Architectures for Global Climate Technology Governance: Options and challenges[*]

Hernan Carlino[+]
Martina Chidiak[++]
Daniel Perczyk[+++]

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[+] Lecturer, Universidad CAECE, Buenos Aires, Argentina

[++] Lecturer in Environmental Economics, Economics Faculty, University of Buenos Aires

[+++] Director, Centre for Global Environmental Change, Instituto Di Tella, Buenos Aires

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I. Introduction

This paper focuses on the global governance challenges posed by the need to enhance climate technology development and diffusion worldwide. As many analysts highlight, climate technology development and deployment is a core element in order to achieve effective global climate change mitigation in the context of international efforts under the UN Framework Convention on Climate Change (UNFCCC) (de Coninck et al, 2007; Bossetti et al, 2006; SBSTA, 2006a, 2006b; Schellnhuber et al, 2006; Stern, 2007, ch.24).

As a matter of fact, this is one of the few pieces of implicit global consensus in the climate change debate, even amongst Kyoto Protocol (to the UNFCCC) supporters and critics. This is probably explained by the fact that development and deployment of climate technology is one prominent means to reduce the costs of curbing greenhouse-gas (GHG) emissions and facilitate (or, even, to improve feasibility of) widespread switch to more sustainable production patterns with high GHG mitigation potential, such as renewable energy, both in developing and developed countries.

However, the process of incorporating climate technology development and diffusion issues in UNFCCC negotiations for global concerted action (i.e. to develop and implement a global climate change regime) has proved, in spite of the efforts devoted to it, difficult and slow. In effect, wide recognition of the crucial need to accelerate innovation, diffusion and technology transfer efforts does not necessarily guarantee consensus on how to proceed (SBSTA, 2006a; 2006b; 2006e). This may well be due to the complexity of the challenges posed by technology development and transfer in general (and in the case of climate technology in particular) and the difficulty for handling those challenges in the UN global negotiation framework.

In parallel, over the past decade we observe a growing importance of public-private partnerships or other multilateral and bilateral initiatives specifically focused on climate technology cooperation and information dissemination (Justus & Philibert, 2005; SBSTA, 2006e; de Coninck et al, 2007). Most of them are organised around key themes or technologies (and many of them are linked to energy issues). This approach, as highlighted by many analysts has several advantages and potential (e.g., due to their flexibility and to the inclusion of private sector as a key actor). However, some important issues are missing in the existing partnerships. For example, coordination among different technology initiatives, an explicit link to the ongoing negotiations on a global climate regime (e.g. commitment negotiation under the UNFCCC), widespread inclusion of developing countries in technology cooperation, and identification of key technologies.

More precisely, this paper is motivated by two puzzling observations:

Firstly, the above-mentioned difficulties faced so far for the establishment of a global governance structure for effective climate technology development and diffusion within the framework of the UNFCCC. This seems a bit paradoxical in view of its recognised relevance and also from the observation that public sector representatives (from Annex I

countries and of some non-Annex I parties) participate actively in public-private partnerships for climate technology cooperation.

Secondly, the fact that some analysts of global climate policy seem to present technology cooperation as an alternative rather than a complement to climate mitigation efforts (Sugiyama, 2005; Otto et al, 2006). Some extreme views even suggest that technology cooperation could prove an alternative to the Kyoto Protocol approach in order to move beyond the stalemate of setting agreed global targets for GHG emissions. However, it has also been recognised that this could prove an inefficient (and probably insufficient solution), since it may provide for a lower than "optimal" environmental effectiveness (Carraro & Buchner, 2005). In other words, a technology focus may not properly address the main issue of the climate change problem: setting a cap to global emissions to avoid "dangerous anthropogenic interference on the climate system" (as stated in Art.2 of the UNFCCC).

As a matter of fact, economic analysis indicates that climate change results from a global "negative externality" problem (GHG emissions are higher than socially optimal due to the fact that markets do not fully internalise the negative environmental effects of GHG generating activities). But even if technology development and diffusion may help reach low-cost solutions to this problem and, thus, may appear as instrumental to this larger goal, technology is embedded in imperfect markets itself. In particular, technology development and diffusion is likely to be lower than socially optimal due to the presence of positive externalities, which imply that those well placed to decide on its development or diffusion cannot fully appropriate the benefits from it (Carraro & Buchner, 2005; de Coninck et al, 2007). Many reasons may explain technology under provision: imperfect appropriability (of R&D results and of social diffusion benefits), uncertainty and imperfect information (those who could invest in R&D or apply new technologies usually don't have full information or certainty of the benefits they will generate), incentives (principal-agent problems), and financial barriers (in particular, for adoption of EST in developing countries) (Jaffee et al, 2005). The standard economic prescription for this double externality problem is to apply two separate policy instruments, one to correct each problem. However, it is usually recognised that in view of the voluntary nature of solutions to the climate problem and of the high levels of uncertainty present in the two problems, the solution to each may benefit from policies implemented in the other field. For example, Barrett (2006) argues that reaching an R&D cooperation agreement (to take advantage of economies of scale) may be facilitated if concerted global action on policies, e.g. standards mandating and promoting the adoption of "breakthrough" climate technologies, is agreed upon. Similarly, the possibility of receiving credits for emissions reductions (via the Clean Development Mechanism or the permit market created by the Kyoto Protocol) may increase the incentives for technology development or diffusion.

For all of the above, this paper argues that the development of a specific mechanism for climate technology development and diffusion must be seen as a key element in the global architecture of a climate regime for the period post 2012, within the UNFCCC framework. In this connection, a preliminary analysis of a number of desirable building blocks for a global governance mechanism for climate technology is offered. In

particular, it is stressed that such specific climate technology governance system must be global in scale, that it should benefit from the experience and lessons coming both from ongoing public-private partnerships and the implementation efforts devoted to the UNFCCC technology framework and that it should aim both at exploiting the reinforcing (complementary) features of these two approaches and at supplementing their weaknesses (in terms of co-ordination, effectiveness, etc.) so far through wider governance provisions.

To this aim, the analysis is presented as follows. Firstly, the general setting in which this paper introduces climate technology issues is presented in section II. Subsequently, the available options for advancing the climate technology agenda within the UNFCCC framework are presented in section III. Section IV identifies, from the previous literature, a number of desirable properties and evaluation methods that can be considered in order to assess the available options for a climate technology mechanism. This is followed by an application of those evaluation criteria -from a social science perspective- to assess the alternatives currently considered for the continuation of the UNFCCC technology framework (section V). It is believed that two pieces of relevant information arise from this exercise. Firstly, it helps identify the barriers faced for successful negotiation and implementation of a climate technology framework. Secondly, it provides a valuable input for the identification of some desirable building blocks for a global climate technology governance system in the future. These and other lessons from the previous analysis are discussed in the concluding section (VI).

