Economics of the environment

Economics

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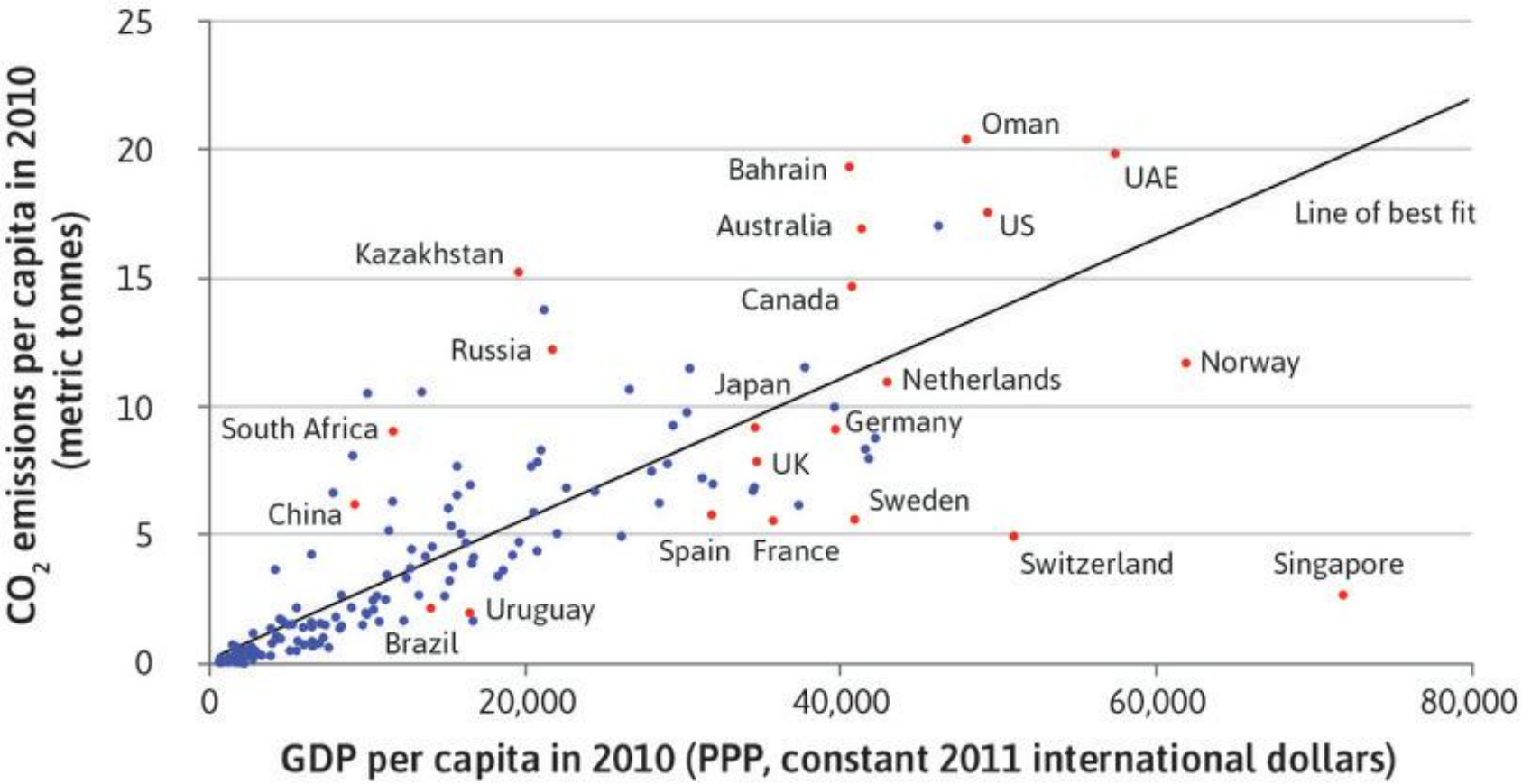
UCL

