SUSTAINABLE BUSINESS COP30

ENERGY TRANSITION

WORKING GROUP DOCUMENT

CNI Brazilian National Confederation of Industry

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FOREWORD BY THE WORKING GROUP CHAIR

DANIELA MANIQUE

CEO LATIN AMERICA, RHODIA, SOLVAY GROUP

The Sustainable Business (SB) COP30 Energy Transition Working Group has demonstrated the private sector's strong engagement toward decarbonization. Members and co-chairs have shared over 110 projects across three key topics: energy efficiency, renewables, and sustainable fuels. Notable initiatives include biomass conversion at Solvay Paulínia, Natura & WEG's solar agro-industrial project in Amazonas, and Acelen's $3 billion investment in Sustainable Aviation Fuel (SAF) and Hydrotreated Vegetable Oil (HVO) biofuels.

However, this is not enough. We need to accelerate our efforts to combat climate change.

Key challenges in achieving important targets include the following:

- Doubling the energy efficiency improvement rate by 2030 is impeded by policy uncertainty, a lack of robust data systems, and internal funding gaps.
- Tripling renewable capacity to 11,000 gigawatts (GW) by 2030 faces barriers such as grid constraints, policy instability, and supply chain vulnerabilities.
- Accelerating the adoption of low-carbon fuels by 2050 is hindered by the high cost of sustainable fuels, feedstock limitations, and regulatory complexity.

Crucial levers to unlock and accelerate the rate of decarbonization include implementing mandates, providing financial incentives, developing infrastructure, increasing R&D investment, adopting a value-chain approach, and fostering cross-sector collaboration.

The case examples shared in this document show that decarbonization is feasible. Let's seize this moment to connect our efforts in order to amplify and accelerate our energy transition initiatives.

Daniela Manique

Chair of the SB COP Energy Transition Working Group
CEO Latin America, Rhodia, Solvay Group

FOREWORD BY THE WORKING GROUP CO-CHAIRS

ANTONIO LACERDA

GENERAL DIRECTOR (BRAZIL), CMPC

The main challenge of the energy transition is to bring together technological innovation, economic viability, and commitment. Driving the use of bio-based products, renewable fuels, and energy efficiency must be a priority. Science- and nature-based initiatives, in addition to robust legislation, are fundamental mechanisms for mitigating investment risks, ensuring revenue stability, and scaling up decarbonization solutions.

JEAN-PIERRE CLAMADIEU

CHAIRMAN OF THE BOARD OF DIRECTORS, ENGIE

SB COP is convened at a pivotal moment for the energy transition, with significant climate change impacts and growing demand for affordable energy. Government incentives and a stable regulatory framework will be crucial to developing an integrated and resilient energy system—one based on a low-carbon combination of electricity and green gas, complemented by robust infrastructure to unleash the full potential of renewable energy.

CLÁUDIA BRUN

VICE PRESIDENT, NEW VALUE CHAINS & MARKETING, EQUINOR

The Working Group has advanced climate action through collaboration and innovative solutions. While challenges remain in aligning diverse stakeholder interests and addressing funding gaps, our commitment to accelerating project implementation is anchored in concrete and pragmatic recommendations. This dedication aligns with Equinor's Energy Transition Plan, and, together, we can drive impactful outcomes for a sustainable future.

BARRY ENGLE

PRESIDENT, LOW CARBON SOLUTIONS, EXXONMOBIL

ExxonMobil believes the SB COP can play a valuable role in the energy transition by supporting the adoption of a ledger-based carbon accounting framework based on financial accounting principles. Such a system can lead to the creation of pragmatic policy such as product-level carbon intensity standards. We're pleased this is being taken up in a cross-cutting working group within the SB COP.

ELIAS ABDALA NETO

VICE PRESIDENT OF LEGAL AND CORPORATE AFFAIRS (BRAZIL), MICROSOFT

Bringing together many business leaders to accelerate energy transition, the group's collective efforts demonstrate that impactful, scalable solutions are within reach, and continued cooperation will be vital to achieving climate goals and fostering sustainable development.

MALU PAIVA

VICE PRESIDENT OF SUSTAINABILITY, COMMUNICATION, AND BRAND, SUZANO

Suzano acknowledges the strategic contribution of the SB COP to structuring and strengthening the private sector's role in implementing impactful actions, fostering cooperation to drive mitigation, adaptation, and inclusive sustainable growth. We are delighted to be part of the Energy Transition Group, whose contribution has been essential to accelerating the global energy transition.

GUSTAVO PIMENTA

CEO, VALE

The global energy transition is a decisive challenge for our generation. As we gather at COP30 in Belém, the energy transition working group of SB COP has provided a valuable space for stakeholders to strengthen dialogue, share technical insights, and identify adaptable solutions to address global climate challenges. The discussions were pragmatic and implementation-focused, reinforcing the importance of measurable results and cross-sector collaboration, such as measures to replace fossil fuels with renewable sources.

DANIEL GODINHO

SUSTAINABILITY AND INSTITUTIONAL RELATIONS DIRECTOR, WEG

The energy transition is not only an environmental imperative but also a strategic opportunity to foster economic development, ensure energy security, and advance decarbonization. As a key enabler, battery energy storage systems (BESS) enhance system resilience and support a cleaner and low-carbon energy future, enabling the integration of renewable energy sources.

EXECUTIVE SUMMARY

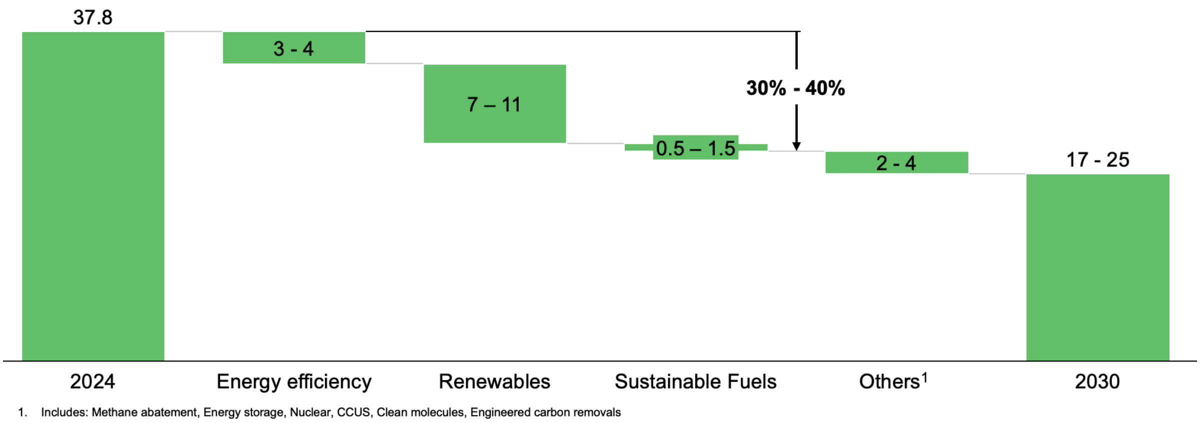
ENERGY TRANSITION REMAINS A CHALLENGE

Achieving a global and equitable energy transition is a significant challenge for humanity in the 21st century. Despite progress on decarbonization and energy transition, the world still falls short on achieving balanced progress on emissions reduction and on the affordability, reliability, and competitiveness of alternative energies.[1] Society is behind schedule on the path to achieve net-zero carbon emissions and limiting global warming to 1.5°C by 2050,[2] and current national decarbonization targets are insufficient to meet this global goal. Even if all countries fulfill their 2023 carbon-reduction commitment[i] by 2030, further emissions reductions of approximately 23 metric gigatons of CO_2 equivalent ($GtCO_2e$) will still be required.[3]

There is significant potential to reduce emissions through three key levers

Total energy-related CO2 emissions rose by 0.8 percent in 2024, reaching a record high of 37.8 GtCO2e.[4] Companies have significant potential to reduce these emissions by 30 to 40 percent (about 13.0 GtCO2e) by 2030 through the use of three key levers: energy efficiency (3.0 to 4.0 GtCO2e), renewable energy (7.0 to 11.0 GtCO2e), and sustainable biofuelsii (0.5 to 1.5 GtCO2e) (Exhibit 1).[5]

EXHIBIT 1. POTENTIAL CONTRIBUTION TO NET EMISSIONS REDUCTION BY 2030, $GTCO_2E$ PER YEAR[6]



i During COP28 in 2023, countries made carbon-reduction commitments and pledges as part of the first Global Stocktake. These commitments and pledges need to be integrated into their updated Nationally Determined Contributions (NDCs) at COP30.

ii Biofuels including liquid, gaseous, and solid fuels.

Current investment is insufficient to meet agreed goals

Investment in **sustainable energy** continues to fall short of commitments made at COP28, despite potentially reaching $3.3 trillion in 2025 (including renewable energy, nuclear, and storage).[7] Annual investment in renewables must double in order to achieve the COP28 goal of tripling installed renewable-power capacity by the end of the decade.[8] Similarly, spending on **energy efficiency** and electrification must almost triple within the next five years to meet the agreed COP28 target of 4 percent annual improvement in energy intensity by 2030.[9] Last, although investment in low-emission e-fuels is set to reach a new high of about $30 billion in 2025, it remains low in absolute terms, and projects remain heavily dependent on policy and regulatory support.[10]

Funding mechanisms and policies should prioritize proven technologies alongside innovation

Low-carbon technologies that are already mature and commercially viable are critical to accelerating the energy transition. Technologies such as biofuels (for example, ethanol) and energy efficiency improvements, whether or not combined with electrification, are among the lowest-cost and most efficient ways to decarbonize the economy.[11] Similarly, existing renewable solutions have demonstrated proven scalability, cost-effectiveness, and immediate impact in reducing emissions.[12]

Investment in these scalable technologies should be prioritized, alongside the expansion of emerging innovations, to enable fast deployment, generate early emissions reductions, and build investor confidence, which, in turn, can unlock further capital for next-generation solutions. To meet COP28 goals, funding mechanisms and policies must explicitly support broader deployment of proven low-carbon technologies. Adoption of this integrated investment strategy, both by governments and the private sector, will maximize the speed, cost-efficiency, and resilience of the energy transition.[iii]

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iii In the case of biofuels, funding mechanisms and policies should be tailored to ensure the best use of available feedstocks internationally.

Scaling up new technologies is important for reducing emissions in hard-to-abate sectors

Additionally, in hard-to-abate sectors such as cement, steel, and primary chemicals, it is important to scale up new low- or no-carbon technologies that need to go through the cost-reduction learning curve by 2050.[13] For example, carbon capture, utilization, and storage (CCUS) can be retrofitted to existing processes to cut emissions. Clean hydrogen is critical for hard-to-abate sectors such as heavy transport and steelmaking, and nuclear power offers reliable, scalable energy. Additionally, carbon dioxide removal (CDR) technologies—which remove CO2 from the atmosphere—are a key tool to complement emissions reduction, address emissions from hard-to-abate sectors, and help limit global warming to 1.5°C.[14] Other solutions are also emerging, such as low-carbon fuels beyond biofuels. These ideas are further developed in a note on hard-to-abate sectors on page 46 of this document.

Strategic priorities to advance the private sector's contribution to the energy transition

The challenges of the energy transition are vast and complex, defying simplification into a single, exhaustive set of actions. That said, the SB COP30 Energy Transition Working Group has identified a clear set of strategic priorities. These priorities aim to enhance the private sector's contribution to scaling and accelerating a flexible, safe, affordable, and reliable energy transition in the short term (that is, to 2030).

1. **Energy efficiency**
   Goal: Double[iv] the global average annual rate of energy efficiency improvements by 2030

- **Priority 1.1:** Implement sector-specific progressive mandates[v] and guidelines (for example, at the national or sector level) based on energy efficiency standards, while enabling companies to self-assess their energy efficiency and carbon intensity.
- **Priority 1.2:** Promote and incentivize cost-effective, energy-efficient initiatives for businesses and consumers.

---

iv Target set during COP28 using the baseline of 2022 energy intensity annual reduction.

v Mandates are regulatory requirements or obligations imposed by governments or international bodies. These mandates often set specific targets or enforce compliance with decarbonization goals. The term "progressive" refers to mandates that are increasingly stringent over time.

2. Renewables Goal: Triple[vi] the installed capacity of renewable energy to 11,000 GW by 2030

- **Priority 2.1:** Maximize the adoption of renewable energy by supporting initiatives that increase grid reliability and flexibility, such as developing grid infrastructure and interconnections; improving grid flexibility, for example, through enhanced energy storage and demand response; and accelerating permitting and licensing processes.
- **Priority 2.2:** Update regulations such as pricing schemes (for example, digitalization, to better align supply with demand) and mechanisms to ensure stable revenues and reduce investment risks.

3. Sustainable fuels

Goal: Increase supply by 85 percent to meet global bioenergy demand by 2030 in line with the Net Zero by 2050 scenario of the International Energy Agency (IEA)[vii]

- **Priority 3.1:** Implement sector-specific progressive mandates[viii] and guidelines, fostering collaboration while ensuring affordability for end users, food security, and land use efficiency.
- **Priority 3.2:** Establish science-based, technology-agnostic incentives based on carbon-intensity fuel certification schemes.

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vi Target set during COP28 using the baseline of 2022 installed renewable energy capacity.

vii Target based on the IEA's projection for bioenergy use by sector globally in the net-zero scenario (modern solid bioenergy: buildings and agriculture, industry and electricity and heat, liquid biofuels and biogas).

viii Mandates are regulatory requirements or obligations imposed by governments or international bodies. These mandates often set specific targets or enforce compliance with decarbonization goals. The term "progressive" refers to mandates that are increasingly stringent over time.