A few notes of caution seem in order. This is an exploratory analysis, and for this reason it necessarily simplifies many features of these highly complex global governance issues and the challenges they pose.

First of all, the paper will only focus on climate mitigation technology issues. The key importance and complexity of adaptation technologies may be better dealt with through a specific adaptation scheme embedded in the future climate regime (Torvanger et al, 2005). Besides, this preliminary approach also takes into account that some GHG mitigation technologies may favour other national objectives (e.g. energy security and sustainable development), all which could help in the implementation of a technology agreement. By contrast, the presence of other related objectives is more difficult to assess in the adaptation technology case. In view of all of the above, including adaptation technology development and diffusion will eventually call for further analysis.

Secondly, when highlighting the desirable building blocks for a global governance mechanism on climate technology, only the most salient interlinkages between climate change objectives and technology development and diffusion are considered, taking into account that we probably are at a first stage of understanding their nature and extent. The approach followed in this paper belongs to a social science perspective, in particular, taking into account some insights coming from applied economic and political analysis. For this reason some technology-climate policy interlinkages that arise from natural science and engineering analyses are likely to be overlooked in this paper, and will eventually call for corrections in the approach.

Finally, it seems worthwhile to explicitly state that, in this paper, the term "climate technology" refers generally to those technologies with a potential to reduce GHG emissions at reasonable cost, regardless of the motivations that might lead to their development and deployment. This means that climate technology encompasses both specific climate technologies (aimed purely or mainly at reducing GHG emissions, e.g. through methane capture and flaring, HFC 23 destruction, etc.) and climate friendly technologies (probably aimed at other related objectives -such as improving energy efficiency or diversifying energy sources- but whose deployment may considerably increase climate change mitigation). Most of the examples cited throughout the paper will refer to the particular case of climate friendly technologies but the focus of the climate technology mechanism should include all climate technology types.

II. The general setting: a developing country view of climate technology issues

There is an expanding consensus that growing emissions of greenhouse gases represent a serious threat to the world. The review of the robust body of climate change science by the Intergovernmental Panel on Climate Change (IPCC) published in January 2007 has confirmed the influence of human activities on the climate system. The IPCC concludes that, this influence is going to increase with adverse effects that are potentially important on ecosystems and human activities.

Climate change is a complex problem requiring global action. While a major environmental challenge for the world in general, for developing countries in particular it constitutes a new and additional barrier to sustainable development, due to their high vulnerability and limited adaptive capacity. Furthermore, a growing body of evidence confirms that impacts of climate change are already evident in many regions of the developing world.

With a forward looking perspective, it is important to note that development efforts will be substantially hindered by the risks of climate change if adverse effects are not addressed. Similarly, uncertainties will significantly increase the costs of and barriers to development: reduced economic growth due to climate change impacts, under-performing or larger investment needs, constraints to food production due to insufficient adaptation to climate variability and change, damage to the natural capital that supports many developing countries' wealth creation processes and threatened social infrastructure. In addition, the current path of development will lead to high emissions of greenhouse gases from energy, transport, agriculture and forestry that will, in turn, exacerbate climate change.

The Kyoto Protocol under the UNFCCC is currently the sole international climate agreement that sets legally-binding commitments for countries in order to mitigate climate change. Commitments under the Protocol cover the period 2008 to 2012, leaving any targets for the ensuing years to be negotiated in the future.

It could be argued that negotiations aimed at the design of a climate regime after 2012 have stalled because of the diverging interests and approaches among countries and regions related to energy security, competitiveness, and differing environmental and socio-economic adverse effects. Furthermore, a strong political leadership in developed countries is needed to address the burden sharing issue from a long-term perspective, and views among this group of countries also diverge. Recognising these different perspectives and circumstances, there are reasons for pessimism about full international cooperation towards the timely completion of an international climate regime in the face of global warming.

On a more optimistic note, a number of developments -such as widespread public concern, ever increasing media attention, and a raising corporate interest in understanding the liabilities and opportunities that result from global climate change- are contributing to the creation of a forward momentum that is channelled through diverse initiatives, both at the national and international level. Some of them even lie beyond the limits of the multilateral negotiation system and its intergovernmental process.

Thus the international community has undertaken several initiatives to discuss strategies and options to address climate change and its related elements: energy security, economic growth, innovation, equity, poverty and, eventually, global governance. At the regional or national level, actions as well as initiatives and debates have multiplied and in some cases interwoven. A common pattern of understanding, awareness and concern creates the appropriate environment for a new stage of negotiations on the future climate regime.

This open ended process has been complementary to the one occurring under the aegis of the UN Framework Convention on Climate Change and its Kyoto Protocol. The focus of incoming negotiations is likely to be defined in the framework of two undergoing processes launched in Montreal in 2005: the Dialogue on long-term cooperative action to address climate change under the Convention and the Ad Hoc Working Group on Further Commitments by Annex I Parties under the Kyoto Protocol. Being closely interrelated, while operating on parallel and eventually convergent tracks, both processes are intended to end up in a political compact that ought to address the major problems and concerns of the Parties. Such political compact must also ensure that the future climate regime (or global governance mechanism) is built on a set of principles that represent the common ground for an agreement.

This set of principles should include at least:

-A common and cooperative approach to meet this global challenge via a long term GHGs emissions reduction goal.

-Universal and equitable participation.

-Efficient incentives for reducing GHGs emissions, by means of market-based approaches.

-These incentives should be set taking into account existing differences in local capacities and development priorities (urgencies).

-A mechanism to address adaptation challenges, by which wealthy nations that are principal contributors to climate change are to help poorer ones to meet their adaptation needs and reduce underlying risks by means of financial and technical assistance.

-Recognition of the key role of technology innovation and diffusion, whose benefits and potential are disseminated via technology cooperation and investment. This fact will imply the need for further financial and technical assistance from developed to developing countries.

On the whole, to optimise the political compact for successful discussions on the future it is also needed to address the means to make these principles operational in a highly complex system.

Some of the issues that will affect future negotiations are related to adaptation, financing mechanism and access to finance, deforestation and land use change, response measures, evolution of scientific knowledge, and inevitably, technology innovation and diffusion along with capacity building. At the same time, the future climate regime should identify and facilitate measures to contribute to mainstream climate concerns in energy investment decisions, financial systems, and development planning.

As in other areas where diverging views created the conditions for protracted negotiations, the basic disagreements between developing and industrialised countries on technology transfer manifested so far should be a source of concern for those that understand that further technological development and diffusion is indispensable to achieve the ultimate goal of the United Nations Framework Convention on Climate Change (UNFCCC).

