Innovation in SAF technologies supporting policy

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ICARUS Workshop, Sustainable Aviation Fuel Policies , Brussels – 09 July 2024

EU policies

European Green Deal and Fit for 55

- RED
- REFuelEU aviation
- FuelEU maritime
- ETS
- ESR
- ETD
- CO2 standards

REPowerEU Plan COM(2022) 230 final

- Biomethane Action Plan
- Biomethane Industrial Partnership

Hydrogen and decarbonised gas markets package

- Renewable gases
- Low carbon gases with<=70% GHG emissions on LCA basis

The Green Deal Industrial Plan

- EU Net-Zero Industry Act
- Sustainable biogas and biomethane
- Sustainable alternative fuels for aviation and maritime
- RFNBOs

Strategic Technologies for Europe Platform

- Clean technologies
  - Renewable energy
  - RFNBOs
  - SAF (alternative)
- Bio technologies
- Deep and digital technologies

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Fit for 55 package

RED

- Collective binding target of renewables in EU's energy mix to 42,5% by 2030 and indicative target for **innovative renewable energy technology** of at least **5%** of newly installed renewable energy capacity
- Advanced biofuels and biogas produced from Annex IX Part A feedstock AND renewable fuels of non-biological origin in energy supplied to transport at least **5,5 % in 2030**, of which renewable fuels of non-biological origin at **least 1 %**
- GHG intensity reduction at least **14,5 % in 2030** by all renewable fuels and renewable electricity supplied to transport OR 29% share of renewable energy in final energy consumption in transport

REFuelEU aviation

- In 2030 SAF at least **6%** of which synthetic aviation fuels average share **1.2%** and minimum annual share 0.7**%,**
- In 2050 SAF at least **70%** of which synthetic aviation fuels at least **35%**
- SAF include biofuels from agricultural or forestry residues, algae, bio-waste, UCO, animal fats, and recycled jet fuels from waste gases and waste plastic, as well as synthetic fuels and renewable hydrogen

FuelEU maritime

- Biofuels, biogas, renewable fuels of non-biological origin and recycled carbon fuels are taken into account to reduce the GHG content of the energy in ships by **2% in 2025, -6% in 2030 and -80% in 2050** from 2020 average of 91.6 gCO2/MJ
- 2 % RFNBO as of 2034 if share of RFNBO in the maritime bunker fuels used by ships is less than 1 % by 2031

ESR

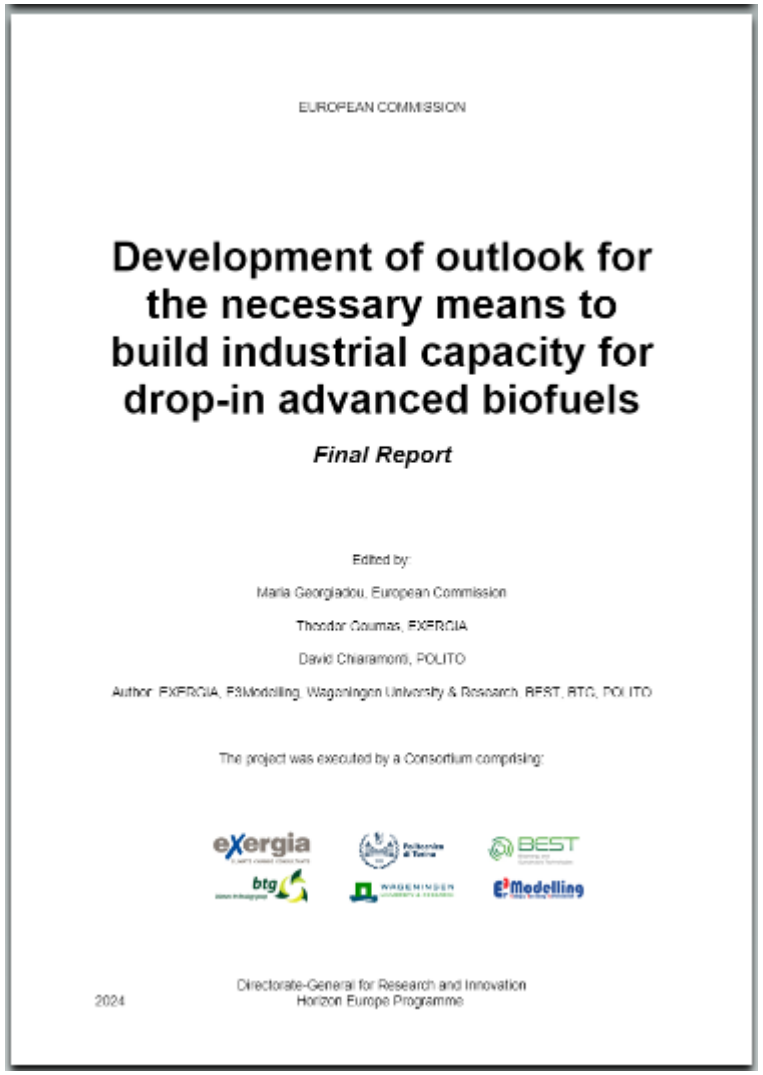
- MS share effort to reduce emissions from road transport + agriculture + buildings + small industries + waste
- EU-wide reduction of **40%** by 2030 in the transport, buildings, agriculture and waste sectors compared to 2005

