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Techno-economic comparisons between the various PtL technologies

Fischer-Tropsch- vs. Methanol-Route

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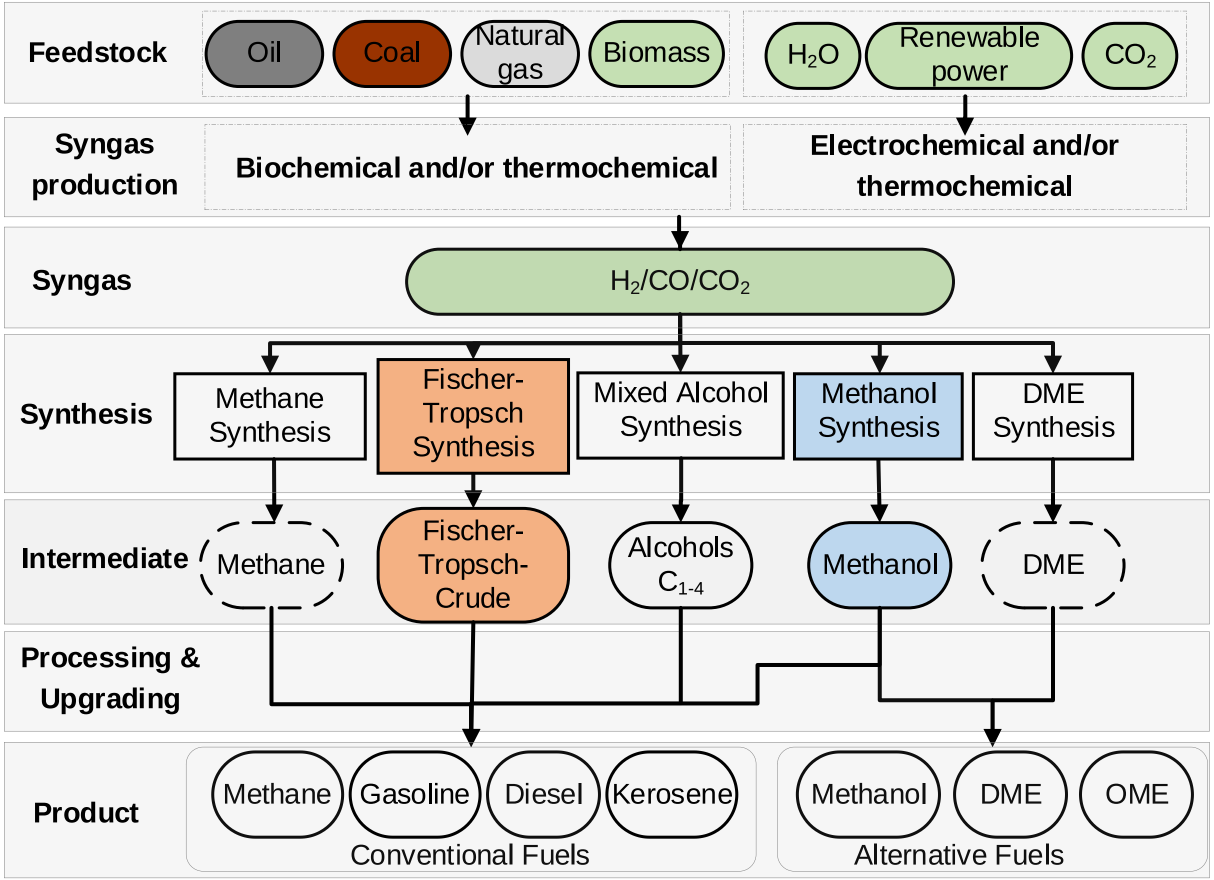
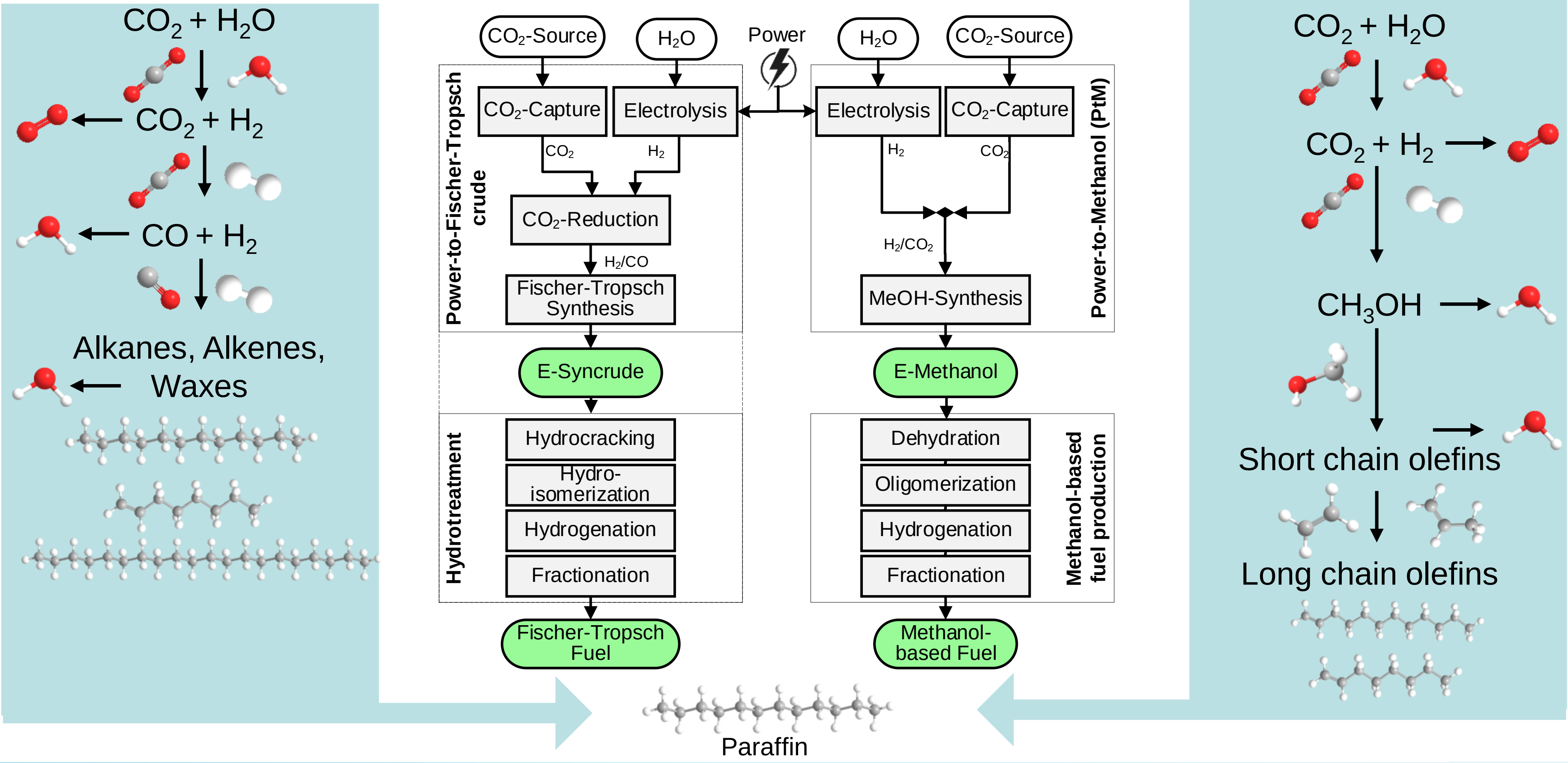
Motivation

