DP IB Environmental Systems & Societies (ESS): SL

Your notes

Climate Change: Mitigation & Adaptation

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Climate Change: Mitigation Strategies

- Climate change **mitigation** is now of crucial importance for human societies and focuses on **reducing** and **stabilising** greenhouse gas (GHG) emissions
  - Climate change mitigation encompasses both reducing GHG emissions at their **source** and developing techniques to **remove them** 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 to **reduce energy demand** in buildings ▪ Promote the use of smart grids and energy management systems to optimise energy usage and reduce waste ▪ Encourage **sustainable transportation** options like public transit, cycling, and walking to decrease reliance on fossil fuel-powered vehicles ▪ Support the development and adoption of energy-efficient industrial processes to reduce energy consumption in **manufacturing** ▪ Promote behaviour change and awareness campaigns to encourage individuals and businesses to adopt energy-saving practices
Reduction of Emissions from Agriculture	▪ Implement agricultural practices that minimise emissions of **nitrogen oxides** (which contribute to tropospheric ozone) and **methane** ▪ Promote sustainable livestock management techniques such as improved feed quality, methane capture systems, and rotational grazing ▪ Improve soil management and encourage precision agriculture methods that **optimise fertiliser use**, so that no more fertiliser is used than is needed
Use of Alternatives to Fossil Fuels	▪ Transition to **renewable energy sources** such as solar, wind, hydropower, and geothermal energy for electricity generation ▪ Promote the use of electric vehicles (EVs) and support the development of charging infrastructure to reduce reliance on fossil fuel-powered

	transportation ▪ Invest in research and development of **biofuels** and **hydrogen** as cleaner alternatives to conventional fossil fuels ▪ Continue to explore the potential of nuclear energy as a low-carbon alternative to fossil fuels
Geo-engineering	▪ Investigate the feasibility of **carbon removal techniques** such as **afforestation**, reforestation, and direct air capture (DAC) to remove carbon dioxide from the atmosphere ▪ Explore solar radiation management techniques like stratospheric aerosol injection to **reflect sunlight** back into space and mitigate global warming

Photo by Ernest Ojeh on Unsplash

Electric vehicles have the potential to play a significant role in mitigating climate change

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- Despite significant mitigation efforts, the impact of past GHG emissions will **persist** for decades due to their long atmospheric lifetime
  - The cumulative nature of GHGs means that even with drastic reductions in future emissions, the GHGs already emitted will continue to contribute to climate change and its effects, such as rising temperatures and sea level, altered weather patterns, and ecological changes
- However, implementing comprehensive mitigation strategies that target energy consumption, agriculture, fossil fuel alternatives, and innovative technologies is still crucial for effectively addressing climate change
  - While reducing future emissions is essential, recognising the long-lasting influence of past emissions highlights the importance of **sustained mitigation efforts** to minimise the impacts and create a more sustainable future


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Removal of Carbon Dioxide from the Atmosphere

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Carbon Dioxide Removal

- In addition to reducing GHG emissions, carbon dioxide removal (CDR) techniques play a crucial role in mitigating climate change

Strategies for Carbon Dioxide Removal

Removal Strategy	Description
Protecting and Enhancing Carbon Sinks through Land Management	▪ Implementing programs like the UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UNREDD) to **prevent deforestation** and **promote sustainable forest management** ▪ Restoring and expanding forests through **afforestation** and **reforestation** initiatives, which absorb carbon dioxide through photosynthesis ▪ Implementing sustainable land management practices such as **agroforestry** and **soil carbon sequestration** (sometimes referred to as "carbon farming" or "regenerative agriculture") to enhance carbon sinks in agricultural landscapes
Using Carbon Capture and Storage (CCS)	▪ Capturing carbon dioxide emissions from industrial facilities, power plants, and other large-scale sources **before they are released** into the atmosphere ▪ Transporting the captured carbon dioxide and securely storing it underground or utilising it for industrial purposes
Using Biomass as a Fuel Source	▪ Utilising bioenergy with carbon capture and storage (BECCS) technology, which involves capturing carbon dioxide emissions from biomass combustion and storing it underground, effectively removing carbon dioxide from the atmosphere ▪ Promoting sustainable cultivation of bioenergy crops that does not cause deforestation - bioenergy crops absorb carbon dioxide from the atmosphere as they photosynthesise
Enhancing Carbon Dioxide Absorption by the	▪ Exploring **ocean fertilisation techniques** by adding compounds like nitrogen, phosphorus, and iron to stimulate the growth of