However, while innovation plays an essential role as an engine of growth and globalization, it has been found lacking as a development tool, because the capacity for innovation is unevenly distributed.

The concentration of innovation capacity in a rather small number of countries, with the consequent direct impact on the global distribution of income and opportunities, contributes to create an imbalance between the national scope of governmental policies and the global nature of markets, diminishing national capacity to participate in the ever expanding globalization upsurge, increasing gaps of wealth and knowledge and eventually hampering the governance of the global system.

If this current concentration of innovation capacities is taken as a given when designing the architecture and building blocks of a future climate regime, the system’s ability to revert the by now limited diffusion of climate technologies in developing countries will be seriously impaired, as will the means to achieve any given global objective for long-term GHG emissions.

III. The UNFCCC technology framework

The UNFCCC established in Art. 4, paragraph 5, that industrialised countries (Annex II countries) should promote, facilitate and provide funding for technology transfer, access to environmentally sound technologies (EST) and knowledge in particular to developing countries in order to allow for the implementation of the provisions of the Convention. Article 10 of the Kyoto Protocol sets out a similar request.

The prevailing view toward climate technology priorities, after a special report of the Intergovernmental Panel on Climate Change (IPCC) in 1990, was that other than a set of policy instruments (eventually set out by the Kyoto Protocol) such as quantitative commitments, market incentives (through the creation of a system and a market for emission permits) and project mechanisms (such as the CDM and JI) further instruments were necessary to guarantee technology transfer to developing countries in a scale sufficient to allow for increasing mitigation efforts worldwide.

Decision 4/CP.7, adopted in Marrakesh, set out the "Technology Framework" that organised the main issues to advance the development and diffusion of EST around five themes:

(i) technology needs and technology needs assessment
(ii) technology information
(iii) enabling environments (including policies for technology "push" –such as R&D subsidies- and technology "pull" –such as standards-)
(iv) capacity building
(v) mechanisms for technology transfer.

To this aim, the Expert Group on Technology Transfer (EGTT), made up of 20 members, representing both developing (13) and industrialised countries (7) was created. The EGTT has a reports to one of the subsidiary bodies of the Convention, the Subsidiary Body for Scientific and Technological Advice (SBSTA). Other important mechanisms related to technology transfer efforts were envisaged, such as the creation of the Technology Transfer Information Clear House and the Special Climate Change Fund (created to provide funding for developing countries' adaptation and technology transfer activities as well as those aimed at economic diversification of oil-exporting countries). The efforts related to technology transfer to developing countries are funded either through the Global Environment Facility –GEF- (under the climate change focus area) or the Special Climate Change Fund (with its only fixed source of funding coming from a contribution from the Clean Development Mechanism –CDM- proceeds). It was also expected that the CDM would contribute substantially to investment in and transfer of climate technologies to developing countries. However, many analysts argue that the scale of technology transfer achieved by the CDM, in comparison to initial expectations, has been scarce due, for example, to high transaction costs (see, for example, Bradley & Baumert (2005) and other references in Sterk & Wittneben, 2005).

After five years, recognition of the slow progress in implementing the UNFCCC technology framework agreed in Marrakesh is leading to many evaluation exercises and

also to call for new proposals and negotiations towards "enhanced implementation" (as seen from UNFCCC documents such as Decisions 6/CP.10 and 6/CP11). The evaluation of EGTT work and the definition of a future programme of action were scheduled for COP 12 (Nairobi, November 2006), but no consensus was reached on the latter. To a large extent, differing views of developing and developed countries over a number of issues may explain such a result. For example, a first contentious issue is the focus of technology transfer efforts (mitigation vs. adaptation) where industrialised countries give higher priority to the former while developing countries to the latter. A second issue under debate concerns the problem of adequate funding for technology transfer. Industrialised countries as a whole do not face mandatory contributions to this aim (in spite of the UNFCCC mandate), and developing countries demand more help. Financial controversies include the relative role of the GEF and the UNFCCC in defining the priorities and terms for access to funding for technology transfer to developing countries. Finally, a third issue for potential divergence between these two groups of countries with regard to technology transfer priorities concerns intellectual property rights (IPR). The basic debate opposes two views: IPR are necessary, from the perspective of industrialised countries, in order to guarantee adequate returns to private R&D and commercial development of new technologies. From a developing country perspective, they act as a barrier to technology transfer (adoption) when considering the costs of access to technologies.

In parallel, a rising trend of public-private partnerships, which are organised either around specific technologies or for climate technology in general, is observed. These initiatives have developed either in cooperation with UNFCCC, for example, the IEA implementing agreements on specific energy technologies, such as Greenhouse Gas R&D, Fluidised Bed Conversion, Bioenergy, Advanced Fuell-Cells, etc. and more generally, the Climate Technology Initiative, or in parallel. Examples of the later trend are many bilateral, regional or international initiatives, such as those initiated by the United States –e.g. the Asia Pacific Partnership; Methane to Markets initiative, FutureGen- and other EU sponsored initiatives, such as EU-China Partnership on Climate Change, EU-India Initiative, and the International Partnership for a Hydrogen Economy (also including the US and Japan). Their number is growing: at least 30 IEA implementing agreements are related to climate technology, while different evaluations identify at least 20 other such initiatives (Justus & Philibert, 2005; de Coninck et al, 2007). Some of these partnerships provide a relatively successful experience in terms of co-ordination of efforts and they also allow for reaching economies of scale, for information diffusion, network creation, and task or cost-sharing among partners. This has led many analysts to consider partnerships as an alternative or a necessary complement to UNFCCC efforts in the technology arena (Justus & Philibert, 2005; Philibert, 2005; Sugiyama, 2005). In the framework of UNFCCC negotiations and efforts, some collaboration is already taking place with a number of partnerships (in particular, co-operation with the Climate Technology Initiative under many themes of the technology framework is worth noting) and the need for further efforts in this regard is underlined in many documents by SBSTA and EGTT (SBSTA, 2006a, 2006b; 2006e; 2007).

The available proposals to move forward within the UNFCCC technology framework are described in SBSTA (2006d; 2006e). Since the future actions and the characteristics of the institutions that will be responsible for promoting and overseeing them are still in the process of negotiation, the two main options under consideration are described and analysed in section V. Similarly, taking advantage of available aggregate information and evaluations of partnerships for technology cooperation (Justus & Philibert, 2005; Ueno, 2006; Stern, 2006 (ch.24); de Coninck et al, 2007; SBSTA, 2007), their salient features are also delineated in that section. The goal of the evaluation analysis is to highlight their features from the perspective of the global governance architecture implied (objectives, actors, actions, and in particular links with important issues missing so far: financial resources, incentives for participation, link with long-term climate mitigation goals, etc.). Before addressing those issues, the framework for evaluation is described in what follows.

