VASUDHA FOUNDATION
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NOVEMBER 2023

MEETING PARIS AGREEMENT GOALS

CLIMATE ACTION AND ACCOUNTABILITY

INDIA'S POWER OUTLOOK | VOLUME 10 | NOVEMBER 2023

Volume 10 meticulously examines past climate interventions amidst the worsening crisis, emphasising insights crucial for navigating the future. Central to its narrative is the Global Stocktake at COP 28, a linchpin for assessing progress in curbing carbon emissions. This edition discerns the effectiveness of climate commitments, particularly within the G20 nations, responsible for 85 percent of global GDP and a substantial share of emissions. It sheds light on tangible actions taken in response to climate change, emphasising a collective evaluation of major economies. This volume provides a foundational evaluation of global climate performance, contributing nuanced perspectives essential for charting an effective and equitable climate action agenda.

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Volume 1: Current State of Play – February 2020
Provides a brief narrative of the Indian power sector and its policy implications across the power sector value chain

Volume 2: The Road to Clean Electricity - July 2020
Provides an overview of renewable energy in India and assesses its progress across the value chain.

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Explores climate transitions, emphasising people's roles in coal, automotive, and battery sectors sustainably.

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Introduction

01 Introduction

1.1 Background and Context

The worsening climate crisis necessitates a comprehensive evaluation of past interventions and determine their effectiveness. Learning from these experiences is crucial for charting an ambitious and robust path forward that aligns with the goals of the Paris Agreement. The Global Stocktake, conducted every five years, holds immense significance in this decade when we must nearly halve global carbon emissions by 2030 in order to limit global temperature rise to 1.5 degrees Celsius. The first Global Stocktake, scheduled for conclusion at COP 28, will assess our progress towards this critical target and provide an opportunity for necessary course corrections.

Other noteworthy deliverables of COP 28 include the establishment of a loss and damage finance mechanism, ensuring a just transition, and more. However, the stocktaking process will be instrumental in enabling individual countries to submit their revised nationally determined contributions (NDCs) by 2025.

There are three main components of the Global Stocktake process:

- information collection and preparation,
- technical assessment,
- consideration of outputs.

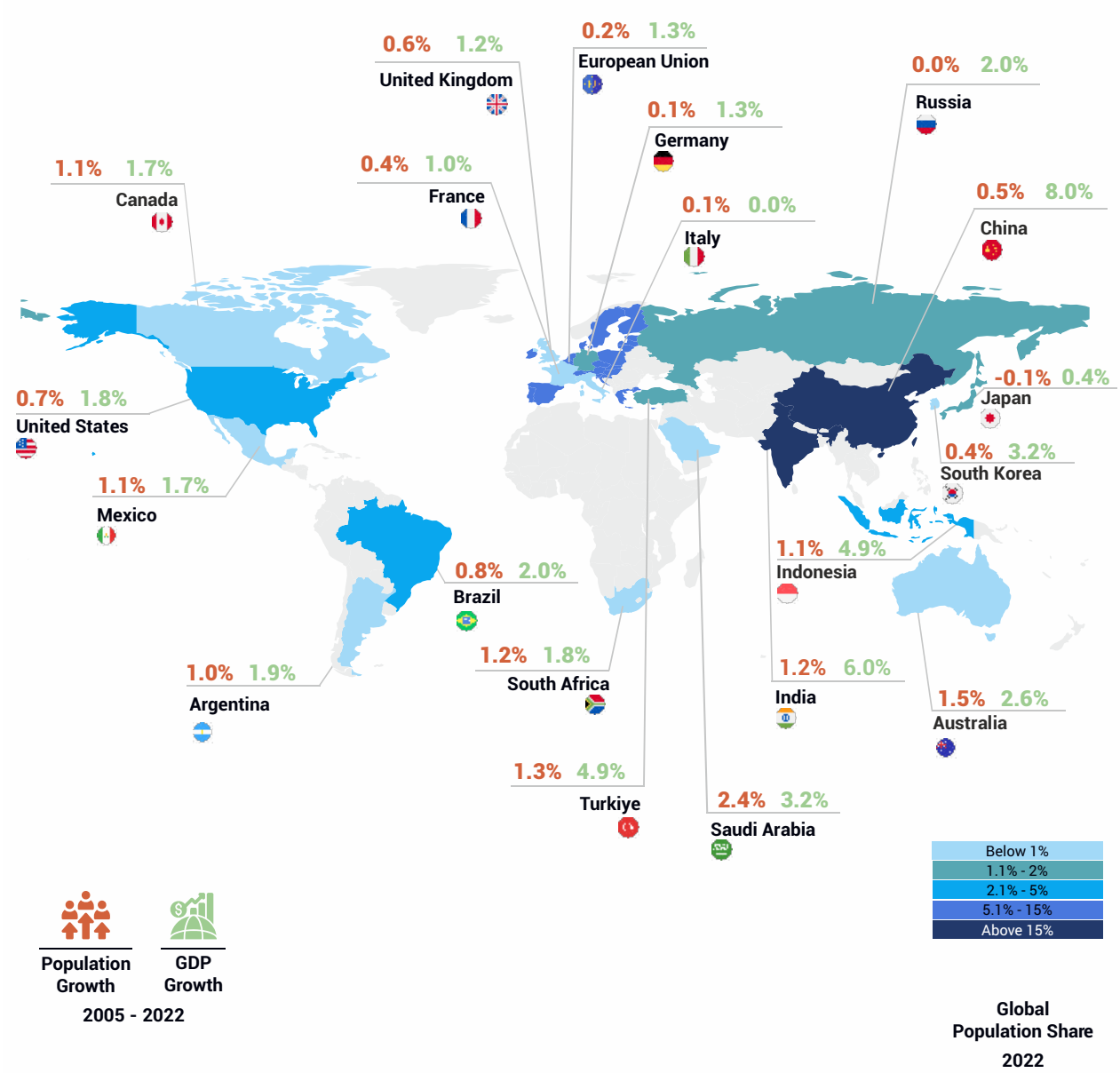
While the first two components have been running concurrently with various climate conferences, the consideration of outputs will be concluded at COP 28.

1.2 Objectives of the Report

This volume within the Power Outlook Series provides a preliminary evaluation of global performance in fulfilling climate commitments, with a specific focus on mitigation efforts. It primarily examines the G20 nations, offering an in-depth and comprehensive perspective on tangible actions taken in response to climate change. The G20 countries are a conglomeration of the major economies in the world. In total, these countries account for 85 percent of global GDP, 75 percent of international trade, 75 percent of the total greenhouse gas (GHG) emissions, and two-thirds of the world's population[1],[2]. With an emphasis on the G20 countries, this volume provides valuable insights into the collective efforts of major economies, shedding light on their contributions to the global climate agenda and progress toward addressing this pressing global challenge.

A landscape view of the economic and population growth of the G20 countries is presented in Figure 1. China and India are the two leading players in the group, followed by Indonesia and Turkiye which have acted as major economic growth centres since 2005.

Figure 1: GDP and Population Growth for G20 countries since 2005 (in CAGR%)[3,4]



Methodology and Data Sources

1. Emissions data has been sourced from Emissions Database for Global Atmospheric Research (EDGAR) database, selected for its inclusion of GHG emissions, covering all G20 nations, and updated for 2022.
2. The renewable energy capacity data has been taken from International Renewable Energy Agency (IRENA).
3. Electric Vehicle data has been sourced from the International Energy Agency (IEA), with a focus on four-wheelers for most countries and all vehicle categories for India.
4. GDP and Population data has been retrieved from the World Bank database.

Although we acknowledge the availability of India-specific data, we opted for a global database to maintain consistency across all G20 countries. Nevertheless, the data for India obtained from the global datasets corresponds with the country-specific information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02

Year-on-Year Emissions and Paris Agreement Targets

02 Year-on-Year Emissions and Paris Agreement Targets

Considering the growing impacts of climate change, it is increasingly important to monitor the progress towards the NDCs at regular and timely intervals. The emission intensity of a country's GDP is the premier indicator for tracking the trajectory towards the NDC target.

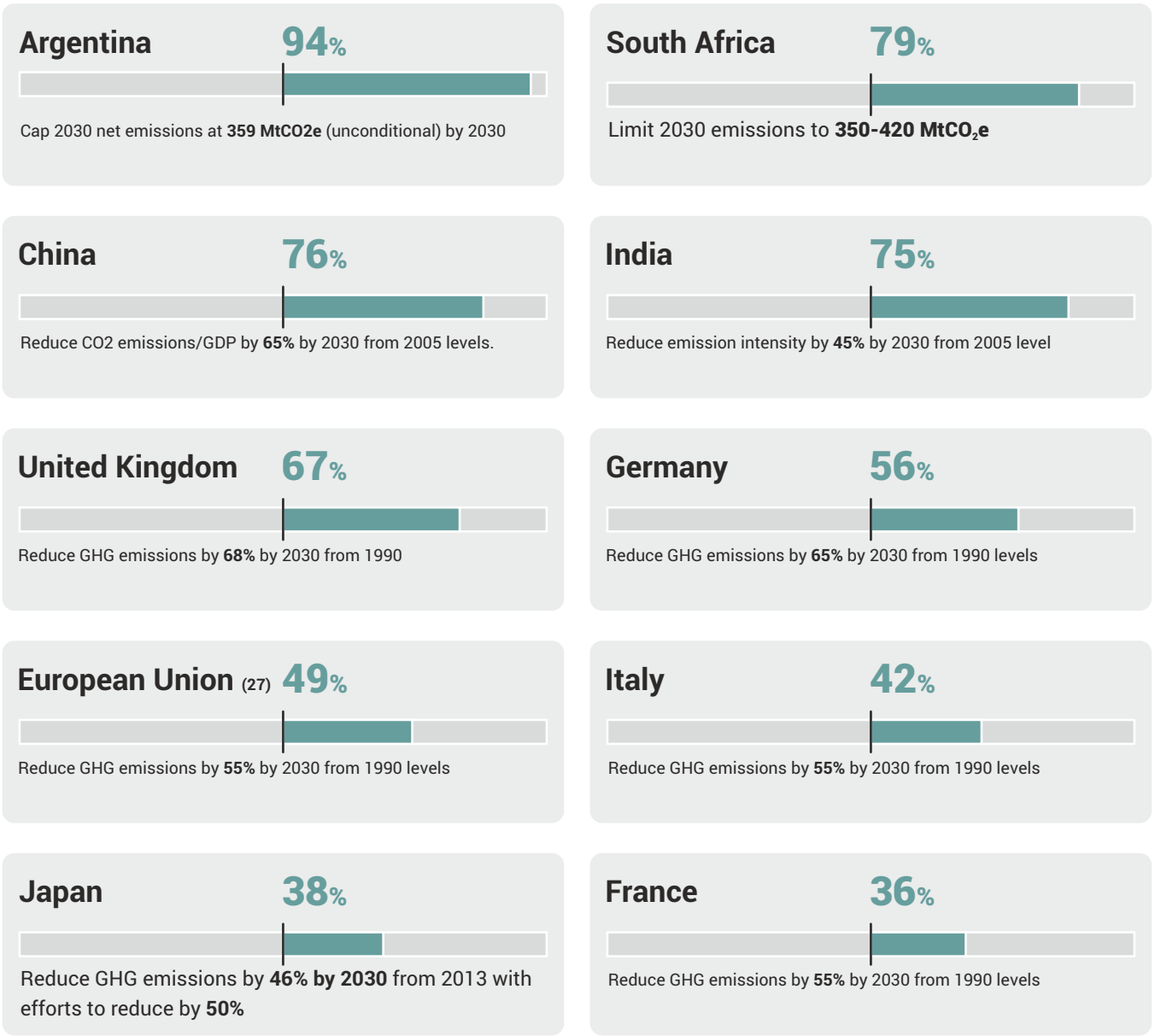
2.1 Tracking Global NDC Targets/Paris Agreements

