

CO2 to Renewable Methanol: experiences and perspectives for the steel industry

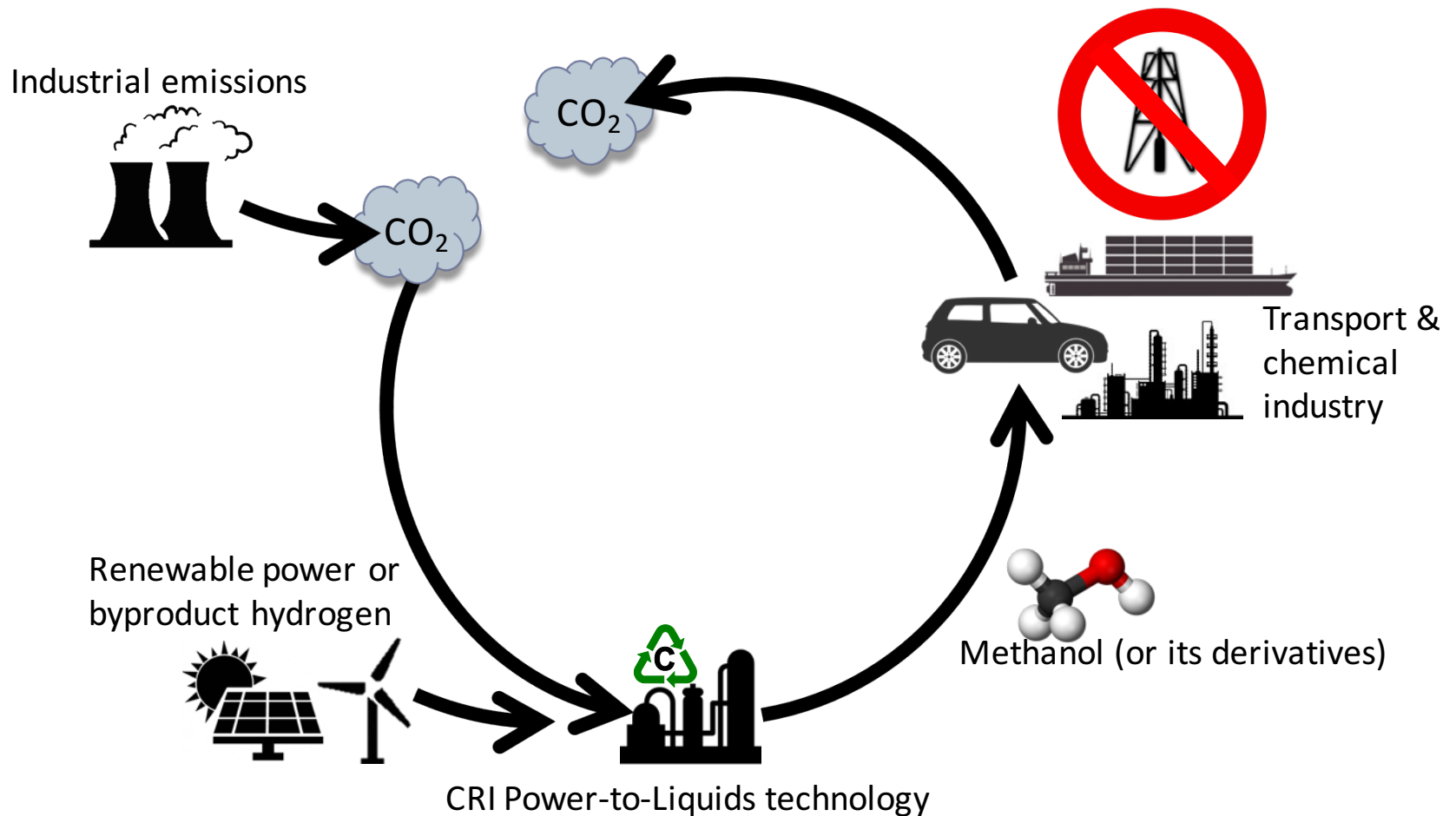
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Enabling a virtuous industrial carbon cycle with low carbon intensity methanol as an energy carrier



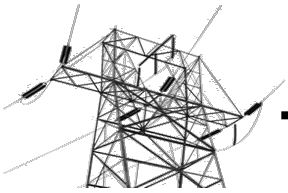
CRI's integrated CO₂-to-methanol solution

Industry partners

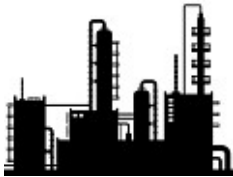
Industry emissions



Electricity generation



Industry H₂ byproduct



Integrated CCU and Power-to-Liquids solution

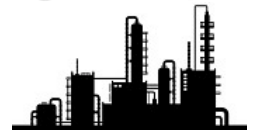
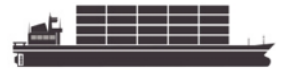
CO₂ Capture

