Module 4

Introduction to Climate Change Mitigation
Learning Objectives

1. Explain the importance of climate change mitigation and low carbon development

2. Describe relevant policy approaches and strategic frameworks

4. Define main international mechanisms to support climate change mitigation and low carbon development

3. Identify key sectors for low carbon development and outline relevant mitigation options

By the end of the module participants will be able to:
Overview

Section 1
Introduction to Climate Change Mitigation and Low Carbon Development

Section 2
Strategic Frameworks and Policy Approaches for Mitigation and Low Carbon Development

Section 3
Sectors with High Mitigation Potential

Section 4
International Initiatives to Support Climate Change Mitigation
Section 1

Introduction to Climate Change Mitigation and Low Carbon Development
What is Climate Change Mitigation?

Mitigation refers to efforts to reduce/prevent emission of greenhouse gases (GHGs) or to enhance their removal from the atmosphere by sinks.

Source: UNFCCC 2009. Further info: UNEP Website
Key Concepts Related to Climate Change Mitigation

Mitigation Option
- A technology, practice, or policy that reduces or limits emissions of GHGs or increases their sequestration

Low Carbon/Emission Development
- Low carbon development refers to economic development with minimal output of GHG emissions

Green Economy
- An economy that results in “improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (UNEP 2010)

Further info: UN Sustainable Development Knowledge Platform
# Major Greenhouse Gases Contributing to Climate Change

<table>
<thead>
<tr>
<th>Greenhouse Gas</th>
<th>Human Source (Examples)</th>
<th>% of Total Global GHG Emissions (2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide (CO\textsubscript{2})</td>
<td>Fossil fuel combustion, land use changes, cement production, …</td>
<td>76%</td>
</tr>
<tr>
<td>Methane (CH\textsubscript{4})</td>
<td>Fossil fuel mining/distribution, livestock, rice agriculture, landfills, …</td>
<td>16%</td>
</tr>
<tr>
<td>Nitrous oxide (N\textsubscript{2}O)</td>
<td>Agriculture (fertilisers) and associated land use change, …</td>
<td>6%</td>
</tr>
<tr>
<td>Hydrofluorocarbons (e.g. HFCs)</td>
<td>Liquid coolants, …</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>Perfluorocarbons (e.g. PFCs)</td>
<td>Refrigerant, electronics industry and aluminium industry, …</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>Sulphur hexafluoride (SF\textsubscript{6})</td>
<td>Insulator in electronics and magnesium industry, …</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>Nitrogen trifluoride (NF\textsubscript{3})</td>
<td>Electronics and photovoltaic industries, …</td>
<td>&lt; 2%</td>
</tr>
</tbody>
</table>

Source: Reproduced from IPCC 2007, UNEP 2012, and FERN
Global “Carbon Budget” to Avoid Warming Beyond 2°C

| Total budget of anthropogenic CO₂ emissions to limit warming to 2°C | appr. 1,000 GtC |
|==================================================================|------------------|
| Total anthropogenic CO₂ emissions 1870-2011                      | appr. 500 GtC    |
| Remaining “carbon budget”                                         | appr. 500 GtC    |

If no action is taken, carbon budget will be exhausted in 30 years

Source: Based on IPCC 2013
Emission Reduction Pledges

Source: UNEP 2012, p2
Estimated and Projected Levels of Annual GHG Emissions

Estimated global emissions

Source: UNEP 2012, p2
Mitigating Greenhouse Gases: A Shared Global Responsibility

- Global emissions need to be reduced by at least 50% by 2050
- The emission pledges made, if fully met, place the world on a trajectory for a global warming of well over 3°C
- Without emission reduction in developing countries it will not possible to stay within the maximum temperature increase of 2°C

Global average surface temperature increase compared to pre-industrial levels (source: World Bank 2012)

Source: Reproduced from IPCC 2007 and World Bank 2012
Total GHG Emissions of G20 Countries

Source: UNEP 2012, p19
GHG Emissions of G20 Countries per Unit of GDP

Source: UNEP 2012, p19
GHG Emissions of G20 Countries per Capita

Source: UNEP 2012, p20
Co-Benefits Resulting from Mitigation and Low Carbon Development

Environmental
- Conservation of biodiversity and ecosystems
- Improved water and air quality
- Restoration of degraded land
- …

Economic
- Employment creation
- Energy security
- New economic opportunities
- Potential cost savings
- …

Social
- Access to better services
- Health benefits
- Lifestyle benefits
- …
Co-Benefits from Biogas Energy Production in Rural China

Video: Example of a project for biogas energy production in China.

