INTERGOVERNMENTAL PANEL ON climate change

Working Group III – Mitigation of Climate Change

# Chapter 16

# Cross-cutting Investment and Finance Issues

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# Chapter 16: Cross-Cutting Investment and Finance issues

## Contents

# Executive Summary

For the first time an IPCC assessment report contains a chapter dedicated to investment and finance. These are the chapter's key findings:

**Scientific literature on investment and finance to address climate change is still very limited and knowledge gaps are substantial, there are no agreed definitions for climate investment and climate finance.** Quantitative data are limited, relate to different concepts, and are incomplete. Accounting systems are highly imperfect. Estimates are available for current total climate finance, total climate finance provided to developing countries, public climate finance provided to developing countries and climate finance under the UNFCCC as well as future incremental investment and incremental cost for mitigation measures. Climate finance relates both to adaptation and mitigation while under the scope of this chapter estimates of future investment needs are presented only for mitigation. [16.1]

**Total climate finance for mitigation and adaptation is estimated at USD 343 to 385 billion (2010/11 USD) per year** using a mix of 2010, 2011 and 2012 data, almost evenly being invested in developed and developing countries (*limited evidence, medium agreement).* The figures reflect the total financial flow for the underlying investments *not the incremental investment* i.e. the portion attributed to the emission reductions. Around 95% of reported total climate finance is for mitigation (*limited evidence, high agreement).* [16.2.1.1]

**The total climate finance currently flowing to developing countries is estimated to be between USD 39 to 120 billion per year** using a mix of 2009, 2010, 2011 and 2012 data (2009/2010/2011/2012 USD) *( limited evidence, medium agreement*). This range covers public and the more uncertain flows of private funding for mitigation and adaptation. Public climate finance is estimated at USD 35-49 billion (2011/2012 USD) *(medium confidence)*. Most public climate finance provided to developing countries flows through bilateral and multilateral institutions usually as concessional loans and grants. Robust information on levels of private sector flows from developed to developing countries is virtually unavailable. Climate finance under the UNFCCC is funding provided to developing countries by Annex II Parties. The climate finance reported by Annex II Parties averaged nearly USD 10 billion per year from 2005 to 2010 (2005-2010 USD) *(medium confidence)*. Between 2010 and 2012, the ´fast start finance´ provided by some developed countries amounted to over USD 10 billion per year (2010/2011/2012 USD) *(medium confidence)*. [16.2.1.1]

**Emission patterns that limit temperature increase from pre-industrial level to no more than 2°C require considerably different patterns of investment.** A limited number of studies have examined the investment needs to transform the economy to limit warming to 2°C. Information is largely restricted to energy use. In the results for these scenarios which are consistent to keeping $CO_2$eq concentration in the interval 430-530 ppm until 2100, annual investment in fossil fired power plants without CCS would decline by USD 30 (20%) (2 to 166) billion during the period 2010-2029, compared to the reference scenarios *(limited evidence, medium agreement)*. Investment in low emissions generation technologies (renewable, nuclear and fossil fuels with CCS) would increase by USD 147 (100%) (31 to 360) billion per year during the same period *(limited evidence, medium agreement)* in combination with an increase by USD 336 (1 to 641) billion in energy efficiency investments in the building, transport and industry *(limited evidence, medium agreement).* Higher energy efficiency and the shift to low-emission energy sources contribute to a reduction in the demand for fossil fuels, thus causing a decline in investment in fossil fuel extraction, transformation and transportation. Scenarios suggest that the average annual reduction of investment in fossil fuel extraction in 2010-2029 would be USD 116 (-8 to 369) billion *(limited evidence, medium agreement)*. Such "spillover" effects could yield adverse effects on economies, especially of countries that rely heavily on exports of fossil fuels. Model results suggest that deforestation could be reduced against current deforestation trends by 50% with an investment of USD 21 to 35 billion per year *(low* *confidence).* Information on investment needs in other sectors in addition to energy efficiency e.g. to abate process or non-$CO_2$ emissions is virtually unavailable. [16.2.2]

**Resources to address climate change need to be scaled up considerably over the next few decades both in developed and developing countries** *(medium evidence, high agreement).* Increased financial support by developed countries for mitigation (and adaptation) measures in developing countries will be needed to stimulate the increased investment. Developed countries have committed to a goal of jointly mobilizing USD 100 billion per year by 2020 in the context of meaningful mitigation action and transparency on implementation. The funding could come from a variety of sources, public and private, bilateral and multilateral, including alternative sources of finance. Studies of how USD 100 billion per year could be mobilised by 2020 conclude that it is challenging but feasible. [16.2]

**Public revenues can be raised by collecting carbon taxes and by auctioning carbon allowances** *(high confidence).* Putting a price on GHG emissions, through a carbon tax or emissions trading, alters the rate of return on high and low carbon investments. It makes low emission technologies attract more investment and at the same time it raises a considerable amount of revenue that can be used for a variety of purposes, including climate finance. These carbon-related sources are already sizeable in some countries [16.2.1.2]. The consideration of alternative sources of public revenue like taxes on international bunker fuels have the potential to generate significant funds but is still in its infancy. Reducing fossil fuel subsidies would lower emissions and release public funds for other purposes [16.2.3].

**The private sector plays a central role mitigation within an appropriate enabling environment** *(medium evidence, high agreement).* Its contribution is estimated at USD 267 billion per year in 2010 and 2011 (2010/2011 USD) and at USD 224 billion (2011/2012 USD) per year in 2011 and 2012 on average, which represents around 74% and 62% of overall climate finance respectively *(limited evidence, medium agreement)* [16.2.1].In a range of countries a large share of private sector climate investment relies on low-interest and long-term loans as well as risk guarantees provided by public sector institutions to cover the incremental costs and risks of many mitigation investments. In many countries, therefore, the role of the public sector is crucial in helping these private investments happen. A country's broader context—including the efficiency of its institutions, security of property rights, credibility of policies and other factors—have a substantial impact on whether private firms invest in new technologies and infrastructures. Those same broader factors will probably have a big impact on whether and where investment occurs in response to mitigation policies [16.3]. By the end of 2012, the 20 largest emitting developed and developing countries with lower risk country grades for private sector investments covered 70% of global energy related $CO_2$ emissions (*low confidence).* This makes them attractive for international private sector investment in low-carbon technologies. In many other countries, including most least developed countries, low carbon investment will often have to rely mainly on domestic sources or international public finance [16.4.2].

**A main barrier to the deployment of low-carbon technologies is a low risk-adjusted rate of return on investment vis-à-vis high carbon alternatives often resulting in higher cost of capital** *(medium evidence, high agreement).* This is true in both developed and developing countries. Dedicated financial instruments to address these barriers exist and include inter alia credit insurance to decrease risk, renewable energy premiums to increase return and concessional finance to decrease the cost of capital. Governments can also alter the relative rates of return of low carbon investments in different ways and help to provide an enabling environment. [16.3, 16.4]

**Appropriate governance and institutional arrangements at the national, regional and international level need to be in place for efficient, effective and sustainable financing of mitigation measures.** *(high confidence*). They are essential to ensure that financing to mitigate and adapt to climate change responds to national needs and priorities and that national and international activities are linked and do not contradict each other. An enabling environment at the national level ensures efficient implementation of funds and risk reduction using international resources, national funds as well as national development and financial institutions. [16.5]

**Important synergies and trade-offs between financing mitigation and adaptation exist** *(medium confidence)*. Available estimates show that adaptation projects get only a minor fraction of international climate finance. Current analyses do not provide conclusive results on the most efficient temporal distribution of funding on adaptation vis-à-vis mitigation. While the uncertainties about specific pathways and relationships remain, and although there are different considerations on its optimal balance, there is a general agreement that funding for both mitigation and adaptation is needed. Moreover, there is an increasing interest in promoting integrated financing approaches, addressing both adaptation and mitigation activities in different sectors and at different levels. [16.6]

**Increasing access to modern energy services for meeting basic cooking and lighting needs could yield substantial improvements in human welfare for a relatively low cost** (*medium confidence*). Shifting the large populations that rely on traditional solid fuels (such as unprocessed biomass, charcoal, and coal) to modern energy systems and expanding electricity supply for basic human needs could yield substantial improvements in human welfare for a relatively low cost; USD 72-95 billion per year until 2030 to achieve nearly universal access. [16.8]

## 16.1 Introduction

This is the first time an IPCC assessment report contains a chapter dedicated to investment and finance to address climate change. This reflects the growing awareness of the relevance of these issues for the design of efficient and effective climate policies.

The assessment of this topic is complicated by the absence of agreed definitions, sparse data from disparate sources, and limited peer reviewed literature. Equity, burden sharing and gender considerations related to climate change are discussed in other chapters, inter alia sections 3.3, 4.7.3 and 3.9.2.5 respectively. This chapter does not include a separate discussion of these considerations in relation to climate finance.

There is no agreed definition of climate finance (Haites, 2011; Stadelmann, Roberts, et al., 2011; Buchner et al., 2011; Forstater and Rank, 2012). The term “climate finance” is applied both to the financial resources devoted to addressing climate change globally and to financial flows to developing countries to assist them in addressing climate change. The literature includes multiple concepts within each of these broad categories (Box 1.1). The specific mitigation and adaptation measures whose costs qualify as “climate finance” also are not agreed. The measures included vary across studies and often are determined by the data available[1].

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**Box 1.1.** Different concepts, different numbers

Different concepts of climate finance are found in the literature. The corresponding values differ significantly.

**Financial resources devoted to addressing climate change globally:**
***Total climate finance*** includes all financial flows whose expected effect is to reduce net greenhouse emissions and/or to enhance resilience to the impacts of climate variability and the projected climate change. This covers private and public funds, domestic and international flows, expenditures for mitigation and adaptation, and adaptation to current climate variability as well as future climate change. It covers the full value of the financial flow rather than the share associated with the climate change benefit; e.g. the entire investment in a wind turbine rather than the portion attributed to the emission reductions. The estimate by Buchner et al. (2012; 2013) of current climate finance of USD 343 to 385 billion (2010/11 USD) per year using a mix of 2010, 2011 and 2012 data, corresponds roughly to this concept.

The ***incremental investment*** is the extra capital required for the initial investment for a mitigation or adaptation project in comparison to a reference project. For example the investment in wind turbines less the investment that would have been required for the coal or natural gas generating unit displaced. Since the value depends on the unknown investment in a hypothetical alternative, the incremental investment is uncertain. Incremental investment for mitigation and adaptation measures is not regularly estimated and reported, but estimates are available from models. It can be positive or negative. Many agriculture and REDD+ mitigation options that involve ongoing expenditures for labor and other operating costs rather than investments are excluded.

The ***incremental cost*** reflects the cost of capital of the incremental investment and the change of operating and maintenance costs for a mitigation or adaptation project in comparison to a reference project. It can be calculated as the difference of the net present values of the two projects. Many

[1] Most of the financial flow data in this chapter originate from 2010, 2011 and 2012 and were published in USD. The exchange rates used by each source to convert other currencies to USD are not specified in the published sources. In these cases the published USD figure has been maintained and the base year is similar to the year the commitment/investment/flow was announced/reported. If no base year is indicated, as for most monetary values in section 16.2.2, the base year is 2010.

mitigation measures, such as energy efficiency, renewables and nuclear, have a higher capital cost and lower operating costs than the measures displaced. Frequently the incremental cost is lower than the incremental investment. Values depend on the incremental investment as well as projected operating costs, including fossil fuel prices, and the discount rate. Models can estimate the incremental cost of energy supply and demand but data is not immediately available and aggregate estimates cannot be provided. Estimates are available for single mitigation options (see e.g. Chapter 7).

The ***macroeconomic cost of mitigation policy*** is the reduction of aggregate consumption or gross domestic product induced by the reallocation of investments and expenditures induced by climate policy. These costs do not account for the benefit of reducing anthropogenic climate change and should thus be assessed against the economic benefit of avoided climate change impacts. Models have traditionally provided estimates of the macroeconomic cost of climate policy (see Chapter 6).

**Financial flows to developing countries to assist them in addressing climate change:**

The ***total climate finance flowing to developing countries*** is the amount of the total climate finance invested in developing countries that comes from developed countries. This covers private and public funds for mitigation and adaptation. Estimates from a few studies suggest the current flow is between USD 39 and 120 billion per year (2009 - 2012 USD).

***Public climate finance provided to developing countries*** is the finance provided by governments and bilateral and multilateral institutions for mitigation and adaptation activities in developing countries. Most of the funds provided are concessional loans and grants. Estimates suggest that public climate finance flows to developing countries were at USD 35 to 49 billion per year in 2011 and 2012 (USD 2011/2012).

***Under the UNFCCC, climate finance*** is funding provided to developing countries by Annex II Parties for climate related activities. Most of the funds provided are concessional loans and grants. The climate finance provided to developing countries reported by Annex II Parties averaged nearly USD 10 billion per year from 2005 to 2010 (2005 - 2010 USD). In addition, some developed countries promised fast start finance amounting to over USD 10 billion per year between 2010 and 2012 (2010/2011/2012 USD).

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The rest of the chapter is structured as follows: section 16.2 reviews estimates of current climate finance corresponding to the different concepts in Box 1, projections of global incremental investment and incremental cost for energy-related mitigation measures to 2030 and options for raising public funds for climate finance. Enabling factors that influence the ability to efficiently generate and implement climate finance are discussed in section 16.3. Section 16.4 considers opportunities and key drivers for low-carbon investments. Institutional arrangements for mitigation finance are addressed in section 16.5. Synergies and trade-offs between financing mitigation and adaptation are discussed in section 16.6. The chapter concludes with sections devoted to financing mitigation activities in developed (16.7) and developing countries (16.8) and a review of important gaps of knowledge (16.9).

## 16.2 Scale of financing at national, regional and international level in short-, mid- and long-term

### 16.2.1 Current financial flows and sources

Figure 16.1 provides an overview of climate finance and the terms used in this chapter. The term “capital” is used because most climate finance involves an investment, but it should be understood to include all relevant financial flows.[2] One or more capital managers mobilize the required capital and invest it in an adaptation or mitigation project. A project owner or sponsor– a government, corporation or household – implements a project using his own and other sources of capital. However, projects often obtain capital from multiple capital managers (Buchner et al., 2011, 2012; Jürgens et al., 2012). An instrument defines the financial agreement between a project owner/sponsor and a manager of capital. A project that obtains capital from several managers would use multiple instruments. The size of the boxes is not related to the magnitude of the financial flow.

Data on current climate finance, summarized below, indicate that most capital deployed is private – private corporations and households. That is not surprising since they dominate the economy in most countries.

Domestically, government funds are disbursed directly as financial incentives or tax credits, or through national financial institutions. Climate finance under the UNFCCC currently is provided mainly by the national governments of Annex II Parties. Climate finance from the budgets of these government flows through bilateral institutions being a national public entity, such as JICA, AFD, KfW, or through multilateral institutions having several countries as shareholders, such as the World Bank, regional development banks, and multilateral climate funds.

There is no internationally agreed definition of mitigation and adaptation projects; for example, whether a high efficiency gas-fired generating unit is a mitigation project or which capacity building activities help to address climate change. The relevant projects, and hence the scale of climate finance, depend upon the definition of mitigation and adaptation projects adopted. In practice, the definition varies across studies and is often determined by the data available.

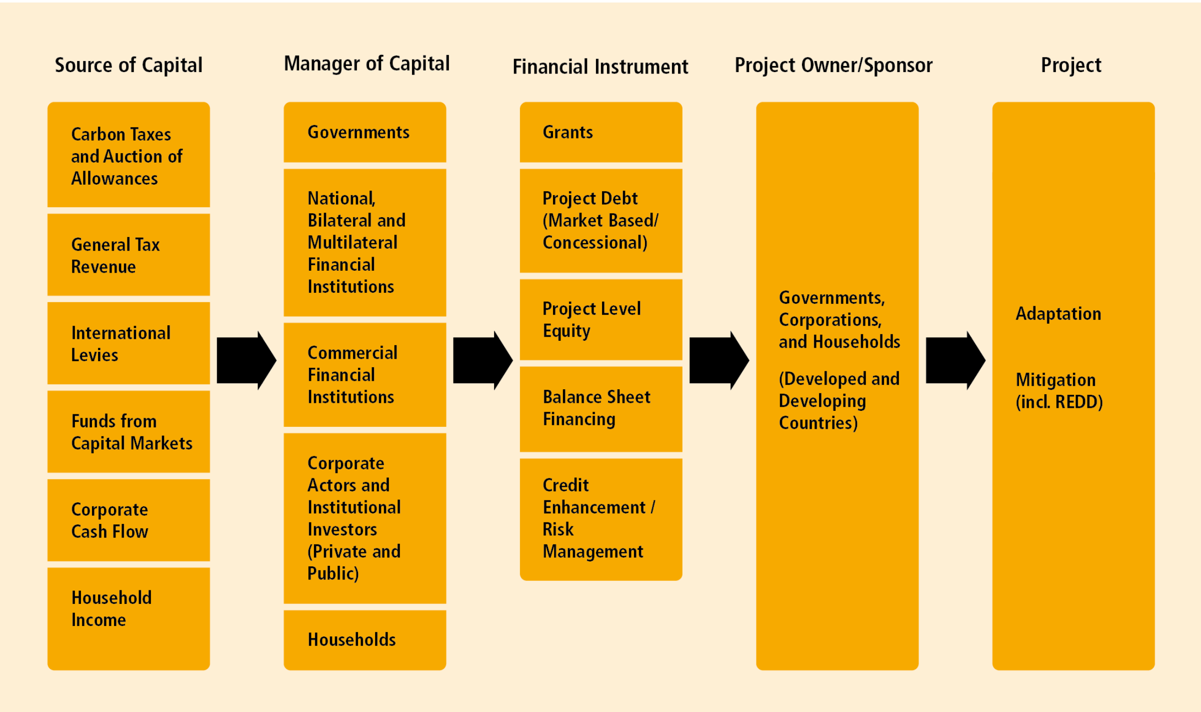


**Figure 16.1.** Overview of climate finance flows. Note: Capital should be understood to include all relevant financial flows. The size of the boxes is not related to the magnitude of the financial flow.

[2] Terms that cover both capital and operating costs, such as "financial resources" or "funds" are cumbersome (sources/managers of financial resources) or potentially confusing ("funds" can also be institutions).

#### *16.2.1.1 Estimates of current climate finance*

This subsection reviews estimates of current global total climate finance, total climate finance flowing to developing countries, public climate finance provided to developing countries and climate finance under the UNFCCC.

There is no comprehensive system for tracking climate finance (Clapp et al., 2012; Tirpak et al., 2012), therefore estimates must be compiled from disparate sources of variable quality and timeliness, sources that use different assumptions and methodologies and have gaps and may occasionally duplicate coverage. Available data typically relate to commitments rather than disbursements, so the amount reported may not equal the amount received by the project owner during a given year. Changes in exchange rates further complicate the picture. For these and other reasons estimates of current climate finance exhibit considerable uncertainties.

**Global total climate finance** is estimated at USD 343 to 385 billion per year for 2010/11 (2010/11 USD) and USD 356 to 363 billion per year for 2011/12 (2011/12 USD), with mitigation accounting for approximately 95% of this amount (USD 350 billion and USD 337 billion respectively)(Buchner et al., 2012; Buchner, Hervé-Mignucci, et al., 2013). This estimate includes a mix of instruments, e.g. grants, concessional loans, commercial loans and equity, as well as the full investment in mitigation measures such as renewable energy generation technologies that also produce other goods or services[3]. The figures reflect new commitments by capital managers using a mix of 2010/11 and 2011/12 data respectively. Private finance dominates the total, but its share declined from 74% (USD 267 billion) on average in 2010 and 2011 to 62% (USD 224 billion) on average in 2011 and 2012 (2010/2011 USD and 2011/2012 USD) (Buchner et al., 2012; Buchner, Hervé-Mignucci, et al., 2013). Investment in renewable generation technologies dominates the mitigation investment (Frankfurt School-UNEP Centre and BNEF, 2012).

Reasonably robust estimates of **total climate finance for individual countries** are available for only a few cases, for instance for Germany (Jürgens et al., 2012). However, some institutions report on their financing commitments for climate and environment. Data from 19 development banks indicate that commitments of mitigation finance increased from USD 51 billion in 2011 to USD 65 billion in 2012 with commitments of adaptation finance rising from USD 6 to USD 14 billion over the same period (2011 USD and 2012 USD). Concessional funding provided by public development banks plays an important role in financing domestic climate projects e.g. in Brazil, China and Germany.

A growing number of developed and developing countries, including Bangladesh, Colombia, Indonesia, Nepal, Samoa, Tanzania, Uganda and the United States as well as the European Commission, calculates the share of their annual budget devoted to climate change mitigation and adaptation often using a methodology known as a Climate Public Expenditure and Institutional Review (UNDP, 2013a). Country estimates range from 3-15% of the national budget.

A few estimates of **total climate finance flowing to developing countries** are available. Clapp et al. (2012) estimate the total at USD 70-120 billion per year based on 2009-2010 data (2009/2010 USD). Data from Buchner et al. (2013) suggest a net flow to developing countries of the order of USD 40 to 60 billion for 2010 and 2011 (2010/2011 USD).[4] For 2011 and 2012 North-South flows are estimate

[3] Methodology used by Buchner et al. (2012; 2013): Finance flows are limited to 'climate-specific finance', capital flows targeting low-carbon and climate-resilient development with direct or indirect greenhouse gase mitigation or adaptation objectives/outcomes. The focus is on current financial flows (upfront capital investment costs and grants expressed as commitments, so risk management instruments are excluded). Data are for total, rather than incremental, investment because incremental investment requires assumptions on the baseline on a project-by-project basis. The data are for 'gross' investment, the full value of the investment, and reflect commitments because disbursement data is not widely available. The data are a mix of 2010 and 2011 data, and 2011 and 2012 data respectively.

[4] Buchner et al. (2013) estimate that developed countries mobilized USD 213 to 255 billion climate finance per year during 2010 and 2011 while USD 160 to 208 billion climate finance had been committed to climate

at USD 39 to 62 billion (2011/2012 USD) (Buchner, Hervé-Mignucci, et al., 2013). Robust information on the magnitude of private flows from developed to developing countries is highly uncertain. Clapp et al. (2012) estimate the private investment at USD 37-72 billion (2009/2010 USD) per year based on 2009-2010 data and Stadelmann et al. (2013) estimate those flows at USD 10 to 37 billion per year based on 2008-2011 data (2010 USD and 2008 USD).

