



Politecnico
di Torino



International Cooperation and the Biofuture Platform Perspective

David Chiaramonti
CEM BFP, Politecnico di Torino

Who we are: Fit4Foresight Team @ POLITO

Team Lead



Prof. David
Chiaramonti



Prof. Matteo
Prussi



Prof. Carlo Cambini

Core competences

Biomass conversion processes, biofuels, bioproduct bioeconomy, process design, sustainability assessment, techno-economic analysis, market&economic impact assessment, carbon markets

Supporting UN-ICAO, UN-IMO, EC, IT MASE, MIT, MASAF, IT Regions, associations, private stakeholders (industries and farmers)

CEM BioFuture Platform Chair since 2025. 25 Member Countries. IEA facilitator



Prof. Michel
Noussan



Dr. Flavio
Pino



Dr. Ing.
Giacomo
Talluri



Dr. Ing.
Viviana
Negro



BFP Members

- 1 Argentina
- 2 Australia
- 3 Brazil
- 4 Canada
- 5 China
- 6 Egypt
- 7 Denmark
- 8 Finland
- 9 France
- 10 Hungary
- 11 Kenya
- 12 India
- 13 Indonesia
- 14 Italy
- 15 Japan
- 16 Morocco
- 17 Mozambique
- 18 Netherlands
- 19 Paraguay
- 20 Philippines
- 21 Portugal
- 22 South Africa
- 23 United Kingdom
- 24 United States
- 25 Uruguay

Benefits from Sustainable Biofuels and Bioeconomy

• Sustainability

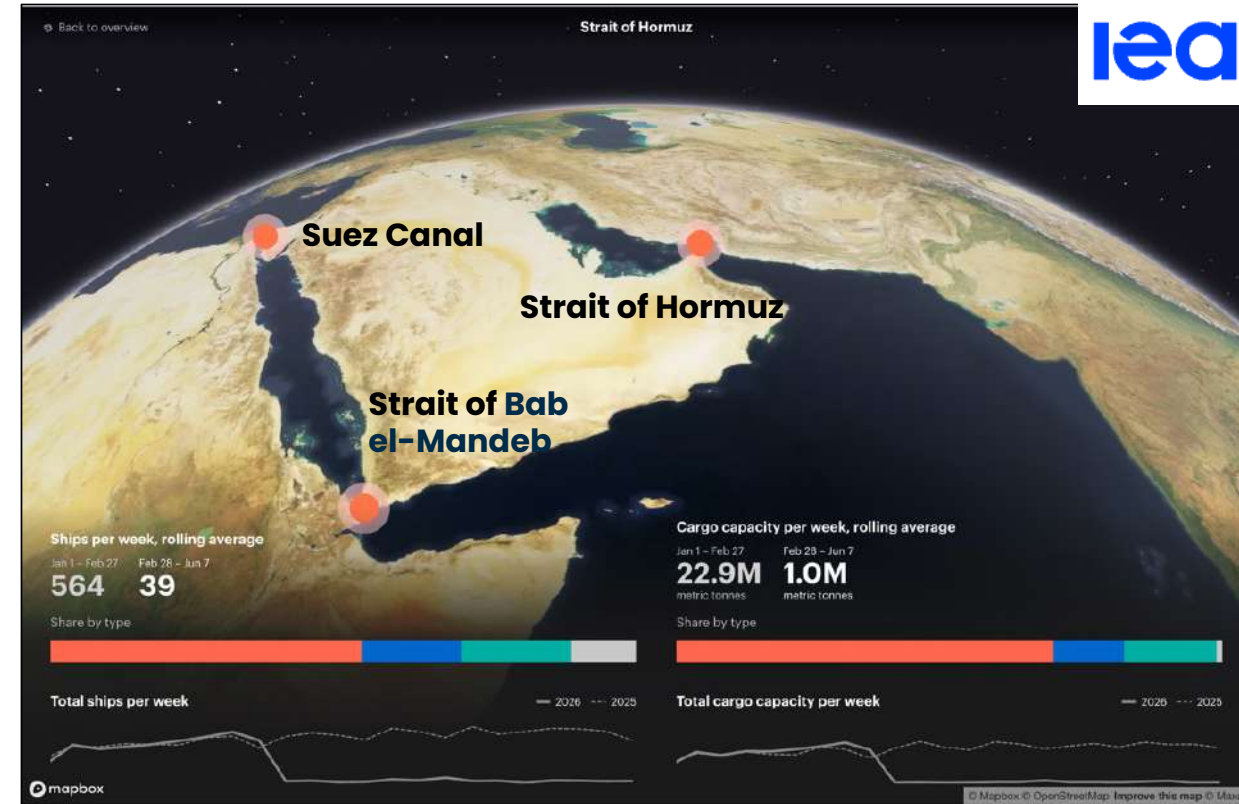
- ✓ GHG emission reduction
- ✓ Advanced land and water management
- ✓ Improved waste management

