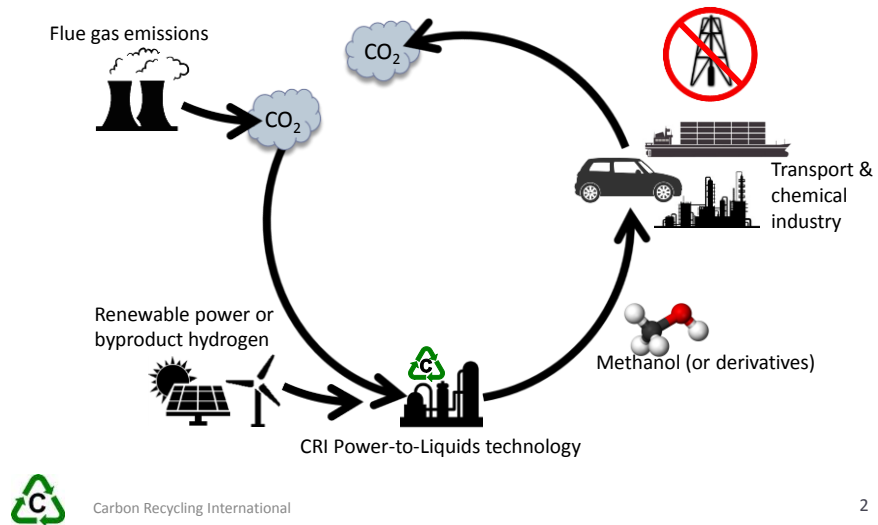


CO2-to-methanol: Nordic technology with global application

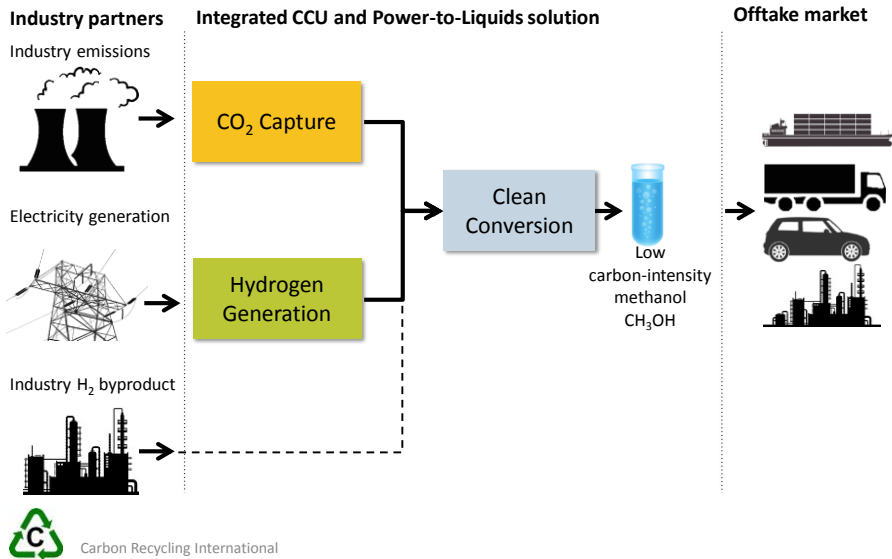
Benedikt Stefansson
Director of Business Development, CRI



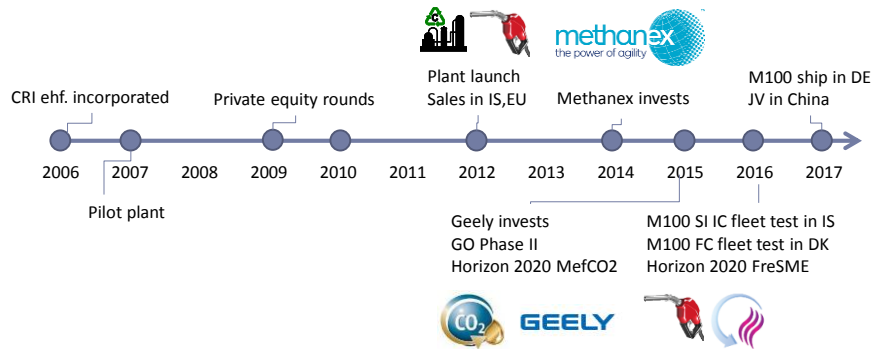
Enabling an industrial carbon cycle with low carbon intensity methanol as an energy carrier



