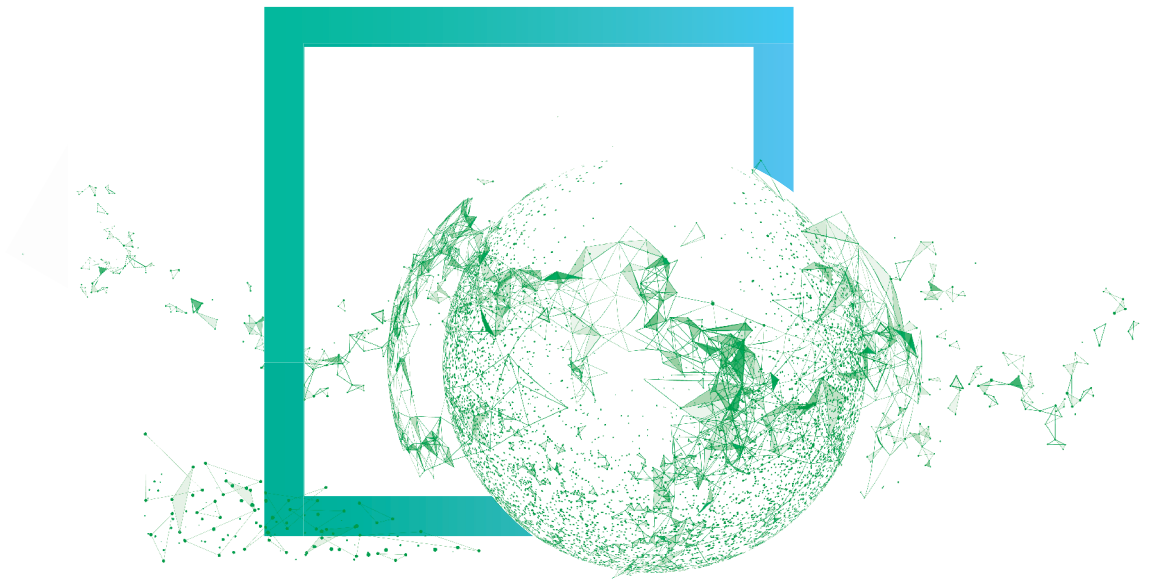


# White Paper 2019

ON GREEN CLIMATE TECHNOLOGY



# Contents

## White Paper 2019 ON GREEN CLIMATE TECHNOLOGY



WHITE PAPER 2019 ON GREEN CLIMATE TECHNOLOGY

### Part I: United Nations Framework Convention on Climate Change (UNFCCC) for Climate Change Response

---

Chapter 1: United Nations Framework Convention on Climate Change (UNFCCC)	04
Chapter 2: Major Discussions about Technology and Finance	06
2-1. Technology Mechanism	07
2-2. Financial Mechanism	08

### Part II: Domestic and Overseas Climate Technologies for Climate Change Response

---

Chapter 1: Climate Technology Classification System	12
Chapter 2: Current Status of Domestic and Overseas Climate Technologies	14
2-1. Renewable Energy	14
2-2. New Energy	15
2-3. Non-renewable Energy	15
2-4. Energy Storage	16
2-5. Power Transmission/Distribution and Power IT	16
2-6. Energy Demand	17
2-7. Greenhouse Gas Fixation	17
2-8. Agriculture/Livestock	17
2-9. Water	18
2-10. Climate Change Prediction and Monitoring	18
2-11. Ocean/Fishery/Coast	19
2-12. Health	19
2-13. Forest/Land	20
2-14. Multidisciplinary Overlap	20
Chapter 3: Fourth Industrial Revolution and Climate Technology	21

### Part III: International Finance for Climate Change Response

---

Chapter 1: Current Status of International Finance for the Climate Change Response	22
1-1. Overview of Financing the Climate Change Responses	22
1-2. Current Status of Multilateral Climate Fund Operations	25
Chapter 2: Association Analysis of Multilateral Climate Funds and Climate Technologies	36
2-1. General Status of Multilateral Climate Funds	37
2-2. Association Analysis of Climate Technologies and Climate Funds	43
2-3. Investment Status Analysis by Technology Type	45

## Preface



In the “Global Risks Report 2018,” the World Economy Forum has selected 20 global risks factors that will soon seriously threaten humanity and the world. Eight of these risk factors are directly related to the environment. This is evidence that the warning signals have rapidly increased worldwide over the last several years. Global risk factors related to the environment include extreme weather events, natural disasters, failure of climate change mitigation and adaptation, and man-made environmental disasters. Even in the case of South Korea and based on concerns regarding successive large natural disasters, the worst heat wave in decades, first CO<sub>2</sub> emission increase in four years, and weakening of the environment protection agreement due to the “national interest first” principle, it is known that occurrences of environmental risk factors are not a matter of the distant future. Hence, we can no longer postpone a proactive

participation in continuous climate change responses.

In the Green Technology Center (GTC), established in March 2013 as a research institution specializing in green technology policies, a variety of projects have been carried out including the support of the government’s green technology research and development policy planning/establishment, creation of international cooperation systems and transfer/spreading of technologies in the green technology area, analysis of the green technology level/trend and managing statistics, and research on future green technology forecasts. Furthermore, the GTC has declared that its mission is “to support green/climate technology policymaking and domestic/international collaboration for climate technology to accelerate the advancement of the national climate industry and contribute to global climate change responses.” Consequently, the GTC has diligently performed its two primary roles of “conducting research on national green/climate technology policies for the implementation of a sustainable society” and “conducting research on strategies to lead the global cooperation in climate technology.”

Starting with a systematic summary of information about the top 10 and 45 green/climate technologies, the GTC has added an overview of the United Nations Framework Convention on Climate Change (UNFCCC) and a finance section for global cooperation to this white paper series this year, thereby providing information about two axes; that is, technology and finance, within the UNFCCC. The focus has been placed on providing a document that can easily be used by members of the industry and academia who seek useful information about climate technology and relevant finances and by citizens who are interested in these fields.

We expect that this white paper will increase people’s understanding of the global issue called climate change and, at the same time, will contribute to the wide use of climate technology and financial resources. Furthermore, we hope that it will contribute to domestic climate technology-related

R&D and policymaking. Through continuous contributions, as demonstrated by the publication of an English version of this whitepaper, we will strive to provide green/climate technology whitepapers including comprehensive information about domestic and international climate technology in the future to improve the future of Earth. We hope for great interest and ask for your support. Thank you.

January 2019

The President of the Green Technology Center

오민환

## Part I

# United Nations Framework Convention on Climate Change (UNFCCC) for Climate Change Response

Part I examines major agreements, such as the Kyoto Protocol and Paris Agreement, as well as the United Nations Framework Convention on Climate Change (UNFCCC), which currently 197 nations participate in. Furthermore, the technology and the financial mechanisms, which support the climate technology and financial resources in developing countries, respectively, will be discussed.

### Chapter 1: United Nations Framework Convention on Climate Change

The UN climate system follows a basic agreement/protocol. At the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, in 1992, the UNFCCC was signed. South Korea joined the UNFCCC in 1994 as the 47th country; as of November 2018, 197 countries are participating in the agreement. In 1997, five years after the establishment of the agreement, the Kyoto Protocol was adopted. The Paris Agreement was established in 2015. The major history of the UN climate system is shown in Table 1.

**Table 1: Principal milestones of the UN climate system**

1988	The first resolution for climate change was adopted at the UN General Assembly and climate change was declared to be an issue of common interest
1990	The UN General Assembly established the Intergovernmental Negotiating Committee (INC) to begin negotiations for the Framework Convention on Climate Change (FCCC) including appropriate responsibilities
1992	The FCCC was adopted at the UN Conference on Environment and Development (UNCED)
1994	The FCCC entered into force
1995	The Berlin Mandate was adopted and mandated negotiations of a protocol that assigns quantitative emission limitation goals to advanced countries but does not assign new obligations to developing countries
1997	The Kyoto Protocol was adopted
2001	The Marrakesh Accord was adopted to operate the Kyoto Protocol
2004	The Kyoto Protocol entered into force
2007	The Bali Action Plan was adopted and a comprehensive procedure for long-term cooperative activities with respect to climate change was established

2009	The heads of states adopted the Copenhagen Accord, but the Conference of Parties (COP) failed to agree on its adoption as a new agreement or protocol
2011	The Durban Platform was adopted and the negotiations dealing with the period after 2020 were started
2012	The Doha Amendment was ratified to extend the Kyoto Protocol to 2020, but it could not be entered into force
2013	Based on the Warsaw COP decision, a request was made to submit the Intended Nationally Determined Contribution (INDC) prior to the COP in 2015
2014	The Lima Call for Climate Action was adopted whereby "elements for a draft negotiating text" was agreed upon and guidelines for the INDC were prepared
2015	The Paris Agreement was adopted
2018	Rulebook negotiations regarding specific execution of the Paris Agreement were started

The world's top five greenhouse gas-emitting countries do not participate in the second commitment period (2013–2020) of the Kyoto Protocol. Furthermore, important specific issues, such as the financial and technological support of developing countries by advanced countries, have not yet been resolved. Consequently, the international climate change response system is criticized to be nothing more than an empty shell. However, in December 2015, major countries, such as the USA and China, the big players on the international diplomatic stage, formed a cooperative relationship in Paris and adopted the Paris Agreement by settling the climate change agreement at the 21st Conference of Parties (COP). Although the US President Donald Trump has declared the withdrawal from the Paris Agreement, this international endeavor will continue to respond to climate change. As we have realized through the heat waves that occurred in the summer of 2018, we should recognize the fact that if we do not respond more actively to climate change, global warming may become an irreparable catastrophe based on which the human race will finally become extinct.

Greenhouse gas mitigation is not just a matter of keeping international promises. It is a path we must take to ensure national interest in the long term, while not falling behind the worldwide transition to low-carbon economies and energy. Thus far, South Korea has tried to maintain the status of developing country in WTO negotiations or under the Kyoto system, while emphasizing the status of advanced country as a member of the OECD and G20.

However, the Paris Agreement, a new climate system agreed upon at the Paris COP, is a new climate change response system in which advanced and developing countries participate together in greenhouse gas mitigation. Therefore, it is meaningless to argue about whether South Korea is an advanced or developing country. It is very important for South Korea to keep up with the climate change response trend of the international society and to faithfully perform roles that commensurate with its status in the international society while continuously increasing its external credibility. Both the government and people should more actively participate in saving "Mother Earth" and realizing climate justice.

## Chapter 2: Major Discussions about Technology and Finance

The goals of climate change response based on the Paris Agreement are mitigation and adaptation. Financial resources, technology development and transfer, and capacity building are measures that were selected to achieve these goals. Transparency is commonly applied to goals and measures. The Paris Agreement consists of six factors, which are connected.

The Paris Agreement specifies a variety of support mechanisms in Articles 9 to 12 as measures of complying with the agreement. Although many mechanisms were created, the details of each mechanism and establishment of the relationship between mechanisms are still being discussed. However, it is clear that financial resources and technology play central roles in various support mechanisms in the new climate change system. Accordingly, the financial and technology mechanisms will be examined below.

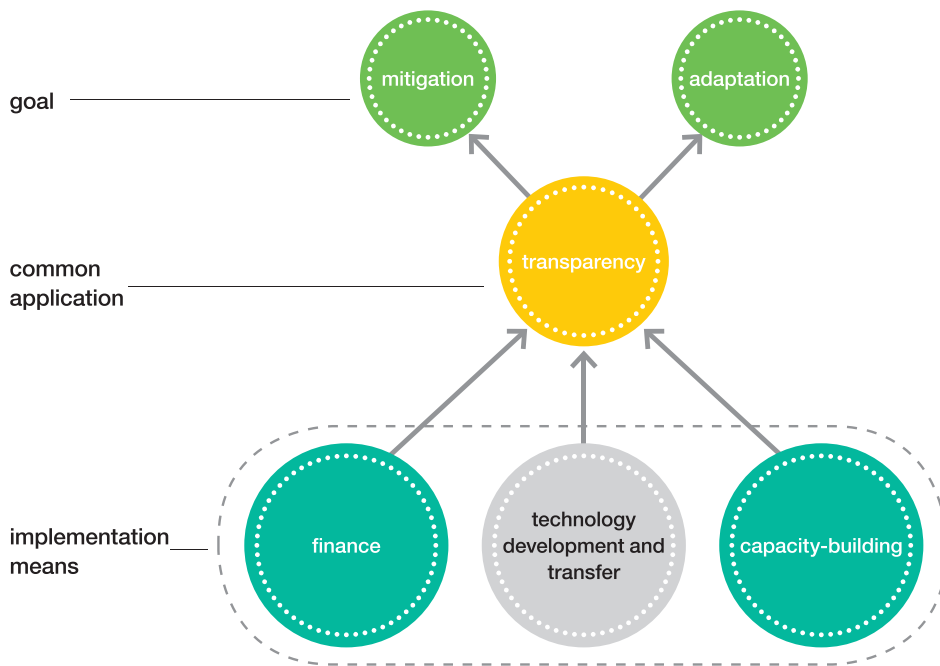


Fig. 1: Components of the new climate system

Source: UNFCCC. (2013). Implementation of all the elements of decision 1/CP.17. <http://unfccc.int/resource/docs/2013/adp2/eng/104a01.pdf>, 2016. para 2(a)

## 2-1. Technology Mechanism

The technology mechanism was established in 2010 to support the smoother development and transfer of climate technology between the countries involved in the UNFCCC.

The technology mechanism consists of mainly two organizations, that is, the Technology Executive Committee (TEC), which performs the role of policy organization, and the Climate Technology Centre and Network (CTCN), which performs the role of execution organization. The TEC and CTCN are complimentary; they hold equal positions. The chairperson and vice chairperson of the TEC serve as advisory board members of the CTCN. The TEC and CTCN compose and publish a joint annual report, which is made available to the COP.