Lecture 20

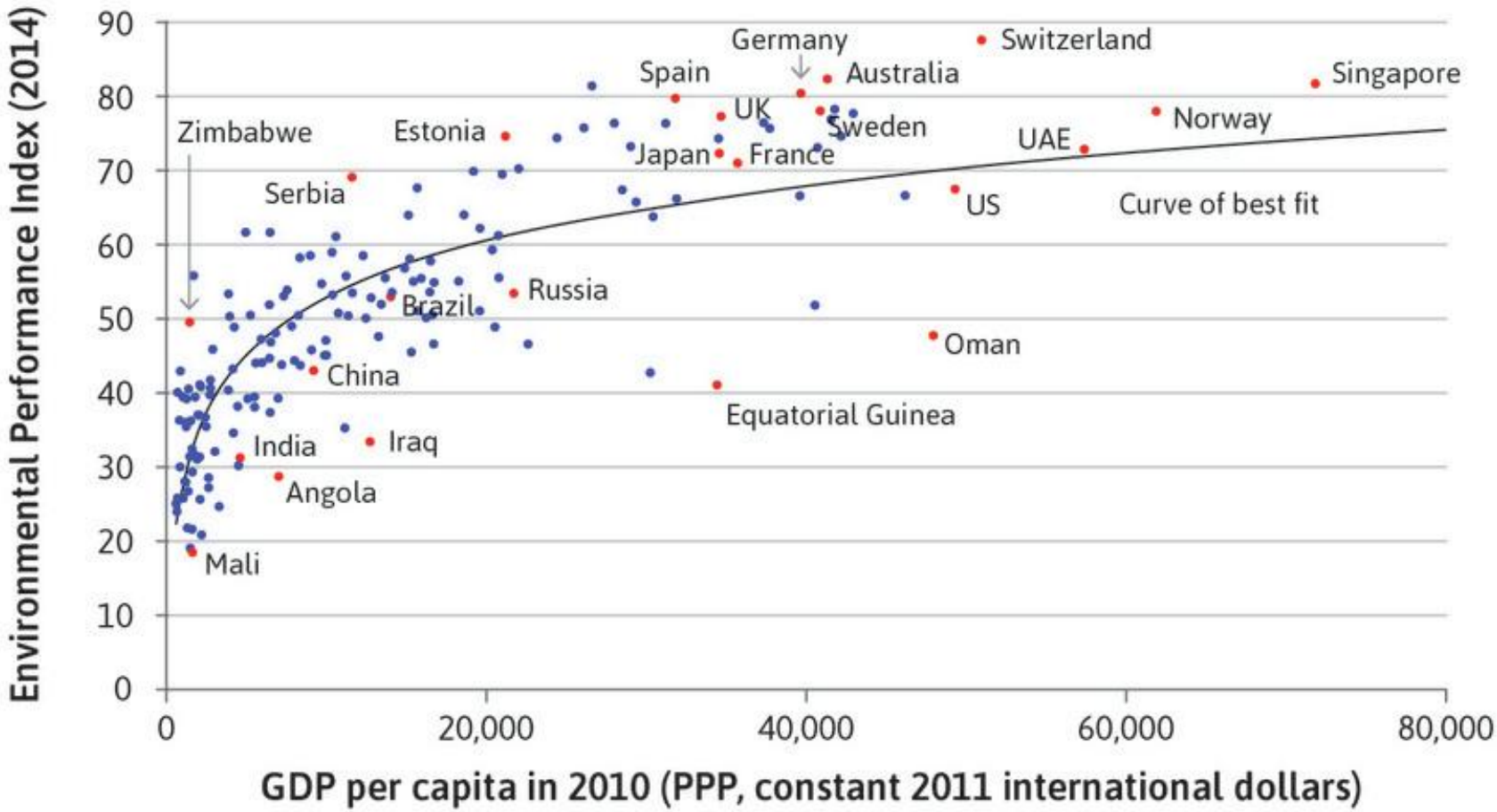
Carbon dioxide and GDP per-capita

Carbon dioxide is higher in richer countries



Local Environment and GDP per-capita

. . . but richer countries also have better local environment



Context

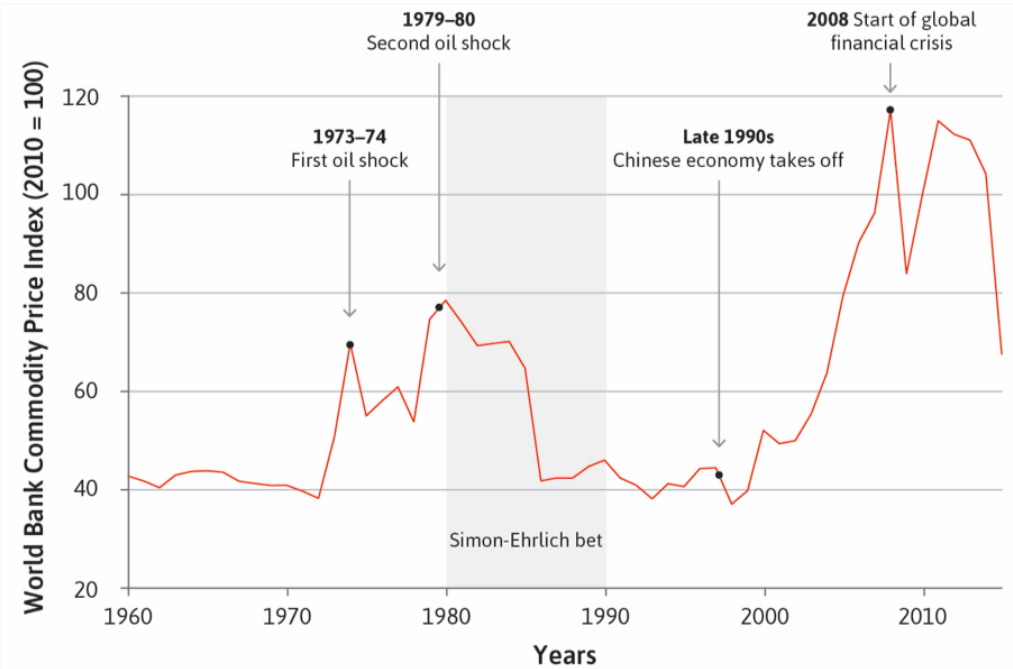
Living standards increased significantly due to technological progress and adoption of capitalism. (Units 1 & 16)

However, this rapid economic growth has negatively affected the environment and natural resources e.g. *overfishing*, *pollution*.

- What are the future **consequences** of our *actions*?
- How can we **lessen our impact** on the *environment*?
- What are the **limitations** of these *approaches*?

Earth's crust

Supply of natural resources (raw materials in Earth's crust) is vast.



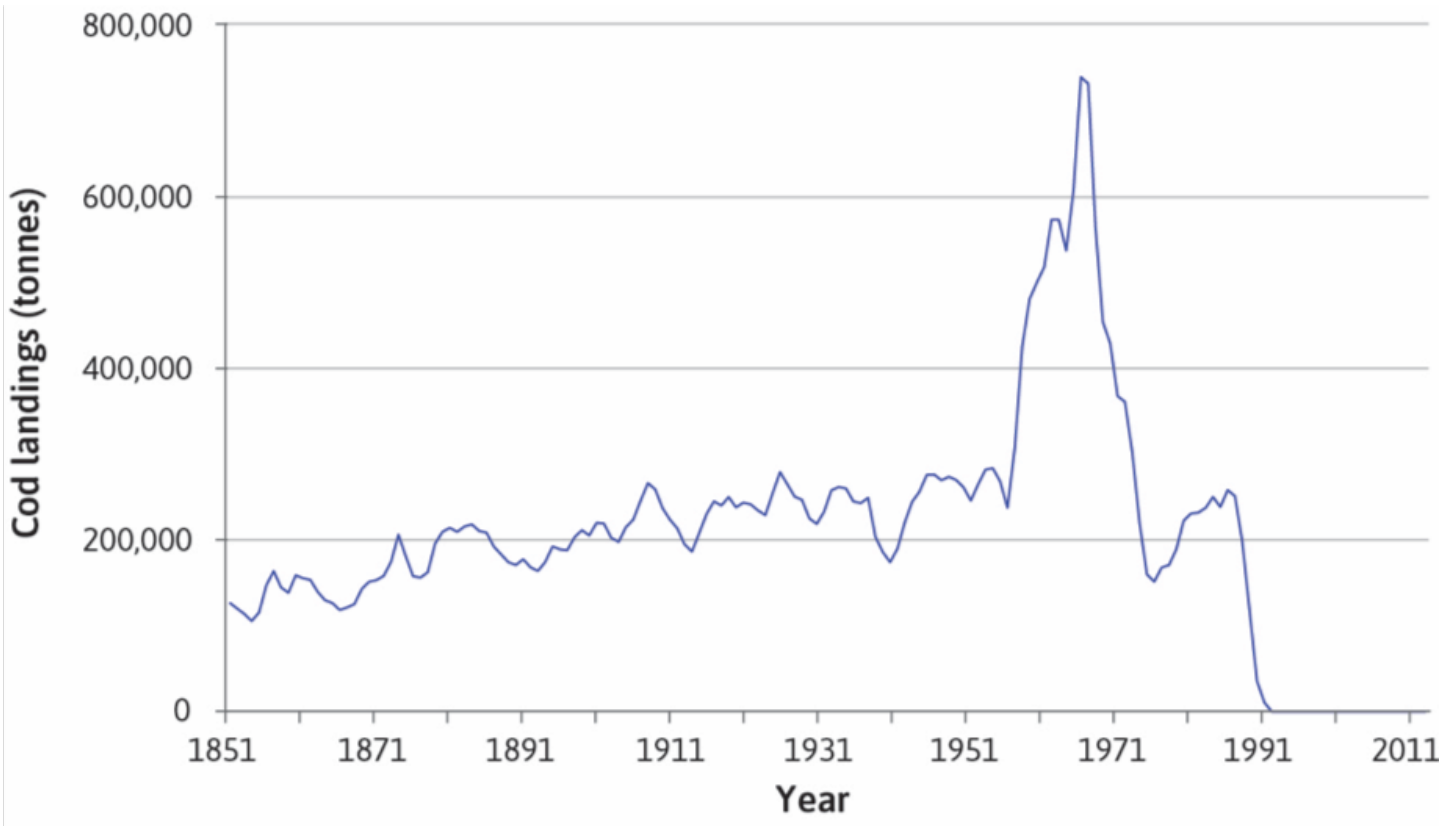
World **commodity prices** have not changed much over long run