URL: http://www.youtube.com/watch?v=iIda6HiXc4k
Section 2

Strategic Frameworks and Policy Approaches for Mitigation and Low Carbon Development
Low Carbon Development Requires:

**Political thinking** to develop and implement plans and strategies resulting in less carbon intense economic development.

Patterns of **consumption and production**, which are resource and energy efficient.

Redirection of **investments** towards clean technologies, renewable energy, and sustainable management of water, agriculture and forests.

Further info: EU and UNPD Low Emission Capacity Building Programme
Low-Emission Development Strategy (LEDS)

Source: Reproduced from GIZ 2012
Examples of LEDS

- Ethiopia’s Climate Resilient Green Economy Strategy
- Bangladesh’s Climate Change Strategy and Action Plan
- Korea’s National Strategy for Green Growth

Further info: UNDP website, UNCSD website
Elements of LEDS

- Economy-wide, long-term mitigation goals and vision
- Emissions data and projections
- Survey of cost-efficient mitigation options and their prioritization
- Identification of mitigation policies, actions and related targets

Further info: Mitigation Partnership website
Policy Instruments to Foster Low Carbon Development

- **Market based instruments**
  - Emission trading schemes
  - Payment for ecosystem services

- **Financial incentives**
  - Subsidies
  - Access to capital

- **Fiscal instruments**
  - Taxes and tariffs
  - Sector-specific fiscal stimulus package

- **Other**
  - Research, development and demonstration activities
  - Environmental and social standards
  - Skills development and awareness-raising
Nationally Appropriate Mitigation Actions (NAMAs)

NAMA Spectrum:

- NAMAs
- Projects
- Sectoral Approaches
- Research and Development
- Policies and Strategies

Source: GIZ 2012
Examples of NAMAs Underway

<table>
<thead>
<tr>
<th>Country</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>Building, Transport</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Peat Land</td>
</tr>
<tr>
<td>Tunisia</td>
<td>Solar Plan</td>
</tr>
<tr>
<td>Chile</td>
<td>Transport Sector</td>
</tr>
</tbody>
</table>

For more information on planned and implemented NAMAs please visit the [NAMA Database](#) or the [NAMA registry](#).
Section 3

Sectors with High Mitigation Potential
Sectors with High Mitigation Potential

Source: IPCC (2014). Fifth Assessment Report
Selected Mitigation Options: Energy

- Use of renewable heat and power (hydropower, solar, wind, geothermal and bioenergy)
- Improved supply and distribution efficiency
- Carbon capture storage (CCS)
- Combined heat and power
- ...
Case Example Energy: Renewable Energy in Bhutan

Rural electrification has been an integral part of the Royal Government of Bhutan’s strategy to reduce poverty and stimulate economic activities in rural areas. In order to improve national energy security, the Department of Energy of the Ministry of Economic Affairs of Bhutan developed a Renewable Energy Policy in 2011.

Further info: UNESCAP Green Growth Website
Selected Mitigation Options: Transport

- More fuel efficient vehicles
- Use of alternative energy sources (biofuels, cleaner diesel, etc.)
- Better land-use and transport planning
- Shift from individual transport to public transport systems
- More efficient driving practices
- Non-motorized transport (cycling, walking)
- …

Source: City Fix
Case Example Transport: Co-Benefits of Bogotá’s Bus Rapid Transit System

Source: UNFCCC
Selected Mitigation Options: Buildings

- Efficient lighting and day lighting
- More efficient electrical appliances and heating and cooling devices
- Improved insulation
- Integrated design of buildings including technologies such as intelligent meters that provide feedback and control
- Solar photovoltaic systems integrated in buildings
- …

Source: UN-Habitat
Case Example Buildings: Energy Efficient Housing in Bulgaria

Video: This video presents an example of work by UNECE on efficient housing in Bulgaria

URL: http://www.youtube.com/watch?v=ym-WAJSqjAY
Selected Mitigation Options: Industry

- Process-specific technologies that improve efficiency and reduce emissions
- Material recycling and substitution
- Heat and power recovery/cogeneration
- Control of greenhouse gas emissions
- ...

