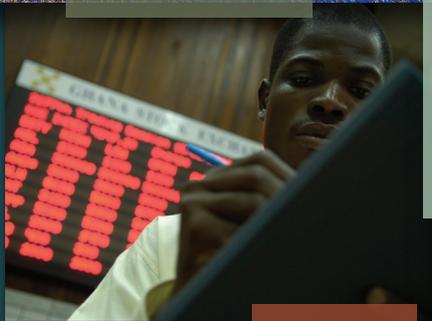
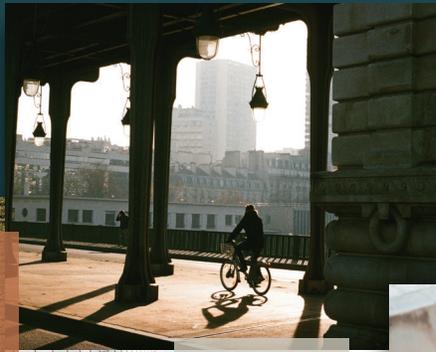


# Global Youth Climate Network 2021 CLIMATE ACTION POSITION PAPER





Global Youth Climate Network

**2021 CLIMATE ACTION**

**POSITION PAPER**

## ABOUT GLOBAL YOUTH CLIMATE NETWORK

Global Youth Climate Network (GYCN) is one of the core programs of the Youth-to-Youth (Y2Y) Community of young professionals at the World Bank Group. GYCN works with the global youth to raise awareness about climate change, drive climate ambition and promote action across the world. To date, we built a community of 1,500+ youth climate leaders representing over 130 countries. Among the members of our network are students, young professionals, entrepreneurs, leaders of local communities and initiatives, researchers, artists, journalists, and climate activists who are addressing the impacts of climate change in their communities. At the GYCN, we connect, inspire and empower young people to deliver climate action and drive impact for people and planet.

In 2021, the GYCN in collaboration with 2021 Climate Ambassadors launched the Climate Action Position Paper. The purpose of the Position Paper is to bring a youth perspective to global climate discussions ahead of COP26 and inform the decision-making process at the global, regional, national, and local levels. This paper represents a collaboration of 60 youth climate leaders representing over 50 countries, with the support and consultation of global experts from all around the world. We aspire that key findings and recommendations outlined in the Position Paper will accelerate the tangible action needed to tackle climate change and build a solid foundation for the future of our planet.

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## **Climate change is undoubtedly humanity's greatest challenge.**

The latest Report of the Intergovernmental Panel on Climate Change – “Climate Change 2021, The Physical Science Basis” – clearly states that “observed increases in well-mixed greenhouse gas concentrations since around 1750 are unequivocally caused by human activities”. Similarly, the scientific and academic community, as well as international think tanks and civil society organizations are repeatedly raising concerns on climate risks.

While climate change is a continuous existing threat, it is also a fundamental transgenerational challenge, calling for the involvement of the global youth community’ in today’s decision that will affect tomorrow’s world. The GYCN provides a platform for youth climate leaders to discuss major challenges and problems that affect their communities and critical actions that should be taken by various stakeholders to address the climate crisis. Through it, the GYCN community aims to engage with decision-makers at different levels, as well as with the general audience, in an attempt to mobilize ourselves and our communities for immediate and decisive climate action.

This Climate Action Position Paper aims to provide a set of solutions and policy recommendations across seven thematic areas: economic recovery and climate finance, energy, transport, agriculture and food, cities, sustainable innovation, and climate education. These areas have been identified and explored because of their significant potential for climate mitigation and adaptation.

## **GREEN ECONOMIC RECOVERY AND CLIMATE FINANCE**

While the COVID-19 crisis has had an unprecedented negative impact on both our day-to-day lives and on the global economies, it also brought to salience some opportunities. As governments around the world are designing stimulus packages to restart the domestic economies, building back by addressing climate change is a critical step forward. In this context, national authorities must gradually, but consistently, remove the still-existing fossil fuel subsidies and support for carbon-intensive projects, by creating net-zero transition policies to incentivize clean technologies’ roll-out and contribute to cost reductions of emerging technologies. This is particularly important for developing countries, as continuing to support fossil fuels will translate into stranded assets and lock-in effects. By doing that, policymakers would support the creating of new green jobs that would unlock a just transition and a fair redistribution of current employees, while creating new markets, thus additional jobs.

Robust climate risk management is required to support economic recovery. Climate risk should be clearly defined for all stakeholders, funding institutions need to speed up their ongoing efforts of diverting investments towards clean technologies and net-zero projects, while international organizations and regulators have to create mandatory standards for financial institutions. To this extent, the development of robust frameworks to assess and manage climate risk and standardization of climate-related data are important solutions to implement.

Ultimately, as sustainable strategies developed and implemented by all stakeholders will play a critical role in reaching net-zero, standardized and regulated ESG practices and sustainability reporting frameworks for companies are mandatory. Regulators and governments would not only have the role of developing the provisions but also to incentivize, through tax incentives and other subsidies, the increased adoption of these practices.

## **TRANSFORMATION OF THE ENERGY SECTOR**

The global energy sector requires profound transformation. While about 800 million people worldwide still lack access to affordable, reliable, sustainable, and modern energy services, the energy sector is responsible for nearly 60% of global GHG emissions. To address the impacts of the climate crisis, there is an urgent need for a global transition to a low-carbon energy

world. Thus, advancing energy access, promoting energy efficiency and renewable energy, and pursuing extensive transport electrification while achieving clean energy targets are among priority areas to tackle.

Focus on long-term clean energy policies and solutions to promote energy access will allow governments to align their national strategies with the current global efforts towards sustainable pathways, instead of opting for a cheaper solution that would provide a quick win. Governments should step up support to expanding energy access through sustainable solutions, as part of their economic recovery plans and encourage multi-stakeholder engagement and collaboration in providing energy access.

Equally, the electricity demand-side must be addressed, as clean and efficient consumers will play an important role in reaching climate targets. Fostering the adoption of electric vehicles (EVs) and nudging consumers towards clean means of transportation (train, e-bikes, electric buses, and trams, etc.; including cycling and walking), developing proper regulation for small-scale utilization of batteries of emerging prosumers, or investing in energy efficiency measures are important puzzle pieces in the collective efforts of consumers to reduce their emission footprint.

## **THE FUTURE OF TRANSPORTATION**

Though transportation-based emissions make up for about one-fifth of our global emissions footprint, this sector is one of the most difficult to transform, due to the abundance of fossil fuel transportation (especially for maritime transportation, the backbone of international trades), the projected increase in the world's population, or the urbanization of many developing countries. The challenge in addressing transportation-based emissions on a global scale is deriving appropriate solutions for countries according to their technological and manufacturing capability. Thus, two sets of solutions and recommendations have been proposed for developed and developing economies to reflect these differences.

Proper policy and urban planning are crucial for transport decarbonization. Key policy recommendations include large subsidy reductions for fossil fuels with the further allocation of those resources towards incentives to produce cleaner means of transportation (public transportation, electric vehicles, and hydrogen fuels). Furthermore, developing economies should focus on promoting urban planning and densification policy while providing capacity building to a wide range of stakeholders.

Sectoral transport (maritime, aviation) will need to undergo drastic changes to become sustainable, especially as some regional policies are considering incorporating them in trading emission systems. Key improvements in this sector would require a mix of electrification of aircraft and development of adequate airport infrastructure, switching to hybrid train and rail systems, promoting hydrogen goods transportation (maritime or road), industrializing and incentivizing cold-ironing, and adopting smart steaming strategies.

## **FOOD SYSTEM AND CIRCULAR ECONOMY**

Feeding a growing population of approximately 10 billion people by 2050 will be impossible without transforming agriculture and the food system. These sectors need to have adequate climate change responses which include both supply-side interventions such as a transformation towards more sustainable and efficient production, transport, and processing systems as well as demand-side interventions such as transforming eating habits and reducing food waste. Additionally, it is important to achieve livelihood security and enable access to food resources to fight poverty and hunger while addressing the impacts of climate change. These transformations will not only enhance food system resilience but also reduce GHG emissions.

The establishment of sustainable waste management practices that are effective, affordable,

promote health and safety benefits to the public, prevent soil, air, and water contamination, conserve natural resources, and provide renewable sources of energy that are generally environment friendly must be the priority. Governments need to develop policies to ensure that circular economy principles are applied to food waste. Financial support from development partners and financial institutions is required to promote effective solid waste management solutions. The private sector should be involved in leading innovation in food waste management, academic institutions should focus on scientific research, and non-governmental organizations should conduct field-based advocacy, monitoring, and evaluation. This, a multi-stakeholder partnership will enable a well-coordinated implementation of solutions that are beneficial to the society and the ecosystem.

## **SUSTAINABLE CITIES AND COMMUNITIES**

Cities consist of large complex systems that humanity has developed to modify its environment to thrive; however, the climate crisis and the COVID-19 pandemic have shown that our cities are still unprepared for future megatrends. Decoupling economic growth from environmental degradation, and mainstreaming climate change aspects through different city systems (institutions, infrastructure, services, communities, etc.) is essential for building resilience and reaching a net-zero future. Thus, while recovering from the pandemic, there is an urgent need to stimulate cities to restructure their economic densities so that their urban fabric is socially inclusive and environmentally sustainable.

Considering increasing urbanization and sea level rise among the main urban challenges that many cities around the world face, four main aspects have been identified that cities should prioritize in the upcoming years to accelerate sustainable and low-carbon transitions and to build resilience. Specifically, cities around the world should: develop and urbanize more sustainably, lower their buildings sector carbon footprint (without compromising housing affordability), increase coastal resilience, and enhance flood management. All these aspects help both climate change mitigation (reducing emissions and resource consumption, increasing carbon uptake) and adaptation (to increased temperatures, urban heat island effect, sea level rise, and flooding). Besides the provided policy recommendations and best practices applied throughout the world, authors highlight the importance of boosting international alliances (helped and guided by science) to support cities' smart and sustainable transformations, applying systems thinking approaches based on contextualized complex frames (like the doughnut economy for cities) to help decision-making towards circularity, and promoting inclusion of citizens in the exploration of new ways of more direct participation and shared governance - which should be cross-cutting across all the provided recommendations.

## **SUSTAINABILITY IN PRIVATE SECTOR**

As the private sector is one of the largest contributors to climate change, this category of stakeholders must take drastic measures to curb their negative impact and unlock sustainable solutions for all, by creating shared value. It's critical that the private sector would actively engage in the battle against climate change, not as a burden or a form of taxation, but rather as a major economic opportunity for our generation.

The private sector can mobilize resources, usually quicker than public institutions, allowing for an agile response to climate change. Formal and informal partnerships are crucial to solving the complex problem that climate change poses to the world. Collaborative actions focused on achieving sustainable development goals will drive unlikely and informal coalitions and partnerships. Engaging with various partners will help develop innovative and sustainable solutions to tackle climate change and address the pressing issues.

Equally, policymakers must support and enable the transition for the private sector.

Among required actions are creating and fostering policies that provide certainty towards a sustainable, zero-emission future, engaging with the private sector in the initial phases of policy planning, incentivizing the private sector to embrace sustainable business practices while developing predictable regulatory and business environments, and bolstering access to digital infrastructure. The private sector should make sustainability a part of its business model while changing its business strategy and promoting transparency in operations.

To charter a new course for the private sector and bring a more sustainable transformation, key actions must be taken. Regulatory provisions can be used to generate specific actions of private companies, as well as to set a standard for environmental performances. Economic instruments can determine enterprises to go beyond compliance and participate in a transformative and more sustainable market engagement. Lastly, additional voluntary instruments create a more collaborative and hospitable environment for businesses to adopt sustainability, as they are founded on the spirit of constructive and consensual cooperation between government and business.

## CLIMATE EDUCATION FOR WOMEN AND YOUTH

Around the world, people still lack basic awareness and understanding of the drivers and impact of climate change, as well as options for reducing carbon emissions and adapting to the climate change impacts. In addition, climate change impacts are not equally distributed. Gender inequalities and development gaps increase the impacts of climate change for women and young people. Driving climate action through educating and empowering women and youth could lead to building resilience within communities. Thus, education and training are crucial to building capacity and enhance their ability to tackle climate change, especially as most of them have no access to information and resources related to climate action.

Despite the evidence that education has a strong role to play in both climate adaptation and mitigation, the global education community has done little to advance wide-scale education efforts. Solid, coherent policies and plans are the bedrock on which to build sustainable education systems, achieve educational development goals and contribute effectively to lifelong learning. At a time of growing inequality, closing the gaps in access to quality education requires a long-term vision, engagement, and effective collaboration between various stakeholders.

To do that, it's critical to develop climate educational guides for developing countries that include the most important elements about formal and informal education for women and young people, as well as relevant learning materials and tools. Establishing a climate education coalition provides a forum for expert discussion and unlocks the potential of collaborative work. Embedding climate topics into formal and non-formal education is another priority area for action that could contribute to increasing climate awareness among youth. Community-level climate education projects and initiatives could be a powerful tool for educating and empowering women. Thus, governments and local authorities should ensure funds and provide resources for these projects and initiatives.

## CONCLUSION

Considering the above-listed challenges, one can clearly understand that climate change is the defining issue of our generation. For this reason, bold actions – such as the ones included in this position paper – need to be taken now. This year's debates on climate must focus both on the global economic restart, as well as on accelerating fast and sustainable transitions across seven thematic areas explored in the Position Paper.

Delaying any decisive measures would endanger even more our chances of alleviating climate change effects. We must act individually and collectively. **And we must act now.**

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# CHAPTER 1 GREEN ECONOMIC RECOVERY AND CLIMATE FINANCE

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Tackling climate change opens a range of opportunities and a glimmer of hope towards a more just, inclusive, and prosperous future. The COVID-19 pandemic, still plaguing most of the world's nations, also provides an opportunity for reshaping and reinventing the global economy. An economic "restart" can be leveraged for a "green" recovery with further reconfiguring global supply chains, reimagining work, and more. However, reshaping the global economy will require collaboration and coordinated action between a myriad of actors: corporations, banks, insurance companies, regulators, policymakers, non-governmental organizations, and consumers.

The financial sector has an important role to play in the fight against climate change. Bringing the climate change narrative into financial decision-making requires mainstreaming of climate reporting, proper risk management, and sustainable financial instruments and mechanisms. In a landmark letter to CEOs in 2020, BlackRock's CEO and founder Larry Fink declared that "Climate Risk is Financial Risk."<sup>2</sup> Although it is not a new concept, this unequivocal statement pointed out the need to change how the financial system measures, evaluates and addresses the risks caused by climate change.

This chapter explores key issues that lie at the center of economic recovery and climate finance and provides policy recommendations for various stakeholders engaged in climate action.

## GREEN ECONOMIC RECOVERY AND GREEN JOBS

The COVID-19 pandemic had a severe impact on the global economy. At the same time, it created momentum for building back better while addressing climate change. The governments have announced various green stimulus packages, but there are some doubts related to their impact

and scope. A significant amount of funding is still allocated for carbon-intensive industries, which contradicts the governments' rhetoric and aspirations for sustainable recovery. Furthermore, many developing countries that have been hit hard by the pandemic lack strong policies and financial mechanisms to address the socioeconomic impacts of the COVID-19.

Green economic recovery allows tackling the climate crisis but also revealing new job opportunities, as a result of the rapid transition to a sustainable economy. Recent studies have shown that the shift to renewable energy creates three jobs for each job lost in the fossil fuel sector, and for each \$1 million that shifts away from fossil fuels to renewable energy, nearly five additional jobs are created.<sup>3</sup>

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Ending carbon-intensive project financing:** Governments should remove fossil fuel subsidies and stop providing public finance for carbon-intensive projects. Instead, they should develop policies that will help to leverage the investment away from fossil fuels. Developing countries can benefit from leapfrogging beyond fossil fuel, which means bypassing the middle stages of the development process that industrialized countries have gone through.
- **Supporting net-zero transition by reducing uncertainties:** Policymakers should offer net-zero transition policies to reduce the uncertainty for the private sector. A clear policy framework will signal the government's approach to this transition and can help address the uncertainties.
- **Providing recovery packages:** Policymakers, with support from international organizations, should devise recovery packages that cater to

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<sup>1</sup> Last name alphabetical order.

<sup>2</sup> Fink, Larry. 2020. "Larry Fink's Letter to CEOs: A Fundamental Reshaping of Finance." <https://www.blackrock.com/corporate/investor-relations/2020-larry-fink-ceo-letter>

<sup>3</sup> Garrett-Peltier, Heidi. 2016. "Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model." <https://doi.org/10.1016/j.econmod.2016.11.012>

developing countries. Examples of powerful mechanisms include state aid or export credits to scale up clean energy in developing countries.<sup>4</sup>

- **Creating new green jobs:** Policymakers should support the creation of new green jobs to achieve a just transition. Furthermore, they should support the development of reskilling programs for the employees from the most affected sectors (e.g. coal, oil, and gas) and allocate sufficient funds for social protection programs to support affected communities.

## CLIMATE RISK

Based on the literature review, the following gaps with respect to climate risk could be identified:

- **Nature of climate risk:** Climate risk has no one-size-fits-all solution due to its multifaceted nature. Climate risk covers a collection of risks and changes, creating a cascade. Climate risk includes a variety of issues, such as the increasing violence and prevalence of storms, damages caused by heat waves, changing ecosystems and threats to biodiversity, and many other factors. Such risks ultimately change the underlying assumptions upon which current risk assessment models operate and turn even some of the most basic truths, such as an area of land not being flooded regularly, untrue. In turn, these changes expose financial institutions, such as investors and insurance companies, to losses that they are not prepared to deal with.
- **Voluntarism:** There are no globally accepted mandatory standards for reporting or managing risks by financial institutions (investors, banks, and insurers). As recognized by Moody, “[t]here is no widely accepted standard for reporting on a firm’s climate vulnerability or any standard for how its lenders should recognize those risks.”<sup>5</sup>
- **Operationalization of climate risk management:** Even if a global framework is to be rapidly adopted, there are still many challenges to tackle from an operational perspective. Effective risk models require granular data, accurate models, and mechanisms to operationalize insights and inform decisions.