↑ . . . growing *demand pushes prices up*,

↓ . . . but *cheaper extraction* technology pushes *prices down*

Consequences of economic growth

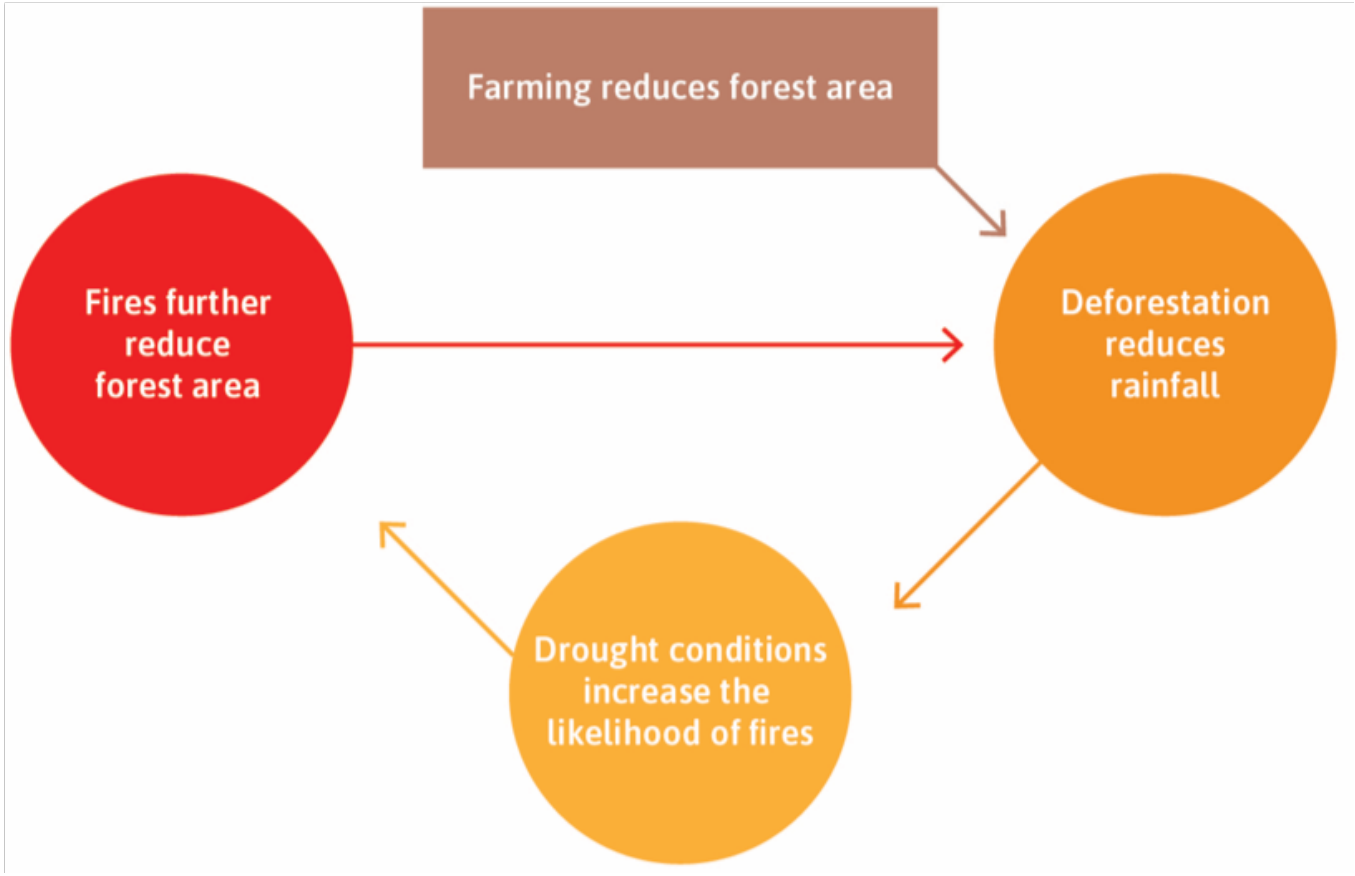
Economic growth and associated changes are a challenge to natural resource management.



Industrial fishing in 1950s led to depletion of cod stocks off Grand Banks

Feedback process

Changes (e.g. *overfishing*, *deforestation*) may become *self-reinforcing* due to *positive feedback processes*.