The investment in registered **CDM** projects is estimated at over USD 400 billion over the period 2004 to 2012 (2004-2012 USD)(UNEP Risø, 2013). Of that amount almost USD 80 billion was for projects registered during 2011 and USD 195 billion for projects registered during 2012 (2011 USD and 2012 USD). All of the investment in CDM projects is private. Renewable energy projects account for over 70% of the total investment. The share of CDM renewable energy projects with some foreign investment has grown over time, representing almost USD 25 billion in 2011 (2011 USD) (Kirkman et al., 2013).[5]

Since 1999 almost 100 **carbon funds** with a capitalisation of USD 14.2 billion have been established (Alberola and Stephan, 2010).[6] Carbon funds are investment vehicles which raise capital to purchase carbon credits (52%) and/or invest in emission reduction projects (23%). A fund may have only private investors (48%) only public investors (29%) or a mix of both (23%) (Alberola and Stephan, 2010). Investment may be restricted to a specific region or project type (e.g., REDD+). Financial data, especially for private funds, is often confidential so the amount of finance provided to developing countries via carbon funds is not available. Scaling up data from 29 funds on the amount invested in projects suggests a maximum cumulative investment of USD 18 billion (1999-2009 USD) (Kirkman et al., 2013).

**Public climate finance provided to developing countries** was estimated at USD 35 to 49 billion per year in 2011 and 2012 (2011/2012 USD) (Buchner, Hervé-Mignucci, et al., 2013).[7] These public funds flow mainly through bilateral and multilateral institutions[8]. Most of the climate finance is implemented by development banks, frequently involving the blending of government resources with their own funds. There two main reporting systems for public support in place which are not fully comparable due to differences in respective methodologies.

The OECD Development Assistance Committee (DAC) reports the amount of official development assistance (ODA) committed bilaterally for projects that have climate change mitigation or adaptation as a "principal" or "significant" objective by its 23 member countries and the European Commission. The DAC defines ODA as those flows to countries on the DAC List of ODA Recipients and to multilateral institutions provided by official agencies or by their executive agencies. Resources must be used to promote the economic development and welfare of developing countries as a main

change projects in developed countries. Developing countries mobilized USD 120 to 141 billion climate finance per year during 2010 and 2011 and USD 162 to 202 billion had been committed to climate change projects in developing countries. Those figures suggest a net flow to developing countries of the order of USD 40 to 60 billion per year (2010/2011 USD).

[5] CDM projects sell emission reduction credits (CERs) to developed country buyers, which provides a return to developed country investors.

[6] UNDP estimates that in addition up to 6,000 private equity funds have been established for the purpose of funding climate-change-related activities (UNDP, 2011).

[7] Buchner et al. (2013) count climate finance provided by bilateral finance institutions, multilateral finance institutions, government bodies and climate funds as public flows. The difference between lower and upper bound results when taking the ownership structure of multilateral institutions into account and excluding all bilateral flows marked as having climate as "significant" objective.

[8] Ryan et al. (2012) estimate the annual average finance provided to developing countries for energy efficiency at USD 18.9 billion in 2010 from bilateral financial institutions and USD 4.9 billion from multilateral financial institutions over the period 2008-2011.

objective and they must be concessional in character, meaning as grants or as concessional loans including a grant element of at least 25 %, calculated at a rate of discount of 10 per cent. The amount is the total funding committed to each project not the share of the project cost attributable to climate change (OECD, 2013a). Researchers have questioned the accuracy of the project classification (Michaelowa and Michaelowa, 2011; Junghans and Harmeling, 2013). Bilateral commitments averaged USD 20 billion per year in 2010 and 2011 (2010/2011 USD) (OECD, 2013a) and were implemented by bilateral development banks or other bilateral agencies, provided to national government directly or to dedicated multilateral climate funds (Buchner et al., 2012; Buchner, Hervé-Mignucci, et al., 2013)

Seven multilateral development banks (MDBs)[9] reported climate finance commitments of about USD 24.1 and USD 26.8 billion in 2011 and 2012 respectively (2011 USD and 2012 USD). The reporting is activity-based allowing counting entire projects but also project components. Recipient countries include developing countries and 13 EU member states. It covers grant, loan, guarantee, equity and performance-based instruments, not requiring a specific grant element. The volume covers MDBs' own resources as well as external resources managed by the MDBs that are also reported to OECD DAC (such as contributions to the GEF, CIFs and Carbon Funds) (AfDB et al., 2012a; b, 2013).

**Under the UNFCCC, Climate Finance** is not well defined. Annex II parties committed to provide new and additional financial resources to cover the 'agreed full incremental costs' of agreed mitigation measures implemented by developing countries (Article 4.3), to 'assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation' (Article 4.4) and to cover the agreed full costs incurred by developing countries for the preparation of their national communications (Article 4.3) (UNFCCC, 1992). None of these terms are operationally defined (Machado-Filho, 2011). These commitments are reaffirmed by the Kyoto Protocol (UNFCCC, 1998, Art. 11). The COP has agreed that funds provided to developing country Parties may come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources (UNFCCC, 2010, para. 99).

Annex II Parties report the financial resources they provide to developing countries through bilateral and multilateral channels for climate change action to increase transparency about public flows of climate finance vis-à-vis expectations and needs. The latest summary of the Annex II reports on their provided climate finance indicates that they provided a total of USD 58.4 billion for the period 2005 through 2010, an average of nearly USD 10 billion per year (2005 - 2010 USD) (UNFCCC, 2011a).[10] Most of the funds provided are concessional loans and grants. In addition, a range of developed countries promised ´fast start finance´ of about USD 10 billion per year from 2010 to 2012 (2010/2011/2012 USD) (see 16.2.1.3 below).[11]

Operating entities of the financial mechanism of the UNFCCC deal with less than 10% of the climate finance reported under the Convention, although that could change once the Green Climate Fund

[9] African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank (IDB), the World Bank (WB) and the International Finance Corporation (IFC).

[10] Although there is an agreed reporting format, the UNFCCC secretariat notes that many data gaps and inconsistencies persist in the reporting approaches of Annex II Parties. The information is compiled by the UNFCCC Secretariat form Annex II national communications. The figures represent "as committed or "as spent" currency over the 6 years. The procedure used by different countries and the Secretariat to convert currencies into USD are not known.

[11] Although COP took note of the ´fast start finance´ commitment in paragraph 95 of Decision 1/CP.16 (UNFCCC, 2010) and the funds committed have been reported annually to the UNFCCC, the fast start finance is not formally climate finance under the UNFCCC.

(GCF) becomes operational. Annex II Party contributions to the Trust Fund of the Global Environment Facility (GEF), the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF) amounted to about USD 3.3 billion for 2005 through 2010, an average of less than USD 0.6 billion per year (2005 - 2010 USD) (UNFCCC, 2011a). Most of the funds are used for mitigation. The Adaptation Fund derives most of its funds from the sale of its share of the CERs issued for CDM projects[12].

#### *16.2.1.2 Current sources of climate finance*

Climate finance comes from the sources of capital shown in figure 16.1 including capital markets, carbon markets and government budgets. Most government funding comes from general revenue but some governments also raise revenue from sources – carbon taxes and auctioned greenhouse gas emission allowances – that have mitigation benefits. Most corporate funding comes from corporate cash flow including corporate borrowing; often called balance sheet finance (Frankfurt School-UNEP Centre, 2013).[13] Household funding comes from household income from wages, investments and other sources. Governments, corporations and households can all access capital markets to mobilize additional funds.

This subsection summarizes estimates of the revenue currently generated by carbon taxes and auctioned greenhouse gas emission allowances. Fuel taxes, fossil fuel royalties and electricity charges can be converted to $CO_2$ equivalent charges but they are excluded here because they are usually implemented for different policy goals.

**Carbon taxes** generate about USD 7 billion in revenue annually mainly in European countries (2010/2011 USD).[14] Denmark, Finland, Germany, Ireland, Italy, Netherlands, Norway, Slovenia, Sweden, Switzerland, and the UK – generated about USD 6.8 billion in 2010 (2010 USD) and USD 7.3 billion (2011 USD) in 2011. India[15], Australia and Japan introduced carbon taxes in July 2010, July 2012 and October 2012 respectively. In some countries part or all of the revenue is dedicated to environmental purposes or reducing other taxes; none is earmarked for international climate finance.

Auctioned allowances, fixed price compliance options and the international sale of surplus AAUs generate about USD 2 billion per year for national governments (2010/2011 USD). Among the 30 countries participating in the EU emissions trading scheme, Austria, Germany, Hungary, Ireland, the Netherlands, Norway and the United Kingdom auctioned some allowances during the second (2008-2012) phase (European Commission, 2012). Buchner et al. (2011, 2012) estimate auction revenue at USD 1.4 and USD 1.6 billion for 2010 and 2011 (2010/2011 USD). Germany has so far earmarked a portion of its auction revenue for international climate finance (Germany Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2012). New Zealand collected USD 1.25 and 1.42 million for 2010 (six months) and 2011 respectively from its fixed price compliance option of USD 10.8 per ton of $CO_2$ (NZD 15) (New Zealand Ministry for the Environment, 2012).

[12] Currently the only international levy is the two per cent of the CERs issued for most CDM projects provided to the Adaptation Fund. The Fund sells the CERs and uses the proceeds for adaptation projects in developing countries. Sale of CERs generated revenue of over USD 90 million for FY 2010 (2010 USD and 2011 USD) and over USD 50 million for FY 2011 (World Bank, 2012a). In December 2012 Parties agreed to extend the share of proceeds levy to the issuance of ERUs and the first international transfers of AAUs (UNFCCC, 2012a, para. 21).

[13] General revenue includes revenue collected from all taxes and charges imposed by a government. Balance sheet finance means that a new investment is financed by the firm rather than as a separate project. The firm may seek external funding (debt and/or equity) but that funding is secured by the operations of the firm rather than the new investment.

[14] Revenue from taxes explicitly named carbon taxes in the OECD database of environmentally-related taxes, available at http://www2.oecd.org/ecoinst/queries/index.htm.

[15] In India the carbon tax is on coal only.

Several eastern European countries (Estonia, Czech Republic, Poland and Russia) sell surplus assigned amount units (AAUs) to generate revenue. Others such as Bulgaria, Latvia, Lithuania, Slovakia and Ukraine, sell their surplus AAUs to fund Green Investment Schemes that support domestic emission reduction measures (Linacre et al., 2011).[16] Revenue rose from USD 276 million in 2008 (2008 USD) to USD 2 billion in 2009 (2009 USD) and then declined to less than USD 1.1 billion in 2010 (2010 USD) (Kossoy and Ambrosi, 2010; Linacre et al., 2011; Tuerk et al., 2013). Buchner at al. (2011, 2012) estimate the revenue at USD 580 and USD 240 million for 2010 and 2011 respectively (2010 USD and 2011 USD).

#### *16.2.1.3 Recent developments*

Climate finance has been affected by the financial crisis of late 2008, the subsequent stimulus packages and the fast start finance commitment of USD 30 billion for 2010-2012 made by developed countries in December 2009 for climate action in developing countries.

The **financial crisis** in late 2008 reduced investment in renewable energy (Hamilton and Justice, 2009). In late 2008 and early 2009, investment in renewable generation fell disproportionately more than that in other types of generating capacity (IEA, 2009). Global investment in renewable energy fell 3% during 2009 but rebounded strongly in 2010 and 2011. In developed countries, where the financial crisis hit hardest, investment dropped 14% while renewable energy investment continued to grow in developing countries (Frankfurt School-UNEP Centre and BNEF, 2012).

In response to the financial crisis, G20 governments implemented **economic stimulus packages** amounting to USD 2.6 trillion dollars. Of that amount, USD 180 to 242 billion was low-carbon funding (2008 USD and 2009 USD) (IEA, 2009; REN21, 2010). The stimulus spending supported the rapid recovery of renewable energy investment by compensating for reduced financing from banks. Some countries facing large public sector deficits scaled down green spending when the economy started recovering (Eyraud et al., 2011).

At the UN Climate Change Conference in Copenhagen in 2009, developed countries committed to provide new and additional resources approaching USD 30 billion of '**fast start finance**' to support mitigation and adaptation action in developing countries during 2010-2012 (UNFCCC, 2009a). The sum of the announced commitments exceeds USD 33 billion (UNFCCC, 2011b, 2012b; c, 2013a)[17]. Japan, USA, UK, Norway and Germany being the five biggest donors have reported commitments amounting to USD 27 billion (2010/2011/2012 USD). Nakooda et al. (2013) finds that around 45% have been provided as grants and around 47% in the form of loans, guarantees and insurance. Approximately 61% of the funds had been committed for mitigation, 10% for REDD+ and 18% for adaptation. The funders reported commitments to recipient country governments via bilateral channels (33%), multilateral climate funds (20%), recipient countries companies (12%) and multilateral institutions (9%). Data on actual disbursements is not available to date because of the multi-year time lag between commitment and disbursement.

The announced pledges triggered questions as to whether they were "new and additional" as promised (Fallasch and De Marez, 2010; BNEF, 2011). Some countries explain the basis on which they consider their pledge to be "new and additional". Criteria have been proposed that, when applied to the pledges, indicate that proportions ranging from virtually none to almost all are new and additional (Brown et al., 2010; Stadelmann et al., 2010; Stadelmann, Roberts, et al., 2011). For Germany, Japan, the United Kingdom and the United States annual FSF contributions were

[16] The Green Investment Schemes are a source of climate finance for these countries.

[17] The information is compiled by the UNFCCC Secretariat from national reports on fast start finance. The figures represent "as committed" currency over the 3 years. The procedures used by different countries and the Secretariat to convert currencies into USD are not known.

significantly higher than the 2009 expenditure related to climate activities in developing countries (Nakooda et al., 2013).

### 16.2.2 Future low-carbon investment

As noted in chapter 6, "Stabilization (of GHGs) will ultimately require dramatic changes in the world's energy system, including a dramatic expansion in the deployment of low-carbon energy sources." This change will require significant shifts in global investment in the energy, land use, transportation and infrastructure sector. The future investment flows summarized in this section are based on several large-scale analyses conducted over the past few years. For the most part these analyses explore scenarios to achieve specified temperature or concentration goals. Hence, the estimates of investment flows drawn from these studies should not be interpreted as forecasts, but rather, as some probable future states of the world.

Figure 16.2 presents estimates of baseline i.e. current investment in energy supply sub-sectors as a reference for the following considerations. It illustrates the very substantial nature of investments in today's energy sector with very strong roles for investments in fossil fuel extraction, transmission and distribution, and electricity generation.

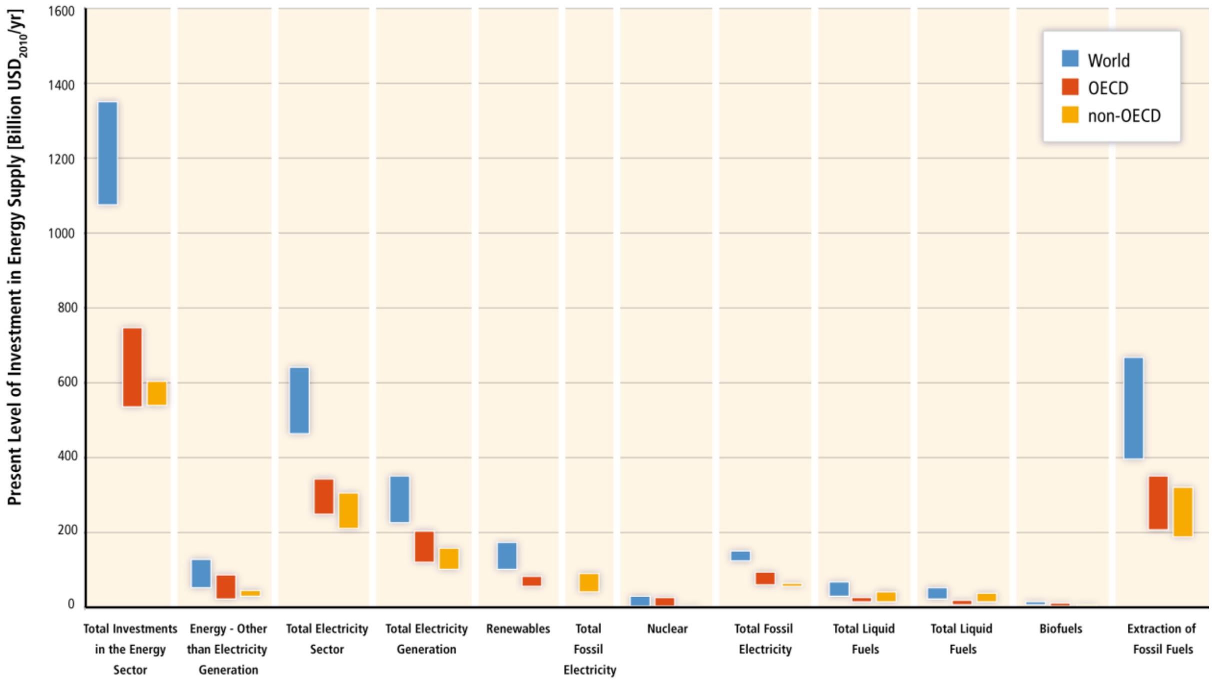


**Figure 16.2.** Present level of investment in energy supply. Note: The bars indicate the minimum and maximum level of investments found in the literature. Ranges result from different sources of market information and differing definitions of the investment components to be included. Source: From McCollum et al. (2013) based on data from IEA World Energy Outlook 2011 (IEA, 2011) and GEA (Riahi et al., 2012).

#### *16.2.2.1 Investment needs*

While a large number of studies and many modeling comparison exercises have assessed technological transformation pathways and the macroeconomic cost of transforming the global economy, only a handful of studies estimate the associated investment needs. Section 16.2.2.2 summarizes available estimates of investment needs under climate policy between 2010-2029 and 2030-2049, for the world as a whole and for non-OECD countries. Models and scenarios differ so the focus is on incremental investment, i.e. the differences in the estimated investment between the reference and mitigation scenarios.[18] It must also be noted that the model estimates crucially rely on assumptions about the future costs of technologies and of subsidies, on the possibility of nuclear phase-out in some countries and on the mitigation policies already included in the reference scenarios.

**Without climate policy**, investments in the power sector would mainly be directed towards fossil fuels, especially in non-OECD countries that rely on low-cost coal power plants to supply their growing demand for electricity. At the global level, fossil fuel-based power generation would require an average annual investment of USD 182 (95 to 234) billion in 2010-2029 and USD 287 (158 to 364) billion in 2030-2049;[19] the bulk of investments (roughly 80%) goes to non-OECD countries.[20] There is greater uncertainty in models about the future of renewable and nuclear power without climate policy. Modeled global investment in renewable power generation is expected to increase over time from USD 123 (31 to 180) billion per year in 2010-2029 to USD 233 (131 to 336) billion over 2030-2049. Nuclear power generation would attract USD 55 (11 to 131) billion annually in 2010-2029 and 90 (0 to 155) billion per year in 2030-2049.

The **introduction of an emission reduction target** in the models abruptly changes the investment pattern. Figures 16.3 and 16.4 report the investment change for major power generation technologies, fossil fuel extraction and for end-use energy efficiency, for emission scenarios compatible with a long-term target of keeping mean global temperature increase below 2°C in 2100.[21] Although the policy targets are not identical, they are close enough to allow a broad comparison of results. The dispersion across estimated emission reductions over 2010-2029 and 2010-2049 is mainly due to differences in reference scenario emissions and because models choose different optimal emission trajectories among the many compatible with the long-term climate goal.

The results of an analysis of investment estimates in figures 16.3 and 16.4, show that climate policy is expected to induce a major reallocation of investments in the power sector. Investments in fossil fired power plants (without CCS) were equal to about USD 137 billion per year in 2010. Investment would decline by USD 30 (2 to 166) billion per year (about -20% for the median) during the period 2010-2029, compared to the reference scenarios. Investment in low emissions generation technologies (renewable, nuclear and fossil fuels with CCS) would increase by USD 147 (31 to 360) billion per year (about 100% for the median) during the same period.

Based on a limited number of studies (McKinsey, 2009; IEA, 2011; Riahi et al., 2012) annual incremental investments until 2030 in energy efficiency investments in the building, transport and industry sector increase by USD 336 (1 to 641) billion. The only three studies with sectoral detail in end-use technologies show an increase of investments of USD 153 (57 to 228) for the building sector, USD 198 (98 to 344) billion for the transport sector, USD 80 (40 to 131) billion for the industry sector. Incremental investments in end-use technologies are particularly hard to estimate and the number of studies is limited (Riahi et al., 2012). Results should therefore be taken with caution.

While models tend to agree on the relative importance of investments in fossil and non-fossil power generation, they differ with respect to the mix of low-emission power generation technologies and the overall incremental investment. This is mainly due to different reference scenarios (e.g. population, economic growth, exogenous technological progress) and assumptions about (1) the

[18] Adaptation costs and economic losses from future climate change are not considered in any of these estimates.

[19] The mean should not be considered as an expected value. It is not possible to attribute any probability distribution to models' outcomes. Therefore policy makers face pure uncertainty in face of future investment needs. The range is presented to provide information on the degree of uncertainty in the literature.

[20] See notes to figures 16.3 and 16.4 for a list of the studies surveyed.

[21] Also in this case the mean and median are used as synthetic indicators having no predictive power.

structure of the energy system and the cost of reducing the energy intensity of the economy versus reducing the carbon intensity of energy, (2) the investment costs of alternative technologies over time and (3) technological or political constraints on technologies. Limits to the deployment of some key technology options or the presence of policy constraints (e.g. delayed action, limited geographical participation) would increase investment needs (Riahi et al., 2012; McCollum et al., 2013).

Higher energy efficiency, technological innovation in transport and the shift to low-emission generation technologies - all contribute to a drastic reduction in the demand for fossil fuels, thus causing a sharp decline in investment in fossil fuel extraction, transformation and transportation. Scenarios from a limited number of models suggest that average annual investment reduction in 2010-2029 would be equal to USD 56 (-8 to 369) billion. The contraction would be sharper in 2030-2049, in the order of USD 451 (332 to 1385) billion per year. All models that provide data on investments for fossil fuel extraction show that overall investments in energy supply would decrease against the baseline trends in scenarios consistent with the 2°C limit (IEA, 2011; Carraro et al., 2012; Riahi et al., 2012; McCollum et al., 2013).

According to a range of models climate policy would thus substantially change the allocation of baseline energy investments rather than increase overall demand for energy investment.

Models with a separate consideration of energy efficiency measures foresee the need for significant incremental investment in energy efficiency in the building, transport and industry sector in addition to the reallocation of investment from high-carbon to low-carbon power supply.

There is wide agreement among model results on the necessity to ramp-up investments in R&D to increase end-use energy efficiency and to improve low emission generation energy carriers and energy transformation technologies. Estimates of the additional funding needed for energy-related R&D range from USD 4.5 to 78 billion per year during 2010-2029 (UNFCCC, 2007; Carraro et al., 2012; McCollum et al., 2013) and from USD 115 to 126 billion per year in 2030-2049 (Carraro et al., 2012; Marangoni and Tavoni, 2013; McCollum et al., 2013). Because of the need for new low carbon alternatives investments in R&D are higher in case of nuclear phase-out and other technological constraints (Bosetti et al., 2011).

