

# Cooperation towards innovation on climate change: an overview on technology development and transfer

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## 1. INTERNATIONAL TECHNOLOGY DEVELOPMENT AND TRANSFER: A CRITICAL TOOL FOR CLIMATE ACTION

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The urgency of addressing climate change and promoting sustainable development has never been more apparent. As the world grapples with the impacts of extreme weather events and strives to meet the ambitious goals of the Paris Agreement, innovative solutions and international cooperation are paramount. Central to these efforts is the concept of technology development and transfer (TDT). TDT is particularly critical because it addresses both climate action needs and development challenges simultaneously, making it an essential tool for achieving global climate goals while supporting economic development in emerging economies. It represents a practical approach to implementing the principle of common but differentiated responsibilities in global climate action.

However, the critical geopolitical landscape and various social and economic barriers often impede a smooth and timely flow of technology, making TDT a complex and challenging endeavour. Within the framework of the United Nations Framework Convention on Climate Change (UNFCCC), the outlines of technology transfer policy in the climate change negotiations emerged while this convention was being negotiated at the “First High-Level Political Meeting to Consider Global Action”, held in the Netherlands in 1989. Since then, the topic has been explored mainly by developing countries on several international fora and instances such as the Technology Executive Committee (TEC), Climate Technology Centre and Network (CTCN), G20 and G77 and China. Yet, it has evolved slowly due to a lack of support from developed countries.

International initiatives have emerged to advance TDT, with notable milestones such as the 2002 Dubai Declaration for the Promotion of Science and Technology in the South, which highlighted the prohibitive costs of acquiring knowledge and technology and called for tangible steps to facilitate the transfer of resources to enhance domestic capacity building in developing economies (DUBAI, 2002). Moreover, the United Nations Conference on Trade and Development (UNCTAD), CTCN and TEC have been working internationally to push this agenda ever since.

The concept of TDT remains in flux, adapting to changing global circumstances, technological advancements, and emerging challenges in the climate action landscape. This evolution reflects the dynamic nature of international cooperation and the need for flexible approaches to address global challenges effectively. According to the literature, TDT can be understood as a multifaceted process involving the technological, social, economic, and international relations dimensions. It entails the sharing of knowledge, skills, and technologies between countries to facilitate sustainable development (RASLAN, 2021; ZHANG, REN, 2023).

The World Intellectual Property Organization (WIPO) (2010) defines technology transfer (TT) as a series of processes of sharing ideas, knowledge, technology and skills with another individual or institution, leading to the acquisition of those ideas, knowledge, technology or skills by the other party. On the other hand,



the UNCTAD Code defines TT as “the transfer of systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service and does not extend to the transactions involving the mere sale or mere lease of goods.” (UNITED NATIONS, 1985).

After defining TT, a term widely used in literature, this note adopts the term TDT, which is used by UN agencies to incorporate the aspect of the international (co-)development of technology as a form of international technology transfer. Development of endogenous capacities is also crucial in this context, according to the TEC, as it involves the ability to (a) assess climate-related technology needs from the individual to the national level; (b) identify appropriate technologies to assist in meeting these needs; and (c) adapt technologies to local needs and conditions (UNFCCC, 2019).

To discuss TDT in the context of the climate crisis, it is essential to first define the concept of “environmentally sound technologies” (ESTs). According to the United Nations Environment Programme (UNEP), ESTs are technologies that offer the potential for significantly better environmental performance compared to other alternatives, contributing to the protection and preservation of the environment. However, ESTs are not merely individual technologies; they encompass entire systems that include technical knowledge, processes, goods, services, and equipment, as well as organizational and managerial strategies designed to promote environmental sustainability (UNEP, 2024).

The Technology Mechanism, established under the UNFCCC, plays a pivotal role in facilitating TDT. Comprised of the TEC and the CTCN, the Mechanism provides guidance, support, and capacity-building to developing countries. The recent COP28 in Dubai marked a significant milestone with the mandate to start negotiations on the establishment of the Technology Implementation Programme (TIP), under the 1st Global Stocktake, designed to address the technology needs of developing countries and enhance the effectiveness of the Technology Mechanism. (UNFCCC, 2023a)

Understanding the complexity of international technology development and transfer (TDT) is crucial for making it timely and effective in addressing climate change and facilitating sustainable development. In this sense, this note highlights the complexities of international TDT, with a particular focus on addressing the technology needs of developing countries in the context of climate change. Beyond identifying gaps and challenges, this study examines how existing and alternative mechanisms can be leveraged to establish a needs-based technology regime. It explores the linkages between the Technology Mechanism and innovative financing instruments to support the specific requirements of developing countries. Furthermore, it also investigates strategies to enhance the effectiveness of technology transfer mechanisms and foster stronger international cooperation in this domain. By examining these issues, it aims to contribute to a more comprehensive understanding of how to accelerate climate action through targeted technology transfer.