CRI's CO₂-to-methanol industrial platform



Recent milestones

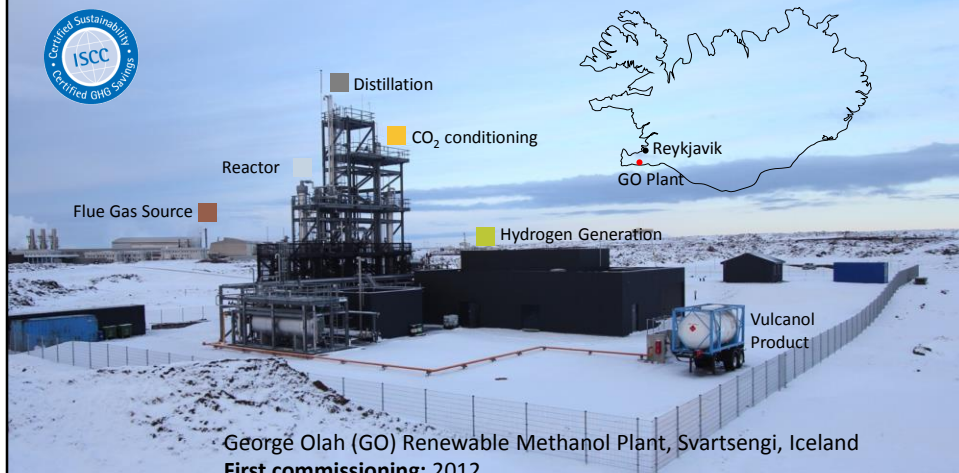


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CRI first of its kind Emissions-to-Liquids facility in Iceland



Georgé Olah (GO) Renewable Methanol Plant, Svartsengi, Iceland

First commissioning: 2012

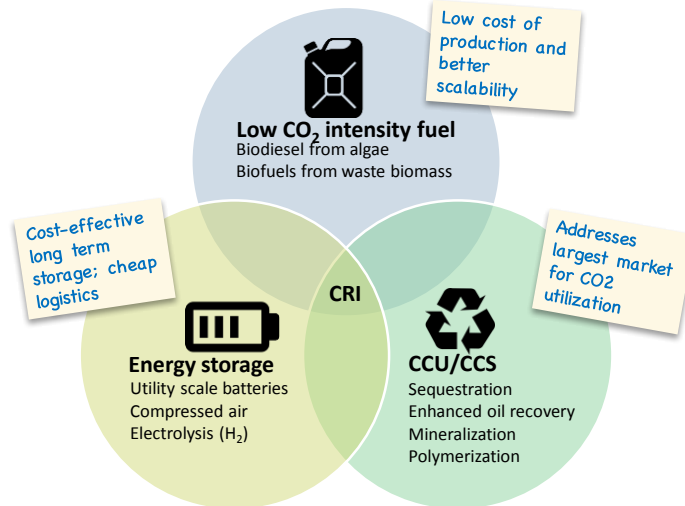
Capacity expansion: 2015

CCU throughput: 5,600 t/yr CO₂

Electrolyzer capacity: 800 t/yr H₂ (1200 Nm³/hr)

