COP29 Key Takeaways

FCA Future Cleantech Architects

COP29 Baku Azerbaijan

Foreword by Dr. Peter Schniering

Dr. Peter Schniering,
Founder & CEO

FCA Future Cleantech Architects

Positive tipping points: a sign of hope in dire political conditions

Dear Reader,

COP29 was special in many ways. Despite a tiring negotiation process and meagre results at the top political level, our team has also seen so many encouraging signs and plenty of dedicated plans to take action in bi- and multilateral collaboration, as well as at the national and regional levels. We have created this overview of topics we have covered at the 29th Conference of the Parties: from innovative high-temperature heat solutions to public-private partnerships, from comprehensive approaches for tapping biofuels for heavy industry to the cross-national potential of RD&D.

As of December 2024, the geopolitical macro environment is everything but encouraging for ambitious climate policy. But cleantech continues its impressive development at the technology level: various systems continue their journey along impressive learning curves. We see the potential that further positive tipping points can be surpassed shortly – other than those tipping elements you know of from IPCC reports, those positive points represent a critical threshold in the adoption of new climate-friedly technologies.

Looking forward to collaborating to drive cleantech innovation harder,

Dr. Peter Schniering,
Founder & CEO

FCA Delegation at **COP29** in Baku

Dr. Peter Schniering, Founder & CEO

Leonie Brand, Head of Operations & Partnerships

Magnolia Tovar, Director of Technologies & Impact

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Leonie Brand,
Head of Operations & Partnerships

Introduction

As FCA reflects on its participation in COP29 in Baku, we are appreciative of the opportunities this Conference of the Parties has afforded our organization. While we have been actively partaking in COPs since Glasgow in 2021, this year represents a milestone for us, marking the first time FCA has been granted the honor of hosting an official side event as an observer organization. Partnering with the Climate Change Center from Korea and the Climate Leadership Coalition from Finland, we co-hosted a panel discussion on "Leveraging Public-Private Synergies to Accelerate the Global Energy Transition". The session was not only well-attended and sparked productive dialogue, but it also paved the way for promising new collaborations with two respected international organizations sharing our commitment to climate action.

The high-level political results of COP29 fall short on ambition, but we are reminded year after year of the importance of these conferences, both within but also outside of the frame of the official negotiations. COPs serve as unparalleled platforms for fostering connections, exchanging ideas, and catalyzing action. They bring together an extraordinary diversity of stakeholders – researchers, media professionals, policymakers, activists, private sectors actors, and representatives from vulnerable communities such as Small Island Developing States (SIDS) and Least Developed Countries (LDCs).

For non-governmental organizations like FCA, few other climate events offer such tangible opportunities to connect with high-level international decision-makers and other like-minded organizations. COPs give us the opportunity to share the outcomes of our research and analyses and elevate our actionable policy calls to advance decarbonization of hard-to-abate sectors. They also provide a rare space to engage directly with other actors committed to the fight against climate change, facilitating collaborations that often extend far beyond the conference itself. These connections are instrumental in driving meaningful emissions reductions and advancing the global energy transition. While the outcomes of COP29 do not meet the urgency of the climate crisis, the relationships and shared resolve fostered at this event remind us why these gatherings remain indispensable. They reinforce our collective commitment to accelerating climate solutions, ensuring that progress continues inside and outside the negotiation rooms and that we can continue to drive climate innovation – together.

Official Side Event: **Leveraging Public-Private Synergies to Accelerate the Global Energy Transition**

Speakers

Young Sook Yoo
(Climate Change Center)
- Opening remarks

Sakari Puisto
(Eduskunta | Riksdagen | Parliament of Finland)
- Keynote Speaker

Boo nam Shin
(Korea Energy Agency)
- Speaker

Simon Benmarraze
(International Renewable Energy Agency (IRENA))
– Speaker

Boo nam Shin
(Korea Energy Agency)
– Speaker

Seth Mahu
(Ministry of Energy, Republic of Ghana)
– Speaker

Magnolia Tovar
(Future Cleantech Architects)
– Speaker

Tuuli Kaskinen
(Climate Leadership Coalition)
- Moderator

Introduction

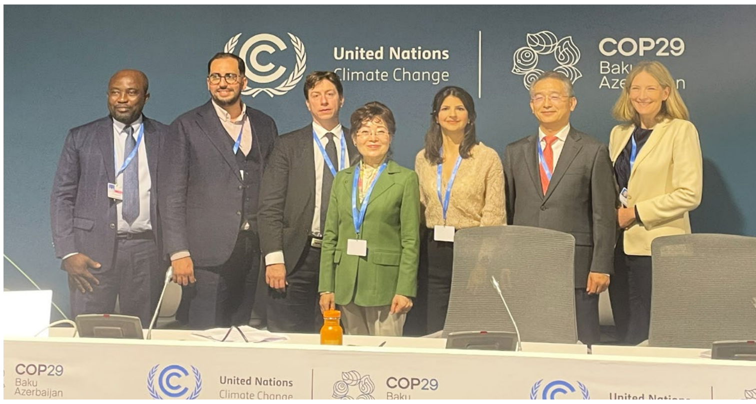
Leveraging public-private synergies will be crucial not only for successfully transitioning from high-polluting energy and industrial systems, but also for enabling emerging economies in the Global South to develop the robust energy and industrial infrastructure needed for their economic growth.

