Research Article

'Just Transition' Initiatives by G20

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Abstract: To achieve the SE4All targets, the share of renewable energy has to be increased in the world's energy mix from 18 per cent to 36 per cent between 2010 and 2030. This calls for an annual rise of nearly one per cent in the proportion of renewable energy in the world's energy mix. For that, the G20 nations expressed their desire to promote the deployment of clean, affordable energy resources to developing countries and committed to sharing best practices and raising the fund for scaling up the Renewable Energy Program. In this regard, the G20 launched various initiatives, especially during Turkey and Indonesia Presidency. Despite these efforts, many countries still have a lower share of renewable energy in their energy mix. Besides that, another conundrum facing by a country is whether to go for energy transition or just transition. Just transition is extremely context-dependent and complicated and it requires a lot of preparedness and a comprehensive framework. Therefore, the G20 nations need to increase policy connectedness and coordination between energy and the rest of the economy. India is closer to its targets of energy transition than ever before. India could showcase its energy transition success story and expand its Green Hydrogen Mission during its G20 Presidency.

Introduction

Global energy consumption has been rising continuously along with population and economic expansion. It is imperative to provide access to clean, affordable, and safe sources of energy to maintain global economic growth and the environment at a sustainable level (Kumar & Majid, 2020). Therefore, it is a challenge for a country to ensure sufficient, reliable, and environmental friendly supplies of energy at an affordable price (Papathanasiou, 2022; Ahuja et al, 2009). Studies show that the use of energy mix has been rising and the renewable energy usage has increased recently, and it is anticipated that it will keep increasing further (Gielen et al, 2019). To save the environment and combat the threat of climate change, it is vital to enhance the supply of clean and renewable energy. The UN Secretary-General has stated that one of the three objectives of the SE4All project is to increase the proportion of renewable energy in the world's energy mix from

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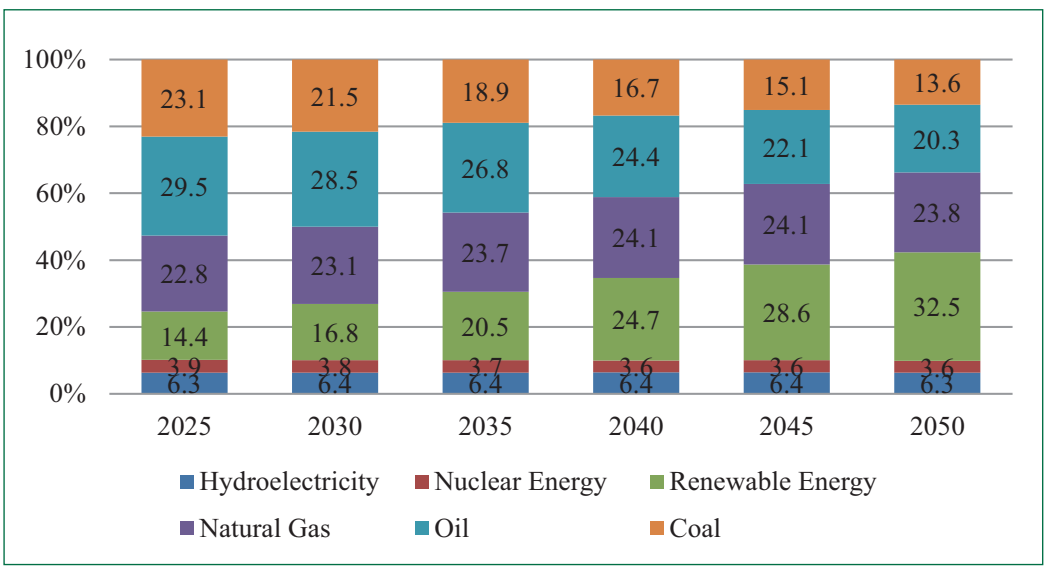
18 per cent to 36 per cent between 2010 and 2030. This calls for an annual rise of nearly one per cent in the proportion of renewable energy in the world's energy mix (IRENA, 2013 & 2014; World Bank, 2015).

Renewable energy consumption was 42 exajoules in 2000, contributing around 10 per cent of the global energy consumption. This consumption figure reached 74 exajoules in 2019 with an average growth of 3 per cent, contributing 12 per cent of the global energy consumption. It is projected that renewable energy consumption would reach 247 exajoules by 2050, contributing about 33 per cent to global energy consumption (Figure 1). More than half of the increase in the world's electricity supply in 2021 has come from renewable sources. This is the highest year-over-year rise in renewable power generation since the 1970s. Two-thirds of the global growth in renewable is projected to come from solar PV and wind (IRENA, 2022). China generated about half of the growth in renewable electricity generated globally in 2021, followed by the US, the EU, and India. This increase in the usage of renewable energy could be a sharp decline in installation costs. Between 2010 and 2020, the global weighted average costs of solar photovoltaic (PV) plants decreased by 85 per cent. Concentrated solar power (CSP) saw cost reductions of 68 per cent, onshore wind of 56 per cent, and offshore wind of 48 per cent (IRENA, 2022). Despite the reduction in the installation costs of renewable energy, still many nations have a lower share of renewable energy in their energy mix. Over the next five years, it is projected that the majority of G20 countries would achieve double-digit shares of variable renewable energy (VRE) in their power supplies, with system integration