The CTCN consists of the Climate Technology Center (CTC), which is the secretariat, and Climate Technology Network (CTN), which is a cooperation between governmental organizations, the private sector, and the NGO. The board of the CTCN performs the role of advisory board for the operation of the CTC and CTN. Moreover, the CTCN is operated by a consortium led by the UN Environment Program (UNEP). The CTCN is a communication channel with respect to technology development and transfer between the countries involved in the UNFCCC and between the National Designated Entities (NDE) of each country. It performs the role of responding to and supporting technology-related NDE requests. The TEC and CTCN hold two meetings (March/April and September/October) every year. Because the chairperson and vice chairperson of TEC are advisory board members of the CTCN, the TEC meeting is usually held first and the CTCN board meeting is held in the following week. Although the functions of TEC and CTCN are different, there is a tendency

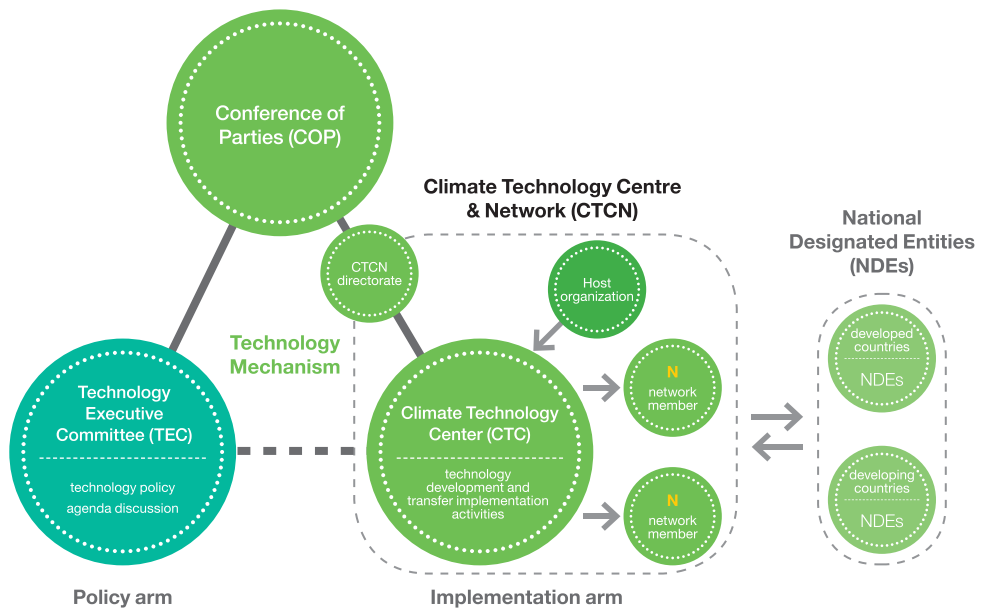


Fig. 2: Components of the technology mechanism

Source: <http://unfccc.int/tclear/support/technology-mechanism.html>

that the same agenda items are discussed in TEC and CTCN board meetings because they have a complementary relationship with respect to the technology mechanism. Nevertheless, the discussed issues can be divided in categories of “policy” and “execution.”

## 2-2. Financial Mechanism

The provision of financial support for mitigation and adaptation actions of developing countries is one of most essential issues discussed in climate negotiation agendas under the UNFCCC. The advanced countries acknowledged the importance of finance for climate change responses in developing countries and established the financial mechanism when the UNFCCC was founded in 1992. Furthermore, mechanisms to provide developing countries with financial resources were established in the Kyoto Protocol and Paris Agreement. The COP determines and is responsible for the funding policy, program priority, and eligibility criteria for the operation of the financial mechanism and provides guidelines for the operating organization. Based on the commitments specified in Article 4, the agreement emphasizes the financial support of developing countries by advanced countries with respect to climate change.

Article 4 of the UNFCCC describes the commitments with respect to financial support for developing countries and the financial mechanism and Article 11 specifies the definition of the

**Table 2: Rules regarding the financial mechanism according to the UNFCCC**

major Articles	detail clause	main content
Article 4. Commitments	4.3	· scale of financial support – providing new and financial resources, considering sufficient and predictable demand
	4.4	· supporting adaptation costs to the states vulnerable to climate change
	4.5	· eco-friendly technology and experience, strengthening capacity of developing countries, financial support for technology transfer
Article 11. Financial Mechanism	11.1	· scope of support (grant or concessional basis, technology transfer) · operational criteria of the operating entities · possibility of entrusting its operation to existing international organizations
	11.2	· emphasis on operational transparency
	11.3	· the relation between operating entities and COP
	11.5	· range of channels for providing financial resources (bilateral, regional and other multilateral)
Article 21.3 Entrustment Clause of Financial Mechanism	21.3	· specifying entities entrusted with the operation of the financial mechanism of GEF

Source: UNFCCC



financial mechanism and the relationship between the operating entity and COP. In addition, paragraph 3 of Article 21 specifies the Global Environmental Facility (GEF) as the operating entity, which is entrusted with the operation of the financial mechanism.

**Table 3: The financial mechanism discussed in Article 11 of the UNFCCC**

<b>ARTICLE 11 FINANCIAL MECHANISM</b>
<p>1. A mechanism for the provision of financial resources on a grant or concessional basis, including for the transfer of technology, is hereby defined. It shall function under the guidance of and be accountable to the Conference of the Parties, which shall decide on its policies, programme priorities and eligibility criteria related to this Convention. Its operation shall be entrusted to one or more existing international entities.</p>
<p>2. The financial mechanism shall have an equitable and balanced representation of all Parties within a transparent system of governance.</p>
<p>3. The Conference of the Parties and the entity or entities entrusted with the operation of the financial mechanism shall agree upon arrangements to give effect to the above paragraphs, which shall include the following:</p> <ul style="list-style-type: none"><li>(a). Modalities to ensure that the funded projects to address climate change are in conformity with the policies, programme priorities and eligibility criteria established by the Conference of the Parties;</li><li>(b). Modalities by which a particular funding decision may be reconsidered in light of these policies, programme priorities and eligibility criteria;</li><li>(c). Provision by the entity or entities of regular reports to the Conference of the Parties on its funding operations, which is consistent with the requirement for accountability set out in paragraph 1 above; and</li><li>(d). Determination in a predictable and identifiable manner of the amount of funding necessary and available for the implementation of this Convention and the conditions under which that amount shall be periodically reviewed.</li></ul>
<p>4. The Conference of the Parties shall make arrangements to implement the above- mentioned provisions at its first session, reviewing and taking into account the interim arrangements referred to in Article 21, paragraph 3, and shall decide whether these interim arrangements shall be maintained. Within four years thereafter, the Conference of the Parties shall review the financial mechanism and take appropriate measures.</p>
<p>5. The developed country Parties may also provide and developing country Parties avail themselves of, financial resources related to the implementation of the Convention through bilateral, regional and other multilateral channels.</p>

**Table 4: The complete text of regulations with respect to the financial mechanism in the Paris Agreement**

<b>FINANCE in the Decision</b>
<p>53. Decides that, in the implementation of the Agreement, financial resources provided to developing countries should enhance the implementation of their policies, strategies, regulations and action plans and their climate change actions with respect to both mitigation and adaptation to contribute to the achievement of the purpose of the Agreement as defined in Article 2;</p>
<p>54. Also decides that, in accordance with Article 9, paragraph 3, of the Agreement, developed countries intend to continue their existing collective mobilization goal through 2025 in the context of meaningful mitigation actions and transparency on implementation; prior to 2025 the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall set a new collective quantified goal from a floor of USD 100 billion per year, taking into account the needs and priorities of developing countries;</p>

55. Recognizes the importance of adequate and predictable financial resources, including for results-based payments, as appropriate, for the implementation of policy approaches and positive incentives for reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks; as well as alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests; while reaffirming the importance of non-carbon benefits associated with such approaches; encouraging the coordination of support from, inter alia, public and private, bilateral and multilateral sources, such as the Green Climate Fund, and alternative sources in accordance with relevant decisions by the Conference of the Parties;
56. Decides to initiate, at its twenty-second session, a process to identify the information to be provided by Parties, in accordance with Article 9, paragraph 5, of the Agreement with the view to providing a recommendation for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;
57. Also decides to ensure that the provision of information in accordance with Article 9, paragraph 7 of the Agreement shall be undertaken in accordance with modalities, procedures and guidelines referred to in paragraph 96 below;
58. Requests Subsidiary Body for Scientific and Technological Advice to develop modalities for the accounting of financial resources provided and mobilized through public interventions in accordance with Article 9, paragraph 7, of the Agreement for consideration by the Conference of the Parties at its twenty-fourth session (November 2018), with the view to making a recommendation for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;
59. Decides that the Green Climate Fund and the Global Environment Facility, the entities entrusted with the operation of the Financial Mechanism of the Convention, as well as the Least Developed Countries Fund and the Special Climate Change Fund, administered by the Global Environment Facility, shall serve the Agreement;
60. Recognizes that the Adaptation Fund may serve the Agreement, subject to relevant decisions by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;
61. Invites the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol to consider the issue referred to in paragraph 60 above and make a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;
62. Recommends that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall provide guidance to the entities entrusted with the operation of the Financial Mechanism of the Convention on the policies, programme priorities and eligibility criteria related to the Agreement for transmission by the Conference of the Parties;
63. Decides that the guidance to the entities entrusted with the operations of the Financial Mechanism of the Convention in relevant decisions of the Conference of the Parties, including those agreed before adoption of the Agreement, shall apply *mutatis mutandis*;
64. Also decides that the Standing Committee on Finance shall serve the Agreement in line with its functions and responsibilities established under the Conference of the Parties;
65. Urges the institutions serving the Agreement to enhance the coordination and delivery of resources to support country-driven strategies through simplified and efficient application and approval procedures, and through continued readiness support to developing country Parties, including the least developed countries and small island developing States, as appropriate;
115. Resolves to enhance the provision of urgent and adequate finance, technology and capacity-building support by developed country Parties in order to enhance the level of ambition of pre-2020 action by Parties, and in this regard strongly urges developed country Parties to scale up their level of financial support, with a concrete roadmap to achieve the goal of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels and to further provide appropriate technology and capacity-building support;

**Table 5: The complete text of regulations related to the financial mechanism in the Paris Agreement**

**Article 9 in Annex**

1. Developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention.
2. Other Parties are encouraged to provide or continue to provide such support voluntarily.
3. As part of a global effort, developed country Parties should continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies, and taking into account the needs and priorities of developing country Parties. Such mobilization of climate finance should represent a progression beyond previous efforts.
4. The provision of scaled-up financial resources should aim to achieve a balance between adaptation and mitigation, taking into account country-driven strategies, and the priorities and needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints, such as the least developed countries and small island developing States, considering the need for public and grant-based resources for adaptation.
5. Developed country Parties shall biennially communicate indicative quantitative and qualitative information related to paragraphs 1 and 3 of this Article, as applicable, including, as available, projected levels of public financial resources to be provided to developing country Parties. Other Parties providing resources are encouraged to communicate biennially such information on a voluntary basis.
6. The global stocktake referred to in Article 14 shall take into account the relevant information provided by developed country Parties and/or Agreement bodies on efforts related to climate finance.
7. Developed country Parties shall provide transparent and consistent information on support for developing country Parties provided and mobilized through public interventions biennially in accordance with the modalities, procedures and guidelines to be adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, at its first session, as stipulated in Article 13, paragraph 13. Other Parties are encouraged to do so.
8. The Financial Mechanism of the Convention, including its operating entities, shall serve as the financial mechanism of this Agreement.
9. The institutions serving this Agreement, including the operating entities of the Financial Mechanism of the Convention, shall aim to ensure efficient access to financial resources through simplified approval procedures and enhanced readiness support for developing country Parties, in particular for the least developed countries and small island developing States, in the context of their national climate strategies and plans.

## Part II

# Domestic and Overseas Climate Technologies for Climate Change Response

Based on a variety of domestic and overseas green climate technology classification cases and literature, a climate technology classification system has been prepared, which includes 14 medium categories in greenhouse gas mitigation and adaptation areas. Accordingly, the domestic and overseas climate technologies have been organized into renewable energy, new energy, non-renewable energy, energy storage, power transmission/distribution and power IT, energy demand, greenhouse gas fixation, agriculture/livestock, water, climate change forecast and monitoring, ocean/marine/coast, health, forest/land, and multidisciplinary overlapping areas.

### Chapter 1: Climate Technology Classification System

The fourth report (2007) of the Working Group 3 of the Intergovernmental Panel on Climate Change

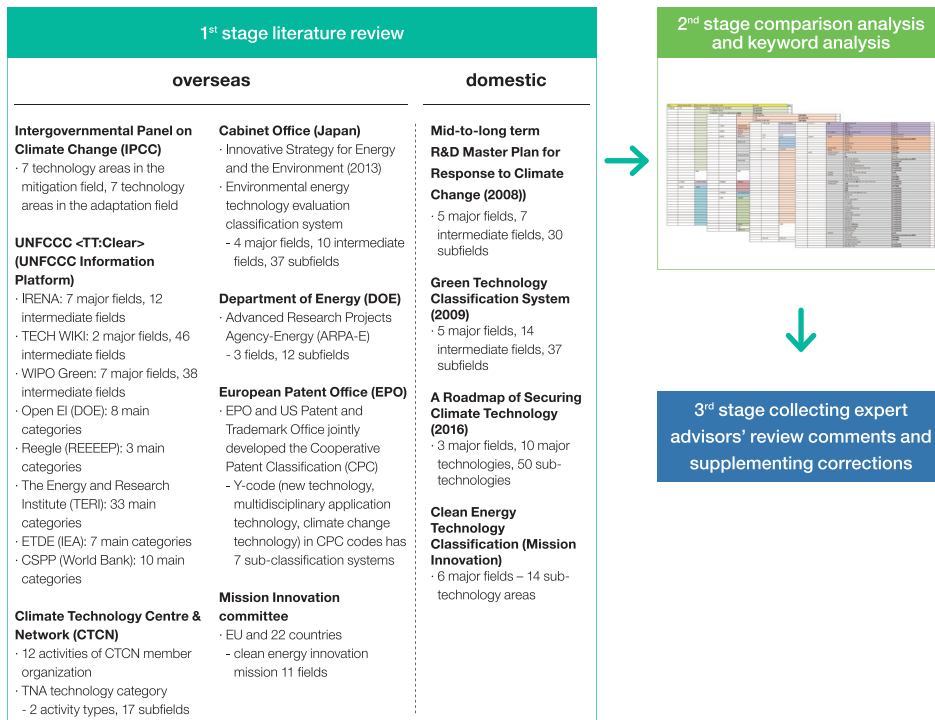


Fig. 3: Establishment stages of the climate technology classification system

(IPCC) provides a policy for greenhouse gas mitigation and adaptation measures with respect to climate change. In addition, mitigation and adaptation are defined in the glossary of the IPCC (2012). Mitigation is defined as coordination activity of humans in reducing the use of resources or increasing greenhouse gas sinks. On the other hand, adaptation is defined as the process of controlling the actual or expected effects of climate change in the human and nature systems to control the risks of climate change or take advantage of benefits.

The climate technology classification system was established through the “Study on the Preparation of a Climate Technology Classification System” (Yeom et al., 2017) conducted from 2016 to early 2017. As shown in Fig. 3, the final climate technology classification system was constructed in three stages.

The green climate technology classification system consists of 3 main, 14 middle, and 45 small categories. With respect to the classification of technology in terms of climate change response, the common international standard is used to classify the greenhouse gas mitigation and adaptation areas. To build a comprehensive climate technology development domain, the present classification system includes three main categories: greenhouse gas mitigation, adaptation, and mitigation and adaptation convergence. The first main category, the greenhouse gas mitigation domain, includes 7 middle categories and 22 small categories; the second main category, the adaptation domain, includes 6 middle categories and 18 small categories; and the third main category, the mitigation and adaptation convergence domain, includes 1 middle category and 5 small categories.