Historically, governments have played a pivotal role in both infrastructure development and providing the stability needed for private investments to flourish. Without legal certainty, adequate infrastructure, and an enabling policy framework, the risks for companies undertaking long-term projects become prohibitively high. This can result in a lack of viable business cases or the construction of stranded assets.

As the world shifts toward energy and industrial systems aligned with net-zero goals, and as developing countries face surging energy demands coupled with increased industrial activities, urgent action is needed to mitigate emissions. In this context, synergistic collaboration between public and private sectors is more critical than ever. Such partnerships are indispensable to achieving the ambitious net-zero emissions targets while fostering sustainable industrial growth.

Recognizing these challenges, Future Cleantech Architects, in collaboration with the Climate Change Center (CCC) and the Climate Leadership Coalition (CLC), had the privilege of hosting an official side event at COP29. This event focused on identifying success factors for impactful global public-private partnerships to accelerate the energy transition. Key topics included unlocking much-needed climate finance, establishing carbon markets, and facilitating technology transfer.

This marked Future Cleantech Architects' first official side event at a COP, and we are deeply grateful for the opportunity to have partnered with like-minded organizations such as the CCC and CLC. We were honored to host distinguished speakers and panelists who provided valuable insights into how public-private partnerships can drive the energy transition forward. We have summarized key takeaways from our intervention below and added additional insights and recommendations to foster private and public partnerships to drive decarbonization.



Key Takeaways

1

Foster a Supportive Environment for Clean-tech Investment.

Governments should strive to establish an appealing and supportive environment to catalyze private sector investment in clean technology. This involves:

a. **Implementing a Strategically Tailored Policy Framework** - Develop policies that balance incentives and regulations to encourage long-term private investments. This may include legally binding targets for decarbonization milestones within specific timeframes and incentives for deploying clean technologies such as advanced geothermal, solar and wind energy, carbon capture and storage, and sustainable fuels for heavy transport.

b. **Developing Necessary Infrastructure** - Ensure that infrastructure for deploying decarbonization technologies is developed in a timely manner. For example: concrete, the second most consumed material globally after water, requires carbon capture and storage to reduce emissions during traditional cement production. Private companies are unlikely to invest in such technologies without assurance of infrastructure to transport and store the captured carbon. This concern also applies to advanced geothermal energy, which depends on transmission infrastructure to deliver electricity to consumers.

c. **Promoting National Systems of Innovation (NSI)** - Encourage collaboration among industry, academia, government, and other stakeholders to develop solutions tailored to local jurisdictions. Fostering innovation in clean technologies can accelerate the decarbonization of energy and industrial systems.

d. **Ensuring a Robust Legal Framework for Investors** - Provide certainty for long-term private investment by addressing risks associated with political changes that could undermine investments or decarbonization goals.

By addressing these areas, governments can create an environment conducive to private investment in clean technologies, thereby advancing decarbonization efforts.

