



Catalysing Climate Finance

A Guidebook on Policy and Financing Options to Support Green,
Low-Emission and Climate-Resilient Development





UNDP is the UN's global development network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life. We are on the ground in 166 countries, working with them on their own solutions to global and national development challenges. As they develop local capacity, they draw on the people of UNDP and our wide range of partners.

Copyright © 2011 United Nations Development Programme

All rights reserved. This publication or parts of it may not be reproduced, stored by means of any system or transmitted, in any form or by any medium, whether electronic, mechanical, photocopied, recorded or of any other type, without the prior permission of the United Nations Development Programme.

The views and recommendations expressed in this report are those of the authors and do not necessarily represent those of UNDP, the United Nations or its Member States. The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by the United Nations. Sole responsibility is taken for errors of omission or commission.

Design: Anvil Creative Group (NY, www.anvilcreativegroup.com)

Production: A.K. Office Supplies (NY)

Catalysing Climate Finance

A Guidebook on Policy and Financing Options to Support Green, Low-Emission and Climate-Resilient Development

This guidebook is part of a series of manuals, guidebooks and toolkits that draws upon the experience and information generated by the United Nations Development Programme's (UNDP) support for climate change adaptation and mitigation projects in some 140 countries over the past decade. These resources are intended to enable project managers, UNDP Country Offices, and developing country government decision makers to acquaint themselves with a variety of methodologies in the preparation of green, low-emission and climate-resilient development strategies (Green LECRDs).

In a flexible and non-prescriptive manner, the reports offer detailed step-by-step guidance for the identification of key stakeholders and establishment of participatory planning and coordination frameworks; generation of climate change profiles and vulnerability scenarios; identification and prioritization of mitigation and adaptation options; assessment of financing requirements; and development of low-emission climate-resilient roadmaps for project development, policy instruments, and financial flows. They are available from www.undp.org/energyandenvironment/climatestrategies.

This publication focuses on the review of policy and financing options to catalyse finance toward green, low-emission and climate-resilient development.

Author: Yannick Glemarec, UNDP Director for Environmental Finance/UNDP-GEF Executive Coordinator

Internal reviewers: Robert Kelly, Stephen Gold, Pradeep Kurukulasuriya, Lucas Black, Manuel Soriano, Benoit Lebot, Simon Billet, Oliver Waissbein, Marcel Alers, John Hough, Nik Sekhran, Andrew Hudson, and Suely Carvalho

External reviewers: Energy Research Center of the Netherlands (ECN)

Editor: Caitlin Connelly

This guidance document should be referenced as: Glemarec, Yannick (2011). *Catalysing Climate Finance: A Guidebook on Policy and Financing Options to Support Green, Low-Emission and Climate-Resilient Development*. United Nations Development Programme, New York, NY, USA.

Contents

FOREWORD	vi
ACRONYMS AND ABBREVIATIONS	viii
OVERVIEW	1
Purpose of Guidebook	3
Target Audience	3
UNDP Framework to Catalyse Finance Toward Green, Low-Emission and Climate-Resilient Development	3
Structure of the Report	5
CHAPTER I: THE CHALLENGE OF UNIVERSAL ACCESS TO CLIMATE CHANGE FINANCE	7
1.1 Capital Requirements to Finance the Transition to a Green, Low-Emission and Climate-Resilient Society	8
1.2 Synergies Between Mitigation, Adaptation and Development Finance	14
1.3 Current Capital Flows to Finance the Transition to a Green, Low-Emission and Climate-Resilient Society	18
1.4 Providing Fair Access to Climate Finance for All Developing Countries	21
CHAPTER 2: CATALYSING CAPITAL TOWARD GREEN, LOW-EMISSION AND CLIMATE-RESILIENT DEVELOPMENT	23
2.1 Key Policies to Create an Enabling Environment for Climate Investing	24
2.2 A Taxonomy of Public Policies to Catalyse Green Investments	27
CHAPTER 3: IDENTIFYING AN APPROPRIATE POLICY MIX TO CATALYSE CAPITAL	41
3.1 Adopting Policy Evaluation Criteria	42
3.2 Designing an Optimal Policy Mix to Catalyse Capital	47
3.3 Preparing a Policy Roadmap	59
CHAPTER 4: CLIMATE CHANGE FINANCING SOURCES	61
4.1 The Global Climate Change Finance Architecture	62
4.2 Public Finance Landscape	67
4.3 Environmental Finance Markers	70
4.4 Capital Markets Landscape	77
4.5 Climate Change Investment Vehicles	81

CHAPTER 5: SELECTING AN OPTIMAL FINANCING MIX TO PROMOTE GREEN INVESTMENT	85
5.1 Private Financing Optimization Criteria	87
5.2 Public Financing Optimization Criteria	88
5.3 Public Financing Eligibility Criteria	91
5.4 Combining and Sequencing Different Sources of Public Climate Finance	92
5.5 Blending and Sequencing Multiple Sources of Public and Private Climate Finance	94
5.6 Adopting a Methodology to Select an Optimal Financing Mix	97
CHAPTER 6: APPLYING THE FOUR-STEP METHODOLOGY TO CLEAN ENERGY	101
6.1 Feed-in Tariffs for Wind Power	103
Case Study 1: Feed-in Tariff Law to Scale Up Renewable Energy in South Africa	111
Case Study 2: FiT Law to Scale Up Renewable Energy in Mauritius	112
6.2 Scaled-Up Distribution of Low Indoor Pollution, Efficient Biomass Stoves	113
Case Study 1: Scaling up Low Pollution, Efficient Fuel Stoves for Institutions and Medium-Scale Enterprises in Kenya	118
Case Study 2: Leveraging Carbon Finance for Low Pollution, Energy-Efficient Stoves	119
6.3 Energy-Efficient Buildings	121
Case Study 1: Promoting Low-Cost, Effective Energy-Efficient Building Technologies in a Cold Climate (Mongolia)	125
Case Study 2: Renovation of Multifamily Buildings in Bulgaria	126
6.4 Low-Emission Vehicles	127
Case Study 1: Commercialization of Electric Three-Wheeler Rickshaws in Sri Lanka	132
Case Study 2: Market Development for Fuel Cell Buses in China	134
CONCLUSION	135
GLOSSARY OF TERMS	139
REFERENCES	143

FIGURES, TABLES, AND BOXES

Figures

Overview

Figure 1: UNDP framework to catalyse finance toward green, low-emission and climate-resilient development	4
--	---

Chapter 1

Figure 1.1: Timing of mitigation efforts	9
Figure 1.2: Global GHG abatement cost curve beyond business-as-usual (V2.1)	11
Figure 1.3: Estimated potential for global mitigation for different regions in 2030	11
Figure 1.4: Impact of cash crops on ability to avert expected loss — Mali test case	14
Figure 1.5: Interdependencies between water and energy generation	16
Figure 1.6: Growth of private investment in clean energy	19
Figure 1.7: New investment by region (2002-2008, \$ billion)	20
Figure 1.8: GHG emission trajectories under a business-as-usual climate finance scenario	22

Chapter 2

Figure 2.1: Creating attractive risk/reward profiles for green investment	27
Figure 2.2: Local information centres	30
Figure 2.3: Impact of energy label with minimum energy performance standards on the refrigerator and freezer market in the European Union	32

Chapter 3

Figure 3.1: UNDP framework to catalyse finance toward green, low-emission and climate-resilient development	48
Figure 3.2: Green, low-emission and climate resilient development strategies	49
Figure 3.3: Methodology to select cornerstone and supportive policies	55
Figure 3.4: Matrix for selecting an appropriate policy mix for wind power	56
Figure 3.5: Policy evaluation scorecard	57

Chapter 4

Figure 4.1: Climate change finance: Sources, agents and channels	63
Figure 4.2: A possible emerging architecture for international public climate finance	65
Figure 4.3: State of carbon markets	72
Figure 4.4: Blending international public climate finance and environmental market finance to catalyse capital	76
Figure 4.5: Key players of the capital markets systems	79
Figure 4.6: A simplified project finance structure	84

Chapter 5

Figure 5.1: Investment vehicles along the clean energy technology life cycle	88
Figure 5.2: Comparative scarcity of funding sources	89
Figure 5.3: Funding options for different stages of technology development	90
Figure 5.4: UNDP/World Bank website on climate finance options	91
Figure 5.5: Accessing, blending and sequencing different sources of finance to phase out ODS-consuming, energy-inefficient refrigerators	93
Figure 5.6: Synergy between innovative climate and ecosystem finance	94
Figure 5.7: Effect of interest rate on the profitability of green investment	95
Figure 5.8: Public venture capital investment roadmap	96
Figure 5.9: Identifying possible sources of funds for each type of policy	98
Figure 5.10: Methodology for selecting an optimal financing mix	99

Chapter 6

Figure 6.1: Renewable power capacities, 2009	104
Figure 6.2: Policy and financing mix to promote wind power in developing countries	106
Figure 6.3: The GET FiT model	109
Figure 6.4: Selecting an optimal policy and financing mix for efficient fuel stoves	115
Figure 6.5: Promoting energy-efficient housing	123
Figure 6.6: Promoting low-emission/zero-emission vehicles	130

Tables

Chapter 1

Table 1.1: Key mitigation options by sector	12
Table 1.2: Key adaptation options by sector	13

Chapter 2

Table 2.1: Common key barriers to clean energy development	25
Table 2.2: Cost-benefit analysis of US environmental regulations (in 2001 \$ millions)	33
Table 2.3: Summary of policy instruments to catalyse green, low-emission and climate-resilient investment	38

Chapter 3

Table 3.1: Policy evaluation criteria	45
Table 3.2: Examples of economy-energy models	50
Table 3.3: Barrier analysis checklist	53
Table 3.4: Policy roadmap for wind power	58

Chapter 4

Table 4.1: List of major multilateral and bilateral climate funds	66
Table 4.2: Status and trends of payments for ecosystem services	74
Table 4.3: Status of payments for ecosystem services programmes	75
Table 4.4: Characteristics of selected institutional investor types	80

Chapter 5

Table 5.1: Risks/return profiles of different funding sources	87
Table 5.2: Key attributes of the global energy efficiency and renewable energy fund	97

Boxes

Chapter 2

Box 2.1: Removal of fossil fuel subsidies in Iran (Islamic Republic of)	35
---	----

Chapter 3

Box 3.1: Creating marginal abatement cost curves	51
--	----

Chapter 4

Box 4.1: Potential sources of climate change financing	64
Box 4.2: Climate Change Alliance Trust Fund in Brazil and Cambodia	70
Box 4.3: What is a CDM project?	72
Box 4.4: Bank financing options	78

Chapter 6

Box 6.1: Most common barriers hindering wind power energy	105
Box 6.2: Most common barriers to the dissemination of efficient stoves	114
Box 6.3: Most common barriers to energy-efficient buildings	122
Box 6.4: Human health toxins found in both tobacco smoke and vehicle exhaust	127
Box 6.5: Most common barriers hindering the adoption of low-emission vehicles	128

Foreword

The scale of the climate change challenge that faces the international community is vast. Holding temperatures at 2°C above pre-industrial levels will require a transformation in production and consumption processes across all countries. It will also necessitate significant support, especially to the most poor and vulnerable people in developing countries, to strengthen adaptation measures and improve community adaptive capacity.

In December 2010, governments came together at the United Nations Climate Change Conference to move the climate agenda forward in a collective and comprehensive manner. They were successful at adopting an agreement, the Cancun Agreement, which calls on governments to scale up financial support to developing countries to better enable them to take climate action over the short and long term. The agreement puts in place a solid foundation to address climate change and achieve green, low-emission and climate resilient development.

In this global context, this guidebook is based on the premise that mitigating and adapting to climate change are entirely compatible with pursuing development. The new sources of climate finance that are available have the potential to deliver multiple development and climate benefits, including poverty reduction and sustainable livelihoods, green employment, biodiversity conservation, carbon sequestration, sustainable water management, and enhanced ecosystem-resilience and ecosystem-based adaptation. But there is a significant risk that only a few large emerging economies and developing countries will be able to fully seize these opportunities.

Developed countries have committed to raising \$100 billion per year by 2020 to assist developing countries in addressing climate change. Even if this level of financing is raised, public expenditures alone will be insufficient to adequately transform economies. It can, however, create a tipping point from which to catalyse much larger scale private investment. This means using international public climate finance to build enabling environments and remove domestic and foreign investment barriers in order to attract and drive public and private capital toward pro-poor low-emission climate-resilient development.

UNDP believes that developing countries will face three key climate finance challenges in the coming decade: (1) access to new and innovative sources of climate finance, (2) promotion of synergies between development and climate finance, and (3) use and delivery of limited sources of public finance to catalyse climate capital. Developing countries will require technical assistance to address these challenges, mitigate climate change impacts, and seize new opportunities associated with the transition to a low-emission climate-resilient society.

This guidebook is offered as a primer to countries to enable them to better assess the level and nature of assistance they will require to catalyse climate capital based on their unique set of national, regional and local circumstances. It serves as a companion manual to a comprehensive UNDP toolkit on policy and financing options to catalyse climate capital. It is also part of a series of UNDP publications that provides guidance to national and sub-national policy makers to prepare, finance, implement, and report on green, low-emission and climate-resilient development.

It is my hope that these publications will contribute to the ongoing discourse about the links between development and climate change, and help provide policy makers with new insights and tools as they seek to take steps to mitigate and adapt to climate change while pursuing national development goals.



Rebeca Grynspan
Associate Administrator

United Nations Development Programme

“

This guidebook is offered as a primer to countries to enable them to better assess the level and nature of assistance they will require to catalyse climate capital based on their unique set of national, regional and local circumstances.

”

Acronyms and Abbreviations

AAU	Assigned amount unit	KfW	German Development Bank
ACAD	Africa Carbon Asset Development Facility	Kw	Kilowatt hour
AF	Adaptation Fund	LDCF	Least Developed Countries Fund
AfD	French Development Agency	LDV	Light Duty Vehicles
AGF	Advisory Group on Climate Change Financing	LP	Limited Partners
BFI	Bilateral finance institution	MACC	Marginal abatement cost curve
BAU	Business-as-usual	MBI	Market-based instruments
BIDC	Barbados Investment and Development Corporation	MDB	Multilateral development bank
BOAD	Banque Ouest Africaine de Developpement	MDG	Millennium Development Goal
CATIE	The Tropical Agricultural Research and Higher Education Center	MFI	Microfinance institutions
CBO	Community-based Organization	MINED	Ministry of Education of El Salvador
CBD	Convention on Biological Diversity	NAMA	Nationally Appropriate Mitigation Action
CDC-UK	Commonwealth Development Corporation	NAP	National Adaptation Plan
CDM	Clean Development Mechanism	NEF	New Energy Finance
CER	Certified emission reduction	NGO	Non-governmental organization
CFI	Commercial Finance Institutions	NIB	Nordic Investment Bank
CFL	Compact fluorescent light	N ₂ O	Nitrous oxide
CH ₄	Methane	ODA	Official Development Assistance
CIF	Climate Investment Fund	ODS	Ozone-depleting substances
CO	Carbon monoxide	OECD	Organisation for Economic Cooperation and Development
COP	Conference of the Parties	OMB	United States (US) Office of Management and Budget
CO ₂	Carbon dioxide	OPIC, USA	Overseas Private Investment Corporation
CO ₂ e	Carbon dioxide equivalent	PES	Payment for ecosystem services
DBCCA	Deutsche Bank Climate Change Advisors	PPA	Power purchase agreements
EC	European Commission	PPM	Parts per million
ECAs	Export Credit Agencies	PPPs	Public-private partnerships
EIB	European Investment Bank	R&D	Research and development
EE	Energy efficiency	RD&D	Research, development, and demonstration
ERU	Emission reduction unit	RE	Renewable energy
ESCO	Energy service company	REDD	Reducing Emissions from Deforestation and Degradation
EIT	Economies in transition	REDD+	Reducing Emissions from Deforestation and Degradation in Developing Countries
ETI	Emission-Trading Instrument	REN 21	Renewable Energy Policy Network for the 21st Century
ERU	Emission Reduction Units	REFIT	Renewable Energy Feed-in Tariff
EU	European Union	RETAP	Renewable Energy Technology Assistance Program
FIT	Feed-in tariff	SCCF	Special Climate Change Fund
FMO	The Netherlands Development Finance Corporation	SEFI	Sustainable Energy Finance Initiative
GCF	Green Climate Fund	SEI	Stockholm Environment Institute
GDP	Gross Domestic Product	SGP	Small Grants Programme (UNDP-GEF)
GEEREF	Global Energy Efficiency and Renewable Energy Fund	TECSA	Technologías Ecológicas Centroamericanas
GEF	Global Environment Facility	TEEB	The Economics of Ecosystems and Biodiversity
GET FiT	Global Energy Transfer Feed-in Tariffs	UK	United Kingdom
GHG	Greenhouse gas	UNCDF	United Nations Capital Development Fund
Gt	Gigatonne	UNDP	United Nations Development Programme
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit	UNECE	United Nations Economic Commission for Europe
GWP	Global warming potential	UNEP	United Nations Environment Programme
HDR	Human Development Report	UNFCCC	United Nations Framework Convention on Climate Change
Ha	Hectare	US	United States
HVAC	Heating, ventilating, and air conditioning	VAT	value-added tax
IBRD	International Bank for Reconstruction and Development	VC/PE	Venture Capital/Private Equity
IDA	International Development Association	VER	Verified Emission Reduction
IEA	International Energy Agency	WB	World Bank
IEPF	Institut de l'Energie et de l'Environnement de la Francophonie	WBGU	German Advisory Council on Climate Change
IFC	International Finance Corporation	WEC	World Energy Council
IPP	Independent power producer	WEF	World Economic Forum
IPCC	Intergovernmental Panel on Climate Change	WFP	United Nations World Food Programme
IPCC AR4	IPCC Fourth Assessment Report	WG	Working Group
IRR	Internal rate of return	WRI	World Resources Institute
JI	Joint Implementation		
JICA	Japanese International Development Agency		

A stylized world map in a light blue color, centered on the Atlantic Ocean, serves as the background for the entire page. The map shows the outlines of the continents in a simplified, artistic manner.

Overview

- Purpose of Guidebook
- Target Audience
- UNDP Framework to Catalyse Finance Toward Green, Low-Emission and Climate-Resilient Development
- Structure of the Report

Overview

DEFINITIONS

Greenhouse gases

Greenhouse gases (GHG) are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect.

Climate change

Climate change refers to any change in climate over time, whether due to natural variability or because of human activity.

Adaptation

Adaptation refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Fossil fuels

Fossil fuels are carbon-based fuels from fossil hydrocarbon deposits, including coal, peat, oil and natural gas.

Mitigation

Mitigation refers to technological change and substitution that reduce resource inputs and emissions per unit of output.

In the absence of a significant reduction in global greenhouse gas (GHG) emissions from current levels between now and 2050, global average temperatures could rise by 4°C, and possibly more, by 2100. The world may have no more than 100–150 months to dramatically change its energy supply trajectory and limit temperature rise to a 'safe' 2°C. Moreover, even if the world immediately stopped emitting GHGs altogether some of the predicted effects of climate change are now unavoidable, thereby making adaptation in many parts of the world a necessity. According to the latest findings of the Intergovernmental Panel on Climate Change (IPCC, 2007), the world is already committed to an increase in average temperatures by 0.5°C to 1°C until approximately 2035, after which temperatures are likely to gradually increase and approach a 2°C increase (relative to 1990 levels) by 2050. There is a growing consensus that action to adapt to the impacts of climate change is as urgent as the need to reduce GHG emissions.

The financial sums involved in a rapid shift to a low-emission climate-resilient economy are considerable but not impossible to achieve. Global capital markets, representing \$178 trillion in financial assets (McKinsey Global Institute, 2008), have the size and depth to step up to the investment challenge. Rather than being a problem of capital generation, the key challenge of financing the transition toward a low-emission and climate-resilient society is the redirection of existing and planned capital flows from traditional high-carbon to low-emission, climate-resilient investments. Over the past few years, the international community has developed a number of regulatory and market-based instruments to shift investments from fossil fuels to more climate-friendly alternatives. As a result, investments in the sustainable energy market have grown from \$22 billion in 2002 to over \$200 billion in 2010 (Pew, 2011); they could reach \$400–500 billion by 2020.

Purpose of Guidebook

Only a limited number of developing countries are currently benefitting from these new financing opportunities, as their markets are not yet in a position to attract climate investments. Contrary to the view that a post-2012 global climate policy regime should focus on the largest GHG-emitting countries, this guidebook argues that a failure to provide fair access to climate finance to all developing countries would have severe political, financial and climate change consequences.

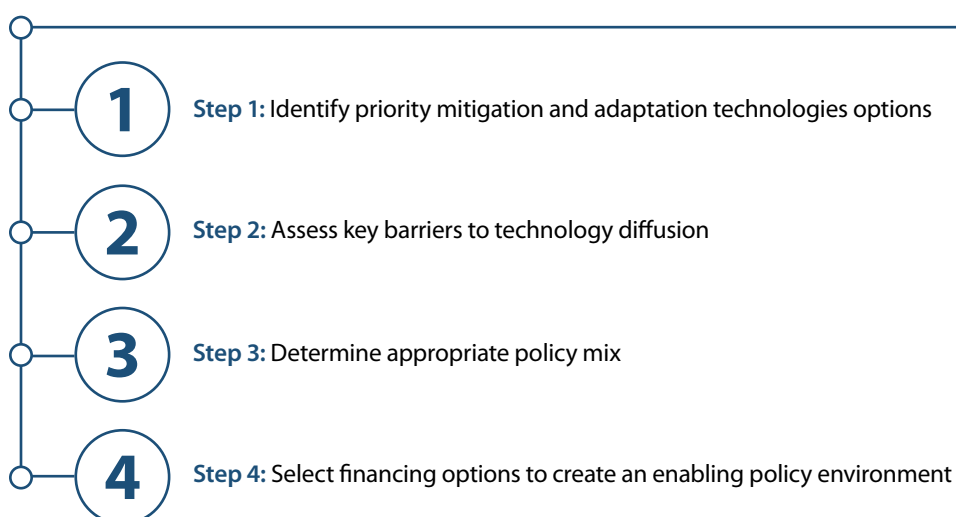
Developing the capacity of low-income countries to create conditions that enable public and private investment flows to address pressing environmental problems is a key priority to finance the transition toward a low-emission climate-resilient society. This guidebook on financing green, low-emission and climate-resilient development is designed to contribute to this vital objective.

Target Audience

The principal audience for this publication is the public development practitioner at the national and sub-national levels, as well as domestic and international experts involved in assisting governments in catalysing finance for climate investment and sustainable development.

UNDP Framework to Catalyse Finance Toward Green, Low-Emission and Climate-Resilient Development

Building on UNDP market-transformation and development experiences for low-emission climate-resilient technologies in over 100 countries over the past 20 years, this document outlines a four-step methodology to assist developing countries select and deploy an optimal mix of public policies and financing instruments to catalyse climate finance in line with national development priorities.



Summary of Key Steps

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

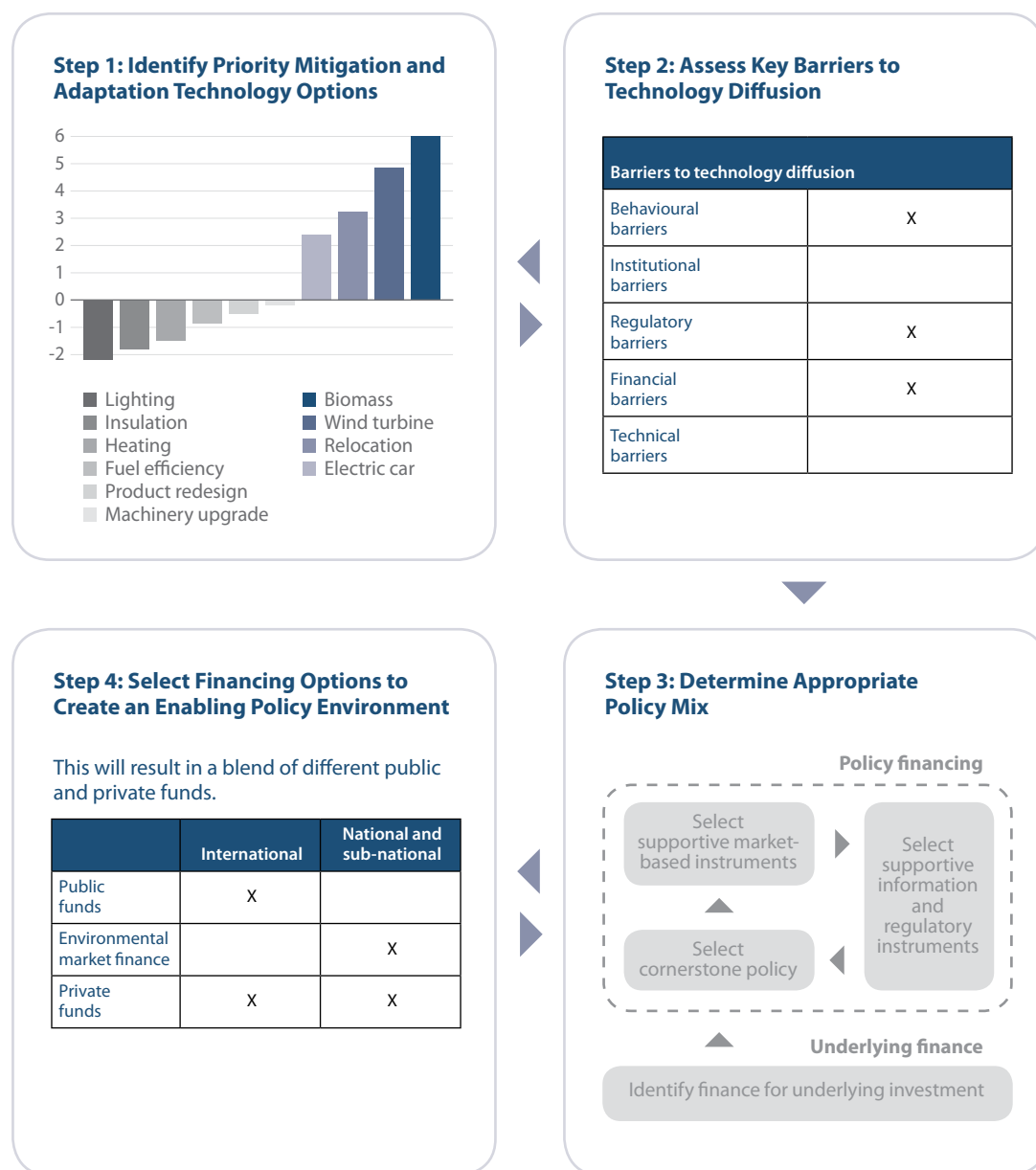
STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Figure 1: UNDP framework to catalyse finance toward green, low-emission and climate-resilient development



This guidebook focuses on clean energy as illustrated in the four-step framework figure. However, this framework can be as readily applied to most mitigation and adaptation technologies, including agricultural and ecosystems-based mitigation and adaptation technologies/solutions. It serves as an introduction and companion manual to a comprehensive UNDP toolkit *Policy Instruments and Financing Options for Low-Emission and Climate-Resilient Development* (UNDP, 2011a). This toolkit applies the methodology presented in this guidebook to a wide range of priority mitigation and adaptation technologies.

Structure of the Report

Chapter 1 discusses the critical importance of ensuring fair access to climate finance across developing countries, as well as creating synergies between development and climate finance to limit the rise of global average temperatures to 2°C. **Chapter 2** reviews possible policy instruments to catalyse climate capital. **Chapter 3** presents UNDP's four-step framework to identify an appropriate public policy mix to attract and drive capital toward green, low-emission and climate-resilient development. **Chapter 4** reviews existing climate change funding sources to design and implement the selected mix of public policies. **Chapter 5** presents UNDP's methodology to access, combine, and sequence various funding sources to implement a selected policy mix and develop and transform climate markets. **Chapter 6** concludes this guidebook by applying the four-step methodology to four priority clean energy technologies: wind power, modern cooking devices, energy efficient building, and low-emission vehicles.

DEFINITION

Ecosystem

Ecosystem is a system of living organisms interacting with each other and their physical environment.



A stylized world map in a light blue color, centered on the Atlantic Ocean, serves as the background for the entire page. The map shows the outlines of the continents in a simplified, artistic manner.

Chapter 1

The Challenge of Universal Access to Climate Change Finance

- 1.1 Capital Requirements to Finance the Transition to a Green, Low-Emission and Climate-Resilient Society
- 1.2 Synergies Between Mitigation, Adaptation and Development Finance
- 1.3 Current Capital Flows to Finance the Transition to a Green, Low-Emission and Climate-Resilient Society
- 1.4 Providing Fair Access to Climate Finance for All Developing Countries

1

The Challenge of Universal Access to Climate Change Finance

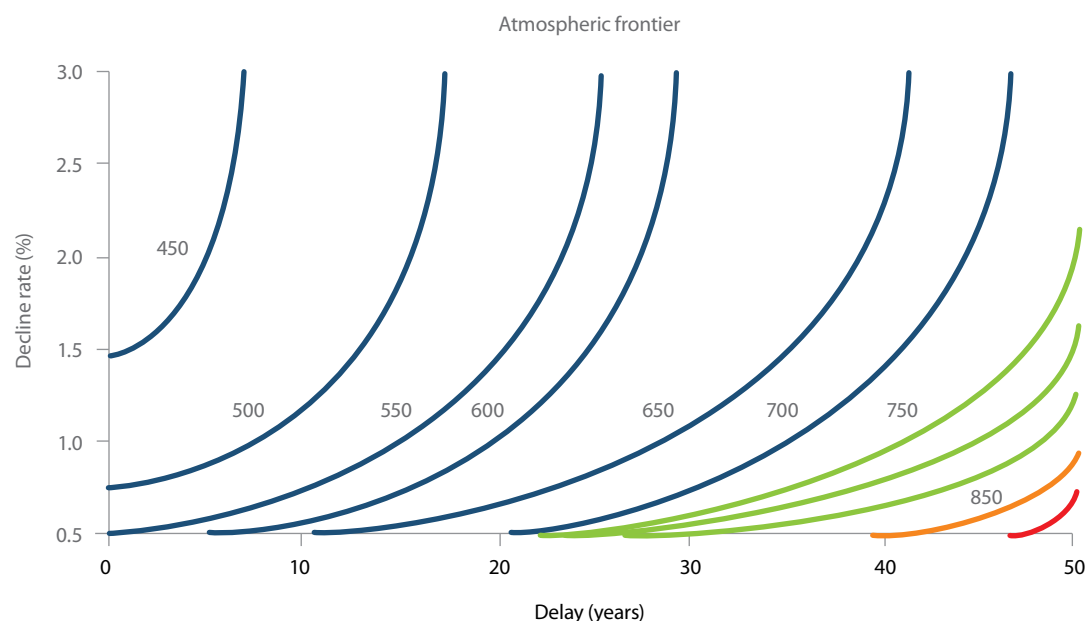
This first chapter briefly reviews the capital requirements to finance the transition to a green, low-emission and climate-resilient society, existing financial flows, and the critical importance of providing fair access to climate finance to all developing countries in order to avoid unmanageable climate change impacts and generate development dividends.

1.1 || Capital Requirements to Finance the Transition to a Green, Low-Emission and Climate-Resilient Society

In the absence of a significant reduction in global emissions from current levels to levels expected in 2050, world temperatures could rise by 4°C, and possibly more, by 2100 (IPCC, 2007). With the world planning to invest approximately \$7 trillion per annum in fixed-asset investments by 2020 (Project Catalyst, 2010), radical measures must be urgently taken both on climate change mitigation and adaptation before we are locked into potentially irreversible climate transformations, whose catastrophic impacts are expected to substantially change the environment and our lives on this planet (Mignone and others, 2007).

“
... we may have only
100-150 months from
today to dramatically
change the world's
energy supply trajectory
and avoid dangerous
climate change.
”

The 2007/2008 Human Development Report (HDR) from the United Nations Development Programme (UNDP) estimates that the international community will have to stabilize GHG concentration in the atmosphere at 450 ppm (parts per million) of carbon dioxide-equivalent (CO₂e) to limit global average temperature increase to the 2°C stipulated in the Cancun Agreement under the United Nations Framework Convention of Climate Change (UNFCCC). The HDR estimates that this would require a 50 percent reduction of GHG emissions by 2050 from 1990 levels (UNDP, 2007). To achieve this global objective, the HDR recommends that developed countries cut GHG emissions by at least 80 percent by 2050, with 20–30 percent cuts by 2020. For major emitters among developing countries, it recommends aiming for an emission trajectory that would peak in 2020 with 20 percent cuts by 2050. This is a contrast to the UNFCCC Kyoto Protocol's target of 5.2 percent emission reductions by the end of 2012, relative to 1990 emission levels, by developed countries only. Given the magnitude of the effort required, a key question is how much time is left to take viable action. Figure 1.1 addresses this question.

Figure 1.1: Timing of mitigation efforts

Source: Mignone and others (2007).

Figure 1.1 shows that the longer mitigation efforts are postponed, the greater the percentage decline rate of emissions needed to achieve the same CO₂e concentration level. Thus, the target concentration level of 450 ppm can be realized through emissions reductions of ~1.5 percent per year provided that reductions begin in 2011. However, if actions are delayed by approximately 8 to 10 years, then the future declines required to realize the target concentration level of 450 ppm will have to be greater than three percent, a reduction rate widely regarded as beyond current technological means. This means that we may have only 100-150 months from today to dramatically change the world's energy supply trajectory and avoid dangerous climate change.

We may have even less time to adapt to the impacts of climate change. A 2007 report from the Hadley Centre predicts a surface temperature for the coming decade based on a global climate model (Smith, 2007). It warns that each year from 2010 to 2014, the world has at least a 50 percent chance of exceeding the record high temperature set in 1998 (average global temperatures reached 14.54°C in 1998). Beyond 2014, the odds of breaking the temperature record rise even further. As climate change develops, large-scale climate change impacts, such as extended droughts over large areas affecting water availability and food security, become more likely. In addition to the economic impact, the social and political impacts could be devastating, particularly if the risk of civil strife escalates as a consequence of competition over scarce natural resources (WBGU, 2007). The next few years will be critical to developing the capacity of the most vulnerable countries to adapt to climate change impacts and avoid the reversal of development gains achieved over the past 50 years.

DEFINITIONS

United Nations Framework Convention on Climate Change

United Nations Framework Convention on Climate Change (UNFCCC) — adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Economic Community — was created to achieve the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. It contains commitments for all parties.

Kyoto Protocol

The Kyoto Protocol to the UNFCCC was adopted at the Third Session of the Conference of the Parties (COP) in 1997 in Kyoto. It contains legally binding commitments, in addition to those included in the FCCC. Annex B countries agreed to reduce their anthropogenic GHG emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) by at least 5 percent below 1990 levels in the commitment period 2008-2012. The Kyoto Protocol came into force on 16 February 2005.

“
Notably, we will
have to rapidly
disseminate mitigation
and adaptation
technologies that are
commercially viable and
accelerate research
and development
(R&D) efforts.”

Can the world achieve such a task? Reducing global CO₂e emissions by 50 percent of 1990 levels by 2050 and adapting to climate change impacts will require revolutionary changes in production and consumption patterns in all economic sectors. Such global changes are critical to both safeguarding development gains and enhancing the climate resilience of the development trajectories of developing countries. Notably, we will have to rapidly disseminate mitigation and adaptation technologies that are commercially viable and accelerate research and development (R&D) efforts.

Achieving this transformation will require a dramatic shift in public and private investments from traditional energy supply sources and technologies to more sustainable climate-friendly alternatives. The International Energy Agency (IEA) estimates that the capital required to meet projected energy demand through 2030 in a non-carbon constrained world would amount to \$1.1 trillion per year on average. Approximately half of this will be required for developing countries, roughly evenly distributed between the large emerging economies (China, India, Brazil, etc.) and all remaining developing countries. Additional investment of close to \$10.5 trillion (\$510 billion per year over the next 20 years) over a business-as-usual fossil fuel scenario is needed globally in the energy sector for the period 2010-2030 to ensure a 50 percent chance of maintaining GHG concentration to less than 450 ppm CO₂e (IEA, 2009).

As pointed out by the IEA (2009), additional investment is all too often understood as additional cost, and climate change management is thus perceived as an extra development burden. However, the bulk of this additional investment could generate attractive commercial returns. Energy bills in transport, buildings and industry could be reduced by over \$8.6 trillion globally over the period 2010-2030 and by \$17.1 trillion over the lifetime of the investments, according to the IEA. These investments could also translate into savings from air pollution control, estimated at up to \$100 billion by 2030 compared with the business-as-usual scenario (IEA, 2009). No single technology can provide all of the mitigation potential in any sector, and the efforts advocated by the IEA in the energy sector will need to be supplemented by action in all economic sectors to limit the increase of global average temperature to 2°C in a cost-effective manner. As shown in Figure 1.2, all economic sectors show some potential for GHG emission reductions, with the highest potentials in the buildings and agriculture sectors.

DEFINITION

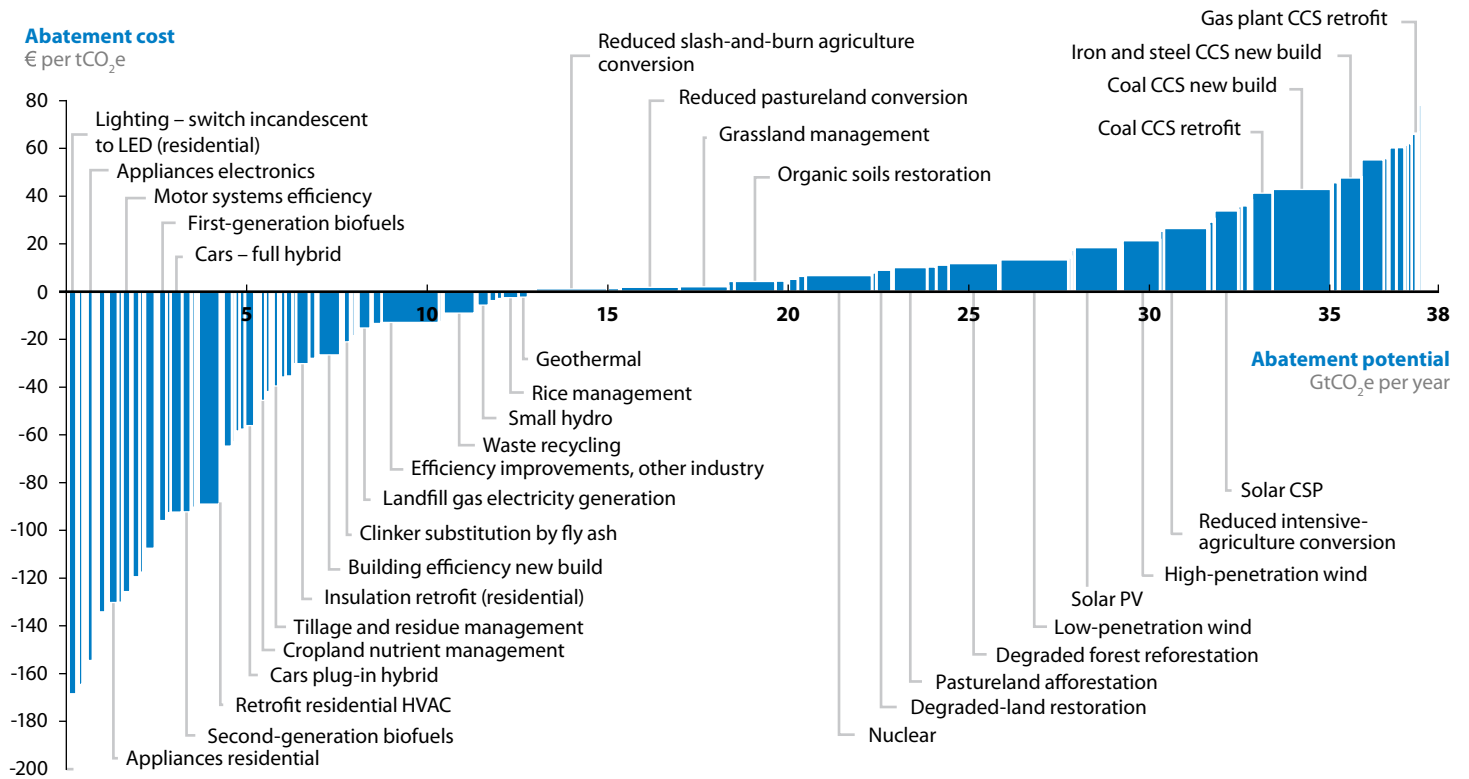
Resilience

Resilience refers to three conditions that enable a social or ecological system to absorb change and not fundamentally fall apart: ability to self-organize, ability to buffer disturbance, and capacity for learning and adapting.

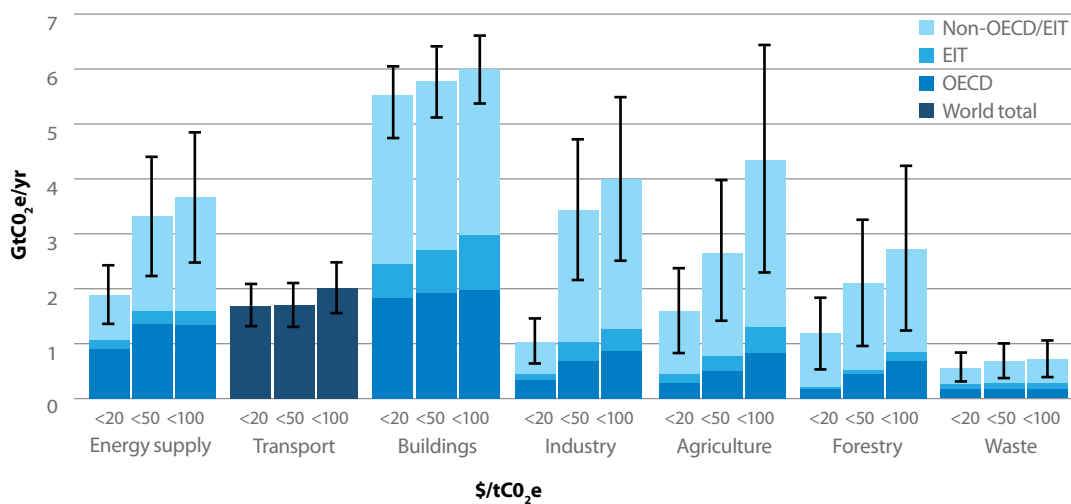
The global GHG abatement cost curve prepared by McKinsey & Company (2009) (Figure 1.1) indicates that close to 10 GtCO₂e (gigatonne of CO₂e) could, in theory, be abated at negative cost, and close to 30 GtCO₂e could be reduced at zero cost beyond business-as-usual by 2030. Figure 1.3 shows that all regions can contribute to this effort. Notably, some of the most cost-effective GHG abatement options in buildings and agriculture can be found in developing countries.¹

In each sector, the Intergovernmental Panel on Climate Change (IPCC) has identified the key technologies that will need to be mobilized (see Table 1.1). As shown by the IEA in the 2010 Energy Technology Perspectives report, many of these technologies are already commercially available or will become available for deployment within the next decade. The IPCC conducted a similar review of key adaptation technologies and measures (see Table 1.2).

¹ For the purposes of this report, the term 'developing countries' refers to countries that are neither members of the Organisation for Economic Co-operation and Development (OECD) nor countries with economies in transition (EIT).

Figure 1.2: Global GHG abatement cost curve beyond business-as-usual 2030 (v2.1)

Source: McKinsey & Company (2009). Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Figure 1.3: Estimated potential for global mitigation for different regions in 2030

Source: Metz and others (2007).

Table 1.1: Key mitigation options by sector

Sector	Key mitigation technologies and practices currently commercially available	Key mitigation technologies and practices projected to be commercialized before 2030
Energy supply [4.3, 4.4]	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of Carbon Capture and Storage (CCS) (e.g. storage of removed CO ₂ from natural gas).	CCS for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and waves energy, concentrating solar and solar PV.
Transport [5.4]	More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorized transport (cycling, walking); land-use and transport planning.	Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries.
Buildings [6.5]	Efficient lighting and day lighting; more efficient electrical appliances and heating and cooling; alternative refrigeration fluids; recovery and recycle of fluorinated gases.	Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings.
Industry [7.5]	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO ₂ gas emissions; and a wide array of process-specific technologies.	Advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminum manufacture.
Agriculture [8.4]	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH ₄ emissions; improved nitrogen fertilizer application techniques to reduce N ₂ O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency.	Improvements of crop yields.
Forestry/forests [9.4]	Afforestation; reforestation, forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use.	Tree species improvement to increase biomass productivity and carbon sequestration. Improved remote sensing technologies for analysis of vegetation/soil carbon sequestration potential and mapping land use change.
Waste management [10.4]	Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimization.	Biocovers and biofilters to optimize CH ₄ oxidation.

Source: Adapted from Table SPM.3 in Metz and others (2010). Note: Key mitigation technologies and practices by sector. Sectors and technologies are listed in no particular order. Non-technological practices, such as lifestyle changes, which are cross-cutting, are not included in this table but are addressed in paragraph 7 in SPM.3.

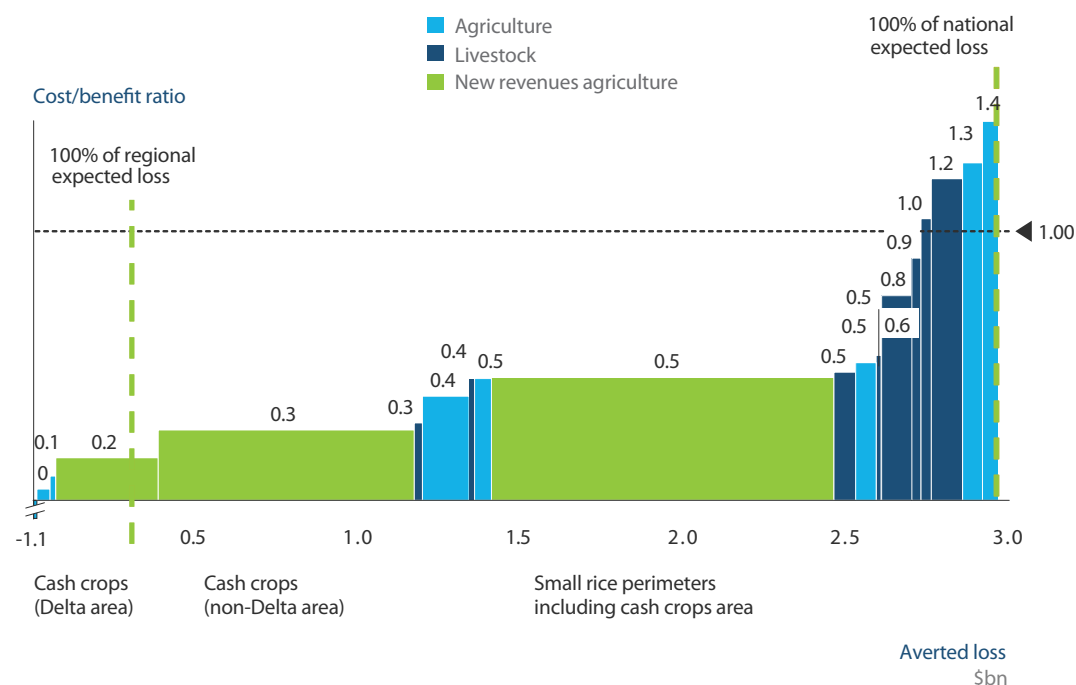
Comparatively limited information is available about adaptation benefits and costs. Furthermore, to date, studies have provided a wide range of estimates for these benefits and costs, from \$4 billion to \$109 billion a year (World Bank, 2010). The reasons for this are threefold: (1) the inability to attribute many observed changes at local and regional scales explicitly to climate change; (2) the diversity of impacts and vulnerabilities across countries and within countries; and (3) the relatively small body of research that focuses on climate change adaptation actions (US National Academy of Sciences, 2010).

Table 1.2: Key adaptation options by sector

	Food, fibre and forestry (crops)	Water resources	Human health	Industry, settlement and society
Drying/Drought	Development of new drought-resistant varieties; intercropping; crop residue retention; weed management; irrigation and hydroponic farming; water harvesting	- Water demand management - Soil moisture conservation - Conservation of groundwater	- Grain storage and provision of emergency feeding stations - Provision of safe drinking water and sanitation	Improved water supply systems and coordination between jurisdictions
Increased rainfall/Flooding	Polders and improved drainage; development and promotion of alternative crops	Enhanced implementation of protection measures including flood forecasting and warning	Early-warning systems; disaster preparedness planning; effective post-event emergency relief	- Improved flood protection infrastructure - Flood hazard mapping; flood warnings
Warming/Heat waves	Development of new heat-resistant varieties; altered timing of cropping activities; pest control and surveillance of crops	- Water demand management through metering and pricing - Education for sustainable water use	- International surveillance systems for disease emergence - Strengthening of public institutions and health systems	- Assistance programmes for especially vulnerable groups - Improve adaptive capacities - Technological change
Wind speed/Storminess	Development of wind-resistant crops (e.g. vanilla)	Coastal defense design and implementation to protect water supply against contamination	Early warning systems; disaster preparedness planning; effective post-event emergency relief	Emergency preparedness, including early-warning systems; more resilient infrastructure; financial risk management options for both developed and developing regions

Source: Parry and others (2007), Climate Change Impacts and Adaptation Priorities.

Although profitable adaptation investments exist for agriculture, water resources and other sectors, preliminary research shows that it will cost to adapt and that the main rationale for investment in adaptation will most often be to avoid higher costs. The report of the Economics of Climate Adaptation Working Group (ECA, 2009) estimates that losses avoided from early adaptation action considerably exceed additional adaptation costs. In the locations studied, between 40 and nearly 100 percent of the expected losses by 2030 (under high climate change scenarios) can be averted through cost-effective adaptation measures that are already known and tested. For example, Figure 1.4 below reproduces the results of the evaluation of a range of measures to protect Mali's agricultural sector against drought losses, and to promote climate-resilient agricultural growth. Some asset-based adaptation measures (such as soil techniques, irrigation systems and the provision of additional water for cattle) would help to 'climate-proof' yields and avoid loss from climate change. The Economics of Climate Adaptation Working Group estimates that about three-quarters of the potential of these measures could provide higher benefits than costs.