In light of the gaps identified, it is important to develop a comprehensive approach to climate risk

management that will enable financial institutions to manage financial risks caused by the climate crisis.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Development of robust frameworks to assess and manage climate risk in financial institutions:** Managing climate risk and ensuring financial institutions can function in the face of a changing climate requires developing more sophisticated and robust frameworks, models, and projections on the risk nature and severity, to properly assign probability and cost to such risks. International organizations and governments must continue developing these frameworks to allow financial institutions to adapt to climate risk.
- **Promotion of mandatory standardization of climate risk management frameworks across the developed and developing markets:** With the growing importance and dominance of climate risk to financial institutions, the voluntary approach is not sustainable, especially given the global nature of both the financial system and climate change. International organizations and regulators need to create mandatory standards that will be applicable in both developed and developing markets, as well as standardized requirements across different industries and institutions. Standardization does not necessarily mean that all organizations will be required to behave the same way; it does, however, mean that financial institutions should be required to uphold certain standards that will be applied according to their contexts.
- **Standardization of climate-related data:** Collecting up-to-date and granular data by the relevant ministries in national governments and international donor agencies is required to produce accurate and reliable models and projections. Data standardization includes several

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<sup>4</sup> Organisation for Economic Co-operation and Development, International Energy Agency, Nuclear Energy Agency, and International Transport Forum. *Aligning Policies for a Low-carbon Economy*. Paris: OECD Publishing, 2015. <http://dx.doi.org/10.1787/9789264233294-en>.

<sup>5</sup> Moody's Analytics. 2021. <https://www.moodyanalytics.com/articles/2021/how-us-banks-are-addressing-climate-risk>.

dimensions: data collection (what, when, how much, and at which level of granularity), data processing, reporting, and analysis. Data standardization will increase its usability, trustworthiness, and reliability. However, it also requires finding the right balance between the global data standardization requirements and local context to unlock its value.

- **Creating global review and testing schemes:**

Managing climate risk requires preparation for different scenarios. Regulators, central banks, and governments should leverage tools to prepare for the realization of high-impact, low-probability scenarios. Examples include the Stress Test, which is a tool driven by central banks. Financial institutions should undergo adequate and periodic tests and simulations that focus on climate risks and their management.

- **Enhancing government and regulatory voice and action:**

Governments and regulators have a pivotal role to play by acting as enablers and drivers of climate risk management. Regulatory action will help to create enforceable standards, while governments can encourage and reward “good” behavior among financial institutions.

## ESG AND SUSTAINABILITY REPORTING

Environment, Social, and Governance (ESG) / Sustainability Reporting is gaining traction and grows in significance. The KPMG Survey of Sustainability Reporting shows that over 80 percent of the largest companies in the world are reporting their sustainability.<sup>6</sup> Environmental concern has risen by 128% among Generation Z in a year.<sup>7</sup> Increasingly, investors are looking for evidence of sustainability (ESG) measures and as per McKinsey’s research, 97% of investors believe sustainability measures should also be audited.<sup>8</sup> The European Union Non-Financial Reporting Directive (Directive 2014/95/EU), being superseded by Corporate Sustainability Reporting Directive, is an example of a successful application of social and environmental reporting.<sup>9</sup>

Despite the growing popularity, many challenges remain, including the following:

- **Greenwashing:** Many organizations understand the need for sustainability-focused operations. However, they use greenwashing to improve the public image of being green and eco-conscious through their marketing without upholding these values in their actions and practice.
- **Lack of standardization:** Reporting on sustainability has not been a common practice among companies and the information disclosed varies significantly. Specifically, disclosed information lacks structure, guidance, enforcement, and consistency.
- **Actionability:** Investors and other stakeholders are unable to properly assess the performance of companies on ESG and have insufficient information for risk assessment and forecasting due to a lack of standardized data.

It is important to implement standardized, effective, and efficient ESG/Sustainability Reporting requirements to ensure a holistic approach to reporting on climate impacts by various organizations.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Development of standardized internal and external reporting frameworks:** Policymakers and regulators should develop mandatory legislative requirements for corporate sustainability reporting, using predefined international frameworks on a country-wise basis. The ESG/Sustainability Reporting disclosures should become more detailed and standardized; this will pave the way towards a global common language for ESG reporting. Such standards should apply

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<sup>6</sup> KPMG. 2020. “The time has to come. The KPMG Survey of Sustainability Reporting.” Accessed September 1, 2021. <https://home.kpmg/xx/en/home/insights/2020/11/the-time-has-come-survey-of-sustainability-reporting.html>

<sup>7</sup> Peakon. 2020. “Peakon Reveals Four Employee Expectations Trends for Workplace.” Accessed September 1, 2021. <https://peakon.com/us/press/press-releases/peakon-reveals-four-employee-expectations-trends-for-workplace-in-2020/>

<sup>8</sup> Sara Bernow, Jonathan Godsall, Bryce Klempner, and Charlotte Merten. 2019. “More than values: The value-based sustainability reporting that investors want.” Accessed September 1, 2021. <https://www.mckinsey.com/business-functions/sustainability/our-insights/more-than-values-the-value-based-sustainability-reporting-that-investors-want>

<sup>9</sup> The European Commission. “Corporate sustainability reporting.” Accessed September 1, 2021. [https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting\\_en](https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en)

both to corporate reporting and reporting by financial and public institutions. One example of this can be found with the International Financial Reporting Standards Foundation, parent of the International Accounting Standards Board, which is working on setting up a parallel body to develop sustainability standards.<sup>10</sup> The rules created by that new body, the International Sustainability Standards Board, would focus narrowly on investor disclosures. These can be adopted by more than 140 countries that use international accounting standards. Other examples of currently used frameworks that can be expanded are Carbon Disclosure Project, the Climate Disclosure Standards Board, the Global Reporting Initiative, the Sustainability Accounting Standards Board, and the Value reporting Foundation.<sup>11</sup>

- **Involvement of small and medium enterprises (SMEs) for greater success:** Regulators and governments should also include SMEs under future regulations for robust green economic development. For this purpose, the framework for SMEs should be separately implemented. Frameworks like GRI, B Impact assessment, etc. can be used in this regard.
- **Providing tax incentives:** Regulators and governments should provide tax benefits for the ease of execution of mandatory requirements of sustainability reporting. For example, this can be accomplished through special tax relief in national budgets for companies meeting sustainability reporting criteria.
- **Supporting capacity building:** Education and training modules should be developed for the capacity building of companies without incurring the material cost. Capacity-building should be provided by governments or by corporate associations.
- **Accelerating reporting through tech:** Algorithm-driven systems are a potential game-changer in pushing the ESG agenda. Therefore, they should be adopted by corporations, financial institutions, international agencies, and governments. Harnessing technology to capture ESG data efficiently can greatly accelerate the adoption of enhanced standards and can play a pivotal role in adhering to existing and emerging climate regulations. The development of ESG reporting software for public and private sectors can enable companies to collect new data and

analyze it more effectively, allowing the creation of data repositories, dashboards, and reports. This can convey data in a meaningful way; not only reduce the burden of ESG reporting but also make it more actionable. Therefore, all stakeholders should adopt software to collect, analyze, process, and communicate ESG data and reports by technological means.

## CONCLUSION

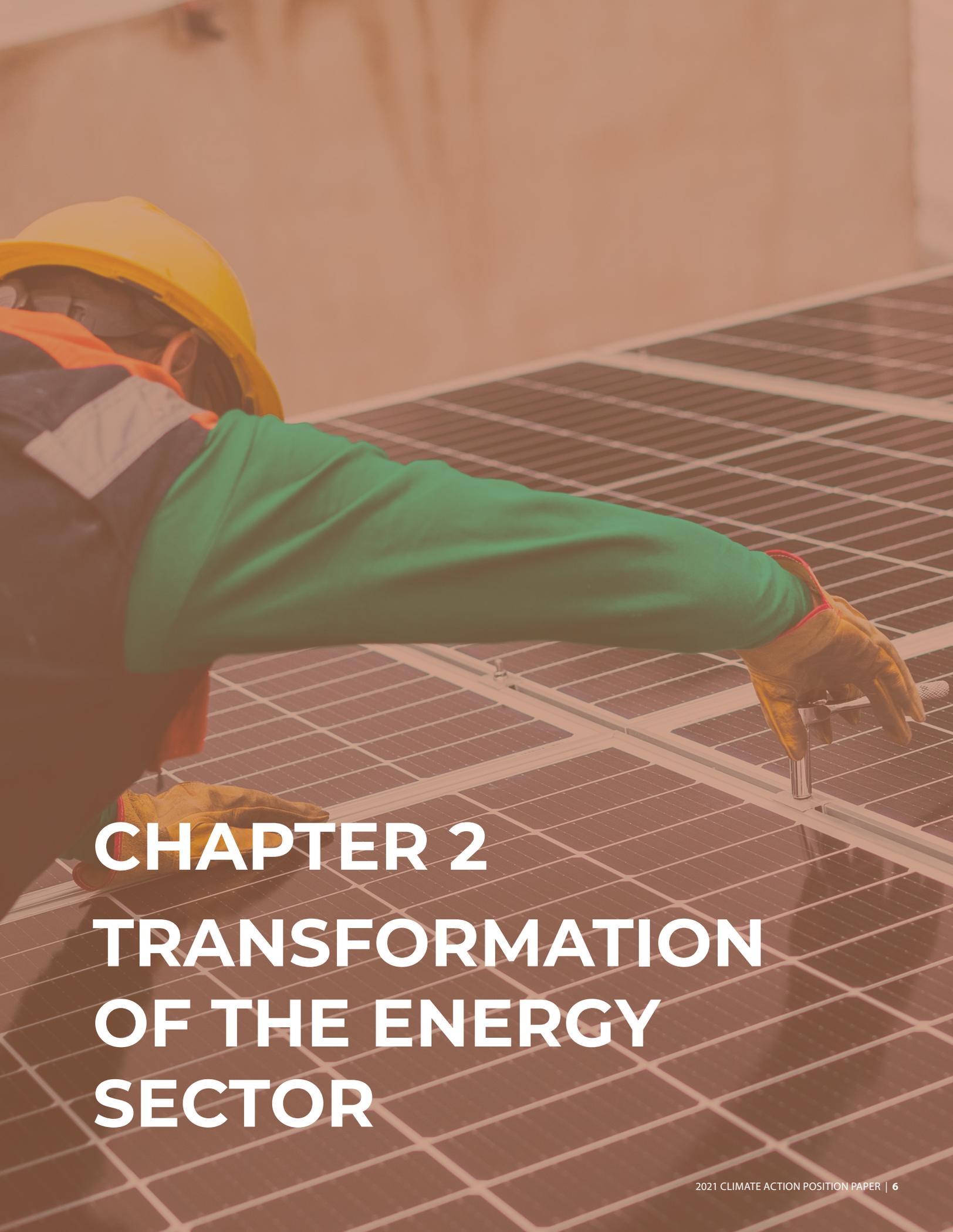
The components discussed in this chapter paint a clear picture regarding the global economic and financial systems and the climate crisis: across the board, these systems still have room to improve and mature. The COVID-19 crisis further exposed the deep inequalities and fragilities and offered an opportunity to address these challenges during the post-pandemic recovery. Governments, financial institutions, standards institutions, corporations, and other stakeholders will have to work in concert to ensure that the global economic and financial systems can withstand the global climate crisis and ensure the business continuity we will need as our planet is changing.

Based on the challenges and recommendations discussed above, there is a clear need to change the fundamentals of the global financial system, including the nature of risk assessment and management along with regulatory policies for sustainability reporting. These suggested changes stem from the understanding that we can no longer pretend that climate change can be tackled by individual actions based on voluntarism. Rather, mandatory global standards, requirements, regulations, and coordination will be among the powerful tools to combat the unfolding crisis. Our recommendations suggest tools that will allow the global financial system to course towards a more green and sustainable future.

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<sup>10</sup> IFRS. "Sustainability-related Reporting." Accessed September 1, 2021. <https://www.ifrs.org/projects/work-plan/sustainability-reporting/#about>

<sup>11</sup> IFRS. "IFRS Foundation Trustees announce working group to accelerate convergence in global sustainability reporting standards focused on enterprise value." Accessed September 1, 2021. <https://www.ifrs.org/news-and-events/news/2021/03/trustees-announce-working-group/>



# CHAPTER 2

# TRANSFORMATION

# OF THE ENERGY

# SECTOR

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Despite ongoing efforts, energy poverty remains a major subject of the international development agenda, particularly in low-income and lower-middle-income countries. Globally, the number of people without access to electricity declined from 1.2 billion in 2010 to 759 million in 2019. However, under current and planned policies, an estimated 660 million people would still lack access in 2030, most of them in Sub-Saharan Africa.<sup>13</sup> A joint response and well-coordinated efforts of various stakeholders are required to ensure closing the access gap and meeting the 2030 target of universal access to affordable, reliable, sustainable, and modern energy services.

While millions of people globally live without access to electricity, the energy sector is responsible for nearly 60% of global GHG emissions.<sup>14</sup> Specifically, electricity and heat generation along with the transport sector accounted for over two-thirds of total emissions in 2019 and have been responsible for almost all global emissions growth since 2010. The remaining third was mainly associated with the industry and buildings sectors.<sup>15</sup> To mitigate climate change, the global energy system must undergo a profound transformation by enhancing energy efficiency, promoting renewable energy, and pursuing extensive electrification while increasing system flexibility. According to the International Renewable Energy Agency (IRENA), renewables and electrification alone could provide 75% of the reductions needed.<sup>16</sup> Thus, renewable energy deployment in the power sector, coupled with transport electrification, would provide significant opportunities for the decarbonization of the energy sector while tackling climate change.

This chapter discusses emerging challenges around energy access in developing countries and proposes key solutions to ensure access to clean, safe, affordable, and reliable energy for all by 2030. Furthermore, it identifies the key sectoral challenges in financing clean energy investment along with

solutions that have the potential to effectively support energy transition. This chapter also outlines key challenges related to the deployment of EVs and their impact on climate change.

## ADVANCING ENERGY ACCESS

Oftentimes, the most economical ways of connecting communities to the grid are not the cleanest ones. There is a never-ending tension within governments between offering relatively quick and affordable energy access by utilizing fossil fuel generators, on one hand, and adopting more expensive clean solutions, such as wind or solar, on the other hand. The COVID-19 pandemic slowed down the efforts made in the last few years in increasing energy access. Among the reasons are governments' decisions to prioritize the available funds or financing to address health crisis, operational and financial problems faced by private companies that were involved in the sector, as well as recorded long delays and multiple shortages of various components across the supply chain due to limited global trade.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Focusing on long-term clean energy policies and solutions to promote energy access:** As international negotiations focus more and more on identifying solutions for fighting climate change, carbon taxes need to be gradually implemented on a larger scale in the coming years. By opting to invest today in fossil fuel generators, countries will be forced to manage stranded assets soon, as markets (technology, commodity, carbon-

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<sup>12</sup> Last name alphabetical order.

<sup>13</sup> International Energy Agency. World Energy Outlook 2020. Paris: IEA, 2020. <https://www.iea.org/reports/world-energy-outlook-2020>

<sup>14</sup> Ellen MacArthur Foundation. 2019. "Completing the Picture: How the Circular Economy Tackles Climate Change." Accessed September 1, 2021. <https://ellenmacarthurfoundation.org/completing-the-picture>

<sup>15</sup> International Energy Agency. 2021. "Greenhouse Gas Emissions from Energy: Overview." Accessed September 1, 2021. <https://www.iea.org/reports/greenhouse-gas-emissions-from-energy-overview>

<sup>16</sup> International Renewable Energy Agency. 2019. "Global energy transformation: A roadmap to 2050." Accessed August 4, 2021. [www.irena.org/publications/2019/Apr/Global-energy-transformation-A-roadmap-to-2050-2019Edition](http://www.irena.org/publications/2019/Apr/Global-energy-transformation-A-roadmap-to-2050-2019Edition).

related ones) will drive these electricity producers out of economically feasible business models. Thus, instead of opting for a cheaper solution that would provide a quick-win, governments should build their strategies on the current global efforts, such as the ones led by the European Union and the United States, and connect their needs to international trends and market evolution. However, as countries are facing different challenges, temporary limited solutions should be considered, as providing energy access “today” may generate enough economic growth “tomorrow” for the green transition to be implemented in time.