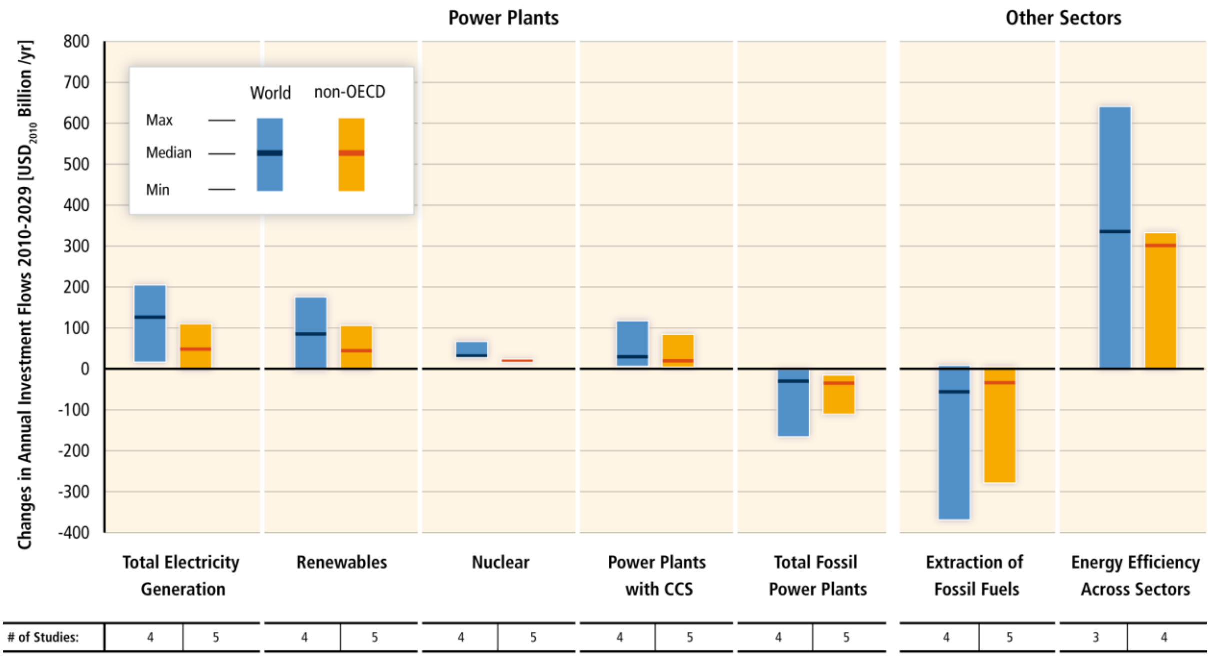


**Figure 16.3.** Change of average annual investment in mitigation scenarios (2010-2029). Investment changes are calculated by a limited number of model studies and model comparisons for mitigation scenarios that stabilize GHG concentrations within the range of approx. 430-530 ppm $CO_2$eq by 2100 compared to respective average baseline investments. Note: The vertical bars indicate the range between minimum and maximum estimate of investment changes; the horizontal bar indicates the median of model results. Proximity to this median value does not imply higher likelihood because of the different degree of aggregation of model results, low number of studies available and different assumptions in the different studies considered. The numbers in the bottom row show the total number of studies available in the literature. Sources: IEA (2011): 450 Scenario (450) relative to the Constant Policies Scenario (CPS). CPS Investment in CCS is also included under Coal & Gas (retrofitting); World investment in biofuels includes international bunkers; investment in solar PV in buildings is attributed to power plants in supply-side investment. Riahi et al. (2012): the Global Energy Assessment Mix scenario (GEA-Mix) relative to the GEA reference scenario. Carraro et al. (2012): 460 ppm CO2eq in 2100 (t460) relative to reference scenario. McCollum et al. (2013): the LIMITS (Low Climate Impact Scenarios and Implications of Required Tight Emission Control Strategies) RefPol-450 scenario (2.8 W/m2 in 2100) relative to the reference scenarios, mean of six models. McKinsey (2009), data obtained from Climate Desk, S2015 scenario with full technological potential, 100% success rate, negative lever of costs, beginning of policy in 2015. IEA (2011), McKinsey (2009) and UNFCCC (2008) provide data only for 2010-2029. Regions: World and non-OECD.

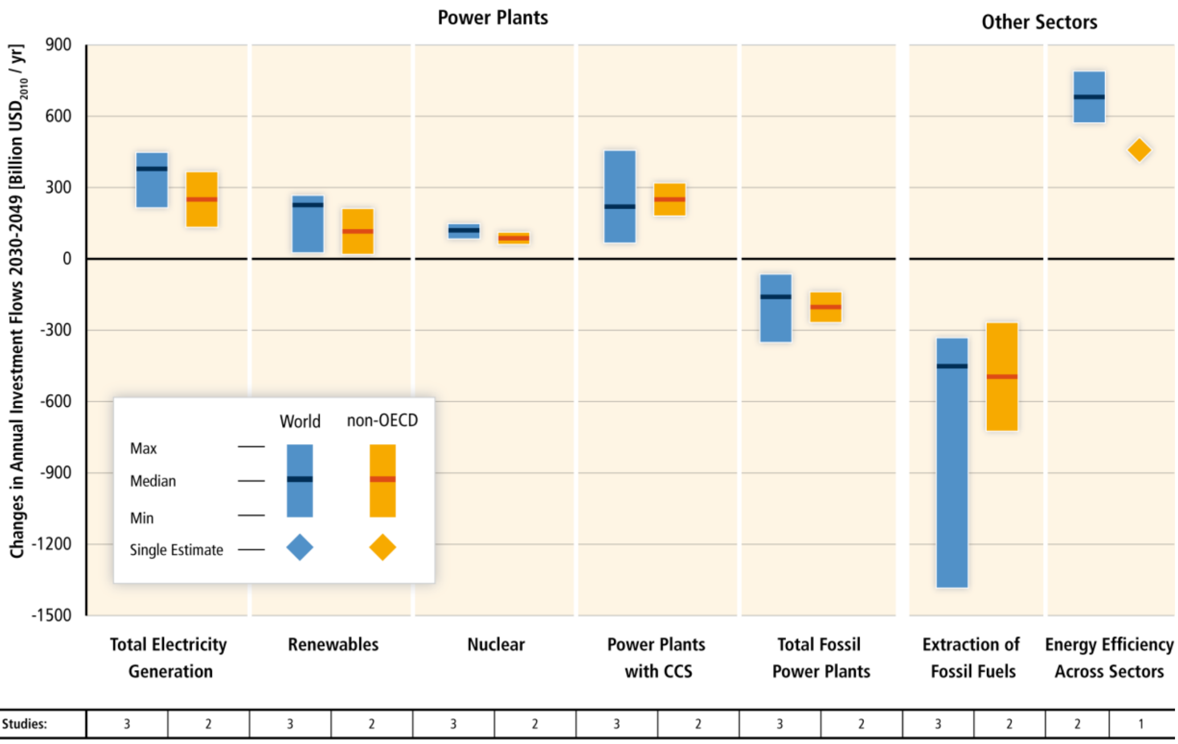


**Figure 16.4.** Change of average annual investment in mitigation scenarios (2030-2049). Investment changes are calculated by a limited number of model studies and model comparisons for mitigation scenarios that stabilize GHG concentrations within the range of approx. 430-530 ppm $CO_2$eq by 2100 compared to respective average baseline investments. Note: The vertical bars indicate the range between minimum and maximum estimate of investment changes; the horizontal bar indicates the median of model results. Proximity to this median value does not imply higher likelihood because of the different degree of aggregation of model results, low number of studies available and different assumptions in the different studies considered. The numbers in the bottom row show the total number of studies available in the literature. Sources: IEA (2011): 450 Scenario (450) relative to the Constant Policies Scenario (CPS). CPS Investment in CCS is also included under Coal & Gas (retrofitting); World investment in biofuels includes international bunkers; investment in solar PV in buildings is attributed to power plants in supply-side investment. Riahi et al. (2012): the Global Energy Assessment Mix scenario (GEA-Mix) relative to the GEA reference scenario. Carraro et al. (2012): 460 ppm CO2eq in 2100 (t460) relative to reference scenario. McCollum et al. (2013): the LIMITS (Low Climate Impact Scenarios and Implications of Required Tight Emission Control Strategies) RefPol-450 scenario (2.8 W/m2 in 2100) relative to the reference scenarios, mean of six models. McKinsey (2009), data obtained from Climate Desk, S2015 scenario with full technological potential, 100% success rate, negative lever of costs, beginning of policy in 2015. IEA (2011), McKinsey (2009) and UNFCCC (2008) provide data only for 2010-2029. Regions: World and non-OECD.

Land-use is the second largest source of greenhouse gas emissions and within land use, tropical deforestation is by far the largest source (see Chapters 5 and 11). Efforts to stabilize atmospheric concentrations of greenhouse gases will require investments in land use change as well as in the energy sector.

Kindermann et al. (2008) use three global forestry and land use models to examine the costs of reduced emissions through avoided deforestation over the 25 year period from 2005-2030.[22] The models' results suggest substantial emission reductions can be achieved. The models estimate that 1.6 to 4.3 Gt of $CO_2$ per year could be reduced for USD 20 t of $CO_2$ with the greatest reductions coming from Africa followed by Central and South America and Southeast Asia. They also use the

[22] The models used are the Dynamic Integrated Model of Forestry and Alternative Land Use (DIMA) (Roktiyanskiy et al., 2007), the Generalized Comprehensive Mitigation Assessment Process Model (GCOMAP) (Sathaye et al., 2006) and the Global Timber Model (GTM) (Sohngen and Mendelsohn, 2003).

models to estimate the costs to reduce deforestation by between 10% and 50% of the baseline. Deforestation could be reduced by 10% (0.3–0.6 Gt $CO_2$ per year) over the 25-year period for an investment of USD 0.5 to 2.1 billion per year in forest preservation activities, and a 50% reduction (1.5–2.7 Gt $CO_2$ per year) could be achieved for an investment of USD 21.2 to 34.9 billion per year. This is comparable to what has been found by UNFCCC (2008) and McCollum et al. (2013).

Investment needs in other sectors commonly relate to energy efficiency measures included above. Information on global or regional investment needs to abate process emissions or non-$CO_2$ emissions in sectors like the waste, petroleum, gas, cement sector or the chemical industry is virtually unavailable. For instance, McKinsey (2009) does not provide information which could be separated from energy efficiency measures in the sectors. An indicative estimate for the waste sector can be derived from Pfaff-Simoneit (2012) suggesting investment needs of approximately USD 10-20 billon per year if access to a modern waste management system were to be provided for an additional 100 million people per year.

#### *16.2.2.2 Incremental costs*

Incremental costs can be calculated for an individual project, for a program, for a sector, a country, or the world as a whole. The incremental cost reflects the incremental investment and the change of operating and maintenance costs for a mitigation or adaptation project in comparison to a reference project. It can be calculated as the difference of the net present values of the two projects. Estimates of the incremental cost of mitigation measures for key sectors or the entire economy have been prepared for over 20 developing countries (Olbrisch et al., 2011). When estimates of both the incremental cost and the incremental investment are available, the former is generally lower because of the annualisation of incremental investments for the calculation of incremental cost.

From an economic perspective macroeconomic incremental cost can be defined as the lost gross domestic product (GDP). This measure provides an aggregate cost of the mitigation actions (estimates provided in chapter 6), but it does not provide information on the specific micro economic investments that must be made and costs incurred to meet the mitigation commitments. This distinction is important if international climate finance commitments will be implemented through institutions designed to provide financial support for specific investments and costs rather than macro-level compensation.

Other than on the project-level investment needs are thus frequently only a fraction of incremental costs on the level of the macro-economy. This difference is largely due to reduced growth of carbon constrained economies in many models. Adaptation costs and economic losses from future climate change, which are not considered in these estimates, should be lower for climate policy scenarios than in the reference scenario.

### 16.2.3 Raising public funding by developed countries for climate finance in developing countries

Comparison of the model estimates of future mitigation investment (section 16.2.2) with the current level of global total climate finance (section 16.2.1.1) indicates that global climate finance needs to be scaled up. Increased financial support by developed countries for mitigation (and adaptation) in developing countries will be needed to stimulate the increased investment. This section reviews possible sources of additional funds that could be implemented by developed country governments to finance mitigation in developing countries.

In December 2009, developed countries committed to a goal of mobilizing jointly USD 100 billion a year by 2020 to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation. This funding will come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance (UNFCCC, 2009a).[23] This goal has been recognized by the COP (UNFCCC, 2010, para. 98). This recognition does not change the commitments of Annex II Parties specified in Article 4 of the Convention to provide financial resources for climate-related costs incurred by developing countries.

Studies by the High-level Advisory Group on Climate Change Financing (AGF, 2010) and the World Bank Group et al. (2011) at the request of G20 finance ministers have analyzed options for mobilizing USD 100 billion per year by 2020. The AGF concluded that it is challenging but feasible to reach the goal of mobilizing USD 100 billion annually for climate actions in developing countries. Both reports conclude that a mix of sources is likely to be required to reach the goal.

Both reports estimate the revenue that could be mobilized in 2020 by various options to finance climate action in developing countries in the context of a carbon price of USD 25 per ton of $CO_2$ in Annex II countries. The feasibility of the options was not assessed. For some options, only a fraction of the revenue was assumed to be available for international climate finance. Their estimates of the international climate finance that could be generated by each option, together with other estimates, where available, are summarized in table 16.1. Only options to mobilize public funds and that yield mitigation benefits are included in the table; options for increased borrowing by multilateral institutions and mobilizing more private finance are excluded.

Virtually all of the options put a price on greenhouse gas emissions thus providing a mitigation benefit in addition to generating revenue. The options are grouped into the following categories (Haites and Mwape, 2013):

1. Options that contribute to developed countries national budgets, dependent on national decisions;
2. Options that contribute to national budgets, dependent on international agreements; and
3. Funds collected internationally pursuant to an international agreement.

Funds mobilized by options in the first two categories flow into national budgets, so the amount allocated for international climate finance depends on national decisions. In contrast, funds mobilized by options in the third category go directly to an international fund.

[23] There is currently no definition of which “climate” activities count toward the USD 100 billion, what “mobilizing” means, or even which countries are covered by this commitment (Caruso and Ellis, 2013).

**Table 16.1:** Summary of Potential Sources of Public Funds for Climate Finance in 2020

| Option | Projected amount generated in 2020 (2010 USD billion/year) | Share assumed to be dedicated to international climate finance |
|---|---|---|
| **1) Options that contribute to developed country national budgets, dependent on national decisions** | | |
| Domestic auctioned allowances | AGF: 125-250 [b]; G20: 250 | AGF: 2-10%; G20: 10% |
| Domestic carbon tax [c] | AGF: 250 | AGF: 4% |
| Phase out of fossil fuel subsidies | AGF: 8; G20: 40-60 | AGF: 100%; G20: 15-25% |
| Higher fossil fuel royalties | AGF: 10 | AGF: 100% |
| Wires charge on electricity generation | AGF: 5 | AGF: 100% |
| **2) Options that contribute to national budgets, dependent on international agreements** | | |
| Border carbon cost levelling | Grubb 2011: 5* | |
| Financial transactions tax | AGF: 2-27 | AGF: 25-50% |
| **3) Funds collected internationally pursuant to an international agreement** | | |
| Extension of the "share of proceeds" | AGF: 38-50 | AGF: 2-10% |
| Auctioning a portion of AAUs | AGF: 125-250 [b] | AGF: 2-10% |
| Carbon pricing for international aviation***, [a] | UNFCCC: 10-25**; AGF: 6; G20: 13 | AGF: 25-50%; G20: 33-50% |
| Carbon pricing for international shipping***, [a] | UNFCCC: 10-15**; AGF: 16-19; G20: 26 | AGF: 25-50%; G20: 33-50% |

**Notes**: AGF, G20 and UNFCCC refer to estimates from AGF (2010), World Bank Group et al. (2011) and UNFCCC (2007) respectively.* = Date not specified; ** = 2006 USD; *** Could fall into category 2 depending upon the method of implementation; [a] The AGF and G20 estimates for international aviation and international shipping assume that a substantial fraction (30 to 50%) of the global revenue is allocated to developing countries. [b] The AGF combines auctioned AAUs and auctioned domestic allowances, here half of the total is included in each category; [c] The AGF estimates revenue of USD 10 billion per USD 1 tax per tonne of $CO_2$, that is equivalent to potential revenue of USD 250 billion and a 4% share for international climate finance as reported here.
Source: Compiled from AGF (2010), World Bank Group et al. (2011), UNFCCC (2007) and Grubb (2011)

The AGF and G20 reports assume for many options that only small fraction of the total revenue mobilized is dedicated to international climate finance. Hence, these options would mobilize revenue to meet the international climate finance goal and at the same time mobilize substantial revenue for domestic use by Annex II governments. The domestic share of the revenue could be used by Annex II treasuries to reduce deficits and debt or to reduce existing distortionary taxes and so help stimulate economic growth.

**Global modelling estimates**

Using integrated assessment models it is possible to estimate the potential carbon revenues when all emissions are taxed or all permits are auctioned. These estimates reflect a scenario in which all world regions commit to reduce GHG emissions using an efficient allocation of abatement effort, i.e. globally equal marginal abatement costs. Therefore it should be used to gain insights rather than exact revenue forecasts.

From the analysis of scenarios already presented in this Chapter (Carraro et al., 2012; Calvin et al., 2012; McCollum et al., 2013) it is possible to derive the following messages:

- Carbon revenues are potentially large, in the order of up to USD 200 billion each in China, the EU and the USA in 2030. At the global level they could top USD 1,600 billion in 2030.
- Carbon revenues may peak in the mid- term and decline in the long-term, as contracting emissions (the tax base) more than offset the increase in the carbon price (Carraro et al., 2012). In regions with lower marginal abatement costs, the tax base contracts faster so carbon revenues fall faster. Fast growing regions may see growing carbon revenues for several decades more.

- Scenarios and/or regions in which absorption of emissions – e.g. by means of bioenergy with CCS – plays an important role may exhibit net negative emissions. This implies net reduction of carbon revenues so governments must finance net negative emissions using either the general budget or international funding (Carraro et al., 2012).

## 16.3 Enabling environments

This section highlights the importance of a supportive enabling environment in facilitating low-carbon investments. The concept of enabling environment is not clearly defined, so it has many different interpretations. One is government policies that focus on “creating and maintaining an overall macroeconomic environment” (UNCTAD, 1998).[24] Another (Bolger, 2000), interprets an ‘enabling environment’ as the wider context within which development processes take place, i.e. the role of societal norms, rules, regulations and systems. This environment may either be supportive (enabling) or constraining.

According to Stadelmann and Michaelowa (2011), capacity building and enabling environment are separate but interrelated concepts. Capacity building targets knowledge and skills gaps, while the enabling environment for low carbon business activities is “the overall environment including policies, regulations and institutions that drive the business sector to invest in and apply low-carbon technologies and services.” According to this definition, the enabling environment has three main components: 1) the core business environment, which is relevant for all types of businesses e.g. tax regime, labour market and ease of starting and operating a business; 2) the broader investment climate, including education, financial markets and infrastructure, which is partially low-carbon related e.g. via climate change education or investments in electricity grids; and 3) targeted policies that encourage the business sector to invest in low-carbon technologies.

Capacity building can also be seen as a subcomponent of an enabling environment (UNFCCC, 2009b) as it aims to improve the enabling environment by overcoming market, human and institutional capacity barriers. Support for capacity building can increase the probability that the recipient country will succeed in implementing mitigation policies and hence may reduce the total funding needed (Urpelainen, 2010).

Reliability and predictability are important elements of an enabling environment. While stable and predictable government policies reduce uncertainty about expected return on investment, frequent and unpredictable changes to policies can undermine market efficiency (Blyth et al., 2007; Brunner et al., 2012). Predictability and stability require well established legal institutions and rule of law. Institutional capacity across sectors and at various levels is also important (Brinkerhoff, 2004).

In their econometric examination, Eyraud et al. (2011) found that lowering the cost of capital is particularly effective in boosting investment in low-carbon activities. Hence, macroeconomic factors and policy regulatory frameworks that are good for private investment as a whole are also important determinants of climate investment. Put differently, obstacles that impede private investment also hamper investment in low-carbon technologies. More elements related to the drivers of low-carbon investments, which are part of enabling environments, are found in the next sub-section.

## 16.4 Financing low-carbon investments, opportunities and key drivers

Financing mitigation projects is, in principle, similar to financing any other investment. This section provides an overview of factors that attract private capital for low-carbon investments. First, different categories of capital managers and their key investment criteria are introduced. Next

[24] For enabling environments for technology transfer see McKenzie Hedger et al. (2000).

challenges that hamper investors, such as investment risks and access to capital, are assessed. Finally, selected financial instruments used in low-carbon transactions are presented and discussed.

### 16.4.1 Capital managers and investment decisions

Mitigation measures often are financed through investments by several different capital managers (see figure 16.1). It is crucial to understand the basic investment logic and the preferred financial instruments of each type of capital manager.[25] Box 16.2 characterises some of the major types of capital managers.

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**Box 16.2.** Types of capital managers relevant for investment and finance in low-carbon activities

***Governments*** commit to mitigation measures to comply with international agreements and self-imposed targets. Their role as capital managers is limited to mitigation measures where they invest directly. In 2011 and 2012, the public sector provided on average USD 135 billion per year (2011/2012 USD) of public funding for climate finance, thereof USD 12 billion provided directly by government bodies[26] (Buchner, Hervé-Mignucci, et al., 2013).

***Public financial institutions*** include national, bilateral, multilateral, and regional finance institutions, as well as UN agencies and national cooperation agencies. These institutions invested USD 121 billion in mitigation and adaptation measures in 2012 (2012 USD), more than 50% was provided as concessional loans (Buchner, Hervé-Mignucci, et al., 2013).

***Commercial financial institutions, such as banks, such as pension funds, life insurance companies and other funds***, manage over USD 71 trillion in assets. They can have long-time horizon investments diversified across asset classes with varying risk return profiles and investment tenors, sectors and geographies (Inderst et al., 2012). The ability of institutional investors to invest in mitigation measures depends on their investment strategy, restrictions agreed upon with their clients as well as the regulatory framework. Life insurance and pension funds are especially constrained by the latter (Glemarec, 2011). Their contribution was estimated at USD 22 billion in 2012 (2012 USD) (Buchner, Hervé-Mignucci, et al., 2013).

***Energy corporations*** including power and gas utilities, independent power producers, energy companies, and independent project developers can design, commission, and operate renewable energy projects. They provided approximately USD 102 billion (2012 USD) for climate finance in 2012 (Buchner, Hervé-Mignucci, et al., 2013).

***Non-energy corporations invest in mitigation measures*** to reduce their energy bills, meet voluntary commitments or comply with emission trading schemes. Altogether, they provided around USD 66 billion in 2012 for low-carbon investment (2012 USD) (Buchner, Hervé-Mignucci, et al., 2013).

***Households'*** investments are funded by income and savings supplemented by loans. In 2012 households provided around USD 33 billion for climate finance projects; 83% of households' contributions were in developed countries, especially in Germany, Japan and Italy (Buchner, Hervé-Mignucci, et al., 2013).