Figure 1.4: Impact of cash crops on ability to avert expected loss — Mali test case

Source: From Economics of Climate Adaptation Working Group, "Shaping Climate-Resilient Development: A Framework for Decision-Making" (2009).

1.2 Synergies Between Mitigation, Adaptation and Development Finance

While it is often useful to separately consider mitigation and adaptation activities given the differences in constituencies, technical options and financial opportunities, at times it can also prove misleading and counterproductive. As illustrated in the examples and case studies given in the following chapters of this guidebook, the frontier between mitigation and adaptation activities can be extremely tenuous.

Clean energy development and water resources management provide a good example of the synergies and trade-offs between mitigation and adaptation activities that could be overlooked by a strict segregation of adaptation and mitigation action. In most cases, clean energy development is regarded as a mitigation activity, while water resources management is considered to be an adaptation issue. However, energy and water are inextricably intertwined. In fact, water is the largest renewable source of electricity. Hydropower accounts for roughly 15 percent of the world's electricity, and in some countries it is the main source of electricity: in Switzerland (60 percent), Venezuela (70 percent), Brazil (85 percent) and Norway (98 percent). Figure 1.5 illustrates some of the interdependencies between water and energy.

As Figure 1.5 shows, even when water is not the energy source for producing electricity, it is often essential to the task. Both fossil fuel and nuclear power stations need large amounts of water for cooling. During droughts, nuclear power plants along French rivers such as the Loire have occasionally had to shut down. Solar thermal power plants, which turn the sun's heat into steam for driving turbines, also need water to run.

The relationship between clean energy development and fresh water is reciprocal, as electricity is also crucial to the supply of fresh water. Desalination of seawater, whether by evaporation or reverse osmosis, is energy-intensive. In Saudi Arabia, this process is the largest consumer of energy. Pumping water to where it is needed also relies on electricity.

Agriculture is another example of a key human activity that will be severely affected by climate change. Sequestering soil carbon through sustainable land management practices not only contributes to climate change mitigation, but also can strengthen the adaptive capacities of vulnerable communities, reduce biodiversity loss, enhance water conservation, and boost agricultural productivity and economic growth. At the same time, as adaptation and mitigation strategies in agriculture are implemented, modifications to local agricultural practices aimed at maintaining production and income to alleviate the potential negative effects of climate change may hamper mitigation efforts (e.g. land use changes, heavy reliance on fertilisers, etc.).

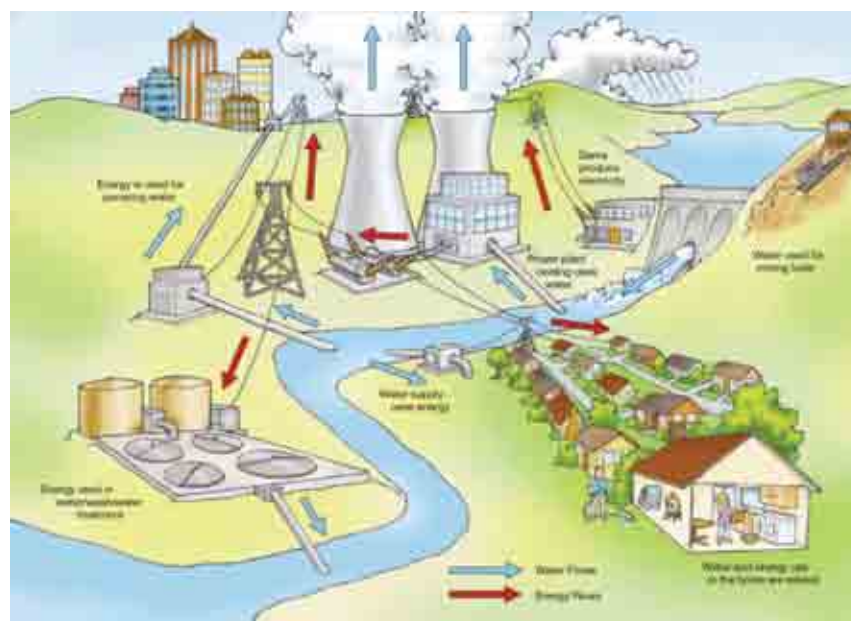
A third example is the case of infrastructure and city design. Depending on its design, a city will be more or less vulnerable to flood (because low-density cities need more land and are pressured to use all available land, including flood-prone areas) and heat waves (because a large city causes more urban heat that increases night time temperatures). The way a city is designed affects transportation demands. Some designs cater to the implementation of efficient public transportation, while others present challenges to the process. A non-efficient system might lead to more emissions, whereas an efficient system could limit the amount of emissions. It is therefore crucial for planners and decision makers to take into account both adaptation and mitigation when designing a city.

Placing too much focus on individual mitigation or adaptation goals, without consideration of the side effects and linkages to other goals, could lead to missed opportunities. For example, enacting new building codes to improve the energy efficiency (EE) of buildings also provides an opportunity to increase the resilience of communities to extreme weather events (e.g. heat waves, cold spells, storms, earthquakes, etc.), as the improvements required in building design and construction to improve their thermal efficiency are very similar to those needed to increase their resilience to extreme events. Increasing the resilience of buildings to extreme events can appear prohibitively expensive in the face of uncertainty about future climate conditions. However, the investment case becomes much more compelling once energy savings are considered. Furthermore, investment in energy efficient buildings can mobilize finance from carbon markets, and this potentially rich source of financing would not be available if potential GHG-emission-reduction revenues were not taken into consideration when planning housing adaptation efforts.

DEFINITION

Biodiversity

Biodiversity refers to the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Figure 1.5: Interdependencies between water and energy generation

Source: Pate and others (2007).

DEFINITIONS

Building codes/regulations

Building codes/regulations are laws that control the construction or remodelling of homes or other structures. They are regulations that are enforceable under the police powers of the state and locality controlling alterations, construction methods and materials, size and setback requirement, use and occupancy of all structures. Building codes have specific regulations covering all aspects of construction and are designed to maximize the health and welfare of the residents.

Energy efficiency

Energy efficiency is the ratio of useful energy output of a system, conversion process or activity to its energy input.

UNDP experience shows that the most cost-effective climate change measures are invariably those that deliver both mitigation and adaptation benefits. Therefore, it is important to address climate change in an integrated manner to maximize synergies and minimize trade-offs between mitigation and adaptation measures. Unfortunately, most climate change investments tend to look at either mitigation or adaptation, but not both. They also rarely consider the possible side effects. A wide range of barriers currently discourages the tighter integration of adaptation and mitigation efforts. For instance, two different communities, energy practitioners and development practitioners, make decisions on mitigation and adaptation. Both actors operate across different sectors and on different spatial, temporal and institutional scales. They also manage different budgets, and sometimes compete with one another for resources. A key objective of public policy efforts to catalyse climate capital is the introduction of investment incentives that encourage the systemic review of possible synergies and trade-offs between mitigation and adaptation options.

UNDP experience also shows that aligning development and climate management goals is critical to scale up climate investments. The necessary policy action to tackle climate change and catalyse climate capital will meet with stronger public consensus and be more effective if it helps address local development issues, such as the provision of basic services, greater energy and food security, and employment. People in developing countries who lack basic services and economic opportunities are primarily concerned with improving their living conditions. One critical factor affecting their livelihoods is whether they have access to affordable and reliable energy services for household and productive uses. The lack of clean and efficient sources of energy can limit access to clean water, prevent children from attending

school regularly, expose communities to health hazards and restrict women's choices and ability to pursue fulfilling activities. Of the 1.2 billion people living on the equivalent of one dollar a day, 70 percent are women. Because of their traditional responsibilities for collecting fuel and water, in many developing countries women and girls would benefit the most from access to improved energy services. The time and physical effort expended by women and girls to gather fuel and carry water seriously limits their ability to engage in educational and income-generating activities (UNDP, 2004).

Improving access to energy in underserved areas and using low-emission technologies can address the development needs of vulnerable populations while promoting a transition to green, low-emission and climate resilient development. Thus, access to energy is strongly connected to the achievements of the Millennium Development Goals (UNDP, 2010a). Increasing energy efficiency and unleashing the local potential of renewable energy can also increase the energy security of developing countries. Of the 50 poorest countries in the world, 38 are net oil importers (Rossi and Lambrou, 2009). Oil and diesel make up 10 to 20 percent of the total imports of 26 African countries; subsidies to fossil fuels are a major drain on the public purse of a number of these countries.

Another key development-climate nexus is ecosystems management. Healthy ecosystems and the services they provide are arguably as important as energy access for the poor. Ecosystems are the foundation for the natural processes of climate regulations and are a vital support for water quality, food security, and flood protection, among others (UNEP, 2010; Ervin and others, 2010). The poor have the least ability to change, if and when their way of life is threatened (i.e. least ability to relocate, change land use, alter income source, etc.), yet they are the most vulnerable to ecosystems degradation. Conservation or sustainable use of natural ecosystems can help buffer potential climate impacts through the provision of key services such as water purification or soil stabilization. Investing in ecosystems conservation and rehabilitation provide both local and global benefits, helping communities preserve their sources of livelihood, generate new sources of income, and adapt to a changing climate while reducing GHG emissions from unsustainable land uses. Climate finance could prove a powerful force for ecosystems management and the achievement of the MDGs in the coming years (see Chapters 4 and 5).

While it is critical to recognize the 'additionality' of climate finance over existing expenditure, it is also imperative to develop synergies between climate and development finance to maximize the economic and social returns of climate change investments. In turn, these synergies will strengthen policy and public support for climate investments. An option to identify and promote such synergies is to mainstream climate change into national development plans and to prepare integrated low emission, climate resilient development strategies.

DEFINITIONS

Energy security

Energy security refers to the various security measures that a given nation, or the global community as a whole, must carry out to maintain an adequate energy supply.

Additionality

Within the context of climate finance, additionality refers to the need for financing above and beyond official development assistance (and other) allocated by governments. Climate finance should be 'additional' to other funds that governments earmark for development assistance. The 'additionality' requirement ensures that the total pool of funds for development does not decrease (through the redirection of funds for x to funds for y) as a result of climate finance.

1.3 | Current Capital Flows to Finance the Transition to a Green, Low-Emission and Climate-Resilient Society

The existence of significant potential, with many options already available and cost-effective, should make a compelling case for businesses, private investors and households to independently adopt priority mitigation and adaptation technologies. However, and as further discussed in the following chapters of this guidebook, investment in seemingly straightforward mitigation and adaptation technologies faces a range of barriers (see Table 3.3).

“

While potentially earning a good return on investment, most renewable energy and energy efficiency investments require substantial upfront costs. The shift to a green, low-emission and climate-resilient economy frequently involves higher upfront capital costs, matched by lower operating costs. The UNFCCC (2007) estimates that 80 percent of the capital needed to address climate change issues will come from the private sector — both businesses and consumers. Similarly, the IEA (2009) estimates that about 40 percent of the global additional investment needed in 2020 will come from households, 40 percent from businesses, and the remaining 20 percent directly from governments.

Upfront investment for clean energy projects can be forbidding. Financial constraints faced by individual consumers are often much more severe than actually revealed by national discount rates or long-term interest rates. Implicit discount rates in industry are over 20 percent compared to less than 10 percent for public discount rates, and 4 to 6 percent for long-term interest rates (WEC, 2004). In addition, households or local governments might find it even more difficult than businesses to access limited credit should they decide to make such an investment. This constraint will be felt even more acutely in developing countries given the limited access to consumer credits in nascent financial markets. Furthermore, individual investors often lack access to information and sufficient expertise at the right time and right place to evaluate investments. The most vulnerable segments of a population tend to have particularly high personal discount rates as well as aversion to risks. Hence, poor farmers are unlikely to spontaneously adopt climate-resilient cultivars in the absence of appropriate agricultural extension services and risk mitigation instruments such as crop failure insurance.

”

Because of these specific challenges, supportive public policies are typically required to facilitate adoption of even highly profitable low-emission climate-resilient development actions. Global capital markets, representing \$178 trillion in financial assets, have the size and depth to step up to the investment challenge (McKinsey & Company, 2009). Rather than a problem of capital generation, the key challenge of financing the transition toward a low-emission society is to address existing policy, institutional, technological, behavioural and technical skill barriers to redirect existing and planned capital flows from traditional high-carbon to low-emission climate-resilient investments. Removal of these barriers can complement and maximise the impact of capital finance such as concessional loan finance.

The shift to a green, low-emission and climate-resilient economy frequently involves higher upfront capital costs, matched by lower operating costs. The UNFCCC (2008) estimates that 80 percent of the capital needed to address climate change issues will come from the private sector — both businesses and consumers.

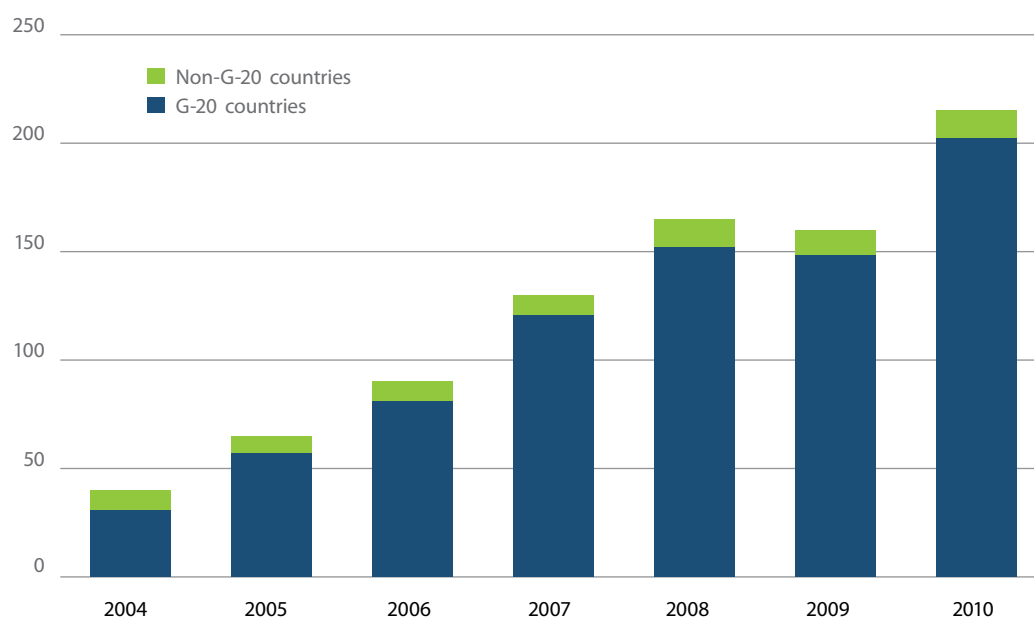
The international community has developed a number of complementary policy and financing instruments to shift investments from fossil fuels to more climate-friendly alternatives over the past few years. The UNFCCC review of Annex I countries' Fourth National Communications refers to more than 1,000 GHG mitigation policies and measures (OECD, 2009). The private sector is reacting positively to both the strong likelihood of policies that support low-emission development, and the financial pressures and incentives to encourage a move in the same direction. Despite the turmoil in the world's financial markets in 2008, and the subsequent economic crisis, the past two years have witnessed continued strong investment in clean energy technologies. According to The Pew Charitable Trusts (2011), in 2010 the clean energy sector grew by 30 percent above 2009 levels to achieve a record \$243 billion worth of finance and investment. Over the medium to long term, and with the appropriate public sector support, private investment in clean energy technologies is expected to reach \$450 billion by 2012 and \$600 billion by 2020 (UNEP, 2010).

“

... a key issue with a number of these new and innovative sources of finance is their acute regional and technological unevenness in availability and use.

”

Figure 1.6: Growth of private investment in clean energy

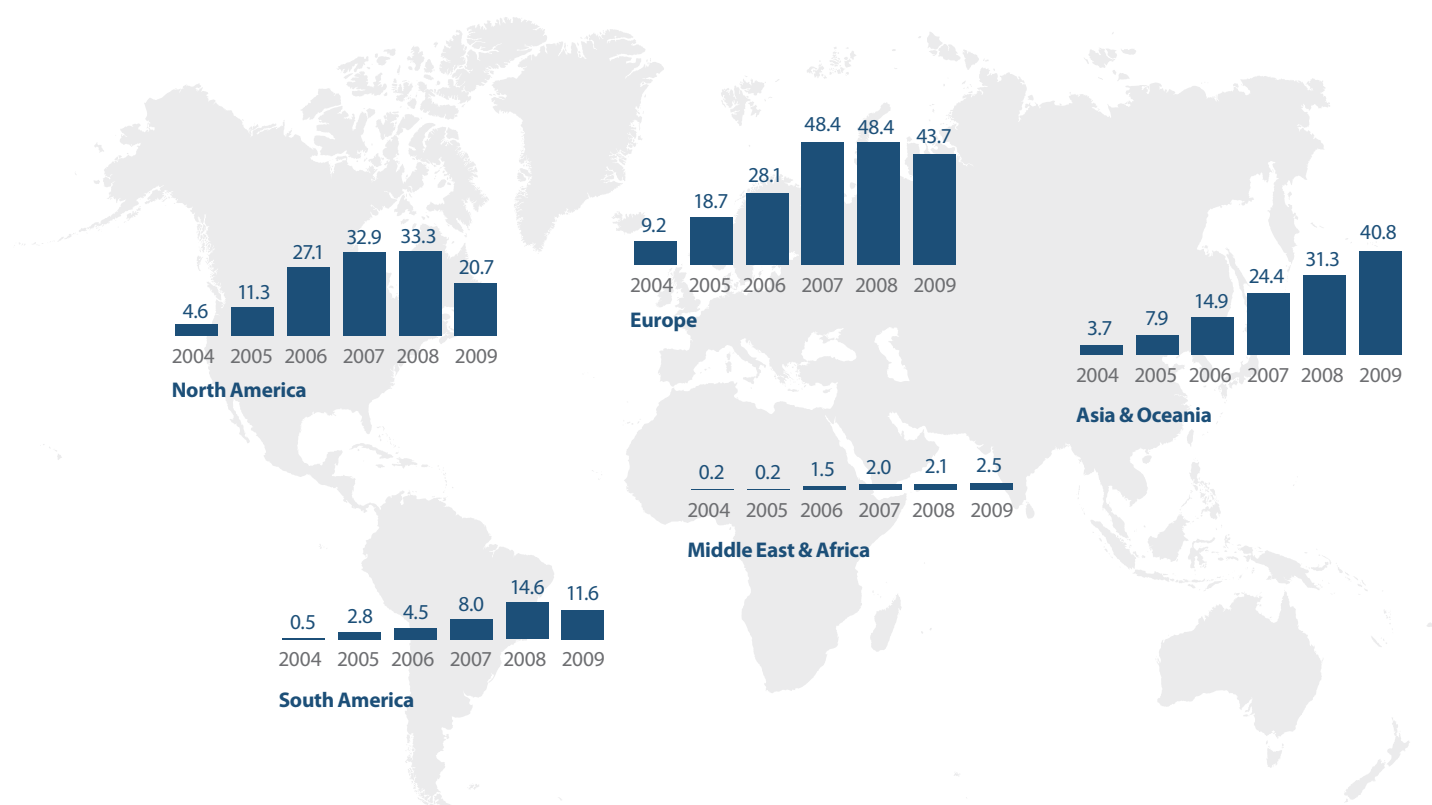


Source: The Pew Charitable Trust (2011).

Purchases of small-scale clean energy technologies (less than 1 megawatt) were a new and important force, driving clean energy investment to record levels in 2010. Investment in small-scale projects among G-20 members grew by 100 percent, doubling annual investment to \$56.4 billion (Pew, 2010) and possibly signalling a new paradigm in renewable power generation. However, a key issue with a number of these new and innovative sources of finance is their acute regional and technological unevenness in availability and use, with the bulk of these funds going to a few large emerging economies and to a small selection of technologies. The European Union (EU), the United States (US), China, and a handful of large emerging economies currently receive the bulk of both the new investment and the acquisition activity.

In 2007, investment in the least developed regions, such as Africa, was limited to asset financing of \$1.3 billion — mainly for biofuel plants. Although an estimated 575 million people still rely on traditional biomass in Africa (IEA, 2006), the region accounted for less than one percent of the total private investment in clean energy in 2007. Despite the existence of highly profitable opportunities in energy efficiency, financial flows to the Middle East and Central Asia also remain very limited (see Figure 1.7).

Figure 1.7: New investment by region (2004-2008, \$ billion)



Source: UNEP (2010).

Even financial instruments specifically established to drive and attract financial resources for developing countries display the same geographical and technological biases. One notable example is the Clean Development Mechanism (CDM). This project-based carbon mechanism was established under the Kyoto Protocol to promote both sustainable development and GHG emissions reduction in developing countries.

The CDM has huge potential in terms of allowing developing countries to earn credits for their emission reduction projects and to sell these credits to industrialized countries. A World Bank study on the potential for CDM in Africa concluded that 170 GW (gigawatt) of additional power-generation capacity could be created in Sub-Saharan Africa through low-carbon projects eligible for CDM (De Gouvello, Dayo and Thioye, 2008). This would equal roughly four times the region's current modern-energy production. However, the analysis of the existing CDM pipeline reveals that only a limited number of countries are benefiting. Just five countries — China, India, Brazil, the Republic of Korea and Mexico — are expected to generate over 80 percent of total CDM credits by 2012, and there is strong concern that this mechanism could largely bypass Africa.

A similar situation is found for most new market-based sources of climate change finance (export credits, green bonds, weather derivatives, etc.). This uneven access to financial resources could worsen in the coming years as climate finance shifts from project-based approaches to scaled-up approaches such as NAMAs (Nationally Appropriate Mitigation Actions), NAPs (National Adaptation Plans), programmatic CDM, sectoral crediting and cap-and-trade systems in both industrial and developing countries (on a voluntary basis) and as the number of global funds and innovative sources of finance multiply.

1.4 || Providing Fair Access to Climate Finance for All Developing Countries

It is sometimes argued that present investment flows correlate reasonably well with the distribution of mitigation potential. However, failure to provide fair access to climate finance to all developing countries will have severe economic, social, political, financial and climate change implications. In many cases, the countries that receive the least public climate finance are the most vulnerable countries to climate change, and have the lowest capacity to access new sources of finance to adapt to it. The inequity of this situation is untenable and not only endangers a successful outcome of the present climate change negotiations, but of all global governance negotiations.

Furthermore, universal access to climate finance should not just be limited to adaptation. A lack of mitigation financing for smaller developing countries would constrain the capacity of industries to capitalize on low-cost opportunities in the most vulnerable countries to improve efficiencies as well as reduce GHG emissions in a cost-effective manner. Cost-effective energy efficiency in the building sector, for example, will not be harvested. This is particularly important over the next 5 to 10 years as low-income countries are currently investing heavily in long-lived power generation and urban infrastructures. Limited access to climate financial flows would lock these countries into high-emission development paths. This would ultimately hinder their economic development as well as significantly constrain the world's capacity to limit global temperature increase to below catastrophic levels in the second part of the 21st Century.

DEFINITIONS

Clean Development Mechanism

The Clean Development Mechanism (CDM), defined in Article 12 of the Kyoto Protocol, is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments.

Bonds

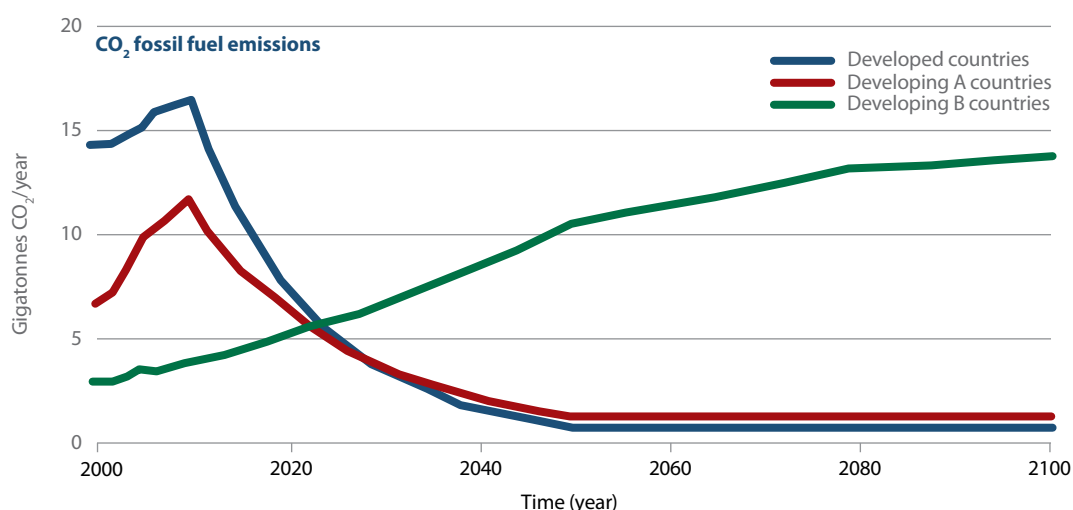
Bonds can variously be described as IOUs, loans or debts. They are similar to bank loans, but generally last longer (from one year to over 30 years). When institutions, companies, governments and other entities want to raise long term finance but do not want to dilute their shareholdings (or, indeed, cannot issue share capital), they turn to the bond markets. The biggest investors in the UK are the insurance companies and pension funds. They buy bonds to generate return, offset their liabilities, generate income or diversify their portfolios.

Nationally Appropriate Mitigation Action

Nationally Appropriate Mitigation Action (NAMA) refers to voluntary emission reduction measures undertaken by developing countries that are reported by national governments to the UNFCCC. They are expected to be the main vehicle for mitigation action in developing countries under a future climate change agreement, and can be policies, programmes or projects implemented at national, regional, or local levels.

Figure 1.8, prepared by Climate Interactive, is based on the C-Roads model and emphasizes the need for universal access of developing countries to both mitigation and adaptation funding. The study shows that if only a limited number of developing countries can access mitigation finance, developed countries (including countries with economies in transition) would need to cut emissions by 95 percent of 1990 levels by 2050 (and large emerging economies by 75 percent) in order to limit global warming to below 2°C. Even in a best-case scenario, emission cuts of this magnitude are clearly unrealistic.

Figure 1.8: GHG emission trajectories under a business-as-usual climate finance scenario



Source: Jones and others (2010). Note on the scenarios: Developed and developing A start in 2010 to reduce emissions by 95 percent and 75 percent, respectively, by 2050, from 1990 levels. Developing B is business-as-usual.

New sources of climate finance for GHG emissions reduction and adaptation to climate impacts hold the promise of leveraging a much greater volume of private resources. There is a significant risk, however, that only a few emerging economies will be able to develop enabling policy environments and climate investment proposals robust enough to lay the foundation for international financial transfers, and that we will see a repeat of the CDM experience in the absence of appropriate technical assistance for developing countries to establish appropriate policies and incentives.

In the coming decade, UNDP believes that developing countries will face three key climate finance challenges:

- Access to new and innovative sources of climate finance
- Promotion of synergies between development and climate finance
- Use and delivery of limited sources of public finance to catalyse and direct much larger private flows

Developing countries will require technical assistance dedicated to these issues in order to address these challenges, mitigate climate change impacts and seize new opportunities associated with the transition to a low-emission climate-resilient society. The present guidebook should enable countries to better assess the specific technical assistance required to meet their unique requirements to catalyse climate finance.

A stylized world map in a light blue color, centered on the Atlantic Ocean, serves as the background for the page. The map shows the outlines of the continents in a simplified, artistic manner.

Chapter 2

Catalysing Capital Toward Green, Low-Emission and Climate-Resilient Development

- 2.1 Key Policies to Create an Enabling Environment for Climate Investing
- 2.2 A Taxonomy of Public Policies to Catalyse Green Investments

2

Catalysing Capital Toward Green, Low-Emission and Climate-Resilient Development

“

Before making a climate investment, financiers will assess a number of project-specific (resources, technology, skills, energy intermediaries, operations and management, etc.) and non-project-specific risks (country risks, size of the economy, macro-economic conditions, investment policies, currency risk, tax rates, proximity to markets, technology, supporting and delivery infrastructure, etc.).

”

This chapter presents a summary of the policy instruments currently used throughout the world to finance green, low-emission and climate-resilient development. It summarizes the objectives and application modalities of these various policy measures.

2.1 || Key Policies to Create an Enabling Environment for Climate Investing

A basic but important principle behind the promotion of climate investment is that climate investment policies must tackle all the relevant factors that financiers assess when considering an investment opportunity. Any activities used to promote climate finance should be embedded within the broader investment framework.

Favourable climate investment policies cannot substitute for an overall positive investment environment. Before making a climate investment, financiers will assess a number of project-specific (resources, technology, skills, energy intermediaries, operations and management, etc.) and non-project-specific risks (country risks, size of the economy, macro-economic conditions, investment policies, currency risk, tax rates, proximity to markets, technology, supporting and delivery infrastructure, etc.). A comprehensive strategy to attract investment would seek to enhance capacity in all of these areas.

Additional targeted climate investment measures, however, will be required to overcome the fact that many markets — and notably energy markets — contain significant distortions, in the form of favourable tax treatment, regulatory privileges, or legacy monopolies. Every single energy system in use today has required government incentives to overcome a number of barriers (Mendonca, Jacobs and Sovacol, 2010).

In essence, targeted measures are required to enable clean energy solutions to compete on an equal footing with an established fossil fuels ecosystem. There are five principal types of barriers to clean energy development:

- Information/Behavioural (awareness, skills, habits, etc.)
- Institutional (delays in administrative processing, etc.)
- Technological (Intellectual Property Rights, etc.)
- Regulatory (discriminatory policies, etc.)
- Financial (upfront costs, etc.)

Table 2.1 presents some common barriers to clean energy development; some are generic to all mitigation and adaptation options while others are more sector-specific.

Table 2.1: Common key barriers to clean energy development

Barrier	Description
1. Information/Behavioural barriers	
Knowledge gaps	Consumers, lenders, developers, utility companies and planners, both in developed and developing countries, often lack adequate information about clean technologies, how to assess them, and how to implement them.
Reliability concern	Clean energy technologies might still suffer from bad press due to performance concerns associated with earlier technology generations or inexperienced service providers.
Lack of green champions	The lack of active promoters in favour of clean energy can be a drawback in some countries compared to fossil fuel-based industries, which tend to have well-organized lobbies.
Higher cost perception	Consumers often give greater weight to upfront costs compared to recurring costs. Even if an investment is cost-effective over a few years, the necessity to pay the initial investment costs may deter consumers.
2. Institutional barriers	
Limited capacity to formulate green policies and strategies	There may be limited capacity in assessing risks and opportunities, engaging stakeholders in defining a vision articulating it into concrete policies and strategies.
Weak policy implementation and enforcement	Government may not be in a position to implement cross-sectoral policies and enforce existing standards. Limited administrative capacity may also delay issuance of sitting license for clean energy plants and deter investment.
3. Technical barriers	
Lack of technical skills	There may be a lack of technical skills to install, operate and maintain clean technologies.
Lack of certification facilities	There may be a lack of national standards and certified operators to guarantee the quality and safety of clean energy facilities and facilitate licensing/permitting processes.
4. Regulatory barriers	
Legacy energy policies/regulations	Historical regulatory structures and policies in both developed and developing countries often favour fossil fuels and nuclear power.
State monopolies and power purchase agreements	Where power utilities have a monopoly on electrical power production and distribution, independent power producers may not be able to sell power to the utility or to third parties through power purchase agreements.
Discriminatory grid policies	Some utilities may engage in discriminatory grid policies (higher prices for transmission access for clean energy and/or remotely located facilities, etc.).
Administrative barriers	Multiple restrictions on location and construction for clean energy technologies such as wind turbines due to concerns relating to noise, unsightliness, safety and wildlife; or protracted approval delays.

Continued on next page

“
... targeted measures are required to enable clean energy solutions to compete on an equal footing with an established fossil fuels ecosystem. There are five principal types of barriers to clean energy development.”

Table 2.1: Common key barriers to clean energy development (cont.)

Barrier	Description
5. Financial barriers	
Split incentives landlords/tenants	In the construction sector, for example, developers and builders are reluctant to pay for initial clean energy investment that they might not be able to recoup from tenants.
Higher risk management costs	Because of perceived higher technology risks and return uncertainty, risk management products (e.g. insurance, hedging products, etc.) are more expensive for clean energy technologies.
Subsidies for conventional fuels	The IEA has estimated that global annual subsidies for fossil fuels exceed \$500 billion and allow fossil and nuclear energy to be sold at artificially low prices.
Lower returns on investments	Returns on investment for clean energy projects can be lower or can be subject to higher uncertainty than those for more conventional energy projects.
Higher upfront costs	Clean energy technologies are often more expensive than conventional technologies and subject to longer payback periods. Available loan terms may be too short relative to the equipment or investment lifetime.
Transaction costs	Transaction costs per kW (kilowatt) of capacity for clean energy technologies are often higher because of the smaller relative size of the projects. Bank regulations and investment policies, often designed for larger conventional energy projects, can be inadequate or unsuitable for smaller, more numerous, distributed clean energy projects.

“
In many cases, policy makers will need to intervene in markets to redress legacy distortions and market barriers in order to drive investment flows toward low-emission climate-resilient economic activity.
”

The existence of legacy systems means that policies and regulations that govern the energy system as a whole are critical. Alongside the structure and regulation of the power or energy sector, separate laws or regulations governing planning and approval processes, regulation around infrastructure (grid and distribution) and so on, will all need assessment for clean energy technology. Clean energy incentives will also have to be coordinated among national, regional and local governments. Similar situations can be found for almost all key climate change management sectors, such as sustainable ecosystems management and water resource management. In many cases, policy makers will need to intervene in markets to redress legacy distortions and market barriers in order to drive investment flows toward low-emission climate-resilient economic activity.

Even the largest financial incentives will not be effective unless appropriate, complementary regulatory and institutional incentives policies are also in place. This is a point underscored in the renewable energy (RE) Country Attractiveness Indices produced by Ernst and Young (2010).² These are based on a range of factors weighted to assess investment conditions, leading to a final country ranking. The Long-Term Index is made up of infrastructure and technology factors, with planning and grid connection issues being weighted 42 percent in the infrastructure segment (electricity market regulatory risk and access to finance weighted 29 percent each). On the technology side, nearly 60 percent of the weighting is made up of power off-take attractiveness (linked to power purchase agreements [PPAs]), resource quality and market growth potential. Accordingly, a key task of policy makers seeking to catalyse finance will be to identify, design and deploy an appropriate combination of public policies to change background conditions in the investment environment to make climate sectors attractive opportunities for investors and businesses.

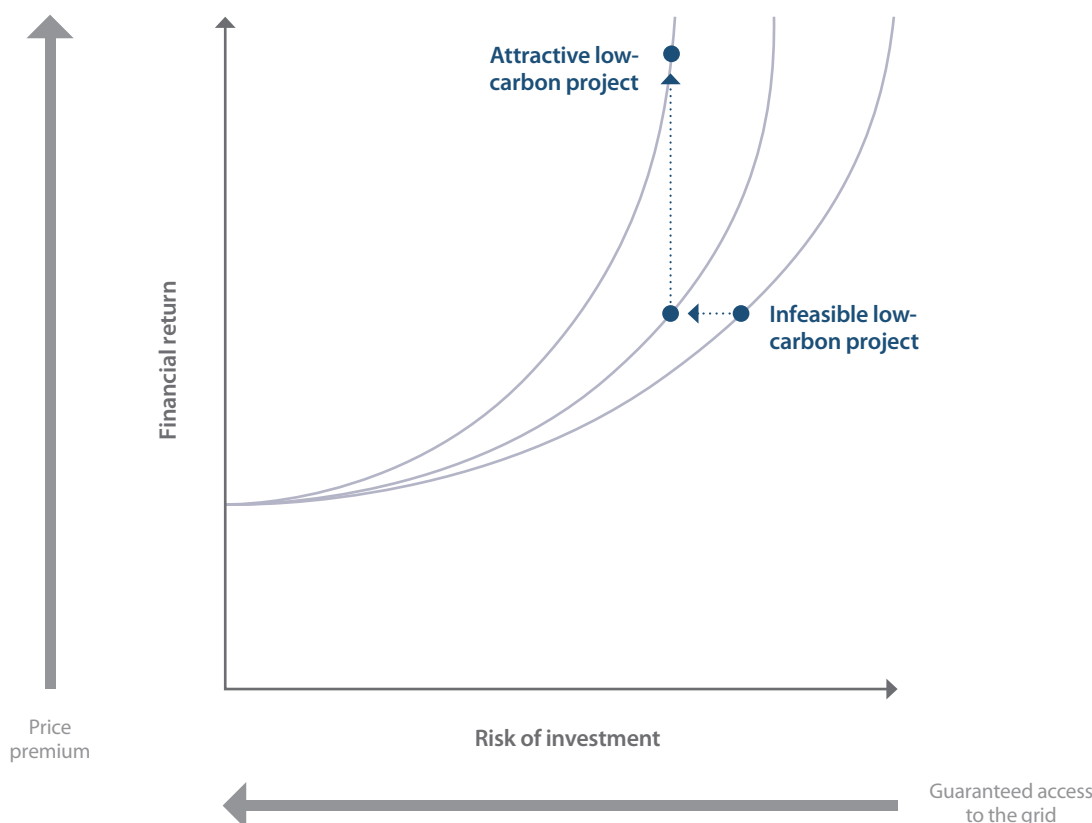
² Retrieved from http://www.ey.com/US/en/Industries/Oil---Gas/Oil_Gas_Renewable_Energy_Attractiveness-Indices.

2.2 || A Taxonomy of Public Policies to Catalyse Green Investments

It would be misleading to think of investors as wealthy institutions or individuals sitting on large piles of money and looking for places to invest. Most of the wealth accumulated globally is deposited in pension and insurance funds and must cover the cost of expected future payouts. Because of these future liabilities, fund managers are generally obliged to invest in very low-risk assets. Other investors, such as venture capital funds, have higher risk appetites but will charge a higher premium in order to achieve an acceptable level of risk-adjusted return (see Chapter 3).

The objective of climate-investment policies is to create conditions for attractive investment risk/reward profiles, adapted to different types of investors, either through reducing risks (stable policy context, guarantee instruments, etc.) or increasing rewards (premium prices, tax credits, etc.). Figure 2.1 provides a conceptual illustration of the approach. The figure illustrates a shift from a commercially unattractive investment opportunity (right) to a commercially attractive one (top). This is achieved in two steps: first, reducing the risk of the activity, for example through a regulatory policy such as guaranteed access to the grid for independent power producers (IPPs); and second, increasing the return on investment, for example, by creating financial incentives such as a premium price for renewable electricity through a feed-in tariff (FiT).

Figure 2.1: Creating attractive risk/reward profiles for green investment



DEFINITIONS

Market barriers

Market barriers are conditions that prevent or impede the diffusion of cost-effective technologies or practices that would mitigate GHG emissions.

Feed-in tariff

Feed-in tariff refers to the price per unit of electricity that a utility or power supplier has to pay for distributed or renewable electricity fed into the grid by non-utility generators. A public authority regulates the tariff.

DEFINITIONS

Standards

Standards are a set of rules or codes mandating or defining product performance (e.g. grades, dimensions, characteristics, test methods, and rules for use).

Stakeholders

Stakeholders are those who have interests in a particular decision, either as individuals or as representatives of a group. This includes people who can influence a decision (including decision makers), as well as those affected by it.

A broad range of public interventions to reduce investment risks or increase investment returns for low-emission climate-resilient technologies is presented below. For the sake of clarity, the present publication categorizes the various climate policy options under three primary categories: capacity and information-based instruments, regulatory instruments, and market-based instruments (MBIs). To enable a more precise discussion of comparative advantages of a wide diversity of MBIs, it further divides MBIs into four sub-categories.

Climate Policy Option Categories**Main categories****Capacity and Information-Based Instruments****Regulatory Instruments****Market-Based Instruments (MBIs)**

- Fiscal incentives (including direct subsidies)
- Early market-development instruments
- Debt-based and equity-based instruments
- Trading instruments

The objectives and characteristics of each of these types of instrument are summarized below by category. This is not a formal taxonomy, as there are many instances where their spheres overlap but it provides a systematic framework for policy analysis. As an illustration of the wide variety of policy options to catalyse capital, Table 2.3 lists over 150 key policies according to this taxonomy. While this list can come across as forbidding, it is by no means exhaustive. Furthermore, each of the general policies listed in Table 2.3, such as carbon tax or standards and labels, can be delineated in a number of ways depending on the unique requirements of each context. The creativity of legislators, backed up by sound analysis that examines the sector-specific and cross-sectoral implications of policy decisions, remains the only constraint to policy innovation and development. Minimum appropriate technical and institutional capacity in government regulatory and enforcement agencies, as well as in the private sector and a variety of other stakeholders, is a prerequisite for the implementation of almost every instrument discussed in this guidebook.

Capacity and Information-Based Instruments

In a number of sectors — such as buildings, transport and agriculture — low-emission climate-resilient technology adoption relies on consumption and investment decisions made by millions of scattered consumers and business owners. This means they all have to be reached, informed and convinced of the benefits of a given climate investment before significant changes can occur.

To be effective, climate policy measures not only require that consumers and investors are well informed on the meaning and implementation modalities of this measure, but that solutions fostered by these measures are actually available, and that local professionals involved in the implementation of these measures have the appropriate skills.

“To be effective, climate policy measures not only require that consumers and investors are well informed on the meaning and implementation modalities of this measure, but that solutions fostered by these measures are actually available, and that local professionals involved in the implementation of these measures have the appropriate skills.”

Information and capacity development instruments aim at developing the general population's awareness and support for technologies through addressing existing knowledge, skills, and perception barriers, as well as enhancing the technical skills required by sector professionals to evaluate, market, install and operate clean technologies. To bring effective results, all levels of information are important, including the following examples:

- General communication campaigns on the issue of climate change and the related risks and opportunities
- In-school education programmes
- Information and training of decision makers in the public and private sectors
- Green accounting
- Vocational training of professionals such as architects, contractors, builders, car repairmen, clean energy installers as well as sales personnel
- Public disclosure requirements helping consumers to make more informed choices, labeling of products (and services) according to their carbon content
- Voluntary or mandatory audits to assess energy performance
- Individual guidance related to project design choices such as technology selection or choice of suppliers and contractors
- Leadership programmes
- Citizen advocacy and watch groups
- Improved data collection and dissemination
- Enhanced forecasting and preparedness capacity

Furthermore, information instruments are critical to improve the effectiveness of other policies. Information instruments do not impose penalties for environmentally harmful behaviour per se, but do enable more informed decisions and often exert moral pressure on individuals and organizations to change behaviour. Ensuring broad understanding of the issue of climate change and the corresponding risks and opportunities is a condition to ensure public acceptance and support of policies and investment projects. Even when barriers are mostly related to perverse incentives that can be adjusted through regulatory changes, providing information and education may prove necessary for successful implementation of the new regulations.

Apart from price signals, information and education programmes are also one of the key ways to influence individual behaviours that are not linked to investment choices, such as temperature choices in buildings, eco-driving, etc. They can also contribute to limiting the so-called 'rebound effect' in which consumers use their energy savings to increase their level of comfort by consuming more energy, thus reducing the overall environmental benefits. Research has shown that approximately half of the energy used in the home depends on the behaviour of residents. As stressed by Janda (2009), "Buildings don't use energy: people do."

DEFINITION

Rebound effect

The so-called 'rebound effect' is the term used to describe the effect that the lower costs of energy services, due to increased energy efficiency, has on consumer behaviour where efficiency improvements are offset by increases in energy service consumption. There is still a very active debate on how significant the 'rebound effect' might be in a variety of situations (Herring, 2008).

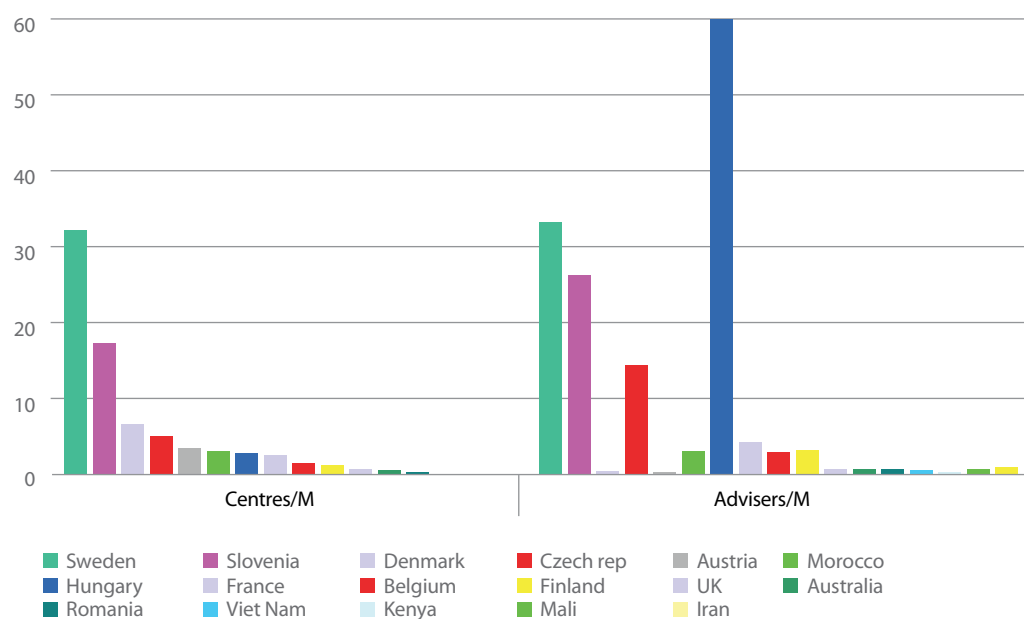
Rebound effect refers to the result, after implementation of efficient technologies and practices, of consumers taking back part of their energy savings for more intensive or other consumption (e.g. improvements in car-engine efficiency lower the cost per kilometre driven, encouraging more car trips or the purchase of a more powerful vehicle).

In recognition of the important role of information in bringing about change, more and more countries have been developing local energy efficiency information centres. These centres offer impartial information on energy conservation and, usually, renewable energy to the general public and/or specific target groups (e.g. housing associations, small business, farmers, schools, etc.), including advice on technology solutions and useful contacts for implementation (installers, manufacturers, relevant authorities, funding sources, etc.).

“Without full valuation of less-tangible natural benefits from ecosystems, use will remain unsustainable and degradation inevitable, leading to the potential collapse of important ecosystem functions and services.”

The 2004 World Energy Council (WEC) Energy Efficiency World Wide Review showed that of the 60 countries reviewed, 14 countries in Europe (of which nine are in the EU-15) have introduced local information centres, four in Asia (Australia, China, the Philippines and Viet Nam), three in Africa (Kenya, Mali and Morocco) and one in the Middle East (Islamic Republic of Iran). Europe, the most active region in this field, reported 750 centres with about 1,600 advisers (see Figure 2.2).

Figure 2.2: Local information centres



Source: WEC (2004). Note: Number of local information centres and advisers per capita (/M - per million inhabitants).

In many countries the main climate change information and capacity gaps are not related to energy use but to ecosystems management. As mentioned in Chapter 1, ecosystems play a key role in terms of poverty reduction, adaptation and mitigation. Ecosystem-based adaptation and mitigation solutions are often extremely cost-effective. However, the global economic model and national accounting currently does not account for all the essential benefits that nature provides to people (UNEP and SEI, 2010). The invisibility of biodiversity values has often encouraged inefficient use or even destruction of this natural capital (TEEB, 2010). Without full valuation of less-tangible natural benefits from ecosystems, use will remain unsustainable and degradation inevitable, leading to the potential collapse of important ecosystem functions and services. Achievements in scaling up clean energy can be more than offset by accelerating ecosystems degradation.

Assessing the full economic values of ecosystems and complementing existing national accounts to reflect depreciation of natural capital are critical in enabling decision makers to identify the root causes of ecosystem degradation and to design incentive measures for their conservation and sustainable use (Secretariat of CBD, 2011). Decision makers will need information about who is affected, and where and when the changes will take place (TEEB, 2010).

Regulatory Instruments

Examples of Regulatory Instruments

- Standards
- Bans
- Licenses
- Zoning laws
- Property and access rights

Rules and regulations specify how something should be done, monitor to check that the rules are followed, and enforce rules with penalties when they are not followed. Regulation can take many forms, including standards, bans, licenses, zoning laws, and property and access rights. Regulations mandating results — such as energy building codes for buildings, energy performance requirements for electric appliances and vehicle fuel economy standards or renewable portfolio standards — can have a widely felt impact if they are properly designed and enforced.

Figure 2.3 shows that combining a sound energy label with minimum energy performance standards radically transformed the refrigerator and freezer market in the EU. The placement of energy labels on domestic refrigerators and freezers was first introduced in Europe in 1995. There are seven different categories on the label representing a range of efficiency from A to G, with 'A' indicating the most efficient model and 'G' the least efficient one. The label is mandatory, and must be displayed on the front door of the appliance, including at the point of sale.

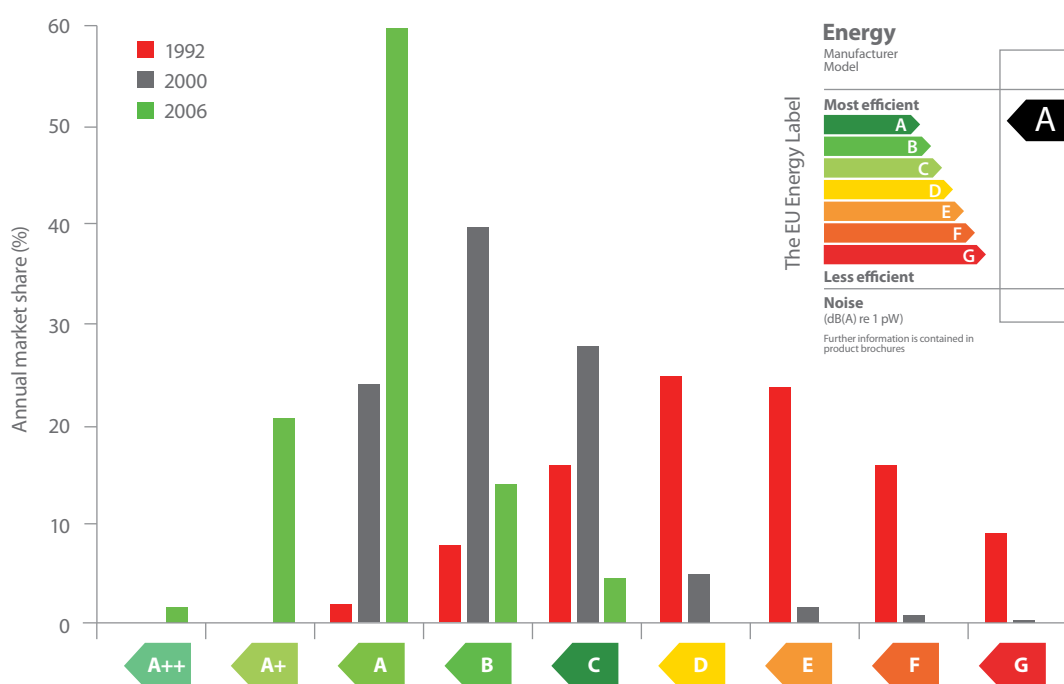
As shown in Figure 2.3, an average refrigerator sold in 2008 is 50 percent more energy efficient than a model sold before the introduction of the EU energy label. The minimum energy performance standards, which became mandatory in Europe as of 1999 as a complement to the EU label, also contributed to the increase in efficiency shown in the figure.