- **Development of off-grid solutions:** Bottom-up, localized solutions that enable users to transition from being passive consumers of energy to active prosumers could support the development of people-centered energy transitions too. To work towards universal energy access, many off-grid solutions have been implemented around the world, possibly benefiting from innovative business models. A good example is an introduction of the Pay-As-You-Go (PAYGo) model, which made it possible for IFC’s Lighting Africa to enable 20.5 million people across Africa to meet their basic electricity needs through quality-verified off-grid solar products.<sup>17</sup>
- **Fostering multi-stakeholder engagement and collaboration in providing energy access:** The number of stakeholders interested in providing energy access has increased significantly over the past years. As new communities are connected to the energy grids, not only utility companies can benefit. Banks and other financial institutions would also benefit from offering micro-credits for new small businesses (e.g. agriculture), while mobile phone operators would facilitate their reimbursement, while also providing connectivity to these new areas. Additionally, education or health services providers may also be interested in contributing to the newly developed local economy. In this context, governments should develop clear strategies, as well as subsidy schemes, for today’s no-access regions, as that will set the path for partnerships and joint investments by the above-mentioned actors.
- **Incorporating energy access solutions in economic recovery plans:** As various multilateral organizations and a vast range of development

banks are redesigning their strategies to boost the economic recovery, while also addressing structural societal issues (such as energy access and clean energy generation), capital will be available for developing countries. Thus, governments should create strong analytical strategies and develop a proper plan for tackling these issues as part of their economic recovery.

## UNLOCKING CLEAN ENERGY INVESTMENT OPPORTUNITIES

To reach net-zero emissions by 2050, annual clean energy investment worldwide will need to be more than triple by 2030 to around \$4 trillion.<sup>18</sup> In this investment scheme, enabling infrastructure and technologies is vital as clean electricity generation, network infrastructure and end-use sectors are key areas for increased investment. The IEA estimates that annual investment in transmission and distribution grids should expand to USD 820 billion by 2030 (from USD 260 billion today) and annual investment in CO<sub>2</sub> pipelines and hydrogen-enabling infrastructure should increase to around USD 40 billion in 2030 (from USD 1 billion today).<sup>19</sup>

Despite the critical need, clean energy investments worldwide remain below their potential. Two barriers remain: (i) lack of funding (investment gap) and (ii) price of technology and technology-related investments such as research & development. The investment gap is particularly problematic in emerging and developing economies, where the IEA estimates that annual clean energy investment needs to increase by more than seven times – from less than \$150 billion last year to over \$1 trillion by 2030 to put the world on track to reach net-zero emissions by 2050.<sup>20</sup> Unless much stronger action is taken, energy-related carbon dioxide emissions from these economies – which are mostly in Asia, Africa,

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<sup>17</sup> International Finance Corporation. 2017. “In Kenya, a Solar Program Puts ‘Last-Mile’ Consumers First.” Accessed July 29, 2021. [https://www.ifc.org/wps/wcm/connect/news\\_ext\\_content/ifc\\_external\\_corporate\\_site/news+and+events/news/impact-stories/lighting-africa-kenya-solar-program](https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/impact-stories/lighting-africa-kenya-solar-program).

<sup>18</sup> International Energy Agency. Net Zero by 2050 - A Roadmap for the Global Energy Sector. Paris: IEA, 2020. <https://www.iea.org/reports/net-zero-by-2050>

<sup>19</sup> International Energy Agency. 2021. *Ibid.*

<sup>20</sup> International Energy Agency. 2021. *Ibid.*

and Latin America – are set to grow by 5 billion tonnes over the next two decades.<sup>21</sup>

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Increasing the renewable energy competitiveness:** Government enabling policies played a critical role in reducing the cost of PVs.<sup>22</sup> Tax incentives could be an effective tool for increasing renewable energy competitiveness. With 0% or low tax rates for renewable energy equipment, solar and other renewable energy sources would rapidly become cheaper, leading to another investment boom, which would decrease the costs (economies of scale effect). Therefore, governments should develop various incentives schemes and de-risking mechanisms, to further accelerate the clean energy transition.
- **Financing research and development to boost innovation in the energy sector:** Through technology innovation, energy systems are bound to get smarter, enabling us to optimize energy flows throughout the system. Globally, there is a need to increase investments in innovation development to help bring ideas to the market. According to the IEA, CO<sub>2</sub> savings from technologies currently at the prototype or demonstration stage would be more than 75% higher in 2050 than in the Sustainable Development Scenario, and 45% of all emissions savings in 2050 would come from technologies that have not yet reached the market.<sup>23</sup> Concentrating efforts not only in scaling up available technologies but also investing in developing more efficient ones is key. Thus, increased levels of funding should be directed to research and development entities (be they public or private, such as start-ups), while peer-to-peer collaboration on these emerging technologies is critical in saving time and funds.
- **Creating an entrepreneurship ecosystem in the energy sector:** Governments should develop relevant policies to create an enabling environment for boosting entrepreneurship and supporting small and medium enterprises in the energy sector. Inadequate access to capital is one challenge faced by entrepreneurs. Thus, the

government should develop special funding programs for new energy companies and energy cooperatives to increase the number of energy sector entrepreneurs and increase investments in total.

- **Developing skills for the clean energy transition:** Deployment of renewable energy technologies can lead to the creation of jobs in the sector. According to IRENA, the renewable energy sector employed at least 11.5 million people, directly and indirectly, in 2019,<sup>24</sup> with the potential to reach 30 million by 2030.<sup>25</sup> Moreover, new jobs created in transition-related technologies would substantially outweigh the job losses in the fossil fuel sectors. Despite the promising forecasts, the success of the creation of new jobs will depend on the existence of a local workforce equipped with the required skills. Well-coordinated action between government energy, education, labor, and social protection entities is crucial to develop a strategy and policy framework for skills development. Furthermore, governments should support the establishment of energy education and professional training centers and fund upskilling and reskilling programs and initiatives to develop the local workforce in the communities where clean energy installations will be located.

## ACCELERATING ELECTRIC MOBILITY DEPLOYMENT

Electric mobility is the cornerstone of climate impact mitigation strategies. Recent studies suggest that

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<sup>21</sup> International Energy Agency. 2021. "It's time to make clean energy investment in emerging and developing economies a top global priority." Accessed August 4, 2021. <https://www.iea.org/news/it-s-time-to-make-clean-energy-investment-in-emerging-and-developing-economies-a-top-global-priority>

<sup>22</sup> Chandler, David. L. 2018. "Explaining the Plummeting Cost of Solar Power." MIT News, Massachusetts Institute of Technology. 2018. Accessed August 3, 2021. <https://news.mit.edu/2018/explaining-dropping-solar-cost-1120>.

<sup>23</sup> International Energy Agency. 2020. "Clean Energy Innovation Needs Faster Progress." Accessed August 4, 2021. <https://www.iea.org/reports/clean-energy-innovation/clean-energy-innovation-needs-faster-progress>.

<sup>24</sup> International Renewable Energy Agency. Renewable Energy and Jobs – Annual Review 2020. Abu Dhabi: IRENA, 2020. <https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020>

<sup>25</sup> Ferroukhi, R., X.G. Casals and B. Parajuli. Measuring the socio-economics of transition: Focus on jobs. Abu Dhabi: IRENA, 2020. <https://www.irena.org/publications/2020/Aug/Measuring-the-socio-economics-of-transition>.

around 30% of the global fleet will be electrified by 2030.<sup>26</sup> However, the fleet of used vehicles remains large. It is now 1 billion units<sup>27</sup> and projected to rise to 2 billion units by 2050. Once out of commission in the origin country, they are sold cheaper in developing markets. The US, EU, and Japan exported 14 million units between 2015-2018, where 80% of vehicles failed to meet minimum safety and environmental standards.<sup>28</sup> Retrofitting could be considered as one of the solutions to address this problem.

There has been much progress in electrifying urban transport, both small and heavy vehicles. However, long-haul transport electrification still faces various challenges. The concept that is generically named "Coordinated Long-Haul Charging (CLC)"<sup>29</sup> prescribes building off-grid, renewable energy driven, fast-charging stations which are intelligently coupled and analyzed with long-haul vehicle's route planning and scheduling. This concept invokes the participation of multiple stakeholders and targets efficient energy generation and distribution amongst long-haul electric vehicles, without negatively impacting the national grid.

In a nutshell, electric trucks and buses will connect to the CLC Server and automatically book charging slots along the highway based on their trip schedule. A pantograph<sup>30</sup> automatically connects to the rooftop connector as the vehicle arrives and delivers the required power. As this technology requires the involvement of multiple high-level stakeholders, advanced AI, large infrastructural rollout, and access to advanced electrical storage technologies, developed economies should lead the way in implementing and making CLC Servers the gold standard for sustainable ground-shipping/transport.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Fostering adoption and manufacturing of EV:** Governments, sector stakeholders, investors in developed economies should focus on the upcoming EV market structure and demand. The international policy should support and promote EV manufacturing and supply. Strict rules related to the material used, quality, and safety are also important to ensure less impact on the environment during the whole life cycle

and recycling of EVs. Furthermore, the government should create financial incentives to support the installation of home, corporate, industrial, and highway clean energy charging stations. Financial institutions and banks should develop relevant financing instruments and mechanisms to further promote EV infrastructure and, thus, adoption.

- **Retrofitting as an effective policy in developing countries:** Policymakers should develop a proper policy, methodology, and regulation to support retrofitting. Governments and local authorities should provide financial and legal support to entrepreneurs to scale up manufacturing and assembly lines.
- **Switching to autonomous and shared EV:** Entrepreneurs are leading this innovation. The tech giants, IT, AI, and data solutions providers, on one side, together with national authorities and funding partners should continue to invest in research of development projects to improve and scale up these technologies.
- **Investing in R&D activities for clean energy smart charging for long-haul transport:** Utility companies, supported by different investing partners should invest efforts and resources in designing this infrastructure's systems and scale the solutions.
- **Promoting EV second-life battery use in energy storage:** EV batteries can be a major environmental issue if not properly recycled. There is a good amount of usable life cycle remaining after the first life use in high-end EVs. Utility companies, EV manufacturers, and governments should partner in deploying grid-scale (or even household scale) and renewable energy storage using second-life battery packs.
- **Supporting clean energy for e-bike and quadricycle (micro-mobility):** E-bikes and quadricycles are the new tools to replace cars and motorbikes in daily, short, personal, and

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<sup>27</sup> UN Environment Programme. Global Trade in Used Vehicles Report. Kenya: UNEP, 2020. <https://www.unep.org/resources/report/global-trade-used-vehicles-report>

<sup>28</sup> McGrath, Matt. 2020. "Climate change: 'Dangerous and dirty' used cars sold to Africa." Accessed September 1, 2021. <https://www.bbc.com/news/science-environment-54665545>.

<sup>29</sup> This term has been proposed by Gopal Kumar Mohoto who authored this section.

<sup>30</sup> Wikipedia. n.d. "Pantograph (transport)." Accessed September 1, 2021. [https://en.wikipedia.org/wiki/Pantograph\\_\(transport\)](https://en.wikipedia.org/wiki/Pantograph_(transport))

commercial city rides. Public-private partnerships are important in scaling up solutions that include solar energy and battery swapping stations across the cities.

- **Investing in bike lanes:** In addition to the above point, local authorities should continue their support in planning, financing, and building bike lanes, coupled with other policies that encourage bike adoption (vouchers for bicycles, bicycle parking lots, bike-only areas in cities).

towards clean means of transportation (train, e-bikes, electric buses, and trams, etc.), developing proper regulation for small-scale utilization of batteries of emerging prosumers, or investing in energy efficiency measures are important puzzle pieces in the collective efforts of consumers to reduce their emission footprint.

## CONCLUSION

Today, the power sector represents 20% of global energy consumption. But the percentage is expected to steeply increase, as the penetration of electrification in the transport, heating, and cooking sectors will significantly rise, as a result of sustainable policies. However, 0.8 billion people still lack access to energy today. They mostly live in harsh economic, social, and environmental conditions, as climate change is affecting them first. Immediate action needs to be taken to unlock the global economic opportunities available by lifting communities out of poverty. As various multilateral organizations and a vast range of development banks are redesigning their strategies to boost the economic recovery, while also addressing structural societal issues (such as energy access and clean energy generation), capital will be available for developing countries. Thus, governments should create strong analytical strategies for tackling these issues.

At the same, to increase the renewable generators' penetration, investment opportunities need to be scaled up, especially in developing regions of the world. Among important actions to be taken by various stakeholders are increasing renewable energy's competitiveness, boosting innovation through research and development, creating enabling environment for entrepreneurship, and developing skills required for the clean energy transition (including empowering utility operators with the know-how and technology to manage variable RE into the power systems). Equally, the electricity demand-side must be addressed, as clean and efficient consumers will play an important role in reaching climate targets. Fostering the adoption of electric vehicles (EVs) and nudging consumers

# CHAPTER 3

# THE FUTURE OF

# TRANSPORTATION

A person is riding a bicycle across a bridge. The bridge has ornate metal railings and hanging lanterns. In the background, a cityscape with various buildings is visible under a clear sky. The scene is captured in a cinematic style with strong shadows and highlights.

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Sustainability and transportation are two inextricably connected aspects in our race against climate change. Alone, the transportation sector accounts for nearly a fifth (16%) of the global greenhouse gas (GHG) emissions,<sup>32</sup> which stem primarily from burning fossil fuels to power transport activities across various sub-sectors (direct emissions) and indirect emissions from electricity generation. Furthermore, the sector has the lowest penetration of clean energy fuels and technologies for abating GHG emissions given that petroleum products account for nearly 94% of the global transportation fuels.<sup>33</sup> Despite vehicle efficiency improvements for land transport which already accounts for 80% of the total GHG emissions for transportation,<sup>23</sup> such emissions related to the sector are on the rise owing to increased demand as driven by the increasing number and size of vehicles on the road, as well as the continuing growth in passenger and freight activity across the air and maritime transportation. The strong growth in the gross domestic product (GDP) of developing economies is expected to continue in the next 20 years, elevating millions to middle-class economic status. As cited in Oxford Economics and Airbus forecasts, the middle class could rise from 40% of the world’s population in 2017 to 57% by 2037.<sup>34</sup> As the middle class expands in developing nations, so will the demand for the global travel and the consequential GHG emissions. To reduce transportation emissions by 2030, one key approach is to actively discourage or even sanction the use of fossil fuels in the sector, and alternatively promote technologies (beyond improving internal combustion vehicles efficiency) that are readily available, including electric vehicles, biofuels, hydrogen power vehicles, and natural gas vehicles. However, widespread implementation has been very limited even though most road transport policies target light-duty vehicles. This is due to the lack of supportive policies and economic structures for a rapid transition for many countries. Therefore, a mix of public-private partnerships and push/pull

policies are necessary to ensure a smooth transition into the usage of emission-free technologies for transportation. The availability of eco-friendly transportation infrastructure would also greatly benefit our sustainability goals, where policymakers can engage sound urban planning to ensure proper integration between the way of life and living sustainably.

The challenge in addressing transportation-based emissions on a global scale is deriving appropriate solutions for countries according to their technological and manufacturing capability. To provide the most effective guidelines possible, the scope of this paper will be divided into two segments: solutions for “developed economies” and solutions for “developing economies”. Studies show that not only are developing economies, such as the Organisation for Economic Co-operation and Development (OECD) countries, facing the largest risk due to climate change, their ability to rapidly produce technological and infrastructural innovations is limited due to reduced manufacturing capacity. While developed economies have the means to adapt more rapidly, they are responsible for the majority of emissions and must work to reduce their footprint to prevent further escalation of the climate crisis. To develop accessible solutions for all countries, the scope of this chapter will determine the best ways to distribute current technological and infrastructural innovations between developed and developing economies. Each solution can therefore be leveraged to the best of its ability by the appropriate economy and expedite our overall strategy towards achieving zero-emission transportation while considering the financial means of low-income countries.

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<sup>31</sup> Last name alphabetical order.

<sup>32</sup> Ritchie, H. 2020. “Sector by sector: where do global greenhouse gas emissions come from? Our World in Data.” Accessed September 1, 2021. <https://ourworldindata.org/ghg-emissions-by-sector>

<sup>33</sup> Intergovernmental Panel on Climate Change. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. Geneva: IPCC, 2014. <https://www.ipcc.ch/report/ar5/wg3/>.

<sup>34</sup> Overton, J. 2019. “Fact Sheet. The Growth in Greenhouse Gas Emissions from Commercial Aviation.” Accessed September 1, 2021. <https://www.eesi.org/papers/view/fact-sheet-the-growth-in-greenhouse-gas-emissions-from-commercial-aviation#1>.

## TECHNOLOGICAL, POLITICAL, AND SOCIAL CONSTRAINTS

There are key restrictions across the technological, political, and social sectors that must be considered before the best solutions can be implemented. The most important technological instance of this being biofuels. Research shows that when taking the land use into account for biofuel production (i.e. using land reserved for forests and converting them into biofuel farms), it is only 40% cleaner than gasoline.<sup>35</sup> Furthermore, cleaner microalgae-based biofuels are not adequately suitable for scale-up due to space constraints and their high cost per liter of biofuel. Therefore, the technological barriers for biofuels are too high to be a viable solution.

Political barriers include the high investment costs needed to build low-emission transport systems, the slow turnover of stock and infrastructure, and the limited impact of a carbon price on petroleum fuels already heavily taxed. Depending on the country's political frameworks, different strategies must be considered and it will be important to work with decentralized governments as their scope of action could positively impact their current community.

The role of changing market dynamics dictated by behavioral changes is a key social constraint that must be given consideration and will differ based on individual situations. These changes include purchasing larger heavier vehicles, the need for same-day deliveries, increased freight demand to move goods and provide services. With strategically-curved pricing strategies coupled with education policies in place, they can drive greater social acceptance about reducing transportation-based emissions, which can, in turn, induce sustainable shifts in purchasing and commuting patterns that are geared towards more efficient or zero-carbon modes of transport.

