# HS 232

Lecture 7 22nd January 2025

Climate mitigation as environmental externality

# Recap

- Marginal cost and Revenue curve
- Positive and Negative externalities
- Shifts in MC and MR curves
- Market Failure
- Public good

# What is climate mitigation?

- Climate mitigation refers to actions aimed at reducing greenhouse gas (GHG) emissions or enhancing carbon sinks to curb the impacts of climate change.
- Examples include transitioning to renewable energy, adopting energy-efficient technologies, afforestation, and promoting sustainable agricultural practices.
- However climate mitigation is a public good and it also leads to market failure due to externalities

# Characteristics of a Public Good

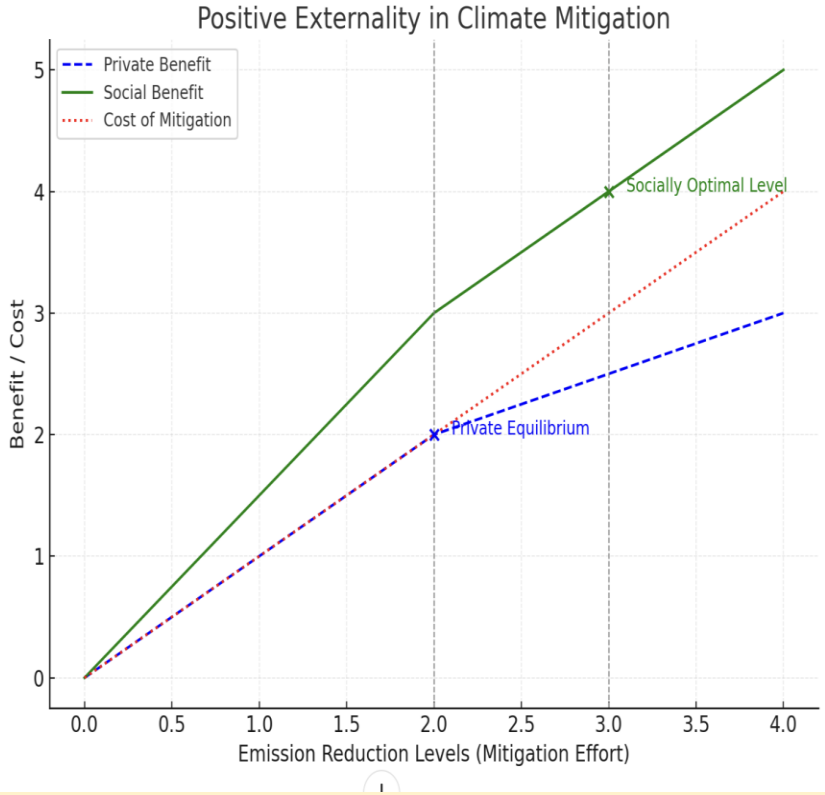
- **Non-excludability:**
  - Once mitigation actions (like reducing greenhouse gas emissions) are implemented, no individual or country can be excluded from enjoying the benefits. For instance, a reduction in global warming benefits everyone, regardless of whether they contributed to the mitigation effort.
- **Non-rivalry:**
  - One person's or country's enjoyment of the benefits of mitigation does not diminish the benefits available to others. For example, a cooler and more stable climate can be enjoyed by all simultaneously without depletion.