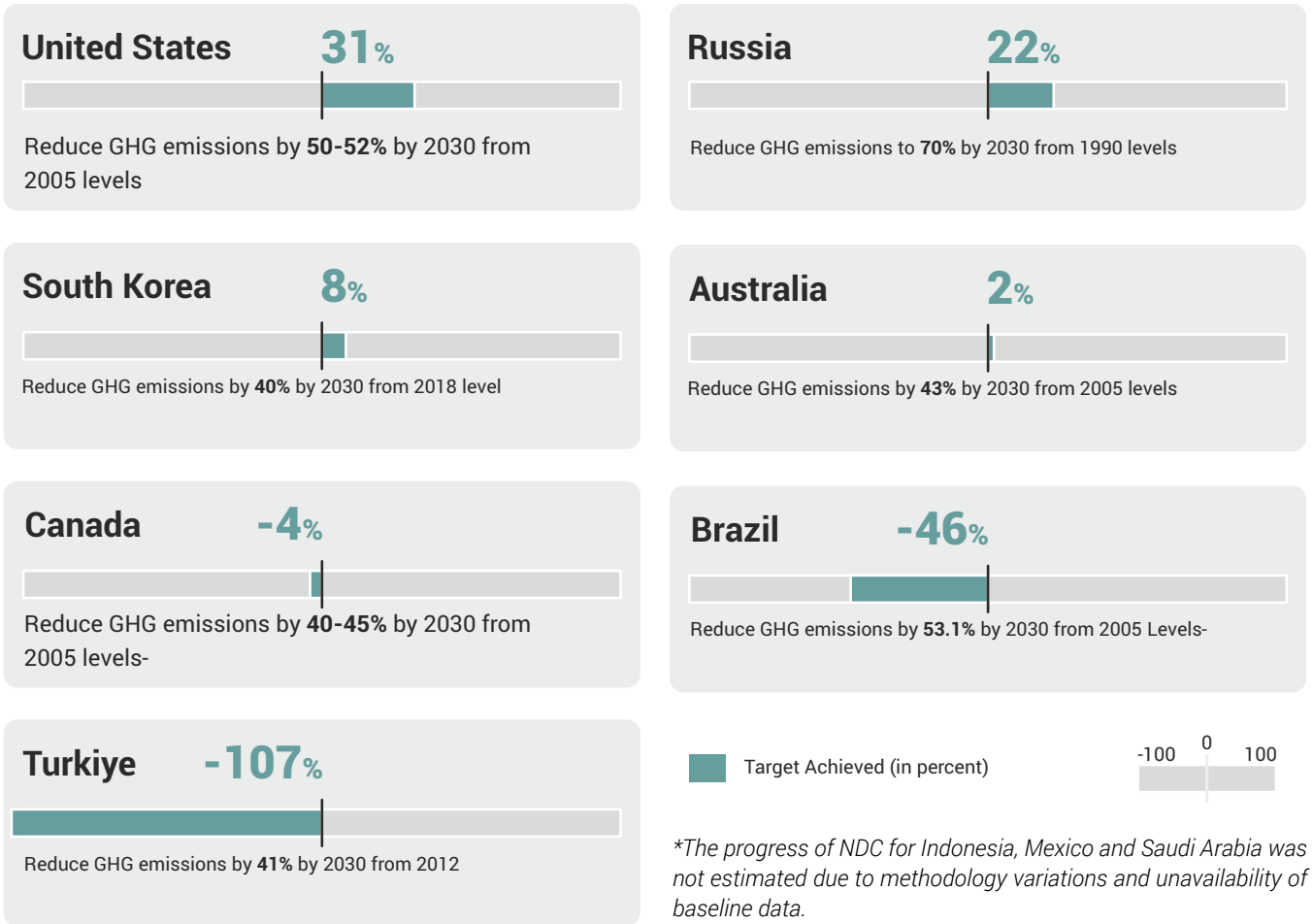
In accordance with the 2015 Paris Agreement (Article 4, paragraph 2), every country is required to submit NDCs to reduce national emissions and adapt to the impacts of climate change. NDCs are where countries set targets for mitigating the GHG emissions that cause climate change and for adapting to climate impacts. While NDCs are updated every five years, this will be the first time that countries will take part in a Global Stocktake at COP 28.

The achievement of NDCs is critical to aligning with the Paris Agreement roadmap which stipulates that global GHG emissions need to peak between 2020 and 2025[5], followed by roughly halved emissions by 2030, achieving net zero CO_2 emissions by 2050 and net zero greenhouse gas emissions soon after[6]. It is, therefore, imperative to assess the progress made by the G20 countries in achieving their 2030 NDC targets.

The Glasgow Climate Pact in November 2021, which followed the NDC announcement at the Paris Agreement in 2015, urged countries to revisit their targets and strengthen their alignment to reach the 1.5-degree Celsius climate goal. All the G20 countries, except Russia, submitted their revised NDC targets. The top six countries that have achieved 50 percent of their 2030 targets as of 2022 are Argentina, South Africa, China, India, the UK and Germany. However, Turkiye, Brazil and Canada are the three countries that have fallen behind their targets.

Figure 2: Assessment of G20 members progress towards NDCs for 2030 (As of 2022)[7],[8]



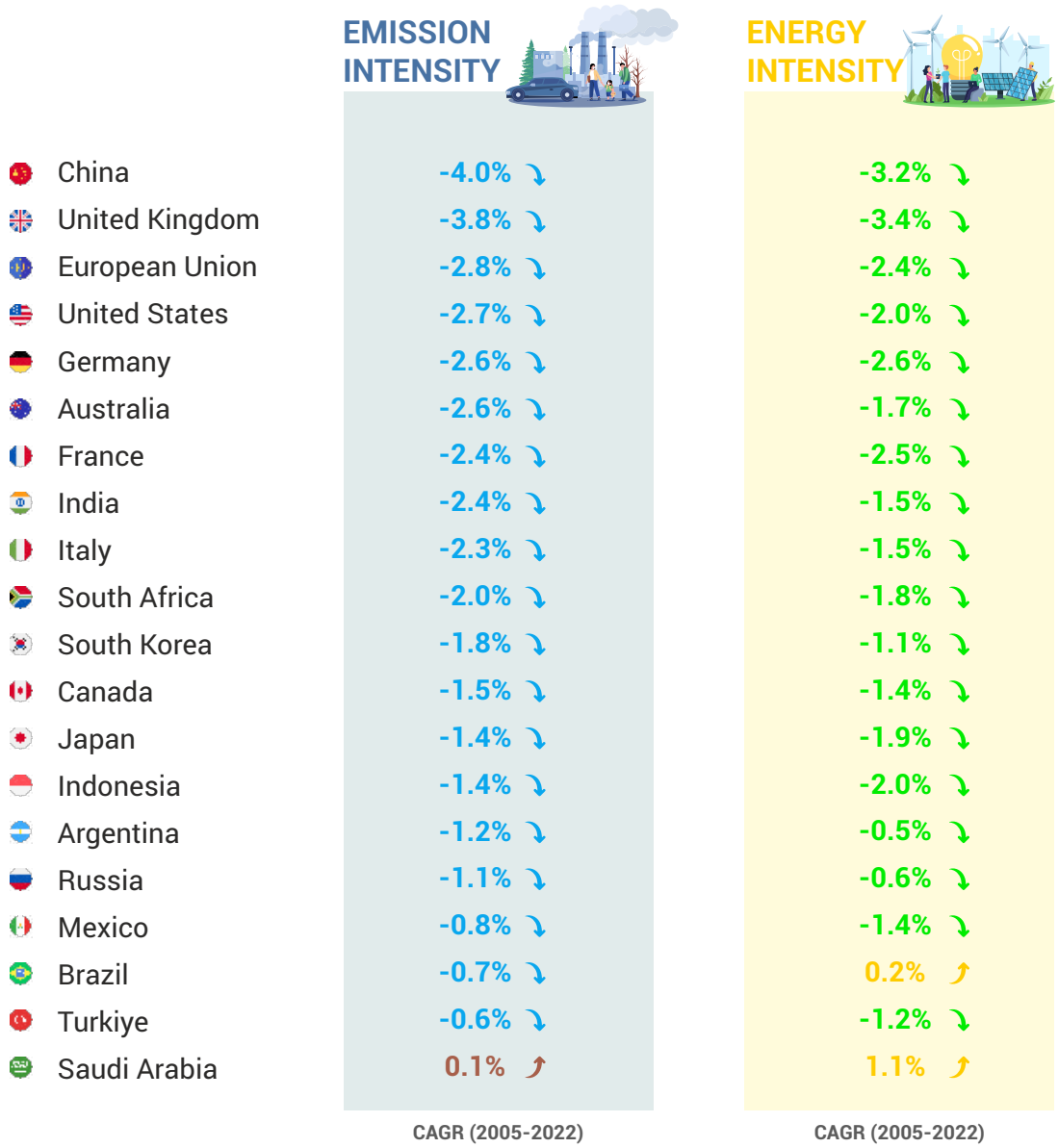


**The progress of NDC for Indonesia, Mexico and Saudi Arabia was not estimated due to methodology variations and unavailability of baseline data.*

2.2 Country-wise Changes in Emissions

Since 2005, the G20 countries have reduced their emission and energy intensity by an average of two percent per year. The largest declines in emission and energy intensity have occurred in China and the UK. While the UK peaked its emissions due to decline in energy consumption, China witnessed the largest reduction due to rapid growth in its GDP. Despite the increasing energy consumption and GDP growth, India and Indonesia were able to reduce their emission intensity by 34 percent and 21 percent, respectively, from 2005 levels whereas Saudi Arabia and Turkiye experienced unimpressive emission intensity reductions even after robust economic growth.

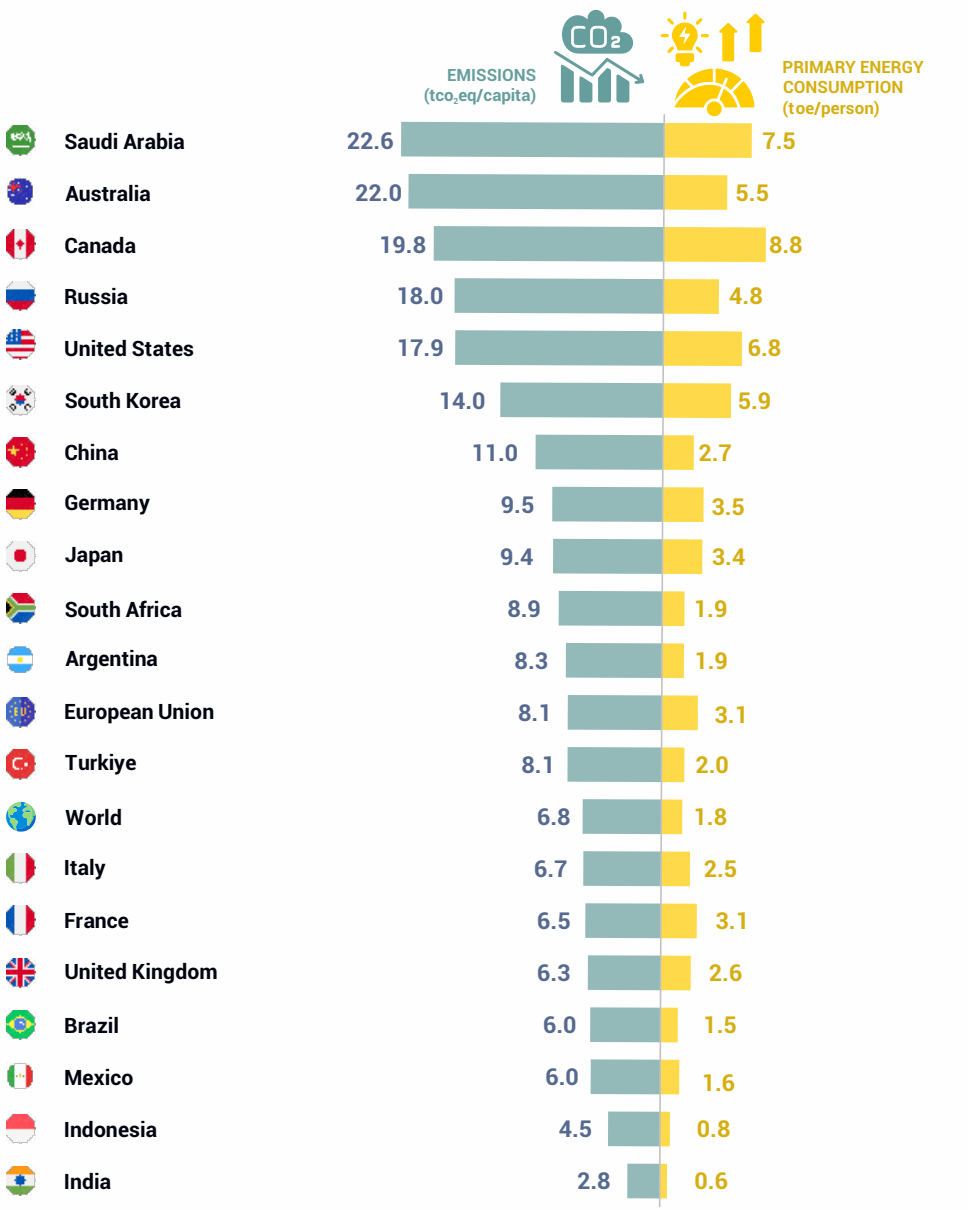
Figure 3: Assessment of G20 members countries reduction in emission and energy intensity[8, 9]



2.3 Emissions Per Capita Vs Energy Consumption Per Capita

In comparison to top emitters, India contributes 7 percent of the global emissions, but its per capita emissions are six times lower than that of the United States, four times lower than that of China, three times lower than the EU and almost six times lower than Russia. For the G20 countries, per capita energy consumption ranges from 0.6 toe/capita for India to as high as 8.8 toe/capita for Canada. It is imperative that countries realise their fair share for middle-income countries like India, Indonesia, Brazil etc, which are still far away from reaching the average energy consumption levels of 3.4 toe for the G20 group.

Figure 4: Comparative assessment of G20 member countries for per capita emissions and energy consumption[10,11]



03

Carbon Budget Analysis

03 Carbon Budget Analysis

A carbon budget is essentially a ceiling limit on the cumulative greenhouse gas emissions (GHGs) that can be released into the atmosphere. It is intended to monitor and control the rise of global average temperatures. Any GHG emissions exceeding this budget must be removed into sinks to counterbalance the increase. This budget is derived from scientific assessments of the climate's tolerance for increased concentrations of the greenhouse gases. It is an integral framework providing a threshold that guides our mitigation and net-zero efforts.

3.1 Comparing Various Carbon Budgets Methodologies

The comparison between the One Earth One Climate Model (OECM) and the Dynamical Carbon Space Model (DCSM) demonstrates two distinct approaches to carbon budgeting and emission reduction, both of which share the goal of mitigating climate change. With a total carbon budget of 450 Gt allocated from 2020 to 2050, OECM hinges on the principle of global fairness, seeking to limit the temperature rise to 1.5 degree Celsius[12]. Furthermore, it incorporates historical emissions as well as economic factors, particularly sector-specific development needs, while emphasising social and ethical considerations and employing a granular approach at the sector level. In contrast, the DCSM, with a larger budget of 1440 Gt for the period 2000 to 2050, adopts a gradual reduction strategy for nations approaching their fair share. Aiming to limit global temperature rise to 2 degree Celsius, the DCSM considers historical emissions, recognises short-term development needs and emphasises on shared responsibility. This approach employs non-linear adjustments to remain within the global budget[13]. For further details, please refer to Table 1.