**Table 6: Technology area and scope of climate technology classification system**

Category	Intermediate category	Subcategory
Greenhouse gas reduction	(1) Renewable energy	1. Hydropower
		2. Photovoltaic
		3. Solar heat
		4. Geothermal heat
		5. Wind power
		6. Ocean energy
		7. Bioenergy
	(2) New energy	8. Waste
		9. Hydrogen production
		10. Fuel cell
		11. Clean thermal power generation and efficiency
		12. Nuclear fusion power generation
	(3) Non-renewable energy	13. Nuclear power generation
		14. Power storage
		15. Hydrogen storage
	(4) Energy storage	16. Transmission and distribution system
	(5) Transmission / distribution, and electric power IT	17. Electric intelligent devices

Category	Intermediate category	Subcategory
Greenhouse gas reduction	(6) Energy demand (use)	18. Transportation efficiency
		19. Industry efficiency
		20. Building efficiency
	(7) Greenhouse gas fixation	21. CCUS
		22. Non-CO <sub>2</sub> reduction
		23. Genetic resources and gene improvement
		24. Crop cultivation and production
25. Livestock disease management		
Climate change adaptation	(8) Agriculture / livestock	26. Processing, storage, and distribution
		27. Water system and aquatic ecosystem management
		28. Securing and supplying water resources
	(9) Water	29. Water treatment
		30. Water disaster management
		31. Climate prediction and modeling
	(10) Climate change prediction and monitoring	32. Climate information alarm system
		33. Marine ecosystem
	(11) Ocean / fishery / coast	34. Fishery resources
		35. Coastal disaster management
(12) Health	36. Infectious disease management	
	37. Food safety and preventative healthcare	
(13) Forest / land	38. Promotion of forest production	
	39. Reduction of forest damage	
	40. Ecology, monitoring, and restoration	
Combined reduction/adaptation	(14) Multidisciplinary overlap	41. New and renewable energy hybrid
		42. Low-power consumption equipment
		43. Energy harvesting
		44. Artificial photosynthesis

## Chapter 2: Current Status of Domestic and Overseas Climate Technologies

### 2-1. Renewable Energy

#### Definition

- Energy that converts and uses renewable energy including sunlight, water, geothermal, precipitation, and biological organisms

#### Trends

- Recognized as the most likely way to prevent climate change by reducing greenhouse gas emission  
- It is expected that the supply of renewable energy will increase due to global efforts to reduce greenhouse gases, expansion of distribution networks, and continued price decline

### Technology Competitiveness

- Securing world-class technology related to photovoltaic, solar heat, bioenergy, waste, and geothermal energy
- In the case of ocean energy, wind power, and hydropower, Korea builds upon the foundations of heavy industries, such as shipbuilding, ocean, and manufacturing

## **2-2. New Energy**

### Definition

- Composed of hydrogen energy and fuel cell technology

### Trends

- Expansion of hydrogen station, utilization of hydrogen as a large-capacity energy storage medium, attempts to apply hydrogen energy to power generation and industrial fields
- Fuel cell power generation market with high efficiency and low carbon dioxide (CO<sub>2</sub>) emission will grow significantly with the expansion of eco-friendly energy demand and dispersed power system

### Technology Competitiveness

- World-class fuel cell system technology for power generation and transportation
- Having an industry with exclusive status, having world's largest production facilities

## **2-3. Non-renewable Energy**

### Definition

- Composed of clean thermal power generation and efficiency improvement, nuclear fusion power generation, and nuclear power generation

### Trends

- Secured 40-60% of basic technology in terms of clean thermal power generation and efficiency improvement compared to that in advanced countries
- Nuclear fusion energy is commercialized through the International Thermonuclear Experimental Reactor (ITER), a very large international collaborative R&D project involving Korea, USA, Russia, EU, Japan, China, and India
- The use of large nuclear power plants will be continued by countries that demand economic growth

### Technology Competitiveness

- Securing plant-based process optimization operation technology and plant engineering technology with domestic heavy industry manufacturing technology and abundant experience
- Securing world-class devices and technologies for nuclear fusion power generation
- In the case of next-generation large-scale nuclear technology development, technology development independence is high, and industrial supply system is well established

## **2-4. Energy Storage**

### Definition

- A device capable of converting a large amount of electric energy produced through renewable energy into different kinds of energy (electrochemical energy, chemical energy, mechanical energy, and potential energy), storing, and converting it into electrical energy again when necessary

### Trends

- A power storage method, which is currently being studied actively, is electrochemical energy storage, which has high efficiency and high energy storage density

- In the case of hydrogen storage, continuous development of technologies for mainly hydrogen electric vehicles (hydrogen fuel cell vehicles) is underway in the United States. In Japan and the EU, the development of renewable energy storage technology for stationary application in addition to transportation is being conducted.

### Technology Competitiveness

- Energy storage technology based on lithium ion secondary batteries stands out

- Ongoing research and development of hydrogen storage technology

## **2-5. Power Transmission/Distribution and Power IT**

### Definition

- To consist of the transmission and distribution system, which is a comprehensive electric power supply system including transmission line, substation, and distribution facilities of power generated in a power plant, and electric intelligent devices, which are a technology to reduce power loss and maximize energy savings

### Trends

- The super grid, which entails international power linkage using long transmission lines and submarine cables, is globally leading the future of the transmission and distribution system in electrometers

- The market for electric intelligent devices is growing continuously

### Technology Competitiveness

- Transmission and distribution system is catching up with advanced technology through experience gained in developing a localized 765 kV AC supply

- Electric intelligent devices are being pioneered through the development of a system for supplying and distributing the smart grid



## 2-6. Energy Demand

### Definition

- Efficiency technology that uses energy in transport, industry, and construction

### Trends

- Eco-friendly cars, carbon emission reducing railways, and aviation system are spreading
- Energy consumption of buildings is decreasing, and high efficiency and zero energy technology is spreading

### Technology Competitiveness

- Establishment and high-level application of transportation system technology such as land, railway, and aviation
- Strengthening the competitiveness of communications equipment and household control equipment

## 2-7. Greenhouse Gas Fixation

### Definition

- Composed of carbon capture and storage (CCUS) technology and non-CO<sub>2</sub> reduction technology

### Trends

- CCUS technology has developed considerably, and a large-scale demonstration project is currently underway
- The non-CO<sub>2</sub> greenhouse gas reduction technologies that have been applied domestically and internationally include post-treatment systems that use various techniques, such as combustion, catalyst, plasma, membrane separation, adsorption and absorption, technology of applying substance with low green warning potential (GWP), and generation suppression technology. Demand for specific technologies is gradually changing due to suppression technology in post-treatment applications.

### Technology Competitiveness

- Securing technology equivalent to some advanced technologies by developing core technology and demonstrating pilot plant size
- Korea shows about 85% technology level compared with the best technology and a 2.9 year gap, but its level of application and industrialization is high.

## 2-8. Agriculture/Livestock

### Definition

- Technology that produces stable agricultural and livestock products according to future climate change, including cultivation and production technology, security of genetic resources, genetic improvement technology, livestock disease prediction and control technology, energysaving processing, storage, and distribution technology

### Trends

- Active development of environmentally adaptive varieties while securing new alternative crops and animal resources according to in accordance with climate change
- Attempts to actively utilize molecular breeding technology, gene transfer technology, and genome editing technology based on genome studies of major flora and fauna around the world

### Technology Competitiveness

- Excellent production and self-sufficiency of major crops and livestock in accordance with domestic consumers' preference
- Biotechnology(BT), such as genome research that is an important basis for the development of climate-responsive breeds, has global competitiveness

## **2-9. Water**

### Definition

- Consisting of water system, water ecosystem, water resource acquisition and management, water treatment, and water disaster management

### Trends

- Increased interest in advancement of water resource management technology based on existing structures and efficient water resource management technology
- Attention to water treatment technology focused on ecosystem recovery by applying safe countermeasure technology against hazardous substances and small-scale and dispersed technology paradigms

### Technology Competitiveness

- Endeavor to evaluate the health of sustainable aquatic ecosystems and develop techniques, possessing world-class biotechnologies
- Securing technology at the level of advanced countries through multidisciplinary R&D projects to improve accuracy of water disaster prediction

## **2-10. Climate Change and Prediction Monitoring**

### Definition

- Climate monitoring uses various observation data and alarm technology based on the monitoring

### Trends

- Improvement of the performance of the Earth system model and the regional climate model by comparison of models of different institutions and the development of technology for realistic Earth system simulations
- Development and application of scenario technology considering human adaptation and response to

climate change

#### Technology Competitiveness

- Securing skills of creating a scenario for the East Asia community and economic path (SSP) scenario
- Active research through organic relations between national institutions and universities

### **2-11. Ocean/Fishery/Coast**

#### Definition

- Consisting of marine ecosystem, fishery resources, and coastal disaster management

#### Trends

- Coastal disasters have become a major issue related to national safety, as the consequences of coastal damage, such as greater coastal erosion, storm surges, inundation, and flooding have increased due to the rapid increase in sea-level around the Korean Peninsula. Swell waves, abnormal waves, and typhoons have intensified because of climate change
- In particular, people and the economy are concentrated due to an increase in the number of marine tourist attractions and coastal residential areas, so there is a high possibility of largescale damage in case of disaster

#### Technology Competitiveness

- Securing artificial fishing reef development technology and seaweed restoration technology through direct supplementary planting
- Various spawning grounds and nursery ground conditions

### **2-12. Health**

#### Definition

To develop pre-emptive early response technology to cope effectively with future problems associated with infectious disease in future society

#### Trends

- The Ministry of Science and ICT supports the development of source technologies to respond to infectious diseases, and it is actively investing in long-term research on new and variant overseas infectious diseases and animal infectious diseases

#### Technology Competitiveness

- It is easy to apply related technology thanks to the high-level of technology development in biotechnology and info-communication
- Establishment of national preventive and response system

## **2-13. Forest/Land**

### Definition

- Technology of monitoring impacts of climate change on biodiversity (the component of forests and terrestrial ecosystems) and on the various functions of biodiversity, and forest damage detection and prevention technology

### Trends

- Enhanced monitoring of ecosystem change and damage  
- Improvement of prevention and mitigation technology for landslides, soil leakage, and pests, due to forest fire and heavy rain

### Technology Competitiveness

- Accumulation of forest management expertise and wood production technology  
- Forest fire, landslide, and pest prediction and control technology at the level of advanced countries  
- Efforts to restore damaged ecosystems, such as Baekdudaegan and obtain connectivity

## **2-14. Multidisciplinary Overlap**

### Definition

- To include energy reduction and adaptation convergence technology, technology of low power consumption equipment in automobiles, homes, and buildings, hybrid system technology, energy harvesting technology that converts the surrounding energy into electrical energy, and technology, including artificial photosynthesis, which produces fuel consisting of carbon, hydrogen, and oxygen using carbon dioxide

### Trends

- R&D on new and renewable energy hybrids, energy harvesting, and artificial photosynthesis is ongoing in advanced universities and research institutes  
- Low-power consumption equipment technology is being widely applied in electronic equipment including mobile phones, data centers, homes, buildings and so on.

### Technology Competitiveness

- Securing technology competitiveness for some elements such as solar and fuel cells  
- World's best semiconductor process technology for low-power processor (SoC)

### Chapter 3: Fourth Industrial Revolution and Climate Technology

The 4th industrial revolution has become a global trend since its first mention as worldwide topic during the Davos Forum (World Economic Forum, WEF, 2016). There are various definitions of the 4th industrial revolution. However, according to Klaus Schwab, the 4th industrial revolution refers to a broad range of new technological innovations, whereby the physics, digital, and biology areas interact with each other based on the combination of all technologies such as genetics, nano, renewable energy, and computing technologies.

The driving force of the 4th industrial revolution is intelligent information technology. Therefore, South Korea established the “Mid-to-Long-Term Comprehensive Plan for Intelligent Information Society in Response to the 4th Industrial Revolution” in December 2016 based on efforts of relevant governmental organizations. Generally, intelligent information technology is technology that implements high-dimensional information processing of humans through information and communication technology (ICT) and refers to the combination of “intelligence,” including artificial intelligence and “information,” which is based on data/network technology (i.e., ICBM : IoT, Cloud, Big data, Mobile).

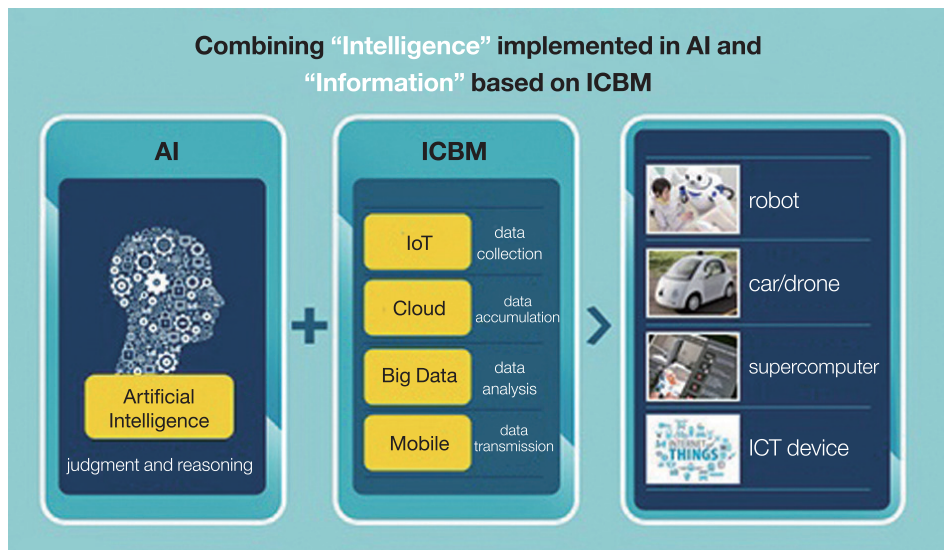


Fig. 4: Conceptual diagram of artificial information technology

Source: Ministry of Science, ICT and Future Planning

# Part III

## International Finance for Climate Change Response

Climate finance is an international financial resource for climate change response and includes the financial mechanism of UNFCCC and non-UNFCCC multilateral climate funds, which will be examined in detail. Moreover, association analysis of multilateral climate funds and climate technology was performed from various viewpoints.

### Chapter 1: Current Status of International Finance for Climate Change Response

#### 1-1. Overview of Financing of Climate Change Responses

Climate finance refers to local, national, or transnational financing (from public, private, and alternative financing sources) to support climate change mitigation and adaptation actions of developing countries (UNFCCC).

