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FIXING CLIMATE GOVERNANCE THROUGH EFFECTIVE TECHNOLOGY PARTNERSHIPS

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Climate scientists agree that human activity has been changing our planet's climate over the long term. Without serious policy changes, scientists expect devastating consequences in many regions: inundation of coastal cities; greater risks to food production and, hence, malnutrition; unprecedented heat waves; greater risk of high-intensity cyclones; many climate refugees; and irreversible loss of biodiversity. Some international relations scholars expect increased risk of violent conflicts over scarce resources due to state breakdown.

Environmentalists have been campaigning for effective policy changes for more than two decades. The world's governments have been negotiating since 1995 as parties to the United Nations Framework Convention on Climate Change (UNFCCC). These talks have not yet produced agreements that are sufficiently effective in curbing greenhouse gas emissions or helping the world adapt to climate impacts. Some effort has shifted to partial measures by national governments, provinces, cities and private companies, which together, also fall far short of the need identified by science so far.

The Fixing Climate Governance project is designed to generate some fresh ideas. First, a public forum was held in November 2013. High-level workshops then developed a set of policy briefs and short papers written by experts. Several of these publications offer original concrete recommendations for making the UNFCCC more effective. Others make new proposals on such topics as how to reach agreements among smaller sets of countries, how to address the problems of delayed benefits from mitigation and concentrated political opposition, ways that China can exercise leadership in this arena and how world financial institutions can help mobilize climate finance from the private sector. These publications will all be published by CIGI in 2015.

ABOUT THE AUTHORS

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ACRONYMS

ASEAN	Association of Southeast Asian Nations
CFTs	climate-friendly technologies
CTCN	Climate Technology Centre and Network
GCF	Green Climate Fund
INDCs	intended nationally determined contributions
IP	intellectual property
IPRs	intellectual property rights
R&D	research and development
SE4All	Sustainable Energy for All
SPEED	Smart Power for Environmentally and Economically Sound Development
SPI	Smart Power India
TEC	Technology Executive Committee
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

Developing countries need better technologies to adapt to the impacts of climate change and mitigate future greenhouse gas emissions. Over the past decade, at least 30 international technology partnerships have been initiated. Most have been too limited in scope to achieve significant progress.

Three obstacles have impeded climate-friendly technologies (CFTs), namely, lack of appropriate financing, intellectual property (IP) restrictions and insufficient or underutilized capacity. At least two new partnerships could be designed that could target these challenges and be more effective than previous efforts.

First, a set of governments — including developing (such as Bangladesh, India and Kenya) and developed (such as Germany and the United States) countries — should create a new multi-country partnership to promote much greater decentralized energy production to satisfy the potential demand from the two billion poor people who still lack access to basic modern energy. The partnership would supply initial working capital for far-flung smaller entrepreneurs in developing countries, help link them to larger investors such as pension funds, establish centres to train technicians and certify products, and create model regulatory codes. Energy access for all is necessary before many developing countries will accept economy-wide emissions limits.

Second, a set of governments — again, involving developing (such as India and China) and developed (such as France, Germany, Sweden and the United States) countries — should create another multi-country partnership to accelerate the development and deployment of better technologies for energy storage and grid balancing. This partnership should conduct market assessments; provide advance procurement commitments to stimulate research and development (R&D); agree on joint ownership of new storage technology licences; help to develop policy frameworks for incorporating these technologies; establish pilot demonstration projects in developing countries; and identify possible joint ventures.

Implementing these ideas could strengthen the credibility of the contributions states are pledging in United Nations Framework Convention on Climate Change (UNFCCC) negotiations, and give future governments confidence to make their pledges more ambitious.

WHY ARE CLIMATE TECHNOLOGY PARTNERSHIPS NEEDED?

Technology is widely recognized as one of the most powerful tools in combatting climate change.[1] Technology transfer (and associated financing) has been a key demand throughout the two decades of climate negotiations.[2] However, thanks to prohibitive costs, restrictive intellectual property rights (IPRs), continued lack of capacity for domestic R&D or cross-border joint ventures, and insufficient capital to underwrite risks, there has been persistent failure in facilitating the development and transfer of CFTs — at least on a scale commensurate with the urgency of mitigating or adapting to climate change.