“

Regulation can take many forms, including standards, bans, licenses, zoning laws, and property and access rights. Regulations mandating results — such as energy building codes for buildings, energy performance requirements for electric appliances and vehicle fuel economy standards or renewable portfolio standards — can have a widely felt impact if they are properly designed and enforced.

”

Figure 2.3: Impact of energy label with minimum energy performance standards on the refrigerator and freezer market in the European Union



Source: Adapted from UNDP (2011a).

Similar results were reported in a study of China's energy-efficiency standards. The study estimated savings from eight new minimum energy performance standards and nine EE endorsement labels that were implemented from 1999 through 2004 for appliances, office equipment, and consumer electronics. It concluded that the measures estimated would save 200 terawatt hours (TWh) and 250 Mt of CO₂ during the first 10 years of implementation (Lin, 2002; Ogden, 2004).

Depending on the situation, rules and regulations can be administratively more straightforward to implement and can pose fewer political challenges than direct financial incentives. For example, it may be easier to establish new energy-efficiency standards and remove obstacles in the planning-permission process of renewable energy projects than to eliminate fossil-fuel subsidies or to reform water tariffs. Regulations impose rules on behaviours and production, and as a result, they have costs for some and benefits for others. However, the total benefits of efficient environmental regulations to some people can greatly exceed the total costs to others. As an illustration, the US Office of Management and Budget (OMB, 2003) reviewed 107 major Federal rulemakings finalized over the previous 10 years (1 October 1992 to 30 September 2002). The estimated total annual quantified benefits of these rules range from \$146 billion to \$230 billion, while the estimated total annual quantified costs range from \$36 billion to \$42 billion. The report shows that in all areas of pollution regulations, the benefits outweigh the costs imposed on industry and local government by more than a 10 to 1 margin (see Table 2.2).

Table 2.2: Cost-benefit analysis of US environmental regulations (in 2001 \$ millions)

Agency	Benefits	Costs
Agriculture	3,094 to 6,176	1,643 to 1,672
Education	655 to 813	361 to 610
Energy	4,700 to 4,768	2,472
Health and Human Services	9,129 to 11,710	3,165 to 3,334
Housing & Urban Development	551 to 625	348
Labor	1,804 to 4,185	1,056
Transportation	6,144 to 9,456	4,220 to 6,718
Environmental Protection Agency	120,753 to 193,163	23,359 to 26,604
Total	146,812 to 230,896	36,625 to 42,813

Source: OMB (2003)

Nonetheless, rules and regulations can be difficult policy tools to deploy efficiently in a number of situations. First, it is often necessary to have a deep understanding of the sectors and technologies to be regulated to ensure that they are effective and affordable. Generic standards might become rapidly obsolete and inefficient as technologies evolve. Furthermore, they may discriminate against small market players, nationally and internationally, who do not have adequate resources available to comply with legislation and demonstrate compliance to regulatory authorities.

Regulations are also prone to capture by self-interest groups to redistribute wealth in their favour or block new market entrants. It is not uncommon for historical power operators (former state monopolies, etc.) to use their power of incumbency to mould government regulations in favour of large, centralized plants and disadvantage small, IPPs (Mendonca, Jacobs and Sovacol, 2010). Regulatory measures can also prove to be ineffective in countries with weak enforcement capacity and, in some worst-case situations, fuel corruption by creating licensing businesses for regulatory authorities.

In addition, regulations can translate into prohibitively expensive transaction costs for investors. For example, a recent publication from SunRun (2011) argues that inefficient local permitting and inspection processes add \$0.50 per watt to the cost of residential solar installation and that standardizing local permitting would transform residential solar. It would have the potential to deliver the equivalent of a new \$1 billion solar subsidy (over five years) in the US. Another example is in France, where the producer must contact 27 different authorities at different political levels in order to install a wind power plant (Mendonca, Jacobs and Sovacol, 2010).

Finally, regulatory instruments can sometimes be politically impossible to enforce.

It can be argued that the climate change crisis, despite all of its complexity, could be resolved with three straightforward bans: (1) a ban on all new coal-fired power plants; (2) a ban on all new

DEFINITIONS

Subsidy

Subsidy refers to a direct payment from the government or a tax reduction to a private party for implementing a practice the government wishes to encourage.

Debt

Debt refers to securities such as bonds, notes, mortgages and other forms of paper that indicate the intent to repay an amount owed.

A cash payment of interest and/or principal is made at a later date.

Equity

Equity is an investment in exchange for ownership of a company entitled to the earnings of a company after all other investors (e.g. debt-holders) have been paid.

extractive logging concessions; and (3) a ban on all new settlements in hazardous areas, such as flood-prone coastal areas. The track record of international and domestic climate change negotiations should suffice as a commentary on the political feasibility and even desirability of such regulatory approaches.

As mentioned earlier, capacity and information-based instruments can greatly facilitate the adoption and enforcement of regulatory measures. Similarly, MBLs can lessen resistance to new environmental regulations by reducing the cost of compliance. The next section describes the main types of financial incentives.

Market-Based Instruments

Market-based instruments use price or other economic variables to provide incentives for polluters to reduce harmful emissions. They seek to address the market failure of negative environmental externalities either by incorporating the external cost of production or consumption activities through taxes or charges on processes or products, or by facilitating the establishment of a market for the use of environmental services. There is a huge array of MBLs. To facilitate their review, this section divides them into four main sub-categories: fiscal incentives (including direct subsidies), early market development instruments, debt-based and equity-based instruments, and trading instruments.

Market-Based Instrument Categories

Fiscal Incentives

Early Market Deployment Instruments

Debt-Based and Equity-Based Instruments

Trading Instruments

Fiscal Incentives

There are three types of tax-related investments: corrective taxes, subsidy reforms, and tax incentives. In a perfect world, the external cost of an unsustainable activity — on the environment and public health, for example — would be reflected in the market price of goods and services, as would any common benefits conferred by sustainable aspects of production, ultimately making climate investments relatively more attractive. However, numerous unsustainable economic activities enjoy a price advantage, as the negative spill-over effects of their production or consumption of goods on third parties (i.e. externalities) are not fully reflected in market prices.

A solution to this problem is to ‘internalize’ the cost of the externality in the price of a good or service via a variety of means, including a corrective tax (Pigou-type taxes).³ In addition to internalizing external costs, environmental fiscal reforms are required to eliminate other price distortions created by market failures (e.g. asymmetric/imperfect information) and market distortions (such as through subsidies).

Subsidy reform focuses on reducing, eliminating or redesigning harmful subsidies that promote inefficient use of common resources in a number of economic sectors, including energy, agriculture, fisheries, forests and water. Conventional energy subsidies are the single most important barrier to the growth of clean

energy technologies today. The IEA estimates that global fossil fuel subsidies exceed \$500 billion per year (IEA, 2009). Their complete phase-out and reinvestment in clean technology subsidies would go a long way to meet the additional investment costs for a rapid transition to a low-emission climate-resilient society. Harmful agricultural and water subsidies in some parts of the world are another serious cause of food insecurity and vulnerability to climate change.

A third key function of tax-related environmental instruments is to help develop green technologies, preserve valuable natural capital, and increase climate resilience through direct fiscal incentives, including preferential tax treatment or exemptions. In addition to their price effects, the three types of tax-related instruments (corrective taxes, subsidy reforms and tax incentives) have the potential to increase public revenue, which can help to finance other policy instruments such as early market development instruments or debt/equity instruments.

The fiscal, environmental and poverty reduction benefits of tax-related instruments can go hand-in-hand. Environmental taxes or removal of harmful subsidies can contribute to poverty reduction directly by addressing environmental degradation issues that particularly affect the poor (such as air and water pollution) and indirectly by releasing resources that can be redirected towards priority social expenditures (OECD, 2005). However, this is not automatic. Although a large body of literature (OECD, 2005 and 2010; World Bank, 2005, Bredenkamp and Pattillo, 2010; Laan, 2010) shows that subsidies mostly benefit the wealthy, indiscriminately removing them can also hurt the poor. Removing subsidies on kerosene, which is used in some countries for cooking, commercial and farming activities can disproportionately affect the poor and spark public protests. It is important to pay special attention to the distributional impact of subsidy reforms. Some cases might require targeted support programmes to mitigate the impact on the poor, either in the form of direct subsidies or removal of regressive taxes such as VAT (value-added tax) on food. The on-going efforts in Iran (Islamic Republic of) to remove extremely high energy subsidies illustrate an ambitious reform effort that draws particular attention to the social concerns of removing subsidies (see Box 2.1).

Box 2.1: Removal of fossil fuel subsidies in Iran (Islamic Republic of)

Iran (Islamic Republic of) used to have some of the highest fossil fuel subsidies in the world, both in relative and absolute terms. The Central Bank put the cost of the energy subsidies alone at \$40 billion to \$100 billion a year, relative to oil prices. The fossil fuel price supports totalled about \$4,000 a year for a family of four, more than the income of many Iranians, and turned the nation into one of the most energy inefficient countries in the world.

At the end of 2010, Iran started a five-year plan to phase out subsidies for diesel fuel, kerosene, natural gas and electricity and replace them with cash payments to the poor. After the five-year phasing out of subsidies, gasoline will sell domestically for 90 percent of the price in the region, according to the legislation. The project has saved as much as \$20 billion during the first 12 months of subsidy cuts, down from an initial estimate of \$40 billion. Two previous administrations failed in their efforts to revise the subsidy system. In the 1990s, reform attempts sparked public protests.

Iran aims to use 80 percent of the money saved through the subsidy-reform plan to provide cash grants to its poorest citizens, and to support energy-intensive industries. Officials in Iran report that about 60 million Iranians have already signed up to receive grants.

Source: OECD (2005); Nasser and Alexander (2010).

The scope for substitution across different fuels is another issue to consider (OECD, 2005). For example, if kerosene becomes more expensive, households might switch to non-renewable fuel wood. This could result in an increase in deforestation rates, as well as magnify the burden on women and girls to collect fuel. Women and girls are also at higher risk and exposure to harmful pollutants from incomplete combustion of biomass (see Chapter 6). Environmental fiscal reforms can be difficult and face political challenges worldwide for a variety of reasons, including the distributional impacts associated with reforms as well as the interests of different constituencies.

Early-Market Development Instruments

Early-market development instruments consist of measures to boost clean technology development and deployment through securing and boosting market demand. These tools take the form of compulsory procurement requirements or direct grants. The most notable early-market development mechanism is arguably the use of public spending to kick-start green market development. Public procurement (construction of public buildings, development of transport infrastructure, etc.) represents a large proportion of government spending in developing countries. Governments can also foster green procurement by commercial companies by requiring public institutions to meet specific energy efficiency targets and to purchase a specific percentage of power from renewable energy sources.

In India, for example, the government (including public sector undertakings, the railways, airports, ports, and defense establishments) is the single largest consumer of energy in the country. In 2002, the Prime Minister called for all government organizations to reduce their energy consumption by 30 percent by 2007. In 2003, the IEPF (Institut de l'Énergie et de l'Environnement de la Francophonie) implemented a programme with the municipality of Bamako in Mali that resulted in the reduction of energy consumption in public buildings by at least 43 percent.

The implementation of mandatory 'green' solutions in the public sector can have significant results.

- The public sector can be directly responsible for a significant share of national emissions that will be reduced as a direct result of the policies.
- Public authorities can set examples for other consumers to follow. Conversely, not working on reducing emissions related to its own activities could seriously undermine the credibility of any public authority's commitment to climate change mitigation.
- Public authorities can, through their purchases and investments, help build markets for efficient products and practices by increasing sales volume and market share, thus lowering unit costs. This signals that sustainable production is secure and that risks can be taken to seek capital, invest in innovation and realize economies of scale that reduce marginal production costs.

The main drawbacks of ambitious green procurement policies are their impact on the public purse and their potential economic distortion effects, as environmentally and socially preferable goods and services often cost more than less-sustainable alternatives. An option for developing countries is to focus green public leadership programmes on cost-effective investments, such as improving energy efficiency in public buildings. In some instances, even related to options that have negative and/or low costs, the implementation of programmes might require policy changes.

Some procurement rules can deter municipalities and public organizations from improving energy efficiency in public buildings. An example is a procurement rule that mandates the purchase of items with the lowest upfront costs rather than items with the lowest overall costs. This type of rule potentially ignores the environmental and social benefits associated with the lowest overall cost options. Changing these rules is often a pre-requisite before any large-scale changes can take place (Schwarz, 2010). Changes will also need to be made to regulations limiting the possibility of signing long-term contracts, such as energy performance contracts (see case studies on energy efficient buildings in Chapter 6).

Finally, government can support early market development through a series of direct grants for R&D, project development or industrial restructuring. Public support for R&D is still needed in a number of areas. Even for fairly mature technologies such as wind power, dedicated research on premature aging of equipment is necessary before transferring technologies developed for temperate conditions to arid and semi-arid countries subjected to water resource constraints and wind storms. As for any other subsidy scheme, the key drawbacks of direct R&D grants are their impacts on public resources and their potential requirement of innovative financing solutions.

Debt-Based and Equity-Based Instruments

These instruments specifically aim to lower the risk of lending to and investing in green investment, thereby attracting lower cost-of-capital finance from the private sector. Debt-based instruments include the provision of credit lines to commercial finance institutions (CFIs) for on-lending to green investors; loan guarantees to cover a portion of the risk of non-repayment of the loan principal; project loan facilities to provide debt financing directly to projects where conventional CFIs are unwilling or unable to provide such financing themselves; or soft loan programmes to provide debt capital at concessional interest rates.

Companies need equity to start up or grow their business, activities that generally cannot be debt-financed. Furthermore, a minimum ratio of equity is required to secure commercial loans. Equity-based instruments foster direct investment in companies or projects. They include tax credits, 'first loss' equity positions by public investors in private equity funds, or deal-flow facilitation in the form of project development facilities (see Chapter 5 for further information on innovative public private debt-based and equity-based instruments).

As with premium prices or direct grants, debt-based and equity-based instruments are popular with beneficiaries. While the risks they aim to address are real, so are their costs. As with early market development instruments, long-term implications of debt-based and equity-based instruments on the public purse and market distortions should be carefully assessed.

Trading Instruments

Trading instruments are used to create markets for a variety of environmental goods, including emission phase out (emission-trading instruments), natural habitat conservation (Habitat Banking) and water quality trading. Emission-trading instruments (ETIs) are fairly recent developments in international environmental finance. However, they, and other tradable permit schemes, are increasingly being considered for the management of natural resources and the environment. This is particularly so where regulatory approaches have failed to arrest ongoing degradation or where the cost of traditional policy tools is prohibitive to government or society in general. ETIs encourage behaviour through market signals rather than through explicit directives. When applying ETIs, the focus is on achieving outcomes through the self-interest of firms and individuals.

DEFINITIONS

Private equity

Private equity focuses on later stage and more mature technology or projects, and generally expect to exit their investment and make their returns in a three to five-year timeframe.

Environmental effectiveness

Environmental effectiveness is the extent to which a measure, policy or instrument produces a decided, decisive or desired environmental effect.

Emission-trading mechanisms, such as carbon cap-and-trade and baseline-and-credit systems, are intended to minimise the cost of a given level of pollution abatement by creating property rights to emit, administratively limiting the supply of permits to ensure that the emissions-target level is not exceeded and distributing permits (either by auction or by direct allocation). Subsequently, a trade in permits is allowed so that emitters lacking permits are forced to buy them from those with a surplus. Theoretically, this should result in the marginal cost of abatement equalling the price of a permit within the scheme, with emissions being cut by the most cost-efficient producers. As a general rule, the greater the degree of heterogeneity amongst firms and the less site-specific the impacts of pollution, the greater the expected gains from such mechanisms relative to traditional command-and-control regulations.

A critical factor in ETI success is a supportive institutional environment. While emission-trading instruments in general tend to be more cost-effective than regulations and standards, the lack of functioning institutions can result in a market-based instrument being more costly to implement. It can also seriously undermine the environmental effectiveness of ETIs. For example, serious concerns have been expressed about the additionality of carbon emission reductions associated with project-based carbon mechanisms such as the CDM (see Chapter 4).

Table 2.3 lists some of the most widespread policy instruments that apply to the categories discussed in Chapter 2.

Table 2.3: Summary of policy instruments to catalyse green, low-emission and climate-resilient investment

Policy Instruments/Stage	Research and Development (R&D)	Proof of Concept & Scale-Up	Commercial Roll-Out	Diffusion & Maturity
Capacity and information-based	- Schemes to improve data collection and climate forecasting capacity - Reliable information on ecosystem impact scenarios, including threatened species	–	–	- Green Accounting - Institutionalized consumer/producer/community/policy-decision maker awareness campaigns - Citizen monitoring and reporting schemes - Voluntary labels and certification schemes - Worker/farmer/professional retraining schemes - Carbon, water, biodiversity and other ecosystem services risk disclosure - Ecological footprint assessments - Energy audits/smart meters - National/local regulations and incentives databases - Monitoring and reporting of subsidies - Public investment and expenditure reviews - Public registry of global environment goals and obligations

Continued on next page

Table 2.3: Summary of policy instruments to catalyse green, low-emission and climate-resilient investment (cont.)

Policy Instruments/Stage	Research and Development (R&D)	Proof of Concept & Scale-Up	Commercial Roll-Out	Diffusion & Maturity
Regulatory	- Regulatory requirements to incorporate climate risk information into policy planning and public investment plans (e.g. national irrigation policy, etc.) - Protection of innovation (copyright / patents) - Redesigning of intellectual property rights - Payments for access to biodiversity-research permits - Bio-prospecting rights	- Mandatory energy insurance programmes - Hazard insurance programs to cover risks from adverse events and floods on investments in coastal areas	- Streamlined/ accelerated permitting - Contractor licensing - Equipment certification - Interconnection policy - Line extension policy - Renewable energy access law	- Best Available Technology Requirements - Standards and mandatory labelling - Utility Regulations (Renewable Portfolio Standard [RPS], etc.) - Building codes - Priority sector lending regulations - Land zoning to protect climate sensitive ecosystem services and public goods - Property laws and asset rights - Regional planning and water allocation - Climate-resilient and low-carbon infrastructure standards - Removal of trade barriers to climate technologies - Establishment of environment rights - Compliance standards aligned with water allocation plans - Water storage regulations - Development of conflict resolution mechanisms (e.g. catchment forum resolving water-use conflicts) - Modification of protected area network planning and coverage to include climate risks considerations: e.g. implementation of strategic environmental zoning plan - Integration of criteria related to adaptation to global change into the regular grant-making activities of government authorities - Requirements to avoid, reduce, mitigate and offset impacts on ecosystems through Environmental Impact Assessment (EIA) legislation, endangered species legislation - Renewable transport fuel obligations - Mandatory emission caps and air quality directives - Trade reforms to support agricultural specialization and virtual water trading
Fiscal mechanisms	- Capital gains tax waivers - R&D tax credits	Tax-free development zones	- Accelerated depreciation - Investment tax credits - Production tax credits - Modified accelerated cost recovery system	- Phase-out of fossil fuel subsidies - Carbon tax - Water pricing reforms to encourage improved irrigation methods and water techniques - Energy emissions taxes - Public benefit charges (e.g. utility customer charges) - Environmental levies on old cars, old refrigerators, polyethylene bags, etc. - Fishery user levy - Ecological fiscal transfers - Phase-out of perverse irrigation/agricultural encroachment subsidies - Phase-out of insurance subsidies for settlement in disaster-prone areas - Waste disposal fees - Water consumption fees - Municipal rates rebates for creating conservation set asides - Clean energy production tax breaks - Income tax deductions for avoiding economic production practices that undermine ecosystem resilience

Continued on next page

Table 2.3: Summary of policy instruments to catalyse green, low-emission and climate-resilient investment (cont.)

Policy Instruments/Stage	Research and Development (R&D)	Proof of Concept & Scale-Up	Commercial Roll-Out	Diffusion & Maturity
Early market development mechanisms	● R&D grants (e.g. to develop climate resistant varieties, etc.) ● Inducement prizes for innovation	● National / state / local procurement ● Advanced market commitment ● Green power purchasing	● Reverse auctions/ requests for contract ● RPS/Green Certificates ● Renewable fuel standards ● Feed-in tariffs ● Production subsidies ● Insurance/ financial incentives to promote agricultural and non-agricultural diversification	● Project development grants ● Net metering ● Restructuring aid for industries ● Negotiated and voluntary industry/investment agreements ● Rural micro-finance facility for climate-resilient practices ● Crop certification ● Seed grants (e.g. diffusion of drought-adapted crop varieties to vulnerable communities)
Debt and equity finance mechanisms	● Incubators ● National laboratories ● Prizes ● National/state-funded venture capital (VC) ● National/state-run VC	● Project grants ● Venture loan guarantees ● Mezzanine/ subordinated debt funds	● Public-private emerging technology funds ● Green bonds ● Loan softening / loan guarantees ● Senior debt funds ● Technology insurance packages	● Technology transfer funds ● National/state/local infrastructure funds ● 'First loss' public equity position in Public Equity Funds (PEFs) ● Export trade credit ● Microfinance ● Sovereign/policy risk insurance ● National/state/local energy service company (ESCO) funds ● Agricultural insurance ● Weather indices ● Catastrophe bonds
Environmental market trading mechanisms	–	–	–	● Domestic compliance and voluntary carbon cap and trade markets ● Project-based carbon credits ● National & multilateral carbon funds ● Payment for ecosystems-based services ● Conservation easements – payments for biodiversity-conserving management practices ● Payments for biodiversity-conserving business (organic/ green markets etc.) ● Water trading (nutrient and salinity trading) ● Fishing quotas ● Tradable wetland mitigation credits ● Habitat banking: tradable development rights ● Voluntary biodiversity offsets ● Tradable biodiversity credits

A stylized world map in a light blue color, serving as a background for the page. The map shows the outlines of continents and major landmasses.

Chapter 3

Identifying an Appropriate Policy Mix to Catalyse Capital

- 3.1 Adopting Policy Evaluation Criteria
- 3.2 Designing an Optimal Policy Mix to Catalyse Capital
 - Step 1: Identify priority mitigation and adaptation technologies
 - Step 2: Assess key barriers to technology diffusion
 - Step 3: Determine appropriate policy mix
 - Step 4: Select financing options to create an enabling policy environment
- 3.3 Preparing a Policy Roadmap

3

Identifying an Appropriate Policy Mix to Catalyse Capital

“ Policy makers must balance environmental objectives against other political pressures and manage trade-offs and distributional effects among stakeholders. ”

This third chapter provides a methodology to select and sequence an appropriate mix of public policies to catalyse capital toward green, low-emission and climate-resilient development.

3.1 Adopting Policy Evaluation Criteria

Policy making is the art of the possible. It is a balancing and negotiation exercise. Policy makers must balance environmental objectives against other political pressures and manage trade-offs and distributional effects among stakeholders. International competition for investment is harsh. As capital is highly mobile, investors will favour the sectors or locations that provide the best risk/reward profiles. Short-term and overly complex public policies with limited effects on the profitability of investment projects are unlikely to attract additional private financial flows. On the other hand, overly generous tax credits and regulatory incentives in the form of exemptions from environmental or labour laws will create economic distortions and harmful distributional effects.

To facilitate the review and evaluation of public policies to catalyse capital toward green, low-emission and climate-resilient development, this guidebook proposes a policy analysis framework based on eight criteria. The first four criteria reflect the views expressed by the business community (Hamilton, 2009; Parker, 2009) on the need for public policies to be loud, long, legal and light. The next four criteria focus on policy effectiveness from the taxpayer's perspective: environmental effectiveness, cost effectiveness, political feasibility including distributional effects, and institutional feasibility.

DEFINITION

Non-Annex I/Annex II Parties/Countries

Non-Annex I/Annex II Parties/Countries refers to the group of countries included in Annex II to the UNFCCC, including all OECD countries. Under Article 4.2 (g) of the Convention, these countries are expected to provide financial resources to assist developing countries to comply with their obligations, such as preparing national reports. Annex II countries are also expected to promote the transfer of environmentally sound technologies to developing countries.

Public Policies to Catalyse Capital Toward Green, Low-Emission and Climate-Resilient Development	
Business Perspective	Taxpayer Perspective
Loud: Policy effect on risk/reward profile	Environmental effectiveness: Environmental gains delivered per unit of resources
Long: Policy stability and longevity	Cost effectiveness: Comparative costs of different policy mixes
Legal: Credible means of enforcement	Political feasibility (including distributional effects): Political implementation costs
Light: Policy clarity and simplicity	Institutional effectiveness: Capacity to implement different mixes of policies

Business Perspective

Loud

As many clean energy technologies are currently not able to compete effectively with traditional forms of energy due to a range of market distortions, public policies must substantially affect climate investment risk/reward profiles if businesses are expected to respond. Incentives need to substantially lower risks and/or make a difference to the bottom line to make investment more commercially attractive.

For example, the Kyoto Protocol's CDM was established with the dual purposes of assisting non-Annex I Parties (developing countries) to achieve sustainable development and assisting Annex B Parties (industrial countries and economies in transition) to achieve compliance with their quantified GHG emission commitments. By putting a price on ecosystem services that were previously treated as free (absorption of GHG and climate stabilization), the CDM was expected to act as a catalyst to channel direct investment toward climate change technologies and practice. However, the actual CDM portfolio was initially dominated by projects to phase out industrial gases (HFC-23, etc.) with few development benefits, as opposed to clean energy projects (CO₂ reducing projects) with high development benefits such as renewable energy and energy efficiency projects (Cosbey and others, 2005 and 2006).

The technology distribution of CDM projects reflected differences in profitability of carbon investments. Carbon finance provides only an additional revenue stream that complements traditional revenue sources. At a price cost of less than \$15/tCO₂, its impact can be marginal on projects aimed at energy efficiency improvement, promotion of renewable energy, and bio-sequestration — processes that typically have strong sustainable development benefits and can positively alter the medium-term energy trajectory of countries, but have relatively low (or risky) immediate carbon benefits. On the contrary, CDM projects focusing on industrial gases were relatively simple to design and implement and could generate excessively high rates of return (>500 percent in some cases). Through its initial design characteristics, the CDM did not provide a signal loud enough to significantly alter the energy trajectory of developing countries.

Long

Given the generally higher upfront costs and longer payback periods of renewable energy technologies, confidence in policy stability and clarity over circumstances that might lead to policy changes are important. Stability and duration are also important for building the supply chain and the necessary fabric of energy intermediaries (importers, consultancy firms, assemblers, etc.).

In policy-dependent investment areas such as clean energy or natural-resource efficiency technologies, confidence in policy stability and clarity over the circumstances of policy review are key decision-making criteria for financiers. Unanticipated policy changes, or reviews of policy, may seriously damage confidence in the national market.

Depending on the policy track record of countries, policy provisions such as legislated 'grandfathering' clauses might prove critical to reduce perceptions of high policy risk. A 'grandfathering' clause is a guarantee that a set of policy conditions will continue to apply to investments made under those conditions, notwithstanding subsequent policy changes.

DEFINITIONS

Annex I Countries/Parties

Annex I Countries/Parties refers to the group of countries included in Annex I (as amended in 1998) to the UNFCCC, including all the OECD countries and economies in transition. Under Articles 4.2 (a) and 4.2 (b) of the Convention, Annex I countries committed themselves specifically to the aim of returning individually or jointly to their 1990 levels of greenhouse-gas emissions by the year 2000. By default, the other countries are referred to as Non-Annex I countries.

Annex B Countries/Parties

Annex B Countries/Parties refers to the countries included in Annex B to the Kyoto Protocol that have agreed to a target for their greenhouse-gas emissions, including all the Annex I countries (as amended in 1998) except for Turkey and Belarus.

Economies in Transition

Economies in Transition refers to countries whose economies changing from a planned economic system to a market economy.

Energy efficiency improvement

Energy efficiency improvement refers to a reduction in the energy used for a given energy service (heating, lighting, etc.)

Legal

Compliance, and the consequences of non-compliance, are other critical factors for investors, and are important aspects of assessing how serious the government is about implementation (i.e. how big is the ‘stick’ if things are not on track) (Hamilton, 2009). Fair and transparent enforcement is important for confidence in the policy regime. Clarifying the rules of the game and assuring the consistency and enforcement of relevant policies can substantially improve the risk/reward profile of a project. The clearer and firmer the compliance regime, the stronger the signal that governments fully intend to meet stated goals.

Light

Financiers consistently emphasize a preference for straightforward policies, support mechanisms and regulations. The greater the complexity and number of variables, the higher the risk for investors and the more likely that financiers will opt for the market with a more attractive overall regime. Generally, financiers have to explain to their credit committees, in head offices which may be far from the country concerned, how a support mechanism or regulatory environment works: if this process is complex, it is likely to make things more difficult.

Taxpayer Perspective

Environment Effectiveness

Environmental effectiveness refers to the environmental gains delivered per unit of resource. Like cost effectiveness, it can be expressed in the form of a ratio (environmental gain/resource use) and used to numerically compare different policy options. Environmental effectiveness lies at the heart of the debate about carbon trading systems versus carbon taxes. By capping total GHG emissions, GHG reduction targets can prove extremely environmentally effective. On the other hand, advocates of carbon taxes challenge the implementation feasibility and cost-effectiveness of cap-and-trade mechanisms (UNDP, 2007).

Cost-Effectiveness

As mentioned in Chapter 2, public policy instruments are not costless, and some of them can prove extremely expensive. For example, subsidies are generally not the most economically efficient policy tool. Where possible, it is generally more efficient to raise the cost of unsustainable activities through regulation or fiscal instruments that help price them at their true cost, making sustainable alternatives relatively more attractive. Eliminating unnecessary non-economic barriers, such as administrative hurdles or trade tariffs, can also ensure that support is as effective as possible. Hence, everything that can be done to first reduce risks at low cost — such as addressing policy uncertainty, project delays because of slow public processes, intellectual property concerns, weak laws enforcing contracts, inadequately informed players in the chain of capital flow, costs of corruption, etc. — needs to be a first-order priority, before resorting to more expansive public policy instruments, such as subsidies, currency hedging or loan guarantees.

Political Feasibility

It is generally easier to give than to take away. The creation of subsidies for climate investments is likely to be popular and their removal by a subsequent administration highly unpopular. The difficulty of reforming subsidies is practical and political: careful policy implementation is needed to offset undesired secondary impacts, notably on the most vulnerable segments of the population, and a combination of strong political will and compensatory policies may be necessary to overcome opposition from vested

“ In policy-dependent investment areas such as clean energy or natural-resource efficiency technologies, confidence in policy stability and clarity over the circumstances of policy review are key decision-making criteria for financiers. Unanticipated policy changes, or reviews of policy, may seriously damage.

”

interests. Because of these complexities, it may be realistic to expect the implementation of politically difficult policy instruments, such as the reform of property laws and phase-out of subsidies benefitting powerful interest groups, to be a gradual process. This can be an important factor in sectors where investments need to be made in the short-term in order to preserve valuable natural resources or prevent the lock-in of unsustainable capital.

Institutional Effectiveness

Some policy instruments are likely to take considerable amounts of time and effort to develop in countries that do not already have the resources and systems in place. For example, the major barrier to the creation of new carbon taxes or the shifting of traditional fossil fuel tax-breaks onto clean energy substitutes may be the development of a country's tax infrastructure. Indeed, the most significant issue facing many lower-income economies is the low tax-base itself (OECD, 2010). In order for many policy measures to be possible, supporting actions may be needed to ensure sufficient enabling conditions in the institutional and political environment. Different countries, for example, have a different range of capacities to implement policies, and national circumstances can influence the general resilience of an economy to cope with change.

Table 3.1 summarizes the main evaluation attributes of three main categories of policies discussed in this guidebook. The third category of policies, MBIs, is broken down into four subcategories: fiscal instruments, early market-deployment, debt-based and equity-based instruments, and trading instruments.

Table 3.1: Policy evaluation criteria

Policy Effectiveness Criteria								
Policy Instruments	From an investor's perspective				From a taxpayer's perspective			
	Loud	Long	Legal	Light	Environmental effectiveness	Cost-effectiveness	Political feasibility	Institutional feasibility
Capacity development and information-based instruments	Depend on existing capacity and information gaps	Depend on needs and consistent funding	Limited requirements	Depend on how consumers use the information; most effective in combination with other policies	Depend on how consumers use the information; most effective in combination with other policies	Potentially low cost, but depends on programme design	Depend on cooperation from special interest groups	Depend on research and dissemination capacity as well as long-term funding
Regulations and standards	Depend on regulation design and enforcement capacity	Usually long-term and certain	Legal by nature	Depend on design but can be straightforward	Emissions level set directly, though subject to exceptions. Depend on deferrals and compliance	Depend on design; uniform application often leads to higher overall compliance costs	Depend on regulatory enforcement capacity. Subject to 'regulatory capture' and to corruption 'licensing business'	Depend on technical capacity; popular with regulators in countries with weakly functioning markets and strong enforcement capacity

Continued on next page

Table 3.1: Policy evaluation criteria (cont.)

Policy Effectiveness Criteria								
Policy Instruments	From an investor's perspective				From a taxpayer's perspective			
	Loud	Long	Legal	Light	Environmental effectiveness	Cost-effectiveness	Political feasibility	Institutional feasibility
Fiscal instruments	Depend on level set and enforcement capacity	Less certain than regulations/standards	Depend on independence and capacity of legal system but tend by nature to be amenable to legal redress	Depend on programme design but can be relatively simple to understand and explain	Depend on ability to set tax at a level that induces behavioral change	Can be cost neutral, the overall tax burden can be kept unchanged by lowering traditional taxes at the same time that new, green taxes are introduced	Often politically unpopular; careful policy implementation is needed to offset undesired secondary impacts; compensatory policies may be necessary to overcome opposition from vested interests	Because of political sensitivity and need for compensatory measures, may be difficult to enforce with underdeveloped institutions
Early market-development instruments	Depend on level and consistent funding	Depend on programme design; less certain than regulations/standards	Based on contractual arrangement subject to legal recourse	Depend on design, but can be kept straight-forward	Depend on programme design, including clear targets, a baseline scenario, third party involvement in design and review and monitoring provisions	Depend on flexibility and extent of government incentives, rewards and penalties. Can be cost neutral if savings from phasing out some 'bad' incentives can be reinvested to support good incentives	Popular with recipients; potential resistance from vested interests. Can be difficult to phase out	Administrative and technical demands of premium, procurement and direct grant monitoring can be high, and require significant number of administrative staff
Debt-based and equity-based instruments	Depend on programme design and the degree of risk	Generally limited in time and purpose (investment-specific)	Based on contractual arrangements subject to legal recourse	Tend to be complex due to need to define precisely risk apportionment	Depend on eligibility criteria and market status	Depend on level and programme design; can be market distorting	Popular with recipients; can be difficult to phase out	Tend to be complex to administer and require qualified administrative staff
Trading instruments	Depending on project design, effect on profitability of underlying projects cannot always be accurately anticipated and used as collateral to secure loans	Depend on political willingness to take on long-term abatement commitments	Based on contractual arrangements by specific legislation for credit ownerships	Tend to be complex due to auditing requirements and tendency to rig the game	Depend on project design; concerns about additionality raised about project-based carbon schemes	Can be very cost effective where the cost of traditional policy tools is prohibitive to government or society in general	Potential resistance from vested interests. Allocation of emission rights can be politically sensitive	Administrative and technical demands to establish and monitor can be high, and require significant number of administrative staff

3.2 || Designing an Optimal Policy Mix to Catalyse Capital

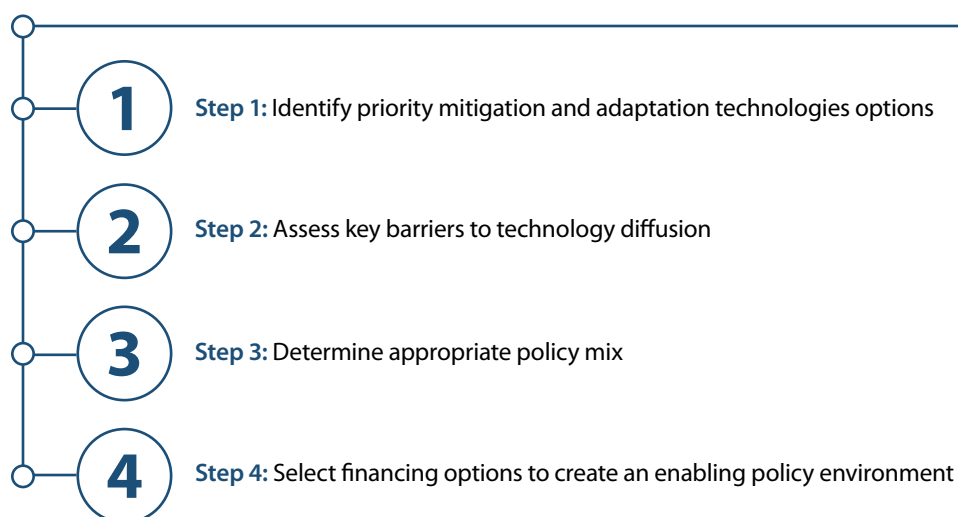
The optimal policy mix for the promotion of climate investment will not be the same everywhere: industrial, emerging and developing countries have different resources, challenges, needs and priorities. Different country and clean technology market characteristics mean that there is no one-size-fits-all best policy approach.

In some cases, governments might need to enlarge (or scale down) their administrative and technical capacity as a prerequisite for the implementation of policies that promote low-emission, climate-resilient markets. In others, information-based and regulatory instruments will need to be implemented (or refined) before market-based instruments can be considered. It might also happen that some existing policies (harmful subsidies, exemptions from environmental and labour laws, etc.) will have to be removed (or re-adjusted) before investment-support policies for clean technologies can be effectively implemented.

The selection of the most appropriate mix of public policies to catalyse climate investment for a given context will depend largely on the following conditions:

- Level of maturity of the targeted technology
- Global market status
- Country conditions, including the macro-economy, the existing policy framework, institutional structures and the maturity of the financial system
- Specific national barriers to the targeted technology

Although a broad range of public interventions can be used to attract investment toward green, low-emission and climate-resilient development, only a very limited number of policy options are likely to apply to a targeted technology for a specific market in a given location. This guidebook suggests a four-step approach to identify an appropriate sub-set of suitable policy options:



Summary of Key Steps

STEP 1

IDENTIFY PRIORITY MITIGATION AND ADAPTATION TECHNOLOGIES OPTIONS

STEP 2

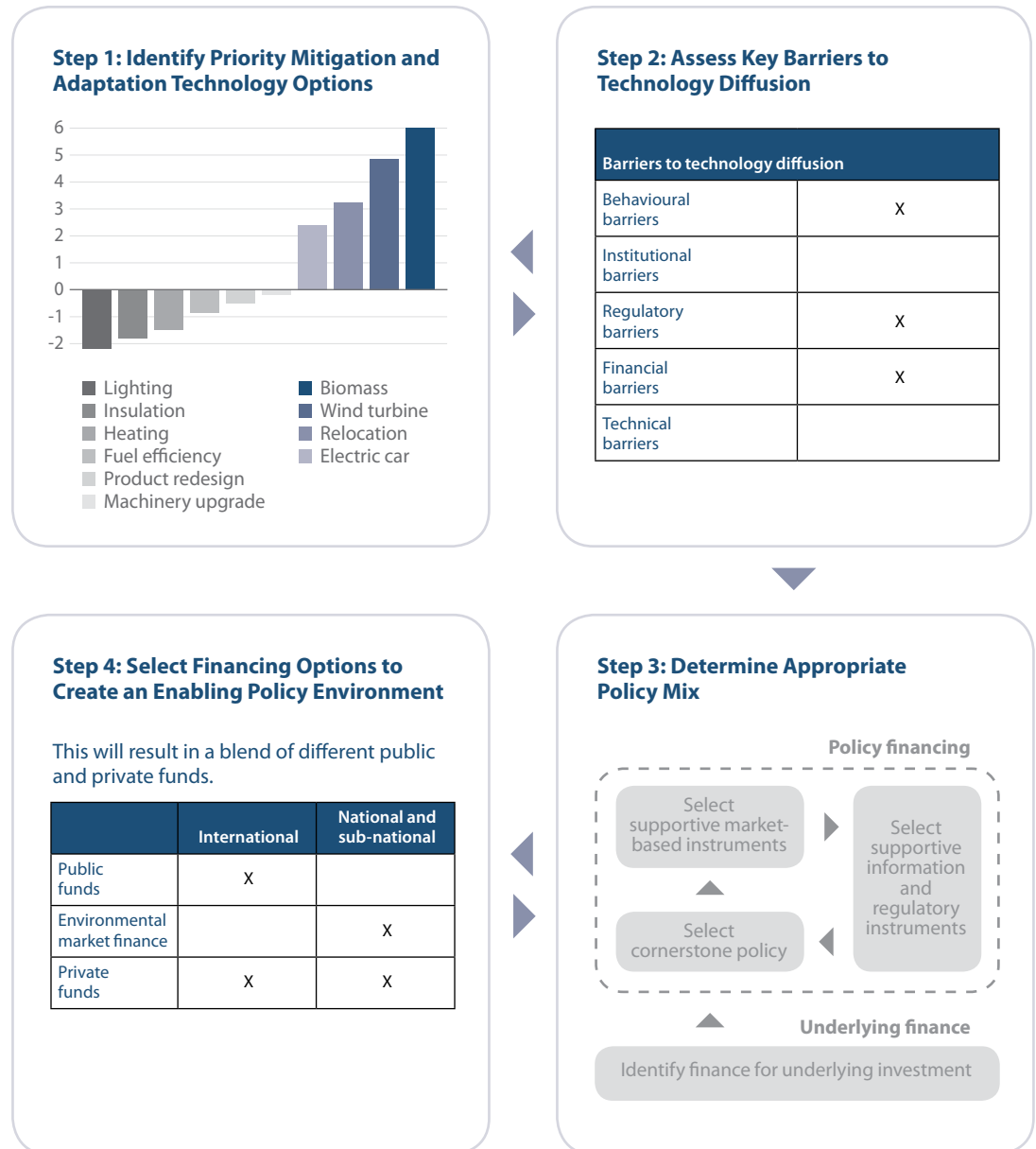
ASSESS KEY BARRIERS TO TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE POLICY MIX

STEP 4

SELECT FINANCING OPTIONS TO CREATE AN ENABLING POLICY ENVIRONMENT

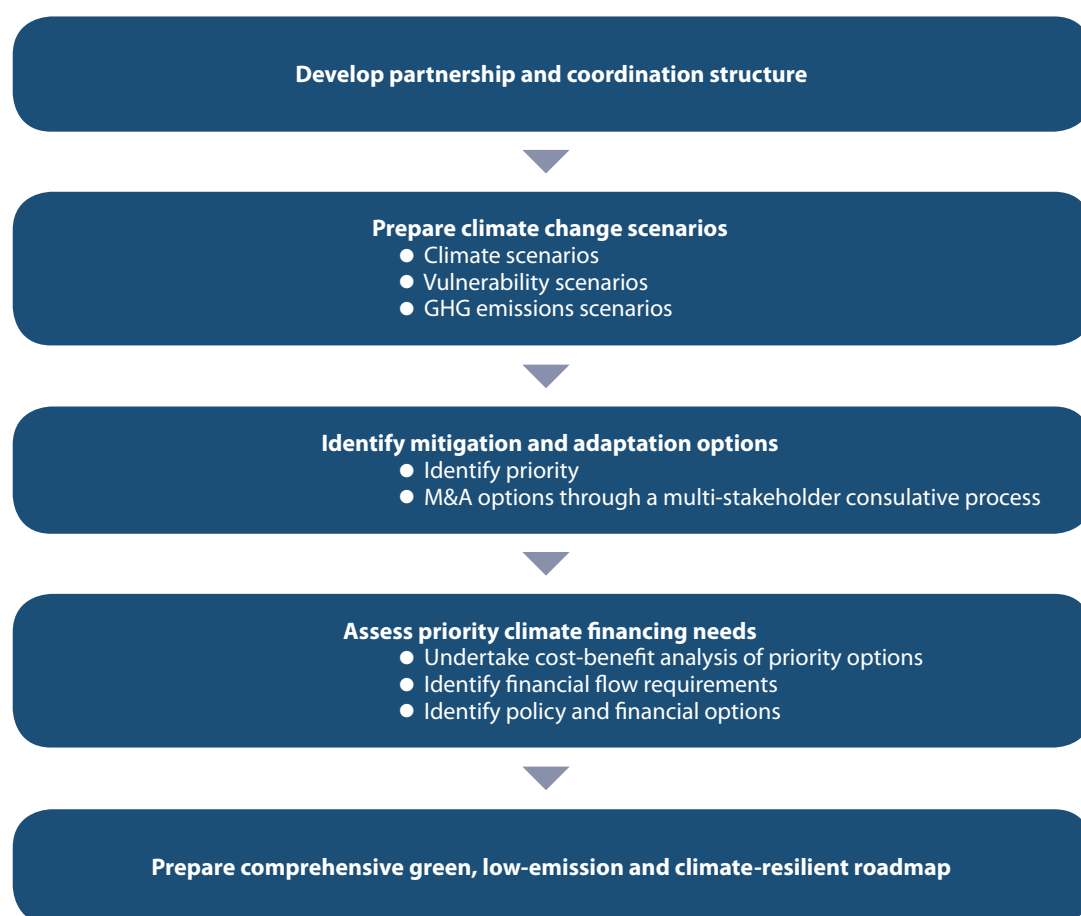
Figure 3.1: UNDP framework to catalyse finance toward green, low-emission and climate-resilient development

Step 1:

Identify Priority Mitigation and Adaptation Technologies Options

Step 1 begins with a technology prioritization process. UNDP's experience in supporting sustainable development over the past decades shows that the most important factor in determining policy and investment success is the alignment of proposed activities with national and local priorities and needs. As mentioned in Chapter 1, policy makers may elect to develop an integrated green, low-emission and climate resilient development strategy to achieve such an alignment, as illustrated in Figure 3.2.

Figure 3.2: Green, low-emission and climate resilient development strategies



Source: Adapted from UNDP (2009a).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

The present guidebook is part of a series of manuals, guidebooks and toolkits that support the preparation of integrated green, low-emission and climate resilient development strategies (UNDP, 2011b). As set out in Figure 3.2, UNDP's technical assistance for green, low-emission and climate-resilient development strategies has a number of different components to assist policy makers in prioritizing mitigation and adaptation activities (UNDP, 2009a):

- Develop coordination structures that bring together key stakeholders (government, business, community) and allow for a participatory approach to planning that accounts for synergies and trade offs
- Plan for both the short term and the long term, up to 50 plus years, to provide the necessary horizon to catalyse certain investment types
- Develop climate change vulnerability scenarios that help identify activities resilient to a range of climate outcomes
- Identify and prioritize mitigation and adaptation activities for efficient planning and use of resources

A number of multi-criteria decision-making tools are available to help countries identify, evaluate and prioritize technological means for both mitigation and adaptation, not only from the perspective of GHG reductions but also in accordance with broader national development goals. A possible tool to conduct such a prioritization exercise is the UNDP/UNFCCC Handbook for Conducting Technology Needs Assessment for Climate Change (2010) and its associated suite of decision-making instruments (TNAAssess, ClimateTechWiki, etc.).

Although focusing more particularly on mitigation technologies, a number of economy-energy models are also available to assess, evaluate and prioritize different technology options. Table 3.2 summarizes two of the most widely used models for national energy policy formulation included in national communications to the UNFCCC.

Table 3.2: Examples of economy-energy models

Model	Type	Data Inputs	Model Outputs
LEAP — Long Range Energy Alternatives Planning System	Bottom-up, Accounting Framework	Least data intensive — data needs include macroeconomic variables and energy supply and demand data. Model includes the Technology and Environmental Database (TED), which has energy technology data for performance and cost as well as environmental impacts for many technologies. Model also includes IPCC emission factors and energy and GHG baselines.	Integrated energy and GHG scenarios — showing interactions between different policies and measures, transformation analysis, social cost benefit analysis.
MARKAL-MARKet Allocation	Bottom-up, Optimization Model (there are also a number of hybrid MARKAL models such as MARKAL-TIMES)	Technology cost and performance data, input cost and price elasticity supply side data (e.g. fuel), market demand-side data, emission inventory and emission factors.	Integrated energy economy and GHG scenarios — estimates of energy prices and demand, marginal value of technologies within the system, fuel and technology mixes, GHG emissions and mitigation costs, optimizes investment in the economy and maximizes consumer welfare.

Source: Averchenkova (2010).

Figure 3.1 illustrates Step 1 through an example national marginal abatement cost curve (MACC). When used in combination with complementary decision-making tools, MACCs can be powerful means for assessing, prioritizing and communicating measures of emissions abatement. In particular, MACCs enable countries to identify measures that can be taken with negative or modest cost and those that can be captured relatively quickly. Many economy-energy models can automatically generate MACCs. Simple, widely available spreadsheet-based MACC calculators can also help create MACCs.

Box 3.1: Creating marginal abatement cost curves

Marginal abatement cost curves (MACCs) compare the merits of competing carbon reduction projects and competing technologies. Marginal abatement costs (MAC) can be formed around different investment criteria, but the most widely used approach is to use project Net Present Values (NPV). The NPV is the net of the initial cash outlay of a given investment and the present value of all other cash flows. It enables businesses or public policy makers to compare the return of different investments. The calculations can be easily made using spreadsheet software's in-built present value (PV) function. In Excel, the syntax for this is as follows:

$$NPV = \text{Project cost} + PV(\text{discount rate, evaluation period, annual benefit/cost})$$

The marginal abatement cost is then the NPV divided by the carbon saved by the project over the same period (the annual carbon savings multiplied by the evaluation period). Negative MAC values signal a project that pays for itself over the evaluation period, while positive MACs cost money over the given period and need to be compared to the cost of inaction (carbon price) or ethical/marketing valuations to judge whether to proceed or not.