A. ENERGY EFFICIENCY

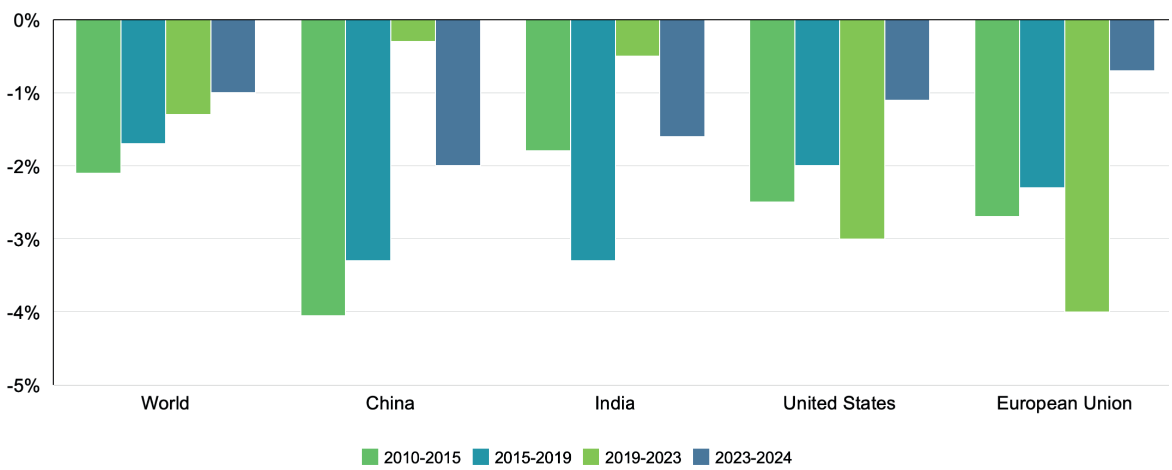
A.1 ENERGY EFFICIENCY: INTRODUCTION

The IEA describes energy efficiency as the "first fuel" in the clean energy transition because it offers some of the quickest and most cost-effective solutions for cutting CO_2 emissions.[15] At the same time, energy efficiency also reduces energy costs for consumers and enhances energy security.

Energy efficiency has the potential to reduce emissions in industry and the built environment by about three to four GtCO2e by 2030.[16]

At COP28, over 130 countries pledged to capture this potential by collectively doubling the global rate of energy efficiency improvements by 2030. Their aim was to accelerate the global reduction in energy intensity[ix] from 2 percent per year to 4 percent,[17] but progress in 2024 was underwhelming. Global energy intensity dropped by only 1 percent, a significant shortfall from the targeted trajectory.[18]

EXHIBIT 2. AVERAGE ANNUAL REDUCTION OF ENERGY INTENSITY IN SELECTED REGIONS: 2010–24[19]



When comparing energy intensity across different regions, it is crucial to consider the relative levels of economic activity. A region with lower economic activity might show a more significant drop in energy intensity simply because its GDP is lower, not necessarily because it has become more energy efficient.

ix Energy intensity is the amount of primary energy used to produce a given amount of economic output.

The COP30 agenda recognizes energy efficiency as a central pillar for accelerated action and strategic redirection in the short term, with a focus on achieving tangible progress by 2030.

Private sector challenges

From a private sector perspective, there are two main challenges to unlocking greater use of energy efficiency as a decarbonization lever.

Lack of guidelines and policies

First, most geographies lack clear sector-specific guidelines and supporting policies. It can be difficult to translate global energy-intensity guidelines into actionable measures for hard-to-abate sectors such as steel, cement, and oil and gas. Furthermore, for industries to achieve such targets, effective enabling policies would need to be in place.

Difficulty in securing funding

Second, although energy efficiency projects typically appear more attractive on a marginal abatement cost curvex (MACC)[xi] when compared with other decarbonization options, they often struggle to secure internal funding. This challenge is intensified by long payback periods for energy efficiency projects, which are frequently deprioritized in favor of alternatives with higher immediate economic returns. This sometimes happens even when internal carbon pricing is factored into decision-making.

Effective public–private collaboration is essential to unlocking the full decarbonization potential of energy efficiency. Mechanisms that incentivize accelerated depreciation for capital expenditure projects and innovation (R&D), as well as collaborative actions coordinated between the public and private sectors, can drive significant progress toward achieving the goals outlined in the COP30 agenda.

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x A marginal abatement cost curve (MACC) is a visual tool that helps prioritize energy efficiency initiatives, and other project categories, by ranking them by cost-effectiveness and carbon reduction potential.

xi A marginal abatement cost curve (MACC) is a visual tool that helps prioritize energy efficiency initiatives, and other project categories, by ranking them by cost-effectiveness and carbon reduction potential.

A.2 ENERGY EFFICIENCY: RECOMMENDED GOALS AND PRIORITIES

The Energy Transition Working Group recommends that the targets set during COP28 should be retained and action should be taken to reduce global energy intensity by the target 4 percent per year by 2030, taking into consideration different starting points and national circumstances, in line with the commitment signed by 133 nations in the UAE Consensus at COP28.[20]

Improvement in global energy intensity should therefore be the measurable KPI to track the evolution of energy efficiency as a key lever of the energy transition (Table 1).

TABLE 1. ENERGY EFFICIENCY KPI TARGET

KPI	Baseline	Target	Classification
Average annual improvement rate of global energy intensity Calculated as the yearly progress (%) on reduction of energy intensity	**~2%** 2022	**~4%** 2030	Aligned with UAE Consensus COP28[21]

The working group recommends two priorities to be implemented in the short term (by 2030):

- **Priority 1.1: Implement sector-specific progressive mandates[xii] and guidelines (for example, at the national or sector level) based on energy efficiency standards, while enabling companies to self-assess their energy efficiency and carbon intensity.**

  Progressive mandates based on sector-specific energy efficiency standards are essential because industries differ significantly in their energy demands and decarbonization pathways. Customizing these mandates allows each sector to implement practical and effective technology-agnostic measures tailored to its unique challenges and opportunities, thereby maximizing the overall impact of energy efficiency improvements in both centralized and decentralized systems.

xii Mandates are regulatory requirements or obligations imposed by governments or international bodies. These mandates often set specific targets or enforce compliance with decarbonization goals. The term "progressive" refers to mandates that are increasingly stringent over time.

Sector-specific standards also help identify and prioritize the most economically viable opportunities, ensuring that resources are directed where they can achieve the greatest results. A progressive approach allows companies to adapt gradually. It fosters innovations, such as leveraging emissions trading systems to incentivize the adoption of energy-efficient technologies,[22] and reduces the risk of economic disruption. An example of sector-specific energy efficiency standards is the European Union's Directive 2009/125/EC and Regulation (EU) 2017/1369, which establish eco-design and efficiency requirements by product category.

However, to avoid potential rebound effects—such as increased energy use due to greater efficiency—it is essential to complement these mandates with broader policies and behavioral measures. Demand- and supply-side measures, such as building renovation plans and grid digitalization, can foster adoption of energy-efficient technologies and promote behavioral change.

Encouraging self-assessment and measurement of carbon intensity improves transparency and empowers companies to take ownership of their sustainability goals, track progress, and identify areas for improvement. These efforts should be complemented by advanced capacity-building mechanisms. Digital solutions can further enhance this process, enabling real-time monitoring and data-driven decision-making.

For example, industry associations—including the World Steel Association (WSA) and the Global Cement and Concrete Association (GCCA)—are working to harmonize energy efficiency definitions, standards, and certification procedures.[23] They are expected to announce sector-specific energy efficiency guidelines and KPIs at COP30.

- **Priority 1.2: Promote and incentivize cost-effective energy efficiency initiatives for businesses and consumers**

  Several information campaigns have been implemented around the world to educate consumers about energy efficiency. Such initiatives have used labeling programs and other educational tools to incentivize energy conservation and efficiency. These include Brazil's National Electric Energy Conservation Program (Procel), which has been active since 1985. In 2022, it delivered energy savings equivalent to 22 billion kilowatt-hours (kWh), enough to supply 11.16 million homes for a year.[24]

At the business level, fiscal measures—including accelerated depreciation; regulatory tools, such as debottlenecking, licensing, and permitting; and demand-side instruments, such as green public procurement—are essential to accelerate the adoption of energy-efficient solutions and clean technologies.25 However, a significant opportunity remains to develop more targeted initiatives that emphasize the economic benefits of energy efficiency within specific sectors. Examples include creating platforms to share global and sector-specific efficiency benchmarks, offering energy efficiency consultancy services tailored to small and medium-size enterprises, and educating consumers on both basic energy-saving practices and emerging technologies.

A3. ENERGY EFFICIENCY: CASE EXAMPLES

The following case studies highlight successful energy efficiency initiatives. Advancing the priorities outlined above will help accelerate the development of similar projects and increase their implementation.[xiii]

Vesta - Improving energy efficiency in a petrochemical complex through a pioneering approach - Braskem

The Vesta project at Braskem's petrochemical complex in São Paulo, Brazil, provides a strong example of a sector-specific energy efficiency initiative. Braskem, in partnership with Siemens Energy, modernized outdated, low-efficiency turbines with high-performance electric motors and installed a cogeneration plant fueled by hydrogen-rich residual process gas.

Through a build-own-operate (BOO) financing model, Siemens assumed responsibility for engineering, operation, and maintenance over a 15-year horizon. This enabled Braskem to commit to a 600 million reais (about $110 million) investment without compromising its core business priorities.

The measurable results—a 6.3 percent reduction in CO_2 emissions, 11.4 percent lower water consumption, and NOx emissions maintained at low levels—illustrate that such initiatives can both advance sustainability outcomes and enhance operational resilience. The project demonstrates that, by leveraging innovation, strategic partnerships, and innovative financing models, industry players can bring down barriers and lead the way in decarbonization.

Vesta is an example of a project that could both inform sector-specific mandates, which are the focus of Priority 1.1, and benefit from them. Data generated by such projects can provide benchmarks for designing petrochemical efficiency standards, while introducing sector-level mandates would create a clearer framework for replication. Likewise, Priority 1.2 measures—such as accelerating licensing and permitting procedures and

xiii Case studies have been provided by the companies concerned. The information they contain has not been independently verified.

introducing demand-side instruments, including green public procurement—would help create an enabling environment for similar projects.

Biomass gasification plant at Suzano's new facility - Suzano

Different sectors face varying challenges and technological requirements and therefore need customized approaches in order to achieve meaningful progress. The biomass gasification project at Suzano's new pulp and paper facility in Ribas do Rio Pardo exemplifies how sector-specific innovation can deliver transformative results.

The pulp and paper industry has traditionally relied on carbon-intensive lime kilns, which are among the most difficult processes to decarbonize due to their high thermal-energy demands. Suzano has replaced fossil fuels in its lime kilns with renewable syngas made from lignocellulosic byproducts, such as black liquor and biomass residues. This approach has reduced CO_2 emissions by as much as 97 percent while simultaneously enhancing operational efficiency and energy self-sufficiency. It not only demonstrates technical feasibility in a traditionally hard-to-abate sector but also highlights how circular-economy principles can be leveraged to advance industrial decarbonization.

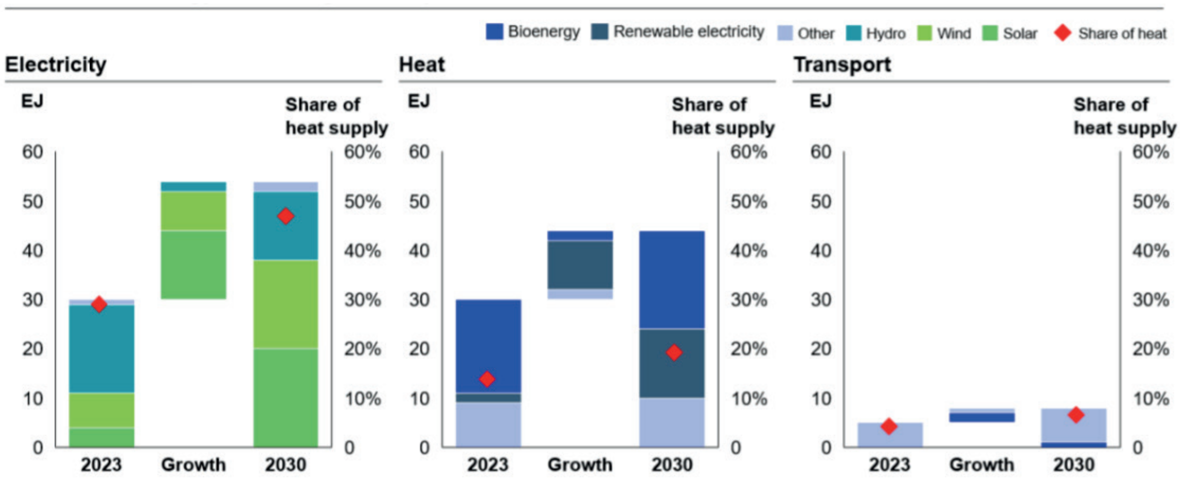
The project emphasizes the case for developing scalable and replicable sector-focused energy efficiency strategies. Its design can be adapted across other pulp and paper facilities and could potentially be applied in other energy-intensive industries with similar thermal processes. By showcasing measurable efficiency gains, significant emissions reductions, and strengthened supply chains, Suzano's initiative illustrates that well-established sector-specific mandates could build on these kinds of results, scaling innovation and best practices across the industry and thereby accelerating progress toward the broader goals outlined in the COP30 agenda.

