Fact sheet: A technology revolution to address climate change

No less than a technological revolution, both in the development of new technologies and in enhancing access to existing technologies by developing countries, is necessary to enabling action to reduce greenhouse gas emissions and adapt to the adverse effects of climate change. Technology cooperation can create win-win outcomes that help both developed and developing countries reduce the cost of tackling climate change, while also stimulating opportunities for sustainable development.

To help meet this challenge Parties to the Convention are working toward the establishment of a new Technology Mechanism under the UNFCCC.

The new Technology Mechanism would consist of:

- A Technology Executive Committee that will set the overall policy direction at the international level for accelerating technology development and transfer.

- A Climate Technology Centre and Network of national, regional, sectoral and international technology centres, networks, organizations, initiatives relevant to both mitigation and adaptation across all sectors of the economy. It will provide practical assistance to help governments prepare and implement the technological transitions that are required to address climate change. The Climate Technology Centre and Network would provide in-country technical assistance and training. It would also develop customized tools and policies, facilitate the establishment of public private partnerships to accelerate the innovation and diffusion of environmentally sound technologies, and stimulate cooperative research and development.

Technology cooperation currently under the UNFCCC

Under the Convention all Parties are to promote and cooperate in the development, deployment and diffusion, as well as transfer of technologies, practices and processes that control, reduce or prevent certain anthropogenic emissions of GHGs in all relevant sectors.

Under the UNFCCC, industrialized countries are urged to take all practicable steps to promote, facilitate and finance the transfer of, or access to, ESTs and know-how to developing countries to enable them to implement the provisions of the Convention. The UNFCCC's Expert Group on Technology Transfer (EGTT) is tasked to identify ways to advance technology transfer activities under the Convention.

The Kyoto Protocol's clean development mechanism (CDM) also provides a number of opportunities for technology diffusion by offering a legal framework and a marketplace for Parties that are required to reduce greenhouse gas emissions. The carbon market has an important role to play in bridging the technology and investment challenge, while addressing climate change concerns.

Challenges for technology development and transfer

One of the most significant challenges is access to financing for technology initiatives and cooperation.

Parties agreed at the thirteenth session of the Conference of the Parties to undertake an assessment of gaps and barriers to the provision and access to financing for technology development and transfer. This assessment was undertaken by the Expert Group on Technology Transfer (EGTT) under the Convention (UNFCCC, 2009a).

As of 2009, estimates of the financing resources available in all countries for technology research, development, deployment, diffusion and transfer for mitigation technologies were between USD 77.3 and 164 billion per year. Only partial estimates are available for current financial resources available within developing countries, as shown in Table 1. Reliable data for technologies for adaptation are not currently available.

Table 1. Estimates of current financing for development and diffusion of climate mitigation technologies, by stage of technological maturity and source
(billions of United States dollars per year)

	R&D (total spending)	Demonstration (total spending)	Deployment (additional cost of climate technologies)		Diffusion (additional cost of climate technologies)		Total
	Global	Global	Global	Developing countries	Global	Developing countries	Global
Public	6 10	Included with R&D	33 45 30	NA	19.5–27.0	8.0–15.5	55.5–82.0
Private	9.8–60	Included with R&D	NA	NA	12–22	3.3	21.8–82.0
Total	15.8–70		30–45	NA	31.5–49	11.3–18.8	77.3–164.0

Abbreviations: NA = not available, R&D = research and development.
Source: UNFCCC, 2009a

The flows of finance to technology development and transfer are classified according to whether they are from public or private sources and whether they target research, development and demonstration of new technologies, the deployment of emerging technologies, or the widespread diffusion of existing technologies.

The gap between current levels of finance and financing required to stabilise greenhouse gas concentrations in the atmosphere at around 500 parts per million carbon dioxide equivalents is illustrated in figure 1, below.

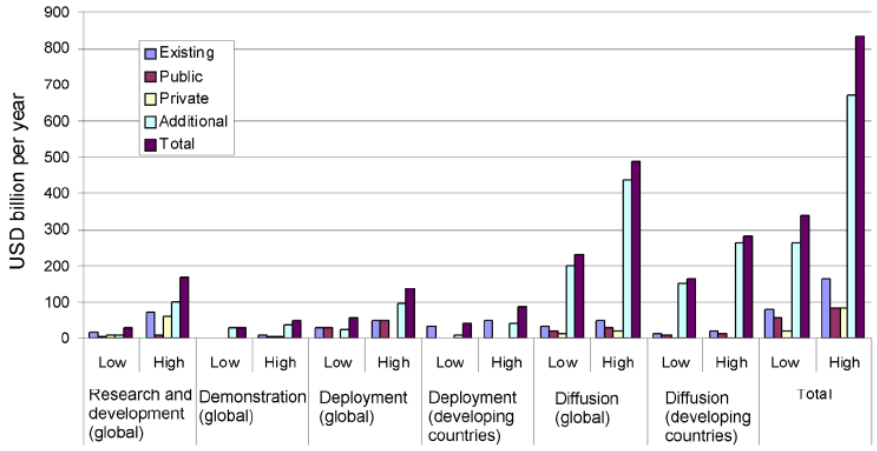
The financing gap is specified for technologies as they progress through the innovation cycle from research and development, to demonstration, deployment, and finally widespread diffusion within the global economy.

The estimates are for a mixture of both public and private sources and the range of estimates reflect different assumptions and scenarios.

Estimates indicate that financing for mitigation technologies in all countries needs to increase above current levels by USD 262–670 billion annually until 2030. Of this increase, 40–60 per cent, or an additional USD 105–402 billion per year, is projected to be needed in developing countries. This reflects the scale of the emissions reduction potential that is estimated to be available in developing countries.