Climate Change

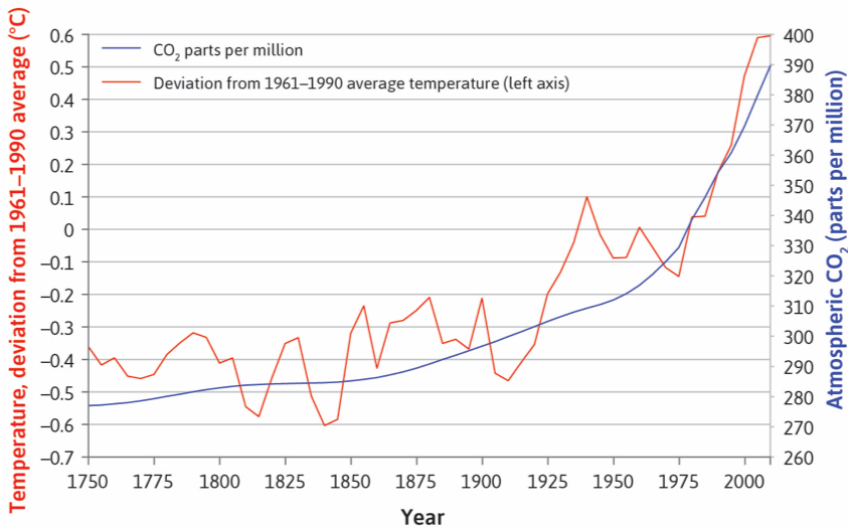
Climate change is a particularly difficult environmental problem to handle

- Capping emissions is not enough because it is not the *flow* but the *stock of CO2* that matters

Requires *global cooperation*

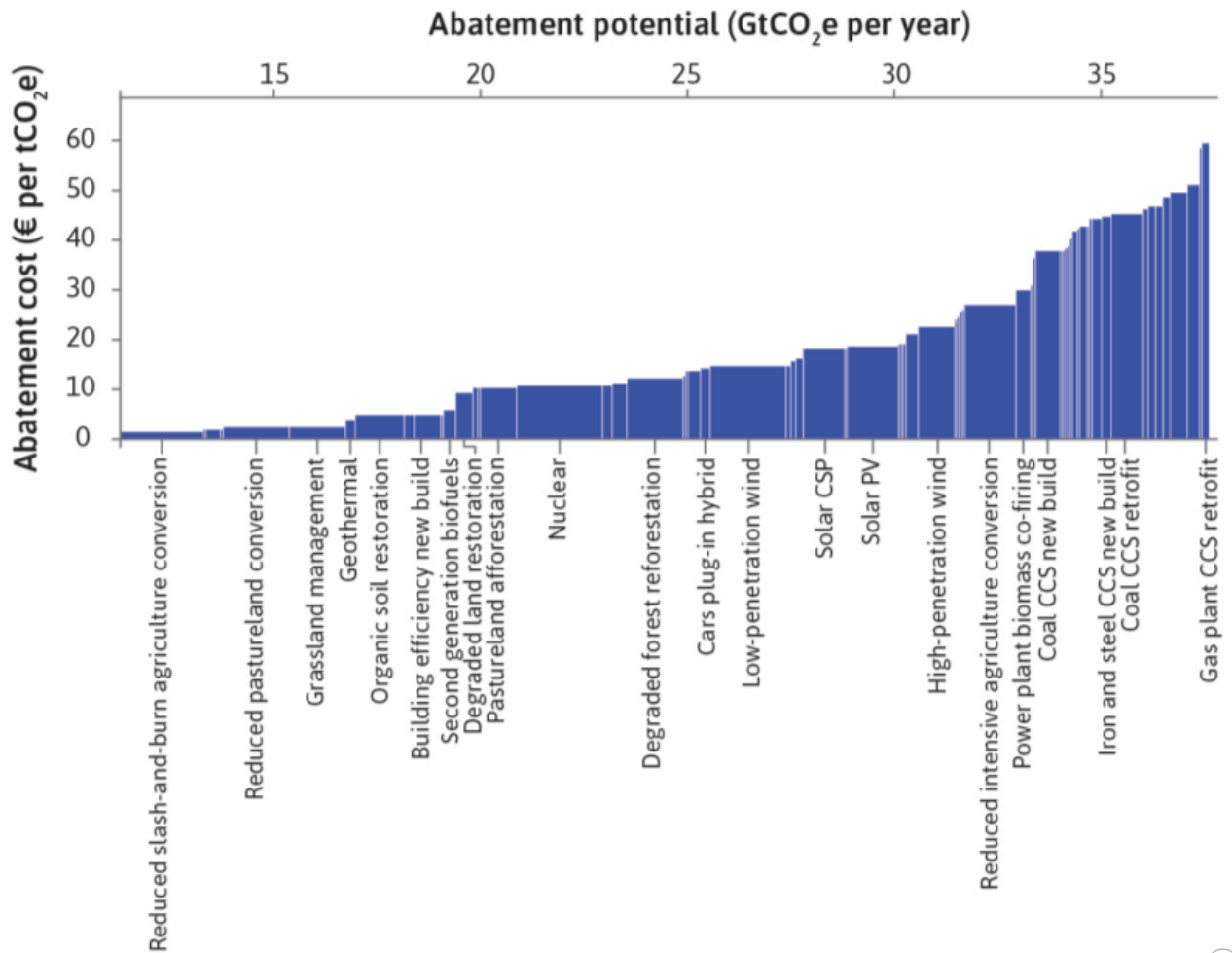
Conflicts of interest between and within countries and generations