B. RENEWABLES

B.1 RENEWABLES: INTRODUCTION

Consumption of renewable energy[xiv] in the electricity, heat, and transport sectors is forecast to increase by almost 60 percent between 2024 and 2030, making renewables responsible for almost 20 percent of final energy consumption.[27] Electricity and heat consumption, with the capacity to reduce global emissions by seven to eleven $GtCO_2e$ by 2030, can play a transformative role in the global energy transition.[28]

EXHIBIT 3. RENEWABLE ENERGY DEMAND GROWTH BY SECTOR, MAIN CASE, 2023-2030[29]



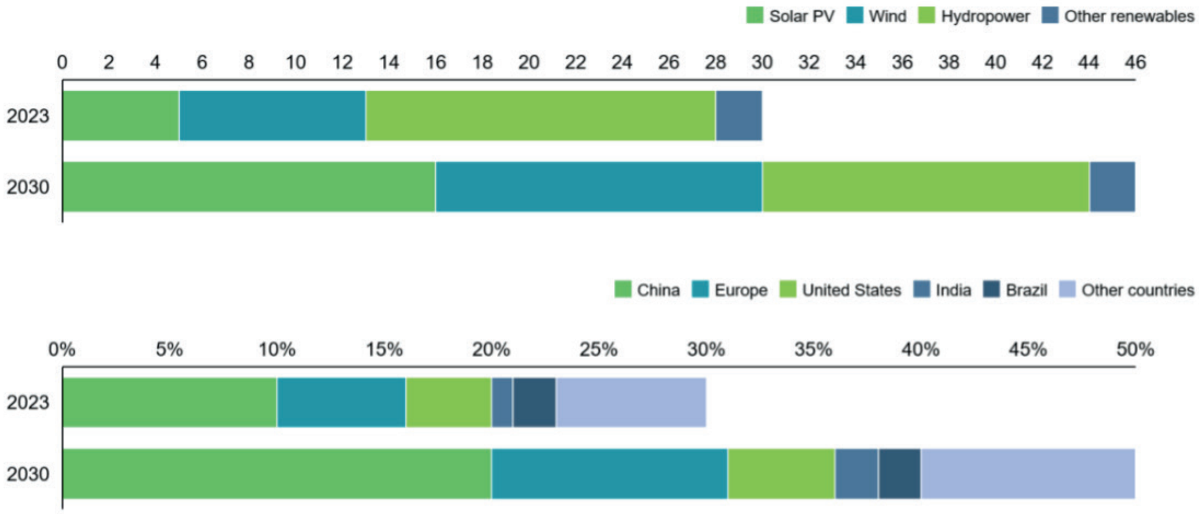
Notes: Other includes geothermal, concentrated solar power, and tidal for electricity generation and geothermal, solar thermal, district heating (primarily bioenergy) and ambient heat for Heat

Global renewable electricity generation is forecast to climb to over 17,000 terawatt-hours (TWh), or 60 exajoules (EJ), by 2030, an increase of almost 90 percent from 2023.[30] In 2024, record annual growth of 15.1 percent added 585 GW of capacity, bringing total installed capacity to 4,448 GW. [31]

From 2023 to 2030, the share of solar photovoltaics (PV) in global power demand is projected to triple, and wind power to almost double. In contrast, the role of hydropower is expected to become less prominent. Although hydropower generation is expected to grow globally, with new projects primarily in emerging and developing countries, its share of total power generation is anticipated to decline (Exhibit 4).[32]

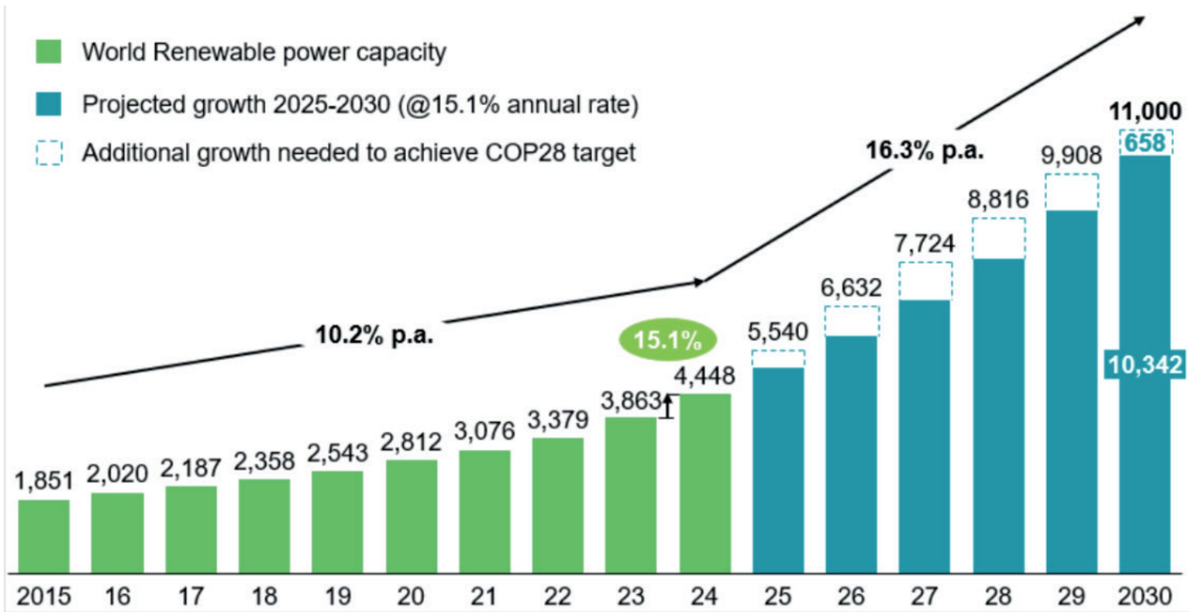
xiv Energy derived from natural processes that is constantly replenished.

Exhibit 4. Global electricity generation by renewable energy technology and country/region, main case, 2023 and 2030 [33]



Despite this progress, projected growth is insufficient to meet the COP28 target of tripling global renewable capacity from approximately 3,400 GW in 2022 to 11,000 GW in 2030. [34]To achieve this goal, growth in installed capacity must increase from an average 10.2 percent per year over the past decade to 16.3 percent per year over the next six years.[35]

Exhibit 5. Installed renewable energy capacity [GW]: past and projected growth rates versus COP28 targets [36]



Renewable heat plays an increasingly important role

Global renewable heat[xv] has played an increasingly relevant role over the past decade. It accounted for almost half of final global energy consumption in 2023 and nearly 40 percent of energy-related carbon emissions. Between 2017 and 2023, global annual heat demand grew by 7 percent (an increase of 14 EJ); half of this additional demand was met by modern renewable heat technologies, such as heat pumps, electric boilers, biomass systems, thermal storage, and district heating and cooling (DHC).[xvi] These sustainable solutions reduce CO_2 emissions and support carbon neutrality, especially in densely populated cities.[37]

Renewable heat is projected to grow by more than 50 percent (15 EJ) from 2024 to 2030, which is 2.4 times the growth observed in the previous six-year period. Most of this additional heat will be provided by renewable electricity (Exhibit 6). Despite this strong growth, driven by policies and investments, a broader technology mix beyond electrification is essential to reach 2030 and 2050 climate goals—including greater deployment of solar thermal, bioenergy, district heating, and thermal storage.[38]

A key driver of this projected growth is the increasing use of renewable energy for heat in industrial processes, which is expected to triple between 2024 and 2030. This is due primarily to the use of heat pumps in processes that require temperatures of up to 200°C, and to the use of electric arc furnaces in scrap metal recycling and aluminum production.[39]

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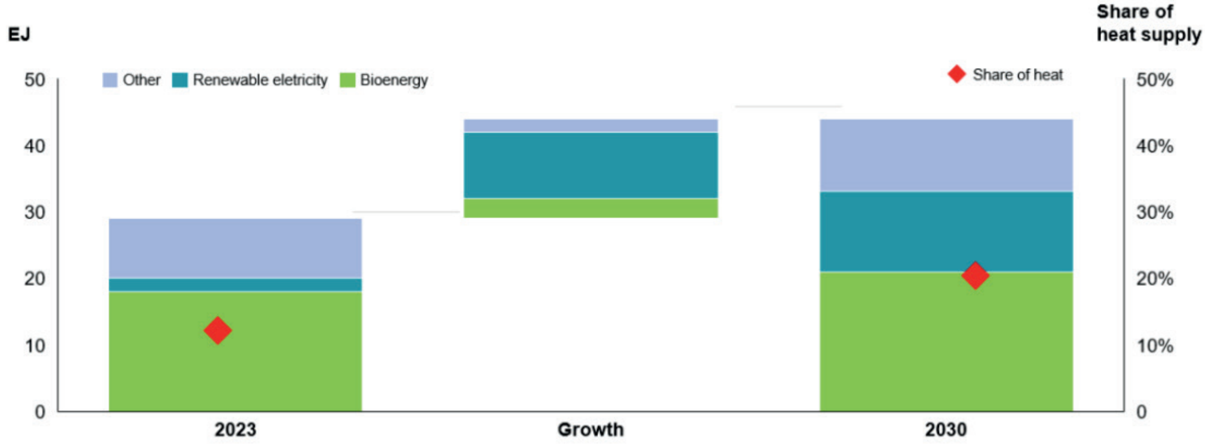
xv Thermal energy generated from renewable energy sources.

xvi District heating and cooling (DHC) refers to centralized systems that supply heating, cooling, or both to buildings and industries through a network of insulated pipes.

Exhibit 6. Renewable heat demand by source 2023–30 [40]



Note: "Other" includes geothermal, solar thermal, district heating (primarily bioenergy) and ambient heat harnessed by heat pumps.

Recognizing this gap in renewable power and heat, the SB COP30 agenda positions renewables as a central pillar for accelerated action and strategic redirection in the short term, with a focus on achieving tangible progress by 2030.

Private sector challenges

The private sector faces four main challenges to unlocking greater deployment of renewable energy.

Grid limitations restrict output

First, the deployment of renewables projects is often affected by grid limitations because of bottlenecks in interconnections, limited transport capacity, and expansion delays caused by licensing and permitting issues. The increased integration of intermittent renewable-energy sources highlights important challenges regarding grid flexibility and reliability. Suboptimal grid flexibility means that not all the additional capacity from renewables can be used. Curtailment—or the intentional reduction of output—is an increasing problem in countries where grid upgrades and integration measures lag behind the deployment of renewable generation. For example, curtailment of wind and solar PV generation recently reduced the renewable-energy supply by 5 to 15 percent of its potential in Chile, Ireland, and the United Kingdom. [41]

In addition, grid investments are struggling to keep pace with both rising power demand and deployment of renewables.[42] At around $400 billion, worldwide annual investment in grids is currently far lower than the $1 trillion invested in generation assets (renewables and conventional).[43] While grid and generation investments do not necessarily need to be equal, the current imbalance between them highlights that grid expansion is not keeping pace with the rapid growth of power demand and deployment of renewables.

Potential options to address this challenge include supply-side management solutions such as battery and thermal energy storage systems (for example, pumped storage) and other solutions to address the variability of renewable-energy sources. Greater power system flexibility can help reduce price volatility, stabilize the grid, and support the effective integration of renewable energy into the market.[44]

To keep pace with rising demand and safeguard energy security, investment in grids must be increased rapidly and closely coordinated with investment in power generation. But progress is slowed by lengthy licensing and permitting processes, supply chain bottlenecks for equipment such as transformers and cables, and—especially in developing economies—the fragile financial situation of some utility companies.[45]

Scarcity of critical supplies

Second, supply scarcity of critical minerals, especially copper, could be a major constraint on scaling renewable technologies. Demand for these materials has doubled in the past five years, and copper consumption alone is expected to grow about 70 percent by 2050 because of its irreplaceable role in electric vehicles (EVs), power grids, and wind turbines.[46] Yet supply faces significant challenges: The IEA projects a potential copper shortfall of 30 percent by 2035 caused by declining ore grades, high costs, and long permitting timelines.[47] Mitigating environmental and social risks while diversifying supply sources—through initiatives such as due diligence and origin diversification—is therefore critical to enabling private investment and safeguarding both climate and strategic objectives.[48]

Falling prices can affect economic viability

Third, as renewables increase their share of the market, their capture prices often fall, creating economic difficulties for projects. This challenge calls for adaptation in market design and price signals. Market rules and processes must evolve to keep pace with changing supply–demand patterns, such as enabling energy trading closer to real-time production and consumption.

This helps participants respond more effectively to variable renewable generation and demand shifts, supporting a balanced power system. Optimizing the day-ahead market remains essential for accurate forecasts, congestion management, and efficient resource allocation.

In addition, external factors such as geopolitical tensions and trade barriers are straining supply chains and driving up costs. One way to mitigate these risks is by adapting market regulations to enable more active consumer and prosumer participation—for example, through demand response, distributed generation, and local storage. These measures not only reduce dependence on vulnerable supply chains but also enhance the flexibility and resilience of the overall energy system.[49]

Permitting and licensing delays

Finally, significant bottlenecks in permitting and licensing processes present roadblocks to achieving global renewable energy capacity targets by 2030. According to the IEA, lengthy and complex approval procedures delay project implementation, with permitting timelines for wind and solar projects often exceeding five to seven years in many regions.[50] This slows the pace of renewable-energy deployment, creating a critical barrier to meeting climate goals.

Supply chain inefficiencies pose another major bottleneck challenge. The International Renewable Energy Agency (IRENA) highlights that shortages of key materials, such as rare earth elements and semiconductors, combined with limited manufacturing capacity for components such as transformers and turbines, are constraining the sector's ability to scale.[51]

These issues are further compounded by growing energy demand from emerging technologies—for example, AI data centers require robust and reliable power infrastructure. Addressing these bottlenecks is essential to ensure the timely expansion of renewable-energy capacity.[52]

Effective public–private collaboration, efficient permitting and licensing processes, and reinforced supply chains are vital to unlocking the full decarbonization potential of renewable energy. These efforts can act as a powerful catalyst for progress toward the ambitious goals outlined in the COP30 agenda.

B.2 RENEWABLES: RECOMMENDED GOALS AND PRIORITIES

This working group recommends maintaining the targets set during COP28 and acting to achieve the measurable KPIs to track progress, defined in Table 2.