### Why TDT in the context climate change?

Climate change presents particularities that make it a unique challenge in terms of Technology Development and Transfer (TDT), requiring innovative and multisectoral approaches. The global and interdependent nature of climate emergency demands rapid dissemination of advanced mitigation and adaptation technologies, especially to developing countries, which, despite being the most vulnerable, have less financial and technological capacity to implement effective solutions. Furthermore, climate change has specific sources of funding and instances of political coordination internationally. For its unique politics and governance, climate change TDT must be addressed from a particular point of view.

## 2. HIGHLIGHTS ON TDT MODALITIES

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Given the evolving concept of TDT, it is important to begin our analysis by shedding some light to its modalities. The following table contain some highlights on TDT modalities, considering consultations and workshops with experts, studies of the

World Bank, “Global integration and technology transfer”, and the OECD, “International Technology Transfer measures in an interconnected world: Lessons and policy implications”:

**Table 1: Key TDT modalities:**

Types of Technology Development and Transfer	Modalities of Technology Development and Transfer	Description
<b>Direct Transfer</b>	International Mergers and Acquisitions	Companies from different countries combine or acquire each other, facilitating the exchange of technologies and business practices.
	Foreign Direct Investment (FDI)	Investments made by a company or individual in a given country in business interests in another country, often involving the establishment of operations or the acquisition of business assets.
	Joint Ventures	Collaborative agreements where two or more companies establish a new business entity, sharing resources, risks and technologies.
	Licensing Agreements	Legal contracts in which the owner of a technology (licensor) allows another party (licensee) to use, modify and sell the technology under specified conditions.
	Franchising Agreements	A form of licensing where the franchisee receives the right to operate a business using the franchisor's trademarks, products and business methods.
	Manufacturing Under License Contracts	Agreements in which a company allows a foreign company to manufacture its products under specific terms and conditions.
	Patent Transfers	The sale or transfer of patent rights from one entity to another, allowing the new owner to exploit the patented technology.
	Transfer of Technical Know-How	The transfer of practical knowledge and skills needed to operate specific technologies, often included in broader agreements.
<b>Indirect Transfer</b>	Importation of Capital Goods	The purchase of machinery, equipment and technology-intensive goods from other countries.
	International Trade of Technological Goods and Services	The export and import of technology-intensive products and services, promoting the diffusion of technology across borders.
	International Trade Fairs and Exhibitions	Events where companies exhibit their latest technologies and products to a global audience, promoting business partnerships and technology exchange.
	Technical Cooperation Between Firms	Collaborations where companies share technological expertise and resources to achieve common goals.
<b>Knowledge Transfer</b>	Training and Capacity-Building Programs	Educational and training initiatives designed to improve employees' skills and knowledge, enabling them to use new technologies effectively.
	Exchange of Technical and Scientific Personnel	Programs that facilitate the movement of experts and researchers between countries, promoting knowledge sharing and collaboration.
	Scientific and Technical Publications	The dissemination of research findings and technical knowledge through journals, books and online platforms.
	International Conferences and Workshops	Events where professionals and researchers from all over the world present and discuss their work, promoting the exchange of ideas and technologies.
	Research Networks and Alliances	Formal collaborations between academic institutions, research organizations and companies to advance scientific research and technological innovation.
	Education and Training in Foreign Institutions	Opportunities for students and professionals to study and train at educational institutions abroad, gaining exposure to new technologies and practices.
<b>Policy-Driven Transfer</b>	Government Policies to Incentivize Innovation	Government policies that promote innovation and the adoption of new technologies through financial and regulatory incentives.
	Subsidies and Funding for R&D	Subsidies and funding offered by governments to support research and technological development activities.
	Bilateral and Multilateral Agreements for Technological Cooperation	Formal agreements between countries to cooperate in the development and transfer of technology.
	Government-Sponsored Technology Transfer Programs	Government-sponsored programs that facilitate the transfer of technology between countries or within a country.
	Free Trade Zones and Technology Parks	Designated areas where companies can operate with tax and regulatory incentives to promote technological innovation and technology transfer.
	Intellectual Property Protection Policies	Policies that protect intellectual property rights, encouraging innovation and technology transfer.