ETS

- By 2030 reduce sectors' GHG emissions by **62%**, compared to 2005 levels
- Carbon pricing for maritime and, aviation from 2026, buildings and road transport (and certain industries) from 2027

Development of Outlook for the Necessary Means to Build Industrial Capacity for Drop-in Advanced Biofuels (2024)

EC RTD study



Development of outlook for the necessary means to build industrial capacity for drop-in advanced biofuels - Publications Office of the EU (europa.eu)

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Development of Outlook for the Necessary Means to Build Industrial Capacity for Drop-in Advanced Biofuels (2024)

EC RTD study

Objective

- *Identification of the factors for industrial growth of advanced and sustainable biofuels production in EU under the pertinent EU policy and respective regulatory framework*

Key Messages

- *Biofuels have a vital role to play in helping reduce emissions in the transport sector as part of the Ff55 and the climate neutrality goals, while contributing to increasing the EU's industrial competitiveness, gross domestic product, and net employment*
- *Such role is expected to further increase in the future, when advanced biofuels will become more and more available because of scale-up to full commercial technologies, processes, and value chains, driven by ambitious policies and sectorial targets and fostered by an EU strategy and R&I support*

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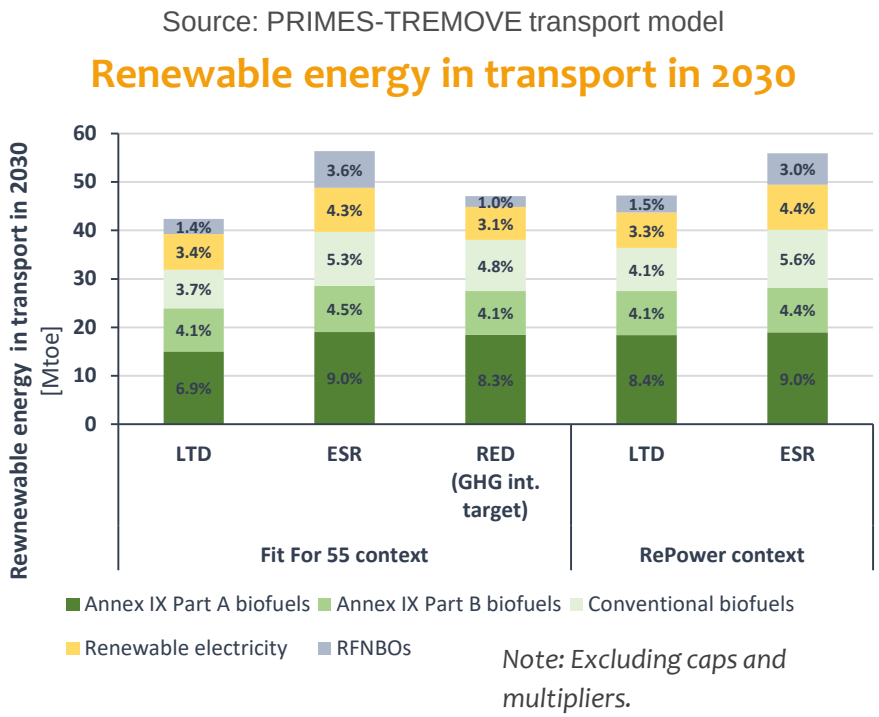
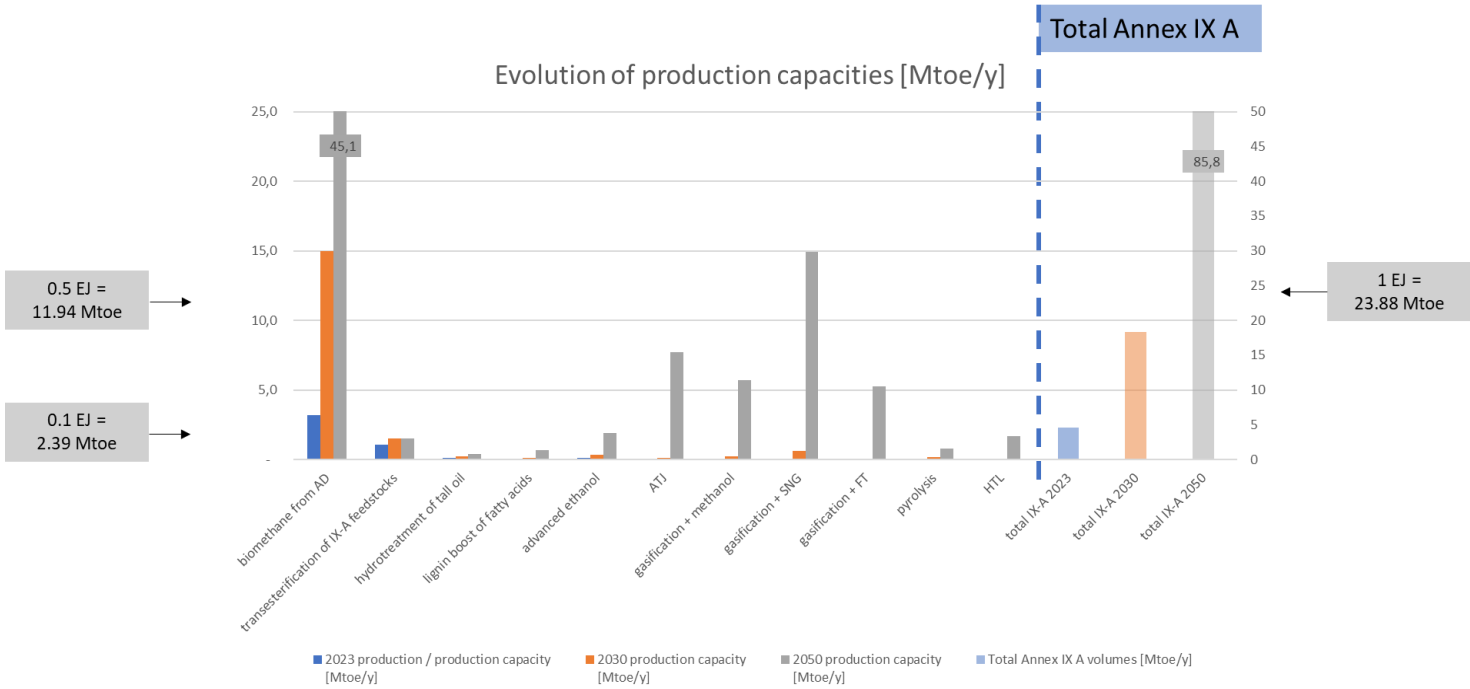
Demand Potential

Source: PRIMES-TREMOVE transport model



Note: Excluding caps and multipliers.

Industrial Capacity Potential



- *Biofuels are critical to meet 2030 policy transport targets, and demand increases by a factor of 2 to 2.5 than 2021 (to 32 – 40 Mtoe in 2030), if e-mobility/DAC fall short of awaited progress*
- *Roughly half of biofuels are advanced biofuels in 2030 and 85-88% of total consumption is in road*
- *Biofuels market grows to 45 Mtoe by 2050, almost exclusively advanced biofuels and waste fats and oils biofuels and 83-87% of total consumption shifts to aviation and maritime*

- *Current production of advanced biofuels and biogas 4.6 Mtoe/y (biomethane 3.2 Mtoe/y), Annex IX Part B biofuels (FAME, HVO) 3.1 Mtoe/y*
- *Capacity expansion for advanced biofuels and biomethane **18.4 Mtoe/y in 2030** (biomethane from AD 15.0 Mtoe/y)and up to **23.6 Mtoe/y with** 5.2 Mtoe/y FAME and HVO from cover crops in Annex IX*
- *Technically, capacity expansion, capped by feedstock availability, could be almost **3 times larger and reach 57.7 Mtoe/y in 2030***

