

Introduction to Climate Change Economics

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Key concepts, mechanisms, and policy tools

1. Why Study the Economics of Climate Change?

Economic Reason	Explanation
Scarcity of Resources	Fossil fuel reserves are finite; their extraction and use have external costs.
Intergenerational Equity	Current emissions affect the welfare of future generations.
Market Failure	Climate impacts are negative externalities not reflected in market prices.
Global Public Good	A stable climate benefits everyone, but individual nations may underinvest in mitigation.
Risk & Uncertainty	Long-run climate outcomes are uncertain, creating challenges for optimal investment.

2. Core Economic Concepts

Concept	Definition	Relevance to Climate
Externalities	Costs/benefits affecting third parties not captured by market prices.	CO ₂ emissions impose health, agricultural, and disaster costs on society.
Social Cost of Carbon (SCC)	Monetary value of the incremental damage caused by emitting one extra ton of CO ₂ .	Guides carbon pricing, regulation, and project appraisal.
Discounting	Reducing the present value of future costs/benefits.	Determines how heavily we weigh future climate damages versus present costs.
Pigouvian Tax	A tax equal to the marginal external damage.	Carbon tax is a classic example.

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Concept	Definition	Relevance to Climate
Cap-and-Trade (Emissions Trading System, ETS)	Sets a total emissions cap and allows trading of permits.	Creates a market price for emissions while guaranteeing a quantity limit.
Co-benefits	Positive side effects of climate actions (e.g., reduced air pollution).	Increases net economic returns of mitigation projects.
Adaptation vs. Mitigation	<i>Adaptation</i> : adjusting to climate impacts. <i>Mitigation</i> : reducing GHG emissions.	Both require resources; economics helps allocate them efficiently.

3. Modeling Climate–Economy Interactions

Model Type	Main Features	Typical Use
Integrated Assessment Models (IAMs)	Combine climate system equations with economic modules (e.g., DICE, PAGE).	Estimate SCC, evaluate policy pathways, cost-benefit analysis.
Computable General Equilibrium (CGE) Models	Capture sectoral linkages, trade, and factor markets.	Assess macro-economic impacts of carbon taxes or ETS.
Partial-Equilibrium Models	Focus on a single market (e.g., electricity).	Study specific policy instruments like renewable subsidies.
Damage Functions	Relate temperature rise to economic loss (GDP, health, agriculture).	Input for IAMs and cost-benefit studies.

Key Insight: Models are simplifications; results depend heavily on assumptions about climate sensitivity, technology progress, and discount rates.

4. Policy Instruments

Instrument	Mechanism	Advantages	Limitations

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Carbon Tax	Direct price on CO ₂ emissions.	Simple, predictable price signal, revenue? generating.	Politically sensitive; may need complementary measures for equity.
Cap and Trade	Fixed emissions cap, tradable permits.	Guarantees quantity, flexible compliance.	Permit allocation can be contentious; price volatility.
Regulation / Standards	Mandates (e.g., fuel efficiency standards).	Guarantees minimum performance.	May be less cost-effective, rigid.
Subsidies & Feed-in Tariffs	Financial support for clean tech		