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Technology and Climate Change: Innovation and Partnerships for Transformational Change[1]

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ABSTRACT The world is facing a climate-change challenge that requires nothing short of a technological revolution to address. Yet the current patterns of technology development and diffusions are not transformative enough; nor are they happening at a pace, rapid enough. Actions at multiple levels engaging different actors are needed to reduce emissions while meeting the developmental needs of the global south. This paper summarises the most innovative ideas shared at the conference on *Technology and Climate Change: Innovation and partnerships for transitional change*, organised by the Observer Research Foundation in September 2015. The conference focused on the strategies and policies on the technology front that will effect transformative changes in global energy systems and build adaptive capacities of the world's most vulnerable populations. The global debate on Intellectual Property Rights (IPRs), national policies for innovation, and bilateral opportunities for joint R&D, are all examined in this paper, to define the technology agenda ahead of the 21st Conference of Parties (COP) in Paris in December.

INTRODUCTION

Limiting dangerous changes to the Earth's climate and adapting to their impacts will require transformative technological breakthroughs. 'Business as usual' technological trajectories and incremental 'greening' of energy systems will just not be enough. Invention and absorption of innovative technologies will be key to reducing emissions while also meeting the development aspirations of the poor. The current pace of development and diffusion of technology is, however, neither quick nor transformative enough. 'Lock-in' in entrenched technological, regulatory and market systems will need to be unlocked. The scale of the challenge ahead is greater than a single country's capacity or budget. The need of the hour is a technological revolution: a portfolio of strategies—multilateral institutional arrangements, partnerships between developed and emerging nations, cooperation between the public and private sectors and the setting up of national frameworks for innovation will be needed to create an 'ecosystem' for development and diffusions of new climate-relevant technologies.

Any agreement on nationally determined emission reduction targets at the 21st Conference of Parties (COP 21) scheduled for December in Paris will be only the beginning of a global response to climate change. A slew of policies promoting climate-friendly technologies will need to be introduced to not only tackle climate change but also support development. Policies targeting innovation and diffusion of so-called 'green' technologies have the added advantage of appealing to many traditional concerns of national governments, such as those around energy security, energy efficiency and environmental protection.[2] Mitigation tends to dominate the climate policy agenda, including that for technology. But adaptation technologies are equally critical. Coping with the impacts of climate change that are being felt currently and will be felt in the future will require major technology breakthroughs in areas such as agriculture, disaster management, health, and human habitation.

It is estimated that 40 percent of global CO2 emissions in 2010 were contributed by the energy sector.[3] Thus the transformation of the world's energy systems to new 'lower' carbon pathways will continue to be a priority agenda. These are socio-technological transformations: institutions and behaviours have to change in addition to technologies.[4] Such transitions have historically been very slow processes. Existing systems enjoy the benefit of increasing returns of scale and therefore cannot be supplanted easily by new ones. For example, the share of coal in the energy generation of England went up from 10 percent in 1560 to 64 percent in 1760.[5] It took a period of 200 years for coal to replace the dominance of charcoal and firewood and other sources of energy in the UK energy system. Energy transitions take decades, even when strong market forces are at play. The atmospheric carbon budget that is remaining, however, leaves us with little time to effect dramatic changes in the global energy mix in favor of reliable 'lower' carbon pathways.

Climate change will push the boundaries of rapid transitional change in a way that only wars and economic crises have done before.[6] At the same time, the threat of climate change provides a window to push through an accelerated agenda of energy transformation that will receive political and financial buy in. Climate change is an opportunity. Drawing on ORF's conversations at a roundtable on "Technology and Climate Change: Innovation and Partnerships for Transformation Change", held in Delhi in September 2015, this Brief outlines the challenges, opportunities and strategies for technological transformations. The discussion is organised in three sections: (i) Multilateral institutional frameworks – how technology should be dealt with in Paris outcomes and mechanisms under the UNFCCC to address issues of Intellectual Property Rights (IPR) and collaboration norms; (ii) transnational partnerships between groups of nations, including public and private sector partnerships, joint R & D, and directing international capital towards technological change; (iii) domestic policies: investment in R&D, market signaling, information provision, and skills and labour development.

MULTILATERAL INSTITUTIONAL ARRANGEMENTS

Technology has always been central to multilateral conversations on climate action. Article 4 of the United Nations Framework Convention on Climate Change (UNFCCC), for example, emphasises the need for all parties to cooperate in the promotion, development and transfer of technologies that will contribute to climate action.[7] The Technology Mechanism (TM) was established in 2010 with the stated aim to foster public-private partnerships, promote innovation, and facilitate joint R&D. The technology mechanisms under the UNFCCC have, however, led to little actual transfer of technologies. The architecture is certainly not designed to facilitate innovation and breakthrough changes. The paradigm continues to be that of one-way transfer of technology from Annex 1 to Annex 2 countries, rather than a focus on innovation, joint development and building of capacity to absorb and use new technologies. TM is an empty shell; it is unlikely to be the platform that will deliver transformative changes.