• Energy Security

- ✓ Reduced dependency on fossil fuel import and price shocks (consistent with AcceleratedEU)
- ✓ Diversification of fuel supply chains, lower risks
- ✓ Enhanced access to renewable energy

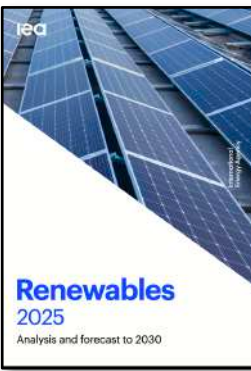
• Economic development

- ✓ Made in EU (consistent with Ind.Accel.Act)
- ✓ Investment and job opportunities in EU
- ✓ Local and global supply chains growth

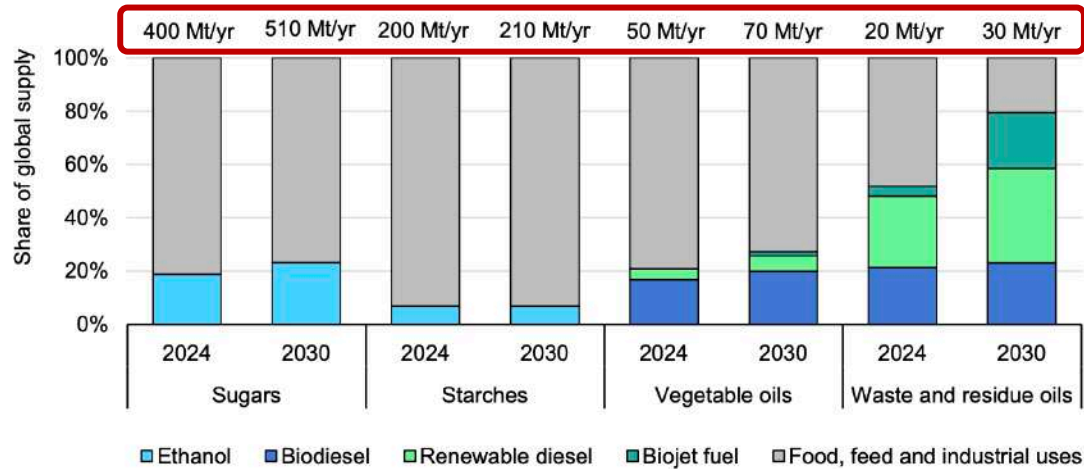


IEA: the largest supply disruption in the history of the global oil market, while also impeding critical flows of natural gas and other key commodities. 3 months interruption of 20% global oil supplies...but.... oil did not (yet) reach 2008 all time spike (140 \$), nor the 2022 figure of \$ 114 after invasion of Ukraine, reaching \$ 109 in April 2026 (considering WTY NIMEX inflation adjusted average-USD)

Liquid Biofuel Feedstocks



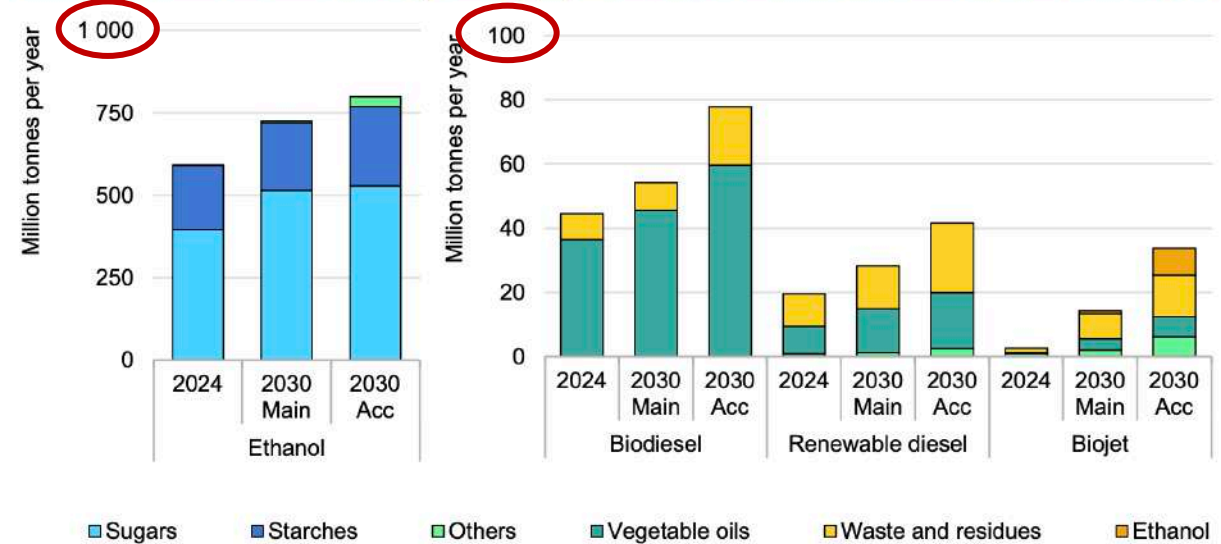
Liquid biofuel feedstock demand and shares of global supply, main case, 2024 and 2030



