Task Force 4
Refuelling Growth: Clean Energy and Green Transitions

A G20 COALITION ON EMERGING TECHNOLOGIES FOR A ZERO-CARBON, CLIMATE-RESILIENT SUSTAINABLE FUTURE

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Abstract

The Paris Agreement and Sustainable Development Goals necessitate a move towards a developmental convergence point where all are safe, prosperous, and live in peace. Such a future partly hinges upon the timely development, deployment, and rapid diffusion of technologies, particularly emerging technologies. While these technologies are on the horizon, the risk lies in the time that they might take to have a mature market across the G20 countries. A coordinated effort among the countries with relevant capacities is needed to facilitate faster maturity of the markets for emerging technologies. This would necessarily require some degree of synchronisation in trade, investment, industrialisation, and governance of these technologies with the concerns of the environment and sustainable development. This policy brief outlines seven principles based on which a coalition on emerging technologies should be pursued at the G20 level.

The Challenge

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Climate change is undoubtedly one of the biggest challenges faced by the G20 nations. Science has adequately established the urgency of transitioning to a net-zero emission economy by the middle of the century.[1] The building blocks of deep decarbonisation are also well established: decarbonisation of the power sector, electrification of the transport sector and energy services, and energy efficiency in industry, infrastructure and buildings sectors, along with conservation and enhancement of natural sinks.[2]

Various modelling studies exploring the technological pathways to achieve the goal of the Paris Agreement, which is to limit temperature rise to 1.5°C, have identified technologies that most of the G20 countries would need to implement sooner rather than later. Some of these technologies are commercially mature and have an impressive rate of diffusion in many countries; for example, nature-based solutions, solar PV, mass transit systems, wind turbines, efficient lighting, efficient home appliances and so on. However, these diffusion rates are not adequate to meet the goals of climate challenge and more ambitious efforts are required.[3, 4] Key hindrances include high upfront costs, inadequate development of complementing technologies, such as storage of renewable energy, and non-affordable market prices of products and capital. Some mature technologies, such as nuclear power, have low diffusion rates due to security perception and political issues. On the other hand, other technologies face slower adoption due to higher maintenance costs and technological compatibility issues, as seen in the case of biofuels. Additionally, it is important to consider that trade and investment in these technologies, along with support to developing countries with finance, capacity building, and institutional reforms, is necessary for a rapid technological transition.

Depending on the level of development and technological capabilities of countries, challenges and solutions for rapid technological transitions vary. The need for technology cooperation between countries has been long established since the negotiations on climate change began in late 1980s.[5] Despite the argument that the era of globalisation is retreating, never have the developmental choices of countries needed the level of cooperation required

today. Sustainable development requires countries to reach a certain developmental convergence point where every community is safe. Climate security for all nations is key to global peace. The vast literature on policy discourse concerning climate change and its trade-offs with the Sustainable Development Goals (SDGs) clearly demonstrates that such a future hinges upon the timely development, deployment and rapid diffusion of technologies that enable the transition to low-carbon development pathways.

Technologies that are still emerging and not commercially mature—e.g., electric vehicles, batteries, green hydrogen, next-generation biofuels, and carbon capture and utilisation—will play the most important role in making the transition possible. But, many of them are yet to be successfully demonstrated at a commercial scale, such as carbon capture and storage. The silver lining is that these technologies are on the horizon. The risk, however, lies in the time that these technologies might take to build a mature market across G20 countries. To illustrate the time dimension of the technology cycle, let us consider the cost of solar PV, which has declined at a constant rate over the last 100 years, and it has taken technological, institutional and business model innovations in three countries—US, Germany and Japan—to reach where they are at today.[6] Clearly, the agenda of sustainability and a climate-safe world cannot afford to wait that long for the markets for emerging technologies to fully mature.

Even for the mature technologies, implementation at scale is challenging. For example, the high cost of solar panels ranging from US$10,000 to US$30,000 for 5kW to 8.5 kW, covers only 25 percent of the overall expenses of solar power installation. Rest is accounted for supplementary equipment (e.g., storage) and maintenance. Solutions would require substantial investment in innovative technologies, such as Perovskite solar cells (PSCs).[7] Compared to silicon-based solar panels, PSCs have demonstrated higher and more stable power conversion efficiency (~25 percent) under fluctuating temperatures.[8] Yet, its commercialisation will have to wait as research, development and deployment (RD&D) projects in the US, Japan, South Korea and several European nations are inadequately funded.[9]

Nuclear energy is another example. The industry is expected to decline by two-thirds by 2040 in Organization for Economic Co-operation & Development (OECD) countries (EU 4percent, US 8percent and Japan 2percent).[10] Further, the volatility in nuclear energy market hampers the upgradation of the old nuclear fleet. About 25 percent of existing plants are expected to shut down by 2025. Investments worth US$500 million to US$1 billion may increase their operational life. Moreover, fossil fuel subsidies and the low-cost wholesale electricity prices in many G20 nations have made their odds of surviving market shocks—wars, COVID-19 and other calamities—better than the low-carbon technologies. In the absence of technology upgradation through investment and policy support to buffer against market shocks for low-carbon technologies, many nations in the Global South rely heavily on fossil fuel usage.[11]