Figure-1: Projected Renewable Energy Share (%) in Global Energy Consumption



Source: BP Energy (2022)

standing in the way of the continuous deployment of solar and wind power. However, a lot of work still has to be done to meet the renewable energy targets by 2030. To prevent climate change and keep global temperatures less than 1.5° of pre-industrial levels, the energy transition must be successful by the second part of this century. To do this, the worldwide energy sector must switch from fossil fuels to zero-carbon sources. To speed up the global energy transition and fulfill both national and regional commitments, the decarbonization of the energy sector necessitates immediate global action. To facilitate the deployment, enabling policies and rules must be implemented. Policymakers need to give more attention to end-use sector decarbonization. Energy transition cannot happen successfully unless energy policy is linked with the demand side of renewable energy. For that, it is required to increase policy connectedness and coordination between energy and the rest of the economy. Such policies must prioritise efficient planning, and the adoption of renewable energy, as well as the reformation of the wider institutional structure, to encourage people to use renewable energy.

Against this backdrop, the paper examines the challenges of energy transition and the debate around just transition. In addition, the paper discusses the initiatives launched by the G20 toward energy transition. The paper is structured as follows. Section 2 outlines the challenges for the energy transition. Section 3 examines the concept of just transition and its implications. Section 4 covers the discussion on energy transition by the G20 countries. Sections 5 and 6 discuss India's take aways and future roadmap for the energy transition. Section 7 outlines the main concludes.

Challenges for Energy Transition

Energy transition does not happen abruptly. It happens after long It takes time to manifest and could lead to greater market diversity for energy. This is an ongoing process that gradually changes the composition of the materials required to generate heat, motion, and light. So far, the energy transition is gone through three phases. The first phase of the energy transition is from wood to coal, followed by coal to petroleum products, and the third phase is from fossil fuels to renewable sources (Jaeger & Machry, 2014). The third phase of the energy transition refers to the shift from fossil fuels to renewable energy sources like wind, solar, etc. The third phase of transition is only made possible by technological developments and a collective desire for sustainability (Kabeyi & Olanrewaju, 2022). But there are many challenges associated with the third phase of transition. These challenges are the following:

Energy Storage

The key component of the entire energy transition is renewable energy storage. There is a mismatch between renewable energy production and electricity demand that causes periods of over generation and periods of under generation (Schill, 2020; Hargreaves & Jones, 2020). This will further create the scenario of energy deficit periods. Energy deficit could last for a few hours, or a few days, a entire season, or even a few years. Electricity is only generated when the sun shines or the wind blows. This does not always correspond to the demand cycle. On the other hand, adding renewable energy sources to the electrical grid also creates the problem of power quality. Power

quality is, therefore, a crucial component of renewable energy delivery systems. Voltage and power frequency changes as well as harmonic frequencies provide the biggest problems for power quality. Voltage and power frequency oscillations on the power grid are exacerbated by the variability of renewable energy sources. The integration of renewable energy systems and energy deficit problems can be resolved by energy storage systems. India is the world's third largest producer of renewable energy, with non-fossil fuel sources accounting for nearly 40 per cent of installed capacity. This green push resulted in a 24 per cent reduction in GDP emission intensity between 2005 and 2016, but it also created challenges with a grid that is increasingly powered by renewable (Kalair et al, 2021). Policymakers believe that India must work quickly to develop viable energy storage options. Thus, energy storage can be used to address production issues that many renewable energy systems face. As costs decrease, renewable energy storage has the potential to be utilized extensively at a larger scale (Shaqsi et al, 2020). Therefore, there is a need for investments in energy infrastructure and building up short-term and long-term storage facilities.

Regulatory Frameworks

The global regulatory frameworks are yet another important issue associated with renewable energy and the overall energy shift, and it has been somewhat uneven across the nations (Denholm et al, 2010). Europe has taken the lead in sponsoring research on how to reach a carbon-neutral economy by setting the EU's net-zero greenhouse gas emissions target for 2050. Many EU countries have been transparent about their objectives for energy and electrification by making their plans public (EU, 2020). Emerging economies are also trying to figure out ways to increase energy availability, maintain development, and move to greener energy sources, and China appears to be at the forefront of this effort (Chiu, 2017). About 131 nations have made commitments to considerably reduce greenhouse gas emissions to curb global warming, but these accords have not all been carried out equally. Despite vows to further decarbonization, some nations have continued to raise their emissions, reflecting unequal regulation and commitment across the world economy (IRENA, 2022).