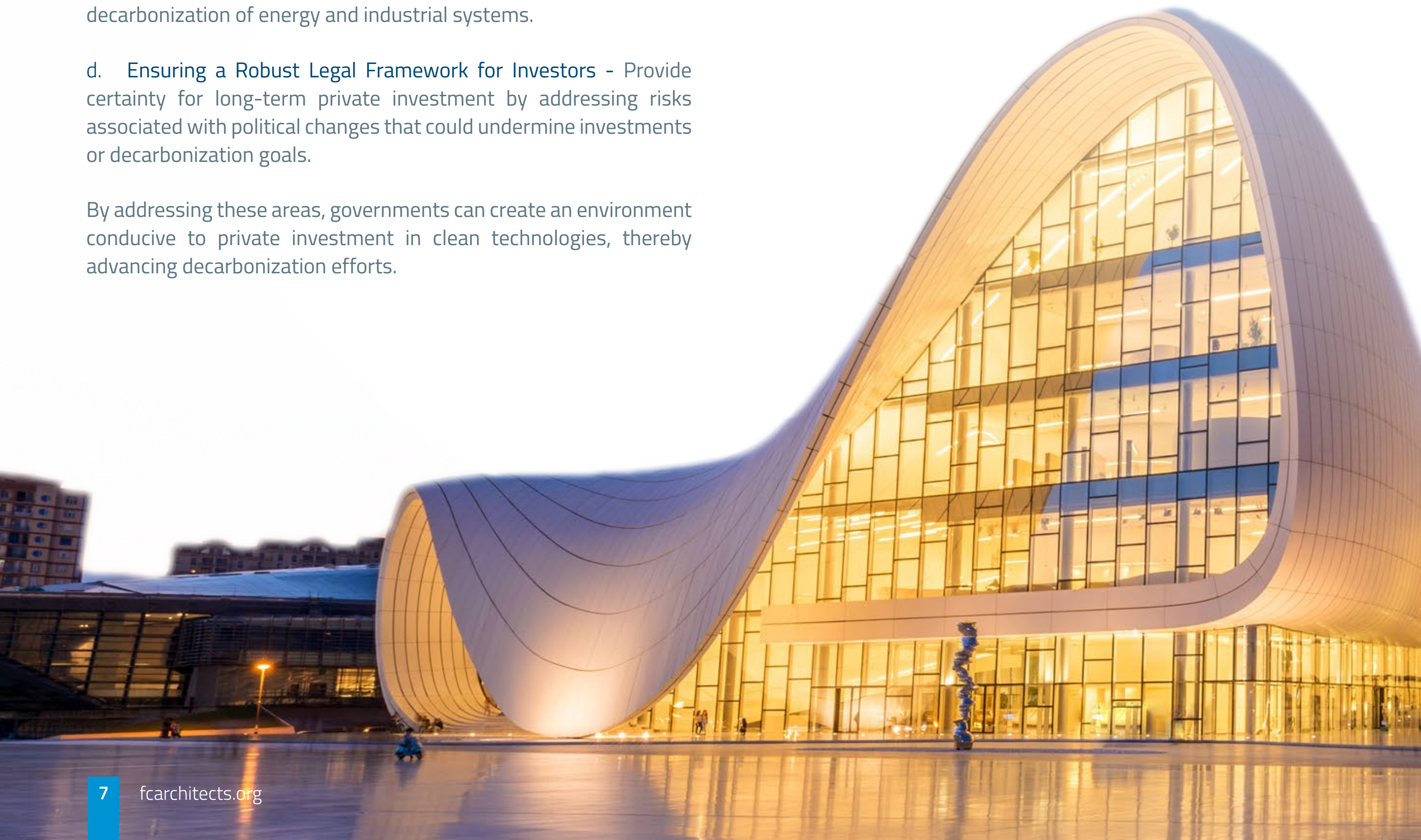
2

Bridge the Commercialization Gap with Public Support.

Governments must actively address the commercialization gap, particularly during the unprofitable stages of investment in decarbonization technologies. Implementing these technologies in industrial processes (e.g. carbon capture and storage, clean hydrogen) and adopting low-carbon electricity production pathways often leads to higher capital (CAPEX) and operational expenditures (OPEX), posing challenges for both the private sector and consumers, especially when long-term profitability is uncertain.

Policy instruments like Contracts for Difference (CfDs) can mitigate these financial risks by ensuring revenue stability for investors. The Dutch SDE++ scheme, for example, incentivizes clean electricity development and carbon dioxide emissions reduction. This mechanism provides long-term certainty by bridging the commercialization gap over a 12 to 15-year period, thereby reducing risks associated with elevated energy or production costs.

Additionally, CAPEX support from governments is pivotal for catalyzing the deployment of clean technologies. For instance, India's National Solar Mission offers various incentives, including CAPEX and OPEX subsidies, to promote solar energy projects. This initiative now boasts a target of 100 GW of solar PV by 2030. The model aims to encourage the adoption of sustainable practices by reducing the financial barriers associated with high upfront costs and reducing long-term investment risks.



3

Integrate Public and Private Financing Holistically.

Governments must ensure a comprehensive strategy that addresses all aspects of the energy transition value chain to mitigate risks and improve the likelihood of achieving emissions reduction targets by adopting a holistic approach to leveraging private and public financing, considering the entire value chain, reducing risks, and incentivizing investment. This includes planning and developing infrastructure critical for deploying clean energy and decarbonization technologies, such as transmission systems, carbon capture and storage (CCS) pipelines, and geological reservoirs. Key components of this approach involve, but are not limited to:

- Long-term incentives to support unprofitable segments of investments (e.g., the Dutch policy mechanism SDE++).
- Blended financing schemes to accelerate the adoption of less-established technologies.
- A robust and inclusive policy framework that covers all elements of the value chain without exclusions, for example from energy generation to end-use sectors.

As an example, decarbonizing existing high-polluting hydrogen production assets expected to remain operational for decades can be achieved through CCS. Simultaneously, clean electricity must be deployed to decarbonize the grid and emerging sectors, such as road transport, until green hydrogen can be produced in abundant quantities for no-regrets sectors. Private stakeholders can be encouraged to invest in these decarbonization efforts if adequate infrastructure for carbon transport and storage is developed in time, policy mechanisms are implemented to address the commercialization gap (such as unprofitable operating expenditures), and legally binding decarbonization targets are in place.