For rapid technological change, a coordinated effort among the countries with relevant capacities is needed. This would entail some degree of synchronisation in trade, investment, industrialisation and governance of these technologies with the concerns of the environment and sustainable development. Developing countries have always advocated for a grand bargain on enabling access to existing technologies at concessional rates to developing countries in global interest. The G77 and China also proposed to set-up a global cooperation in RD&D for new and emerging technologies for low-carbon development on a shared intellectual property rights (IPR) basis.[12] There have been successful examples of this kind, such as the Consultative Group on International Agricultural Research (CGIAR) research programme on rice, addressing the global hunger challenge. It is time to replicate similar examples of technology cooperation among G20 countries in the global interest.

The G20's Role

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The G20 nations account for 80 percent of greenhouse emissions. The G20 includes countries with historically projected emission rates among the highest, which is why they are morally obliged to embrace green energy through their combined political will and economic strength.[13] The G20 possesses 85 percent of the world's GDP, about 80 percent of CO2 emissions, and 80 percent of the world population , thus, owning most of the world's economic and human resources that can be channelised to reduce the planet's carbon footprint. Moreover, G20 controls the frontier of technology with almost 95 percent of global investment in R&D.[14] They are also the epicentre of the cooperation towards achieving the global goal of net-zero emissions by 2050. The agenda of technology cooperation is not new for the G20. What is needed is a new approach and a firm political commitment going beyond the short-term interest of private corporations. The lack of cooperative exchange in green technology is an obstacle for G20 countries in ending their dependence on fossil fuels. About US$ 90 billion in funding is necessary to make projects on clean energy technologies to be commercially viable by 2030.[15] Furthermore, emerging economies within G20, with the exception of China, and partly India and Brazil, have not yet been able to catch up with the developed G20 members in this area, making it even more important for the G20 to cooperate on exchanging green technology with countries in need.

Many G20 countries have already established partnerships within and outside of G20. India and Germany have recently announced a partnership on green hydrogen; South Africa, Germany and the UK announced a Just Energy Transition Partnership. The list is long. What is missing, however, is a comprehensive framework of long-term, predictable and accountable cooperation. It is important, therefore, to further build on the existing mutual understanding between the developed and developing country members of the G20 and take a big leap of cooperation to set up a global coalition on emerging technologies for a zero-carbon, climate resilient, sustainable future. This policy brief outlines the principles on which such a G20 coalition may be built.

Recommendations to the G20

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Despite the diversity in scale, competence and outcomes, G20 countries have reasonable technical capacity, technological capability and markets for new technologies. They all have their own versions of technological RD&D strategies. Without judging their efficiency, all of them have sectoral and national innovation systems. We propose that a technological "coalition" connecting these dispersed innovation systems and markets for new technologies can offer a higher sustainability dividend at a lower cost than merely mobilising finance for rapid technological deployment. Of course, this does not mean that the question of finance is secondary. In fact, adequate sustained financial support would be required for such an initiative to bear fruit. Further, and in addition to adequate sustained financing provision, we recommend a number of principles to guide the "coalition" that connects innovation systems and markets across G20 countries.

Principle 1: A robust and sustainable global technology supply chain

Most technological systems are assembled by sourcing different sub-systems or parts from different suppliers, often located in different countries. Therefore, a smoothly functioning global supply chain of a technological system is essential for the rapid diffusion of technologies. Inconsistencies and friction in the global supply chain increase the transaction cost of acquiring technology from the open market and cause delays in deployment. The proposed "coalition" should therefore identify potential sources of hiccups and frictions in the global supply chain of emerging technologies and address them to reduce capital costs, transaction costs and time till final assembly. One way to operationalise this is by combining the comparative advantages of countries in technology supply change. For example, the transition in the manufacturing sector that can support the pace and direction of low carbon transition needs production capacity enhancement as well as design innovations. While emerging economies can scale up production capacity, they lack the capacity for design innovation, a gap that can be filled by OECD countries.

Another example can be drawn from observing the management of the photovoltaic supply chain in EU countries. It required coordinated decisions for all the supply chain stages,

including raw material supply; waste disposal; the location of assembling plants, suppliers and consumers; the requirements of power distribution companies; and the location of the recycling industry, among others. Each of these was highly influenced by social, economic and environmental factors. A similar coordination could be done at the G20 level keeping in mind socio-economic development indicators such as job creation and energy security.

Principle 2: Prioritisation of technologies

The "coalition" would need to decide whether it would be a generic coalition for promoting all relevant emerging technologies or would bet on a few selected ones. A generic agreement is usually long lasting, but substantive progress is often slow. A potential way could be that a layered approach of prioritisation of technologies in conjunction with sectors is adopted, such as PVCs in the power sector as discussed above. The first layer could consist of technologies in which all G20 countries have a stake in infrastructure, market and supply chain. For example, arguably, solar and EVs are obvious global priorities, and the "coalition" should focus on all priority areas of concern in these technologies. The second layer could be specific to the needs of developing country; for example, the decarbonisation of the micro, small, and medium-sized enterprises sector. The supply chain would, probably, predominantly involve developing countries. Of course, design innovations could come from OECD countries. There could be technologies that cut across the sectoral boundaries and country contexts, such as waste heat recovery and efficient electric motors, which can be prioritised. These applications are likely to have a significant market already, hence are good candidates for cooperation. Another concern while prioritising technologies for the "coalition" would be to see their contribution towards the achievement of SDGs.