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**Risk and return** are crucial decision factors in any investment finance decision, including low-carbon activities. The higher the perceived risk, the higher the cost of capital and required return needing to

[25] For the different types of financing typically used, i.e. required, in the different stages of renewable technologies, such as R&D, commercialization, manufacturing and sales see Mitchell et al.(2011).

[26] This estimate excludes financing by public financial institutions and by dedicated climate fund, the latter providing approximately USD 1.6 billion (2012 USD) in 2012 (Buchner, Hervé-Mignucci, et al., 2013).

be generated to cover the costs (i.e. higher risk results in a higher discount rate for cash flow) (Romani, 2009).

**Equity and debt** are basically the two basic types of finance. Both come at a certain cost, which is very sensitive to risk, i.e. risk premium or risk margin. The type of finance required depends on the type of activity, its development phase and its application.

**Project finance** is usually the preferred financing approach for infrastructure or energy projects worth more than USD 21.4 million (UNEP, 2005). In this financing structure, debt and equity are paid back exclusively from the cash flows generated by the project and there is no recourse to the balance sheet (also call non-recourse finance); as opposed to balance sheet financing, where all **'on-balance sheet'** assets can be used as collateral. In 2012, around USD 70 billion of project-level market rate debt went towards emission reduction (70% provided by the public sector). Project-level equity was estimated at approximately USD 11 billion. However, the largest share of mitigation , USD 198 billion, consisted of balance sheet financing (2012 USD) (Buchner, Hervé-Mignucci, et al., 2013).

**Risk profile, tenor** (i.e. loan duration) and **size** are the primary criteria to characterize the financing demand. The total financing demand can be split into tranches with varying risk profiles (e.g. debt vs. equity) and varying tenors that match the characteristics of existing financing instruments. For renewable energy projects, higher costs of capital will increase start-up costs which are generally front loaded and higher per unit of capacity than for fossil fuel based projects even if financing conditions are identical (Brunnschweiler, 2010). Lenders require a higher equity share if a project is perceived as risky. A typical project finance structure in an industrialised country consists of 10-30% equity, whereas in developing countries this share tends to be higher (UNEP, 2007). However, equity tends to be scarce in many developing countries (see 16.4.2.2).

### 16.4.2 Challenges for low-carbon investment

Factors that reduce the relative attractiveness of implementing a low-carbon technology shall be considered as a challenge. Many factors pertaining to the general investment environment can have an enabling character or can act as a challenge (see 16.3). However, there are also low-carbon specific factors – especially in absence of a clear price signal for carbon emissions – that, if they remain, may keep the market penetration of these technologies to low percentages (Gillingham and Sweeney, 2011). The latter will be assessed in this Subsection.

Challenges vary significantly within the different investment categories, dependent upon the investor and the type of activity. For instance, each group is faced with some additional typical financial challenges. Energy efficiency measures, for instance, often face misaligned incentives between the asset owner, user and lender. It is more complex for energy efficiency projects to structure and share the underlying risks. In addition, energy savings are intangible as collateral (Hamilton and Justice, 2009; Ryan et al., 2012; Venugopal and Srivastava, 2012).

**Investment risks:** Investments in low-carbon activities face partly the same risks as other investments in the same countries analogous to the core and broader investment climate. These risks can be broadly grouped into political risks (e.g. political instability, expropriation, transfer risk, breach of contract, etc.) and macroeconomic risks (e.g. currency risk, financial risks, etc.). In some developing countries, political and macroeconomic risks represent a high barrier to investment (Ward et al., 2009; World Bank, 2011a; Venugopal and Srivastava, 2012).

There are also types of risks characteristic for low carbon investments: **Low-carbon policy risks** are one type of these risks that concern the predictability, longevity and reliability of policy, e.g. low-carbon regulations might change or not be enforced (Ward et al., 2009; Venugopal and Srivastava, 2012; Frisari et al., 2013). Private capital will flow to those countries, or markets, where regulatory frameworks and policies provide confidence to investors over the time horizon of their investment (Carmody and Ritchie, 2007).

Mitigation activities also face **specific technology and operational risk**. For relatively new technologies, these are related to performance of the technology (i.e. initial production and long-term performance), delay in the construction, and the risk of not being able to access affordable capital (see 16.4.2.2). Some low carbon activities also tend to depend on an expected future development, e.g. steep learning curves for certain technologies. Operational risks include the credit quality of the counterparties, off-take agreements, especially in a scenario where the mitigation technology has a higher cost of production, supply chain scalability, unreliable support infrastructure and maintenance costs (Jamison, 2010; Venugopal and Srivastava, 2012).

Moreover, risks may be overestimated due to limited information in markets that are undergoing a technological and structural transition (Sonntag-O'Brien and Usher, 2006) and the longer time frame used to assess the risk increases uncertainty. A lack of quantitative analytical methodologies for risk management may add to the perceived risk.

**Return on investment:** The basic challenge is to find a financing package that provides the debt and equity investors with a reasonable return on their investment given the perceived risks. Debt financiers have a strong interest in seeing that their loans are paid back and hence provide funds to less risky, proven technologies and established companies (Hamilton, 2010). It is estimated that in 2009 they required an average internal rate of return (IRR) of round 3 to 7% above the LIBOR reference interest rate, for renewable energy projects in industrialised countries. Venture capitalists, angel investors, and some foundations (through so-called program-related investments) are situated on the other side of the financing continuum. They typically invest in new companies and technologies, and are willing to take higher risks while expecting commensurately larger returns. These investors may require an internal rate of return (IRR) of 50% or higher because of the high chances that individual projects will fail. Private equity companies that invest in more established companies and technologies may still require an IRR of about 35% (Hamilton and Justice, 2009). However, these typical IRR have to be considered with care since they may vary according to the prevailing basis interest rates (i.e. the current LIBOR rate), perceived risks of the investment category and the availability of alternative investment opportunities. Many renewable energy projects, especially in developing countries where additional risk margins are added, are struggling to reach returns of this level to satisfy the expectations of financiers of equity and debt.

**Cost of capital and access to capital:** In many countries there are imperfections in the capital market restricting the access to affordable long-term capital (Maclean et al., 2008). This is particularly the case in many developing countries where local banks are not able to lend for 15-25 years due to their own balance sheet constraints (Hamilton, 2010), e.g. to match the maturity of assets and liabilities.

Attracting sufficient equity is often critical for low-carbon activities, especially for renewable energy projects in developing countries (Glemarec, 2011). The equity base of a company is used to attract (leverage) mezzanine or debt finance especially in project finance investments. Since equity is last in the risk order and can be recovered only by means of sale of shares of the asset or its liquidation, return expectations are significantly higher than for debt or mezzanine finance. Often, equity is also the key limiting factor in the expansion of a low-carbon activity, e.g. through growth of a company, expansion into new markets, research and development or multiplication of a project approach (UNEP, 2005).

**Market and project size:** Since the pre-investment costs vary disproportionally with the project size, smaller low-carbon project incur much higher transaction cost than larger ones of conventional energy projects (Ward et al., 2009). These costs include feasibility and due diligence work, legal and engineering fees, consultants and permitting costs. Hamilton (2010) finds that small low-carbon projects in developing countries seeking less than USD 10 million of debt are generally not attractive to an international commercial bank. Due to the higher transaction costs small projects might also generate lower gross returns, even if the rate of return lies within the market standards (Sonntag-O'Brien and Usher, 2006).

There is basically no secondary market to raise debt for low-carbon projects. Hence, institutional investors, whose major asset class is bonds, lack opportunities to invest in low-carbon energy projects because they do not issue bonds or the issuance size is too small (Hamilton and Justice, 2009; Kaminker and Stewart, 2012). The minimum issuance size for investment grade bonds tends to be about USD 460 million, so few projects can achieve this standard (Veys, 2010). Many renewable energy projects need investment in the range of USD 70 million – 700 million, with only a few big ones towards the upper end (Hamilton and Justice, 2009). In 2011, clean energy bonds amounted to only about 0.2% of the global bond market (Kaminker and Stewart, 2012).

**Tenor-risk combination:** Capital markets tend to prefer a combination of long tenor with low risk and are willing to finance high risk only in the short-term. Due to higher political and macroeconomic instability in developing countries, investors are particularly reluctant to invest in projects with such a long investment horizon. Although pension funds and insurance companies are long-term investors, concerns about quality and reliability of cash flow projections, credit ratings of off-takers for power purchase agreements, short-term performance pressures, and financial market regulations often inhibit them from investing in long-term low carbon assets (Kaminker and Stewart, 2012). Industrial firms also face constraints with extended payback periods, since they typically operate with a short-term horizon that requires rapid positive returns on investment (Della Croce et al., 2011). A significant positive consideration, however, is that low-carbon projects like waste heat, geothermal, wind, and solar have zero or negligible fuel price volatility risk.

**Human resources and institutional capacity:** The lack of technical and business capabilities at the firm, financial intermediary and regulatory level are significant barriers to harness low carbon technologies especially in many developing economies (Ölz and Beerepoot, 2010). In countries where private sector actors do not only own the low-carbon technology but are also predominately responsible for the diffusion of technologies in the market, capacity building efforts need to focus on these actors' ability to develop, fund and deploy the respective technologies (Lall, 2002; Figueiredo, 2003; Mitchell et al., 2011).

### 16.4.3 Financial instruments

Policy instruments to incentivize mitigation activities are assessed in depth in chapters 13, 14 and 15. Evidently a missing price signal for carbon emissions is a major obstacle for low-carbon investments. But not only in absence of such a price signal, other important measures can be applied to reduce critical barriers for low-carbon investment. Basic financial instruments are illustrated in figure 16.1 and introduced in section 16.4.1. This subsection focuses on three types of financial instruments with the following purposes: reducing risk, reducing the cost of capital and providing access to capital, as well as enhancing cash-flows. In a simplified manner, figure 16. 5 illustrates how these instruments can enhance market competitiveness of low-carbon projects. There is a growing literature on how the public sector can use these instruments to mobilize additional private finance, and can help to improve the risk-return profile of investments for low-carbon activities.


**Figure 16.5.** Instruments to enhance market competitiveness of low carbon projects

#### *16.4.3.1 Reducing investment risks*

Risk mitigation can play an essential part in helping to ensure that a successful project financing structure is achieved by transferring risk away from borrowers, lenders and equity investors. Various instruments provided by private insurers, and by means of public mechanisms, can help to partially or fully reduce the exposure of investors to political risk, exchange rate fluctuations, business interruption, shortfalls in output, delays or damage during fabrication, construction, and operation of a product, project, and company (Marsh, 2006).

There is a wide portfolio of proven commercial and government supported risk mitigation products that can be instrumental in efficiently expanding low-carbon investment. Their allocation and application requires a substantial level of expertise, experience and resources available in specialised insurance companies, export credit agencies, selected commercial and development banks. Examples of such products are highlighted below. They signal the potential for expanded use of risk mitigation instruments to support low-carbon investment (Frisari et al., 2013).

**Credit enhancements / guarantees**, such as commercial credit insurance and government guarantees, usually cover part of the loan and reduce the loss incurred by a lender if the borrower is unable to repay a loan. The lender must still evaluate the creditworthiness and conditions of the loan, but these instruments can reduce the interest rate and improve the terms thereby expanding the available credit or reducing the cost (Stadelmann, Castro, et al., 2011).

**Trade credit insurance** provides partial protection against certain commercial risks (e.g. counterparty default) and political risks (e.g. war and terrorism, expropriation, currency transfer or conversion limitations) and other risks like non-honouring of sovereign financial obligations or breach of contract by sovereign actors (MIGA, 2012; OPIC, 2012). Such insurance is provided by commercial insurance companies and by governments to their manufacturers, exporters or financiers.

**Production and savings guarantees** are typically provided to their clients by energy service companies (ESCO) and large energy performance contracting (EPC) contractors. Only proven practices and technologies are eligible to receive these guarantees, covering both technical risk (from customer payment default due to non-performance attributable to the ESCO or EPC contractor), and comprehensive risk (defaults due to technical and financial creditworthiness of the customer) (IDB, 2011).

**Local currency finance** can be used if currency fluctuations are particularly risky for a project or company because a major investment is made in foreign currency and revenues are in local currency. Loans in local currency or risk management swaps to hedge foreign currency liability back into respective local currency can be provided by development finance institutions (IFC, 2013; TCX, 2013a). Structured funds like the Currency Exchange Fund (TCX) are dedicated to hedge these cross-border currency and interest rate mismatches (TCX, 2013b).

By the end of 2012, the 20 largest emitting developed and developing countries with lower risk country grades for private sector investments were producing 70% of global energy related $CO_2$ emissions (Harnisch and Enting, 2013). In investment-grade countries, risk mitigation instruments and access to long-term finance can be provided at reasonably low cost, and have the potential to mobilise substantial additional private sector mitigation investments. In other countries, low-carbon investment would have to rely mainly on domestic sources or international public finance.

#### *16.4.3.2 Reducing cost of and facilitating access to capital*

In many situations emission mitigation measures imply additional or incremental investments. Independent of the specific role of equity or debt finance in these individual investments, and irrespective of potential future reductions of operating and maintenance costs, the level of these investments can be a severe barrier to the investment decisions of different investors (as outlined in section 16.4.2).

**Concessional or "soft" loans** are repayable funds provided at terms more favourable than those prevailing on the market including lower interest rates, longer tenor, longer grace period and reduced level of collateral. Providers of concessional loans are typically development banks on behalf of governments. In international cooperation, concessional loans of varying degree and type have been established as main financing instruments to support public sector entities and local banks by bilateral and multilateral development banks (Maclean et al., 2008; Birckenbach, 2010; UNEP, 2010, 2011, 2012). In 2011, bilateral finance institutions, for instance, disbursed 73 % of their mitigation finance as concessional loans (UNEP, 2012). National finance institutions provided around 87% of their climate funding in 2010/11 via soft loans (Buchner et al., 2012).

**Grants** are non-repayable funds provided to a recipient for a specific purpose by a government, public financial institution or charity. Grants can play an important role in reducing up-front capital investment costs, and meeting viability gaps for projects that are more expensive than business as usual (Buchner et al., 2012).

**Rebates** provide immediate price reductions for purchase of an eligible product. Rebates can be structured to decline over time, encouraging early adopters and reflecting anticipated technology cost reductions (de Jager and Rathmann, 2008). Rebates are typically administered by retailers of respective products in cooperation with a government agency.

**Tax deductions or tax credits** increase the after tax cash flow for a specific investment. Hence, they can have a similar effect as soft loans by reducing the net annual payments for the amortisation of a capital investment. They can be useful in enticing profitable enterprises to enter the market for renewable energies to reduce their tax liabilities. However, they require to be embedded in a country's tax system and a base in the tax code. Additionally, the specific level cannot be easily adapted to changed market conditions and will depend on the specific tax burden of the taxed entity (Wohlgemuth and Madlener, 2000).

**Equity plays a** critical role in financing a project and it is potentially attractive for governments to provide equity to companies or projects in order to support desirable activities. At the same time, limited expertise of the public sector in allocating capital in risky operations and in management of companies, and problems arising from the relationships of owners and regulators are frequently cited as reasons against a broad public engagement as equity investor. In support of emission mitigation activities a number of approaches have been successfully demonstrated. Because of the challenges discussed above, some public sector investors have decided to limit their equity investment to minority stakes and apply clear investment criteria to avoid crowding-out of private investors and to use defined exit strategies (IFC, 2009).

#### 16.4.3.3 Enhancing cash flow

Nationally agreed **feed-in tariffs** (FITs) or **third-party guaranteed renewable energy premiums** for individual power purchase agreements provide a secure long-term cash-flow to operators of renewable energy systems—based on technology, system size, and project location. Debt and equity for a project can hence be secured due to the long duration, the guaranteed off-take of the electricity generated and the grid access. Consequently, FIT do not only increase and stabilize the return but do also reduce the risks for developers, lenders and investors. As a result, the cost of capital and required rate of return can be reduced as well (Cory et al., 2009; Kubert and Sinclair, 2011). FITs for renewable energy have been implemented in a broad range of industrialised and developing countries (Fulton et al., 2010). The level of the FIT for a specific technology, region and time determines the effectiveness and efficiency of the program but is difficult to establish it up-front and to adapt it as the market evolves and technologies mature.

**$CO_2$ Offset-Mechanisms** can also provide additional cash flow via the sales of credits to support the economics of a mitigation investment. Unlike renewable energy premiums, however, there is uncertainty about the future level of this payment stream. This has made many financiers hesitant to provide debt finance for these projects. Some MDBs, like the ADB have a provision to buy credits upfront contributing to investment capital and reducing uncertainty on the future cash-flows from the sale of carbon credits (ADB, 2011, 2012).

## 16.5 Institutional arrangements for mitigation financing

Institutions are essential to channel climate finance to mitigation and adaptation measures (Stadelmann, 2013) and to ensure that the actions funded respond to national needs and priorities in an efficient and effective way.[27] Through institutions knowledge is accumulated, codified and passed on in a way that is easily transferable and used to build capacities, share knowledge, transfer technologies, help develop markets, and build enabling environments for effective climate investments. Without proper institutions, some actions and investments may remain simply as stand-alone projects with no lasting effects, or a one-off capital equipment supply rather than a transaction with a transfer of skills, know-how, full knowledge of the technology, and a contribution to a broader system of innovation and technological change (Ockwell et al., 2008).

### 16.5.1 International arrangements

**Global arrangements** for climate change mitigation finance are essential for several reasons. Most commonly cited is the fact that because the earth's climate is a public good, investing within borders is often not seen as beneficial to a particular country unless doing so becomes a collective effort (Pfeiffer and Nowak, 2006). The UNFCCC, among others, was established to address this dilemma and turn the global effort on climate change into a collective action that would be seen by all as beneficial to the whole (Burleson, 2007). Trusted institutions are needed to channel and implement the funding in an orderly and efficient process.

Funds that are part of the financial mechanism of the UNFCCC are subject to guidance from the Conference of the Parties (COP). Until recently, these included only the GEF Trust Fund, the Special Climate Change Fund (SCCF) and the Least Developed Country Fund (LDCF), all of which are administered by the GEF (see section 16.2.1.1) (UNFCCC, 2013b). In 2010, the COP decided to establish the GCF to be designated as a new operating entity of the Financial Mechanism (UNFCCC, 2010). The GCF, that is currently being operationalized, is expected to become the main global fund

[27] The term "institution" in this context is defined narrowly to mean an established organization dedicated to facilitate, manage, or promote mitigation finance, as opposed to the broader meaning of the term commonly used in the study of the social sciences and used to mean a structure or mechanism of social order and cooperation governing the behavior of individuals in society, e.g. the institutions of marriage, or religion.

to support climate action in developing countries, but it has not yet been capitalised. In addition, the Adaptation Fund has been established under the Kyoto Protocol.

The UNFCCC recognizes that funding for mitigation may come from a variety of sources and through a variety of channels beyond the financial mechanism, such as multilateral and bilateral institutions engaged in official development assistance. There has been an expansion in the number of public and private climate funds in the last decade. UNDP estimates that over the last decade some 50 international public funds, 45 carbon market funds, in addition to 6,000 private equity funds (set up largely independent of international climate policy) have been established for the purpose of funding climate-change-related activities (UNDP, 2011). Some of these, such as Climate Investment Funds (CIF) are multi-donor funds administered by the World Bank but with their own governance and organizational structure. The CIFs were designed as an interim measure to demonstrate how scaled-up support can be provided and include a sunset clause linked to progress on the financial architecture under UNFCCC. They consist of two trust funds: the Clean Technology Fund (CTF) which promotes scaled-up financing for demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term greenhouse gas emissions savings and the Strategic Climate Fund (SCF) under which are three separate initiatives for piloting transformational, scaled-up action on climate change (World Bank, 2011b; c). The pledges and contributions to the CIFs are recorded as ODA and, therefore, constitute a multi-bilateral arrangement (World Bank, 2010).

The Clean Development Mechanism (CDM) and carbon funds are directly linked to emission. Prior to the decline of certificate prices they played a central role in attracting climate investments. The CDM is one of three trading mechanisms created by the Kyoto Protocol that a developed country can use to help meet its national commitment. The CDM allows a developed country to use credits issued for emission reductions in developing countries. The other two mechanisms – Joint Implementation (JI) and International Emissions Trading – involve only developed countries with national commitments. The CDM is the largest of the mechanisms (UNFCCC, 2013c). Some of the carbon funds have been established by multilateral financial institutions. The World Bank established the first fund, the Prototype Carbon Fund, in 1999 and has since created several additional funds (World Bank, 2013).

There are several institutions promoting mitigation finance by private actors, which frequently combine financial power of up to several trillions. However, their scope of work differs considerable. Some of the major private sector institutions include inter alia the World Business Council on Sustainable Development (WBCSD, 2013), the Climate Markets and Investment Association (CMIA, 2013) and the Global Investor Coalition on Climate Change (Global Investor Coalition on Climate Change, 2013).

**Regional arrangements** play an important role in fostering regional cooperation and stimulating action and funding. These regional institutions include the regional multilateral development banks and the regional economic commissions of the United Nations on the multilateral side.[28] They are increasingly engaging in the promotion of mitigation and adaptation activities in their respective regions and establishing and helping to manage regional financing arrangements (Sharan, 2008). In the Asia and Pacific region examples of regional financial arrangements to promote funding for mitigation activities, include ADB´s Clean Energy Financing Partnership Facility, the Asia Pacific Carbon Fund and the Future Carbon Fund. Other regional development banks have been equally active (ADB, 2013a; b; c).

[28] Economic Commission for Latin America, Inter American Development Bank (IDB), Economic Commission for Africa (ECA), African Development Bank (AfDB), Economic Commission for Asia and the Pacific (ESCAP), Asian Development Bank (ADB), Economic Commission for Europe (ECE), European Bank for Reconstruction and Development (EBRD).

Regional groupings such as the Economic Community for West African States (ECOWAS), the Association of Southeast Asian Nations (ASEAN), the Secretariat for Central American Economic Integration, Mercosur, Corporación Andina de Fomento, and the Andean Pact to name just a few, have been actively promoting sub-regional integration of energy systems and cooperation in climate change activities in developing countries for some years. In the developed world, one of the best examples of these regional political groupings is the European Union which has been very active in the area of climate change and in supporting activities in developing countries.

**Bilateral cooperation arrangements** are widely used by donor countries to provide funding to partner country governments and their implementing organisations. They frequently involve development banks and agencies with a proven track record in international cooperation. The three principal means to channel climate change funding bilaterally are: a) bilateral programs for funding international cooperation in the energy, water, transport or forestry, b) dedicated funding windows established to target climate change funding open to a wider range of implementing institutions and c) new funds implemented by bilateral development institutions with their own governance structure. The OECD has established a framework for the implementation and reporting modalities which can be applied to all climate relevant ODA and partially for other official flows (see OECD (2013b) for agreed principles on statistics, effectiveness, evaluation and alike). Officially supported export credits provided by export credit agencies on behalf of national governments are also covered by a respective OECD arrangement (OECD, 2013c).

