CO_2 valorisation

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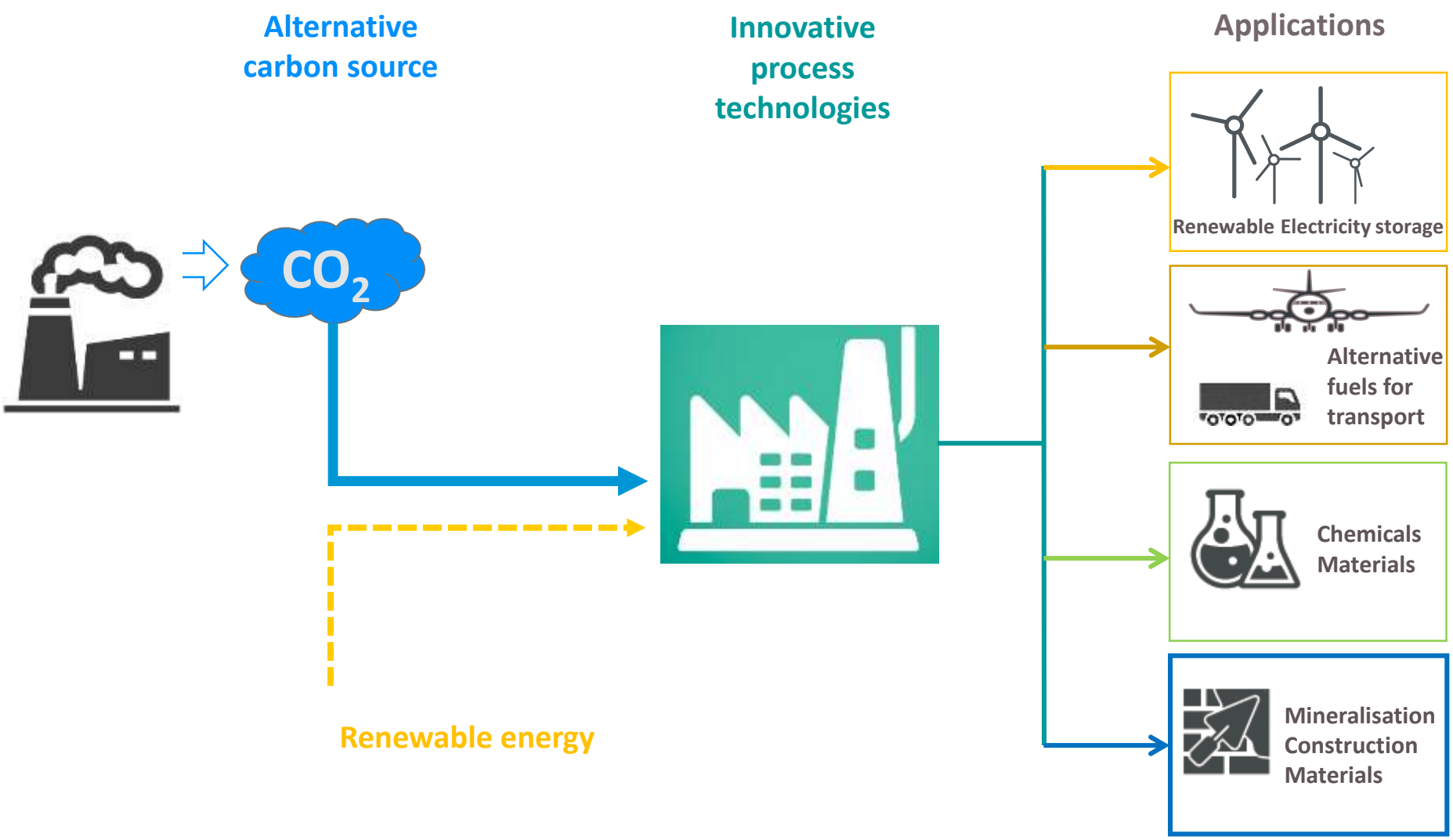
Chemical sector - Valorisation of CO_2

CO_2 an alternative source of carbon

Reduce Re-use Replace Re-invent

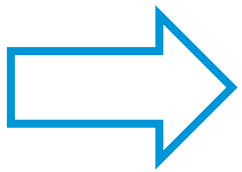
Energy & Resource Efficiency
Industrial symbiosis