The multilateral discourse on technology transfer has ossified around the rather complex issue of IPRs. It is estimated that to generate 1500 GW of sustainable energy, for instance, an investment of US$1.5 trillion is needed. Much of these costs stem from "compulsory licensing" costs. This prohibitive cost remains a significant barrier to clean technology adoption and should either be addressed through relaxing IPR regimes or through a broader nexus between climate finance and technology needs. The TM and financial mechanisms under the UNFCCC are not working in tandem and this must be addressed ahead of 2020. For example, the Green Climate Fund (GCF) may be used to purchase key IPRs going forward.

Many developed nations have argued that the technology needs of developing countries have not been clearly identified. The main issue here seems to be that proposals around technology for climate change are not concrete enough. But, often it is not a single IPR that is needed for a project. For example, a wind turbine alone may involve about 300 separate patents. The exact role of Intellectual Property in the transfer of climate technologies needs more clarity as no comprehensive study has looked at the impact of IPR on exclusively climate technologies.[8]

Developed nations have maintained that IPR protection is critical for innovation; IPR stimulates innovation by ensuring incentives for innovators. But recent studies have challenged the assumptions around IPR and innovation. For example, Michele Boldrin and David K. Levine, two economists from Washington University, St. Louis, have pointed out that the current patent and copyright system discourages inventions from actually entering the market.[9] Often IPR systems only help large corporations and Multi-National Corporations (MNCs) as they, rather than individual innovators, register the majority of patents. Corporate interests in fact shape global intellectual property domain and those very interests perpetuate inequality through the IPR regime.[10]

It can also be argued that IPR is, legally, not a "natural right", like the right to life. Climate action cannot be compromised on the basis of ability to pay. In fact, the world has come together before to set aside IPR debates and take action on a critical threat to large parts of humanity. For example, the case of HIV AIDS saw the world join hands to fight the epidemic effectively because medicines were made cheap and IPR costs were not billed to the consumers. IPR is a double-edged sword: it can give protectionism as well as act as a barrier to technology adoption. In order to avoid the IPR deadlock to define and limit climate action, the global community needs to devise mechanisms wherein the innovators are rewarded but the costs are not passed on to the consumers. The GCF should support capacity building and technology development and transfer.

Another option is to have a differentiated IPR regime. For example, India could place industries such as transportation, pharmaceuticals, scientific instruments and IT which were found to be R&D intensive and sensitive to strengthening of India's IP regime,[11] under the auspices of the global IPR framework. On the other hand, industries that have to do with climate change, such as those relating to energy and adaptation technologies, need to be invited to set up in India with open-access arrangements. This will contribute to developing local innovation in these sectors, thereby enabling their possible incorporation under the IPR regime in the future. This is because having access to IPR or a favourable IPR regime alone is also not enough. A lot more is needed for diffusion, localisation and, ultimately, absorption of new technologies. These themes are discussed in the following sections.

TRANSNATIONAL TECHNOLOGY PARTNERSHIPS AND FINANCING INNOVATION

Multilateral negotiation processes, where all 193 countries have to agree on everything, are by their very nature neither dynamic nor innovative. More opportunities for technology partnerships perhaps exist outside of the multilateral forum – among two nations, groups of nations, and within the private sector, globally. Here there are opportunities to get started quickly and to accelerate, joint R&D, technology financing opportunities, and building capacity for diffusion and localisation of technology.

JOINT R&D

It is not just technology transfer that needs to be scaled up but also joint R&D mechanisms. Prime Minister Narendra Modi has proposed to set up a consortium of around 50 solar-rich countries.[12] Such an alliance could be a powerful tool to attract the investments that countries currently lack and that is needed to develop business across countries, acquire new technologies, and lower the costs of solar. Joint R&D is already a key feature of the India-UK relationship which aims to bring together Indian and British scientific research and innovation through the Newton Bhabha Fund to tackle the challenges facing India in its economic development.[13] The fund currently focuses on three priority areas: sustainable cities and rapid urbanisation; public health and well-being; and energy-water-food nexus.[14] The Fund could be expanded both in scope and financial weight to create joint research hubs for clean energy innovation.

EARLY-STAGE INVESTMENTS

Financing clean technologies should revolve around both demand and supply sides covering the entire innovation cycle from embryonic R&D to deployment in the markets. On the supply side, crucial investments are needed towards R&D. Ideally, these investments should be channelled towards supporting dedicated research institutions and universities pursuing blue sky research. Due to the 'high risk/high return' nature of such research, governments should be willing to underwrite them wherever the private sector finds it difficult to justify such investments commercially.