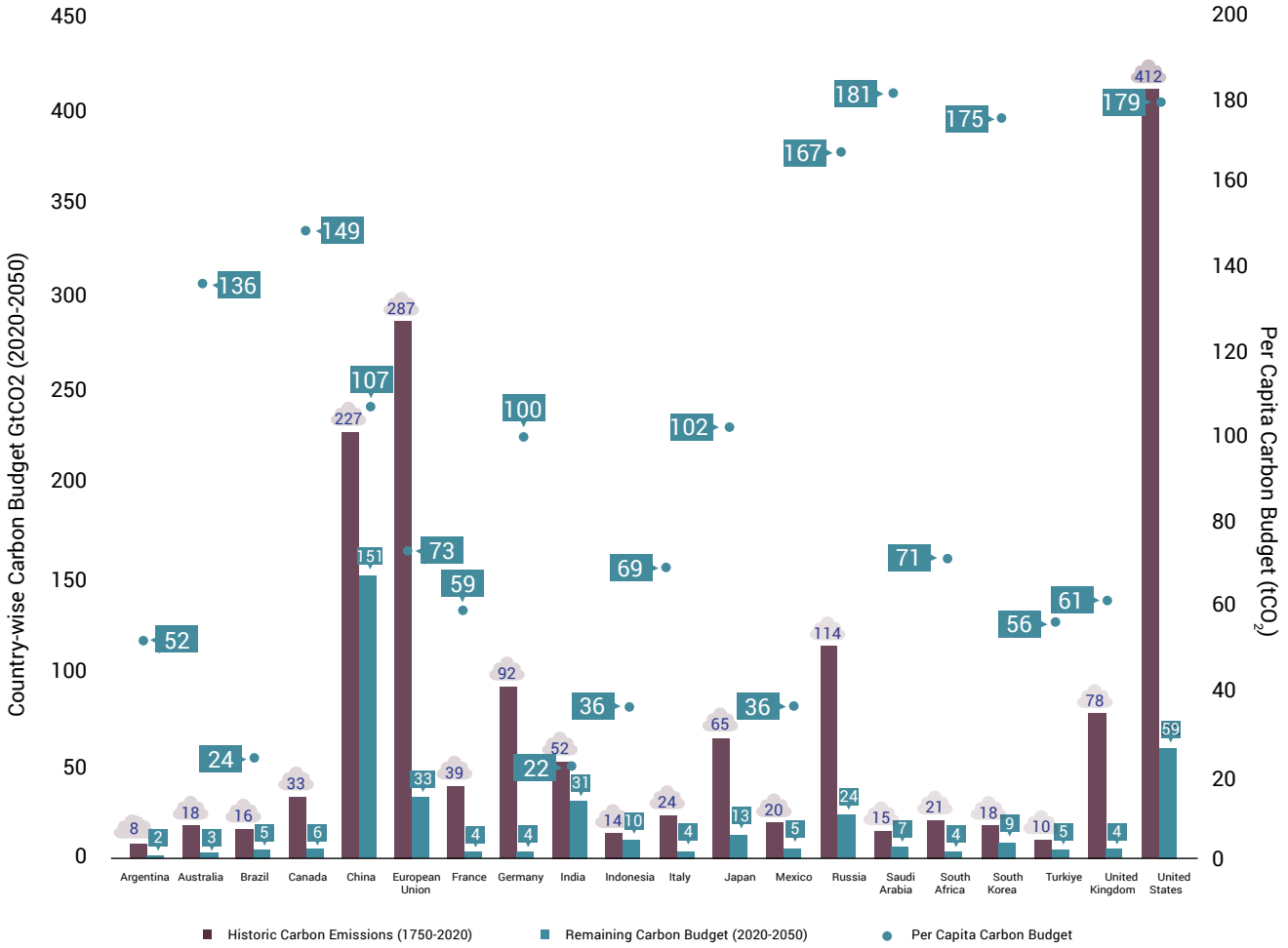
Table 1: Comparison of various carbon budget methodologies[12,13]

Carbon Model	Author	Total Carbon Budget	Duration	Equity principle	Justification	Historical Emissions Consideration	Economic Consideration	Social and Ethical Considerations	Granularity
One Earth One Climate (OECM)	Sven Teske	450 Gt	2020 to 2050	Global Fairness	Limiting global temperature rise to 1.5°C	Yes	Yes, considers sector wise development needs	Yes, but more focused towards efficiency	Granular (sector-level)
Dynamical Carbon Space Model	Tejal Kanitkar*, T. Jayaraman*, Mario D'Souza*, Mukul Zanwal, Prabir Purka-yastha, Rajbans Talwar	1440 Gt	2000 to 2050	Gradual reduction for nations approaching fair share	Limiting global temperature rise to 2.0°C	Yes	Yes, Recognizes short-term development needs	Consideration of shared responsibility	Non-linear adjustments to stay within global budget

3.2 Comparing Country-Specific Carbon Budget Allocation and Per Capita Carbon Budgets

Using data from the OECM framework, Figure 5 illustrates that the combined carbon budgets of China, the USA, and the EU account for approximately 54 percent of the total carbon budget allotted globally. Furthermore, when we examine the per capita carbon budget, the situation becomes even more bleak. The countries that

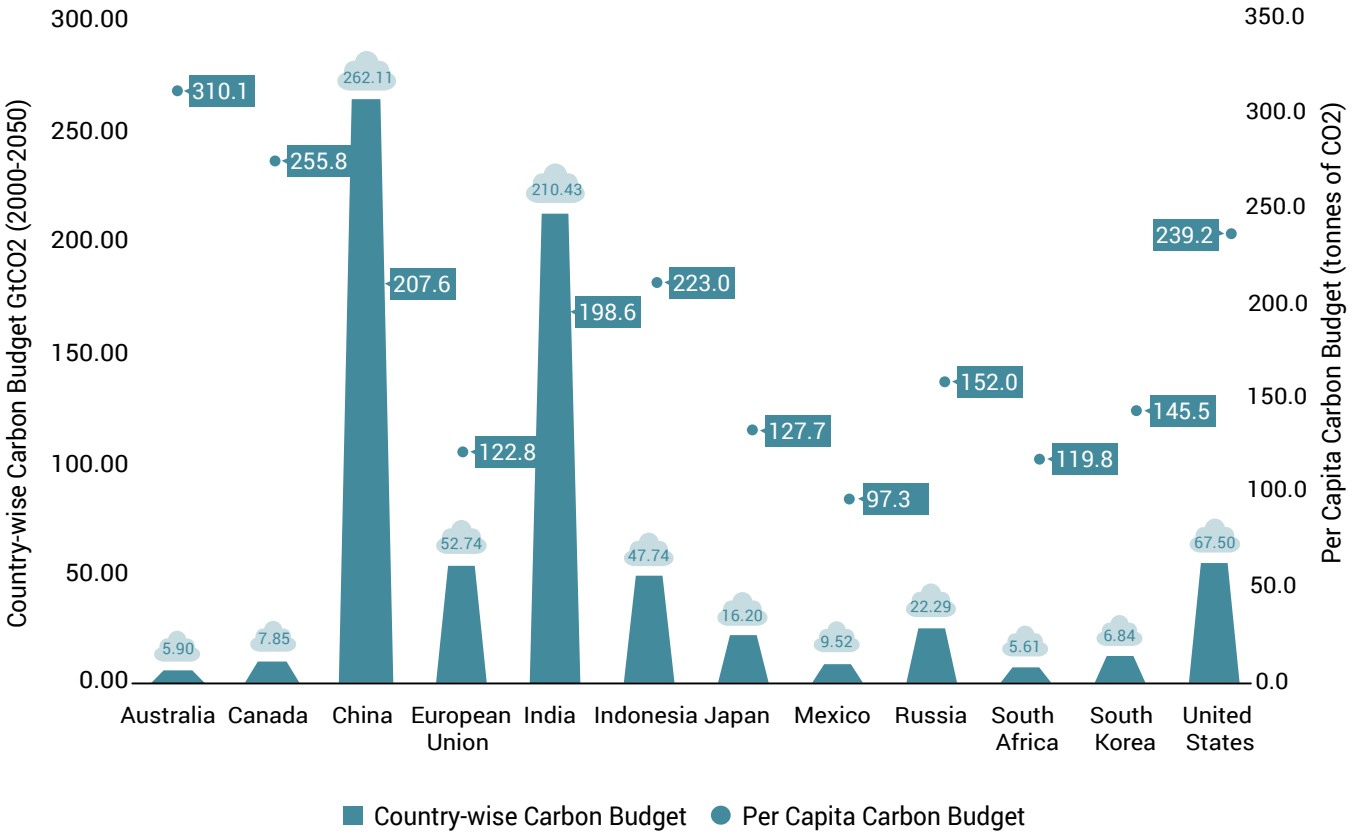
Figure 5: Country-wise comparison of carbon budget allocation and per capita budget based on OECM Model[14]



have substantially contributed to global warming still maintain the highest shares of per capita carbon share, ranging from 22 to 181 tons per capita[14]. This allocation leaves little room for countries like India and Indonesia to pursue their economic aspirations while simultaneously controlling their carbon emissions.

Upon analysing the DCSM framework and the corresponding Figure 6, it becomes apparent that this approach is more equitable, offering greater flexibility to developing nations such as India and Indonesia. It appropriately allocates a higher per capita carbon budget to the populations of developing nations, while simultaneously reducing the per capita carbon budget for the populations in developed nations.

Figure 6: Country-wise comparison of carbon budget allocation and per capita budget based on DCSM[13]

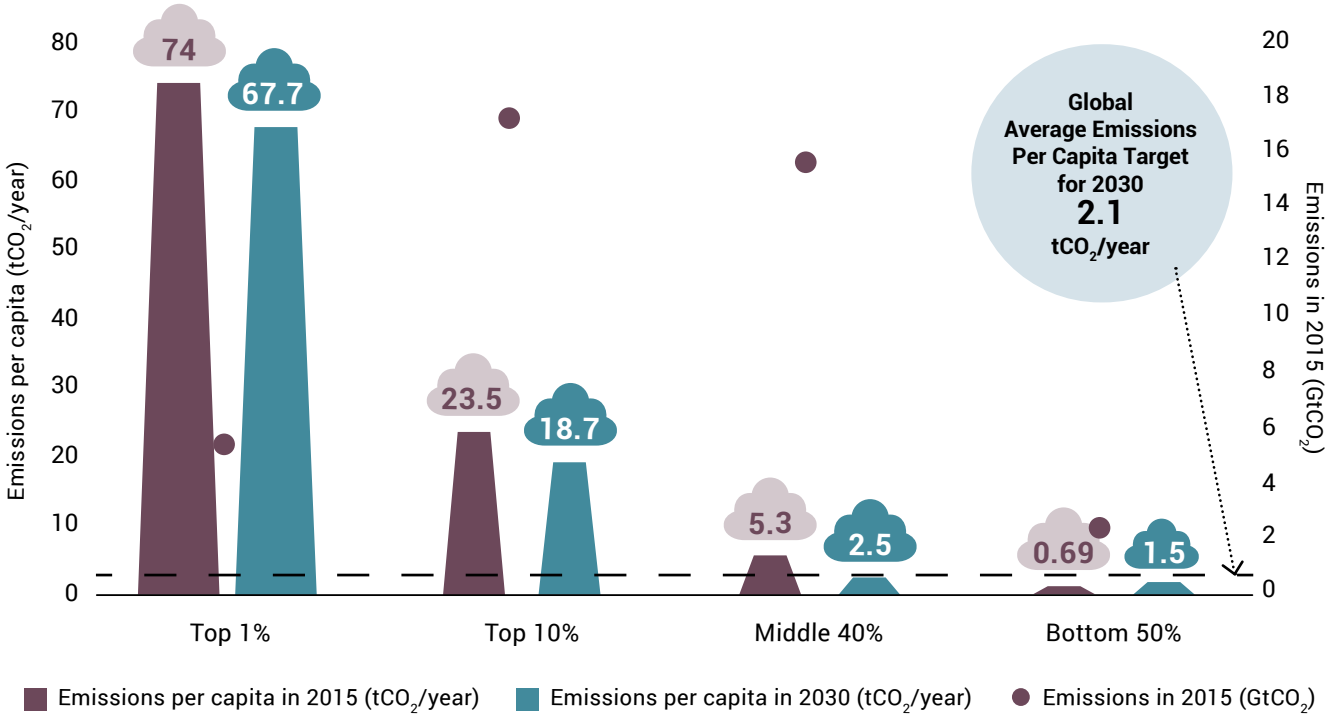


3.3 Comparing Income Share & Carbon Budget Allocation

There are several approaches to assign responsibility for global carbon emissions. In comparison to the two models discussed in the previous section, OECM and DCSM, which allocated the country-wise emissions based on the key principles of global fairness and historical emissions, there is another approach of modelling estimates developed by the Stockholm Environment Institute and Oxfam.