## POLICY AND URBAN PLANNING FOR TRANSPORT DECARBONIZATION

- **Greater fiscal policy support is required for cleaner fuels:** A critical element for

decarbonizing transport will be providing greater fiscal support for market conditions to promote sustainable transport solutions. Fiscal policies have the power to stimulate actors throughout the transport value chain, such as vehicle makers to provide more efficient technologies, industry players to support infrastructure development, and consumers for influencing behaviors. Research from Bloomberg New Energy Finance indicated that between 2015-2019 approximately \$3.3 trillion was spent supporting fossil fuels by the G20 countries alone.<sup>36</sup> Such funds could have been diverted to support the development of sustainable transport solutions. Within developing countries, high costs are incurred due to the volatile commodity markets of imported fuels. Utilizing sustainable energy sources through renewable energy or improved infrastructure has the potential to improve energy security. However, finance for supporting such a transition has been restricted, and now with developing countries still recovering from COVID19, trade-offs are being made between emission reduction activities and sustaining collapsing economies.

- **Policy instruments promoting urban planning in major cities:** Incorporating urban planning for reducing transport emissions is a growing trend given that in 2050 cities are estimated to host 70 percent of the world's population.<sup>37</sup> Thaller et al. 2021, indicated changes in transport will require various policy instruments to introduce structural changes within the urban environment.<sup>38</sup> The approach addresses not only emissions but tackles issues of air pollution, traffic congestion, and noise promoting overall better health and environmental awareness. Shifting from typical

<sup>35</sup> Scully et al. 2021. "Carbon Intensity of Corn Ethanol In The United States: State Of the Science." *Environmental Letters Research*, Volume 16, Number 4. <https://iopscience.iop.org/article/10.1088/1748-9326/abde08/pdf>

<sup>36</sup> BloombergNEF. 2021. "New Report Finds G-20 Member Countries Support Fossil Fuels at Levels Untenable to Achieve Paris Agreement Goals." Accessed September 1, 2021. <https://about.bnef.com/blog/new-report-finds-g-20-member-countries-support-fossil-fuels-at-levels-untenable-to-achieve-paris-agreement-goals/?sf147770597=1>

<sup>37</sup> United Nations. 2018. "68% of the World Population Projected to live in Urban Areas by 2050." Accessed September 1, 2021. <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

<sup>38</sup> Thaller et al. 2021. "How to design policy packages for sustainable transport: Balancing disruptiveness and implementability." *Transport Research Part D: Transport and Environment* Volume 91, February 2021, 102714. <https://www.sciencedirect.com/science/article/pii/S1361920921000201>

development traits economically developed economies have encouraged which includes individual mass car ownership, urban sprawl, and decentralized economic centers. Coordinating urban development with strategically placed transport hubs and paths, compounded with densified building layouts creates the opportunity for making movements more efficient. Globally cities in Europe, Asia, and the Americas have started to implement measures to support this movement. Policies have addressed three main areas related to pricing, regulatory instruments, and promoting public transport. The International Energy Agency outlined the diverse mechanisms used to influence mobility behaviors such as: Shared Bicycle Systems, Subsidized Public Transport Fares and Incorporating Cleaner Transport Options, Promoting Active Mobility through walking and cycling, Low Emission Zones and Tax Schemes affecting individual car owners.<sup>39</sup> Policies can avoid, shift and improve transport emissions reductions in both developed and developing countries.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS FOR DEVELOPED ECONOMIES:

- **Decreasing subsidies on fossil fuels:** Subsidy reforms by governments are requisite, for both producers and end consumers, to promote the competitiveness of cleaner options. Such subsidies include tax breaks, production credits, export credits, and other indirect benefits.
- **Increasing incentives for clean fuels:** Governments should apply tax incentives to accelerate the large-scale adoption of clean fuels. Rewarding early adopters and risk-taking behavior also encourage clean energy innovation.
- **Improving public transport infrastructure:** It will be incumbent upon governments in consultation with all stakeholders, to establish and execute enabling policies as well as regulatory frameworks for public transport systems that are electrified, automated, connected, shared, safe and smart.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS FOR DEVELOPING ECONOMIES:

- **Requesting increased financial support:** Government stakeholders should mobilize financial and technical assistance to invest and lift subsidies on fossil fuels while pursuing sustainable economic recovery.
- **Promoting urban planning and densification policy:** Sustainable urban development will require planned infill and densification. Judicious and stringent land-use policies by city authorities will curb inefficiencies and environmental degradation within the sprawling and newly emerging cities.
- **Providing capacity building for local stakeholders:** There is a great need for governments in collaboration with non-government and private stakeholders. In addition, academic and research institutions should raise their capacity to research, document, and disseminate innovations.

## SECTORAL TRANSPORT INNOVATION

- **Electric Aviation and Efficient Use of Airport Infrastructure:** Sustainable transportation extends well and far beyond vehicles on the road. Besides zero CO<sub>2</sub> emissions, electric aircrafts like the eFlyer have higher motor and aerodynamic efficiencies that yield lower operating costs than conventional fuel-based planes.<sup>40</sup> Developed economies can thus emulate the Norwegian government's approach of working with aircraft makers Airbus and Boeing to develop airliner-size electric aircrafts that can carry 100 passengers for at least 1,000 km, to mandatorily support all of its short-haul flights by 2040.<sup>41</sup> With greater demand elasticities, developed economies

<sup>39</sup> International Energy Agency. Tracking Transport 2020 Report - More Efforts Needed. Paris: IEA, 2020. <https://www.iea.org/reports/tracking-transport-2020>

<sup>40</sup> Bachmann, D. 2021. "This New 8-Seat Electric Airplane Costs 80% Less to Fly Than Conventional Aircraft." Accessed September 1, 2021. [https://www.yahoo.com/lifestyle/8-seat-electric-airplane-costs-140000654.html?soc\\_src=social-sh&soc\\_trk=ma](https://www.yahoo.com/lifestyle/8-seat-electric-airplane-costs-140000654.html?soc_src=social-sh&soc_trk=ma)

<sup>41</sup> Dowling, S. 2018. "Norway's plan for a fleet of electric planes. BBC." Accessed September 1, 2021. <https://www.bbc.com/future/article/20180814-norways-plan-for-a-fleet-of-electric-planes>

<sup>42</sup> UIC. 2020. "Making Railway Greener, Quieter and More Energy Efficient. UIC." Accessed September 1, 2021. <https://uic.org/sustainability/>

can also tax flight providers and consumers to discourage fuel-based air travel, opening them to electric aviation or alternative modes of transport.<sup>23</sup> By setting up adequate airport infrastructure, developing economies can not only reduce considerable emissions from overcoming air traffic congestion with greater efficiency, but they can also leverage the growing electrification of flights to increase tourism opportunities and boost domestic economic growth.

- **Hybrid Locomotive, Hyperloop, and Electric Trams:** Having accounted for 8% of global passenger and freight transportation, railway contributes 2% of the sector's emissions.<sup>42</sup> For developed economies, switching from diesel to hybrid locomotives can yield significant savings and reduce CO2 emissions.<sup>43</sup> These benefits can be compounded as freight transport is increasingly decarbonized by way of rail options. Hyperloop technology can also be adopted as a fuel-free, high-speed solution for long-distance travel, especially as an alternative to short-to-medium haul aviation for developed economies,<sup>44</sup> which further alleviates air pollution, noise, road, and air congestion. For developing economies, replacing diesel commuter trains serving short routes with electric trams or having a mixed train-tram operation can cut fuel consumption and emission levels without compromising on commute. These trams should also be powered by renewable sources, as in Kenya's case, which lowered its emission factors by 81.8% via deriving 87% of its electricity from renewable hydro/geothermal sources.<sup>45</sup>
- **Maritime Cold Ironing and Smart Steaming:** Seaports can undertake the role of environmental stewards via cold ironing - to supply clean power to ships at berth through a land-based electrical grid powered by renewable sources for dockside needs while keeping their engines off.<sup>46</sup> Since cold ironing operates on a complex electrical infrastructure that hinders adoption, developed economies can offer incentives such as emission reduction credits to support port and ship owners in the cold ironing setup. Besides reducing fuel consumption, cold ironing cuts dock-side air and noise pollution in port cities, making them more hospitable for living. Developed economies can also industrialize cold ironing by introducing guidelines to encourage its widespread adoption.

On the other hand, developing economies can leverage smart steaming alongside the uptake in long-haul shipments. By incentivizing the optimization of vessel speed based on environmental conditions such as weather and port congestion, it can enable up to 30% reduction in fuel usage and consequently, GHG emissions.<sup>23</sup>

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS FOR DEVELOPED ECONOMIES:

- **Stipulating the electrification of aircrafts:** Governments can restrict short-haul flights to be served only by electric aircrafts and work concurrently with electric aircraft manufacturers to ensure adequate supply. Alternatively, flight providers and consumers can be taxed to discourage fuel-based air travel and induce positive sentiments towards electric air travel.
- **Switching to hybrid locomotives/hyperloop:** As freight transport becomes increasingly decarbonized via rail, the benefits of CO2 emission reduction through hybrid locomotives can be compounded. Hyperloop is another high-end rail solution that can serve, in the future, as an alternative for short-to-medium haul air travel, particularly reducing noise, road, and air congestion.
- **Industrializing and incentivizing cold ironing:** Seaports and ship owners can be guided by clear industry standards on setting up the cold ironing infrastructure and concurrently receive incentives to go ahead with the implementation of such a complex but sustainable solution.

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<sup>43</sup> Zasiadko, M. 2020. "DB Cargo upgrades fleet with dual-mode locomotives. Rail Freight." Accessed September 1, 2021. <https://www.railfreight.com/technology/2020/09/09/db-cargo-upgrades-fleet-with-dual-mode-locomotives/technology/2020/09/09/db-cargo-upgrades-fleet-with-dual-mode-locomotives/>

<sup>44</sup> Hansen, I. 2020. "Hyperloop transport technology assessment and system analysis." *Transportation Planning and Technology*, 43:8, 803-820, DOI: 10.1080/03081060.2020.1828935; Nøland, J. 2021. Prospects and Challenges of the Hyperloop Transportation System: A Systematic Technology Review. *IEEE Access*. 9, 28439-28458. 10.1109/ACCESS.2021.3057788.

<sup>45</sup> Wangai, A.W., Rohacs, D., and Boros, A. 2020. "Supporting the Sustainable Development of Railway Transport in Developing Countries." *Sustainability* 12, no. 9: 3572. <https://doi.org/10.3390/su12093572>

<sup>46</sup> Safety4Sea. 2019. "Cold Ironing: The role of ports in reducing shipping emissions. Safety4Sea." Accessed September 1, 2021. [https://safety4sea.com/cm-cold-ironing-the-role-of-ports-in-reducing-shipping-emissions/?\\_\\_cf\\_chl\\_jschl\\_tk\\_\\_=pmd\\_50d2ae4dfbf02837b7a7eccd43a75f836d3f6676-1627748493-0-gqNtZGzNAiKjcnBszQj6](https://safety4sea.com/cm-cold-ironing-the-role-of-ports-in-reducing-shipping-emissions/?__cf_chl_jschl_tk__=pmd_50d2ae4dfbf02837b7a7eccd43a75f836d3f6676-1627748493-0-gqNtZGzNAiKjcnBszQj6)

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS FOR DEVELOPING ECONOMIES:

- **Development of adequate airport infrastructure:** This can primarily overcome air traffic congestion and reduce emissions contributed by the airport cluster. The improved infrastructure can also play host to the growing fleet of electric aircrafts and create tourism opportunities.
- **Switching to electric trams for short routes:** Besides achieving similar commuting objectives, it, more importantly, reduces fuel consumption and emission levels, especially renewable energy sources are leveraged to power the tram operations.
- **Promoting smart steaming with long haul shipping:** With the growth in long haul maritime shipments, smart steaming can be capitalized to calibrate vessel operations according to situational conditions such as port congestion and weather adversity, to reduce GHG emissions.

## CONCLUSION

Developing a global sustainable transportation network will not be easy. Although technologies do exist for a theoretical elimination of GHG emissions, no single technology or policy will be able to eliminate emissions on a global scale. This is why developing an intimate understanding of the best policies and technologies as well as where they can be applied will be key in reaching our climate goals.

While there are regional differences in transport mitigation pathways, therein lies major opportunities to shape transport systems and infrastructure around low-carbon options, particularly in developing economies where most future urban growth will occur and consequently, a significant impact on the future share of transport-based GHG emissions. Therefore, developing economies should focus on mechanisms such as urban planning, seeking financial support, accurate collection of emissions data, leveraging renewable energy sources, and combustion vehicle retrofitting, to minimize the growth in emissions moving forward. On the other

hand, with a wealth of resources and robust access to technologies, developed economies must bear the burden of a dramatic shift in infrastructure and mindset to accommodate our climate goals. This will include maximizing the injection of electric vehicles and aircrafts in the global market along with policies to induce acceptance of emission-free travel, developing a critical infrastructure such as CLC Servers and cold ironing ports, and finally decreasing the average citizen's reliance on private commuting by improving the public transportation infrastructure.

Given a scenario where developed economies are unsuccessful in being an exemplar in sustainability for the rest of the world, it is likely that many developing economies will emulate the same infrastructural mistakes as they expand and progress towards the likes of their OECD counterparts. Should this happen, our ability to eliminate emissions in the transportation sector will be severely compromised along with our race against climate change. Nevertheless, an array of mutually supportive solutions will be needed for the transportation sector to decarbonize and for the co-benefits to be reaped. If we coordinate our efforts and utilize the solutions presented in this chapter on a global scale, we can achieve the coordination necessary to develop an equitable and sustainable transportation network for the world.

# CHAPTER 4

# FOOD SYSTEM AND

# CIRCULAR ECONOMY



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The global food system needs a fundamental transition to address the current production systems' challenges, including inaccessible technologies for food storage in developing countries, an increasing distance of newly urbanized populations to the source of production, and the need to fulfill nutritional needs of an approximated 10 billion people by 2050. Stakeholders from domains of research, development, business, governance across the entire agriculture value chain need to step out of silos and cooperate to create a sustainable food system. A sustainable food system could be defined as a food system that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised.<sup>48</sup> A systemic transition from current trends of production and consumption to the one that facilitates localized solutions in globalized settings would also ease pressure on the ecosystem, reduce GHG emissions and allow using resources more effectively.

According to the Food and Agriculture Organization, an estimated 1.3 billion tons of food is wasted globally each year – one-third of all food produced for human consumption. Food wastage's carbon footprint is estimated at 3.3 billion tons of CO<sub>2</sub> equivalent released into the atmosphere per year, making food loss waste responsible for about 8 percent of global GHG emissions. Less food loss and waste would lead to more efficient land use and better water resource management with positive impacts on climate change and livelihoods. Addressing food loss waste with a circular economy approach can help mitigate climate change.<sup>49</sup>

## FOOD PRODUCTION SYSTEMS

In order to feed the world's population by 2050, forecasts show that the total food production needs to increase by about 70% between 2005/07

and 2050.<sup>50</sup> Moreover, developing countries would need to double their food production capacity. To this end, agricultural economies of the world are facing post-green-revolution stress as governments continue to support chemical-based farming through input-based subsidies. This, combined with a lack of proper knowledge dissemination to farmers has led to overuse and misuse of chemicals in food production. Soil degradation, loss in biodiversity, and groundwater pollution are some of the well-known environmental impacts of pesticide overuse.<sup>51</sup> As the world sees an increase in the intensity and number of transboundary outbreaks of animal and plant pests and diseases,<sup>52</sup> this further threatens the global agricultural production systems. Moreover, changing climatic conditions predict a decline in crop growth, the availability of water, fisheries, and aquaculture yields, as well as the dysfunction of ecosystem services in all regions.<sup>53</sup>

There is a lack of consensus in the international community about the right solutions to overcome the challenges. The debates for the most suitable pathways for food production revolve around intensification (increasing output over the same area) or land sparing v/s extensification (bringing more land into agricultural production) of agriculture or land sharing.<sup>54</sup>

Sustainable intensification of agriculture is commonly interpreted as a practice where the same amount of land is used to increase yield per hectare without affecting the environment or with a low

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<sup>47</sup> Last name alphabetical order.

<sup>48</sup> Food and Agriculture Organization. 2018. "Sustainable Food Systems Concept and Framework. What is a Sustainable Food System? Why Take a Food Systems Approach? Changing Food Systems." Accessed September 5, 2021. <http://www.fao.org/3/ca2079en/CA2079EN.pdf>.

<sup>49</sup> Food and Agriculture Organization. 2015. "Food Loss and Waste Facts." Accessed September 5, 2021. <http://www.fao.org/3/i4807e/i4807e.pdf>

<sup>50</sup> Food and Agriculture Organization. 2009. "Global Agriculture towards 2050. In High Level Expert Forum - How to Feed the World in 2050." Accessed September 5, 2021. [http://www.fao.org/fileadmin/templates/wsfs/docs/Issues\\_papers/HLEF2050\\_Global\\_Agriculture.pdf](http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf)

<sup>51</sup> Sud, Megha. n.d. "Managing the Biodiversity Impacts of Fertiliser and Pesticide Use Overview and Insights from Trends and Policies across Selected OECD Countries- Environment Working Paper N°155." Accessed July 12, 2021. [www.oecd.org/environment/workingpapers.htm](http://www.oecd.org/environment/workingpapers.htm).

<sup>52</sup> Calicioglu, Ozgul, Alessandro Flammini, Stefania Bracco, Lorenzo Bellù, and Ralph Sims. 2019. "The Future Challenges of Food and Agriculture: An Integrated Analysis of Trends and Solutions." *Sustainability* 2019, Vol. 11, Page 222 11 (1): 222. <https://doi.org/10.3390/SU11010222>.

