# Contribution by IEA Bioenergy Task 39 (Biofuels to decarbonise transport) to the COP30 Presidency Roadmap consultations

Date: 31 March 2026

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## Transitioning Away from Fossil Fuels in a Just, Orderly and Equitable Manner

IEA Bioenergy Task 39 (Biofuels for Decarbonization of Transport) welcomes the initiative of the COP30 Presidency to develop a roadmap for implementing the Global Stocktake call to transition away from fossil fuels in energy systems in a just, orderly and equitable manner.

Transport remains one of the most difficult sectors to defossilize. Liquid fuels currently provide more than 90 % of transport energy globally, and existing vehicle fleets, infrastructure and supply chains will remain in operation for decades. For this reason, a realistic transition requires scalable sustainable renewable liquid fuels alongside electrification and other technologies.

In the 2025-2027 Triennium Task 39 is conducting its activities through six projects:

- Biofuels Implementation Agenda (including Emerging Markets)
- Advanced Biofuels Demonstration
- Renewable Hydrocarbons for Heavy Duty and Jet Fuel Sectors
- E-Fuels and Synergies with Biofuel Production
- Biofuel Value Chain Analysis: Case Study-Based Approach for Maritime Biofuels
- Management of Biogenic CO2: BECCUS

The Task 39 work programme contributes directly to the energy transition by analyzing implementation pathways, technology deployment, sustainability frameworks and sector-specific fuel strategies.

Task 39 has representatives of 19 countries plus the European Commission: Australia, Austria, Belgium, Brazil, Canada, China, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, South Korea, Spain, Sweden, United States and EC.

Based on ongoing analytical work under Task 39 and its contributions as a Cooperative Climate Initiative under the Climate Action Agenda “Plans to Accelerate Solutions (PAS)”, we propose a two-lane transition framework:

### Lane 1 – Rapid deployment of sustainable commercial biofuels

Immediate scaling of **commercially available fuels** such as ethanol, biodiesel, renewable diesel (HVO) and biomethane, using sustainable feedstocks and existing infrastructure to to allow fast defossilization and $CO_2$ emission reduction in existing vehicle fleets especially for road transport.



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## Lane 2 – Accelerated scale-up of advanced and emerging biofuels

Developing and scaling renewable fuels derived from advanced biogenic resources (esp. intermediate crops, residues, wastes and lignocellulosic biomass, and lignocellulosic and oil crops from severely degraded and contaminated lands) and other renewable sources (biogenic $CO_2$ and renewable electricity) to defossilize harder-to-abate segments such as aviation, maritime transport and long-distance heavy duty freight, including advanced ethanol, SAF pathways (e.g., ATJ, FT), biomethanol and other renewable fuels, to decarbonize harder-to-abate sectors such as aviation, maritime transport and long-distance heavy duty freight.

Together, these lanes create a bridge between today's energy systems and long-term net-zero transport, enabling both immediate emissions reductions and sustained technological progress.

The following reflections respond to the questions raised by the COP30 Presidency.

# (a) What are the most critical barriers — whether physical, economic, financial, institutional, technological or social— preventing a transition away from fossil fuels?

Despite strong technological progress, several structural barriers continue to slow the transition.

## 1. System-wide infrastructure lock-in: assets, markets and feedstocks

Transport systems are deeply locked into fossil fuels through long-lived vehicle fleets (often operating for 15–25 years or more), infrastructure and supply chains. While biofuels can leverage existing systems (e.g., blending and co-processing), without rapid deployment of renewable fuels fully compatible with current processing and engines, these assets risk locking in emissions for decades. The lock-in is reinforced by market structures and fossil fuel subsidies, which distort price signals and slow the adoption of sustainable alternatives. A further dimension is feedstock lock-in, where current biofuel systems rely heavily on established biomass resources (e.g., sugar, starch, oil crops, woody biomass), potentially limiting diversification toward residues, wastes and emerging pathways. Addressing this requires coordinated action to unlock infrastructure, correct market distortions and diversify sustainable biomass supply.