Source: prepared by the authors based on OECD, 2017 and World Bank, 2006.



### 3. WHAT DO WE HAVE TO OVERCOME?

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Several obstacles have prevented the effective dissemination of EST, which has a direct impact on advances in climate change mitigation and adaptation. International technology transfer is affected by systemic barriers involving trade, national and international regulatory regimes, investments and intellectual property regimes, as well as geopolitics, which directly influences cooperation.

Innovation regimes and laws can limit access to cutting-edge technologies in developing countries, which is particularly challenging for those that depend on the import of ready-made technologies for technological development and, therefore, increased productivity and economic development (UNCTAD, 2022). In addition, the lack of certain endogenous capacities or the identification of the existing ones, especially absorption capacity, is a significant obstacle. Developing countries often lack the technological infrastructure and technical skills needed to create, adapt and disseminate innovations (UNFCCC, 2023b).

Financial constraints are another key challenge. The high cost of acquiring new technologies, combined with the challenge of accessing adequate funding, prevents local governments and industries from adopting sustainable technologies on a large scale (World Bank, 2023). At the same time, weak institutions and uncertain regulatory regimes make it difficult to attract investment in clean technologies, creating a scenario of insecurity (IEA, 2022). Moreover, the fragmentation of international research and development (R&D) efforts creates inequalities in access to knowledge and innovations, limiting opportunities for collaboration (OECD, 2022).

Developing countries also face additional challenges related to their economic and structural conditions. Financial limitations for developing and maintaining R&D, inadequate infrastructure and a lack of technical training are critical obstacles. With high costs and limited access to financial mechanisms, the implementation

of sustainable technologies is often unfeasible (World Bank, 2023). In addition, the lack of adequate physical and digital infrastructure reduces the capacity to apply new technologies (UNFCCC, 2023b), limiting the absorption capacity of developing countries, and the low technical qualifications of the workforce make it difficult to absorb and adapt these innovations (OECD, 2022).

At the same time, there are important opportunities to boost the development and transfer of technology (TDT). One of the greatest opportunities lies in strengthening international cooperation, especially through initiatives such as the Green Climate Fund, which provides financial support for technological modernization in developing countries, promoting the strengthening of internal capacities (Green Climate Fund, 2023). Another promising approach is the promotion of public-private partnerships, where the private sector can act as a catalyst, helping to integrate technology transfer with the creation of local skills and capacities (IEA, 2022). In addition, South-South represents a growing opportunity to diversify sources of technology and knowledge. Developing countries such as Brazil, India and China have accumulated valuable experience in clean technologies and can share solutions adapted to the socio-economic realities of other developing nations.

This type of cooperation can accelerate the transfer of suitable technologies and technical capacity building, reducing dependence on technologies from the global North. Technical cooperation initiatives, institutional capacity building, and the development of regional innovation networks are strategies that can facilitate this exchange and create a more inclusive environment for sustainable technological innovation (UNFCCC, 2023). In the next section, possible ways to overcome the barriers and exploit current opportunities will be pointed out, focusing on practical strategies that favor a more inclusive and effective transfer of technology in the context of climate change.

### 4. STRENGTHENING COORDINATION AND MONITORING MECHANISMS


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Effective coordination of International TDT is a pressing need to address global climate challenges, and this requires a technical and multi-faceted approach. Firstly, strengthening the CTCN is essential, as it acts as a critical facilitator for TDT. To maximize its impact, it is necessary to increase the financial resources allocated to the CTCN, expand its network of global partnerships and develop robust digital tools that improve connectivity between technology demanders and suppliers. The creation and identification of digital platforms aimed at the TDT can enable real-time analysis of the technological needs of developing countries, facilitating the identification of cooperation and funding opportunities.

Coordination with TEC should also be strengthened, improving the technical and political support needed to accelerate innovation and mobilize the essential resources for implementing

sustainable technologies in developing countries. An integration between TEC, CTCN and other international initiatives could enhance knowledge exchange, accelerate innovation and facilitate the mobilization of financial resources needed to support the technological transition in developing countries.