<sup>53</sup> Foresight. 2011. "The Future of Food and Farming: Challenges and Choices for Global Sustainability"

<sup>54</sup> Gabriel, Doreen, Steven M. Sait, William E. Kunin, and Tim G. Benton. 2013. "Food Production vs. Biodiversity: Comparing Organic and Conventional Agriculture." *Journal of Applied Ecology* 50 (2): 355–64. <https://doi.org/10.1111/1365-2664.12035>

impact.<sup>55</sup> Proponents of intensification of agriculture believe that less land used for agriculture gives more space for forest land to thrive, thus conserving biodiversity as well as lower net GHGEs compared to a scenario without intensification.<sup>56</sup> In contrast to this, others believe that sustainable intensification has replaced the term “green revolution” and become the most commonly used term to date to cope with the negative impact of traditional agricultural intensification methods.<sup>57</sup> Studies show that salinization, waterlogging, and water shortage are some of the back draws of an intensive irrigated agricultural system.<sup>58</sup>

On the one hand, land sharing seeks to restore biodiversity on existing ecosystems through principles of agroecology. Extensive agriculture uses lower inputs and allows the agricultural systems to benefit from ecological processes that are an offshoot of increased biodiversity on farmland.<sup>59</sup> On the other hand, extensification comes with risks of soil erosion and deforestation, leading to desertification.

Clearly, there are no well-defined solutions for any given place and time. Multiple agricultural solutions cater to diverse issues of climate change mitigation, adaptation, and biodiversity conservation. Coupled with socio-economic issues associated with different solutions, it becomes furthermore challenging to develop a “correct” solution at international or even national and sub-national levels. Such misalignment in schools of sustainable agriculture is a barrier for any sustainable solution to scale up at a level that generates viable impact. In India, for example, only five of the sixteen Sustainable Agriculture Practices have been scaled up beyond 5% of the net sown area and to 4% of the farmers.<sup>60</sup>

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<sup>55</sup> Xie, H., Huang, Y., Chen, Q., Zhang, Y., & Wu, Q. 2019. “Prospects for Agricultural Sustainable Intensification: A Review of Research.” *Land* 2019, Vol. 8, Page 157, 8(11), 157. <https://doi.org/10.3390/LAND8110157>

<sup>56</sup> Charles, H., & Godfray, J. 2015. The debate over sustainable intensification. *Food Security*, 7, 199–208. <https://doi.org/10.1007/s12571-015-0424-2>; Linus Blomqvist. n.d. “Sustainable Intensification: let’s refine industrial farming instead of abandoning it | Water, Land and Ecosystems.” Accessed July 12, 2021. <https://wle.cgiar.org/thrive/big-questions/sustainable-intensification-agriculture-oxymoron-or-real-deal/sustainable-4>

<sup>57</sup> Xie, H., Huang, Y., Chen, Q., Zhang, Y., & Wu, Q. 2019. *Ibid.*

<sup>58</sup> Sud, Megha. n.d. “Managing the Biodiversity Impacts of Fertiliser and Pesticide Use Overview and Insights from Trends and Policies across Selected OECD Countries-Environment Working Paper N°155.” Accessed July 12, 2021. [www.oecd.org/environment/workingpapers.htm](http://www.oecd.org/environment/workingpapers.htm).

<sup>59</sup> Salles, J.-M., Teillard D’eyry, F., Tichit, M., & Vinicuro Zanella, M. 2017. Land sparing versus land sharing: an economist’s perspective. Accessed July 12, 2021. <https://doi.org/10.1007/s10113-017-1142-4i>

<sup>60</sup> Gupta, N., Pradhan, S., Jain, A., & Patel, N. 2021. “Sustainable Agriculture in India 2021: What we know and how to scale up.” Accessed July 12, 2021. <https://www.ceew.in/sites/default/files/CEEW-FOLU-Sustainable-Agriculture-in-India-2021-20Apr21.pdf>

## **CASE STUDY: ANDHRA PRADESH COMMUNITY-MANAGED NATURAL FARMING**

Community-managed Natural Farming (CNF) is the biggest experiment of agroecology in the world. Started by Rythu Sadhikara Samstha (RySS) in Andhra Pradesh, it seeks to create a system-wide agroecological transformation. The initiative emerged in the midst of an ongoing agri-crisis in India where farmer livelihoods were under severe distress from rising costs of inputs, high debts, failing harvests, and lack of sufficient reasons for the youth to continue farming. The idea that “mother nature has solutions to all kinds of human-induced problems in the agriculture and food sector” was propagated by Subhash Palekar, the founder of principles of Zero Budget Natural Farming. The current form of CNF combines the principles of Zero Budget Natural Farming along with other agroecological techniques such as farmyard manure, vermicompost, NADEP compost, dung from buffaloes, and the use of bio inoculants.

The unique aspect of CNF is the way ecological science is made complementary to local cultures and knowledge. By teaching the principles of agroecology to the farmer community, CNF has found success as a knowledge-based initiative instead of pushing a new product in the market which might or might not be accessible to the farmers, particularly smallholder farmers. By making farmers the center of the solution, the adoption of localized and innovative natural farming techniques stays in the hands of the community, as RySS provides them transitional support and required handholding through their community champions. Over the years, various agro-ecological techniques have been adapted by community champion farmers according to the needs of their farms and context.

<https://apcnf.in/about-apcnf/>

In this context, the case study below serves as a good practice of how to scale sustainable agriculture at a principle level, without trying to fit a single solution to diverse contexts.

## FOOD DISTRIBUTION AND CONSUMPTION

The current food system feeds the great majority of the globe and over a billion people directly depend on it for their livelihoods. Climate change negatively affects all four pillars of food security: availability, access, utilization, and stability.<sup>61</sup> The changing climate adds food insecurity to the economic vulnerability of the poor, particularly the resource-dependent population such as farming communities. Food availability and productivity are threatened due to variations in the length of the cropping period and the rise in extreme weather events such as rising temperatures, precipitation, drought, and flood events. This also impacts food access and stability, particularly to remote places, as they make the transportation and logistics of the distribution of food more difficult. The nutrition stability of food is also being threatened with the changes in atmospheric CO<sub>2</sub> concentrations which can lead to a reduction in protein and mineral concentration in certain crops. Lastly, with the increase in climatic pests, diseases, and other human health risks, food utilization is impaired as we could have seen during the COVID-19 pandemic.

Cities will play a particularly important role in the coming decades. Food demand is expected to increase by over 70% in 2050, of which 80% will be consumed in cities that themselves are growing exponentially. Our current challenge is to provide tangible alternatives which can be adopted by cities around the world, particularly the global south where food security is a bigger challenge.

Packaging is playing a substantial role in the food system as plastic is one of the most lasting pollutants on earth, with a lifespan that can exceed 400 years. At each phase of its lifecycle, even after it is discarded, plastic produces GHG emissions that are contributing to climate change. A report of the Center for International Environmental Law, released in May 2021, indicates that the effect of the production of plastic on the global climate in 2021 amounts to the

output of 189 coal-fired stations. By 2050, the year by which plastic production is forecasted to triple, the report contends that it will account for 13% of the global carbon budget.<sup>62</sup> Packaging can simplify the safe transit of food, nevertheless, the increase in the use of plastic and other single-use packaging for food and e-commerce parcel deliveries has been observed during the COVID-19 pandemic. Plastic waste is principally introduced in the environment via poor management such as open burning, dumping, and disposal in waterways. Given that more than one-fourth of waste is dumped openly and many times improperly managed also informal disposal sites, the amount of plastic litter is increasing.<sup>63</sup> Even when collected, the problem in certain countries represents the processing of this plastic litter. Increasing awareness about the subject is critical.

## CIRCULAR ECONOMY SYSTEM FOR FOOD WASTE

A circular economy is significantly relevant to the sustainable food value chain due to the purpose to avoid waste and preserving the value of resources (raw materials, energy, and water) for as long as possible. While the linear economy clearly exposed the principle of take-make-dispose, circular economy replaces that principle with a new model of reduce-reuse-recycle that further transforming to a very innovative 5R methodology of refuse, reduce, reuse, repurpose, and recycle.

About a third of the global food production is either lost or wasted along the food chain, from production to consumption. This massive food loss and wastage

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<sup>61</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu. 2019. "Food Security". In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [PR. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)].

<sup>62</sup> Center for International Environmental Law, *Plastic and Planet, The Hidden Cost of a Plastic Planet*, May 2019

<sup>63</sup> Kaza, Silpa, Yao, Lisa C., Bhada-Tata, Perinaz, Van Woerden, Frank. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Urban Development. Washington, DC: World Bank, 2018. <https://openknowledge.worldbank.org/handle/10986/30317>.

is even more appalling when we consider the fact that currently, about 2 billion people consume low-quality diets, and around 850 million people in this world are undernourished.<sup>64</sup> Reduction in food losses and wastes contributes to both climate mitigation and adaptation efforts. Additionally, redirecting these losses and wastes to food insecure populations can contribute towards building resilience and help the vulnerable communities adapt to climate change.<sup>65</sup>

There are different approaches to achieving the targets of the food loss and waste policies. One approach is to target the food system as a whole, including food loss and waste as its integral component, and thus apply specific measures to the whole system to reduce food loss and waste. Among examples of the application of this approach are a tax on farming and a better information system to reduce weather risks. Another approach is to target food loss and waste directly, as a subset of the larger food system. One of the examples of this approach is related to preventing or abating loss and waste by financing storage systems or cold chains, and bringing waste back into the supply chain (i.e. by composting, using food waste for animal feed, donating edible food for charities, etc.).

Current waste management practices should be transformed. In the context of food usage, the circular economy needs innovation to create a more sustainable economy that seeks to reduce the amount of food loss and waste. In this regard, food waste can generate biogas fuel through anaerobic digestion (methane gas fermentation), providing households with clean energy.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

The following set of recommendations is proposed to policymakers and other stakeholders across the agriculture and food value chain.

### Solutions and Recommendations for Policymakers:

- A multi-stakeholder approach involving researchers, businesses, farmers, distributors, producers as well as consumers should be taken to enable the transformations required.
- Climate adaptation in general, and especially in

### CASE STUDY: TECHNO-ECONOMIC EVALUATION OF BIOGAS PRODUCTION FROM FOOD WASTE VIA ANAEROBIC DIGESTION<sup>66</sup>

Based on a study conducted on 12 types of food waste, all types used in that study showed a potential for biogas production through the anaerobic digestion process. The amount of biogas produced, and the methane concentration level depends on the nature of the food waste sample. The waste with higher carbohydrate content, such as rice, generated more biogas in a shorter retention time due to its easy and rapid degradability. Meanwhile, food waste with higher fat content, such as meat, needed more retention time to produce a higher amount of biogas, due to the complexity of the organic compound in fats. Biogas is mainly composed of methane and carbon dioxide, with trace elements of gases such as hydrogen sulfides, ammonia, and water vapor. There are several possible uses of biogas such as in cooking, heating, electricity generation, etc. This would generate mitigation on climate change and resilient communities for adaptation.

<https://www.nature.com/articles/s41598-020-72897-5>

the context of agriculture, cannot be a “one-size-fits-all” and has to be context-specific. Hence, knowledge-based localized solutions with support from the global community are the right way to go.

<sup>64</sup> Calicioglu, Ozgul, Alessandro Flammini, Stefania Bracco, Lorenzo Bellù, and Ralph Sims. 2019. “The Future Challenges of Food and Agriculture: An Integrated Analysis of Trends and Solutions.” *Sustainability* 2019, Vol. 11, Page 222 11 (1): 222. <https://doi.org/10.3390/SU11010222>.

<sup>65</sup> Food and Agriculture Organization. The future of food and agriculture – Trends and challenges. Rome: FAO, 2017.

<sup>66</sup> Al-Wahaibi, A., Osman, A.I., Al-Muhtaseb, A.H. et al. 2020. “Techno-economic evaluation of biogas production from food waste via anaerobic digestion.” *Sci Rep* 10, 15719. <https://doi.org/10.1038/s41598-020-72897-5>

- Farmers' entrepreneurship must be kept at the center of the solution. Active support to Farmer Producer Organizations and farmer cooperatives should be given to create appropriate market linkages for all farmers (smallholders, medium, and large farms).
- The convergence of resources in agriculture and agriculture-related activities such as forest management and livestock should be prioritized to optimize resource use and streamline policies that are currently created in silos.
- Awareness and education to consumers on nutrition, impacts of the food system on land, water, and air, as well as the threats from climatic and non-climatic stressors, need to be imparted.

### **Solutions and Recommendations for Businesses and Consumers:**

- Cities will be the key driver for food system changes requiring their food system to become more sustainable. Urban consumers need to become more aware of the importance and the availability of healthy, sustainable, and locally sourced food, and drive the change required to make the transformations required.
- Startups should bring farms closer to the cities by creating kitchen gardens and rooftop farms that would shift meager pressure away from rural areas, but more importantly, sensitize a growing urban population about food waste and the need to consume locally.
- Adopt approaches for food production and the food economy that are more sustainable and inclusive. Regenerative agriculture and more local, circular food systems are two ways to make the best out of our soils and other resources while reducing climate impacts and building local value and health.



# CHAPTER 5 SUSTAINABLE CITIES AND COMMUNITIES

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Cities consist of large complex systems that humanity has developed to modify its environment to thrive.<sup>68</sup> Nowadays, they are identified as the engine of the global economy, generating over 80% of the global GDP, but at the same time account for more than two-thirds of the global energy consumption and more than 70% of the global GHG emissions,<sup>69</sup> hence the main drivers of climate change.<sup>70</sup> Besides emissions (deriving from energy, transport, industrial, agriculture, waste sectors), cities contribute to climate change through resource depletion (destroying natural habitats that initially served as carbon sinks and home of biodiversity) and land albedo changes (due to uncontrolled urbanization) as well.

Rapid population growth, urbanization, infrastructure, and consumption trends will further increase cities' contribution to climate change,<sup>71</sup> but also the costs and damages caused by related impacts. Many cities are already facing the impacts caused due to the changing climate, which following the business-as-usual scenario will further increase other environmental and socio-economic challenges. According to the latest IPCC's Assessment Report (AR6 WG1), further urbanization will amplify heatwave and precipitation intensities.<sup>72</sup> In coastal areas, issues with flooding will become more probable due to sea level rise, storm surge, extreme rainfall, and river flow events.<sup>73</sup>

Being both a cause and a victim of climate change, cities can play a crucial role in mitigating it.<sup>74</sup> Smart choices in land use and urban planning, energy (renewable energy, green buildings, electric vehicles), industry, waste, and investments in public transport and open public spaces could help significantly lower GHG emissions.<sup>75</sup> This is especially true in developing countries (since they will be experiencing the fastest urbanization rate during the upcoming

two decades). However, while developed cities (with more financial and human resources) may manage to build resilience and develop on net-zero emissions, cities in the developing and the least developed countries continue to struggle, therefore, are left behind.

## SUSTAINABLE URBANIZATION

Nowadays, more than half of the global population lives in urban areas, and this is expected to increase to almost 70% by 2050.<sup>76</sup> In the last 50 years alone, humanity has built more than all civilizations' buildings in the previous times combined.<sup>77</sup> Following the growing urban population trend, it is estimated that 60% of the buildings that will exist by 2050 are yet to be built, which is like building a city the size of Stockholm or Milan (with around 1.5 million people) per week.<sup>78</sup>

This urbanization normally happens with the rise of industrialization and migration levels, energy

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<sup>67</sup> Last name alphabetical order.

<sup>68</sup> World Bank, United Nations Development Programme, Global Infrastructure Facility. Catalyzing Private Sector Investment in Climate Smart Cities. Invest4Climate Knowledge Series. Washington DC: World Bank, 2020. <https://openknowledge.worldbank.org/handle/10986/35928>

<sup>69</sup> World Bank. 2020. "Urban Development. Overview. Context." Accessed September 7, 2021. <https://www.worldbank.org/en/topic/urbandevelopment/overview#1>.

<sup>70</sup> Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, & W. Solecki. 2014. Urban areas. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

<sup>71</sup> World Bank et al. 2020. *Ibid.*

<sup>72</sup> Intergovernmental Panel on Climate Change. 2021. Summary for Policymakers. *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the IPCC. Cambridge University Press. In Press. Accessed September 10, 2021. <https://www.ipcc.ch/report/ar6/wg1/>.

<sup>73</sup> Intergovernmental Panel on Climate Change. 2021. *Ibid.*

<sup>74</sup> Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, & W. Solecki. 2014. Urban areas. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA; World Bank et al. 2020. *Ibid.*; UNFCCC. 2019. Guterres: 'Cities Are Where the Climate Battle Will Largely Be Won or Lost'. News. October 11, 2019.

<sup>75</sup> Bazaz, A., Bertoldi, P., Buckeridge, M., Cartwright, A., de Coninck, H., Engelbrecht, F., ... & Waisman, H. 2018. *Summary for urban policymakers: What the IPCC Special Report on global warming of 1.5°C means for cities*.

<sup>76</sup> United Nations. 2018. "68% of the world population projected to live in urban areas by 2050, says UN. Department of Economics and Social Affairs." News. May 16, 2018. New York. <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

<sup>77</sup> Gao, J., & O'Neill, B. C. 2020. "Mapping global urban land for the 21st century with data-driven simulations and Shared Socioeconomic Pathways." *Nature communications*, 11(1).

<sup>78</sup> C40 Cities, n.d. "Clean Construction Forum". Networks. <https://www.c40.org/networks/clean-construction-forum>.

consumption, and economic growth, while destroying fertile lands, topsoils and ecosystems, and depleting of water resources.<sup>79</sup> Hence, increased rural-urban migration and uncontrolled/unmanaged urbanization have created an almost internationally applied model that imposes great pressures on the natural systems that sustain human lives and it is now the time to revert that tendency.