Source: How to Create Marginal Abatement Cost Curves in Excel (2010).

However, MACCs focus essentially on technology costs and do not capture other costs of implementation such as identifying and addressing behavioural, technological, political, institutional, perceptual and financial barriers to technology transfer. These additional barrier removal costs can often substantially alter the easily understandable, but potentially misleading, priority order conveyed by a MACC. The identification of these barriers constitutes the second step of the UNDP four-step methodology.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Step 2: Assess Key Barriers to Technology Diffusion

“
... there is very seldom,
if ever, only one
market barrier
preventing the
adoption of a
clean technology.”

Step 2 consists of identifying existing market barriers for the adoption of priority mitigation and adaptation measures. In each country and for each market, a sound understanding of the market barriers to be addressed and of the strengths and limitations of the proposed measures will be required for any particular market transformation exercise to succeed. Based on UNDP experience in market transformation for climate change technologies in about 140 countries over the past 20 years, there is very seldom, if ever, only one market barrier preventing the adoption of a clean technology. As a precondition to any technology transfer effort, policy analysts and decision makers will need to thoroughly review national conditions and priorities, and establish the extent to which existing policy frameworks, behavioural standards, beliefs and skills are aligned with climate investment objectives. In other words, what incentives and disincentives relevant to clean technologies do they already create? Such an analysis should engage all stakeholders, including representatives from the private sector, worker unions, civil society organizations, and local communities directly impacted by the proposed technological change. Preparing a simple checklist of enabling conditions/key stakeholders as shown in Table 3.3 could facilitate the planning and implementation of this barrier analysis exercise.

Public policies do not operate in a vacuum. As a corollary to the observation made earlier that there is very seldom, if ever, only one market barrier preventing the adoption of a clean technology, UNDP's experience in market transformation demonstrates that a single policy measure is very unlikely to effect change in the absence a range of complementary information efforts, regulations and financial incentives. Similarly, there is not a single particular measure, or mix of measures, that can be considered as the most effective choice in all circumstances. Policies should be adapted to local circumstances such as the climate, demography, structure of economic activities and level of decentralisation of a country, as well as a country's energy and fiscal context, degree of market development for low carbon products and services, etc.

Table 3.3: Barrier analysis checklist

Key enabling conditions	Key stakeholders
Macro-economic conditions ● Economic and political stability ● Low restriction on foreign direct investment (FDI) ● Import/export tariffs ● Fossil fuel subsidies ● Etc.	● National, provincial and local governments ● International and national chambers of commerce and private sector association ● Academia, civil society organizations (CSOs)
Institutional and regulatory conditions ● Relevant institutions in place and with sufficient capacity ● Ease of obtaining necessary permits and licenses ● Legacy energy monopolies and policies ● Etc.	● National, provincial and local governments ● International and national chambers of commerce and private sector association ● Academia, CSOs
Social and behavioural conditions ● Size and demographic of skilled labour pool ● Perception related to climate change, green energy and energy efficiency ● Strength and capacity of civil society organizations, worker unions and citizen groups ● Etc.	● Government education institutions, academia, trade unions, CSOs
Technical conditions ● Condition of physical infrastructure ● Presence of energy and natural resource management intermediaries (component suppliers, assemblers, operation and maintenance) ● Existing green technologies under commercialization ● Etc.	● Engineering associations, technical infrastructure departments, utilities, academia, international and national chambers of commerce
Financial conditions ● Development status of financial markets ● Access to project financing, financial de-risking tools (guarantees, hedging facilities) ● Involvement of institutional and social investors in green technologies ● Etc.	● Government financial institutions, banks, financial intermediaries; institutional investors, international and national chambers of commerce and private sector associations

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Step 3:

Determine Appropriate Policy Mix

DEFINITION

Project Finance or Limited Recourse Finance

Project Finance or Limited Recourse Finance refers to debt borrowed for a specific project. The amount of debt made available will be linked to the revenue the project will generate over a period of time. This amount is then adjusted to reflect inherent risks.

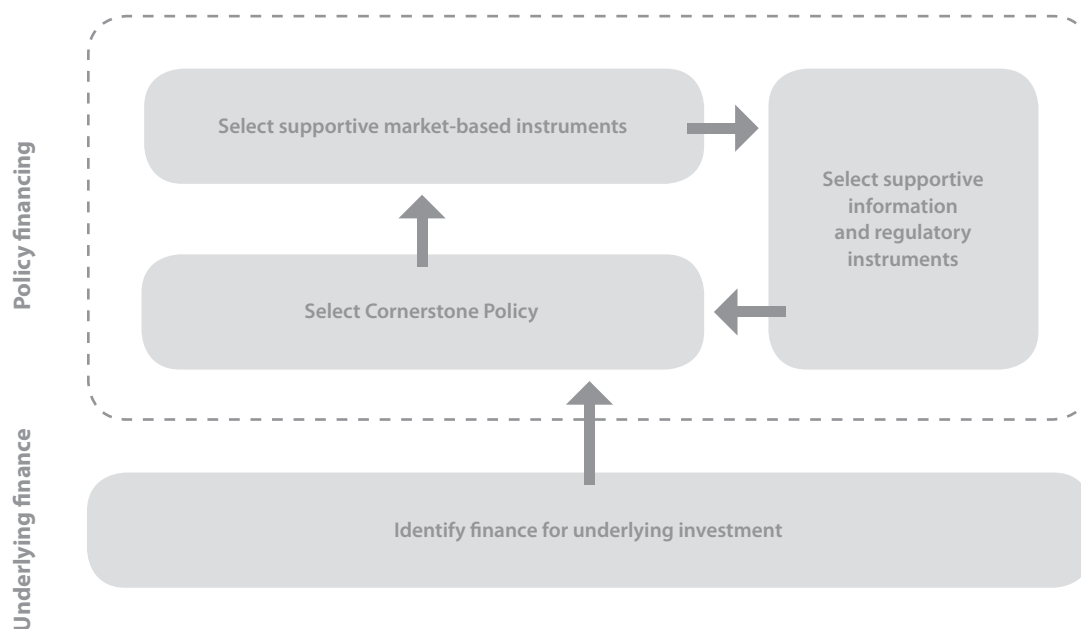
“... there is very seldom, if ever, only one market barrier preventing the adoption of a clean technology.”

The existence of ‘legacy systems’ means that policies and regulations that govern, for example, the energy system as a whole, are critical. Alongside the structure and regulation of the power or energy sector, separate laws or regulations governing planning and approval processes; regulation around infrastructure (grid and distribution) etc., will all need assessment and possible amendment for clean energy technology. In order to create an enabling environment for clean technologies, an appropriate combination of information, regulatory or financial policies will be needed to change the entire investment framework. For example, a financial incentive to promote renewable energy (tax break, feed-in tariff, renewable energy certificates, etc.) will be largely ineffective in the absence of guaranteed access to the grid and local supply of project finance and expertise. Selecting and sequencing an appropriate policy mix can prove to be one of the most challenging steps of a policy change process.

Figure 3.3 illustrates a possible methodology for establishing a well-crafted suite of complementary instruments to promote climate investment. In accordance with this methodology, the first task consists of identifying the source of climate change finance required to finance the underlying climate investment projects (e.g. international and national asset financing for large-scale RE power plants and household finance for single-family houses). The second task is to select a cornerstone policy. This cornerstone policy is the pivotal market transformation policy around which all other policies will be articulated. The cornerstone policy is selected in function of the type of underlying finance to catalyse, the development status of the targeted technology, the local market status, the specific local barriers to climate investment, and the existing policy system. The third and fourth tasks will require identifying complementary information, regulation and market-based instruments required to support the implementation of this cornerstone policy (guaranteed access to the grid, RE vocational training to ensure a local supply of expertise, etc.).

As mentioned in Chapter 2, public change is not costless. Packaging and sequencing policy measures in this way also enables policy makers to implement the less costly/most critical market access measures first. If the expected policy effect is not achieved, they are then able to decide which additional and more costly measures to apply to reinforce the first package of measures. As a general rule, everything that can be done to reduce investment risks or return at low cost — such as simplifying and shortening administrative processes, or improving consumer information — should be a first-order priority, before resorting to more expansive public policy instruments such as subsidies, soft loans, or loan guarantees. In addition, it is generally more efficient to raise the cost of unsustainable activities through regulation or fiscal instruments that help price them at their true cost than to subsidize sustainable activities.

The promotion of renewable energy can be used to illustrate the application of this methodology. The range of renewable energy in place allows for the promotion of this type of energy at the national, state/provincial, and local levels. In early 2010, more than 100 countries had enacted some type of policy target and/or promotion policy related to renewable energy, up from 55 countries in 2005. Developing countries now make up over half of all countries with renewable energy policy targets (REN 21, 2010).

Figure 3.3: Methodology to select cornerstone and supportive policies

There are four main policies that support the bulk of installed renewable energy capacity:

- Feed-in tariffs (where laws provide a guaranteed purchasing price and access to the grid for renewables)
- Quota-based instruments (where the government sets a minimum level of output or consumption of electricity from renewables, and the market determines the price)
- Tenders (tendering or competitive bidding schemes involve regulators specifying an amount of capacity or share of total electricity to be achieved and the maximum price per kWh)
- Investment/production tax credits (production tax credits provide an incentive for RE investments by reducing the amount of tax a qualified producer owes to the government)

The most appropriate instrument for any given location will depend, to a large extent, on the development status and local market conditions for a RE given technology (Schwarz, 2008). A successful tendering process can lead to the lowest cost option but often does not penalize developers that fail to install the capacity, allowing for unrealistically low or unprofitable bids to win. Tendering is best used as a price discovery mechanism for technologies at an early deployment/pilot stage. Feed-in tariffs provide developers with long-term stability and predictability and have proven to be extremely effective instruments for rapid commercialization of renewables. In jurisdictions uncomfortable with central pricing mechanisms such as feed-in tariffs, and with well-developed market institutions, quota-based mechanisms may be preferred. The selection of the key cornerstone policy should assist with the identification of complementary policies. Figure 3.4 illustrates this approach for wind power.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

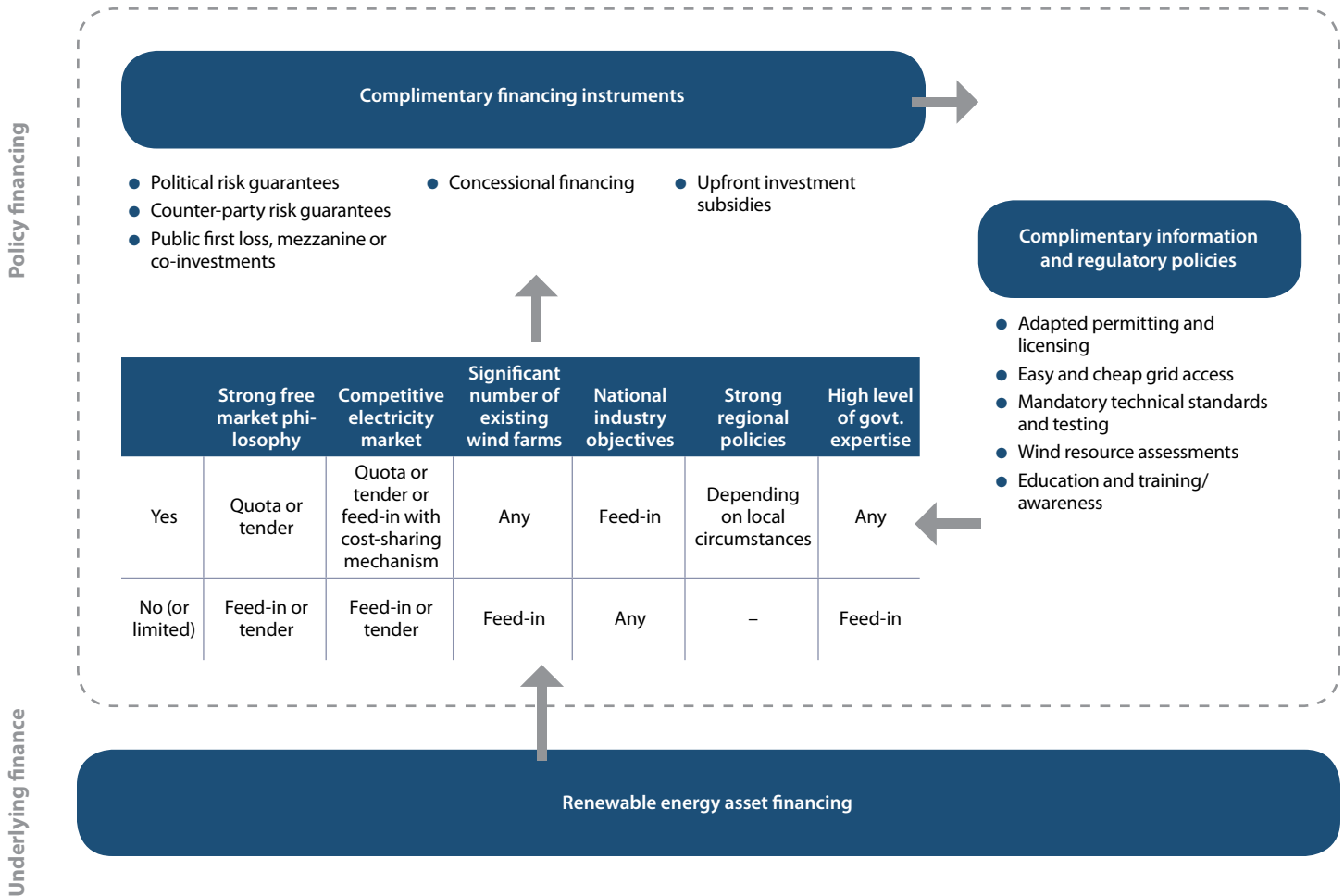
ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Figure 3.4: Matrix for selecting an appropriate policy mix for wind power

Source: Schwarz and Glemarec (2009).

In designing public policies to catalyse green investment, policy makers will need to strike a subtle balance: being flexible enough to promote innovation and adapt to circumstances, but having enough stability to give investors adequate certainty; and achieving their policy objectives without having unintended and distortive consequences in other sectors, or placing an unbearable burden on taxpayers. Even with a consistent, methodology-driven approach, the identification, evaluation, and selection of policy instruments in an objective manner is challenging. This is the case even in situations where criteria for such evaluation and selection have been established because the evaluative criteria must still be weighed one against the other during the selection process. Therefore, this selection is essentially a political decision. For example, deciding which criteria should have greater weight between environmental effectiveness or cost-effectiveness will depend on the actual risks and the risk appetite of policy makers (e.g. thresholds, clear accountability lines, etc.). The weighting will also depend on country conditions.

Institutional feasibility is of critical importance in most developing countries, and will, to a large extent, determine environmental effectiveness and cost-effectiveness. As mentioned earlier, the creation of environmental taxes to internalize pollution costs might be hindered by the limited tax infrastructure in a number of developing countries. Accordingly, this criterion is likely to receive more weight in a developing country than in a developed country. Ultimately, criteria that receive the most weight will be those that are assessed to be the most important in terms of each country's specific circumstances.

A scorecard mechanism might provide a useful framework for systematizing the discussion and guiding policy makers by providing a quantitative assessment of a given instrument in light of the country conditions. Ranking instruments for a given context means considering many variables, interactions and conducting various subjective assessments. A policy evaluation and selection scorecard can help throughout the process by applying a systematic approach. It is not supposed to provide definitive answers or give a final ranking of all the instruments in a given context, but is meant to help organize the discussion among various stakeholders and highlight the different issues and diverging views.

Although there are unavoidable subjectivities when carrying out a quantitative evaluation of this sort, a guided discussion will guarantee that no important issues are left out. Furthermore, a scorecard can provide a useful participatory mechanism to value, record, and consolidate the opinions of the various stakeholders on which the policy effectiveness will ultimately depend. Based on the eight evaluation criteria outlined in the previous section, Figure 3.5 provides an example of a possible scorecard. Such a scorecard should be prepared for each technology targeted to address climate change.

Figure 3.5: Policy evaluation scorecard

Mechanism	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Investors' Criteria														
● Loud	4	2	3	3	4	1	2	5	1	2	4	1	4	2
● Long	4	1	3	2	2	4	3	1	2	4	4	2	2	3
● Legal	3	2	3	3	1	4	3	3	2	3	2	1	1	4
● Light	2	2	1	1	3	1	2	3	3	5	3	2	1	1
Taxpayers' Criteria														
● Environmental Effectiveness	5	4	4	4	5	2	3	1	4	3	3	5	1	4
● Cost Effectiveness	4	3	4	1	4	2	4	2	1	3	1	3	2	3
● Political Feasibility	1	1	3	4	4	3	5	4	2	3	2	4	1	2
● Institutional Feasibility	1	3	2	2	2	2	2	4	2	1	4	3	2	1

Throughout the entire policy evaluation and selection exercise, it will be critical to involve all stakeholders, including representatives from the business and finance communities. In policy-dependent markets, investors need to be confident that governments are fully committed and have the capacity to implement policy change. Misgivings on government commitment or the effectiveness of chosen policy and regulations will have consequences on the cost of capital. The higher the risk associated with a given set of national policies and regulations, the higher the cost of capital charged by lenders, and the higher the returns required by equity investors for taking that risk.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“
Ultimately, criteria that receive the most weight will be those that are assessed to be the most important in terms of each country's specific circumstances.
”

Table 3.4: Policy roadmap for wind power

		2010-2015	2015-2025	2025-2050
Public authorities (national, regional or local depending on the institutional setup) and regulators	Control and regulatory instruments	- Review permitting and licensing procedures to offer simple, clear, predictable rules for wind projects - Review grid connection and usage rules (with grid operators)	- Adopt targets for share of wind energy in electricity - Set mandatory Feed-in tariffs or quotas (e.g. RPS, etc.) - Adopt environmental integration regulations to increase acceptance without hindering the development of wind energy - Control new grid connection operators to develop the grid in anticipation of future wind development	- Increase national/regional targets - Decrease tariffs as wind energy becomes more competitive - Update regulations as technology and impacts evolve - Monitor grid development
	Financial incentives and market instruments	- Support demonstration programmes - Create a favorable environment for CDM projects	- Offer tax credits, subsidies, and soft loans where necessary - Promote CDM projects	- Stimulate the availability of financing matching the characteristics of wind energy projects - Stimulate regulated and voluntary carbon markets
	Information and training	- Conduct wind resource assessments - Organize information campaigns on wind energy	- Make wind resources assessments available to developers - Create standards and labels for turbines and set up testing facilities - Develop technical training programmes	- Expand and update information - Enforce standards and promote labels - Make disclosure of the carbon content of electricity mandatory
Developers		–	Avoid environmentally and socially sensitive areas and adopt 'good neighbour' practices	Adopt best technologies to minimise impacts
Investors/Financial institutions		Train staff on wind energy	Develop financial products adapted to the specificities of wind energy (long-term pay-back, small projects)	–
Utilities and grid operators		- Train staff on wind energy - Review grid connection and usage rules (with regulators)	- Launch commercial offers promoting wind energy - Adopt internal wind energy generation/purchase objectives - Develop standard power purchase contracts - Ensure fair and transparent access to and use of the grid - Include future wind development for grid planning - Develop new technologies on smart flexible grids, electricity storage and management of intermittent sources	- Maintain 'green' offers and adjust them to customer requirements - Tighten objectives - Incentivize staff on wind results - Offer fair and simple power purchase contracts - Ensure fair and transparent access to and use of the grid - Continue to develop the grid to connect new wind farms - Integrate new technologies allowing easier management of intermittent generation sources
Contractors		Train on installation and maintenance of wind farms	–	Update training on new technologies
Suppliers and manufacturers		Train installers	- Pursue research to decrease costs and environmental impacts and improve the management of intermittency - Provide technical support to installers	- Promote new technologies and make them available in as many countries as possible - Provide technical support to installers

Source: Schwarz (2009), included in Chapter 3 of Glemarec and others (2009).

3.3 || Preparing a Policy Roadmap

Most transformational initiatives involving multiple policy instruments and stakeholders are phased in over a long period of time. It takes 50 years to change the policy mix of a nation, and possibly longer to change its housing stock. Thus, the final step will be to draw an actionable roadmap to design, implement and finance the selected policy mix possible over a period of 25 years or more. Table 3.4 above shows a roadmap for wind power.

Step 4: Select Financing Options to Create an Enabling Policy Environment

The fourth and final step will be to identify and access appropriate climate change funding sources to design and deploy the selected policy mix. The next chapters will discuss this step in detail. Steps 3 and 4 should be regarded as an iterative process. An ambitious feed-in tariff policy, for example, might need to be downscaled if no suitable financial mechanism can be identified to cover the required price premium.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT



A stylized world map in a light blue color, centered on the Atlantic Ocean, serves as the background for the entire page. The map shows the outlines of the continents in a simplified, almost abstract manner.

Chapter 4

Climate Change Financing Sources

- 4.1 The Global Climate Change Finance Architecture
- 4.2 Public Finance Landscape
- 4.3 Environmental Finance Markets
- 4.4 Capital Markets Landscape
- 4.5 Climate Change Investment Vehicles

4 Climate Change Financing Sources

“
Over 90 percent of climate change finance is sourced from private markets (venture capital, asset financing, etc.).
”

This fourth chapter maps the principal sources of public and private climate change finance available to developing countries. It then describes its main agents and channels. Given the diversity of climate finance, this chapter is divided into four parts. Part one provides an overview of the global climate change financial architecture. Part two reviews public climate finance, part three addresses the fast developing environmental market finance, and part four addresses private climate finance. While this analytical approach should facilitate an understanding of the various sources, agents, and channels of climate finance, it is important to bear in mind that private and public climate finance are closely linked and increasingly blended to scale up climate action. Climate investments are policy-dependent and decision makers will need to be familiar with both sources of finance to catalyse capital toward green, low-emission and climate-resilient development.

4.1 The Global Climate Change Finance Architecture

As seen in Chapter 2, a number of policy options exist to remove barriers and catalyse capital toward climate investing. An equally vast array of financial options exists to help developing countries design and deploy these public policies.

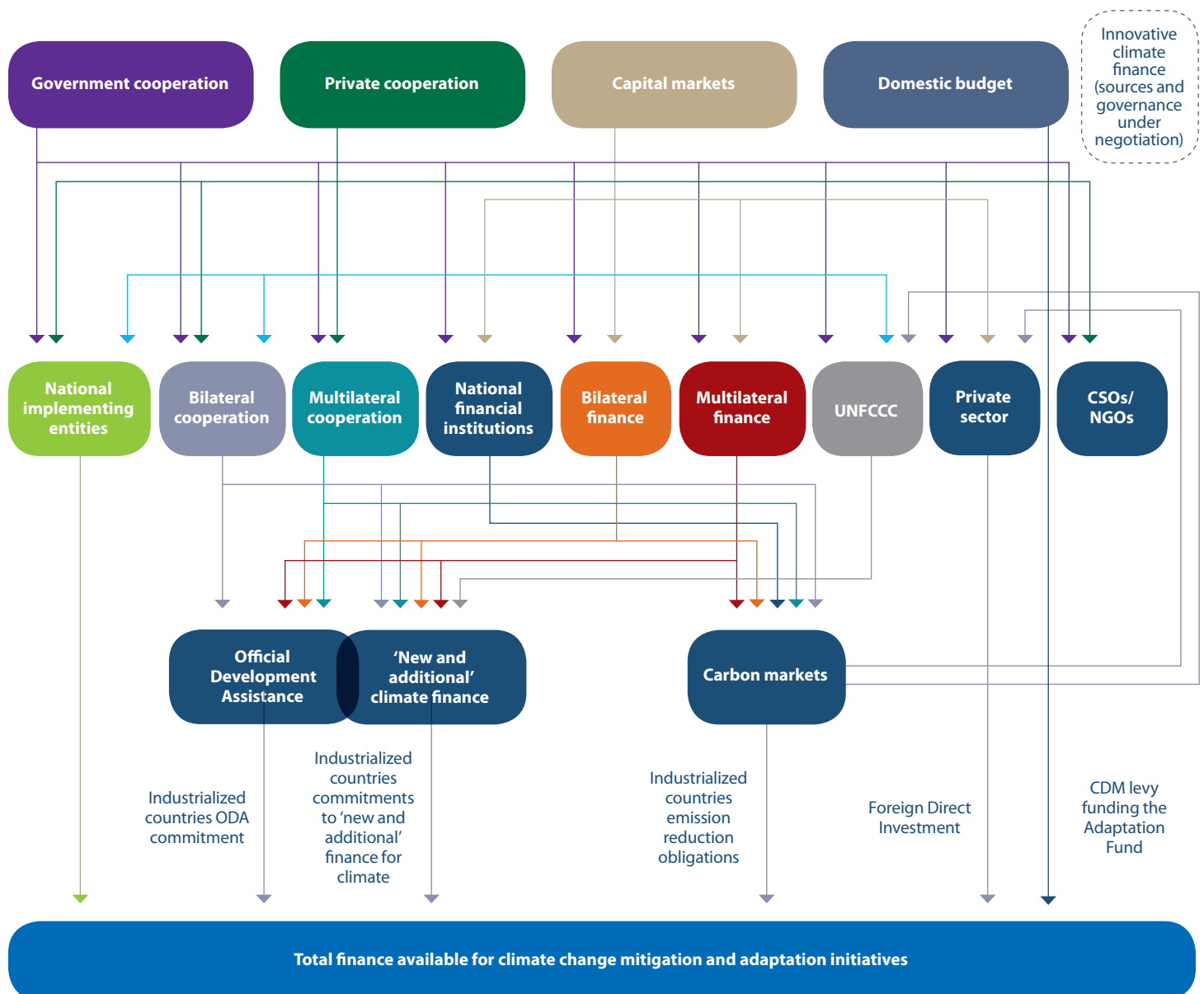
Sources, Agents and Channels

Climate finance is sourced either from capital markets or government budgets, and channelled through various multilateral and bilateral agencies, the UNFCCC and a multitude of private financial intermediaries. Figure 4.1 below schematizes sources, agents and channels. Over 90 percent of climate change finance is sourced from private markets (venture capital, asset financing, etc.). However, public finance is critical to removing barriers to climate technologies and attracting direct investment.

The Evolving Public Climate Finance Architecture

The global public climate change financial architecture is complex and is evolving fast. It is likely to see further diversification of sources, agents and channels in the coming years. The UNFCCC Copenhagen Accord (December 2009) and Cancun Agreements (December 2010) committed developed countries to jointly mobilizing \$100 billion per year by 2020 to support climate change mitigation and adaptation activities in developing countries. The funds for these activities are expected to come from “public and private, bilateral, multilateral, and alternative sources of finance.”

Figure 4.1: Climate change finance: Sources, agents and channels



Source: Adapted by author from Atteridge and others (2009).

Box 4.1: Potential sources of climate change financing

The High Level Advisory Group on Climate Change Financing (UN AGF) report emphasizes three potential public funding instruments.

Auction emission allowances. Under the Kyoto Protocol arrangements, developed countries have their emission targets expressed as assigned amount units (AAUs). To date, countries have received AAUs at no charge. Under this proposal, countries would pay for a portion of the AAUs they receive. The proceeds from the sale of the AAUs would be earmarked for international climate finance. According to the AGF report, this could raise about \$30 billion annually.

Redirect fossil fuel subsidies. This option would require developed countries to reduce or phase out fossil fuel production and consumption, and divert part of the revenues saved from the elimination of fossil fuel subsidies to international climate finance. The report estimates that this could raise between \$10 to \$15 billion per year.

Carbon pricing of international transport. This recommendation would involve raising a fuel levy or establishing an emissions trading scheme in the international aviation or maritime sectors. In the case of a trading scheme, a portion of the allowances in the scheme would be auctioned and proceeds directed toward international climate finance. Alternatively, an international ticket tax (a tax paid on each ticket sold) could be introduced in the aviation sector. The report estimates that this could generate around \$10 billion per year (after adjusting for any incidence in developing countries).

The United Nations AGF report also stresses that enhanced private funding flows will be essential for economic transformation toward low-carbon growth. Furthermore, the report recommends that carbon markets are further strengthened and developed. The report estimates that a global carbon offset market could abate 1.5–2.0 gigatonnes of carbon per year; this could lead to \$120–150 billion of climate finance investment.

In early 2010, the UN Secretary General established a High Level Advisory Group on Climate Change Financing (UN AGF) to assess the feasibility of new and increased financial support for climate finance and to make proposals on where new sources of funds would come to support a stronger commitment by developed countries. The Group released its report in November 2010, which focused on the identification of sources of climate finance. It concluded that mobilizing \$100 billion per year by 2020 would be “challenging but feasible.” The report listed a range of options, both national and international, with a mix of public and private/market sources (see Box 4.1).

Unlike traditional development financing approaches, the innovative sources of finance³ recommended by the AGF would not depend on the political goodwill of contributing nations. However, turning the report’s recommendations into tangible, new financial flows will require political leadership at a senior level. Realizing this ambitious goal will require the active engagement of countries of widely varying situations to mobilize, invest, monitor and report on these funds. This could pose additional challenges to the global climate finance architecture. In parallel to innovative sources of finance, a number of developing countries are championing the idea of direct budget contributions from industrial to developing countries to meet the Copenhagen and Cancun pledges. The Cancun Agreements specify that such finance should be **new and additional** to Official Development Assistance (ODA).

³ The concept of Innovative Finance was first endorsed at the International Conference on Development and Finance. The term is used in a relatively broad manner in professional development literature. In the context of the AGF, it mostly refers to a range of non-traditional mechanisms to raise new and additional funds for development such as taxes on transport or financial transaction. Innovative financing mechanisms of that nature have already raised \$2 billion over the past 3 years (Taskforce on Innovative International Financing for Health Systems). The term is also sometime used to define innovative public financial schemes such as public-private equity funds, government-sponsored loan guarantee funds to scale up development action (WEC, 2004). It is also found in reference to environmental markets (carbon finance, bio-prospection, habitat trading, etc.). In the present guidebook, innovative financing will only be used as original defined at the International Conference on Development and Finance. For a discussion of challenges associated with innovative finance, see Schroeder (2006).

In December 2010, at the sixteenth session of the Conference of the Parties (COP 16) to the UNFCCC in Cancun, governments noted the AGF report and laid the foundations for a set of new finance structures under the UNFCCC, and in particular, the establishment of the Green Climate Fund. The Green Climate Fund will now undergo an intensive design process in 2011, with a view to COP 17 adopting operational decisions on the fund in December 2011. Key to the design process is the formation of a Transitional Committee with 40 members (25 developing countries, 15 developed countries).

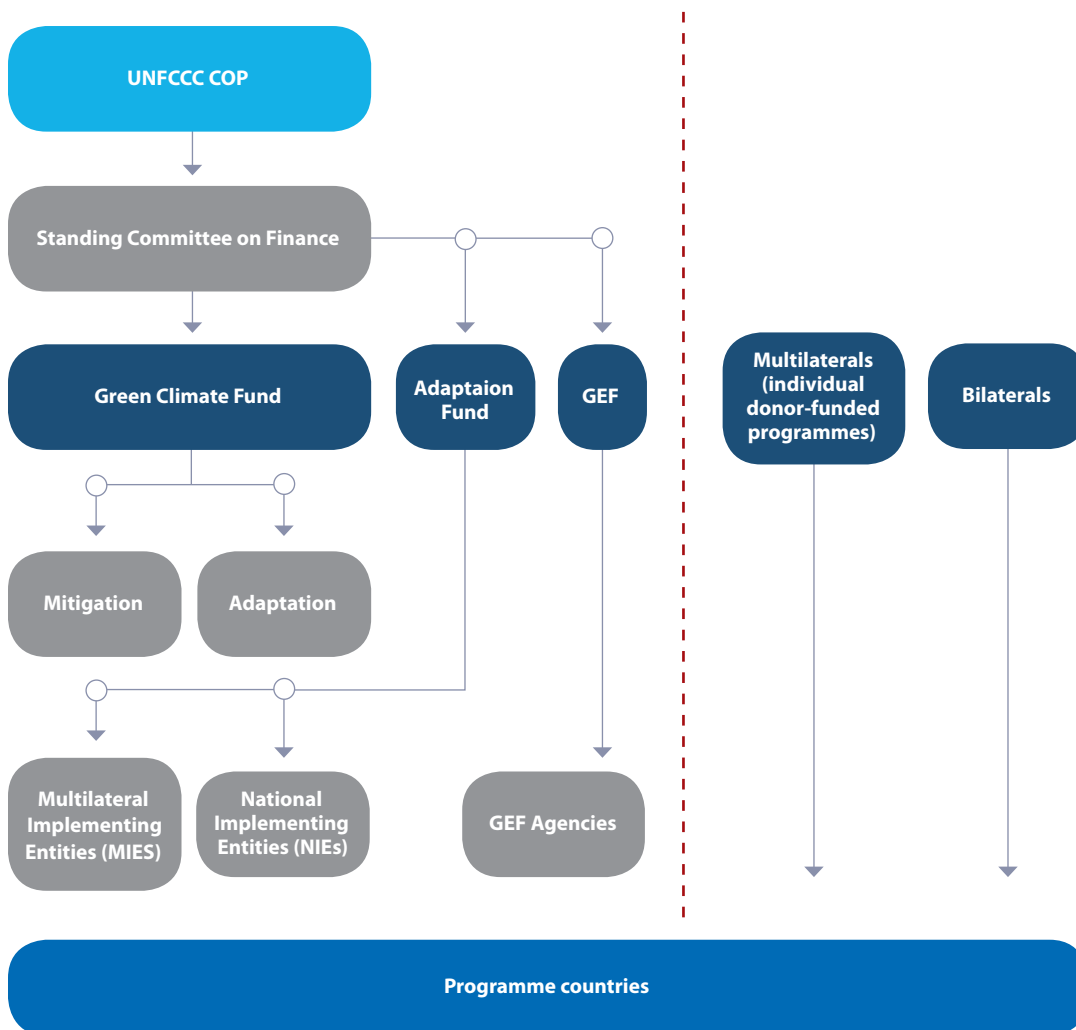
While the establishment of the Green Climate Fund might facilitate some harmonization among climate funds and centralize a slice of international public climate finance, the coming years are likely to see a continued increase in the total number of international public climate funds. Figure 4.2 below sets out a possible emerging architecture for international public climate finance.

DEFINITION

Conference of the Parties (COP)

Conference of the Parties (COP) is the supreme body of the UNFCCC, comprising countries with right to vote that have ratified or acceded to the convention.

Figure 4.2: A possible emerging architecture for international public climate finance



Source: Billet and Glemarec (2010).

Based on this emerging architecture, the section below provides a hypothetical distribution of financial flows by type of funds by 2020, without prejudging the outcome of the ongoing UNFCCC negotiations.

Table 4.1 summarizes the major multilateral and bilateral finance channels.

Table 4.1: List of major multilateral and bilateral climate channels

Type of fund	Financial flow
Bilateral channels	This will likely remain the largest source of financing, ⁴ and will be channelled through a variety of bilateral and multi-bilateral channels (e.g. Germany's International Climate Initiative [ICI]);
Multilateral channels	The UN and the multilateral development banks currently act as fund managers for a number of multi-donor climate change funds (e.g. the World Bank's Climate Investment Fund [CIF]).
The Global Environment Facility (GEF)	This multi-donor fund serves as an operating entity of the UNFCCC financial mechanism and is expected to remain important due to the GEF's unique role in creating synergies between different multilateral environmental agreements.
The Adaptation Fund (AF)	Under the Kyoto Protocol, the AF will continue to receive funding from a 2% levy on the CDM (see section 4.3 on carbon mechanisms/funds), as well as ad hoc donor grant contributions. In addition to its innovative source of finance, the AF takes a groundbreaking approach to project implementation, making both national and multilateral implementation arrangements (see section on agents).
The Green Climate Fund (GCF)	This fund will likely be capitalized at a significant annual amount (potentially 20 percent of total public resources). The precise sources of funding are still under determination. The GCF will undergo an intensive design process in 2011.

⁴ Some donor countries have national policies in place that cap their ODA and additional non-ODA contributions to multilateral instruments to a given percentage.

4.2 || Public Finance Landscape

Based on the above mapping of the public climate finance landscape, this section describes its main actors and instruments.

Climate Finance Actors and Instruments
Multilateral Development Institutions and Funds
Bilateral Finance Institutions and Funds
Export Credit Agencies
UNFCCC Funds
National Development Institutions and Climate Funds

Multilateral Development Institutions and Funds

The ownership of Multilateral Development Institutions is shared among multiple countries and includes both technical assistance agencies such as UNDP, United Nations Environment Programme (UNEP), multilateral development banks such as the World Bank, and regional development banks (Asian Development Bank, African Development Bank, Inter-American Development Bank, etc.).

Multilateral technical assistance agencies provide both policy advisory and technical project management services. For example, UNDP and UNEP are, with the World Bank, the founding agencies of the GEF. They rank among the largest sources of sectoral (market transformation) and cross-sectoral (low-emission climate-resilient development strategies/institutional strengthening/skills development) technical assistance for climate change management. In addition, United Nations agencies directly manage a number of multilateral climate funds such as UN-REDD (Reducing Emissions from Deforestation and Degradation). UNDP and UNEP also provide direct project management services to private investors in carbon finance to increase market participation of developing countries through facilities such as the UNDP Millennium Development Goal (MDG) Carbon Facility and the UNEP ACAD (UNEP Africa Carbon Offset Development Facility).

Multilateral development banks (MDBs) are broadly defined as development institutions with a banking business model. In addition to their lending activities, they can also provide development research and advisory services. They have also set up a number of dedicated climate change funds. Notably, the World Bank established the Climate Investment Fund (CIF) in 2008, implemented jointly with the regional development banks. Overall, the CIF has an initial multi-annual capitalization of just over \$ 6 billion. Over the past 10 years, the World Bank also played a pioneering role in establishing carbon funds to purchase and trade carbon emissions. In 2009, it successfully issued green bonds to finance clean energy projects, opening a new avenue for climate change financing. In addition, a number of MDBs have private sector lending arms, such as the International Finance Corporation (IFC) at the World Bank Group, that lend directly to corporations at commercial but secured rates.

“

With some major donor countries capping their contribution to climate change finance through multilateral channels to a given percentage (e.g. 30 percent), BFIs could become the largest source of international public climate change finance in the coming years.

”

DEFINITION**Underwriting**

Underwriting is the process by which investment banks agree to provide a large bank debt facility to a client for a particular project.

“
... a wide diversity
of national climate
funds exists in terms
of mandate, governance
structure and
financing criteria.”

Bilateral Finance Institutions and Funds

The term bilateral finance institutions (BFIs) might be misleading as it implies single-country ownership. In practice, some bilateral finance institutions can be connected to a group of countries. If we accept this broader definition, bilateral finance institutions include the European Investment Bank (EIB), the Nordic Investment Bank, the Islamic Development Bank, the French Development Agency (Afd-France), the Japanese International Development Agency (JICA), the Commonwealth Development Corporation, the German Development Bank (KfW), the Overseas Private Investment Corporation, and the Netherlands Development Finance Corporation. In 2008, total climate change-related finance disbursed by Afd, EIB, KfW and JICA alone was about \$13 billion, nearly equalling the total climate change lending of MDBs reported to \$15 billion in 2009 (UNEP, 2010). These figures are a combination of ODA and non-ODA finance.

With some major donor countries capping their contribution to climate change finance through multilateral channels to a given percentage (e.g. 30 percent), BFIs could become the largest source of international public climate change finance in the coming years. The organizational structures and mandates of the BFIs vary according to their relationship with the other development institutions in their country of origin.

Industrial countries have also established a number of multilateral/bilateral climate change funds. In addition to financing the interventions supported by their respective bilateral cooperation agencies, some of these funds, such as the German International Climate Initiative (ICI), are also accessible to a number of additional multilateral, national and non-governmental institutions.

Export Credit Agencies

Export credit agencies (ECAs) act as an intermediary between national governments and exporters to issue export financing. ECAs offer medium- and long-term credit insurance or guarantees, or act as direct lenders to importers on behalf of governments. In doing so, they facilitate the export of capital goods and related services, in particular in sectors such as infrastructure, transport, manufacturing, energy production or distribution facilities.

ECAs currently finance or underwrite about \$430 billion of business activity abroad — about \$55 billion of which goes toward project finance in developing countries. Some ECAs are government-sponsored, others quasi-governmental, and others private. Financial terms and conditions are regulated internationally, primarily through the Arrangement on Officially Supported Export Credits (OECD, 2009). Almost all exporting countries have at least one ECA, which plays a counter-cyclical role especially during moments of financial crisis when private market export financing becomes a scarce resource (IEA, 2010a).

UNFCCC Funds

Under Article 4.3 of the UNFCCC, Annex I Parties commit to providing financial assistance to non-Annex I Parties to support the implementation of the Climate Change Convention. To facilitate this transfer of funds, the Convention established a financial mechanism with operating entities. Until December 2010, the GEF was the sole operating entity of the UNFCCC's financial mechanism. In December 2010, the UNFCCC Cancun Agreements established the Green Climate Fund. It will serve as second operating entity to the UNFCCC financial mechanism. This fund is expected to become the largest single source of international public climate finance by 2020.

In addition to the GEF Trust Fund, two special funds exist under the UNFCCC that are managed by the GEF: the Special Climate Change Fund (SCCF) and Least Developed Countries Fund (LDCF). The SCCF finances projects relating to adaptation, technology transfer, and capacity building, as well as sectors such as energy, transport, industry, agriculture, forestry, and waste management. The LDCF was established specifically to finance activities in Least Developing Countries (LDC), and to help them to prepare and implement NAPAs.

A third fund, the AF, exists under the Kyoto Protocol. Although the GEF also provides secretariat services to this fund, the AF is governed by its own Board, which decides programme priorities and criteria for funding eligibility. The AF is capitalized by a two percent levy on the carbon credits generated through the CDM.

National Development Institutions and Climate Funds

Sub-regional development banks (BOAD,⁵ BIDC,⁶ CATIE,⁷ etc.) or national development banks provide an alternative funding channel for long-term investment in many developing countries. Although these institutions have an uneven record in generating long-term financing, they are expected to play an increasingly important role in assisting countries with a successful transition to low-emission climate-resilient development pathways. Notably, they could play a major role in developing PPPs, such as the underwriting of green bonds and the capitalization of public private equity funds (see Chapter 5).

A number of developing countries are also in the process of establishing national climate funds to raise innovative sources of domestic climate finance. The intent is to house together existing national funds/financial programmes with similar objectives but disparate governance and accountability arrangements, or to blend these resources with multiple complementary international and national resources for specific sectors/projects. It would also attempt to manage, monitor and evaluate them in an integrated manner. In line with these different objectives, a wide diversity of national climate funds exists in terms of mandate, governance structure and financing criteria. Box 4.2 describes the National Climate Fund for Cambodia and the Brazilian National Fund on Climate Change. Further information on national climate fund objectives, funding sources, governance structure, implementation modalities and MRV (measurement, reporting, and verification) arrangements can be found in the UNDP guidebook on national climate funds (UNDP, 2011c).

⁵ Banque Ouest Africaine de Développement

⁶ Barbados Investment and Development Corporation

⁷ The Tropical Agricultural Research and Higher Education Center

Box 4.2: Climate Change Alliance Trust Fund in Brazil and Cambodia

Brazilian National Fund on Climate Change: The Fund was created to allocate a portion of the State's revenue from oil production in the country to mitigate the impact of oil production and combat climate change. The Fund was established by a law adopted in December 2009. It provides grants and loans to adaptation and mitigation initiatives. The resources from the Fund can also be used to leverage international public finance and private finance in pursuit of the Fund's mandate. The Fund is overseen by the Ministry of Environment and operated by the National Social and Economic Development Bank.

Cambodia Climate Change Alliance Trust Fund: This UNDP-administrated Trust Fund was established in December 2009. A significant component of funding will go toward building the capacity of the National Climate Change Committee, an inter-ministerial body composed of 20 ministries, to better coordinate national policy-making. The trust fund creates a harmonized engagement point for donors, thereby minimizing transaction costs for government. The Trust Fund will also provide a demand-driven grant facility to support climate change adaptation and mitigation initiatives by Government and Civil Society at national and sub-national levels. A Technical Advisory Panel provides technical assistance and recommends proposals for funding from the trust fund. To date, the trust fund has received contributions from the European Union, the Swedish International Development Agency, the Danish International Development Agency and UNDP. It is envisaged that the responsibility for administering the fund will ultimately be transferred to the Government.

Source: Glemarec, Waissbein and Bayraktar (2010); UNDP (2011c).

Under the UNFCCC Adaptation Fund, accredited national institutions can also directly access international financial resources to support climate change interventions in their countries. Direct access as a programming modality is expected to grow in importance in the coming years.

4.3 | Environmental Finance Markets

Fiscally constrained governments around the world are increasingly turning to market-based schemes to finance climate change. This global trend is being observed in the biodiversity and water sectors as well. The objective of environmental markets is to pay communities or individuals to adopt production systems that conserve or increase the supply of these valuable ecosystems services.

Environmental finance markets can be broadly broken down into two main categories: carbon finance and payments for ecosystems services (PES). There are considerable overlaps between these two categories as carbon finance could be assimilated to a payment for climate stabilization and regarded as a payment for ecosystems services. However, the scale and the specificity of carbon finance mechanisms warrant a separate treatment.

For most ecosystem services, there are generally three types of payments: (1) payments directly from the government; (2) voluntary payments from businesses, non-governmental organizations and individuals; and (3) payments made to comply with government regulations. The ratio between private sector and public sector payments will vary depending on countries' conditions. In the United States, where environmental markets have been in existence for at least 25 years, roughly 80 percent of the payments made for forest-based ecosystem services come from private sources (Evans, Cooley and Hamilton, 2011). The same PES for forest-based ecosystems will be entirely funded from domestic or international finance in other countries. As such, environmental market finance does not fit easily under either public or private climate finance and should be best regarded as a new asset class on its own, with its own set of opportunities and constraints.

A comprehensive review of environmental markets would go beyond the scope of this guidebook. However, the present section will briefly present the status of both carbon markets and PES before discussing their potential contribution to low-emission climate-resilient development.

Status and Trends of Carbon Markets

Carbon finance is an innovative, policy-based source of finance. The Kyoto Protocol under the UNFCCC broke new ground with the introduction of innovative cap-and-trade and credit-and-trade carbon markets. Based on the principle that the effect on the global environment is the same regardless of where GHG emissions reductions are achieved. Countries may meet their targets through a combination of domestic activities and use of the Kyoto Protocol 'Flexibility Mechanisms,' which are designed to allow Annex I Parties (industrialized countries and economies in transition) to meet their GHG reduction targets in a cost-effective manner, and to assist developing countries (non-Annex I Parties) in particular to achieve sustainable development.

There are three Kyoto Protocol Flexibility Mechanisms:

- International Emissions Trading (cap-and-trade mechanism) – Article 17 of the Kyoto Protocol, allows Annex I countries that exceed their emission targets to buy allowances from another Annex I country that was successful in reducing emissions below its target.
- The CDM (project-based, credit-and-trade mechanism) – CDM (Article 12), allows developed countries to obtain credits (known as Certified Emission Reductions, CERs) for supporting mitigation and sequestration projects in developing countries.
- Joint Implementation (project-based, credit-and-trade mechanism) – JI allows Annex I countries to earn credits (known as Emission Reduction Units, ERUs) by financing an emission reduction project in another Annex I country, typically an economy-in-transition.

Both JI and CDM are project-based mechanisms that involve developing and implementing projects that reduce GHG emissions, thereby generating carbon credits that can be sold on the carbon market (see Box 4.3). Public and private finance institutions established many carbon funds to allow for the purchase and trade of CERs and ERUs.

DEFINITIONS

Certified Emission Reduction Unit

Certified Emission Reduction Unit (CER) is equal to one metric tonne of CO₂-e emissions reduced or sequestered through a Clean Development Mechanism project, calculated using Global Warming Potentials.

Joint Implementation

Joint Implementation is a market-based implementation mechanism defined in Article 6 of the Kyoto Protocol, allowing Annex I countries or companies from these countries to implement projects jointly that limit or reduce emissions or enhance sinks, and to share the Emissions Reduction Units.

Emissions Reduction Unit

Emissions Reduction Unit (ERU) is equal to one metric tonne of CO₂-e emissions reduced or sequestered arising from a Joint Implementation (defined in Article 6 of the Kyoto Protocol) project.

Box 4.3: What is a CDM project?

A CDM project reduces or avoids the emission of GHGs in a developing country (renewable energy, waste management practices, forestry, etc.). Project proponents — private-sector companies, public-sector bodies, utilities or non-governmental organizations, etc. — can initiate these projects.

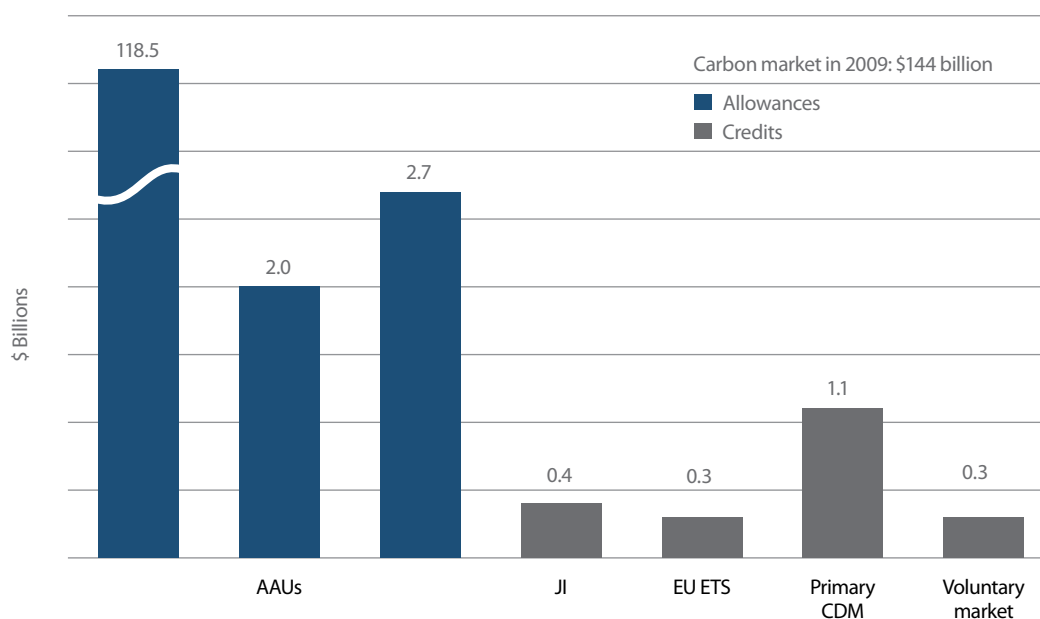
Example

A power utility in a developing country is considering whether to invest in a coal-fired power plant or a wind power plant. The cost of wind power is higher than the cost of coal-fired power. However, by investing in wind power, a lower carbon energy technology, the power utility can avoid a certain quantity of carbon emissions that would have been generated by the coal-fired power plant. The power utility would then be compensated for this reduction (tonne of GHG reduced, expressed as CO₂e) with carbon credits, or CERs.