Source: UNIDO
Case Example: Emission Reductions in the Cement Industry in Mongolia

- New emission removal and control system
- Investment costs: USD 2,210
- Annual net savings: USD 14,400
- Payback period: less than 2 months

Source: UNEP/Yurtcimento. Further info: Green Industry Platform
Selected Mitigation Options: Agriculture

- Manure and livestock management to reduce CH$_4$ emissions
- Improved fertilizer application techniques to reduce N$_2$O emissions
- Improved crop and grazing land management to increase soil carbon storage
- Restoration of cultivated peaty soils and degraded lands
- Agro-forestry practices
- ...
Agriculture faces intertwined challenges

- Ensuring food security
- Adapting to climate change
- Contributing to climate change mitigation
Selected Mitigation Options: Forestry

- Reduced deforestation
- Afforestation/reforestation
- Forest management
- Tree species improvement to increase biomass productivity and carbon sequestration

Source: UN-REDD
Case Example Forestry: UN-REDD in Indonesia

Video: This video presents the UN-REDD programme in Indonesia

URL: http://www.youtube.com/watch?v=Fia4RxqU4Sk
Selected Mitigation Options: Waste

- Landfill methane recovery
- Waste incineration with energy recovery
- Composting of organic waste
- Controlled wastewater treatment
- Recycling and waste minimization
- Biocovers and biofilters to optimize CH$_4$ oxidation

Source: UNEP
Case Example: Waste Management in South Africa

- **Mariannhill Landfill** - South Africa’s first Clean Development Mechanism (CDM) project
- Landfill electricity generation from methane
- The project is made possible via the flexible mechanisms for carbon funding

Source: [Africa Trust](https://www.africatrust.org/)
Section 4

International Initiatives to Support Climate Change Mitigation
International Mechanisms to Promote Climate Change Mitigation

Mechanisms under Kyoto Protocol
- CDM
- JI
- IET

Bilateral, domestic and voluntary
- Bilateral/Joint mechanism
- Domestic offset scheme
- Voluntary offset scheme

Regional, national, sub-national trading scheme
- Non-market mechanisms
  - Net Avoided Emissions
  - Other approach

Mechanism under COP
- New Market Mechanism

Source: IGES 2013, slide 10
Kyoto Flexible Market Mechanisms

Three Kyoto Mechanisms

Joint Implementation (JI)
Clean Development Mechanism (CDM)
Emission Trading
New Market Mechanism (NMM)

Recognized limits of CDM implementation (project focus)

Decision at COP 17 to create a New Market Mechanism to account for sector-wide emissions

NMM will operate under COP and will be voluntary – details to be negotiated
How Does the European Emissions Trading Scheme Work?

URL: http://www.youtube.com/watch?v=ReOj12UAus4

Video: This video provides more detailed information on the Emission Trading Scheme
Some UN Work Programmes and Initiatives to Support Mitigation

**Nairobi Framework**

- To assist countries with CDM implementation
- To enable countries to identify, develop and submit and process CDM projects

**UN REDD Program**

- Seeks to create a financial value for carbon stored in trees
- Offers incentives for developing countries to reduce emissions from forested lands

**NAMA Registry**

- Web based platform linking developers and facilitators
Module Summary

- Mitigation refers to efforts to reduce greenhouse gases emissions or to enhance their removal from the atmosphere by sinks.

- Implementing mitigation actions can bring social, economic and environmental co-benefits.

- The sectors with the biggest mitigation potential are: energy, industry, transport, agriculture, forestry and waste.

- Given the fundamental changes required to achieve low carbon development, mitigation actions needs to be integrated with broader development goals and plans.

- Many countries have made pledges to reduce their emissions. However current pledges are not sufficient to prevent dangerous climate change (global temperature increase beyond 2°C).

- There are several international mechanisms to support mitigation, many of them created under the Kyoto Protocol.
Useful Links

- NAMA Partnership
- CIFOR – Forest Carbon Database
- CDM Bazaar
- International Partnership on Mitigation and MRV
- Green Growth Knowledge Platform
- UNEP CDM Methodologies & Technologies Selection Tool
- WBI e-Courses on Low Carbon Development
- UNESCAP Green Growth Online e-Learning Facility
- ClimateTechWiki
Recommended Readings

- FAO (2013). Climate-Smart Agriculture Sourcebook
- IPCC (2011). Renewable Energy Sources and Climate Change Mitigation
- World Bank (2012). Turn Down the Heat
Main References

- UNFCCC. CGE Training Materials – Mitigating Climate Change
- UNFCCC. Official Website – Mitigation
- UNITAR (2013). Climate Change Diplomacy: Negotiating Effectively under the UNFCCC, Module IV Mitigating Climate Change