TABLE 2. KPIs RECOMMENDED BY THE WORKING GROUP TO TRACK PROGRESS TOWARD COP28 RENEWABLE-ENERGY TARGETS

KPIs	Baseline	Target	Classification
Annual global electrical grid investments ($ billion, 2022) Investment in electrical grids includes transmission and distribution as well as spending on digital equipment for smart monitoring and operation of the grid (eg, smart meters, automation, and public electric-vehicle charging stations).	**332** 2022	**680** 2030	Aligned with International Energy Agency[1]
Global energy-related CO_2 emissions ($GtCO_2e$) Includes CO_2 emissions from the combustion of fossil fuels and nonrenewable waste, and from industrial and fuel transformation processes. Will require CO_2 removal through nature-based solutions and carbon capture, utilization, and storage (CCUS) deployment.	**37.8** 2024	**23** 2030	Aligned with IRENA 1.5°C scenario[2]
Triple renewable energy generation capacity [GW] Includes solar, wind, hydro, geothermal, solid, liquid and gaseous bioenergy, and other renewables, based on 2022 baseline.	**3,655** 2022	**11,000** 2030	Aligned with UAE Consensus COP28[3]

1 Net zero roadmap: A global pathway to keep the 1.5 °C goal in reach, IEA, September 26, 2023.

2 Net zero roadmap: A global pathway to keep the 1.5 °C goal in reach, IEA, September 26, 2023; World energy transitions outlook 2023: 1.5°C pathway, IRENA, June 2023.

3 "Global renewables and energy efficiency pledge," COP28 UAE, accessed July 2, 2024.

The working group recommends two priorities to be implemented in the short-term (before 2030):

- **Priority 2.1: Maximize the adoption of renewable energy by supporting initiatives that increase grid reliability and flexibility, such as developing grid infrastructure and interconnections; improving grid flexibility (for example, through enhanced energy storage and demand response); and accelerating permitting and licensing processes.**

  According to the IEA, modern, smart, and expanded grids are fundamental to enable flexibility, improve reliability, and secure the transition to a low-carbon energy system.[53,54] Policy and market reforms concerning grid connection in Europe, the United States, India, and other emerging and developing economies are expected to enhance project bankability and help the renewables sector recover from recent financial difficulties.[55]

  Initiatives that can directly improve reliability and flexibility include investment in advanced transmission and distribution lines, digitalization of transmission and distribution grids with focus on cybersecurity risks, and deployment of storage technologies such as batteries and supercapacitors. These measures can be supported, for example, through robust methodologies for the allocation of interconnection costs and streamlined permitting processes to reduce the costs of financing.[56]

  Developing power interconnections in regions with low connectivity is especially important. For example, in Central and Latin America, as well as in Southeast Asia, the development of interconnections will promote regional integration, ensure supply security, and enable greater physical energy trading flows. Interconnection is also a lever for increased flexibility and facilitates greater integration of renewable-energy sources.

- **Priority 2.2: Update regulations such as pricing schemes (for example, digitalization to better align supply with demand) and mechanisms to ensure stable revenues and reduce investment risks.**

  Electricity markets must evolve to accommodate new generation and consumption patterns. This requires advances in technology and regulation. Potential initiatives include introducing mechanisms such as long-term contracts to provide policy stability and predictability and shifting focus to competitive auction mechanisms to provide revenue stability and mitigate investment risks.

  An example of successful innovation to improve the integration and efficiency of renewables is the 2018 European Cross-Border Intraday (XBID) Solution in Europe, which enhances the absorption of renewable energy into the grid.[57] It matches bids across regional markets and optimizes cross-border transmission, thereby boosting the liquidity and efficiency of the intraday power market.[58]

B.3 RENEWABLES: CASE EXAMPLES

The following case studies highlight successful renewable-energy initiatives. Advancing the priorities outlined above will help accelerate the development of similar projects and increase their implementation.[xviii]

Kenhardt Hybrid (Dispatchable Renewable Energy Facility) – Scatec and partners

Challenges to increasing renewable deployment include curtailment, midday price drops driven by high solar output, and reliability issues. These can undermine the scale-up of solar and wind power generation, while grid investments and storage deployment struggle to keep pace.

The Kenhardt Hybrid Renewable Energy Facility in South Africa is an example of how these challenges can be overcome in practice. By integrating 540 megawatts (MW) of solar PV with a 225 MW/1,140 MWh battery storage system, the project can deliver 150 MW daily of firm, dispatchable power under a 20-year power purchase agreement (PPA) with Eskom. This is equivalent to the baseload generation of a conventional coal plant. This hybrid model directly addresses intermittency and grid integration challenges, proving that renewables paired with advanced storage can provide reliable, on-demand energy at scale. As such, it is an example of a project that contributes directly to the objectives of Priority 2.1 above.

With an investment of $1 billion and delivery ahead of schedule, the Kenhardt project shows how international financing partnerships can derisk large-scale renewable infrastructure.

It also has a strong socioeconomic impact. The project created more than 3,000 jobs during construction (around 13 percent of which were filled by women) and now sustains 100 to 120 permanent positions with a strong focus on gender inclusion.

xviii Case studies have been provided by the companies concerned. The information they contain has not been independently verified.

Gralha Azul Power Transmission Line - ENGIE

The Gralha Azul Power Transmission Line Project in Brazil illustrates how public–private collaboration can unlock solutions to some of the most pressing challenges in renewable-energy deployment. Developed by ENGIE through a federal build-own-operate-transfer (BOOT) concession model, the project mobilized more than 2 billion reais (approximately $0.37 million) in investment and delivered 1,000 kilometers of transmission lines and new substations to reinforce the National Interconnected System (SIN).

This structure created the conditions for stable long-term financing—via Brazil's National Bank for Economic and Social Development (BNDES) and debentures—while ensuring regulatory certainty for investors and aligning incentives between government and private developers.

Gralha Azul expands transmission capacity and reinforces the Brazilian grid system, thereby enhancing grid reliability and flexibility. As such, it is an example of a project that contributes to the objectives of Priority 2.1 above. Furthermore, the project illustrates how clear regulatory frameworks and stable revenue can reduce investment risks, aligning with the objectives of Priority 2.2.

By reinforcing Brazil's grid, preventing 1.39 million tons of CO^2 emissions annually, and stabilizing electricity tariffs across 27 municipalities, the project exemplifies how public–private partnerships can move beyond theory to tangible results, strengthening energy security while advancing the renewable transition.

C. SUSTAINABLE FUELS

C.1 SUSTAINABLE FUELS: INTRODUCTION

Sustainable fuels—including solid biomass, liquid biofuels, biogases, renewable hydrogen, and e-fuels (such as e-kerosene, green ammonia, and methanol)—are emerging as critical solutions for reducing greenhouse gas (GHG) emissions.

These renewable sources not only support decarbonization but also enhance energy security and foster economic growth.[59] Increased use of sustainable fuels could reduce global emissions by 0.5 to 1.5 GtCO2e by 2030 through a biogenic cycle that reabsorbs CO2 emissions during biomass production, thus helping mitigate the intensification of climate change.[60] Under the IEA's Net Zero Emissions by 2050 scenario, demand for sustainable fuels must double by 2030 and then double again by 2050.

Bioenergy, including liquid, gaseous, and solid fuels—will make up about 95 percent of renewable-fuel growth from 2023 to 2030.[61] Biofuels, in particular, benefit from commercialized production and strong policy support, making them a practical solution for near-term climate goals.[62]

It is also important to highlight the potential role of biogas and biomethane as a sustainable solution for the energy transition, especially as a long-term alternative to natural gas. Global biogas demand is forecast to increase by about 30 percent between 2024 and 2030, reaching nearly 2,270 petajoules (about 59 bcme20xix) per year by 2030.[63] In this context, biomethane is gaining traction in the energy mix, supported by policies and voluntary carbon markets, particularly in Europe and the United States. Industries, corporations, utilities, and cities are beginning to sign long-term contracts for green gases to meet carbon-reduction goals, thereby opening market opportunities.[64]

xix Billion cubic metre equivalent (bcme), calculated using a conversion factor of 38 200 TJ/bcme

Significant increase required in use of hydrogen and e-fuels

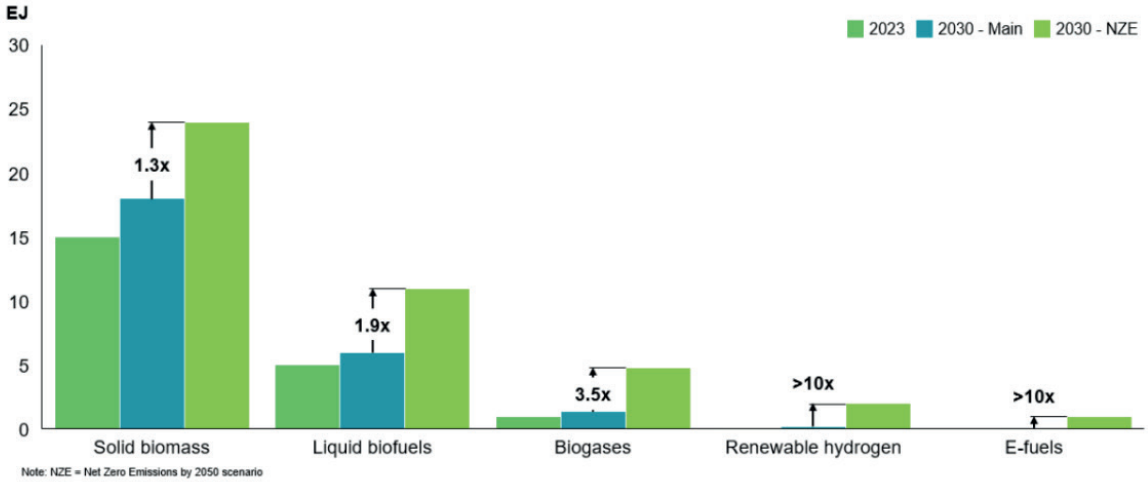
Use of other types of renewable fuels, such as hydrogen and e-fuels,[xx] must increase more than ten times by 2030 under the IEA's Net Zero Emissions by 2050 scenario (Exhibit 7). One of the key challenges to this expansion is cost: Hydrogen, emerging biofuels, and e-fuels would carry a premium of over five times average fossil fuel prices.[65]

While bioenergy adoption is expected to grow across multiple sectors and countries, demand for hydrogen and e-fuels remains concentrated in a few nations.[66] E-fuel growth is largely confined to the European Union. European regulations require renewable fuels of non-biological origin (including hydrogen and e-fuels) to account for 1.2 percent (approximately 0.03 EJ) of fuel in aviation by 2030, and for 1 percent of transport fuel across all sectors. Hydrogen demand is also expanding primarily in Europe, supported by EU funding for industrial applications.[67]

An example of increasing demand is the growth of e-methanol use in the maritime, aviation, and industrial sectors. E-methanol also serves as a drop-in replacement for fossil methanol in industrial applications. For example, as shipping companies aim to meet FuelEU Maritime emissions targets, the adoption of methanol-powered ships with dual-fuel engines is growing. With growing demand and regulatory development driving the transition to synthetic fuels, e-methanol is emerging as a potential enabler of global decarbonization.[68]

xx Synthetic fuels produced using renewable electricity.

EXHIBIT 7. RENEWABLE FUEL CONSUMPTION BY FUEL, MAIN CASE, AND NET ZERO SCENARIO, 2023–30[69]



Deployment of these technologies can be accelerated if governments implement supply and demand policies to bridge the cost gap with fossil fuels, support innovation, develop robust supply chains, enforce sustainability requirements, and eliminate other barriers to renewable-fuel adoption. Closing the cost gap requires proven policies including mandates, financial incentives, performance-based standards, and carbon pricing. All of these can play a critical role in driving adoption of renewable fuels and accelerating the transition to a low-carbon economy.[70]

ROAD TRANSPORT EXPECTED TO LEAD BIOFUEL DEMAND

Road transport is expected to remain the dominant transport sector for overall biofuel demand through 2030 (Exhibit 8).[71] Demand is projected to rise by 27 billion liters in 2023 (0.80 EJ), reaching 205 billion liters (5.4 EJ) by 2030. The majority of this increased demand will come from developing countries, where liquid fuel consumption continues to grow, electric vehicle adoption remains relatively slow, and governments have announced plans to raise biofuel blending mandates.[72] Hence, solutions such as hybrid flex-fuel vehicles, plug-in hybrids, and other advanced technologies are expected to continue playing a significant role in decarbonizing the automotive sector, paving the way for a cleaner and more sustainable future.