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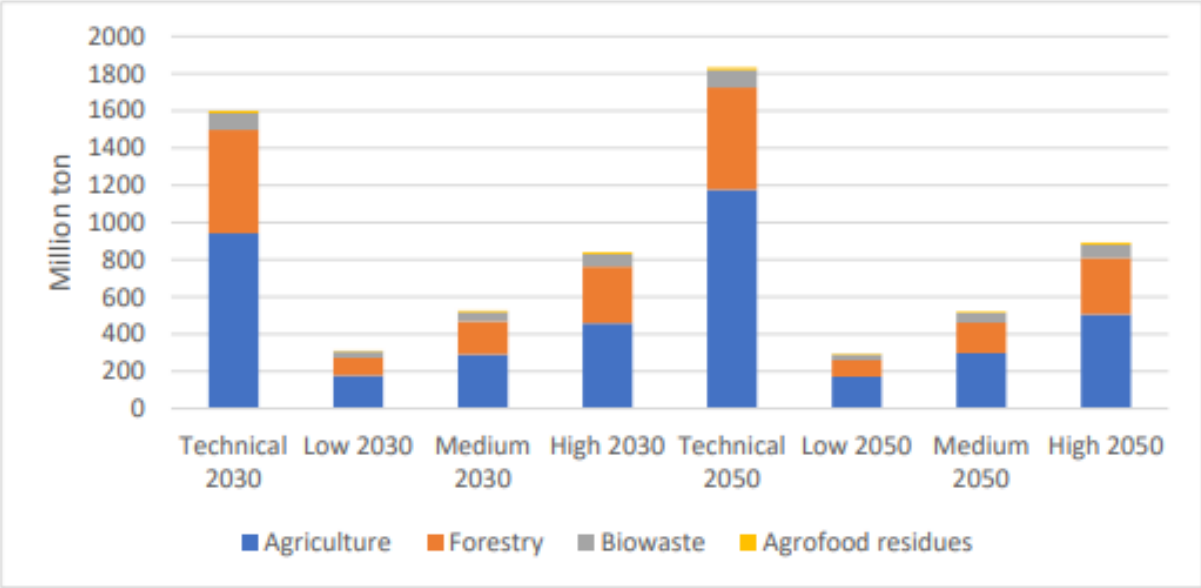
Biomass Potential for Bioenergy

Biomass (Annex IX Part A & B) Potential per type distribution Technical, low, medium, high potentials in 2030 and 2050



- *Biomass potentials available for energy markets for 2030 range **310 - 836 million dry tons** (135 to 360 Mtoe) and for 2050 **294 - 892 million dry tons** (127 to 390 Mtoe)*
- *Largest potential to be further mobilized are **primary residues from arable crops, manure and stem wood and primary forestry residues** and substantial exploitation of agricultural solid biomass exists even in low mobilization*
- *Towards 2050 the dedicated lignocellulosic crops and oil crops produced on **unused degraded lands and as cover and intercrop** in combination with normal food production also become more important*

A way to fill the gap

- *A **significant biofuels gap of 10.6 Mtoe/y** in central scenario*
- *The present 4.6 Mtoe/y production capacity **for advanced biofuels and biogas** is projected to increase x6, needing a strong regulatory, financing, and technological effort, a strategy and a roadmap for the EU to build the capacity*
- *Potential synergies between RFNBOs and advanced biofuels technologies development should be identified and utilized for the benefit of both pathways*

Role of RFNBOs

Capacity development of e-fuels for 2030 from announced projects (Mtoe)

Capacity e-fuels	e-H2 for mobility	e-kerosene	e-methanol	e-ammonia	e-methane	Total
Implemented	0.025	0.001	0.003	0.002	0.005	0.04
Under development	0.146	0.063	0.083	0.116	0.043	0.45
Planned	7.485	1.129	0.666	0.798	0.085	10.16
Total capacity	**7.66**	**1.193**	**0.752**	**0.916**	**0.134**	**10.65**

Source: project elaboration using several sources, among others the IEA database on RFNBO projects

- *3 – 4% of total RED II transport target covered by implemented capacity*
- *Availability of renewable hydrogen and CO2 after 2041 critical*

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FACILITATING TECHNOLOGY DEPLOYMENT