Through the creation of carbon markets, the power utility is able to sell the CERs, which creates a hard currency revenue stream for the company. The size of this revenue stream will vary by project depending of the tonnes of GHG reduced. The range is between tens of thousands to tens of millions of US dollars per year.

The CER revenue stream is additional to a project's other revenue streams. It therefore enhances the economics of 'clean' projects and provides an incentive for similar projects. In this case, the additional revenues from CERs could make wind power financially competitive with coal-fired electricity.

In 2009, despite the uncertainty surrounding a post-2012 climate change framework, carbon markets reached \$144 billion.

Figure 4.3: State of carbon markets

Source: Adapted from World Bank (2010). Note: Assigned amount units (AAUs), Joint Implementation (JI), European Union Emission Trading Scheme (EU ETS), Clean Development Mechanism (CDM).

It is believed that new potential carbon-finance-based mechanisms such as NAMAs, bilateral offsets, sectoral mechanisms and REDD could play a more significant role in the future while project-based mechanisms such as JI or CDM will be gradually phased out or restricted to LDCs and other under-represented carbon markets (Point Carbon, 2011). Irrespective of the exact instruments to be used, carbon finance is likely to remain a major source of finance for GHG abatement projects in the coming decades. As mentioned previously, the AGF report recommends that carbon markets are further strengthened and developed and estimates that globally, the carbon offset market could lead to \$120–150 billion of investment.

As also mentioned in Chapter 1, a critical issue with the CDM as a source of finance for low-emission climate-resilient development is the uneven regional distribution of projects to date. Just five countries — China, India, Brazil, South Korea and Mexico — are expected to generate over 80 percent of the CERs (UNDP, 2006; UNDP 2009). A key challenge for the coming decade will be to ensure that the shift from project-based approaches to scaled-up approaches such as NAMAs, NAPs, programmatic CDM, sectoral crediting, and cap-and-trade systems does not worsen the existing imbalance with respect to regional access to climate finance. As a contribution to this objective, UNDP has established MDG Carbon (UNDP, 2007; for further reading access www.mdgcarbonfacility.org), a dedicated programme facility to assist project proponents in under-represented markets in accessing carbon finance. In addition to providing project management services for CDM, MDG Carbon services enhance the capacity of governments and investors to formulate and implement scaled-up market approaches.

Status and Trends of Payments for Ecosystem Services

Payment for Ecosystem Services cover a range of initiatives, from government conservation incentive programs, to voluntary markets, to compliance-driven ecosystem service markets such as wetland mitigation credits. There are both mature and nascent payment systems for biodiversity compensation around the world. Each one is a bit different and they often go by different names: biodiversity offsets, mitigation banking, conservation banking, habitat banking, payments for watershed services, quality water trading, fish habitat compensation, BioBanking, complementary remediation, conservation certificates, and many more.

There is no universally accepted definition of payments for PES. For the sake of this publication, we will adopt the definition of Mercer, Cooley and Hamilton (2011), as follows:

“Formal and informal contracts in which landowners are remunerated for managing their land to produce one or more ecosystem service; PES transactions must consist of actual payments between at least one willing buyer and one willing seller to produce or enhance a well defined ecosystem service or bundle of services.”

Table 4.2 summarizes some of the major existing PES markets. Although significant, these figures are likely to substantially under estimate the actual size of existing PES because of a lack of data for some markets. Furthermore, PES schemes are likely to continue growing in the coming decade. Despite their differences on mandatory GHG emissions reductions, countries demonstrated a strong willingness to cooperate on a number of issues in Cancun in December 2010. Notably, the Cancun Agreement establishes a formal REDD+ (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries) initiative. This is the first time that an international agreement has formally endorsed the concept of financial

“ Irrespective of the exact instruments to be used, carbon finance is likely to remain a major source of finance for GHG abatement projects in the coming decades.

”

DEFINITION

Deforestation

Deforestation is the natural or anthropogenic process that converts forest land to non-forest.

support to mitigate climate change through stemming the loss of forests. The scope of REDD+ covers: reducing emission from deforestation and forest degradation; conserving and enhancing forest carbon stocks; and sustainably managing forests.

Reducing Emissions from Deforestation and Forest Degradation in Developing Countries is a climate change mitigation measure that seeks to reduce GHG emissions by preventing or reducing forest loss and forest degradation. Essentially, REDD+ is about compensating tropical forest nation-states and companies or owners of forests in developing countries not to cut their carbon-rich forests or to reduce their deforestation and forest degradation rates, thus avoiding GHG emissions.

In 2009, the Informal Working Group on Interim Finance for REDD+ concluded that a 25 per cent reduction in annual global deforestation rates might be achievable by 2015. The success of which would result from €15-25 billion in financing between 2010 and 2015 to fund results-based incentives and capability building that would complement other REDD+ efforts. These costs are made up of €13-23 billion for payments for emission reductions (of which €3 billion would go toward reduced peat related emissions) and €2 billion to invest in preparedness activities.⁸

⁸ A standing natural forest, particularly rainforests, has more value to the world for their ability to absorb carbon dioxide emissions. While it could cost between \$17.2 to \$37.5 billion per year by 2030 to protect the forests and cut emissions by 2.7 gigatonnes of carbon dioxide a year, UNEP (2010) estimates that the benefits of action is \$37 trillion, in present value terms.

Table 4.2: Status and trends of payments for ecosystem services

Ecosystem market	Products	Suppliers	Customers	Market value	Market type
Biodiversity offset and compensation programs	Acres of restored or conservation land managed/wetlands	Acres of restored or conservation land managed	Governments; Real estate developers; Conservation organizations	\$1.8-2.9 billion in 2008 (Ecosystem Marketplace, 2009)	Credit-and-trade, voluntary agreements
Payments for watershed services and quality water trading	Streams, rivers and lakes meeting water quality standards	Landowners	Governments; Water basin agencies; Industrial businesses; Real estate developers	\$9.3 billion in 2008 (Ecosystem Marketplace, 2009)	Voluntary agreements; credit-and-trade of pollutant reduction credits
Sustainable fisheries	Permits to catch a set weight of fish species; Certified marine fish	Governments issue quotas; Retiring fishers sell quotas; Certification organizations issue certificates	Fishing fleets; Voluntary purchase of certified marine fish	\$5-10 billion (Ecosystem Marketplace, 2008)	Cap-and-trade, voluntary agreements
Green commodities	Goods produced using biodiversity and climate friendly methods (e.g. shade-grown coffee)	Farmers; Certification organizations issue certificates	Consumers paying a 5-10% price premium on certified goods	\$42 billion and could reach (Ecosystem Marketplace, 2008)	Voluntary agreements
Bio-prospecting contracts	Commercially valuable genetic information	Local communities and conservation agencies	Pharmaceutical companies and academic institutions	\$0.4-1.9 billion (Costello and Ward, 2006)	Bilateral agreements between governments and firms
REDD	Acres of restored or conservation managed forest	–	–	About \$100 million but could reach \$17.2-37.5 billion per year by 2030 (Parker, Brown and Pickering, 2009)	Baseline-and-credit markets

Source: Ecosystem Marketplace (2009).

In addition to natural habitat-related PES, an increasing number of PES associated with preserving the quality and quantity of water resources are being developed across the world on a local, national and international scale. For example, Stanton and others (2010) identified 216 payments for watershed protection programmes (PWS) in varying stages of activity in countries. Interestingly, the majority of these PES programmes were to be found in developing countries in 2009 (see Table 4.3).

Table 4.3: Status of payments for ecosystem services programmes

	Programs identified	Active programs	Transactions 2008 (\$ millions)	Hectares protected 2008 (million ha)	Historical transactions through 2008 (\$ millions)	Hectares protected historically
Latin America	101	36	31	2.3	177.6	–
Asia	33	9	1.8	0.1	91	0.2
China	47	47	7,800	270	40,800	270
Europe	5	1	–	–	30	0.03
Africa	20	10	62.7	0.2	570	0.4
United States	10	10	1,350	16.4	8,355	2,970
Total PWS	216	113	9,245	289	50,048	3,240
Water quality trading	72	14	10.8	–	52	–
Totals	288	127	9,256	289	50,100	3,240

Source: Adapted from Stanton and others (2010).

Governments manage half of these programmes, which are by far the main source of payments. However, these government-financed PWS could lay the foundation for private sector-financed water quality trading (WQT). The WQT initiatives are driven by regulated standards and implemented at the state/regional and local levels where water quality goals are met by trading pollutant reduction credits. Across the world, there were only 14 WQT active programmes in 2008, with most of them based in the United States, and a handful in Australia, Canada and New Zealand. In principle they offer a more cost-effective approach to meeting water quality standards than traditional command-and-control instruments. Consequently, they could become increasingly popular as a tool to tap private sector resources and technical know-how, as experience in designing and implementing environmental market schemes is gradually gained.

Potential of Environmental Markets to Foster Low-Emission Climate-Resilient Development

Environmental markets have the potential to deliver multiple development and climate benefits, including biodiversity conservation, carbon sequestration (green and blue), sustainable water management, enhanced ecosystems resilience and ecosystem-based adaptation, green employment, poverty reduction and sustainable livelihoods.

DEFINITIONS

Emissions trading

Emissions trading refers to a market-based approach to achieving environmental objectives. It allows those reducing GHG emissions below their emission cap to use or trade the excess reductions to offset emissions at another source inside or outside the country.

European Union Emissions Trading Scheme

European Union Emissions Trading Scheme (EUETS) is an example of a carbon market-based cap-and-trade system, whereby binding emission targets are set by the EU and tradable allowances to emit up to these targets are then offered to emitters (as gifts or auctioned). Companies that pollute more can then buy surplus credits from those who pollute less, ensuring that overall emissions do not exceed the cap.

The most ardent supporters of environmental market finance believe that one day they will become a fundamental part of our economic system and represent the missing link between public and private finance to foster a low-emission climate-resilient development. Figure 4.4 illustrates this concept.

Figure 4.4: Blending international public climate finance and environmental market finance to catalyse capital



Environmental markets are not without their critics. There is an abundance of literature challenging the increasing reliance on carbon cap-and-trade or credit-and-trade markets, in terms of efficiency (respective efficiency of emission trading schemes versus carbon taxes); the level of effectiveness (actual impact of industrial gazes on the world energy trajectory); and the equity of the market (distributional effect and uneven access). The UNDP 2007/2008 Human Development Report on Climate Change provides a concise overview of current debate.

The effectiveness of payments for ecosystems is also challenged. For example, Simpson (2011) questions the actual demand for ecosystem services and believes that effective conservation will have to rely on international transfers from wealthier to poorer countries. Based on a review of PES schemes supported by the GEF, the GEF Science and Technical Advisory Panel (2010) identified four main threats to PES: non-compliance with contractual conditions; poor administration of services; spill-over and adverse selection. Like Simpson, they also note the lack of empirical evidence about the effectiveness of PES for environmental conservation and the need to ensure that the targeted PES users are credible as prospective buyers.

In terms of fundraising potential, true PES consisting “of actual payments between at least one willing buyer and one willing seller to produce or enhance a well defined ecosystem service or bundle of services” is hard to find (Parker and Cranford, 2010). In most developing countries, governments remain the main source of funding for PES. Payments for ecosystem services directly from the government are in practice nothing more than direct fiscal incentives. For PES to become a true new source of climate and ecosystem finance, a key challenge in developing countries will be to increase the ratio between private sector and public sector payments. Experience with private payments for forest-based ecosystem services in the US show that these types of payments were made in response to polluter-pays regulations. This experience highlights the need to combine MBIs with regulatory and information instruments.

Besides preserving the natural capital of the poor, PES in principle can reduce poverty insofar as they constitute an income transfer from richer groups (e.g. taxpayers, urban residents, businesses, richer countries, etc.) to lower-income groups. However, as pointed out in the TEEB report for policy makers (2009), PES schemes require careful design and favourable conditions to avoid unintended distributional side

“
For PES to become a true new source of climate and ecosystem finance, a key challenge in developing countries will be to increase the ratio between private sector and public sector payments.”

effects and ensure positive outcomes for the poor and marginalized. Even in mature markets like the United States, the distribution of payments among landowners tends to be highly uneven and the vast majority of private landowners do not receive any kind of ecosystem service payments (Mercer, Cooley and Hamilton, 2011).

A critical theme for the coming decade will be to design PES that not only preserve ecosystem services in a more effective manner, and mobilize more overall payments from the private sector for ecosystem services, but that also optimize positive outcome for the poor. Once these changes are made, PES schemes will be able to play their bridging role between public and private finance to catalyse capital for low-emission climate-resilient development.

To help national, state and local government design and administer effective and pro-poor PES schemes UNDP established with its UN and development partners two dedicated facilities: UN-REDD (UN-REDD, 2011; for further access www.un-redd.org) and Green Commodities Facilities (UNDP, 2010b; for further reading access www.undp.org/greencommodities). Both facilities recognize the potential of PES for low-emission climate-resilient development as well as the practical challenges associated with developing environmental markets.

4.4 || Capital Markets Landscape

Between the sources of investible capital and those who need capital to develop climate-friendly projects, there exists a myriad of intermediary players. This includes those who 'own' the financial assets (e.g. households), those who have a fiduciary responsibility to invest the financial assets (e.g. commercial banks, pension trustees), and those who actually invest the assets (e.g. investment managers) for a fee. Alongside these three main groups, investment consultants, research analysts (sell-side research), brokerage firms and credit rating agencies contribute to the investment process. It is this complex constellation of financial actors that decides what gets financed, and what does not, as well as the cost of this financing.

Corporations

Business can finance climate investment projects by using either on-balance sheet financing or borrowing funds from a bank in the form of a loan, or through equity capital from selling a stake in the business itself. The borrowing capacity of power utilities is large. With a current market capitalisation of the global electricity market estimated at \$1.5 to \$2 trillion, power utilities could potentially raise \$3 trillion to \$6 trillion in debt to fund clean energy projects (IEA, 2010a).

Banks focus on getting that debt repaid, earning a relatively small return on the transaction. Usually, commercial debt is the cheapest source of finance available to project proponents. Box 4.4 describes the main commercial bank financing options.

Equity investors take equity positions in companies, projects or a portfolio of projects, and expect a greater return for the level of risk they take, to account for the percentage of new ventures that can be expected to fail. As described below, equity investment is usually in the form of funds and involves many actors, often with overlapping boundaries and responsibilities.

“

A critical theme for the coming decade will be to design PES that not only preserve ecosystem services in a more effective manner, and mobilize more overall payments from the private sector for ecosystem services, but that also optimize positive outcome for the poor.

”

Box 4.4: Bank financing options

Corporate Lending: Banks provide finance to companies to support everyday operations. An assessment is made of the company's financial strength and stability, and debt is priced accordingly. Banks place few restrictions on how the company can use the funds, provided certain general conditions are met.

Project Finance, or Limited Recourse Finance: Money is borrowed to fund a specific project; the amount of credit made available will be linked to the revenue the project will generate over a period of time, as this is the means to pay back the debt. This amount is then adjusted to reflect inherent risks, e.g. the production and sale of power. In the case of a problem with loan repayment, rather like a typical mortgage, the bank will establish first 'charge' or claim over the assets of a business. The first tranche of debt to get repaid from the project is usually called 'senior debt.'

Mezzanine Finance: As its name implies, this type of lending sits between the top level of senior bank debt and the equity ownership of a project or company. Mezzanine loans take more risk than senior debt because regular repayments of the mezzanine loan are made after those for senior debt; however, the risk is less than equity ownership in the company. Mezzanine loans are usually of shorter duration and more expensive for borrowers, but pay a greater return to the lender (mezzanine debt may be provided by a bank or other financial institution). A green investment project may seek mezzanine finance if the amount of bank debt it can access is insufficient: the mezzanine loan may be a less expensive way of replacing some of the additional equity that would be needed in that situation, and therefore can improve the cost of overall finance (and thus the rate of return for owners).

Refinancing: This is where a project or a business has already borrowed money, but decides or needs to replace existing debt arrangements with new ones, similar to refinancing a mortgage. Reasons for refinancing include: more attractive terms becoming available in the market (perhaps as lenders become more familiar with the technology, meaning more money can be borrowed against the asset); or the duration of the loan facility, e.g. loans are often structured to become more expensive over time because of the increasing risk of changes to regulation or market conditions.

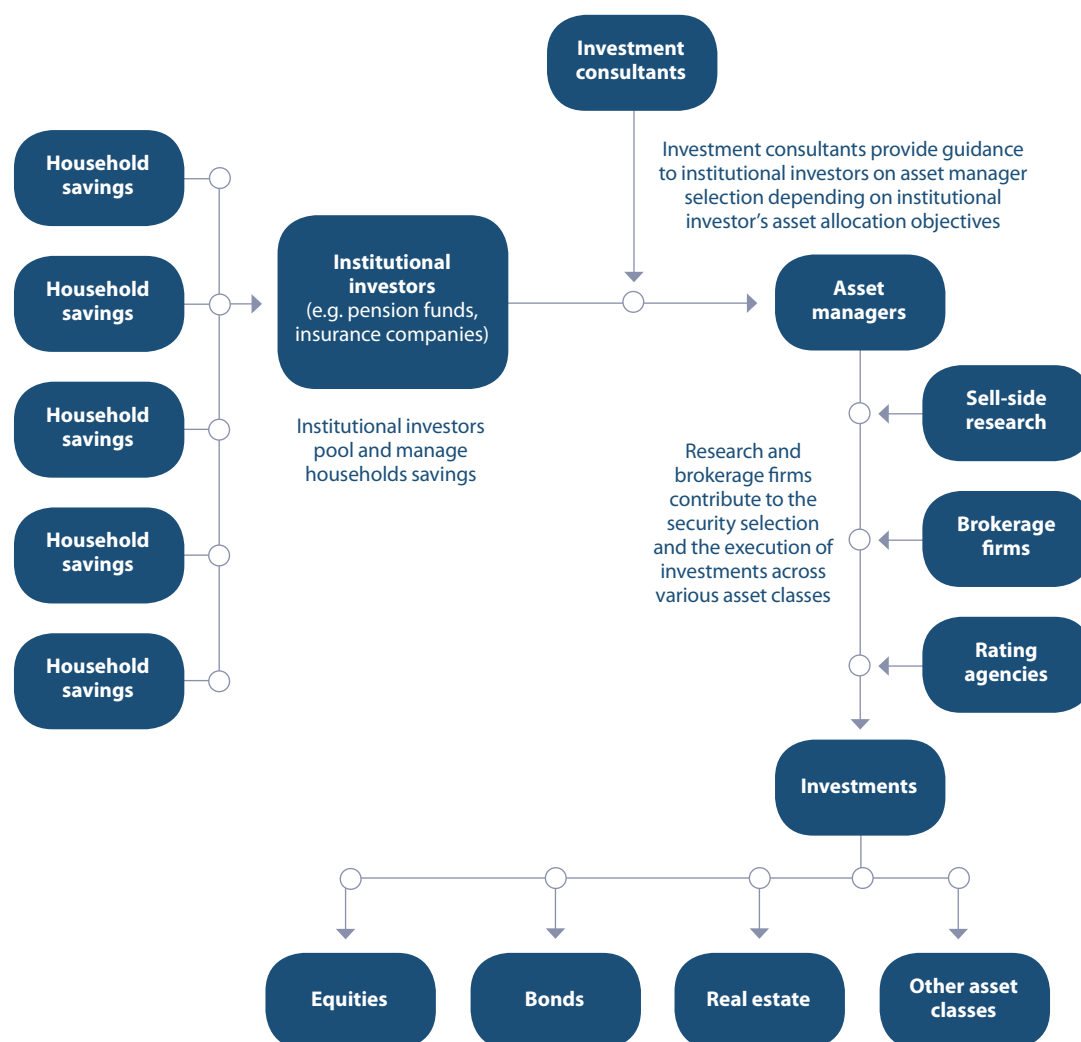
Source: UNEP (2009).

DEFINITION**Institutional investors**

Institutional investors include insurance companies and pension funds, which tend to invest large amounts of money over a long-time horizon with lower risk appetite.

Institutional Investors

Given their pivotal importance for green investment, this section will focus on institutional investors. Institutional investors have a long-term investment horizon, which matches the long-term financing requirements of climate investment such as wind power or timber forestry. The term 'institutional investors' may be described as organizations that pool and manage the savings of small investors by investing on their behalf. They include pension funds, insurance companies, investment companies (e.g. mutual funds), endowments and foundations. Individual investors or retail investors on the other hand can be described as those who invest on their own behalf either directly or through financial intermediaries, such as investment advisers/financial planners. Investment management, also known as asset management or fund management, refers to the process whereby assets collected by institutional investors are actually invested in capital markets in the form of equities, bonds, commodities, real estate, etc., depending on the investors' investment objectives. Figure 4.5 provides a simplified illustration of the various actors in the investment management process.

Figure 4.5: Key players of the capital markets systems

Source: Bayraktar (2010).

The primary objective of most institutional investors is to maximize risk-adjusted returns from their investments;⁹ however, due to their structural differences they have differentiated risk/return appetites that result in varying asset allocation strategies. In addition to the level of risk they are willing to accept, institutional investors also have operational and regulatory constraints that they need to take into account when making investment decisions. For instance, the nature of their liabilities and the regulatory framework in which they operate are two of the major constraints faced by pension funds and life insurance companies.

Table 4.4 prepared by Hande Bayraktar (2010) highlights general characteristics that can be ascribed to each category of institutional investor in terms of their level of risk aversion, asset allocation strategy, and geographical focus. Any climate change strategy aiming to catalyse capital toward low-emission climate-resilient development will have to take into consideration the specific investment horizons and risk appetites of these different institutional investors and the information requirements of their agents and intermediaries.

“Any climate change strategy aiming to catalyse capital toward low-emission climate-resilient development will have to take into consideration the specific investment horizons and risk appetites of these different institutional investors and the information requirements of their agents and intermediaries.”

”

⁹ In some cases, state-backed investment vehicles may have national-strategic goals. As discussed later in this chapter, ethical investors may also shun very profitable investment opportunities that do not conform to their investment ethics (oil industries, military industries, etc.).

Table 4.4: Characteristics of selected institutional investor types

Institution	Investment Horizon	Investment Objective	Asset Size (2008)	Level of Risk Aversion	Example of Investments	Geographic Focus	Regulatory Constraints
Life Insurance Companies	Long-term	Asset liability matching	\$19tn	High	- Publicly listed equities and bonds in developed financial markets - Relatively small allocations to alternative asset classes, such as private equity and hedge funds	- Developed countries - Select emerging markets with relatively strong financial market development and transparency	High
Pension Funds	Long-term	Asset liability matching	\$26tn	Moderate-High	- Publicly listed equities and bonds in developed financial markets - Increasing allocations to alternative investments, such as private equity and infrastructure funds	- Developed countries - Select emerging markets with relatively strong financial market development and transparency	Moderate
Sovereign Wealth Funds	Mid-to long-term	Long-term return	\$3tn	Moderate	- Active across all asset classes - More aggressive allocation to alternatives when compared with pension funds and life insurance companies	Global	Low-Moderate, may have restrictions on % of geographical allocations
Endowments	Mid-to long-term	Long-term return	~\$1tn	Low-Moderate	- Active across all asset classes - Aggressive allocation to alternatives	Global	Low

Source: Bayraktar (2010).

Private Cooperation Finance (Foundations and Social Investors)

In the coming years, an emerging group of social investors could be called to play an increasingly important role in climate change finance in developing countries. With more investors rejecting the notion that they face a binary choice between investing for maximum risk-adjusted returns or donating for social purpose, social investment is becoming a new funding source for socially responsible and environmentally sustainable investment. Social investors range from philanthropic foundations and commercial financial institutions to high net-worth individuals. According to a report published by J.P. Morgan (O'Donohoe and others, 2010), this new investment trend could represent an investment potential of between \$400 billion and \$1 trillion over the next decade in five critical sectors to scale up climate action — housing, water, health, education, and financial services — serving global populations earning less than \$3,000 annually. The J.P. Morgan report assesses expected and realized returns from more than 1,000 impact investments collected by the Global Impact Investing Network. Reported return expectations vary dramatically, from competitive to concessionary. Some investors expect financial returns from their impact investments that would outperform traditional investments in the same category, while others expect to trade off financial return for social impact. The willingness of some social investors to accept trade-offs (lower returns or higher risks) could facilitate the emergence of innovative PPPs to scale up climate investment to service low income households in developing countries (see Chapter 6 on identifying an optimal financing mix to promote green investment).

However, a great challenge for the emerging field of social investment, which seeks to apply lessons from venture capital to the field of development, is a severe shortage of investment propositions in which to invest (Tallberg Project, 2011). The capital available does not necessarily match the existing investment opportunities. Presently, the capacity of grass roots organizations to promote themselves to investors as good investment propositions is weak.

International and national financial institutions, as well as central banks and regulators, are not familiar with the unique requirements of low income households. Consequently, they find it difficult to develop appropriate financial products for these markets. On the other hand, existing ventures and grass root organizations seldom have the ability or sophistication to propose the kind of business plans and structures required to place them on the radar screen of either commercial or social investors (Tallberg Project, 2011).

What seems to be missing is a market development/market transformation mechanism to bridge this gap. Developing sustainable business models to provide green, low-emission and climate-resilient products and services to the poor could be one of the key mandates of emerging technology transfer centres supported under the UNFCCC process. Low-cost, small-scale renewable energy systems and water/energy efficient appliances are two good examples for possible business models.

4.5 || Climate Change Investment Vehicles

Depending on their investment objective and risk appetite, investors have a number of options to choose from within each asset class to obtain exposure to climate change investments. Broadly speaking, these asset allocation strategies may fall into four areas: asset allocation strategies, public equity and equity products, publicly listed debt market (debt/bonds), real assets (including real estate and timber & sustainable forestry, and alternative investments.

Asset Allocation Categories
Public Equity and Equity Products
Publicly Listed Debt Market (Debt/Bonds)
Real Assets (including Real Estate and Timber & Sustainable Forestry)
Alternative Investments

Alternative Investments is a broad category of asset classes that include private equity/venture capital, hedge funds, infrastructure, commodities, etc. It is worth noting that carbon funds — funds that invest in projects generating carbon credits either for the voluntary or compliance markets — also fall under the alternative investment category. For the purposes of this guidebook, this section will focus on private equity/venture capital, infrastructure funds and carbon funds, given their increasing significance and relevance as financial vehicles in climate change investing.

Public (Listed) Equity and Equity Products

An equity share represents one unit of ownership in a company whose shares can be bought and sold on an exchange, such as the New York Stock Exchange or London Stock Exchange. An equity investor can profit in two ways: when the company's equity increases in value or when the company passes a portion of

DEFINITION

Public-Private Partnership

Public-Private Partnership (PPP) refers to a government service or private business venture that is funded and operated through a partnership of government and one or more private sector companies. PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project.

“The willingness of some social investors to accept trade-offs (lower returns or higher risks) could facilitate the emergence of innovative public-private partnerships (PPP) to scale up climate investment to service low income households in developing countries.

”

DEFINITION**Infrastructure Funds**

Infrastructure Funds are funds traditionally interested in lower risk infrastructure such as roads, rail, grid, waste facilities, etc., which have a longer-term investment horizon and so expect lower returns over this period.

its profits by paying dividends to its shareholders. Institutional investors can invest in climate change activities by purchasing the publicly-traded equity shares of companies, established or newly listed, either in domestically- or internationally-listed equity markets. Investors can invest in listed equities by individually picking the shares of companies and/or investing in climate change-related investment funds. Even though worldwide there are an increasingly large number of equity funds targeting climate change investments, equity shares of companies in developing countries only make up a very small percentage of these investments. Investors often look for well-developed financial markets and transparency in capital markets when making their investments; the majority of developing countries, apart from the leading emerging markets, fall short of offering these conditions to the global investment community. So, while equity markets present many opportunities for institutional investors to obtain exposure to climate change opportunities, they are limited to companies that are already listed on stock exchanges and are operating in well-developed, transparent, and liquid capital markets.

Publicly Listed Debt Markets

On the fixed-income side, institutional investors can invest directly by participating in the bonds issued to finance green projects. A bond is a type of a security that is similar to a loan in that when the bond is issued, money is lent to the entity issuing the bond that then promises to repay the principal and interest through to the bond's maturity. Depending on national legislation, a company, a municipality or a government can issue bonds.

In the realm of climate change investing, climate bonds/green bonds have been especially attractive to sustainability-oriented institutional investors who are looking for stable, long-term returns. Green bonds, also known as climate bonds, have been recently introduced by microfinance institutions (MFIs) such as IFC and EIB as a financial vehicle for institutional investors to invest in climate change-related activities and to finance green infrastructure in developing countries. The interest rates of these bonds ranged from 2.25 to 5.23 percent, substantially lower than the prevailing rates associated with debt finance that project developers in developing countries might access from local banks — which typically are still in the low-mid teens (Ward, 2010).

Real Assets

Real assets refer to those assets that have an intrinsic value and are tangible, and include real estate, timber, and forestry. Timber and forestry investments are particularly critical for both climate change mitigation and adaptation. Timber investments have a low correlation with other asset classes and are also often seen as an inflation hedge. There are a number of new funds offering exposure to timber and sustainable forestry. For instance, in April 2010, MSS Capital, a London-based firm, launched three separate funds that invest in sustainable forestry, with varying time horizons and return expectations. The first fund, at \$38 million, will have a 1-year time horizon and will invest in mature mahogany and teak trees that need felling, with expected returns of 12 to 25 percent. The other two funds, which are expected to close at £100 million each, will be for a five-year agro-forestry fund, and a 15-year teak and agarwood fund (Environmental Finance, April 2010).

“
In the realm of climate change investing, climate bonds/green bonds have been especially attractive to sustainability-oriented institutional investors who are looking for stable, long-term returns.”

Alternative Investments

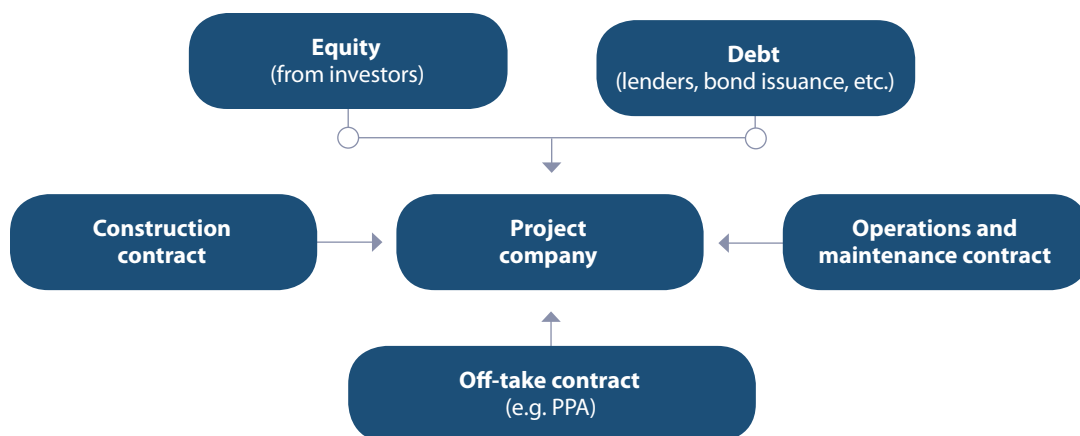
Private Equity/Venture Capital Funds

Private equity (PE) can be defined as an equity investment in a company or an asset that is not publicly traded on capital markets, which means that private equity investments are not traded on exchanges. Venture capital (VC) is a form of private equity that invests in early-stage companies targeting new technologies and/or new markets. Investors usually invest in private equity through limited partnerships (as Limited Partners, or LPs) and take part in a portfolio of private equity investments while preserving their limited liability. This leaves management to the general partners (GPs), who often get involved in the management of the companies they in which they invest. PE/VC investments tend to be illiquid and are considered long-term, with an investment horizon of 3-5 years for PE and 4-7 years for VC (UNEP, 2009).

Private equity/Venture capital funds play an important role in providing capital to start-up clean technology companies. In emerging market private equity, investments have focused on more mature segments and more proven technologies, and have taken the form of (1) providing growth/expansion capital where access to capital markets has been limited, and (2) making efficiency improvements in operations. According to Bloomberg New Energy Finance, during 2004-2009 nearly \$35 billion worth of new clean energy investments were made through private equity and venture capital funds, led by activity in Europe and the Americas. Overall, private equity activity has risen steadily in emerging markets. A newly published survey from EMPEA/Collier Capital suggests that institutional investors increasingly view emerging markets as attractive for private equity, both on a standalone basis and relative to more developed markets. According to the survey, more than half of the LPs currently invested in emerging markets private equity investments plan to increase their commitments over the next two years, with investment interest continuing to focus on China, Brazil and India, while seeking investment opportunities in less penetrated markets, including Viet Nam, Indonesia and Thailand (Emerging Markets Private Equity Association, 2010).

Infrastructure Funds/Project Finance

Infrastructure assets can be defined as the system of public works in a country, state or region, including roads, utility lines and public buildings, and they generally have long-term, predictable and stable cash flows. The private sector financing of public infrastructure usually takes the form of project finance, which is a type of long-term financing that is provided for a 'ring-fenced' project set up as a separate legal and economic entity (i.e. an off-balance sheet, special purpose vehicle, or SPV), whereby the project's cash flows are used for debt repayment.

Figure 4.6: A simplified project finance structure

Source: Adapted from Yescombe (2002).

As Figure 4.6 illustrates, in project finance structure, equity and debt financing are the two main sources of financing. However, the separate legal entity structure of the project company allows project finance deals to be highly leveraged, with debt financing covering more than 70 percent of a project's total cost and the debt financing often coming from multiple lenders, depending on the size of the project. Private sector project finance debt is mainly provided by commercial banks in the form of long-term loans, and by bond investors (e.g. insurance companies, pension funds) that purchase the bonds issued by project companies. In developing countries, multilateral and regional banks as well as export credit agencies also play an important role in the provision of loans and guarantees. Project finance debt has priority of repayment from the project's cash flows, while the equity investors' return is dependent on the level of success (high, low, etc.) of the project. Equity investors who are actively involved in the promotion, development, and management of the project are often referred to as 'sponsors,' and may bring in other equity investors such as insurance companies, pension funds, and international financial institutions, especially in the case of developing countries.

Carbon Funds

For private investors, carbon finance has become a new asset class. In 2009, despite the uncertainty surrounding a post-2012 climate change framework, assets under management by carbon funds grew by 26 percent to \$16 billion (Carbon Finance, 2010).

A stylized world map in a light blue color, serving as a background for the page. The map shows the outlines of continents and major landmasses.

Chapter 5

Selecting an Optimal Financing Mix to Promote Green Investment

- 5.1 Private Financing Optimization Criteria
- 5.2 Public Financing Optimization Criteria
- 5.3 Public Financing Eligibility Criteria
- 5.4 Combining and Sequencing Different Sources of Public Climate Finance
- 5.5 Blending and Sequencing Multiple Sources of Public and Private Climate Finance
- 5.6 Adopting a Methodology to Select an Optimal Financing Mix

5

Select an Optimal Financing Mix to Promote Green Investment

This fifth chapter provides a methodology to select and sequence an optimal financing mix to promote climate investment. To develop clean technology markets, public policy makers will often have to blend domestic and international, public and private, loan and grant, innovative and traditional sources of finance. This chapter will discuss each of these different sources of finance and possible mechanisms for their blending at the national level.

“The types of finance that might be the most applicable for the development, commercialization and deployment of a technology will depend on the nature of the development stage of the technology and of its targeted market.”

There is abundant and widely available corporate finance literature on how to best structure private finance. Hence, this chapter only presents private financing optimization criteria as a brief introduction to the more in-depth discussion on maximizing the use of public climate finance as shown below.

Identifying possible sources of funds for each type of policy



5.1 Private Financing Optimization Criteria



5.2 Public Financing Optimization Criteria



5.3 Public Financing Eligibility Criteria



5.4 Combining and Sequencing Different Sources of Public Climate Finance



5.5 Blending and Sequencing Multiple Sources of Public and Private Climate Finance

5.1 Private Financing Optimization Criteria

A company will choose whether to use its cash flow, commercial loans, project finance, equity finance or corporate facilities depending on which offers the cheapest source of funding to the project. Capital cost, repayment schedule and cash flow constraints will be the main decision-making criteria to identify an optimal financing mix for specific climate investments.

The types of finance that might be the most applicable for the development, commercialization and deployment of a technology will depend on the nature of the development stage of the technology and of its targeted market. This is connected to the perceived risk and the appetite of different types of investors to risk. This will in turn affect the level of return expected by the investor. As a general rule for private sector investment, the greater the risk, the greater the expected return. Table 5.1 illustrates the different types of finance, the type of risk taken and the expected level of return.

At the more commercial deployment end of the spectrum, finance is usually in the form of regular equity and debt finance, and potentially carbon finance and other related PES. Venture capital funds provide exposure to early-stage technology development to investors who are looking to generate high returns by investing in early-stage companies, who are at the same time willing to take on the additional risk that arises from the likelihood of failure of the new venture. In private equity, the investment is often made in a later-stage company or project that has more mature technology, including pre-IPO (initial public offering) companies, demonstrator companies, or under-performing publicly listed companies (UNEP, 2009).

Public equity and debt investments are relatively lower risk and hence lower return investments, investing in the equity shares or bond issues of established public companies that have the ability to tap capital markets to raise capital for investing in new projects and developing new products. Figure 5.1 provides a visual description of where, and in which form private finance is most needed.

DEFINITION

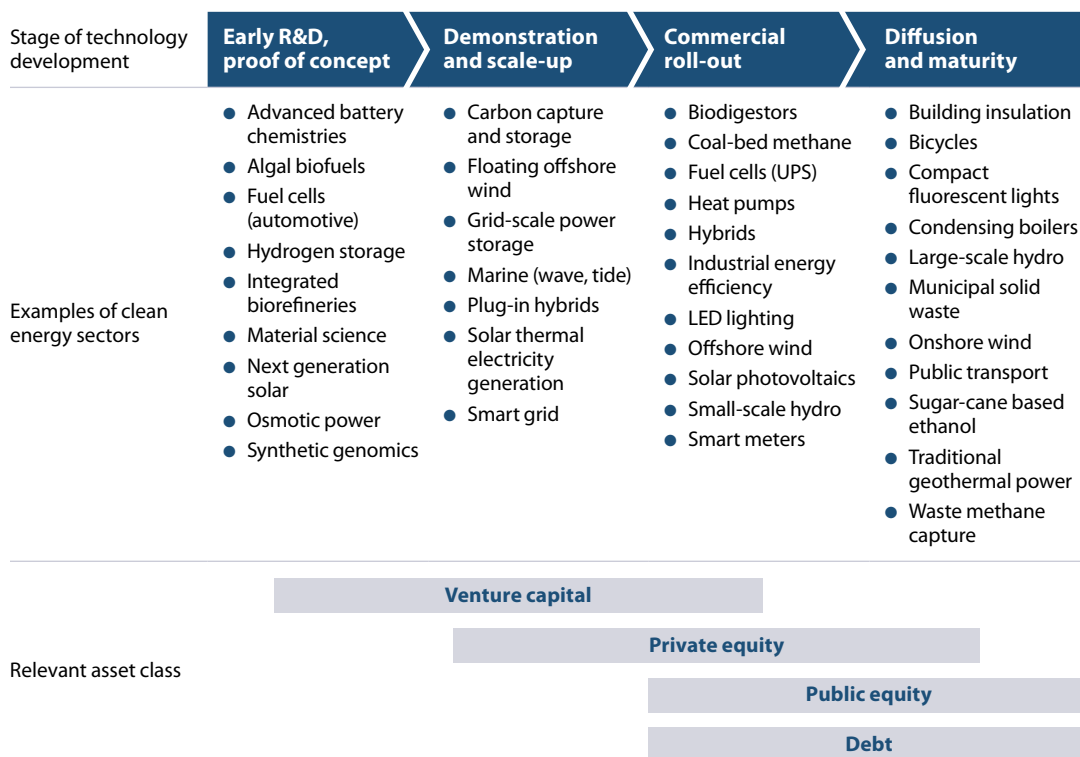
Corporate Finance

Corporate Finance refers to debt provided by banks to companies that have a proven track record, using 'on-balance sheet' assets as collateral. Most mature companies have access to corporate finance, but have limited total debt loads and therefore must rationalise each additional loan with other capital needs.

Table 5.1: Risks/return profiles of different funding sources

Venture Capital	Private Equity	Infrastructure Funds	Pension Funds	Bank Mezzanine Debt	Bank Senior Debt
Start ups, new technology, prototypes	Pre-IPO* companies, demonstrator technology	Proven technology, Private companies	Proven technology	Demonstrator/ proven technology, new companies	Proven technology, established companies
>50% Internal Rate of Return (IRR)	35% IRR	15% IRR	15% IRR	LIBOR* + 700 bps	LIBOR + 300 bps

Source: UNEP (2009). * Initial public offering (IPO); London Interbank Offered Rate (LIBOR).

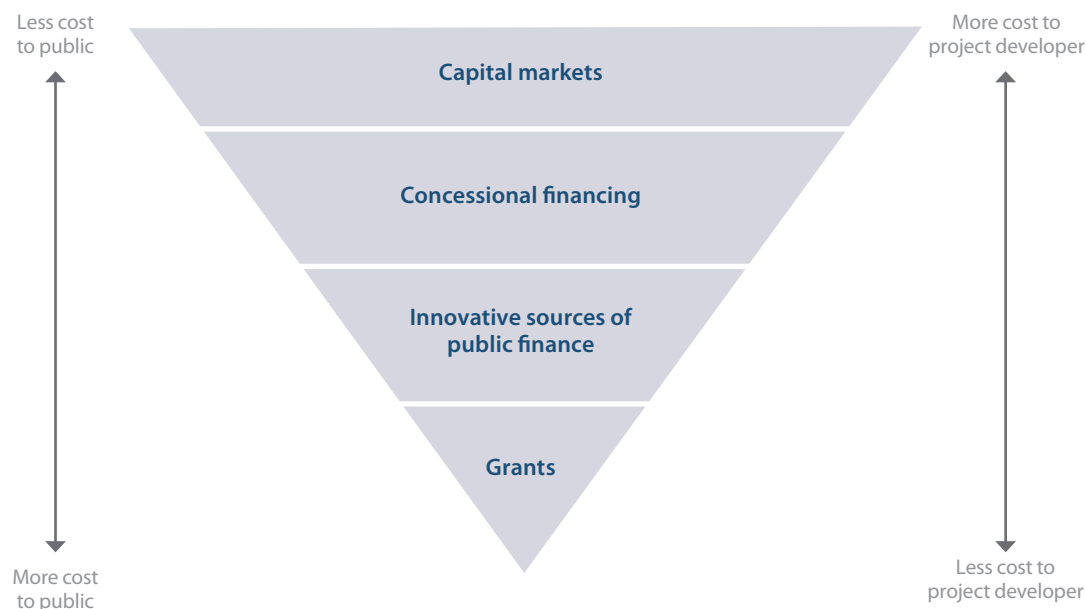
Figure 5.1: Investment vehicles along the clean energy technology life cycle

Source: Adapted from *Green Investing 2010*, World Economic Forum, January 2010.

5.2 Public Financing Optimization Criteria

The emerging public climate architecture is often described as being massively underfunded. As discussed earlier, a number of proposals have recently been put forward regarding the mobilization of resources for climate finance (e.g. the UN AGF Report). However, public funding is expected to remain constrained and fragmented, especially for policy change and skills development efforts, in the coming years. Thus, it is essential to channel these additional resources in the most efficient and effective fashion.

As a general rule, scarce public money should be used to finance issues for which private funds are not readily available — and not to substitute for private finance. Accordingly, a first priority for public finance should be to create conditions that allow markets and private investment flows to address pressing environmental problems (policy change, institutional strengthening, local supply of expertise, etc.).

Figure 5.2: Comparative scarcity of funding sources

A second priority should be to finance the early stages of the clean energy technology life cycle, where high technology risks combined with high country risks can prove a major barrier for private finance in developing countries. Investment needs rise significantly as technologies move up along the innovation chain and limited investment in R&D and demonstration can make a vital difference in catalysing much larger capital for technology commercialization at a later stage.

With the exception of 2009 which benefitted from the effect of a number of green stimulus packages, total public sector budgets for energy RD&D (research, development and demonstration) have declined in real terms over the last 35 years: pre-stimulus nominal levels in 2008 were only slightly above amounts budgeted in 1976. Moreover, the relative share of energy in total RD&D has declined significantly, from 12 percent in 1981 to 4 percent in 2008. In 2008, the last year with detailed data, nuclear fission and fusion attracted around 40 percent of declining public RD&D spending.

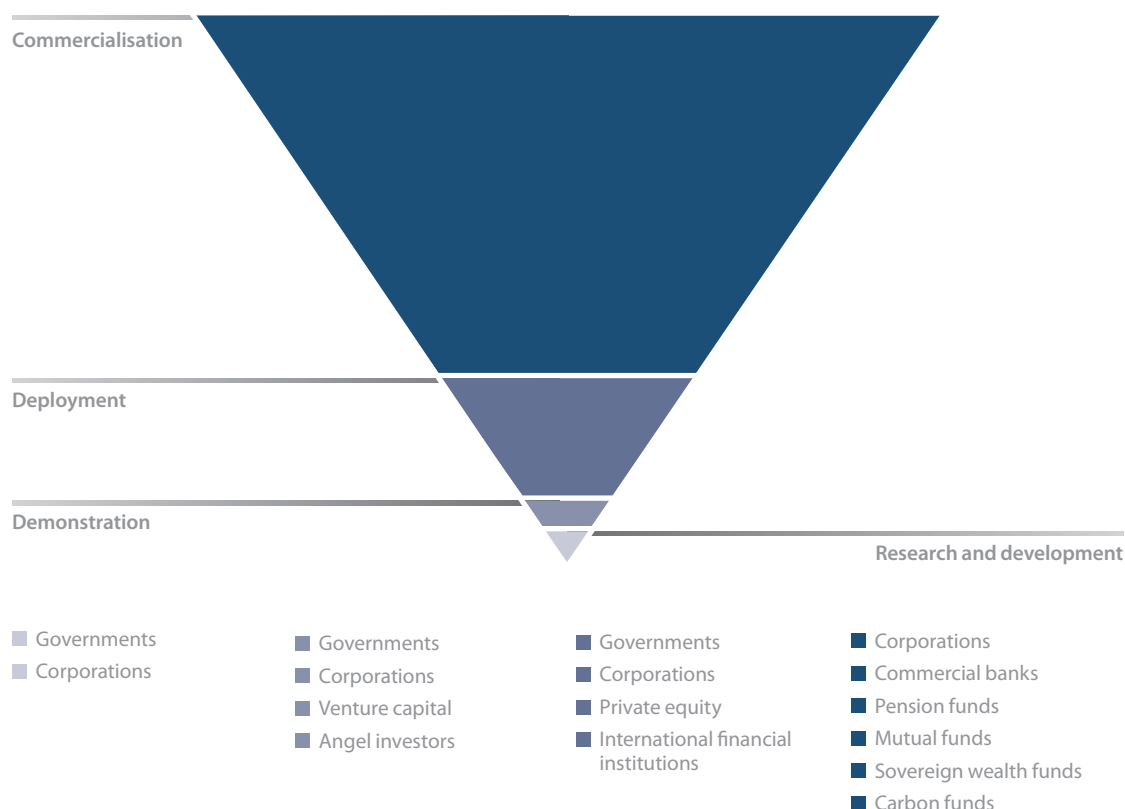
In addition to establishing an enabling environment to catalyse private finance and technology innovation by industry, it will be critical for governments worldwide to step up R&D efforts in clean energy and adaptation technologies to address the challenges of climate change, energy access and energy security.

For clean energy technologies alone, the IEA (2010b) estimates a shortfall between the current \$10 billion in annual public RD&D spending and the \$40 to \$90 billion of investment needed. Half of this investment gap is expected to come from public sources. Therefore, achieving global energy and climate change ambitions will require a two-fold to six-fold increase in public RD&D spending (IEA 2010a and 2010b).

“

... it will be critical for governments worldwide to step up R&D efforts in clean energy and adaptation technologies to address the challenges of climate change, energy access and energy security.

”

Figure 5.3: Funding options for different stages of technology development

Source: Adapted from IEA (2010a, Chapter 14: Finance).

While these general rules for maximizing the use of public finance might sound relatively straightforward compared with the need to tailor different sources of private capital to each technology development stage, this impression could not be further from reality.

Accountability is to public money what the bottom line is to private capital, and each source of international and national public finance is governed by its own set of stringent eligibility criteria. Furthermore, several sources of public finance will usually need to be combined to achieve a given policy objective. In addition, public money will most often need to be tightly blended with private finance through innovative PPPs to bring to scale climate change efforts piloted through stand-alone projects. The following sections will address in further detail these three public finance challenges.

5.3 Public Financing Eligibility Criteria

From a developing country's perspective, the wide differences in eligibility criteria among the numerous international and public domestic funds described in Chapter 4 make it very hard to apply for funding. It is not unusual for developing countries to spend considerable resources applying to sources of public finance that do not match their unique requirements. Additionally, specific delivery processes often slow disbursement. Delays in accessing the public finance component of broader policy-dependent climate change interventions can prove devastating to the entire investment.