In addition, integrating TDT with existing financial mechanisms, such as the Green Climate Fund (GCF), Global Environment Facility (GEF), Adaptation Fund (AF), and other regional and national funding sources, is key to ensuring that adequate resources are available for implementing clean technologies. Creating specific funds focused on TDT can catalyze investment and foster innovative initiatives that meet local needs. The Poznan Strategic Technology Transfer Program, for example, offered an investment window that supported various initiatives, such as actions related to climate change, the creation of climate



technology centers and pilot projects that promote innovation. Its continuation through more structured initiatives presents itself as an opportunity to developing countries.

However, it is important to note that the resources available, such as the 50 million dollars allocated to the program over a ten-year period, are limited and may not be enough to meet all demands (GCF, 2021). In this context, Global Stocktake initiatives, such as the TIP, should be considered to strengthen collaboration between developed and developing countries, promoting an innovation agenda that prioritizes the development and transfer of clean technologies.

It is also important to highlight the importance of South-South and triangular cooperation. Models of collaboration between developing countries (South-South) and between developing countries and developed countries or international organizations (triangular) should be promoted to facilitate the exchange of experiences and successful practices in the adoption of sustainable technologies. By sharing knowledge and building cooperation networks, countries can accelerate the adoption of solutions adapted to their specific contexts, overcoming barriers that hinder implementation.

The participation of a wide range of actors is fundamental to the effectiveness of the TDT. Governments play an essential role in formulating policies and regulations that encourage the adoption of clean technologies and research and development (R&D). The private sector must be engaged not only as a supplier of technologies, but also as an investor in R&D, establishing partnerships with governments and research organizations to enable innovation. Civil society organizations have the role of overseeing processes and mobilizing communities, raising awareness about the importance of TDT and defending the interests of the most vulnerable groups, ensuring that their voices are part of decision-making processes.

Furthermore, multilateral institutions must continue to facilitate international cooperation by providing technical and financial assistance, connecting actors and promoting the strengthening of local capacities. To ensure equitable participation, it is necessary to empower developing countries by improving their institutional capacities and ensuring that they can actively participate in negotiations and project implementation. It is also essential to promote the inclusion of vulnerable groups, such

as women and indigenous communities, in decision-making processes and to guarantee transparency at all stages of the TDT.

A well-structured monitoring system is key to assessing the progress of the TDT and identifying areas in need of attention. This system should include clear indicators such as the number of clean technologies adopted, the reduction in greenhouse gas (GHG) emissions attributable to the transfer of technology, investments in infrastructure to implement the technologies and the number of trained professionals. Such indicators will allow an accurate assessment of the impact of TDT and the identification of challenges that may emerge.

The success of the TDT is intrinsically connected to the ability to strengthen the synergy between technological and financial mechanisms, as well as the effectiveness of public policies and collaboration between academia, private and public sectors. Strengthening the CTCN, implementing the TIP and promoting South-South and triangular cooperation, combined with an effective monitoring system, are crucial steps to ensure the international transfer and development of technologies that not only address climate challenges, but also promote sustainable development in an equitable and inclusive manner.

### Ways to effective coordination

TEC and CTCN are existing mechanisms to enhance climate technology development and transfer. At the same time, UNCTAD, initiatives of the G20 and the G77 and China are examples of spheres for facilitating TDT's agenda, although all those instances have limitations. TEC, CTCN and UNCTAD, for example, face challenges related to funding and institutional capacity. G20 initiatives, in turn, can be influenced by national interests and prioritize the agendas of developed countries. In this context, the G77 and China presents a space for developing countries to coordinate their priorities.

To overcome these limitations, it is necessary to strengthen coordination between the different actors and mechanisms, to promote the creation of digital platforms, as well as the identification, updating and maintenance of existing platforms, to facilitate the connection between technology demanders and suppliers, and to invest in training to strengthen the institutional capacities of developing countries.


## 5. DEVELOPING A NEEDS-BASED TECHNOLOGY REGIME

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Identifying and prioritizing the specific technological needs of developing countries involves a structured process aimed at ensuring the effective implementation of technological solutions adapted to local realities and sustainable development goals. This process can be divided into several stages (UNFCCC, 2023b). Firstly, a comprehensive technology needs assessment must be carried out. Many developing countries have already drawn up technology priorities reports, often based on methodologies

such as the Technology Needs Assessment (TNA). These reports allow countries to identify technology gaps that need to be filled to support climate change mitigation and sustainable development (UNEP, 2020). The TNA, for example, provides a basis for understanding which technologies are most relevant and impactful for local needs (UNFCCC, 2023c).