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HORIZON EUROPE

EURATOM

SPECIFIC PROGRAMME: EUROPEAN DEFENCE FUND

Exclusive focus on defence research & development

- Research actions
- Development actions

SPECIFIC PROGRAMME IMPLEMENTING HORIZON EUROPE & EIT*

Exclusive focus on civil applications

Pillar I
EXCELLENT SCIENCE

- European Research Council
- Marie Skłodowska-Curie
- Research Infrastructures

Pillar II
GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS

Clusters

- Health
- Culture, Creativity & Inclusive Society
- Civil Security for Society
- Digital, Industry & Space
- Climate, Energy & Mobility
- Food, Bioeconomy, Natural Resources, Agriculture & Environment

Joint Research Centre

Pillar III
INNOVATIVE EUROPE

- European Innovation Council
- European Innovation Ecosystems
- European Institute of Innovation & Technology*

WIDENING PARTICIPATION AND STRENGTHENING THE EUROPEAN RESEARCH AREA

- Widening participation & spreading excellence
- Reforming & Enhancing the European R&I system

EURATOM

- Fusion
- Fission
- Joint Research Center

* The European Institute of Innovation & Technology (EIT) is not part of the Specific Programme

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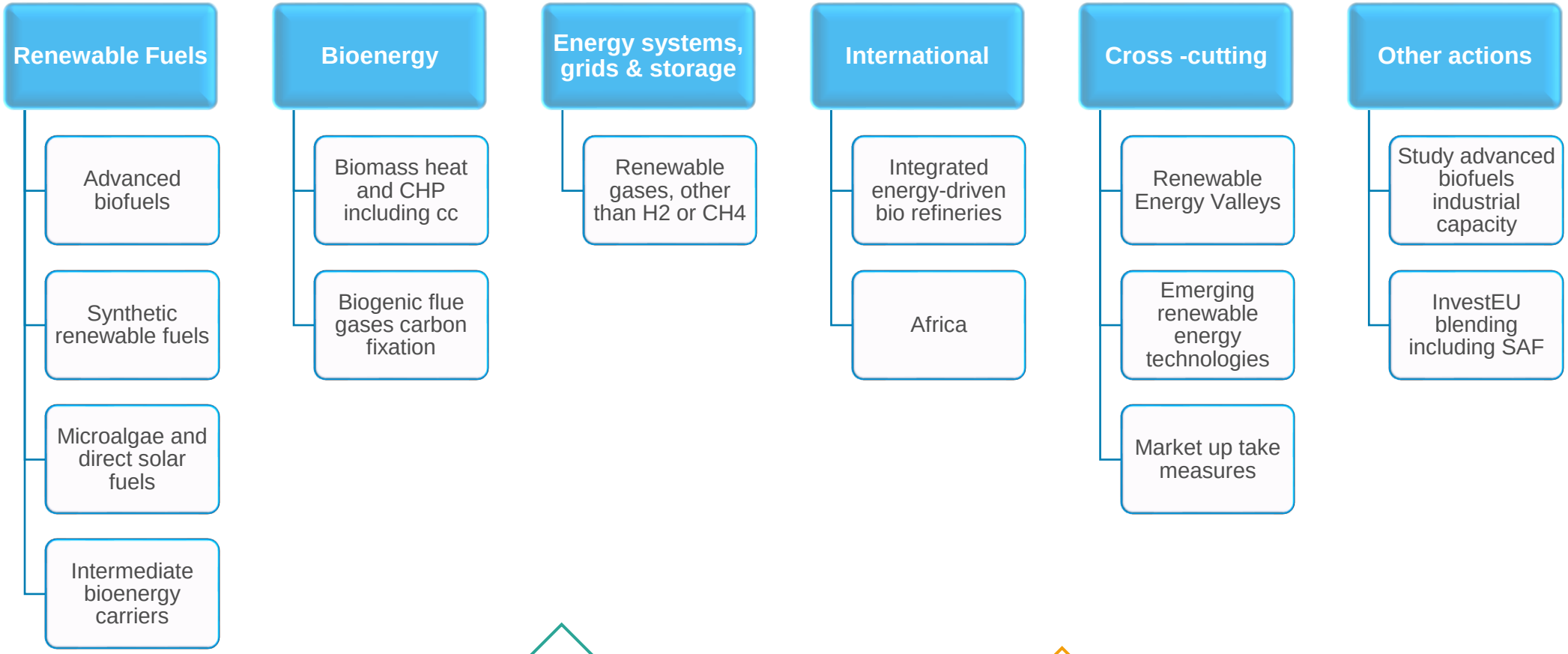
Horizon Europe Work Programme 2023-2024