Although there is a multitude of climate change funds, only a very limited number of them are likely to be accessible for a given project at a given location. The selection of the most appropriate sources of public finance will depend largely on:

- Country eligibility criteria (e.g. to be eligible for the GEF, countries must be either a World Bank or a UNDP Programme Country)
- Thematic focus (most public funds focus on a limited number of themes/strategic priorities, such as REDD)
- Financing terms (loans vs. debt, co-financing requirements, etc.)
- Delivery mechanisms (disbursement timing, etc.)

To minimize transaction costs associated with accessing individual funding sources, this guidebook recommends thoroughly assessing the eligibility criteria of each prospective fund before preparing an application. Information on the eligibility criteria of the main sources of public climate finance can be found on the UNDP/World Bank website for climate finance (www.climatefinanceoptions.org).

“Accountability is to public money what the bottom line is to private capital...”

Figure 5.4: UNDP/World Bank website on climate finance options



Source: UNDP/World Bank(www.climatefinanceoptions.org)

5.4 Combining and Sequencing Different Sources of Public Climate Finance

“ ... governments throughout the world are enacting policies and developing financial mechanisms to promote energy efficiency in the commercial and public buildings sectors, and to phase out existing energy inefficient and ozone depleting substances (ODS)-consuming HVAC appliances.

Despite the array of public funds and funding mechanisms, the lack of adequate coordination among funds leaves many gaps and overlaps. In most cases, public authorities will need to access and combine several public funding mechanisms to catalyse capital to support specific climate change interventions. The phasing out of energy inefficient and ODS-consuming refrigerators provides one such example.

In many countries, over 40 percent of electricity is consumed by heating, ventilation and air conditioning (HVAC) systems in private and public buildings. Not surprisingly, governments throughout the world are enacting policies and developing financial mechanisms to promote energy efficiency in the commercial and public buildings sectors, and to phase out existing energy inefficient and ozone depleting substances (ODS)-consuming HVAC appliances.

The term ODS refers to the group of chemicals governed by the Montreal Protocol. Ozone depleting substances can also be GHGs, often with global warming potentials (GWPs) many thousands of times more potent than CO₂. These ODS governed by the Montreal Protocol are not eligible in the Kyoto Protocol which governs GHGs. Because the Montreal Protocol only covers the phase-out of ODS production and the Kyoto Protocol expressly excludes the coverage of Montreal Protocol chemicals, no instrument addresses the collection and safe recycling of ODS already in use.

Due to a gap between the Montreal Protocol and the Kyoto Protocol, there is now the potential that over 30 Gt CO₂e of GHGs could be emitted from ODS stockpiles over the next two to three decades. By comparison, the Kyoto Protocol is expected to reduce emissions of approximately 5 Gt CO₂e¹⁰ in the 2008-2012 period. In the absence of a financial mechanism to incentivize the collection and safe disposal of energy inefficient and ODS-consuming appliances, there is a risk that interventions aiming at promoting energy efficient and ODS-free refrigerators would result in the opposite effect. Through increased consumer awareness and the provision of financial incentives such as rebates or zero-interest credits, energy efficiency programmes can successfully encourage the purchase of new energy efficient and ODS-free refrigerators. However, in the absence of incentives to collect and recycle them, old appliances are likely to be kept as secondary systems and actually increase net energy consumption. Ultimately, they will be discarded in landfills, and the ozone-depleting substances with high global warming potential will gradually seep into the atmosphere.

To mitigate this risk, governments will have to access, combine and sequence multiple sources of public and environmental market finance to address the full life cycle of domestic refrigerators. At the refrigerator manufacturing stage, funding from the Multilateral Fund for the Montreal Protocol can assist manufacturers to switch to lower global warming potential refrigerants. At the usage stage, funding from the GEF can help bring about energy efficient market transformation. Third, at the end of a refrigerator's lifetime, funding from voluntary carbon finance or from an innovative financing instrument such as a levy on electricity consumption can be used to cover the costs of financing the recovery and destruction of high global warming refrigerants. Figure 5.5 provides a schematic of the structured public finance used by UNDP to help public authorities in phasing out energy inefficient ODS consuming fridges in several developing countries.

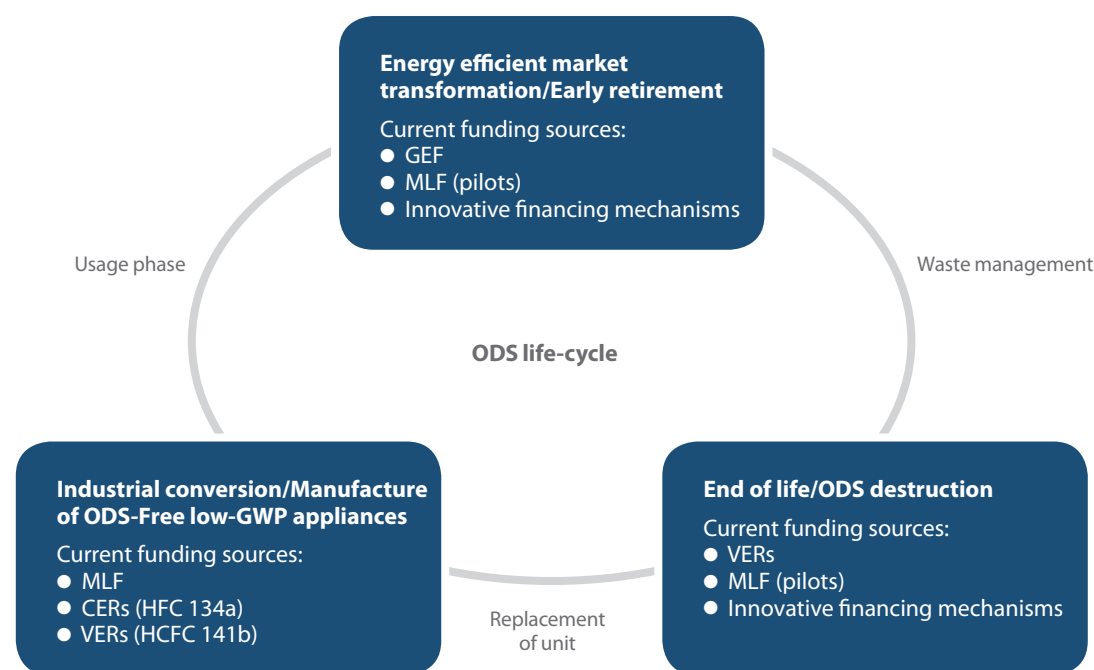
DEFINITION

Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer — adopted in Montreal in 1987, and subsequently adjusted and amended in London (1990), Copenhagen (1992), Vienna (1995), Montreal (1997) and Beijing (1999) — controls the consumption and production of chlorine- and bromine-containing chemicals that destroy stratospheric ozone, such as chlorofluorocarbons, methyl chloroform, carbon tetrachloride, and many others.

¹⁰ Source: UNDP estimate.

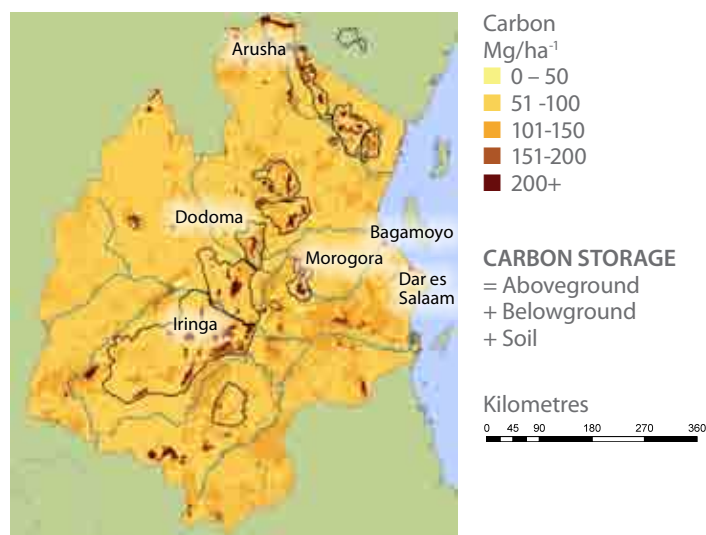
Figure 5.5: Accessing, blending and sequencing different sources of finance to phase out ODS-consuming, energy-inefficient refrigerators



Developing the capacity of policy makers to blend and sequence different sources of public climate finance is also critical to establishing synergies between development, climate and ecosystems finance. For example, protected areas not only play a key role in conserving globally important biodiversity hotspots, but they are also critical for water flow regulation, carbon sequestration, clean water supply, drought and flood risk reduction, provision of timber and non-timber forest products, opportunities for nature-based tourism, and pollination of crops by wild bees and other insects (UNDP, 2010).

The map in Figure 5.6 shows an overlay of carbon-related ecosystem services with Tanzania's protected area network. The carbon storage in protected areas (PAs) is up to 155 tonnes per hectare, compared with 80 tonnes per hectare for unprotected land, and 35 percent of the carbon is stored within protected areas. The global community agreed in Nagoya in October 2010 to increase protected areas from 10 to 17 percent of land surface area by 2020. Integrating development and climate concerns into the new PA strategy would provide a unique opportunity to leverage the extension of protected areas to deliver additional benefits such as climate stabilization, adaptation, risk reduction and socio-economic development. Conversely, it should enable countries to leverage new sources of finance to protect biodiversity.

“Due to a gap between the Montreal Protocol and the Kyoto Protocol, there is now the potential that over 30 Gt CO₂e of GHGs could be emitted from ODS stockpiles over the next two to three decades.

Figure 5.6: Synergy between innovative climate and ecosystem finance

Source: Willcock and Swetnam, *Valuing the Arc*, presented by Prof. P.K.T. Munishi, December 2009. Available from <http://www.valuingthearc.org>.

5.5 Blending and Sequencing Multiple Sources of Public and Private Climate Finance

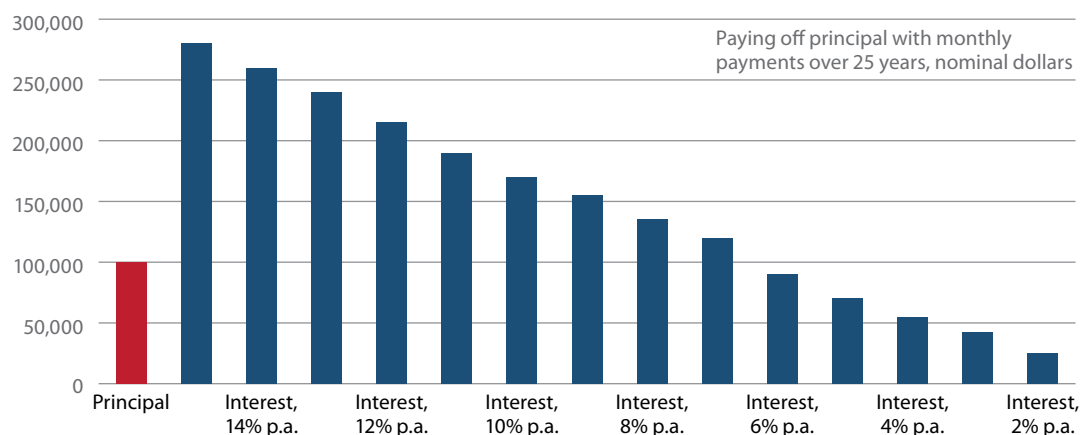
As mentioned in Chapter 4, this guidebook artificially divides climate finance into public climate finance and private climate finance to simplify the review of the wide variety of funding sources. However, climate investment is policy-dependent given the existence of legacy market distortions in favour of fossil fuels. Hence, private and public climate finance are intimately linked and increasingly blended to effect transformational market changes. The past few years have seen the emergence of a number of innovative PPPs to reduce investment risks, optimize the use of both sources of finance and pool public and private sector talents and strategic capabilities. There is increasing recognition among climate finance practitioners that PPPs could hold the key to a rapid scaling-up of climate change management efforts in both industrial and developing countries (e.g. WEF, 2010; Fulton, 2010; UNECE, 2010). There exists a spectrum of different types of PPPs. This section will focus on two key types of PPPs for climate change: PPPs to close the debt gap and PPPs to close the equity gap.

The common objective of these two types of innovative climate change public-private finance mechanisms is to lower the weighted average cost of capital for low-emission climate-resilient investment in developing countries. Figure 5.7 graphically depicts the effect of the interest rate on the proportion of repayments of principal and interest over a period of time that is typical of infrastructure investments. Debt finance for renewable projects in developing countries from local financial institutions is typically in the mid-teens percent per annum compared to about 6 percent in developed countries (Ward, 2010). Over the long-life term of infrastructure investments, the difference in total project costs can be quite substantial. Over 25 years, the total of capital expenditure plus costs of finance would be reduced by 50 percent if the effective interest rate were 6 versus 12 percent. As mentioned in Chapter 2, a key financial barrier for a number of low-emission, climate-resilient investments, such as renewable energy technologies, is the need for substantial upfront investment. Hence, climate investment is particularly sensitive to

“The past few years have seen the emergence of a number of innovative PPPs to reduce investment risks, optimize the use of both sources of finance and pool public and private sector talents and strategic capabilities.”

interest rates and the weighted average cost of capital. The effect of interest rate on the profitability of low-emission climate-resilient investment is such that, ultimately, it is not the cost of the technology that counts, but the cost of its financing.

Figure 5.7: Effect of interest rate on the profitability of green investment



Source: Ward (2010).

To lower the cost of debt financing for clean energy projects in developing countries and economies in transition, a number of multilateral development banks (e.g. the World Bank, the European Investment Bank) have been floating low-cost green bonds leveraging their AAA ratings over the past three years. Typically, these green bonds have had coupon rates of between 2 and 5.23 percent and have been taken up by institutional investors such as pension funds as part of their portfolio allocation to fixed-income products (Ward, 2010).

A number of developing countries have also witnessed the growth of markets for government bonds in recent years. Accordingly, the issuance of public or public-guaranteed ‘green bonds’ could become an additional climate-financing tool in emerging economies. Government guarantees and tax breaks could be used to facilitate the issuance and purchase of such bonds. Brazil, China and India have gained some experience in using both development banks and special lending windows of commercial banks underwritten by government guarantees to channel savings into infrastructure investments that reduce carbon use. Their experience could prove immensely valuable to other emerging economies and developing countries.

In addition to debt financing, projects through IPPs also require equity as a source of finance. Unless the sponsor is a large company or utility, this equity is generally supplied by private equity funds. Until the 2008 financial crisis, the share of equity funding in the project capital structure could be as low as 15 to 20 percent in the most developed markets. The financial and economic crisis has led to the deleveraging of project capital structures and, therefore, a higher proportion of equity is now required, around 30 to 50 percent. This means that hundreds of billions of additional private equity will need to be mobilized annually to support low-emission climate-resilient investments in developing countries in the coming decades. Securing such a large ratio of equity can be a deal-breaker in developed countries. In developing countries, mobilizing such a large share of equity finance can prove an insurmountable barrier.

“

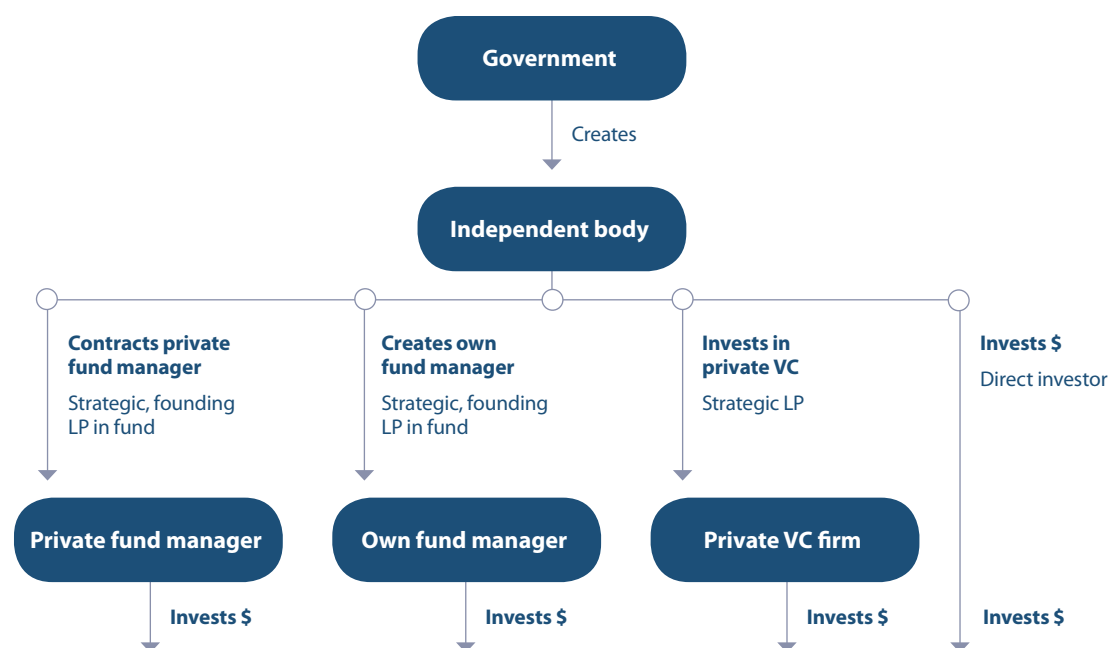
... hundreds of billions of additional private equity will need to be mobilized annually to support low-emission climate-resilient investments in developing countries in the coming decades.

”

Recognizing this constraint, a number of public venture capital institutions are trying to address the equity gap in developing countries, and through public venture capital funds establish a successful track record of investment in local climate technologies and initiatives with the hope of attracting private venture capital in the future. A small group of such public venture capital clean energy funds already exists, mostly in developed countries, with funds under management totaling \$675 million (Crespo, 2008). These funds face a number of challenges, including attracting the talent necessary to make successful investment decisions and securing enough organizational flexibility to operate similarly to a private venture firm. Furthermore, they are also constrained by competing demands on scarce public resources. To address these challenges and maximize the use of public finance, some public venture capital institutions prefer to invest instead in private capital venture organizations as a limited partner or a funding limited partner. Figure 5.8 summarizes the four possible routes available to public institutions to address the equity gap.

A few international development organizations are currently piloting similar public private equity funds to catalyse private equity for low-emission, climate-resilient projects in developing countries. Table 5.2 summarizes the key attributes of the Global Energy Efficiency and Renewable Energy Fund (GEEREF) a public-private equity fund aimed at promoting clean energy investments in developing countries and economies in transition.

Figure 5.8: Public venture capital investment roadmap



Source: Adapted from Crespo (2008)

The Global Energy Efficiency and Renewable Energy Fund was launched by the European Commission (EC) in 2008, and focuses mainly on sub-investments in equity (or quasi-equity) below €10mIn. The European Commission, Germany and Norway have committed about €110m to the GEEREF over the period 2007-2011. The EIB is the fund manager. The Global Energy Efficiency and Renewable Energy Fund is a public private partnership where public investors' shares are subordinated to those held by private investors, with a 'waterfall' mechanism whereby, once the fund is liquidated, the latter will receive their investment plus a certain return before any other distribution to public shareholders. This scheme has been effective in mobilizing capital for new asset classes in developing countries, especially in those regions where perceived risks are a high hurdle to private capital mobilization.

Table 5.2: Key attributes of the global energy efficiency and renewable energy fund

Fund	Date	Amount	Target end-users	TA	Subsidy	DFIs	Website
Global Energy Efficiency and Renewable Energy Fund (GEEREF)	2007	€110 million (target €200 million)	Clean energy investments in developing countries and economies in transition	No	Yes, subordinate equity	Yes: EC (€80 million)	www.eif.org/about/geeref.htm

5.6 || Adopting a Methodology to Select an Optimal Financing Mix

As highlighted in the previous sections, most climate change investments necessitate multiple sources of private and public funds. They can involve lining up multiple investor-types (for example, debt, equity, and mezzanine investors), possibly entering or exiting the investment at different times. While these innovative PPPs have the potential to scale-up climate change investment opportunities, they also add up to considerable execution risk in closing and managing the investment process for a given activity. It is often difficult for private investors to master the timelines and governance requirements of increasingly fragmented public sources of financing. If the public components in an investment package cannot be accessed in a timely manner, this may critically undermine the ability to leverage matching private capital.

The appropriateness of PPPs to scale-up climate management efforts and the optimal mix of mechanisms employed will vary depending on factors such as national economic conditions, target technologies, prior green policy and financial engineering experience.

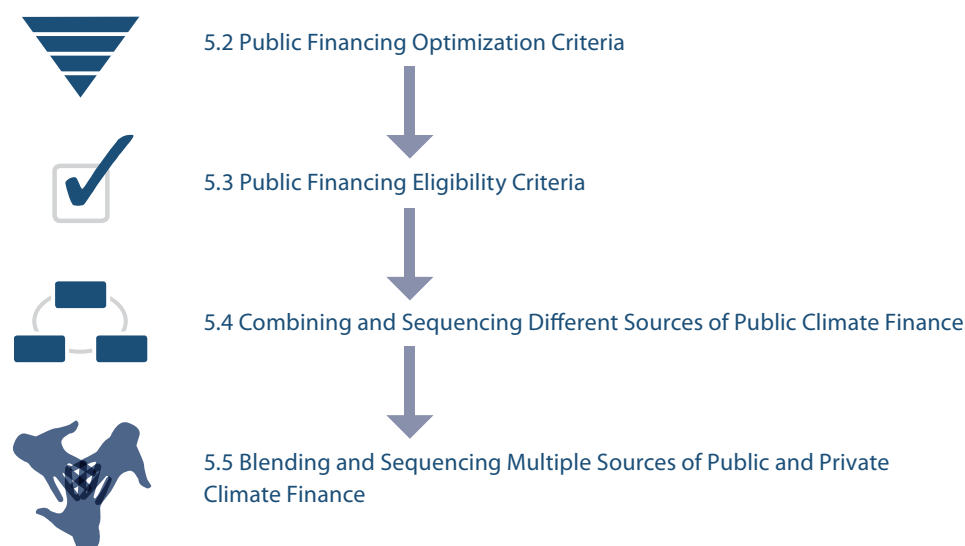
“The appropriateness of PPPs to scale-up climate management efforts and the optimal mix of mechanisms employed will vary depending on factors such as national economic conditions, target technologies, prior green policy and financial engineering experience.”

Chapter 3 presented UNDP’s four-step approach to select an appropriate policy and financing mix to catalyse climate capital (see Section 3.2). In line with this approach, the fourth and final step of the process is to empower policy makers to blend domestic and international, public and private, concessional, and grant resources to finance the design and implementation of the selected mix of public policies to catalyse climate finance. This task can be broken down into the following steps:

- Assess the financing terms and delivery requirements (financing scale, disbursement timing, etc.) of the envisaged public policy measures to support technology development and deployment
- Take into account the constraints of all parties concerned, and notably private investors in public-private partnerships, prioritize possible uses of public funds
- Review country and thematic eligibility criteria to existing relevant international and national public funds
- Identify possible gaps and overlaps in funding sources
- Identify possible cross-sectoral blending of finance to address gaps and minimize overlaps
- If necessary, adjust the mix/sequencing of public policy instruments to address financial constraints

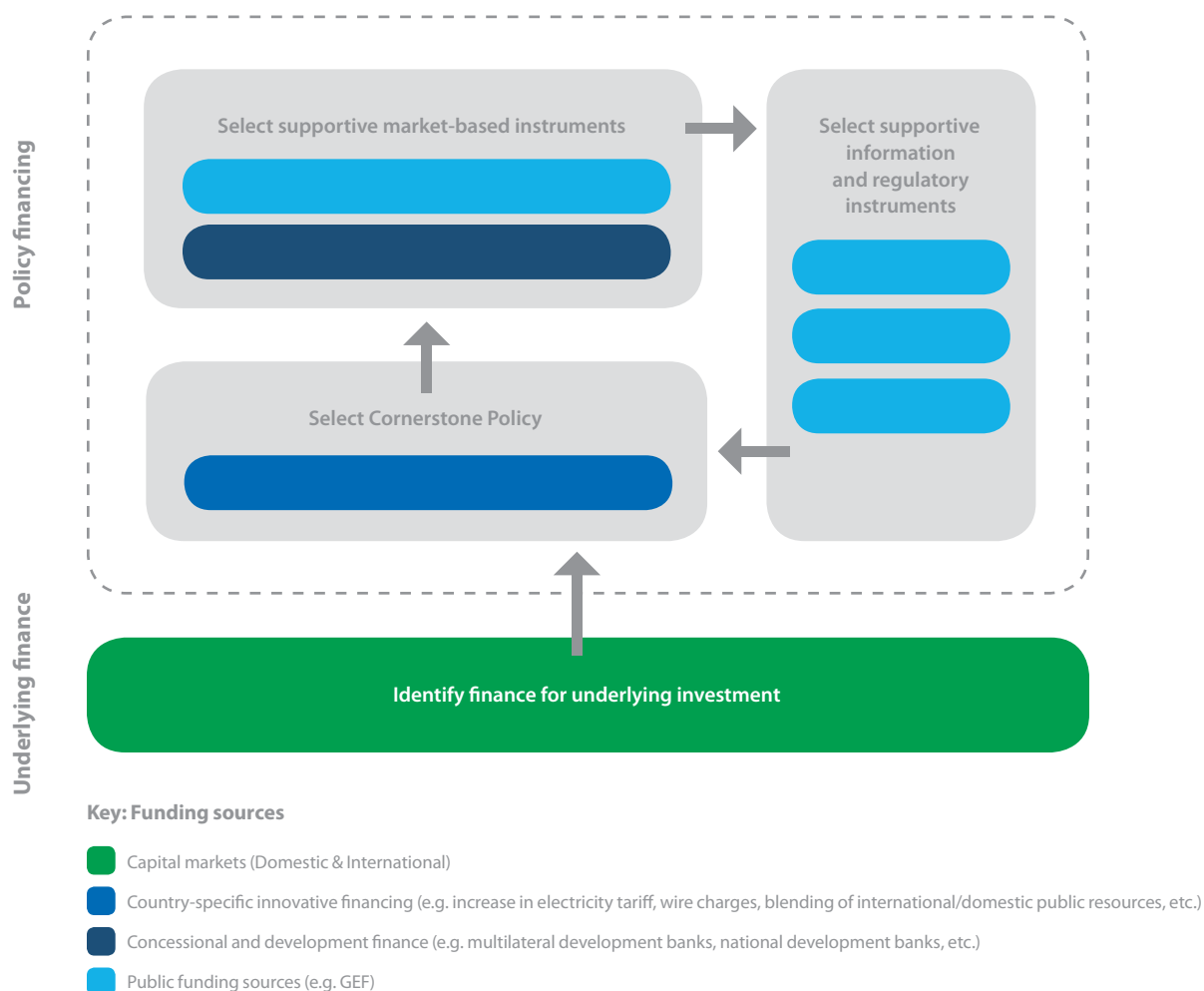
A possible approach to conduct this process is to build on the tool presented in Chapter 3 (see Figure 3.3) to establish a well-crafted suite of complementary policy instruments. Once a possible mix of policy instruments has been selected (cornerstone policy and supporting information, regulatory, and MBIs), the next step is to identify possible sources of funds for each type of policies and the underlying investment projects. As a starting point, criteria given in Section 5.2 to optimize the use of public finance, in Section 5.3 to identify appropriate sources of public funds with respect to their eligibility criteria, in Section 5.4 to combine and sequence different sources of public funds, and in Section 5.5 to blend public and private money, can be used for this exercise.

Figure 5.9: Identifying possible sources of funds for each type of policy



Once this exercise has been conducted for each public policy, the optimal mix of public policy and financing instruments to catalyse finance for a given clean technology can be undertaken as summarized in Figure 5.10.

Figure 5.10: Methodology for selecting an optimal financing mix



As shown in Figure 5.10, a given set of similar public policies, such as supporting MBIs, could be financed from different funding sources.

To illustrate the UNDP framework, the next chapter will present some possible policy and financing mixes for three priority clean energy sectors: renewable energy, energy efficient building and domestic appliances (efficient cook stove), and low-emission vehicles. Further background information on policy and financing options for energy-efficient building can be found in the UNDP toolkit *Policy and Financial Instruments Toolkit for Low-Emission Climate-Resilient Development* (UNDP, 2011a).



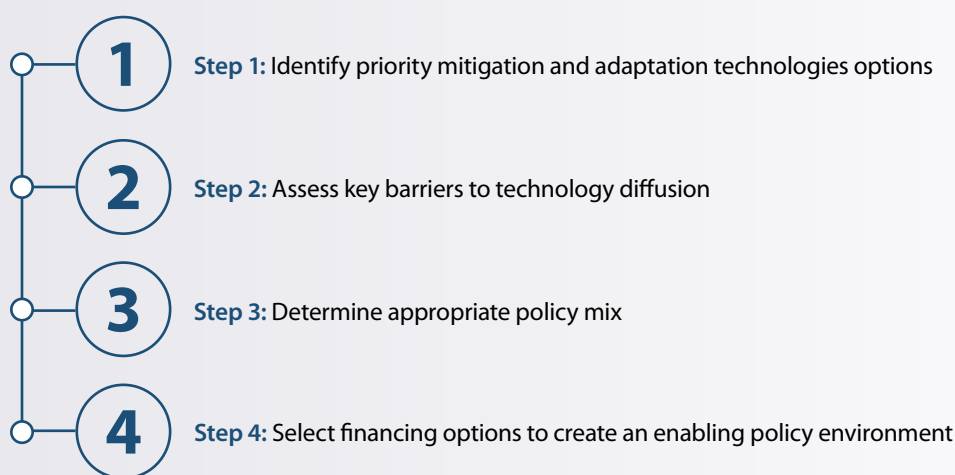
Chapter 6

Applying the Four-Step Methodology to Catalyse Climate Capital

- 6.1 Feed-in Tariffs for Wind Power
 - **Case Study 1:** Feed-in Tariff Law to Scale up Renewable Energy in South Africa
 - **Case Study 2:** FiT Law to Scale up Renewable Energy in Mauritius
- 6.2 Scaled up Distribution of Low Indoor Air Pollution, Efficient Biomass Cookstoves
 - **Case Study 1:** Scaling Up Low Pollution, Efficient Fuel Stoves for Institutions and Medium-Scale Enterprises in Kenya
 - **Case Study 2:** Leveraging Carbon Finance for Low Pollution, Energy-Efficient Stoves
- 6.3 Energy-Efficient Buildings
 - **Case Study 1:** Promoting Low-Cost, Effective Energy-Efficient Building Technologies in a Cold Climate (Mongolia)
 - **Case Study 2:** Renovation of Multifamily Buildings In Bulgaria
- 6.4 Low-Emission Vehicles
 - **Case Study 1:** Commercialization of Electric Three-Wheeler Rickshaws in Sri Lanka
 - **Case Study 2:** Market Development for Fuel Cell Buses In China

6 Applying the Four-Step Methodology to Catalyse Climate Capital

As mentioned in the first chapter of this guidebook, the UNFCCC (2007) and IEA (2009) estimate that about 80 percent of the capital needed to address clean energy issues will come from the private sector — both businesses and consumers. Robins (2010) reaches a similar conclusion and estimates that households will account for around one-third of total capital investments, ranging from 20 percent of investments in solar electricity generation equipment, through 50 percent of investment in energy-efficient building and domestic appliances (modern cooking, energy efficient heating, ventilation and air conditioning equipment, etc.), to 80 percent of capital investment in purchases of low-emission vehicles.



This chapter presents possible policy and finance mixes for four key consumer technologies:

- Feed-in Tariffs for wind power
- Scaled-up distribution of low indoor air pollution, efficient biomass cookstoves
- Energy-Efficient buildings
- Low-Emission vehicles

It applies the UNDP four-step process for selecting policy and financing options to catalyse climate capital for priority climate initiatives introduced in earlier in the guidebook.

6.1 || Feed-in Tariffs for Wind Power



Development is a primary concern for developing countries. The promotion of renewable energy technologies to reduce GHG emissions in absence of a connection to development is unlikely to be a top priority in non-OECD countries. However, there is a positive relationship between development and renewable energy. In fact, unleashing the local potential of renewable energy in developing countries can be a major driver for sustainable growth (Schwarz and Glemarec, 2009).

About 25 percent of the world's population (1.6 billion people) lives without access to electricity (IEA, 2010c). Developing countries in Asia and Africa account for the vast bulk of these populations. Conventional approaches to expanding modern energy access through mostly national grid extensions are failing to reach people living in poor communities; meanwhile, off-grid solutions relying on diesel power produce expensive, low-quality energy, resulting in high levels of CO₂ emissions and imposing greater vulnerability to communities because of fluctuations in oil prices.

Renewable energy, on the other hand, can result in the following positive outcomes:

- Increased access and affordability of energy services for the poor
- Reduced reliance on imported oil
- Increased energy security

Renewable energy also leads to critical adaptation co-benefits. Notably, the development of off-grid renewable energy can enhance the ability of communities to cope with the adverse effects of climate change by reducing indoor and outdoor air pollution and health hazards, as well as time spent gathering fuel. In addition, increased access to electricity enhances children's educational achievements in poor areas through the provision of high quality lighting for studying. Improved lighting also saves on kerosene and battery costs and promotes new income opportunities (food and lodging businesses, etc.), further contributing to poverty reduction and the capacity to adapt to climate change impacts. Collectively, developing countries produce more than half of global renewable energy (REN 21, 2010) (see Figure 6.1).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

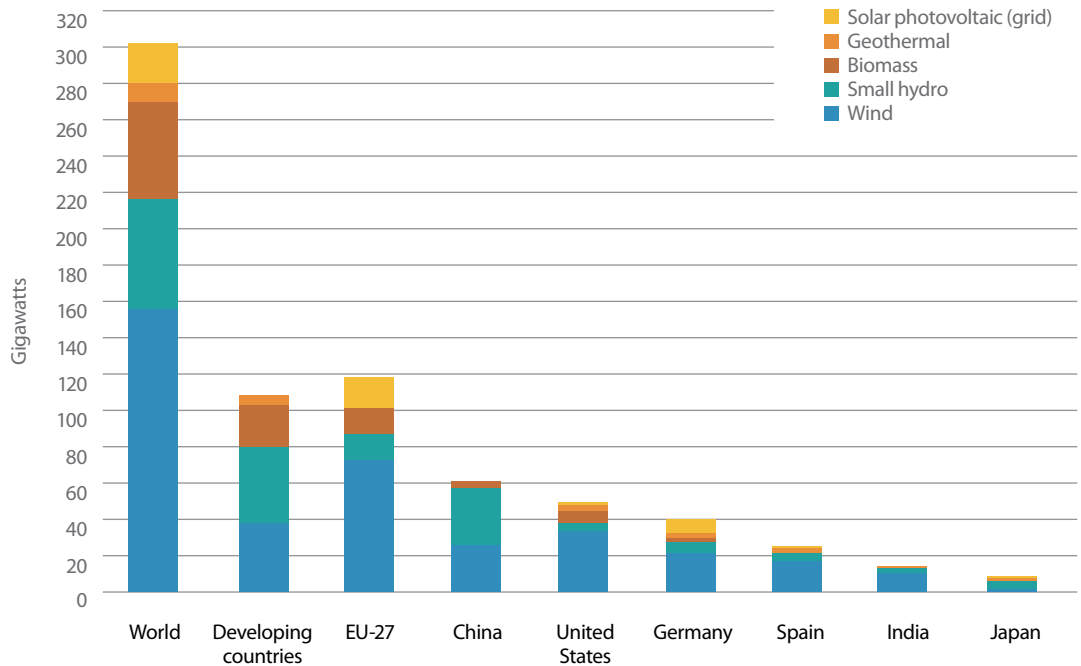
ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Figure 6.1: Renewable power capacities, 2009

Source: REN 21 (2010).

“China now leads in several indicators of wind market growth, while India is fifth worldwide in total existing wind power capacity (REN 21, 2010). Today, wind energy is a proven technology; windy sites can be competitive with conventional sources of electricity.”

Unleashing the potential of local renewable energy resources is likely to become a development priority for most nations, irrespective of their socio-economic conditions. Notably, wind power has become increasingly attractive for the generation of electricity in both developed and developing countries in the last decade. China now leads in several indicators of wind market growth, while India is fifth worldwide in total existing wind power capacity (REN 21, 2010). Today, wind energy is a proven technology; windy sites can be competitive with conventional sources of electricity.

However, experience shows that good wind resources alone are not sufficient to ensure high levels of wind power deployment. Like many renewable energy technologies, wind energy faces a number of interrelated barriers.



Box 6.1 summarizes some of the most common barriers to the development of wind energy in both industrial and developing countries (see Chapter 3, Table 3.3 for overview of types of barriers).

Box 6.1: Most common barriers hindering wind power energy**Institutional**

- A lack of clear administrative procedures for obtaining sitting licences and permits and for selling electricity.

Regulatory

- The absence of an appropriate legal and regulatory framework that (1) allows IPPs, (2) provides for transmission access for renewable resources which can be located away from centres of demand, (3) deregulates electricity rates, and (4) streamlines permitting processes for wind energy sites and provides access to land.

Technical

- A lack of expertise: This is a concern for both methods of site selection and technical aspects of wind power as specialised skills and expertise are required to pre-select sites and plan wind farms.
- Lack of supporting infrastructure and skills relating to installation, operation and maintenance: While international contractors can install wind farms and perform initial maintenance, some minimum level of local equipment (e.g. cranes, transport vehicles) and infrastructure (e.g. good roads for equipment transport) are still required for accomplishing these tasks. Furthermore, specialized technicians will need to carry out the eventual maintenance of the turbines locally over a period of decades.

Financial

- Market risk or uncertainty in future electricity prices: This can affect even cost-competitive projects, as the electricity tariffs that a developer can expect in the future are difficult to accurately predict years in advance.
- Direct and indirect subsidies for conventional fuels and electricity: Public financial support for energy supply and access is used in many countries to reduce consumer energy costs; however such subsidies can put renewables at a comparative disadvantage unless they are carefully structured.
- The scale of upfront costs: Appropriate investors, financing mechanisms and structures are necessary to overcome the relatively high initial investment requirements of wind energy projects.

Source: UNDP (2011a).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

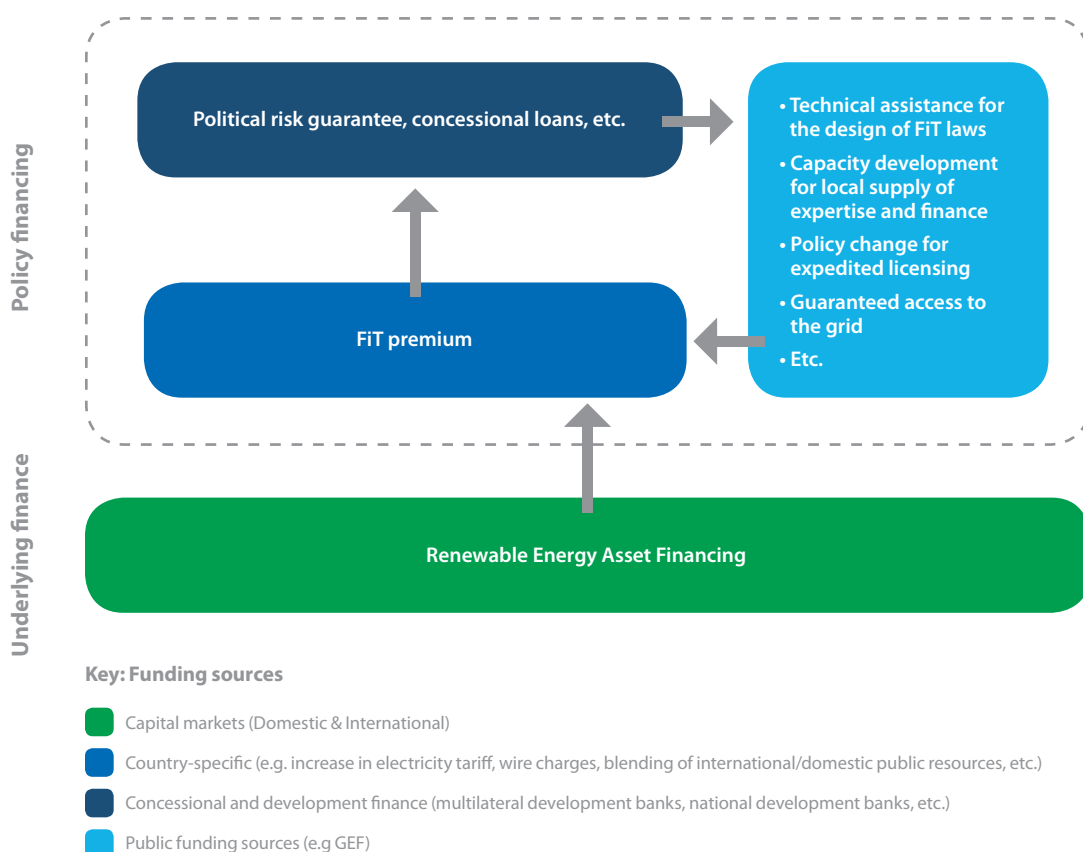
3

The next step requires an evaluation of public policy options to catalyse climate capital and sequence an optimal mix of policies. This exercise should take into consideration the viewpoints of both investors and taxpayers. In doing so, the results will provide a more holistic view of viable options and will allow for the approval of all parties.

At least 83 countries have some type of policy to promote renewable power generation. The most common policy is the feed-in tariffs (FiT). In recent years, many countries and regions have enacted this policy; by early 2010, at least 50 countries and 25 states/provinces had FiTs, more than half of these adopted since 2005 (REN 21, 2010). Given the strong momentum for FiTs around the world, both at the national and state/provincial level, this policy is used in the following example to illustrate Step 3 of the UNDP framework for catalysing climate capital. In this case, FiT is an example of the cornerstone policy for a wind power development scenario.

Figure 6.2 illustrates a possible mix of public policies and funding sources to support renewable energy centered on a FiT (as mentioned earlier, FiTs provide guaranteed access to the grid at a premium price for renewable energy, often over a period of 15 to 25 years).

Figure 6.2: Policy and financing mix to promote wind power in developing countries



Source: Fulton (2011).

Experience shows that even well designed FiTs cannot catalyse large investment for renewable energy in the absence of complementary information, regulatory and market-based instruments.

Lack of information and an inadequate supply of technical skills are significant barriers to RE generation activities in developing countries. One cannot regulate or participate in an industry without first understanding its opportunities and limitations. Administrative procedures to develop RE projects and allow for the sale of their electricity should be clear, simple and efficient. Independent power producers should be able to obtain sitting licenses and permits within a reasonable time period.

The governing legal framework should also be clear and enforceable. Uncertainties regarding land-title rights to a proposed RE project site may deter project activities. The same is true of intangible property rights because technology suppliers seek to protect their intellectual property rights when licensing new technologies. Furthermore, investors, technology suppliers and other actors want the safeguard of an impartial judicial system that will enforce contracts in the event of breaches. As mentioned in Box 6.1, adequate supply of local technical expertise must also be available to design, construct, operate and maintain renewable energy plants, as relying on international manpower is simply too expensive for RE proponents (particularly given that many RE projects already face high upfront capital costs).

Depending on the unique requirements of each location, a number of targeted policy changes and institutional and regulatory strengthening programmes might be required to complement the FiT law and to reduce policy, administrative, regulatory and technical risks. Additional financial instruments such as country risk guarantees might be needed to further reduce risks for domestic and international investors.

4 In accordance with the prioritization criteria for public finance discussed in the preceding chapter, national and international public grants are appropriate to fund information and regulatory instruments aimed at removing administrative and regulatory barriers, creating enabling environments and designing FiTs. The GEF has been a major source of international finance for such barrier removal efforts over the past 20 years.

Complementary financial instruments to reduce investment risks (guarantees, etc.) can be covered by international and domestic concessional financing. Multilateral, bilateral and national development banks, as well as some export credit agencies, are the main source of concessional finance to support such efforts.

As discussed in Chapter 5, scarce public finance should not be used to substitute for private finance, and the bulk of asset financing for the underlying investment projects should come from the private sector. However, additional concessional finance (soft credits) may need to be raised and innovative public-private finance mechanisms (green bonds, public-private equity funds, etc.) may need to be established to reduce investment risks and attract private capital at scale in developing countries.

Funding sources for the RE price premium (the guaranteed FiTs over a long period of time) will vary depending on country conditions and can include a blend of hybrid and innovative sources such as public, private, international and domestic funding. For example, the RE price premium could be directly financed from an increase in electricity tariffs spread over all electricity consumers; an innovative financing

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“
Complementary
financial instruments
to reduce investment
risks (guarantees, etc.)
can be covered
by international
and domestic
concessional
financing.
”

instrument, such as a wire charge or a tax on oil production; the phase-out and recycling of obsolete fossil fuel subsidies; carbon finance; a blending of international and domestic budget contribution; or a combination of all of the above.

While a detailed discussion of each of these financial options goes beyond the scope of this guidebook, further discussion on carbon finance might be useful. With only limited public financial resources available for renewables, carbon finance (essentially CDM in developing countries) has been playing an increasingly important role in promoting wind power over the past few years. The additional revenue stream from carbon finance is not always sufficient to ensure the profitability of projects. As highlighted by Schwarz (2008), a FiT is the easiest market access policy to combine with carbon revenues. Under the current CDM regulations, FiT does not alter the CDM project eligibility and will not negatively influence potential investors seeking to generate CERs (World Future Council, 2009).

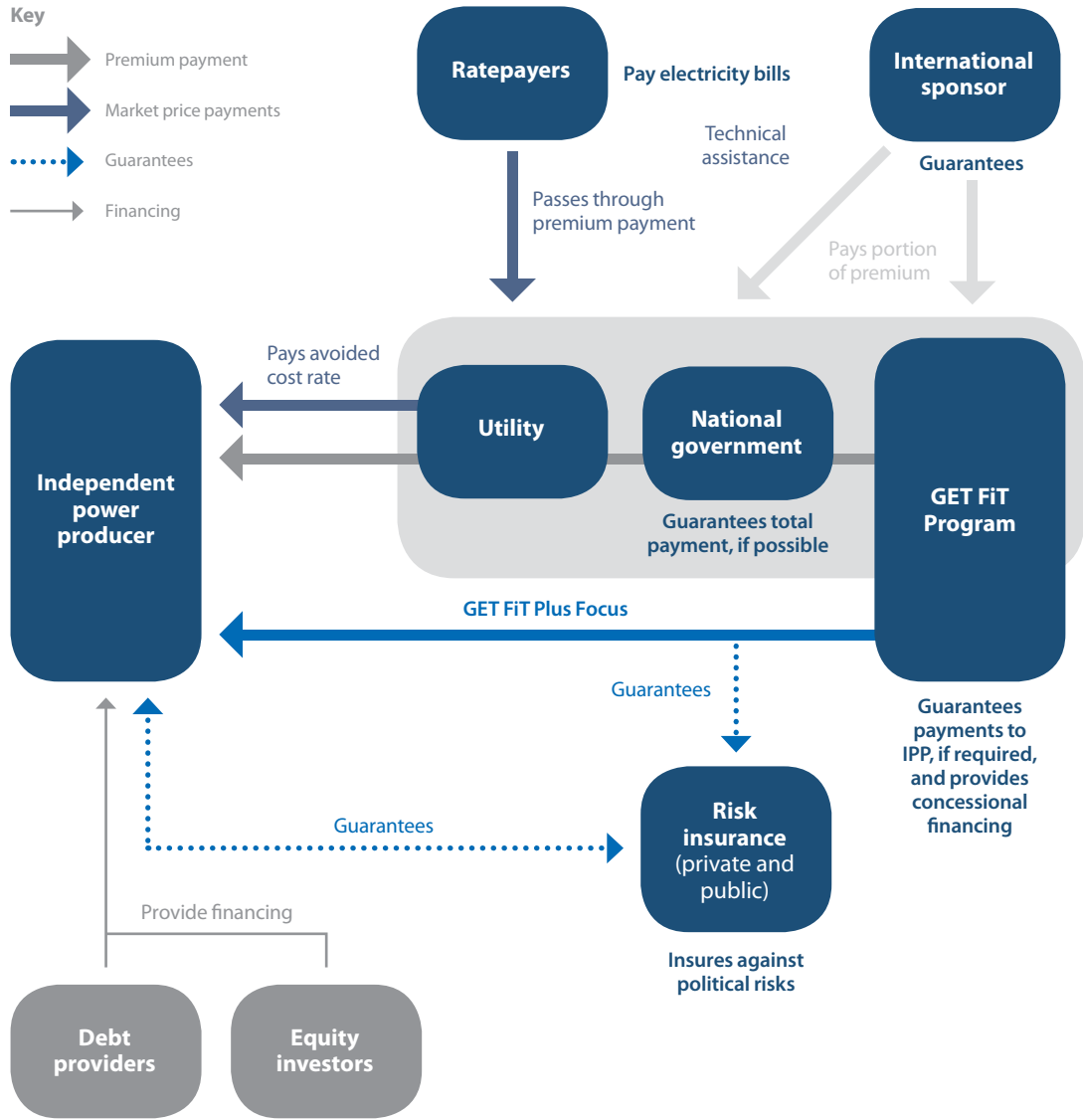
“Funding sources for the RE price premium (the guaranteed feed-in tariffs over a long period of time) will vary depending on country conditions and can include a blend of hybrid and innovative sources such as public, private, international and domestic funding.”

A FiT can be set up with tariffs a little below the required level for the project to be profitable and still generate projects if project proponents can make up the revenues they are missing because of lower tariffs from sales of carbon credits. The drawback in such cases is that only projects that can go through the CDM process can be implemented in developing countries. Countries with a very large wind energy potential, such as South Africa, China, India, Morocco, would need several hundred projects to reach their wind energy development objectives.

A key challenge to leveraging carbon finance and FiTs to scale up wind power in countries with very large wind energy potential will be to develop schemes that do not require a project-by-project review. The Global Energy Transfer Feed-in Tariffs Programme (GET FiT) is a good illustration of a new generation of sectoral public-private partnership proposals. Figure 6.3 summarizes the GET FiT structure.

GET FiT was first conceived by Deutsche Bank Climate Change Advisors (DBCCA) in early 2010 to drive renewable energy investment in the developing world through the creation of new international PPPs. Recognizing the success of FiTs to scale up renewable energy in industrial countries, GET FiT is a global partnership aimed at scaling up renewable energy in developing countries through the development and implementation of FiT laws as well as their associated complementary policies, to reduce investment risks for institutional equity investors and asset financiers.

Figure 6.3: The GET FiT model



Source: Adapted from Fulton (2010).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

The types of support envisioned under GET FiT include a combination of public and private money. Public money will be used for technical assistance to address behavioural, technical and regulatory barriers. In addition, it will pay for financial risk mitigation instruments, such as international guarantees and insurance, to create a comprehensive enabling environment for cost-effective private investment in RE in developing countries. As discussed above, a key issue will be to select the most appropriate funding source(s) to finance the price premium.