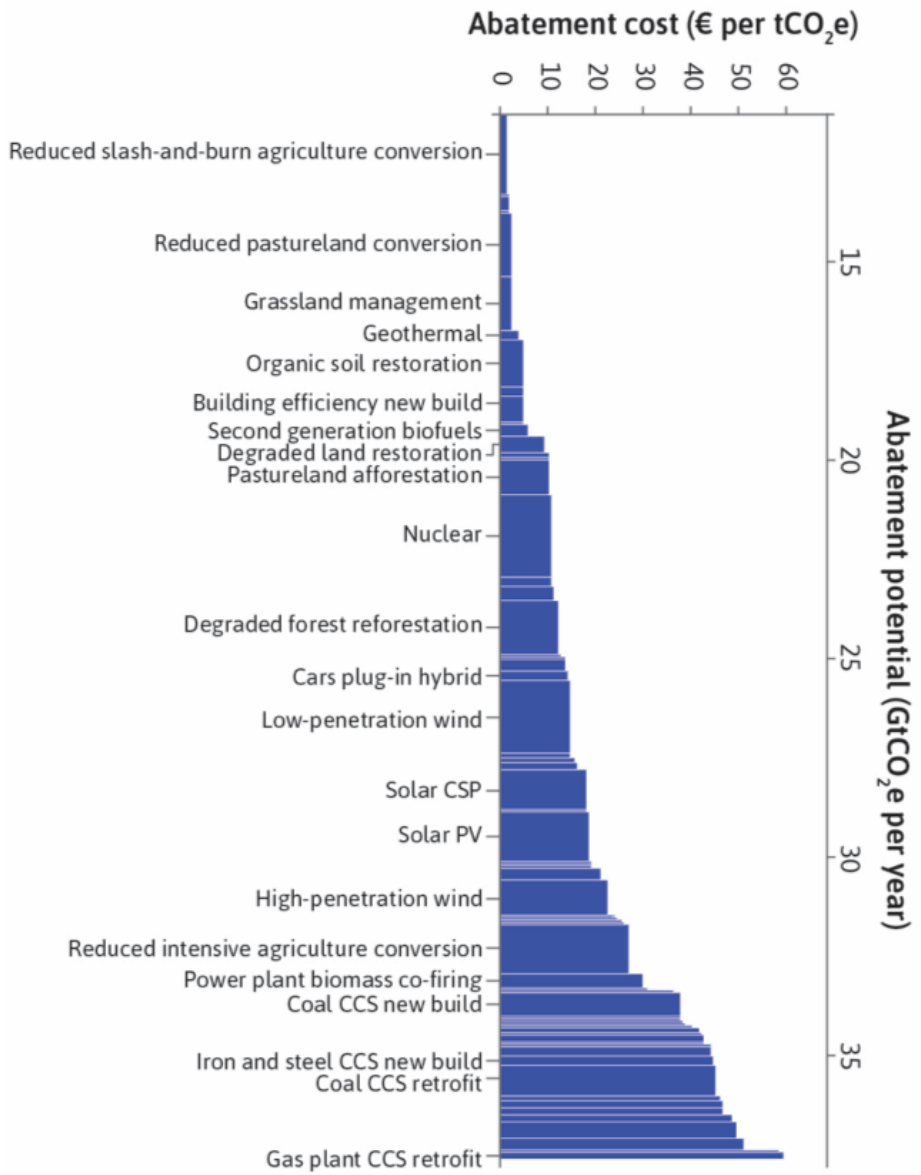
Worst-case scenario is catastrophic



Abatement Policy

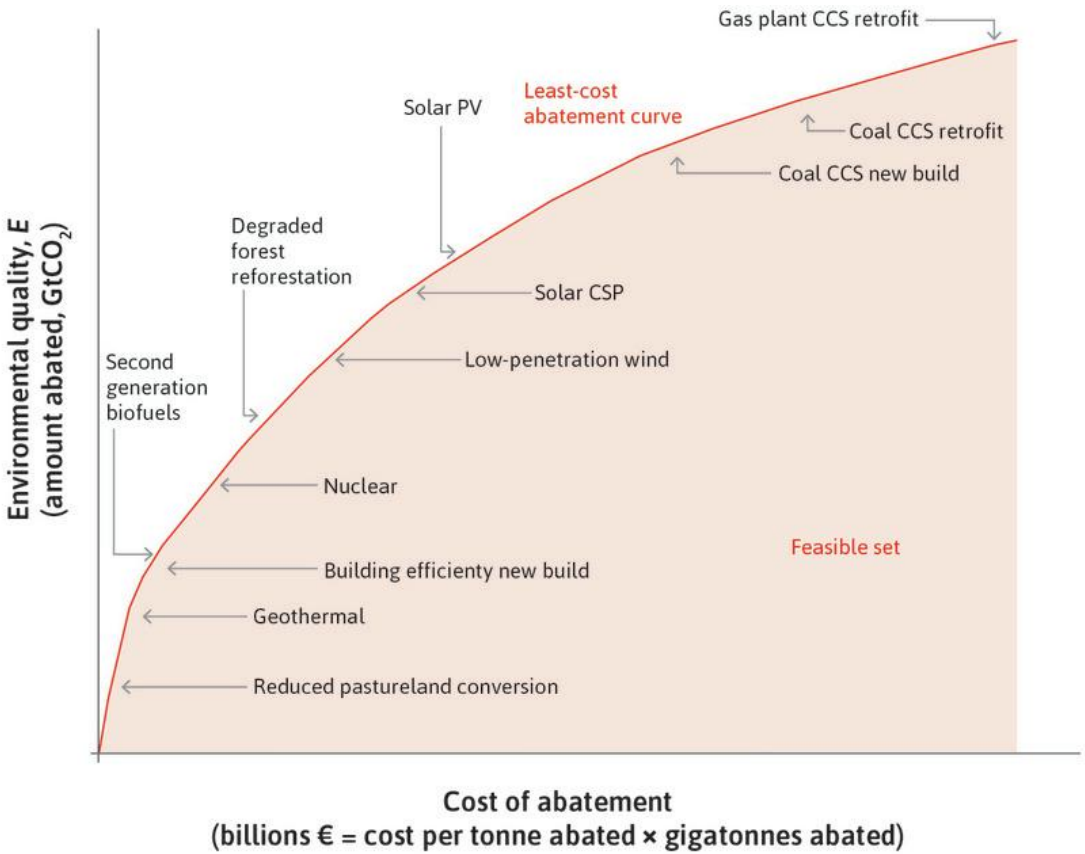
Abatement policy: a policy designed to reduce environmental damage. The exact policy depends on the relative costs and benefits abatement