Boosting Technology Adoption

The G20 agreed to increase cooperation on enhanced country-driven capacity building and technology development and transfer on mutually agreed terms, including through key global initiatives and joint or bilateral projects on the most efficient energy transition solutions since the G20 UK Presidency (2009). The G20 also pushed for the development and implementation of Clean Energy Education and Empowerment (C3E). The new technology can help to improve energy efficiency in the industrial, commercial, and residential sectors, lowering overall demand, while the digital revolution is creating new sources of flexible energy to help balance the overall system and further optimise energy consumption. For example, the adoption of clean cookstoves can also promote gender and social equity. The majority of the day in some regions of the world is spent by women and girls looking for wood to light conventional cookstoves, which produce pollutants. An enhanced cookstove, which is more energy-efficient and burns cleaner, can provide significant health and environmental benefits to users. In this context, MLICs lag behind developed countries, which is the main impediment to energy transition.

Finance & Investment

Another key component of the energy transition is investment. Under the 1.5° c scenario, the IEA estimates that investments in clean energy in MLICs excluding China would be around $ 900 billion per year. Currently, total energy investments are approximately $150 billion per year in MLICs. China needs to invest an additional $ 300 billion per year in its energy system by 2040 to achieve its 2060 carbon neutrality goal. The investment requirements differ greatly between countries. For example, it is estimated that India requires an average annual investment of $ 27.9 billion from 2022 to 2030 to meet its commitment to install renewable energy. Indonesia requires an average of $ 13.7 billion by 2060 (IEA, 2022). But energy transition investments continue to be mostly confined to a small number of nations and regions. In 2021, over half of all investments made worldwide were in the Asia-Pacific region. China is the top investment destination in the world, leading the area with $ 251 billion. Less than eight per cent of global investments were attracted to the rest of the Asia-Pacific region, which includes all of Southeast Asia. Around 28 per cent of worldwide investments went to Europe, and more than half of that money flowed to just a few nations such as Germany, the United Kingdom, Ireland, France, and Spain. The USA drew about 5 per cent of all investments worldwide, with the USA alone accounting for more than $ 105 billion, making it the second most popular investment location. These patterns unequivocally demonstrate persistent inequalities in the capacity of nations to draw investments. In contrast to many nations with lower public spending, China, Europe, the United States, Japan, and India together received almost 84 per cent of all global investments (IRENA, 2022). To achieve a just and inclusive global energy transition, international cooperation and the flow of public financing will be more important than ever.

An estimation by International Renewable Energy Agency (IRENA) shows that the overall worldwide cost to achieve the energy transition goals by 2030 would be $ 131 trillion. So, the necessary question arises where does this money come from? The obvious answer is that money would be generated through multilateral institutions, blended finance, or fintech. This would require greater levels of both public and private investment, as well as political will, and extensive and comprehensive policy frameworks that address a wide range of challenges. Despite having reached record levels, investments in energy transition technologies remain low and are concentrated in a few numbers of nations. If the energy transition is to happen globally, investment opportunities must be considerably expanded.

Just Transition Concept and Associated its Nuances

The concept of 'Just Transition' has origins in the labour market. Since the early 1970s, activists, labour unions, and related organisations have advocated for the idea of a just transition (Newell & Mulvaney, 2012; Stevis & Felli, 2015; Wang & Lo, 2021). In the 1990s, it was made obvious by the work of two unions in the American and Canadian chemical sectors. In 1995, the Oil, Chemical, and Atomic Workers Union president unveiled the just transition proposal, and by 1997, several US and Canadian unions had formally endorsed it (ILO, 2022). The International Trade Union Confederation (ITUC) and the International Labor Organization (ILO)

have taken the forefront in advocating for a variety of objectives in support of a just transition. It has integrated itself into the global union's environmental agenda over the past 15 years (Stevis & Felli, 2015). In the environmental context, it was first expressly acknowledged in the Cancun Agreement (2010) by the United Nations Framework Convention on Climate Change (UNFCCC) that efforts to combat climate change should ensure a just transition of the workforce. As stated in the agreement "Climate change requires a paradigm shift towards building a low-carbon society that offers substantial opportunities and ensures continued high growth and sustainable development, based on innovative technologies and more sustainable production and consumption & lifestyles while ensuring a just transition of the workforce that creates decent work and quality jobs".