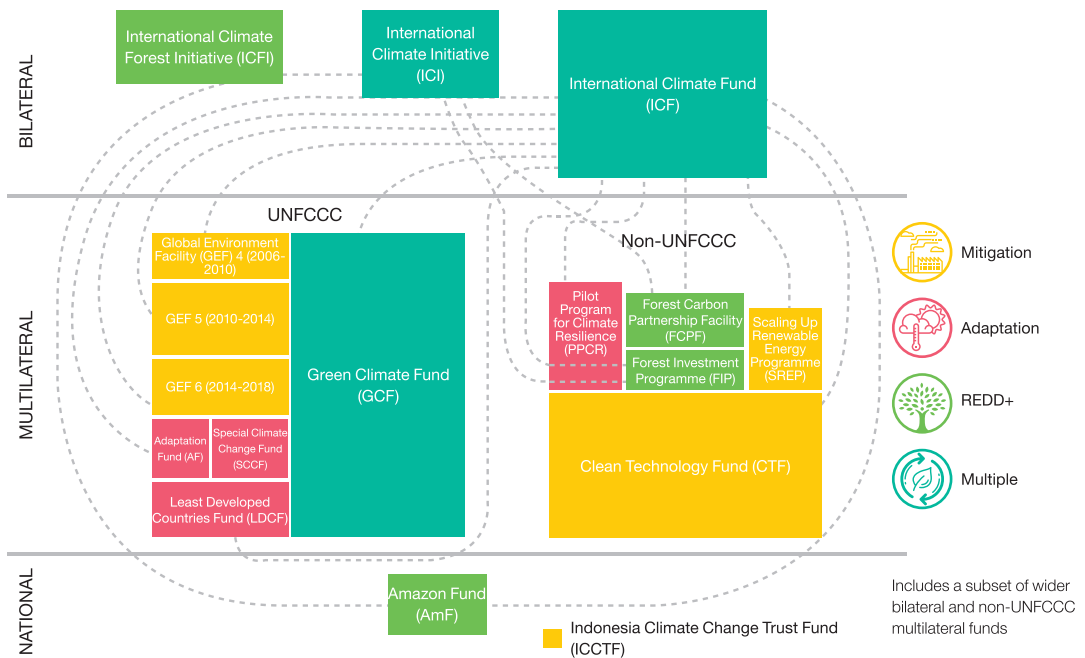


Fig. 5: Structure of the global climate fund  
Source : Climate Funds Update (2014), Lee, H. K. (2017)

The types of climate finance can be classified into public and private finance. Public finance flows through bilateral channels (between nations, DFIs between two parties, and national climate funds) and multilateral channels (multilateral development banks, MDBs, and multilateral climate funds) and the transfer can be investigated by continuous monitoring, estimation, and analysis of nations or corresponding organizations.

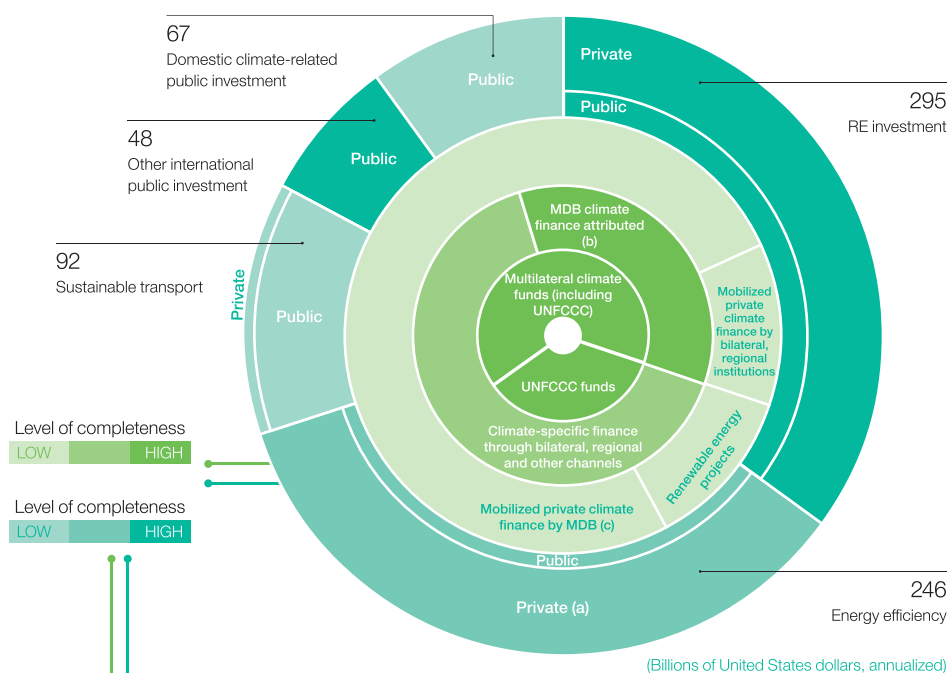
**Table 7: Investment entities by climate finance source**

Finance Type	Finance Source	Investor
Public	Public Finance	Public aid of the government and affiliated organizations and climate fund support project
	Public Financial Intermediary	Development Finance Institutions (DFIs)
		Climate funds
Private	Private Finance	Corporate actors Project developer Households
	Private Financial Intermediary	Commercial financial institutions
		Institutional investors
Private equity Venture capital Infrastructure funds		

Source : OECD (2015)

The current status of global climate finance should be investigated by considering the reports [biennial assessment and overview of climate finance flows (BA)] published by the UNFCCC Standing Committee on Finance (SCF), by evaluating the flows of climate finance every two years starting in 2014, and using reports published by the Climate Policy Initiative (CPI).

The global climate finance can be mainly divided into: ① international public climate finance, ② private/public investment in new and renewable energy, ③ private investment in energy efficiency, ④ private investment in sustainable transport, climate-related land use, and adaptation, and ⑤ public investment in domestic climate.



		2015 (USD billion face value)	2016 (USD billion face value)	Sources of data
Global total flows	Renewable energy investments	320.9	269.5	CPI based on multiple sources
	Public investment	61.7	52.3	
	Private investment	259.2	217.1	
	Energy efficiency investments	233.9	257.8	IEA Energy Efficiency Market Reports/CPI
	Public investment	25.7	32.9	
	Private investment (a)	208.2	224.9	
	Sustainable transport	78.0	105.8	IEA World Energy Investment Report/CPI
Public investment	69.7	92.5		
Private investment (b)	8.3	13.3		
	Other sectors public investment	47.3	47.5	CPI based on multiple sources
	Domestic climate-related public investment	67.0	67.0	BURs, CPEIRs(UNDP), I4CE
Flows to non-Annex I Parties	UNFCCC funds	0.6	1.6	Fund financial reports, CFU
	Multilateral climate funds (including UNFCCC)	1.4	2.4	Fund financial reports, CFU
	Climate-specific finance through bilateral, regional and other channels	29.9	33.6	Annex II Party Biennial Reports
	MDB climate finance attributed (b)	17.4	19.7	
	Renewable energy projects	2.4	1.5	CPI based on multiple sources
	Mobilized private climate finance by MDB (c)	10.9	15.7	MDB Joint Reports
	Mobilized private climate finance by bilateral, regional institutions (c)	2.3		OECD

Fig. 6: Flows of global climate finance (2015–2016, annual)

Source: UNFCCC (2018) Biennial Assessment and Overview of Climate Finance Flow. p56



## 1-2. Current Status of Multilateral Climate Fund Operations

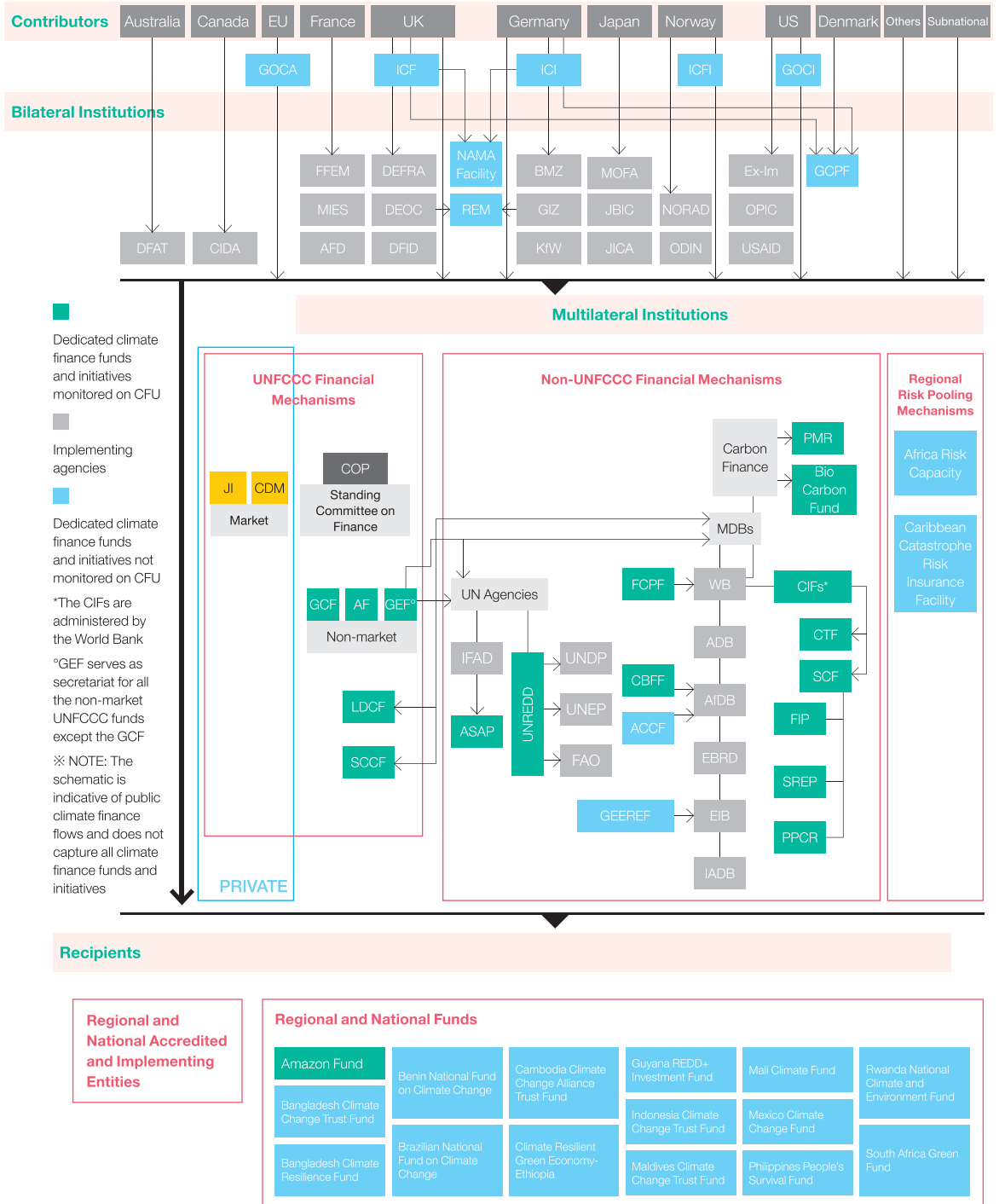


Fig. 7: Structure of climate finance

Source: Figure 1 in CFU (2017)

Climate finance is broadly classified into private and public finance and public finance is subclassified into UNFCCC fund, multilateral climate fund, bilateral finance, and MDB finance. Fig. 7 shows an overview of the worldwide climate finance system based on the climate finance mechanism of the public sector. The figure shows that there are many channels of climate finance including climate funds.

The transparency of climate finance planned through multilateral projects is improving, whereas detailed information on bilateral projects and local/national funds is often not provided. The governance structure of multilateral climate finance differs from that of typical government-led development of financial institutions. In other words, the opinions of governments of developing countries should be reflected more during decision-making. Hence, the developing country's voice and power of representation in decision-making will be strengthened and the inclusiveness and responsibility with respect to the multilateral climate fund governance system will increase.

The current status of international climate finance will be examined by classifying the financial mechanism of the UNFCCC and other mechanisms and focusing on the multilateral climate funds, as shown in Table 8.

Climate finance can be broadly divided into multilateral climate funds under the financial mechanism of the UNFCCC and non-UNFCCC funds. The general status of each fund, support amounts, supported core areas, project certification procedure, number of supported projects, and representative project cases will be examined.

**Table 8: Types and current status of public climate finance**

Fund and Program Name <sup>1)</sup>			Fund Type	Operating Agency	Focal Area	Establishment Year	
UNFCCC	Global Environment Facility (GEF) Trust Fund		Multilateral	GEF	Mitigation	1994	
	Least Developed Countries Fund (LDCF)				Adaptation	2001	
	Special Climate Change Fund (SCCF)				Adaptation	2001	
	Adaptation Fund (AF)				AF Board	Adaptation	2010
	Green Climate Fund (GCF)				GCF Board	Mitigation/ Adaptation overall	2010
Non-UNFCCC	Climate Investment Fund (CIF)	Clean Technology Fund (CTF)	Multilateral	WB	Mitigation overall	2008	
		Pilot Program for Climate Resilience (PPCR)			Adaptation	2008	
		Forest Investment Program (FIP)			REDD	2009	
		Scaling Up Renewable Energy Program in Low Income Countries (SREP)			Mitigation overall	2009	

1) The list is an example of multilateral climate resources and does not include all multilateral climate resources.

	Fund and Program Name	Fund Type	Operating Agency	Focal Area	Establishment Year
Non-UNFCCC	Asian Development Bank (ADB)	Multilateral	ADB Board	Mitigation/Adaptation overall	1966
	African Development Bank (AfDB)		AfDB Board	Mitigation/Adaptation overall	1964
	European Bank for Reconstruction and Development (EBRD)		EBRD Board	Mitigation/Adaptation overall	1991
	European Investment Bank (EIB)		EIB Board	Mitigation/Adaptation overall	1958
	Inter-American Development Bank (IDB)		IDB Board	Mitigation/Adaptation overall	1959
	Islamic Development Bank (IsDB)		IsDB Board	Mitigation/Adaptation overall	1973
	World Bank (WB)		World Bank Group (WBG)	Mitigation/Adaptation overall	1944
	Asian Infrastructure Investment Bank (AIIB)		AIIB Board	Mitigation/Adaptation overall	2015
	Amazon Fund (Amf)		National Specific Multilateral Fund	Brazilian Development Bank (BNDES)	REDD
	Bangladesh Climate Change Trust Fund (BCCTF)	Ministry of Environment and Forests (Bangladesh)		Adaptation	2010
	Bangladesh Climate Change Resilience Fund (BCCRF)	WB		Adaptation	2010
	Rwanda's Green Fund (FONERWA)	Global Green Growth Institute		Adaptation	2012
	Guyana REDD+ Investment Fund (GRIF)	Guyana Government		Mitigation/Adaptation overall	2011
	Indonesia Climate Change Trust Fund (ICCTF)	National Development Planning Agency (BAPPENAS) Indonesia		Mitigation/Adaptation overall	2010

## 1. Financial Mechanism of the UNFCCC

### Global Environment Facility Trust Fund

The Global Environment Facility (GEF) Trust Fund is a fund that is directly operated by the GEF. The operating fund is regenerated every four years. Currently, the 6th Trust Fund (GEF-6, 2014–2018) is used to support related projects.

### Least Developed Countries Fund

The Least Developed Countries Fund (LDCF) is a fund of the GEF and is managed by the GEF. It is a fund that exclusively deals with the adaptation area among climate change areas. It was established together with the Adaptation Fund (AF) and Special Climate Change Fund (SCCF) when the need for the development of funds for climate change responses of developing countries was agreed upon in the 7th Conference of Parties (COP7) in 2001.

### **Special Climate Change Fund**

The Special Climate Change Fund (SCCF) was established based on a decision made during the Marrakesh COP7 in 2001. The SCCF supplements the LDCF. In contrast to the LDCF, which only supports 48 least developed countries, the SCCF is open to all weakly developing countries. Moreover, it is used for financial support activities in more comprehensive climate change areas. As of 2017, the SCCF has supported 77 projects in 79 countries based on financial resources of US\$350 mio.