Hydrogen
Generation

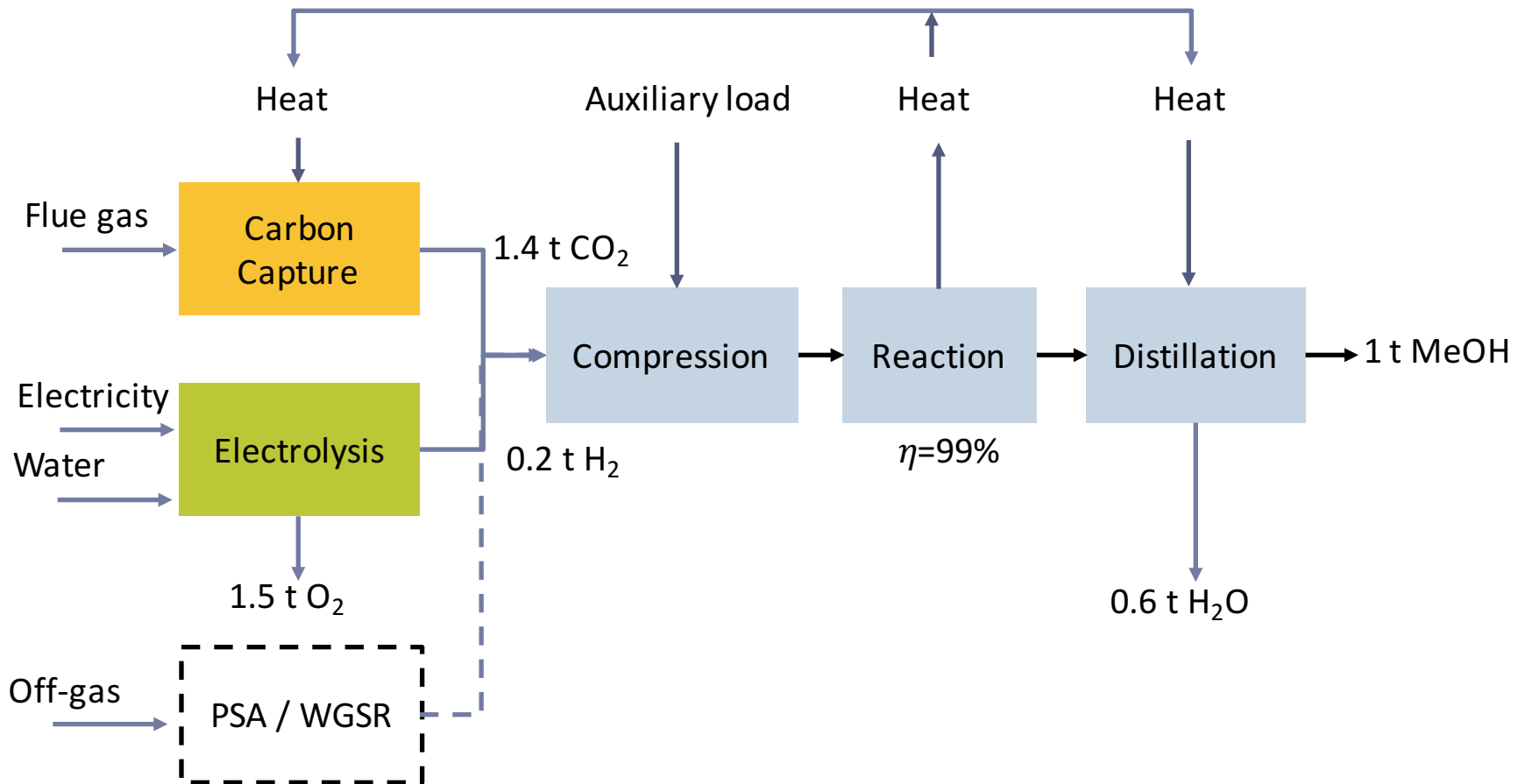
Clean
Conversion

Low
carbon-intensity
methanol
CH₃OH


Offtake




CO₂-to-methanol mass balance




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

Synthesis 

 CO₂ capture



Output 4000 t/yr
methanol from 6000 t CO₂
using 6 MWe electrolyzers

 Water electrolysis

Recent milestones



- 4 kt/yr plant in continuous operation since 2012; 3x capacity expansion in 2015



- Renewable methanol used as fuel in Iceland, Sweden, Netherlands, Denmark



- CRI developing new projects in EU and China



- Equity injections enable expanded engineering team, project management and research