Additionally, during COP21 in Paris in 2015[1], the idea was incorporated into the preamble. The historic global agreement on reducing emissions that came out of the summit specified a just and balanced energy transition that leaves no one behind. Through the formal "Declaration" that was drafted at the 2018 Katowice Conference, a stronger foundation for just transition was established. The "Solidarity and Just Transition Silesia Declaration" was drafted and presented during the Conference by the Polish president of the COP with the assistance of around 52 nations (iFOREST, 2021). The document stated that "Just transition of the workforce and the creation of decent work and quality jobs are crucial to ensure an effective and inclusive transition to low greenhouse gas emission and climate-resilient development". More than 30 nations signed the Glasgow Just Transition Declaration in 2021 at COP26, reinforcing the need of making ensuring that no worker or community is left behind in the transition to net zero emission, especially those employed in sectors, cities, and regions dependent on carbon-intensive industries and production. The declaration is in line with the ILO's 2015 Guidelines for a Just Transition, which outline the measures that must be done to realize well-managed, environmentally sustainable economies and communities, decent work for all, social inclusion, and the eradication of poverty (ILO, 2022). The nations are devoted to upholding their commitments made in the declaration. The following commitments are made; (a) assist those who are most at risk from the effects of the shift away from carbon-intensive economies, including workers, communities, and geographic areas, (b) encourage social involvement and conversation between governments, representatives of employers and employees, and other groups impacted by the shift to green transition, (c) implement economic policies that promote the use of renewable energy, encourage resource-efficient economic expansion, provide income and decent employment opportunities, and lessen poverty and inequality, (d) in addition to retraining and social assistance for those in need, create excellent jobs for individuals in their communities, and (d) ensure that all parties, particularly the most disadvantaged, have access to decent employment through both new and existing supply chains that uphold human rights.

COP23 emphasized the current promise to mobilize $ 100 billion per year under climate finance. At the national, sectoral, and regional levels, stakeholders must also make sure that funds are devoted towards financing just transition initiatives. The challenge of raising funds and resources remains quite high due to generally uneven development levels in developing countries, the

Table-1: Commitment to Just Transition in various COP conferences

COP Conference	Commitments	Documents/Para No
COP21: 2015	The necessity of a just transfer of the workforce and the creation of respectable employment and high-quality jobs is in line with the country's development priority.	Paris Agreement, para-10.
COP22: 2016	Economic diversification is a crucial step in the direction of a just transition, which focuses on a workforce transformation that is fair and the creation of good work and high-quality jobs.	
COP23: 2017	The government pledges to stop supporting and developing fossil fuels subsidies and to fund a just transition to a sustainable energy economy.	Bluegreen Alliance
COP24: 2018	A strategy to protect the jobs and way of life of those who live in unsustainable production economies must be taken into account to ensure a "just transition" to sustainable low-carbon economic practices.	Silesia Declaration
COP25: 2019	Emphasizes the importance of pursuing all climate measures in close coordination with civil society and social partners and in accordance with the idea of a just transition.	Madrid Declaration
COP26: 2021	Recognizes the necessity of ensuring just transitions that support sustainable development, the eradication of poverty, the establishment of respectable work and high-quality jobs, and all of the aforementioned. Providing specialized assistance to the poorest and most vulnerable under local conditions and recognizing the need for assistance in the direction of a just transition.	Glasgow Climate Pact, para-20 & 52.
COP27: 2022	Just, equitable and inclusive transitions are to be in line with the principles and objectives of the Convention, the Kyoto Protocol, the Paris Agreement, and the Glasgow Climate Pact.	Sharm el-Sheikh Implementation Plan, para-6.

Source: Author's compilation from various documents of COP conference.

higher dependency of employee on the coal sector, limited capabilities of local governments, limited coverage of existing unemployment benefits and social security schemes which would eventually create much difficultly to implement just transition in the developing countries. Considering the situation, the Just Transition Mechanism (JTM) was established to ensure that the transition to a climate-neutral economy occurs fairly and without leaving no-one behind to minimize the socio-economic effects of the transition. It also offers targeted assistance to help mobilize almost €65-75 billion during the years 2021-2027 in the most affected regions.

The Just Transition Mechanism, a component of the European Green Deal, offers resources for overcoming the difficulty of the transition towards the European Union's 2030 climate target and the goal of carbon neutrality in the Union by 2050 (Dutta, 2021). The JTM has three pillars of financing; (a) the Just Transition Fund (JTF), (b) dedicated just transition schemes under Invest EU, and (c) the Public Sector Loan Facility and the European Investment Bank (EIB) support all three pillars. To be eligible for grants from the JTF, each Member State will be expected to submit Territorial Just Transition Plans to the Commission, outlining which regions it would like support for and a detailed timeline for the transition. One of the criteria used to establish eligibility is the proportion of production in the region that is based on fossil fuel-intensive industries. On the other hand, JTM mainly focuses on energy production. This not only conceals a sizable portion of the work necessary to carry out a just transition, but it may also heighten perceptions of injustice if countries believe that the JTF transfers money between countries that have already started the decarbonization process and those that have not to "reward" carbon-intensive energy producers. Developing countries must take all of these factors into account before joining JTM.

Recently, India's Power Ministry[2] expressed opposition to the G7's energy transition plans for India. The G7 nations plan to persuade India to begin negotiations on the Just Energy Transition Partnership (JETP), a rich-country initiative to accelerate the phase-out of coal power plants. So far, the Power Ministry has refused to give its consent to the negotiations, arguing that coal cannot be singled out as a polluting fuel and that energy transition talks must take place on equal footing. The reason for not reaching an agreement is that a critical clause of the agreement will require the gradual closure of our coal mines and a reduction in the number of coal-burning power plants currently under construction (Sen & Kala, 2022; Sharma, 2022). In contrast with this, Indonesia joined this group to mobilize $ 20 billion over the next three to five years to accelerate a just energy transition.