The spatial distribution of this growing urban population and related land use designations will shape the societal impacts of environmental stresses, including exposure to air pollution, heatwaves, and vector-borne diseases.<sup>80</sup> Therefore, sustainable urbanization is key for overall development.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Promoting holistic/comprehensive urban planning:** Policymakers should develop integrated land use, housing, and transportation policies, which address climate change and other socio-economic aspects for longer-term periods. Future urban growth should follow principles of proximity and efficient resource consumption, which could be achieved by enabling the regulatory frameworks (e.g. zoning rules) for compact, mixed-use, and transit-oriented developments,<sup>81</sup> always in balance with rural areas (and at the regional scale) on a functional basis. Through urban development plans, local governments can restrict settlements' expansion in risk-prone areas. However, reserving urban land for flood mitigation (above or below ground) will likely lead to conflict with other potential uses (such as housing or agriculture); therefore, urbanization trends and potential trade-offs about land and water usage must be anticipated and addressed. The new concept of the "15-minute city" might help to promote development and wellbeing when creating more liveable and balanced urban spaces.
- **Enhancing collaboration between decision-makers at all levels:** National and local decision-makers should increase communication and collaboration towards enhancing cities' sustainable and low-carbon development. National authorities should equip local authorities
- with adequate decision-making capacity and sufficient financial resources to tackle respective challenges. Similarly, local authorities should consult with national authorities to ensure efficient and effective service delivery, and to monitor the results of national programs.
- **Integrating planning and financing:** Since climate action and related measures are usually expensive, integrated planning and financing with carefully planned investments is required. The governments of all levels, private sectors, and other stakeholders need to explore new funding models, policies, and risk assessments to overcome barriers towards developing cities smarter and more sustainable. The inclusion of green development incentives in the COVID-19 recovery packages is a start, however, climate change measures require continuous support, accompanied by ongoing awareness-raising campaigns.
- **Increasing international and regional support to developing and low-developed countries:** Having less human and financial resources to adapt to climate change impacts and shift to cleaner economies, developing and low-developed countries need increased international and regional support. International cooperation is also essential to design complex systems that accelerate the transition from the current unsustainable models at the pace needed, through both knowledge sharing and increased financing mechanisms. Besides direct infrastructural improvements (e.g. slums and informal settlements upgrades), financing can also support academic research and increased data availability, which helps in designing better and more sustainable cities.
- **Increasing inclusivity and equity in urban governance:** : At the governance level, both national and local governments should strive to increase the meaningful participation of

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<sup>79</sup> Jiménez Cisneros, B.E., T. Oki, N.W. Arnell, G. Benito, J.G. Cogley, P. Döll, T. Jiang, & S.S. Mwakalila. (2014). Freshwater resources. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

<sup>80</sup> Gao, J., & O'Neill, B. C. 2020. *Ibid.*

<sup>81</sup> The Worldwatch Institute. *State of the World: Can a City Be Sustainable?* Washington, DC: Island Press 2016. ISBN: 978-1-61091-755-1

women, men, girls, and boys and those who are vulnerable populations in urban governance, especially in decision-making processes. At the same time, they should establish effective, reliable, and transparent governance mechanisms that respond to their specific needs, interests, and challenges. A new urban planning approach would require tackling everything from an inclusive and equitable approach, including the needs, priorities, and perspectives of women, LGBTQI+ communities, indigenous people and ethnic minorities, youth, elderly, people with disabilities, and people from different religions, contexts or backgrounds. Furthermore, local authorities can further advance gender equality by integrating these perspectives into regulations and governance, and in the development of urban interventions.

## LOW-CARBON BUILDINGS

Buildings comprise one of the most significant functions in a city; however, current construction and consumption practices make them high resource and energy consumers. In 2019, buildings (including the construction industry) accounted for 38% of the total global energy-related emissions consumption.<sup>82</sup> Following the foreseen climate change impacts, the need for cooling or heating indoor spaces will increase. It is estimated that a 1 °C temperature increase may increase the need for cooling residential buildings by 5-20% and commercial ones by 9-15%.<sup>83</sup>

According to the IPCC, improvements in buildings' design and construction practices, coupled with advancements in technology, policies, and consumer behaviors, could reduce the energy demand in new buildings by ten times and existing buildings by two to four times.<sup>84</sup> In this regard, buildings have the highest cost-effective potential for reducing energy consumption and CO<sub>2</sub> emissions.<sup>85</sup> To curb the 1.5 °C warming, in 2050, emissions from the total global buildings stock should be 80-90% lower than the present day.<sup>86</sup> Therefore, buildings will have to become more energy-efficient and more resilient to the foreseen changes (e.g. increased temperatures).

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Improving building codes and standards:** Governments should improve the building codes, requiring new buildings to be more energy-efficient and more flexible (allowing for adaptation to changing needs). Many countries have adopted green codes (such as Green Building Code, EnergyStar and LEED in the United States, BREEAM in the United Kingdom, Low Energy Class in Denmark, and Green Mark in Singapore)<sup>87</sup> and require new buildings to follow the respective standards. Building codes should be flexible enough to adjust to local conditions in countries with more considerable climatic differences.<sup>88</sup> Cities, like Stockholm (Sweden) and Milan (Italy), have advanced their timber building standards, by starting to build wooden skyscrapers, which spend 10-20% less energy than those of concrete.<sup>89</sup> Many other cities require buildings to integrate features like rainwater harvesting, green roofs, natural indoor space lighting, and double balconies.
- **Providing financial incentives for retrofitting existing buildings or building new low-carbon ones:** To encourage increased energy efficiency, governments of Japan, Ireland, Luxembourg, and Germany provide financial support for installing solar panels for both residential and public buildings. Whereas those of Australia, Italy, and France issue 'white certificates' for projects that consume less energy, emit less, capture

<sup>82</sup> UN Environment Programme. 2020 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi: UNEP, 2020. [https://globalabc.org/sites/default/files/inline-files/2020%20Buildings%20GSR\\_FULL%20REPORT.pdf](https://globalabc.org/sites/default/files/inline-files/2020%20Buildings%20GSR_FULL%20REPORT.pdf)

<sup>83</sup> Goldman, S., Ungar, L., Capanna, S., & Simchak, T. 2012. *Energy Efficiency: A Tool for Climate Change Adaptation*. Technical Report February, Alliance to save energy.

<sup>84</sup> Lucon O., D. Urge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L. F. Cabeza, N. Eyre, A. Gadgil, L. D. D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, & M. V. Vilarino. 2014. *Buildings. Climate Change 2014: Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

<sup>85</sup> UN Environment Programme. Buildings and climate change: Summary for decision-makers. United Nations Environmental Programme, Sustainable Buildings and Climate Initiative. Paris: UNEP, 2009; UN-Habitat and UN Environment Programme. 2015. *Green building interventions for social housing*. ISBN: 978-92-1-132647-5.

<sup>86</sup> Bazaz et al. (2018). *Ibid.*

<sup>87</sup> The Worldwatch Institute. 2016. *Ibid.*

<sup>88</sup> Organisation for Economic Co-operation and Development. 2014. "Cities and Climate Change: National governments enabling local action." Accessed September 8, 2021. <https://www.oecd.org/env/cc/Cities-and-climate-change-2014-Policy-Perspectives-Final-web.pdf>

<sup>89</sup> Lucon et al. 2014. *Ibid.*

and store carbon.<sup>90</sup> However, current measures towards decarbonizing the buildings sector are not enough, and one of the opportunities for pushing this agenda forward can be through green (COVID-19 pandemic) recovery packages supporting buildings efficiency retrofits and performance standards (for new buildings).<sup>91</sup> The modernization of electric and water installations in most buildings, and also the implementation of smart and more energy-efficient systems of cooling and heating in buildings, is deeply needed for the years to come.<sup>92</sup>

- Addressing housing affordability:** Governments at all levels should make sure that buildings' upgrades or neighborhood regenerations do not contribute to environmental gentrification, further deepening the housing affordability crisis and social inequities. Affordable housing mandates and incentives (such as impact fee obligations or floor area ratios and credits) for the developers could increase the number of social and affordable housing units within the neighborhoods; hence, reducing the spatial mismatch between housing and jobs. Cities like Berlin (Germany), New York (US), or Barcelona (Spain) are applying rent control methods to regulate the market and protect the most vulnerable communities. On the other hand, cities like Vienna (Austria), Paris (France), and Helsinki (Finland), have utilized public-private partnerships and inclusive planning approaches to design sustainable public/social housing buildings (through compact designs and local materials). Helsinki, in addition, as a response to the housing shortage and increasing flux of refugees and migrants, reintroduced the concept of flexible space usage, encouraging standard apartments divisions through prefabricated walls by providing a 25% rent reduction to the donor apartment residents.<sup>93</sup>
- Increasing buildings' resilience to climate impacts:** Many people in developing countries such as Sub-Saharan Africa, Orangi Town in Karachi (Pakistan), Dharavi in Mumbai (India), Neza in Mexico live in substandard housing conditions or informal settlements on marginal land, hence being more vulnerable to climate hazards and related health impacts. Therefore, adapting buildings to the expected impacts (e.g. increasing structural stability, increasing

insulation, elevating structures on stilts) or managing retreat and prohibiting construction in risk-prone areas is also crucial.

## COASTAL RESILIENCE AND FLOOD MANAGEMENT

Sea level rise is one of the most significant climate change impacts,<sup>94</sup> posing severe risks to coastal communities' health and wellbeing, economies, ecosystems, infrastructure, and other systems,<sup>95</sup> as well as hindering the overall global development (as coastal areas serve as home to over half of the world). More than 90% of cities are located in coastal areas with almost half a billion urban residents,<sup>96</sup> significantly vulnerable to natural disasters and climate change effects caused by sea level rise.

Scientific research shows that climate change will continue to lead to an increase in sea level rise along many coastal communities. Following IPCC projections, many coastal cities will have land and property inundation issues,<sup>97</sup> whereas small island states will face significant challenges to their territorial integrity.<sup>98</sup> Many coastal cities could be permanently flooded by 2050, with millions (and even billions) of people being displaced.<sup>99</sup> At the same time,

<sup>90</sup> UN Environment Programme SBCL. 2009. *Ibid.*

<sup>91</sup> UN Environment Programme. 2020. *Ibid.*

<sup>92</sup> Khairi, M., Jaapar, A., & Yahya, Z. "The application, benefits and challenges of retrofitting the existing buildings." *IOP Conference Series: Materials Science and Engineering*, Vol. 271, No. 1, p. 012030.

<sup>93</sup> Peters, A. 2016. "How Europe's influx of refugees is inspiring creative, affordable housing for everyone." Accessed September 8, 2021. <https://www.fastcodesign.com/3063095/how-europes-influx-of-refugees-is-inspiring-creative-affordable-housing-for-everyone>

<sup>94</sup> Steinemann, M., Simonett, O., Stuhlberger, C., Diallo-Sahli, Y., Etter, B., Maselli, D., & Sigrist P. 2016. *Migration*. Climate Change & Environment Nexus Brief. Swiss Agency for Development and Cooperation: Bern, Switzerland.

<sup>95</sup> Caka, F., Chamberlain, A., Clessas, C., Ellis, E., & Tappan, N. 2017. Understanding Climate Change Induced Sea Level Rise in Coastal Cities. Cities and Climate Conference 2017, Potsdam, Germany.

<sup>96</sup> World Bank. 2020. *Ibid.*

<sup>97</sup> Neumann, J., D. Hudgens, J. Herter, & J. Martinich (2010). The economics of adaptation along developed coastlines. *Wiley Interdisciplinary Reviews: Climate Change*, 2, doi:10.1002/wcc.90; Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, & J. Weiss. (2012). Global Sea Level Rise Scenarios for the United States National Climate Assessment. NOAA Tech Memo OAR CPO-1, National Oceanic and Atmospheric Administration, Silver Spring, MD.

<sup>98</sup> Adger, W.N., J.M. Pulhin, J. Barnett, G.D. Dabelko, G.K. Hovelsrud, M. Levy, U. Oswald Spring, & C.H. Vogel. 2014. Human security. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

<sup>99</sup> Geisler, C., & Currens, B. 2017. "Impediments to inland resettlement under conditions of accelerated sea level rise." *Land Use Policy*, 66.

floods in cities can be caused by a combination of meteorological and hydrological variables (rainfall frequency and intensity, storms, temperature), which are aggravated by human behaviors. Many cities and communities around the world are already dealing with flooding issues, and climate change will further intensify them, with expected changes in frequency, intensity, and patterns that we have grown accustomed to over the last few decades.

Options to respond to coastal threats include coastal protection, accommodation, and planned retreat. There are a variety of measures to protect, replace, and redesign existing infrastructure (including flood proofing and flood protection) through dikes, berms, pumps, integration of natural landscape features, elevation, more frequent upgrades, or relocation.<sup>100</sup> Impact and adaptation assessments evaluate where these responses might be implemented and then calculate the costs of implementation and the damages to resources that are not protected. Depending on the policy options chosen to respond to sea level rise, the impact of rising seas could fall disproportionately on a small number of people or communities in the most vulnerable areas. Therefore, addressing sea level rise and planning respective adaptation measures requires joint planning by the impacted governments and local communities (especially those living in risk-prone areas or with lower capacities to adapt), weighing social, economic, and ecological considerations.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Undertaking sustainable coastal management measures:** Governments must reinforce the sustainable management and conservation of coastal zones to avoid significant adverse impacts caused by the rise of sea level and develop more sustainably at the same time. Hard shoreline protection against the encroaching sea (like building sea walls or riprap) generally aggravates erosion and beach loss, and causes negative effects on coastal ecosystems, undermining the attractiveness of beach tourism (which is the largest and fastest-growing economic sector in many parts of the world, providing service for different industries). Thus,

“soft protection,” such as beach replenishment or conservation and restoration of dunes and wetlands, is increasingly preferred to “hard protection” measures. Many local governments are already undertaking nature-based solutions (NBSs) to reduce the impact of storm surges, including expansion of beaches and dunes, creation of natural buffers (such as barrier islands, oysters, and coral reefs), and restoring wetlands and mangroves, seagrass, and salt marshes.<sup>101</sup> NBSs are often cost-effective and may improve the natural environment for the community. Another low-impact development measure is the increment of pervious surfaces in urban areas, including the adaptation of public spaces as retention ponds.

- **Multi-stakeholder planning:** Civil Society Organizations and funders at the national level should cooperate in taking action that should strengthen the resilience of coastal areas, and work with coastal communities for their restoration to achieve healthy and productive coastal ecosystems. Ministries of environmental protection shall develop, apply, maintain, and monitor limitation strategies for the construction of infrastructures alongside the coastal areas. Coastal authorities can make bye-laws to ensure the effective use of coastal areas and ensure that flood risk management is effective.
- **Involving population at risk in decision-making processes:** Local authorities need to work with coastal communities in the interests of flood risk management. People who will be affected by sea level rise must be sensitized and included in the decision-making process at the design phase before any plans are put into effect so that they can understand the importance and relevance of perhaps being relocated or altering their behaviors in a bid to climate mitigation.
- **Risk-informed planning:** Academia/scientists need to work with the planning authorities on the

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<sup>100</sup> Hallegatte, S. 2008. *Adaptation to climate change: Do not count on climate scientists to do your work*; Executive Order 13514. (2009). Federal Leadership in Environmental, Energy, and Economic Performance. Federal Register, 74, 52117-52127.

<sup>101</sup> Temmerman, S., Meire, P., Bouma, T. J., Herman, P. M., Ysebaert, T., & De Vriend, H. J. 2013. “Ecosystem-based coastal defence in the face of global change.” *Nature*, 504(7478), 79-83; Nicholls, R. J. 2011. Planning for the impacts of sea level rise. *Oceanography*. doi: 10.5670/oceanog.2011.34; Mendelsohn, R. 2012. “The economics of adaptation to climate change in developing countries.” *Climate Change Economics*, 3(02), 1250006.

implications of structures for flood and coastal erosion risk management in development plans. Additionally, scientists must identify, communicate, and make available data related to flood and coastal erosion prediction for the investors to carry out sustainable coastal protection work, including construction to mitigate against sea level rise. Research and innovation addressing the topic must be expanded and conducted in places all over the world, especially the developing and low developed countries, and regions.<sup>102</sup>

- **Developing policies and regulations for effective flood management:** Governments should develop national policies to ensure proper management of water resources in close coordination with other stakeholders, particularly combined management of surface and groundwater. A combined approach should involve planning at all levels, by getting the involvement of specialized technical agencies and local governments. It would maximize the efficient use of flood management resources for all the administration levels. Furthermore, necessary regulations, including building and municipal drainage and stormwater codes should be developed by relevant urban authorities while respective central environmental agencies and local authorities should undertake the monitoring. At the same time, governments should address water scarcity and boost resilience to droughts, making it possible to expand a region's overall water storage capacity.
- **Promoting the use of GIS technique in flood risk assessment and mapping for management and mitigation of flood:** Using Geographical Information System (GIS) technique will help reduce the damages caused by floods by analyzing and tracking inward and outward flow of rainwater and monitoring where and to which extent the flood has taken place in the particular location. By using that information, it will support the decision-making process in ensuring a better and well-managed flood in the future. By using the GIS technique and remote sensing, the map on areas where flooding occurs frequently; can be made and the decisions will be made based on the available map and locations on building sewage drains to ensure smooth water flow.
- **Enhancing emergency management systems:** When focusing on emergencies amidst climate

change, a significant portion should be given to the vulnerabilities that could occur due to climate change. Emergency managers should focus on certain hazards, with a certain frequency, and certain expectations regarding what is likely to happen. The preparation of Emergency Management Plans requires higher consideration to the evaluation of the historical experience of hazards and disasters. Funding, staffing, and resources should be based on these evaluations. Furthermore, it is critical to undertake a post-event evaluation after any flood occurrence (or emergency in general) to capture lessons gained from the experience and to identify methods to improve preparedness and response in the future. Representatives from all actors including responsible agencies, NGOs, community organizations, and victims should be included in such reviews while coordination must be carried out by relevant authorities.