Taking a bottom-up approach to allocate emissions, the latter assumes that it is the household income that drives one's energy consumption which in turn determines the household's consumption emissions. According to the Stockholm Environment Institute (SEI) and Oxfam 2020 estimates, between the first report of the Intergovernmental Panel on Climate Change (IPCC) in 1990 and the Paris Agreement in 2015, the world's richest one percent population accounted for twice (111 Gt) the global carbon emissions of the poorest half (51 Gt).[15]

Figure 7: Per capita emissions for different income groups in 2015 and 2030 with absolute emissions in 2015



From a carbon budget lens and in accordance with 1.5-degree Celsius temperature rise, the study infers that approximately one-third of the global carbon budget (1,205 Gt CO_2) was utilised between 1990 and 2015 to meet the consumption requirements of only the richest 10 percent of the global population[16]. By 2030, the global average per capita emissions should be approximately 2.1 tonnes per year[17] if global warming is to be limited to 1.5 degree Celsius. However, as shown in Figure 7, the per capita emissions of the top one percent population in 2015 were around 35 times higher than the 2030 target and are expected to remain similar in 2030. On the other hand, the bottom 50 percent population will remain well below the 2030 target.

In terms of absolute emissions, according to the estimates of Oxfam and the Institute for European Environmental Policy (IEEP)[18], the total emissions in 2030 are expected to be 35.5 Gt CO_2. Furthermore, the estimates suggest that the world needs to limit its total emissions to at least 17 Gt of CO_2, at an absolute level, in order to align with the target of 1.5-degree Celsius temperature rise. Figure 8 alludes that 90 percent of the world's population together will just exceed the total 1.5-degree compatible emission levels in 2030; however, the richest 10 percent of the population will meet this level alone, with 35 percent of this share coming from only the top 1 percent.

Figure 8: Total consumption emissions by different income groups (1990-2030)[18]

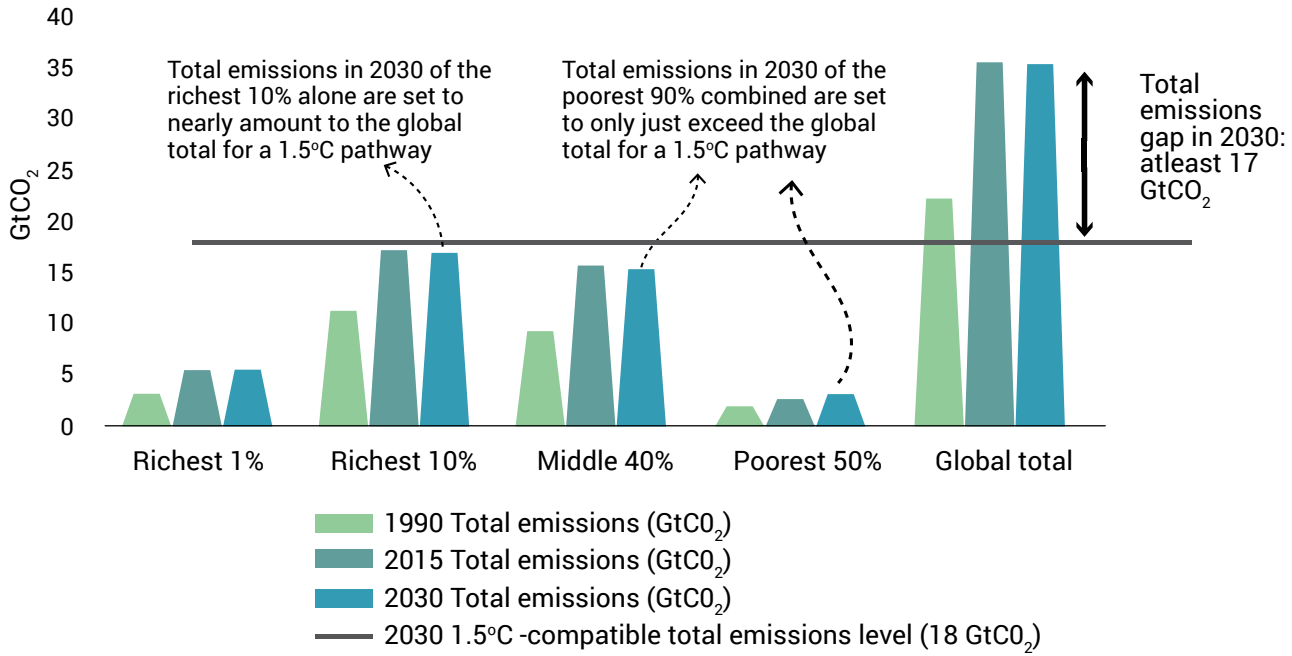
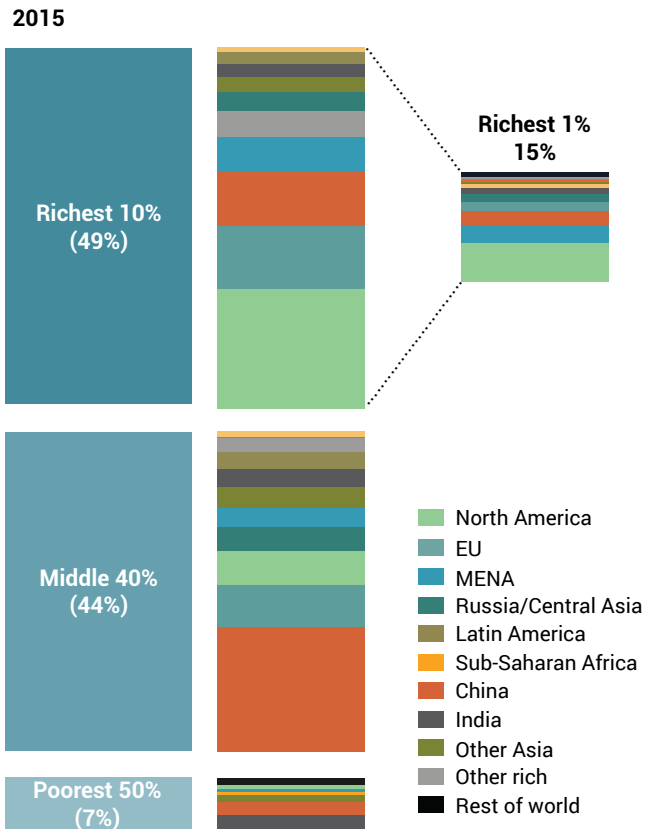


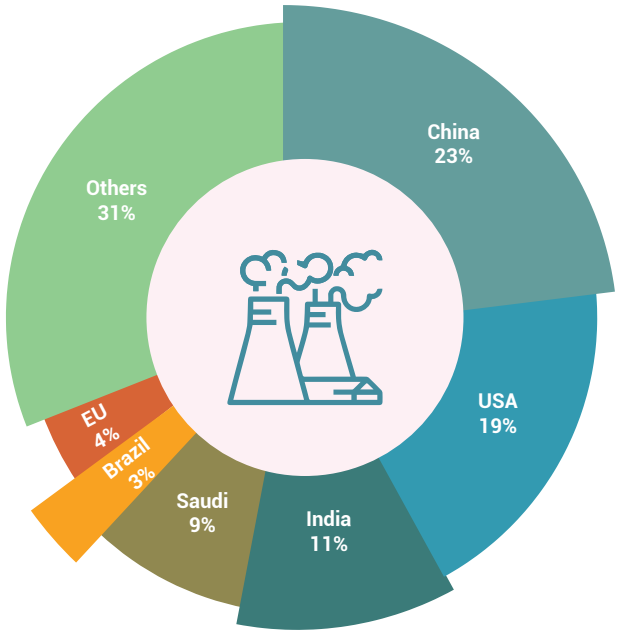
Figure 9: Share of global income groups emissions from countries and regions



It is to be noted that the top 10 percent population, including the richest 1 percent, can be located anywhere across the globe. As indicated in Figure 9, In 2015, almost 50 percent of the emissions from the richest 10 percent population are attributed to the residents of North America and Europe alone, followed by China and the Middle East.

Notably, India and China are also responsible for a significant share of emissions from the poorest 50 percent of the population. By 2030, however six major G20 countries namely China, the USA, India, Saudi Saudi Arabia, Brazil and EU will account for almost 70% of the emissions from the top 1 percent (Figure 10).

Figure 10: Geographical location of the top 1% of the emission contributors in 2030



04

Fossil Resources and Dependency

04 Fossil Resources and Dependency

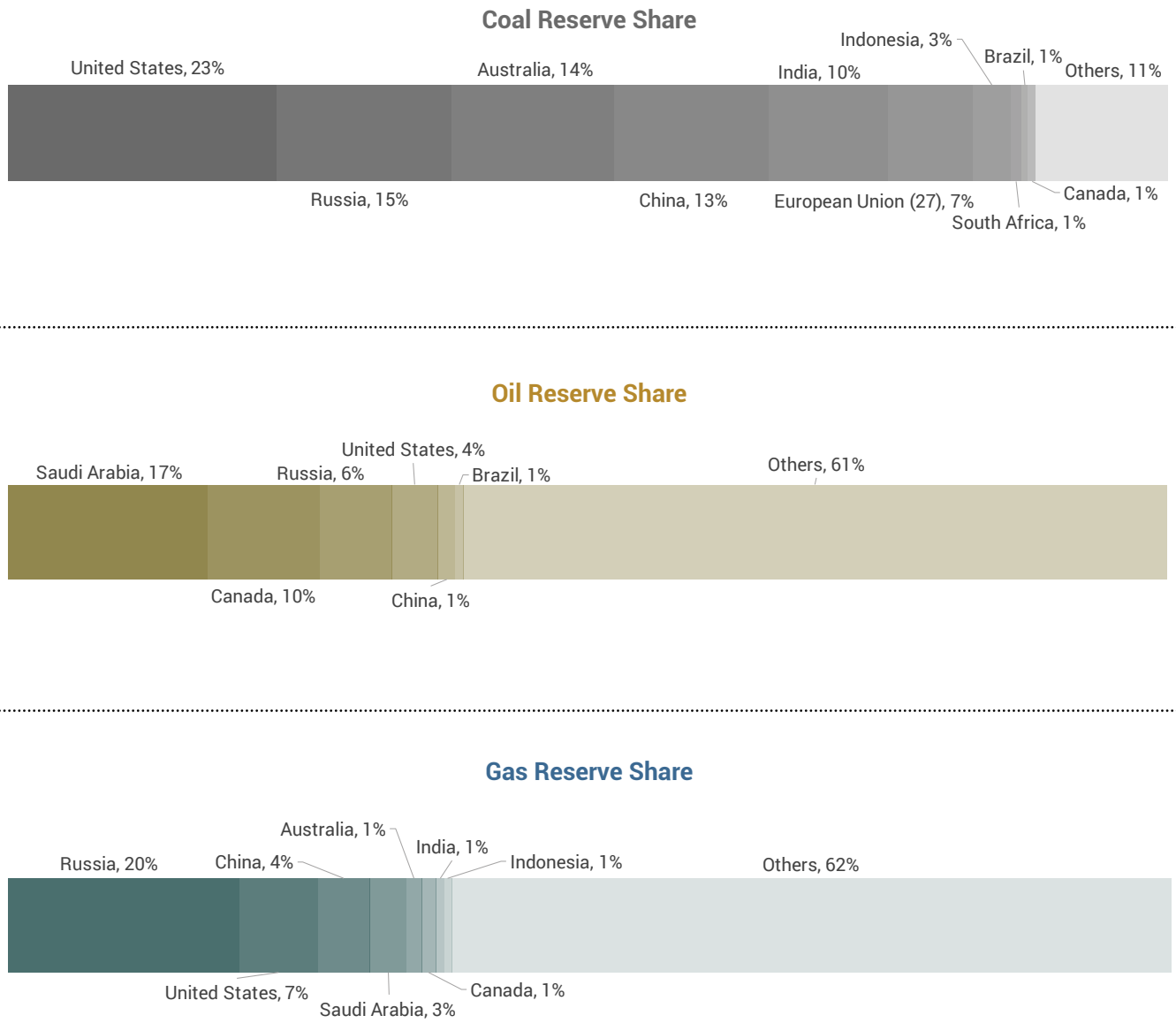
According to the NDCs the countries are expected to reduce GHG emissions significantly, while also transitioning to non-fossil fuel energy sources, primarily renewable energies, as a way to reduce GHG emissions.

4.1 Country-wise Fossil Fuel Reserves

The G20 countries hold around 93 percent of the world's coal reserves, 41 percent of oil reserves and 39 percent of gas reserves. Among these nations, the US has the largest coal reserves of 23 percent, followed by Russia and Australia. With 17 percent, Saudi Arabia leads the pack for oil reserves, followed by Canada with 10 percent and Russia with 6 percent.

In terms of gas reserves, Russia holds 20 percent of the world's reserves, followed by the US with 7 percent and China with 4 percent. The remaining G20 nations collectively hold 8 percent of the world's gas reserves.