The development and deployment of CFTs needs a combination of market signals and public policy direction. Without the latter, persistent market failures have stymied research in, or deployment of, CFTs. The bulk of such technologies have not evolved in developing countries — where they are most needed, given the massive potential to avoid future emissions, and the imperative of adapting to adverse climate impacts (Keith 2010, 3). Studies suggest that international coordination could be particularly useful

1 The importance of technology is reflected in its inclusion in Article 4 of the UNFCCC and Article 10 of the Kyoto Protocol.

2 In 2007 at Bali, technology became one of the four pillars for the then envisioned post-2012 agreement. Persistent failure in addressing the various challenges of technology transfer led to the creation of the Technology Mechanism in 2010. The mechanism includes two components: the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN). However, there is still discord between Annex I and Non-Annex I countries over the mechanism's design and mandate. The TEC is responsible for the policy component of the mechanism and seeks to accelerate technology development through multiple avenues, including facilitation of collaboration between governments, the private sector, and non-profit and R&D centres.

to augment climate technology research and deployment. Such partnerships could stimulate technology transfer through knowledge sharing, joint R&D collaboration and funding, thus increasing the cost-effectiveness and deployment of CFTs (Newell 2008).

Several climate/energy technology partnerships have been initiated across the world, with many emerging within the past decade. Some serve as forums for discussion, some focus on research and policy, some have regional or city-level focus and some target specific technologies. Yet, a review of more than 30 climate and energy technology initiatives finds that very few partnerships have been designed to extend beyond sharing knowledge and some preliminary R&D activities (Ghosh, Vijayakumar and Ray 2015). Very few have an enlarged functional focus on actual transfer of technology and/or extensive deployment mandates.

WHAT ARE THE BARRIERS TO EFFECTIVE PARTNERSHIPS?

Three key obstacles have impeded climate technology partnerships and the development and deployment of CFTs, namely, lack of appropriate financing, intellectual property restrictions and insufficient or underutilized capacity.

For existing technologies, even with willing buyers, deployment at scale is difficult unless appropriate financing is available. For instance, many renewable energy technologies require upfront capital investment. Up to 45 percent of the capital cost of a solar-power irrigation pumpset in India could be subsidized if the subsidy on a traditional electric pump paid out over 15 years could be redirected as an upfront payment (Agrawal and Jain 2015). Without a financing mechanism to front-load the subsidy or to provide low-interest loans to farmers, deployment remains limited. Apart from capital costs, entrepreneurs also need significant working capital to hold inventories of CFTs. Technology and policy risks imply that a vendor of, say, solar hot-water systems or home lighting systems would have to bear much of the risk until customers pay for the product, or for a pay-per-use service, or would need to receive subsidy disbursements. Lags in any of these payment cycles could delay further deployment or force vendors to scale back their ambitions of market penetration (Jha, Jain and Ghosh 2012). Financing to cover for the licensing costs of patented technologies is also a challenge and limited information about energy demand, especially among many dispersed and disparate rural communities, can hinder matching financiers with firms. New technologies or business models, such as rural micro-grids, could be viable, but being small in scale, they often fail to attract the attention of large institutional investors. Even interested investors are unable to find clear exit strategies for their investments, further limiting the enthusiasm to deploy equity funds or extend credit (CEEW 2015).

A second set of barriers concerns the development of new, or advancement of, existing technologies. One issue is that unless innovators have a reasonable expectation that a market will develop for CFTs, they will be reluctant to invest in R&D. But without further investment, prices of new technologies might remain prohibitively high. Public policy intervention is needed to stimulate investment. The US Department of Energy's SunShot Initiative was designed to tackle such a problem and resulted in a steep fall in utility-scale solar prices (US Department of Energy 2014). But IPRs are another hurdle, particularly in the case of CFTs that require cumulative or incremental innovation (Chatham House 2007). For such technologies, "open source" registration of the IP could be promoted, which has been done for software such as Linux. This would enable interested parties to tailor technologies to local conditions and improve performance (such as increasing efficiency of solar cells). Another approach could be to develop partnerships wherein contributing firms/research institutions would retain their original IP but any new technology would have shared IP, while making it accessible to smaller nations that may not have the capacity to contribute.[3] The India-US Joint Clean Energy Research and Development Centres on solar energy, energy efficiency and biofuels follow this approach (CEEW 2011).