IEA. CC BY 4.0

Sources: OECD/FAO (2024), [OECD-FAO Agricultural Outlook 2024-2033](#); World Economic Forum (2020), [Clean Skies for Tomorrow: Sustainable Aviation Fuels as a Pathway to Net-Zero Aviation](#).

Biofuel feedstock demand by fuel type, main and accelerated cases, 2024 and 2030



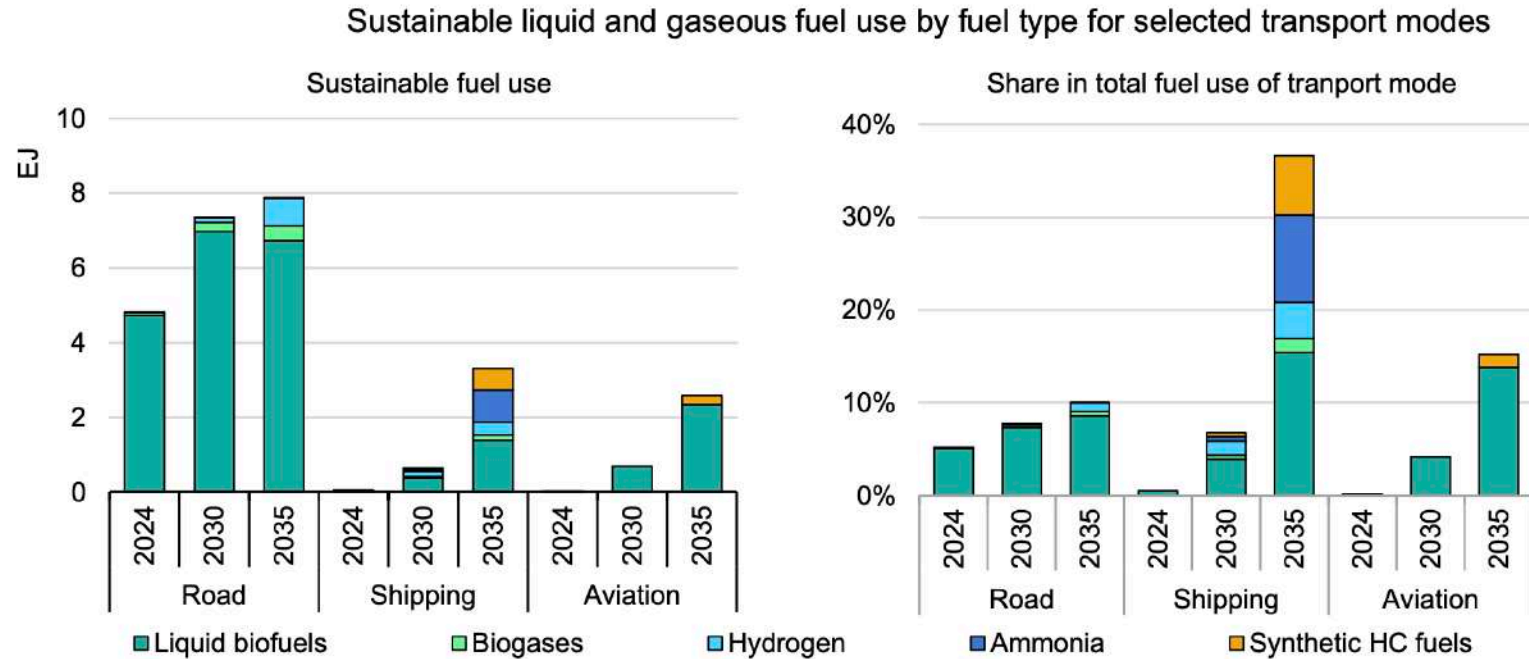
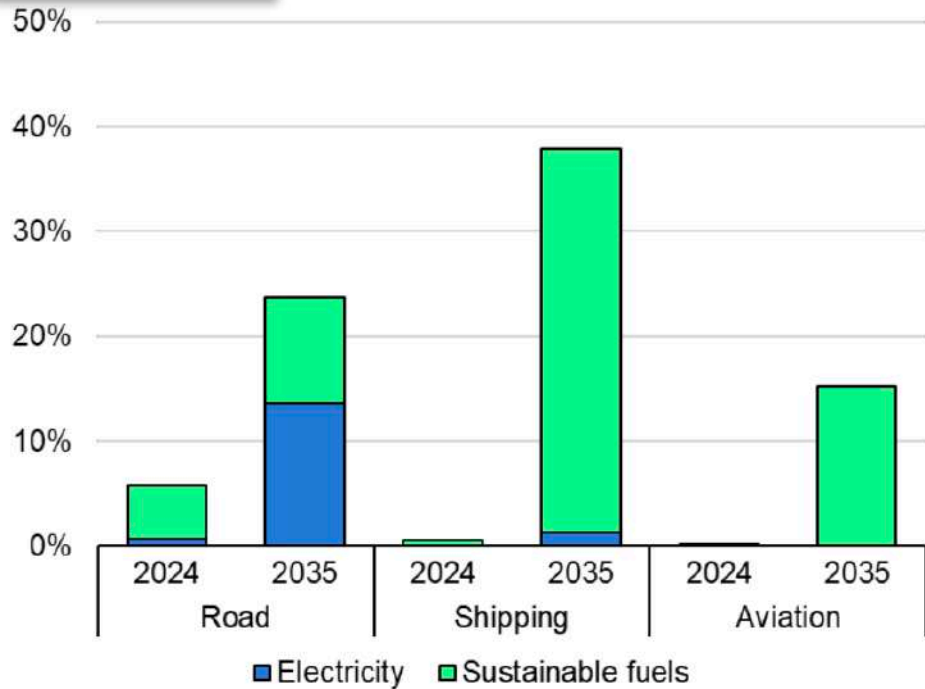
IEA. CC BY 4.0