**Triangular cooperation arrangements** are defined by the OECD as those involving a traditional donor, most likely a member of DAC, an emerging donor in the south (providers of South-South Cooperation), and the beneficiary countries or recipients of development aid (Fordelone, 2011). Although they have grown in number in recent years, triangular arrangements, and particularly those for climate change financing, are a relatively recent mode of development cooperation (ECOSOC, 2008). These arrangements have attracted a number of countries particularly for technology cooperation across sectors or specified industries. The rise of triangular arrangements has been driven by the growing role of middle-income countries and their increasing presence in providing development co-operation in addition to receiving it and by the desire to experiment with other types of cooperation where the experience of developing countries can be brought to bear.

### 16.5.2 National and sub-national arrangements

The landscape of institutional arrangements for action on climate change is diverse. In many countries, actions on climate change are not clearly defined as such. Consequently, many of the national arrangements that exist to promote programs and activities which contribute to mitigation do not appear in the literature as institutions dedicated to support climate finance.

In many countries, particularly in developed countries and in a few larger developing countries, finance for mitigation comes mainly from the private sector, often with public support through regulatory and policy frameworks and/or specialized finance mechanisms. Institutional arrangements and mechanisms that are successful in mobilizing and leveraging private capital tend to be more cost-effective in climate change mitigation but some projects with low private investments (e.g. projects reducing industrial greenhouse gases or projects owned by state-owned enterprises) are also among the most cost-effective (Stadelmann, 2013). The institutions and public finance mechanisms are diverse, but all aim to help commercial financial institutions to do this job effectively and efficiently. Many of the institutions support specialized public finance mechanisms such as dedicated credit lines, guarantees to share the risks of investments and debt financing of projects, microfinance or incentive funds and schemes to mobilize R&D and technical assistance funds to build capacities across the sectors including the private and commercial sectors (Maclean et al., 2008). National development banks play an important role in financing domestic climate projects in many development countries especially by providing concessional funding (Smallridge et al., 2012; Höhne et al., 2012; IDFC, 2013).

Many developing countries, other than the larger ones, are trying to cope with the multiplicity of sources, agents and channels offering climate finance (Glemarec, 2011). These efforts take two forms.

One form is coordination of national efforts to address climate change by relevant government institutions. Very few developing countries have an institution fully dedicated to climate finance (Gomez-Echeverri, 2010). Climate finance decisions rather involve multiple ministries and agencies often coordinated by the ministry of the environment. Involvement of ministries of foreign affairs and ministries of finance is becoming more common due to their engagement in international negotiations and the promise of increased resources under UNFCCC.

The second form is the establishment of specialized national funding entities designed specifically to mainstream climate change activities in overall development strategies. These institutions blend international climate funding with domestic public funds and private sector resources (Flynn, 2011). Table 16.2 lists examples of national funding entities. A common feature is the desire to allocate resources for activities that are fully mainstreamed to the national needs and priorities. To do this they seek to tap the numerous international sources of climate finance and supplement them with domestic resources. They are also expected to develop the governance and capacity requirements for 'direct access' to funds from the Adaptation Fund and the GCF.[29]

[29] Direct access means that an accredited institution in the recipient country may receive funds directly to implement a project. Currently, most international funding institutions insist that projects be implemented by a multilateral development bank or UN agency.

**Table 16.2:** A sample of national funding entities in developing countries

| Name, country, establishment | Description | Source of fund and operations | Governance |
|---|---|---|---|
| **Amazon Fund, Brazil (2010)** | Established to combat deforestation and promote sustainable development in the Amazon. Focus: adaptation and mitigation | Designed to attract national and private investment for Amazon rainforest projects as well as donations and earnings from non-reimbursable investments made | Managed by National Development Bank of Brazil (BNDES), a Guidance Committee composed of federal and state governments and civil society and a Technical Committee |
| **Bangladesh Climate Change Resilience Fund (BCCRF) (2010)** | Established to provide support for the implementation of Bangladesh's Climate Change Strategy and Action Plan 2009-2018 and particularly vulnerable communities. Focus: adaptation and mitigation | Designed to attract funds from UNFCCC finance mechanisms, and direct donor support | Managed by a board composed of Ministers of Environment, Finance, Agriculture, Foreign Affairs and Women and Children Affairs and disaster management, as well as donors and civil society organizations |
| **China CDM Fund (CDMF) (2007)** | Established jointly by Ministries of Finance, Foreign Affairs, Science and Technology and National Development and Reform Commission (NDRC). Focus: mitigation | Funded by revenues generated from CDM projects in China, as well as grants from domestic and international institutions | Governed by the Board of the China CDM Fund that comprises representatives of 7 line ministries, and managed and operated by a management centre affiliated with the Ministry of Finance |
| **Indonesia Climate Change Trust Fund (ICCTF) (2010)** | Established jointly by the National Development Planning Agency and Ministry of Finance to pool and coordinate funds from various sources to finance Indonesia's climate change policies and programs | Currently funded by grants from development partners but designed for direct access to international climate funding and to attract private funding | UNDP is an interim Trustee operating under a Steering Committee headed by the National Development Planning Agency that also includes donors and other line ministries |
| **Guyana REDD Investment Fund (GRIF) (2010)** | Established to finance activities under the Low Carbon Development Strategy of Guyana and to create an innovative climate finance mechanism. Focus: mitigation and adaptation | Designed to attract donor support. Operates under a performance-based funding modality, based on an independent verification of Guyana's deforestation and forest degradation rates and progress on REDD+ enabling activities | A Steering Committee with members of government and financial contributors chaired by the Government of Guyana, is the decision-making and oversight body. The IDA of the World Bank Group acts as Trustee and the partner entities provide operational services |
| **Ethiopia Climate Resilient Green Economy Facility (2012)** | Established to support country's vision of attaining a middle income economy with low carbon growth by 2020.Focus: mitigation and adaptation | Designed to mobilize, access, and blend both local and international public and private resources to support Ethiopia's Climate Resilience Green Economy Strategy | Governed by a Ministerial Steering Committee chaired by Ministry of Finance and Economic Development with an advisory body composed of development partners, multilateral organizations, national NGOs, civil society, private sector and academia |

**Source:** Adapted from Gomez-Echeverri (2010),updated based on UNDP and World Bank (2012), Amazon Fund (2012), BCCRF (2012), CDMF (2012), ICCTF (2012), World Bank (2012b), UNDP (2013b)

In many countries, sub-national arrangements are increasingly becoming an effective vehicle for advancing energy and climate change goals. These arrangements and the institutions that support them are being established to advance regional collaboration in areas of common interest and to benefit from greater efficiency and effectiveness through actions with greater geographical coverage (Setzer, 2009). For example, because of their population densities and economic activities, cities are major contributors to global GHG emissions, and as such they are major potential contributors to worldwide mitigation efforts (Corfee-Morlot et al., 2009). In recent years, there has been an increase in the number of networks and initiatives specifically dedicated to enhance the role of cities in the fight against climate change. As a result, these initiatives are potentially big contributors to mitigation efforts, but because of the lack of clear processes linking these initiatives to national and international climate change policy, their impact in broader policy frameworks is less certain (UN-Habitat, 2011). One possible opportunity for enhancing this linkage is through the new National Appropriate Migitation Actions (NAMAs) being submitted by developing countries within the context of UNFCCC. The NAMA process agreed to at Bali provides an opportunity to incorporate sectoral policies with relevance to their cities (Li, 2011).

### 16.5.3 Performance in a complex institutional landscape

The institutional landscape for climate finance is becoming increasingly complex as interest of actors to enter the field of climate change finance and mitigation activities in developing countries increases. As in other international cooperation, there are discussions about effectiveness of climate finance (see OECD (2008) for politically agreed principles on aid effectiveness). Concerns have been raised about diverting attention and resources from development aid, i.e. ODA, such as health and education, the additionality of expanded funding for mitigation and adaptation (Michaelowa and Michaelowa, 2011), the difficulty of defining and measuring comparable results and achieving coherence with national priorities and development strategies, the lack of transparency, the fragmentation and duplication of efforts, and that the number of established funds may undermine the authority of the operating entities of the financial mechanism of the UNFCCC (Poerter et al., 2008). The proliferation of climate funds (HBF and ODI, 2013) and funding channels with their own governance procedures can create a substantial bureaucratic burden for recipients (Greene, 2004). Compounding these problems is the fragmentation of governance architectures which prevail in most developing countries (Biermann et al., 2009). Climate finance may be more effective if the operation of related institutions is streamlined and the capacity in developing countries to cope with the increasing number of these institutions is developed further. Evidence on the effectiveness of institutions to mainstream climate change mitigation and adaptation activities is currently lacking.

## 16.6 Synergies and trade-offs between financing mitigation and adaptation

This section introduces a conceptual framework linking adaptation and mitigation in terms of financing and investment. Estimates of investments needed for mitigation are provided in 16.2.2, and for adaptation investments in the sectoral chapters of WG II. Firstly, this section addresses the interactions of financing adaptation and mitigation in terms of their specific effectiveness and trade-offs, as well as their competition for funding over time. Secondly, it discusses examples of integrated financing approaches.

### 16.6.1 Optimal balance between mitigation and adaptation and time dimension

Both mitigation and adaptation measures are necessary to effectively avoid harmful climate impacts. However, an assessment on whether, where, and which types of adaptation and mitigation measures and policies are substitutes or complements requires theoretical analysis and empirical evidence (section 13.3.3). Investing in mitigation may reduce the need to invest in adaptation, and vice versa. Several authors have recognized that optimal mitigation and adaptation strategies should be jointly determined (Schelling, 1992; Kane and Shogren, 2000; Dellink et al., 2009; Bosello et al., 2010), including from the perspective of a global decision maker. The optimal balance of mitigation and adaptation depends on their relative costs, for any given profile of climate change impacts. In order to avoid inefficiencies the socially discounted rate of return on resources invested in mitigation and adaptation should be equal. Therefore, mitigation and adaptation compete to attract investments. From the perspective of simple economic models, a reduction in the cost of mitigation should lead to more mitigation and less adaptation and, according to this view, they are substitutes (Ingham et al., 2005).

From the perspective of development and climate studies (Tol, 2007; Ayers and Huq, 2009), climate change in most cases will impact the economy by reducing its production potential (part of the residual damage), and the level of impacts will depend on its efficiency and diversity, vulnerability as well as on how institutions are able to adapt. On the other hand, policies to address mitigation and/or adaptation could promote the transfer of technologies and financial resources, and strengthen institutions and markets, which could lead to the enhancement of a country's productive capacity (Halsnæs and Verhagen, 2007).

Combined mitigation and adaptation strategies taking into account cost-effectiveness may involve economic trade-offs. The optimal balance, including allocation of resources, should be determined taking into account possible co-benefits, which may be difficult to assess. Many actions that integrate mitigation and adaptation have enough co-benefits to make obvious sense their immediate implementation (see WG II), in spite of the fact that in many cases assessment of their effective combination, cost-effectiveness and trade-offs requires improved information, improved capacities for analysis and action, and further policymaking (Wilbanks and Sathaye, 2007). Modelling of any direct interaction between adaptation and mitigation in terms of their specific effectiveness and trade-offs would also be desirable (Wang and McCarl, 2011).

An analysis on the time composition (timing of mitigation and adaptation) of the optimal climate change strategy is also important to assess how to best allocate climate change funds. Emerging frameworks for assessing the trade-offs between adaptation and mitigation include those from the point of view of risks and costs. People invest resources to reduce the risk they confront or create (Ehrlich and Becker, 1972; Lewis and Nickerson, 1989). Recent studies have used integrated assessment models to numerically calculate the optimal allocation of investments between mitigation and adaptation. They confirm the analytical insights of Kane and Shogren (2000) and suggest that investments in mitigation should anticipate investments in adaptation (Lecocq and Shalizi, 2007; de Bruin et al., 2009; Bosello et al., 2010). The reason for this being that climate and economic systems have inertia and delaying action increases the cost of achieving a given temperature target. These studies suggest that the competition between mitigation and adaptation funds extends over time.

By arguing "uncertainty on the location of damages reduces the benefits of 'targeted' proactive adaptation with regard to mitigation and reactive adaptation", some authors reinforce the idea that it is optimal to wait to invest in adaptation (Lecocq and Shalizi, 2007). For the above reasons, Carraro and Massetti (2011) suggest that the greatest share of the GCF should finance emissions reductions rather than adaptation in developing countries. Other authors propose a framework that could integrate into an optimization model not only mitigation and adaptation, but also climate change residual damages. In the light of the uncertain impacts of climate change, prioritizing mitigation measures is justified, on the basis of a precautionary approach. Adaptation actions "should be optimally designed, consistently with mitigation, as a residual strategy addressing the damage not accommodated by mitigation" (Bosello et al., 2010).

Wang and McCarl (2011) recognizes that, in terms of an overall investment shared between mitigation and adaptation, mitigation tackles the long-run cause of climate change while adaptation tackles the short-run reduction of damages and is preferred when damage stocks are small. Contrary to Bosello et al. (2010), they advocate that, instead of taking adaptation as a "residual" strategy, well-planned adaptation is an economically effective complement to mitigation since the beginning and should occur in parallel. Thus, adaptation investment should be considered as an important current policy option due to the near term nature of given benefits.

Moreover, the optimal balance of adaptation and mitigation measures and investments should be determined in function of the magnitude of climate change; "if mitigation can keep climate change to a moderate level, then adaptation can handle a larger share of the resulting impact vulnerabilities" (Wilbanks et al., 2007). While the uncertainties about specific pathways remain, and although there are different considerations on their optimal balance, there is a general agreement that funding for both mitigation and adaptation is needed.

### 16.6.2 Integrated financing approaches

Despite the lack of modelling of any direct interaction between adaptation and mitigation in terms of financing, there is an increasing interest in promoting integrated financing approaches, addressing both adaptation and mitigation activities in different sectors and at different levels. Although the GCF will have thematic funding windows for adaptation and mitigation, an integrated approach will be used to allow for cross-cutting projects and programs (UNFCCC, 2011c, para 37).

The theoretical literature reviewed in sub-section 16.1.1 provides only general guidance on financing mitigation and adaptation measures. Analysis of specific adaptation and mitigation options in different sectors reveals that adaptation and mitigation can positively and negatively influence on each other's effectiveness (see also WGII). Particular opportunities for synergies exist in some sectors (Klein et al., 2007), including agriculture (Niggli et al., 2009), forestry (Ravindranath, 2007; Isenberg and Potvin, 2010), buildings and urban infrastructure (Satterthwaite, 2007).

Mitigation activities have global benefits while most adaptation activities benefit a smaller geographical area or population. Funding sources with a regional, national or sub-national perspective, therefore, will increasingly favour adaptation over mitigation measures (Dowlatabadi, 2007; Wilbanks and Sathaye, 2007). Thus the sources of climate finance available may yield a mix of mitigation and adaptation measures quite different from the global optimal mix. Additional studies "to understand the complex way in which local adaptation aggregates to the global level" are needed (Patt et al., 2009). Although the optimal mix cannot be determined precisely, the availability of international climate finance for both mitigation and adaptation is necessary to counteract such tendencies.

Taking into account the strong regional nature of climate change impacts, a regional financing arrangement will be more responsive and relevant than a global one, and may play an important role in adaptation (Sharan, 2008). Regional funding tools have made arrangements for financing adaptation activities in complement to mitigation measures: e.g. the Poverty and Environment Fund (PEF) of the Asian Development Bank promotes the mainstreaming of environmental and climate change considerations into development strategies, plans, programs and projects of the bank (ADB, 2003).

The African Development Bank (AfDB) acts as manager and coordinator of new funding for the Congo Basin forest ecosystem conservation and sustainable management (UNEP, 2008). According to the operational procedures by AfDB, in order to be eligible for financing under the Congo Basin Forest Fund (CBFF), project proposals and initiatives considered for funding should, among other things, aim at slowing the rate of deforestation, contribute to poverty alleviation, provide some contribution to climate stabilization and greenhouse gas emissions reduction, and may show environment, economic and social risk assessment in addition to appropriate mitigation measures, as well as be supported by national strategies to combat deforestation while preserving biodiversity and promoting sustainable development (AfDB, 2009). See section 14.3.2 for additional information on regional examples of cooperation schemes identifying synergies between mitigation and adaptation financing.

Many ongoing bilateral and multilateral development activities address mitigation and adaptation at the same time. A recent survey by Illmann et al. (2013) discusses examples from agriculture (conversion of fallow systems into continuously cultivated area; the reuse of waste water for irrigation), forestry (reforestation with drought resistant varieties; mangrove plantations), and from the energy sector (rural electrification with renewable energy, production of charcoal briquettes from agricultural waste). The study identifies significant potential to further mobilise these synergies within existing development cooperation programs.

Another point of debate regarding synergies and trade-offs between financing mitigation and adaptation relates to the conceptual framework that suggests allocating responsibility for international financing of adaptation based on the historical contribution of countries to climate change in terms of greenhouse gas emissions and their capacity to pay for the costs of adaptation at international level (Dellink et al., 2009). The provision of international climate finance, of course, raises other issues of equity and burden sharing which are beyond the scope of this chapter.

## 16.7 Financing developed countries' mitigation activities

This and the next section consider the manner in which developed and developing countries may choose to finance the incremental investments and operating costs associated with greenhouse gas mitigation activities. It is fully recognized that a country's individual circumstances will in large part determine how financing is accomplished, and further, that individual national circumstances vary widely among members of the developed and developing country groups.

The manner in which developed countries finance their mitigation activities depends largely on the policies chosen to limit GHG emissions and the ownership of the sources of emissions. Policies and ownership also determine the distribution of the burdens posed by the financing needs, i.e. if it will be financed by households and firms through higher prices, or taxes, or both.

In 2011 and 12, on average USD 177 billion of global climate finances were invested in developed countries (49% of the global total climate finance) of which the vast majority (81%) originated in the same country as the investment was undertaken (2011/2012 USD) (Buchner, Hervé-Mignucci, et al., 2013). Due to the financial crisis investment in renewable energy in developed countries dropped 14% in 2009 (Frankfurt School-UNEP Centre and BNEF, 2012), but saw a rapid recovery due to the green stimulus packages (IEA, 2009; REN21, 2010). The eight development banks of OECD countries that are members of the International Development Finance Club (IDFC*)* allocated USD 28 billion (2011 USD) and USD 33 billion (2012 USD) "green"[30] finance to domestic projects in 2011 and 2012 respectively (Höhne et al., 2012; IDFC, 2013). Public climate finance was also directed to developing countries at a range of USD 35-49 billion per year for 2011 and 2012 (2011/2012 USD) (Buchner, Hervé-Mignucci, et al., 2013).

Without climate policy, an estimated USD 96 (70 to 126) billion per year of investment in fossil power generation will occur in developed countries from 2010-2029; from 2030 to 2049 this figure increases to USD 131 (86 to 215) billion per year. In a climate policy scenario compatible with a 2°C warming limit in 2100 OECD countries are expected to reduce investments in fossil power generation by 57% (-2 to -89%) during 2010-2029 but investments will drop by 90% (-80 to -98%) during 2030-2049. Investment in renewable power generation instead will increases by 86% (58 to 116%) during 2010-2029 and by 200% (77 to 270%) during 2030-2049 (based on IEA (2011), Carraro et al. (2012), Calvin et al. (2012) and McCollum et al. (2013) used in 16.2.2).

To date, public sourcing for climate finance originates primarily from general tax revenues. However, under ambitious stabilization targets financial sources that yield mitigation benefits have the potential to generate high revenues which could be used for climate finance. Carbon taxes and the auctioning of emissions allowances carry the highest potential, a phase out of fossil fuel subsidies and a levy or emission trading scheme for international aviation and shipping emissions are estimated to generate considerable revenues as well (UNFCCC, 2007; AGF, 2010; World Bank Group et al., 2011).

Most developed countries offer a reasonably attractive core and broader enabling environment for climate investments. Developed countries, as do many emerging economies, combine substantial

[30] "Green" finance as reported by IDFC includes projects with other environmental benefits. Approximately 93% (80%) of the "green" finance by IDFC in 2011 (2012) was climate finance (Höhne et al., 2012; IDFC, 2013).

energy related greenhouse gas emission reduction potential with low country risks. At the end of 2012, 29 out of 36 assessed developed countries fell into the group of lower risk country grade, producing 39% of global fuel related $CO_2$ emissions (Harnisch and Enting, 2013). Private finance can thus be the main source of low-carbon investment in these countries, however often dependent on public support through regulatory and policy frameworks and/or specialized finance mechanisms.

While macroeconomic and policy risk have been reasonably low in the past, low-carbon policy risks have affected investments in developed countries. In principle, risk-mitigation instruments and access to long-term finance can be provided at reasonably low cost. Suitable institutions exist to implement specialized public finance mechanisms to provide dedicated credit lines, guarantees to share the risks of investments, and debt financing of projects, microfinance or incentive funds and schemes to mobilize R&D and technical assistance funds for building capacities across the sectors. The institutions and types of public finance mechanisms in existence across countries are diverse but share the common aim of helping commercial financial institutions to effectively and efficiently perform this job (Maclean et al., 2008).

In 2012, the most widespread fiscal incentives were capital subsidies, grants and rebates. They were in place in almost 90% of high-income countries. In 70% of the countries public funds were used to support renewable energy e.g. public investment loans and grants. Feed-in tariffs were in place in 27 high income countries at national or state level (75% of all countries analyzed) (REN21, 2012).

## 16.8 Financing mitigation activities in and for developing countries including for technology development, transfer and diffusion

Analogous to the previous section, this section outlines key assessment results for mitigation finance in and for developing countries, i.e. embracing domestic flows as well as financing provided by developed countries.

It is estimated that 51% of the total global climate finance in 2011 and 2012, namely on average USD 182 billion per year, was invested in developing countries (2011/2012 USD). Thereof 72% was originating in the same country as it was invested ) (Buchner, Hervé-Mignucci, et al., 2013). The total climate finance flowing from developed to developing countries is estimated to be between USD 39 and 120 billion per year in 2011 and 2012 (2011/2012 USD). This range covers public and the more uncertain flows of private funding for mitigation and adaptation. Clapp et al. (2012) estimate the total at USD 70-120 billion per year based on 2009-2010 data. Data from Buchner et al. (2013) suggest a net flow to developing countries for 2010 and 2011 of the order of USD 40 to 60 billion. North-South flows are estimate at USD 39 to 62 billion per year for 2011 and 2012 (2011/2012 USD) (Buchner, Hervé-Mignucci, et al., 2013).

Public climate finance provided by developed countries to developing countries was estimated at USD 35 to 49 billion per year in 2011 and 2012 (2011/2012USD) (Buchner, Hervé-Mignucci, et al., 2013). Multilateral and bilateral institutions played an important role in delivering climate finance to developing countries. Seven MDBs[31] reported climate finance commitments of about USD 24.1 and USD 26.8 billion in 2011 and 2012 respectively[32] (2011 USD and 2012 USD)(AfDB et al., 2012a; b,

[31] African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank (IDB), the World Bank (WB) and the International Finance Corporation (IFC).