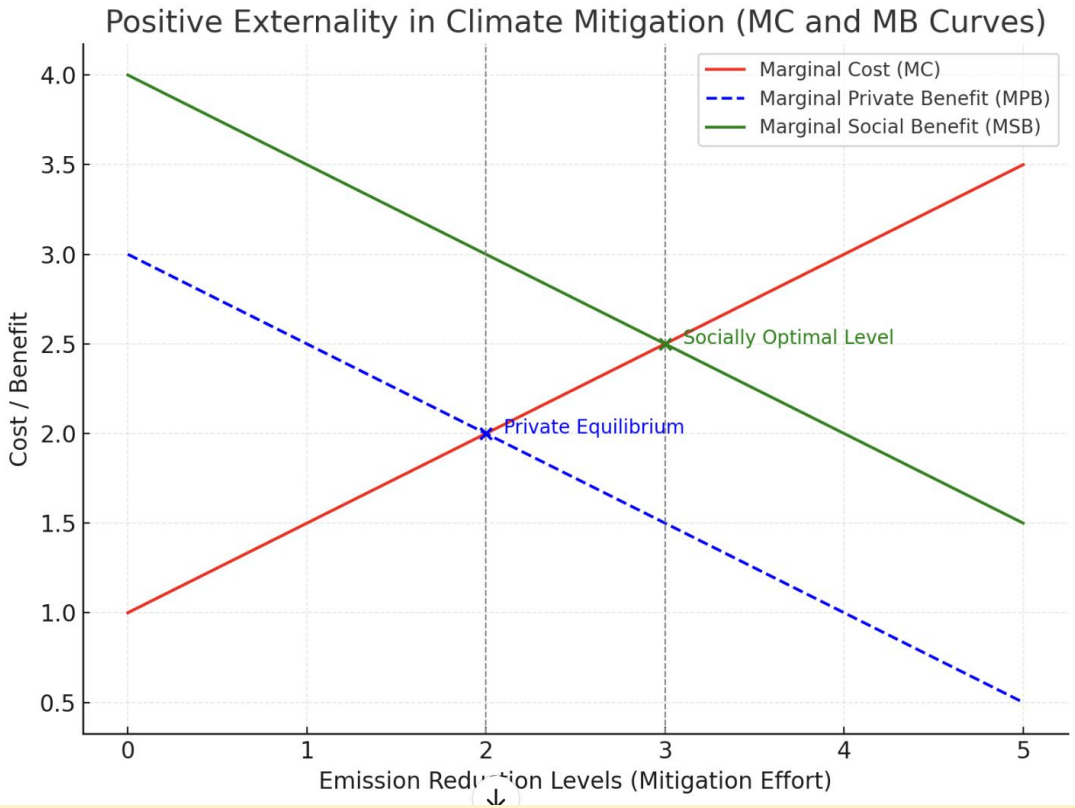
# Positive Externalities in Climate Mitigation

- **Global Benefits of Emission Reductions:**
  - A country or organization that invests in reducing emissions benefits the entire world by slowing climate change. However, these global benefits—such as reduced temperature increases, less extreme weather, and fewer ecosystem disruptions—are not limited to the entity bearing the cost of mitigation.
  - For instance, if India invests in solar energy, it reduces global GHG levels, benefiting not just its citizens but also people in other countries.
- **Health Benefits:**
  - Actions like reducing fossil fuel use lower air pollution, leading to fewer respiratory and cardiovascular diseases. While the country implementing these measures enjoys these health benefits directly, neighboring regions might also benefit from cleaner air without contributing to the costs.
- **Economic Opportunities:**
  - Investments in clean energy and green technologies often lead to innovation, job creation, and lower energy costs over time. These innovations may spill over to other regions or countries, boosting global progress without direct compensation for the innovating entity.
- **Preservation of Ecosystems:**
  - Mitigation efforts, such as protecting forests, contribute to biodiversity conservation. Healthy ecosystems provide services like pollination, water purification, and climate regulation, benefiting communities globally

# Why is Climate Mitigation Underprovided?

- Due to the nature of positive externalities, individuals, firms, or nations may not fully account for the broader benefits of their actions. This leads to underinvestment in climate mitigation because:
- The **costs** of mitigation are borne locally or immediately, while the **benefits** are shared globally and occur over the long term.
- There is a **free-rider problem** where some entities rely on others to take action while reaping the shared benefits.




1. **Private Benefit Curve (Blue Dashed Line):** Represents the benefits accrued to the entity directly undertaking mitigation actions.
2. **Social Benefit Curve (Green Solid Line):** Represents the total benefits, including private and external (global and societal) benefits.
3. **Cost Curve (Red Dotted Line):** Represents the costs of mitigation efforts.

## Key Points:

- **Private Equilibrium:** Occurs where the private benefit equals the cost. This results in an underinvestment in mitigation because the entity does not account for societal benefits.
- **Socially Optimal Level:** Occurs where the social benefit equals the cost. This level of mitigation accounts for both private and external benefits.

The gap between private equilibrium and the socially optimal level highlights the **underprovision of mitigation efforts** due to the positive externality.

# Costs Borne Locally/Immediately

- **Financial Costs:**
  The local or national government, private companies, or communities invest in expensive renewable energy infrastructure, such as solar panels, wind turbines, or grid upgrades.
- **Economic Transition Costs:**
  Workers in fossil fuel industries may lose their jobs, and governments may face revenue losses from reduced fossil fuel taxes.
- **Social Disruption:**
  Communities near renewable energy projects may face land-use conflicts or displacement (e.g., wind farms or solar installations occupying agricultural or grazing lands).
- **Opportunity Costs:**
  Immediate funds allocated to mitigation could be used for other pressing local needs, such as healthcare or education.