### **Adaptation Fund**

The Adaptation Fund (AF) was established based on a discussion in the 11th COP (held in Montreal, Canada in 2005 in association with the 1st Kyoto Protocol COP). It is used for support activities in countries that have joined the Kyoto Protocol. The AF is a financial organization of the Kyoto Protocol that is mainly operated under the decisions and guidelines of the UNFCCC COP. Because it has its own governing board, decisions about major issues are reported to the COP.

### **Green Climate Fund**

The Green Climate Fund (GCF) is one of the financial mechanism-operating entities established based on Article 11 of the UNFCCC. Its establishment was approved at the 16th UNFCCC COP (UNFCCC COP 16) in 2010 and a temporary secretariat was set up in Bonn, Germany. During the 2nd board meeting of the GCF in 2012, it was decided to move the secretariat to Songdo, Incheon, South Korea. This decision was approved at the 18th COP and the secretariat was officially opened in Songdo, Incheon, South Korea, which was designated to be a free economic zone in December 2013. Based on a fundraising meeting and the UNFCCC COP (COP20, Lima, Peru) in 2014, the initial fund of US\$10 bio was pledged by 35 countries. To respond to the increasing demand for climate change in developing countries, a fund of US\$100 bio will be provided annually until 2020 and it is expected to play a vital role in the long-term support of climate finance.

## **2. Non-UNFCCC Multilateral Climate Funds**

### **Climate Investment Fund**

The Climate Investment Fund (CIF) is an investment program that is jointly managed by multiple multilateral development banks. It is used to assist developing countries in improving climate resilience and to support the transition to a low-carbon emission system. Its establishment was officially approved at the board meeting of the World Bank (WB) on July 1, 2008, and it was launched with a contribution of more than US\$8 bio from 14 donor countries. The fund is spent in form of grants, loans, and risk mitigation measures in beneficiary countries via multilateral development banks. Furthermore, the CIF is the only execution organization that exclusively cooperates with MDBs regarding the multilateral climate fund. It promotes the cooperation between the recipient countries and MDBs, which supports the growth of an environment-friendly market and the MDBs

themselves.

The CIF comprises two trust funds that have different goals, activity domains, and governance structures: Clean Technology Fund (CTF) and Strategic Climate Fund (SCF).

#### Clean Technology Fund

The CTF provides finance of an extended magnitude to contribute to the demonstration, deployment, and transfer of low-carbon technologies with significant potential for long-term greenhouse gas emission savings. The CTF aims to provide support for climate-friendly technologies based on national or local investment plans that support these technologies. The investment plan is executed in a way that granters, such as MDBs, other development partners, private sector companies, citizens, and society complement each other, whereby the CTF supplements overall development activities of a nation based on the existing national strategy. The CTF supports investment plans for technologies that can be used to reduce greenhouse gas emission and can be deployed quickly because they are cost-effective and ready for implementation. To be eligible for the support of the CTF, a nation must be qualified to receive Official Development Assistance (ODA) and must possess an MDB program.

#### Strategic Climate Fund

The SCF supports the development of low carbon/climate resilience in developing countries. Several governments and civic social organizations are concerned that climate change will worsen the poverty and have a severe economic impact on developing countries due to the rising temperature, sea level rise, droughts, precipitation changes, disease distribution changes, and drinking water reduction. They think that financial support must be provided for the response in such low-income countries. The SCF comprises three programs that provide grants and concessional loans: ① Forest Investment Program (FIP), ② Pilot Program for Climate Resilience (PPCR), and ③ Scaling-up Renewable Energy Program in low-income countries (SREP).

#### **Climate Finance of Multilateral Development Banks**

The MDB climate finance refers to financial resources (MDB's own financial resources and external resources directly managed by the MDB) provided by MDBs for the developments for climate change mitigation and adaptation in developing countries and emerging markets.

Since 2012, the MDBs have jointly released reports about the status of climate finance. The reports aim to disclose the magnitude of climate finance that MDBs support in developing countries and emerging markets and to explain the methodologies used for tracking the flow of funds. Until 2016, the African Development Bank (AfDB), Asian Development Bank (ADB), European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Inter-American Development Bank (IDB), and WB have jointly composed and released these reports. In October 2017, the Islamic Development Bank (IsDB) joined the MDBs and participated for the first time in the 2017 joint report. According to the 2017 report, the magnitude of climate finance in developing countries and emerging markets in the last seven years amounts to roughly US\$194 bio.

In 2017, the MDBs invested a total of US\$35.219 bio in developing countries and emerging markets; 79% of the funds, that is, US\$27.868 bio, were invested in climate change mitigation. The remaining 21%, US\$7.352 bio, were used for climate change adaptation. Based on the “2017 Joint Report on Multilateral Development Banks’ Climate Finance,” the total amount of co-financing was US\$51.718 bio. The total amount related to climate finance, which is the sum of this and the MDBs’ climate finance, reached US\$86.937 bio in 2017.

As mentioned earlier, the MDBs invested US\$35.219 bio, including their own funds and external funds, in developing countries and emerging markets in 2017. The highest proportion, that is, 36.84%, was provided by the World Bank Group (WBG), followed by 15.27% from the EIB, 14.59% from the ADB, 12.83% from the EBRD, 12.12% from the IDB, 6.54% from the AfDB, and 1.80% from the IsDB.

#### World Bank Group

The WB consists of the International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA). The WB, International Finance Corporation (IFC), Multilateral Investment Guarantee Agency (MIGA), and International Center for Settlement of Investment Disputes (ICSID) are collectively called the WBG.

#### Asian Development Bank

The Asian Development Bank (ADB) is a development bank that was established in the early 1960s through the UN Economic Commission for Asia and the Far East (ECAFE) when the need for prompt post-war recovery emerged in the Pacific region of Asia. In the early 2000s, support activities for climate change were fully implemented. Many mitigation activities, including energy efficiency and new/renewable energy-related activities, have been carried out and a variety of adaptation programs have been implemented since then.

#### African Development Bank

The African Development Bank (AfDB) is a regional development financial institute established for African countries that became politically independent after World War II. It aims to promote their economic development and end economic subordinated relationships with former suzerain countries. The AfDB, the African Development Fund (ADF), and the Nigeria Trust Fund (NTF) are collectively called the AfDB Group. The ADF is a fund that provides 40 least developed countries of Africa with concessional loans and the NTF is a special fund that aims to assist the development efforts of regional low-income countries whose economic and social conditions and prospects require concessional financing.

#### European Investment Bank

The European Investment Bank (EIB) is the European Union (EU)’s policy-driven financial institution established in 1958 and supports economic growth and job creation in Europe through financial

support of innovative companies, small and medium companies, infrastructure, and the environment. It is operated by 28 EU member countries. Major shareholding countries are Germany (16.1%), France (16.1%), the UK (16.1%), and Italy (16.1%).

#### European Bank for Reconstruction and Development

The European Bank for Reconstruction and Development (EBRD) is a development bank founded in 1991 after being proposed at a summit conference of the European Communities (EC). Unlike other banks, which were established to support the economic development of regional member countries, it provides development funds under the premise of the transformation of the political/economic system.

#### Inter-American Development Bank

The Inter-American Development Bank (IDB) is a development bank established in 1959 by the USA and 19 Central/South American and Caribbean countries based on a proposal of President Kubitschek of Brazil. Three organizations, the IDB, Inter-American Investment Corporation (IIC), and Multilateral Investment Fund (MIF), are collectively called the IDB Group.

### **National Climate Funds**

#### Amazon Fund

The Amazon Fund (Amf) is a “reducing emissions from deforestation and forest degradation plus” (REDD+) mechanism created to raise donations for non-reimbursable investments in efforts to prevent deforestation and to promote the preservation and sustainable use in the Brazilian Amazon. This fund is managed by the Brazilian Development Bank (BNDES) and comprises the Guidance Committee (COFA) and Technical Committee (CTFA). The COFA establishes guidelines and monitors the results and the CTFA certifies the performance of the Ministry of Environment with respect to the effective mitigation of carbon emissions from deforestation.

#### Bangladesh Climate Change Trust Fund

The Bangladesh Climate Change Trust Fund (BCCTF) was established with budget support from the Bangladesh government to execute the 2009 Bangladesh Climate Change Strategy and Action Plan. It is used to improve the ability of local people to respond to climate change risks and develop and expand climate-friendly technologies.

#### Bangladesh Climate Change Resilience Fund

In May 2010, the Bangladesh government entered into a memorandum of understanding (MOU) with four development partners to execute the Bangladesh Climate Change Strategy and Action Plan and established the Bangladesh Climate Change Resilience Fund (BCCRF). Denmark, the EU, Sweden, and UK’s Department for International Development (DFID) were the initial partner organizations; Switzerland joined as a new development partner in December 2010, followed by the United States Agency for International Development (USAID) in 2012.

#### Rwanda's Green Fund

Rwanda's Green Fund (FONERWA) is a fund for activities related to climate change and the ground-breaking environment in Rwanda. It endeavors to provide an engine for the next 50 years of green growth. It provides technical and financial support of the best public and private projects that align with the Rwanda government's commitment to a green economy. The FONERWA invests in public and private projects that lead to changes and it is one of Africa's first national environment and climate change investment funds.

#### Guyana REDD+ Investment Fund

The Guyana REDD+ Investment Fund (GRIF) is a fund established to finance activities identified under the Guyana government's Low Carbon Development Strategy (LCDS). Norway has committed to provide up to US\$250 mio to the fund until 2015 to reduce damages due to deforestation and the forest degradation of Guyana. As part of this agreement, both countries agreed to establish the GRIF as a financial means to pay performance-based incentives to Guyana.

#### Indonesia Climate Change Trust Fund

The Indonesia Climate Change Trust Fund (ICCTF) is the only national trust fund dedicated to climate finance in Indonesia equipped with a governmental mandate. The ICCTF is a key government organization for the mitigation of climate change and it proposed the goal of an emission reduction by 29% by 2030 together with international support for emission reduction. "Financial Management" and "Monitoring and Evaluation" are core services of the ICCTF. Based on past success records of accomplishment in managing complex and innovative projects, the ICCTF will continue to advance its business model to increase the participation of the private sector and leverage funds from public and development partners to scale up mitigation and adaptation activities.

#### Mexico Climate Change Fund

The Mexico Climate Change Fund (MCCF) was established in November 2012. The financial resources of MCCF consist of federal government grants, domestic/overseas contributions, overseas governments' contributions, and international organization's contributions. The Technology Committee of the MCCF held two periodic meetings and one special meeting in 2013. In the latter meeting, the operation regulations for the climate change fund were approved. The Technology Committee approved the first use of the MCCF in a special climate change fund meeting held in June 2014.

#### Philippines People's Survival Fund

The Philippines' government established a plan to contribute at least PHP1 bio every year from the government budget to operate the Philippines People's Survival Fund (PSF). The rest of the budget is funded through local government organizations, the private sector, and external funds such as those of individual people that support adaptation incentives. Moreover, the budget can be additionally



funded based on the review and evaluation conducted by the President and the Department of Budget and Management (DBM) with respect to the performance of the fund and other related local government organizations. The committee's personal service fund and other operation expenses are not subsidized by the fund. The PSF receives support from donations, contributions, and grants defined in the general articles of the General Appropriations Act (GAA).

### **Reducing Emissions from Deforestation and Degradation Plus (REDD+)**

#### **Biocarbon Fund–Initiative for Sustainable Forest Landscapes**

The Biocarbon Fund– Initiative for Sustainable Forest Landscapes (ISFL) is a multilateral fund managed by the WB, which was established to sustain the forest landscape. It aims to reduce the greenhouse gas emissions in the land sector by preventing deforestation and forest degradation in developing countries and promoting sustainable agriculture through better land use plans and policy establishment. The Initiative for Sustainable Forest Landscapes (ISFL) has a geographically diverse large-scale program portfolio. These programs change and affect rural areas through forest protection, degraded land restoration, improvement of the agricultural productivity, improvement of the local environment, and improvement of the living standard. The ISFL supports programs of Colombia, Ethiopia, and Zambia and is reviewing the program of Indonesia.

#### **Congo Basin Forest Fund**

In February 2008, collaborating with the Commission of Central African Forests (COMIFAC) and the Department for International Development (DFID) of the UK, the AfDB hosted an international conference to provide financial support for the sustainable management of the forest ecosystem in the Congo Basin. In the conference, the cooperation and dialogues via the Congo Basin forest partnership were emphasized and an agreement was made to establish the Congo Basin Forest Fund (CBFF) to support the COMIFAC, which aims to conserve and continually manage the forest and ecological system. The CBFF aims at poverty reduction, sustainable social and economic development, local cooperation, and environmental preservation. The size of the fund is €15 mio and the major supporting countries are Norway and the UK.

#### **Forest Carbon Partnership Facility**

The Forest Carbon Partnership Facility (FCPF), a program supported by the WB, comprises the “Readiness Fund” and “Carbon Fund.” The FCPF was launched to reduce the carbon emissions from deforestation in developing countries and to improve forest carbon stock conservation through sustainable forest management (REDD+).

#### **UN–Reducing Emissions from Deforestation and Degradation Programme**

The REDD program is a measure that facilitates the creation of incentives for forest protection activities in developing countries. In addition, work is performed to assign value to carbon stocks in the forest. In September 2008, the UN-REDD Programme (a cooperative program of the US for the prevention of

deforestation in developing countries and reduction of emissions from deforestation) was established according to the decisions of REDD, FAO, UN Development Programme (UNDP), and UNEP at the Bali UNFCCC COP-13.

## **Other Non-UNFCCC Multilateral Climate Funds**

### Africa Climate Change Fund

The Africa Climate Change Fund (ACCF) supports African countries in performing response activities for damages due to climate change and activities that build sustainable low-carbon growth engines. The ACCF was established as a bilateral trust fund in 2014, with a contribution of €4.72 bio from the German government. In early 2017, it was scaled up to a multi-donor trust fund after receiving €4.7 mio from the government of Italy and €2 mio from the government of Flanders, Belgium. The support activities of the AfDB are overseen and managed by climate change and green growth departments and executed through cooperation with other bank departments.

### Adaptation for Smallholder Agriculture Programme

The Adaptation for Smallholder Agriculture Programme (ASAP) is a flagship program of the International Fund for Agriculture Development (IFAD) set up to channel climate finance to smallholder farmers to respond to climate change. The ASAP is incorporated into IFAD's regular investment processes and benefits from rigorous quality control and supervision systems. With respect to future management of climate-related risks, the ASAP is planned to be integrated with all loan and grant portfolios of the IFAD.

### Global Climate Change Alliance Plus

The Global Climate Change Alliance Plus (GCCA+) is an initiative of the EU that supports countries that are most vulnerable to climate change in responding to climate change. It mainly assists Small Island Developing States (SIDS) and Least Developed Countries (LDCs) to increase their resilience to climate change. The GCCA was established with a contribution of €300 mio from the EU and started with four pilot projects in 2008. It has supported over 70 projects in Africa, Asia, the Caribbean, and Pacific regions. The GCCA entered a new phase, called GCCA+, with a contribution of €730 mio obtained through the European Commission's Multiannual Financial Framework (MFF) from 2014 to 2020.