## 2. Financing barriers for emerging fuel supply chains

Advanced technologies for renewable fuels often face high capital and operational costs and technology risk, making first of its kind and early projects difficult to finance. This is particularly true for start-ups in general, as well as emerging economies where capital costs are higher leaving them constrained despite strong resource potential. Large-scale deployment of sustainable fuels requires investment across the entire value chain: feedstock production, conversion facilities, fuel distribution and blending infrastructure. Moreover, advanced technologies significantly better in terms of GHG mitigation have very high production costs and thus facing higher GHG mitigation costs compared to conventional biofuels.

## 3. Policy fragmentation and regulatory uncertainty

Ambitious strategies and targets do not automatically create conditions that allows increasing or building up innovative technologies along the well-to-wheel/wake chain. These emerging technologies face the well-known "valley of death," where commercialisation stalls without dedicated, risk-tolerant support mechanisms, as current strategies and targets largely favour technologies that are commercially competitive. Fragmented policies, missing fuel standards, lifecycle accounting methodologies and sustainability certification systems vary widely across

jurisdictions, creating trade barriers and increasing investor risk. Many countries lack stable long-term policies such as blending mandates, carbon intensity standards or investment frameworks. This uncertainty discourages large-scale investments in production capacity and infrastructure. To achieve required fuel production capacities, harmonised technology neutral and feedstock agnostic push and marketpull policies and a comprehensive monitoring of their impacts are necessary as well. This also include steering instruments to secure financing in order to lower the risk of investments and plant operation.

### 4. Perception gaps regarding sustainability and misaligned sustainability narratives

Debates around land use change, food competition and environmental impacts can create policy paralysis despite growing scientific evidence that sustainable biofuel systems can coexist with food production and ecosystem protection when properly governed. Public debate around land use, food security and indirect land-use change often lacks recognition of advances in agricultural productivity, integrated food-energy systems and sustainability governance frameworks. Moreover, defossilization of the transport sector needs a transition process that allow starting promising technology options to gain experience and learn lessons for continuous improvement. We don´t have time to wait for optimized options that might fulfil all SDGs from a very early beginning.

### 5. Limited deployment in emerging markets

Many countries with strong agricultural potential lack technical capacity, regulatory frameworks or financing mechanisms to develop biofuel industries. Task 39 research projects sustainability assessments and emerging market analyses indicate that overcoming these barriers requires science-based sustainability frameworks and coordinated international cooperation.

Task 39 has led an “Assessment of successes and lessons learned for biofuels deployment” which contains important recommendations (summarized here: https://www.ieabioenergy.com/wp-content/uploads/2022/08/IEABio_LLBF_Executive_summary.pdf).

## (b) What potential levers, whether economic, financial, institutional, social or technological, exist for accelerating the implementation of the transitioning away commitment?

Several economic, technological and institutional levers can significantly accelerate the deployment of sustainable fuels. Government backed offtake mechanisms is a critical lever, particularly for innovative value chains.

### 1. Policy frameworks that reward and support carbon performance

Carbon intensity standards, lifecycle-based regulation and long-term blending mandates and targets create predictable demand signals for renewable fuels. Modern policy frameworks that reward renewable fuels can stimulate the development of innovation ecosystems that further sustainability gains.

Blending mandates have proven to be among the most effective policy instruments for scaling sustainable fuels. Programs in countries such as Brazil, the United States, India and Indonesia demonstrate that ethanol and biodiesel blends can scale rapidly when supported by stable regulatory frameworks.

## 2. Financing mechanisms for sustainable fuel deployment

Bankability of renewable fuel projects is a key for market implementation. Blended finance, development banks and public-private partnerships can support demonstration, first of its kind and early commercial plants. Task 39 analysis of global demonstration plants highlights the importance of public support during early deployment phases.

Public-private financing mechanisms can accelerate the deployment of sustainable fuels:

- concessional financing for renewable fuel production facilities
- contracts-for-difference for early cost intensive movers on the market
- carbon intensity credit systems linked to lifecycle emissions reductions and thus GHG mitigation costs
- multilateral development bank investment programs

## 3. Technology development across the two lanes

Scaling advanced renewable fuels requires bridging the “valley of death” between demonstration and commercial deployment. The Task 39 Advanced Biofuels Demonstration Database monitors global demonstration facilities and provides evidence of technology progress and commercialization potential.