A holistic approach ensures that every part of the value chain is addressed, minimizing silos that could preclude the adoption of clean technologies and fostering robust public-private partnerships. Such comprehensive cooperation enables the adoption of clean technologies, mitigates risks, and paves the way for impactful and coordinated progress toward net-zero emissions.

4

Leverage Standards and Public Procurement to Mitigate Investment Risks.

The public sector has a pivotal role to play in fostering a market for decarbonized products such as green cement and steel. Deploying decarbonization technologies in heavy industries such as cement, steel, and chemicals will require substantial upfront capital investment and is likely to result in higher operational expenses, especially if decarbonized energy sources are more expensive than traditional fossil fuels. This creates a challenge, as not all buyers may be willing to pay a "green premium" for decarbonized products, particularly when cheaper alternatives are available in the market.

Governments have an unprecedented opportunity to address this challenge by leveraging green public procurement to create demand and provide market certainty for decarbonized products. For instance, public infrastructure projects often require large quantities of materials like cement and steel. By implementing mandatory Green Public Procurement (GPP) policies, governments can drive demand for decarbonized products, reduce the perceived investment risks, and encourage industries to adopt decarbonization technologies.

Additionally, the public sector can play a crucial role in accelerating the adoption of construction efficiency standards and practices. These measures promote the development of more energy-efficient buildings, encourage the reuse of materials, and ultimately minimize environmental impacts, contributing to a more sustainable and resource-efficient society.

Such policies not only support the adoption of low-carbon solutions, but also send a clear signal to investors and industries that the market for green products is growing, ensuring reliable off-takers for their innovations.

At FCA, we actively advocate for policies that accelerate the development and deployment of clean technologies, emphasizing the importance of strong collaboration between the public and private sectors. For more insights, explore our High-Temperature Industrial Heat Decarbonization and Cement Policy Brief resources.

ERLG Roundtable on **The Future of Industrial Heat: How to Align Decarbonization and Competitiveness**

Speakers

Paula Schmid Schmidsfelden
(BMW Foundation Herbert Quandt)
– Moderator

Dr. Peter Schniering
(Future Cleantech Architects)
– Keynote | Presentation of FCA High-Temperature Heat Report

Florian Nitzinger
(BMW Foundation Herbert Quandt)
– Speaker

Dr. Bryan Scheler
(BMW Foundation Herbert Quandt)
– Speaker

Philipp Offenberg
(Breakthrough Energy)
– Speaker

Susanne König
(KRAFTBLOCK)
– Speaker

Thomas Birr
(E.ON)
– Speaker

Anna Celsing Klingberg
(Alfa Laval)
– Speaker

Vanessa Z Chan
(U.S. Department of Energy (DOE)
– Speaker

Introduction

Every day, millions of people work in industries that produce essential materials such as cement, steel, minerals, and chemicals. These materials are vital for creating infrastructure and goods such as wind turbines, high-speed trains, hospital equipment, and agricultural tools, and heat is a crucial element in their manufacturing processes.

Yet, industrial heat is a major energy user, accounting for about 25% of global energy consumption and contributing 15% of global greenhouse gas emissions. Reducing emissions from industrial heat becomes even more challenging at higher temperatures, and many solutions are not ready to be scaled up yet. In the EU, most high-temperature heat is currently produced by burning natural gas. This method generates a substantial amount of greenhouse gasses – about 166 million tons of CO_2 equivalent in 2022, representing 40% of all industrial emissions in the EU. Additionally, much of this natural gas is imported, which introduces geopolitical risks and supply uncertainties.

To build a lasting competitiveness strategy and improve energy security, transitioning to cleaner industrial heat sources is essential. Several strategies can help achieve this. While low-carbon on-demand sources like geothermal and solar thermal are part of the solution, electrification stands out due to its scalability and potential to leverage any clean electricity source. Thermal energy storage is also an often-overlooked technology that can facilitate this transition by storing low-cost electricity and decoupling supply and demand. These solutions can offer efficient and cost-effective means to integrate renewable energy sources and provide flexibility to balance the intermittency of renewables.

FCA was honored to collaborate with the Energy Resilience Leadership Group and the BMW Foundation to co-host the event: "The Future of Industrial Heat: How to Align Decarbonization and Competitiveness – Examples from Europe." The event was based on our latest report "Decarbonizing High-Temperature Heat in Industry" and focused on underscoring the critical role of industrial heat in ensuring competitiveness and energy resilience while addressing the technical, economic, and policy challenges associated with decarbonizing high-temperature heat.

Key discussions during the event explored innovative solutions, including transitioning away from fossil fuels and integrating technologies like thermal energy storage to support this transition. Participants also emphasized the importance of fostering collaboration and providing thought leadership to establish a robust policy framework. Such a framework is vital for driving the decarbonization of this often-overlooked, hard-to-abate industrial process.

We are delighted to share the key takeaways from the event, as well as FCA's resources developed for policymakers and other stakeholders to advance industrial high-temperature heat decarbonization.

