Driving transformative climate action with sectoral decarbonisation

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Mitigation Action Facility

On behalf of

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IKI INTERNATIONAL CLIMATE INITIATIVE

UK Government

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European Commission

CIFF CHILDREN'S INVESTMENT FUND FOUNDATION

on the basis of a decision by the German Bundestag

Abbreviations

BECCS	Bioenergy with Carbon Capture and Storage
BMWK	Bundesministerium für Wirtschaft und Klimaschutz (German Federal Ministry for Economic Affairs and Climate Action)
CCS	Carbon Capture and Storage
CIFF	Children's Investment Fund Foundation
COP	Conference of Parties
CO2	Carbon Dioxide
DENZ	Department for Energy Security and Net Zero
DEO	Desk Officer
EE	Energy Efficiency
EU	European Union
EUR	Euro
EV	Electric Vehicles
GESI	Gender Equality and Social Inclusion
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Corporation for International Cooperation)
ICCT	International Council on Clean Transportation
IEA	International Energy Agency
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LNOB	Leave No One Behind
LTE	Long-term Energy Scenarios
MAF	Mitigation Action Facility
MCFI	Mainstreaming Climate in Financial Institutions
NDC	Nationally Determined Contribution
LT-LEDS	Long-Term Low Emission Development Strategies
OECD	Organisation for Economic Cooperation and Development
RE	Renewable Energy
TA	Technical Assistance
tCO_2	Metric tons of carbon dioxide
TW	Terawatts
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UN SDGs	United Nations Sustainable Development Goals
UNSDG	United Nations Sustainable Development Group
WWF	World Wide Fund For Nature

Content

Preface

As the world faces the increasing urgency of the climate crisis, sectoral decarbonisation has emerged as a critical pathway to achieving global climate goals. The energy, industry, and transport sectors, which account for more than two-thirds of global greenhouse gas emissions, must undergo deep transitions to limit global warming to a 1.5°C a temperature rise from pre-industrial time that might prevent or reduce many of the most dramatic effects of climate change. The 29th Conference of the Parties (COP29) in November 2024 in Baku, Azerbaijan, provides a unique opportunity to accelerate sectoral transformations, galvanising nations to increase their climate ambitions and take decisive action. It is within this context that this report highlights the pivotal role sectoral decarbonisation plays in driving a sustainable, just, and equitable global transition.

The Mitigation Action Facility has been at the forefront of efforts to decarbonise key sectors of the economy. Since its inception, MAF has supported ambitious projects aimed at reducing GHG emissions while fostering social, economic, and environmental benefits. The Facility has demonstrated its ability to drive significant climate action: More than 11.3 million tons of CO2 have already been reduced, and the lives of millions of people are positively affected. As the global community gathers at the climate summit, MAF commits to intensifying its efforts and leveraging new opportunities to scale up its impact and accelerate the sectoral transformations that are essential for a sustainable future.

This report provides insights into how best to address sectoral emissions while also addressing essential human needs. By decarbonising energy, industry, and transport, we can create social and economic systems that protect the climate and empower, employ, and mobilise people of all sexes and ages: Modernised, efficient, climate-compatible sectors will drive innovation, generate decent employment and new business opportunities, enhance education, nutrition, and public health; and further social inclusion. The report highlights the critical challenges and opportunities and explores actionable strategies for transitioning three sectors at the centre of MAF's work.

In the blue textboxes, you can find more detailed information on specific MAF projects in the context of the respective chapters, as well as interviews with MAF representatives and partners.

The Mitigation Action Facility remains steadfast in its mission to support sectoral decarbonisation ensuring that our collective actions deliver lasting benefits for people and the planet. The Facility is committed to fostering inclusive and transformative climate solutions that leave no one behind, guiding the global community toward a more sustainable and resilient future.

1. Introduction

How do we best accelerate our efforts to embark on a climate-compatible development path? Climate change has been described as the defining global challenge of the 21st century (Guterres, 2018; Stern, 2008; World Economic Forum, 2023). Yet, it is only one of 17 Sustainable Development Goals that the international community has set to achieve in 2030 (UN SDGs, n.d.). How do we save the earth's climate system and still support the development aspirations of people around the globe? How do we engage people on the transformations needed?

Achieving the internationally agreed goal of limiting global warming to well below 2°C, with efforts to cap it at 1.5°C (IPCC, 2018; Umweltbundesamt, 2024; UNFCCC, n.d.b), requires rapid and far-reaching mitigation of global greenhouse gas (GHG) emissions well beyond what is currently planned, and their almost complete phaseout to net zero emissions by mid-century (IEA, 2021). Even with the full implementation of current worldwide climate commitments, we will fall short of the 1.5°C target (UNFCCC, 2023): *"[N]ational climate action plans remain insufficient to limit global temperature rise to 1.5 degrees Celsius and meet the goals of the Paris Agreement"* (UNFCCC, 2023, para.1).

Energy, industry, and transport are responsible for more than two-thirds of global GHG emissions (IEA, 2021; UNEP, 2023). Decarbonising these three sectors will thus be crucial to meeting global climate goals. Their deep transformation, however, will have profound economic and social implications. Transitioning to low- and ultimately no-emissions systems can lead to substantial risks and losses – but if designed and implemented carefully, can also produce unprecedented environmental, social, and economic benefits.

This report first investigates the concept and importance of decarbonising the energy, industry, and transport sectors for effective global climate mitigation (Chapter 2). It then identifies key challenges and opportunities regarding the deep transition of the three sectors (Chapter 3) and explores the potential ecologic, social, and economic benefits of sectoral mitigation actions (Chapter 4). Finally, Chapter 5 provides an outlook on what lies ahead for sectoral climate mitigation, underlining the urgency and scope of action required to achieve a sustainable and equitable transition.

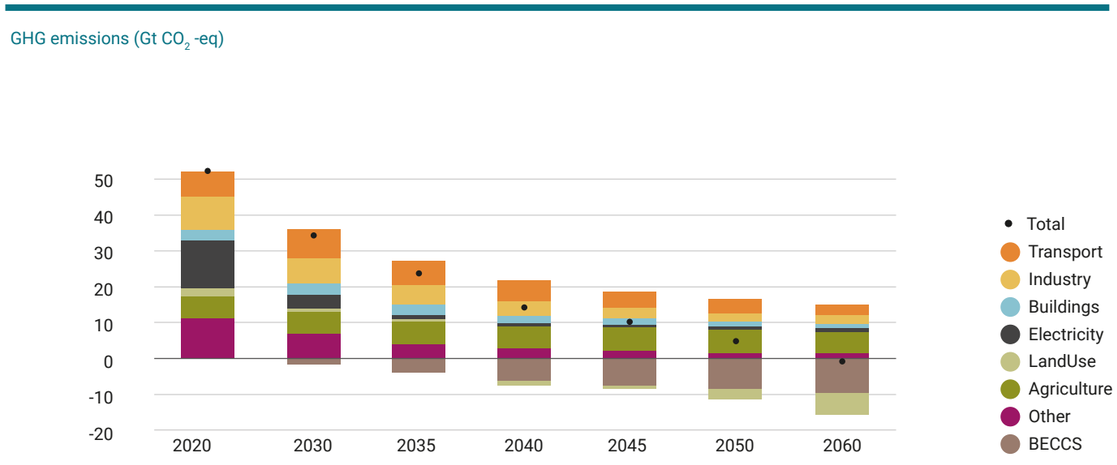
The Mitigation Action Facility – Advancing the decarbonisation of key sectors

The Mitigation Action Facility supports projects worldwide that decarbonise key sectors of the economy and society, including the three most carbon-intense sectors energy, transport, and industry. The platform provides financial and technical assistance to projects implementing ambitious climate change mitigation measures in line with the Paris Agreement. This report will examine the importance of the Mitigation Action Facility's efforts and situate its work within the broader context of global climate action, highlighting its critical role.

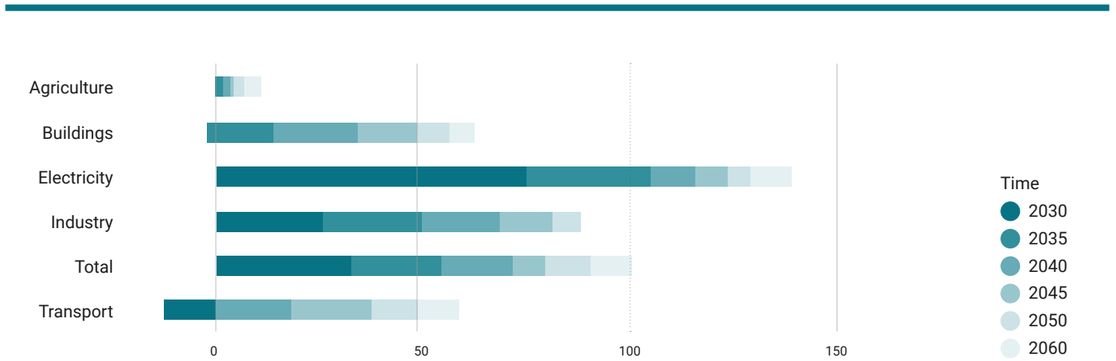
As of 2024, approximately 11.3m tons of CO2 emissions have been reduced solely by the efforts of the Mitigation Action Facility. Additionally, these efforts have been directly benefiting 28.1m people since 2022, with 53 mitigation projects in 34 countries in 2024. In total, the 2024 budget for the Mitigation Action Facility accounts for 826 million euros and is still growing, thereby increasing finance for sectoral decarbonisation projects worldwide.

Figure 1

Projected global greenhouse gas emissions using the IMAGE model, in a scenario that keeps global temperature at 1.5 °C, by the end of the century (top); and global greenhouse gas emission reductions, over time and per sector (including those from BECCS), by 2060, compared to 2020 (below).



Note: industry includes cement process emissions and emissions from cokes production. Land-use change emissions are not included in the total greenhouse gas emissions.



***Graphs**: Edelenbosch et al., 2022, p.1*

2. Sectoral decarbonisation: Key to protecting the climate

Without swift and substantial decarbonisation of the energy, industry, and transport sectors, global temperatures will rise significantly, exceed safe thresholds and likely lead to catastrophic climate impacts (UNFCCC, 2023). The urgency to significantly accelerate sectoral action is underscored by the Paris Agreement, an international treaty on climate change signed in 2016, which states that "deep reductions in global emissions will be required in order to achieve the ultimate objective of the Convention [...] in addressing climate change" (UNFCCC, 2016, p.25) by mid-century.

2.1 The importance of sectoral commitments for immediate and long-term action

The Paris Agreement proposes so-called Nationally Determined Contributions (NDCs) as a tool for individual countries to outline their national emissions reduction targets and implementation strategies (UNFCCC, n.d.a). The collective short-, mid-, and long-term climate ambition of countries is crucial to "reach global peaking of GHG emissions as soon as possible and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century" (UNFCCC, n.d.a, para. 2).