### Global Energy Efficiency and Renewable Energy Fund

The Global Energy Efficiency and Renewable Energy Fund (GEEREF) is a fund that leverages public sector funds to catalyze private sector investments into clean energy projects. The GEEREF focuses on and invests in new and renewable energy and energy efficiency projects in emerging markets based on advice of the European Investment Bank Group. Renewable energy investments in developing countries are identified based on three principle factors: (1) population and economic growth, (2) energy demand growth, and (3) growing share of clean power in the energy mix. The GEEREF focuses its support on infrastructure projects that produce clean power through low-risk and validated

technologies.

#### Millennium Development Goals Achievement Fund

The Millennium Development Goals (MDG) Achievement Fund (MDG-F) was established by the government of Spain and the UNDP. One of the goals of this fund is to reduce poverty and vulnerability by improving the climate change adaptation capacity and increase accessibility to new financial mechanisms through national and local levels of environment management and service provision by intervening in countries that are suitable for receiving the fund. The financial support of a project approved by the MDG is paid out and monitored by the Climate Funds Update (CFU). In December 2006, the UNDP Administrator and Spanish Secretary of State for International Cooperation signed an agreement to contribute €528 mio over the next four years through the UN system.

#### Partnership for Market Readiness

The Partnership for Market Readiness (PMR) functions both as a forum for joint innovations and actions and as a fund for supporting capacity building for the mitigation of climate change. To expand the greenhouse gas mitigation strategy, it provide support for the preparation and implementation of climate change mitigation policies including carbon pricing policies. Through grant funding, it develops carbon pricing policy instruments required for greenhouse gas mitigation and NDC implementation, builds capacity in nations that can implement them, builds a knowledgebase for carbon price policy instruments, and promotes information exchange through technical discussions and knowledge product deployment. It supports each country in determining and implementing best-practice approaches, ensures design compatibility for the support of carbon market developments, and provides a joint innovation platform for information sharing and carbon pricing instruments, thereby disclosing national and international policy discussions with respect to greenhouse gas mitigation.

## Chapter 2: Association Analysis of Multilateral Climate Funds and Climate Technologies

In the “Green and Climate Technology Whitepaper 2019,” relevant data were collected to perform association analysis of multilateral climate funds and climate technology-related projects supported by those funds. The investigation targets were selected by using the CFU website operated and managed by the Overseas Development Institute (ODI). Among 29 multilateral climate funds provided when the website was accessed in September 2018, data were collected for a total of 19 multilateral climate funds by excluding funds that did not provide information or project documents. The final investigation target list is shown in Table 8.

**Table 9: Final list of investigation targets of multilateral climate funds**

List of research subjects (name of multilateral climate funds)	Adaptation for Smallholder Agriculture Programme (ASAP)
	Amazon Fund (Amf)
	Adaptation Fund (AF)
	Biocarbon Fund Initiative for Sustainable Forest Landscapes (BioCF-ISFL)
	Congo Basin Forest Fund (CBFF)
	Clean Technology Fund (CTF)
	Forest Carbon Partnership Facility (FCPF)
	Forest Investment Program (FIP)
	Global Climate Change Alliance Plus (GCCA+)
	Global Environment Facility (GEF) 4 (GCF4)
	Global Environment Facility (GEF) 5 (GCF5)
	Global Environment Facility (GEF) 6 (GCF6)
	Green Climate Fund (GCF)
	Least Developed Countries Fund (LDCF)
	Millennium Development Goals (MDG) Achievement Fund
	Partnership for Market Readiness (PMR)
	Pilot Program for Climate Resilience (PPCR)
	Special Climate Change Fund (SCCF)
	Scaling Up Renewable Energy Program in Low Income Countries (SREP)

## 2-1. General Status of Multilateral Climate Funds

The projects of climate funds that have been launched since 2003 can be examined according to the total support amount and number of projects, as shown below. The total support amount of investigated target multilateral climate funds is ~US\$12.1 bio and the total number of supported projects is 1,372.

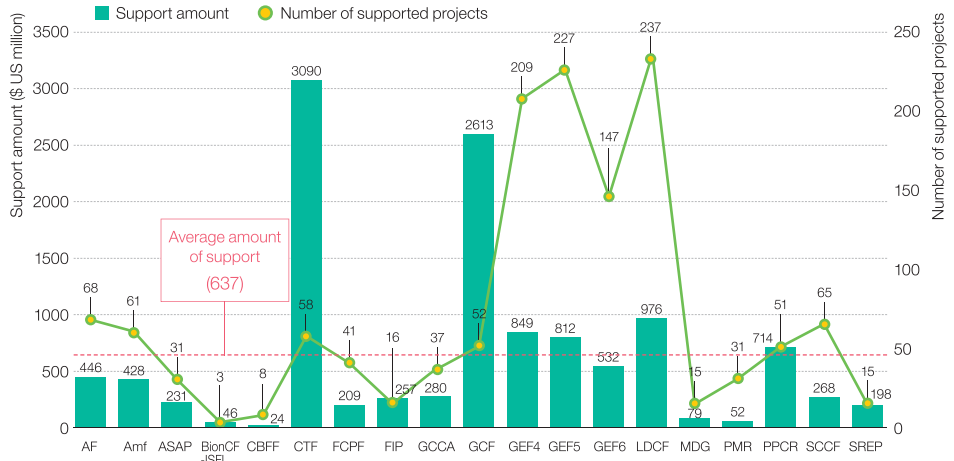


Fig. 8: Total project support amount from multilateral climate funds

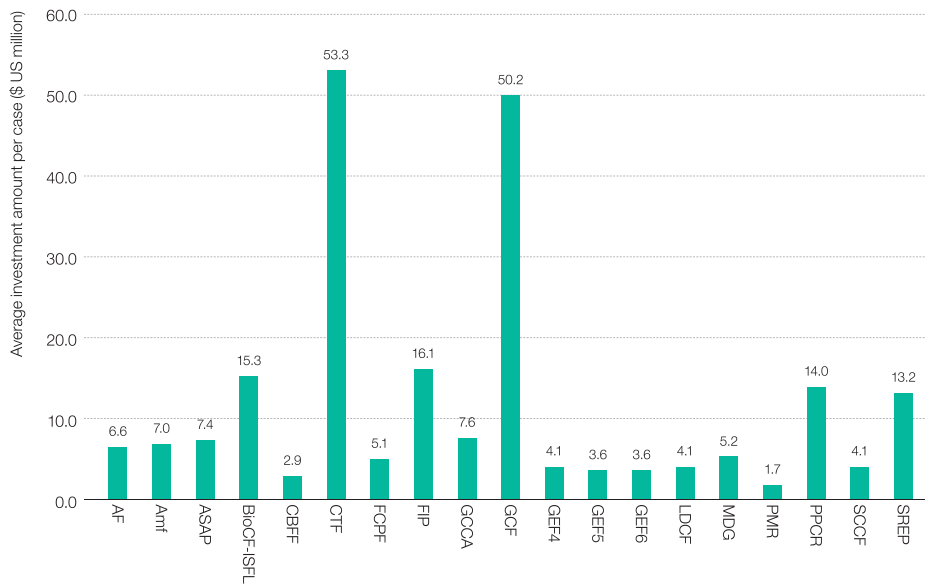


Fig. 9: Average investment by climate funds

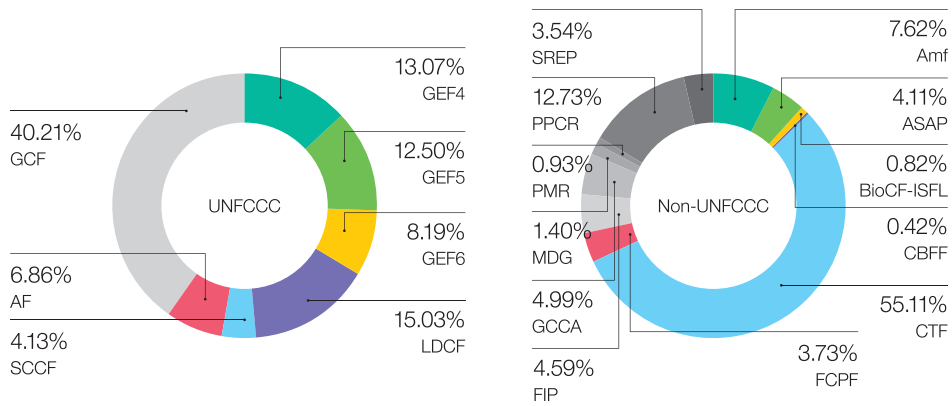


Fig. 10: Financial resource composition proportions of funds

### Investment status by project approval year

Among the investigated and collected projects, projects that were already approved were used for the analysis of the investment status by project approval year. Based on the status analysis, the total support amount of approved projects is ~US\$11.9 bio and a total of 1,325 projects are in progress.

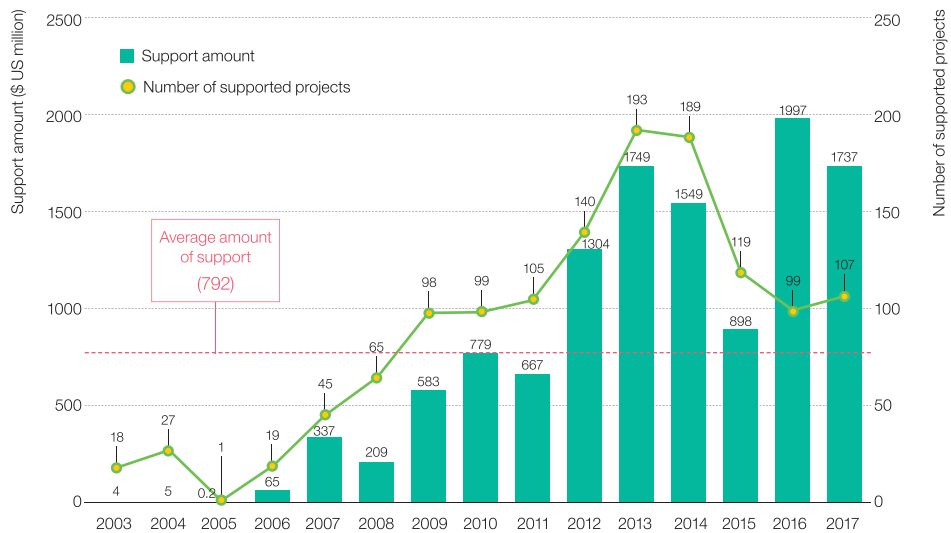


Fig. 11: Support status by project approval year

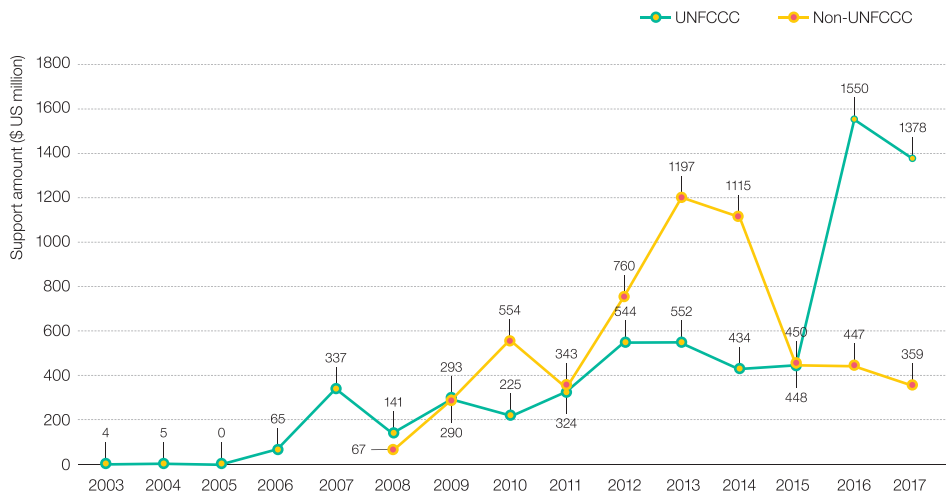


Fig. 12: Support amount status by project approval year

#### Investment status by financial support type

Based on the examination of the current status of the total support amount of projects and the number of supported projects according to the financial support type, multilateral climate funds use the following methods to support projects: co-finance, grant, loan, equity, and credit. In the case of climate funds, the grant (61.78%) is the biggest support type, followed by loan (34.13%) and co-finance (2.41%).

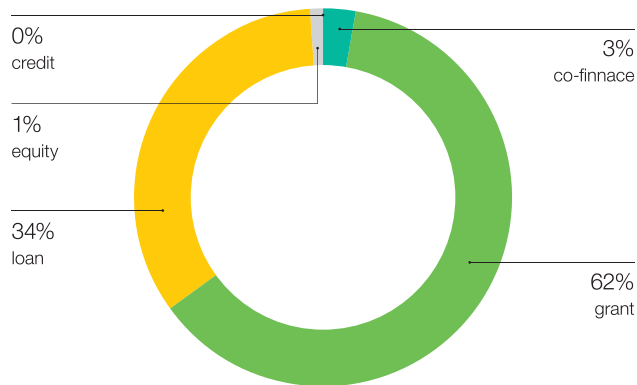


Fig. 13: Total support amount proportions by financial support type

### Current status by project implementation period

Projects with a duration of 4–6 years account for 70% of the total climate projects, followed by projects with a duration of 7 years or more (long-term; 16%) and those with a duration of 3 years or less (short-term; 14%). When examining the projects by classification into financial and nonfinancial types, the projects with a duration of 4–5 years account for highest amount and number of projects.

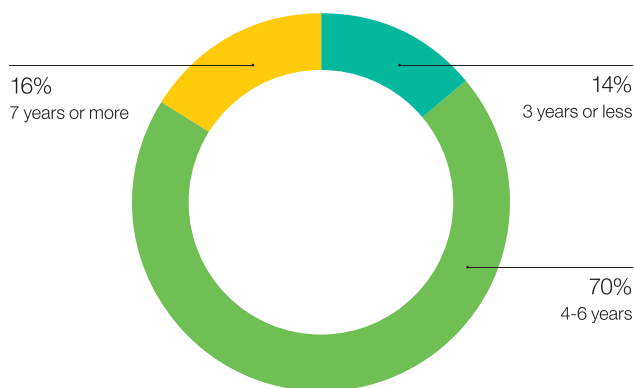


Fig. 14: Support amount proportion by project implementation period

### Investment status by project implementation region

Multilateral climate funds were invested in nine regions. The status analysis shows that the African region south of the Sahara Desert received the highest total amount of support, followed by Latin America, the Caribbean region, East Asia, and the Pacific region, in that order.