[32] The reporting is activity-based allowing counting entire projects but also project components. Recipient countries include developing countries and 13 EU member states. It covers grant, loan, guarantee, equity and performance-based instruments, not requiring a specific grant element. The volume covers MDBs' own resources as well as external resources managed by the MDBs that might also be reported to OECD DAC (such as contributions to the GEF, CIFs and Carbon Funds)

2013). These institutions manage a range of multi donor trust climate funds, such as the Climate Investment Funds, and the funds of the financial mechanism of the Convention (GEF, SCCF, LDCF). The GCF is expected to become an additional international mechanism to support climate activities in developing countries. Bilateral climate-related ODA commitments were at an average of USD 20 billion per year in 2010 and 2011 (2010/2011 USD) (OECD, 2013a) [33] and were implemented by bilateral development banks or bilateral agencies, provided to national government directly or to dedicated multilateral climate funds (Buchner et al., 2012). However, bilateral and multilateral commitments are not fully comparable due to differences between methodologies.

Climate projects in developing countries showed a higher share of balance sheet financing and concessional funding provided by national and international development finance institutions than developed countries (Buchner et al., 2012). Domestic public development banks played an important role in this regard. The 11 non-OECD development bank members of IDFC provided USD 44 billion of domestic "green"[34] finance in 2011 and 2012 (2011 and 2012 USD) (Höhne et al., 2012; IDFC, 2013).

According to UNFCCC (2011a), Annex II countries provided an average of almost USD 10 billion per year of climate finance to developing countries. In 2009, developed countries committed to provide new and additional resources approaching USD 30 billion of 'fast start finance' to support mitigation and adaptation action in developing countries during 2010-2012. The sum of the announced commitments exceeds USD 33 billion (UNFCCC, 2011b, 2012b; c, 2013a). Data on the amount actually disbursed is not available. Some analyses question whether these funds were "new and additional" (Brown et al., 2010; Stadelmann et al., 2010; Stadelmann, Roberts, et al., 2011).

Robust information on the current magnitude of private flows from developed to developing countries is highly uncertain. Clapp et al. (2012) estimate the private investment at USD 37-72 billion per year based on 2009-2010 data (2008/2009 USD) and Stadelmann et al. (2013) estimate those flows at USD 10 to 37 billion (2010 USD and 2008 USD) per year based on 2008-2011 data.

In reference scenarios as well as in policy scenarios compatible with a 2°C warming target in 2100, non-OECD countries absorb the greatest share of incremental investments in power generation technologies. Without climate policy, investments in the power sector are mainly directed towards fossil fuels. About 73% (65% to 80%) of global investment in fossil power plants between 2010-2029, and 78% (76% to 80%) between 2030-2049, would flow into in the non-OECD because many developing countries rely on low-cost coal power plants to supply an ever growing demand of electricity in the scenarios examined (based on IEA (2011), Carraro et al. (2012), Calvin et al. (2012) and McCollum et al. (2013) used in 16.2.2). In a climate policy scenario compatible with a 2°C warming limit in 2100, non-OECD countries are expected to absorb 51% (34% to 66%) of incremental average annual investment in renewables over 2010-2029 and 67% (61% to 73%) over 2030-2049.

In tackling climate change, developing countries face different types and magnitudes of constraints. Out of the 149 assessed developing countries, only 37 were assigned lower risk country grades. These countries, being attractive for international private sector investment in low-carbon technologies, represent 38% of global $CO_2$ emissions. However, the majority of developing countries currently exhibits higher country risk grades – reflecting less attractive international investment conditions – and finds it more difficult to attract foreign private investment (Harnisch and Enting, 2013). Moreover, the lack of technical capacity and training systems is a significant barrier for low

[33] It covers total funding committed to projects that have climate change mitigation or adaptation as a "principal" or "significant" objective. ODA is defined as those flows to countries on the DAC List of ODA Recipients and to multilateral institutions provided by official agencies or by their executive agencies. Resources must be used to promote the economic development and welfare of developing countries as a main objective and they must be concessional in character (OECD, 2013a).

[34] "Green" finance as reported by IDFC includes projects with other environmental benefits. Approximately 93% (80%) of the "green" finance by IDFC in 2011 (2012) was climate finance (Höhne et al., 2012; IDFC, 2013).

carbon investment in many developing economies (Ölz and Beerepoot, 2010). Between 2005 and 2009, developed countries provided USD 2.5 billion of ODA to support creation of general enabling environments in developing countries (2005 - 2009 USD) (Stadelmann and Michaelowa, 2011).

Since investment risks for low-carbon projects in developing countries are typically perceived to be higher than in developed countries, the cost of capital and the return requirements of investors are respectively higher. The IRR for general infrastructure in developing countries, for instance, is a median of 20% compared to about 12% in developed countries (Ward et al., 2009). Access to affordable long-term capital is limited in many developing countries (Maclean et al., 2008), where local banks are not able to lend for 15-25 years due to balance sheet constraints (Hamilton, 2010), such as the mismatch in the maturity of assets and liabilities. In addition, appropriate financing mechanism for end-users' up-take are also often missing (Derrick, 1998). Moreover, equity finance is scarce in many developed countries, increasing the dependence on project finance. Especially in low income countries, project sponsors frequently rely on external assistance to cover project development costs for many investments because of their high risks and non-commercial nature (World Bank, 2011d).

Many developing countries use a range of incentives for investments in renewable energies, especially fiscal incentives (OECD, 2013d). Public financing instruments to stimulate RE, such as public investment, loans or grants, were in place in 57% of the countries analyzed and feed-in tariffs were established in 39 developing countries in 2012 (REN21, 2012). Carbon pricing has not yet widely been adopted by developing countries, apart from the non-perfect carbon price incentive via the CDM. However, currently new ETS are set-up, planned or under consideration in some developing countries such as China (provinces and cities), Kazakhstan, Ukraine, Chile, Brazil and South Korea, but it will take time until such ETS will be fully operational and provide enough investment certainty (Kossoy et al., 2013).

Regional groupings such as the Economic Community for West African States (ECOWAS), the Association of Southeast Asian Nations (ASEAN) and the Mercosur, have been actively promoting sub-regional integration of energy systems and cooperation in climate change activities.

On the national level, there is an on-going attempt to cope with the multiplicity of sources, agents and channels offering financial resources for climate action (Glemarec, 2011). Most developing countries rely on relevant ministries and agencies chaired by the ministry of the environment or finance to coordinate climate change finance (Gomez-Echeverri, 2010). Some developing countries are establishing national implementing entities and funds that mainstream climate change activities into overall development strategies. Often these institutions are designed to blend international funding with domestic and private sector resources (Flynn, 2011).

**Box 16.2:** Least Developed Countries' investment and finance for low-carbon activities

This Box highlights key issues related to investment and finance for Least Developed Countries (LDCs), however some of these issues are certainly also relevant for other developing countries.

Climate change increased the challenges LDCs are facing regarding food, water and energy which exacerbates sustainable development. Most LDCs are highly exposed to climate change effects as they are heavily reliant on climate-vulnerable sectors such as agriculture (Harmeling and Eckstein, 2012). Most of the LDCs, already overwhelmed by poverty, natural disasters, conflicts and geo-physical constraints, are now at risk of further devastating impacts of climate change. In turn they contribute very little to carbon emissions (Baumert et al., 2005; Fisher, 2013).

At the same time, LDCs are faced with a lack of access to energy services and with an expected increase in energy demand due to the population and GDP growth. Of the 1.2 billion people without electricity in 2010, around 85% live in rural areas and 87% in Sub-Saharan Africa and Southern Asia. For cooking, the access deficit amounts to 2.8 billion people who primarily rely on solid fuels. About

78 % of that population lives in rural areas, and 96 % are geo- graphically concentrated in Sub-Saharan Africa, Eastern Asia, Southern Asia, and South-Eastern Asia (Sustainable Energy for All, 2013). By investing in mitigation activities in the early and interim stages, access to clean and sustainable energy can be provided and environmentally harmful technologies can potentially be leapfrogged. Consequently, needs for finance and investment are pressing both for adaptation and mitigation.

Regarding specific mitigation finance needs there are no robust data for LDCs. It is estimated that shifting the large populations that rely on traditional solid fuels (such as unprocessed biomass, charcoal, and coal) to modern energy systems and expanding electricity supply for basic human needs could yield substantial improvements in human welfare for a relatively low cost (USD 72-95 billion per year until 2030 to achieve nearly universal access) (Pachauri et al., 2013). For instance in Bangladesh, the cost to provide a minimum power from solar home system's energy source to off-grid areas was around USD 285 per household (World Bank, 2012c). However, the very few country studies on mitigation needs and costs are not representative of the whole group of LDCs and are not comparable. Data on international and domestic private sector activities in LDCs are also lacking, as are data on domestic public flows. With respect to North-South flows, the OECD DAC reported that developed countries provided USD 730 million in mitigation related ODA to LDCs in the year 2011. Bangladesh received the highest share with USD 117 million, followed by Uganda and Haiti with more than USD 70 million (OECD, 2012).

Most LDCs have very few CDM projects which are also an important vehicle for mitigation (UNFCCC, 2012d; UNEP Risø, 2013). To improve the regional distribution of CDM projects, the CDM Executive Board has promoted the regulatory reform of CDM standards, procedures and guidelines. Furthermore, stakeholder interaction has been enhanced and a CDM loan scheme has been established by UNFCCC to provide interest-free loans for CDM project preparation in LDCs (UNFCCC, 2012e).

Some LDCs are starting to allocate public funds to mitigation and adaptation activities, e.g. NAPAs or national climate funds (Khan et al., 2012). However, pressing financial needs to combat poverty favour other expenditures over climate-related activities.

Most LDCs struggle to provide an enabling environment for private business activities, a very common general development issue (Stadelmann and Michaelowa, 2011). It is noteworthy that among the 30 lowest-ranking countries in the World Bank's Doing Business Index 23 countries are LDCs (World Bank, 2011a). Obstacles to general private business activities in turn hinder long-term private climate investments (Hamilton and Justice, 2009). Due to very high perceived risk in LDCs, risk premiums are very high. This is particularly problematic as low-carbon investments are very responsive to the cost of capital (Eyraud et al., 2011). In a challenging environment, it is difficult to implement targeted public policies and financial instruments to mobilize private mitigation finance. Moreover, the weakness of technological capabilities in LDCs presents a challenge for successful development and transfer of climate-relevant technologies (ICTSD, 2012).

To develop along a low-carbon growth path, LDCs rely on international grant and concessional finance. It is especially important to ensure the predictability and sustainability of climate finance for LDCs, as these countries are inherently more vulnerable to economic shocks due to their structural weaknesses (UNCTAD, 2010).

While all donors and development institutions provide mitigation finance to LDCs, there are some dedicated institutional arrangements, such as the LDCF and the SCCF under the Convention. Some LDCs have also implemented national funding institutions, e.g. Benin, Senegal and Rwanda in the framework of the Adaptation Fund, or the Bangladesh Climate Change Resilience Fund.

While knowledge and data gaps regarding mitigation finance are generally higher in developing than in developed countries, they are even more severe in LDCs.

## 16.9 Gaps in knowledge and data

Scientific literature on investment and finance for low-carbon activities is still very limited and knowledge gaps are substantive.

- **Common definitions and data availability**. To date there are no common definitions for central concepts related to climate finance or financial accounting rules. Neither are there complete or reasonably accurate data on current climate finance and its components namely developed country sources or commitments, developing country sources or commitments, international flows, private vs. public sources. The role of domestic and South-South flows and domestic investments in developing countries is also not adequately understood and documented. Frequently it is not possible to distinguish exactly between adaptation and development finance, since they are closely interconnected. Another difficult assessment is on the differences between funding under the Official Development Assistance (ODA) and "new and additional" funds available. Important metrics like the high carbon investment by sub-sector and region, the carbon intensity of new investments, downward deviations from reference emission pathways or the cost-effectiveness of global mitigation investments are not tracked systematically.
- **Model outputs and approaches**. Only very limited model results exist for additional investments and incremental costs to abate $CO_2$ emissions in sectors other than energy supply, e.g. via energy efficiency in industry, buildings and transport, as well as in other sectors like forestry, agriculture and waste or to mitigate process and non-$CO_2$ emissions in the petroleum and gas, cement and chemical industry or from refrigeration and air conditioning. Very limited analysis has been published which takes a globally consistent perspective of incremental investments and costs at the level of nation states and regions. This perspective could enrich the scientific discussion as global and regional netting approaches among sectors and sub-sectors may fall short of the complexity of real political decision making processes.
- A comprehensive and transparent treatment of investment and technology risks in energy models is not available. The impact of fuel price volatility on low-carbon investments is generally not considered. Reasonably robust quantitative results of the need for additional R & D for low-carbon technologies and practices and on the timing of these needs (infrastructure and technology deployment roadmaps) are not available. While there is literature on mitigation technology diffusion and transfer in general, it is not clear whether specific financial requirements to this end are different from finance for other mitigation activities.
- For the energy sector there is no convergence on the order of magnitude of net incremental investment costs across its sub-sectors. Interactions of stringent climate policies with overall growth and investment of individual economies and the world economy as a whole are also not understood well yet.
- **Effectiveness and efficiency of climate finance.** Knowledge about enabling environments for effective deployment of climate finance in any country is insufficient. There is very limited empirical evidence to relate the concept of low-carbon activities to macro determinants from a cross-country perspective. More research is especially needed regarding determinants for mitigation investment in least developed countries.
- There is only case-specific knowledge by practitioners on the selection and combination of instruments that are most effective at shifting (leveraging) private investment to mitigation and adaptation. There is no general understanding of what are the efficient levers to

mobilize private investment and their potential in any country (since they will differ by investment and country).

- The effectiveness of different public climate finance channels in driving low-carbon development is insufficiently analyzed. Estimates of the incremental cost value of public guarantees, export insurances and non-concessional loans of development banks would provide valuable insights. Little is known on determinants for an economically efficient and effective allocation of public climate finance. A comprehensive assessment of the interrelation between private and public sector actors in sharing incremental costs and risks of mitigation investments, for example via concessional loans or guarantee instruments has not been undertaken yet.
- There is no agreement yet which institutional arrangements are more effective at which level (international - national - local) and for what investment in which sector. However, an understanding of the key determinants of this efficiency and of the nature of a future international climate policy agreement is needed first.
- **Balance between mitigation and adaptation finance and investment.** The optimal balance, including its time dimension, is a difficult exercise given the lack of modelling of any direct interaction between adaptation and mitigation in terms of their specific effectiveness and trade-offs. A better informed assessment of the effective integration of mitigation and adaptation, including trade-offs and cost avoidance estimates is needed. Moreover, there is limited research and literature to assess synergies and trade-offs between and across sector-specific mitigation and adaptation measures from the specific financing and investment point of view.

## 16.10 Frequently Asked Questions

### *FAQ 16.1. What is climate finance?*

There is no agreed definition of climate finance. The term “climate finance” is applied both to the financial resources devoted to addressing climate change globally and to financial flows to developing countries to assist them in addressing climate change. The literature includes multiple concepts within each of these broad categories.

There are basically three types of metrics for **financial resources devoted to addressing climate change globally.** ***Total climate finance*** includes all financial flows whose expected effect is to reduce net greenhouse emissions and/or to enhance resilience to the impacts of climate variability and the projected climate change. This covers private and public funds, domestic and international flows, expenditures for mitigation and adaptation, and adaptation to current climate variability as well as future climate change. It covers the full value of the financial flow rather than the share associated with the climate change benefit; e.g. the entire investment in a wind turbine rather than the portion attributed to the emission reductions. The ***incremental investment*** is the extra capital required for the initial investment to implement a mitigation or adaptation measure, for example the investment in wind turbines less the investment that would have been required for a natural gas generating unit displaced. Since the value depends on a hypothetical alternative, the incremental investment is uncertain. The ***incremental cost*** reflects the cost of capital of the incremental investment and the change of operating and maintenance costs for a mitigation or adaptation project in comparison to a reference project. It can be calculated as the difference of the net present values of the two projects. Values depend on the incremental investment as well as projected operating costs, including fossil fuel prices, and the discount rate.

**Financial flows to assist developing countries in addressing climate change** typically cover the following three concepts. The ***total climate finance*** flowing to developing countries is the amount of the total climate finance invested in developing countries that comes from developed countries. This covers private and public funds for mitigation and adaptation. ***Public climate finance*** provided to developing countries is the finance provided by governments and bilateral and multilateral institutions for mitigation and adaptation activities in developing countries. Under the UNFCCC, ***climate finance*** is funding provided to developing countries by Annex II Parties for climate related activities. Most of the funds provided are concessional loans and grants.

### *FAQ 16.2. How much investment and finance is currently directed to projects that contribute to mitigate climate change and how much extra flows will be required in the future to stay below the 2°C limit?*

Current climate finance was estimated at around USD 359 billion per year of which USD 337 billion per year was invested in mitigation using a mix of 2011 and 2012 data (2011/12 USD). This covers the full investment in mitigation measures, such as renewable energy generation technologies, that also produce other goods or services. Climate finance invested in developed countries amounted to USD 177 billion and in developing countries USD 182 billion (2011/2012 USD).

Climate policy is expected to induce a significant change in investment pattern in all scenarios compatible with a 2°C limit. Based on data from a limited number of scenarios there would need to happen a remarkable reallocation of investments in the power sector from fossil fuels to low emissions generation technologies (renewable power generation, nuclear and fossil fuels with carbon capture and sequestration (CCS)). While annual investment in **fossil fuel** extraction, transformation and transportation and fossil fired power plants without CCS is estimated to decline by about USD 86 billion per year in 2010-2029 (i.e. by 20%), annual investment in **low emission generation technologies** is expected to increase by about USD 147 billion per year (i.e. by 100%), over the same period.

Investment in **energy efficiency in the building, transport and industry sector** would need to increase by several hundred billion USD per year from 2010-2029. Information on investment needs in other sectors e.g. $CO_2$ to abatement processes or non-$CO_2$ emissions, is sparse.

Model results suggest that **deforestation** could be reduced against current deforestation trends by 50% with an investment of USD 21 to 35 billion annually.

References

**ADB (2003).** Poverty and Environment Fund. ADB. Available at: http://www.adb.org/sites/default/files/r123-03.pdf.

**ADB (2011).** Carbon Market Program: Future Carbon Fund—Change in Fund Regulations. ADB. Available at: http://www.adb.org/sites/default/files/cmp-carbon-fund-regulation-change.pdf.

**ADB (2012).** Services. *The Carbon Market Programme*. Available at: http://adb-fcf.org/services/.

**ADB (2013a).** Asia Pacific Carbon Fund (APCF). Available at: http://www.adb.org/site/funds/funds/asia-pacific-carbon-fund-apcf.

**ADB (2013b).** Future Carbon Fund (FCF). Available at: http://www.adb.org/site/funds/funds/future-carbon-fund-fcf.

**ADB (2013c).** Clean Energy Financing Partnership Facility (CEFPF). Available at: http://www.adb.org/site/funds/funds/clean-energy-financing-partnership-facility.

**AfDB (2009).** Congo Basin Forest Fund. Operational Procedures. African Development Bank. Available at: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/Congo%20Basin%20Forest%20Fund%20-%20Operational%20Procedures%20EN.pdf.

**AfDB, ADB, EBRD, EIB, IDB, IFC, and World Bank (2012a).** Joint MDB Report on Adaptation Finance 2011. AfDB, ADB, EBRD, EIB, IDB, IFC, World Bank. Available at: http://climatechange.worldbank.org/sites/default/files/Joint%20MDB%20Report%20on%20Adaptation%20Finance%202011.pdf.

**AfDB, ADB, EBRD, EIB, IDB, IFC, and World Bank (2012b).** Joint MDB Report on Mitigation Finance 2011. AfDB, ADB, EBRD, EIB, IDB, IFC, World Bank. Available at: http://climatechange.worldbank.org/sites/default/files/MMF_2011_version_21.pdf.

**AfDB, ADB, EBRD, EIB, IDB, IFC, and World Bank (2013).** Joint Report on MDB Climate Finance 2012. AfDB, ADB, EBRD, EIB, IDB, IFC, World Bank. Available at: http://www.ebrd.com/downloads/sector/sei/climate-finance-2012.pdf.

**AGF (2010).** *Report of the Secretary-General's High-level Advisory Group on Climate Change Financing (AGF)*. United Nations, New York, NY, USA. Available at: http://www.un.org/wcm/webdav/site/climatechange/shared/Documents/AGF_reports/AGF%20Report.pdf.

**Alberola E., and N. Stephan (2010).** *Carbon Funds in 2010: Investment in Kyoto Credits and Emissions Reductions*. CDC Climat, Paris, France. Available at: http://www.policymeasures.com/content/files/Carbon_Funds_2010.pdf.

**Amazon Fund (2012).** Purpose and Management. *Amazon Fund*. Available at: http://www.amazonfund.gov.br/FundoAmazonia/fam/site_en/Esquerdo/Fundo/.

**Ayers J.M., and S. Huq (2009).** Supporting Adaptation to Climate Change: What Role for Official Development Assistance? *Development Policy Review* **27**, 675–692. (DOI: 10.1111/j.1467-7679.2009.00465.x).

**Baumert K.A., T. Herzog, and J. Pershing (2005).** *Navigating the Numbers. Greenhouse gas data and international climate policy*. World Resources Institute (WRI), Washington, D.C., USA, (ISBN: 1-56973-599-9).

**BCCRF (2012).** About us. *Bangladesh Climate Change Resilience Fund (BCCRF)*. Available at: http://bccrf-bd.org/.

**Biermann F., O. Davies, and N. van der Grijp (2009).** Environmental policy integration and the architecture of global environmental governance. *International Environmental Agreements* **9**, 351–369. (DOI: DOI 10.1007/s10784-009-9111-0).

**Birckenbach F. (2010).** Instruments to Finance Climate Protection and Adaptation Investments in Developing and Transition Countries. KfW Entwicklungsbank. Available at: http://www.kfw-entwicklungsbank.de/ebank/DE_Home/I/Download_Center/Positionspapiere/Positionspapier_Klima_Eng.PDF.

**Blyth W., M. Yang, and R. Bradley (2007).** *Climate Policy Uncertainty and Investment Risk*. IEA, Paris, France, (ISBN: 978-92-64-03014-5 – 2007).

**BNEF (2011).** Have developed nations broken their promise on $30bn? Bloomberg New Energy Finance. Available at: http://bnef.com/WhitePapers/download/47.

**Bolger J. (2000).** *Capacity Development: Why, What and How*. Canadian International Development Agency, Gatineau, Quebec. Available at: http://portals.wi.wur.nl/files/docs/SPICAD/16.%20Why%20what%20and%20how%20of%20capacity%20development%20-%20CIDA.pdf.

**Bosello F., C. Carraro, and E. De Cian (2010).** Climate Policy and the Optimal Balance Between Mitigation, Adaptation and Unavoided Damage. *Climate Change Economics* **01**, 71. (DOI: 10.1142/S201000781000008X).