Production hubs for sustainable fuels can supply multiple sectors. Therefore, the road transport sector can act as a catalyst by helping create the production infrastructure needed to expand the use of sustainable fuels in other sectors, including aviation and maritime transport. An integrated approach to production not only enables economies of scale but also improves cost competitiveness across various fuel types, helping accelerate the transition to a more sustainable energy ecosystem.[73]

Sustainable fuel: The primary decarbonization tool in aviation

In the aviation sector, the forecast rise in demand for aviation services is likely to increase emissions. According to the IEA, aviation accounts for about 2 percent of global energy-related emissions. Without mitigating policies, these emissions could grow from about 0.8 GtCO2 in 2022 to 1.6 to 1.8 GtCO2 in 2050.[74]

At the same time, aviation is expected to account for an increasing share of growth in biofuel use from 2026 to 2027. Sustainable aviation fuel (SAF), produced from a wide range of organic feedstock and agricultural technologies, is expected to be the aviation sector's primary tool in meeting its goal of reaching net zero by 2050. This aim is embedded in the long-term aspirational goal (LTAG) established by the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) agreement, which has been adopted by the member states of the International Civil Aviation Organization.[75] Brazil is one country with significant potential for cost-efficient SAF production at scale, because it has experience in biofuels and wide availability of raw materials.[76]

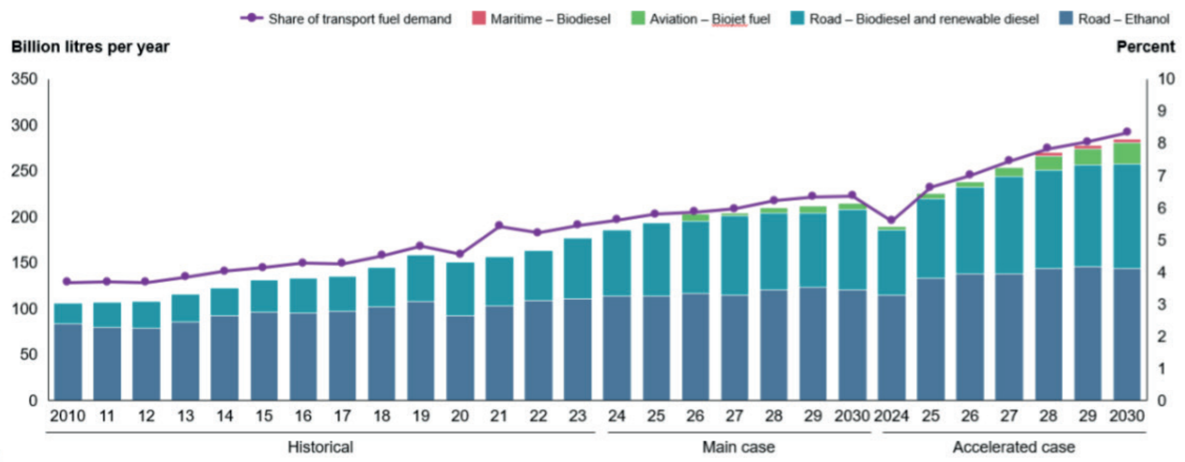
The growth in aviation demand for biofuels will also likely heighten market competition for residue oils. By 2030, the sector's demand for used cooking oil, tallow, and palm oil mill effluent is expected to rise by 70 percent to 30 metric ton per year, consuming nearly 80 percent of available supplies.[77]

Regulation drives adoption of sustainable fuels in the maritime sector

Maritime transport—accounting for approximately 3 percent of global GHG emissions, according to the International Renewable Energy Agency (IRENA)[78]—is also expected to increase its use of sustainable fuels. This is largely in response to international regulations and national targets that push for reductions in shipping emissions.

An example is the 2023 International Maritime Organization (IMO) Strategy on Reduction of GHG Emissions from Ships. This strategy sets ambitious targets for the maritime sector, including a 40 percent reduction in carbon intensity by 2030 and net-zero GHG emissions by around 2050. To meet these goals, the strategy calls for fuels with zero or near-zero GHG emissions to account for at least 5 percent of the energy used by international shipping by 2030, with an aspirational target of 10 percent.[79] The IMO has recently achieved important steps towards establishing a framework to reduce greenhouse gas (GHG) emissions in the 83rd session of Marine Environment Protection Committee (MEPC 83), in April 2025. First, under the draft regulation, ships must gradually reduce their annual greenhouse gas emissions fuel intensity (GFI), which is how much GHG is emitted for each unit of energy used. Second, ships that exceed the GFI thresholds will be required to purchase remedial units to offset their excess emissions, while those operating with zero or near-zero GHG technologies will qualify for financial incentives.[80]

Exhibit 8. Biofuel consumption by transport sector 2010–30[81]



Use of degraded land and regenerative agriculture can support biofuel production

An additional opportunity lies in prioritizing the use of degraded land for biofuel crops and adopting regenerative agricultural practices, such as second-cropping techniques. This integrated approach delivers both environmental and economic benefits by enabling biofuel production that also restores soil health and enhances carbon sequestration.[82]

An example is the integration of Brazil's agricultural and energy systems, where around 3 percent of soybean output is used to produce biodiesel. Following the soybean harvest, second-crop corn is grown in the same area immediately, without requiring land expansion. This system, based on sequential cropping, maximizes efficient use of land and has enabled large-scale ethanol production with a low risk of indirect land use change (ILUC) and strong co-benefits such as soil improvement, crop diversification, and stable incomes for farmers. The model unlocks potential for sustainable ethanol production without displacing food crops or encroaching on native ecosystems.

Biofuel production also yields co-products such as sugar from sugarcane and distillers dried grains with solubles (DDGS)[xxi] from corn, which are used in the food and animal feed markets. Residues from the production process are used to generate bioelectricity, demonstrating how biofuels can coexist with, and even strengthen, food security.[83]

According to the Brazilian Energy Research Company (EPE), ethanol production could increase by up to 38 billion liters annually if the currently available soybean areas in regions with favorable climate conditions were sequentially planted with corn. Even under current market conditions—in which only about 15 percent of Brazil's corn production is used for ethanol—the planned expansion of corn ethanol capacity could yield an additional six billion liters of renewable fuel, bringing total output closer to 38 billion liters per year. This growth would also generate co-products such as DDGS and corn oil.[84]

International collaboration is crucial to effectively balance rising global demand for sustainable fuels with the available supply of suitable land and feedstocks. Regions such as Latin America and sub-Saharan Africa, which

xxi DDGS is a by-product of ethanol production used widely as an animal feed ingredient.

collectively hold over 190 million hectares of degraded land, are poised to play a pivotal role. By cultivating biofuel crops on these underused lands, these regions can help meet both local and international energy needs and supply other markets that lack sufficient land resources. Such a demand-driven approach would strengthen global supply chains, optimize resource allocation, and support equitable access to sustainable fuels, ensuring that expanding bioenergy production does not threaten food security or encroach on vital ecosystems.[85]

Private sector challenges

From a private sector perspective, there are two main challenges to unlocking greater deployment of sustainable biofuels.

Cost premium over conventional fuels

First, the cost premium of biofuels over conventional fuels in some countries is a significant barrier to wider adoption. This is especially the case for fuels that are not yet well established in the market, such as SAFs.[86]

Government support for first-of-a-kind projects can help mitigate risks, and international collaboration can ensure widespread sharing of best practices. Additionally, policy action can address nonfinancial barriers to renewable fuel uptake—for example, by establishing safety and quality standards, enabling co-benefits such as fertilizer production from biogas, and supporting infrastructure deployment.[87]

North America, for example, allows a broader range of feedstocks for biofuel production, including edible oils, and relies heavily on financial incentives such as tax credits to promote the adoption of sustainable fuels.[88]

Lack of universal classification system for biofuel carbon intensity and increased adoption of blending mandates

The second challenge relates to variable carbon intensity of biofuels and the current lack of a standardized global classification system. Such a framework would assess the life cycle emissions of biofuels, from feedstock production to end use, using science-based research to ensure a transparent and consistent methodology. This framework should complement and harmonize existing regional approaches—such as blending mandates or sustainability schemes. By building on existing international standards, regulations, and certifications, a global classification framework would enable reliable verification of biofuel carbon intensity across global markets and help accelerate the adoption of clean fuel technologies.

A contributing challenge is presented by the varying approaches of regulatory regimes when it comes to considering land use changes. While emissions from direct land use change are often addressed in a relatively consistent manner, the consideration of indirect land use change varies widely across regulatory frameworks.[89]

Government approaches to these challenges vary across regions. The European Union, for example, enforces blending requirements for low-carbon feedstocks through supply-side mandates and penalties under legislation including RED III, ReFuelEU aviation, and FuelEU maritime.[90]

Beyond Europe and North America, emerging markets also provide important lessons. An example of progressive fuel mandates comes from Brazil, which enforces nationwide ethanol blending rates of 30 percent in gasoline.[91] This policy is anchored by RenovaBio and Combustível do Futuro, a robust regulatory framework with high traceability standards.[92] Brazil's experience shows that large-scale, technology-neutral blending mandates can be successfully deployed beyond the aviation and maritime sectors to achieve emissions reductions, enhance energy security, and maintain affordability.[93] This model offers valuable insights for other regions aiming to expand sustainable fuel adoption across multiple transport modes.

Further considerations relevant to sustainable fuels

Beyond the standardization of classification systems for carbon intensity, decarbonization strategies must also be evaluated in terms of their broader climate, social, and environmental impacts, as well as their long-term contributions to climate mitigation and resilience. Tools such as life cycle assessment (LCA) are essential to ensure that these strategies achieve real emissions reductions, avoid unintended consequences, and provide the evidence base for effective policies, equitable carbon pricing, and efficient resource allocation.[94]

C.2 SUSTAINABLE FUELS: RECOMMENDED GOAL AND PRIORITIES

This working group recommends acting to increase global bioenergy demand by 85 percent by 2030 in line with the IEA Net Zero by 2050 scenario.[95]

Consequently, KPIs have been defined to track progress in this initiative (Table 3). However, sector-specific KPIs might be needed to tailor actions and measure advancements.

Table 3. Sustainable fuels KPIs and targets

KPIs	Baseline	Target	Classification
Global bioenergy demand, EJ	**29.3**	**54.4**	
Includes demand from buildings, electricity generation, industry, and transport sectors	2022	2030	Aligned with IEA Net Zero scenario[96]

The working group recommends two priorities to be implemented in the short term (before 2030):

- **Priority 3.1: Implement sector-specific progressive mandates[xxii] and guidelines, fostering collaboration while ensuring affordability for end users, food security, and land use efficiency**

  Industry-specific progressive mandates and science-based sustainable-fuel standards help address the unique challenges and demands of each transport sector through tailored solutions.

  Mandates can also benefit from collaboration between neighboring countries. By integrating biofuel policies across regions, countries can reduce trade barriers and scale up the cost-competitive supply of sustainable fuels to sectors, such as aviation, to reach global SAF mandates. Lowering tariffs and aligning international standards are key to scaling up cross-border trade in biomass and biofuels while leveraging regional assessments and fostering technology transfer and capacity building for developing countries, according to the IEA.[97] This approach is consistent with several studies highlighting the importance of

xxii Mandates are regulatory requirements or obligations imposed by governments or international bodies. These mandates often set specific targets or enforce compliance with decarbonization goals. The term "progressive" refers to mandates that are increasingly stringent over time.

competitiveness and ongoing global initiatives, especially when considering the opportunities for scalability and collaboration with neighboring countries and regions in the transport sector.[98] A progressive approach allows sectors to adapt gradually, fostering innovation, scaling both production and logistical infrastructure—including fuel storage, blending, distribution, and delivery systems—and reducing costs over time. This ensures an effective transition to sustainable fuels without economic disruptions or affordability concerns for end users. Good governance addresses risks related to land and resource use, food security, natural ecosystems, and carbon stocks.[99]

An example of such an approach is the International Civil Aviation Organization's CORSIA scheme.[100] This is the first market-based biofuel scheme applied to a sector on a global scale and covers over 670 aviation operators across 131 nations. It is technology agnostic, spanning 48 types of biofuel feedstock. Starting in 2027, airlines are mandated to offset emissions progressively through the acquisition of CORSIA certificates.[101]

While the CORSIA scheme addresses international aviation, it can be supported by national mandates for domestic aviation operators. The Fuel for the Future law in Brazil, for example, establishes progressive decarbonization targets for domestic aviation over a decade, from 1 percent in 2027 to 10 percent in 2037.[102]

In the shipping sector, the International Maritime Organization's Net Zero Framework sets mandatory emissions limits and GHG pricing for shipping.[103] The European Union has also set progressive decarbonization targets for large vessels, aiming for 2 percent by 2025, 6 percent by 2030, and up to 80 percent by 2050,[104] under the FuelEU Maritime Regulation supported by fuel mandates and certification schemes.

- **Priority 3.2: Establish science-based, technology-agnostic incentives based on carbon-intensity fuel certification schemes**

  Science-based, technology-agnostic incentives promote innovation in diverse low-carbon pathways. Robust carbon-intensity certification is critical because it provides a transparent and science-based method to compare fuels across their entire life cycle, from feedstock production to end use. This ensures that incentives reward the options that deliver the greatest emissions reductions rather than favoring specific technologies. By linking incentives to verified performance, carbon-intensity certification reduces the risk of unintended land-use change, strengthens market credibility, and creates investor confidence.

A successful example of technology-agnostic incentives is the EU Innovation Fund, which is investing €40 billion between 2020 and 2030 to deploy new technologies such as SAFs, bioenergy with carbon capture and storage (BECCS), synthetic fuels, advanced sustainable fuels, and recycled carbon fuels.[105] The fund provides grants for pilot, small, midsize, and large-scale projects, with a focus on innovative, low-carbon technologies.

Establishing technology-agnostic incentives based on carbon-intensity fuel certification schemes requires robust monitoring and international comparability. Tools such as the IEA's Global Energy Policies Hub, which tracks and benchmarks energy and climate policies across 85 countries, can provide the transparency needed to ensure that incentives are consistent, science-based, and aligned across jurisdictions.[106]

The importance of science in sustainable-fuel policy and strategy

The benefits of carbon-intensity certification of biofuels demonstrate the importance of science as a central pillar in policymaking and decision-making. The application of science ensures that the energy transition is technically sound and aligned with long-term climate commitments.

As such, decarbonization technologies should be assessed not only on the basis of capital and operating expenditure costs but also on their social and environmental impacts and their contribution to climate mitigation and resilience.-

This broader approach to assessment is essential to guide effective public policy, fair carbon pricing, and efficient resource allocation.[107] This principle is particularly important for bio-based solutions, which must be science-based to ensure they deliver genuine environmental benefits. Assessment must include the sourcing of feedstock, land use changes, and resource efficiency. Without rigorous scientific validation, bio-based solutions risk creating unintended trade-offs.

C.3 SUSTAINABLE FUELS: CASE EXAMPLES

The following case studies highlight successful sustainable fuel initiatives. Advancing the priorities outlined above will help accelerate the development of similar projects and increase their implementation.[xxiii]

Hybrid-Flex Fuel Vehicle Technology - Toyota

Brazil's Hybrid Flex Fuel Vehicle initiative is an example of how the automotive sector is playing a pioneering role in deploying sustainable fuels. The technology, developed by Toyota, combines the efficiency of an electric motor with a flex-fuel engine capable of running on ethanol, gasoline, or both. It delivers battery electric vehicle–level efficiency without requiring charging infrastructure or changes in consumer behavior. It was launched in 2019 (with the Corolla Altis Flex Hybrid) and has rapidly gained traction, accounting for nearly 25 percent of Toyota Corolla sales in Brazil by February 2020.