Figure 11: Share of G20 countries in fossil fuel reserves [19,20,21]

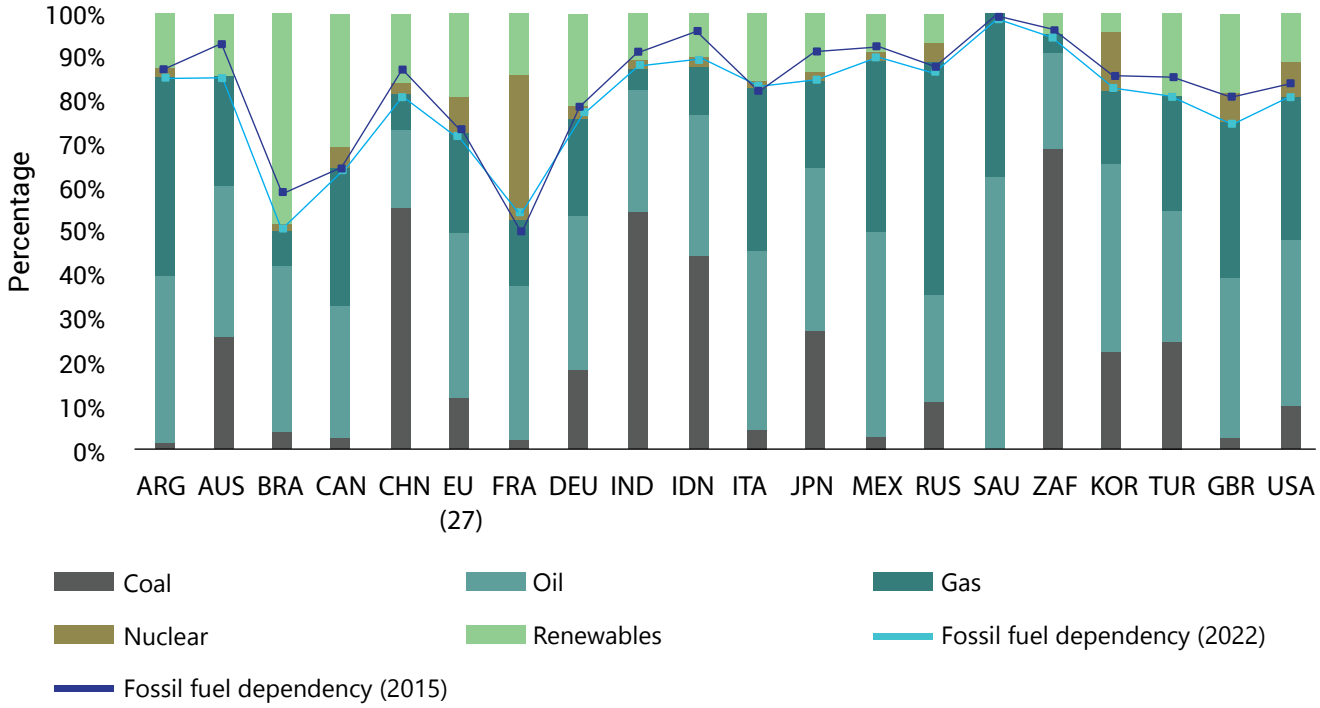


4.2 Energy Consumption Dependency across Countries

There has been an increase in the energy consumption for countries such as India, Indonesia and Saudi Arabia following robust economic growth.

Between 2015 and 2022, the global energy consumption has increased by 10 percent, with a reduction of 3 percent fossil fuel dependency. Concurrently, the global share of renewable energy (RE) consumption has ramped up from 10.5 percent in 2015 to 14 percent in 2022.

Figure 12: Source-wise energy consumption share for the G20 countries[22]



Below is a list of the major coal, oil and gas producing G20 countries. The three major coal producing countries, China, India and Indonesia continue to demonstrate an increasing share in the overall coal consumption for the G20 countries. The US, however, records a substantial decline in coal consumption from 14 percent in 2010 to 7 percent in 2022 as result of rising dependency on renewable energy and gas. Further, the

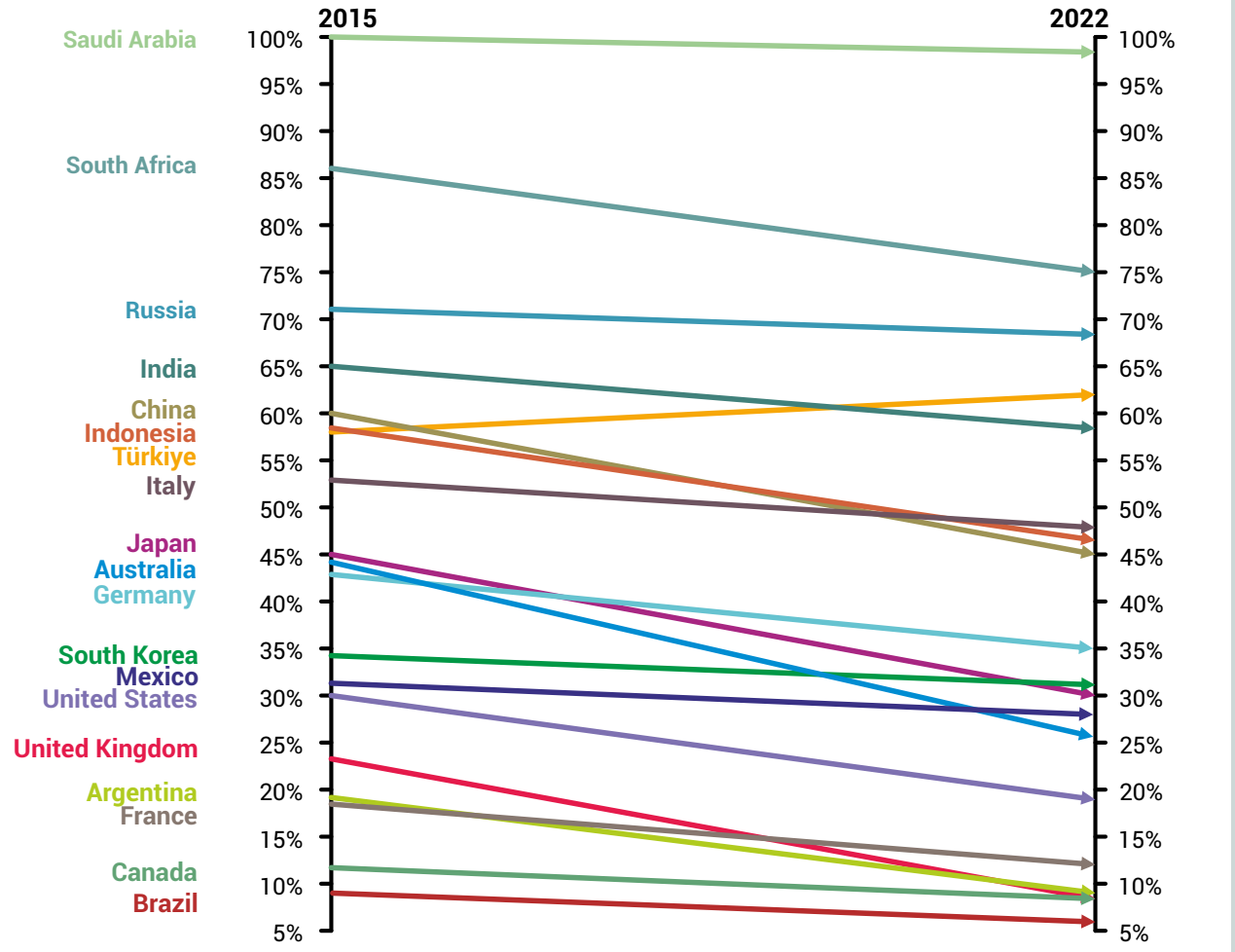
economic slowdown caused by the pandemic and the soaring oil and gas prices due to geopolitical events led to decreased consumption and dependence on oil for the US and the EU and on gas for Russia and the EU. Moreover, the EU accounts for the second highest RE capacity addition since 2010 after China.

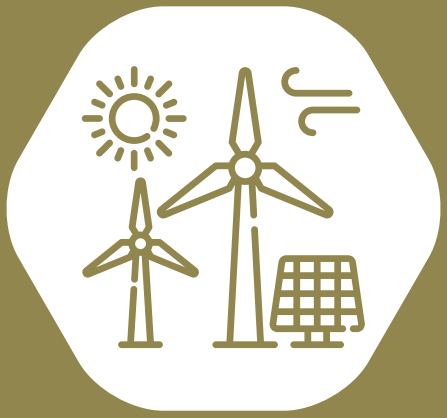
Table 2: Assessment of coal, oil and gas consumption share within the G20 countries (in percent)

Coal	2010	2015	2022
China	50%	53%	58%
India	8%	11%	13%
United States	14%	10%	7%
Indonesia	1%	1%	3%
Oil	**2010**	**2015**	**2022**
United States	24%	23%	23%
China	13%	15%	18%
European Union (27)	17%	15%	14%
India	4%	5%	6%
Saudi Arabia	4%	5%	5%
Gas	**2010**	**2015**	**2022**
United States	25%	28%	29%
Russia	17%	15%	13%
China	4%	7%	12%
European Union (27)	17%	13%	11%
Saudi Arabia	3%	4%	4%

As can be seen from Figure 13, a notable declining trend has emerged in the dependence on thermal power plants in the majority of G20 countries over the past seven years. Evidently, these nations are focussing their efforts on both greening their energy grids and diversifying their portfolios by introducing non-fossil fuel energy sources into the energy mix.

Figure 13: Reducing reliance on thermal power plants[23]





05

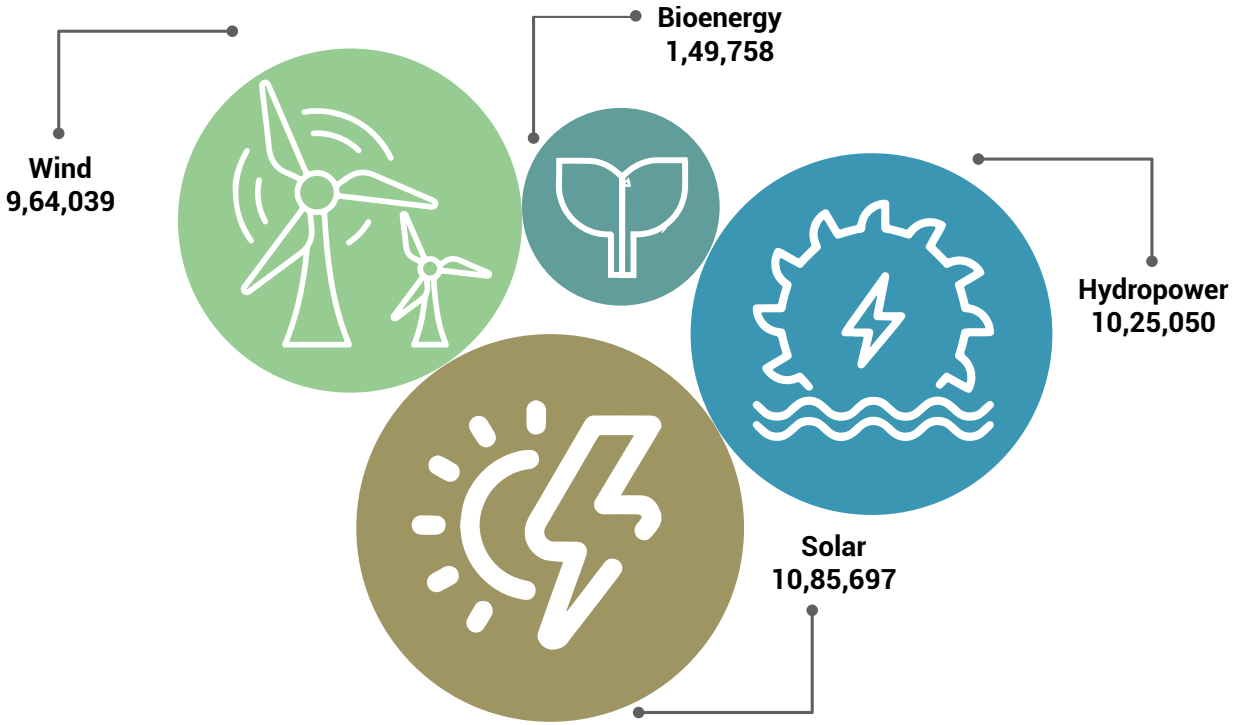
Decarbonising Electricity Sector - Renewable Energy Deployment

05 Decarbonising Electricity Sector- Renewable Energy Deployment

5.1 Renewable Energy Capacity Overview

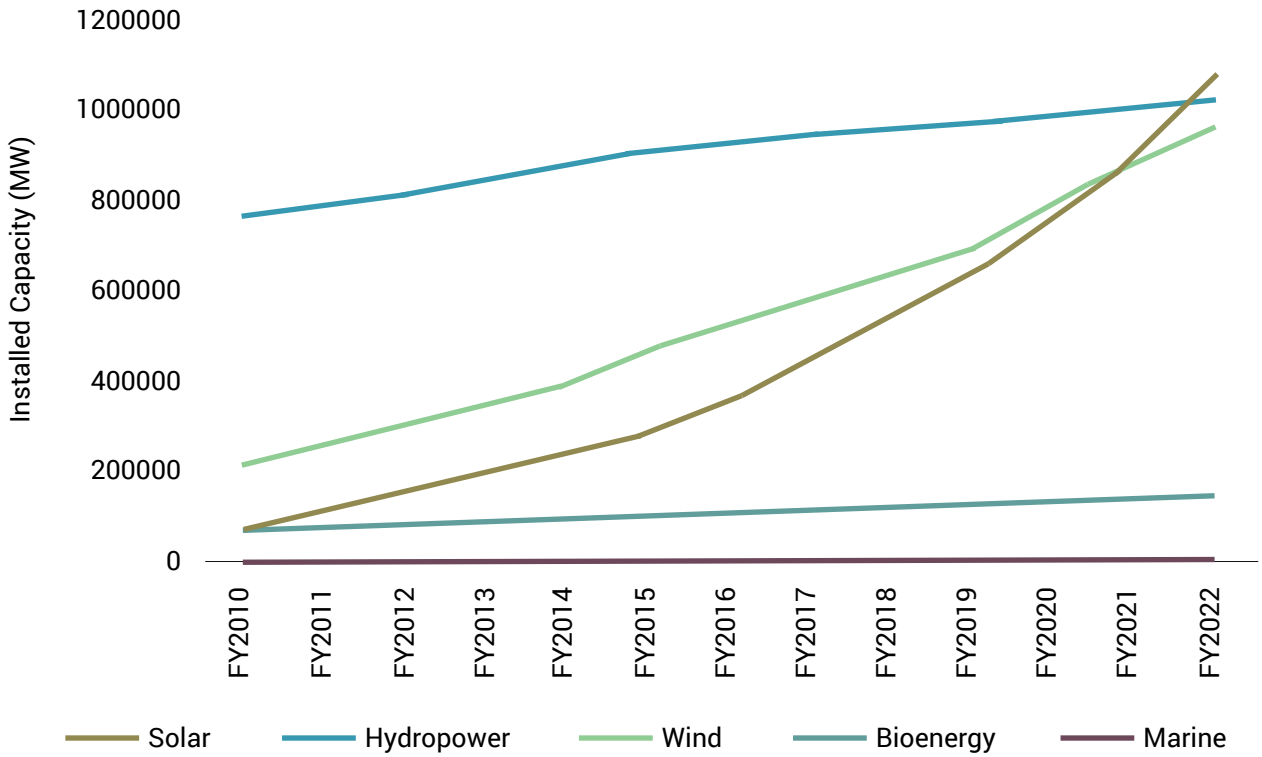
The G20 countries have installed approximately 3.225 TW of renewable energy capacity until 2022 as depicted in Figure 14[24]. The largest share of this capacity comes from solar technology, encompassing both photovoltaic (PV) and concentrated solar, which accounts for 1.085 TW[24]. In contrast, marine technology contributes the least, with only 735 MW deployed across the G20 nations[24].