IV. Framework for the evaluation of a global governance mechanism for climate technology

Biermann (2007) offers a good starting point to enunciate the reasons why the complexity and magnitude of the challenges posed by climate technology development and diffusion grant the need for a global governance mechanism for this problem.

Briefly, this author identifies an "earth system governance" challenge (in which the climate technology problem is embedded) when the problem structure exhibits the following features:

(i) persistent uncertainty (on environmental impacts, causes and solutions);

(ii) intergenerational dependencies;

(iii) functional interdependence of earth system transformation and potential response options; and

(iv) spatial interdependence.

The author's analysis shows why the climate change problem constitutes an "earth system governance" challenge. It may be added that climate technology, among other climate change challenges, also presents us with a specific global governance problem. On the one hand, since it is instrumental to reaching a global solution to the climate change problem. On the other hand, since it exhibits many of the above-mentioned characteristics.

More precisely, we may review each of the above-listed characteristics:

Persistent uncertainty surrounds the issue of how crucial is the development and deployment of new technologies (rather than massive diffusion of available ones) in order to meet the challenge of climate change. This results both from climate uncertainties, notably, with regard to the thresholds of maximum allowable emissions or GHG concentrations to fulfil the ultimate objective of the UNFCCC (as stated in its

Article 2); but also from innovation uncertainty. Current efforts towards applied research and commercial development may or may not lead to the availability of ready-to-use, low-cost technology options in the near future. Thus, uncertainty looms over private and public decisions that need guidance on which technologies are necessary (e.g. this constrains climate-related and technology policy decisions both in developed and developing nations, as well as private actors' investment choices on both R&D and technology deployment).

Intergenerational dependencies are clear since R&D and diffusion efforts today (as well as present climate policies) may condition the technology and development paths available for future generations, adding new complexity to decisions regarding technology policy and private decisions on R&D and investment. If technologies are available at reasonable cost, the challenge of climate change could be easy to tackle, whereas if new (uncertain) technologies are needed, it may prove difficult to control.

Spatial interdependence results from the global nature of the climate change problem for which policy goals and approaches are better assessed at global level, but the suitability of technological solutions is better evaluated at local level. This poses a key challenge in the case of climate technology. Developing countries need to assess their own technology needs in a context of imperfect information on impacts (the challenge) and of the suitability of available technologies (developed by and for industrialised countries) for application in their specific context. The presence of financial constraints and barriers to adoption in developing countries adds further complexity to this issue.

An extraordinary degree of harm could result from climate change, and thus a "precautionary principle" (adopted in the UNFCCC), as well as 'global solidarity' calls for action now and to develop global response mechanisms (e.g. in mitigation technology, as well as in adaptation). This also has implications for the development of financial mechanisms to overcome barriers to development and diffusion of technologies better adapted to developing country needs.

If we consider that climate technology poses a global governance challenge, we might as well discuss the desirable principles for a global governance mechanism on this issue. As a point of departure, we consider those principles set out in Biermann (2007) for any global governance problem:

1) Credibility. Satisfying this principle is necessary in order to grant wide participation in any global governance mechanism. Achieving credibility is related to the setting of incentives and rules in order to achieve participation (cooperation) of both developing and developed countries. In the climate technology case, this involves incentives for cooperation for information exchange and dissemination, as well as for technology development and diffusion.

2) Stability. Given the long term nature of technology and climate objectives and needs, both effectiveness and participation calls for a high degree of stability in the global governance mechanism. This requirement also has implications for the design of

incentives and rules for the sake of continuity and flexibility of the mechanism over time.

It could be added that satisfying both properties above have to do with breaking the "prisoners' dilemma" for non cooperation in technology issues observed so far.

3) Adaptiveness. From this perspective, a global governance system for climate technology needs to grant information diffusion and update of information on technology developments, technology needs and climate challenges (at global and local scale).

4) Inclusiveness. A high degree of inclusion calls for equality in allocation of rights; transparency; and for involving different kinds of institutions (not only governments at national, regional and local levels, but also NGOs and other representatives of communities, industrial associations, private companies, multilateral organisations, etc.).

One could argue that most of the above principles call for the establishment of any global governance mechanism in the framework of UNFCCC. In addition, the adaptiveness and inclusiveness principles may call for higher flexibility in the rules for participation of different actors. This implies that a complex web of actors may be involved in its global governance architecture.

From a different perspective, more oriented towards the practical aspects of technology co-operation and its effectiveness, de Coninck et al (2007) further elaborate and add to the set of criteria that a "technology-oriented agreement" should satisfy:

5) Environmental effectiveness (contribute effectively to the reduction of GHG emissions worldwide)

6) Technological effectiveness (contribute effectively to the development and deployment of mitigation technologies for GHG)

7) Economic efficiency and cost-effectiveness (achieve their environmental and technology goals at lower cost than alternative policy or cooperation options)

8) Incentives for participation and compliance (rules should be set so that incentives and not only mandates will guarantee wide participation and compliance)

9) Administrative feasibility (accountability and evaluation of the global governance mechanism should be manageable through a reasonable administrative structure)

These criteria are applied to analyse the relative advantages and disadvantages of the UN technology framework and public private partnerships based on the information available from existing evaluation exercises.

Wittneben et al (2005) apply an interesting methodology by which different proposals (and their building blocks) for future climate regimes[1] are discussed in terms of the priorities of developing and industrialised countries, and such an analysis provides insights regarding what could be called their "political acceptability". Such considerations will also be taken into account in section VI when identifying desirable building blocks for a global governance mechanism on climate technology. Overall, the analysis aims at identifying some implications of the evaluation results for a global governance architecture options in order to meet the climate technology challenge.

V. Evaluation of available options

UNFCCC activities toward the implementation of the technology framework have focused and have been evaluated on the basis of the five themes set out in Marrakesh.

a. Progress under the five themes of the UNFCCC technology framework

Recent evaluations of progress made in implementing the UNFCCC technology framework, as well as in EGTT work, are available from SBSTA (2006a; 2006b; 2006c; 2006d; 2006e). In general, evaluations are organised around the five framework themes and recommendations indicate that the scope of framework as reflected in those themes continues to provide a solid background for the implementation of Art. 4.5 of the Convention (see for example, SBSTA, 2006b; 2006e).

The available evaluations suggest that actions under the UNFCCC technology framework have successfully advanced mainly in two respects: diffusion of information and evaluation of technology needs in developing countries. As a matter of fact, the EGTT reported that activities included under the first (technology needs and needs assessments) and second themes (technology information) of the UNFCCC framework were almost fully completed successfully. In addition, progress with regard to the third, fourth and fifth themes seem to have advanced mostly in those activities related to information gathering, sharing and diffusion (SBSTA, 2006a; 2006b; 2006d).