Energy, industry, and transport must be central to both the NDCs and Long-Term Low Emission Development Strategies (LT/LEDS). If these sectors are not addressed with urgency and ambition, the world remains on track for dangerous levels of warming, far beyond the thresholds set by international climate agreements (UNEP, 2022). These three sectors represent a significant share of global emissions, as illustrated by the graph below, highlighting their pivotal role in shaping the success of climate action.

The evolution to NDC 3.0 marks a shift in climate action by emphasising increased ambition and the establishment of specific sectoral targets to drive meaningful change (UNFCCC, 2024). As highlighted in the Troika Concept Note, this next generation of NDCs must be transformational and aim to incorporate climate action into broader development planning. The framework calls for an economy-wide approach, covering all GHGs and sectors, and stresses the importance of financing, capacity-building, and technology transfer as key enablers of these actions. In addition countries are encouraged by NDC 3.0 to address social inclusivity by incorporating gender, youth, Indigenous peoples, and local communities into their climate strategies. This inclusive approach ensures that climate action benefits all, especially those most vulnerable to climate impacts. As a result, NDC 3.0 not only seeks to mitigate climate change but also promotes resilience and equity across nations.

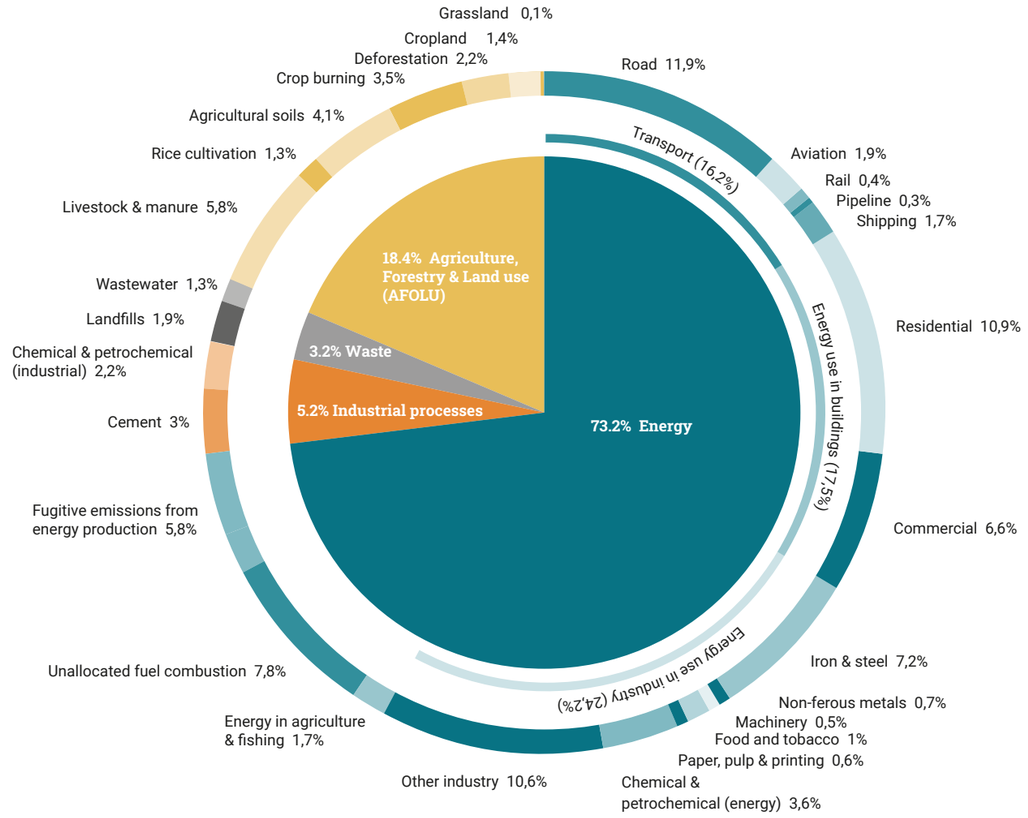
Benchmarking the energy, industry, and transport sectors

The Mitigation Action Facility benchmarks the three sectors in line with the definitions of the International Panel on Climate Change (IPCC) and leading international organisations: The energy sector covers all processes related to energy extraction, conversion, storage, transmission, and distribution, excluding the final energy use in sectors like industry, transport, and agriculture (World Energy Council, 2014).

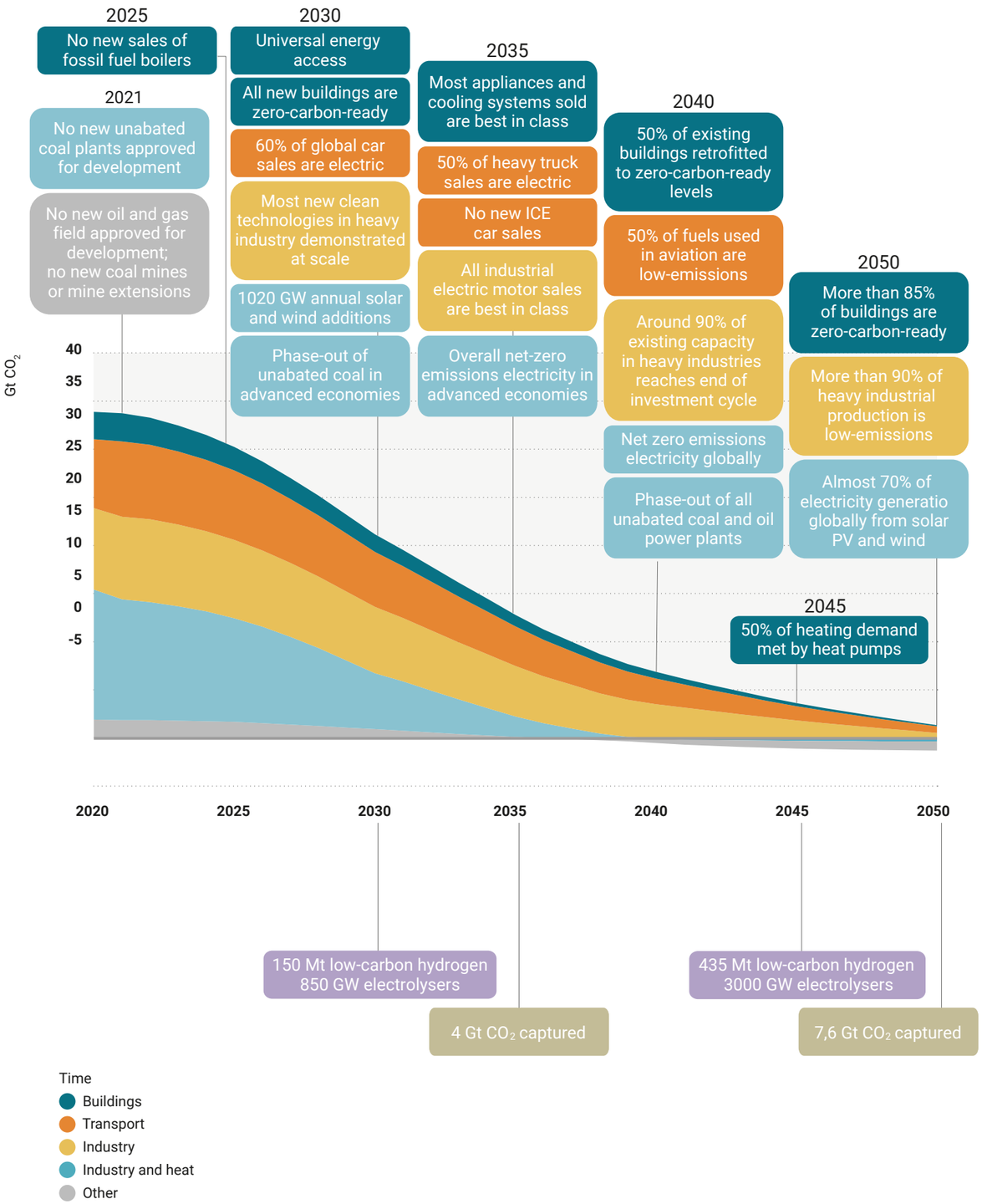
The industrial sector encompasses ores and minerals mining, manufacturing, construction, and waste management, all significant contributors to global emissions (IPCC, 2022b). Finally, the transport sector includes activities related to the shipment of goods or the movement of people across air, road, water, and rail. The focus is on transport-related emissions, primarily from vehicles and fuels (IPCC, 2022a).

Global greenhouse gas emissions by sector

This is shown for the year 2016 - global greenhouse gas emissions were 49.4 billion tonnes CO_2eq.



Graph: *Emissions (GtCO2) per sector (Ritchie, 2020)*



Graph: *Key milestones in the pathway to net zero (International Energy Agency, 2021, p.20)*

Another critical strategy for achieving deep transformations in decarbonisation is the adoption of Long-Term Low Emission Development Strategies (LT-LEDS). These strategies are essential for outlining pathways to net-zero emissions, offering a clear vision of how countries can achieve this goal over time (Van Tilburg/Ochs/Lee, 2024). LT-LEDS serve as a roadmap for transforming various economic sectors and societal behaviours, ensuring that near-term climate actions are aligned with long-term sustainability objectives: "LT-LEDS are crucial in guiding this transition across various economic sectors and societal behaviours, ensuring that immediate climate actions are consistent with long-term goals" (Van Tilburg & Ochs & Lee, 2024). In addition to aligning policies and actions, LT-LEDS help governments and industries anticipate and plan for the evolving technological, financial, and social changes needed to achieve a low-carbon future. By integrating these strategies into national planning, countries can aim towards a just transition, minimise economic disruption, and enhance resilience to climate impacts.

2.2 Mainstreaming climate across sectors and engaging all actors

The global financial requirements to embark on climate-compatible sectoral pathways are immense, necessitating trillions of dollars in investment across energy, industry, and transport. Achieving these goals demands concerted action among countries, where international cooperation and resource-sharing will be critical for success. Collaboration between the public and private sectors as well as NGOs is essential to mobilise the necessary funding and drive innovation. Furthermore, vertical integration of policy across local, national, and international levels is key to aligning objectives and ensuring cohesive implementation. In addition, mainstreaming and integrating climate goals across all sectors will be vital for achieving long-term sustainability. Finally, sectoral strategies play a critical role in addressing climate change and aligning national efforts with global climate objectives, such as the LT-LEDS. Therefore, it is essential to establish clear connections between sectoral strategies and the LT-LEDS framework to ensure an effective approach to climate mitigation efforts.

To achieve transformational change, climate considerations must be embedded, or 'mainstreamed,' across all sectors of the economy, but mainly across the energy, industry, and transport sectors. Mainstreaming climate means "the systematic integration of climate considerations throughout a financial institution's strategies, and operations" (MCFI, n.d., para.1). In other words, each sector must integrate climate-resilient investments and policy frameworks. What is needed is a shift in resource allocation to prioritise different initiatives in each sector. For the energy sector, this could mean prioritising renewable energy generation, in alignment with the LT-LEDS, to reduce the carbon intensity of national power grids. For the transport sector, climate mainstreaming could be the transition towards electric vehicles (EVs) or expanding public transport infrastructure. An example of a sectoral strategy in the industry sector could be the implementation of low-carbon technologies in manufacturing processes and Carbon Capture and Storage (CCS).