The establishment of efficient and cost-effective FiTs requires relatively strong clean energy policy design and enforcement capacity, as well as fairly well developed domestic financial markets. However, there is a huge array of policy options to promote renewables in developing countries, and a number of alternative cornerstone policies that can be selected to meet the unique requirements of each country. As recommended by DBCCA (Fulton, 2010), individual PPAs could prove a more appropriate cornerstone policy than FiTs in countries that have not established an appropriate track record with renewable energy yet. The required supporting policies are likely to be similar to those appropriate for FiT, and PPAs could lay the foundations to establish full fledged FiTs.

Feed-in tariffs can also be used to encourage decentralized power production and off-grid renewable energy. Most homeowners do not have the resources to purchase their own small-scale wind turbine, or to invest in a community energy project. In countries with mature capital markets, the secured income from tariff payments allows people with limited disposable cash to get a loan from the bank in order to buy a wind power system (Mendonca, Jacobs and Sovacol, 2010). In countries with nascent capital markets, partial upfront investment grants and state-guaranteed concessional financing could be explored as incentives for private investment in mini-grids. Further background information on policy and financing options for wind power can be found in the UNDP toolkit *Policy and Financial Instruments for Low-Emission Climate-Resilient Development* (UNDP, 2011a).

Case Studies: Feed-in Tariffs

Case Study 1: Feed-in-Tariff Law to Scale Up Renewable Energy in South Africa

The South African Wind Energy Programme is a multi-year technical assistance project, implemented by UNDP and co-financed by GEF, which is supporting the Government of South Africa in promoting the large-scale commercialization of wind energy.

The Wind Energy Programme supported Government officials on a range of issues related to wind energy (e.g. connection to the grid, licensing and PPAs, etc.), as well as a first-of-its-kind IPP demonstration project, the 5.2 MW Darling Wind Farm. This demonstration project used a premium pricing model and entered into a 20-year power purchase agreement with the City of Cape Town, for which a UNDP-established, GEF-funded \$5.0 million Green Power Guarantee Fund was instrumental. The Programme has been a key contributor to South Africa's national REFIT (Renewable Energy Feed-in Tariffs) framework announced in 2009. Eskom, the State-owned utility coordinating IPP interactions, has currently received in excess of 3 GW of advanced stage wind farm grid connection applications. The South African Wind Energy Association estimates that approximately 5 GW could be commissioned by 2015. In indicative dollar terms, every 1 GW of newly installed wind energy typically amounts to between \$1.5 billion and \$2 billion in capital investments.

The South Africa Wind Energy Programme is an example of the importance of upstream technical assistance to put in place an optimal mix of policy and financial mechanisms which are tailored to each country's unique market status and macroeconomic conditions. The result is a risk/reward profile that attracts developers and investors at scale. Key to this scaling up is a shift from project-based to sector-wide approaches, such as the national REFIT. The next step in this shift is to identify new sources of financing, national or international, for example, nationally appropriate mitigation actions (NAMAs) or green bonds, which can provide transitional or long-term funding for such sector-wide incentives.

Source: United Nations Secretariat (2010).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Case Study 2: FiT Law to Scale Up Renewable Energy in Mauritius

The Government of Mauritius has the long-term vision of transforming Mauritius into a sustainable island. One important element toward the achievement of this vision is to increase the country's usage of renewable energy, and promote energy efficiency measures to reduce dependence on fossil fuels and achieve energy security. In 2007/2008, the price of oil rose significantly from around \$40 a barrel several years earlier to reach a peak of \$147 a barrel, and the petroleum import bill increased from Rs 6.5 billion in 2000 to around Rs 25 billion in 2008. As a country that relies on imports for around 80 percent of its energy, the Government of Mauritius reviewed its strategies and placed primary focus on building an attractive, modern, inclusive, green, open Mauritius. This included the adoption of the Long-Term Energy Strategy 2009-2025, which seeks to diversify the country's energy supply by improving energy efficiency and modernizing the energy infrastructure. Among other targets, the strategy sets a target to increase the renewable energy share to 35% by 2025.

UNDP is supporting the Government of Mauritius to implement these national strategies through a mix of assistance for the enactment of several critical policies and institutional structures, together with targeted initiatives to facilitate investments in renewable energy (RE) and energy efficiency (EE) measures at the community and household levels. The UNDP/GEF-funded Removal of Barriers to Energy Efficiency and Energy Conservation in Buildings project has been instrumental in developing the grid code and piloting a FiT scheme for small-scale RE-distributed generation, which was launched in late 2010 and 80 percent subscribed within the first six months. This pilot project is expected to lay the foundation for a follow-up FiT for on-grid, utility-scale systems. In preparation for this next phase, UNDP's Millennium Development Group Carbon Facility has supported a clean development mechanism (CDM) scoping study for renewable energy; and the development of a CDM project for a 25 MW Wind Farm at Britannia.

Source: Black (2011).

6.2 || Scaled-Up Distribution of Low Indoor Pollution, Efficient Biomass Stoves

Today, 2.7 billion people around the world rely on biomass for cooking. In the absence of additional policies, this number is projected to rise to 2.8 billion in 2030 (IEA, 2010c). Lack of access to clean cooking facilities is a serious barrier to social and economic development. The World Health Organization (WHO, 2008) estimates that more than 1.45 million people die prematurely each year from household air pollution due to inefficient biomass combustion. Using WHO estimates, the IEA (2010c) project that household air pollution from the use of biomass in inefficient stoves would lead to over 1.5 million premature deaths per year in 2030, greater than estimates for premature deaths from malaria, tuberculosis or HIV.

1 Traditional combustion in an open fire or simple stove emits substantial products of incomplete combustion, including methane, carbon monoxide and non-methane organic compounds. These emissions result in pollution levels inside households and institutions cooking with biomass that are often many times higher than typical outdoor levels, even those in highly polluted cities. This situation could be significantly improved through the adoption of energy-efficient and less-polluting technologies. Complete combustion of biomass produces little more than CO₂ and water; and when effectively installed and utilized, modern stoves fitted with a chimney eliminate smoke. Improved wood-burning cookstoves also reduce the average daily suspended particulate matter emission concentration during burning time by about 50 percent (Ezzati and others, 2000). They result in cleaner kitchens and better cooked meals that are reported to taste better than those cooked on traditional cookstoves (Matiru and Schaffler, 2011).

Energy efficient cookstoves can also play a key role in climate change mitigation and adaptation. They reduce the emission of GHGs while enhancing the ability of communities to cope with the adverse effects of climate change in the following ways:

- Improving respiratory and general health
- Reducing time spent cooking and gathering fuel
- Reducing fuel costs
- Increasing school enrollment rates for girls who have had the responsibility of cooking and fetching fuel wood
- Reducing unsustainable harvesting of biomass and more climate resilient ecosystems
- Increasing time for people to engage in productive activities that help to generate income and reduce poverty

Accordingly, improved fuel stoves for institutions and households are likely to be a priority mitigation and adaptation activity in all countries relying on biomass for cooking.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“The World Health Organization (WHO, 2008) estimates that more than 1.45 million people die prematurely each year from household air pollution due to inefficient biomass combustion.”

2

Despite the multiple development and climate benefits associated with efficient stoves, universal access to modern cooking facilities is hampered by a number of informational, behavioural, technical, institutional and financial barriers. Box 6.2 summarizes some of the most common barriers to the dissemination of efficient stoves.

“Despite the multiple development and climate benefits associated with efficient stoves, universal access to modern cooking facilities is hampered by a number of informational, behavioural, technical, institutional and financial barriers.”

Box 6.2: Most common barriers to the dissemination of efficient stoves

Behavioural

- **Limited awareness about the benefits of efficient stoves:** There is a strong behavioural inertia associated with cooking and heating habits and adoption rates can be low, even when devices are provided free of charge. This may be due to the absence of appropriate marketing campaigns. Although biomass energy use is set to increase in the coming two decades and is often a superior solution in terms of energy access, security and sustainability, it is usually perceived as a backward source of energy. Very few developing countries (11 in 2009) have set up targets for improved stoves (WHO and UNDP, 2009).

Institutional

- **Limited capacity of financial institutions to support efficient stoves:** Currently, only a few financial institutions have the capacity to design, market-test and distribute appropriate financing schemes for efficient stoves to a low-income, dispersed clientele.

Regulatory

- **Lack of supportive policy frameworks:** Targeted national and provincial policies are necessary to encourage efficient stoves.
- **Lack of standards for improved stoves:** In the absence of standards for improved stoves, cheap but sub-standard imitations of improved stoves can flood the market and, ultimately, hamper the commercialization by failing to deliver the expected performance gains.

Technical

- **Lack of supporting infrastructure and skills:** This is a particular issue with the installation, operation and maintenance of efficient stoves, which are compatible with household-specific cooking and heating habits, food preferences and domestic architecture.

Financial

- **Upfront costs:** Investment costs for efficient stoves fall on consumers (households and institutions); upfront costs are a major barrier to the adoption of efficient stoves, and appropriate financing mechanisms and structures are required to meet the upfront costs.

3

The severity of these different barriers will vary with locations, cooking technologies and consumer groups; however, they are all likely to be present in one form or another in most situations. Programmes aimed at scaling up the use of efficient stoves by households and institutions (hospitals, schools, etc.) will need to address these barriers in an integrated manner.

Six principal models exist to provide upfront costs, depending on the maturity of the banking sector and the socio-economic conditions of the targeted beneficiaries:

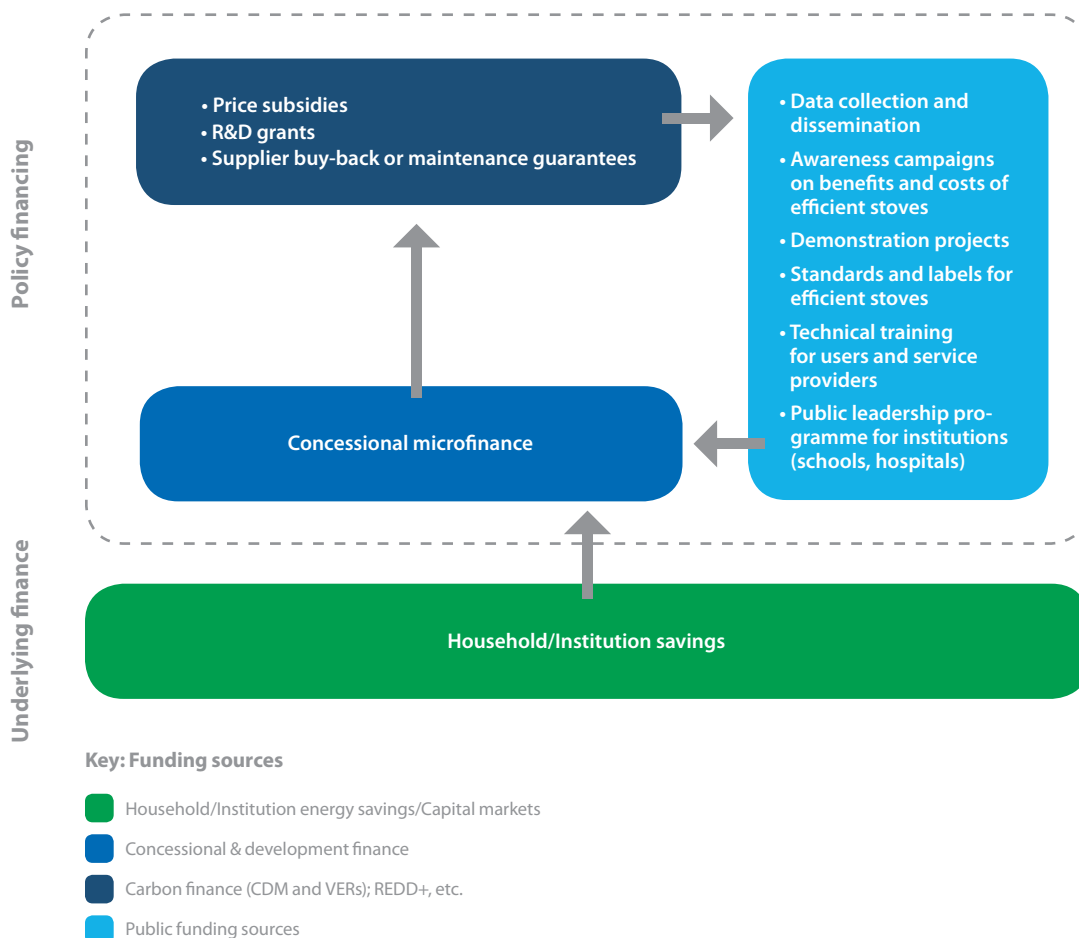
- Dealer/supplier credit-based sales
- Consumer credit through commercial banks

- Consumer credit through MFIs
- Fee-for-service model where the equipment remains the property of the service provider
- Public sector-operated revolving fund credit scheme
- Direct grant

In most developing countries, consumer credit through MFIs could be the most appropriate solution in the near future. Supplier credits tend to be limited by the lack of specific lending expertise of energy service companies, while financing solutions through conventional banks are hampered by the high transaction costs of delivering financial services to distant, dispersed communities and the very small margins on micro-loans (UNCDF, 2011).

Figure 6.4 illustrates a possible mix of public policies and funding sources to overcome barriers and support energy efficient stoves. Given the increasing use of MFIs to provide distributed clean energy, this example uses concessional credit through microfinance as the cornerstone policy to remove the barrier posed by high upfront costs to households and institutions.

Figure 6.4: Selecting an optimal policy and financing mix for efficient fuel stoves



STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“
In most developing countries, consumer credit through MFIs could be the most appropriate solution in the near future.
”

While the price and payment terms are important factors, experience shows that even well designed financing schemes will not be enough to promote wide adoption of efficient stoves. A number of complementary informational, regulatory and market-based instruments will be required to achieve success. Adequate demand for promoted cooking technologies is a pre-condition for success. In the absence of targeted public information and marketing campaigns about the health and socio-economic benefits of efficient stoves, household demand may be low and may limit dissemination efforts.

Community demand will also depend on the performance of the stoves and follow-up technical-support activities to fix and maintain failing stoves. Research and development grants might be required to cover the costs of research, product design and market-testing of cooking devices that are suited to the unique household cooking and heating requirements of each location. Communities in which people prefer to squat for cooking will require different cookstove designs than communities in which people cook standing up. In cold localities, combining cooking and heating systems will accelerate adoption of efficient stoves (see overview of cookstove designs in the case study at the end of this section).

Quality control will also play a critical role in the adoption of efficient stoves by communities. Sub-standard stoves performing below people's expectations will cause a general decline in cookstove reputation and demand for efficient cooking technologies. In addition, they may cause loan defaults in instances where systems were acquired through consumer credit, which could discourage finance institutions from entering the cookstove market. However, public policies can assist in reducing technological risks by establishing some standards and regulating the quality of the stoves produced. Supplier buy-back or maintenance guarantees for large systems (e.g. improved stoves for institutions) can also reduce the risk of technological failure.

“
In the absence of
targeted public
information and
marketing campaigns
about the health and
socio-economic benefits
of efficient stoves,
household demand may
be low and may limit
dissemination efforts.



4 End users should expect to bear part of or the full cost of efficient stoves in mature microfinance markets. Given the limited availability of public finance and its critical role in financing an enabling information and regulatory environment, it is essential to promote end-user investment in efficient stoves. A key objective of market transformation efforts to disseminate efficient stoves should be to encourage MFIs to enter this market and provide consumer credits to meet the upfront costs of efficient stoves. Development banks could capitalize such an expansion by providing concessional finance to MFIs for clean energy development.

”
However, some marginalized communities will not be able to afford these stoves, even when provided with credit. For these communities, access to low indoor pollution and energy efficient stoves will require subsidizing the production cost of the stoves. The broader objectives of environmental conservation and the socio-economic benefits of the stoves provide a strong rationale for grant incentives to very low-income households.

Efforts are ongoing to leverage carbon finance to support such grant schemes. Improved cookstoves save 50 to 70 percent on fuel compared to traditional stoves (Brinkmann and Klingshirn, 2005; Gibbons, Sai and Vuong, 2009; Limmeechokchaia and Chawana, 2006). In places where non-renewable biomass or fossil fuel (e.g. coal in South Africa) is used for cooking, improved stoves can significantly reduce CO₂ emissions (1 tonne of CO₂ per year, as a conservative first estimate). In such cases, carbon finance (CDM and voluntary carbon offsets) could constitute an additional source of revenue, could be used as a production subsidy and, as a result, could lower retail price to below the cost of production.

However, stoves vary widely in their ability to reduce GHG emissions because of differences in types of fuel, stove technology, and household usage. The need to comply with rigid CDM emission-reduction monitoring and verification for a wide range of efficient stoves used in a variety of conditions can make the transaction costs of CDM projects prohibitively expensive. The creation of Programmes of Activities (PoAs), which enable multiple CDM projects to be included under a policy or programmatic umbrella, could prove to be a more promising option to scale up improved cookstoves with lower GHG emissions. Large programmes, however, might remain at odds with the need to customize cooking devices for meeting the needs of a heterogeneous clientele (Simon, Bumpus and Mann, 2010). A solution to overcome this barrier is to focus PoAs on relatively standardized fuel-efficient stoves for institutions (see case studies at the end of this section).

REDD+ financing (see Chapter 4, Section 4.3 on environmental finance markets) could become an alternative source of finance for efficient stoves. Although the scope and financing of REDD+ is still being negotiated under the UNFCCC, REDD+ is increasingly understood as a way to launch developing countries onto sustainable development paths that are not carbon-intensive. If deforestation and the resulting GHG emissions are driven by demand for charcoal or fuel wood, REDD+ payments could be used to reduce this demand and gradually substitute these energy sources with renewable energies. In contrast to existing carbon markets, REDD+ payments will likely depend on the overall performance of programme countries in reducing deforestation and forest degradation, and not on the performance of individual efficient stoves. Due to the decoupling of REDD+ investments and payments, this new source of finance could support efficient stoves in a cost-effective manner.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Case Studies: Fuel-Efficient Cookstoves

Case Study 1: Scaling Up Low-Pollution, Fuel-Efficient Stoves for Institutions and Medium-Scale Enterprises in Kenya

Over 95 percent of about 20,000 institutions (schools, colleges, hospitals) in Kenya use fuelwood as the main source of energy for cooking and heating. In 1996, with support from GEF's Small Grants Programme (SGP) implemented by UNDP, the Renewable Energy Technology Assistance Program (RETAP) was established to assist 20 schools in Mt. Kenya with planting wood lots in their schools and installing energy-efficient stoves in their kitchens. Each school used on average 160 tonnes of non-renewable wood per year. A revolving credit fund was successfully established (with \$50,000 from SGP) to facilitate the purchase of the stoves, with loan repayments made within two years from the savings on firewood purchases.

Based on the success of the SGP pilot, the UNDP/GEF-funded programme **Market Transformation for Efficient Biomass Stoves for Institutions and Medium-Scale Enterprises** in Kenya was implemented from 2007 to 2010 with funding of \$1 million (including an additional \$200K for the revolving fund). Over a four-year period, the project sold and installed approximately 1,500 institutional stoves to more than 1,000 schools, small and medium enterprises (and households, and planted 500,000 trees. The revolving credit facility has expanded by four-fold and Rural Technology Enterprise (RTE) was spun-off as a private sector company and registered MFI that fabricates and installs EE stoves.

In 2010, RETAP, UNDP and United Nations World Food Programme (WFP) have signed a memorandum of understanding to supply stoves to marginalized communities. This programme will be partly financed by the Japanese-supported Africa Adaptation programme implemented by UNDP, WFP and United Nations Industrial Development Organization, and partly by the WFP school feeding programme. Building on lessons from the GEF Market Transformation project, the Government of Kenya is exploring options to scale up this approach via utilization of a proposed allocation from the World Bank's Strategic Climate Fund's Scaling Up Renewable Energy Program (SREP) in Kenya.

The programme could also benefit from the support of the United Nations Capital Development Fund/ UNDP **Clean Start Programme**, which aims to develop the capacity of macro-finance institutions to enter the low pollution, energy-efficient stoves' market (2011). The preparation of a Programme of Activities (PoAs) to access carbon finance to further scale up the programme will also be considered.

One of the greatest successes of the RTE/RETAP project has been its ability to gradually grow, from a small-scale operation into a prominent operation specializing in fabricating and installing energy-efficient stoves. When an operation starts small, it is able to consolidate its gains and to learn from its mistakes and make adjustments along the way (Matiru and Schaffler, 2011).

Source: Black (2011); SGP (2003).

Case Study 2: Leveraging Carbon Finance for Low-Pollution, Energy-Efficient Stoves

The use of fuel wood for cooking has long been predominant in El Salvador, with around 60 percent of urban households and 85 percent of rural households using firewood for their cooking needs. This has been linked to a variety of adverse health effects in households and to the country's current high level of deforestation, where over 85 percent of forest cover has disappeared since the 1960s. El Salvador is now the second most deforested country in Latin America after Haiti.

In this context, UNDP, through its carbon-finance-related activities, has been supporting a public-private partnership to distribute Turbococina efficient stoves to schools and households. The Turbococina stove, which uses a patented technology designed in El Salvador, results in a 90 percent reduction in the need for firewood, and eliminates virtually all smoke emissions. For a typical household, this reduces the required firewood from 3.3 tonnes to 0.3 tonnes a year.

An El Salvadorian socially oriented business, Tecnologías Ecológicas Centroamericanas (TECSA), is behind the project, in full partnership with two government entities, the Ministry of Education (MINED) and the Ministry of Environment and Natural Resources (MARN). TECSA is using an innovative business model stipulating that the company will provide the Turbococina stoves to users for free, and then recover its investment through the sale of the emission reductions in the carbon markets. The Turbococina stoves are being distributed in two phases. The first phase involves the distribution to 3,500 schools. Turbococina stoves will be used to cook the schoolchildren's daily meals as part of the government's Programa de Alimentación Escolar. So far, a pilot of 750 Turbococina stoves has been implemented in 300 schools. The second phase will involve the distribution to 100,000 rural households participating in the government's social program Comunidades Solidarias Rurales. The schools from the first phase will act as the platform to raise awareness and develop the capacity for families' use of the stoves.

These activities are being submitted to the UNFCCC's CDM as a PoA. The project is also seeking Gold Standard certification reflecting its high contribution to sustainable development. Using the CDM methodology AMS-II.G, each household stove is anticipated to generate 4–5 tonnes of CO₂e reductions in each year, for a total annual project size of approximately 500,000 certified emission reductions. Currently the project has completed CDM validation, and CDM registration is expected in the second quarter of 2011.

UNDP has been working to support this initiative since 2008, where UNDP's objective has been to put in place an enabled policy environment for a financially sustainable, CDM efficient stove project. The following is a list of key achievements:

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

- Building capacity of national authorities: UNDP has provided information and training to El Salvadorian government bodies to facilitate the comprehension of carbon finance and PoAs, and promote its use linked to social programmes.
- Facilitating an agreement with the MINED: As a result, MINED has mandated the use of efficient stoves in schools in its Programa de Alimentacion Escolar network, creating an important initial market base and platform.
- Raising awareness and training with users: UNDP has contributed to various activities to address awareness and capacity barriers. This has included the publication of a user manual for Turbococina stoves in households.
- Accessing the CDM: UNDP has provided technical input to TECSA on the structure and phases of the CDM project, including the use of the PoA modality, which is well suited to dispersed activities at scale.

Source: Salomon and Waissbein (2011).

6.3 || Energy-Efficient Buildings

Rapidly growing, especially in developing countries, the building sector offers the largest, most cost-effective opportunities for energy efficiency and the greatest co-benefits. These opportunities are particularly significant when energy efficiency concerns are addressed during the conception of new buildings. Conversely, retrofitting of existing buildings is more difficult and more expensive.

1 In addition to being the sector with the largest potential for cost-effective emission reductions, the building sector also offers important socio-economic co-benefits, including the creation of jobs, business opportunities and increased energy security (Schwarz, 2010). In countries with constraints on electricity generating capacity, especially in Africa, improving energy efficiency for electricity will increase energy security and energy access by making it possible to supply more consumers with the same electricity production capacity. In countries with rapidly increasing demand for electricity, such as China and many Southeast Asian countries, energy efficiency can slow down growth in electricity demand, and reduce the investments necessary in the electricity sector. In both cases, investments in energy efficiency can often be implemented more rapidly than their supply and network alternatives. Energy efficiency also leads to social co-benefits, such as increased capacity of low-income households to pay their energy bills and greater access to energy services.

As for distributed renewable energy and modern cooking devices, energy-efficient buildings also bring about critical adaptation co-benefits. Improving the building design and construction — including choice of location, orientation, structure, and layout, as well as choice of building materials — can dramatically increase resilience to heat waves or extreme cold weather. These improvements can also lessen vulnerability to floods and earthquakes. For example, UNDP (with GEF support) piloted the construction of 400 energy-efficient and earthquake-resistant houses for the poor in collaboration with the Government of Sindh, Pakistan in 2009 (SGP, 2010). Built through local NGOs, these energy-efficient houses are also disaster-resistant (cyclones and earthquakes are common to this area).

People living in well-insulated buildings will also be better able to withstand power outages during extreme events. Accordingly, improved building design and construction can be as much an adaptation, hazard-proofing, and poverty-reduction measure as a mitigation concern. The improvement of building design and construction is likely to be among the key priorities identified in most developing countries' green, low-emission and climate-resilient strategies. If measures are implemented, developing countries will be able to seize the benefits and opportunities stemming from increased energy efficiency.

2 Realizing the opportunities that stem from improvements in EE can be hindered by a variety of behavioural, technical, institutional, and financial barriers. Box 6.3 summarizes some of these barriers.

Among these different barriers, upfront investment for household and municipal EE projects can prove particularly forbidding. Indeed, improving the EE of existing buildings can be the equivalent of pre-paying the building's electricity bill for the next five to ten years in the absence of subsidies. In addition, households or local governments might find it even more difficult than businesses to access limited credit,

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“
... improved
building design
and construction
can be as much an
adaptation, hazard-
proofing, and
poverty-reduction
measure as a
mitigation concern.
”

Box 6.3: Most common barriers to energy-efficient buildings**Behavioural**

- **Limited political priority:** Energy savings represent an amount of unconsumed energy. Mobilizing support for the absence of energy, in particular in cases where economies and consumption are growing, can be difficult. In such instances, energy savings may be perceived as a backward agenda.
- **Lack of information, awareness and expertise:** There is a lack of awareness, information and expertise on EE options across the building sector as a whole, including households, small enterprises, building designers, bank and other financiers of EE investments.
- **Low priority of energy issues, high transaction costs and behavioural aspects:** In many instances, EE is not a major concern for households or firms because energy costs are relatively low compared to total family income or company costs, such as labor costs (IEA, 2008b). Moreover, compared to the generally small size of individual energy saving options, the transaction costs involved — including the time, inconvenience and other costs of gathering information, installing new equipment — may be perceived to be high. Finally, rather than paying attention to EE, consumers may choose to follow certain behavioural or lifestyle aspects related to energy use such as comfort, status, custom or tradition.

Institutional

- **The complex character and fragmented market structure of the building sector.** Buildings are complex systems requiring a sequence of complicated design processes to optimize and reduce energy use. The building sector is also characterized by fragmentation, with decisions at each stage of design, construction and operation involving multiple stakeholders such as private developers, architects, designers, banks, landlords, tenants, etc.

Regulatory

- **Lack of profitability of EE investments:** This may be due to energy subsidies and/or a lack of internalisation of environmental, health or other external costs of energy use. As a result, energy prices may be significantly lower than their true social costs, thereby disfavoring energy savings. Moreover, consumers may use a higher discount rate than the social rate to discount future energy savings or they may demand a relatively short payback period, thereby disfavoring investments in energy savings over longer-term periods.

Financial

- **Misplaced or split incentives:** Misplaced or split incentives take place when agents responsible for EE investments are different from those benefitting from the resulting energy savings. For instance, in residential buildings, landlords often are responsible for investments in insulation, while the tenant pays the energy bill. Because the landlords are not rewarded for the investment, they are not likely to invest in EE measures. Tenants are also reluctant because they are not sure they can recover the costs of EE investments once they decide to relocate. This issue is usually called the 'landlord-tenant' problem or 'agent-principal' barrier to enhancing EE.
- **Higher upfront costs for more energy efficient investments, combined with a lack of access to financing these costs.** Although investments in EE are often profitable over time, they usually have higher initial investment costs. This may prevent investments in EE, notably by low-income households and small firms in developing countries, which have limited access to finance these upfront costs.

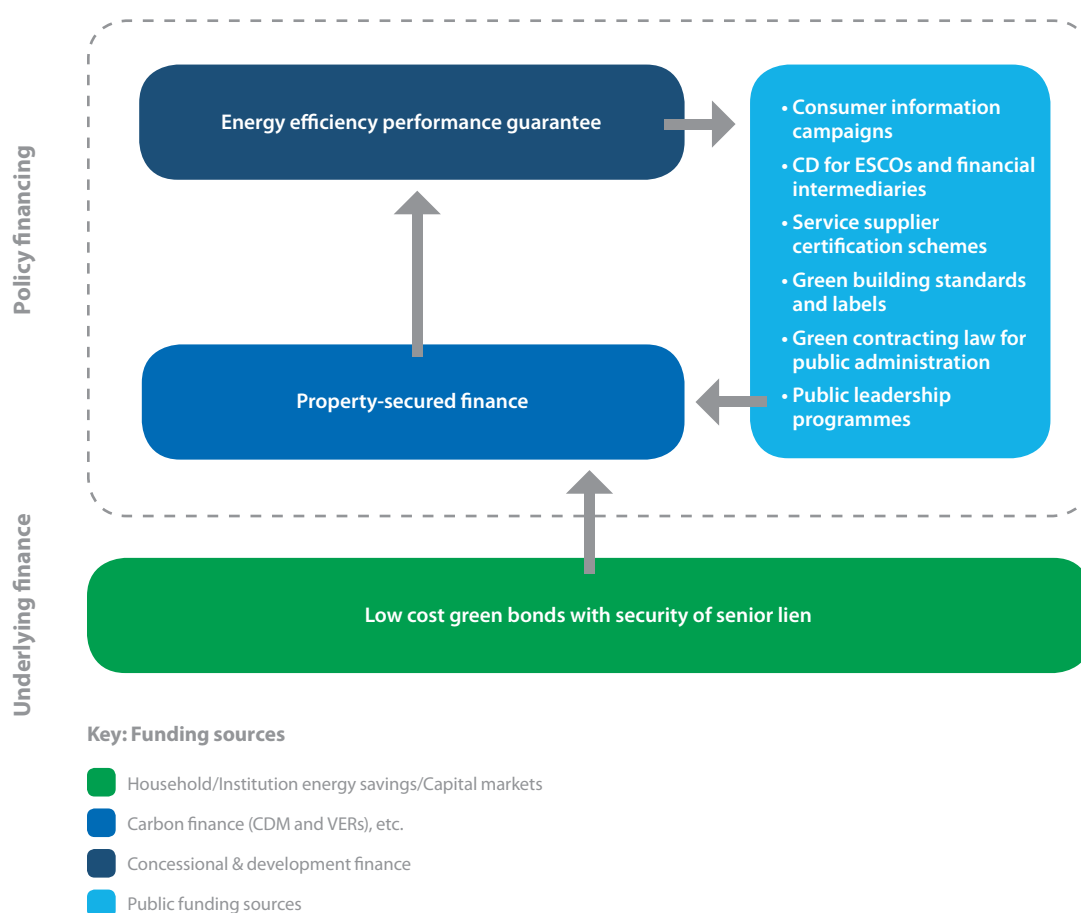
Source: UNDP (2011a); Schwarz (2010).

should they decide to make such an investment. Furthermore, individual investors often lack access to information and sufficient expertise to evaluate investments.

3

Figure 6.5 illustrates a possible mix of public policies and funding sources to overcome these barriers and support energy-efficient housing using property-secured financing schemes to remove the barrier posed by high upfront costs for households.

Figure 6.5: Promoting energy-efficient housing



While the cornerstone policy in the case of the wind power example was a fiscal incentive (price premium), the cornerstone policy in this third example is a debt-based instrument similar to efficient fuel stoves. Property-secured financing schemes enable local governments to raise money through the issuance of green bonds to fund these clean energy projects (Fuller, Kunkel and Kammen, 2009). The financing is repaid by participating property owners over a set number of years through a special tax on the property tax bill. Other options include a charge attached to the meter as a special tariff or the expansion of an existing tax. There is little or no upfront cost to the property owner, and if the property is sold before the end of the repayment period, the new owner inherits both the repayment obligation and

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“
Property-secured
financing schemes
enable local
governments to raise
money through the
issuance of green bonds
to fund these clean
energy projects
(Fuller, Kunkel and
Kammen, 2009).
”

the financed improvements. To encourage home owners to enroll in similar programmes, and to limit the rebound effect, this type of cornerstone policy usually needs to be supported by EE building codes, consumer awareness campaigns, public sector leadership programmes, electricity pricing reforms or EE performance guarantees. Once again, the optimal policy mix will depend on the unique conditions of each country/state/province/municipality.

Until recently, the issuance of state-guaranteed low-cost bonds to finance climate infrastructure was mostly an OECD phenomenon. Nevertheless, the next few years are likely to witness an increased reliance on green or social bonds to finance energy efficiency and renewable energy at the local level (Tallberg Project, 2011). Where financial markets are still in nascent stage, green bonds can be replaced by government-financed schemes such as municipal revolving funds, revolving funds with zero interest to banks or innovative public-private mechanisms such as equity participation or direct investment through ESCOs. In each case, a specific set of supportive policies will need to be selected (see case studies on energy efficient buildings in Bulgaria).

4 Similar to the discussion on wind power and efficient fuel stoves, national and international public sources of finance are appropriate to fund information and regulatory instruments aimed at removing barriers to energy-efficient buildings. If reimbursement of upfront costs can be made simple, and payments are spread out in affordable increments, households will be largely responsible for the bulk of funds invested in EE improvements. Additional support measures may be necessary to ensure that energy-efficient housing does not only benefit the wealthiest segments of the population. Partial upfront investment grants might be required to enable the poorest communities to improve the EE of their housing.

Energy-efficient building projects are eligible under for funding under the CDM and JI. As such, wind power projects can be financed, at least in part, through carbon finance. In practice, however, energy-efficient projects make up small share of the CDM market. As a result, the CDM has contributed very little to energy-efficient-building financing.

The following are some of the main barriers to a greater role of carbon finance in the building sector:

- Small size of the projects in the building sector and, hence, the relatively high transaction costs compared to the low amount of carbon credits generated
- Lack of available methodologies for setting baselines and calculating emission reductions
- Difficulty of demonstrating carbon additionality when often the energy-efficient option is also the lowest cost option (over a lifetime period)

Opportunities for funding under the CDM are likely to remain limited, although further development of Programmatic CDM and standardised baselines may increase opportunities to some extent.

Further background information on policy and financing options for energy efficient building can be found in the UNDP toolkit *Policy and Financial Instruments for Low-Emissions, Climate-Resilient Development* (UNDP, 2011a).

Case Studies: Energy-Efficient Buildings

Case Study 1: Promoting Low-Cost, Effective Energy-Efficient Building Technologies in a Cold Climate (Mongolia)

Straw has been used worldwide as part of various traditional building systems for millennia. Modern straw bale buildings (SBB) are a promising small buildings super-insulation solution for areas with limited local wood supplies for construction, local waste straw availability, cold winters, and low rain and snowfall per year, such as Mongolia. SBB buildings use agricultural grain production waste materials, which are traditionally burned with major smoke emissions. Straw has minimal animal feed value. SBB can be built at similar or slightly lower cost to conventional buildings with high levels of insulation (super-insulation).

In Mongolia, UNDP has been assisting the government over the last 14 years with the introduction and promotion of straw-bale building technologies: innovative, low-cost solutions using locally available waste material. Starting with a five-year project on the **Provision of Energy-Efficient Social Services** in 1997 with \$300,000 in UNDP financing, this project mobilised an additional \$1.7 million in cost sharing from the Government of Norway. The focus of the project was the promotion of SBB technologies in the public sector. By the end of 1999, the project had built 18 SBBs (including health clinics, kindergartens, primary schools and dormitories) and trained over 300 builders in SBB technologies. The project also had a number of other components not related to SBBs including retrofitting existing institutional buildings, installing photovoltaic systems, and developing improved windows and doors. The project had an important demonstration role and increased the public's awareness of its potential, but also revealed important behavioural, technical, institutional and financial barriers to full-scale market transformation toward widespread commercialization of SBB technologies (appropriate SBB designs for Mongolian conditions, perception of SBB as a backward technology, lack of trained entrepreneurs, upfront costs, etc.).

A follow-up project, supported by a GEF grant of \$725,000 and co-funding of \$1,084,000, the **Commercialization of Super-Insulated Buildings in Mongolia**, was implemented by UNDP to overcome these barriers. Its goal was large-scale replication of super-insulated SBBs in Mongolia. This was initially to be achieved through technical support, training, awareness raising and full funding of demonstration of super-insulated SBB for institutional buildings. This was later extended to private housing, with a majority of the funding for building construction coming from beneficiary households.

Despite its multiple development and climate benefits, SBB is not yet a mainstream construction technology anywhere in the world. However, Mongolia already has the highest per capita number of SBB in the world, with a relatively modest and declining 20 percent subsidy level. The necessary technical conditions are now in place for a sustainable market development of SBB in Mongolia.

Sources: Soriano and Alders (2011); Pool and Lodon (2007).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Case Study 2: Renovation of Multifamily Buildings in Bulgaria

The total housing sector in Bulgaria amounts to 3,746,758 dwellings (2007). Ninety-six-and-a-half percent of the housing stock in the country is private property and 65 percent of the dwellings in the cities are in buildings. The vast majority of Bulgaria's housing stock was industrially built in residential complexes between 1960 and 1980. The present condition of the housing stock is poor and in constant decay. This is mainly due to insufficient maintenance and inadequate management by the owners. The residential sector is characterized by very low thermal efficiencies and inefficient heat distribution systems (energy performance is about two-and-a-half times worse than current national technical standards require), and is a significant contributor to Bulgaria's high-energy intensity. Bulgaria's Energy Efficiency Action Plan states that the residential sector accounts for 23 percent of the overall energy consumption in Bulgaria.

The annual average expenditure for energy per household is estimated to €1,200 per year. The energy savings resulting from home retrofitting are estimated between 40 and 60 percent of the total energy use before renovation. Assuming a required investment of €5,000 for the renovation of each dwelling, the return on the investment will be over a seven-year period at a discount rate of 14 percent per annum.

Despite the strong financial case for the renovation of multi-family buildings in Bulgaria, efforts were hindered by several barriers, including the lack of tradition in the joint management of common property through associations of owners; the limited familiarity of building industry with modern renovation techniques and the inability of the majority of landowners to finance the upfront renovation costs, combined with the lack of financial support mechanisms (e.g. low-interest loans and/or subsidies).

In 2007, the Ministry of Regional Development and Public Works (MRDPW) teamed with UNDP to address these barriers. Building on the policy change effected by an earlier GEF-funded project implemented by UNDP to build local capacity for promoting EE in private and public building, the MRDPW/UNDP programme aimed at developing a replicable scheme for renovation of multifamily buildings, consisting of three major components: a) conditional subsidies to condominiums for renovation purposes; b) facilitated access to loans for renovation; and c) technical assistance to the voluntarily associated homeowners of entire buildings for the organization of the renovation process.

As of June 2010, 1,063 households had already benefited from the project, and 50 voluntary associations of condominium owners had been established to promote energy-efficient multifamily dwellings. For these achievements, the MRDPW/UNDP programme received the 2011 EU Award for Sustainable Energy in the Living category (<http://www.eusew.eu/awards-competition>).

The total energy-efficient building market is estimated at €4 billion. The experience, lessons learned, and recommendations developed by the MRDWP/UNDP Programme will be used for the future implementation of the National Programme for the Renovation of Residential Buildings, which will be financed by the National Budget, as well as for the implementation of Action 1.2 Housing Policy of Operational Programme Regional Development (European Structural Funds). The execution of the full National Program is expected to take 15 years.

Source: Stoyanova, Zlatareva and Dinu (2011).

6.4 Low-Emission Vehicles

The mobility of people, goods and services is essential for economic growth, poverty alleviation and human development. However, the present transport paradigm based on petrol- and diesel-fuelled private vehicles generates serious economic, social, health and environmental costs. The health damage caused by petroleum is similar in many ways to harm caused by tobacco. Whether you inhale from a cigarette, or simply breathe the air in most major cities in the world, you are inhaling benzene, polycyclic aromatic hydrocarbons, carbon monoxide, and a host of other toxins (see Box 6.4). Lead is the only constituent that is not common to both petroleum and tobacco smoke. Living in Madrid is said to be the equivalent of smoking half a pack of cigarettes a day, and this number pales in comparison with the situation in a number of rapidly growing metropolitan areas in developing countries (Tamminen, 2006). No matter the source, inhaling these pollutants can cause cancer, respiratory illness, and damage to your heart, lung and reproductive system.

Box 6.4: Human health toxins found in both tobacco smoke and vehicle exhaust

Pollutant

Benzene
PAH (hydrocarbons)
I, 3- butadiene
Formaldehyde and acrolein
Carbon monoxide (CO)
Heavy metals
Hexane
Acids

Associated Health Effects

Cancer; respiratory/reproductive toxicity
Cancer; immune system toxicity
Cancer
Respiratory illness, cancers
Respiratory illness; cardiovascular toxicity
Cancer; neurotoxicity
Neurotoxicity
Lung irritation and damage

Source: Tamminen (2006).

1 Passenger Light Duty Vehicles (LDV) ownership around the world is expected to rise broadly in parallel with incomes. Although current per capita transport emissions in developing countries are relatively low compared to OECD countries, close to 90 percent of the increase is expected to take place in developing countries, mostly from private vehicles and freight (IEA, 2009). Depending on the level of ambition of public policies to be implemented by governments worldwide to promote mass transit and other alternatives to private vehicles, the total stock of LDV could increase from about 750 million in 2007 to anywhere between 1.8 billion and 2.7 billion in 2050 (IEA, 2010a).

In addition to its health impact, unchecked growth in LDV would clog limited road space in developing countries, convert large tracks of arable lands to road networks and divert scarce public money to support the extension and maintenance of the road transport infrastructure. In terms of effect on climate, the transport sector already accounts for nearly 20 percent of global CO₂ emissions and is one of the fastest growing sources of CO₂ emissions worldwide, with a projected growth of 80 percent by 2050 compared to current levels.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“In most developing countries, immediate investment in mass transit will be a priority to promote sustainable mobility and dramatically reduce the growth in LDVs.”

In most developing countries, immediate investment in mass transit will be a priority to promote sustainable mobility and dramatically reduce the growth in LDV. However, complementary efforts will be required to promote both low-emission public and private passenger vehicles when alternative mass transit options are not the solution. In industrial countries and emerging economies, it may make economic sense to immediately focus on very low-emission vehicles such as electric cars to capitalise on new opportunities offered by a climate economy. As a first step in lower income countries, phasing out or restricting high-emission, inefficient vehicles (such as two-stroke engines) may be a pragmatic win-win option.



Policy makers face a number of challenging barriers to promote low-emission vehicles. Box 6.5 summarizes some of these barriers.

Box 6.5: Most common barriers hindering the adoption of low-emission vehicles

Behavioural

- **Lack of information and behavioural inertia:** There is a lack of awareness, information and expertise on low-emission, fuel-efficient EE transport options across consumers as a whole. The transaction costs involved in purchasing a low-emission, fuel-efficient vehicle — including the time, inconvenience and other costs of gathering information, installing and learning to use new refueling infrastructure, changing driving habits, and adjusting to new autonomy constraints — may be perceived as high. Furthermore, there is a strong emotional dimension in vehicle purchase, and consumers may choose to follow certain behavioural or lifestyle aspects related to comfort, status, custom or tradition.
- **Extremely fragmented transportation-sector market structure:** Adoption of low-emission vehicles will require the early retirement of tens of millions of vehicles worldwide. Ultimately, investment in low-emission vehicles will be made directly by individual households. Thus, awareness campaigns must convince millions of consumers about the health and socio-economic benefits associated with the adoption of low-emission vehicles in order to justify this additional investment.

Technical

- **Lack of supportive infrastructure:** A precondition for the widespread commercialisation of very low-emission vehicles, such as electric vehicles or fuel cell vehicles, will be the ability to put in place a recharging infrastructure for electric vehicles and hydrogen refueling facilities for fuel-cell vehicles.

Regulatory

- **Lack of internalisation of external costs:** Lack of internalisation of environmental, health or other external costs of transport significantly lowers the true social costs of high-emission, fuel-inefficient vehicles, thereby disfavoring more sustainable alternatives.

Financial

- **Higher upfront costs for low-emission vehicles:** Even when fuel-efficient gains are taken into consideration, currently most low-emission vehicles are significantly more expensive than conventional technologies and cost more than most consumers are willing or able to pay.
- **High R&D costs:** The development and deployment of low-emission vehicles will require large capital outlays by car manufacturers, potentially ahead of market demand.



Figure 6.6 illustrates a possible mix of public policies and funding sources to support low-emission vehicles. While the cornerstone policy was a fiscal incentive in the case of wind power and a debt-based instrument in the case of energy efficient stoves and energy efficiency housing, the cornerstone policy in this fourth and last example is a regulatory instrument: a vehicle emission standard.

Vehicle emission standards are requirements that set specific limits to the amount of pollutants that can be released into the environment by automobiles. Vehicle emission standards are increasingly used in both industrial and developing countries to tackle urban air pollution, as well as to promote fuel efficiency and greater energy security. For example, India enacted its first vehicle emission regulations in 1989. These regulations were gradually tightened during the 1990s. In 2000, India started adopting European emission and fuel regulations for four-wheeled light-duty and for heavy-duty vehicles. China has also been adopting controls on automobiles, equivalent to successive generations of European standards, since 2010.

Countrywide vehicle emission standards can be supplemented by tighter emission standards in priority air control areas (congested urban centres, etc.). Such priority air pollution standards are already enforced in over 100 cities worldwide. They limit road traffic in priority air control areas (usually the centre of the cities) to low-emission vehicles.

A key message of this guidebook is that policies do not operate in a vacuum. The effectiveness of individual climate policy measures is most often dependent on the other measures taken simultaneously and their interaction with the existing policy framework. For example, people are likely to react more positively to measures restricting the use of private vehicles, such as vehicle emission standards or priority air pollution areas, if they can concurrently benefit from good public transport policies. Mobility is intimately linked to economic opportunities, and availability of alternative means of transportation will be critical to reducing the adversarial impact of more stringent vehicular emission standards on the poor.

Awareness campaigns on the impacts of local air pollution on health (e.g. correlation between smog days and local hospital admissions) are also likely to lessen resistance to change. Fiscal incentives such as tax-break/direct subsidies for low-emission vehicles will further facilitate restrictive policy implementation by lowering compliance costs. Accordingly, a regulatory cornerstone policy to support low-emission vehicles will most often need to be supported by awareness campaigns, fuel taxes, fiscal incentives for low-emission vehicles, urban planning regulations to reduce commuting, and investment in reliable and comfortable public transport.

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

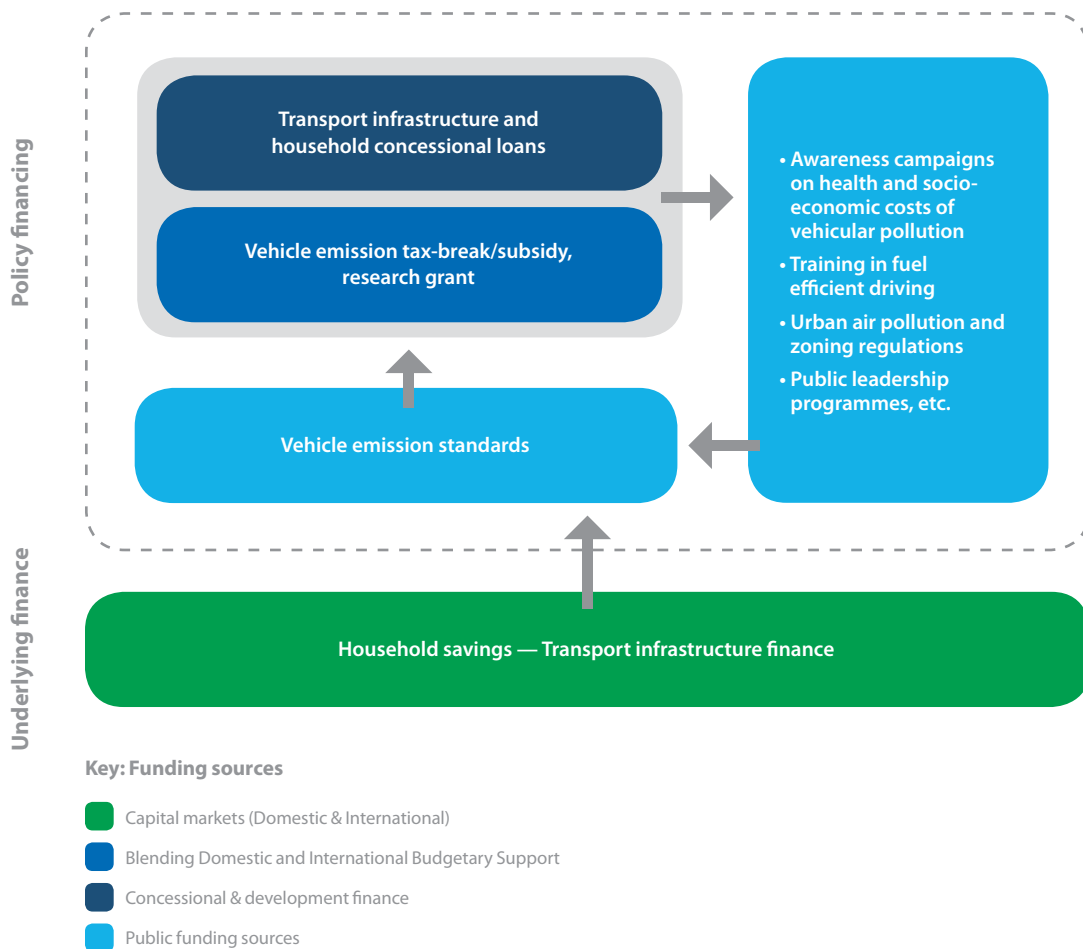
STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

“
A key message of
this guidebook is
that policies do not
operate in a vacuum.
”

Figure 6.6: Promoting low-emission/zero-emission vehicles

“ Given the sheer scale of capital required to finance this transition toward a low emission transport infrastructure, governments may need to help develop a green infrastructure bond market to help companies access at low cost the deep pools of capital available from institutional investors and the debt capital markets.