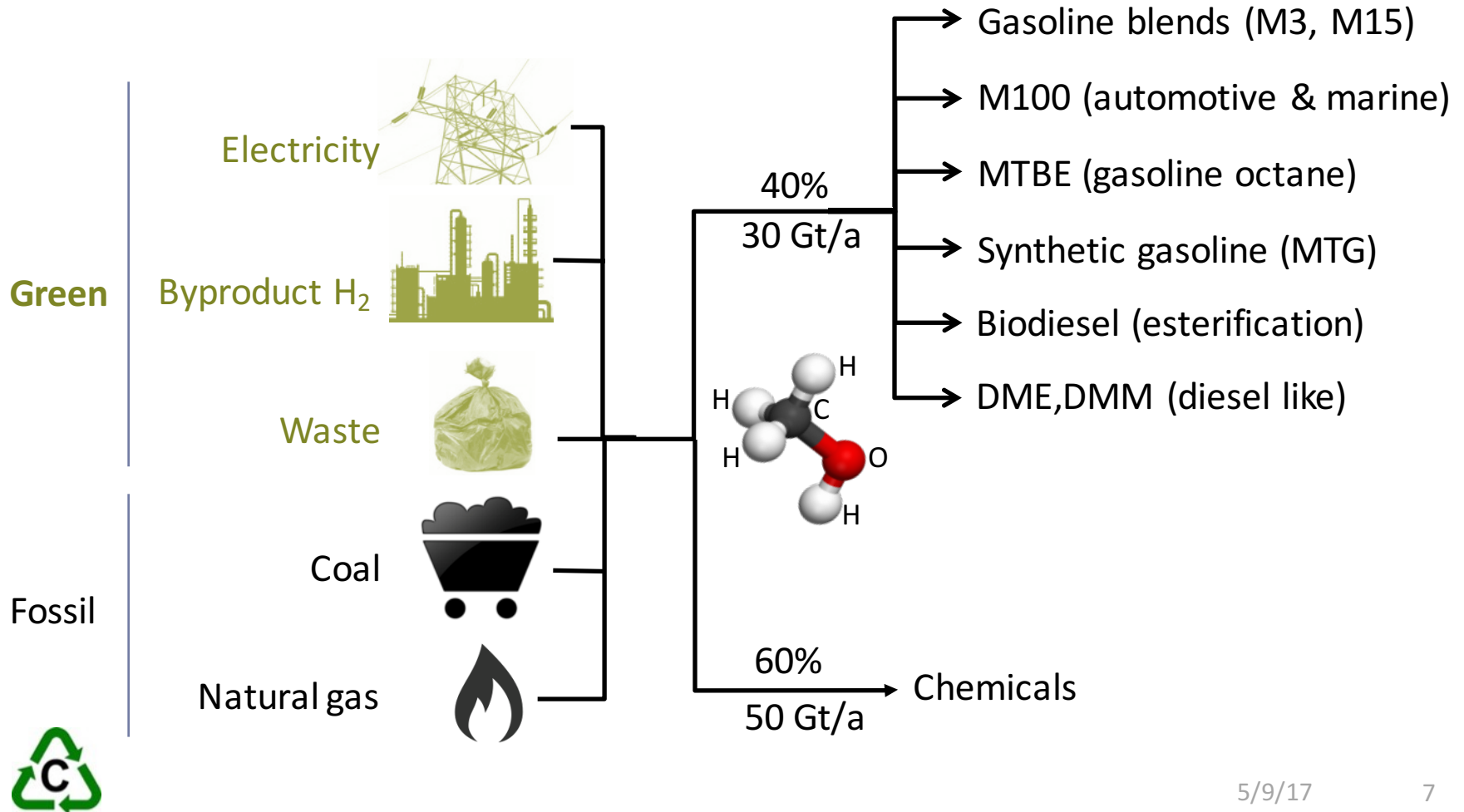


- EU research consortia awarded to build CO₂-to-methanol plants ( MefCO₂ and  FReSMe)



Methanol: the versatile hydrocarbon

As fuel can be seen as “liquid hydrogen”, has no C-C bonds and thus burns cleanly (no PM), no ozone, no sulfur, low NO_x, suits higher compression ratio



Increased penetration of methanol



Geely Emgrand 7 M100 fleet test in Iceland

Normal spark-plug ignited internal combustion engine capable of operating on petrol or 100% methanol



Fiat-Chrysler marketing Euro 6 M15 cars

Fiat 500 now offered with M15 capability (15% methanol 85% petrol) in the Israeli market with Euro 6 rating



Danish oil distributor OK selling methanol for FC vehicles

Production EVs fitted with Serenergy direct methanol fuel cells (FC) range extenders operating on 100% methanol from CRI with water



Stena Line passenger ferry operating on methanol

Stena Germanica Wartsillä main engines retrofitted to be M100 and diesel capable.