Finally, in many cases, much technology transfer or investments in demonstration projects are cornered by a subset of members. The European Commission-Association of Southeast Asian Nations (ASEAN) COGEN Programme helped accelerate biomass cogeneration through joint ventures between Southeast Asian and European companies. But resources were not evenly distributed across all ASEAN members (Ghosh, Vijayakumar and Ray 2015). **To be inclusive and effective, partnerships should contribute to capacity building in weaker partner countries to ensure that technologies will be deployed widely, not captured by a few**. Members need not only be required to contribute in hard currency terms. In-kind contributions of research staff, facilities or land for demonstration projects are ways in which the contributions of all members could be recognized and duly rewarded.

This has taken place with the International Thermonuclear Experimental Reactor as well as with the European Organization for Nuclear Research, with developing countries contributing parts or materials (Ghosh 2014). The recently proposed Global Apollo Program (seeking to increase investments in clean energy R&D) envisages that participating governments would pledge an annual average of 0.02 percent of their GDP as public expenditure

3 Many global technology partnerships in agriculture, genetics, nuclear physics, etc., have adopted similar approaches. See Ghosh (2014).

on the program from 2016 to 2025, to be spent according to each member's discretion (King et al. 2015, 8).

If these challenges were overcome, effective technology partnerships would complement the country-specific intended nationally determined contributions (INDCs), and they would have three advantages. First, they would set out a road map for action at scale and across both developed and developing countries, not merely for transferring technologies from one to the other. Second, they would prioritize action now on some key issues of common concern with specific deliverables and targets, thereby building the trust necessary for implementing the 2020–2030 commitments. Third, they would overcome the concerns about the voice of small countries. They could be designed to be inclusive, draw on the most appropriate capabilities of different institutions, and involve the private sector and financiers. Two such proposals are outlined below.

PARTNERSHIP ON ENERGY ACCESS

Energy access is a priority for the more than one billion people who do not have access to electricity and the more than two billion who use traditional, polluting fuels for cooking energy. It is at the core of developing countries' reluctance to accept carbon emission limits until all citizens cross a minimum threshold of baseline energy consumption. UN Secretary-General Ban Ki-moon has made sustainable energy for all a key priority for his second term. The UN's Sustainable Energy for All (SE4All) initiative has specific targets, including universal access to modern energy services, doubling the rate of improvements in energy efficiency and doubling the share of renewable energy in the global energy mix by 2030 (SE4All 2011). In 2011, Kenya and France announced the Paris-Nairobi Climate Initiative, which would focus on energy access activities in Africa and in countries most vulnerable to climate change (Ministry for Ecology, Sustainable Development and Energy [France] 2011). In 2015, one of the sustainable development goals includes improving access to affordable, reliable, sustainable and modern energy for all. Within the UNFCCC's TEC, special attention has been given to the role of decentralized energy systems for the purposes of energy access. The TEC organized a series of workshops in 2015 to identify barriers and facilitate collaboration to increase deployment of such systems. In June 2015, a TEC expert meeting called for new partnerships on decentralized energy among a wide range of stakeholders (Kumar 2015).

Who Could Be Involved?

India could lead this partnership but other countries — such as Bangladesh, China, Ghana, Germany, India, Indonesia, Japan, Kenya, Korea, Pakistan, Singapore, Switzerland, the United Kingdom and the United States — could be involved. Decentralized energy offers a range of business models, across technologies and scales of operation, through leasing, sales of home systems, community-based products, and mini-grids with productive anchor baseloads. In India alone there are more than 400 companies delivering decentralized energy services. Entrepreneurs are combining innovations in technology and business models with building the capacity and skills of rural and urban youth, along with outreach to financiers, including the vast network rural bankers (Ghosh et al. 2013). With India in the lead, innovations to deliver energy access could be applicable in other regions. In Bangladesh, millions of solar home systems have been deployed. In Sub-Saharan Africa, these systems could combine with innovative mobile payment mechanisms. In Southeast Asia there are opportunities and demonstration projects using agricultural waste in cogeneration systems. There is also extensive experience with decentralized energy in developed countries such as Germany and, more recently, the United States.