With regard to the first theme, evaluation of technology needs assessments (TNAs) in developing countries, the EGTT guided the elaboration, revision and application of a bottom-up methodology to conduct the assessments (with regard to both adaptation and mitigation technologies). The GEF committed funding for conducting TNAs in 94 developing countries. Some 50 have been carried out either as stand alone exercises or in the framework of National Communications to the UNFCCC (SBSTA, 2006c). Future actions proposed by EGTT reasonably focus on enlarging the list of developing

[1] The options analysed by the authors include a continuation of the Kyoto Protocol (i.e. mandatory caps on emissions) and a US- type policy, only aimed at technology promotion and cooperation with no emissions targets.

countries completing TNAs (calling for further allocation of funding to this aim), on updating and disseminating a handbook on best practices to conduct them, on information sharing between parties who have completed TNAs, and on elaborating summaries and analysis of TNA information for feedback to the UNFCCC negotiation process. As a matter of fact, the available TNA results suggest that technology needs for climate change mitigation in developing countries share many features both regarding priority (from a local perspective) technology types, sectors and barriers to overcome in order to facilitate technology adoption (SBSTA, 2006c). This suggests considerable scope for collective learning and global action to overcome barriers.

As regards the second theme, technology information, the main effort envisaged was the compilation and dissemination of relevant information through the Technology Transfer Clear House, which was implemented and is available from the UNFCCC website. However, recent evaluations and recommendations have pointed at the need to maintain and update the database, and to increase outreach efforts since most consultations have, so far, come from organisations in industrialised countries.

By contrast, activities under the third, fourth and fifth themes should be strengthened, as follows from both EGTT and SBSTA recommendations (SBSTA, 2006a; 2006b; 2006d; 2006e).

Under the third theme (enabling environments) activities mainly related to gathering and facilitating the exchange of information on "technology push" and "technology pull" policies implemented by UNFCCC parties. Further work should focus, as follows from the EGTT and SBSTA recommendations, on identifying remaining barriers to technology transfer, highlighting best practices and recommendations on policy design. A similar result is observed with regard to the fifth theme (mechanisms for technology transfer), where information regarding policies and measures aimed at the removal of barriers to technology transfer was gathered, reviewed and disseminated, but further analysis is necessary in order to identify best practice and policy recommendations. Future work under these two themes, it is further recognised, will require closer cooperation with ongoing technology-related partnerships and dialogue with private sector representatives.

With regard to the fourth theme, capacity building, activities carried out focused on capacity building for conducting TNAs, information dissemination and sharing of views regarding not only climate technologies but also enabling environments for technology transfer and mechanisms to this aim.

A cross-cutting issue related to the third, fourth and fifth themes, concerns financial instruments and funding for technology transfer. In this regard, recent surveys and workshops highlight the need for "innovative finance mechanisms", and suggest the need to enlarge capacity building efforts to strengthen the ability of developing countries' public agencies and private sector agents to present and access to available multilateral funding for climate-technology related investment (SBSTA, 2006a).

It is worth noting that the focus of the UNFCCC technology framework on technology transfer issues suggests that initial concerns were biased toward the view that IPR might prove an important barrier to development and diffusion of climate technologies. On the one hand, imperfect IPR protection could hamper successful development; while IPR enforcement might limit technology diffusion in developing countries by adding up to total implementation costs. However, the analyses available do not clearly show that IPR has proved so far a main barrier to climate technology deployment in developing countries (SBSTA, 2006c). Rather, the lack of information regarding climate technologies (and their performance in the local environment) and the need to strengthen and guarantee adequate finance and incentives for EST adoption in development-related infrastructure (e.g. in energy and other productive sectors) appears more crucial.

An additional word on the role of the EGTT (and its work programme under the UNFCCC technology framework) seems in order. The role of EGTT is mostly focused on providing information and advice to the Conference of the Parties (to the UNFCCC) through the SBSTA. This means that it has no political role (i.e. in negotiations) and very limited executive power (confined to capacity building activities). This limits the scope and extent of action that could be achieved under the UNFCCC technology framework. In this regard, (i.e. potential for action) the UNFCCC framework appears in contrast with action-oriented partnerships, where governments play a key role as initiators and funding suppliers as well as actors, through specific agencies. In addition, other key players in technology transfer, such as private actors and international organisations also participate directly in activities, as discussed below.

b. Evaluation of international technology-related partnerships

A number of evaluations of the achievements under international (multilateral, regional or bilateral) partnerships for technology cooperation and diffusion are available (Ueno, 2006; de Coninck et al, 2007; Justus & Philibert, 2006).

Most partnerships were initiated by public sector agents (national government agencies) in charge of technology policy in the relevant area. Agreement or partnership design allows for adapting to specific technology needs in the fields of R&D, demonstration and diffusion. For some technologies, basic R&D is the main bottleneck, whereas for others commercial development or demonstration is the main objective. The flexibility in design allowed in partnerships implies varying roles of public sector and private sector institutions.

In de Coninck et al (2007), a classification of partnerships and international initiatives according to their main focus (and contribution) is offered:

- Knowledge sharing and coordination (eg. many US led initiatives, like Methane to Markets and the Carbon Sequestration Leadership Forum, as well as task sharing implementing agreements within IEA framework).

- R&D and demonstration (e.g., many cost-sharing IEA implementing agreements, and some US led international partnerships such as FutureGen (for

zero emissions coal-based energy), the Carbon Sequestration Leadership Forum, etc.)

- Technology Transfer (e.g. the Multilateral Fund created under the Montreal Protocol, and the GEF)

- Technology mandates and incentives (dealing with coordination of national policies to enhance an enabling environment for technology development and diffusion, such as standards, e.g. the EU Renewables Directive)

The authors show that each type may exhibit different advantages, depending on the criterion for evaluation. While R&D and knowledge-sharing partnerships have highly uncertain results regarding environmental effectiveness, cooperation to set international technology standards may have a high environmental impact (i.e. EST diffusion effects). By contrast, R&D and demonstration agreements have a high technological effectiveness (in advancing technologies or in achieving a high market penetration). Those on technology mandates or incentives may also play a key role in this regard. As regards economic efficiency (e.g. resulting in an efficient distribution of abatement burdens on those technologies with lower mitigation cost) or cost-effectiveness (achieving lowest cost technology development and diffusion means), it is important to add dynamic considerations. From this point of view, increasing the availability of low-cost technology options is key in order to achieve high emissions reductions over time, and R&D and demonstration agreements offer a valuable instrument. All in all, the authors highlight that partnerships for knowledge sharing and coordination are the least demanding and involve the lowest cost (possibly implying the weakest challenge). However, they help raise awareness of opportunities for technology cooperation as well as of barriers for advancing technology development and diffusion.