Key Takeaways

1

Electric heat is the most future-proof option for decarbonizing most industrial processes working at high temperatures.

Electric high-temperature heat is a mature technology with numerous variants and decades of operational experience, even though its applications to date have often been small-scale and specialized. Notably, exceptions like electric arc furnaces (EAF) showcase its scalability and effectiveness in high-temperature processes. Contrary to perceptions that smaller-scale usage indicates low technological readiness, electric heat is highly advanced and ready to play a central role in industrial decarbonization.

In fact, the entire range of industrial temperatures can be covered with electric heat. Electric heating methods, including plasma, lasers, electric arcs, and electron beam heating, offer a wider temperature range than burning fossil fuels or hydrogen. Many of these advanced methods also provide an efficiency advantage of 10% or more compared to burning gas. This is because much of the heat energy from a flame escapes in the exhaust gases, which are only partially recoverable, highlighting the superior energy efficiency of electric heating.

With the right policy interventions, particularly to address electricity price disparities and reduce the cost gap with natural gas, electric heat can become the leading solution for many high-temperature processes.

2

Nonetheless, implementing it requires very cheap energy costs, as energy costs dominate cost differences between alternatives, be they fossil or clean.

The main economic challenge for electric high-temperature heat is not capital cost but rather the higher operating costs of electricity compared to gas. For most companies with high-temperature heat needs, going electric would not mean sinking capital costs into a risky experiment, but rather installing proven technology. However, in most cases, operating costs for energy dominate (5-6 times higher than investment costs), often outrunning installation cost within a few years. Because of this, operating costs are a large lever on profitability, and with electricity usually being 2 to 3 times more expensive than natural gas, the economic balance is currently very much in favor of gas. This is especially true for high-temperature heat applications, as opposed to low-temperature heat applications, as there is no heat pump efficiency advantage to make up the difference.

Electricity must become cheaper. This means that grid expansion must not only catch up with the expansion of renewables, but also accelerate to encompass many new assets.

Thermal energy storage has the potential to eventually make electric heat cheaper than gas, though this is not necessarily guaranteed as it depends on several enabling conditions. It could potentially not only lower energy costs of electric high-temperature heat, but also alleviate grid bottlenecks at the same time, tackling the electricity infrastructure challenge from two sides.

Future Cleantech Architects recommend that policymakers support industrial electric heat in combination with heat storage technology as both technologies are efficient, technologically mature, scalable, can cover all temperatures, have medium to low capital cost, have the potential for low operating costs when combined, and emit no harmful particulates.

3

It is therefore vital to avoid pathways with high energy losses, keep pushing for a low-cost de-carbonized and expanded grid, and make use of the unique opportunity of cheap thermal storage for these applications.

It is important to avoid reliance on biomethane, as feedstock is insufficiently available and true zero-emissions biomethane is hard to achieve due to methane leakage. Applications with scant viable alternatives, such as methanol production for shipping fuel or seasonal balancing of the power grid, must be prioritized. Select high-temperature processes could be eligible for biogas prioritization where no competitive alternatives exist yet.

It is recommended to prioritize clean hydrogen (e.g., renewable hydrogen) applications with no other viable alternative, like steel reduction and ammonia for fertilizer. Policymakers should preclude from designing mechanisms that will promote the reliance on hydrogen and derived synthetic fuels for high-temperature heat because of their costly and inefficient production and transport as well as lack of advantages over electric heat in terms of infrastructure needs.

Additionally, it is recommended to avoid reliance on carbon capture due to carbon dependency lock-in, energy security concerns, lack of cost reductions potential, additional infrastructure needs for CO_2 pipelines and storage sites, and harmful particulate emissions.

We advocate for the development of a robust policy framework to support the adoption of heat storage at existing and future industrial plants, as it could lower electric heat costs enough that it may become competitive with gas in the near to medium term by allowing electricity consumption to shift to times of abundance. This will also enable additional income from offering grid services, improve grid congestion issues, and reduce pressure on much delayed grid expansion.

Future Cleantech Architects' Cleantech and Policy Analysts conduct research and analysis to close the remaining gaps to achieve net zero in hard-to-abate industries. For more information on high-temperature heat decarbonization, please see our report Decarbonizing High-Temperature Heat in Industry, a technology assessment and policy recommendations for Europe.