- All PtL products require a synthesis step
- Syntheses enable the use of a wide variety of input materials for conversion into a wide variety of products
- In particular, high production potentials can be unlocked through PtX
- Todays focus is on carbon-based energy carrier
- Fischer-Tropsch and methanol-based production currently widely discussed

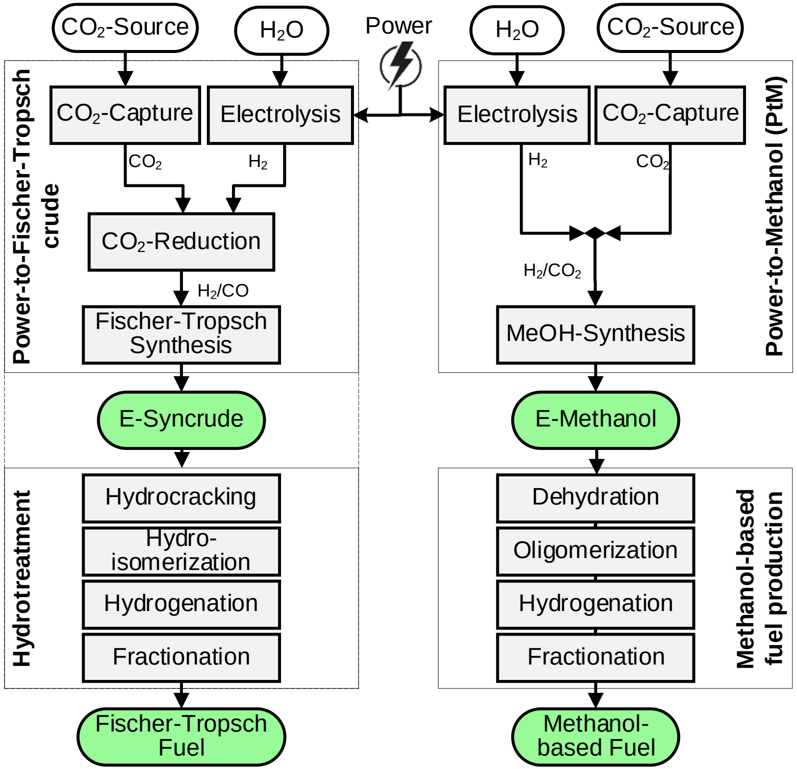


Overall Process Route



Overall Process Route

- Both production paths can be based on PtL approaches
  - Basis: Electricity, Water, CO_2
- FT route the direct formation of paraffins from synthesis gas takes place
- Synthesis (PtM) and paraffin formation takes place separately in methanol route



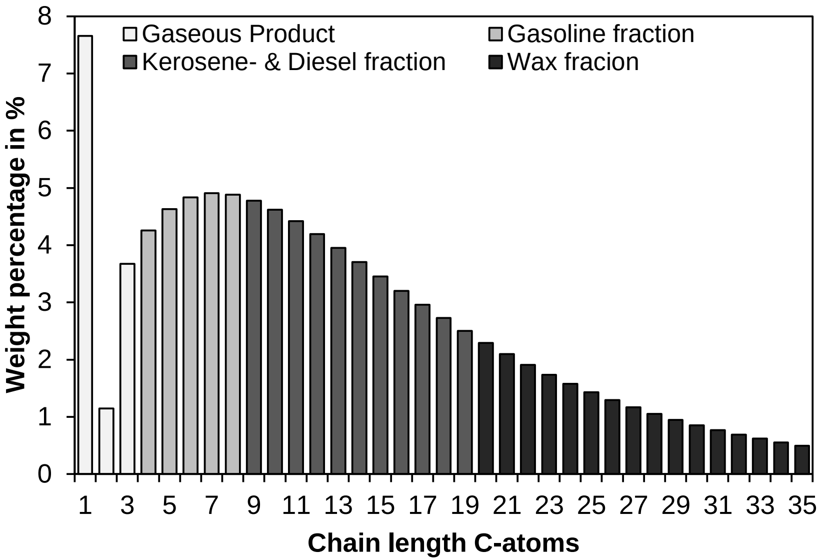
Process Route – Fischer-Tropsch

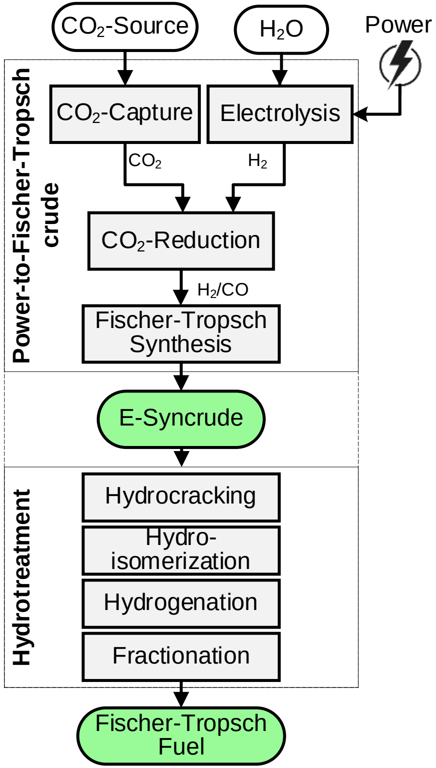
- High-temperature RWGS used for CO generation from CO_2

$$CO_2 + H_2 \rightleftharpoons CO + H_2O \quad \Delta H_R^{\,0} = 42\ {}^{kJ}/_{mol}$$