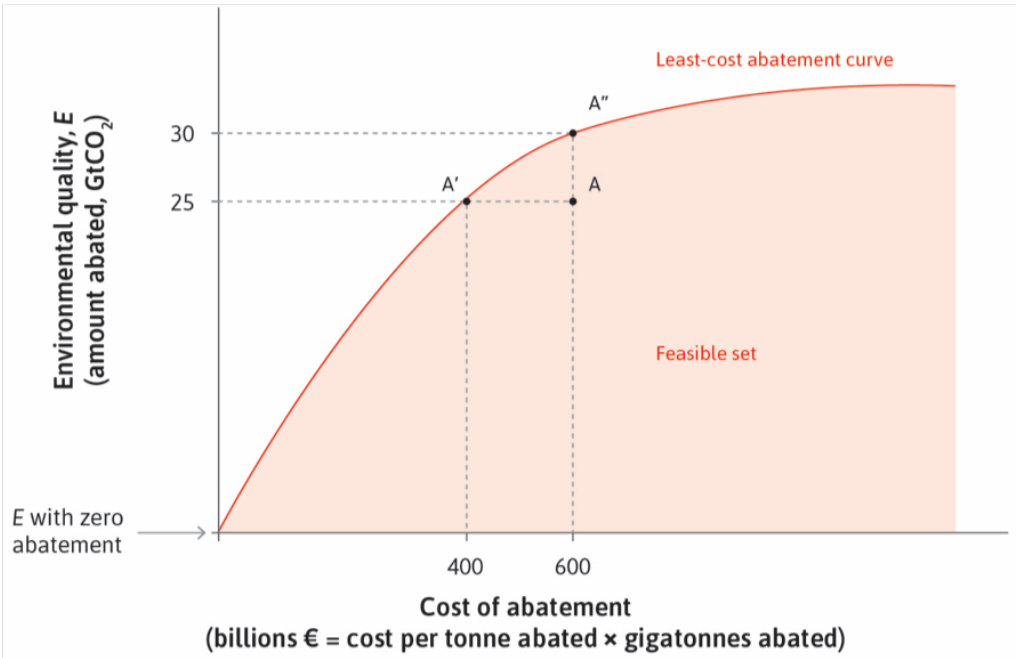
Abatement Cost Curve

Abatement cost curve shows the per-unit cost of abating greenhouse gas emissions using abatement policies, ranked from the most to the least cost-effective



Least-cost abatement curve

Abatement cost curve shows all the combinations of environmental quality (E) and cost of abatement, when the abatement technologies are adopted in ascending order of cost.

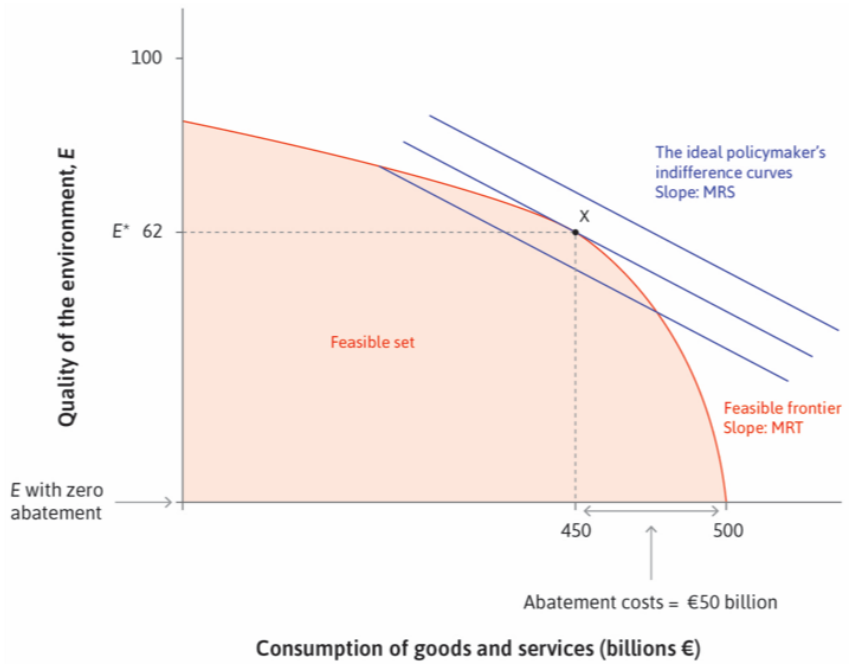


Environment quality-consumption trade-off can be derived from the abatement curve by flipping it horizontally.

Choice of abatement level

The *feasible set* contains all combination of consumption and environmental quality that can be achieved

Policy-marker trade-offs the consumption and environmental quality in her own way



At x, policy maker's trade-off is tangent to feasible set

Who should pay for abatement

Intuitive policy:

- *Polluter pays principle:* those responsible for external effects should pay for these damages.

Counter-intuitive consequences

- *Fairness:* polluters may be low-income families and may require to burn wood to keep warm
- *Effectiveness:* if tracking down the polluters is expensive, subsidies and taxes may be a more cost-effective abatement policy

Missing market in environment

Environmental externalities arise because there is a missing market

Creating a market requires

- *Allocating endowments*

  either *right to pollute*

  or *right to live in a pollution free environment*

- *Enabling a market*

  where unit sized *right to pollute can be bought and sold*

Types of abatement policies

How can we achieve the desired level of abatement?

Policymaker's aim: Achieve the desired amount of effective abatement (units of CO_2) at minimum cost.

There are 2 types of abatement policies:

- *Price-based policies* use taxes and subsidies to affect prices

  Aim to internalise the external effects of individual choices

- *Quantity-based policies* use bans, caps, and regulations

Cap and trade

A *cap and trade* market for emissions is created by taking the following steps.

- Government sets a limit or a *cap* on pollution
- It *creates permits to pollute* that add up the set cap
- Government *allocates the permits* to firms

  i.e., the permits can be auctioned
- Firms are *allowed to buy and sell* these permits amongst themselves

Cap and trade is a policy that combines quantity and price based policy

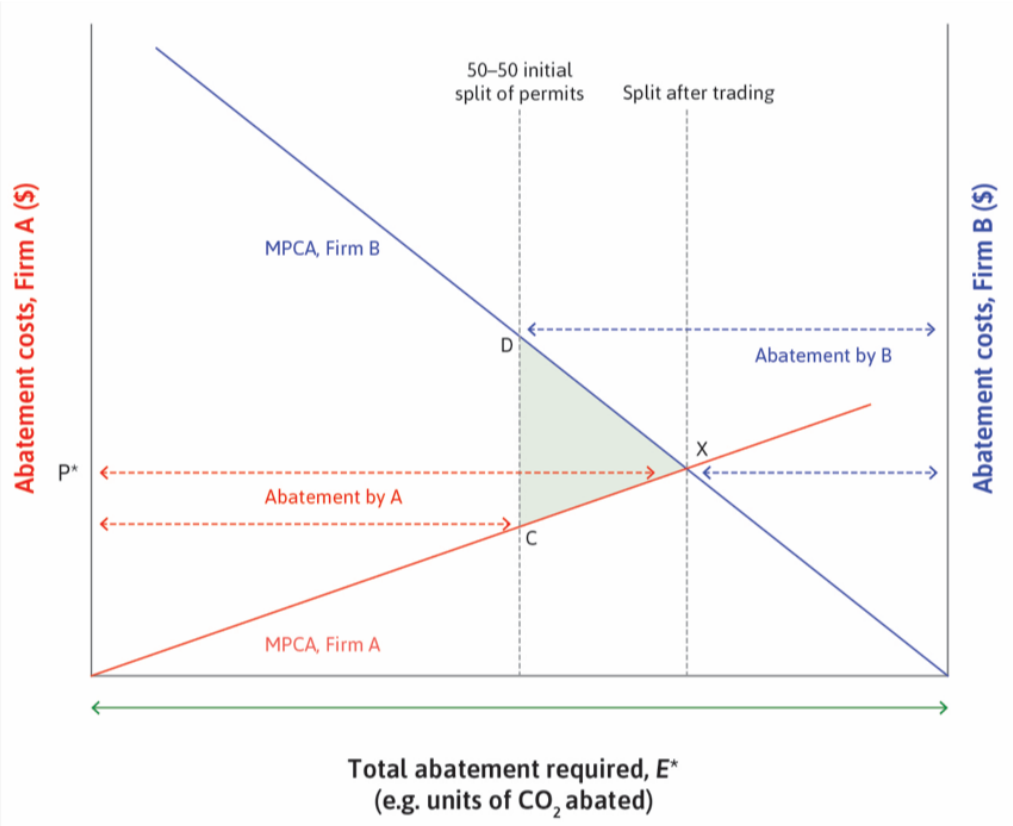
government sets the quantity and the *market for carbon determines the price for carbon*