Cluster 5 Climate Energy and Mobility, Destination Sustainable, secure and competitive energy supply, Renewable Energy



The European Green Deal

REPowerEU:

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Horizon Europe Work Programme 2023-2024

Cluster 5 Climate Energy and Mobility, Destination Sustainable, secure and competitive energy supply, Renewable Energy

Renewable Fuels	HORIZON-CL5-2024-D3-02-02	Development of next generation synthetic renewable fuel technologies	RIA, 3 M per project, opens 17 September 2024, closes 21 January 2025
International	HORIZON-CL5-2024-D3-02-03	Development of smart concepts of integrated energy driven bio-refineries for co-production of advanced biofuels, bio-chemicals and biomaterials	RIA, 3.5 M per project, opens 17 September 2024, closes 21 January 2025
Cross- cutting	HORIZON-CL5-2024-D3-02-10	Market Uptake Measures of renewable energy systems	CSA, 2 M per project, opens 17 September 2024, closes 21 January 2025
Other actions		Study on how to mobilize industrial capacity building for advanced biofuels	Other action, 0.5 M, Q3 2024
		Contribution to InvestEU blending operation under the Green Transition product (including Sustainable aviation fuels)	Indirectly managed action through EIB, 100 M, as of 1st quarter 2023 and 1st quarter 2024

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HORIZON-CL5-2024-D3-02-03 : Development of smart concepts of integrated energy driven bio-refineries for co-production of advanced biofuels, bio-chemicals and biomaterials

- Develop **zero-waste** and **neutral** or **negative** carbon emission **energy-efficient** biorefinery concepts to produce **low-cost** advanced biofuels through **co-production** of added value bio-based products and bioenergy
- Convert **biogenic wastes** and **residues**, **algae** and **aquatic biomass** through chemical, biochemical, electrochemical, biological, thermochemical pathways or combinations of them in **highly circular** processes
- Include **mass** and **energy flows**, addressing the **process heat** and **power** needs by using co-produced bio-heat /power, **capturing** and **reusing** biogenic effluent gases and **sequestering** biogenic emissions, for example as **biochar** for soil amendment, to **maximize** overall material and energy **efficiencies**
- **International cooperation** with **Mission Innovation countries** is expected
- Assess the feedstock **supply cost** at regional and local level and improve the feedstock **mobilization** including via **enabling technologies**, e.g., digitalization
- Assess **socioeconomic** and **environmental sustainability** including circular economy, social, economic and environmental aspects on a **life-cycle** basis
- Aim to reduce the advanced biofuels cost **at parity** with **marketed** biofuel equivalents or in the absence of these **competitive** to the fossil fuel equivalents
- Technology **validated** in relevant environment is required
- Provide **information** and **assessment** about the economic **feasibility** and the potential of **scaling-up** the technology at commercial scale as appropriate
- Possible synergies with topic HORIZON-CL6-2023-ZEROPOLLUTION

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Renewable Fuels Horizon 2020 projects

From biomass residues and waste to drop-in aviation fuels

The transport sector guzzles liquid fuels. Hydrothermal liquefaction to produce feedstock-flexible advanced biofuels could slash global emissions.

HyFlexFuel - Hydrothermal liquefaction:
Enhanced performance and feedstock flexibility for efficient biofuel production

COORDINATED BY
Bauhaus Luftfahrt, Germany

H2020

Advanced process makes biodiesel greener, cheaper and competitive

Four newly developed technologies enhance the efficiency and effectiveness of biodiesel production from waste biomass through a biomethanol route.

CONVERGE - CarbON Valorisation in Energy-efficient Green fuels

COORDINATED BY
The Polytechnic University of Milan, Italy

H2020

From domestic sewage waste to your gas tank: advanced biofuels from sewage

Naturally renewable, carbon-rich biogenic waste is turned into drop-in fuels for transport in the first industrial-scale demonstration of the process and product.