# Benefits Shared Globally/Over the Long Term

- **Reduction in Greenhouse Gas Emissions:**
  The benefits of reduced $CO_2$ emissions contribute to global climate stabilization, reducing the frequency and intensity of climate disasters worldwide.
- **Long-Term Climate Resilience:**
  Slower global warming means fewer droughts, floods, and extreme weather events, which benefits the entire planet, not just the local area investing in mitigation.
- **Health Benefits (Global):**
  Reduced air pollution from burning fossil fuels leads to fewer respiratory illnesses, improving public health globally.
- **Economic Co-Benefits (Long Term):**
  Mitigation efforts reduce the long-term costs of climate change impacts, such as damage to infrastructure, loss of agricultural productivity, and displacement caused by rising sea levels.

# Example: India's Solar Energy Initiative

- **Costs:** India has invested billions in solar parks under the National Solar Mission, borne primarily by the government and local industries. These costs include land acquisition, capital investment, and retraining workers from fossil fuel sectors.
- **Benefits:** The reduction in global emissions benefits all nations by slowing climate change. However, these benefits are global and long-term, whereas India bears the immediate financial and social costs of transitioning to renewable energy.
- This imbalance between **local costs** and **global benefits** makes mitigation a classic example of a global public good and market failure

# Free-Rider Behavior:

- Some countries, particularly smaller or less developed ones, might choose not to invest in mitigation efforts. Instead, they rely on larger economies (like the U.S., EU, or China) to reduce global emissions, assuming their efforts will stabilize the climate for all.
- For example, if Country A invests heavily in renewable energy while Country B does nothing, both countries benefit equally from reduced climate risks.

**Outcome:**

- The shared benefit of climate mitigation (a more stable global climate) encourages some countries to "free-ride" on the efforts of others.
- If too many countries adopt this strategy, global emissions remain high, and climate goals (like limiting global warming to 1.5°C) are not achieved.

# Implication : Market failure in case of Mitigation

- Market failure refers to a situation defined by an inefficient distribution of goods and services in the free market.
- In the case of **climate mitigation**, market failure arises because the costs and benefits of reducing greenhouse gas (GHG) emissions are not adequately reflected in market transactions.
- Incomplete information leads to suboptimal decisions, such as continued reliance on carbon-intensive activities instead of shifting to sustainable practices.

# Policy Interventions to Correct Market Failure

***Internalizing the externality*** *refers to adjusting market mechanisms so that the social costs or benefits of an economic activity are reflected in its price.*

## Direct methods

- **Subsidies for Clean Energy:** Provide financial incentives for renewable energy and energy efficiency projects to encourage mitigation investments.
- **International Agreements:** Foster global cooperation through agreements like the Paris Accord to ensure coordinated action (climate finance).
- **Public Awareness Campaigns:** Educate people about climate change and the importance of mitigation to increase demand for mitigation

# Subsidy

- Subsidies aim to make clean energy more affordable, increase its competitiveness compared to traditional energy sources like fossil fuels, and promote the transition to a sustainable energy system.

Example :

- The Indian government offers various subsidies and incentives for solar energy, such as capital subsidies for individuals or companies installing solar panels. Under the **National Solar Mission**, the government provides subsidies that reduce the upfront cost of purchasing and installing solar power systems, making it more accessible for consumers, especially in rural areas.
- **Increased Adoption**: By reducing the cost of renewable energy technologies, subsidies help more people and businesses transition to cleaner energy.

# Indirect methods

**Carbon Tax**

- A carbon tax directly imposes a fixed cost on every ton of $CO_2$ emitted.
- It raises the price of fossil fuels, making carbon-intensive activities more expensive.
- **How It Works:**
  - Firms and individuals are incentivized to reduce emissions by switching to cleaner energy sources, improving energy efficiency, or adopting greener technologies.
- **Example:**
  - **Sweden's Carbon Tax**:
    - Sweden implemented a carbon tax in 1991, starting at \$23/ton $CO_2$ and now exceeding \$130/ton.
    - The tax significantly reduced emissions while the economy grew, as businesses and consumers shifted toward renewable energy and energy-efficient practices.

# Cap-and-Trade System

- A cap-and-trade system sets a limit (cap) on total emissions and allows firms to trade emission permits in a market.
- Firms that reduce emissions below their cap can sell unused permits to others.
- **How It Works:**
  - By creating a market price for carbon, firms are incentivized to cut emissions in cost-effective ways.
- **Example:**
  - **European Union Emissions Trading System (EU ETS)**:
    - The EU ETS caps emissions from power plants, industrial facilities, and airlines.
    - Firms buy or sell allowances, encouraging innovation in clean technologies.
    - The system has contributed to a steady decline in emissions across the EU.