Oceans	**phytoplankton**, which absorb carbon dioxide through photosynthesis ▪ Investigating methods to increase upwellings, which bring **nutrient-rich** deep waters to the surface, with the same effect of promoting the growth of phytoplankton and enhancing carbon dioxide absorption


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Climate Change: Adaptation Strategies

- As the impacts of climate change become increasingly evident, 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	▪ Constructing and reinforcing **flood protection infrastructure**, such as **levees**, flood barriers, and coastal defences, to mitigate the risks associated with **rising sea levels** and increased rainfall ▪ Implementing **sustainable drainage systems** (SUDs) to manage and control excess water during heavy rainfall events ▪ Restoring and preserving natural floodplains, wetlands, and mangroves, which act as **natural buffers against flooding**
Vaccination Programmes	▪ Developing and implementing proactive public health measures, including vaccination programs, to address the **changing disease patterns** and emergence of new health risks associated with climate change ▪ Strengthening disease surveillance systems to monitor and respond to climate-related health impacts, such as the spread of **vector-borne diseases** in new regions
Desalination Plants	▪ Investing in **desalination** technologies to increase freshwater availability in regions facing **water scarcity** due to reduced rainfall or saltwater intrusion ▪ However, it is important to also ensure the **sustainability** of any desalination practices by integrating energy-efficient methods, utilising renewable energy sources, and minimising the environmental impacts (e.g. of brine disposal)
Planting of Crops in Previously Unsuitable	▪ As climate patterns shift and certain regions experience milder temperatures or increased rainfall, areas that were once unsuitable for

Areas	certain crops may become suitable for cultivation ▪ This expansion of suitable growing conditions can open up new opportunities for farmers, allowing them to cultivate a broader range of crops and **increase agricultural output** ▪ This has the potential to contribute to food security by reducing reliance on specific crops or specific regions that may be more vulnerable to climate change impacts

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Photo by David Clode on Unsplash

Mangrove forests act as natural buffers against flooding

- These adaptation strategies aim to **reduce vulnerability** and enhance the capacity of communities, ecosystems, and sectors to cope with the impacts of climate change
- By implementing these measures, societies may be able to minimise potential harm, seize opportunities, and **increase resilience** in the face of a changing climate

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International Policy on Climate Change

- Climate change is a global challenge that requires **international cooperation** and **coordination** to address its impacts

Various organisations and conferences play a crucial role in formulating and implementing mitigation and adaptation strategies

Intergovernmental Panel on Climate Change (IPCC)

- The IPCC is a scientific body established by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) in 1988
- It provides policymakers with **objective scientific assessments** of climate change, including its impacts, future risks, and potential mitigation and adaptation options
- The IPCC's reports and findings serve as a vital foundation for global climate action

United Nations Framework Convention on Climate Change (UNFCCC)

- The UNFCCC is an international treaty that provides a platform for **global cooperation** on climate change
- Its objective is to **stabilise greenhouse gas concentrations** in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system
- The UNFCCC organises annual Conference of the Parties (COP) meetings, where countries discuss and negotiate climate policies, commitments, and agreements

Conference of the Parties (COP)

- The COP meetings serve as crucial forums for **decision-making** and **policy development** on climate change

- The COP meetings have resulted in landmark agreements, such as the Kyoto Protocol and the Paris Agreement
- These agreements outline international commitments and targets for reducing greenhouse gas emissions and supporting adaptation efforts


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National Adaptation Programmes of Action (NAPAs)

- NAPAs are a key component of the UNFCCC's efforts to **support developing countries** in addressing climate change impacts
- NAPAs enable the most **vulnerable** countries to identify their priority adaptation needs and develop strategies to reduce their vulnerability to climate change
- These programs aim to enhance resilience and adaptive capacity in vulnerable regions

Other Initiatives

- In addition to the above, various other initiatives and conferences, such as the United Nations Climate Action Summit and the Global Climate Action Agenda, aim to mobilise and showcase climate action at the global, regional, and local levels
- These platforms encourage collaboration, knowledge sharing, and the implementation of innovative solutions to address climate change
- It is through these international efforts and conferences that countries and stakeholders come together to share knowledge, exchange best practices, and develop collective strategies to mitigate greenhouse gas emissions and adapt to the impacts of climate change