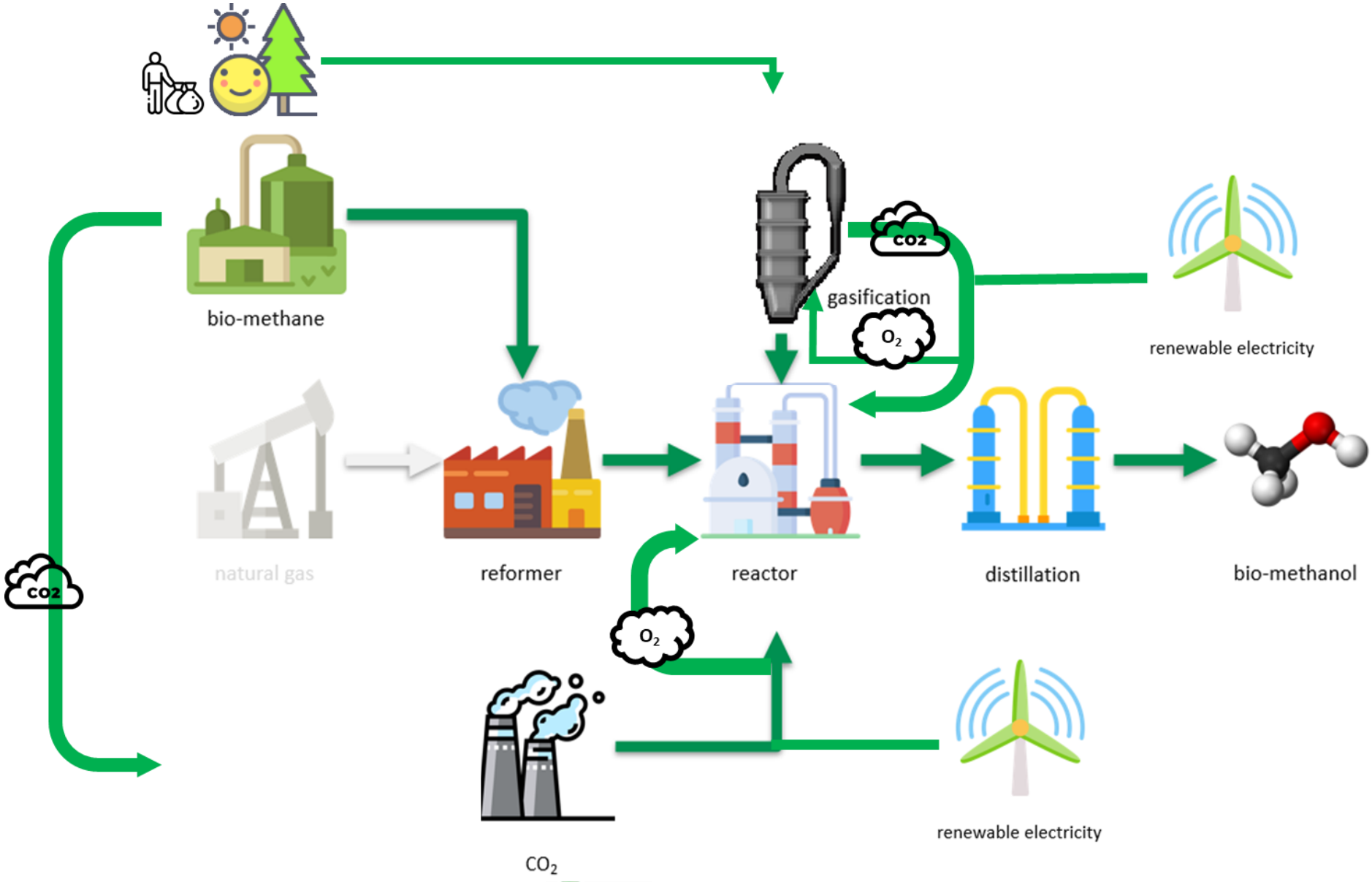
- E-methanol is obtainable from CO_2 and green hydrogen through a catalytic process