Rapid deployment of existing technologies must occur simultaneously with investment in advanced fuel pathways, including:

- lignocellulosic ethanol
- advanced biodiesel and renewable paraffinic diesel (HVO
- sustainable aviation fuel (SAF) pathways (e.g., HEFA, ATJ, FT)
- biomethane and bioLNG
- biomethanol and other renewable alcohols
- fuels derived from residues and waste streams

## 4. Integrated renewable energy systems

Emerging fuel systems increasingly combine biomass resources with renewable electricity and hydrogen, enabling higher carbon utilization and lower lifecycle emissions. Task 39’s research on hybrid biofuel-e-fuel production pathways highlights the potential of integrating renewable hydrogen and biogenic $CO_2$ to produce synthetic fuels compatible with existing engines.

## 5. Integration with agricultural and rural development

Biofuel value chains can stimulate rural economies, increase agricultural productivity and support economic diversification, particularly in developing countries. Also, developments for e-fuels often start with value networks based on biomass as renewable carbon source.

## 6. International trade and green fuel corridors

Regional renewable fuel trade corridors can help match resource availability with fuel demand while contributing to harmonization of sustainability standards and facilitating certification.

## 7. International cooperation and knowledge sharing

Global collaboration through initiatives such as the Global Biofuels Alliance, Clean Energy Ministerial Future Fuels Community, and IEA Bioenergy can accelerate learning and reduce deployment risks.

## (c) What country, regional or sector roadmap experiences, best practices, and lessons learned can be shared?

Several regional and national experiences demonstrate how sustainable fuels can contribute to the transition away from fossil fuels.

### 1. Brazil's integrated biofuel system

Brazil's ethanol and biodiesel programs illustrate how long-term policy frameworks, sustainability governance and industrial innovation can create large-scale biofuel industries while maintaining strong agricultural productivity.

### 2. Global South

Task 39 analyses show that fewer than a dozen countries could collectively produce more than 100 billion liters of additional biofuels, particularly in Latin America, Africa and Asia. These regions often combine:

- suitable climate and land availability
- agricultural expertise
- growing domestic transport demand

### 3. Demonstration and innovation pathways

The global portfolio of biofuel demonstration plants highlights key lessons:

- early government support is essential
- technology learning curves reduce GHG mitigations costs rapidly by improving the industrial competitiveness at the same time.
- international collaboration accelerates scale-up

### 4. Sector-specific roadmaps

Aviation and maritime sectors have global strategies while road transport is subject to regionalisation with no single entity establishing principles such as in aviation (ICAO) and maritime (IMO).

Several regional experiences demonstrate that scaling sustainable fuels is feasible:

#### Ethanol programs

Countries including Brazil, the United States and India have successfully implemented large-scale ethanol blending programs. Ethanol blending mandates exist in 57 across all continents.

These programs demonstrate that:

- blending mandates can scale quickly
- flex-fuel vehicles enable higher ethanol blends
- domestic agriculture can supply both food and fuel markets.

#### Biodiesel and renewable diesel

Indonesia's B35 program and the rapid expansion of renewable diesel in North America and Europe demonstrate the scalability of diesel substitutes. Biodiesel blending mandates exist in 45 countries.

#### Aviation fuels

Sustainable aviation fuel (SAF) pathways such as HEFA and alcohol-to-jet are progressing rapidly toward commercialization, supported by international initiatives including ICAO's CORSIA framework.

Maritime fuels

Case studies analyzed by Task 39 show that green shipping corridors provide effective platforms for fuel deployment and infrastructure coordination.

Shipping is beginning to adopt bio-derived fuels including biomethanol, biodiesel blends and biomethane. Support for IMO deep defossilization and the establishment of a development fund has reached consensus but implementation has been recently hindered.

## (d) How can a just, orderly and equitable transition best reflect the diverse realities of countries at different stages of development and with different degrees of dependence on fossil fuels?

A global transition away from fossil fuels must reflect the diverse realities of countries and sectors.

### 1. Differentiated pathways for developing countries

Many developing economies rely heavily on agriculture and biomass resources. Sustainable biofuel industries can provide:

- new income streams for farmers
- rural employment
- domestic energy security
- export opportunities

### 2. Recognizing diverse resource potentials

Many developing countries possess significant agricultural and biomass resources that can support domestic biofuel industries. Sustainable fuel production can therefore serve as a development pathway combining climate mitigation with rural economic growth.