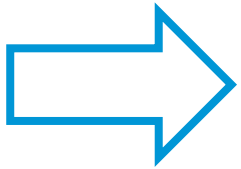
Chemical valorisation of CO_2

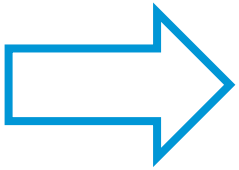


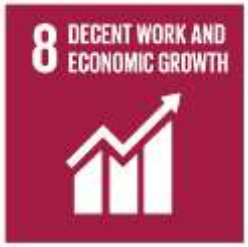
CO_2 valorization

- Sustainable production of chemicals, materials
- Produce advanced alternative fuels
- Store renewable energy
- Leadership in clean technologies
- Business opportunities









CO_2 valorization

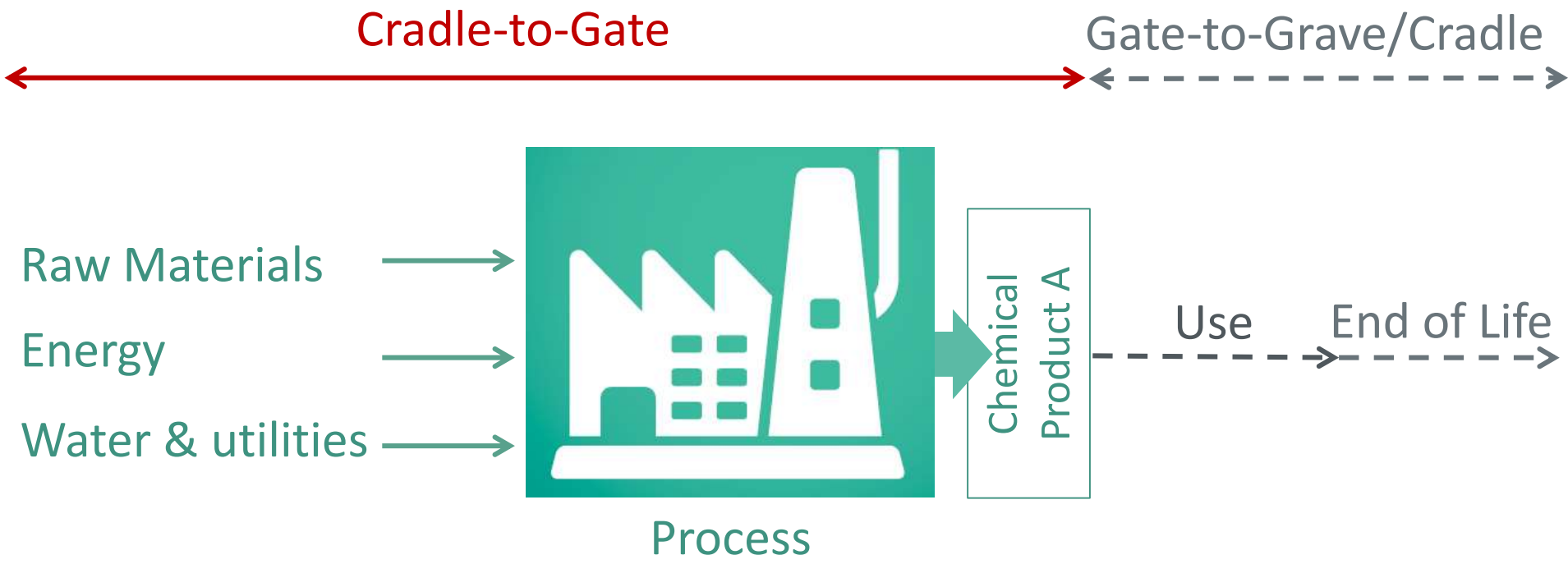
- Sustainable production of chemicals, materials
- Produce advanced alternative fuels
- Store renewable energy
- Decrease CO_2 emissions
- Leadership in clean technologies

European Policy

- **Circular Economy** and Resource efficiency
- **Energy**
  - "Decarbonisation" of the transport sector
  - Renewable energy storage
- **Climate**
- **Industrial policy**