Notes: "Sugars" includes sugarcane, molasses and sugar beets. "Starches" refers to maize, wheat, rice, cassava and other starches. "Vegetable oils" indicates soybean, rapeseed, palm and other vegetable oils. "Waste and residue oils" refers to used cooking oil, tallow and palm oil mill effluent and other oils. "Other" includes woody wastes and residues for cellulosic ethanol and Fischer-Tropsch fuel production.



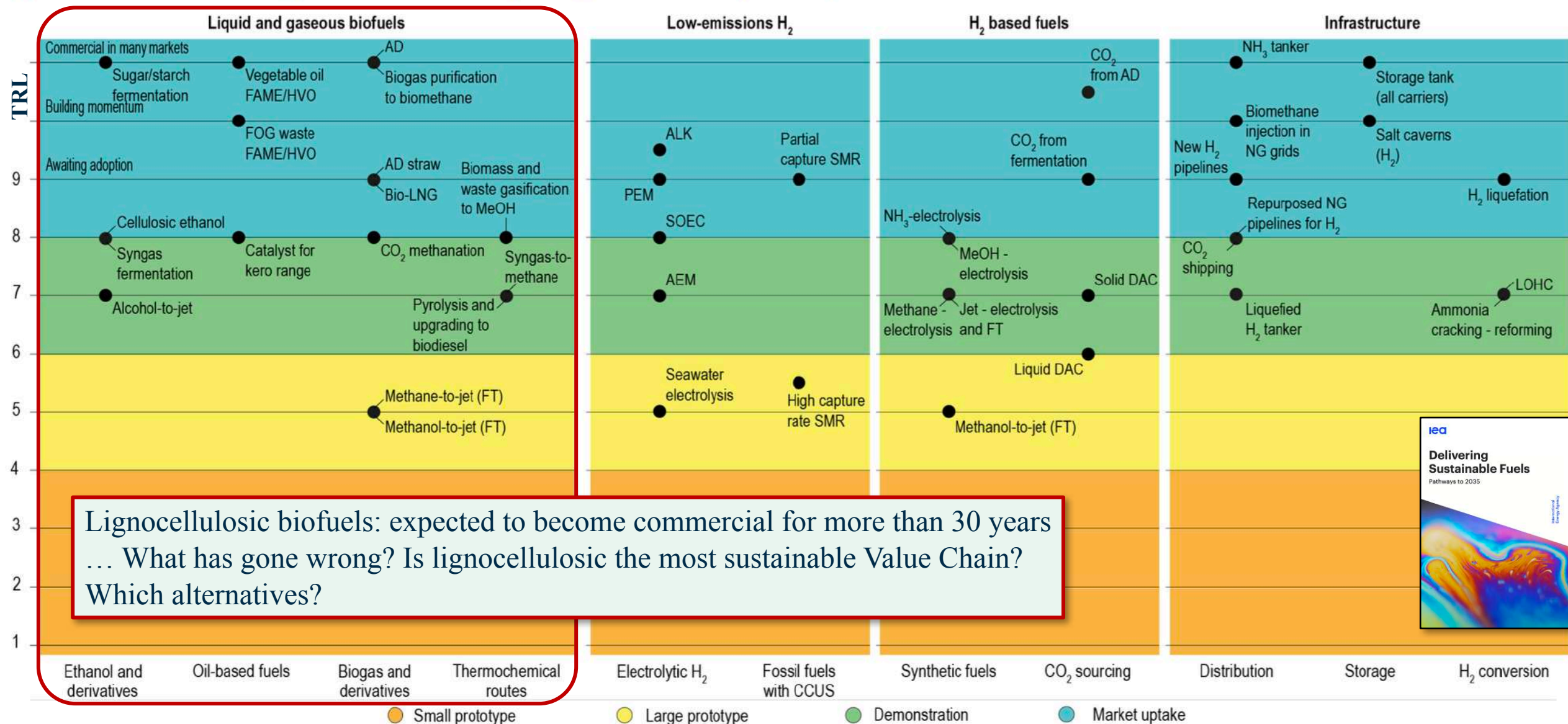
Sustainable Biofuel Demand

Sustainable fuels include liquid biofuels, biogases, low-emissions hydrogen and hydrogen-based fuels



→ Massive growth in shipping & aviation, but still very significant role in road at 2035

IEA technology readiness levels (TRLs) for selected pathways



Sustainable Fuels and Carbon: main EU/INT Policies

Very **complex** and **continuously evolving** legislative environment – **Opportunities & Barriers**

In force:



- **REDII/REDII–IR and REDIII on Sustainable Biofuels**



- **ReFuelEU Aviation and FuelEU Maritime**



- **CRCF: Carbon Removals and Carbon Farming**, DG Clima. Relevant to voluntary and (possibly) mandated (ETS revision, EC proposal in 2026) carbon markets



- **ICAO for SAF**

Incoming:



- **CO2 Regulation** (for Passenger cars/LDV, HDV)



- **996 RED Implementing Regulation** (intermediate crop,



- **New EU RED**



- **EU ETS: 2026 revision; ETS2**, delayed to end 2026, on buildings and road transport sector and fuels for additional sector

Sustainable Biofuels GHG Accounting and Carbon in Soil/Removals are connected through Sustainable Farming → two options:

- **GHG accounting (RED, ICAO)**
 - **BCR for ETS**

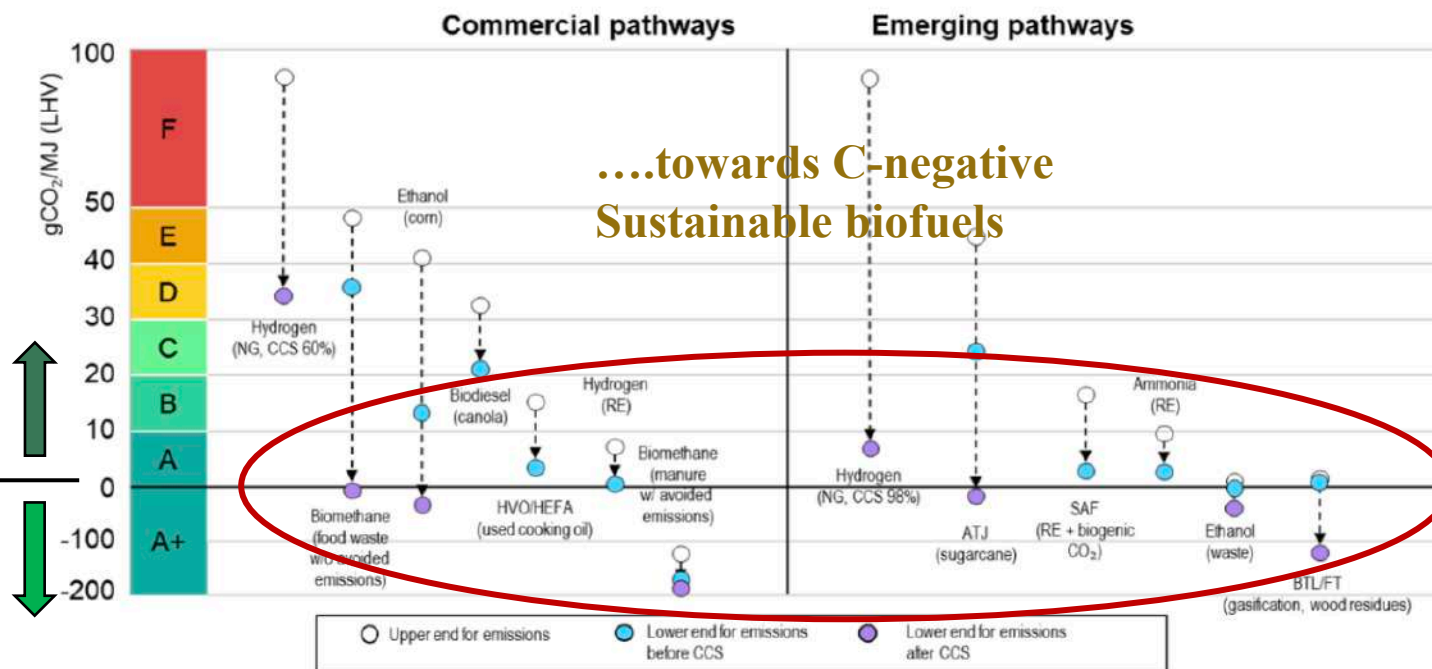


- **IMO: announced April 2025, decision postponed to late 2026**

GHG performances & Labelling



Figure 4.3 Lifecycle GHG emission ranges for selected fuel pathways



IEA. CC BY 4.0.

Low Carbon

Carbon
Negative (CDR)

How is it possible?

- **More organic Carbon in coproducts** (residues) than in main product
- Wording is important... **Organic Carbon is not a residue**, it has a high-value for soil, agriculture & environment
- **High GHG performing fuels essential** to the alternative fuel mix to reach 2040-2050 GHG targets

This Carbon can be used for compliance towards two lines

- Sustainable Fuels (RED: e_{SCA} , ICAO: F^{SCA})
- Carbon Removals

“Biofuels Done Right”: C-Negative & sustainable farming

- Food/feed primary production suffer from climate change impacts: more “fossil” use in agriculture
- Energy can support food/feed production while removing CO2 from the atmosphere:
 ✓ *improved soil resilience to climate change via sustainable farming and soil health*
- From LOW Carbon, to Carbon NEUTRAL, to Carbon NEGATIVE and CO-BENEFITS & “MADE IN EU”



Biofuels have been getting bad press, not always for good reasons. Certainly important concerns have been raised, but preliminary studies have been misinterpreted as a definitive condemnation of biofuels. One recent magazine article, for example, illustrated what it called “Ethanol USA” with a photo of a car wreck in a corn field. In particular, many criticisms converge around grain-based biofuel, traditional farming practices, and claims of a causal link between U.S. land use and land-use changes elsewhere, including tropical deforestation.

KEITH KLINE
VIRGINIA H. DALE
RUSSELL LEE
PAUL LEIBY

Focusing only on such issues, however, distracts attention from a promising opportunity to invest in domestic energy production using biowastes, fast-growing trees, and grasses. When biofuel crops are grown in appropriate places and under sustainable conditions, they offer a host of benefits: reduced fossil fuel use; diversified fuel supplies; increased employment; decreased greenhouse gas emissions; enhanced habitat for wildlife; improved soil and water quality; and more stable global land use, thereby reducing pressure to clear new land.

C, N, ...

In Defense of Biofuels, Done Right

Despite recent claims to the contrary, plant-based fuels developed in economically and environmentally sensible ways can contribute significantly to the nation’s—indeed, the world’s—energy security while providing a host of benefits for many people worldwide.