The JTF has recently come under criticism, raising the question of whether the fund can address injustices in the most impacted areas. The just transition to renewable energy will require significant financial support. This issue has gotten worse due to the global epidemic. The nations make an effort to prevent escalating the socio-economic obligations of their citizens. The pandemic's effects should be well-mitigated to prevent harm to vulnerable populations and the general public. The energy transition just requires making sure that the costs and advantages of a society powered by renewable are allocated fairly. As a result, it "must create alternatives to people and regions trapped in fossil fuel dynamics through

new economic opportunity, education and skills training, and adequate social safety systems" (Blackmon, 2022).

Without social safety net programmes or appropriate mechanisms to reallocate labour and create decent and skilled jobs, a just energy transition is challenging. To implement the just energy transition framework a country should be clear on whether there is a need for energy transition or just transition. The notion has been the subject of multidisciplinary discussion, which has produced a variety of ambiguous definitions. Just transitions do not have a standard definition or conceptual foundation. The idea of just transition has grown so unclear and has taken on so many diverse interpretations that it is now challenging to communicate and have a meaningful discussion. It is vitally necessary to review and compile the academic literature on a just transition to better understand the various views and how they relate to one another (Wang & Lo, 2021; Henry et al, 2020). Thus, just energy transition is extremely context-dependent and complicated and it requires a lot of preparedness and a comprehensive framework.

India's Take Aways

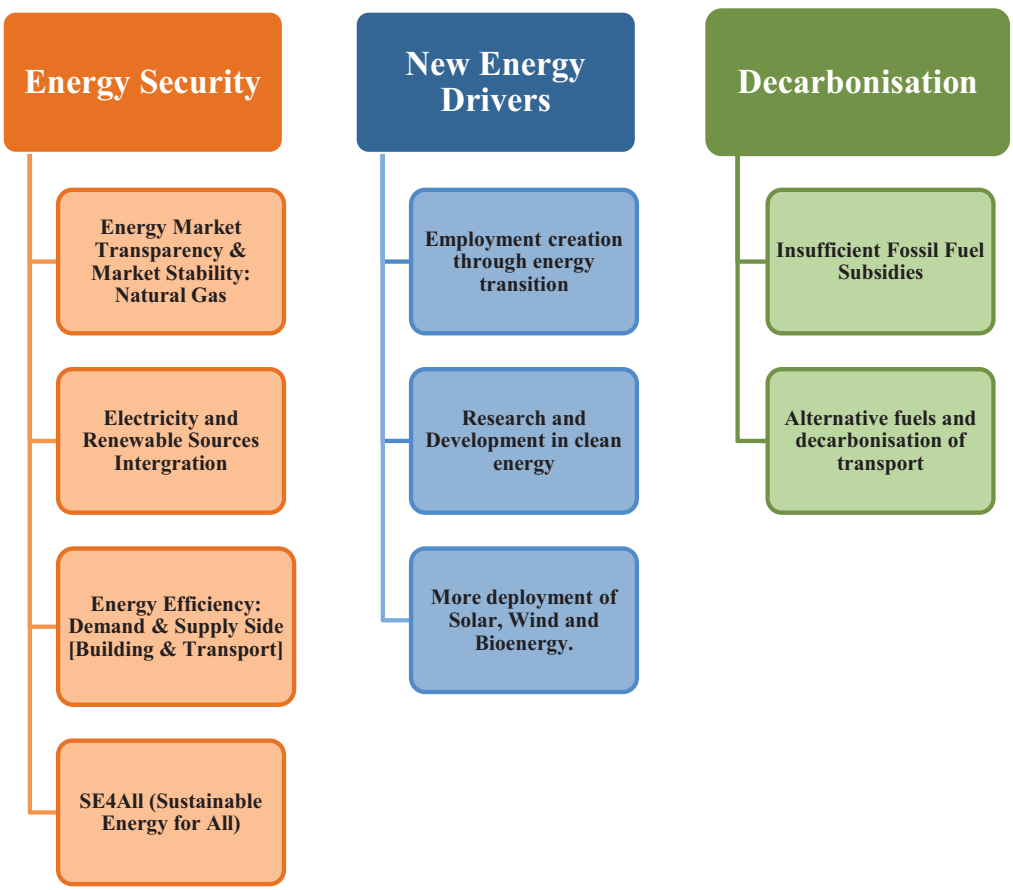
As India embarks on energy mix, focus on solar, wind, and other renewable energy sources continue to remain the topmost priority; perhaps necessary to set high budgetary allocation. In line with India's commitments to climate change actions, the Union Budget 2022-23 pushed energy transition by encouraging domestic production of solar power equipment. The government of India allocated Rs. 19.50 billion to boost domestic manufacturing of solar photovoltaic (PV) modules under the government's flagship Production Linked Incentive (PLI) scheme. India stands fourth globally in Renewable Energy Installed Capacity and set a target to achieve a capacity of 175 GW of renewable energy by the end of 2022, expanding to 500 Giga Watts (GW) by 2030, comprising 280 GW of solar energy and 140 GW of wind energy. India's installed renewable energy capacity has increased by 396 per cent in the last 8.5 years and stands at more than 159.95 GW (including large Hydro) as of 31st March 2022[3].