Growth & Jobs

Carbon emissions reduction potential



Carbon Footprint - Production of chemical product A

Carbon source								
								Cradle-to-Gate Carbon Footprint (CF)
	**Feedstock 1 C_{CO2}** CF (incl. capture and purification)	+	Energy 1 & other utilities CF	+	Process 1 CF with appropriate consideration of co-products(s)	=	CF1 of Product A containing C_{CO2}
	**Feedstock 2 C_{Waste}** CF (incl. logistic and pre-treatment	+	Energy 2 & other utilities CF	+	Process 2 CF with appropriate consideration of co-products(s)	=	CF2 of Product A containing C_{Waste}
	**Feedstock 3 $C_{Biomass}$** CF (incl. cultivation, harvesting, logistic)	+	Energy 3 & other utilities CF	+	Process 3 CF with appropriate consideration of co-products(s)	=	CF3 of Product A containing $C_{Biomass}$
	**Feedstock 4 C_{Fossil}** CF (incl. extraction, refining)	+	Energy 4 & other utilities CF	+	Process 4 CF with appropriate consideration of co-products(s)	=	CF4 of Product A containing C_{Fossil}

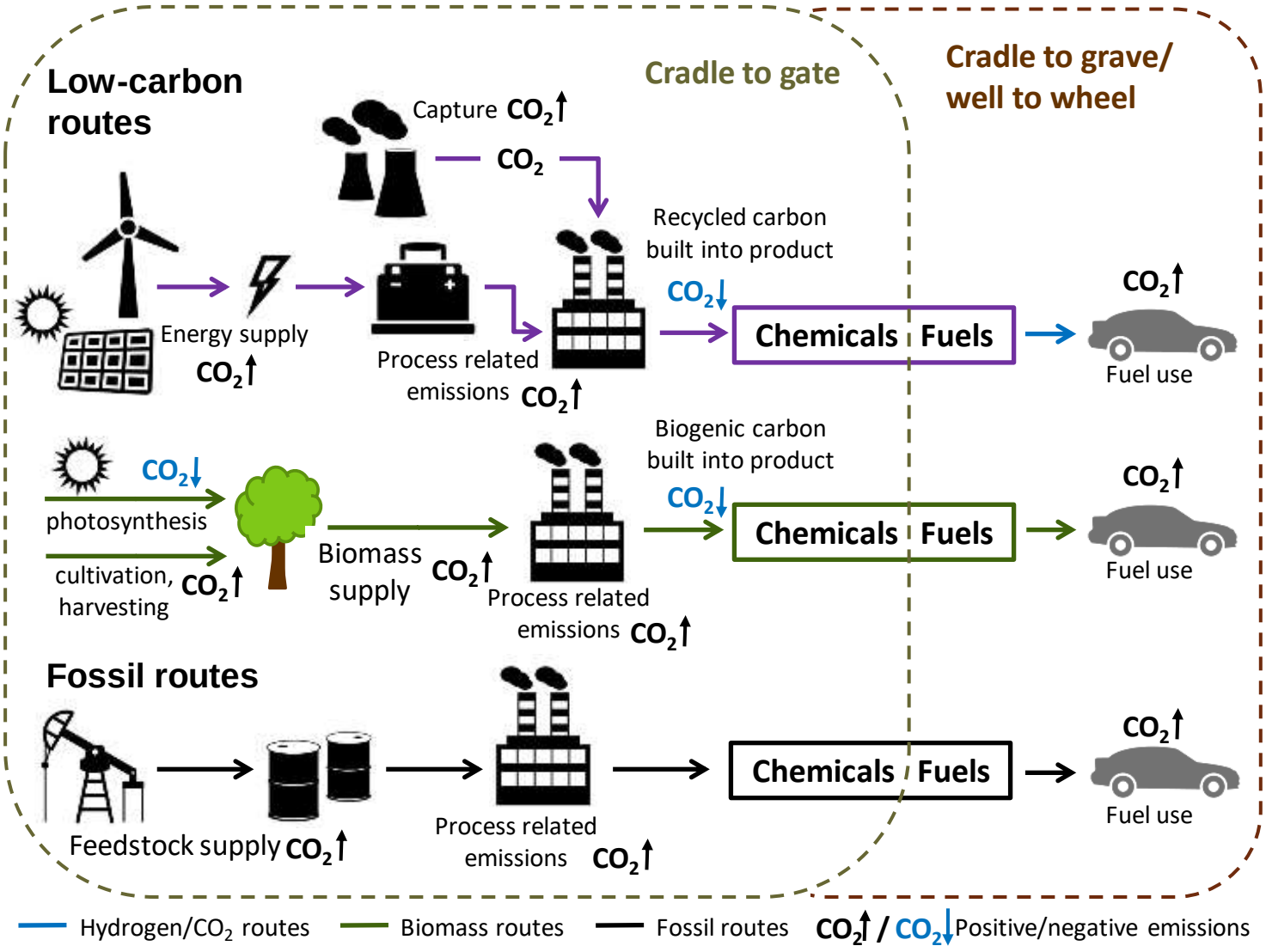
Potential Impact of CO_2 valorisation

CO_2-based chemical Product A vs Fossil-based chemical Product A:

$$\Delta_{(CO_2 \text{ emissions})} = \text{CO_2 emissions from the production of Fossil-based Chemical Product A (CF4)} - \text{CO_2 emissions from the production of CO_2-based Chemical Product A (CF1)}$$

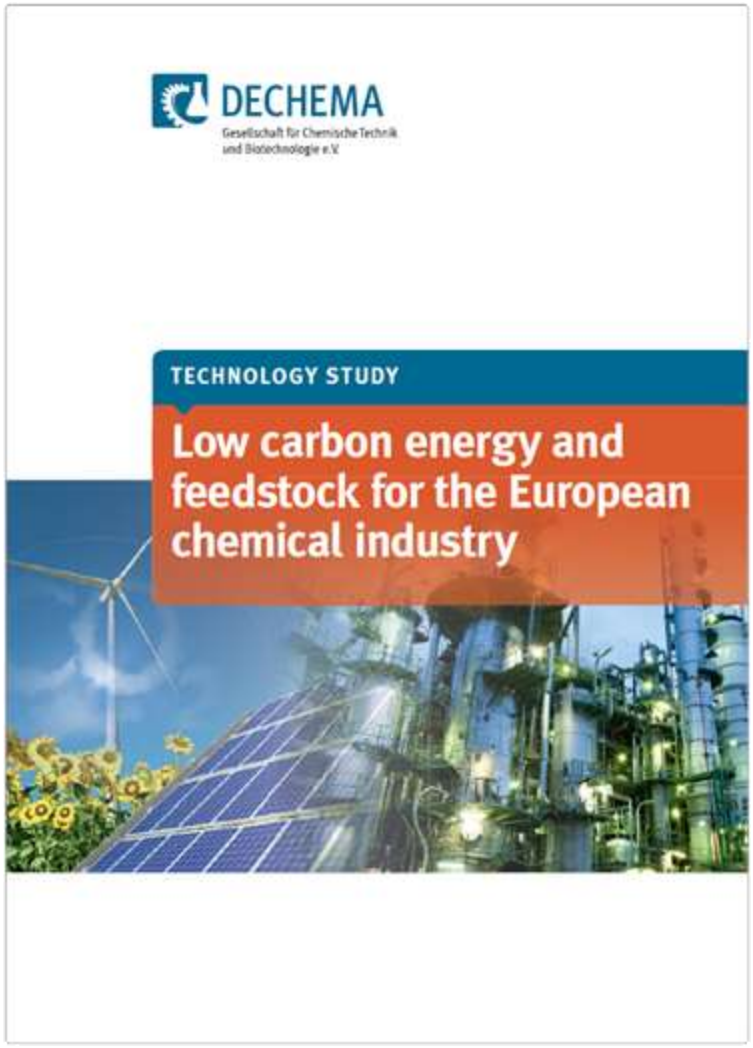
Potential impact of CO_2 valorisation

Appropriate evaluation of CO_2 emissions reduction. Not volume of CO_2 stored.



