



DP IB Environmental Systems & Societies (ESS): SL

6.3 Climate Change Mitigation & Adaptation

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Global Action & Decarbonisation

Global Action on Climate Change

Importance of global action

- Climate change affects the entire planet
 - Therefore, coordinated global action is essential
- Actions by individual countries and states are insufficient to address the global nature of climate change
 - This means that **international cooperation** is necessary for **effective** climate action

State sovereignty and international cooperation

- State sovereignty:** the principle that each country has the authority to govern itself without external interference
- Climate change crosses national borders, requiring countries to work together and often requiring countries to **compromise** some of their sovereignty
- International cooperation is achieved through negotiations, protocols, conventions and treaties

Key UN treaties and protocols

- United Nations Framework Convention on Climate Change (UNFCCC), 1992:**
 - Established at the Earth Summit in Rio de Janeiro
 - Framework for international efforts to address climate change
 - Encouraged developed countries to lead in reducing emissions and supporting developing countries
- Kyoto Protocol, 1997:**
 - First major international treaty to reduce greenhouse gas emissions
 - Set legally binding targets for developed countries to reduce emissions
- Doha Amendment to the Kyoto Protocol, 2012:**
 - Extended the Kyoto Protocol beyond 2012
 - Set new emission reduction targets for developed countries for 2013–2020

- Encourages further international cooperation and support for developing countries on how to adapt to climate change
- **Paris Agreement (2015):**
 - Aim: limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C
 - Nearly all countries have committed to reducing their emissions
 - Countries submit Nationally Determined Contributions (NDCs) outlining their climate action plans
 - Set a mechanism for regular review and enhancement of NDCs every five years

International cooperation mechanisms

- **Negotiations:** countries discuss and agree on common goals, commitments and actions to tackle climate change
- **Protocols and conventions:** formal agreements that outline specific commitments and actions countries must take
- **Sanctions:** tools like **cross-border carbon taxes** can be used to encourage compliance and ensure countries adhere to climate policies
 - A cross-border carbon tax is a levy imposed on imported goods based on the carbon emissions produced during their manufacture
 - These taxes aims to equalise the cost of carbon between countries with different climate policies
 - They encourage global reduction of greenhouse gas emissions and help reduce carbon leakage

Decarbonisation

What is decarbonisation?

- Reducing or ending the use of fossil fuels (coal, oil, natural gas) that emit carbon dioxide when burned
- **Transitioning to renewable energy sources** such as wind, solar, hydro and geothermal energy

Carbon neutrality

- Achieving **net-zero** carbon emissions
- This means balancing the amount of emitted CO₂ with an equivalent amount of CO₂ removal
 - Methods to achieve this include:
 - Reducing emissions
 - Enhancing carbon sinks (e.g. forests)

- Using technologies like carbon capture and storage (CCS)

Targets for carbon neutrality

- Different countries have set varied dates for achieving carbon neutrality, for example:
 - UK: by 2050
 - China: by 2060
 - Germany: by 2045
- These targets are crucial for meeting global climate goals and are part of each country's NDC under the Paris Agreement

Steps towards decarbonisation

- **Transitioning to renewable energy:**
 - Solar, wind, hydro and geothermal energy
- **Energy efficiency:**
 - Improving efficiency of energy and lowering energy waste in buildings, transportation and industry
- **Electrification:**
 - Using electricity (preferably from renewable sources) for heating, cooking and transportation
- **Carbon Capture and Storage (CCS):**
 - **Capture:** capturing CO₂ emissions directly from sources like power plants and industrial processes
 - **Transport:** once captured, CO₂ is compressed and transported, typically via pipelines, to a storage site
 - **Storage:** CO₂ is injected deep underground, where it is securely stored

Real-world examples

European Union (EU) Green Deal

- **Objective:** aimed at making Europe the first climate-neutral continent by 2050
- **Policies:**
 - **Carbon border adjustment mechanism:** introduces a carbon tax on imports to prevent "carbon leakage" and ensure fair competition for EU industries that have stricter climate regulations
 - **Renewable energy expansion:** sets targets for increasing the share of renewable energy sources in the EU's energy mix

- **Energy efficiency:** promotes energy-efficient technologies and practices across various sectors

Norway's renewable energy initiatives

- **Achievement:** Norway generates nearly 100% of its electricity from renewable sources, primarily hydropower
- **Incentives for electric vehicles (EVs):**
 - Offers incentives for purchasing electric vehicles, including tax exemptions, toll reductions and free parking
- **Climate policies:**
 - Plans to phase out fossil fuel-based vehicles by 2025, contributing significantly to reducing transportation emissions

Climate Change Mitigation

Climate Change Mitigation Strategies

- Climate change **mitigation** is now of crucial importance for human societies
- Mitigation strategies focus on **reducing** and **stabilising** greenhouse gas (GHG) emissions
- Climate change mitigation includes:
 - Reducing GHG emissions at their **source**
 - Developing techniques to **remove GHGs** from the atmosphere

Mitigation Strategies to Reduce GHGs

Mitigation Strategy	How to Implement Strategy
Reduction of Energy Consumption	Implement energy efficiency measures such as insulation, efficient lighting and higher efficiency appliances Promote smart grids and energy management systems Support energy-efficient industrial processes
Transport Policies	Implement fuel efficiency standards for vehicles Implement policies to promote electric vehicles, hybrid cars and fuel-efficient transportation systems Invest in public transportation infrastructure to reduce reliance on individual car usage Encourage sustainable transportation options like public transit, cycling, and walking
Reduction of Emissions from Agriculture	Implement agricultural practices to minimise nitrogen oxides and methane emissions Promote sustainable livestock management techniques such as improved feed quality, methane capture systems and rotational grazing
Use of Alternatives to Fossil Fuels	Transition to renewable energy sources such as solar, wind, hydro and geothermal energy