## CONCLUSION

Our cities are still unprepared for future megatrends. The COVID-19 pandemic has once again emphasized the social and spatial disparities within cities, with the urban poor being among the most affected in terms of health impacts and loss of livelihoods, and women in general in terms of reduced mobility and increased gender-based violence. At the same time, it has shown that worldwide collective action (e.g. reduced transportation) can have a greater impact, such as improved air quality, which not only improves local services and public health outcomes but also reduces the intensity of carbon emissions. While recovering from the pandemic, there is an urgent need to stimulate cities to restructure their economic densities so that their urban fabric is socially inclusive and environmentally sustainable. An overall more holistic and integrated systems-based thinking is required when managing cities. Decoupling economic development from environmental degradation, and mainstreaming climate change aspects through different city systems (institutions, infrastructure, services,

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<sup>102</sup> Mcguire, C.J. 2017. Adapting to Sea Level Rise in the Coastal Zone. doi:10.4324/9781315097572

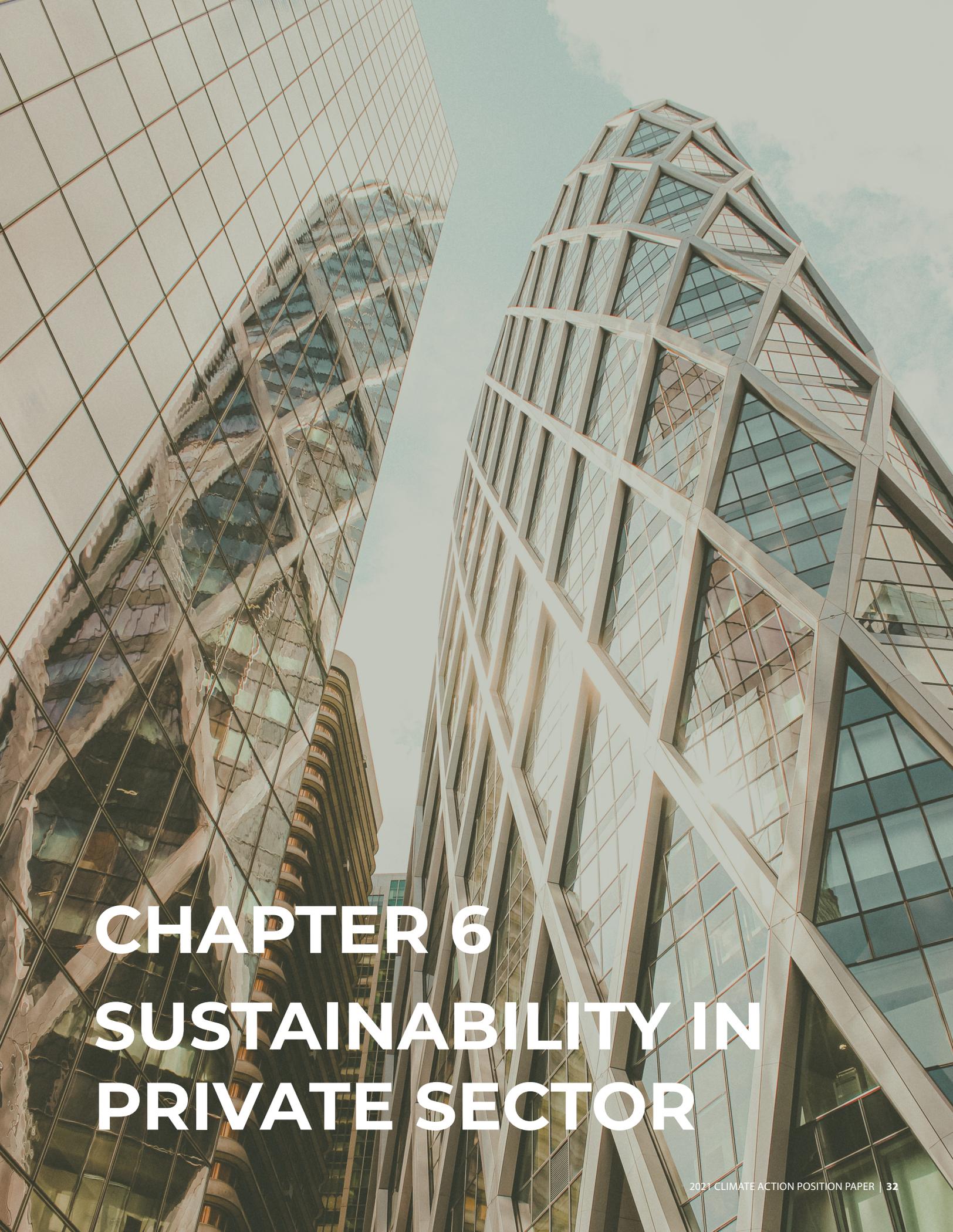
communities, etc.) is essential for building resilience and reaching a zero-carbon future. Cities and communities should definitely rebound with their nature and resources, leaving plenty for the upcoming generations.

This chapter explores a few aspects that could enhance cities' role in lowering their carbon footprint through urban form and buildings, and adapting to climate change impacts such as sea level rise and floods. Encouraging cities to develop evidence-based spatial planning documents (based on lots of data), to attain a specific benchmark of climate change action (in a range of smart services such as transport, energy, education, health services, water and sewerage, waste management, disaster management, data services, and networking), and to rethink the scale, design, and spatial layout of their public spaces (including sidewalks, parks, open spaces, and public facilities, such as libraries and community centers) is also critical for developing smarter. The doughnut economics model, already adopted by Amsterdam (the Netherlands) and currently being explored by Copenhagen (Denmark), Brussels (Belgium) and Nanaimo (Canada), is a great tool for context-based development planning, within the standards for human wellbeing without exceeding the planetary boundaries.<sup>103</sup>

Therefore, a new out-of-the-box approach that considers human well-being, climate mitigation and adaptation, and ecosystem restoration must be integrated into every decision taken, even if there is no simple relationship identified across the elements. Solutions must consider the whole of the global population to promote a green and just long-term urban strategy, even if they are implemented in a local context.

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<sup>103</sup> Meredith, S. 2021. "Amsterdam bet its post-Covid recovery on 'doughnut' economics — more cities are now following suit." Accessed September 7, 2021. <https://www.cnbc.com/2021/03/25/amsterdam-brussels-bet-on-doughnut-economics-amid-covid-crisis.html>



# CHAPTER 6 SUSTAINABILITY IN PRIVATE SECTOR

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Climate change has not slowed down and its connection with human well-being and poverty is increasingly visible. Unchecked, it will push 132 million people into poverty over the next 10 years, undoing hard-won development gains. There is slow adaptation and mitigation of the effects. The good news is that the Intergovernmental Panel on Climate Change (IPCC) AR6 Report published in August 2021 emphasizes the possibility to stop climate change and provides a clear call to action.<sup>105</sup> New policies have to be developed by policymakers while the private sector should take an action.

Research shows that 81% of consumers globally strongly feel that companies should help the environment and this belief will only become more prevalent as Millennials and Generation Z become the primary consumers in the market.<sup>106</sup> To fulfill the expectations and needs of consumers, businesses need to innovate now, and they have been. Private sector innovations like electric cars, remote working tools, and solar energy have already influenced the fight against climate change.

It is critical that the private sector actively engages in the battle against climate change, not as a burden or a form of taxation, but rather see it as a major economic opportunity for our generation. Businesses and investors across all countries are receiving a clear policy signal to undertake low-emissions or emission-neutral investment, whether through project financing or new technology investment. Governments are pledging to create an enabling policy environment for businesses and investors to accelerate the transition to a thriving clean economy.<sup>107</sup>

## ADDRESSING CHALLENGES TO BOOST SUSTAINABLE INNOVATION

The private sector faces several challenges to sustainable innovation, including the following:

- **Profitability:** Most private sector companies have concerns related to the cost of transitioning to a green economy (e.g., the cost of retraining staff and the cost of eco-friendly packaging). Moreover, the private sector is concerned about profitability, which is backed by demand and supply. The demand for sustainable products is low compared to the existing demand for non-sustainable products.
- **Lack of incentives:** Existing incentives result in further depletion of limited resources. Therefore, the private sector has limited financial incentives to promote sustainable innovation (e.g. tax reductions, limited access to finance, etc.).
- **Limited alternatives:** Economically viable alternatives and innovations to supplement current production processes are limited. It is stemming from inconclusive data on the effectiveness of innovations, the prevalence of cynics who do not see value in sustainability innovation, etc.
- **No structure for collaboration:** The supportive systems needed for collaboration between various actors across or within industries are either weak or non-existent. Better cooperation between a company and technical research institute or university on developing an innovative idea or a product is needed to further promote sustainable innovation.

There are several ways how different stakeholders are currently addressing these challenges. Firstly, national governments are providing internal incentives for green businesses. Secondly, private sector individual

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<sup>104</sup> Last name alphabetical order.

<sup>105</sup> Intergovernmental Panel on Climate Change. "IPCC Sixth Assessment Report (AR6-WG1)." IPCC, August 2021.

<sup>106</sup> Rickenbacher, Philipp. 2020. "Why Conscious Consumption Beats Retail Therapy." Accessed September 10, 2021. <https://www.weforum.org/agenda/2020/01/conscious-consumption-not-retail-therapy/>

<sup>107</sup> Wei, David, Edward Cameron, Samantha Harris, Emilie Prattico, Gareth Scheerder, and Joanna Zhou. The Paris Agreement: What it Means for Business. New York: We Mean Business, 2016.

investors and investment firms such as Blackrock and Goldman Sachs are providing packages that are focused on green businesses. Thirdly, development organizations such as the United Nations Framework Convention on Climate Change (UNFCCC) provide policy/treaties and incentives to nudge state parties to incite sustainable innovation with the private sector. And lastly, development banks at both international and regional levels are collaborating to provide financial incentives to private sector actors by creating funds and issuing low-interest rate loans and grants. The World Bank and Asian Development Bank, along with other development partners, have been working via Infrastructure Development Company Limited (IDCOL) to provide loans for Solar, Biogas, and other alternative energy projects.

Climate change requires joint efforts of various stakeholders. Climate action will result in the biggest transition of humankind in the modern days. This transition comes with different risks and opportunities for all stakeholders. To enjoy the opportunities brought by the transition, a various set of rules and activities has to be implemented by the different actors, policymakers, businesses, and society. There is an urgency to act now, as different measures have to be taken to take effect within the next few years to come. To combat climate change and ensure its longevity, the private sector must find ways to ramp up its sustainability efforts through rapid innovation. Sustainable innovation not only yields both top-line and bottom-line returns but also transforms the marketplace, stimulating innovation across industries and sectors. Through redesigning technology, processes, and business models with sustainability in mind, the private sector can create positive externalities and solidify itself as a key player in the fight against climate change.

Governments and policymakers have to quickly set the rules and boundaries for sustainable business activities. Businesses and society will need this clear commitment, ambitious tasks, and certainty of the way forward. There is a need to do everything to change behavior and changing behavior can only be reached with a clear objective and certainty of the way forward. Only this certainty and a clear plan will encourage businesses to look for innovation, build new business models, and take sustainable actions. At the same time, free-riding and exploitation have to be punished to strengthen the certainty of a sustainable future.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

### SHORT-TERM SOLUTIONS AND RECOMMENDATIONS:

- **Setting up a policy pathway that provides certainty towards a sustainable, zero-emission future:** Private sector decision-makers fear the uncertainty of new developments in the climate space and must change their mindset to allow for a net zero-emission and sustainable future. Policymakers have to ensure there is a policy pathway that provides the private sector with the certainty of future developments in sustainability (i.e. policies, guidelines, quotas, subsidies, etc.), encouraging them to move towards a cleaner future and prevent unsustainable behavior. It is vital that the policy pathway makes unsustainable actions more costly and provides certainty that things will not regress.
- **Encouraging informal partnerships between sectors to bridge pressing needs:** Informal cross-sectoral partnerships will be crucial to solving the complex problem that climate change poses to the world. Moving towards a more circular economy will bring sustainability to business operations while deploying agile solutions. The Adidas Group provides a fitting example, with their partnership with Parley for the Oceans.<sup>108</sup> To move towards a more circular economy, parties remain dependent on each other to complete the cycle. Adidas and Parley partnered together to reuse ocean plastic to create running shoes, diverting ocean plastic, reducing CO<sub>2</sub> emissions, and bringing additional awareness to the issue.
- **Improving supply chains through incentives from the public sector:** The public sector must act as a role model for transparent supply chains, building on the certification and traceability of commodities. This transparency is required for and sustainable activities. The policies must be designed in a way that the private sector has no other option than to transparently show the source and the

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<sup>108</sup> Liedtke, Eric, and Frank Henke. "Adidas Group Announces New Partnership WITH PARLEY for the Oceans and Launches SUSTAINABILITY Progress Report." Adidas, April 2015. <https://www.adidas-group.com/en/media/news-archive/press-releases/2015/adidas-group-announces-new-partnership-parley-oceans-and-launche/>.

impacts of their economic activity within their supply chain.

- **Promoting collaborative actions where national and subnational government agencies identify and mobilize resources:** At the current stage, it can be observed that certain regions, activities, businesses, and innovations evolve heterogeneously across the world. One way to foster and extend the reach of new business models is through partnerships or unlikely and informal coalitions.
- **Bolstering access to digital infrastructure:** Many new, scalable and sustainable business models exist or depend on the digital infrastructure. To provide these business models and opportunities a chance to compete in the marketplace and to access their full potential, the digital infrastructure is required and needs to become widely adopted.
- **Urging businesses to prioritize shared value creation:** The private sector is seen as a major source of social, economic, and environmental issues as they continue to focus on optimizing short-term financial performance, whilst neglecting the importance of long-term success and viability. By prioritizing the creation of shared value through producing economic value, as well as social value, companies have the opportunity to implement out-of-the-box solutions to address society's issues. Shared value steers companies to pursue profitable ventures that create societal benefits rather than diminish them. The private sector can create societal value by addressing various needs and challenges through reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters at the company's location.

### **MEDIUM- AND LONG-TERM SOLUTIONS AND RECOMMENDATIONS FOR GOVERNMENTS AND POLICYMAKERS:**

- **Development of hybrid environmental policies:** If the public and the private sector are both engaged in the initial phases of policy planning pertaining to their area, this will help bring on board various stakeholders to cooperate. This cooperation between the policymakers and the private sectors will not only help implement the policy, but the private sector would be more willing to execute it. The Government and the

private sector stakeholders have to meet halfway. This solution could be sustainable and viable in the long run.

- **Incentivizing the private sector:** Profit maximization and capturing of market share drives private companies. Therefore, not all private companies are and will be keen on embracing environmental policies that bind them to follow certain rules at the cost of their profit outlooks. Therefore, to win the partnership and cooperation of the private sector towards achieving this common goal, certain subsidies and exemptions have to be made, as well as taxes and complex regulations. These could be tariff reductions on green goods produced and import subsidies on the import of green technology.

### **MEDIUM- AND LONG-TERM SOLUTIONS AND RECOMMENDATIONS FOR THE PRIVATE SECTOR STAKEHOLDERS:**

- **Boosting sustainable development partnerships:** The private sector while building on partnerships should leverage shared overall objectives, mission, values, core competencies, and networking to implement projects which can be fostered. Such partnerships should be based on strong legal instruments like MoUs/ MoAs/agreements etc., which clearly state a sustainable business model to ensure that the activities through the partnership are in line with the written statements. This partnership should not only be built on financial benefits but should encourage one another to be the change for the future. When one key player in the private sector becomes sustainability-driven, it drives others within the sector to follow.
- **Promoting transparency:** As Martine Jarlgaard stated in an interview, "Being open and transparent is the only way forward."<sup>109</sup> With the importance given to sustainability and the impact of climate change, companies are releasing statements about their lofty sustainability goals and targets. However, many companies have fallen short of their environmental goals, leading to issues like "greenwashing" becoming material

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<sup>109</sup> Arthur, Rachel. "Transparency – Kering's Forensic Science Innovation Enables Traceable Organic Cotton." Current Daily, October 2018. <https://thecurrentdaily.com/tag/transparency/page/2/>.

topics in the sector. National governments need to have in place a feasible monitoring system to help ensure that the private sector is not deceiving the public. Being transparent will help businesses become more accountable, which in turn ensures that they are striving to find innovations to decrease their footprint, which will foster credibility with consumers.

- **Changing the business model:** Making sustainability a part of the business model would require a change in business strategy. This will give rise to innovation within the employees, from production to marketing products and services that generate sustainable choices from consumers. This change will help the private sector regain trust from society, consumers, and employees. It can also assist the sector in building cross-sector partnerships with the government, civil society and contribute positively to the community. For example, Unilever completely shifted their business model to be centered around sustainability, with their *Unilever Sustainable Living Plan*.<sup>110</sup> This shift in strategy allowed more value creation, better stakeholder relations, and an incredibly high return on investment. Overall, businesses should set holistic, yet realistic goals and with sustainability at the forefront, they'll be able to innovate further and improve their longevity in this changing world. There is a market opportunity for businesses that highlight their sustainability activities. The next 5-10 years may not be a realistic goal to achieve, as it will take a while for the private sector to adapt to a new business model, and find solutions to recover any impacts the change can have on their business returns. There is the possibility of a change and reaching the goal in the next 20 years, especially if the main players which are the Government, policymakers, and the private sectors work hand-in-hand.