- CO_2 feedstock for e-methanol
  - Industrial sources
  - DAC or BECCS/U

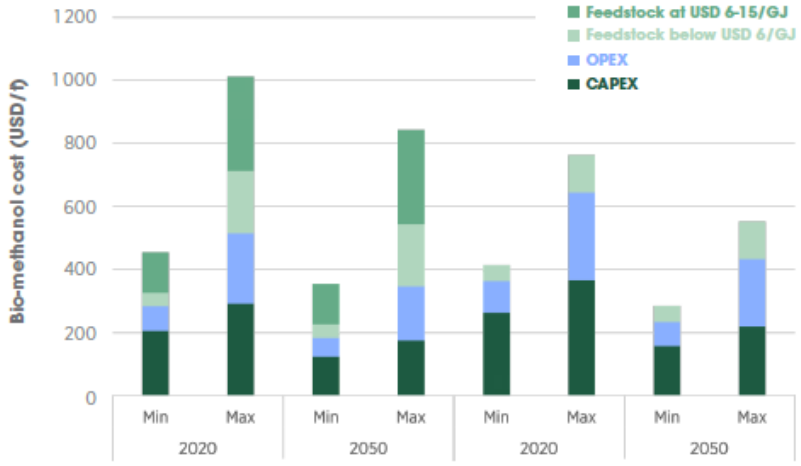


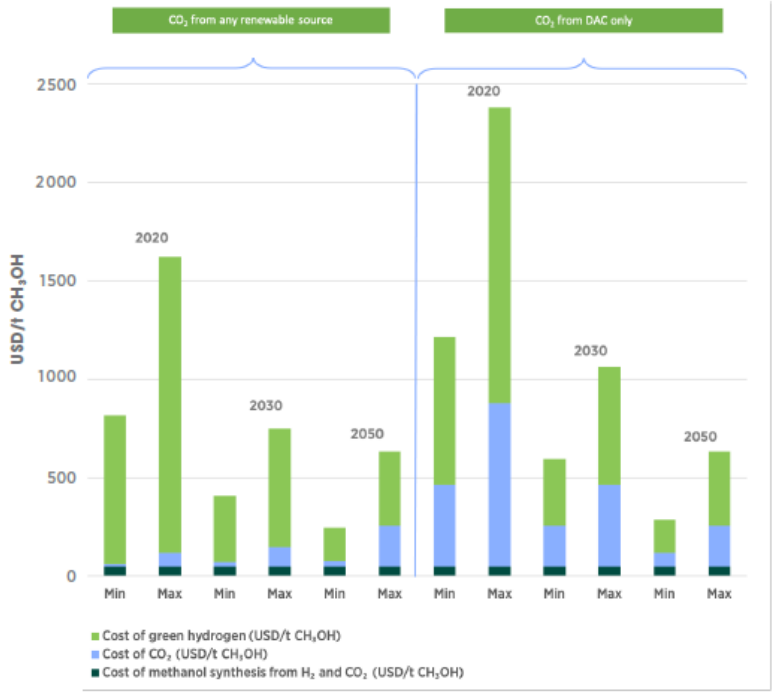


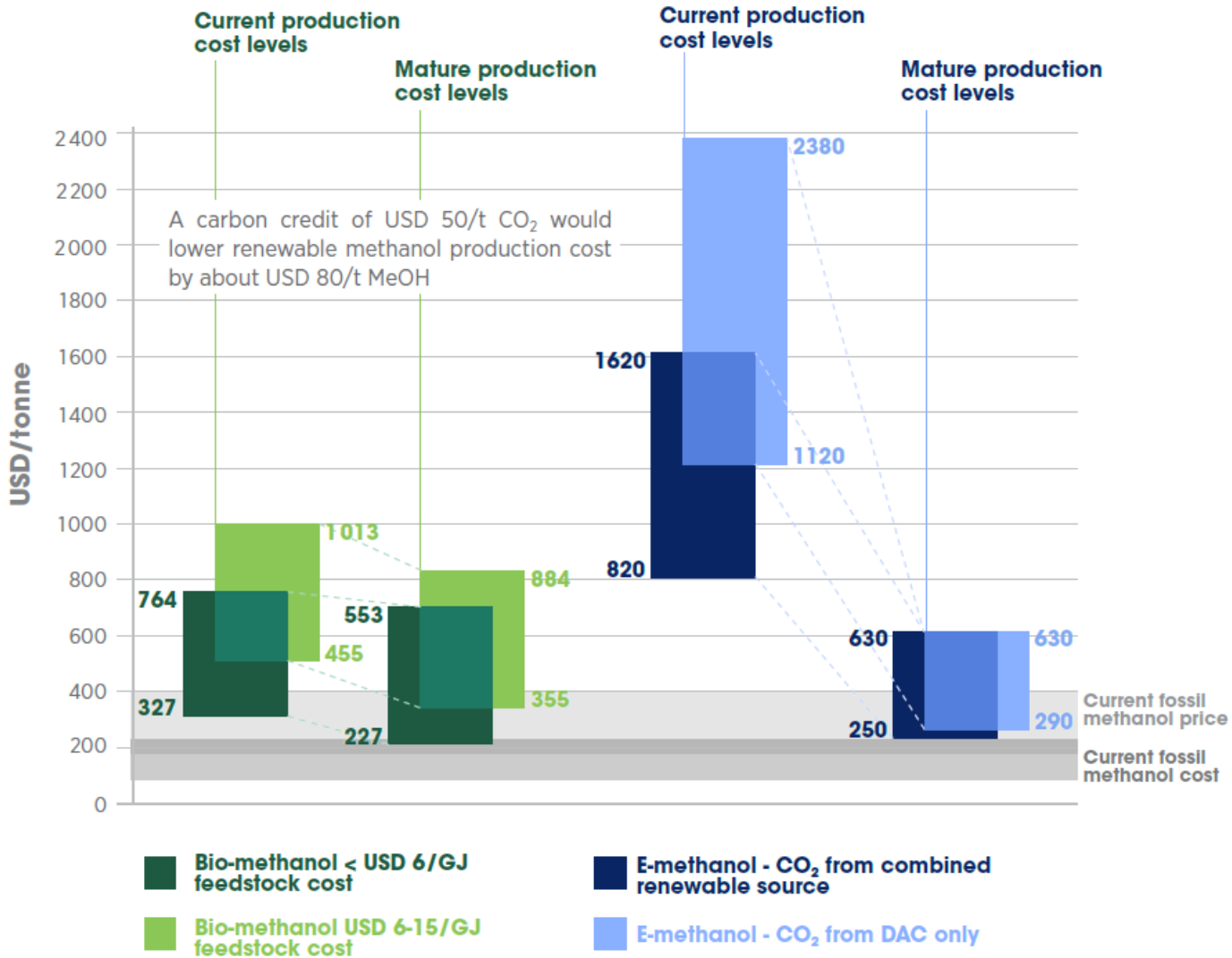
Combined bio and e-methanol



Renewable methanol cost competitiveness







Facilitating the transition to renewable methanol

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- Ensure systematic investment throughout the value chain, including technology development, infrastructure and deployment
- Create a level playing field through public polity to facilitate sector-coupling
- Support market forces in the chemical sector, focusing on carbon intensity in consumer products
- Acknowledge how renewable methanol can contribute to carbon neutrality in "green deals," COVID-19 economic recovery packages, and hydrogen strategies
- Translate the political will for carbon reduction into regulatory measures and support to facilitate long-term growth
- Encourage international co-operation on trade strategies to create jobs and foster competitive new industries for e-methanol in both producing and consuming regions
- Institute policy instruments to ensure equitable tax treatment and a long-term guaranteed price floor for renewable methanol and other promising fuels

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Q & A
10 min

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