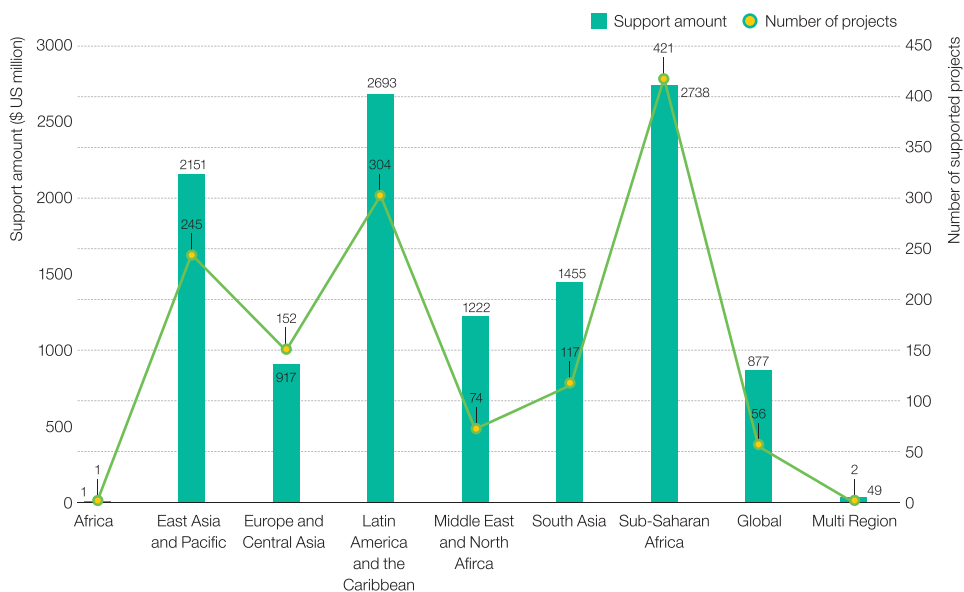


Fig. 15: Current status of projects by region



### Current status of beneficiaries by region

The current status of project beneficiaries by region shows that the African region south of the Sahara Desert accounts for 39%, followed by South Asia (27%) and East Asia and the Pacific region (14%). Meanwhile, Latin American and Caribbean beneficiaries account for 6%, which is low considering the total investment of US\$2.6 bio (ranking number 2).

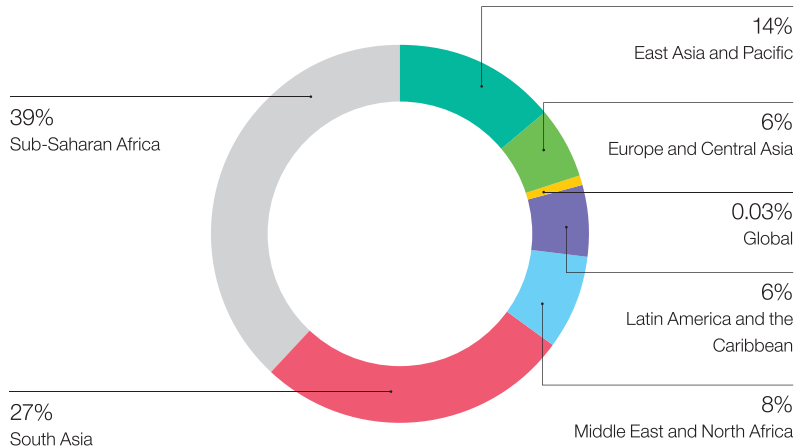


Fig. 16: Current status of project beneficiaries by region

### Current status by region and country

The examination of the investments by region and country showed that the highest amount in the African region south of the Sahara Desert was spent on alliance projects within the region, followed by projects in Tanzania, South Africa, and Mozambique, in descending order. In Latin America and the Caribbean, the investment was the highest in Brazil, followed by Mexico and Colombia.

### Current status of the climate fund network

First, to understand the characteristics of general projects of climate funds, the titles of 1372 projects included in the climate funds were examined by using “Word Cloud.” It was confirmed that major words such as Climate, Change, Adaption, UNFCCC, Development, Energy, and Energy Efficiency appear in the titles, as shown below.



## 2-2. Association Analysis of Climate Technologies and Climate Funds

In this section, the investment trends of climate funds are examined by association analysis of 14 climate technologies and 19 climate funds. The technology classification results for each project show an average US\$800 mio investment in each technology. Fig. 19 shows that the investments in technologies related to renewable energy, energy demand, and water are high. A total of US\$4.1 bio was invested in renewable energy, accounting for 34% of the total investments, and a total of US\$1.9 bio was invested in the energy demand, accounting for 16% of the total investments. In terms of the number of projects, 233 projects are related to the energy demand, representing the highest proportion, followed by 203 and 169 projects related to renewable energy and agriculture/livestock, respectively.

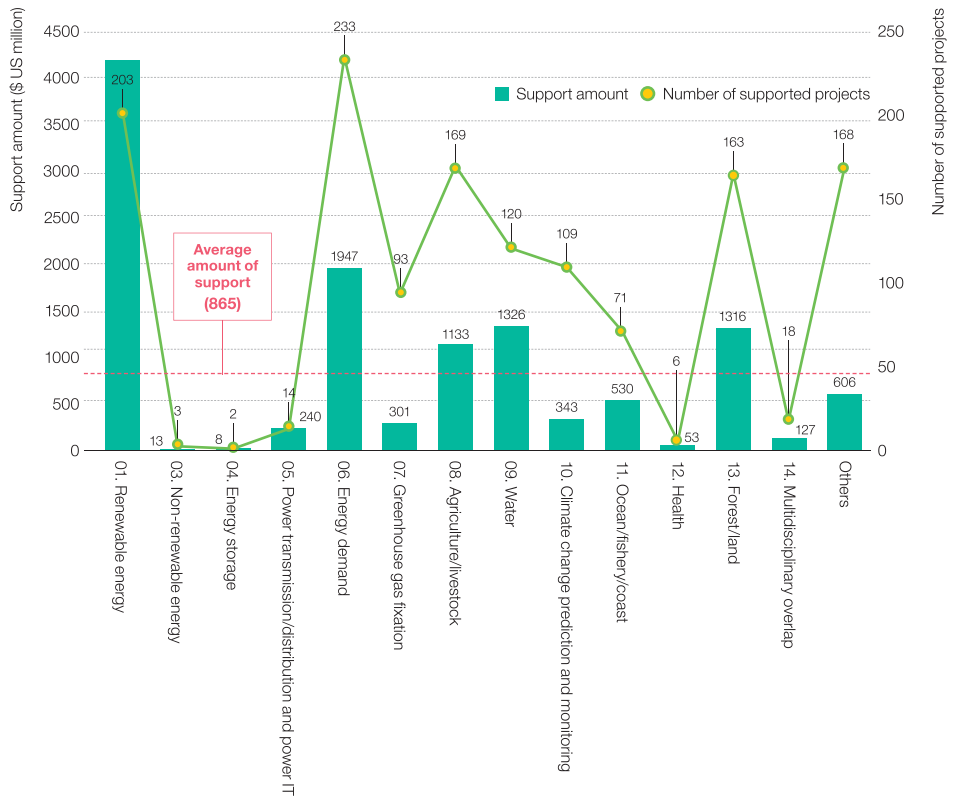


Fig. 19: Investment and project status by technology

The association analysis results of climate technologies and funds are discussed in the following section. In terms of the technology type, the highest number of funds was invested in the forest/land sector, followed by agriculture/livestock, others, and energy demand. In terms of funds, on the other hand, the highest number of investments was made by the GEF5, followed by the GEF4, GCF, and GCCA funds, in descending order.

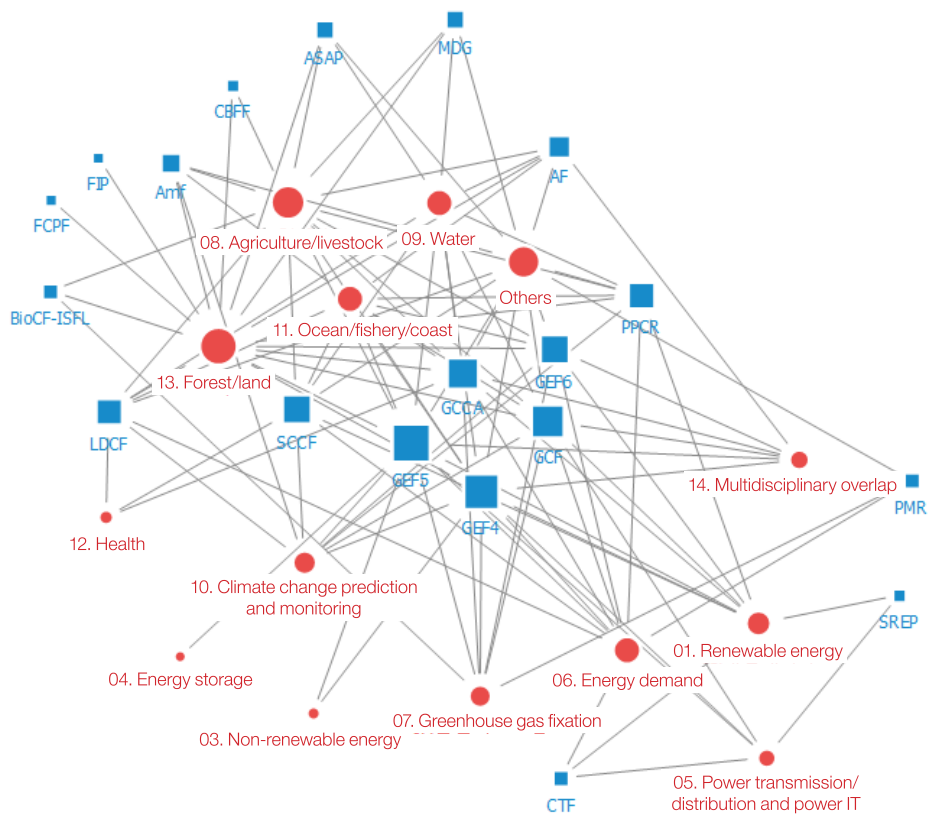


Fig. 20: Technology–fund association analysis

The analysis of the association between technologies and countries led to the following results. Projects in the renewable energy area have been conducted in 96 countries, followed by projects related to agriculture/livestock (82 countries), energy demand (80 countries), and climate change prediction and monitoring technology (77 countries) areas. This shows that projects have been implemented in various countries.

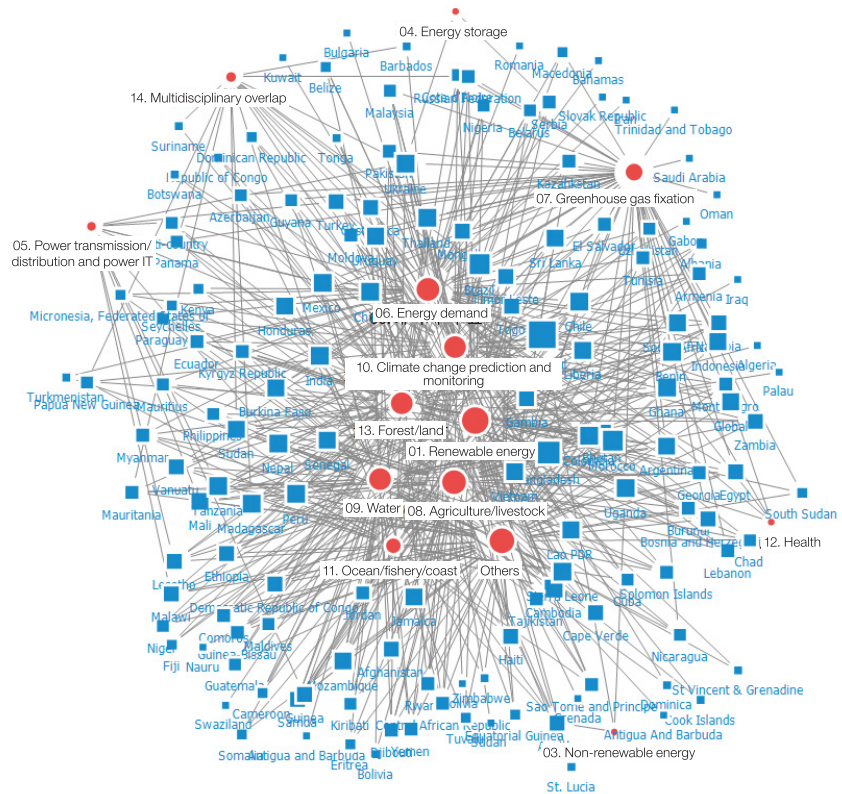


Fig. 21: Technology–country association analysis

### 2-3. Investment Status Analysis by Technology Type

The investment status by technology type was analyzed for each middle category level of the climate technology classification system. The analysis pertained to the total support amount, support status by financial support type, current status by investment fund, support status by approval year, support status by implementation period, beneficiary status by region, and fund–country association. In the summary report, only the results with respect to renewable energy as representative are presented in detail; the results for the other areas are provided briefly (please refer to the main “Green/Climate Technology White Paper 2019” for detailed information).

#### 1. Renewable Energy

The total amount of support in the renewable energy area is US\$4.16 bio and the average project investment size is US\$20.49 mio. In terms of the financial support type, the loan support accounts for 71.38%, followed by grants (27.39%).

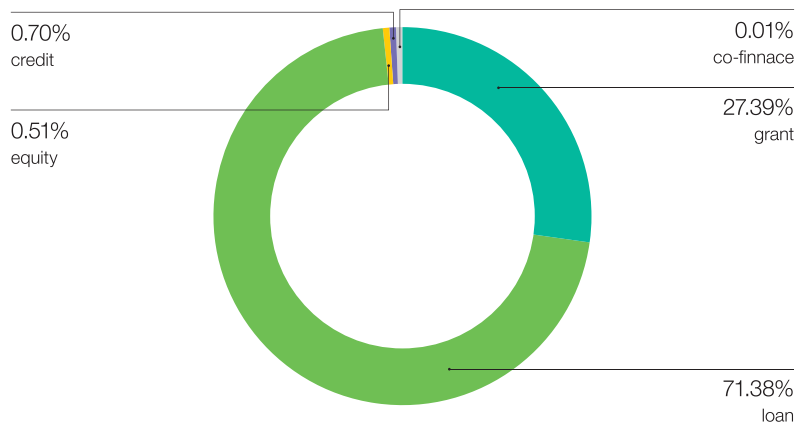


Fig. 22: Amount by financial support type in the renewable energy area

The CTF made the largest investment (US\$2.2 bio), followed by the GCF (US\$1.1 bio). The GEF5 invested in the largest number of projects (60 projects), followed by the GEF4 (58 projects).