Production capacity: 4,000 t/yr methanol

CRI solution addresses three key markets

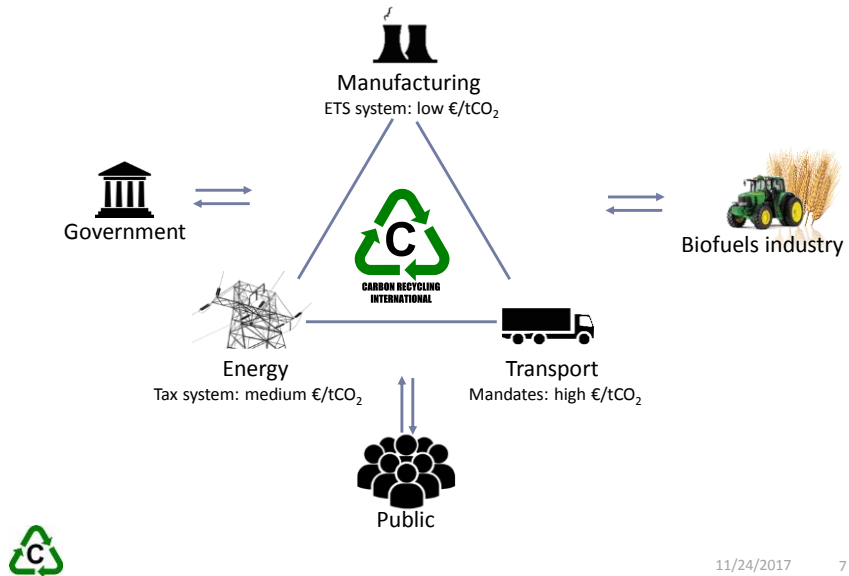


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CO2-to-fuel connects 3 industries



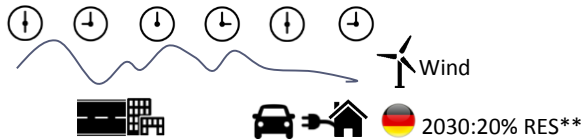
...relevant metric: efficiency of “decarbonization”

Fully electric power train faces challenges

Only a fraction of transport can be fully battery operated



Matching intermittent sources and EV charging challenging



Challenging to ramp up sustainable battery production

500,000 = +1x world production of li-ion batteries†
 14,000,000 = annual car registrations in EU-28‡

Power-to-methanol

Addresses larger market

Fuel for road transport and shipping and potential feedstock for jet fuel.

Integrates with grid

Industrial production plants can make better use of electricity from non-dispatchable sources

Scalability is important

Use no rare earth metals or scarce commodities and can be readily scaled



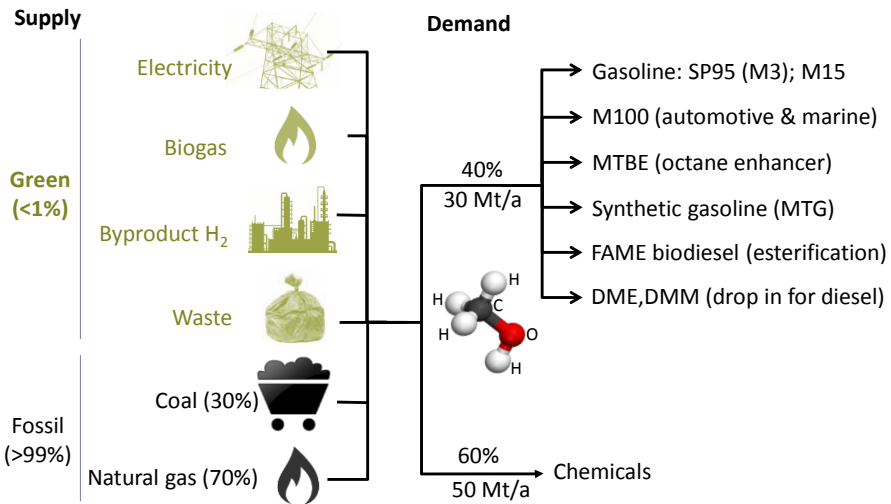
*Bloomberg New Energy Finance **Hennings et al. Energy Policy 2013 (case of Germany) †Economist ‡ICCT

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The versatile hydrocarbon



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Why is methanol such an attractive green fuel option?

Energy density



Carries 2x more H_2 / litre than liquid H_2
Carries 100x more energy / volume than EV battery

IC engine efficiency



Achieves higher break thermal efficiency than gasoline or diesel
Allows cheaper and lighter materials to be used

Health risks



Less toxic than gasoline or diesel
No soot, No SO_x
Ultra-low NO_x
No ozone formation

Future scalability



Available fossil as well as green
Fits heavy duty as well as light vehicles
Compatible with IC engines as well as fuel cells



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Examples of increased penetration of methanol

Automotive applications



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Marine applications



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Near term prospects

- Scale plants to tens of kt
- Standardized units (low CAPEX)
- Deploy in EU and China
- Meet demand for liquid sustainable fuels



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