Although ethanol production indeed contributes to higher corn prices, it is not a major factor in world food costs. The U.S. Department of Agriculture (USDA) calculated that biofuel production contributed only 5% of the 45% increase in global food costs that occurred between April 2007 and April 2008. A Texas A&M University study concluded that energy prices were the primary cause of food price increases, noting that between January 2006 and January 2008, the prices of fuel and fertilizer, both major inputs to agricultural production, increased by 37% and 45%, respectively. And the International Monetary Fund has documented that since their peak in July 2008, oil prices declined by 69% as of December 2008, and global food prices declined by 33% during the same period, while U.S. corn production has remained at 12 billion bushels a month, one-third of which is still used

SPRING 2009

C, N, ...

Biochar

BIOGASDONERIGHT®
ANAEROBIC DIGESTION AND SOIL CARBON SEQUESTRATION
A SUSTAINABLE, LOW COST, RELIABLE AND WIN-WIN BECCS

Modeling and Analysis



The potential for expanding sustainable biogas production and some possible impacts in specific countries

Bruce E. Dale, Chemical Engineering and Materials Science, Michigan State University, East Lansing, MI, USA
Stefano Bozzetto, Biogas Refinery Development Srl, Cittadella, Italy
Christian Couturier, Solagro, Toulouse, France
Claudio Fabbri, Environment Department, CRPA Research Center on Animal Production, Reggio Emilia, Italy
Jorge A. Hilbert, Instituto Nacional de Tecnología Agropecuaria, Castelar, Argentina
Rebecca Ong, Chemical Engineering and Materials Science, Michigan State University, East Lansing, MI, USA
Tom Richard, Department of Agricultural and Biological Engineering, Pennsylvania State University, University Park, PA, USA
Lorella Rossi, CIB Consorzio Italiano Biogas, Technical Area, Lodi, Italy
Kurt D. Thelen, Department of Plant, Soil & Microbial Sciences, Michigan State University, East Lansing, MI, USA
Jeremy Woods, Centre for Environmental Policy, Imperial College London, London, UK

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Abstract: Current food production practices tend to damage and deplete soil, diminish biodiversity, and degrade water supplies. For agriculture to become environmentally sustainable and simultaneously increase food output for a growing world population, fundamental changes in agricultural production systems are required. Renewable energy can reduce greenhouse gases (GHGs) but we also need simple, low-cost approaches to remove atmospheric carbon and sequester it in stable forms. Recycling of digestate from the anaerobic digestion of agricultural and waste materials to soils can sequester atmospheric carbon and provide many other economic, social and environmental benefits. Biogasdoneright™ (BDR) is a set of practices that link biogas production with sustainable agriculture. The BDR approach to sustainable agriculture is being implemented on a large scale in Italy. In this paper, we examine the potential impact of implementing BDR in selected other countries. The biogasdoneright potential in these countries, estimated conservatively, varies from about 10–30% of their current annual natural gas consumption. Biomethane from sequential (double) crops provides by far the greatest fraction of the biogasdoneright potential. Double cropping also drives many of the environmental and economic benefits of BDR systems. Depending on where and how widely it is implemented, the production of biogas in BDR systems could have very significant national-level impacts. For example, sufficient biomethane could

Correspondence to: Lorella Rossi, CIB Consorzio Italiano Biogas, Technical Area, Lodi, Italy. E-mail: l.rossi@cibconsorzioitaliano.it