Source: DECHEMA Low carbon energy and feedstock for the European chemical industry (2017)

Low carbon energy and feedstock for the European chemical industry



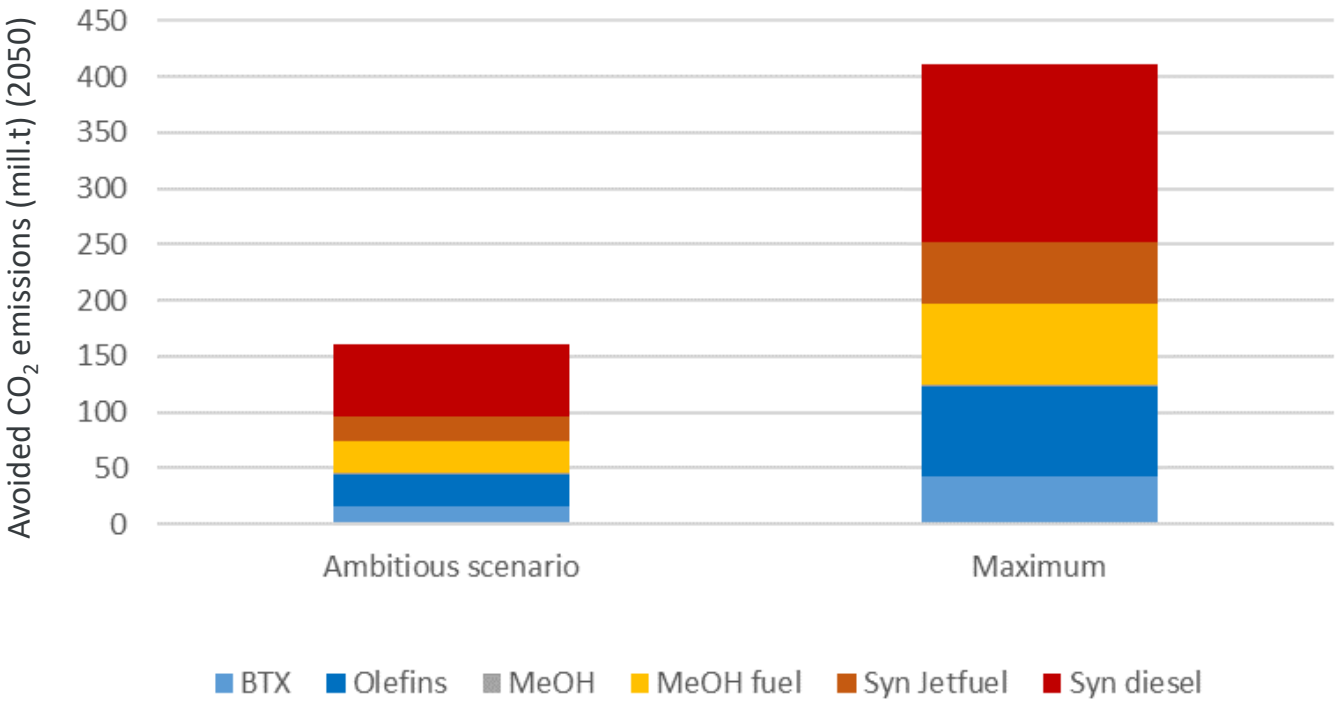
How the European chemical industry can become carbon neutral by 2050 ?

Focus on major chemical building blocks

Includes study of CO_2 as alternative carbon source for the production of methanol, olefins, BTX, and fuels

DECHEMA Low carbon energy and feedstock for the European chemical industry (2017)