Achieving net zero is not about lowering greenhouse gas emissions but it also benefits its citizens through the energy transition. India has always shown its willingness to take the lead in combating climate change. The country's vision is to achieve Net Zero Emissions by 2070, in addition to meeting short-term targets such as obtaining 50 per cent of energy from renewable sources. Although the concept of just transitions was not widely used in India until recently, approaches such as environmental and social justice, as well as climate sustainability, have provided important direction to India's development agenda. In India, it is difficult to adopt the principles of just transition without any proper framework/exercise because of 90 per cent[4] workers are informal and only 25 per cent of people come under the coverage of social security benefits[5]. For example, Badarpur Thermal Power Station in New Delhi was permanently shut down on 15th October 2018. The formal workers were shifted to the Tughlaqabad sub-station while contractual workers were not re-employed. Furthermore, no negotiated transition plan was put in place to protect contractual workers, leaving them worse off and vulnerable (CIF, 2021). Therefore, deliberate policy discussions on coal phase-outs are required at the national, state, and local levels. However, at present, no convening body has either the mandate or institutional structure to support a socially inclusive dialogue on

a just transition in India. The country is closer to its targets of energy transition than ever before, yet a proper framework is required to facilitate 'Just Transition' which should be based on a human-centric approach. In addition, India could showcase its energy transition success story and expand its Green Hydrogen Mission during its G20 Presidency. India's experience would be useful to other developing countries for implementing their climate pledges and energy transition to a more sustainable way.

To increase renewable electricity generation, India introduced several policy measures such as PLI Scheme for Solar, National Solar Mission, Green Hydrogen Mission, Pradhan Mantri Kisan Urja Surakshaevam Utthaan Mahabhiyan Yojana (PM KUSUM), Solar Park, and Green Grids Initiative-One Sun One World One Grid. These initiatives could progress faster to achieve renewable energy targets by 2030 but lack of proper coordination and limited financial tools available for the many schemes could pose a hurdle to this progress. For that there is a need for policy alignment between the centre and the states, and more integrated planning should thus be established, with medium term targets at the state level to provide a better sense of direction of existing

Chart 1: The G20 Commitments/Actions on Energy Transition



policies. It is also crucial to support and build on the responsibility of single states' policy-makers and their capacity for designing and enforcing policies.

G20 Commitment/Actions for Energy and Just Transition

The energy transition is one of the key themes for discussion in the G20. The G20 nations committed to stimulating investment in clean and renewable energy and to facilitating the diffusion or transfer of clean energy technology including by conducting joint research and building capacity since the UK presidency (2009). Around 40 per cent of global electricity production is based on coal[6]. Thus, renewable energy can play a much larger role in the global economy. The G20 nations hold 75 per cent of the total global deployment potential and a similar share of the total global investment potential for renewable energy[7]. The G20 nations expressed their desire to promote the deployment of clean, affordable energy resources to the developing world. The G20 also committed to sharing best practices and raising the fund for scaling up the Renewable Energy Program and the Energy for the Poor Initiative for developing countries voluntarily. For that, G20 leaders adopted nine principles for energy collaboration in the 2014 Turkey presidency, and of these principles; three are closely connected to renewable energy. The G20 also developed a roadmap of energy transition during the G20 Indonesia presidency in 2022 called the 'Bali Energy Transition Roadmap'. The G20 agreed to work on three pillars of energy i.e. Energy Security, New Energy Drivers, and Decarbonisation (Chart-1).

The G20 nations agreed to fund scaling up renewable energy programs in developing nations to improve access to energy. To achieve green growth and ensure sustainable development in G20 nations and beyond G20, the G20 committed to promoting low-carbon development policies. The G20 agreed to support effective policies that promote innovation and the use of clean and renewable energy technology. The G20 praised the "Sustainable Energy for All" proposal launched by the UN Secretary-General during Germany's G20 presidency. The G20 encouraged the creation and application of C3E technologies, or clean energy and energy efficiency. The G20 applauded the assessment of each nation's present state of deployment of these technologies as well as the ongoing exchange of best practices as a foundation for better policymaking. The G20 also welcomed the work of Finance and Energy Ministers in delivering implementation strategies and timeframes, based on national circumstances during the Seoul summit.