Fig. 23: Current status by fund in the renewable energy area

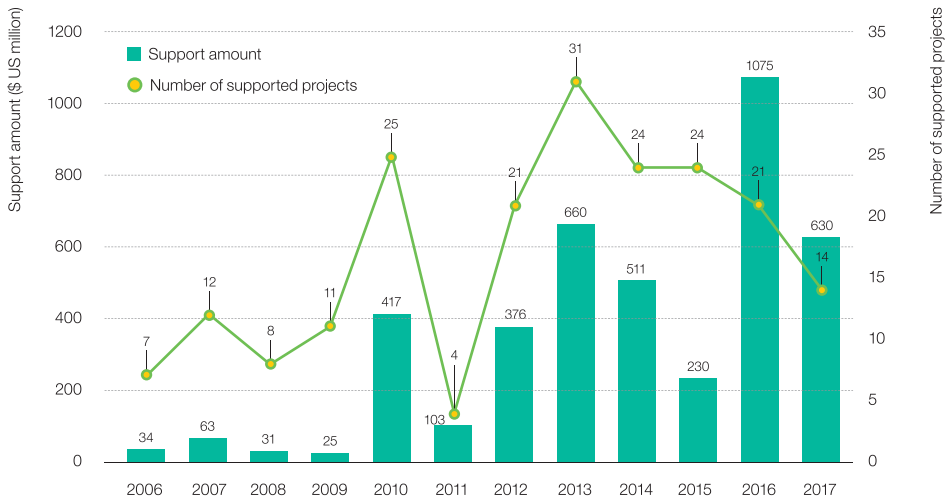


Fig. 24: Current status by approval year in the renewable energy area

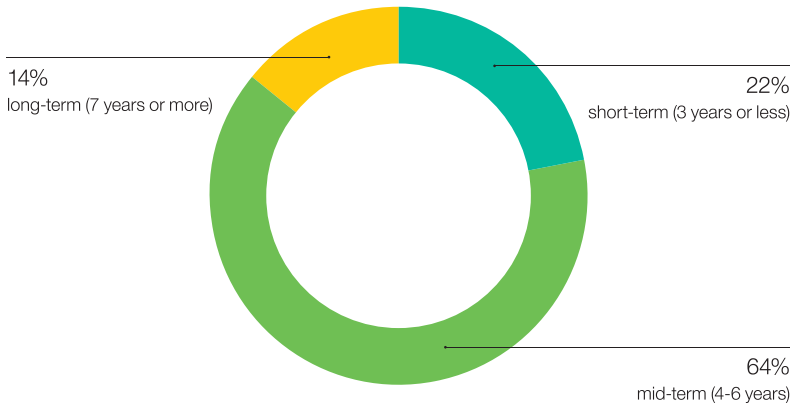


Fig. 25: Current status by implementation period in the renewable energy area

**Table 10: Current status by project implementation period in the renewable energy area**

Period of enforcement	< 1 year	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	Total
Support amount (\$ US million)	94	31	14	105	683	1,406	447	133	110	46	9	378	3,455
Percentage (%)	2.7	0.9	0.4	3.0	19.8	40.7	13	3.8	3.2	1.3	0.3	10.9	100
Number of projects	5	2	7	18	37	37	18	11	5	2	1	1	144
Percentage (%)	3.4	1.4	4.8	12.5	25.7	25.7	12.5	7.6	3.5	1.4	0.7	0.7	100

Based on the analysis of the composition of beneficiaries of projects by region, the African region south of the Sahara Desert accounts for 38%, the highest proportion.

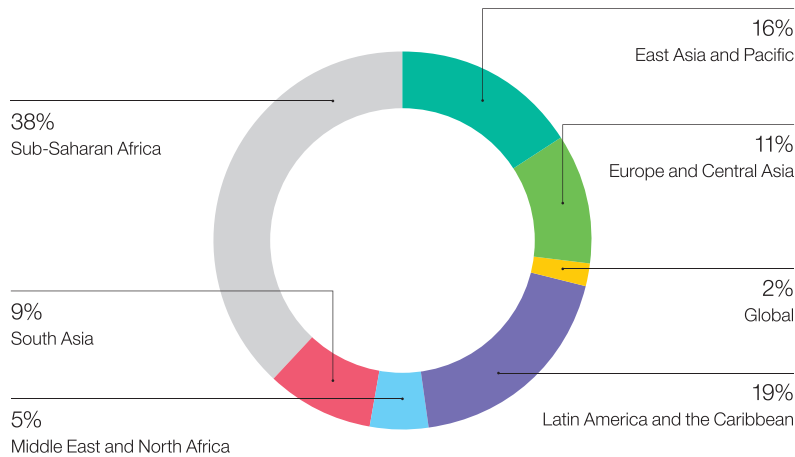


Fig. 26: Beneficiaries by region in the renewable energy area

The analysis of the association between funds and countries showed that the number of funds that were associated with projects via alliances within regions was the largest among a total of 96 participating countries. In terms of funds, the GEF5 supported the largest number of countries (53 countries), followed by the GEF4 (45 countries).

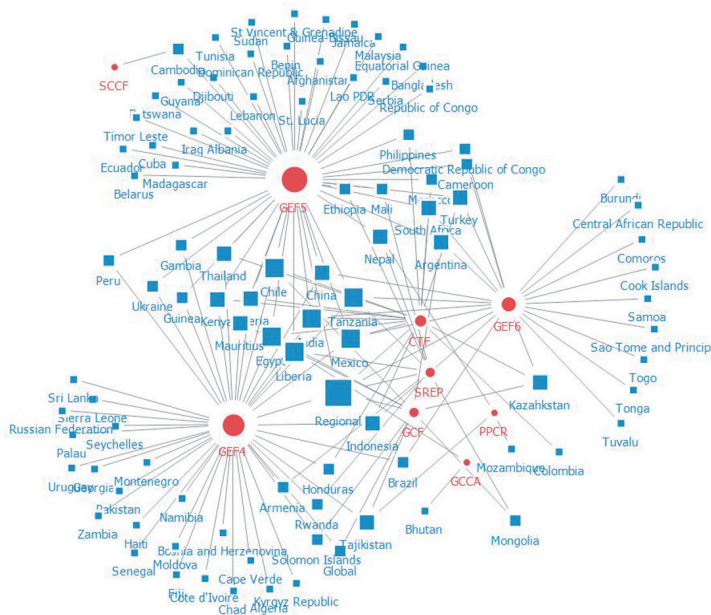


Fig. 27: Fund–country association in the renewable energy area



## **2. New Energy (Not Applicable)**

## **3. Non-renewable Energy**

According to the CFU, the total amount provided by multilateral climate funds for non-renewable energy is US\$13 mio and the average project investment size is US\$4.45 mio. The current status of funds shows that investments in the non-renewable energy have been provided by only two funds:

US\$5 mio by the GEF4 and US\$8 mio by the GEF5. A total of US\$5 mio was invested in 2007, US\$3 mio in 2011, and US\$5 mio in 2014; only one project was approved each year. One project based on which a total of US\$5 mio was invested was approved with an 8-year implementation period.

## **4. Energy Storage**

The total amount provided for the energy storage sector is US\$8 mio and the average project investment size is US\$4 mio. Grant support accounts for 100% of the financial support. The current status of funds shows that the GEF5 has invested US\$8 mio in a total of two projects. In the energy storage sector, US\$6 mio and US\$2 mio were invested in 2012 and 2014, respectively, and only one project was approved in each year. One project based on which a total of US\$6 mio was invested was approved with a 5-year implementation period.

## **5. Power Transmission/Distribution and Power IT**

The total amount supported in the power transmission/distribution and power IT sector is US\$240 mio and the average project investment size is US\$17 mio. In terms of the financial support type, grant support accounts for 33.49%, followed by loans (32.86%) and equities (32.81%). The CTF invested the largest amount (US\$83 mio), followed by the GCF (US\$80 mio). The SREP invested in the largest number of projects (5). Since 2013, the investments have been increasing. The investment size significantly increased from US\$87 mio in 2014 to US\$100 mio in 2016. An investment of US\$21 mio was made in 2017, indicating a 79% decrease compared with that of the previous year. The number of projects with a duration of seven years or longer is the largest, accounting for 50%. In terms of beneficiaries, the African region south of the Sahara Desert accounts for 98%, that is, the majority.

## **6. Energy Demand**

The total amount provided for the energy demand sector is US\$1.947 bio and the average project investment size is US\$8.36 mio. In terms of the financial support type, grant support accounts for 55.2%, followed by loans (44.7%). The CTF invested US\$733 mio, that is, the largest amount, followed by the GEF4 (US\$458 mio). The GEF4 invested in the largest number of projects (99 projects), followed by the GEF5 (65 projects). In 2009, the investment size was the largest (US\$366 mio) and the largest number of projects was approved (34 projects).

Projects with a 4–6-year implementation period account for ~60% and the number of beneficiaries is the highest in the African region south of the Sahara Desert (36%), followed by Latin

America and the Caribbean (34%).

The analysis of the association between funds and countries showed that Colombia, global alliances, Ukraine, and India conducted projects associated with the largest number of funds, in descending order, in the energy demand area with a total of 80 participating countries. The GEF4 and GEF5 have invested in 47 and 37 countries, respectively.

## 7. Greenhouse Gas Fixation

The total amount provided for the greenhouse gas fixation sector is US\$300 mio and the average project investment size is US\$3.24 mio. In terms of the financial support type, grant support accounts for 93%. The GEF4 invested the largest amount (US\$100 mio) and the GEF5 invested in the largest number of projects (38 projects). In 2013, the investment size was the largest (US\$54 mio) and the largest number of projects (21 projects) was approved. Projects of with a 3-year implementation period account for 26.5%, followed by those with 5-year (20.6%) and 2-year (17.6%) implementation periods. With respect to the beneficiaries, information was investigated only in the European and Central Asia regions. In the greenhouse gas fixation sector, Ethiopia and Nepal have executed many funds and projects associated with a variety of funds. A total of 52 countries participated in this sector. Projects have been implemented in many countries via the LDCF (38 countries), ASAP (28 countries), AF (25 countries), and SCCF (11 countries), in descending order.

## 8. Agriculture/Livestock

The total amount provided for the agriculture/livestock sector is US\$1.133 bio and the average project investment size is US\$6.71 mio. In terms of the financial support type, grant support accounts for 93%. The LDCF invested the largest amount (US\$280 mio) and carried out the largest number of projects (54 projects). In 2013, the investment size was the largest (US\$219 mio). In 2014, investments were made in the largest number of projects (28 projects). Projects with a 4–5-year implementation period account for the largest proportion (58%). In terms of the investment size, those with 4–5-year implementation periods also account for the largest proportion (52%). In terms of beneficiaries, the African region south of the Sahara Desert accounts for the largest proportion (40%).

## 9. Water

The total amount provided for the water sector is US\$1.326 bio and the average project investment size is US\$11.05 mio. In terms of the financial support type, grant support accounts for 82%. The GCF has invested US\$623 mio, that is, the largest amount. In terms of the number of projects, the LDCF has invested in 34 projects, that is, the largest number of projects. The investment size was the largest in 2017 (~US\$400 mio). The largest number of projects was implemented in 2012 (17 projects). Projects with a 4–5-year implementation period account for the largest proportion (59.6%). With respect to the number of beneficiaries, the South Asian region accounts for the largest proportion (58%). A total of 74 countries participates in water-related projects and projects have been carried out in association with various funds by regional alliances,

Cambodia, Mozambique, Uganda, Pakistan, and Cambodia, in descending order. Furthermore, funds have been used to support various countries: in descending order, LCDF (29 countries), AF (26 countries), and SCCF (20 countries).

## **10. Climate Change Prediction and Monitoring**

The total amount provided for the climate change prediction and monitoring sector is US\$343 mio and the average project investment size is US\$3.15 mio. In terms of the financial support type, grant support accounts for 100%. The LDCF invested the largest proportion (US\$120 mio). In terms of the number of projects, the GEF6 invested in 45 projects, that is, the largest number of projects. In 2012, the investment size was the largest (US\$150 mio). The largest number of projects (19 projects) was implemented in 2012 and 2013. Projects with a 4-year implementation period account for 26.5%, that is, the largest proportion. In terms of the number of beneficiaries, the African region south of the Sahara Desert accounts for 99%. While a total of 77 countries participates in this sector, most countries implement projects by participating in one or two funds. The GEF6, GEF5, and LDCF support projects in 37, 28, and 20 countries, respectively.

## **11. Ocean/Fishery/Coast**

The total amount provided for the ocean/marine/coast sector is US\$530 mio and the average project investment size is US\$7.46 mio. In terms of the financial support type, grant support accounts for 99%, that is, the majority. The GCF and LDCF have invested the largest amount (US\$164 mio). In terms of the number of projects, the LDCF has invested in 33 projects. In 2012, the investment size was the largest (US\$85 mio). In 2009, the largest number of projects was carried out (10 projects). Projects with a 4–5-year implementation period account for the largest proportion (~58%). In terms of beneficiaries, East Asia and the Pacific region account for 50.78%, that is, the largest proportion. A total of 44 countries participate; Bangladesh has implemented ocean/marine/coast area-related projects through three funds. Furthermore, the LDCF, SCCF, and AF have supported projects in 25, 9, and 8 countries, respectively.

## **12. Health**

The total amount provided for the health sector is US\$53 mio and the average project investment size is US\$8.84 mio. In terms of the financial support type, grant support accounts for 100%. The LDCF invested US\$31 mio, that is, the largest amount. In terms of the number of projects, the LDCF and SCCF have invested in two projects, respectively. In 2009, the investment size was the largest (US\$16 mio). In 2016, investments were made in the largest number of projects (2 projects). One project each was approved for 4-, 5-, 6-, and 7-year implementation, respectively. In terms of the investment size, the six-year project accounts for 59%. There will be 150,000 beneficiaries in the African region south of the Sahara Desert.

### 13. Forest/Land

The total amount provided for the forest/land sector is US\$1.316 bio and the average project investment size is US\$8.07 mio. In terms of the financial support type, grant support accounts for 95%. The Amf has invested the largest amount (US\$344 mio). The Amf also invested in the largest number of projects (42 projects). In 2014, the investment size was the largest (US\$286 mio). The number of projects was also the largest (31 projects) in 2014. Projects with a 4–5-year implementation period account for 57%. In terms of beneficiaries, the African region south of the Sahara Desert accounts for 81.8%. While a total of 76 countries are participating, Burkina Faso, Ethiopia, Brazil, and regional alliances have implemented projects in the forest/land sector. In terms of funds, the FCPF has supported the largest number of countries (41 countries).

### 14. Multidisciplinary Overlap

The total amount provided for the multidisciplinary overlap sector is US\$127 mio and the average project investment size is US\$7.08 mio. In terms of the financial support type, grant support accounts for 72%. The GCF invested the largest amount, with US\$54 mio, and the GEF4 and GEF5 (6 projects respectively) invested in the largest number of projects. In 2017, the investment size was the largest (US\$54 mio). A total of 1–3 projects was implemented every year. Projects with a 4–5-year implementation period account for the largest proportion (41%) and the number of beneficiaries is the largest in the South Asian region (83.64%). While a total of 18 countries are participating, the GEF mainly supports these multidisciplinary technology projects.

### 15. Others

The total amount provided for the “others” sector is US\$660 mio and the average project investment size is US\$3.6 mio. In terms of the financial support type, grant support accounts for 87%. The PPCF invested the largest amount, with US\$166 mio, and the LDCF invested in the largest number of projects (77 projects). In 2011, the investment size was the largest (US\$125 mio) and the largest number of projects (28 projects) was carried out. The projects with a 1–2-year implementation period account for the largest proportion (51%) and the number of beneficiaries is the largest in the African region south of the Sahara Desert (93.3%). A total of 89 countries have participated in climate-related regular policy projects that are not related to technology. South Africa and the global alliances have implemented projects with 4–5-year funds. The LDCF has supported projects in 52 countries, that is, the largest number of countries.