Overall, available evaluations suggest that partnerships (as well as UNFCCC efforts towards technology transfer) exhibit their main achievement in the information generation and diffusion area. In addition, partnerships also show some progress with regard to R&D and demonstration cooperation and coordination (pooling) of efforts. In the case of IEA implementing agreements, it has been noted that these initiatives have facilitated the standardisation of technologies and practices (eg. testing procedures).

By contrast, little success was identified in generating additional funding for R&D and demonstration (i.e. additional from that domestically available from national government and private sources). As regards participation, many partnerships have been chosen according to their relevance in specific sectors or technologies (eg. coal based energy, oil production, etc.) and include in some but not all cases, a few large developing countries. In the case of IEA implementing agreements, it should be noted that IEA members include industrialised as well as developing nations. However, information access of non members seems rather restricted. In any case, information diffusion effects could be mostly concentrated among partners, and the inclusion of developing countries in general could be seriously hindered in this approach.

Two multilateral initiatives that are usually highlighted because they are truly global and have made a difference in providing fresh funds for demonstration and effective adoption of EST worldwide are the Multilateral Fund created in the framework of Montreal Protocol and its London amendment, and the Global Environment Facility, initiated by the World Bank along with two UN development institutions (UNDP, UNEP).

The information included in de Coninck et al (2007) indicates that total funding provided by each of these initiatives has been in the order of US$ 2 billion over the period 1991-2004. However, the evaluation of these two initiatives differs from many perspectives.

Firstly, as regards the contribution to facilitating mitigation of the environmental problem at hand in developing countries, the Multilateral Fund of the Montreal Protocol has proved successful, while it is recognised that GEF funding has made only a small contribution to total funding needs for EST adoption in the climate change area.

Secondly, the two environmental problems are also different in many important respects (which makes reaching environmental effectiveness relatively simpler in the case of the Multilateral Fund of the Montreal Protocol). For example, while the range of technologies to limit ozone layer depletion were available and identified by the time the Multilateral Fund was created, that was far from being the case for climate change.

Furthermore, from the perspective of developing countries, the evaluation of the two mechanisms differs. In the case of the Multilateral Fund, funding was available to cover for incremental costs under clear rules under the Protocol (and due to little co-benefits of alternative technology adoption in the case of ozone depleting substances, in many cases implied funding the full costs of technology switch), that does not apply for GEF funding channelled to the adoption of climate technologies. Firstly, in many cases substantial co-benefits (in terms of reduced local pollution effects, for example) are available and thus incremental costs are only a small share of total implementation costs. Secondly, the rules for the allocation of GEF funding seem to favour large-scale projects rather than small scale projects which could be priority from a local perspective. All in all, developing countries usually complain that GEF criteria for the evaluation and for the allocation of funding are not responsive enough to local development priorities and thus are not completely in line with UNFCCC principles (e.g. with regard to the need to recognise sustainable development needs of parties to the Convention).

For this reason, the recent focus on “innovative finance” for technology transfer both under the UNFCCC framework and some partnerships (in particular, CTI) appears very interesting. The developing of a pilot project under CTI (PFAN) for private funding of technology transfer may also open the door for new sources of funding to cater for the large funding needs in developing countries.

To sum up the discussion so far, Table 1 below presents some basic information available from the evaluation of actions under the UNFCCC technology framework as

well as of public-private partnerships (de Coninck et al, 2007). The information is organised, for the sake of simplicity, around the five themes of the UNFCCC framework (even if these are not necessarily the focus of bilateral, regional or international partnerships). The discussion above as well as the information presented in the table suggest that progress has been mixed in both types of approaches, and somewhat complementary. All in all, the analysis above suggests that neither approach provides a solution to the future challenges for climate technology development and diffusion worldwide. However, combining these two types of efforts could bring substantial benefits for future action.

For its part, Table 2 presents some lessons from the evaluation of actions under both the UNFCCC framework and partnerships from the perspective of the desirable properties indicated in section IV.

This analysis suggests that the UNFCCC framework shows a high promise for both credibility and stability but its potential has not been exploited yet. This has probably to do with the difficulties found to reach consensus in international negotiations and also to the advisory (versus political and executive) role of EGTT.

On the other hand, the flexible contractual forms of partnerships exhibit relative advantages from the perspectives of adaptiveness and inclusiveness.

As regards effectiveness, it seems clear that the only way to achieve higher environmental, technological and cost effectiveness is to combine the two approaches, which appear highly complementary in nature. The UNFCCC framework could provide a solid basis to enlarge participation in partnerships, and at the same time improve their coordination features. The action-oriented nature of partnerships could help improve the UNFCCC framework performance with regard to effective technology transfer to developing countries (possibly through demonstration or pilot projects first, then enlarged to full scale).

Table 1. Progress under the five UNFCCC themes

Progress in dealing with key themes	From available evaluations of UNFCCC technology framework	From available evaluations of Technology Private-Public Partnerships
1. Technology needs and technology needs assessments	EGTT has led the elaboration of a bottom up methodology to conduct Technology Needs Assessments. These TNAs have been carried out in some 50 developing countries (other 40 expected in the future) with highly relevant (and novel) information provision results.	CTI collaboration with UNFCCC Secretariat and EGTT to provide TNA related technical assistance in developing countries
2. Technology information	TT: Clear has been developed as a platform for technology diffusion, in particular among developing countries. Available evaluations suggest TT Clear is used mostly by industrialised country organisations. Joint activities with some partnerships and specific seminars (i.e. on particular technologies or sectors) have led to substantial information diffusion	Contribution to creation of networks and platforms for effective information diffusion for each specific technology, mostly among partners (outsiders rarely have access) Important flow of information disseminated through seminars CTI collaboration with UNFCCC Secretariat and EGTT. Regional workshops and CTI side events at SB meetings to disseminate success stories (based on CTI technology transfer cases).
3. Enabling environments	Documents were elaborated and workshops organised to present information and discuss the issue of barriers to technology transfer. Some of these activities involved partnerships and the private sector/industrial organisations. A technical paper on enabling environments (explaining the range of policies related to technology "push" and "pull" and providing examples of policies in parties to the Convention) also helped pave the way for the debate. However, more specific documents on recommendations and "best practices" are not available yet.	CTI collaboration with UNFCCC Secretariat/EGTT. CTI side event at SB meetings to disseminate information
4. Capacity building	Initiatives to enhance capacities in developing country to apply to multilateral institutions funding for climate technology adoption (workshops and other activities carried out with CTI)	CTI collaboration with UNFCCC Secretariat/EGTT. CTI side events at SB meetings to disseminate information
5. Mechanisms for technology transfer.	Workshops and round table organised to disseminate aspects of the key role of finance instruments to facilitate technology transfer (joint with CTI).	Some partnerships include demonstration projects and/or participation of developing countries to this aim (Methane to Markets, CCS, biofuels bilateral and regional collaboration, GHG R&D, etc.) CTI collaboration with UNFCCC/EGTT. CTI side events at SB meetings to disseminate information. CTI's PFAN pilot project (private finance advisory network): 8 pilot projects in implementation (in developing countries).