**Bosetti V., C. Carraro, R. Duval, and M. Tavoni (2011).** What should we expect from innovation? A model-based assessment of the environmental and mitigation cost implications of climate-related R&D. *Energy Economics* **33**, 1313–1320. (DOI: 10.1016/j.eneco.2011.02.010).

**Brinkerhoff D.W. (2004).** The Enabling Environment for Implementing the Millennium Development Goals: Government Actions to Support NGOs. Paper presented at: George Washington University Conference “The Role of NGOs in Implementing the Millennium Development Goals.” Research Triangle Institute, Washington, DC, USA. 12-May-2004, .Available at: http://www.rti.org/pubs/Brinkerhoff_pub.pdf.

**Brown J., N. Bird, and L. Schalatek (2010).** Climate finance additionality: emerging definitions and their implications. Heinrich Böll Foundation North America. Available at: http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6032.pdf.

**De Bruin K., R. Dellink, and S. Agrawala (2009).** Economic Aspects of Adaptation to Climate Change: Integrated Assessment Modelling of Adaptation Costs and Benefits. *OECD Environment Working Papers No. 6, OECD* **ENV/WKP(2009)1**. (DOI: 10.1787/225282538105). Available at: http://dx.doi.org/10.1787/225282538105.

**Brunner S., C. Flachsland, and R. Marschinski (2012).** Credible commitment in carbon policy. *Climate Policy* **12**, 255–271. (DOI: 10.1080/14693062.2011.582327).

**Brunnschweiler C.N. (2010).** Finance for renewable energy: an empirical analysis of developing and transition economies. *Environment and Development Economics* **15**, 241–274. (DOI: 10.1017/S1355770X1000001X).

**Buchner B., A. Falconer, M. Hervé-Mignucci, and C. Trabacchi (2012).** *The Landscape of Climate Finance 2012*. Climate Policy Initiative, Venice, Italy. Available at: http://climatepolicyinitiative.org/wp-content/uploads/2012/12/The-Landscape-of-Climate-Finance-2012.pdf.

**Buchner B., A. Falconer, M. Hervé-Mignucci, and C. Trabacchi (2013).** The landscape of climate finance. In: *International Climate Finance*. E. Haites, (ed.), Earthscan, London, United Kingdom, (ISBN: forthcoming).

**Buchner B., A. Falconer, M. Hervé-Mignucci, C. Trabacchi, and M. Brinkmann (2011).** *The Landscape of Climate Finance*. Climate Policy Initiative, Venice, Italy. Available at: http://www.climatepolicyinitiative.org/files/attachments/177.pdf.

**Buchner B., Hervé-Mignucci, C. Trabacchi, J. Wilkinson, M. Stadelmann, R. Boyd, F. Mazza, A. Falconer, and V. Micale (2013).** *The Global Landscape of Climate Finance 2013*. Climate Policy Initiative (CPI), Venice, Italy. Available at: http://climatepolicyinitiative.org/wp-content/uploads/2013/10/The-Global-Landscape-of-Climate-Finance-2013.pdf.

**Burleson E. (2007).** Multilateral Climate Change Mitigation. In Proceedings: *Climate Change Symposium, University of San Francisco Law Review*. University of San Francisco, San Francisco, CA, USA. 2007, 373 pp. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=982763.

**Calvin K., L. Clarke, V. Krey, G. Blanford, K. Jiang, M. Kainuma, E. Kriegler, G. Luderer, and P.R. Shukla (2012).** The role of Asia in mitigating climate change: Results from the Asia modelling exercise. *Energy Economics* **34, Supplement 3**, S251–S260. (DOI: 10.1016/j.eneco.2012.09.003).

**Carmody J., and D. Ritchie (2007).** *Investing in Clean Energy and Low Carbon Alternatives in Asia*. ADB. Manila, Philippines pp. Available at: http://www-personal.umich.edu/~thoumi/Research/Carbon/Issues/Best%20Practices/clean-energy-low-carbon-alternatives-in-asia.pdf.

**Carraro C., A. Favero, and E. Massetti (2012).** Investments and public finance in a green, low carbon, economy. *Energy Economics* **34, Supplement 1**, S15–S28. (DOI: 10.1016/j.eneco.2012.08.036).

**Carraro C., and E. Massetti (2011).** Beyond Copenhagen: a realistic climate policy in a fragmented world. *Climatic Change*. (DOI: 10.1007/s10584-011-0125-6). Available at: http://www.springerlink.com/content/u31316uv01277086/.

**Caruso R., and J. Ellis (2013).** *Comparing Definitions and Methods to Estimate Mobilised Climate Finance*. OECD, Paris, France. Available at: http://www.oecd.org/env/cc/Comparing%20Definitions%20and%20Methods%20to%20Estimate%20Mobilised%20Climate%20Finance_Caruso%20&%20Ellis.pdf.

**CDMF (2012).** About us. *China Clean Development Mechanism Fund*. Available at: http://www.cdmfund.org/eng/about_us.aspx?m=20121025100609733502.

**Clapp C., J. Ellis, J. Benn, and J. Corfee-Morlot (2012).** *Tracking Climate Finance: What and How?* OECD/IEA Publishing, Paris, France. Available at: http://www.oecd.org/env/climatechange/50293494.pdf.

**CMIA (2013).** Climate Market and Investment Association (CMIA). Available at: http://www.cmia.net/.

**Corfee-Morlot J., L. Kamal-Chaoui, M.G. Donovan, I. Cochran, A. Robert, and J. Teasdale (2009).** *Cities, Climate Change and Multilevel Governance*. OECD, Paris. Available at: http://www.oecd.org/dataoecd/30/35/44232263.pdf.

**Cory K., T. Couture, and C. Kreycik (2009).** *Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions*. National Renewable Energy Laboratory, Golden, Colorado, USA. Available at: http://www.nrel.gov/docs/fy09osti/45549.pdf.

**Della Croce R., F. Stewart, and J. Yermo (2011).** Promoting long-term investments by institutional investors. *OECD Journal: Financial Market Trends* **1**, 145–164. (DOI: 10.1787/fmt-2011-5kg55b0z1ktb).

**Dellink R., M. den Elzen, H. Aiking, E. Bergsma, F. Berkhout, T. Dekker, and J. Gupta (2009).** Sharing the Burden of Financing Adaptation to Climate Change. *Global Environmental Change* **19**, 411–421. (DOI: 10.1016/j.gloenvcha.2009.07.009).

**Derrick A. (1998).** Financing mechanisms for renewable energy. *Renewable Energy* **15**, 211–214.

**Dowlatabadi H. (2007).** On Integartion of Policies for Climate and Global Change. *Mitigation and Adaptation Strategies for Global Change* **12**, 651–663. (DOI: 10.1007/s11027-007-9092-7).

**ECOSOC (2008).** Trends in South-South and Triangular Development Cooperation. Background Study for the Development Cooperation Forum. United Nations Economic and Social Council. Available at: http://www.un.org/en/ecosoc/docs/pdfs/south-south_cooperation.pdf.

**Ehrlich I., and G.S. Becker (1972).** Market Insurance, Self-Insurance, and Self-Protection. *Journal of Political Economy* **80**, 623–648.

**European Commission (2012).** Phase 2 auctions (2008-2012). Information by Member States. *Climate Change Directorate General-Policies-Emission Trading Systemt-EU ETS 2005-2012*. Available at: http://ec.europa.eu/clima/policies/ets/pre2013/second/index_en.htm.

**Eyraud L., A.A. Wane, C. Zhang, and B. Clements (2011).** *Who's Going Green and Why? Trends and Determinants of Green Investment*. IMF, Washington, D.C., USA.

**Fallasch F., and L. De Marez (2010).** New and Additional? An assessment of fast-start finance commitments of the Copenhagen Accord. Climate Analytics. Available at: New and Additional? An assessment of fast-start finance commitments of the Copenhagen Accord.

**Figueiredo P.N. (2003).** Learning, capability accumulation and firms differences: evidence from latecomer steel. *Industrial and corporate change* **12**, 607–643. (DOI: 10.1093/icc/12.3.607).

**Fisher S. (2013).** Low carbon resilience in the least developed countries: a panacea to address climate change? *International Institute for Environment and Development. Climate change, Policy and planning*. Available at: http://www.iied.org/low-carbon-resilience-least-developed-countries-panacea-address-climate-change.

**Flynn C. (2011).** *Blending Climate Finance through National Climate Funds: A guidebook for the design and establishment of national funds to achieve climate change priorities*. UNDP, New York, NY, USA. Available at: http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Change/Capacity%20Development/Blending_Climate_Finance_Through_National_Climate_Funds.pdf.

**Fordelone T.Y. (2011).** *Triangular Co-operation and Aid Effectiveness. Can Triangular Cooperation Make Aid More Effective?* OECD. Available at: http://www.oecd.org/dataoecd/63/37/46387212.pdf.

**Forstater M., and R. Rank (2012).** *Towards climate finance transparency*. aidinfo / Publish What You Fund. Available at: http://www.publishwhatyoufund.org/files/Towards-Climate-Finance-Transparency_Final.pdf.

**Frankfurt School-UNEP Centre (2013).** *Global Trends in Renewable Energy Investment 2013*. Frankfurt School-UNEP Centre/BNEF, Frankfurt, Germany. 88 pp. Available at: http://fs-unep-centre.org/sites/default/files/attachments/gtr2013keyfindings.pdf.

**Frankfurt School-UNEP Centre, and BNEF (2012).** *Global Trends in Renewable Energy Investment 2012*. UNEP, Paris, France. Available at: http://fs-unep-centre.org/sites/default/files/publications/globaltrendsreport2012final.pdf.

**Frisari G., M. Hervé-Mignucci, V. Micale, and F. Mazza (2013).** *Risk Gaps: A Map of Risk Mitigation Instruments for Clean Investments*. Climate Policy Initiative. Available at: http://climatepolicyinitiative.org/wp-content/uploads/2013/01/Risk-Gaps-A-Map-of-Risk-Mitigation-Instruments-for-Clean-Investments.pdf.

**Fulton M., B.M. Kahn, N. Mellquist, E. Soong, J. Baker, L. Cotter, and S. Kreibiehl (2010).** *GET FiT Program. Global Energy Transfer Feed-in Tariffs for Developing Countries*. DB Climate Change Advisors. Available at: https://www.dbadvisors.com/content/_media/GET_FIT_-_042610_FINAL.pdf.

**Germany Federal Ministry for the Environment Nature Conservation and Nuclear Safety (2012).** About the ICI. *International Climate Initiative*. Available at: http://www.bmu-klimaschutzinitiative.de/en/about_the_ici.

**Gillingham K., and J. Sweeney (2011).** Barriers to Implementing Low Carbon Technologies. Stanford-RFF Climate Policy Conference. 2011, .

**Glemarec Y. (2011).** *Catalyzing Climate Finance: A Guidebook on Policy and Financing Options to Support Green, Low-Emission and Climate-Resilient Development*. UNDP, New York, NY, USA, 160 pp.

**Global Investor Coalition on Climate Change (2013).** Global Investor Coalition on Climate Change. Available at: http://globalinvestorcoalition.org/.

**Gomez-Echeverri L. (2010).** National Funding Entities. Their Role in the Transition to a New Paradigm of Global Cooperation on Climate Change. Climate Strategies, European Capacity Building Initiative. Available at: http://www.climatestrategies.org/component/reports/category/55/266.html.

**Greene W. (2004).** Aid fragmentation and proliferation: Can donors improve the delivery of climate finance? *IDS Bulletin* **35**, 66–75. (DOI: 10.1111/j.1759-5436.2004.tb00137.x).

**Grubb M. (2011).** International Climate Finance from border cost levelling. *Climate Policy* **11**, 1050–1057.

**Haites E. (2011).** Climate change finance. *Climate Policy* **11**, 963–69.

**Haites E., and C. Mwape (2013).** Sources of long-term climate change finance. In: *International Climate Finance*. E. Haites, (ed.), Routledge, Abingdon, UK, (ISBN: 1849714053).

**Halsnæs K., and J. Verhagen (2007).** Development based climate change adaptation and mitigation—conceptual issues and lessons learned in studies in developing countries. *Mitigation and Adaptation Strategies for Global Change* **12**, 665–684. (DOI: 10.1007/s11027-007-9093-6).

**Hamilton K. (2010).** *Scaling up Renewable Energy in Developing Countries: finance and investment perspectives*. Chatham House, London, United Kingdom. Available at: http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/0410pp_hamilton.pdf.

**Hamilton K., and S. Justice (2009).** *Private Financing of Renewable Energy: A Guide for Policy Makers*. UNEP SEFI, Bloomberg Renewable Energy Finance, Chatham House. Available at: http://sefi.unep.org/fileadmin/media/sefi/docs/publications/Finance_guide_FINAL-.pdf.

**Harmeling S., and D. Eckstein (2012).** *Global Climate Risk Index 2013: Who suffers most from extreme weather events? Weather-related loss events in 2011 and 1992 to 2011*. Germanwatch, Bonn, Germany, (ISBN: 978-3-943704-04-4). Available at: http://germanwatch.org/fr/download/7170.pdf.

**Harnisch J., and K. Enting (2013).** Country risk levels and cost of political risk of international greenhouse gas mitigation projects. *Greenhouse Gas Measurement and Management* **3**, 55–63. (DOI: 10.1080/20430779.2013.815088).

**HBF, and ODI (2013).** Global Climate Finance Architecture. Available at: http://www.climatefundsupdate.org/global-trends/global-finance-architecture.

**Höhne N., S. Khosla, H. Fekete, and A. Gilbert (2012).** *Mapping of Green Finance Delivered by IDFC Members in 2011*. IDFC.

**ICCTF (2012).** Background. *Indonesia Climate Change Trust Fund (ICCTF)*. Available at: http://www.icctf.or.id/about/background/.

**ICTSD (2012).** Ways to promote enabling environment and to address barriers to technology development and transfer. Submission by the International Centre for Trade and Sustainable

Development. International Centre for Trade and Sustainable Development (ICTSD). Available at: http://unfccc.int/ttclear/pdf/Call%20for%20Inputs/EE/ICTSD_EE.pdf.

**IDB (2011).** The Energy Efficiency Guarantee Mechanism. IDB. Available at: http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=36200782.

**IDFC (2013).** *Mapping of Green Finance Delivered by IDFC Members in 2012*. International Development Finance Club (IDFC). Available at: http://www.idfc.org/Downloads/Publications/01_green_finance_mappings/IDFC_Green_Finance_Mapping_Report_2013_11-01-13.pdf.

**IEA (2009).** *World Energy Outlook 2009*. IEA, Paris, France, (ISBN: 978-92-64-06130-9).

**IEA (2011).** *World Energy Outlook 2011*. OECD/IEA, Paris, France, (ISBN: 978-92-64-18084-0).

**IFC (2009).** IFC's role and additionality: A primer. IFC. Available at: http://www1.ifc.org/wps/wcm/connect/e8b825004750cb4db387bfbae11ad97e/AdditionalityPrimer.pdf?MOD=AJPERES.

**IFC (2013).** Overview of Local Currency Loans and Hedges. *IFC Treasury*. Available at: http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+finance/derivative+based+products/local+currency+financing.

**Illmann J., M. Halonen, P. Rinne, S. Huq, and S. Tveitdal (2013).** *Scoping study financing adaptation-mitigation synergy activities*. Nordic Council of Ministers, Copenhagen, Denmark. Available at: http://www.norden.org/en/publications/publikationer/2013-902.

**Inderst G., C. Kaminker, and F. Stewart (2012).** *Defining and Measuring Green Investments: Implications for Institutional Investors' Asset Allocations*. OECD, Paris, France. Available at: http://www.oecd.org/finance/privatepensions/WP_24_Defining_and_Measuring_Green_Investments.pdf.

**Ingham A., J. Ma, and A.M. Ulph (2005).** Can adaptation and mitigation be complements? Tyndall Centre for Climate Change Research. Available at: http://www.tyndall.ac.uk/sites/default/files/wp79.pdf.

**Isenberg J., and C. Potvin (2010).** Financing REDD in developing countries: A supply and demand analysis. *Climate Policy* **10**, 216–231.

**De Jager D., and M. Rathmann (2008).** *Policy Instrument Design to Reduce Financing Costs in Renewable Energy Technology Projects*. IEA Implementing Agreement on Renewable Energy Technology Deployment. Available at: http://iea-retd.org/wp-content/uploads/2011/10/Policy_Main-Report.pdf.

**Jamison E. (2010).** *From Innovation to Infrastructure: Financing First Commercial Clean Energy Projects*. CalCEF Innovations, San Francisco, CA, USA. Available at: http://calcef.org/files/20100601_Jamison.pdf.

**Jürgens I., H. Amecke, R. Boyd, B. Buchner, A. Novikova, A. Rosenberg, K. Stelmakh, and A. Vasa (2012).** *The Landscape of Climate Finance in Germany*. Climate Policy Initiative (CPI), Berlin, Germany. Available at: http://climatepolicyinitiative.org/wp-content/uploads/2012/11/Landscape-of-Climate-Finance-in-Germany-Full-Report.pdf.

**Junghans L., and S. Harmeling (2013).** Different Tales from Different Countries. A first assessment of the OECD "Adaptation Marker." Germanwatch. Available at: http://germanwatch.org/en/download/7083.pdf.

**Kaminker C., and F. Stewart (2012).** *Role of Institutional Investors in Financing Clean Energy*. OECD Publishing. Available at:

http://www.oecd.org/insurance/privatepensions/WP_23_TheRoleOfInstitutionalInvestorsInFinancingCleanEnergy.pdf.

**Kane S., and J.F. Shogren (2000).** Linking Adaptation and Mitigation in Climate Change Policy. *Climatic Change* **45**, 75–102. (DOI: 10.1023/A:1005688900676).

**Khan S.M.M., S. Huq, and M. Shamsuddoha (2012).** *The Bangladesh National Climate Funds*. IIED, ECBI. Available at: http://ldcclimate.wordpress.com/ldc-paper-series/.

**Kindermann G., M. Obersteiner, B. Sohngen, J. Sathaye, K. Andrasko, E. Rametsteiner, B. Schlamadinger, S. Wunder, and R. Beach (2008).** Global cost estimates of reducing carbon emissions through avoided deforestation. *PNAS* **105**, 10302–10307. (DOI: 10.1073/pnas.0710616105).

**Kirkman G.A., S. Seres, and E. Haites (2013).** Renewable energy: Comparison of CDM and Annex I projects. *Energy Policy*. (DOI: 10.10.16/j.enpol.2013.08.071).

**Klein A., A. Held, M. Ragwitz, G. Resch, and T. Faber (2007).** *Evaluation of different feed-in tariff design options: Best practice paper for the International Feed-in Cooperation*. Karlsruhe, Germany and Laxenburg, Austria: Fraunhofer Institut für Systemtechnik und Innovationsforschung and Vienna University of Technology Energy Economics Group.

**Kossoy A., R.C. Reddy, M. Bossi, and S. Boukerche (2013).** *Mapping Carbon Pricing Initiatives. Developments and Prospects 2013*. World Bank, Washington, DC, USA. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/05/23/000350881_20130523172114/Rendered/PDF/779550WP0Mappi0til050290130morning0.pdf.

**Kubert C., and M. Sinclair (2011).** *State Support for Clean Energy Deployment: Lessons Learned for Potential Future Policy*. National Renewable Energy Laboratory (NREL), Golden, Colorado, USA. Available at: http://www.cleanenergystates.org/assets/2011-Files/Renewable-Energy-Finance/49340.pdf.

**Lall S. (2002).** Linking FDI and Technology Development for Capacity Building and Strategic Competitiveness. *Transnational Corporations* **11**, 39–88.

**Lecocq F., and Z. Shalizi (2007).** Balancing Expenditures on Mitigation of and Adaptation to Climate Change: An Exploration of Issues Relevant to Developing Countries. *World Bank Policy Research Working Paper* **WPS4299**. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/08/02/000158349_20070802095523/Rendered/PDF/wps4299.pdf.

**Lewis T., and D. Nickerson (1989).** Self-insurance Against Natural Disasters. *Journal of Environmental Economics and Management* **16**, 209–223. (DOI: 10.1016/0095-0696(89)90010-7).

**Li J. (2011).** Supporting greenhouse gas mitigation in developing cities: a synthesis of financial instruments. *Mitigation and Adaptation Strategies for Global Change* **16**, 667–698. (DOI: 10.1007/s11027-011-9288-8).

**Linacre N., A. Kossoy, and P. Ambrosi (2011).** *State and Trends of the Carbon Market 2011*. World Bank. Available at: http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/StateAndTrend_LowRes.pdf.

**Machado-Filho H. (2011).** Financial mechanisms under the climate regime. In: *Promoting Compliance in an Evolving Climate Regime,*. J. Brunnée, M. Doelle, L. Rajamani, (eds.), Cambridge University Press, pp.216–239, (ISBN: 9780521136136).

**Maclean J., J. Tan, D. Tirpak, V. Sonntag-O'Brien, and E. Usher (2008).** *Public Finance Mechanisms to Mobilize Investment in Climate Change Mitigation*. UNEP SEFI. Available at: http://www.sefalliance.org/fileadmin/media/sefalliance/docs/Resources/UNEP_Public_Finance_Report.pdf.

**Marangoni G., and M. Tavoni (2013).** The clean energy R&D gap to 2C. *Climate Change Economics* **Forthcoming**.

**Marsh (2006).** *Scoping Study on Financial Risk Management Instruments for Renewable Energy Projects*. UNEP SEFI. Available at: http://www.sefi.unep.org/fileadmin/media/sefi/docs/publications/RiskMgt_full.pdf.

**McCollum D., Y. Nagai, K. Riahi, G. Marangoni, K. Calvin, R. Pietzcker, J. van Vliet, and B. van der Zwaan (2013).** Energy investments under climate policy: a comparison of global models. *Climate Change Economics* **Forthcoming**.

**McKenzie Hedger M., E. Martinot, T. Onchan, D. Ahuja, W. Chantanakome, M. Grubb, J. Gupta, T. Heller, L. Junfeng, M. Mansley, C. Mehl, B. Natarajan, T. Panayotou, J. Turkson, and D. Wallace (2000).** Enabling Environments for Technology Transfer. Special Report. In: *Methodological and Technological Issues in Technology Transfer*. B. Metz, O. Davidson, J.-W. Martens, S. van Rooijen, L. van Wie McGrory, (eds.), IPCC, Geneva, Switzerland, .

**McKinsey (2009).** *Pathways to a Low-Carbon Economy. Version 2 of the Global Greenhouse Gas Abatement Cost Curve*. McKinsey, New York, NY, USA. Available at: https://solutions.mckinsey.com/ClimateDesk/default.aspx.

**Michaelowa A., and K. Michaelowa (2011).** Coding Error or Statistical Embellishment? The Political Economy of Reporting Climate Aid. *World Development* **39**. (DOI: 10.1016/j.worlddev.2011.07.020).