The process of technological development is currently



advancing at an accelerated rate, highlighting the need to adopt simultaneous and agile approaches that make it possible to objectively identify technological needs, in line with the availability of financial and human resources and with effective coordination between the industry, government and civil society sectors. This approach should guide the subsequent implementation phase, which involves organizing Technology Action Plans (TAPs). The organization of TAPs should be more dynamic, with short- and medium-term goals that can be adjusted according to the local context and technological changes, clear objectives, activities, necessary resources and success indicators, with continuous monitoring to ensure that projects can be implemented effectively and sustainably through the TIP (UNEP, 2020). The definition of measurable indicators is important, as it makes it possible to monitor progress and assess the effectiveness of the initiatives implemented. Thus, the TNA and TAP drafting process could be improved by introducing a more integrated, flexible and adaptive approach, capable of responding quickly to technological transformations and local challenges.

Conducting a data collection and analysis process in consultation with multiple stakeholders is crucial. This ensures that different perspectives and needs are considered (CTCN, 2021). In addition, the assessment of barriers to the adoption of identified technologies should be carried out. These barriers

can include financial limitations, lack of adequate infrastructure, deficiencies in technical training and cultural issues that can hinder the acceptance of new technologies (World Bank, 2023). Understanding these obstacles is key to developing strategies that address both the needs and the difficulties that countries will face in implementing these solutions (OECD, 2022). It is also necessary to establish an ongoing monitoring and evaluation system to ensure that technology projects meet their objectives and can be adjusted as necessary (UNFCCC, 2023c).

The use of processes such as Technology Needs Assessment (TNA) is key to facilitating this identification and ensuring that the technologies adopted are effective and sustainable. Ensuring a needs-based regime is intrinsically linked to valuing the endogenous capacities of each country, and the importance of identifying and improving absorption capacities related to infrastructure and investments (World Bank, 2023; UNFCCC, 2023b). Nevertheless, in order for this identification and strengthening of local capacities to be effective, it is crucial to guarantee adequate funding. This implies a clear connection between the Technology and Financial Mechanisms of the UNFCCC, ensuring that the projects developed are not only technically feasible, but also financially sustainable, with sufficient resources to support the implementation and ongoing strengthening of endogenous capacities.

## 6. LINKAGES BETWEEN FINANCE AND TECHNOLOGY TRANSFER

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### How to Encourage Private Sector Support?

Encouraging the private sector to actively participate in technology transfer to developing countries requires an integrated approach that combines effective public policies, financial incentives and collaboration mechanisms. Firstly, formulating public policies that emphasize the importance of technology transfer can create an environment conducive to private investment. This can include the creation of regulatory frameworks that favor innovation and collaboration between companies and research institutions (OECD, 2021).

Financial incentives, such as subsidies and tax credits, can be offered to companies that commit to developing and transferring relevant technologies to developing countries. In addition, the implementation of corporate social responsibility (CSR) programs that focus on technology transfer can encourage companies to get involved in projects that benefit these nations (UNIDO, 2019). Promoting partnerships between the private sector, governments and non-governmental organizations is also an important strategy. These partnerships can facilitate the sharing of knowledge, resources and best practices, as well as providing access to markets and networks that can support the

implementation of technologies. Creating platforms that connect technology companies with stakeholders in developing countries can be an effective approach to facilitating this collaboration (World Bank, 2020).

### Funding Strategies for Technology Transfer

In order to guarantee technology transfer, it is important to restructure and diversify the financing mechanisms available. One option is to develop targeted investment funds that can channel resources to specific projects that meet the technological needs of developing countries. These funds can be created in collaboration with international financial institutions, governments and the private sector, ensuring a combination of public and private resources (UNEP, 2021).