Table 2. Lessons from the evaluation of progress under the UNFCCC framework and of public-private partnerships

Criteria	UNFCCC technology framework	Partnerships
Credibility/Stability Rules and incentives for participation	High promise but scarce results so far (framework is under review) Suggests little incentives for participation (insufficient funding from industrialised countries and lack of information and scepticism on the side of developing countries)	High participation rates Specific technology focus and rules for cost sharing or task sharing grants incentives for participation
Adaptiveness	Large degree of flexibility in technology objectives (subject to UNFCCC objectives)	Large degree of flexibility in contractual forms and arrangements
Inclusiveness	Formal participation limited to parties to the Convention (national governments and supranational bodies)	Flexibility to include government as well as private sector and research institutions' representatives
Effectiveness	Global design of targets may help coordinate efforts in different technologies (potential), and identify key technologies for concerted action So far, mainly aimed at information generation (TNAs) and diffusion (TT Clear), and to a lesser extent, policy recommendations.	They have led to the development of networks and platforms to advance diffusion of information among participants in each partnership (theme). So far, little evidence that they led to additional R&D and demonstration/diffusion resources above and beyond domestic budgets for R&D and demonstration. Helped cooperation and sharing among national efforts to avoid overlaps within each technology topic (partnership), but not across technologies. Scarce information transfer and co ordination amongst themes.
Administrative feasibility	Slow progress in technology framework implementation suggests institutional complexity and barriers to incorporating technology issues into UN framework Problems to reach consensus over financial mechanisms (obligations and rights) between developing and industrialised countries. UNFCCC mandate to GEF to be more responsive to developing countries' needs (Nairobi)	IEA framework for implementing agreements (energy technologies) has facilitated different forms of co-operation: through task or cost sharing. Multilateral Fund of Montreal Protocol reached high effectiveness with little administrative burden. The case of GEF seems less clearcut: many agencies are involved and a long project cycle/large scale of project suggest high transaction costs.

c. Stylised features of available options for further action under the UNFCCC technology framework

For the sake of simplicity, the two options currently under analysis in the UNFCCC framework (SBSTA, 2006e) are analysed as alternatives:

Option 1: Continuation of the work of the EGTT (in a strengthened version) in parallel to ongoing (and future) partnership initiatives. This option implies scarce change in the UNFCCC framework, with its role in effective climate technology development and transfer declining as compared to the momentum gained by parallel bilateral-multilateral initiatives, even if cooperation between EGTT and some partnerships continues.

It is believed that in this case, funding available and the political status of EGTT may remain the same, i.e. EGTT mandate and activities will prove insufficient for an enhanced implementation of the UNFCCC technology framework. However, progress may continue in specific issues related to information generation and dissemination (e.g. with the development of technology needs assessments (TNAs), and information diffusion and sharing in continued collaboration with partnerships such as CTI and other IEA implementing agreements, as well as multilateral organisations, such as GEF, the World Bank and UN agencies). It is important to note that EGTT has an important role to play in informing the Long Term Dialogue and Ad Hoc Group on technology developments (in association with partnerships) but no formal channel for this is expected in this option.

Option 2: Setting of a Technology Development and Transfer Board (TDTB) –with a number of assisting expert groups–. This body will be responsible for enhancing the implementation of the technology framework. In parallel, ongoing partnership initiatives will continue (and new ones may be added), including collaboration between the two kinds of efforts.

It is assumed that in this case some improved funding for technology-related activities in the framework of UNFCCC will be achieved. Partnerships will continue and possibly enlarge cooperation with TDTB (notably through CTI, GEF, and international organisations, such as the World Bank and IEA).

Table 3 below presents a preliminary analysis of the two proposals for enhanced action in the framework of UNFCCC.

A clear implication of the analysis is that no new institutions or arrangements are aimed at reaching better coordination and further collaboration between partnerships and the UNFCCC framework. Lacking such provisions it is difficult to expect important progress in collaboration and cooperation between the two approaches.

In this regard, and looking into the future, the information and analysis offered in Stern (2007, chapter 24) can be illuminating in two particular respects. To start with, if no

globally concerted efforts for technology development and deployment are reached, climate technologies for mitigation may focus too much on industrialised countries needs and neglect low-cost mitigation options needed in developing countries (e.g. based on energy sources with wide use in these countries, such as biomass). Furthermore, if no further cooperation between actions under the UNFCCC framework and private-public partnerships is reached, an interesting means for pooling risks of technology development (and thus to deal with the uncertainty involved in climate technology development and deployment) will be missed. In this direction goes one conclusion from the senior-level round-table discussion on international technology cooperation organised in the framework of the 25th session of SBSTA (following the mandate of Decision 6/CP.11). It stresses the need for a broad portfolio of technologies in order to tackle climate change and meet the world's growing energy demand. Some technologies such as those in the fields of energy efficiency and renewable energy are more relevant for addressing climate change in the short term, whereas others such as carbon capture and storage and fusion are expected to contribute in the long term (SBSTA, 2007).

Similarly, in the round-table, it was stressed that the public and private sector have differing (and complementary) roles at different stages of the technology development and diffusion process. During the first stage of basic technology development, the public sector may play an important role in providing adequate funding (since market failures may imply private underprovision of R&D efforts). At the demonstration stage, both sources of funding may be combined to provide for adequate funding, since some commercial potential may be detected but uncertainty may lead to underinvestment by private actors. Finally, at the diffusion stage (technologies are commercially available) the role of the private sector is key as compared to the public sector. If market returns are normal and no further barriers exist, the public sector role could be limited to providing the adequate signals for "technology push". In this last regard, it may be added that the stability of GHG permit markets and project mechanisms (CDM and JI) is also key, and crucially depends on achieving long term commitments under the UNFCCC.