3. Key challenges and opportunities for decarbonising the energy, industry, and transport sectors

Decarbonising the energy, industry, and transport sectors is crucial for mitigating climate change and meeting global sustainability goals. These sectors hold tremendous potential for innovation and transformation. Transitioning to low-carbon alternatives presents both challenges and opportunities, from advancing technology and infrastructure to reshaping policies and economic models. Understanding these dynamics is essential for accelerating the shift to a cleaner, more sustainable future.

3.1 Accelerating the energy transition

The energy sector plays a critical role in global efforts to mitigate climate change due to its significant contribution to greenhouse gas (GHG) emissions. Accounting for about 34% of global GHG emissions, "the energy sector holds the key to responding to the world's climate change" (IEA, n.d., para. 1; IPCC, 2023). At the same time, energy plays a key role in enabling modern life as we know it. It builds the basis for the configuration of today's economies and societies. Sustainable, affordable, reliable, and modern energy access for all people worldwide is consequently a central Sustainable Development Goal (i.e., SDG 7) but arguably also an enabler of several other SDGs, e.g. SDG 2 (Zero Hunger), as energy is essential for modern agriculture, including food production, storage, and distribution.

The energy sector's emissions are primarily driven by the combustion of fossil fuels for electricity and heat production, with the most significant subsectors including coal-fired power plants, natural gas, and oil-based generation, including for transport, and industrial energy use (Ge et al., 2020). Achieving the goal of transitioning to a sustainable energy sector requires significant decarbonisation actions, made possible through investments in renewable energy, energy efficiency, and grid modernisation (European Commission, 2024).

Tangeni Tshivute - Senior Engineer of Nampower

Namibia – Biomass

How do you collaborate with the Mitigation Action Facility?

We became involved with the Mitigation Action Facility through our 40 MW biomass power project, which focuses on harvesting wood chips from encroacher bushes in the project area – a unique challenge in Namibia, where aggressive plant growth overtakes farmland and reduces productivity. This impacts both farming and wildlife. The encroacher bush also absorbs scarce rainwater, further worsening the issue.

Namibia currently imports 50-60% of its electricity, mostly from neighbouring countries which have a high reliance on coal-fired power stations. Our project, located in Tsumeb, creates a sustainable energy source by using wood chips instead of coal, helping to reduce reliance on imported energy. Our biomass project provides reliable electricity and contributes to both economic and environmental goals.

What is the impact of your project on people's lives?

We have so-called resettlement farms, where communities, mostly San people, live with limited economic opportunities. On these farms, up to 400 people rely mostly on drought relief for survival; many of them are unemployed. Through our project, with support from NGOs, we assist these communities to supply wood logs, allowing them to earn income where they live. We expect to create approximately 1,500 new jobs across various stages of the project and uplift entire communities.

Significant funding for the energy transition is needed, of which a large portion must be dedicated to infrastructure development and clean energy technologies (European Commission, 2024). Estimations say that a "1.5°C compatible energy transition requires a global investment of more than US$5 trillion per annum until 2050" (Alam & Srivastava, 2023, para. 3). Especially for countries in the Global South, by "the end of the 2020s, annual capital spending on clean energy in these economies needs to expand by more than seven times, to above USD 1 trillion, in order to put the world on track to reach net-zero emissions by 2050" (IEA, 2021a, para. 4). Therefore, energy efficiency improvements must double, and renewable energy capacity must expand to 11 terawatts (TW) by 2030 to meet the targets outlined in the 1.5°C pathway (European Commission, 2024).

Furthermore, decarbonising the energy sector requires a fundamental transformation, often referred to as an energy transition. This transition involves multiple components, including:

- Renewable energy expansion: Scaling up the deployment of renewable energy sources, such as solar, wind, and hydroelectric power, is essential to reducing reliance on fossil fuels.

- Energy efficiency: Improving energy efficiency across all sectors (including residential, commercial, and industrial) can significantly reduce overall energy demand while maintaining economic productivity.

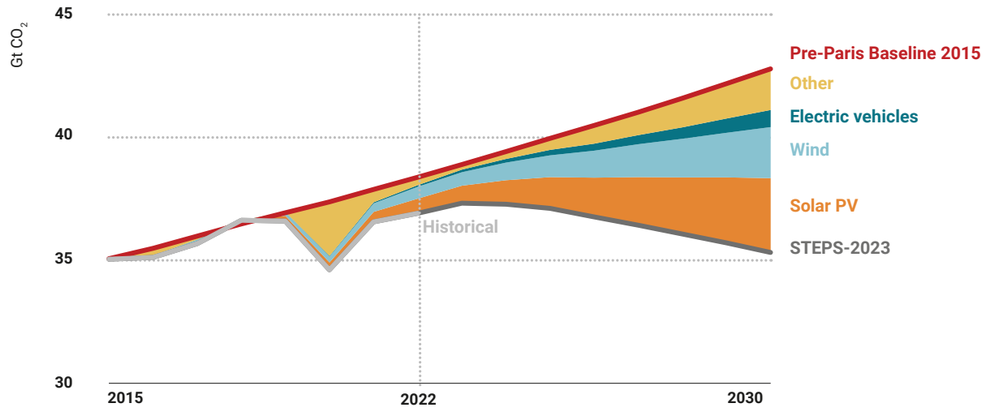
- Decentralisation and grid modernisation: The transition from centralised, fossil-fuel-based power plants to decentralised systems that integrate distributed energy resources, such as rooftop solar, is crucial. Grid modernisation efforts will improve reliability and resilience while accommodating renewable energy.

- Energy storage: The development and deployment of advanced energy storage technologies, including batteries and hydrogen, are critical to addressing the intermittency of renewable energy sources and ensuring a stable energy supply.

In the short term, there are significant opportunities for progress in decarbonising the energy sector (IRENA, 2023). For instance, governments and industries are increasingly adopting LTEs that prioritise the scaling of renewables, improvements in energy efficiency, and investment in emerging technologies, such as grid-scale batteries and green hydrogen (Van Tilburg et al., 2024).

Despite the opportunities, several challenges must be addressed to accelerate the energy transition. These challenges include the continued reliance on coal as a "cheap" baseload energy source, the underutilisation of renewable energy assets, and the technical difficulties associated with storing intermittent electricity (Van Tilburg et al., 2024). Additionally, the heating and cooling sectors, which are heavily reliant on fossil fuels, present unique challenges in the decarbonisation process. Investment risks, lack of incentives, and counterproductive policies also pose barriers to progress.

However, several game changers are emerging that could significantly alter the trajectory of the energy sector. These include the sharp reduction in renewable energy generation costs, breakthroughs in energy storage technologies (particularly batteries and hydrogen), and the introduction



Graph: *Global energy sector CO2 emissions in the Pre-Paris Baseline and Stated Policies Scenarios, 2015-2030 (IEA, 2023a)*

Juan David Jaramillo Salamanca – Mitigation Action Facility Desk Officer/Sector Lead Energy

What is the focus of the Mitigation Action Facility in the energy sector?

Our projects focus on reducing the risks of adopting new technologies, especially for organisations such as utilities unfamiliar with them. We support the creation of regulatory standards and the establishment of financial mechanisms, like concessional loans, to help first movers overcome barriers. By creating best practices and attractive credit lines, other companies and institutions can replicate their successes. Ultimately, all citizens benefit because the projects make energy cheaper, more reliable, and more sustainable by replacing dirty, and often expensive imported fossil fuels.

What are your projects' impacts beyond decarbonisation?

Benefits include improved air quality, reduced noise pollution, and better health conditions, both through mitigation of local air, water, and soil pollutants and through access to affordable and reliable energy for, e.g. clinics and hospitals. Decentralised solutions empower local communities and foster socio-economic development. Energy access also benefits other areas like food security and education.

What do you see as the potential game changers in the energy sector?

Three key trends have yet to fully take off and could be game changers. First, the democratisation of energy production allows communities to generate their own electricity. Second, the need to decarbonise energy-intense industries by adopting technologies such as hydrogen and high-voltage electricity. Lastly, exploring alternative energy storage and modernising existing infrastructure for greener uses, like repurposing former oil fields or mines for solar plants or water storage.

of policies designed to de-risk investments (Shukla et al., 2022). Comprehensive strategies that align climate action with socio-economic benefits will be essential for overcoming these challenges (see Chapter 4).

3.2 Sustaining industry

The industrial sector plays a critical role in the global economy but is also a major source of greenhouse gas (GHG) emissions, particularly in high-emission industries like steel, cement, and chemical manufacturing (IEA, 2023b). As the IEA (2023b) states, these industries contribute to nearly 30% of global CO2 emissions. Steel, cement, and chemical production are among the most carbon-intensive industrial processes. Steel production, for example, relies heavily on coal, both for energy and as a reducing agent in the blast furnace process. Cement production not only requires substantial energy inputs but also emits CO2 through chemical reactions involved in clinker production. These high-temperature, energy-intensive processes are considered hard to abate because they require either significant technological innovation or large-scale systemic changes to reduce emissions (IEA, 2021b).

Moreover, the IEA (2021b) underscores that achieving net-zero emissions by 2050 requires a multi-faceted approach, involving both existing technologies and emerging innovations. The pathway to decarbonisation involves strategies ranging from process optimisation to material substitution, and from adopting highly efficient technologies to implementing circular economy practices (IEA, 2021b).

Decarbonising the industry sector is only possible through significant investments. By 2050, investments of 235-335 billion US dollars are required for the steel sector alone, and around 300 billion US dollars for the decarbonisation of the cement sector (UNIDO, 2024). A special focus must be shed on countries in the Global South whose steel and cement demand will likely increase by 30-45% by 2050 (UNIDO, 2024). Inaction in the industry sector will hinder reaching the 1.5°C goal and would lead to higher and partially unforeseeable costs in the future (UN, 2022). However, a transition towards a climate-smart industry sector would allow for energy efficiency and better infrastructure and generally bring forth the potential to reduce GHG emissions by 40-70% by 2050.

Decarbonising the industry sector requires a fundamental transformation, involving multiple components, including:

- Process optimisation: Improving energy efficiency is a cornerstone of industrial decarbonisation. In steel production, for example, replacing traditional blast furnaces with electric arc furnaces, which rely on electricity instead of coal, can significantly reduce emissions. Similarly, optimising the efficiency of cement kilns, using waste heat recovery, and improving insulation can lead to substantial energy savings. These measures not only lower carbon emissions but also reduce operational costs in the long term.

- Material substitution: Substituting traditional carbon-intensive materials with low-emission alternatives offers another avenue for reducing emissions. "Green steel," produced using hydrogen as a reducing agent instead of coal, is an emerging technology that could revolutionise the steel industry. In the cement sector, alternative binders such as fly ash or slag can replace clinker, which is responsible for most CO2 emissions in cement production. While these technologies are still in the development or pilot stages, they hold great promise for reducing the carbon intensity of key industrial sectors.