The G20 applauded initiatives that support energy security, renewable energy technologies, and inclusive green growth for the long-term prosperity and well-being of the current and future generations during the Russian presidency (2013). The G20 will carry out work on related policy options and technological developments voluntarily and will continue working with international organizations to share national experiences and case studies regarding sustainable development, and clean energy as well as their development, deployment, and wider application. The G20 recognised the importance of sustainable and responsible bioenergy production and use, as well as the role of the Global Bioenergy Partnership (GBEP), and took note of the recent World Bank report 'Toward a Sustainable Energy

Future for All', which aims to improve developing-country access to reliable and affordable energy.

To support future global growth and development, significant investments in energy infrastructure will be required in the G20 and other nations. It is in everyone's best interest to evaluate current barriers and find ways to encourage more investment in smart and low-carbon energy infrastructure, especially in clean and sustainable energy infrastructure. In this regard, G20 urges the private sector and multilateral development banks to work more closely with the G20 Energy Sustainability Working Group (ESWG). The G20 also call for a dialogue to be initiated on the ESWG's foundation in 2014 that will bring together the interested public sector, market participants, and international organizations to discuss the barriers to energy investment, including in clean and energy-efficient technologies, and possible measures needed to promote sustainability. In addition to other policy levers, the G20 encourage interested regulators to continue their communication and asks the ESWG to take notice of this dialogue as part of the efforts to promote investment in energy infrastructure, particularly in clean, affordable, and sustainable energy, and to involve all interested stakeholders.

The G20 nations are aware of how crucial it is for both the public and commercial sectors to invest in research and development of the technologies and best practices required to increase productivity, efficiency, and sustainable development. Additionally, the G20 is in favor of continuing to fund the research, testing, and use of cutting-edge energy technology for a variety of energy sources, including clean energy technologies and improved global collaboration for research and development in sustainable energy. Such efforts can enable larger levels of energy access, assist economic growth, create jobs and commercial possibilities, and benefit the environment.

The energy transition is the result of numerous markets, technological, and policy factors that vary from nation to nation. Through innovation, risk management, and the implementation of supportive policy frameworks, investment in renewable energy can spare nations from the effects of greenhouse gas (GHG) emission-intensive economic growth and help the world move toward a more environmentally and economically sustainable development path. During the Turkey presidency (2014), the G20 nations adopted nine guiding principles for cooperation in the energy sector, of these principles; three are closely connected to renewable energy. These three principles are following; (a) make sure that everyone has access to reliable, cheap energy; (b) encourage sustainable growth and development that is consistent with our efforts and pledges to combat climate change, especially by encouraging clean, renewable, and cost-effective energy sources; and (c) promote and ease the creation, advancement, public display, and wide-scale use of cutting-edge energy technology, particularly clean energy technologies.

Further, the G20 emphasized the importance of renewable energy sources and their potential for long-term growth during Turkey's presidency (2014). The G20 agreed that increasing investments in renewable energy through risk management, innovation, and the implementation of supportive policy frameworks, in accordance with national priorities, can help to steer the development of energy transition. Further, G20 adopted the G20 Toolkit of Voluntary Alternatives on Renewable Energy Deployment, which lays out

helpful options for further work. With an understanding of the current unique national circumstances, to emphasize the significance of innovation, technologies, and knowledge sharing to promote the increased uptake of renewable energy sources in the energy mix, as well as the crucial roles played by system integration and stable national policy and regulatory frameworks. This initiative was further supported by China's presidency and reiterated the significance of energy cooperation toward a cleaner energy future and sustainable energy security.

The G20 recognized the benefits of greater investment in clean energy technologies, infrastructure, and sustainable energy sources for innovation, sustainable growth, competitiveness, and job creation during Germany (2017) and Argentina (2018) presidencies. The G20 also supported financing from multilateral development banks to encourage universal access to affordable, dependable, sustainable, and clean energy. They also welcomed international cooperation on the development, deployment, and commercialization of sustainable and clean energy technology. The G20 acknowledged the importance of energy transitions that realize the "3E+S" (Energy Security, Economic Efficiency, and Environment + Safety) to transform our energy systems into affordable, reliable, and sustainable ones to achieve SE4All goals during the Japanese presidency (2019). During this presidency, the G20 Research and Development ("RD20") for Clean Energy Technologies project was launched. The G20 acknowledged the importance of global cooperation on a variety of energy-related challenges, such as energy access, affordability, and efficiency, as well as energy storage. To achieve the "3E+S", the G20 Saudi Arabia presidency (2020) recognized the significance of utilizing the broadest range of fuels and technical possibilities, depending on the country's context.

G20 will work together to accelerate the development and deployment of the most efficient and effective solutions and aid them in rapidly achieving cost parity and commercial viability to fully utilise the potential of zero, low-emission, innovative, modern, and clean solutions. This includes ensuring that everyone has access to clean energy, especially in developing nations. The G20 committed to scaling up public Research, Development, and Deployment and increasing the cooperation on enhanced country-driven capacity building and technology development and transfer on mutually agreed terms, including through key global initiatives and joint or bilateral projects on the most efficient solutions in all sectors of the economy. The G20 Italy (2021) presidency committed to ensuring energy security while addressing climate change and ensuring just and orderly transitions of our energy systems in accordance with the 2030 Agenda for Sustainable Development and the Paris Agreement. The G20 Italy presidency also committed to mobilizing international public and private finance to support green, inclusive, sustainable energy development, and just energy transition. The first time word 'Just Energy Transition' was introduced during the Italian presidency.