50 kt methanol tankers operating on methanol

Flex-fuel engines from MAN in 9 new 50.000 ton methanol tankers operating for Methanex world-wide

Fleet study with Geely M100 cars in Iceland

Geely Emgrand 7 2016

1.8 L spark-plug ignited engine

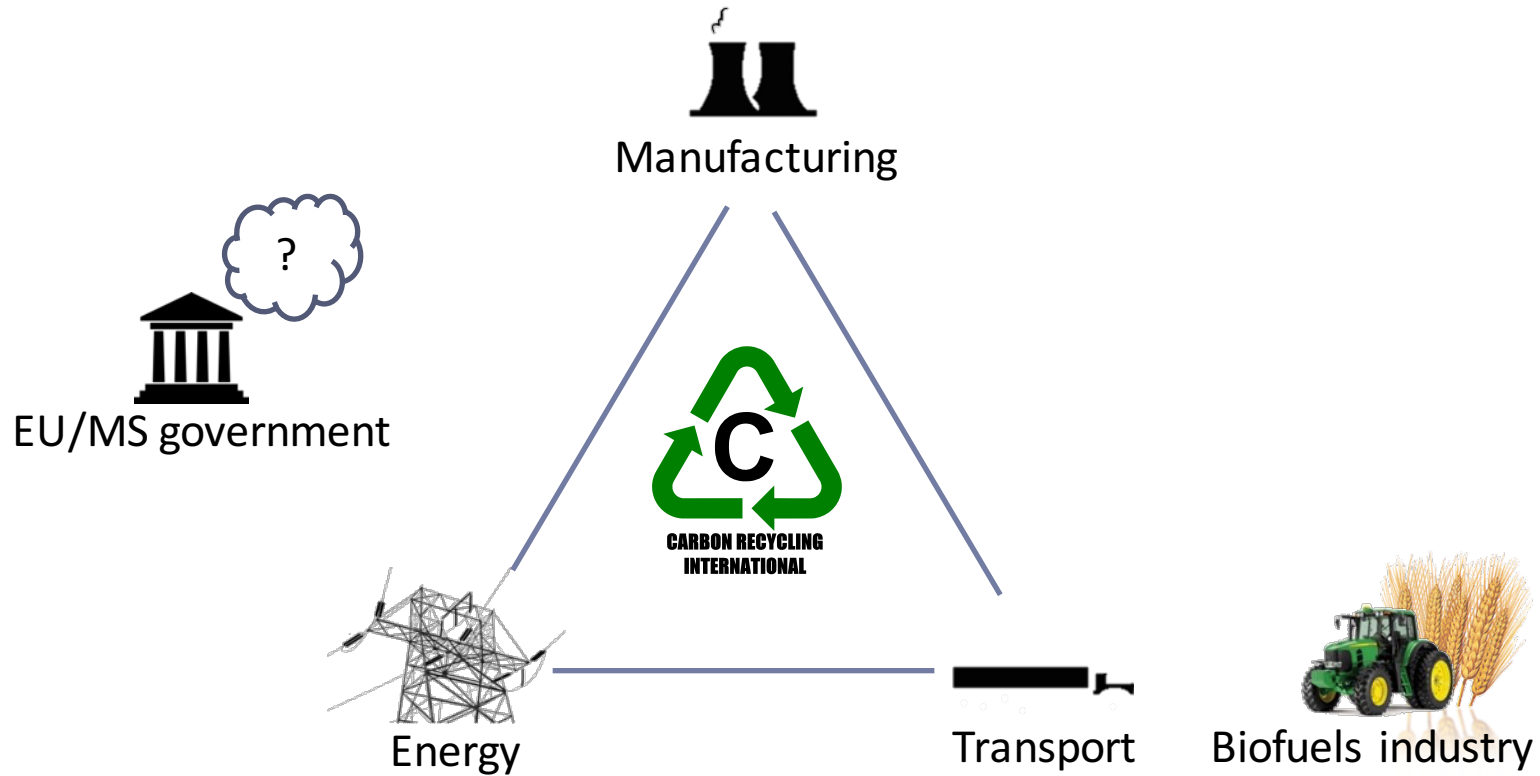
50 L M100 tank

10 L Gasoline tank

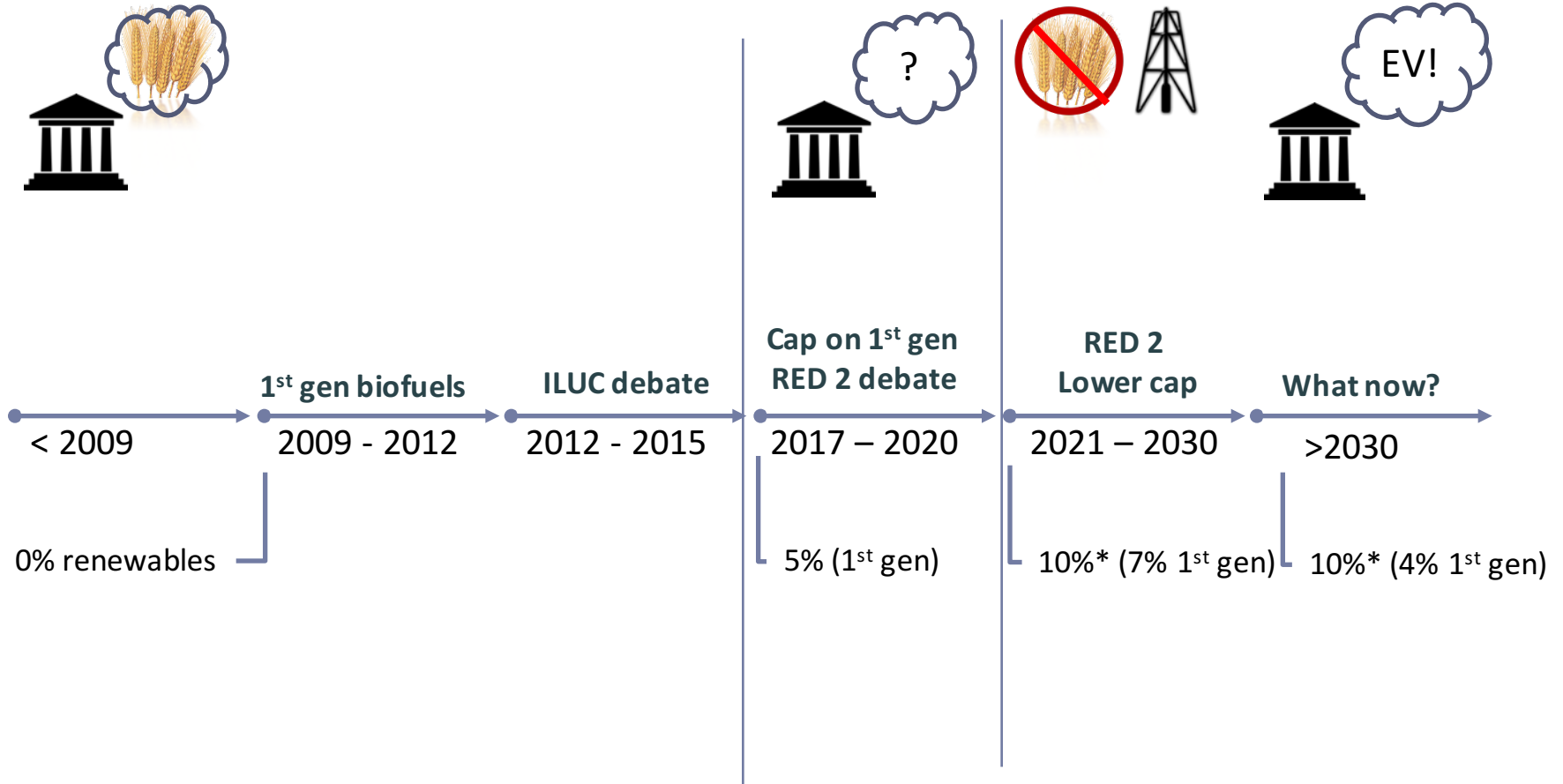
18 L MeOH/100 km



Business model based on connecting 3 industries



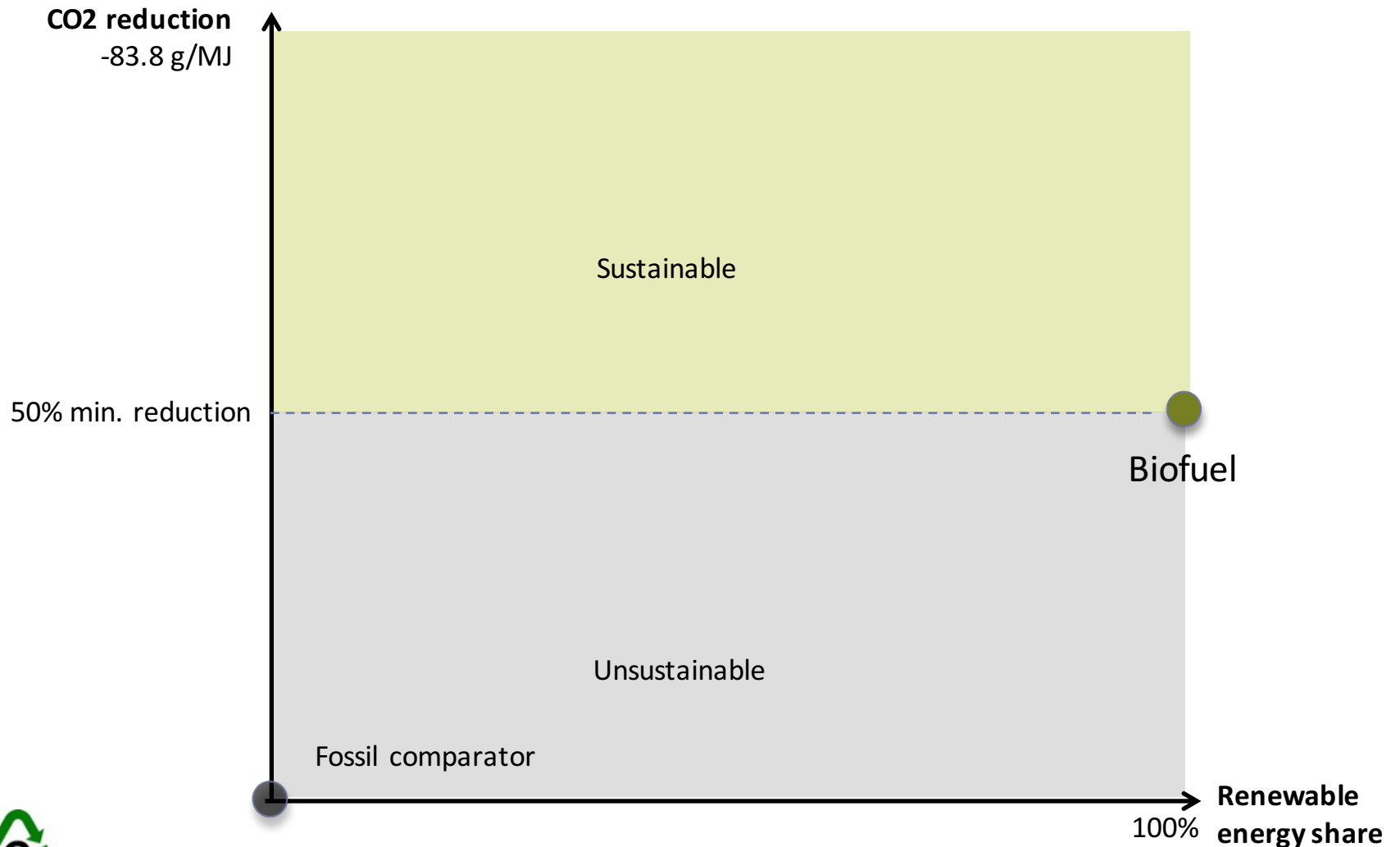
Fuel regulatory environment: Confusing vision