- Highly efficient industries: The adoption of advanced technologies such as automation, AI-driven process optimisation, and precision manufacturing can significantly enhance the energy efficiency of industrial operations. The integration of these state-of-the-art technologies into industrial processes is crucial for transforming energy-intensive industries into low-carbon entities.

- Circular economies: Emphasising recycling and reusing materials within the production cycle can dramatically reduce both raw material consumption and emissions. For example, integrating recycling processes in steel and aluminium production has significant potential to cut emissions.

- Carbon Capture and Storage (CCS): CCS technologies capture and store carbon emissions from industrial processes, preventing them from entering the atmosphere. While still in its early stages, CCS could be a game changer for sectors where full decarbonisation is otherwise challenging.

Marco Schiewe – GIZ Project Manager

Transformative Investments for Industrial Energy Efficiency in Brazil

How do you collaborate with the Mitigation Action Facility?

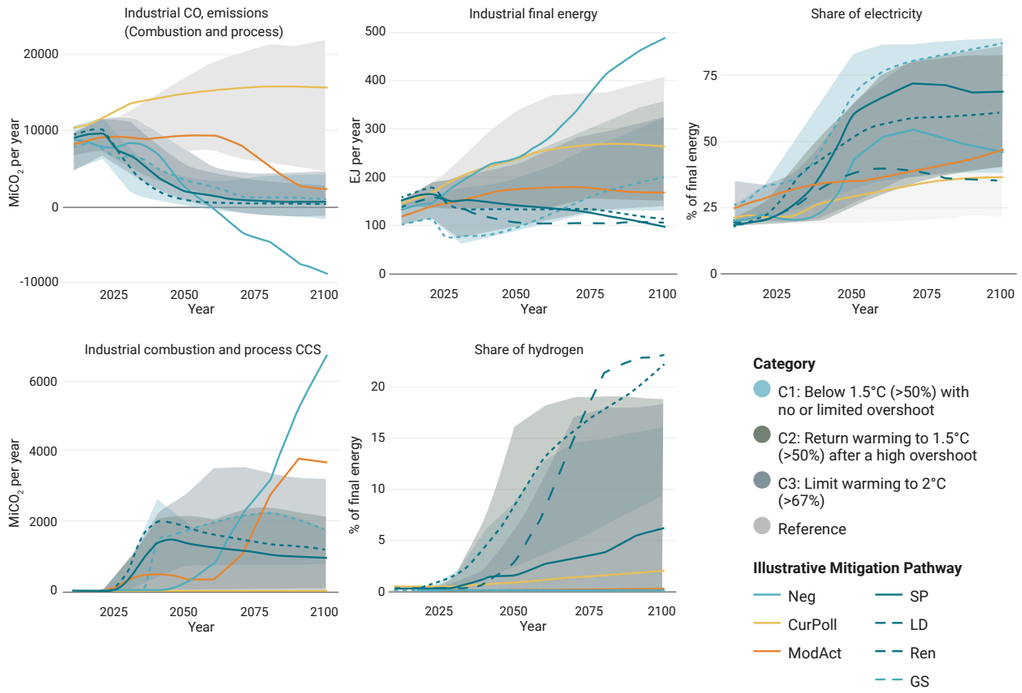
Funded by the Mitigation Action Facility, our project supports small and medium-sized manufacturing companies in Brazil to adopt energy efficiency measures that reduce greenhouse gas emissions and enhance competitiveness. We started in São Paulo, the largest manufacturing hub in Latin America, and are now expanding to other states with the support of the Brazilian government. The project aligns with the country's energy transition and green industrialisation strategy. We provide energy audits, develop energy efficiency projects, and offer a guarantee fund to ease access to financing. Additionally, we train local engineers, particularly women, to guide companies in implementing these measures.

What do you consider the most significant impact on people and companies?

Our project helps companies save up to 40% on energy costs through energy efficiency and decarbonisation measures. This allows them to grow, create new jobs, invest in research and development, and improve their reputation with clients and their positioning within the market. In some cases, these measures can even prevent shutdowns due to rising energy costs, ensuring job security and delivering significant social impact. We also train energy auditors and efficiency specialists to help companies save energy. Our project also seeks to empower female engineers. Currently, only 12% of engineers in Brazil are women; we actively support and attract them, offering training and good working conditions.

What do you consider to be potential game changers for decarbonising the industry sector?

It's crucial to upskill experts, as traditional universities often don't cover new technologies and production methods. The environment is dynamic, with frequent adjustments in best practices. Flexibility is also key because different companies require different solutions. It cannot be all done with green hydrogen! Financial solutions are equally important, as decarbonisation has long-term benefits but also high upfront costs. Our project demonstrates the feasibility of this transition, engaging financial institutions and showing that it can be economically viable.



Graph: *IPCC, 2022b*

Paer Gebauer – Mitigation Action Facility Desk Officer/Sector Lead Industry

What is special about the Mitigation Action Facility approach?

Our proposal solicitation process requires applicants to address various barriers, including behavioural, cultural, socioeconomic, and gender factors. We encourage applicants to consider societal impacts and propose measures to mitigate negative effects while ensuring universal benefits. Our projects aim to foster knowledge and technology transfer, train local workforces, and generate positive ecological outcomes. By designing initiatives that address both challenges and opportunities, we can create high-impact projects that contribute to sustainable development across technological, economic, educational, and environmental dimensions, ensuring long-term progress in the countries we support.

Within the industry sector, what do you consider to be the main drivers for transformation?

The main drivers include regulatory frameworks, market dynamics, and technological advancements. Industry leaders make decisions primarily based on economic viability, so for deep transformation to occur, technical solutions must be economically feasible. The public sector plays a crucial role by setting legislation, providing subsidies, and promoting technologies like hydrogen production and electric vehicles. By funding pilot projects and driving down costs, we can accelerate the transition and shorten the time it takes for new technologies to become viable.

What do you consider to be the main challenges?

A crucial question is how we manage this transformation, particularly in emerging and developing countries that often focus on economic development through further conventional industrialisation. We must demonstrate that decarbonisation can yield enormous economic and social benefits. However, these countries face unfavourable conditions regarding international financing and trade. Expecting them to bear the costs of decarbonisation despite limited resources can seem hypocritical. While in theory, decarbonisation is appealing, its practical implementation can be far more complex.

Despite the promising pathways outlined above, decarbonising the industrial sector faces several key barriers. The cost of transitioning to low-carbon technologies remains high, particularly in sectors like steel where new production methods, such as hydrogen-based steelmaking, require significant capital investment. Moreover, certain products – such as high-grade steel – pose unique decarbonisation challenges due to their specific material properties and the extreme conditions required for production.

On the other hand, technological innovation and effective policy frameworks can act as powerful enablers. For example, "green steel" and CCS technologies are rapidly gaining traction, and policy measures that de-risk investments in these technologies could accelerate their adoption. Co-benefits such as job creation, local economic revitalisation, and improved public health outcomes make decarbonisation a politically viable goal. The Mitigation Action Facility's work supporting these transitions underscores the potential of well-designed policy interventions to align industrial decarbonisation with broader socio-economic benefits.

3.3 Greening mobility

The transport sector is one of the fastest-growing sources of greenhouse gas (GHG) emissions, contributing around 24% of global CO2 emissions (IEA, 2023c). If business-as-usual continues in this sector, the 1.5°C limit by 2100 will not be reached, having catastrophic impacts on the climate. Therefore, a major goal for the transport sector in order to become more climate-friendly lies in accomplishing climate-compatible mobility on a large scale. Achieving climate-compatible mobility requires a profound transformation in how people and goods are transported, with a shift toward electric vehicles (EVs), sustainable fuels, improved public transport, and the promotion of active modes of transportation like cycling and walking (IEA, 2023c). Currently, the main emissions from the transport sector stem from road vehicles, aviation, shipping, and rail (IEA, 2023c). As road transportation accounts for the highest emissions in the sectors, this sub-sector must attain special attention for decarbonisation efforts. Road transportation mainly includes passenger cars, freight vehicles, and buses, which are heavily reliant on fossil fuels (IEA, 2023c). Especially as electric vehicles are currently not yet able to do long-haul routes, electrifying the sector is a challenge.

In order to transition towards a sustainable transport sector, there is a need for significant investments. According to the European Investment Bank (2022), by 2040, globally, approximately 50 trillion US dollars are needed for the transport sector. These investments would be needed to further research and development of cutting-edge technologies and new infrastructure solutions. However, there is a

Diego Senoner – GIZ Programme Manager

Nepal – Electric Public Transportation

How do you collaborate with the Mitigation Action Facility?

We are working to strengthen and support the electrification and improvement of the public transport sector in Nepal. Our approach combines both technical and financial assistance, using these tools to introduce innovative business and financing models. The goal is to replace diesel-powered micro and minibuses with electric alternatives, improving the overall public transport system. This includes also introducing an e-ticketing system, GPS tracking, and supporting the establishment of fast public charging stations. By the end of the programme, we aim to support the deployment of more than 3,500 electric mini and microbuses on the roads. Additionally, we hope to have an even larger impact indirectly, promoting the adoption of electric vehicles and contributing to a more sustainable public transport infrastructure in Nepal.

What's the impact of your project on people's life?

The project will significantly reduce pollution while improving public transport. Passengers will no longer have to wait for long periods, as they'll be able to see bus locations in real-time and pay digitally. Besides that, the project aims to cut CO2 emissions by at least 1.6 million tonnes directly and over 3 million tonnes indirectly. By reducing diesel imports and utilising locally produced hydropower, the project will help address Nepal's trade deficit and fiscal challenges.

What does decarbonisation mean to you?

I believe in leading by example. In Kathmandu, I ride a Nepali-made electric motorbike, and in Europe, I drive an electric vehicle. My family's home is solar-powered with a battery. Small individual actions can lead to meaningful change, and decarbonisation not only benefits the environment but is also economically advantageous in the long run.

momentary investment gap that accounts for 10 trillion US dollars (European Investment Bank, 2022). If no action is taken in these areas and the investment gap is not closed, transport emissions are estimated to rise as much as 60% by 2050 (World Bank, n.d.).

Decarbonising the transport sector requires a fundamental transformation, involving multiple components, including:

- Electric vehicles (EVs): EVs are crucial for reducing emissions from road transport. Major advancements in battery technology and decreasing costs are making EVs more accessible. However, widespread adoption will require a rapid expansion of charging infrastructure and incentives for both manufacturers and consumers.