Some of the risks of the proposed solutions include the following:

## RISKS AND BARRIERS TO THE IMPLEMENTATION OF THE PROPOSED SOLUTIONS

- **Greenwashing:** Greenwashing is a deceptive marketing practice in which companies disseminate misinformation or misrepresent themselves in an attempt to improve their environmental image to appear favorable to consumers.
- **Exploitation:** Going green or sustainable is not cheap, and for higher returns to the business, companies may feel compelled to cut costs by acting unethically, through the exploitation of cheap raw materials and labor.
- **Opportunity inequalities:** Small companies and start-ups may lack access to the necessary capital required to assist them in developing their green programs. This may initially put them at a disadvantage when compared to bigger companies that can afford to go partially or fully green. This may create severe inequalities in opportunities, where large corporations capture significant incentives/subsidies for their green initiatives, leaving smaller companies behind indefinitely.
- **Consumer preferences:** Even if companies and industries make the effort to go green, they have no control over consumer preferences. If there is a demand, the private sector has no choice but to comply with consumers and supply what is in need.
- **Compliance with policy:** How will the stakeholders be monitored? Who will ensure that the private sector is abiding by the policies in place?

Climate adaptation projects require high levels of tailoring based on the risks associated with a specific geography, sector, and the exposure of assets or a population. What may be a highly effective intervention in one place may create new vulnerabilities and maladaptation in another place.<sup>111</sup> Companies cannot carry over learning effects from one place to another, requiring a need to be flexible

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<sup>110</sup> Unilever. "Unilever: Planet & Society." Unilever. Accessed September 15, 2021. <https://www.unilever.ca/planet-and-society/>.

<sup>111</sup> Miller, Alan, and Stacy Swann. 2019. "Driving Finance Today for the Climate Resilient Society of Tomorrow." Accessed September 10, 2021. [https://climatefinanceadvisors.com/wp-content/uploads/2019/07/GCA-Adaptation-Finance-background-paper\\_FINAL-7-17-19.pdf](https://climatefinanceadvisors.com/wp-content/uploads/2019/07/GCA-Adaptation-Finance-background-paper_FINAL-7-17-19.pdf)

and unique in all solutions which is costly, as replicating solutions is much easier.

There are also significant uncertainties about future climate change impacts, socioeconomic factors, population and migration trends, as well as policy and behavioral shifts. Adaptation planning often requires flexible, low- or no-regret investments, and a focus on broader development goals, so projects yield benefits whether or not the expected climate hazard manifests. A lack of understanding of how to handle these uncertainties, limited decision-making tools, and difficulties in ascertaining return on investment can all make it challenging for private actors to finance adaptation projects.

Quality data and information are critical to addressing those issues and assisting in mitigating those risks. Ideally, robust information systems should be available, detailing climate risks and opportunities and providing tailored services on the costs and benefits of adaptation actions. They need to be channeled to facilitate access to information, as well as decision support tools to understand and apply the data.<sup>112</sup>

Some policy instruments proposed by United Nations Environment Programme can be used to encourage the adoption of sustainable innovation.<sup>113</sup> Among the examples are:

- Regulatory instruments, including substance restriction and bans, emission targets, landfill and substance restrictions, technical norms and products standards, recycling and recovery quotas, can be used to require or prohibit specific actions, as well as to set a standard for environmental performance. They remove confusion and provide unambiguous signals to the market where priorities should be set while inducing people to change their behavior. These instruments can influence change by establishing appropriate strictness levels and using life cycle thinking.
- Economic instruments urge enterprises to go beyond compliance and participate in a transformative and more sustainable market engagement. Examples include energy efficiency subsidies, extended producer responsibility, eco-taxes, sustainable public procurement, emission charges, tradable permit schemes, and equity support measures. They can help generate market demands for sustainable products and business

practices by providing greater economic incentives for companies to incorporate sustainability into their business strategy.

- Through voluntary instruments such as voluntary agreements, supply chain initiatives, environmental management systems, awareness campaigns, training, and capacity building, clustering, knowledge networks and platforms of eco-industrial parks motivated first movers can demonstrate sustainability performance and dependability. They create a more collaborative and hospitable environment for businesses to adopt sustainability, and they are founded on the spirit of constructive and consensual cooperation between government and business, which can result in improvements in both parties' values and behavior.

Sustainable innovation by businesses would have

## CONCLUSION

repercussions across the economy. Additionally, it supports the growth of an inclusive green economy, which is critical given the current urgency of the climate issue. Sustainable innovation helps decouple economic growth from resource use and achieve sustainability, making it important in the fight against climate change. Job creation and the generation of new sources of value for productive growth are two ways that eco-innovation can boost economic returns. Higher demand for sustainable products and services results in the creation of new jobs in growing industries, as well as in established businesses. Eco-innovation implemented by businesses with solutions scaled across their value chains can reduce resource consumption while also stabilizing resource supply and prices for long-term productive growth possibilities.<sup>114</sup>

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<sup>112</sup> Miller, Alan, and Stacy Swann. 2019. Ibid.

<sup>113</sup> UN Environment Programme. 2015. "Sustainable Consumption and Production: A Handbook for Policymakers." Accessed September 10, 2021. <https://sustainabledevelopment.un.org/content/documents/1951Sustainable%20Consumption.pdf>

<sup>114</sup> UN Environment Programme. 2017. "Mainstreaming Eco-innovation in Sustainable Consumption and Production Policies." Accessed September 10, 2021.

An enabling environment for innovation is created by support for innovative activity. Governments must also adopt a suite of demand-and supply-side innovation policies and financial measures targeted to the climate problem.<sup>115</sup> Direct assistance might come in the form of financial schemes ((loans and credits), subsidies, venture capital funds, and investments in research and development. They can also indirectly promote innovation by creating an atmosphere conducive to investment and innovation (such as business incubator programs).<sup>116</sup>

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<sup>115</sup> Organisation for Economic Co-operation and Development, World Bank, UN Environment. *Financing Climate Futures : Rethinking Infrastructure*. Paris: OECD, 2018. <https://openknowledge.worldbank.org/handle/10986/32517>

<sup>116</sup> European Bank for Reconstruction and Development. "Policies supporting innovation" *In Transition report*. 2014. Accessed September 10, 2021. <https://www.ebrd.com/downloads/research/transition/tr14.pdf>



# CHAPTER 7 CLIMATE EDUCATION FOR WOMEN AND YOUTH

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Globally, climate change has disproportionately affected both women and young people. Women's vulnerability to climate change stems from a number of social, economic, and cultural factors. Women represent a high percentage of poor communities that are highly dependent on local natural resources for their livelihood. Natural disasters affect more women than men and the effects of climate change can also further exacerbate existing gender inequalities. Moreover, women have negligible participation in decision-making and are not involved in the distribution of environment management benefits.<sup>118</sup> Despite these factors, women have the potential to play an important role in addressing climate change in their communities. As women are mainly in charge of managing their households and family affairs in many developing countries, they can be change agents in their communities and also educate their children on the sustainable use of natural resources.<sup>119</sup>

Climate change also poses a major threat to the health and socio-economic stability of youth. There are 3.7 billion people under the age of 30 – about half of the world's population. Of those, 1.2 billion are adolescents or early adults, ranging from the age of 15 to 24. As of 2019, 17% out of those currently residing in the least developed countries, with associated vulnerability to exacerbating climate risks.<sup>120</sup> As youth constitute the majority of the population in many countries, they have the power to transform the future towards low-carbon and climate-resilient pathways.

Addressing climate change requires knowledge transfer and use that could enable informed decision-making and action at all levels in society. Thus, education and training are crucial to building capacity, empowering women and youth, enhancing their understanding and ability to act against climate change, especially as most of them have no access to information and resources related to climate action.<sup>121</sup> Therefore, climate change education for women and youth has the potential to contribute to building resilient communities and reducing development gaps.

## ADDRESSING CHALLENGES TO PROMOTE CLIMATE EDUCATION

The IPCC identifies a range of education options to adapt to and mitigate climate change, including raising awareness on climate and integration of climate change education in school curricula, various forms of adult and non-formal education, including extension services, sharing indigenous, traditional, and local knowledge, etc.<sup>122</sup> Despite the evidence that education has a strong role to play in both climate adaptation and mitigation, the global education community did not do much to promote climate education efforts at a large scale.

Multilateral agencies and development partners strongly advocated for climate education at the global level. In 2014, United Nations Educational, Scientific and Cultural Organization (UNESCO) launched the official follow-up to the UN Decade of SDGs, with climate change as a critical thematic focus, with the aim to make climate change education a more central and visible part of the international response. Moreover, UNESCO promoted new partnerships and supported various learning resources and education initiatives to promote climate education.<sup>123</sup> United Nations Children's Fund (UNICEF) is also committed to helping young people to act. The institution has

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<sup>117</sup> Last name alphabetical order.

<sup>118</sup> UN. n.d. "Women...In The Shadow of Climate Change," Accessed September 9, 2021. <https://www.un.org/en/chronicle/article/womenin-shadow-climate-change>.

<sup>119</sup> United Nations Educational, Scientific and Cultural Organization. "Climate Change and Gender Equality," *Gender and Sciences*, 2017, <http://www.unesco.org/new/en/natural-sciences/priority-areas/gender-and-science/cross-cutting-issues/climate-change-and-gender-equality/context/>; Ciara Nugent, "The Unexpected Ways Climate Change Is Reshaping College Education," *Time* 2030, 2021, <https://time.com/5953399/college-education-climate-change/>.

<sup>120</sup> UNFPA, "The World at Seven Billion," 2019. [https://www.unfpa.org/sites/default/files/resource-pdf/7B\\_fact\\_sheets\\_en.pdf](https://www.unfpa.org/sites/default/files/resource-pdf/7B_fact_sheets_en.pdf)

<sup>121</sup> Diana Chanika Mataya, Katharine Vincent, and Andrew J Dougill, "How Can We Effectively Build Capacity to Adapt to Climate Change? Insights from Malawi," *Climate and Development* 12, no. 9 (October 20, 2020): 781–90, <https://doi.org/10.1080/17565529.2019.1694480>; Fortunate Machingura et al., "Climate Information Services, Integrated Knowledge Systems and the 2030 Agenda for Sustainable Development," *Sustainable Earth* 1, no. 1 (2018): 1, <https://doi.org/10.1186/s42055-018-0003-4>.

<sup>122</sup> Intergovernmental Panel on Climate Change. *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. Geneva: IPCC, 2014. <https://www.ipcc.ch/report/ar5/wg3/>.

<sup>123</sup> United Nations Educational, Scientific and Cultural Organization. n.d. "Global Action Programme on Education for Sustainable Development." Accessed September 8, 2021. <https://en.unesco.org/gap/priority-action-areas>.

created Voices of Youth, a dedicated platform for young advocates to offer inspiring and original insights on issues that matter to them.<sup>124</sup> Similarly, UN Environment Programme (UNEP) contributed significantly to the area of environmental education.<sup>125</sup> However, the scale and impact of these initiatives are limited.

Recent research shows that if only 16% of high school students in high and middle-income countries were to receive climate change education – when education helps students develop a strong personal connection to climate solutions, as well as a sense of personal agency and empowerment – that can have a consequential impact on students’ daily behaviors and decision making, thus reducing their overall lifetime carbon footprint. Several other case studies highlight that integrating a collaborative and experiential learning approach to students’ school experience does far more than harness their energies for the implementation of a global catalog of climate projects. New evidence also shows that the combination of women’s empowerment and education that includes everyone could result in an 85 gigaton reduction of carbon dioxide by 2050.<sup>126</sup> Therefore, a well-coordinated joint action of various stakeholders is needed to promote climate education and embed it into national policies and formal education systems.

Despite the importance of climate education, it is necessary to keep in mind that many children and youth from developing countries do not have access to education. Language barriers, gender roles, and reliance on child labor can all stall the progress to provide quality education. Teacher effectiveness has been found to be the most important predictor of student learning. There are not enough teachers or educators to achieve proper education yet many of them are untrained. The lack of learning materials is another problem where outdated and worn-out textbooks are often shared among children. Besides, students with disabilities also face lower attendance rates and are more likely to be out of school before completing primary education. Aside from that, gender is another driver which denies children education. Despite the recent advances in education for girls and women, there is still a generation gap among the young women that have been left behind.<sup>127</sup> All these factors also impact the promotion of climate education and should be considered while designing relevant policies and programs.

## PROPOSED SOLUTIONS AND POLICY RECOMMENDATIONS:

- **Developing a comprehensive approach to climate education:** As education has become a greater priority in strengthening our societies, governments have developed a significant number of policies to improve the equity and quality of their education systems for student learning. As a next step, governments with support from the international organizations and development partners should develop a climate education guide that would cover the most important elements of formal and informal education for women and young people based on the best international practices. The guide should also include useful learning resources and materials on climate and environmental topics as well as specific tools for teachers and educators. Stakeholder groups should be formed to engage in the consultation process at the early stages of the guide development. These groups should include a wide range of stakeholders along with women and youth to ensure diversity and inclusion. It is crucial to identify their vision of climate education and their interests and to acknowledge how they can contribute to, or hinder, setting up the approach to climate education. Furthermore, proper dissemination of the guide is needed.
- **Promoting collaboration between different stakeholders through climate education coalition:** Governments should support forming a climate education coalition to incentivize diverse actors to work collaboratively toward achieving the goal. The coalition should include: (i) government representatives from the relevant sector ministries appointed to promote climate

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<sup>124</sup> UN Environment Programme. n.d. "Education and Environment." Accessed September 8, 2021. <https://www.unep.org/explore-topics/education-environment>

<sup>125</sup> Christina Kwauk and Rebecca Winthrop. n.d. "Change: An Opportunity for Global Leadership." Accessed September 8, 2021. <https://www.brookings.edu/research/unleashing-the-creativity-of-teachers-and-students-to-combat-climate-change-an-opportunity-for-global-leadership/>.

<sup>126</sup> Phineas Rueckert. 2019. "10 Barriers to Education That Children Living in Poverty Face," *Magazine Citizen*. Accessed September 8, 2021. <https://www.globalcitizen.org/en/content/10-barriers-to-education-around-the-world-2/?template=next>.

<sup>127</sup> Phineas Rueckert. 2019. "10 Barriers to Education That Children Living in Poverty Face," *Magazine Citizen*. Accessed September 8, 2021. <https://www.globalcitizen.org/en/content/10-barriers-to-education-around-the-world-2/?template=next>.

education at the national level; (ii) educators' networks dedicated to peer mentoring, training, and resource sharing with an interest in advancing climate change education and highlighting the crucial role of women and youth; (iii) content developers with expertise in developing and curating existing teaching and learning materials using experiential learning approaches, gender lens, focused on learning about the natural environment and climate change, and linking to a range of curricular subjects across grades; (iv) women and youth-led networks interested in working in their communities to act on climate change; (v) media organizations with an interest in sharing the stories of how different school communities around the world are tackling education challenges; (vi) technology companies that are willing to support school communities, and/or track impact of education interventions; (vii) research organizations with an interest in iteratively capturing and sharing lessons learned across partners and innovating methods for tracking the impact of educational interventions on both behavioral change and emissions reduction; (viii) partners from multilateral, philanthropic, and corporate sectors drawing on those interested in supporting education for women and youth.

- **Embedding climate topics into formal and non-formal education:** It is important to support the integration of climate education into curricula of schools and universities. This would allow to increase climate awareness, promote behavioral change, support capacity building, and skills development required for youth to lead climate actions. While universities should integrate climate topics through specialized programs and modules, schools should promote experiential learning approaches. Similarly, with youth groups and networks of girls, extracurricular activities can be used for building in opportunities for mentoring, leadership development, and enhancing “green life skills” and civic engagement. This could not only help to combat harmful stereotypes and barriers to opportunities but also empower youth to rewrite their narratives as agents of change in their communities. More attention should be paid to non-formal education opportunities, especially those in the virtual format. Massive open online courses allow reaching out to larger audiences by leveraging technology and different networks.

- **Funding community-level climate education projects and initiatives to educate women:**

Governments and local authorities should support non-governmental and civil society organizations to foster climate education for women. Capacity building and training programs should be developed to empower women to lead climate actions in their communities. Given the wide range of local community-based organizations and international organizations with high interest in this type of work, the rollout strategy should link early adopters and their local ecosystem of community organizations with resources and networks to adapt work to those communities not yet engaged in the topic.

## CONCLUSION

When it comes to climate change, humanity sits at an important crossroads with a rapidly closing window of time to take action. Establishing a climate education coalition and boosting cooperation between them could help set humanity down the path to sustainability. The will is there, as indicated by the millions of youths who have skipped school to demand their governments take greater climate action, as well as the large percentage of teachers who want to teach climate change. Therefore, governments should develop coherent policies and programs to integrate climate education into their national agendas and support embedding climate topics in formal and non-formal education. Multilateral agencies and international organizations should ensure sufficient funds and resources are allocated to support climate education, especially in developing countries.

Community-level projects and initiatives could further contribute to mitigating the causes of climate change and to adapting to the impacts of climate change (by helping build the resilience and adaptive capacity of the most vulnerable – especially women and young people – to climate impacts, risks, and vulnerabilities). These projects could help seed the social transformations and systemic change required to address climate change equitably, including tackling gender inequality, racial discrimination, poverty, and other human rights challenges underlying and exacerbated by climate change.