In case the private sector does step in, governments should incentivise it through regulatory and tax interventions. For example, private-sector investments in clean technology should be brought into the ambit of corporate social responsibility and treated as such. Wealthy investors around the world can launch the funding pipeline for early stage companies that are working to deliver low carbon solutions that provide affordable and reliable energy. Such a funding pipeline should address the capital gap between pure play R&D and go-to-market commercialisation.

At a more macroeconomic level, governments should support the issuance of asset-backed securities to expand debt financing of clean energy projects for long-term and low volatility yields.[15] Regulations should be put in place that resolve double taxation issues when it comes to investments in clean energy. While for most infrastructure projects such regulations are already in place, "there is a lag in including new types like renewable energy projects, aggregated distributed generation or energy efficiency portfolios".[16]

NUCLEAR ENERGY AND LOWER CARBON PATHWAYS

Technology and finance flows must not discriminate. In terms of specific technologies, India has had a long history of domestic innovation in civil nuclear energy. Going forward, this needs to find global support so that nuclear power can play a significant part in any low carbon pathway for India. India is developing thorium reactors which are proliferation-resistant and will make use of the ample thorium reserves in the country. Such research which will contribute to both climate mitigation action as well as energy security needs to find global support and partnership. India has the potential to be a world leader in thorium technology which could then find applicability in other countries, thereby contributing to a global low carbon future. The world is already collaborating for nuclear fusion reactors through the International Thermonuclear Experimental Reactor (ITER) project. Thorium reactors are far more ahead on the road to deployment than fusion reactors and international collaboration and support in this could further speed up their commercialisation. Mass deployment of thorium reactors is a potential gamechanger in not just the Indian but the global climate battle.

Secondly, coal will continue to play a massive role in India's energy system for at least the next two decades. The World Coal Association estimates that a one-percent improvement in the efficiency of a coal power plant results in reductions of two to three percent in CO_2 emissions.[17] Research in improving the efficiency of coal-fired power stations is the low hanging fruit in the mitigation game.

INDIA'S TECHNOLOGY NEEDS AND POLICIES

Technology needs of emerging economies such as India are central to the Paris outcome. Enhanced domestic climate action in India can serve as a catalyst for greater technological collaboration globally and increased opportunities for climate relevant technology industries of developed nations. India's ambitious renewable energy targets mean that it can show the world how to deliver low carbon economic growth. Low carbon growth in India can be at the heart of several interlinked governmental initiatives such as Smart Cities, Make in India, and the Swachh Bharat Campaign. Furthermore, India's reputation for innovation and its demographic dividend can support a technology transformation in the country.

While most discussions around technology for climate change mitigation revolve around *transfer* of said technology, a strong argument could be made for technology *diffusion*. The main difference between the two lies in the fact that the latter relies more on human capital around technology adoption and sharing of best practices independent of IPR regimes. The rapid profusion of ICT is an example of diffusion of adoption; there are many lessons to be drawn from the same. The Indian position is that "domestication of technology" is an imperative. Technology transfer is a bit like FDI, that is, not enough in itself. While product innovation might be Western, India could contribute to process innovation. There is also a need for business model innovation alongside innovation in terms of products, processes, and practices. Just because certain technologies worked for certain regions, it cannot be guaranteed to work for all regions. Local contexts are extremely important. Therefore, identifying the right technologies as well as identifying the technological and policy gaps is crucial for each developing country.

Domestic policy frameworks to support clean energy innovation are currently inadequate or non-existent. For example, the ORF roundtable brought to light some of the challenges faced by clean energy startups in India. Incentives for adoption of energy efficient technologies are not strong enough which constrains the growth of such enterprises. Secondly, at times the policy exists but is not implemented, such as in the case of subsidies provided for using solar energy. The time taken for customers to get the subsidy is so long and the process so arduous that they do not wish to adopt the technology.

Three focus areas are highlighted for improving the domestic innovation environment: skills, R&D, and de-risking capital.

SKILLS

Increasingly, there is a strong pressure to evaluate policy outcomes from a commercial perspective; but in the case of government policies it is equally important to pay attention to the development of skills, particularly from a long-term perspective. India can reap its demographic dividend (especially the rich pool of young technologists) to develop climate-relevant technologies. Innovation policy should be more broadly defined to include skills development which will facilitate effective adoption of imported technology. This can be facilitated through the recently announced "Skill India" initiative. Human resource development is crucial but easily forgotten in technology policy discussions. Skill Development and Entrepreneurship policy aims to provide employable skills, and by promoting a culture of innovation-based entrepreneurship employment. Domestic skill development will enable India to shift from a stance of demanding technology transfer to demanding co-evolution and co-creation of technology. This "regionalisation of technology" would blend product innovation from the West with process innovation from the East.