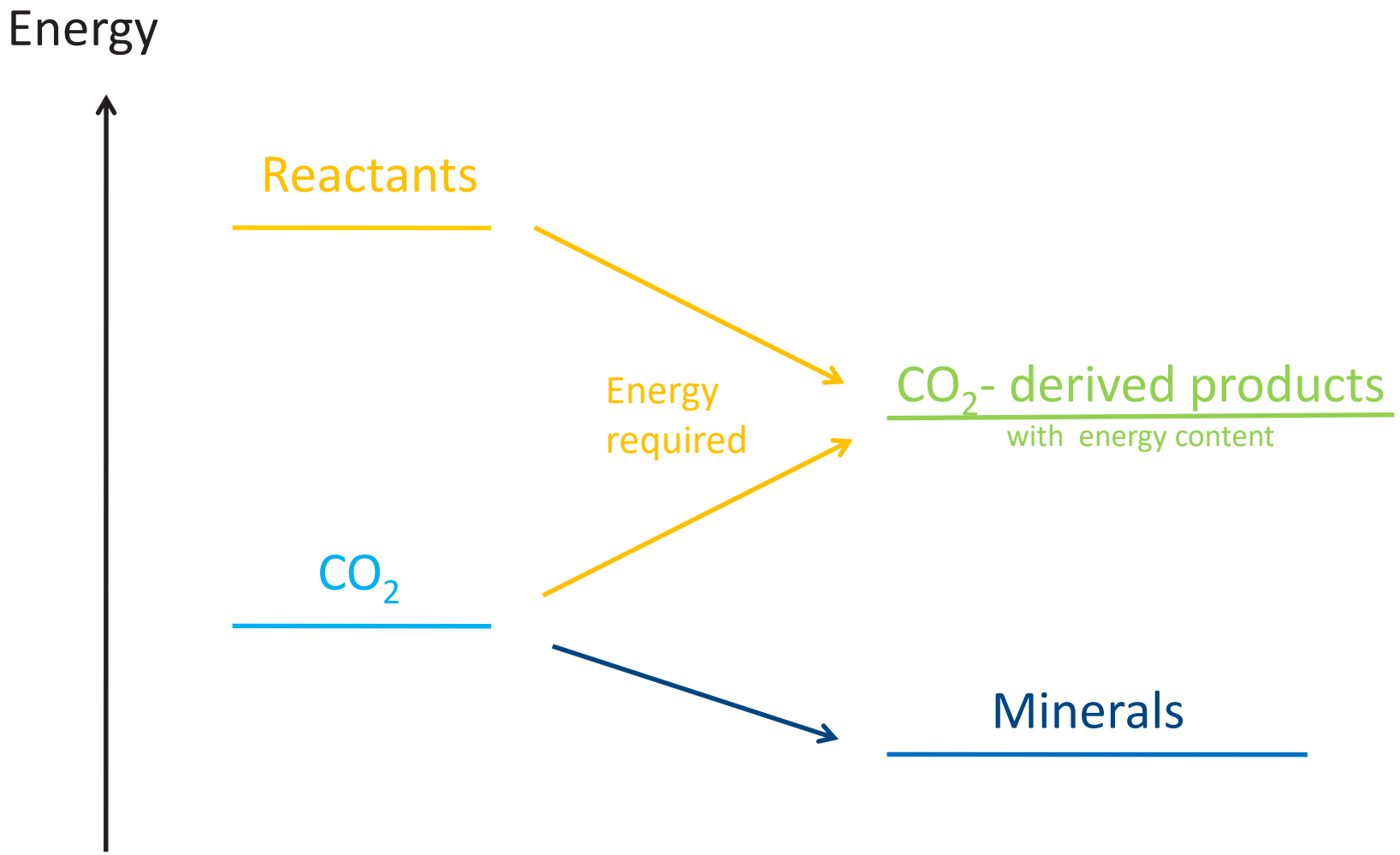
Potential impact of CO_2 valorisation
Major chemical building blocks & fuels



Potential CO_2 emissions reduction for the production of major chemical building blocks and synthetic fuels from CO_2 and H_2 from renewable electricity vs. fossil-based routes

Source: DECHEMA Low carbon energy and feedstock for the European chemical industry (2017)