a high price of carbon encourages firms to abate

Cap and Trade: Example

Firm A has a lower marginal private cost of abatement (MPCA) than Firm B

Both firms benefit from buying and selling permits until the MPCA is equalised across firms.

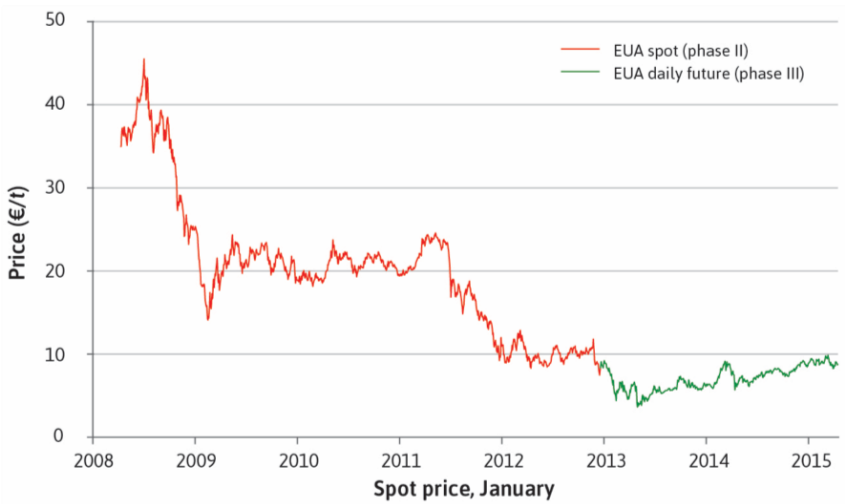


Cap and Trade: Issues

Policymakers need to set the right cap, which can be challenging to to determine in advance

- Putting a price on pollution may send the wrong signal to firms e.g. making production profitable
- A price floor on permits can mitigate this issue (e.g. UK).

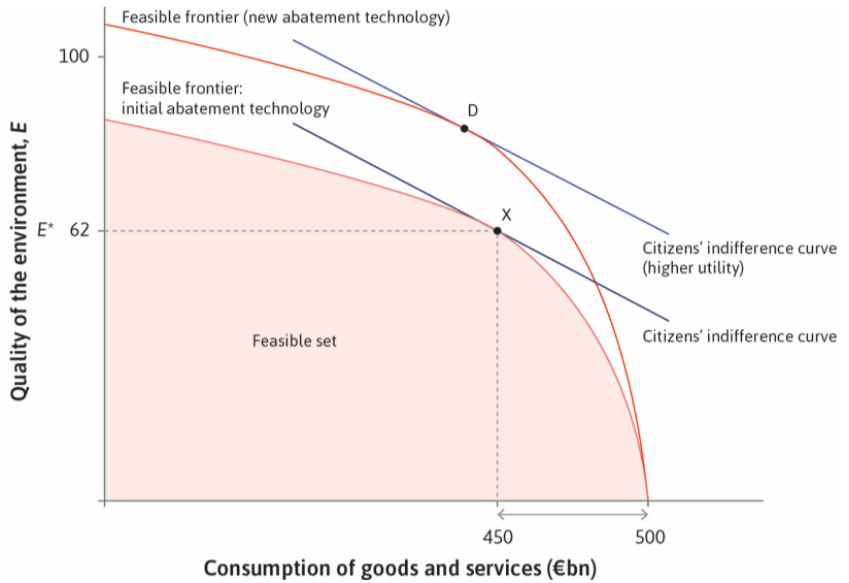
EU Emissions Trading Scheme set too large a cap. The price fell dramatically after the 2008 crisis, providing little incentive to abate



Effect of technological improvement

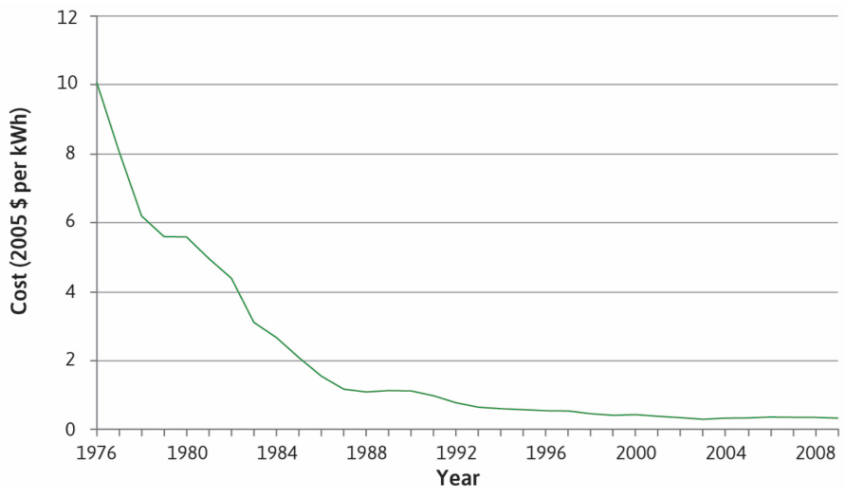
Technological improvements can enlarge the feasible set by making abatement more efficient or reducing the environmental costs of consumption.