Table 3. Available options for enhancing the implementation of theUNFCCC technology framework

	Option 1	Option 2
Core Institution Members	EGTT + Elected representatives for regions	TDTB Elected representatives for regions + observers (private sector, eg.)
Objectives	Enhance implementation of technology framework	Enhance and address urgency in implementing technology framework
Set of actions included (selected)	Improve TNASs, incorporate TNA information in National Communications Update and enlarge outreach regarding TT Clear. Encourage link to private sector and partnerships Capacity building: develop handbook for conducting TNAs Enabling environments: prepare technical studies on barriers, good practice and elaborate recommendations. Cooperation with partnerships. Mechanisms for technology transfer: Cooperate with international organisations and partnerships, such as CTI to provide technical support for project presentation for funding at multilateral organisations. Disseminate success stories in financing technology transfer projects. Elaborate recommendations.	Improve TNASs, incorporate TNA information in National Communications Update and enlarge outreach regarding TTClear. Encourage link to private sector and partnerships Capacity building: develop handbook for conducting TNAs Enabling environments: prepare technical studies on barriers, good practice and elaborate recommendations. Cooperation with partnerships. Mechanisms for technology transfer: Cooperate with international organisations and partnerships, such as CTI to provide technical support for project presentation for funding at multilateral organisations. Disseminate success stories in financing technology transfer projects. Elaborate recommendations. Analyse the need and present options for: a specific agreement on technology, developing incentives (rewards) for technology transfer, establishing MTAF (for buying intellectual property rights)
TOR for UNFCCC institution	EGTT Provide analysis and identify ways to enhance implementation of technology framework Work programme to be presented to SBSTA (technical forum)	TDTB Provide analysis and technical support for implementation of technology framework Work programme to be presented to COP (political forum)
Link to partnerships	Missing	Missing
Link with PK or continuation objectives	Missing	Missing

VI. Lessons

The preceding analysis, although simplifying in many ways the complex problem of climate technology development and deployment worldwide, may help highlight a number of key evaluation criteria and a few issues that deserve priority in any future efforts to reach a global governance mechanism or agreement to this aim.

In order to summarise some lessons that may be derived from the analysis, what follows attempts at identifying some key "building blocks" that appear as necessary to construct a global governance architecture on climate technology and that deserve further elaboration.

Implications for a global governance architecture on climate technology

Actors involved

The UN framework, with participation of 189 parties to the UNFCCC, seems the most appropriate as the central node for any global governance architecture for climate technology. This is the only way to effectively link technology assessment and efforts to solutions/commitments to the climate change challenge (ie. to direct technology efforts towards the challenges faced). Parallel initiatives, though important and effective in each particular field, may be aimed at objectives other than climate change (eg. energy security, competitive edge in future technologies, etc.) and due to their specific focus could not add up to the global challenge of advancing climate technology development and diffusion to achieve the UNFCCC goals.

An additional advantage of the UNFCCC multilateral framework is that it provides a forum as open and inclusive as possible, a desirable characteristic from many perspectives: in order to avoid unnecessary overlapping of efforts (cost-effectiveness and environmental effectiveness), and also in order to achieve environmental and technological effectiveness and stability of the global governance mechanism.

Focus

Another issue worth mentioning is that the focus of UN framework mandate on technology is aimed at technology transfer. In view of the global governance challenges in the field of climate technology, this approach is probably insufficient to define the objective and aim of a climate technology global governance architecture.

In particular, the characteristics of the climate technology challenge (uncertainty, spatial and intergenerational interdependencies and the unprecedented scale of damage risks) calls for a more active role for developing countries than being mere recipients of ready-to-use technology packages. In these regards, feedbacks from technology users and information on technology needs will play an important role for adequate technology development and diffusion. It could be argued that the scepticism of developing countries towards technology transfer so far is probably rooted in the risk of receiving (investing in) technologies not fully adapted to their actual needs and technical capacities to manage and apply technology. From this perspective, the focus of any

climate technology global governance effort should be directed at including developing countries in technology cooperation or collaboration initiatives rather than technology transfer efforts only.

Desirable Building blocks

Coordination between bilateral, regional or multilateral initiatives and the UNFCCC framework

In order to have UN institutions at the centre of this architecture, an appropriate link to parallel partnerships has to be guaranteed. This is missing in the proposals available so far. Only exchange of information and informal cooperation can be taken for granted from the available options.

The above-mentioned evaluation lessons also suggest the importance of channelling financial resources in the proper scale in order to advance technology development and diffusion, and to identify promising technologies from a market potential perspective. Taking these insights into account, explicitly including international organisations (international financial institutions and development agencies) and private sector representatives as active members of the governance system will prove crucial for a successful technology governance system.

Coordination between climate technology efforts and the UN climate regime (link to long term and medium term emissions goals)

The Ad Hoc Group and the Long Term Dialogue have both asked for more inputs on technology issues to inform the debate and international negotiations. Creating a formal link between technology-related efforts and and the negotiations under the Convention is necessary (and missing). This probably reflects the view that technology initiatives are an alternative rather than a complement to climate policy (quantitative limit to emissions/incentives). However, many technology development analyses highlight that in order to guarantee stability in R&D and diffusion efforts it is key to provide the right medium and long term incentives (such as a price per ton of GHG).

Creation of new finance incentives and access to financial resources to grant effective development and diffusion of technologies

Means for pooling public and private sector resources for R&D and demonstration and for technology diffusion should be envisaged. In this regard, the experience of partnerships may bring further lessons. As regards the availability of funds, it is important to note that only a very minor share of national climate technology budgets are directed at UN Framework initiatives. Most funds devoted to this aim in industrialised nations are directed at national or partnership efforts. Incentives should be modified in order to strike a balance between national and global efforts.

Obligations and rights (rules) have to be specified in a manner to guarantee incentives for participation of both developing and industrialised nations

The contribution of industrialised countries towards concerted efforts for climate technology development and deployment (especially in developing countries) could be organised and shared according to specific rules. These should be negotiated and set under clear, acceptable and transparent criteria for allocating rights and obligations.

Other key rules that need to be negotiated in the UNFCCC framework concern:

- Rewards to industrialised countries' and private sector participation in concerted climate technology R&D, demonstration and deployment efforts.

- The conditions/elegibility to access funding for climate technology deployment in developing countries. These rules should be specified in a way that reflects priority technologies, sectors, and regions from a global mitigation potential and development rights perspectives.

Final Remarks

It is believed that the building blocks identified above could provide a solid basis for advancing climate technology development and deployment worldwide.

Furthermore, since they include many aspects (and satisfy criteria) that receive priority both from a developing country and an industrialised country perspective, they may receive global support and help go beyond the current stalemate in international negotiations over the implementation of the technology framework. This could lead to improved incentives for participation, and in turn, to higher inclusiveness, stability, credibility, effectiveness and fairness of the system.

However, it is important to note that defining the specific architecture of a global governance mechanism on climate technology may pose an enormous challenge even if the basic building blocks are agreed by UNFCCC parties. This relates to the additional criterion of administrative feasibility.

Other than setting a specific negotiation process on climate technologies in the UNFCCC framework, it would be important to define at which level technology-related negotiations are to be included, and which UNFCCC body should deal with technology issues. Refining some political and practical aspects of the building blocks identified above and providing practical answers to these questions sets an interesting research and policy agenda for the future.

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