Roundtable on **Setting up Common Definition for Sustainable Biofuels to Accelerate Biofuels Adoption**

Speakers

Rahool P Panandiker
(BCG)
– Moderator

Pankaj Jain
(Ministry of Petroleum and Natural Gas, Government of India)
– Chair

Lais Garcia
(Ministry of Foreign Affairs, Brazil)

William Hohenstein
(USDA)

Bharadwaj Kummamuru
(World Bioenergy Association)

Elena Guede
(CRH)

Dr. Peter Schniering
(Future Cleantech Architects)

Juliana Almeida
(Inter-American Development Bank)

Yousuf Lootah
(Lootah Biofuels)

Dr. Vibha Dhawan
(TERI)

Nikolaus Widmann
(TES H2)

Jesica Olson
(Americas Topsoe)

Charlotte Morton
(World Biogas Association)

Oki Muraza
(Petramina)

Ana Paolo Gonzalez Alonso
(Climate Strategies)

Selen Inal,
(Women in Renewable Energy)

Kristin Hughes,
(Diageo)

Introduction

Biofuels represent one of the promising solutions to replace high-polluting fossil fuels such as diesel, gasoline, and jet fuel (kerosene). The demand for liquid biofuels has been steadily increasing in recent years, reaching ~200 Mtoe globally in 2023. Most of the biofuel production is in the form of bioethanol, biodiesel, and renewable diesel, which are primarily used in road transport. The largest consumer of biofuels is the USA (30% of consumption with 2/3 as bioethanol), followed by Latin America, Asia, and Brazil. The EU is the 5th largest consumer globally and China the 7th.

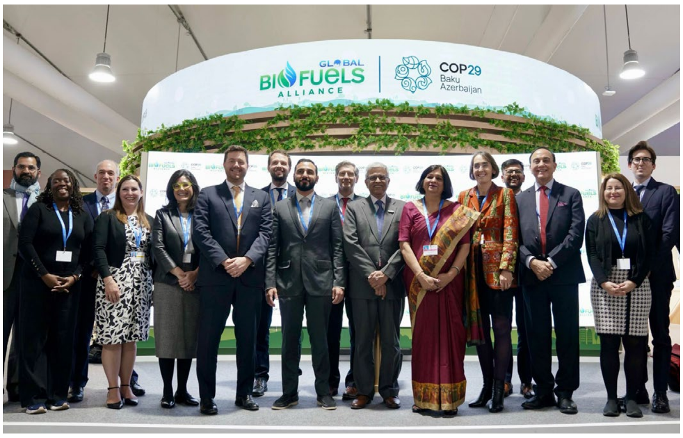
When biofuels are produced from sustainable feedstocks that do not compete with food resources and are backed by lifecycle assessments demonstrating significant emissions reductions, they become an attractive option for powering sectors of the economy, particularly heavy transport such as aviation and shipping. Their compatibility with existing fossil fuel infrastructure adds to their appeal, as they can seamlessly integrate into current energy systems.

However, not all biofuels are produced equal, and it is critical for policymakers to establish stringent sustainability criteria to ensure their deployment aligns with the overarching goal of transitioning to environmentally responsible energy sources that support net-zero targets. Policymakers must avoid biofuels produced from feedstocks or production pathways that will lead unfortunate consequences such as food competition, deforestation, or high embodied emissions associated with some biofuel production processes.

Biofuels are generally categorized into three generations based on the type of feedstock used. First-generation biofuels, derived from food crops like corn and vegetable oil, should be avoided as they compete with essential food resources. In contrast, second-generation biofuels are produced from non-food organic materials, such as waste oil, forestry residues, animal fats, and municipal solid waste, potentially offering a more sustainable alternative with lower environmental trade-offs. Third-generation biofuels, derived from algae, represent a promising technology, offering high yields without competing with food production.

A robust certification framework is essential for ensuring the sustainability of biofuels. Such a framework must include a universally accepted definition of sustainability and shared standards that consider direct and embedded emissions throughout the entire value chain, as well as indirect environmental impacts such as land use change. This approach is critical to delivering meaningful climate benefits and ensuring that biofuels contribute positively to global decarbonization efforts.

Future Cleantech Architects was invited to participate in a timely and needed roundtable discussion organized by the Global Biofuels Alliance, focusing on defining sustainable biofuels to accelerate their adoption. The event underscored the urgent need for a clear



and actionable definition of sustainable biofuels while emphasizing the importance of international collaboration to achieve this goal. Participants explored different approaches to sustainability criteria, such as performance-based versus feedstock-based definitions, and shared insights from sustainability frameworks across regions. The discussion also highlighted the importance of setting strong guardrails to ensure biofuel production aligns with broader environmental and social objectives.

During the roundtable, FCA shared insights from its technical assessment on biofuels, emphasizing the need for a sustainability framework that guarantees significant emissions reductions across the entire value chain. This event marked a step forward in fostering dialogue and collaboration among stakeholders, policymakers, and industry leaders to accelerate the development and adoption of sustainable biofuels as a key component of the energy transition.

Key Takeaways

1

Science-based education efforts must be accelerated.

Biofuels – and their production pathways – are complex. Science-based education efforts must be significantly accelerated to address the complexities of biofuels and their production pathways. Developing a global market for sustainable biofuels with high climate integrity requires policymakers across key jurisdictions to have a deep understanding of these systems. Currently, gaps in knowledge often lead to counterproductive policies that hinder progress. The Global Biofuels Alliance can play a pivotal role in bridging these gaps through targeted education and awareness initiatives.

2

Flexible sustainability assessments are crucial for developing novel biofuel feedstocks and production pathways.