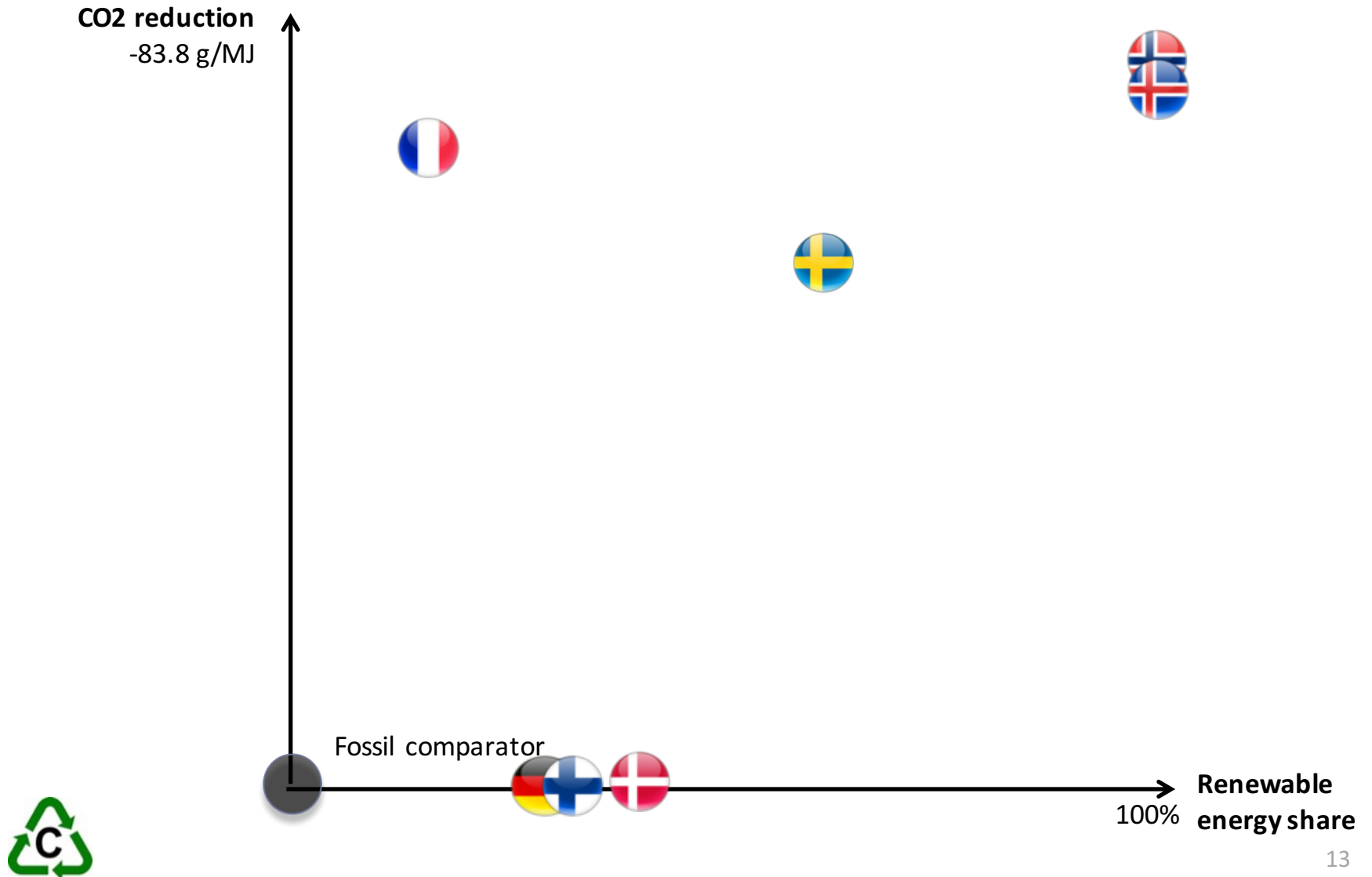
*Target



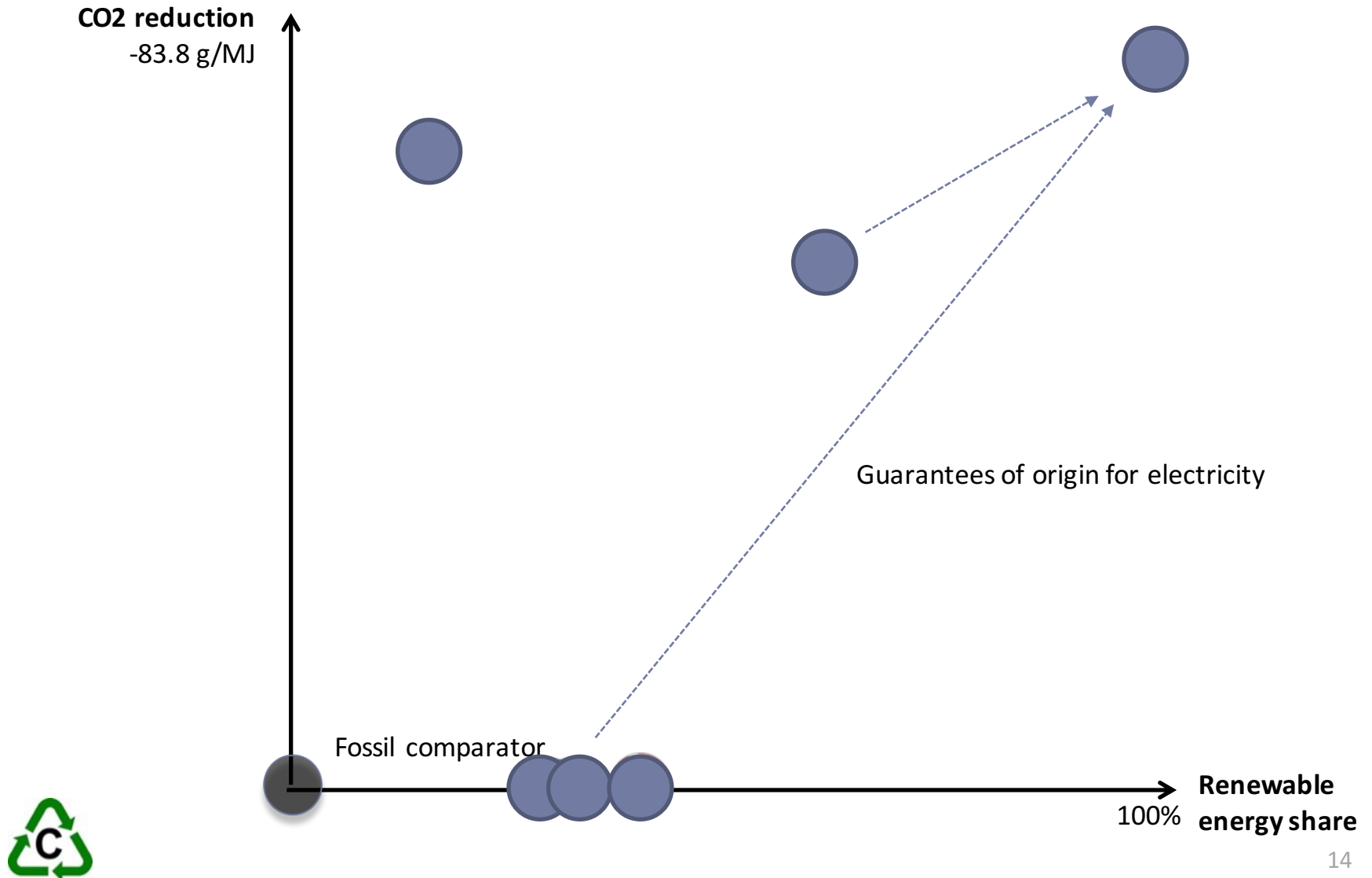
EU framework mixes two metrics: CO₂ reduction per unit energy and overall share of renewable energy