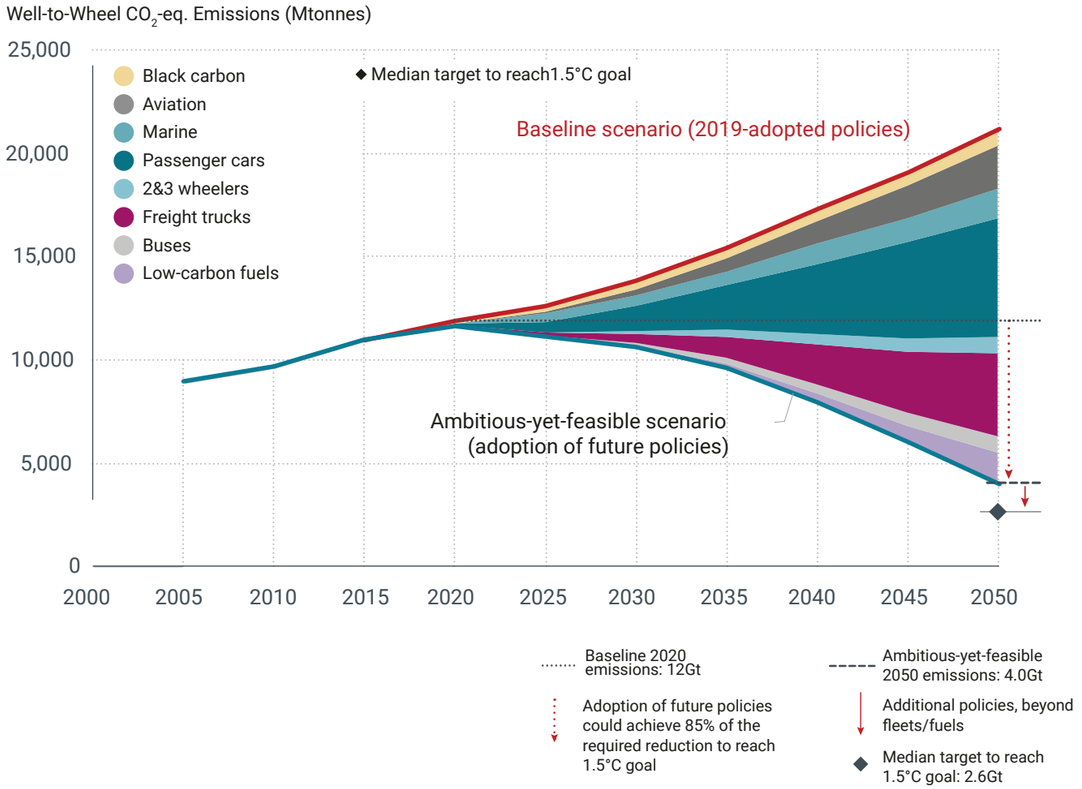
- Sustainable fuels: For hard-to-abate subsectors such as aviation, shipping, and heavy vehicles, sustainable fuels, including biofuels and hydrogen, are key solutions. These technologies are still developing but they offer a pathway for decarbonising long-distance transport that cannot easily be electrified.

- Public transport improvements: Expanding and upgrading public transport networks, especially in urban areas, can significantly reduce emissions. Investment in electric buses, trams, and rail systems will play a pivotal role.

- Active transport promotion: Walking and cycling offer zero-emission alternatives for short trips. Cities worldwide are investing in bike lanes, pedestrian infrastructure, and bike-sharing programmes to reduce reliance on cars.

The transition towards sustainable technologies and practices presents a wide array of opportunities, challenges, and game-changing developments. However, several social, technological, market and investment risks and barriers complicate progress in key areas. For instance, there are high-cost infrastructure needs, as investments are required for building infrastructure such as rail systems, electric vehicle charging stations, and other sustainable transport networks. These infrastructure needs can act as a deterrent due to their high upfront costs. Additionally, the transport sector has hard-to-abate subsectors such as heavy-vehicle road transport, aviation, and shipping, which face unique challenges in reducing emissions. These industries often rely on long-range fuel sources, making it difficult to transition to cleaner alternatives without sacrificing efficiency. Cheap and available fuels are another challenge facing this sector, as the continued availability of inexpensive fossil fuels slows down the shift towards cleaner energy sources, as it remains cost-effective for many industries to rely on traditional fuels. Lastly, there is a general failure to internalise pollution costs, as these costs are often not factored into the pricing of products and services, leading to market distortions. This failure to incorporate the true environmental costs of certain activities makes it harder to promote sustainable alternatives.

In response to the challenges facing the decarbonisation of the transport sector, several solutions can drive change. For one, the consumer behaviour of people is crucial to transition towards a climate-smart transport sector. Encouraging shifts in consumer preferences towards sustainable products and services can create demand for greener alternatives, supporting industries that adopt eco-friendly practices. Moreover, de-risking policies and measures is another way for governments and organisations to implement policies that reduce the perceived risks of investing in sustainable technologies. This includes offering incentives, subsidies, and guarantees to mitigate financial risks. Additionally, thoughtful policy design can help minimise the economic burden of transitioning to sustainable systems while enhancing social welfare. This includes measures that promote equitable access to new technologies and ensure that social benefits, such as job creation, are maximised during the transition. For further strategies related to economic costs and social benefits, see Chapter 4.



Graph: *Global CO2 reduction scenarios from transportation segments (ICCT, 2020, p.17)*

Alexandra Neubert – Mitigation Action Facility Desk Officer/Sector Lead Transport

Can you give us an example of a specific project the Mitigation Action Facility supports in the transport sector?

One project in Pakistan, for example, focuses on small vehicles by providing battery-swapping infrastructure. Instead of concentrating on the vehicles, we've built a business case around battery swapping, strengthening the local supply chain and addressing on-the-ground needs.

What are the characteristics that make projects in the transport sector potentially successful?

Successful transport sector projects are characterised by a holistic approach that addresses both supply and demand. Overcoming financial barriers, particularly the high initial capital investment, is crucial. While electric vehicles are cheaper in the long run due to lower operational costs, the upfront investment remains a challenge.

Projects must also ensure a reliable electricity supply and address demand issues, such as alleviating range anxiety through technical support and outreach. Ideally, they should not only replace internal combustion engine vehicles but also encourage a shift from private to public transport.

What are the benefits for businesses, people, and communities beyond decarbonisation?

A core benefit of our work is reducing air pollution, which leads to significant health improvements. Our projects also enhance convenience by providing new and comfortable travel options, particularly for women, offering safer travel that addresses their unique mobility needs. Additionally, these initiatives create employment opportunities through supply chain development, benefiting young people and the broader community. By addressing these factors, we are fostering social and economic benefits for women, youth, and communities.

What are the big game changers in the transport sector?

The big game changers in decarbonising the transport sector involve coupling economic development with sustainability. Supporting the development of local supply chains, including manufacturing and maintenance, can drive transformational change while boosting a country's overall economic growth. Adopting a circular economy approach is also essential, as it considers the entire technology lifecycle, including end-of-life and waste disposal. This comprehensive perspective significantly impacts deep decarbonisation efforts.

Decarbonisation hotspots

Moving without polluting

The movement of goods and people is a cornerstone of modern life, with global passenger transport increasing by over 50% and freight transport by 70% over the last two decades (ITF, n.d.). This surge has led to a 10-fold increase in transportation GHG emissions over the same period. The challenge is clear: How can we ensure mobility without harming the planet?

A broad mix of actions is needed, from avoiding unnecessary trips, to shifting to less carbon-intensive transportation modes, to improving or switching vehicle technologies. MAF is making a difference by enabling decarbonisation in key mobility hotspots. In the area of **e-mobility**, MAF supports projects around the world. In Cabo Verde, for example, the Fund promotes the ProMEC project **(Cabo Verde, Electric Vehicles, → https://mitigation-action.org/projects/cabo-verde-electric-vehicles/)**, which aims to integrate clean energy and sustainable transport solutions by increasing the number of electric vehicles (EVs) and powering them by a larger share of renewable energy in the grid. By addressing both supply and demand, ProMEC makes electric mobility more accessible, sustainable, and affordable.

MAF's projects around **sustainable urban transport** span from Indonesia, where rapid bus transit networks reduce traffic emissions and offer mobility to all people including those less privileged, to Colombia, where new transport solutions will create walkable spaces **(Colombia, Transit-Oriented Development, → https://mitigation-action.org/projects/colombia-transit-oriented-development-tod/)**.

Where electrification is hard or impossible to achieve, MAF supports the development of **sustainable biofuels** solutions. For instance, in Indonesia, MAF has established a Biogas Guarantee Facility (BGF), that provides loans and, thus, reduces financial risks for developers of biogas projects **(Indonesia, Biogas, → https://mitigation-action.org/projects/indonesia-biogas/)**.

Becoming hyper-efficient

In the quest for sustainability, **efficiency** is key. By making smarter use of energy, material resources, and end products, we can significantly reduce emissions and environmental impact while maintaining or even improving the quality of life. Through greater efficiency, we can reduce our energy and resources consumption multiple times, while still delivering the same services and outcomes (IEA, n.d.; Lovins et al., 1998). This vision of hyper-efficiency can be applied across different sectors.

Industrial processes are one of the largest consumers of energy, but they also offer some of the greatest opportunities for efficiency gains. Through energy-efficient technologies and **smarter industrial practices**, we can reduce energy use and emissions while maintaining or improving productivity. MAF supports the adoption of energy-efficient technologies and practises in industry projects. The Brazilian project PotencializEE, e.g., provides financial support and technical assistance that helps small and medium-sized enterprises (SMEs) to transform their production **(Brazil, PotencializEE, → https://mitigation-action.org/projects/brazil-transformative-investments-for-industrial-energy-efficiency-potencializee/)**.

The "Waste Solutions for a Circular Economy" project in India aims to **minimise waste** (municipal solid waste (MSW) by turning it into a resource. By encouraging industries to adopt zero-waste strategies, projects like these contribute to the transition to a **circular economy**, significantly lowering GHG emissions as well as local pollutants, improving health conditions, and creating new economic opportunities **(India, Waste Solutions for a Circular Economy, → https://mitigation-action.org/projects/india-waste-solutions-for-a-circular-economy/)**.

Efficiency is also about reducing the overall energy footprint of the goods. From energy-efficient appliances to smart product design many different measures have in combination an enormous cumulative impact. In Mexico, MAF helps SMEs improve energy efficiency and optimise processes for sustainable practices **(Mexico, Energy Efficiency in Small and Medium Enterprises, → https://mitigation-action.org/projects/mexico-energy-efficiency-in-small-and-medium-enterprises/)**. This includes the manufacturing of consumer goods, resulting in lower energy consumption and cost savings for producers and consumers.

Clean energy where and when you need it

On global average, renewable energy has become cost-competitive with fossil fuels, and in most places worldwide generating electricity from at least one renewable energy source can be considered the most affordable and reliable technology (IRENA, 2023). Unlike fossil fuels, domestic renewables are not subject to the risks of supply chain disruptions or geopolitical dependencies. However, many renewable energy technologies, like wind and solar, are intermittent, producing power only when the sun shines or the wind blows (but then they are sometimes exceeding consumption needs). Although batteries have advanced significantly, a key challenge for the global energy transition thus is how to store this energy during production surpluses, and ensure it is delivered to where it is needed.

To reliably power economies, renewable energy generation must be transmitted and distributed by modern and efficient grids. **Smart grids** allow for better management of supply and demand. In Jordan, MAF supports the "Pumped Hydro Energy Storage" project which uses pumped **hydro storage** to stabilise the grid and support renewable energy integration **(Jordan, Pumped Hydro Energy Storage, → https://mitigation-action.org/projects/jordan-pumped-hydro-energy-storage/)**, ensuring that renewable sources like solar and wind can provide consistent power even during peak load times.