Not all biofuel production pathways are at the same technology readiness levels (TRLs), nor do they offer equal emissions savings. A flexible approach that sets eligibility thresholds based on lifecycle greenhouse gas (GHG) emissions savings is critical. For example, an initial threshold of 50% emissions savings could be made more stringent over time as technologies mature. This gradual approach would enable the introduction of new eligible pathways while driving continuous improvement.

Additionally, establishing benchmarks that account for the unique impacts of different feedstocks is key. For instance, energy crops should be monitored for land-use change, while agricultural residues should be assessed for water and soil degradation. For novel pathways and feedstocks that are currently more expensive to develop, government incentives could stimulate innovation and adoption, encouraging a shift away from pathways with lower emissions savings. These measures would ensure that biofuel production aligns with global decarbonization goals while supporting the advancement of high-impact, sustainable technologies

3

Biofuels must be prioritized for hard-to-abate sectors.

Biofuels must be strategically prioritized for use in hard-to-abate sectors where direct electrification is not a feasible decarbonization solution, such as aviation and shipping. These sectors face limited alternatives for reducing emissions, making biofuels an essential component of their transition to net zero. In contrast, sectors like road transport, where direct electrification is more efficient and cost-effective, should not compete for scarce biofuel resources.

Global competition for biofuels will continue to intensify, particularly in the European Union and other regions where demand is growing across various industries. To address this challenge, national, regional, and global biofuel strategies must incorporate clear downstream allocation frameworks to ensure biofuels are directed toward sectors that need them most. Flexibility in production pathways is important, but this flexibility must be aligned with the needs of hard-to-abate sectors rather than expanding biofuel production for road transport or power generation, where alternative solutions are more viable.

By prioritizing biofuels for hard-to-abate sectors and investing in advanced production pathways, governments can ensure these vital resources are utilized where they provide the greatest emissions reductions and contribute most meaningfully to global decarbonization efforts

4

New pathways and feedstocks must be supported.

Novel pathways and feedstocks remain expensive and require further R&D investment. Incentives for their development and adoption from governments could help minimize risk and stimulate the switch from other pathways that provide lower emissions savings.

Moreover, first-generation biofuel pathways – those relying on food crops – should be phased out in favor of second-generation, or advanced, biofuels that utilize waste and non-food biomass. Developing new pathways to convert solid biomass into liquid biofuels through processes such as gasification will be critical. These technologies can enable the production of sustainable biofuels for aviation and shipping, ensuring that scarce resources are used efficiently and effectively while avoiding their diversion to less urgent applications like electricity or heat generation

5

International sustainability standards must be developed.

To avoid market distortions and maintain a level playing field, an internationally recognized and harmonized sustainability framework for biofuel eligibility is essential. Biofuels that fail to meet minimum sustainability standards – based on lifecycle GHG emissions, competition with food, water and soil management, and indirect land-use change (ILUC) – should be excluded from eligibility. The European Union's Renewable Energy Directive III (RED III) offers a robust model by establishing clear criteria for eligible biofuels, whether imported or domestically produced. Expanding these criteria through multilateral negotiations could create globally harmonized certification and eligibility standards, ensuring consistent practices across all markets.

It is therefore crucial to establish a minimum sustainability standard and common certification process to broaden the market for biofuels internationally. Biofuels can be produced from many feedstocks and through various pathways, with a range of emissions savings and costs. To avoid market distortions, there needs to be a minimum agreed-upon standard of sustainability that is adhered to globally, based on lifecycle greenhouse gas emissions, and indirect effects such as land use change.

In this context, the team of the Global Biofuels Alliance (GBA) can play an important role in serving as a platform and expanding its authority as an honest broker in the emerging markets for biofuels as climate solutions, in particular for the hard-to-abate sectors, such as shipping or aviation, where they will be indispensable given the limitations of electrification for heavy transport.

Future Cleantech Architects has conducted a technical feasibility study on ReFuelEU Aviation targets, including the role of biofuels in meeting the Sustainable Aviation Fuels (SAF) mandate. Our analysis highlights the need to gradually transition biofuels from road transport to aviation, where they are essential to putting the sector on a net-zero trajectory.

Building on this work, in 2025, our analysts will undertake a comprehensive study of emerging sustainable fuels for hard-to-abate sectors, including heavy transport. The findings will include in-depth insights and policy recommendations aimed at guiding policymakers and other key stakeholders in accelerating the transition to sustainable fuels.