Figure 14: Renewable energy installed capacity (in MW)[24]



The year-on-year trends for all RE technologies are shown in Figure 15. Solar energy, in particular, has experienced a tremendous rise, registering a remarkable 27 percent increase and surpassing hydropower deployment capacity in 2022[24]. The wind sector experienced the second most promising growth, with a significant increase of 13 percent[24].

Figure 15: Year-on-year renewable energy installed capacity in G20 countries



5.2 Leading G20 Countries in Renewable Energy Deployment

Sparklines in Table 3 illustrate the year-on-year growth in RE capacity additions for each G20 country, with notable highs and lows highlighted in red. From 2010 to 2022, China, the EU, the USA and India were the four leading countries demonstrating the largest deployment of RE capacity[24].

Table 3: Year-on-year growth in renewable energy capacity for G20 countries (in MW)[24]

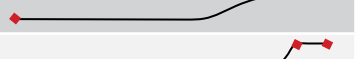
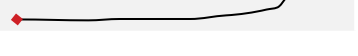
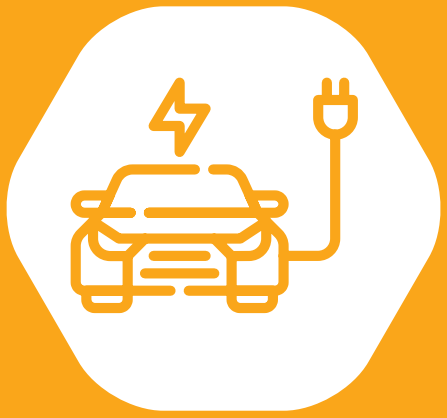
Countries	Absolute Growth in Capacity (2010-2022)	Year-on-Year Growth
China	9,27,542	
European Union	3,11,109	
USA	2,13,634	
India	1,10,751	
Germany	91,876	
Brazil	85,704	
Japan	85,459	
United Kingdom	43,398	
Türkiye	38,574	
Australia	37,577	
France	33,664	
Italy	30,384	
Republic of Korea	28,307	
Canada	25,659	
Mexico	18,512	
South Africa	9,452	
Russian Federation	8,817	
Indonesia	5,746	
Argentina	5,269	
Saudi Arabia	441	

Figure 16: Renewable energy capacity addition (MW/day)[24]

Countries	2012		2022	
South Africa	0.02	↗	0.4	**x26.2**
Republic of Korea	1.0	↗	9.1	**x9.1**
India	6.6	↗	43.4	**x6.6**
Brazil	8.7	↗	38.7	**x4.4**
China	93.5	↗	385.1	**x4.1**
Japan	4.3	↗	15.5	**x3.6**
Indonesia	0.9	↗	2.9	**x3.1**
Canada	3.1	↗	7.1	**x2.3**
Australia	4.8	↗	10.7	**x2.2**
France	6.3	↗	13.7	**x2.2**
European Union	80.9	↗	133.9	**x1.7**
United States of America	48.2	↗	69.9	**x1.5**
United Kingdom	8.5	↗	10.3	**x1.2**
Mexico	3.9	↘	3.7	
Germany	29.3	↘	27.0	
Turkiye	8.5	↘	7.6	
Italy	16.1	↘	8.3	
Argentina	0.4	↘	0.2	
Russian Federation	4.7	↘	1.1	
Saudi Arabia	0.03	↘	0.0	

Among the G20 countries, South Africa, South Korea and India are the top three countries to witness the highest MW per day RE capacity addition. Notably, India added 43 MW per day of RE capacity in 2022, a significant increase from 6 MW per day in 2012.



06

Decarbonising Transport Sector - Electric Vehicles (EVs) Deployment

06 Decarbonising Transport Sector - Electric Vehicles (EVs) Deployment

6.1 Government Initiatives and Incentives for EV Adoption

Globally, Governments are implementing a range of initiatives and incentives to promote the widespread adoption of EVs and drive the transition to cleaner and more sustainable transportation systems.

France and Germany, for example, are offering substantial financial bonuses and tax incentives to encourage consumers to purchase EVs, while also providing tax exemptions for EV chargers to facilitate the deployment of EV charging infrastructure. In Australia and Canada, significant investments in charging networks, along with fleet incentives and subsidies, are being made to promote EV ownership among businesses and local councils.

China, on the other hand, has established a comprehensive New Energy Vehicles (NEV) Subsidy Program and a Zero Emission Vehicles (ZEV) Mandate, setting ambitious targets to facilitate a rapid shift to electric mobility. To enhance the affordability of EVs, India and Turkey have lowered taxes and are offering financial incentives, such as the Faster Adoption and Manufacturing of Electric Vehicles–II (FAME-II) scheme and special reduction in consumption tax.

Furthermore, the United States and the European Union are strategically focusing on building competitive EV supply chains, investing substantially in domestic manufacturing, research, and development to reduce dependence on foreign suppliers.

Some countries, including Saudi Arabia and South Africa, will soon be releasing dedicated EV policies. This global trend of promoting eco-friendly transportation alternatives and fostering a sustainable EV ecosystem highlights the commitment of Governments to combat climate change and reduce emissions.

6.2 Leading Countries for EV Relevant Mineral Production

The global shift toward EVs necessitates a reliable supply of critical minerals. As shown in Figure 17, a number of minerals, including cobalt, copper, graphite, pig iron, manganese ore, nickel, lithium, and platinum group metals, are vital for the production of EVs.

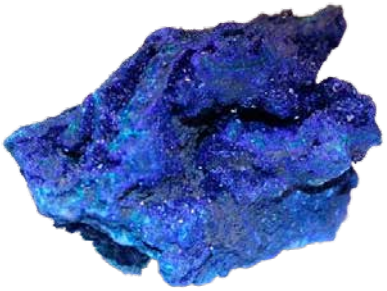
The top five mineral producing countries play a significant role to support the growing demand for EVs. As can be seen in Figure 17, China, Australia, and South Africa contribute substantially to the global supply chain by ensuring a sustainable and robust foundation for the growth of EV industry.

The prominent producers of lithium, Australia and Chile

Figure 17: Top five countries producing EV relevant mineral production (in million tonnes)[25]

*(The countries highlighted in **orange colour** represents the G20)*

Cobalt



China 0.13

Finland 0.01

Japan 0.004

Canada 0.01

Norway
0.004

Copper

China 10.49

Chile 2.27

Russia 1.10

Japan 1.52

Congo, Democratic Republic
1.30

Graphite

China 0.82

Brazil 0.10

Madagascar
0.10

Mozambique
0.08

North Korea
0.04

Pig Iron

China 868.60

India 116.60

South Korea 46.44

Japan 70.34

Russia
53.90

Lithium[26]

Australia
0.24

Chile
0.11

USA
0.02

China
0.05

Argentina
0.03

Manganese ore

South Africa
19.16

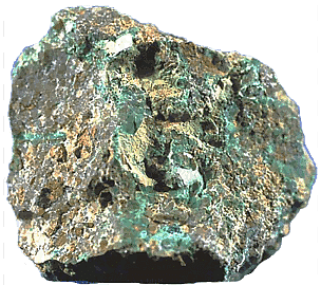
China
6.50

Ghana
3.34

Gabon
9.24

Australia
6.29

Nickel



Indonesia
1.17

Philippines
0.39

Canada
0.13

Russia
0.19

New Caledonia
0.19

Platinum Group Metal[27]

South Africa
1.31

Russia
0.56

USA
0.09

Zimbabwe
0.15

Canada
0.14

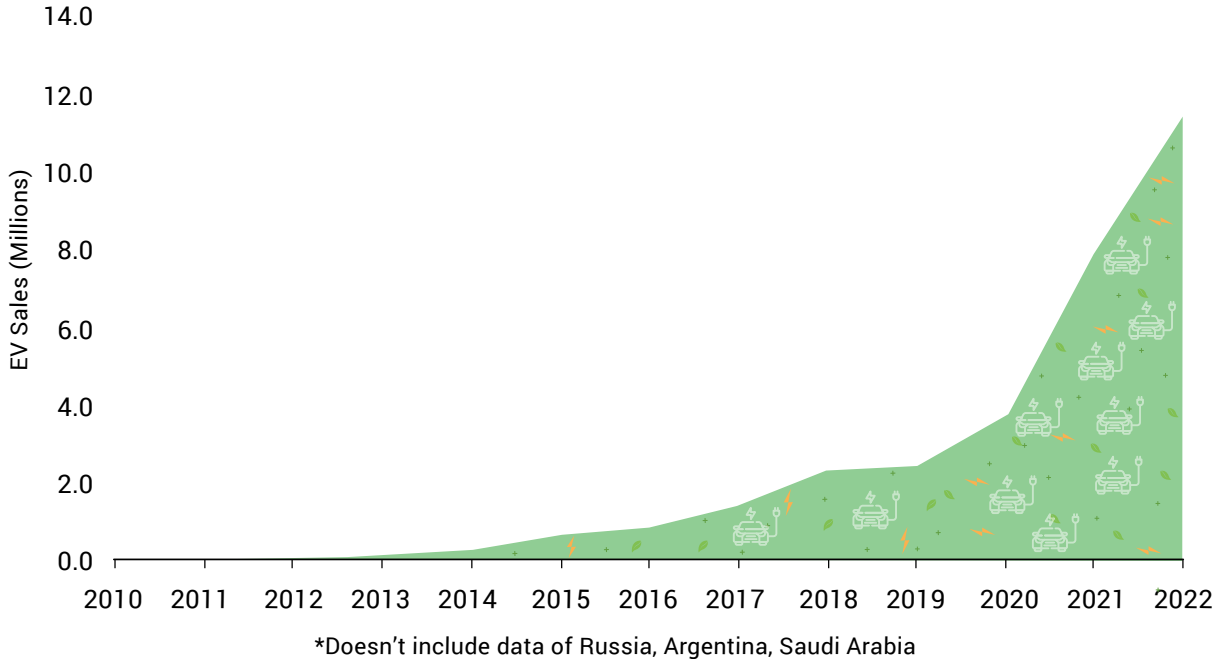
underpin the development of EV batteries, while South Africa, the top producer of manganese ore, ensures the availability of Nickel, Manganese and Cobalt Oxide (NMC) types of Lithium-ion batteries. The contribution of countries like Indonesia, Russia, and Canada in nickel production and South Africa, Russia, and Zimbabwe in mining of the platinum group metals, highlight the importance of global collaboration in meeting the EV demand. As the automotive industry electrifies, these countries remain at the forefront of the mineral production landscape, essential to a sustainable and eco-friendly future in transportation.

Figure 17 highlights a noteworthy observation indicating that at least two G20 nations consistently rank among the top five leading producers of various minerals. This underscores the pivotal role of the G20 countries in fostering international cooperation in the realms of EVs and EV battery manufacturing.

6.3 EV Adoption by G20 Countries

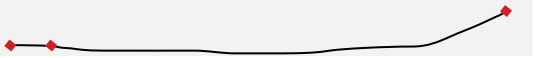
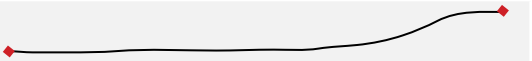
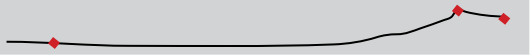
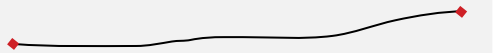
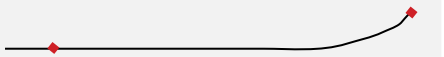
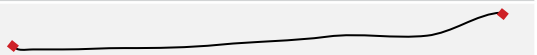
EVs stand out as the most effective solution for reducing carbon emissions in the transportation sector, which accounts for approximately 20 percent of GHG emissions. EV adoption has gained momentum across G20 nations, with total EV sales reaching around 11.45 million in 2022[28]. Figure 18 encompasses four primary vehicle categories-

Figure 18: Year-on-year EV sales in G20 countries[28]



buses, cars, trucks, and vans. It is worth noting that in some countries within G20, 2 and 3-wheelers constitute a significant share of the vehicle market. However, due to a lack of comprehensive data on electric 2 and 3-wheelers, this comparison focuses solely on the four categories of vehicles mentioned above.