### 3. Inclusive economic development

Biofuel supply chains integrate farmers, industrial actors, logistics providers and technology developers, enabling broad participation in the energy transition.

### 4. Sustainability governance and contributions of biofuels to the SDGs

Robust sustainability frameworks—including lifecycle carbon accounting, land-use governance and certification systems—are essential to ensure environmental integrity and maintain public confidence.

Key safeguards include:

- zero deforestation and ecosystem protection
- lifecycle greenhouse gas accounting with public CI registry
- best management practices and adequate water, soil and nutrient management
- protection of Indigenous rights and land tenure.

### 5. Integrating food and energy systems

Modern agricultural systems increasingly integrate food, fuel and product production through co-products, crop rotation and productivity improvements (including cascading aspects of circular economies with integrated value networks).

Examples include:

- double cropping systems (e.g., soybean–corn rotations; sugarcane-peanut rotation)
- integrated biorefineries producing food, feed, fuel and bioelectricity (e.g., sugarcane, corn, soybean)
- waste and residue-based biofuel pathways (e.g., biomethane from sugarcane ethanol vinasse; biomethane from urban waste)

### 6. Complementarity with other technologies

Biofuels are not only a standalone solution but with lots of innovative opportunities being part of a portfolio approach including coprocessing, electrification, hydrogen, efficiency improvements and modal shifts. They can also improve integration, flexibility and optimization of the energy system. Operated in flexible modes (e.g. with combined heat/cooling and power plants) this also help to secure regional energy independency and industrial competitiveness.

### 7. Integration with other industrial applications

Sustainable Biofuels can play a dual role by contributing to energy supply while also serving as renewable carbon sources for the chemical industry. Many advanced biofuel intermediates, such as bio-naphtha, bio-oil fractions, bio-methanol and bio-ethylene can be integrated into existing chemical production routes, enabling the production of biobased chemicals. This creates valuable synergies between the energy and chemical sectors, supports industrial circularity, and accelerates the shift from fossil to renewable carbon feedstocks.

Insights from IEA Bioenergy Task 32—focused on biomass combustion for industrial heat and other applications — highlight system-level barriers such as infrastructure dependencies, long asset lifetimes, and weak demand signals that are equally relevant to transport fuels. These shared challenges underscore strong synergies across bioenergy sectors and reinforce the need for coordinated, portfolio-based approaches to scale sustainable liquid and gaseous fuels for transportation.

### 8. Supporting emerging economies

International climate finance should prioritize fuel transition infrastructure in developing economies, recognizing their role and potential for large contributions, including blending facilities, logistics systems and support for certification frameworks.

### 9. Bridging today and the future

The two-lane framework allows countries to reduce emissions immediately while investing in long-term innovation, ensuring that the transition remains ambitious, equitable and feasible.

## Concluding Perspective

The transition away from fossil fuels in transport requires solutions that are scalable, deployable today, and compatible with existing infrastructure while enabling technological progress.

The two-lane approach—rapid deployment of sustainable conventional biofuels combined with accelerated development of advanced renewable fuels—offers a practical pathway to achieve this goal.

Through its analytical work on sustainability, technology deployment, emerging markets and sector roadmaps, IEA Bioenergy Task 39 stands ready to contribute scientific evidence and policy insights to support the COP30 Presidency Roadmap and to help translate global ambition into actionable pathways for transport defossilization.

## Further Reading

- IEA Bioenergy Task 39 Reports - https://task39.ieabioenergy.com/publications/
- IEA Bioenergy Countries' Report – Update 2024. Offers a comparative analysis of bioenergy deployment across IEA Bioenergy member countries, based on harmonized statistics (2010–2022). https://www.ieabioenergyreview.org/
- IEA Bioenergy Report (2022): How to Implement Sustainable Bioenergy. Presents a comprehensive assessment of bioenergy systems across technologies and sectors, including transport fuels, biogas, heat and power. https://www.ieabioenergy.com/blog/publications/2024-country-reports/

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