TO-SYN-FUEL - The Demonstration of Waste Biomass to Synthetic Fuels and Green Hydrogen

COORDINATED BY
Fraunhofer Society for the Advancement of Applied
Research, Germany

H2020

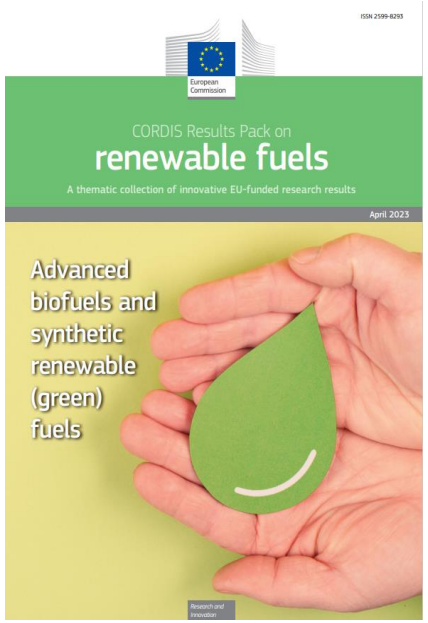
Exploiting available land to promote sustainable bioenergy in Europe

Freely accessible digital tool assesses the environmental, social and economic sustainability of producing biomass on marginal, underutilised and contaminated European lands, and finds great potential.

BIOPLAT-EU - Promoting sustainable use of underutilized lands for bioenergy production through a web-based Platform for Europe

COORDINATED BY
WIP Renewable Energies, Germany

H2020



CORDIS results pack on renewable fuels - Publications Office of the EU (europa.eu)

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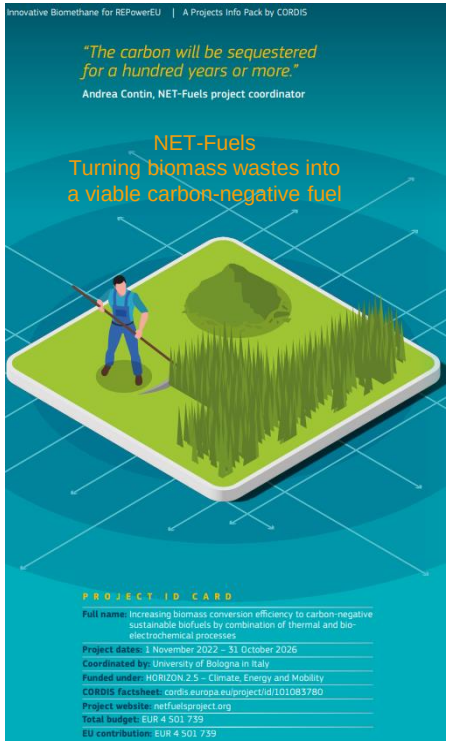
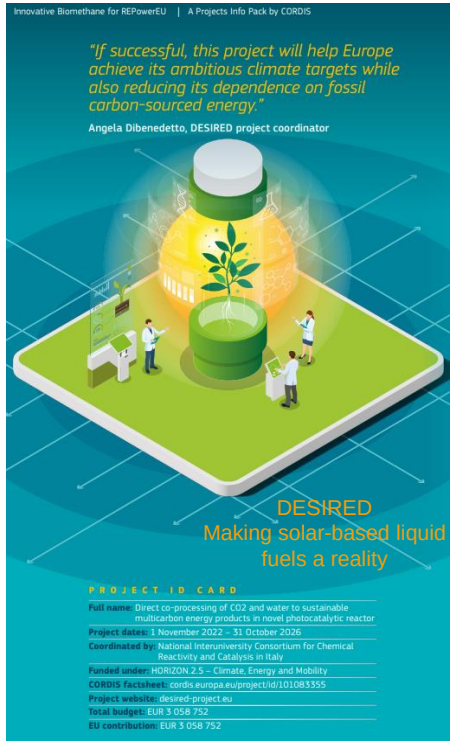
Carbon-negative Fuels Horizon Europe projects





- https://op.europa.eu/en/publication-detail/-/publication/c4651f9b-eaf2-11ed-a05c-01aa75ed71a1/language-en
  - video Innovative Biomethane for REPowerEU – A Cordis info Pack - YouTube

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Clean Energy Transition (CET) Partnership

- 30+ Countries: EU MS + ACs + International Partners, 50+ Funding Partners Funding Agencies & Ministries,13 Coordination Units, Coordinators: Austrian Ministry of Climate Action Swedish Energy Agency
- Annual Joint Calls for RTDI Projects 100 – 130 Mio €/a 2021 – 2027
  - International Part 2 - stage call
  - National/Regional Part evaluated to national/regional eligibility
- The joint Call 2023 - 12 Call modules of which:

5. Hydrogen and renewable fuels

Objectives	To accelerate the development of technologies for hydrogen and renewable fuels to facilitate their use in "hard-to-abate" carbon sectors and to serve flexibility and sector coupling needs in the energy system.
Topics	Technological development, demonstration, and deployment of renewable and synthetic fuels production, including hydrogen and energy storage
Activities	Targeting technological solutions for end users
Stakeholders	Research organisations, Universities, Companies, Public organisations, NGOs
TRLs	Final TRL = 5–9

- Stage 2 Closing: 27 March 2024, 14:00 CET - Projects start September 2024 (Tentative)
- Application to National/Regional Funding Agencies

- **Joint Call 2024**: Opening in June
  - Call Launch is planned for 12 Sep 2024 - *Stay tuned!*
  - Pre-announcement Event on 4 June 2024
  - Registration and Agenda of the events coming soon
- Matchmaking Platform: Clean Energy Transition Partnership | Registration (b2match.io)

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Mission Innovation 2.0 - Integrated Biorefineries Mission

Launched 4 April 2022

Develop and demonstrate innovative solutions to accelerate the commercialization of integrated biorefineries, with a target of replacing 10% of fossil-based fuels, chemicals and materials with bio-based alternatives by 2030

23 September 2022: Launch of the Integrated Biorefineries Mission Innovation Roadmap

Members will (a) promote research, development, and innovation across the biorefining supply and value chain, (b) advance pilot-scale demonstration projects for sustainable biorefining technologies, and (c) collaborate with industry and standards-setting organizations to support regulatory development for these new products

The Co -Leads	**India**: (Department of Biotechnology, Ministry of Science and Technology, Gov of India
	Netherlands: Ministry of Economic Affairs and Climate Policy
Members	Brazil, Canada, European Commission, United Kingdom
The Knowledge Partners	IEA, IEA Bioenergy (Task42), HLCAC, Nova Institute (Germany), CEM, Biofuture Initiative

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Mission Integrated Biorefineries - Actions

3 Pillars	Research and Development	New products	Workshops with Industry: Joint Research new products:
		Improved efficiency	Support efficiency improvement:: consortia for proposals to EU call
	Pilots and Demo	Showcase results	Legislation and regulations: Integrated biorefinery business plan:
		Learn and Improve	Standards
	Market and Policies	Sustainability	Collaboration with CEM Biofuture Campaign
		LCA and Carbon accounting	Collaboration with CEM Biofuture Campaign and UN LCA Initiative
Work Plan 2024	Increase deployment of innovative biorefineries for biofuels and chemicals	International collaboration with industries Matchmaking platform Financial instruments Possible joint calls	*Based on webinars and national consultations with industries, areas for collaboration will be identified and through the matchmaking tool and consultations with researchers and companies, collaboration will be initiated and executed, based on existing funding*
Bioresources in Missions and Initiatives	CEM Biofuture Initiative CEM Biofuture campaign with industry MI SAF Platform MI CDR/ BiCRS MI Zero Industries	Availability, Sustainability New Feedstocks Carbon Sequestration Fuels/ Chemicals SAF Carbon Storage Zero emission industries LCA	

Useful links

- **Horizon Europe Info Days – Cluster 5**

  Destination 3: Renewable solutions, Ocean energy, Carbon Capture and Utilisation (CCU)

  https://research-innovation-community.ec.europa.eu/events/4MjD45QEP6eLsP9j3MCEOc/programme

- **Horizon Europe Work Programme 2023-2024**

  8. Climate, Energy and Mobility

  https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-8-climate-energy-and-mobility_horizon-2023-2024_en.pdf

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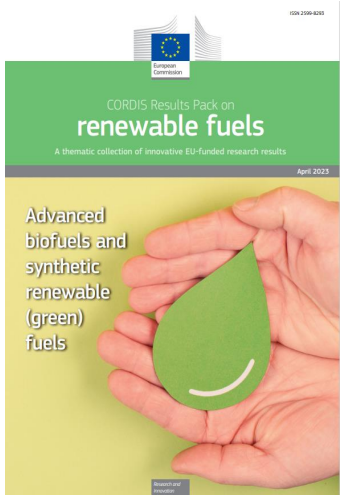

[CORDIS results pack on renewable fuels]

Thank you!

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[Innovative biomethane for REPowerEU]