R&D

India's R&D investments lag behind those of developed and other emerging economies. For example, in 2013, it produced only 366 R&D personnel per million population, spent 0.85 percent of GDP on research activities (global average stood at 1.8 percent), and researchers were paid 22-percent less than they would have been if they worked in other sectors.[18] Domestic innovation and research therefore needs a significant push by the government. Climate change presents an opportunity to transform the domestic innovation agenda. Public sector needs to spend on innovation since 'climate action' is a public good; a complete reliance on private firms/sectors for R&D would be ill-advised. History has seen innovation being centred in the west, and consumed in the west. Today, however, the biggest consumers of innovation are in the east. India's growing and transforming energy system offers the biggest market for energy innovators. An energy research laboratory could be set up in India with international support and, in turn, could offer a platform for energy startups from all over the world. The centre of innovation would produce localised solutions but also give international innovators the facility for quick adoption and trialing of their solutions for the world to learn from.

DE-RISKING CAPITAL

India's ambitions for renewable energy are contingent on financing frameworks which support the achievement of those goals. Financing modelling of renewable energy projects in India has raised doubts regarding the availability of low-cost, long-term debt. The flow of capital for climate-compatible development is restricted by the perception of regulatory and market risks.[19] The high cost of debt in India and inferior terms may raise the cost of renewable energy in the country by 24-32 percent compared to the US.[20] Indian policy-makers need to send clear signals which de-risk climate finance and look at the successful efforts by China and Brazil in this regard.[21] Broader macroeconomic policies—such as Central Bank guidelines, structure of the electricity market, and international financial norms—have also been guilty of providing conflicting signals which drive investors towards low-risk investments in fossil fuels.[22] At an international level, the Basel III regulations appear to make long-term financing more expensive; the capital and liquidity requirements in Basel III are also likely to act as impediments for financing capital-intensive renewable energy technologies.[23] Streamlining domestic and international signals to reduce any investment bias against clean energy solutions is crucial. Traditionally, investments in renewable energy have followed broader trends in foreign direct investment: countries with poor frameworks for FDI will have a harder time attracting foreign investments in renewable energy.[24] This points to the necessity of macroeconomic interventions to make FDI more attractive in general.

CONCLUSION

There is no silver bullet for facilitating transformational technological changes. Free IPRs has often been posited as being one. Rather, a silver buckshot approach–or a portfolio of strategies—is the imperative. Relying on inter-governmental processes or markets on their own will not deliver. National policies, international coalitions, and multilateral institutional arrangements, will all be required to work together in order to promote technology innovation as a system and create the conditions for successfully combating climate change. The question is not limited to inventing technology to solve climate change *per se*, but rather to understand what policies and institutions will help deliver the dramatic technological changes and emission reduction necessary for stabilising GHG concentration.[25]

There is a bias towards large-scale mitigation technologies; small-scale, effective, adaptation technologies are equally important for the developing world. Technological trajectories that are pursued cannot ignore long-term, pro-poor and non-market friendly technologies or the local innovation systems and capabilities that it must work with.[26] At the same time, export control regimes which restrict the flow of technologies due to dual use concerns and military confidentiality requirements dilute technology transfer arrangements and hinder significant action on climate change.

India needs to work with its international partners. Technology cooperation between the global north and south must be seen as a win-win proposition. It would be a global failure if ambitious action on climate change was compromised by the inability to agree on technology cooperation.

LIST OF SPEAKERS:

Ms. Amber Rudd, UK Secretary of State for Energy and Climate Change; Shri Prakash Javadekar, Minister for Environment, Forests and Climate Change, Government of India; JM Mauskar, Advisor ORF; Sunjoy Joshi, Director, ORF; Dr Vikrom Mathur, Senior Fellow, ORF; Dr Prodipto Ghosh, Distinguished Fellow, TERI; Henriette Faergemann, EU Climate Counsellor, India; François-Joseph Schichan, Counsellor, Embassy Of France, New Delhi; Professor Masaru Yarime, Associate Professor of Science, Technology and Innovation Governance, University of Tokyo; Dr Eugene Yun, Managing Director, P80 Group Foundation, South Korea; Dr Narasimalu Srikanth, Programme Director Wind and Marine Energy, Nanyang Technology University, Singapore; Professor Rakesh Basant, Head, Centre for Innovation, Incubation and Entrepreneurship, IIM Ahmedabad and; Dr. Ajay Mathur, Director General, TERI.

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ENDNOTES:

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