By leveraging Brazil's unique ethanol infrastructure, hybrid flex vehicles provide a scalable and cost-effective pathway to reduce emissions in transport. When fueled with ethanol, these vehicles cut CO_2 emissions by up to 70 percent compared to gasoline-only models, while offering drivers 20 to 40 percent savings on fuel costs. Crucially, this innovation avoids the need for major public investment in charging stations, transmission upgrades, or new generation capacity, making it particularly relevant for emerging markets with limited infrastructure budgets.

The initiative also underscores how private sector innovation can accelerate decarbonization when aligned with local resources. Other automakers, including GM, Honda, and Stellantis, have followed Toyota's lead and together committed hundreds of millions of dollars to expand hybrid flex production in Brazil. This momentum demonstrates that sustainable fuels, when paired with electrification, can create practical, market-ready solutions that deliver climate and economic benefits.

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xxiii Case studies have been provided by the companies concerned. The information they contain has not been independently verified.

Sector-specific mandates and guidelines, as recommended under Priority 3.1, could amplify the impact of such solutions across the transport sector. By setting progressive requirements for sustainable fuels in road transport, mandates could create a clear pathway for scaling innovations such as hybrid flex vehicles.

De-risking and scaling up of a first-of-a-kind (FOAK) waste to methanol project (Ecoplanta) - REPSOL

The €800 million Ecoplanta Waste-to-Methanol Project in Spain, developed by Enerkem in partnership with Repsol, will be the first large-scale facility in Europe to convert nonrecyclable municipal solid waste into renewable methanol, using advanced gasification technology. Ecoplanta will produce 240,000 metric tons of methanol annually, supplying the transport and chemicals sectors with sustainable alternative fuel while diverting 400,000 metric tons of waste from landfills each year. Supported by a €106 million grant from the EU Innovation Fund, the project shows how public co-funding can derisk pioneering ventures and catalyze private investment.

Over its first decade, Ecoplanta is expected to avoid 3.4 million metric tons of CO_2 e emissions while creating nearly 3,000 construction jobs and 340 permanent positions. By combining cutting-edge technology, strong industrial partnerships, and robust policy support, Ecoplanta illustrates how incentive frameworks and innovation funding can unlock transformative solutions.

D. HARD-TO-ABATE SECTORS

D.1 HARD-TO-ABATE SECTORS: A NOTE

Hard-to-abate sectors, such as chemicals, steel, cement, and transport, together account for 45 percent of global direct and indirect energy system emissions.[108] Early action is essential to address the long lead times required for developing and scaling breakthrough technologies and to enable these sectors to achieve meaningful impact by 2050. Delaying action risks locking in high-emission infrastructure and missing key milestones for 2050 targets.

Achieving deep decarbonization in these sectors also demands early strategic decisions about adopting alternative fuels—such as hydrogen and advanced biofuels—and rapidly scaling up CDR infrastructure. Hydrogen and biofuels are particularly key for sectors that cannot easily be electrified, such as steel, aviation, and maritime transport. The anticipated surge in demand for clean hydrogen underscores this, with projections indicating that low-emission hydrogen could account for up to 98 percent of total hydrogen use by 2050.[110]

CCUS technologies play a pivotal role in cutting emissions from existing industrial operations. If net-zero objectives are to be achieved, global CCUS capacity must expand to as much as six metric gigatons by mid-century. However, scaling these solutions is not without challenges: High costs, lengthy lead times, and the need for robust regulatory support must all be addressed to unlock their full potential.[111]

Funding challenges require a system-wide approach to investment

The financial requirements to achieve these goals are substantial: The World Economic Forum estimates that $30 trillion in additional capital is needed by 2050 to decarbonize hard-to-abate sectors. This represents around 45 percent of the total incremental net-zero investment required by 2050.[112] Investments in infrastructure, such as the expansion of electricity transmission and distribution networks, are also necessary to support the increased electrification of industrial processes.[113]

This need for investment is particularly challenging given the competitive profit margins of most of these sectors, which limit companies' capacity to absorb the substantial costs while maintaining adequate profitability. This emphasizes the importance of a system-wide approach—with collaboration among industry stakeholders, governments, and research institutions—to effectively transition to net-zero emissions by 2050.[114]

Enabling policy is critical

Policy support is essential to drive the transition toward low-carbon technologies. Governments need to implement regulations that promote the use of sustainable alternative fuels and materials, establish carbon-pricing mechanisms, and encourage the adoption of low-carbon products. Additionally, public procurement policies that specify low-carbon materials for construction projects can stimulate demand and drive industry-wide changes.[115] Policy measures should also aim to jump-start and accelerate the learning curve of new technologies and production routes by providing funding support and creating demand mechanisms, such as guarantees for long-term offtake agreements.

Collaboration among industry stakeholders, governments, and research institutions is also vital. Initiatives such as the Global Alliance on Circular Economy and Resource Efficiency[116] and the Industrial Deep Decarbonization Initiative[117] highlight the importance of collective action in achieving decarbonization goals. By leveraging advancements in research, innovation, and policy support, hard-to-abate sectors can make significant strides toward a sustainable, low-carbon future.[118]

E. PRIVATE SECTOR CASES

The SB COP30 Energy Transition Working Group received over 160 case studies from companies from around the world. These were evaluated through a structured selection methodology designed to identify those with the greatest impact and scalability potential. Six standout cases were selected for inclusion in this report.[xxiv]

E.1 ENERGY EFFICIENCY: VESTA: IMPROVING ENERGY EFFICIENCY IN A PETROCHEMICAL COMPLEX[xxv]

The Vesta Project, part of the strategic modernization of the thermoelectric system at the ABC Petrochemical Complex in São Paulo, represents a pioneering leap in industrial energy efficiency. Braskem, a global petrochemical company and the largest producer of thermoplastic resins in the Americas, in partnership with Siemens Energy, replaced outdated low-efficiency steam turbines with high-performance electric motors and introduced a state-of-the-art cogeneration plant powered by highhydrogen-content residual process gas. This integrated redesign enhances operational performance, sustainability outcomes, and business competitiveness.

The initiative aligns closely with SB COP's climate goals by modernizing energy systems to reduce CO_2 emissions, enhance efficiency, and secure operational resilience. By converting waste gas into cogenerated power, the project exemplifies how industrial facilities can become drivers of decarbonization and energy transition.

At the heart of the project is its innovative approach to cogeneration. Siemens Energy designed a plant fueled by residual process gas rich in hydrogen, capable of cofiring up to 80 percent hydrogen by volume in its gas turbines. This advanced configuration not only delivers reliable electric and steam output (38 megawatts and 160 tons per hour, respectively) but

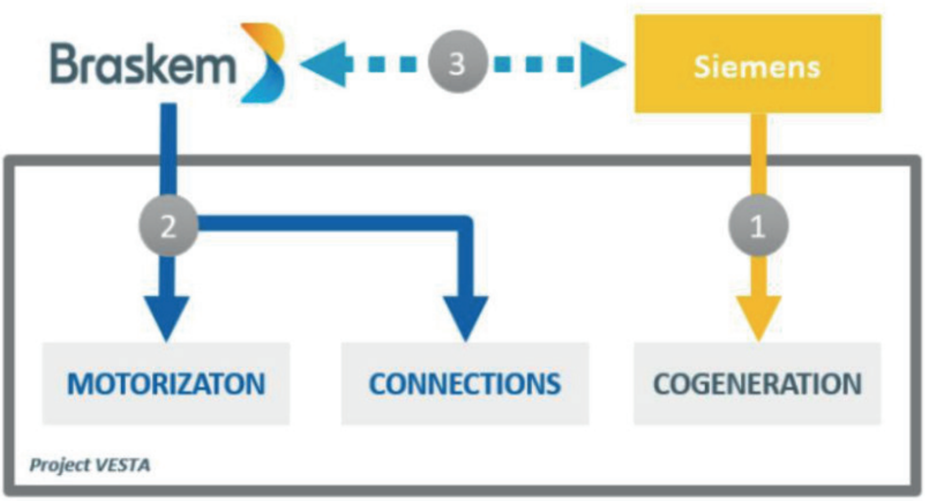
xxiv Case studies have been provided by the companies concerned. The information they contain has not been independently verified.

xxv This version was reviewed and approved by the company.

also reduces CO_2 and NOx emissions and water usage through optimized lowemission combustion technologies.

The impact is both quantitative and transformative. Braskem expects reductions of 6.3 percent in CO_2 emissions (100 kt/y), 7.3 percent in energy consumption, and 11.4 percent in water consumption. The savings in energy consumption are equivalent to a city of one million inhabitants. Emissions of NOx are maintained at low levels (25 ppm). The economic model demonstrates clear efficiency gains and operational resilience.

Implementation commenced in 2019, with a total investment of approximately 600 million reais (about $110 million), jointly funded by Braskem and Siemens. The build-own-operate (BOO) framework enables Braskem to focus on its core business while Siemens manages technology development, engineering, installation, operation, and maintenance over a 15-year period. The cogeneration plant began operations in 2021, marking successful completion ahead of schedule and setting a benchmark for energy modernization in the petrochemical sector.




SIEMENS
energy
Global

The ABC Petrochemical Complex in São Paulo is powered by a cogeneration plant that is fueled by residual process gas with a very high content of hydrogen.

Abobe: The two SGT-600 turbines for this project, like the one pictured above, will feature third-generation dry low emissions (DLE) technology and run on residue gas with high concentrations of hydrogen

E.2 ENERGY EFFICIENCY: SUZANO: BIOMASS GASIFICATION AT A PULP AND PAPER FACILITY[xxvi]

The biomass gasification project at Suzano's - the largest pulp and paper company in Latin America and the world's foremost eucalyptus pulp produce - new pulp and paper facility in Ribas do Rio Pardo, Brazil, embodies a groundbreaking industrial energy transition. The facility is engineered to convert lignocellulosic byproducts—specifically black liquor and other biomass residues—into steam and electricity. In addition, the facility considers a biomass gasification plant, which is responsible for producing the renewable syngas from biomass. This syngas replaces conventional fossil fuels in lime kilns, reducing CO_2 emissions by up to 97 %, while bolstering energy self-sufficiency and advancing Suzano's sustainable and clean-energy objectives.

This initiative aligns seamlessly with SB COP priorities by dramatically lowering greenhouse gas emissions at scale, leveraging circular economy principles, and advancing energy efficiency within the industrial sector. Through biomass valorization, it highlights how established industrial operations can pivot sustainable practices with tangible environmental benefits.

The innovative drive of the project lies in its application of biomass gasification at scale within the pulp and paper industry's lime kilns. By producing renewable syngas from biomass, the process enables significant decarbonization of high-emission lime kilns, driving industrial innovation without compromising productivity.

The impact of the project is multi-dimensional. It enhances Suzano's pulp production capacity by around 20 %, strengthens local supply chains, and streamlines logistics efficiency. In environmental terms, it achieves up to 97 % reduction in CO_2 emissions from lime kilns—substantial progress toward cleaner operations and energy circularity.

As for implementation, the project has moved beyond pilot stages and

xxvi This version was reviewed and approved by the company.

is already generating initial results. Its scalable design allows replication across other industrial units looking to decarbonize thermal systems. Operational success hinges on stable biomass feedstock supply, syngas adaptation, and sophisticated process control to ensure seamless integration within kraft pulp operations.

E.3 RENEWABLES: KENHARDT HYBRID RENEWABLE ENERGY FACILITY

The Kenhardt Hybrid Renewable Energy Facility in South Africa is one of the world's first and largest utility-scale hybrid plants that integrates solar power and battery storage to provide reliable, dispatchable renewable energy. With 540 MW of installed solar PV and a 225 MW/1,140 MWh battery energy storage system, the project delivers 150 MW of firm power daily from 5:00 a.m. to 9:30 p.m. under a 20-year PPA with Eskom. Covering nearly 879 hectares and incorporating about one million solar panels and 456 battery containers, the facility ensures consistent supply equivalent to the baseload generation of a conventional coal unit.

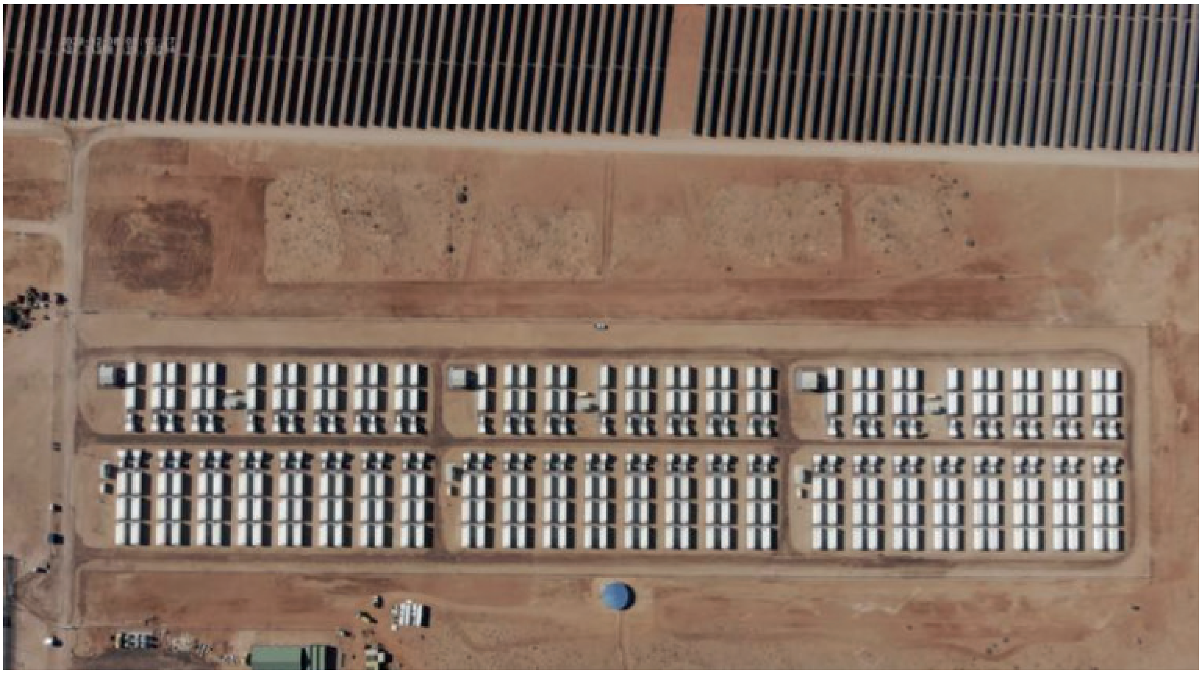
The initiative was developed by Scatec ASA, a Norwegian independent renewable-energy producer with a growing global footprint across Africa, Asia, Europe, and the Americas. Representing the company's largest capital commitment to date, with an investment of approximately $1 billion, the Kenhardt facility was built in partnership with South Africa's H1 Holdings and financed through an international consortium led by Standard Bank Group and British International Investment.