What Barriers Would the Partnership Address?

An Energy Access Partnership Fund, created among the partner countries, could increase access to working capital for small-scale entrepreneurs to enable them to build their inventories and to continue servicing poor consumers, even when revenue flows are interrupted (Jha, Jain and Ghosh 2012). The fund, initially capitalized by public finance, could also attract private financing through two routes: by issuing sovereign guaranteed green bonds; and by blending public and private financing to ensure that private investors receive an attractive return while avoiding unreasonable demands from the project. Further, the fund could help aggregate large numbers of small projects (within or across countries) so that financiers could be attracted to investable portfolios with lower transaction costs. It would also provide capital for licensing technologies that are already available in the market. By focusing on deployment, the Energy Access Partnership Fund would finance skills-training programs to increase capacity across rural communities to build, service and maintain decentralized energy systems.

What Would a Partnership on Energy Access Do?

The following could be the core activities of the initiative.

- **Knowledge sharing and coordination:** The partnership could help in sharing best practices on innovations in delivering basic energy services. Virtual networks have already been created under the SE4All initiative. The Clean Energy Access Network in India also has a presence on the ground with a membership of dozens of decentralized energy firms and other affiliated institutions, through which knowledge and best practices are shared.[4] Such initiatives could be linked together across member countries as well as across firms and civil society organizations.

- **Research, development and demonstration:** The partnership would enable firms, supporting research institutions and interested investors to experiment with various business models (for example, rooftop solar home systems, community micro-grids and pay-per-use models) to better understand the market conditions under which they are likely to succeed. The Rockefeller Foundation's Smart Power for Environmentally and Economically Sound Development (SPEED) program was conceived with a very similar idea. The key function of SPEED was to identify business models for off-grid renewable energy generation systems that harness the power demand of local enterprises to increase the commercial viability of the models (Khan 2011). The expanded form of this program, Smart Power India (SPI), was launched in 2015 and aims to take forward the lessons of SPEED to electrify 1,000 villages by the end of 2017 (SPI 2015). Additionally, R&D on technologies for demand-side efficiency, such as more efficient appliances, or appliances based on direct current, could have significant benefits for many communities that are not served by a centralized electricity grid.

- **Technology transfer:** While the technologies for decentralized energy might be well known, two areas where a multi-country partnership could greatly help are in skills development and in integrating hardware and software solutions. Many initiatives for decentralized energy fail to scale or be replicated in other regions because of the shortage of skilled personnel to install energy systems, maintain them over several years, or manage the business and financial aspects of the projects. The partnership could develop curricula for training technicians and managers, thereby creating job opportunities and rural entrepreneurs. Further, both hardware and software solutions are needed to integrate decentralized energy systems with grid-connected systems. While the technologies are known, there is limited awareness in far-flung areas. Transferring these technologies could greatly help in ensuring that those currently "off the grid" are able to integrate with the grid as and when the opportunity arises.

- **Deployment mandates and standards:** In order to scale decentralized energy solutions, the partnership could support collaborations between members in three areas: deepening the financial markets linkage (including with large pension funds in order to secure greater volumes of investment); establishing a network of centres to develop, test, set standards and certify technologies (in order to increase consumer confidence in such projects); and creating model regulatory codes, which could help to promote decentralized energy, in particular hybrid models (using solar, wind and biomass), in order to improve the efficiency of resource use.

Who Would Enjoy the Benefits?

All countries would be welcome to join, initially or after the partnership begins operating. Those who do not join would not have access to its benefits until they join. This would mean that technology transfer and deployment or flexible intellectual property provisions would be applicable only to members. Asking members to make an unconditional commitment to the entire world might deter countries from creating the partnership in the first place.