Table 4: Growth of EV sales in G20 countries[28]

Row Labels	Absolute Growth in Sales (Million EVs)	Year-on-Year Growth (2010–2022)
Australia	0.039	
Brazil	0.021	
Canada	0.125	
China	6.131	
EU27	2.041	
France	0.353	
Germany	0.848	
India	0.117*	
Italy	0.119	
Japan	0.116	
Korea	0.167	
Mexico	0.009	
South Africa	0.001	
Turkiye	0.008	
United Kingdom	0.387	
USA	0.972	

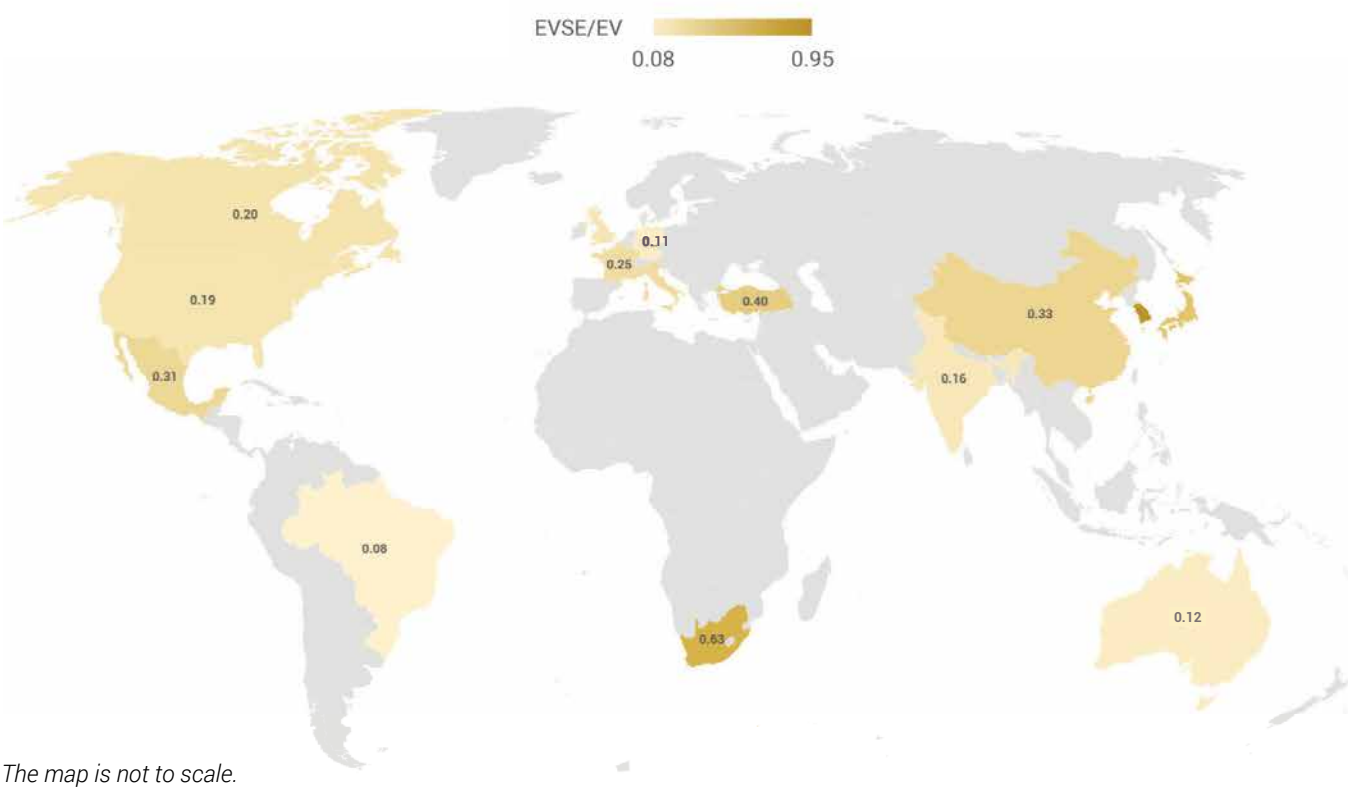
**It includes all type of vehicle categories data.*

Furthermore, the year-on-year growth in EV sales within the G20 nations exhibits a positive trend, as indicated in Table 4. Nevertheless, considering the actual sales number, it is apparent that China leads with the highest absolute growth in EV sales, followed by the EU.

6.4 Growth of Charging Infrastructure

Electric Vehicle Supply Equipment (EVSE) or charging infrastructure plays a pivotal role in promoting widespread adoption of EVs. Figure 19 illustrates that South Korea outperforms most countries by achieving a heartening EVSE/EV ratio, which is closest to 1. However, the number of EVs adopted are only 0.4 million. With regard to the number of chargers deployed, China leads the way with the highest number, totalling approximately 4.94 million, which include both fast and slow public chargers as well as over 15 million EVs[28]. Considering the combined deployment of chargers for all the other G20 countries, it becomes evident that their infrastructure are far from matching China's extensive infrastructure.

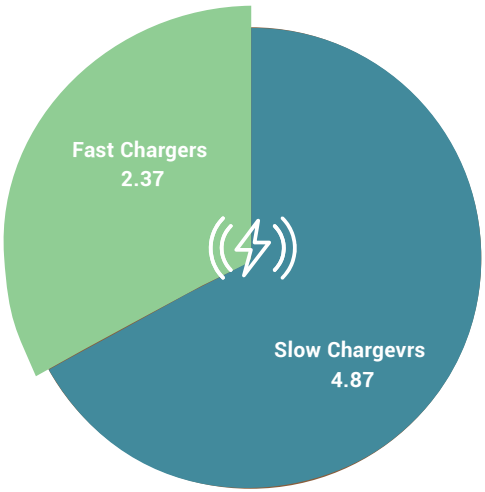
Figure 19: World EVSE/EV charger map[25]



The map is not to scale.

Fast chargers constitute approximately one-third (33 percent) of the total number of chargers deployed across these countries, as indicated in Figure 20. This is understandable since slow chargers do not require extensive electrical infrastructure upgrades for the nearby installation. Furthermore, fast charging is applied more selectively, as deploying fast chargers is not recommended when vehicles are parked for extended periods at home or in an office setting.

Figure 20: Distribution of fast and slow chargers across G20 countries[28]



Across all G20 countries, the expansion of charger deployment exhibit a positive trend, whether they are fast or slow chargers, as evident from the sparklines in Table 5 and Table 6. It is worth mentioning that approximately five countries, including Brazil, Indonesia, Mexico, South Africa and Turkiye, have a total charger deployment of less than 10,000 units[28]. This observation directly correlates with the lower adoption of EVs in these countries.

Table 5: Growth in slow EV chargers[28]

Countries	Absolute Growth (In Millions)	Year-on-Year Growth
Australia	8,910	
Brazil	3,250	
Canada	71,820	
China	29,24,000	
France	2,59,100	
Germany	2,20,300	
India	8,920	
Indonesia	684	
Italy	84,800	
Japan	1,72,600	
Korea	3,79,100	
Mexico	7,423	
South Africa	777	
Turkiye	5,099	
United Kingdom	1,79,100	
USA	5,41,900	

Table 6: Growth in fast EV chargers[25]

Countries	Absolute Growth (In Millions)	Year-on-Year Growth
Australia	1,491	
Brazil	25	
Canada	12,057	
China	20,19,000	
France	23,999	
Germany	37,585	
India	4,257	
Indonesia	311	
Italy	11,977	
Japan	67,200	
Korea	62,620	
Mexico	436	
South Africa	728	
Turkiye	540	
United Kingdom	35,816	
USA	94,200	

07

Climate Finance Flows to Developing Countries

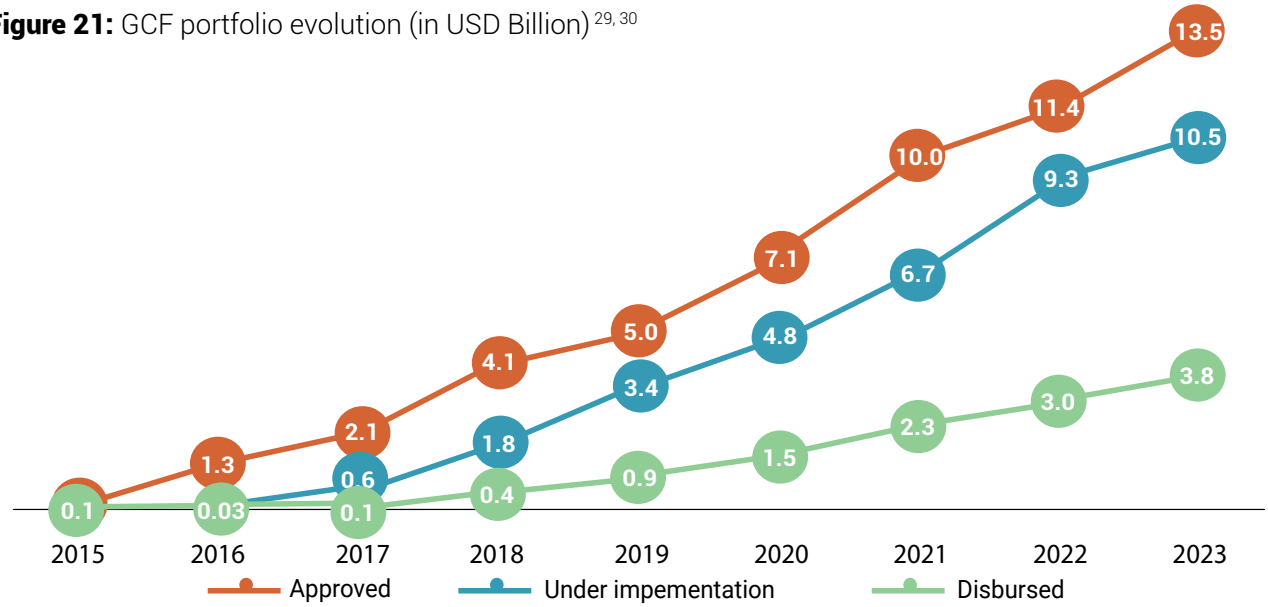
07 Climate Finance Flows to Developing Countries

7.1 Overview of Year-on-Year Climate Finance Flows

The global community has widely recognised the crucial role of public finance in addressing the challenges of climate change. As the operational body responsible for managing the financial mechanisms of the UNFCCC and the Paris Agreement, the Green Climate Fund (GCF) is taking the leadership role in the international climate finance framework. The GCF is the world's largest dedicated fund that assists developing countries to reduce GHG emissions and adapt to climate change by providing support in the form of grants, loans, guarantees, equity etc.

In recent years, the GCF's portfolio has experienced substantial growth. The GCF board approved USD 13.5 billion in 2023, as against USD 1.3 billion approved in 2016 (when GCF became fully operational). As of October 26, 2023, the value of approved projects, including GCF and co-financing, totalled USD 51.8 billion. Figure 21 shows the GCF portfolio over the years.

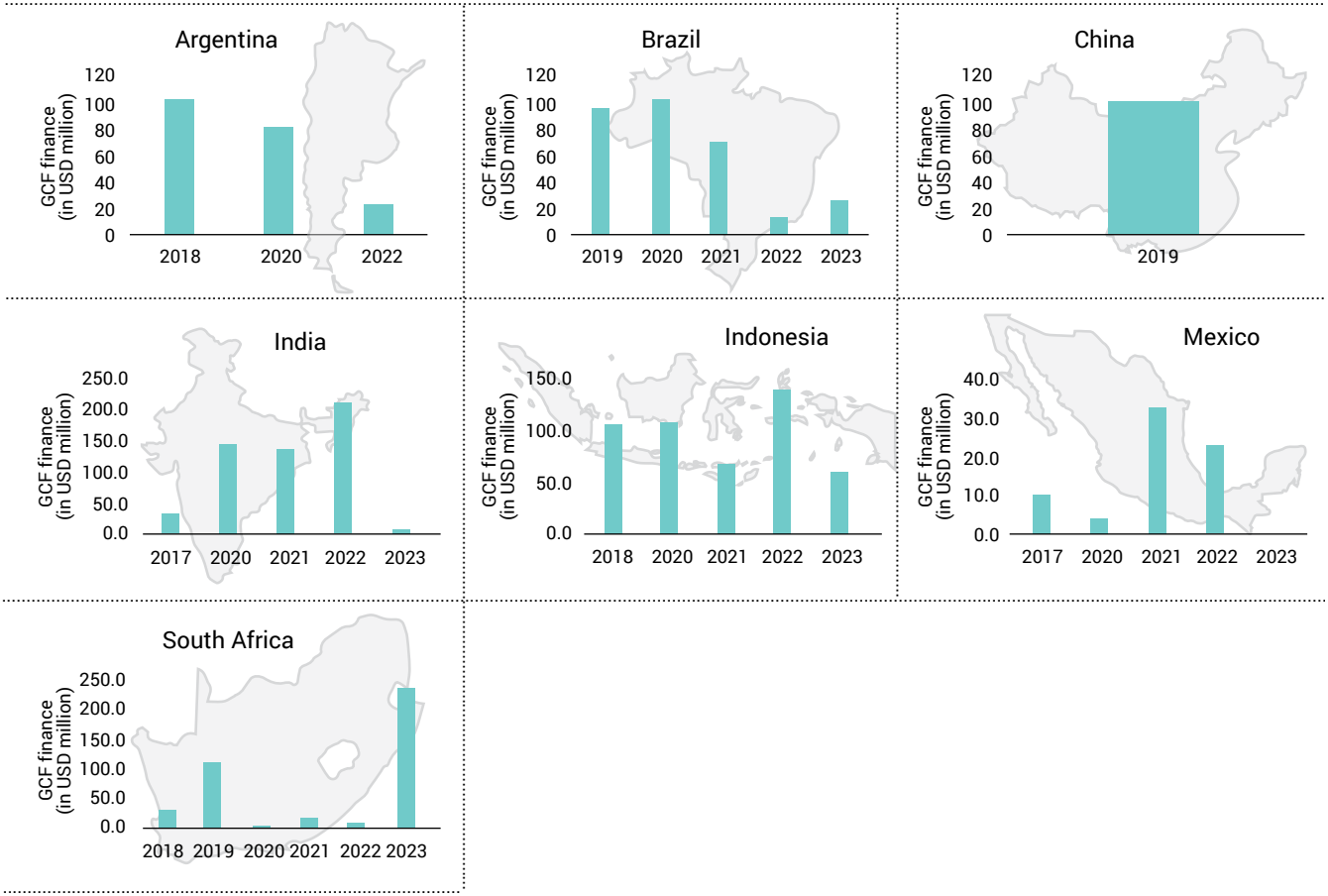
Figure 21: GCF portfolio evolution (in USD Billion) [29, 30]