Principle 3: Institutional reforms and competitive interests of member countries

The flow of technological goods and services is rarely smooth across borders. For emerging technologies, the demand for technology services is expected to be higher due to nascent technological capabilities and institutional factors (e.g., commercial contracts and IPR), hindering the use

of services from other providers. There would also be trade barriers, both tariffs and non-tariff based. The effectiveness of the "coalition" hence would hinge upon a reasonable bargain between the competing interests of member countries and embedding it in institutional reforms governing international trade and investment flows. A critical area of institutional innovation could be to explore an alternative incentive to IPR on emerging technologies. For example, a share of profits or tax collection from businesses deploying new technologies may be promised to innovators over a fixed period. Collaborative innovation effort with shared IPR among countries is another option. Innovation cost buy-out by G20 governments can also be explored where private innovators are paid the full cost of innovation with a provision of mark-up payment by public finance based on the principle of common bud differentiated responsibility. The new technology thus procured can be made IPR-free.

Principle 4: Sustained investment and consumption

Timely deployment of identified technologies on a large scale is critical for an effective transition. The rapid development of the market for emerging technologies will hold the key. While the G20 countries together guarantee a potentially huge market, sustained upfront investment at scale will be required to unlock this potential. In addition, it would also be critical to ensure that such investments are economically productive and profitable. This would require investment and consumption expenditure in the sectors demanding those products. For its design, the "coalition" must explore suitable cooperation to nurture demand and supply towards a net-zero economic transition. To achieve this, the experience of the International Solar Alliance (ISA) could be insightful. The ISA is a platform for cooperation among member countries to mobilise about US$1,000 billion worth of investment in the solar energy sector by 2030.[16] The goal is to reduce technology and capital cost through projects and demand aggregation achieved by incubation, acceleration, facilitation and enabling member countries as per their needs and requirements.

Principle 5: Sustained, coordinated and transparent RD&D

Sustained investments in RD&D are also critical. Since most technologies

work as systems, it is crucial to ensure that investments in innovations occur at a systemic level. These investments could be complementary to each other and support interventions that address challenges such as the "valley of death" for new technologies and the adoption of locally suitable design. In addition to having a globally envisioned innovation roadmap on clean energy technology, such an RD&D endeavour is only possible with some degree of transparency about what innovations are being pursued in different parts of the world by different public and private agencies. This requires a regularly updated database of clean energy demonstration projects of all G20 countries to ensure their development progress.[17] This integrative approach will establish links and coordination among them before creating a collective roadmap for RD&D. While this is a matter of strategic importance for companies and governments, a political deal must be struck to ensure complementarity and partnership in a transnational context. Learning from evidence in several G20 countries, foreign direct investment (FDI) inflows and public investments in RD&D can also significantly help transition into cleaner energy.[18]

Principle 6: Waiving market shocks from green energy sector

Waiver on market shocks for the green energy industry is indispensable to make it a "high trust" industry. When governments fund a certain industry, its reliability increases, making it less vulnerable to market volatility. A case in example is Brazil where contract with various factories and shopping malls have helped solar energy to shrug off market volatility after the COVID-19 pandemic. The short tenured contracts are renewed regularly to ensure sustained demand.[19] Governments in the US and Sweden offer tariff cuts and premium guarantees to project developers in the green energy sector. Corporate power purchase agreements (PPAs) allowing long-term procurement contracts have ensured investment in green energy sector. Corporate PPA in clean energy is a growing market that can certainly help the industry to absorb market shocks and survive.[20] Besides, funding green energy technology and waiving market shock from the industry are complementary. An increase in funding can build confidence of private players in the

clean energy industry. The "coalition" can also allow the price of renewables to function on a level playing field alongside fossil fuels. This effectively reduces market shocks from the green energy industry during volatile times.

Principle 7: Gradual harmonisation of standards

Technology diffusion happens in the context of the institutional ecosystem that in national interest regulates technological choices by introducing various compliance costs. This often takes the form of introducing various environmental and social standards, such as impact on ambient air quality and different mandatory disclosures related to health and cultural concerns. While global diffusion of climate-friendly technologies would require that these standards are harmonised across G20 countries, at least, the macroeconomic implications of such harmonisation would have to be taken into consideration. For example, the carbon border adjustment measures proposed by the EU, while encouraging the diffusion of low-carbon technologies, could potentially have negative impacts on other economies. Therefore, the "coalition" should explore the extent of the need for such harmonisation of standards along with mechanisms to offset the potential negative impacts on other economies, particularly the developing economies. One option could be to accept country-specific differentiated standards on embedded carbon to begin with and an agreement on a timeframe for achieving full harmonization.

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