- Cobalt-catalyzed low-temperature synthesis requires H_2:CO-based syngas

$$n\,CO + (2n+1)\,H_2 \rightarrow C_nH_{2n+2} + n\,H_2O$$





- Hydrotreatment of FT syncrude necessary

Process Route – Methanol

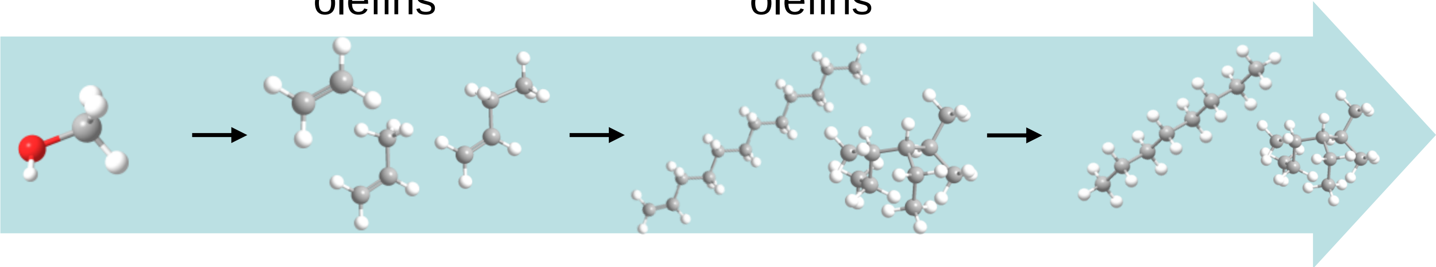
Methanol production:

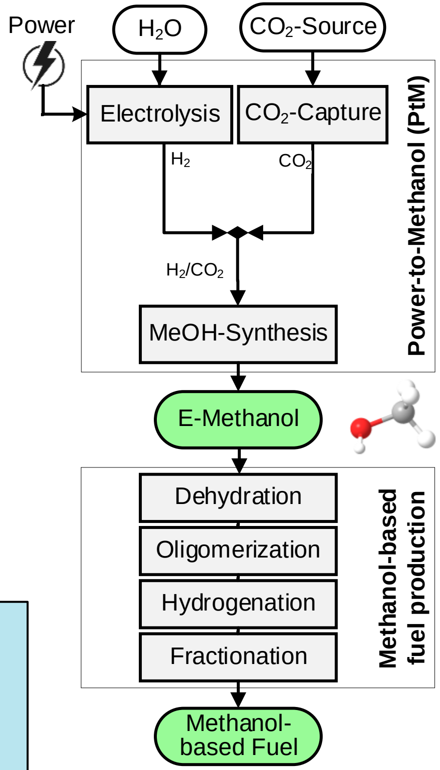
$$CO_2 + 3H_2 \rightleftharpoons CH_3OH + H_2O \qquad \Delta H_R^{298K} = -49\ ^{kJ}/_{mol}$$

$$CO_2 + H_2 \rightleftharpoons CO + H_2O \qquad \Delta H_R^{298K} = 42\ ^{kJ}/_{mol}$$

$$CO + 2H_2 \rightleftharpoons CH_3OH \qquad \Delta H_R^{298K} = -91\ ^{kJ}/_{mol}$$

Methanol → Short chain olefins → Long chain olefins → Alkanes





Dehydration	Oligomerization	Hydrogenation & Fractionation
• Methanol-to-Olefins; state-of-the-art for ethene and propene production	• Coupling of shorter olefins to longer olefins	• Typical processes

Qualitatively Techno-Economic Comparison

- FT route tends to be deployable at shorter notice
- FT-Syncrude can be refined with conventional refinery technology
- Methanol route not yet regulatory applicable for a jet fuel product
- Potentially higher jet fuel selectivities and more flexible production concept in the methanol route
- With high contribution of electricity costs to total production costs leads potentially economically advantageous

	FT	MeOH
Electricity demand	+	+(++)
Target product selectivity	+	++
TRL	+	o
Feedstock availability	+	+
Infrastructure and handling	+	++
Flexible operation	o	++

++: strongly advantageous
+: advantageous
o: neutral
-: disadvantageous
--: strongly disadvantageous

TRL: Technology Readiness Level

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