	<p>Promote electric vehicles (EVs) and support the development of charging infrastructure</p> <p>Invest in research and development of biofuels, hydrogen and nuclear energy</p>
Geoengineering	Explore solar radiation management techniques like stratospheric aerosol injection to reflect sunlight back into space
Carbon Tax	Implement a tax on carbon emissions to incentivise reduction in GHG emissions
Natural carbon Sinks (e.g. forestation, rewilding)	Afforestation and reforestation, promote rewilding initiatives, restore degraded ecosystems, and protect existing forests to increase carbon sinks
Carbon Capture and Storage	<p>Carbon removal techniques such as direct air capture (DAC) to remove carbon dioxide from the atmosphere</p> <p>Develop and deploy technologies to capture carbon dioxide emissions from industrial and energy processes</p> <p>Store captured carbon dioxide underground or in other long-term repositories</p>



Electric vehicles have the potential to play a significant role in mitigating climate change (Photo by Ernest Ojeh on Unsplash)

Climate Change Adaptation

Climate Change Adaptation Strategies

- As the impacts of climate change increase, it is essential to implement adaptation strategies to **reduce adverse effects** and maximise any potential positive outcomes
- Climate change adaptation strategies focus on **building resilience** and adapting to changing climate conditions

Climate Change Adaptation Strategies

Adaptation Strategy	How to Implement Strategy
Flood Defences	<p>Construct and reinforce flood protection infrastructure (levees, flood barriers, coastal defences)</p> <p>Implement sustainable drainage systems (SUDs) to manage and control excess water during heavy rainfall events</p> <p>Restore and preserve natural floodplains, wetlands, and mangroves as natural buffers against flooding</p>
Vaccination Programmes	<p>Develop and implement proactive public health measures, including vaccination programs</p> <p>Strengthen disease surveillance systems to monitor and respond to climate-related health impacts, such as the spread of vector-borne diseases in new regions</p>
Desalination Plants	<p>Invest in desalination technologies to increase freshwater availability in water-scarce regions</p> <p>Ensure sustainability through energy-efficient methods, renewable energy use and responsible environmental management</p>
Planting of Crops in Previously Unsuitable Areas	<p>Expand cultivation into areas now suitable due to shifting climate patterns</p> <p>Diversify crop varieties to adapt to new environmental conditions and enhance food security</p>

Adapting Agricultural Practices	<p>Promote adoption of drought-resistant crops and resilient crop varieties</p> <p>Implement soil management techniques to conserve water and nutrients in changing climate conditions</p>
Land Zoning and Building Code Changes	<p>Update zoning regulations to consider climate risks like sea-level rise and extreme weather events</p> <p>E.g. restrict development in areas prone to flooding or require elevated construction; limit development along vulnerable coastlines</p> <p>Strengthen building codes to enhance resilience against hurricanes, floods, wildfires and heatwaves</p> <p>E.g. enforce building materials and landscaping practices that reduce fire risk; promote green spaces and reflective building materials to mitigate urban heat islands</p>



Mangrove forests act as natural buffers against flooding (Photo by David Clode on Unsplash)

Adaptation Plans

- Adaptation plans are strategies designed to help individuals, communities and societies cope with the impacts of climate change
- These plans aim to:
 - Reduce vulnerability** to climate-related hazards
 - Increase resilience** to climate change impacts

National Adaptation Programmes of Action (NAPAs)

What are NAPAs?

- NAPAs are plans developed by Least Developed Countries (LDCs) to identify and prioritise urgent adaptation needs
 - These plans are submitted to the United Nations Framework Convention on Climate Change (UNFCCC)
- They focus on immediate actions to address climate change impacts, particularly in sectors like agriculture, water resources and health
- For example:
 - Bangladesh:** has implemented NAPA projects to improve flood forecasting and early warning systems
 - Malawi:** has developed strategies to enhance food security through drought-resistant crops and sustainable land management

Resilience and adaptation plans

- Resilience plans aim to strengthen the ability of communities and ecosystems to **recover from climate shocks**
- Adaptation plans focus on long-term strategies to **adjust** to changing climate conditions

- For example:
 - **New York City One NYC plan:** includes measures to protect against coastal flooding and enhance green infrastructure
 - **Netherlands Delta Programme:** involves constructing robust flood defences and adaptive water management systems to protect against sea-level rise
 - **UK Climate Change Risk Assessment (CCRA)** identifies key risks and adaptation priorities, such as flood risk management and resilient infrastructure

UN Development Programme (UNDP) Assistance

Role of UNDP

- The UNDP helps developing countries create and implement adaptation plans
- Provides technical and financial support to address the most imminent impacts of climate change
- **Process:**
 - Assess local vulnerabilities and climate risks
 - Develop action plans prioritising urgent needs
 - Implement projects with community involvement
- For example:
 - **Samoa**, with UNDP support, has improved its coastal infrastructure to protect communities from storm surges
 - **Bhutan** has developed climate-resilient agricultural practices to adapt to changing weather patterns