Side Event: **Strengthening National Systems of Innovation for Collaborative RD&D on Climate Technology**

Speakers

Stephen Minas
(CTCN Advisory Board and TEC Member)
– Moderator

Edeltraud Guenther,
(UNU Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES))
– Keynote Speaker

Magnolia Tovar,
(Future Cleantech Architects)
– Speaker

Surachai Sathitkunarat
(National Higher Education Science Research and Innovation Policy Council (NXPO) Ministry of Higher Education, Science, Research and Innovation, Thailand)
– Speaker

Joel Onyango
(African Centre for Technology Studies)
– Speaker

Prof. Maria Gavouneli
(Hellenic Foundation for European and Foreign Policy)
– Speaker

Introduction

The IPCC's 2023 Synthesis Report underscores that existing technologies can limit global warming to 1.5°C. There is a pressing need for countries to establish robust National Systems of Innovation (NSI) to effectively implement decarbonization technologies taking into account the local needs. This involves developing supportive policies, enhancing research, development, and deployment (RD&D), facilitating technology transfer, building capacity, and securing financial mechanisms.

The UNFCCC's Technology Mechanism, comprising the Technology Executive Committee and the Climate Technology Centre and Network (CTCN), plays a pivotal role in this effort. The CTCN's Partnership and Liaison Office (PALO), established in 2022 in Songdo, Republic of Korea, focuses on fostering collaborative RD&D through North-South, South-South, and triangular partnerships. Strengthening NSIs is central to these collaborations, aiming to enhance innovation ecosystems by creating supportive policy frameworks, engaging in international standardization, and establishing favorable conditions for technology deployment. This approach promotes climate technology innovation and facilitates international RD&D collaboration.

The Technology Executive Committee and Future Cleantech Architects jointly conceptualized a survey that aimed to provide an overview of future RD&D needs and key barriers and enablers to meet these. The survey examines needs both globally and specifically in developed and developing economies and serves as a starting point to identify areas for further analysis.

Drawing from the recommendations of the Future Needs in Research and Development and Demonstration report, Future Cleantech Architects had the privileged to share key findings from the survey at this event, hosted by the Greek Pavillion at COP29. During the event, FCA highlighted the key takeaways from the Future needs in Research, Development and Demonstration report, and provided examples of successful NSI.

Key Takeaways

1

Energy storage ranked as priority RD&D acceleration area across all countries and sectors.

Solar photovoltaics and wind energy are the cheapest and fastest growing sources of clean electricity at a global scale. However, they also pose several challenges such as dependency on unpredictable weather conditions and intermittency across the day and seasons. The exponential growth of wind and solar energy is starting to spur an equally dramatic need to invest in so-called flexibility tools, such as thermal and electrical energy storage. The RD&D survey highlighted this need in investing in energy storage. In fact, energy storage was ranked as the top RD&D priority until both 2030 and 2035 by respondents from developed economies. Survey participants from developing economies, on the other hand, ranked clean electricity generation as the key priority until 2030, with energy storage only becoming the top priority from 2030 to 2035.

2

The public sector is identified as the key stakeholder in accelerating RD&D globally.

Governments must provide an enabling environment to accelerate RD&D globally. An overwhelming 73% of all survey participants mentioned the public sector as the most important stakeholder for speeding up critical innovation. However, while the public sector is recognized as the most capable actor in driving progress, it also constitutes one of the biggest roadblocks due to bureaucratic, economic, and legislative challenges.

3

Large-scale deployment and finance are the key valleys of death in which promising developments stagnate.

As highlighted previously, a combination of enabling policy mechanisms are crucial to advance decarbonization technologies that will successfully accelerate emissions reductions. NSI play a pivotal role in moving technologies through the valleys of death, catalyzing deployment. An example of a successful NSI is Morocco's Noor Ouarzazate Solar Complex. The Moroccan Agency for Sustainable Energy (MASEN) spearheaded this initiative, integrating policy development, institutional support, and public-private partnerships to foster innovation. The complex, with a capacity of 580 megawatts, supplies electricity to over one million households, significantly reducing greenhouse gas emissions.

Future Cleantech Architects is dedicated to bridging the innovation gap to achieve net-zero emissions by 2050. We collaborate with stakeholders across the entire value chain of hard-to-abate sectors, creating platforms to advance innovation. Our joint RD&D report with the UNFCCC Technology Executive Committee, elevates future RD&D needs among policymakers and other crucial stakeholders. Additionally, we organize the annual Future Cleantech Festival, convening policymakers, innovators, civil society, and media to discuss strategies for driving innovation. Insights from the festival are compiled into the Future Cleantech Priorities, which are shared with key decision-makers and intergovernmental organizations as part of our advocacy efforts.

FCA Future Cleantech Architects

We are a climate innovation Think Tank. We exist to close the remaining innovation gaps to reach net-zero emissions by 2050. To reach this objective, we accelerate innovation in critical industries – such as cement, aviation, or shipping – where sustainable solutions are still in very early stages. We urge policy-makers to intensify and better prioritize their R&D activities. Moreover, we initiate and actively drive high-level research consortia on critical technologies for these neglected technological sectors.

We are based in Germany, operating with a global impact. We focus on high-impact R&D, targeting technologies that carry the potential to drive down greenhouse gas emissions massively. We build on a strong network of experts that contribute their knowledge to our projects, analyses, events, publications, and workshops.

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