7.2 Assessment of the Green Climate Fund

As of now, the GCF provides support to 148 countries, covering 243 projects across the developing nations. The following graph illustrates the annual approval for GCF financing for developing countries that are member of the G20. Among the seven G20 member countries receiving GCF financing, India has taken the lead in total GCF financing with USD 542.3 million since 2017. Next on the list are Indonesia, Brazil and South Africa, with USD 496.3 million, USD 421.4 million and 414.8 million, respectively.

Figure 22: Year-on-year GCF financing approved for developing countries (data taken on 26-10-2023)[31]



08

Conclusion

08 Conclusion

In 2015, at the 21st Meeting of Parties to the United Nations Framework Convention to Climate Change (UNFCCC) (COP21) in Paris, countries came together to agree on a historic agreement[32] with the goal of limiting the global temperature increase to 1.5 degrees Celsius above pre-industrial levels. Since COP21, close to 140 countries have committed to a Net Zero Target, with close to 151 countries either submitted new Nationally Determined Contributions (NDCs) or updated their existing NDCs as of November 2021.

Fast forward to the 28th Meeting of Parties to the UNFCCC (COP28), scheduled in Dubai in December 2023; one of the key agenda of the meeting is the Global Stocktake- which takes stock of countries progress on addressing climate change and to evaluate their advancements in implementing stated climate goals either through their NDCs or long-term decarbonisation pathways or both.

However, the IPCC synthesis report 2023 presents a sobering picture. Upon scrutinizing the climate action plans (NDCs) of 198 countries, the report highlights insufficient headway and a lack of ambition aligning with the objectives of the Paris Agreement. However, the report also clearly emphasises that achieving the 1.5°C target is still possible and outlines the critical actions required across sectors and by everyone at all levels in order to meet the target. Some of the key suggestions include, a focus on climate justice and climate resilient development. It also underlines the importance of sharing best practices, climate friendly technology, effective policy measures and mobilising adequate finance in order to meet the requirements of developing and least developing economies to meet their climate goals.

To underscore the finding of the IPCC's synthesis report, it is pertinent to point out to the current global emissions scenarios. Various estimates suggests that the world needs to limit cumulative emissions between 2020 and 2050 to 450-500 $GtCO_2$ to meet the 1.5 degree Celsius rise. Between 2020 and 2022, CO_2 emissions have persistently remained at approximately 35 gigatons of CO_2 per year, already reducing 20% of the 1.5 degree Celsius-compatible budget. Further, in order to achieve the target of 1.5 degree Celsius, global emissions must decline at more than 3 $GtCO_2e$ per annum, a very tall order indeed! This stark reality serves as a wake-up call for Governments and citizens alike.

As global efforts to address climate change intensify, the focus turns to the role of major economies, particularly those within the G20, in curbing carbon emissions. COP28 presents a pivotal opportunity to achieve global consensus on three critical issues: a drastic reduction in the G20's current 81 percent reliance on fossil fuels, bridging the massive shortfall in climate finance which currently falls far short of the $100 billion per year commitment and finally, achieving

net-zero emissions by mid-century. However, the disparity in development and growth among nations necessitates that developed countries accelerate technology transfer and facilitate capacity building efforts across sectors for developing nations.

Further and in line with the recommendations of the IPCC synthesis report, and particularly with regard to new technologies that can help in reducing emissions and particularly for hard to abate sectors, it is important to address the challenge of availability and access to critical minerals, which is very crucial for advancing clean energy technologies. These minerals often originate from geopolitically high-risk nations, posing a significant hurdle to the smooth transition to sustainable energy. To mitigate this risk, it is also imperative to prioritize the development of technologies that reduce dependence on these critical minerals, favouring those more evenly distributed across regions.

Finally, the glaring inadequacy in the progress of financial assistance from developed to developing nations for scaling up climate action must be addressed. If the world is genuinely committed to achieving the 1.5 degree Celsius Paris Agreement goals, it is absolutely essential for financial commitments to be fulfilled promptly and consistently. In addition, there is a need to scale up the levels of technological cooperation and transfers for dealing with climate change effectively and equitably.

BIBLIOGRAPHY

1 Vrinda Gupta, J. S. (2022). ***India's Power Outlook Series, Volume 5.*** Vasudha Foundation. Retrieved November 09, 2023, from https://www.vasudha-foundation.org/wp-content/uploads/Indias-Power-Outlook-Vol-5-Net-Zero.pdf

2 Sven Teske. (2023). The 'Global Stocktake' and the remaining carbon budgets for G20 countries to limit global temperature rise to +1.5 °C. ***SN Applied Sciences***. Retrieved November 09, 2023, from https://link.springer.com/article/10.1007/s42452-023-05482-w

3 World Bank. (2023). ***Population***. Retrieved November 09, 2023, from World Bank Databank: https://data.worldbank.org/indicator/SP.POP.TOTL

4 World Bank. (2023). ***GDP (constant 2015 US$)***. Retrieved November 09, 2023, from World Bank Databank: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD

5 UNFCCC. (2023). ***Technical dialogue of the first global stocktake. Synthesis report by the co-facilitators on the technical dialogue.*** UNFCCC. Retrieved November 09, 2023, from https://unfccc.int/documents/631600#:~:text=This%20synthesis%20report%20on%20the,comprehensive%20overview%20of%20discussions%20held

6 Climate Action Tracker. (2023). ***Paris-aligned benchmarks for the power sector.*** Climate Action Tracker. Retrieved November 09, 2023, from https://climateactiontracker.org/publications/paris-aligned-benchmarks-power-sector/

7 UNFCCC. (2023). ***Nationally Determined Contributions (NDCs) Registry.*** Retrieved November 09, 2023, from https://unfccc.int/NDCREG

8 European Commission. (2023). ***EDGAR - Emissions Database for Global Atmospheric Research.*** Retrieved November 09, 2023, from https://edgar.jrc.ec.europa.eu/report_2023?vis=gdp#emissions_table, Vasudha Analysis

9 Enerdata. (2023). World Energy & Climate Statistics Yearbook. Retrieved November 09, 2023, from https://yearbook.enerdata.net/total-energy/world-energy-intensity-gdp-data.html

10 European Commission. (2023). ***EDGAR - Emissions Database for Global Atmospheric Research.*** Retrieved November 09, 2023, from https://edgar.jrc.ec.europa.eu/report_2023?vis=gdp#emissions_table

11 Our World in Data. (2022). ***Energy use per person.*** Retrieved November 09, 2023, from https://ourworldindata.org/grapher/per-capita-energy-use

12 University of Technology, Sydney. (2021, November). ***How can we limit global warming to 1.5°C?*** Retrieved from https://www.uts.edu.au/isf/explore-research/projects/how-can-we-limit-global-warming-1.5degc

13 Tejal Kanitkar, T. J. (2010). ***Meeting Equity in a Finite Carbon World.*** Retrieved November 09, 2023, from http://re.indiaenvironmentportal.org.in/files/TISS-BackgroundPaper31May2010.pdf

14 Spencer Scott. (2023, September 20). ***One Earth G20 models: a "fair share" roadmap for socially just climate transitions at the national level***. Retrieved from One Earth: https://www.oneearth.org/new-g20-fair-share-roadmaps-illustrate-how-the-world-can-achieve-a-just-energy-transition/

15 Tim Gore. (2020). Confronting Carbon Inequality: Putting climate justice at the heart of the COVID-19 recovery. ***Oxfam***. Retrieved November 20, 2023, from https://policy-practice.oxfam.org/resources/confronting-carbon-inequality-putting-climate-justice-at-the-heart-of-the-covid-621052/

Antonio Guterres, U. S. (2021). Carbon inequality in 2030. ***IEEP and Oxfam***. Retrieved November 20, 2023, from https://oxfamilibrary.openrepository.com/

bitstream/10546/621305/1/bn-carbon-inequality-2030-051121-en.pdf.

16 Tim Gore. (2020). Confronting Carbon Inequality: Putting climate justice at the heart of the COVID-19 recovery. ***Oxfam***. Retrieved November 20, 2023, from https://policy-practice.oxfam.org/resources/confronting-carbon-inequality-putting-climate-justice-at-the-heart-of-the-covid-621052/

17 SIVAN KARTHA, E. K.-B. (2020). THE CARBON INEQUALITY ERA. ***Oxfam***. Retrieved November 20, 2023, from https://oxfamilibrary.openrepository.com/bitstream/10546/621049/4/rr-carbon-inequality-era-210920-en.pdf.

18 Antonio Guterres, U. S. (2021). Carbon inequality in 2030. ***IEEP and Oxfam***. Retrieved November 20, 2023, from https://oxfamilibrary.openrepository.com/bitstream/10546/621305/1/bn-carbon-inequality-2030-051121-en.pdf. The UNEP Emissions Gap Report estimates the gap at 28Gt CO_2e, which is approximately 20Gt CO_2. However, the above SEI-Oxfam paper estimates a gap of approximately 17Gt CO2, using a slightly later cut-off point to consider NDCs than the UNEP Emissions Gap Report, and using RCP1.9 SSP2 projections for a selection of countries, which may result in a slight over-estimation of emissions reductions through 2030 based on unconditional NDCs.

19 Our World in Data. (2023). ***Coal reserves***. Retrieved from https://ourworldindata.org/grapher/coal-proved-reserves

20 Our World in Data. (2023). ***Oil Reserves***. Retrieved from https://ourworldindata.org/grapher/oil-proved-reserves?tab=chart

21 Our World in Data. (2023). ***Gas Reserves***. Retrieved from https://ourworldindata.org/grapher/natural-gas-proved-reserves

22 Our World in Data. (2023). ***Energy consumption by source, World***. Retrieved from https://ourworldindata.org/grapher/energy-consumption-by-source-and-country?stackMoWde=absolute

23 IRENA. (2023). Installed electricity capacity (MW) by Region/country/area, Technology and Year. Retrieved from IRENASTAT Online Data Query Tool: https://pxweb.irena.org/pxweb/en/IRENASTAT/IRENASTAT__Power%20Capacity%20and%20Generation/ELECCAP_2023_cycle2.px/

24 IRENA. (2023). ***Installed renewable electricity capacity (MW) by Region/country/area, Technology and Year***. Retrieved from IRENASTAT Online Data Query Tool: https://pxweb.irena.org/pxweb/en/IRENASTAT/IRENASTAT__Power%20Capacity%20and%20Generation/RECAP_2023_cycle2.px/

25 N E Idoine, E. R. (2017-21). WORLD MINERAL PRODUCTION. British Geological Survey. Retrieved November 09, 2023, from https://nora.nerc.ac.uk/id/eprint/534316/1/WMP_2017_2021_FINAL.pdf

26 Showing overall lithium content from different sources

27 Data shows Mine Production for Platinum Group Metals

28 IEA. (2023). ***Data and Statistics***. Retrieved from Global EV Outlook: https://www.iea.org/data-and-statistics/data-product/global-ev-outlook-2023#global-ev-data

29 Green Climate Fund. (2023). Progress Report - GCF's first replenishment period 2020-2023. Retrieved November 09, 2023, from https://www.greenclimate.fund/sites/default/files/document/20230501-gcf-1-progress-report.pdf

30 2023 numbers taken from GCF website on 26-10-2023. Green Climate Fund. (2023, October 26). Project portfolio. Retrieved from https://www.greenclimate.fund/projects/dashboard

31 Green Climate Fund. (2023, October 26). PROJECTS & PROGRAMMES. Retrieved from https://www.greenclimate.fund/countries

32 UNFCCC. (2015). The Paris Agreement. Retrieved November 27, 2023, from https://unfccc.int/process-and-meetings/the-paris-agreement

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Our mission is to promote environment-friendly, socially just and sustainable models of energy by focusing on renewable energy and energy-efficient technologies as well as sustainable lifestyle solutions. Through an innovative approach and data-driven analysis, creation of data repositories with cross-sectoral analysis, along with outreach to ensure resource conservation, we aim to help create a sustainable and inclusive future for India and Mother Earth.

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