Hydrogen offers another solution to the intermittency of renewables, particularly their application in heavy industry and long-distance transport, where direct electrification is difficult. It can be produced using excess renewable energy during times of generation surpluses and then stored for later use. In Costa Rica, e.g., MAF supports an initiative using renewable energy to produce hydrogen for the industrial and transport sectors **(Costa Rica, Green Hydrogen, → https://mitigation-action.org/projects/costa-rica-green-hydrogen/)**. The project helps Costa Rica to achieve its ambitious decarbonisation goals and make these two sectors future-proof.

Heating & cooling without warming the planet

Heating and cooling (H&C) are among the largest contributors to global energy consumption, accounting for nearly 50% of total energy use in buildings and contributing to approximately 40% of energy-related CO2 emissions globally (WEF, 2022). Transitioning to more efficient systems for heating and cooling presents an enormous opportunity for climate mitigation, potentially reducing billions of tons of CO2 emissions annually (Royal Society, n.d.).

To decarbonise H&C, buildings must be better insulated and H&C technology more **energy efficient**. This includes constructing new buildings to high efficiency standards and retrofitting existing ones to reduce energy waste. MAF supports the "Energy Efficiency in Small and Medium Enterprises" project which improves the H&C performance of Mexican buildings used by SMEs **(Mexico, Energy Efficiency in Small and Medium Enterprises, → https://mitigation-action.org/projects/mexico-energy-efficiency-in-small-and-medium-enterprises/)**. By implementing measures like better insulation, energy-efficient lighting, and more efficient HVAC systems, this project also cuts the monthly bills of these businesses and makes them more resilient to the volatility of the energy market.

Another hotspot for the decarbonisation of buildings is the transition to renewable sources for H&C. **Technologies** such as solar thermal heating can greatly reduce the carbon footprint of houses. Heat pumps are three to four times more efficient than traditional heating systems.

A comprehensive list of all ongoing MAF projects can be found in the appendix (page 27).

4. Supporting people: Ecologic, social, and economic benefits of sectoral mitigation action

Embarking on a global transition to climate-compatible development requires more than just technological advancements – it demands a paradigm shift that fully integrates the support, participation, and engagement of a diversity of people (WWF, 2022). Technology alone cannot address the complex, interconnected issues associated with climate change; the transition must actively improve the quality of life for all and foster inclusivity and fairness at every level of society (WWF, 2022). Only through the alignment of technological innovations with human-centred policies can we ensure that this transformation is not only successful but sustainable and just (World Economic Forum, 2024).

Globally, marginalised and vulnerable communities dominantly bear the burden of climate change impacts and are at risk of being further excluded if mitigation strategies do not account for their needs. It is critical that climate actions address social equity by ensuring that the opportunities created are available to all (Amorim-Maia et al., 2022). Furthermore, the transition must be economically viable for countries in the Global North and Global South. While wealthy nations may have the resources to quickly adopt new technologies and adapt to green infrastructure, less wealthy countries face significant barriers, including financial constraints, lack of technological access, and the need to balance climate priorities with immediate developmental challenges (Sultana, 2022). Addressing these disparities is crucial for creating a truly global climate-compatible future. International cooperation, financial support, and technology transfer must be prioritised to ensure that nations are not left behind in this transition.

The global transition to climate-compatible development offers an unprecedented opportunity to create a more just, inclusive, and sustainable world. To achieve this vision, policymakers must prioritise transparency, public participation, and education. People must understand the importance of climate action and feel that they have a role in shaping its implementation. The move towards a low-carbon future has the potential to unlock profound ecological, social, and economic co-benefits (International Renewable Energy Agency, 2023). Mitigation actions across the key sectors can drive improvements in public health, create jobs, and stimulate economic growth, all while reducing emissions and mitigating climate impacts. These co-benefits present an opportunity to reframe the climate challenge as not just a burden to be managed, but a unique chance to create a more equitable and prosperous global society.

4.1 Leave No One Behind

"Leave no one behind (LNOB) is the central, transformative promise of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs). It represents the unequivocal commitment of all UN Member States to eradicate poverty in all its forms, end discrimination and exclusion, and reduce the inequalities and vulnerabilities that leave people behind and undermine the potential of individuals and of humanity as a whole." (UNSDG, n.d., para.1)

As we move towards a climate-compatible future, it is essential that no one is left behind. Central to this vision is the need to promote gender equality and social inclusion (GESI), ensuring that all individuals – regardless of gender or sexuality – benefit from and contribute to the transition (Social Development Direct, 2016). Often, it is women who face greater vulnerability to the effects of climate change, especially in countries in the Global South (Arora-Jonsson, 2011). The inclusion and prioritisation of women and people of marginalised genders who have historically been excluded from decision-making processes is not only a moral imperative but also key to achieving a more just, resilient, and sustainable world. Youth – who will inherit the consequences of today's actions – must also be given a stronger voice in shaping a future that reflects their needs and aspirations (Ingaruca & United Nations Development Programme, 2022). Younger people can be the strongest force for innovative ideas and energetic action, enabling swift and ambitious change. Underprivileged and often marginalised communities, such as Indigenous peoples, racial and ethnic minorities, and low-income groups, also face disproportionate risks from climate change. Yet, they are often excluded from the conversations and solutions that could directly benefit them. Ensuring their inclusion in climate strategies is essential to creating solutions that work for everyone. The cost of exclusion of women, youth, and marginalised communities in decision-making worldwide is enormous (reference to follow).

True social inclusion means creating opportunities for all individuals to participate in and benefit from the social, economic, and environmental changes that are shaping our world. Excluding women, youth, and marginalised communities from climate action not only perpetuates inequality but also limits the effectiveness of global climate efforts (Ingaruca & United Nations Development Programme, 2022). The cost of exclusion is both social and economic. Socially, it exacerbates existing inequalities, deepening the divide between those who have access to resources and opportunities and those who do not. Economically, exclusion limits innovation, stifles growth, and undermines the potential for sustainable development.

To ensure that the transition to a sustainable future is just and equitable, policies and strategies must be designed to actively address the needs of all groups, especially those who are most vulnerable. A just transition involves not only reducing emissions but also creating pathways to economic and social equity (UNDP, 2022). This means ensuring that women have equal access to education, financial resources, and leadership positions in the green economy. It means providing youth with the skills and opportunities to participate in and lead the transition to a low-carbon world. It also means safeguarding the rights of marginalised communities, ensuring they have access to the benefits of clean energy, sustainable jobs, and resilient infrastructure (UNDP, 2022).

4.2 Create markets that further public goods

In the pursuit of a sustainable future, markets must be structured to advance public goods, ensuring that economic systems contribute to the well-being of people and the planet. The Agenda 2030 and the SDGs provide a clear yardstick for global development, guiding nations toward economic, social, and environmental sustainability. However, recent global crises – ranging from the COVID-19 pandemic to the rise of populism – have challenged this progress, highlighting the urgent need to reshape markets to better serve public interests, particularly in addressing climate change (Hartwell & Devinney, 2021).

"National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment." (UNEP, n.d., para.1)

One of the most critical ways to reshape markets for the public good is by ensuring that they reflect the real costs of environmental damage (UN Environment Management Group, 2023). Currently, many markets fail to internalise the costs of climate pollution, allowing companies and industries to offload environmental harm onto the public. This creates a distorted market where fossil fuels and other polluting industries remain artificially cheap, incentivising continued reliance on unsustainable practices. By accurately pricing carbon emissions and other pollutants, we can create economic incentives for businesses to adopt cleaner technologies and practices (UN Environment Management Group, 2023). This shift would not only reduce GHG emissions but also encourage innovation in renewable energy, energy efficiency, and sustainable manufacturing.

Moreover, investments in clean energy, sustainable infrastructure, and energy efficiency are not only necessary to address climate change but also represent significant economic opportunities. Decarbonising the global economy can lead to substantial cost savings in the long term by reducing the economic damage caused by climate impacts such as extreme weather events, health costs related to air

Gender Action Plan of the Mitigation Action Facility

The Gender Action Plan of the Mitigation Action Facility aims to ensure gender equality and social inclusion in climate action (Mitigation Action Facility, 2023). Its main objectives are to integrate gender justice into all projects, promote capacity-building, and support marginalised groups through gender-responsive and transformative actions. The plan outlines milestones for enhancing gender inclusivity in project design, monitoring, and evaluation. It aligns with the Paris Agreement and aims to contribute to closing gender data gaps while fostering knowledge exchange and innovation in gender-inclusive climate solutions.

pollution, and economic losses from biodiversity decline (UN Environment Management Group, 2023). Moreover, the transition to a low-carbon economy can stimulate job creation in emerging industries such as renewable energy, green construction, and electric mobility. Thus, while there are upfront costs associated with decarbonisation, the long-term savings and economic benefits far outweigh the initial investments, making a strong economic case for accelerating this transition.

A fair transition to a decarbonised world requires prioritising the needs of vulnerable communities (UNDP, 2022). This involves ensuring access to clean energy, resilient infrastructure, and financial support for climate adaptation and mitigation. Wealthier nations and global institutions have a responsibility to support these efforts through financial assistance, technology transfer, and capacity building. Only by addressing the disproportionate burden faced by the Global South can we create a truly equitable and sustainable global economy (Sultana, 2022).

4.3 Towards a healthy planet

As we work towards mitigating climate change, it is critical to recognise the inextricable link between climate action and biodiversity preservation. While climate change is often viewed as the greatest environmental crisis of our time, biodiversity loss represents the other crisis – one that is equally urgent and interconnected with efforts to reduce global emissions (UNFCCC, 2016). For example, expanding renewable energy infrastructure, such as solar farms or hydropower, can have unintended consequences if they disrupt natural habitats or lead to deforestation. Similarly, large-scale monoculture plantations for biofuels can degrade ecosystems and reduce species diversity. To move toward a healthy planet, sectoral mitigation actions must consider not only their impact on greenhouse gas emissions but also their effects on ecosystems and the species that inhabit them.

"Noting the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth, and noting the importance for some of the concept of 'climate justice,' when taking action to address climate change." (UNFCCC, 2016, p.3)

Humanity's global ecological footprint is now far beyond what the planet can sustainably support. Overconsumption, deforestation, pollution, and resource depletion are driving the world toward ecological exhaustion, with consequences for both human and environmental health. This overexploitation not only drives biodiversity loss but also exacerbates climate change, as ecosystems such as forests and oceans play a critical role in carbon sequestration. By depleting these natural buffers, we are weakening the planet's ability to regulate its climate. To move towards a healthy planet, we must urgently reduce our ecological footprint by transitioning to sustainable consumption and production patterns, conserving natural resources, and restoring degraded ecosystems (UN, 2023).

Achieving a truly healthy planet requires maintaining the systemic integrity of our natural world. Systemic integrity calls for solutions that enhance the resilience of ecosystems and safeguard natural processes (UNFCCC, 2016). There are many different systems in our world, one of which, the ecosystem, is crucial to consider. By respecting the integrity of this system and all the others, we can create a more balanced relationship between people and nature.