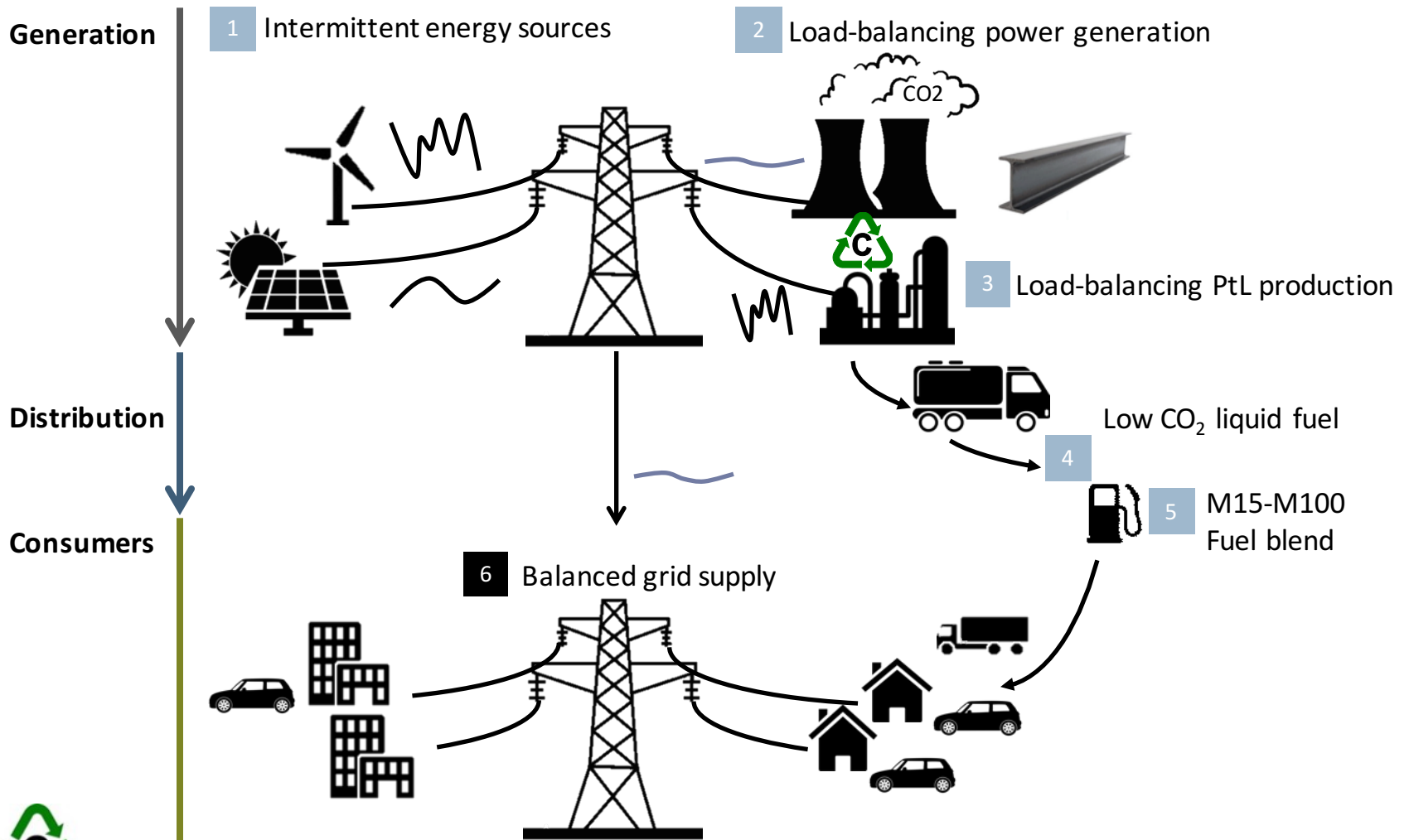
The member state average share of renewable energy and CO₂ footprint of energy determine where CO₂-to-methanol fits



A system allowing use of guarantees of origin for electricity would be more transparent and based on market signals



Rationale for GoO: Enabling energy transition with grid balancing CO₂-to-methanol production



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