PARTNERSHIP ON ENERGY STORAGE AND GRID BALANCING

Energy storage R&D is making important breakthroughs and will be a critical component of the push toward more renewable energy. Energy storage solutions could significantly increase the reliability of a growing share of renewable energy in the electricity mix and the stability of electricity grids. Systems with high storage density could transform the electric vehicle market as well as electricity-based public transport in rapidly urbanizing emerging economies. Appropriately sized and durable systems could provide a fillip to innovators and entrepreneurs operating in the decentralized clean energy sector, targeting poor and underserved communities.

Who Could Be Involved?

As with energy access, progress on energy storage could be a common interest for many countries, whether developed or developing, that have the need to develop, test, deploy and commercialize technologies across many segmented markets. In India, storage needs are getting attention since the country has quintupled its solar energy deployment target to 100 gigawatts by 2022, by which time renewable energy could account for 20 percent of electricity generation. With the announcement of India's INDC, which have a target of 40 percent non-fossil electricity capacity by 2030, the share of non-fossil sources in electricity generation could be as high as 30 percent in that year. Given the imperative of storage technologies to stabilize India's vast grid, India could co-chair this partnership along with a developed country. France, Japan, Sweden and the United States have some of the most innovative firms and research laboratories in this area and could be the drivers of global collaboration in energy storage. China has a large manufacturing capacity for batteries. Germany has already deployed renewable energy on a large scale,

4 See www.thecleannetwork.org.

which now meets a significant share of electricity demand on many days in the year. Its ability to integrate rooftop solar systems with the grid offers learning opportunities in terms of technology and grid management expertise for other countries.

What Barriers Would the Partnership Address?

Energy storage remains the holy grail of large-scale deployment of renewable energy. But this has created a chicken-and-egg situation. The demand for renewable energy scale-up is contingent on energy storage and grid stability solutions; yet, the investments in R&D are held up until there is clarity on the scale of renewable energy deployment. A dedicated financing facility is needed to encourage more research in storage technologies. Advance commitments for procurement of storage technologies (based on technology-neutral parameters) could give the impetus for the demand needed to drive private R&D investment in this area. The US Advanced Research Projects Agency — Energy has defined parameters for a range of storage research needs (electrical energy, thermal storage, electrochemical energy, protection of storage devices and batteries for transportation). Similar parameters for a cross-country partnership could help leverage limited amounts of public funds for greater private R&D investments.

The partnership could develop and promote innovative financing models, which would encourage the uptake of high capital cost storage solutions. Examples include direct purchase, wherein the funder decides the price and guarantees the sale of the technology; top-up instruments that guarantee a certain price to the developers, but are explicitly linked to the market to absorb market risks in the process; and tradable "put" options, which give technology developers the option to sell their products to the public authority if the market for storage technologies has not developed sufficiently. The advantage of these approaches is that they use limited amounts of public funds to encourage private capital investment. There is no outlay of public funds at the present time, and it is likely that future payouts will decline as more commercial market opportunities emerge to absorb new technologies (Ghosh et al. 2012).

A partnership on storage could also overcome IPR-related barriers. Partner institutions could build on their existing intellectual property, but jointly own new technology licences. The scale of renewable energy deployment in countries such as India would offer significant market opportunities to build R&D capacity, test technologies and commercialize viable options.

What Would a Partnership on Energy Storage and Grid Balancing Do?

The purpose and activities could be structured around key functional aspects of technology partnerships.

- **Knowledge sharing and coordination:** The first major task of the partnership could be to conduct detailed market needs assessments for different market segments.[5] These market assessments would be needed for utility-scale storage solutions (including reducing transmission capacity requirements, balancing grid frequency and smoothing power output from renewable energy plants); off-grid energy storage for mini-grids, community uses and home systems; energy management for large user groups; and mobile storage technologies for electric vehicles and public transport. Alternative cost- and technology-based scenarios could also be prepared. Sharing this knowledge and the methodologies would greatly help member countries develop the road map by which to encourage R&D and manufacturing in storage solutions and envision how to scale renewable energy.