"Ecosystem integrity is the ability of an ecosystem to support and maintain ecological processes and a diverse community of organisms. It is measured as the degree to which a diverse community of native organisms is maintained, and is used as a proxy for ecological resilience, intended as the capacity of an ecosystem to adapt in the face of stressors while maintaining the functions of interest." (IPBES, 2018, para.1)

In summary, sectoral mitigation actions must be carefully crafted to support biodiversity, reduce humanity's ecological footprint, and uphold the systemic integrity of the natural world. By doing so, we can create a more sustainable, resilient planet for current and future generations.

MAF's financial mechanism

MAF within the global climate finance context

Climate finance is a critical component for decarbonisation efforts, particularly in mobilising resources to achieve the goals of the Paris Agreement. While international climate finance initiatives have gained traction, systemic solutions are still needed to scale up funding. The MAF plays a crucial role in this landscape by utilising targeted financial mechanisms to equip countries with the technical capacity necessary for effective project implementation. Moreover, the MAF ensures that projects are bankable and scalable, helping to attract further investment in climate action. By embedding financial sustainability into policy frameworks, the MAF supports long-term, low-carbon initiatives in countries. In doing so, the MAF aligns national priorities with the objectives of the Paris Agreement and plays an important role in achieving climate targets. It also contributes to the implementation of Just Energy Transition Partnerships and sectoral decarbonisation, as pursued by the Climate Club. As the demand for climate finance grows, the MAF facilitates both private and public investments to drive progress toward a low-carbon future.

Effective funding strategy

The MAF's funding strategy supports the implementation of Nationally Appropriate Mitigation Actions (NAMAs), which form the foundation for Nationally Determined Contributions (NDCs) under the Paris Agreement. These NAMA Support Projects (NSPs) must demonstrate both "implementation readiness" and "transformational change potential." These concepts are closely tied to the use of effective financial mechanisms. "Implementation readiness" means that an NSP is well-developed and prepared to move forward. Projects that don't meet this criterion, such as research activities or technological pilots without proven business models, generally do not qualify. "Transformational change potential" is crucial for NSPs, as it reflects their capacity to redirect public and private funds toward greenhouse gas (GHG) mitigation efforts in a sustainable manner. Successful NSPs should influence national or sectoral policies, have a catalytic effect, and be scalable and replicable.

Tools and insights to enhance transformative potentials

MAF's financing tools include concessional loans, loan guarantees, grants, and results-based financing. Many NSPs use a combination of mechanisms, such as revolving funds paired with grants or loan guarantees, aiming for systemic financial transformation. While results-based financing is used, its scalability can be limited when tied to grants. Each project must provide a rationale for its chosen financial mechanisms, addressing business models, institutional arrangements, and phase-out strategies. The business models should demonstrate that investments can achieve both economic success and sustainability, with appropriate incentives to avoid market distortions. MAF programmes also incorporate insights from the finance sector from the outset to maximise leverage and sustainability. By employing innovative, well-aligned financial mechanisms, the MAF enhances the transformative potential of NSPs, strengthening their contribution to climate action.

Financing instruments of the Mitigation Action Facility		
Public sector sourcing instruments	**Public sector operational instruments**	**Private sector financing instruments**
Environmental fiscal return	Grants	Equity
Loans	Purchase contracts for goods	First-loss (mezzanine, junior debt)
Bonds	Purchase contracts for services	Loans
Dedicated credit lines	Additional payments (e.g. premium price)	Bonds
Risk cover guarantees	Regulation (e.g. feed in tarrif; quotas)	Risk cover guarantees
Grants	Public procurement guidelines	Project finance
	Tax credits; reductions/exemptions	Grants
	Variable or accelerated depreciations	
	Removing subsidies	
	Loan schemes	
	Guarantee schemes	

Source: *Soren E. Lütken: Financial engineering of climate investment in developing countries, Anthem Press 2014*

5. Outlook

As the world confronts the pressing challenges of climate change, the future depends on how effectively we can decarbonise key sectors such as energy, industry, and transport. These sectors are central to global emissions, but they also hold the greatest potential for transformative change that creates sustainable growth, benefits society, and engages people.

The energy sector, through the transition to renewable energy, has the potential to drastically reduce global greenhouse gas emissions while creating new economic opportunities. Similarly, advancements in industrial processes – such as cleaner production methods, energy efficiency, and the adoption of circular economy principles – are crucial for reducing emissions from manufacturing and heavy industry. Meanwhile, the transformation of the transport sector through electric vehicles, sustainable fuels, and enhanced public transit systems is key to lowering emissions and improving air quality, public health, and urban mobility.

Thus, decarbonisation efforts are not just beneficial for the planet; they also provide significant social and economic co-benefits. Cleaner energy, more sustainable industries, and greener mobility systems can improve the quality of life, create jobs, and reduce inequalities.

Despite the clear benefits of decarbonisation, the funding gap remains one of the most significant challenges remains the funding gap. The transition to a low-carbon economy requires substantial investment in new technologies, infrastructure, and systems. While progress is being made, the financial resources currently allocated to decarbonisation efforts are largely insufficient to meet the scale of the challenge.

Continued innovation is also essential. Technological breakthroughs in areas such as renewable energy storage and carbon capture and storage (CCS) will be critical in driving sector-specific decarbonisation forward. Innovation is particularly important in sectors that are hard to abate, such as heavy industry and long-distance transport, where existing solutions may be inadequate to fully decarbonise.

Additionally, international collaboration will be key to overcoming these challenges. Climate change is a global issue that transcends national borders, and no single country can tackle it alone. Intensified cooperation between nations will be crucial for accelerating decarbonisation across all sectors. By sharing best practices and resources, countries can collectively push forward climate solutions at a pace and scale necessary to meet global climate goals.

Looking ahead, sectoral activities will be the prerequisite for raising ambition and accelerating NDCs 3.0. By aligning NDCs with sectoral decarbonisation targets, countries can demonstrate real progress toward emissions reductions, enabling a higher level of ambition in future climate negotiations. Decarbonising the energy, industry, and transport sectors will directly contribute to several SDGs, including those related to clean energy (SDG 7), sustainable cities (SDG 11), climate action (SDG 13), and decent work and economic growth (SDG 8).

In conclusion, the path forward is clear: Sectoral decarbonisation is essential for mitigating climate change and delivering broader social and economic benefits. The opportunities are immense, but the time for action is now.

6. Appendices

A) Active MAF Projects

Brazil – Fertiliser Industry - https://mitigation-action.org/projects/brazil-accelerating-key-net-zero-technologies-by-leveraging-industrial-decarbonisation-investment-action/
Brazil – Transformative Investments for Industrial Energy Efficiency (PotencializEE) - https://mitigation-action.org/projects/brazil-transformative-investments-for-industrial-energy-efficiency-potencializee/
Cabo Verde – Electric Vehicles - https://mitigation-action.org/projects/cabo-verde-electric-vehicles/
Chile – Self-Supply Renewable Energy (SSRE) - https://mitigation-action.org/projects/chile-self-supply-renewable-energy-ssre/
Colombia – Energy Communities - https://mitigation-action.org/projects/colombia-energy-communities/
Colombia – Domestic Refrigeration - https://mitigation-action.org/projects/colombia-domestic-refrigeration/
Costa Rica – Green Hydrogen - https://mitigation-action.org/projects/costa-rica-green-hydrogen/
Egypt – Industry PV program - https://mitigation-action.org/projects/egypt-solar-pv-industry/
Guatemala – Sustainable Cookstoves - https://mitigation-action.org/projects/guatemala-sustainable-cookstoves/
Honduras – Transforming the Livestock Sector - https://mitigation-action.org/projects/honduras-transforming-the-livestock-sector/
India – Steel - https://mitigation-action.org/projects/india-steel/
India – Waste Solutions for a Circular Economy - https://mitigation-action.org/projects/india-waste-solutions-for-a-circular-economy/
Indonesia – Biogas - https://mitigation-action.org/projects/indonesia-biogas/
Jordan – Pumped Hydro Energy Storage - https://mitigation-action.org/projects/jordan-pumped-hydro-energy-storage/
Kenya – Small Vehicles E-Mobility - https://mitigation-action.org/projects/kenya-small-vehicles-e-mobility/
Kenya Solar – Powered Cold Chain Services - https://mitigation-action.org/projects/kenya-solar-powered-cold-chain-services/
Mauritius – Energy Efficiency - https://mitigation-action.org/projects/mauritius-energy-performance-contracting/
Mexico – Energy Efficiency in Small and Medium Enterprises - https://mitigation-action.org/projects/mexico-energy-efficiency-in-small-and-medium-enterprises/
Mongolia – Clean Heating - https://mitigation-action.org/projects/mongolia-clean-heating/
Mongolia – Energy Performance Building Retrofitting - https://mitigation-action.org/projects/mongolia-energy-performance-building-retrofitting/
Mozambique – Sustainable Waste Management for a Circular Economy - https://mitigation-action.org/projects/mozambique-sustainable-waste-management-for-a-circular-economy/
Namibia – Biomass - https://mitigation-action.org/projects/namibia-biomass/
Nepal – Electric Public Transport - https://mitigation-action.org/projects/nepal-electric-transportation/
Nepal – Sustainable Forest Management and Bioenergy - https://mitigation-action.org/projects/nepal-sfm-and-bioenergy/
Pakistan – Battery Swapping Network - https://mitigation-action.org/projects/pakistan-swappable-battery-based-network-for-promoting-electric-vehicles/
Paraguay – Public Transport - https://mitigation-action.org/projects/paraguay-public-transport/
Philippines – Tidal Stream - https://mitigation-action.org/projects/philippines-tidal-stream/
Rwanda – Accelerating the deployment of E-motos - https://mitigation-action.org/projects/rwanda-accelerating-the-deployment-of-electric-motorcycle-taxis-e-motos-and-e-buses/
South Africa – Public Buildings and Infrastructure - https://mitigation-action.org/projects/south-africa-public-buildings-and-infrastructure/
Tunisia – Clean Energy in Buildings - https://mitigation-action.org/projects/tunisia-clean-energy-in-buildings/

B) References

Alam, S., Srivastava, S. (2023). Investment in clean energy transition for our planet's future. *IEEFA*. https://ieefa.org/resources/investment-clean-energy-transition-our-planets-future

Amorim-Maia, A. T., Anguelovski, I., Chu, E., & Connolly, J. (2022). Intersectional climate justice: A conceptual pathway for bridging adaptation planning, transformative action, and social equity. *Urban climate*, *41*, 101053. https://www.sciencedirect.com/science/article/pii/S2212095521002832?via%3Dihub

Arora-Jonsson, S. (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global environmental change*, *21*(2), 744-751. https://linkinghub.elsevier.com/retrieve/pii/S0959378011000069

Edelenbosch, O., van den Berg, M., de Boer, H. S., Chen, H. H., Daioglou, V., Dekker, M., van Vuuren, D. (2022). Mitigating greenhouse gas emissions in hard-to-abate sectors. PBL Netherlands Environmental Assessment Agency. https://www.pbl.nl/en/publications/mitigating-greenhouse-gas-emissions-in-hard-to-abate-sectors