To speed up the energy transition, the G20 Indonesia presidency (2022) introduced the Bali Energy Transition Roadmap initiative and underlined the need for support towards just transitions. The Bali Energy Transitions Roadmap's objective outlines a course for discussions of climate, finance, and related G20 tracks on clean energy transition actions that will, systematically, reflect national circumstances, needs, and priorities

of G20 members in their low emission development pathways toward net zero emissions. The Roadmap's main objectives are to Advance Clean Energy Financing, Scale-up Smart and Clean Energy Technologies, and Secure Energy Accessibility. For enhancing finance and investment, developed countries are urged by the G20 to provide expanded support, including financial resources to help developing nations under the UNFCCC's commitment. This can help leverage the billions of dollars in clean energy investments that are needed. To determine the G20's top priorities, the G20 will adopt fundamental principles and guidelines for equitable and inclusive energy transitions during Indonesia's presidency of the G20 in 2022.

Conclusion

Energy transition as a process necessitates the coordination of various policy and governance measures, which could face significant implementation challenges. Some of the challenges that a country's energy transition efforts may face include the role of pressure groups, policy hurdles, a lack of a strong institutional structure, and perceptions of the economic feasibility of shifting away from older fuel mixes, and so on. There is no specific framework that provides exclusive legal direction for the energy transition. Various policy acts and regulations pertaining to the energy sector promote and positively contribute to the future transition to a low-carbon energy mix. The G20 commitments give a special emphasis on energy supply and demand options, the role of new and renewable energy in the global energy mix, the critical linkages between energy and the environment, and necessary policy options. However, in terms of the energy transition, the policy document suggests that existing institutional structures in the energy sector be considered when developing long-term transition strategies. Because of the continued importance placed on the existing energy sector, which is dominated by conventional fossil fuels, policies for 'demand side management' have evolved to be a key component of energy transition strategies. Thus, it is time to revisit the G20 Turkey Presidency's 'Toolkit of Voluntary Options for Renewable Energy Deployment' and the G20 Indonesia Presidency's 'The Bali Energy Transitions Roadmap' initiatives. Furthermore, the G20 nations could look into other renewable energy sources and explore them through proper policy framework and coordination among the G20 nations.

Adopting renewable energy does not have a one-size-fits-all answer. It also needs to focus on the demand side. Countries must have a toolkit at their disposal to create their own unique renewable energy policies that are tailored to local conditions and priority areas for sustainable development. The creation and promotion of such a toolkit by the G20 might result in a wider application of best practises in policy design, innovations that expand the pool of renewable resources and their technological applicability, and lower finance costs for renewable energy projects. The prospects for renewable energy solutions over a longer time horizon will largely depend on how economically competitive they are compared to fossil fuel alternatives and how willing nations are to maintain policy assistance during an extended era of low fossil fuel costs. The G20 committed to promoting the deployment of clean, affordable energy resources to the developing world and agreed to share best practices and raise the fund for scaling up the Renewable Energy Program and the Energy for the Poor Initiative for developing countries voluntarily. On the

other hand, the idea of just transition has termed to be ambiguous with multiple interpretations, so that it is even now challenging to have a comprehensive and meaningful discussion. It is extremely context-dependent and complicated and it requires a lot of preparedness and a comprehensive framework. To implement the just energy transition framework a country should be clear on whether there is a need for energy transition or just transition. Therefore, the G20 nations need to increase policy connectedness and coordination between energy and the rest of the economy. Such policies must prioritise efficient urban planning, and the adoption of renewable energy, as well as the reformation of the wider institutional structure, to encourage people to use renewable energy.

Endnotes

1. The details of commitment on Just Transition in various COP conferences are presented in table-1.
2. It was during G7 Germany Presidency 2022.
3. https://www.investindia.gov.in/sector/renewable-energy#:~:text=The%20installed%20power%20capacity%20in,the%20total%20installed%20electricity%20capacity
4. Raveendran & Vanek (2020) estimate show that 90 percent workers are informal in India.
5. https://www.wiego.org/sites/default/files/publications/file/WIEGO_Statistical_Brief_N24_India.pdf
6. The figure is estimated from NSS 75th round of Health Expenditure 2017-18.
7. According to IEA estimates, coal generated 38.03% of the electricity in 1987 and 35.99% of the electricity in 2021. In the G20 countries, the share of coal in the electricity generation has declined from 44.34% to 39.77% in the period 2009 to 2021.
8. According to 'Report on G20 Deployment of Renewable Energy' of G20 Turkey (2015) presidency.

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