- **Research, development and demonstration:** R&D activities are already underway in laboratories and companies across several developed economies. The storage partnership could support research development and deployment by establishing pilot projects in developing countries. Full-scale demonstration projects, in different ambient conditions, with different efficiency parameters and different customer needs, could provide inputs for both scientific and commercial parties interested in this sector. Moreover, targeted R&D (for example, in increasing the life of batteries, reducing their weight or shortening their charging cycle rates) could be promoted through institutions and firms in member countries. If co-financing from public and private sources was introduced, it could draw in many more interested parties.

- **Technology transfer:** Our research indicates that very few partnerships have been designed to facilitate actual transfer of technology and/or eventual deployment; they have been limited to transfer of soft skills or demonstration projects. Combining the results from pilots with detailed market assessments would help identify new business opportunities, establish manufacturing facilities and set up new links in the supply chain for components used in storage technologies.

5 Of the 30 partnerships analyzed, a few of them included the described features, including market needs assessments and so on. However, none of them addressed the issue in its entirety and, therefore, the proposed design features represent more holistic versions of these.

- **Deployment mandates and standards:** The partnership could support entrepreneurship via links between universities, laboratories and firms across member countries. It could also help to develop policy frameworks, which could prioritize intermittent renewable energy over other sources in accessing the grid. Frameworks for developing markets and regulations for net metering could incentivize residential and commercial consumers of storage solutions.

Who Would Enjoy the Benefits?

As with the energy access partnership, all countries would be welcome to join, initially or after this partnership begins operating. Those who do not join would not have access to its benefits until they join. This would mean that technology transfer and deployment or flexible intellectual property provisions would be applicable only to members. Asking members to make an unconditional commitment to the entire world might deter countries from creating the partnership in the first place.

CONCLUSION: LINKING BACK TO THE UNFCCC

The two partnerships proposed here have wide-ranging functions as well as improved design: access to funds in cash and in kind; flexible intellectual property arrangements; and a focus on building existing capacity and leveraging networks. They would not be exclusive clubs, but would have an open and expanding membership over time, making valuable contributions to global climate governance. The member countries could also form advisory bodies in order to have representation from technology developers, the private sector and relevant international organizations.

The partnerships would also support the UNFCCC. Without energy access for all, developing countries will not countenance any moves to limit their emissions. Without energy storage research, several countries that have announced large renewable energy targets will struggle to meet them. The TEC is convinced of the need for greater coordination among UNFCCC institutions (both arms of the TEC and CTCN — as well as the Green Climate Fund [GCF]) for accelerated global deployment (Kumar 2015). It is also seeking input on how the Technological Needs Assessments can be converted into implementable projects (UNFCCC TEC 2015). An energy access partnership could lead to a series of such implementable projects based on in-depth needs assessments. Further, rather than duplicate capacities, such a partnership could help reduce the burden on GCF finances by leveraging mutually beneficial collaborations. The partnership on energy storage could also report back to the TEC on its progress. If periodic reviews were conducted at the UNFCCC on how the world was progressing toward its climate stabilization goal, reports on the activities of this partnership would be crucial. The partnership could also increase coordination between the United Nations Environment Programme and the United Nations Industrial Development Organization as technological shifts begin to support new commercial opportunities.

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ABOUT CIGI

The Centre for International Governance Innovation is an independent, non-partisan think tank on international governance. Led by experienced practitioners and distinguished academics, CIGI supports research, forms networks, advances policy debate and generates ideas for multilateral governance improvements. Conducting an active agenda of research, events and publications, CIGI's interdisciplinary work includes collaboration with policy, business and academic communities around the world.

CIGI's current research programs focus on three themes: the global economy; global security & politics; and international law.

CIGI was founded in 2001 by Jim Balsillie, then co-CEO of Research In Motion (BlackBerry), and collaborates with and gratefully acknowledges support from a number of strategic partners, in particular the Government of Canada and the Government of Ontario.

Le CIGI a été fondé en 2001 par Jim Balsillie, qui était alors co-chef de la direction de Research In Motion (BlackBerry). Il collabore avec de nombreux partenaires stratégiques et exprime sa reconnaissance du soutien reçu de ceux-ci, notamment de l'appui reçu du gouvernement du Canada et de celui du gouvernement de l'Ontario.

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