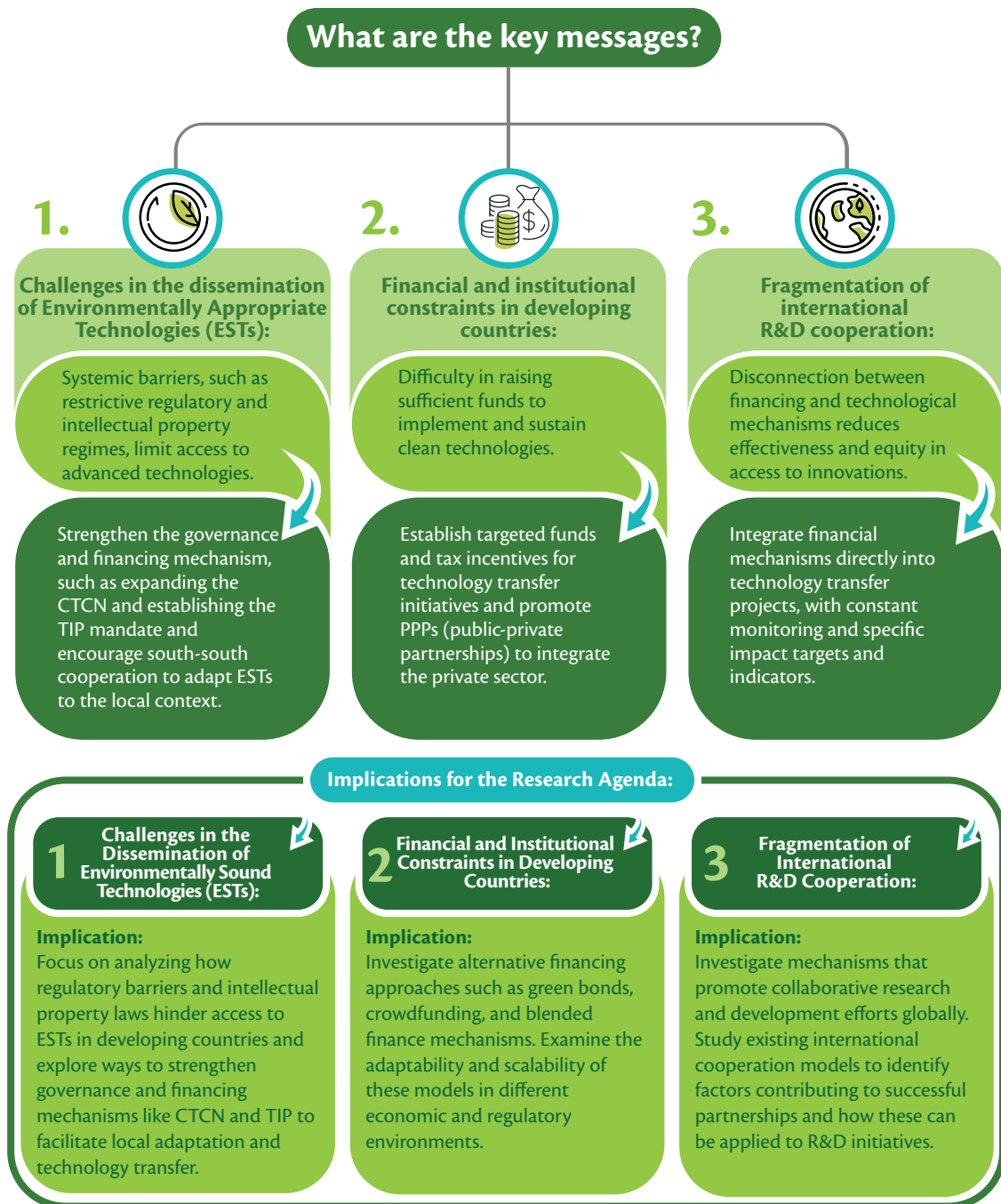
Public-private partnerships (PPPs) are also a promising approach. Through PPPs, the private sector can be encouraged to invest in technology transfer projects, sharing risks and benefits with governments. This approach not only leverages financial resources, but also brings technical expertise and innovation to the process (OECD, 2018).

Moreover, tax incentives can be an effective tool for stimulating private investment. Granting tax deductions or exemptions to companies that make investments in sustainability-oriented technologies can be an attractive strategy for attracting private capital (IEA, 2020). Innovative financing mechanisms such as green bonds and social impact bonds can be explored. These financial instruments allow investors to finance projects with a positive environmental or social impact, making it possible to raise funds for

technology transfer initiatives (World Bank, 2022).

Promoting a favorable environment for the private sector and restructuring financing mechanisms are important to support international technology transfer. Appropriate public policies, financial incentives, strategic partnerships and the use of innovative financial instruments can facilitate the mobilization of resources and ensure that the technological needs of developing countries are met effectively and sustainably.

## 7. WHAT ARE THE KEY MESSAGES?





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