By overcoming the intermittency of solar energy, Kenhardt directly supports the goals of the SB COP and the Paris Agreement, demonstrating how renewables paired with storage can provide baseload power, improve energy security, and reduce reliance on fossil fuels. The project proves that large-scale hybrid solutions can be both economically viable and environmentally transformative, setting a model for replication across Africa and beyond.

The facility is also a milestone of innovation, being the first in Africa to dispatch renewable power on demand at this scale. Delivered in only 18 months from financial close, it was awarded under a technology-agnostic tender, showcasing how advanced design and flexible solutions can meet urgent energy challenges.

The impact is considerable: an estimated 900,000 metric tons of CO_2 emissions avoided annually, along with strong economic returns through a long-term PPA. During construction, Kenhardt created over 3,000 jobs—about 13 percent filled by women—and now sustains 100 to 120 permanent positions, with nearly 40 percent women employed. Beyond direct employment, the project has stimulated local supply chains and enhanced skills development in the region.

Implementation began in July 2022 and culminated in December 2023, when the facility was successfully commissioned on schedule and within budget. Its delivery exemplifies how large-scale renewables projects can unite climate ambition, financial innovation, and socioeconomic development while accelerating the energy transition and setting a precedent for global adoption.



E.4 RENEWABLES: GRALHA AZUL POWER TRANSMISSION LINE[XXVII]

The Gralha Azul Power Transmission System is a large-scale federal BOOT concession in Brazil designed to strengthen the country's energy infrastructure. Its developer, ENGIE, is a global leader in energy and services and the largest 100 percent–renewable power generator in Brazil, with around 7 percent of Brazil's total power generation capacity.

The initiative involved building 15 transmission lines, which connect ten substations across approximately 1,000 kilometers, reinforcing Brazil's National Interconnected System (SIN). The aim is to expand the supply of renewable energy in the Brazilian state of Paraná by leveraging resources such as the Itaipú Hydropower Plant along with reducing costs, improving transmission efficiency, and fostering stable public–private collaboration through long-term concession contracts.

By integrating and distributing renewable energy sources, transmission systems such as Gralha Azul contribute directly to reduced reliance on fossil fuels and help advance low-carbon energy systems.

ENGIE was the first company in Brazil to deploy advanced drones at scale to install cables, reducing the projected vegetation suppression rate by half. Complementary design measures, such as elevated towers with wider spans and adjusted routes that avoid sensitive areas and communities, further minimize ecological and social impacts.

Furthermore, the project implemented 17 socio-environmental programs linked to the licensing process, which included initiatives for the conservation of native flora species, reforestation, and the restoration of degraded areas.

ENGIE also invested approximately 2 million reais in voluntary socio-environmental initiatives focused on health, education, and the installation of solar panels in a *quilombola* community.

xxvii This version was reviewed and approved by the company.

The Brazilian federal scheme for transmission line concessions enables long-term financing through BNDES and debentures. It promotes power security, moderates tariffs, and reduces the risk of curtailments in the system, enhancing grid reliability.

Implementation began after ENGIE secured the concession in 2017, backed by more than 2 billion reais in investment. Following comprehensive technical and socio-environmental studies, construction started in 2018, with partial energization achieved in 2021. The project was fully completed in February 2023, 18 months ahead of schedule—delivering critical infrastructure that strengthens Brazil's energy transition.

E.5 SUSTAINABLE FUELS – ECOPLANTA: DERISKING AND SCALING UP WASTE TO METHANOL[XXVIII]

The Ecoplanta Waste-to-Methanol Project, located in El Morell in Tarragona, Spain, is poised to become the first large-scale commercial plant in Europe to convert nonrecyclable municipal solid waste into renewable and circular methanol. Using Enerkem's advanced gasification technology, the facility will process approximately 400,000 metric tons of waste annually, transforming it into 240,000 metric tons of methanol per year—a versatile output used for biofuels and feedstocks for chemicals. Repsol, a global multi-energy company based in Spain, is the project promoter and has made the official final investment decision, committing over €800 million in capital. Enerkem, a Canadian cleantech firm founded in 2000 and headquartered in Montreal, is the technology provider, bringing its expertise in advanced waste-to-methanol solutions.

The Ecoplanta initiative aligns closely with SB COP's objectives—advancing sustainable fuels, enabling circular economy practices, and reducing GHG emissions. By diverting waste from landfills and producing renewable methanol, the project supports decarbonization strategies, particularly in sectors that are hard to abate such as transport and chemicals.

The project's molecular recycling approach is groundbreaking in Europe, showcasing how cutting-edge waste management can yield high-value circular materials and fuels.

The impact is substantial across environmental, economic, and social dimensions. Over its first ten years, Ecoplanta is expected to reduce GHG emissions by roughly 3.4 million metric tons of CO_2e. It promotes the circular economy by reclaiming carbon from waste, alleviating landfill pressure, and fostering resource efficiency. The project also strengthens regional industrial capacity by generating 340 permanent jobs upon operation and 2,800 jobs during construction.

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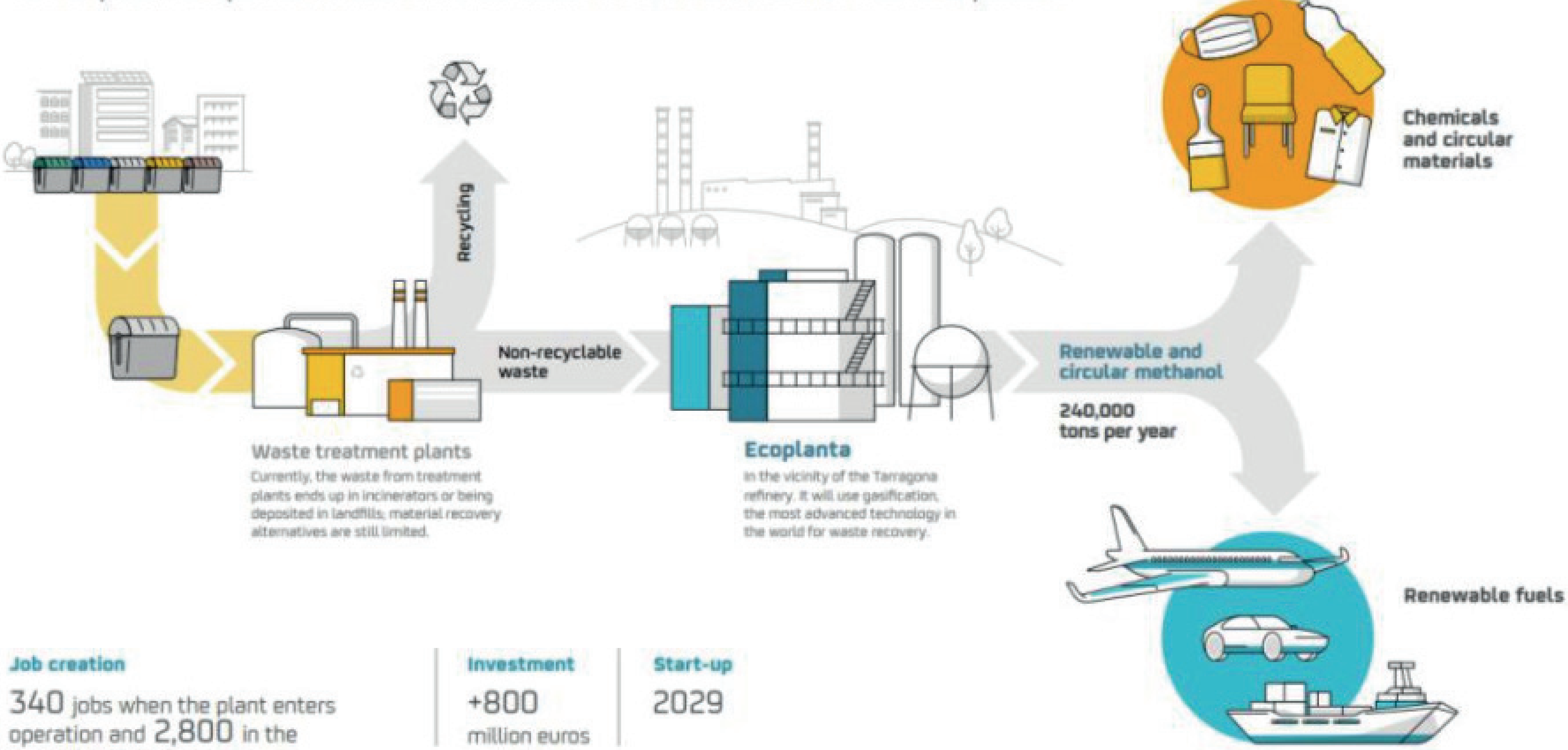
xxviii This version was reviewed and approved by the company.

Implementation has entered the development phase, with Repsol having approved the financial investment decision (FID) in early 2025. The plant benefits from support through the European Union's Innovation Fund, which co-funded the project with a grant of over €106 million, recognizing its high climate mitigation potential and scalability. Operations are scheduled to begin in 2029.

Ecoplanta in Tarragona

The first plant in Europe that will transform urban waste into renewable methanol and circular products



Job creation

340 jobs when the plant enters operation and 2,800 in the construction phase

Investment

+800 million euros

Start-up

2029

E.6 SUSTAINABLE FUELS: HYBRID FLEX-FUEL VEHICLE TECHNOLOGY[xxix]

The Hybrid Flex-Fuel Vehicle initiative is a pioneering technology development that combines an efficient electric motor with flex-fuel engines capable of running on ethanol or gasoline. It enables significant CO_2 reductions while requiring no external charging or behavioral change from drivers.

This innovative technology was introduced in Brazil by Toyota. The company unveiled a prototype in São Paulo in 2018 and launched the Corolla Hybrid Flex, marking the beginning of series production, in 2019. By February 2020, this hybrid flex model accounted for nearly 25 percent of all Corolla sales in Brazil, confirming Toyota as the leader in electrified vehicles.

In 2021, the second vehicle—and the first SUV with this technology in Brazil—was launched: the Corolla Cross Hybrid Flex.

Corolla Sedan Hybrid Flex

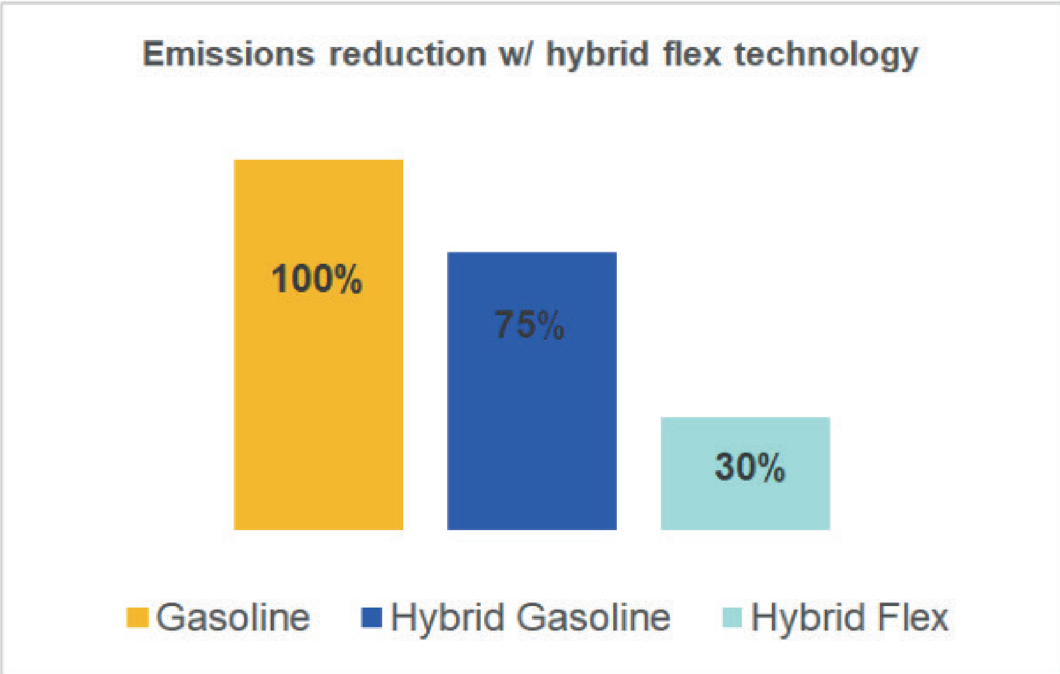
Corolla Cross Hybrid Flex

through practical, deployable solutions tailored to local realities. As Brazil's energy infrastructure is uniquely aligned with ethanol availability, hybrid flex vehicles provide a practical and scalable pathway to lower emissions in transport without the need for major investments in new infrastructure.

xxix This version was reviewed and approved by the company.

The impact is substantial. Hybrid flex vehicles running on ethanol cut CO_2 emissions by up to 70 percent compared to traditional gasoline models, and drivers can save 20 to 40 percent on fuel costs. The technology requires no public investment in EV charging infrastructure, transmission lines, or additional energy generation. It also attracts significant investment from automakers. For example, Toyota recently announced a $2.2 billion investment in Brazil to build a new factory for hybrid flex vehicles and support the domestic auto industry.