Energy requirement for chemical valorisation of CO_2



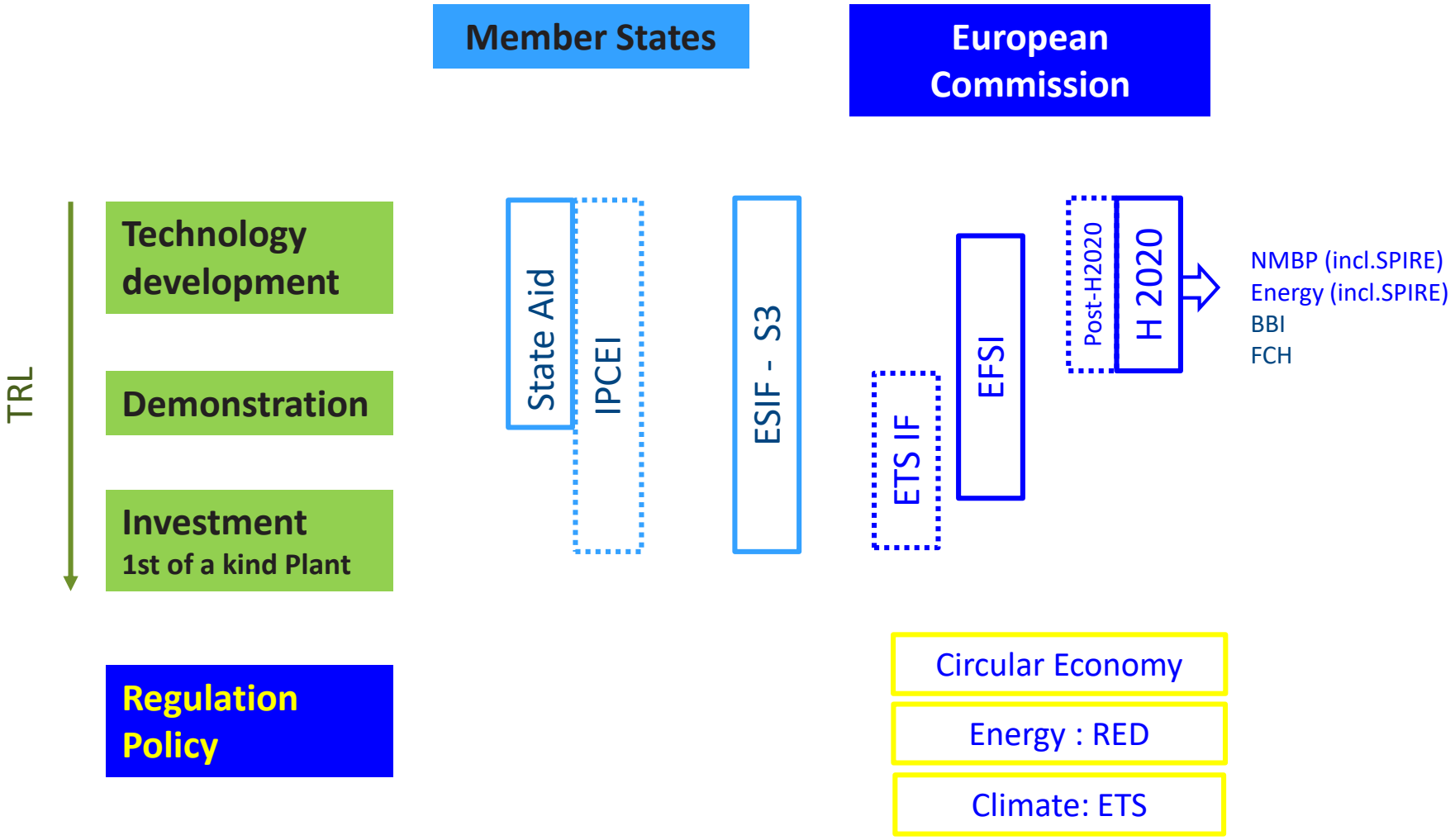
Energy required – Methanol case

Fossil based vs CO_2 and electricity

per t methanol	Fossil (SMR+ methanol synthesis)	Low carbon (power to methanol)
Energy feedstock [GJ]	25	-
Fuel demand [GJ]	13.9	-
Electricity [GJ]	0.6	34.3
Utilities [GJ]		5.4
Steam balance [GJ]	-2	0
Total energy [GJ]	37.5 (12.5 excl. feedstock)	39.7 (41.7 incl. compensation for missing steam export)

Source: DECHEMA Low carbon energy and feedstock for the European chemical industry (2017)

EU Funding schemes & Policy framework



Potential Impact vs EU Policy framework

Methanol from CO_2 and renewable H_2 :

- As Fuels for transport

Potential impact (well-to-wheel):
73.1g CO_2 emissions avoided / MJ fuel* vs gasoline