**MIGA (2012).** *Annual Report 2012*. Multilateral Investment Guarantee Agency (MIGA), Washington, D.C., USA, (ISBN: 978-0-8213-9735-0).

**Mitchell C., J.L. Sawin, G.R. Pokharei, D. Kammen, Z. Wang, S. Fifita, M. Jaccard, O. Langniss, H. Lucas, A. Nadai, R. Trujillo Blanco, E. Usher, A. Verbruggen, R. Wüstenhagen, and K. Yamaguchi (2011).** Policy, Financing and Implementation. In: *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*. O. Edenhofer, Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., von Stechow, C., (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp.865–950, (ISBN: 9781107607101). Available at: http://srren.ipcc-wg3.de/report.

**Nakooda S., T. Fransen, T. Kuramochi, A. Caravani, A. Prizzon, N. Shimizu, H. Tilley, A. Halimanjaya, and B. Welham (2013).** *Mobilising International Climate Finance: Lessons from the Fast-Start Finance Perios*. ODI, WRI, IGES. Available at: http://www.wri.org/sites/default/files/mobilising_international_climate_finance.pdf.

**New Zealand Ministry for the Environment (2012).** The New Zealand Emission Trading Scheme. NZ ETS 2011- Facts and figure. Info 662. New Zealand Ministry for the Environment. Available at: http://www.climatechange.govt.nz/emissions-trading-scheme/building/reports/ets-report/nzets-2011-facts-and-figures-2012.pdf.

**Niggli U., A. Fließbach, P. Hepperly, and N. Scialabba (2009).** *Low greenhouse gas agriculture: Mitigation and adaptation potentials of sustainable farming systems*. FAO, Rome.

**Ockwell D.G., J. Watson, G. MacKerron, P. Pal, and F. Yamin (2008).** Key Policy Considerations for Facilitating Low-carbon Technology Transfer to Developing Countries. *Energy Policy* **36**, 4104–4115. (DOI: 10.1016/j.enpol.2008.06.019).

**OECD (2008).** The Paris Declaration on Aid Effectiveness and the Accra Agenda for Action. OECD Publishing. Available at: http://www.oecd.org/development/effectiveness/34428351.pdf.

**OECD (2012).** OECD.StatExtracts. Aid activities targeting global environmental objectives. Available at: http://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS.

**OECD (2013a).** A Post 2015 Information System for International Development and Climate Finance. OECD. Available at: http://www.post2015hlp.org/wp-content/uploads/2013/05/OECD_A-Post-2015-Information-System-for-International-Development-and-Climate-Finance.pdf.

**OECD (2013b).** Development Co-operation Directorate (DCD-DAC). Available at: http://www.oecd.org/dac/.

**OECD (2013c).** Arrangement on Offcially Supported Export Credits. 1 October 2013. TAD/PG (2013) 11. OECD. Available at: http://search.oecd.org/officialdocuments/displaydocumentpdf/?doclanguage=en&cote=tad/pg%282013%2911.

**OECD (2013d).** *Policy guidance for investment in clean energy infrastructure. Expanding access to clean energy for green growth and development*. OECD Publishing, Paris, France. Available at: http://www.oecd.org/daf/inv/investment-policy/CleanEnergyInfrastructure.pdf.

**Olbrisch S., E. Haites, M. Savage, P. Dadhich, M.K.U.N.D.P.-E. Shrivastava, and 304 East 45th Street Energy Group (2011).** Estimates of incremental investment for and cost of mitigation measures in developing countries. *Climate Policy* **11**, 970.

**Ölz S., and M. Beerepoot (2010).** *Deploying Renewables in Southeast Asia: Trends and potentials*. OECD Publishing.

**OPIC (2012).** *OPIC 2011 Annual Report. Investing with Impact for 40 Years*. Overseas Private Investment Corporation (OPIC), Washington, D.C., USA. Available at: http://www.opic.gov/sites/default/files/docs/051912-annualreport-FINAL.pdf.

**Pachauri S., B.J. van Ruijven, Y. Nagai, K. Riahi, D.P. Van Vuuren, A. Brew-Hammond, and N. Nakicenovic (2013).** Pathways to achieve universal household access to modern energy by 2030. *Environmental Research Letters,* **8**. (DOI: 10.1088/1748-9326/8/2/024015). Available at: http://iopscience.iop.org/1748-9326/8/2/024015/.

**Patt A.G., D.P. van Vuuren, F. Berkhout, A. Aaheim, A.F. Hof, M. Isaac, and R. Mechler (2009).** Adaptation in integrated assessment modeling: where do we stand? *Climatic Change* **99**, 383–402. (DOI: 10.1007/s10584-009-9687-y).

**Pfaff-Simoneit W. (2012).** Entwicklung eines sektoralen Ansatzes zum Aufbau von nachhaltigen Abfallwirtschaftssystemen in Entwicklungsländern vor dem Hintergrund von Klimawandel und Ressourcenverknappung. Universität Rostock, Rostock, 249 pp. Available at: http://rosdok.uni-rostock.de/file/rosdok_derivate_0000005003/Dissertation_Pfaff-Simoneit_2013.pdf.

**Pfeiffer T., and M.A. Nowak (2006).** Climate Change: All in the Game. *Nature* **441**, 583–584. (DOI: 10.1038/441583a).

**Poerter G., N. Bird, N. Kaur, and L. Peskett (2008).** New Finance for Climate Change and the Environment. WWF, Heinrich Böll Stiftung. Available at: http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/3882.pdf.

**Ravindranath N.H. (2007).** Mitigation and adaptation synergy in forest sector. *Mitigation and Adaptation Strategies for Global Change* **12**, 843–853. (DOI: 10.1007/s11027-007-9102-9).

**REN21 (2010).** *Renewables 2010—Global Status Report*. REN21 Secretariat, Paris, France. Available at: http://www.ren21.net/Portals/0/documents/activities/gsr/REN21_GSR_2010_full_revised%20Sept2010.pdf.

**REN21 (2012).** *Renewables 2012. Global Status Report*. REN21, Paris, France. Available at: http://www.ren21.net/Portals/0/documents/Resources/GSR2012_low%20res_FINAL.pdf.

**Riahi K., F. Dentener, D. Gielen, A. Grubler, J. Jewell, Z. Klimont, V. Krey, D. McCallum, S. Pachauri, S. Rao, B. van Ruijven, D.P. Van Vuuren, and C. Wilson (2012).** Energy Pathways for Sustainable Development. In: *Global Energy Assessment: Toward a Sustainable Future*. Cambridge University Press and the International Institute for Applied Systems Analysis, Cambridge, United Kingdom ; Laxenburg, Austria, pp.1203–1306, (ISBN: 9781107005198).

**Roktiyanskiy D., P.C. Benítez, F. Kraxner, I. McCallum, M. Obersteiner, E. Rametsteiner, and Y. Yamagata (2007).** Geographically explicit global modeling of land-use change, carbon sequestration, and biomass supply. *Technol Forecasting Social Change* **74**, 1057–1082. (DOI: 10.1016/j.techfore.2006.05.022).

**Romani M. (2009).** Gobal architecture. In: *Meeting the Climate Challenge: Using Public Funds to Leverage Private Investment in Developing Countries*. LSE Grantham Research Institute on Climate Change and Environment, London, United Kingdom, .Available at: http://www2.lse.ac.uk/GranthamInstitute/publications/Other/Leveragedfunds/sectionfive.pdf.

**Ryan L., N. Semet, and A. Aasrud (2012).** *Plugging the Energy Efficiency Gap with Climate Finance. The role of international financial institutions (IFIs) and the Green Climate Fund to realise the potential of energy efficiency in developing countries*. IEA, Paris, France. Available at: http://www.iea.org/publications/freepublications/publication/PluggingEnergyEfficiencyGapwithClimateFinance_WEB.pdf.

**Sathaye J., W. Makundi, L. Dale, P. Chan, and K. Andrasko (2006).** GHG mitigation potential, costs, and benefits in global forests. *Energy J* **27**.

**Satterthwaite D. (2007).** Adaptation Options for Infrastructure in Developing Countries. *A Report to the UNFCCC Financial and Technical Support Division, UNFCCC, Bonn, Germany*.

**Schelling T.C. (1992).** Some Economics of Global Warming. *The American Economic Review* **82**, 1–14.

**Setzer J. (2009).** Sub-national and Transnational Climate Change Governance: Evidence from the State and City of Sao Paulo, Brazil. In Proceedings: *Fifth Urban Research Symposium. Marseille, France*.2009, .Available at: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1256566800920/6505269-1268260567624/Setzer.pdf.

**Sharan D. (2008).** *Financing Climate Change Mitigation and Adaptation Role of Regional Financing Arrangements*. ADB, Manila, Philippines. Available at: http://www.adb.org/Documents/Papers/ADB-Working-Paper-Series/ADB-WP04-Financing-Climate-Change-Mitigation.pdf.

**Smallridge D., B. Buchner, C. Trabacchi, M. Netto, J.J. Gomes Lorenzo, and L. Serra (2012).** *The Role of National Development Banks in Intermediating International Climate Finance to Scale Up Private Sector Investments*. IDB, Washington, DC, USA. Available at: http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=37292040.

**Sohngen B., and R. Mendelsohn (2003).** An optimal control model of forest carbon sequestration. *Am J Agric Econ* **85**, 448–457.

**Sonntag-O'Brien V., and E. Usher (2006).** Mobilizing finance for renewable energies. In: *Renewable Energy: A Global Review of Technologies, Policies and Markets*. D. Aßmann, U. Laumanns, D. Uh, (eds.), Earthscan, Sterling, VA, USA, (ISBN: 978-1-84407-261-3).

**Stadelmann M. (2013).** The effectiveness of international climate finance in enabling low-carbon development: Comparing public finance and carbon markets. University of Zurich, Zurich. Available at: http://opac.nebis.ch/ediss/20131748.pdf.

**Stadelmann M., P. Castro, and A. Michaelowa (2011).** *Mobilizing private finance for low-carbon development*. Climate Strategies, London, United Kingdom. Available at: http://www.climatestrategies.org/research/our-reports/category/71/334.html.

**Stadelmann M., and A. Michaelowa (2011).** *How to Enable the Private Sector to Mitigate?* Climate Strategies Working Paper.

**Stadelmann M., A. Michaelowa, and J.T. Roberts (2013).** Difficulties in accounting for private finance in international climate policy. *Climate Policy*. (DOI: 10.1080/14693062.2013.791146).

**Stadelmann M., J.T. Roberts, and S. Huq (2010).** Baseline for trust: defining "new and additional" climate funding. International Institute for Environment and Development (IIED),. Available at: http://pubs.iied.org/pdfs/17080IIED.pdf.

**Stadelmann M., J.T. Roberts, and A. Michaelowa (2011).** New and additional to what? Assessing options for baselines to assess climate finance pledges. *Climate and Development* **3**, 175–192. (DOI: 10.1080/17565529.2011.599550).

**Sustainable Energy for All (2013).** Chapter 2: Universal Access to Modern Energy Services. In: *Global Tracking Framework*. United Nations, New York, NY, USA, .Available at: http://www.sustainableenergyforall.org/images/Global_Tracking/7-gtf_ch2.pdf.

**TCX (2013a).** Local Currency Matters. Currency Exchange Fund (TCX). Available at: https://www.tcxfund.com/sites/default/files/attachments/160113_tcx_overview_global_english_master.pdf.

**TCX (2013b).** About TCX. Available at: https://www.tcxfund.com/about-tcx.

**Tirpak D., K. Stasio, and L. Tawney (2012).** Monitoring the Receipt of International CLimate Finance by Developing Countries. WRI. Available at: http://pdf.wri.org/monitoring_receipt_of_international_climate_finance_by_developing_countries.pdf.

**Tol R.S.J. (2007).** The double trade-off between adaptation and mitigation for sea level rise: an application of FUND. *Mitigation and Adaptation Strategies for Global Change* **12**, 741–753. (DOI: 10.1007/s11027-007-9097-2).

**UNCTAD (1998).** Report of the Expert Meeting on the Impact of Government Policy and Government/Private Action in Stimulating Inter-Firm Partnerships regarding Technology, Production and Marketing, with Particular Emphasis on North–South and South–South Linkages in Promoting Technology Transfers (Know-How, Management Expertise) and Trade for SME Development. UNCTAD. Available at: http://unctad.org/en/Docs/c3em4d3.en.pdf.

**UNCTAD (2010).** *The Least Developed Country Report 2010. Towards a New International Architecture for LDCs*. UNCTAD, Geneva, Switzerland, (ISBN: 978-92-1-112813-0).

**UNDP (2011).** *Blending Climate Finance Through National Climate Funds*. UNDP, New York, NY, USA. Available at: http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Change/Capacity%20Development/Blending_Climate_Finance_Through_National_Climate_Funds.pdf.

**UNDP (2013a).** Country Reports on Climate Public Expenditures and Institutional Reviews (CPEIR). Available at: http://www.climatefinance-developmenteffectiveness.org/publications.html.

**UNDP (2013b).** Ethiopia Climate resilient Green Economy Facility. Available at: http://mptf.undp.org/factsheet/fund/3ET00.

**UNEP (2005).** *Public finance mechanism to catalyze sustainable energy sector growth*. UNEP, Geneva, Switzerland, (ISBN: 92-807-2592-0).

**UNEP (2007).** *Guidebook to Financing CDM Projects*. (ISBN: 978-87-550-3594-2).

**UNEP (2008).** Study on establishing the Congo Basin Forest Fund (CBFF). Governance Structure. UNEP. Available at: http://www.cbfp.org/docs/rapports_act/UNEP%20CBF%20study.pdf.

**UNEP (2010).** *Bilateral Finance Institutions and Climate Change. A Mapping of 2009 Climate Financial Flows to Developing Countries*. UNEP, Paris, France. Available at: http://www.unep.org/pdf/dtie/BilateralFinanceInstitutionsCC.pdf.

**UNEP (2011).** *Bilateral Finance Institutions and Climate Change. A Mapping off Public Financial Flows for Mitigation and Adaptation to Developing Countries in 2010*. UNEP, Paris, France. Available at: http://www.unep.org/pdf/Mapping_report_final.pdf.

**UNEP (2012).** *Bilateral Finance Institutions and Climate Change. A Mapping of 2011 Climate Finance Flows to Developing Countries*. UNEP, Paris, France. Available at: http://www.unep-fin.org/publications/unep-bfi-ccwg.html.

**UNEP Risø (2013).** UNEP Risø CDM/JI Pipeline Analysis and Database, September 2013. Available at: http://www.cdmpipeline.org/.

**UNFCCC (1992).** United Nations Framework Convention on Climate Change. UNFCCC.

**UNFCCC (1998).** Kyoto Protocol to the United Nations Framwork Convention on Climate Change. Available at: http://unfccc.int/resource/docs/convkp/kpeng.pdf.

**UNFCCC (2007).** *Investment and financial flows to address climate change*. UNFCCC, Bonn, Germany, (ISBN: 92-9219-042-3).

**UNFCCC (2008).** Investment and financial flows to address climate change: an update. FCCC/TP/2008/7 26 November 2008. Available at: http://unfccc.int/resource/docs/2008/tp/07.pdf.

**UNFCCC (2009a).** Copenhagen Accord (2/CP.15). UNFCCC.

**UNFCCC (2009b).** Strategy paper for the long-term perspective beyond 2012, including sectoral approaches, to facilitate the development, deployment, diffusion and transfer of technologies under the Convention. Report by the Chair of the Expert Group on Technology Transfer. FCCC/SB/2009/3. UNFCCC. Available at: http://unfccc.int/resource/docs/2009/sb/eng/03.pdf.

**UNFCCC (2010).** The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (1/CP.16). UNFCCC.

**UNFCCC (2011a).** *Compilation and synthesis of fifth national communications*. UNFCCC, Bonn, Germany. Available at: http://unfccc.int/resource/docs/2011/sbi/eng/inf01a02.pdf.

**UNFCCC (2011b).** Submissions on information from developed country Parties on the resources provided to fulfil the commitment referred to in decision 1/CP.16, paragraph 95. FCCC/CP/2011/INF.1. UNFCCC. Available at: http://unfccc.int/resource/docs/2011/cop17/eng/inf01.pdf.

**UNFCCC (2011c).** Launching the Green Climate Fund (3/CP.17). FCCC/CP/2011/9/Add.1. UNFCCC. Available at: http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=55.

**UNFCCC (2012a).** Outcome of the work of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol: Draft decision proposed by the President. Draft decision -/CMP.8, Amendment to the Kyoto Protocol pursuant to its Article 3, paragraph 9. Available at: http://unfccc.int/resource/docs/2012/cmp8/eng/l09.pdf.

**UNFCCC (2012b).** Submissions on information from developed country Parties on the resources provided to fulfil the commitment referred to in decision 1/CP.16, paragraph 95. FCCC/CP/2012/INF.1. UNFCCC. Available at: http://unfccc.int/resource/docs/2012/cop18/eng/inf01.pdf.

**UNFCCC (2012c).** Submissions on information from developed country Parties on the resources provided to fulfil the commitment referred to in decision 1/CP.16, paragraph 95.

FCCC/CP/2012/INF.1/Add.1. UNFCCC. Available at: http://unfccc.int/resource/docs/2012/cop18/eng/inf01a01.pdf.

**UNFCCC (2012d).** *Benefits of the Clean Development Mechanism 2012*. UNFCCC, Bonn, Germany, (ISBN: 92-9219-097-0).

**UNFCCC (2012e).** Annual report of the Executive Board of the clean development mechanism to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol. FCCC/KP/CMP/2012/3 (Part I). UNFCCC. Available at: http://unfccc.int/resource/docs/2012/cmp8/eng/03p01.pdf.

**UNFCCC (2013a).** Submissions on information from developed country Parties on the resources provided to fulfil the commitment referred to in decision 1/CP.16, paragraph 95. FCCC/CP/2013/INF.1. UNFCCC. Available at: http://unfccc.int/resource/docs/2013/cop19/eng/inf01.pdf.

**UNFCCC (2013b).** Finance - Introduction. Available at: http://unfccc.int/cooperation_and_support/financial_mechanism/items/2807.php.

**UNFCCC (2013c).** The Mechanism under the Kyoto Protocol: Emission Trading, the Clean Development Mechanism and Joint Implementation. Available at: http://unfccc.int/kyoto_protocol/mechanisms/items/1673.php.

**UN-Habitat (2011).** *Cities and Climate Change: Global Report on Human Settlements 2011*. Earthscan, (ISBN: 978-92-1-131929-3).

**Urpelainen J. (2010).** *A Theory of North-South Climate Finance*. New York University, New York, NY, USA. Available at: http://politics.as.nyu.edu/docs/IO/16188/north.pdf.

**Venugopal S., and A. Srivastava (2012).** *Moving the fulcrum: A primer on public climate financing instruments used to leverage private capital*. World Resources Institute (WRI), Washington, D.C., USA. Available at: http://pdf.wri.org/moving_the_fulcrum.pdf.

**Veys A. (2010).** The Sterling Bond Markets and Low Carbon or Green Bonds. E3G. Available at: http://www.e3g.org/images/uploads/The_Sterling_Bond_Markets.pdf.

**Wang W., and B.A. McCarl (2011).** Inter-Temporal Investment in Climate Change Adaptation and Mitigation. Department of Agricultural Economics, Texas A&M University, Pittsburgh, Pennsylvania. 24-26-2011, .

**Ward J., S. Frankhauser, C. Hepburn, and H. Jackson (2009).** *Catalyzing low-carbon growth in developing economies. Public finance mechanisms to scale up private sector investment in climate solutions*. UNEP, Geneva, Switzerland. Available at: http://www.unep.org/PDF/PressReleases/Public_financing_mechanisms_report.pdf.

**WBCSD (2013).** World Business Council for Sustainable Development (wbcsd) - Business Solutions for a Sustainbale World. Available at: http://www.wbcsd.org/home.aspx.

**Wilbanks T.J., P. Leiby, R. Perlack, J.T. Ensminger, and S.B. Wright (2007).** Toward an integrated analysis of mitigation and adaptation: some preliminary findings. *Mitigation and Adaptation Strategies for Global Change* **12**, 713–725. (DOI: 10.1007/s11027-007-9095-4).

**Wilbanks T.J., and J. Sathaye (2007).** Integrating mitigation and adaptation as responses to climate change: a synthesis. *Mitigation and Adaptation Strategies for Global Change* **12**, 957–962. (DOI: 10.1007/s11027-007-9108-3).

**Wohlgemuth N., and R. Madlener (2000).** Financial support of renewable energy systems: Investments vs operating cost subsidies. In Proceedings: *Proceedings of the Norwegian Associations for Energy Economics (NAEE)*. Bergen, Norway. 2000, .

**World Bank (2010).** Monitoring Climate Finance and ODA. World Bank. Available at: http://climatechange.worldbank.org/sites/default/files/documents/DCFIB%231-web-June15.pdf.

**World Bank (2011a).** *Doing Business 2011: Making a difference for entrepreneurs*. World Bank, Washington, D.C., USA, (ISBN: 978-0-8213-7960-8).

**World Bank (2011b).** Climate Investment Funds. Governance Framework for the Clean Technology Fund. Adopted November 2008 and amended December 2011. World Bank. Available at: http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/CTF%20Governance%20Framework-FINAL.pdf.

**World Bank (2011c).** Climate Investment Funds. Governance Framework for the Strategic Climate Fund. Adopted November 2008 and amended December 2011. World Bank. Available at: http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/SCF%20Governance%20Framework-FINAL.pdf.

**World Bank (2011d).** Financing renewable energy. Options for developing financing instruments using public funds. World Bank. Available at: http://siteresources.worldbank.org/EXTENERGY2/Resources/SREP_financing_instruments_sk_clean2_FINAL_FOR_PRINTING.pdf.

**World Bank (2012a).** Trustee Presentation: Update on Status of Resources and CER Monetization. AFB/B.19/Inf.4. Adaptation Fund. Available at: https://www.adaptation-fund.org/sites/default/files/AFB.B.19.Inf_.4%20CER%20trustee%20presentation.pdf.

**World Bank (2012b).** Guyana REDD+ Investment Fund (GRIF). *Concessional Finance and Global Partnerships*. Available at: www.worldbank.org/grif.

**World Bank (2012c).** *Bangladesh Economic Update. Oktober 2012*. World Bank, Washington, DC, USA. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/10/19/000386194_20121019040128/Rendered/PDF/733020WP0Bangl0disclosed0100180120.pdf.

**World Bank (2013).** Cabon Finance at the World Bank: List of Funds. Available at: https://wbcarbonfinance.org/Router.cfm?Page=Funds&ItemID=24670.

**World Bank Group, IMF, OECD, AfDB, ADB, EBRD, EIB, and IDB (2011).** *Mobilizing Climate Finance. Paper prepared at the request of G20 Finance Ministers*. World Bank, Washington, D.C., USA. Available at: http://www.imf.org/external/np/g20/pdf/110411c.pdf.

**World Bank, and UNDP (2012).** Funding Sources. *Climate Finance Options*. Available at: http://climatefinanceoptions.org/cfo/funding-sources.