More than 100,000 hybrid flex vehicles have been produced in Brazil, achieving significant market traction. Toyota's initiative is also inspiring others to invest in similar technologies.



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ANNEXES

ANNEX A - GLOSSARY OF TERMS

ENERGY EFFICIENCY | USING LESS ENERGY TO PROVIDE THE SAME LEVEL OF OUTPUT, OR PRODUCING MORE WITH THE SAME ENERGY INPUT

Energy efficiency | Using less energy to provide the same level of output, or producing more with the same energy input

Residential Buildings · Commercial & Industri · Transportation

Examples	Definition	Use		
ENERGY INTENSITY	A measure of energy consumed per unit of economic output (e.g., GDP). It is the main global indicator to track efficiency improvements.	Residential Buildings	Commercial & Industrial	Transportation
CARBON INTENSITY	The amount of CO_2 emitted per unit of activity or output (e.g., per ton of steel, per MWh of power).	Residential Buildings	Commercial & Industrial	Transportation
MARGINAL ABATEMENT COST CURVE (MACC)	A tool to compare the cost-effectiveness of different options for reducing emissions, showing the cost per ton of CO_2 avoided.		Commercial & Industrial	Transportation
INDUSTRIAL COGENERATION (CHP)	Systems that produce both electricity and heat from the same fuel source, improving efficiency.		Commercial & Industrial	
BIOMASS GASIFICATION	Conversion of biomass into syngas that can replace fossil fuels in high-temperature processes.		Commercial & Industrial	
ENERGY MANAGEMENT SYSTEMS (EMS)	Digital tools and platforms that monitor, control, and optimize energy use in real time.	Residential Buildings	Commercial & Industrial	
ENERGY PERFORMANCE STANDARDS	Regulations that set minimum energy efficiency requirements for equipment, buildings, or vehicles.	Residential Buildings	Commercial & Industrial	Transportation

Renewables | Natural resource or source of energy that is not depleted by use

Electricity genera · Heat G ation · Transportation

Sources	Definition	Use		
SOLAR ENERGY	Energy generated using solar panels to capture and convert sunlight into electricity or heat.	Electricity generation	Heat generation	
WIND ENERGY	Energy generated from wind turbines that convert wind power into electricity.	Electricity generation		
HYDROPOWER	Energy generated by moving water through turbines connected to generators.	Electricity generation		
GEOTHERMAL ENERGY	Heat extracted from underground reservoirs to produce electricity or heating.	Electricity generation	Heat generation	
BIOMASS ENERGY	Energy from plant residues, wood, or organic waste used directly for heat or converted into electricity.	Electricity generation	Heat generation	Transportation
BATTERY ENERGY STORAGE SYSTEMS (BESS)	Technology that stores electricity to provide stable and dispatchable renewable power.	Electricity generation		Transportation
GREEN HYDROGEN	Produced through electrolysis of water using renewable electricity, splitting it into hydrogen and oxygen.	Electricity generation	Heat generation	Transportation
TRANSMISSION INFRASTRUCTURE	High-voltage lines and substations that move electricity from generation to end-users.	Electricity generation		
GRID	The interconnected system of power lines, substations, transformers, and control systems that deliver electricity.	Electricity generation		
CURTAILMENT	The intentional reduction of renewable energy output (e.g., wind or solar) when supply exceeds grid capacity.	Electricity generation		
DEMAND RESPONSE	Adjusting energy consumption in response to supply conditions (e.g., shifting industrial demand away from peak hours).	Electricity generation		Transportation

Sustainable Fuels | Fuels made from renewable materials, have a lower carbon footprint than fossil fuels on a life-cycle basis, and are designed to replace or supplement fossil fuels

Road Transport · Aviation · Maritime · Other

Products	Definition	Use
BIOETHANOL	Produced by fermenting sugars (corn, sugarcane) or processing cellulosic residues; blended into gasoline or used directly.	Road Transport
BIODIESEL (FAME)	Produced by transesterification of vegetable oils, animal fats, or used cooking oils.	Road Transport
RENEWABLE DIESEL (HVO/HEFA)	Advanced biofuel made via hydrotreating; chemically similar to fossil diesel.	Road Transport, Other
SUSTAINABLE AVIATION FUEL (SAF)	Jet fuel from renewable feedstocks (e.g., waste oils, residues).	Aviation
E-FUELS (SYNTHETIC FUELS)	Fuels made using renewable electricity to create hydrogen, then combined with captured CO_2.	Aviation, Maritime, Other
BIOGAS / BIOMETHANE	Gas from anaerobic digestion of organic waste, upgraded to biomethane.	Road Transport, Other
HYBRID FLEX-FUEL VEHICLES	Vehicles combining an electric motor with a flex-fuel engine running on ethanol and/or gasoline.	Road Transport
CCUS (CARBON CAPTURE, UTILIZATION AND STORAGE)	Technology to capture CO_2 and either store it underground or reuse it.	Other
CDR (CARBON DIOXIDE REMOVAL)	Technologies or natural processes that remove CO_2 directly from the atmosphere.	Other
METHANOL (FOSSIL & RENEWABLE)	A liquid fuel and chemical feedstock. Fossil methanol is derived from natural gas or coal; renewable methanol is produced from CO_2 and hydrogen or biomass.	Maritime, Other

ANNEX B - ACRONYMS

ABRAFATI	Brazilian Paint Manufacturers Association (*Associação Brasileira dos Fabricantes de Tintas*).
AI	Artificial Intelligence
ANFAVEA	National Association of Motor Vehicle Manufacturers (*Associação Nacional dos Fabricantes de Veículos Automotores*)
BECCS	Bioenergy with Carbon Capture and Storage
BESS	Battery Energy Storage Systems
BNDES	Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social)
BOO	Build–Own–Operate
BOOT	Build–Own–Operate–Transfer
CCUS	Carbon Capture, Utilization and Storage
CDR	Carbon Dioxide Removal
CNI	Brazilian National Confederation of Industry (*Confederação Nacional da Indústria*)
CO_2 / CO_2e / $GtCO_2e$ / $MtCO_2e$	Carbon Dioxide / Carbon Dioxide Equivalent (gigatonnes / megatonnes)
COP / COP28 / COP30	UN Climate Change Conference of the Parties (28th / 30th)
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation.
DDGS	Distillers Dried Grains with Solubles (used in biofuel context).
DHC	District Heating and Cooling.
EC	European Community (in Directive 2009/125/EC).
EJ	Exajoule
EPE	Brazilian Energy Research Office
EU	European Union
EV	Electric Vehicle
FID	Final Investment Decision
FOAK	First-of-a-Kind (projects)
FuelEU	FuelEU Maritime Regulation (European Union)
GCCA	Global Cement and Concrete Association

GDP	Gross Domestic Product
GFI	Greenhouse gas Fuel Intensity (from IMO marine fuel standard, 2025)
GHG	Greenhouse Gas
GM	General Motors (company)
GW	Gigawatt
HVO	Hydrotreated Vegetable Oil (renewable diesel)
IBP	Brazilian Institute of Oil and Gas (*Instituto Brasileiro de Petróleo e Gás*)
IEA	International Energy Agency
ILUC	Indirect Land Use Change
IMO	International Maritime Organizatio
IRENA	International Renewable Energy Agency
KPI / KPIs	Key Performance Indicator(s)
kWh	Kilowatt-hour
LTAG	Long-Term Aspirational Goal (aviation, ICAO context).
MACC	Marginal Abatement Cost Curve
MW	Megawatt
MWh	Megawatt-hour
NOx	Nitrogen Oxides
PPA	Power Purchase Agreement
PPM	Parts Per Million (appears in NOx reference "25 ppm")
PROCEL	Brazil's National Electric Energy Conservation Program (*Programa Nacional de Conservação de Energia Elétrica*)
PV	Photovoltaic (as in "solar PV")
R&D	Research and Development
RED / RED III	Renewable Energy Directive (EU) / third version
ReFuelEU	ReFuelEU Aviation Regulation (European Union)
SAF	Sustainable Aviation Fuel
SB COP	Sustainable Business COP (initiative)
SCMs	Supplementary Cementitious Materials
SIN	Brazil's National Interconnected System (*Sistema Interligado Nacional*)
TWh	Terawatt-hour
UAE	United Arab Emirates (as in UAE Consensus)

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ANNEX C - COMPOSITION AND MEETING SCHEDULE

Distribution of Members by country

Brazil	31
United States	3
Spain	3
Argentina	2
France	1
Netherlands	1
China	1
Kenya	1
India	1
Switzerland	1
Sweden	1
Finland	1
United Kingdom	1

Distribution of Members by gender

Male	39
Female	10

Task Force Chair

Name	Organization	Position	Country
Daniela Manique	Solvay	CEO Latin America	Brazil

Task Force Deputy Chairs

Name	Organization	Position	Country
Ronia Oisiovici	*Solvay*	Sr. Sustainability, Research and Innovation Manager	Brazil

Task Force Co-Chairs

Name	Organization	Position	Country
Jean-Pierre Clamandieu	Engie	Chairman of the Board of Directors	France
Claudia Brun	Equinor	Vice President Strategy and Business Development	Brazil
Barry Engle	Exxon Mobil	President, Low Carbon Solutions at ExxonMobil	United States
Priscyla Laham;	Microsoft	President Microsoft Brasil	Brazil
Malu Paiva	Suzano	Executive VP of Sustainability, Communication, and Brand	Brazil
Gustavo Pimenta	VALE S/A	CEO	Brazil
Alberto Kuba	WEG	CEO	Brazil
Antonio Lacerda	CMPC	Director General	Brazil

Task Force PMO

Name	Organization	Position	Country
Bernardo Passerino Szvarça	GSS	PMO	Brazil
Priscila Alcântara	GSS	PMO	Brazil
Cecília Michelis	GSS	PMO	Brazil

Task Force CNI Focal Point

Name	Organization	Position	Country
Marina Scalon	CNI	Industry and Policy Specialist	Brazil

Task Force Members

Name	Organization	Position	Country
Gustavo Estrella	CPFL	CEO	Brazil
Marcelo Lyra	Acelen	VP of ESG Communications and Institutional Relations	Brazil
Erasmo Carlos Battistela	Be8	CEO	Brazil
Viviana Franco Hernandez	Van Oord	Sustainability Project Lead	Netherlands
Sun Tao	China State Grid	CEO	China
Francisco Gomes Neto	Embraer	CEO	Brazil
Peter Njenga	Kenya Electricity Generating Company	CEO	Kenya
Jimmy Samartzis,	Lanzajet Inc.	CEO & Board Director	United States
Yoshiki Yamamoto	Mitsubishi Corporation do Brasil S.A.	Managing Director of Environmental Energy Department / Mitsubishi Corporation do Brasil S.A.	Brazil
Hayato Yanagisawa	Mitsui	CEO Brasil	Brazil
André Valente	Raizen	Sustainability Director	Brazil
Arun Prakash	CII-CESD	Consultant	India
Ciro Possobom	Volkswagen	CEO	Brazil
Takamasa Ueda	Sumitomo	Senior Director, Energy Innovation Initiative, Sumitomo Corporation do Brasil	Brazil
Ana Cabral	Sigma Lithium	CEO	Brazil
Jerome Cadier	Latam	CEO Latam Brasil	Brazil
Rafael Ceconello	Toyota	Director of Regulatory and Government Affairs	Brazil
Roberto Ardenghy	IBP Brazilian Petroleum, Gas & Biofuels Institute	CEO	Brazil
Roger Martella	GE Vernova	CEO	United States
Anna Celsing	Alfa Laval	CSO	Suíça
Cesar Armero	Schneider Electric	Regional Director	Brazil
André Lavor	Binatural	CEO	Brazil
Gustavo Bonini	Scania	Institutional Director	Brazil
Cristina Rivero	Spanish Confederation of Employers and Industries	Director for Industry, Energy, Environment and Climate	Spain

Filip Rosengren	SKF	Global Head of Sustainability	Sweden
Juan Llobell	Moeve	Director of Communications and Institutional Relations	Spain
Herkko Plit	P2X Solutions	CEO	Finland
José Fonrouge	Ternium	Global Sustainability Director	Argentina
Enrique Prini Estebecorena	A&F Allende Ferrante Abogados	Sr Of Counsel - Compliance, ESG & Energy	Argentina
Flavio Ribeiro	Bunker One	Managing Director LATAM	Brazil
Daniel Costa Lopes	FS Fueling Sustainability	Executive Vice President of Sustainability & New Business	Brazil
André Clark	Siemens Energy Brazil Ltda.	Senior Vice President for Siemens Energy Latin America	Brazil
Luis Mosquera	Siemens Brasil	Vice President of Legal, Government Relations and Sustainability	Brazil
Paulo Augusto Alvarenga	Thyssenkrupp	CEO	Brazil
Luis Cabra	Repsol	EMD Energy Transition, Technology, Institutional Affairs, & Deputy CEO and President of Fuels Europe	Spain
Gustavo Souza Checcucci	Brasken	Director of Energy and Industrial Decarbonization at Braskem	Brazil
Allyson Book	Baker Hughes	Chief Sustainability Officer	USA
Caio Dafico	Atvos	Investments and Business Development VP	Brazil
Charlie McLellan	ITA	Strategy Lead	UK

Task force Meetings Schedule

Data	Format
19/05/2025	Online
04/06/2025	Online
03/07/2025	Online
04/08/2025	Online
02/09/2025	Online

ANNEX D - PARTNERS

Knowledge Partner

McKinsey & Company

Network Partners

ibp

Global Renewables Alliance

IOE A powerful and balanced voice for business

ABRAFATI Brazilian Coatings Manufacturers Association

Anfavea

Anfavea

UN Global Compact — Global Compact Network Brazil

World Economic Forum

DISCLAIMER AND ACKNOWLEDGEMENTS

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CNI Brazilian National Confederation of Industry