Engaging the private sector, as the key owner and implementer of technologies, is a crucial component of any response to enhance technology development and transfer.

Figure 1. Estimates of annual financing needs for mitigation technologies up to 2030, by source and stage of technological maturity



Note: in this figure 'existing' refers to estimates of current levels of finance. Additional is the amount estimated to be needed beyond current levels.

Many developing countries have undertaken detailed assessments of their technology needs. A synthesis of technology needs in 69 developing countries was prepared in 2009 (UNFCCC, 2009b). Eighteen of the 69 technology needs assessments prepared by developing countries go beyond the identification of technology needs and include specific project proposals. Within these technology needs assessments there is a total of 264 project proposals with a total estimated budget of at least USD 11.2 billion.

The most commonly identified technology needs for mitigation were renewable energy technologies, technologies for improved crop management, energy-efficient appliances, waste management technologies, forestry-related technologies and more clean and efficient vehicles. The most commonly identified technology needs for adaptation were related to crop management, efficient water use, improving irrigation systems, technologies for afforestation and reforestation, and technologies to protect against and accommodate rises in sea level.

The main barriers to technology transfer identified by developing countries were economic and market barriers, particularly lack of access to finance. The measures identified by Parties to address these barriers were measures to increase foreign investment, increasing participation of the private sector in technology transfer, introducing supporting policies and laws, improving collaborative research and development of technologies, and increased public awareness. Most countries indicated that existing in-country capacity was insufficient to adequately address national technology needs, indicating that there remains a large demand for capacity-building support within developing countries.

A major push on research and development (R&D) in new technologies, such as further research on carbon capture and storage, hydrogen and fuel cells, biofuels, power storage systems and micro-generation, clean energy technologies, early warning systems for extreme weather events and biotechnology will also be required – which will in turn require a range of government support packages.

Technology cooperation between developed and developing countries, and increasingly between developing countries, will be needed on an unprecedented scale. Many developing countries experiencing rapid growth, are making huge investments worth billions of dollars in capital stock, such as infrastructure and power generation, that will be used for thirty years or more. Such investments need to contribute to sustainable development. A well functioning carbon market is likely to be a prominent feature in any future mitigation framework.

Examples of technologies for mitigation and adaptation

Technologies for **mitigation** of greenhouse gas emissions

Examples of technologies for mitigating carbon dioxide (CO_2) emissions may include:

- Energy efficiency;
- Renewable energy technologies, including solar panels, wind turbines, biomass and hydro-power generation, as well as technologies for geothermal energy and ocean energy;
- Carbon capture and storage, which involves capturing carbon dioxide before it can be emitted into the atmosphere, transporting it to a secure location, and isolating it from the atmosphere, for example by storing it in a geological formation;
- Hybrid vehicles, for example those that switch between electric and combustion engines;
- Nuclear power.

Examples of technologies for mitigating methane (CH_4) emissions may include:

- Animal waste management: Methane released from liquid manure management systems can be captured and used to meet a portion of a farm's energy requirements or simply flared;
- Livestock management: Improved nutrition and grazing management has been identified as effective in increasing efficiency and reducing methane emissions;
- Landfill methane capture and use: The principal approach to reducing methane emissions from landfills involves the collection and combustion or use of landfill gas. Landfill gas utilization technologies focus on electricity generation and direct gas use;
- Natural gas and oil systems: Current opportunities for reducing methane emissions include both process and hardware improvements, such as equipment upgrades.

Examples of technologies for mitigating nitrous oxide (N_2O) emissions may include:

- Matching nitrogen supply with crop demand, tightening nitrogen flow cycles, and optimising tillage, irrigation and drainage could reduce nitrous oxide emissions from fertiliser use by 19%;
- Fertiliser: Nitrogenous fertilizers play an important role in increasing crop yields. Reducing N2O emissions can include the use of low N2O-emitting fertilizer or the use of slow-release fertilizers and nitrification inhibitors.

Examples of technologies for mitigating hydrofluorocarbons (HFCs) emissions may include:

- Improved design, tighter components, and recovery and recycling during servicing and disposal of refrigeration, air conditioning, and heat pumps can reduce lifetime HFC emissions at moderate to low costs.

Technologies for **adaptation** to adverse impacts of climate change

Examples of technologies for coastal areas:

- Accommodate sea-level rise (improved drainage, emergency planning);
- Protect against sea-level rise (hard, soft and indigenous technologies);
- Managed retreat.

Examples of technologies in the agricultural and fishing industries:

- Tolerant/resistant crop varieties (to drought/heat, salt, insects/pests);
- Efficient water utilization and improved irrigation systems;
- Heat-tolerant livestock breeds.

Examples of technologies for water resources:

- Water recycling and conservation (including rainwater harvesting);
- Water desalination.

Examples of technologies for health improvement:

- Disease monitoring and surveillance;
- Upgrading of drinking water and sanitation.

Examples of technologies for systematic observation and monitoring:

- Improved data collection;
- Improved data management and data processing systems.

UNFCCC (2009a). Recommendations on future financing options for enhancing the development, deployment, diffusion and transfer of technologies under the Convention. Report by the Chair of the Expert Group on Technology Transfer, Document FCCC/SB/2009/2 and its summary, UNFCCC: Bonn, Germany.

UNFCCC (2009b). Second synthesis report on technology needs identified by Parties not included in Annex I to the Convention. Note by the secretariat, Document FCCC/SBSTA/2009/INF.1, UNFCCC: Bonn, Germany.