4 At present, consumers are responsible for the vast majority of LDV purchases. Consumers are financing these purchases through local banks or through the car companies themselves. However, national and international public sources of finance will be required to remove information and regulatory barriers to low-emission vehicles.

Furthermore, public grants might be required for research, development and demonstration of new low emission transport technologies (see Case Study 2 below on fuel-cell buses in China). Public money might also prove necessary for the development of a recharging infrastructure for electric vehicles or/ and hydrogen refuelling facilities for fuel-cell vehicles. Developing this infrastructure will require very

large sums in the coming decades. Government guarantees might be required to mobilise this often risky upfront investment. Given the sheer scale of capital required to finance this transition toward a low emission transport infrastructure, governments may need to help develop a green infrastructure bond market to help companies access at low cost the deep pools of capital available from institutional investors and the debt capital markets. They could do it through temporary holdings of first-loss tranches (Caldecott, 2010).

Finally, the public purse may also be put forward to contribute to the finance Public Leadership Programmes to guarantee a market demand to car manufacturers. For example, the French government has already ordered 100,000 battery-powered cars called 'Fluence' from Renault, one of its national car companies. According to the CEO of Renault, it would be easier to produce components like electric motors and batteries in Europe competitively than it would be to produce conventional vehicles and, therefore, preserve employment in the automobile industry (Motavilli, 2011).

The Chinese government, determined to reduce air pollution in major cities and to become a world leader in green technology, is planning to invest 15 billions of dollars over the next few years to develop electric and hybrid vehicles and wants more than a million electric and hybrid vehicles in use in the next few years (Barboza, 2010). Additional public support could be necessary in the form of tax-break or direct subsidies to compensate for the higher upfront costs of low-emission vehicles. For example, the price of the five-seat Renault electric car Fluence will include a €5,000 euro (\$6,994) government incentive (Motavilli, 2011).

As for energy-efficient buildings, CDM has not played a significant role in promoting sustainable mobility in developing countries and enabling them to take some first steps to reduce vehicular emissions. Less than 0.5 percent of climate-related funding under the Kyoto Protocol has gone to transportation (UNEP/Risø, 2010). Barriers include methodological complexity, difficulty in demonstrating carbon additionality, and high data requirements (UNDP, 2011). Opportunities for funding sustainable mobility under the CDM are likely to remain limited. International support to NAMAs under the UNFCCC may increase opportunities to blend public and private and domestic and international finance, as well as develop innovative PPPs to scale up GHG reduction efforts in the transport sector. As of March 2011, 26 of the 43 submissions made under the Copenhagen Accord made explicit reference to the land transport sector (Dalkmann and others, 2011).

Further background information on policy and financing options for low-emission transport systems can be found in the UNDP toolkit *Policy and Financial Instruments for Low-Emission Climate-Resilient Development* (UNDP, 2011a).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Case Studies: Low-Emission Vehicles

Case Study 1: Commercialization of Electric Three-Wheeler Rickshaws in Sri Lanka

Colombo is a bustling city with 25 percent of Sri Lanka's population, 60 percent of its motor vehicles, and a major air pollution problem. Inefficient vehicles, especially motorbikes and three-wheelers, both contribute to toxic air pollution and emit large amounts of CO₂ per unit distance travelled. Being a relatively dense and compact city with abundant supplies of relatively inexpensive electricity, electric vehicles have a good deal of potential in the city's mass transit sector. This creates a unique opportunity to introduce zero-emission electric vehicles to the dense core areas of Colombo — improving the quality of the air while decreasing the greenhouse gas emissions from the transport sector.

This SPG/UNDP project received \$40,000 in funding from the GEF. It sought to demonstrate the viability of, and pave the way for, commercial introduction of three-wheeled electric vehicles (EVs) in Colombo. It was clear early on through the implementation of initial project activities that policy barriers were far greater than technical ones. This realization prompted a change of focus on the part of the grantee toward advocacy for an enabling policy environment for electric vehicles. The project sought to demonstrate the viability of EVs in mass-transit applications in Colombo and build capacity for their assembly and maintenance. However, when the imported equipment (chassis) for the first prototype vehicle arrived, it was discovered that there was no Sri Lankan customs code covering EVs. Consequently, the prototype could not be cleared for entry. This was a significant and unexpected barrier to the project and to the demonstration of the technology.

Initially planned as a demonstration and capacity building project, the grantee had to switch focus, approaching the project from a policy standpoint. The grantee approached the director of fiscal policy, and lobbied for an amendment to the customs code to allow for the import of the vehicles. This was eventually granted, the vehicle was brought in, and a team of 10 youths was hired and trained to assemble and service the vehicle. Though the vehicle was ultimately granted access to the country as a result of the project's advocacy efforts, it was further hindered by yet another policy barrier. Because there was no provision in the Motor Traffic Act covering EVs, the vehicle could not be registered to drive on Colombo's roads. Once again, the project eventually succeeded in securing an amendment to the code, permitting the vehicle to ply the streets of Colombo.

The vehicles were then demonstrated to Sri Lankan national government officials, as well as Colombo municipal city officials. Taking into consideration Colombo's air quality problems, and being suitably impressed by the vehicle trials, the government decided to throw its support behind increased EV transport in Colombo. A cabinet subcommittee was set up to make recommendations relating to the lowering of import duties on EVs, while the grantee was requested to produce a proposal for the import and deployment of 25 electric buses for mass-transit duty on Kathmandu's streets.

Meanwhile, private sector actors have taken advantage of the improving policy and public awareness climate around EVs to begin developing commercial EV markets. Three Sri Lankan firms are spearheading the commercial EV sector in Sri Lanka — Cento Lanka, Ceylinko Consolidated, and Super Star (pvt) Ltd — are importing, assembling, and manufacturing electric three-wheelers, small electric cars, and electric motorcycles, respectively. Funding for these efforts is coming from investors (private sector) as opposed to public grant money. The future looks quite promising for these companies as the policy environment surrounding EVs continues to improve, and as electricity continues to remain less expensive than imported petroleum fuels.

In the meantime, use of EVs is taking off in the ecotourism sector, with Eco-Hotelier Sanasuma Development (pvt) Ltd demonstrating and using the vehicles in its hospitality operations, while the city of Kandy is exploring increased use of EVs in its tourism sector as well.

Source: Gitonga (2005).

STEP 1

IDENTIFY PRIORITY
MITIGATION AND
ADAPTATION
TECHNOLOGIES OPTIONS

STEP 2

ASSESS KEY BARRIERS TO
TECHNOLOGY DIFFUSION

STEP 3

DETERMINE APPROPRIATE
POLICY MIX

STEP 4

SELECT FINANCING OPTIONS
TO CREATE AN ENABLING
POLICY ENVIRONMENT

Case Study 2: Market Development for Fuel-Cell Buses in China

Widespread use of fuel-cell vehicles, which produce water as their only main emission, could yield major reductions in air pollution and result in significantly higher fuel efficiency, compared to conventional vehicles. Fuel-cell bus technology is considered one of the most promising technologies for the development of emission-free public transport vehicles. To capitalize on this tremendous potential, UNDP launched, with the support of GEF, a major effort in 2002 to support commercial demonstrations of fuel-cell buses (FCBs) and re-fuelling systems in the large bus markets of emerging economies: China, India, Brazil, Egypt, and Mexico.

The first major investment in the global effort was undertaken in China. The Government of China attaches great importance to the reduction of air pollution in its cities and to the improvement of energy efficiency in relation to climate change. Under the leadership of the Ministry of Science and Technology, a national Clean Vehicle Action programme is being implemented to develop technology, policy and national incentive programs, which will foster the reduction in vehicular emissions. The transportation sector, which relies almost entirely on oil, is one of the main sources of air pollution in Chinese cities, and vehicle emissions contribute significantly to the environmental degradation and related health problems in Chinese cities. Incidents of respiratory illnesses are increasing, and at least 270 million urban residents are currently experiencing air quality that is below what is considered acceptable by the Chinese air quality standard. Over the coming decades, the projected growth in the vehicle population will put significant pressure on the urban air quality in China. The widespread use of FCBs in major Chinese cities can reduce both urban air pollution and GHG emissions. It is estimated that the potential impact of FCBs in terms of GHG reductions in China is an annual savings of 9.1 million tonnes per year.

The objective of the \$15.9 million **UNDP-GEF Demonstration for Fuel Cell Bus Commercialization in China** project was to stimulate FCB technology transfer by supporting demonstration of FCBs and their fuelling infrastructure in Beijing and Shanghai. With considerable support not only from UNDP-GEF and the Chinese Government but from the private sector as well, Shanghai and Beijing are successfully piloting fuel cell technologies. The Shanghai Municipal Government fielded 90 fuel cell cars, six fuel cell buses, and 100 fuel cell powered tourist shuttles — as part of the fuel cell vehicle technology demonstrations of the World 2010 Exposition. In addition, the project contributed to the development and demonstration of energy-efficient and new-energy vehicles in China. There are now 20 Chinese cities that have become pilot cities for these demonstrations. The Government of China has introduced fiscal incentives to support energy-efficient and new-energy-vehicle pilot projects in 13 cities in the country. Part of that incentive scheme is the provision of a subsidy of 600,000 RMB per FCB.

Source: Soriano (2011).



Conclusion

Conclusion

As discussed throughout this guidebook, there is a large array of options to reduce GHG emissions and adapt to the impacts of climate change. Many of these options rely on technologies that already are, or will rapidly become, available. And there is significant economic potential, including negative-cost and no-regret opportunities, both for climate mitigation and adaptation.

Despite the existence of a significant potential in all geographical regions, a key issue associated with climate finance to date is its acute inequitable regional distribution in availability and use, with the bulk of the funds going to OECD countries and a few large emerging economies. Failure to provide fair access to climate finance to all developing countries would have severe economic, social, political, financial and climate change implications.

If the private sector is going to be the main source of funds for climate change management, a priority for climate public finance should be to address the regional imbalance in private finance investments. The challenge in climate finance is to find ways to mobilize a variety of resources at scale, while at the same time ensuring that it can be delivered fast enough to where it is most needed.

A key task for decision makers will be to identify the most appropriate set of public policy and financing instruments to catalyse capital in line with their national climate objectives. A huge array of public policy and financial instruments is available to help decision makers remove existing barriers and successfully implement mitigation and adaptation measures in different sectors.

A first fundamental and recurring theme of this guidebook is that policies do not operate in a vacuum. The optimal policy for the promotion of climate investment will not be the same everywhere: industrial, emerging and developing countries have different resources, challenges, needs and priorities. Different country and clean-technology market characteristics mean that there is no one-size-fits-all 'best' policy approach.

Furthermore, public policies and measures are not free. Whatever the policy mix and implementation scheme is selected, there is a cost for the taxpayer. As a general rule, everything that can be done to first reduce investment risks or return at low cost — such as simplifying and shortening administrative processes, or improving consumer information — needs to be a first-order priority, before resorting to more expansive public policy instruments such as subsidies, soft loans or loan guarantees. In addition, it is generally more efficient to raise the cost of unsustainable activities through regulation or fiscal instruments that help price them at their true cost than to subsidize sustainable activities.

A second fundamental and recurring theme of this guidebook is the need for dedicated efforts to promote synergies between development and climate finance. New sources of climate finance such as environmental markets and innovative PPPs hold the promise of delivering multiple development and climate benefits, including poverty reduction and sustainable livelihoods, biodiversity conservation, carbon sequestration, sustainable water management, enhanced ecosystems resilience and ecosystem-based adaptation. However, experience shows that it is not automatic.

Social implications must be taken into consideration when selecting an optimal mix of public-policy and financing instruments. Removing kerosene or fertilizer subsidies, increasing electricity and water tariffs, imposing a tax on vehicular air pollution, or otherwise restricting the promotion of green, low-emission and climate-resilient development can negatively affect marginalized segments of society. Achieving such synergies requires careful design and favourable conditions.

A third fundamental and recurring theme of this guidebook is the importance of using international public climate finance strategically. Developing the capacity of low-income countries to create conditions that allow markets and private investment flows to address pressing environmental problems — issues for which private funds are scarce — should be a priority for the new international public finance for climate change.

A critical challenge for the international community in the coming decade will be to enhance the capacity of developing countries to address these three challenges and seize the new opportunities associated with the transition to a low-emission climate-resilient society. The UNDP four-step framework described in this guidebook provides a practical tool to guide policy makers in this task. An ambition of this guidebook is to serve as an introduction to policy change to catalyse climate capital and to encourage readers to consult the comprehensive UNDP companion toolkit on *Policy and Financial Instruments for Low-Emission Climate-Resilient Development*. This toolkit applies the four-step approach presented in this guidebook to a wide range of priority mitigation and adaptation technologies.





Glossary of Terms

Adaptation – Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Additionality – Reduction in emissions by sources or enhancement of removals by sinks that is additional to any that would occur in the absence of a Joint Implementation (JI) or a Clean Development Mechanism (CDM) project activity as defined in the Kyoto Protocol Articles on JI and CDM.

Annex I countries – The group of countries included in Annex I (as amended in 1998) to the United Nations Framework Convention on Climate Change, including all the OECD countries and economies in transition. Under Articles 4.2 (a) and 4.2 (b) of the Convention, Annex I countries committed themselves specifically to the aim of returning individually or jointly to their 1990 levels of greenhouse-gas emissions by the year 2000. By default, the other countries are referred to as non-Annex I countries.

Annex II countries – The group of countries included in Annex II to the United Nations Framework Convention on Climate Change, including all OECD countries. Under Article 4.2 (g) of the Convention, these countries are expected to provide financial resources to assist developing countries to comply with their obligations, such as preparing national reports. Annex II countries are also expected to promote the transfer of environmentally sound technologies to developing countries.

Annex B countries – The countries included in Annex B to the Kyoto Protocol that have agreed to a target for their greenhouse-gas emissions, including all the Annex I countries (as amended in 1998) except for Turkey and Belarus.

Assigned Amount Unit – An AAU equals 1 tonne (metric ton) of carbon dioxide equivalent (CO₂e) emissions calculated using the Global Warming Potential.

Biodiversity – The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Bonds – Can variously be described as IOUs, loans or debts. They are similar to bank loans, but generally last longer (from one year to over 30 years). When institutions, companies, governments and other entities want to raise long term finance but do not want to dilute their shareholdings (or, indeed, cannot issue share capital), they turn to the bond markets. The biggest investors in the United Kingdom are the insurance companies and pension funds. They buy bonds to generate return, offset their liabilities, generate income or diversify their portfolios.

Building code/regulations – Laws that control the construction or remodelling of homes or other structures. They are regulations that are enforceable under the police powers of the state and locality controlling alterations, construction methods and materials, size and setback requirement, use and occupancy of all structures. Building codes have specific regulations covering all aspects of construction and are designed to maximize the health and welfare of the residents.

Certified Emission Reduction Unit (CER) – Equal to one metric tonne of CO₂-equivalent emissions reduced or sequestered through a Clean Development Mechanism project, calculated using Global Warming Potentials.

Clean Development Mechanism (CDM) – Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments.

Climate change – Any change in climate over time, whether due to natural variability or because of human activity. (Burton and Huq, et al., 2004 Climate variability — Variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate of all temporal and spatial scales beyond that of individual weather events. Variability may result from natural internal processes within the climate system (internal variability) or to variations in natural or anthropogenic external forcing (external variability). (Burton and Huq, et al., 2004)

Conference of the Parties (COP) – The supreme body of the UNFCCC, comprising countries with right to vote that have ratified or acceded to the convention.

Corporate Finance – Debt provided by banks to companies that have a proven track record, using 'on-balance sheet' assets as collateral. Most mature companies have access to corporate finance, but have limited total debt loads and therefore must rationalise each additional loan with other capital needs.

Cost of Capital – The weighted average of a firm's costs of debt and equity, in turn linked to risk involved in the underlying project or company. From an investment perspective, to be worthwhile, the expected return that an investor receives for putting money at risk must be greater than the cost of capital.

Debt – Securities such as bonds, notes, mortgages and other forms of paper that indicate the intent to repay an amount owed. A cash payment of interest and/or principal is made at a later date. This is in contrast to an equity investment where there is an exchange of shares of common stock, or ownership of the company.

Deforestation – The natural or anthropogenic process that converts forest land to non-forest.

Economies in Transition – Countries whose economies are changing from a planned economic system to a market economy.

Ecosystem – A system of living organisms interacting with each other and their physical environment.

Emission permit – An emission permit is a non-transferable or tradable entitlement allocated by a government to a legal entity (company or other emitter) to emit a specified amount of a substance. A tradable permit is an economic policy instrument under which rights to discharge pollution — in this case an amount of greenhouse gas emissions — can be exchanged through either a free or a controlled permit-market.

Emissions Reduction Unit – Equal to one metric tonne of CO₂-equivalent emissions reduced or sequestered arising from a Joint Implementation (defined in Article 6 of the Kyoto Protocol) project.

Emissions trading – A market-based approach to achieving environmental objectives. It allows those reducing GHG emissions below their emission cap to use or trade the excess reductions to offset emissions at another source inside or outside the country.

Energy efficiency – The ratio of useful energy output of a system, conversion process or activity to its energy input.

Energy efficiency improvements – Refers to a reduction in the energy used for a given energy service (heating, lighting, etc.).

Energy security – The various security measures that a given nation, or the global community as a whole, must carry out to maintain an adequate energy supply.

Energy Service Company – A company that offers energy services to end-users, guarantees the energy savings to be achieved tying them directly to its remuneration, as well as finances or assists in acquiring financing for the operation of the energy system, and retains an on-going role in monitoring the savings over the financing term.

Environmental effectiveness – The extent to which a measure, policy or instrument produces a decided, decisive or desired environmental effect.

Equity – An investment in exchange for ownership of a company entitled to the earnings of a company after all other investors (e.g. debt-holders) have been paid.

European Union Emissions Trading Scheme – A carbon market based on cap and trade, whereby binding emission targets are set by the EU and tradable allowances to emit up to these targets are then offered to emitters (as gifts or auctioned). Companies that pollute more can then buy surplus credits from those who pollute less, ensuring that overall emissions do not exceed the cap.

Feed-in tariff – The price per unit of electricity that a utility or power supplier has to pay for distributed or renewable electricity fed into the grid by non-utility generators. A public authority regulates the tariff.

Fossil fuels – Carbon-based fuels from fossil hydrocarbon deposits, including coal, peat, oil and natural gas.

Greenhouse gases – Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect. Water vapour (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and ozone (O₃) are the primary greenhouse gases in the earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides carbon dioxide, nitrous oxide and methane, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride, hydro fluorocarbons, and per fluorocarbons.

Infrastructure Funds – Traditionally interested in lower risk infrastructure such as roads, rail, grid, waste facilities, etc., which have a longer-term investment horizon and so expect lower returns over this period.

Institutional Investors – Includes insurance companies and pension funds, which tend to invest large amounts of money over a long time horizon with lower risk appetite.

Joint Implementation – A market-based implementation mechanism defined in Article 6 of the Kyoto Protocol, allowing Annex I countries or companies from these countries to implement projects jointly that limit or reduce emissions or enhance sinks, and to share the Emissions Reduction Units.

Kyoto Protocol – The Kyoto Protocol to the UNFCCC was adopted at the Third Session of the Conference of the Parties (COP) in 1997 in Kyoto. It contains legally binding commitments, in addition to those included in the FCCC. Annex B countries agreed to reduce their anthropogenic GHG emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) by at least 5 percent below 1990 levels in the commitment period 2008-2012. The Kyoto Protocol came into force on 16 February 2005.

Market barriers – In the context of climate change mitigation, market barriers are conditions that prevent or impede the diffusion of cost-effective technologies or practices that would mitigate GHG emissions.

Mitigation – Technological change and substitution that reduce resource inputs and emissions per unit of output.

Montreal Protocol – The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in Montreal in 1987, and subsequently adjusted and amended in London (1990), Copenhagen (1992), Vienna (1995), Montreal (1997) and Beijing (1999). It controls the consumption and production of chlorine- and bromine-containing chemicals that destroy stratospheric ozone, such as chlorofluorocarbons, methyl chloroform, carbon tetrachloride, and many others.

Nationally Appropriate Mitigation Action – NAMAs are voluntary emission reduction measures undertaken by developing countries that are reported by national governments to the UNFCCC. They are expected to be the main vehicle for mitigation action in developing countries under a future climate change agreement, and can be policies, programmes or projects implemented at national, regional, or local levels.

Private Equity – Focus on later stage and more mature technology or projects, and generally expect to exit their investment and make their returns in a three to five-year timeframe.

Project Finance or Limited Recourse Finance – Debt is borrowed for a specific project, the amount of debt made available will be linked to the revenue the project will generate over a period of time, as this is the means to pay back the debt. This amount is then adjusted to reflect inherent risks, e.g. the production and sale of power. In the case of a problem with loan repayment, rather like a typical mortgage, the banks will establish first ‘charge’ or claim over the assets of a business, as described above. The first tranche of debt to get repaid from the project is usually called ‘senior debt’.

Public-Private Partnership – A government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies. PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project.

Rebound effect – After implementation of efficient technologies and practices, part of the savings is taken back for more intensive or other consumption, e.g., improvements in car-engine efficiency lower the cost per kilometre driven, encouraging more car trips or the purchase of a more powerful vehicle.

Resilience – Refers to three conditions that enable a social or ecological system to absorb change and not fundamentally fall apart. The conditions are: ability to self-organize, ability to buffer disturbance and capacity for learning and adapting.

Stakeholders – Those who have interests in a particular decision, either as individuals or as representatives of a group. This includes people who can influence a decision as well as those affected by it. Decision makers are also stakeholders.

Standards – Set of rules or codes mandating or defining product performance (e.g., grades, dimensions, characteristics, test methods, and rules for use).

Subsidy – Direct payment from the government or a tax reduction to a private party for implementing a practice the government wishes to encourage.

Underwriting and Syndication – A lead bank agrees to provide a large bank debt facility to a client for a particular project, but the loan will be larger than the bank itself can provide on its own for the long term. The bank receives a fee from the client for providing, or underwriting, the whole facility at the outset and taking the risk that it can ‘sell’ pieces of the agreed loan to other lenders required (‘syndication’), on terms and pricing already agreed with the client. The underwriting bank takes the risk that it has achieved the right balance of risk and return to attract enough other lenders into the transaction.

United Nations Framework Convention on Climate Change (UNFCCC) – The Convention was adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Economic Community. Its ultimate objective is the ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’. It contains commitments for all parties. Under the Convention parties included in Annex I aimed to return greenhouse gas emission not controlled by the Montreal Protocol to 1990 levels by the year 2000.

Vulnerability – The degree to which an individual, group or system is susceptible to harm due to hazards to a hazard or stress, and the (in) ability to cope, recover, or fundamentally adapt (become a new system or become extinct).



References

1. World Health Organization. *World Health Statistics Quarterly*. 1985;38:30-40.
2. World Health Organization. *World Health Statistics Quarterly*. 1986;39:30-40.
3. World Health Organization. *World Health Statistics Quarterly*. 1987;40:30-40.
4. World Health Organization. *World Health Statistics Quarterly*. 1988;41:30-40.
5. World Health Organization. *World Health Statistics Quarterly*. 1989;42:30-40.
6. World Health Organization. *World Health Statistics Quarterly*. 1990;43:30-40.
7. World Health Organization. *World Health Statistics Quarterly*. 1991;44:30-40.
8. World Health Organization. *World Health Statistics Quarterly*. 1992;45:30-40.
9. World Health Organization. *World Health Statistics Quarterly*. 1993;46:30-40.
10. World Health Organization. *World Health Statistics Quarterly*. 1994;47:30-40.
11. World Health Organization. *World Health Statistics Quarterly*. 1995;48:30-40.
12. World Health Organization. *World Health Statistics Quarterly*. 1996;49:30-40.
13. World Health Organization. *World Health Statistics Quarterly*. 1997;50:30-40.
14. World Health Organization. *World Health Statistics Quarterly*. 1998;51:30-40.
15. World Health Organization. *World Health Statistics Quarterly*. 1999;52:30-40.
16. World Health Organization. *World Health Statistics Quarterly*. 2000;53:30-40.
17. World Health Organization. *World Health Statistics Quarterly*. 2001;54:30-40.
18. World Health Organization. *World Health Statistics Quarterly*. 2002;55:30-40.
19. World Health Organization. *World Health Statistics Quarterly*. 2003;56:30-40.
20. World Health Organization. *World Health Statistics Quarterly*. 2004;57:30-40.
21. World Health Organization. *World Health Statistics Quarterly*. 2005;58:30-40.
22. World Health Organization. *World Health Statistics Quarterly*. 2006;59:30-40.
23. World Health Organization. *World Health Statistics Quarterly*. 2007;60:30-40.
24. World Health Organization. *World Health Statistics Quarterly*. 2008;61:30-40.
25. World Health Organization. *World Health Statistics Quarterly*. 2009;62:30-40.
26. World Health Organization. *World Health Statistics Quarterly*. 2010;63:30-40.
27. World Health Organization. *World Health Statistics Quarterly*. 2011;64:30-40.
28. World Health Organization. *World Health Statistics Quarterly*. 2012;65:30-40.
29. World Health Organization. *World Health Statistics Quarterly*. 2013;66:30-40.
30. World Health Organization. *World Health Statistics Quarterly*. 2014;67:30-40.
31. World Health Organization. *World Health Statistics Quarterly*. 2015;68:30-40.
32. World Health Organization. *World Health Statistics Quarterly*. 2016;69:30-40.
33. World Health Organization. *World Health Statistics Quarterly*. 2017;70:30-40.
34. World Health Organization. *World Health Statistics Quarterly*. 2018;71:30-40.
35. World Health Organization. *World Health Statistics Quarterly*. 2019;72:30-40.
36. World Health Organization. *World Health Statistics Quarterly*. 2020;73:30-40.
37. World Health Organization. *World Health Statistics Quarterly*. 2021;74:30-40.
38. World Health Organization. *World Health Statistics Quarterly*. 2022;75:30-40.
39. World Health Organization. *World Health Statistics Quarterly*. 2023;76:30-40.
40. World Health Organization. *World Health Statistics Quarterly*. 2024;77:30-40.

- Agrawala, Shardul, and Samuel Fankhauser, eds. (2008). *Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments*. Paris: Organization for Economic Cooperation and Development.
- Atteridge, Aaron, and others (2009). Bilateral finance institutions and climate change: a mapping of climate portfolios. SEI Working Paper. Stockholm: Stockholm Environmental Institute. Available from <http://www.sei-international.org/publications?pid=1324>.
- Avchenkova, Alina (2010). *How to Guide on Low-emission Development Strategies and Nationally Appropriate Mitigation Actions: Eastern Europe and CIS*. New York: United Nations Development Programme.
- Barboza, David (2010). China to invest billions in electric and hybrid cars. *New York Times*, August 19.
- Bayraktar, H. (2010). *Institutional Investors and Climate Change Financing*. New York: United Nations Development Programme.
- (LECRD): UNDP case studies from South Africa and the region. Slides presented at ICLEI Local Climate Change Solutions for Africa Conference 2011. 28 February.
- Black, Lucas (2011). Supporting countries to transition to low-emission, climate-resilient development
- Bloomberg New Energy Finance (2010). *Weathering the Storm: Public Funding for Low-Carbon Energy in the Post Financial Crisis Era*. UNEP SEF Alliance. Available from <http://bnef.com/free-publications/white-papers/0>.
- Boyle, Rohan, and others (2008). *Global Trends in Sustainable Energy Investment 2008: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency*. United Nations Environment Programme; SEFI; and New Energy Finance Ltd. Available from www.unglobalcompact.org/docs/issues.../Global_Trends_2008.pdf.
- Bredenkamp, Hugh, and Catherine A. Pattillo (2010). Financing the response to climate change. IMF Staff Position Note No. 2010/06. International Monetary Fund.
- Brinkmann, Verena and Agnes Klingshirm (2005). *Stove Producers Assess Their Impact: Methodology and Results of a ProBEC participatory Impact Assessment*. Pretoria, South Africa: Programme for Biomass Energy Conservation, GTZ.
- Caldecott, Ben (2010). Green infrastructure bonds: accessing the scale of low-cost capital required to tackle climate change. ThinkTank Publications (December). London: Climate Change Capital.
- Calvillo, Angelo (2010). *Environmental Alpha: Institutional Investors and Climate Change*. Hoboken, US: John Wiley & Sons.
- Carbon Finance (2010). Carbon fund managers upbeat on 2010, 27 January. Available from <http://www.carbon-financeonline.com/index.cfm?section=lead&action=view&id=12682>.
- Coady, David, and others (2010). Petroleum product subsidies: costly, inequitable, and rising. IMF Staff Position Note No. 2010/05. International Monetary Fund.
- Cosbey, Aaron, and others (2005). *Realizing the Development Dividend: Making the CDM Work for Developing Countries* (Phase I Report). Winnipeg: International Institute for Sustainable Development.
- Cosbey, Aaron, and others (2006). *Making Development Work in the CDM: Phase II of the Development Dividend Project*. Winnipeg: International Institute for Sustainable Development.
- Costello, Christopher and Michael Ward (2006). Search, bioprospecting and biodiversity conservation. *Journal of Environmental Economics and Management*, vol. 52, No. 3 (November), pp. 615–626.
- Crespo, Jacqueline R. (2008). SEF Alliance public venture capital study. Slides presented in London, 11 November. New Energy Finance.
- Dalkmann, Holger and others (2011). Cancun can, can land transport? A summary of the proceedings from the United Nations Climate Change Conference in Cancún, Mexico, and their significance for the land transport sector. Bridging the gap. Available from www.transport2012.org.
- De Gouvello, Christophe, Felix B. Dayo, and Massamba Thiye (2008). *Low-Carbon Energy Projects for Development in Sub-Saharan Africa: Unveiling the Potential, Addressing the Barriers*. Washington DC: The World Bank.
- Economics of Climate Adaptation Working Group (2009). *Shaping Climate-Resilient Development: A Framework for Decision-Making*. Washington D.C. Economics of Climate Adaptation.
- Emerging Markets Private Equity Association (2010). Emerging markets to gain greater share of private equity commitments as investors seek high growth markets, 19 April. Available from www.preqveca.ru/news/2007/.
- Cundy, Christopher (2010). MSS launches suite of sustainable forestry funds, 1 April. Available from <http://www.environmental-finance.com/news/view/1087>.
- Ernst and Young (2010). Renewable Energy Country Attractiveness Indices, Issue 27. Available from http://www.ey.com/GL/en/Industries/Oil---Gas/Oil_Gas_Renewable_Energy_Attractiveness-Indices.
- Ervin J. and others (2010). *Protected Areas for the 21st Century: Lesson from UNDP/GEF's Portfolio*. New York: United Nations Development Programme. Montreal: Convention on Biological Diversity.
- Ezzati, Majid, Bernard M. Mbinda, and Daniel M. Kammen (2000). Comparison of emissions and residential exposure from traditional and improved cookstoves in Kenya. *Environmental Science & Technology*, vol. 34, No. 4, pp. 578–583.
- Fuller, Merrian C, Cathy Kunkel, and Daniel M. Kammen (2009). *Guide to Energy Efficiency & Renewable Energy Financing Districts for Local Governments*. Berkeley: University of California.

- Fulton, Mark, ed. (2007). *Investing in Climate Change: An Asset Management Perspective*. Deutsche Asset Management. New York: Deutsche Bank Group.
- Fulton, Mark, ed. (2010). *GET FIT Program: Global Energy Transfer Feed-in Tariffs for Developing Countries*. New York: Deutsche Bank Group. Available from www.dbcca.com/research.
- Fulton, Mark, ed. (2011). *GET FIT Plus: De-Risking Clean Energy Business Models in a Developing Country Context*. New York: Deutsche Bank Group. Available from http://www.dbcca.com/dbcca/EN/investment-research/investment_research_2367.jsp.
- Global Environment Facility Science and Technical Advisory Panel (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP Advisory Document*. GEF; UNEP.
- German Advisory Council on Global Change (2007). *Climate Change as a Security Risk*. London: Earthscan.
- Gibbons, Drew, Nii Sai Sai, and Bao Vuong (2009). *Improved Cookstoves Project: Scale up to Northern Ghana & Ghana School Feeding Program: Biogas Installation Update*. Berkeley: University California Berkeley.
- Gitonga, Stephen (2005). *Partnerships in shaping national policy*. SGP Publications: Climate Change. New York: United Nations Development Programme.
- Glemarec, Yannick, Oliver Waissbein, and Hande Bayraktar (2010). *Human development in a changing climate: a framework for climate finance*. Discussion Paper. New York: United Nations Development Programme.
- Green Investment Bank Commission (2010). *Unlocking Investment to Deliver Britain's Low Carbon Future*. London.
- Hamilton, Kristy (2009). *Unlocking finance for clean energy: the need for 'investment grade' policy*. Energy, Environment and Development Programme Paper: 09/04. London: Chatham House.
- How to Create Marginal Abatement Cost Curves in Excel (2010). Somar Energy Saving News. Available from <http://www.energy-saving-news.com/2010/10/marginal-abatement-cost-curves-how-to-create-one-using-excel/#ixzz1K5ZFD7J>. Under Creative Commons License: Attribution
- Inderst, G. (2009). *Pension fund investment in infrastructure*. OECD Working Papers on Private Pensions and Insurance, No. 32. Paris: Organization for Economic Cooperation and Development.
- Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. Geneva.
- International Energy Agency (2006). *World Energy Outlook 2006*. Paris.
- International Energy Agency (2008a). *Energy Technology Perspectives 2008: Scenarios & Strategies to 2050*. Paris.
- International Energy Agency (2008b). *World Energy Outlook 2008*. Paris.
- International Energy Agency (2009). *World Energy Outlook 2009*. Paris.
- International Energy Agency (2010a). *Energy Technology Perspectives 2010*. Paris.
- International Energy Agency (2010b). *Global Gaps in Clean Energy RD&D: Update and Recommendations for International Collaboration*. Paris.
- International Energy Agency (2010c). *World Energy Outlook 2010*. Paris.
- Janda, Kathryn B. (2009). Buildings don't use energy: people do. In *Proceedings of the International Conference on Passive and Low Energy Architecture (PLEA 2009)*, Claude MH Demers and André Potvin, eds. Québec: Les Presses de l'Université Laval.
- Jones, Drew, and others (2010). Leaders for a new climate: day 1. Slides presented at Massachusetts Institute of Technology Slone Management. Climate Interactive. Available from <http://www.climateinteractive.org/resources/course-materials/leaders-for-a-new-climate-2010/LNC%20Day%201.pdf/view>.
- Justice, Sophie (2009). *Private Financing of Renewable Energy: A Guide for Policymakers*. United Nations Environment Programme; Bloomberg New Energy Finance; Chatham House. Available from <http://www.chathamhouse.org.uk/publications/papers/view/-/id/811/>.
- Klein, Richard and others (2008). *International climate policy*. A Stockholm Environment Institute policy brief for the Commission on Climate Change and Development. Stockholm: Stockholm Environment Institute.
- Laan, Tara (2010). *Gaining traction: the importance of transparency in accelerating the reform of fossil-fuel subsidies*. Untold Billions: Fossil-fuel Subsidies, Their Impacts and the Path to Reform. Geneva: International Institute for Sustainable Development.
- Lerner, Josh, with Felda Hardyman and Ann Leamon (2008). *Venture Capital & Private Equity: A Casebook, Fourth Edition*. New York: John Wiley & Sons.
- Limmeechokchaia, Bundit and Saichit Chawana (2006). Sustainable energy development strategies in the rural Thailand: The case of the improved cooking stove and the small biogas digester. *Renewable Energy Reviews*, vol. 11, No. 5 (June), pp. 818–837.
- Lin, Jiang (2002). *Appliance efficiency standards and labeling programs in China*. *Annual Review of Energy Environment*, Vol. 27, pp. 349–367.
- Madsen, Becca, Nathaniel Carroll, and Kelly Moore Brands (2010). *State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide*. Washington D.C.: Ecosystem Market Place. Available from <http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf>.

- Matiru V., and Schaffler (2011). *Market Transformation for Highly Efficient Biomass Stoves for Institutions and Medium-Scale Enterprises in Kenya: Terminal Project Evaluation*. New York: United Nations Development Programme.
- McKinsey Global Institute (2008). *The Case for Investing in Energy Productivity*. San Francisco: McKinsey & Company.
- McKinsey Global Institute (2009). *Global Capital Markets: Entering a New Era*. San Francisco: McKinsey & Company.
- McKinsey & Company (2009). *Pathway to a Low Carbon Economy: Version 2.0 of the Global GHG Abatement Cost Curve*. Available from <https://solutions.mckinsey.com/ClimateDesk/default.aspx>.
- Mendonca, Miquel, David Jacobs, and Benjamin Sovacool (2010). *Powering the Green Economy: The Feed-in Tariff Handbook*. London: Earthscan.
- Mercer, D. Evans, David Cooley, and Katherine Hamilton (2011). *Taking Stock: Payments for Forest Ecosystem Services in the United States*, Washington D.C.: Ecosystem Market Place.
- Metz, Bert, and others, eds. (2007). *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press.
- Mignone B. K., and others (2008). Atmospheric stabilization and the timing of carbon stabilization. *Climate Change*, vol. 88, No. 3–4, pp. 251–265.
- Mills, Paul (2008). The greening of markets. *Finance and Development*, vol. 45, No. 1 (March), pp. 31–36.
- Motavilli, Jim (2011). Better place reveals E.V. charging plan and customer center in Denmark. *New York Times*, 4 March.
- Munang, Richard, and others (2010). The role of ecosystems in developing a sustainable 'green economy'. UNEP Policy Series: Ecosystem Management, Policy Brief 2. Nairobi: United Nations Environment Programme.
- Nasseri, Ladane, and Caroline Alexander (2010). Iran cuts energy subsidies as sanctions take toll. Bloomberg, 19 December. Available from <http://www.bloomberg.com/news/2010-12-19/iran-begins-cutting-energy-subsidies-as-united-nations-sanctions-take-toll.html>.
- National Academy of Sciences (2010). *Adapting to the Impacts of Climate Change*. Washington D.C.: The National Academy Press.
- O'Donohoe, Nick, and others (2010). *Impact investments: an emerging asset class*. Global Research. New York: J.P. Morgan.
- Office of Management and Budget (2003). *Informing Regulatory Decisions: 2003 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on States, Local and Tribal Entities*. Washington, D.C. Available http://www.whitehouse.gov/omb/inforeg_regpol_reports_congress/.
- Ogden, Doug (2004). *China's Energy Challenge*. San Francisco: Energy Foundation.
- Organisation for Economic Co-operation and Development (2005). *Environmental fiscal reform for poverty reduction. OECD Guidelines and Reference Series*. Paris.
- Organisation for Economic Co-operation and Development (2009). *TGHG Mitigation Actions: MRV Issues and Options*. Paris.
- Organisation for Economic Co-operation and Development (2010). *Taxation, Innovation and the Environment*. Paris.
- Parker, Charlie, and Matthew Cranford (2010). *The Little Biodiversity Finance Book: A guide to Proactive Investment in Natural Capital*. Oxford: Global Canopy Foundation.
- Parker, Charlie, Jessica Brown, and Jonathan Pickering (2009). *The Little Climate Finance Book: A Guide to Financing Options for Forests and Climate Change*. Oxford: Global Canopy Foundation.
- Parker, Kevin, ed. (2009). *Paying for Renewable Energy: TLC at the Right Price - Achieving Scale through Efficient Policy Design*. New York: Deutsche Bank Group. Available from www.dbcca.com/research.
- Parry, Martin, and others, eds. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- Pate, Ron R., and others (2007). *Overview of Energy-Water Interdependencies and the Emerging Energy Demands on Water Resources*. Albuquerque, US: Sandia National Laboratories.
- Pool, F., and E. Lodon (2007). *Promoting Low Cost, Energy Efficient Building in Mongolia*. UNDP-GEF Final Evaluation Report. Ulan Bator.
- The Pew Charitable Trusts (2011). *Who's Winning the Clean Energy Race? Growth, Competition and Opportunity in the World's Largest Economies*. Washington D.C.; Philadelphia.
- Point Carbon (2011). *Who's in, Who's out: Credit Eligibility after 2012*. London.
- Project Catalyst (2010). *From climate finance to financing green growth*. Briefing Paper. Climate Work Foundation. Available from www.project-catalyst.info/.../101127_from_climate_finance_to_financing_green_growth_formatted.pdf.
- Rao, P. K. (2011). *The Architecture of Green Economic Policies*. Heidelberg, Springer.

- Robins, Nick and others (2010). Sizing the climate economic. Global Climate Change (September). HSBC Global Research. Available from <http://www.research.hsbc.com/midas/Res/RDV?ao=20&key=wU4BbdyRmz&n=276049.PDF>.
- Rossi, Andrea and Yianna Lambrou (2009). *Making Sustainable Biofuels Work for Smallholder Farmers and Rural Households: Issues and Perspectives*. Rome: Food and Agriculture Organisation.
- Renewable Energy Policy Network for the 21st Century (2008). *Renewables 2007: Global Status Report*. Paris: REN 21 Secretariat; Washington, D.C.: Worldwatch Institute.
- Renewable Energy Policy Network for the 21st Century (2010). *Renewables 2010: Global Status Report*. Paris: REN21 Secretariat.
- Schroeder, Frank (2006). *Innovative sources of finance after the Paris Conference: the concept is gaining currency but major challenges*. FES Briefing Paper May 2006. New York: Frierich Eber Stiftung.
- Schwarz, Virginie, and Yannick Glemarec (2009). *Energy access and climate change mitigation: friends or foes? In Rethinking Development in a Carbon-Constrained World: Development Cooperation and Climate Change*, Eija Palosuo, ed. Finland: Ministry For Foreign Affairs.
- Schwarz, Virginie (2008). *Promotion of Wind Energy: Lessons Learned from International Experience and UNDP-GEF Projects*. New York: United Nations Development Programme.
- Schwarz, Virginie (2010). *Promoting Energy Efficiency in Building: Lessons Learned from International Experience*. New York: United Nations Development Programme.
- Secretariat of the Convention on Biological Diversity (2011). Incentive measures for the conservation and sustainable use of biological diversity: case studies and lessons learnt. CBD Technical Series No.56. Montreal.
- SEF Alliance (2009). *Why Clean Energy Public Investment Makes Economic Sense-The Evidence Base*. United Nations Environment Programme. Available from www.unep.org/publications/search/pub_details_s.asp?ID=6158.
- Simon, Gregory, Adam G. Bumpus, and Philip Mann (2010). *Win-Win Scenarios at the Climate-Development Interface: Challenges and Opportunities for Cookstove Replacement Programs Through Carbon Finance*. Denver: University of Colorado.
- Simpson, David R. (2011). *The "Ecosystem Service Framework": a critical assessment*. Ecosystem Services Economics Working Paper Series, No. 5. Nairobi: United Nations Environment Programme.
- Small Grants Programme (2003). *Community Action to Address Climate Change: Case studies Linking Sustainable Energy Use with Improved Livelihoods*. New York: United Nations Development Programme.
- Small Grants Programme (2010). *Energy Efficient Earthquake Resilient Housing for the Poor in Pakistan*. New York: United Nations Development Programme.
- Smith, Doug M. and others (2007). *Improved surface temperature prediction for the coming decade from a global climate model*. *Science*, vol. 317, No. 5839 (August), pp. 796-799.
- Soriano, Manual and Marcel Alers (2011). United Nations Development staff communication. New York, April.
- Stanton, Tracy, and others (2010). *State of Watershed Payments: An Emerging Marketplace*. *Ecosystem Marketplace*. Available from http://www.forest-trends.org/documents/files/doc_2438.pdf.
- Stern, Nicholas (2006). *Stern Review on the Economics of Climate Change*. Cambridge: Cambridge University Press.
- Stoyanova, Tatyana, Maria Zlatareva, and Adriana Dinu (2011). United Nations Development Program Staff Communication. New York, April.
- SunRun (2011). *The Impact of Local Permitting on the Cost of Solar Power*. Available from www.sunrunhome.com/.../solar-report-on-cost-of-solar-local-permitting.original.pdf.
- Tallberg Project (2010) *Rework the World*. Stockholm: Tallberg Foundation.
- Tamminen, Terry (2006). *Lives Per Gallon: The True Cost of Our Oil Addiction*. Washington D.C.: Island Press.
- Taskforce on Innovative International Financing for Health Systems (2010). *More Money for Health, and More Health for the Money*. International Health Partnership. Available from www.international-healthpartnership.net/.../Final%20Taskforce%20Report.pdf.
- The Economics of Ecosystems and Biodiversity (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB*. Nairobi: United Nations Environment Programme.
- The Economics of Ecosystems and Biodiversity (2009). *TEEB – The Economics of Ecosystems and Biodiversity for National and International Policy Makers*. Wesseling: United Nations Environment Programme.
- United Nations Capital Development Fund (2011). *CLEAN START: Sustainable Model of Renewable Energy Finance for Low-Income Households and Micro-Entrepreneurs*. New York.
- United Nations Development Programme (2004). *Gender and Energy for Sustainable Development: A Toolkit and Resource Guide*. New York.
- United Nations Development Programme (2006). *The Clean Development Mechanism: An Assessment of Progress*. New York.
- United Nations Development Programme (2007). *MDG Carbon Facility: Leveraging Carbon Finance for Sustainable Development*. New York.
- United Nations Development Programme (2007). *Human Development Report 2007-2008: Fighting Climate Change: Human Solidarity in a Divided World*. New York: Palgrave Macmillan.

United Nations Development Programme (2009a). *Charting a New Low-Carbon Route to Development: A Primer on Integrated Climate Change Planning for Regional Governments*. New York.

United Nations Development Programme (2009b). *Efficient Low Cost Housing for the Poor in Thatta, Badin and Karachi Districts*. Karachi, Pakistan.

United Nations Development Programme (2009c). *Market Transformation for Energy Efficiency in Brazil*. New York.

United Nations Development Programme (2010a). *UNDP and Energy Access for the Poor: Energizing the Millennium Development Goals*. New York.

United Nations Development Programme (2010b). *UNDP Green Commodity Facility*. New York.

United Nations Development Programme, and United Nations Framework Convention on Climate Change (2010). *Handbook for Conducting Technology Needs Assessment for Climate Change*. New York.

United Nations Development Programme, and PWC (2010). *Habitat Banking in Latin America and Caribbean: A Feasibility Assessment*. New York.

United Nations Development Programme (2011a). *Policy and Financial Instruments for Low-Emission Climate-Resilient Development*. New York.

United Nations Development Programme (2011b). *Preparing Low-Emission Climate-Resilient Development Strategies: A UNDP Guidebook*. New York.

United Nations Development Programme (2011c). *Establishing National Climate Funds: Guidebook for Development Practitioners*. New York.

United Nations Economic Commission for Europe (2010). Financing global climate change mitigation. The ECE Energy Series, No. 37. Sales No. E.10.11.E.1

United Nations Environment Programme (2008). *Public Finance Mechanisms to Mobilize Investment in Climate Change Mitigation: An Overview of Mechanisms Being Used Today to Help Scale-Up the Climate Mitigation Markets, with a Particular Focus on the Clean Energy Sector*.

United Nations Environment Programme (2009). *Global Trends in Sustainable Energy Investment 2009: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency*. United Nations Environment Programme and Bloomberg New Energy Finance Ltd. Available from www.unep.org/pdf/Global_trends_report_2009.pdf.

United Nations Environment Programme (2010). *Global Trends in Sustainable Energy Investment 2010: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency*. UNEP; Bloomberg New Energy Finance Ltd. Available from bnef.com/WhitePapers/download/30.

United Nations Environment Programme, and Stockholm Environmental Institute (2010). *Bilateral Finance Institutions and Climate Change: A Mapping of 2009 Climate Financial Flows to Developing Countries*. Available from <http://www.unep.org/pdf/dtie/BilateralFinanceInstitutionsCC.pdf>.

United Nations Framework Convention on Climate Change Secretariat (2007). *Investment and Financial Flows to Address Climate Change*. Bonn. Available from unfccc.int/files/cooperation.../financial.../background_paper.pdf.

UN-REDD (2011). *2010 Year in Review*. Geneva.

United Nations Secretariat (2010). *Report of the UN Secretary General's High-Level Advisory Group on Climate Change Financing*. New York.

United States National Academy of Sciences/National Research Council (2010). *Adapting to the Impacts of Climate Change, America's Climate Choices*, Report to Congress. Washington D.C.

Victor, David (2009). The politics of fossil-fuel subsidies. Untold Billions: Fossil-fuel Subsidies, Their Impacts and the Path to Reform. Geneva: International Institute for Sustainable Development.

Ward, Murray (2010). *Engaging Private Sector Capital at Scale in Financing Low-Carbon Infrastructure in Developing Countries*. Auckland: Global Climate Change Consultancy.

Willcock and Swetnam, *Valuing the Arc*, presented by Prof. P.K.T. Munishi, December 2009. Available from <http://www.valuingthearc.org>.

World Bank (2005). *Environmental Fiscal Reform: What Should Be Done and How to Achieve It*. Washington D.C.

World Bank (2010). *The Economics of Adaptation to Climate Change*. Washington D.C.

World Energy Council (2004). *Energy Efficiency: World Wide Review – Indicators, Policies, and Evaluation*. London.

World Economic Forum (2010). *Green Investing 2010: Policy Mechanisms to Bridge the Financing Gap*. Geneva.

World Future Council (2009). *Unleashing Renewable Energy Power in Developing Countries: Proposal for a Global Renewable Energy Policy Fund*. Hamburg.

World Health Organization, and United Nations Development Programme (2009). *The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa*. New York: United Nations Development Programme.

World Health Organization (2008). *The Global Burden of Disease: 2004 Update*. Geneva: World Health Organization.

Yescombe, E. R. (2002). *Principles of Project Finance*. London: Academic Press.





**United Nations Development Programme
Bureau for Development Policy
Environment and Energy Group
304 East 45th Street, 9th Floor
New York, NY 10017 USA**

www.undp.org