EU → RED under specific conditions (Renewable Energy content) & FQD

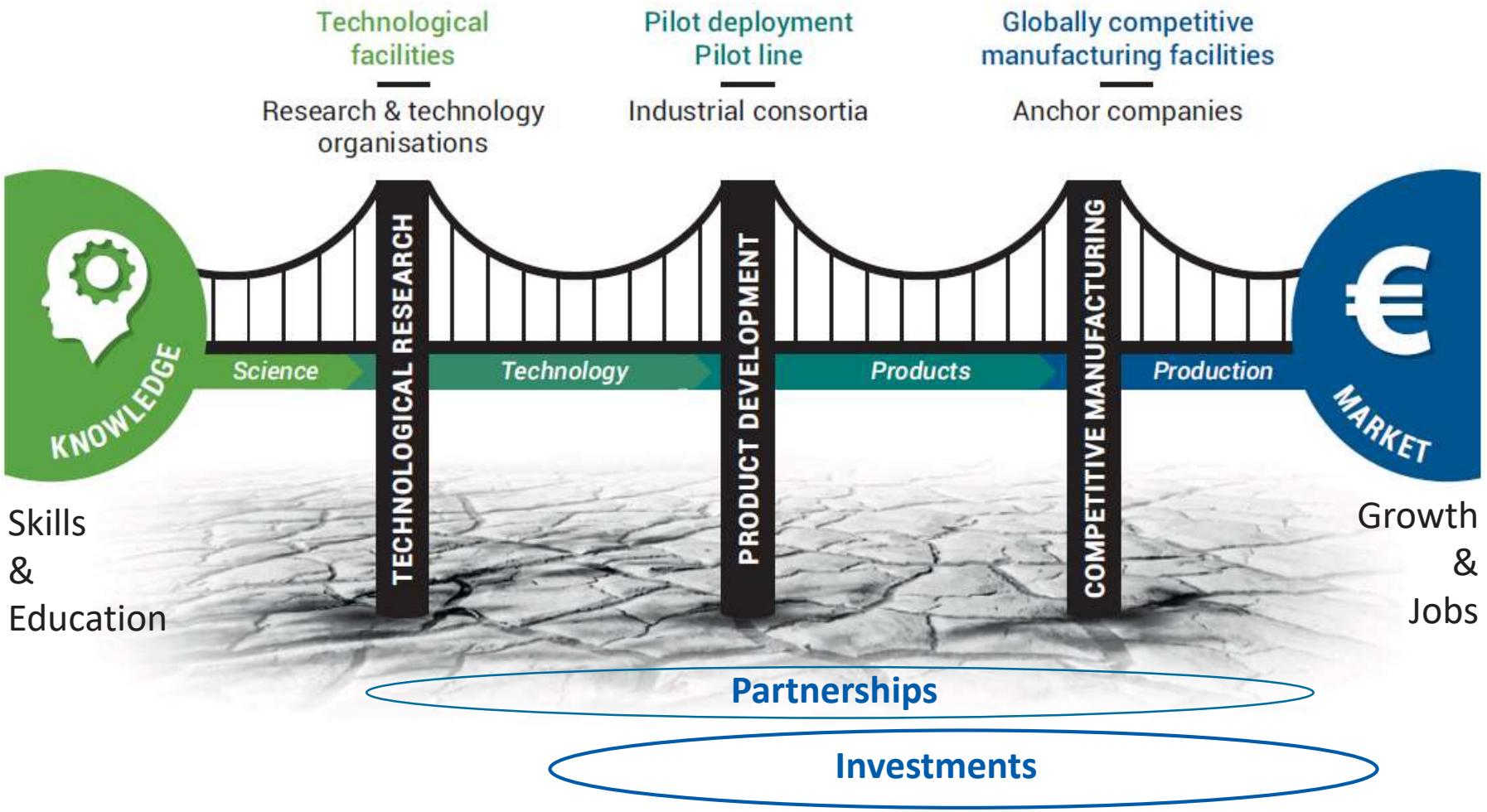
- As Chemical building block

Potential impact (cradle-to-gate):
1.53t CO_2 emissions avoided / t CH_3OH *

EU → ?

*Source: DECHEMA Low carbon energy and feedstock for the European chemical industry (2017)

Enabling development and deployment in Europe



Major public funding schemes

Sustainability-based approach to policy design needed

Source: High Level Group on Key Enabling TechnologiesFinal report « KETs: Time to Act » - 24 June 2015
http://ec.europa.eu/growth/industry/key-enabling-technologies/european-strategy/high-level-group/index_en.htm

Thank you!

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