European Commission. (2024). Accelerated investment in renewables and energy efficiency key to 1.5°C target. *EU Science Hub.* https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/accelerated-investment-renewables-and-energy-efficiency-key-15degc-target-2024-01-12_en

European Investment Bank. (2022). Infrastructure Solutions: How to adapt transport to a sustainable future. *EIB*. https://www.eib.org/en/essays/sustainable-transport-investment

Ge, M., Friedrich, J., Vina, L. (2020). 4 Charts Explain Greenhouse Gas Emissions by Countries and Sectors. *World Research Institute.* https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors

Guterres, A. (2018). Secretary-General's remarks on Climate Change [as delivered] | United Nations Secretary-General. *United Nations.* https://www.un.org/sg/en/content/sg/statement/2018-09-10/secretary-generals-remarks-climate-change-delivered

Hartwell, C. A., & Devinney, T. (2021). Populism, political risk, and pandemics: The challenges of political leadership for business in a post-COVID world. *Journal of World Business*, *56*(4), 101225. https://www.sciencedirect.com/science/article/pii/S1090951621000377?via%3Dihub

ICCT. (2020). Vision 2050 – A Strategy to decarbonize the global transport sector by mid-century. The International Council on Clean Transportation. https://theicct.org/sites/default/files/publications/ICCT_Vision2050_sept2020.pdf

IEA. (2021a). Financing Clean Energy Transitions in Emerging and Developing Economies. *IEA50.* https://www.iea.org/reports/financing-clean-energy-transitions-in-emerging-and-developing-economies/executive-summary

IEA. (2021b). Net Zero by 2050. *IEA50*. https://www.iea.org/reports/net-zero-by-2050

IEA. (2023b). Industry. *IEA50.* https://www.iea.org/energy-system/industry

IEA. (2023c). Transport. *IEA50.* https://www.iea.org/energy-system/transport

IEA. (2023a). Data and Statistics. *IEA50*. https://www.iea.org/data-and-statistics/charts/global-energy-sector-co2-emissions-in-the-pre-paris-baseline-and-stated-policies-scenarios-2015-2030

IEA. (n.d.). Energy System – Energy Supply & Transportation. *IEA50.* https://www.iea.org/energy-system

IEA. (n.d.). Transport. International Energy Agency. https://www.iea.org/energy-system/transport

Ingaruca, M. & United Nations Development Programme. (2022). *Elevating meaningful youth engagement for climate action* (Office of United Nations Secretary-General's Envoy on Youth, Plant for Planet Nigeria, United Nations, B. Hall, P. Kurukulasuriya, S. Lister, & C. Flynn, Eds.). https://www.undp.org/sites/g/files/zskgke326/files/2022-05/UNDP-Elevating-Meaningful-Youth-Engagement-for-Climate-Action-2.pdf

International Energy Agency. (2021). Net zero by 2050: A roadmap for the global energy sector. *OECD Publishing*. https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

International Renewable Energy Agency. (2023). World Energy Transitions Outlook 2023. *IRENA.* https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2023

IPBES. (2018). Ecosystem Integrity. *Ocean Health Index.* https://www.ipbes.net/glossary-tag/ecosystem-integrity

IPCC. (2022b). Chapter 11: Industry. *IPCC.* https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-11/#:~:text=The%20industrial%20sector%20includes%20ores,as%20well%20as%20from%20waste

IPCC. (2018). Global Warming of 1.5°C. *Intergovernmental Panel on Climate Change.* https://www.ipcc.ch/site/assets/uploads/sites/2/2018/07/SR15_SPM_version_stand_alone_LR.pdf

IPCC. (2022a). Chapter 10: Transport. *IPCC.* https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-10/

IPCC. (2023). Climate Change 2023: Synthesis report. (Core Writing Team, H. Lee, & J. Romero, Eds.; pp. 35–115). https://doi.org/10.59327/IPCC/AR6-9789291691647

IRENA. (2023). Renewables Competitiveness Accelerates, Despite Cost Inflation. IRENA. https://www.irena.org/News/pressreleases/2023/Aug/Renewables-Competitiveness-Accelerates-Despite-Cost-Inflation

ITF. (n.d.). Modal shift to cleaner transport fails to materialize. International Transport Forum. https://www.itf-oecd.org/modal-shift-transport-trends

Lovins, L. H., Von Weizsacker, E., Lovins, A. B., & Milani, B. (1998). Factor Four: Doubling Wealth, Halving Resource Use. Alternatives Journal, 24(2), 33.

MCFI. (n.d.). What is climate mainstreaming? Mainstreaming Climate in Financial Institutions. https://www.mainstreamingclimate.org/what-is-climate-mainstreaming/#:~:text=Climate%20mainstreaming%20is%20the%20systematic,financial%20institution's%20strategies%2C%20and%20operations.

Mitigation Action Facility. (2023). Gender Action Plan: Embracing gender equality and social inclusion in climate action. *Mitigation Action Facility*. https://mitigation-action.org/wp-content/uploads/Gender-Action-Plan-2023-2025.pdf

Ritchie, H. (2020). Sector by sector: where do global greenhouse gas emissions come from?. *Our World in Data.* https://ourworldindata.org/ghg-emissions-by-sector

Royal Society. (n.d.). Low-carbon heating and cooling: overcoming one of world's most important net zero challenges. *Royal Society*. https://royalsociety.org/-/media/policy/projects/climate-change-science-solutions/climate-science-solutions-heating-cooling.pdf

Shukla, P. R., Skea, J., Slade, R., Al Khourdajie, A., Van Diemen, R., McCollum, D., Malley, J. (2022). Climate change 2022: Mitigation of climate change. *Contribution of working group III to the sixth assessment report of the Intergovernmental Panel on Climate Change*, *10*, 9781009157926.

Social Development Direct. (2016). *Gender Equality and Social Inclusion (GESI) Strategy*. https://www.sddirect.org.uk/sites/default/files/2022-03/STAR-Ghana_Gender%2BEquality%2Band%2BSocial%2BInclusion%2BStrategy.pdf

Stern, N. (2008). "The Economics of Climate Change." *American Economic Review*, 98 (2): 1–37.DOI: 10.1257/aer.98.2.1

Sultana, F. (2022). The unbearable heaviness of climate coloniality. *Political Geography*, *99*, 102638. https://linkinghub.elsevier.com/retrieve/pii/S096262982200052X

Umweltbundesamt. (2024). Indicator: Greenhouse gas emissions. *Umwelt Bundesamt.* https://www.umweltbundesamt.de/en/data/environmental-indicators/indicator-greenhouse-gas-emissions#at-a-glance

UN. (2023). *Sustainable consumption and production*. United Nations Sustainable Development. https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

UN. (2022). The Evidence Is Clear: The Time for Action Is Now. We Can Halve Emissions by 2030. United Nations Climate Change. https://unfccc.int/news/the-evidence-is-clear-the-time-for-action-is-now-we-can-halve-emissions-by-2030

UNDP. (2022). What is just transition? And why is it important?. *UNDP*. https://climatepromise.undp.org/news-and-stories/what-just-transition-and-why-it-important

UN Environment Management Group. (2023). The United Nations System Common Approach Towards a Pollution-Free Planet. In Q.-A. HAIDER (Ed.), *The United Nations System Common Approach Towards a Pollution-Free Planet* [Book]. https://unemg.org/wp-content/uploads/2023/12/UNEP_EMG_UN-system-common-approach-to-Pollution-231122.pdf

UNEP. (2022). Emissions Gap Report 2022. *United Nations Environment Programme.* https://www.unep.org/resources/emissions-gap-report-2022

UNEP. (2023). Emissions Gap Report 2023. *United Nations Environment Programme.* https://wedocs.unep.org/handle/20.500.11822/43922

UNEP. (n.d.). Polluter Pays Principle. *United Nations Environment Programme.* https://leap.unep.org/en/knowledge/glossary/polluter-pays-principle

UNFCCC. (2016). The Paris Agreement. *UN Climate Press Release.* https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

UNFCCC. (2023). New Analysis of National Climate Plans: Insufficient Progress Made, COP28 Must Set Stage for Immediate Action. *UN Climate Press Release.* https://unfccc.int/news/new-analysis-of-national-climate-plans-insufficient-progress-made-cop28-must-set-stage-for-immediate

UNFCCC. (2024). NDC 3.0: Driving the next generation of climate action and ambition. *United Nations Climate Change.* https://unfccc.int/documents/640864

UNFCCC. (n.d.a). Nationally Determined Contributions. *United Nations Climate Change*. https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs
UNFCCC. (n.d.b). The Paris Agreement. *United Nations Climate Change*. https://unfccc.int/process-and-meetings/the-paris-agreement
UNIDO. (2024). Unlocking the finance needed to decarbonize heavy industries through partnerships. *UNIDO*. https://www.unido.org/news/unlocking-finance-needed-decarbonize-heavy-industries-through-partnerships
UN SDGs. (n.d.). THE 17 GOALS | Sustainable Development. *UN*. https://sdgs.un.org/goals
UNSDG. (n.d.). Leave No One Behind. *United Nations Sustainable Development Group*. https://unsdg.un.org/2030-agenda/universal-values/leave-no-one-behind
Van Tilburg, X., Ochs, A., Lee, S. (2024). PLANNING FOR A NET-ZERO FUTURE: Guidance on how to develop a Long-Term Low Emission Development Strategy (LT-LEDS). *UNDP*. https://www.undp.org/publications/planning-net-zero-future-guidance-how-develop-long-term-low-emission-development-strategy-lt-leds
WEF. (2022). Here's how we can heat, ventilate and cool buildings more efficiently. WEF. https://www.weforum.org/agenda/2022/10/here-s-how-heat-ventilate-cool-buildings-energy-consumption/
World Bank. (n.d.). Transport Decarbonization Investment series (TDI). World Bank Group. https://www.worldbank.org/en/topic/transport/publication/transport-decarbonization-investment-series
World Economic Forum. (2023). The UN now focuses on climate change as a health issue too. Here's why. *World Economic Forum*. https://www.weforum.org/agenda/2023/11/climate-change-health/
World Economic Forum. (2024). Why it's vital to take a people-centered approach to equitable energy transitions. *World Economic Forum*. https://www.weforum.org/agenda/2024/06/people-centred-approach-towards-equitable-energy-transitions/
World Energy Council. (2014). Climate Change: Implications for the Energy Sector - Key Findings from the Intergovernmental Panel on Climate Change Fifth Assessment Report. *Cambridge University Press*. https://www.worldenergy.org/assets/images/imported/2014/06/Climate-Change-Implications-for-the-Energy-Sector-Summary-from-IPCC-AR5-2014-Full-report.pdf
WWF. (2022). Amplifying Voices for Just Climate Action. *WWF*. https://www.wwf.nl/globalassets/pdf/full-programme-proposal_amplifying-voices-for-just-climate-action_web-version.pdf

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