No fertilization

Mineral fertilization

100% Compost

100% Biochar

Biochar+ Compost 10%

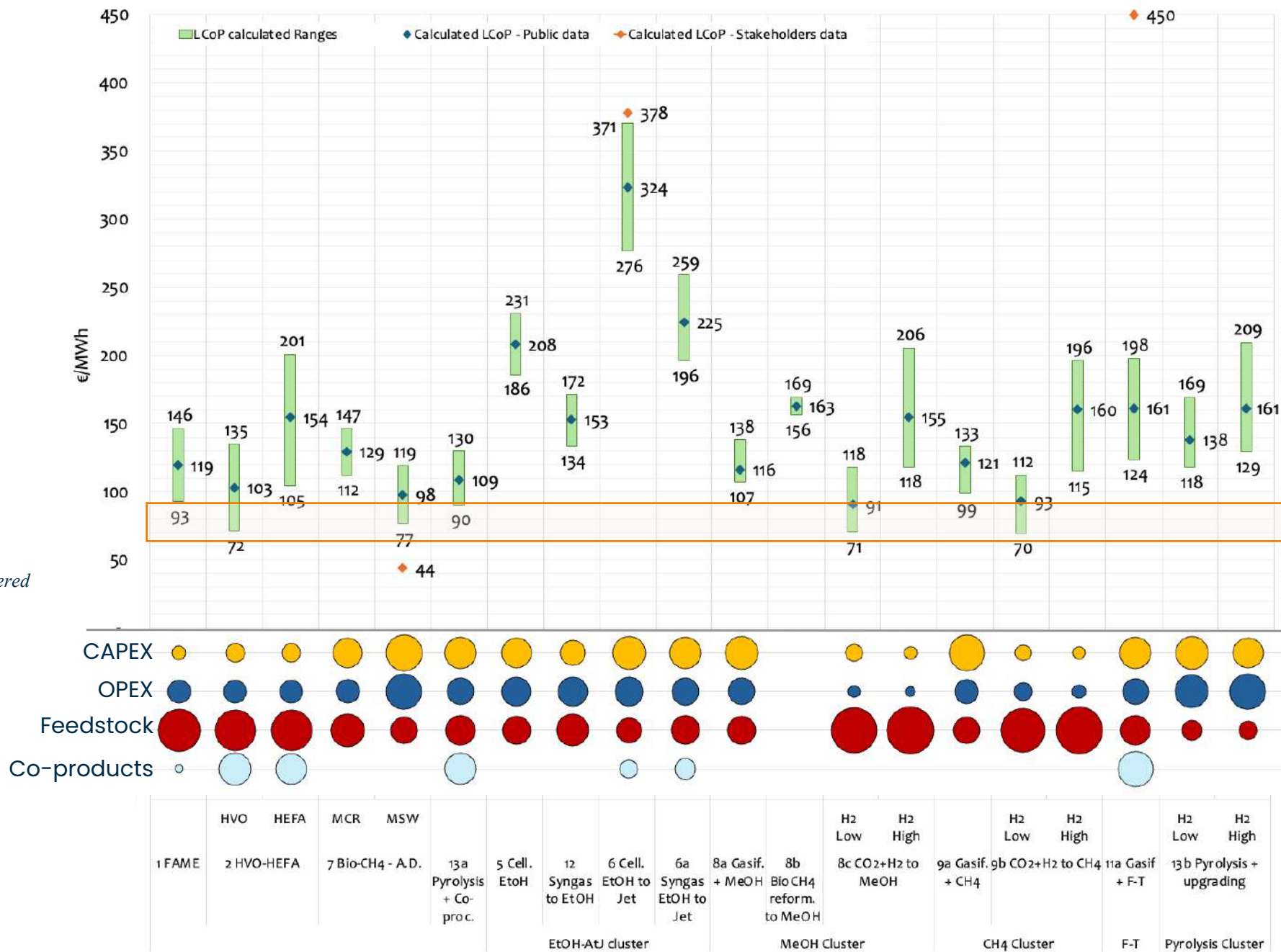


Cost estimates

Before Hormuz

Diesel: 84 €/MWh
JetA1: 65 €/MWh

No inflation considered



* For IVC 8b the use of existing refineries leveraging on guarantees of origin is considered, thus CAPEX, OPEX values need different calculation.

Conclusions

- **Policies and regulations: very complex and diversified** (Regional, International)
- **Carbon Accounting:** towards unique metric, LCA-based evidence, interoperability
- “**Security & competitiveness components**” to be incorporated in policy
- Recognise the **multi-feedstock & multi-product in biorefining** to leverage investments
- **Land transport:** sustainable liquid and gaseous biofuels
 - Still key by 2035 and beyond
 - Ready to deliver, compatible with infrastructures
- **Pricing:** From Energy/Volume mandates to CO2/GHG performance
- Policies and regulations should focus on **industrially** and **socially** viable **Roadmaps**
- Beyond setting the goals, key is **how** to reach the goal
 - ✓ *All options necessary and **complementary** : **urgency to act***
 - ✓ ***Security** cannot be addressed with urgent measures only*
 - ✓ ***Short- and medium-/long-term plans** to be equally developed*

Investment decisions based on long-term considerations (stable & clear policy needed)

Thanks for your attention

David Chiaramonti

Politecnico di Torino

david.chiaramonti@polito.it

 **biofuture platform**
Kickstarting a global, advanced bioeconomy
AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL



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