Technological improvement increases the *marginal productivity of abatement expenditure* (MRT of consumption into abatement), making the feasible frontier steeper.



Example: Renewable energy production

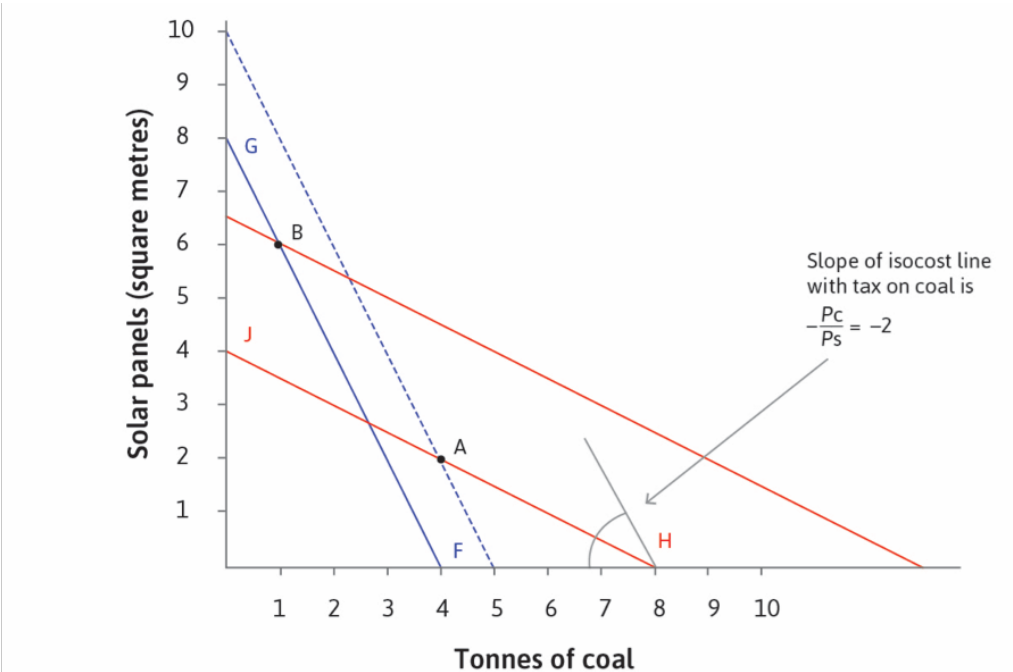
Innovation rents can drive progress, leading to technological breakthroughs that deliver substitutes for non-renewable resources.



- Subsidies to firms that produce solar panels has helped fund R&D in alternative energy sources.
- Growing demand for solar panels led to a sharp decrease in their price, thanks to *learning by doing* in the production process.

Taxing firms

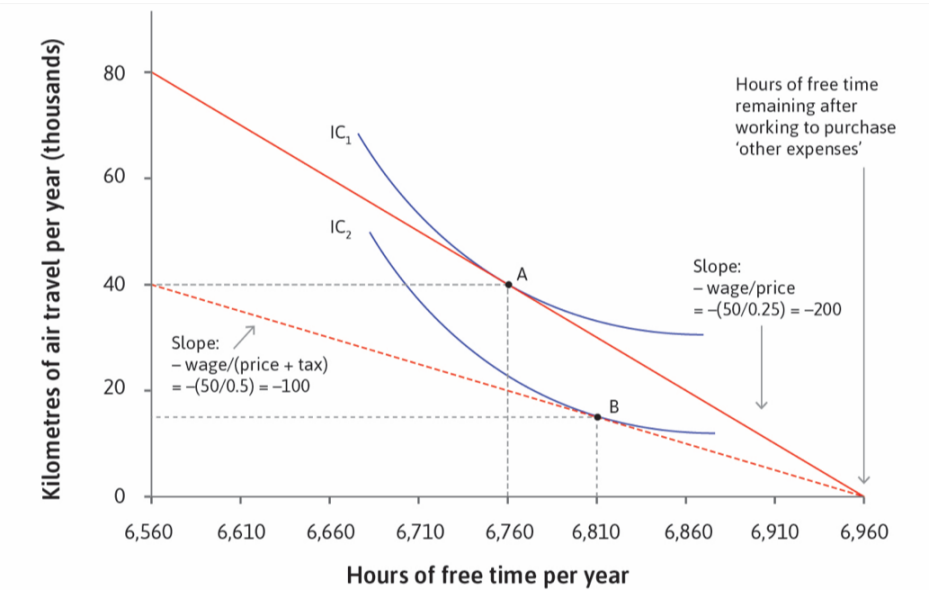
Taxes can *create innovation rents* by changing relative prices, which promotes private-sector innovation.



- Without a tax, the coal-intensive technology *(red)* is cheaper .
- Tax on coal makes solar-intensive technology *(blue)* cheaper .

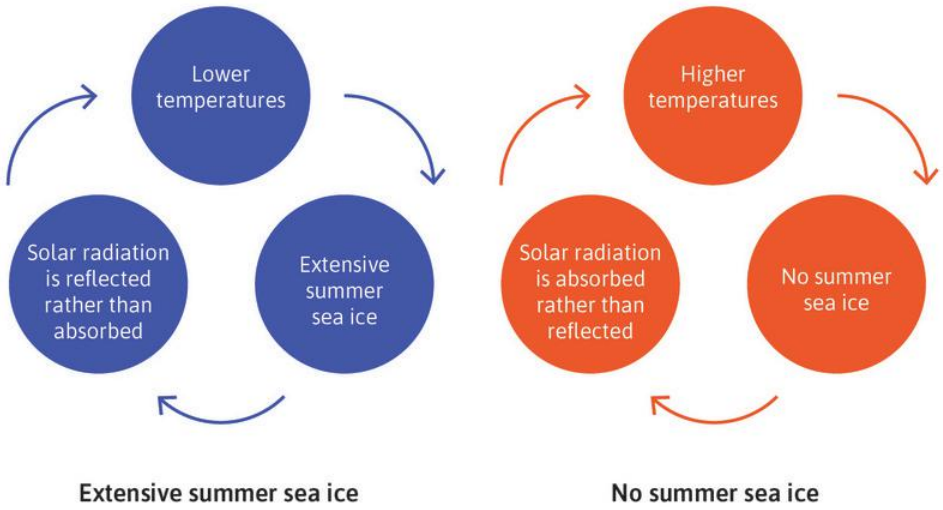
Taxing consumers

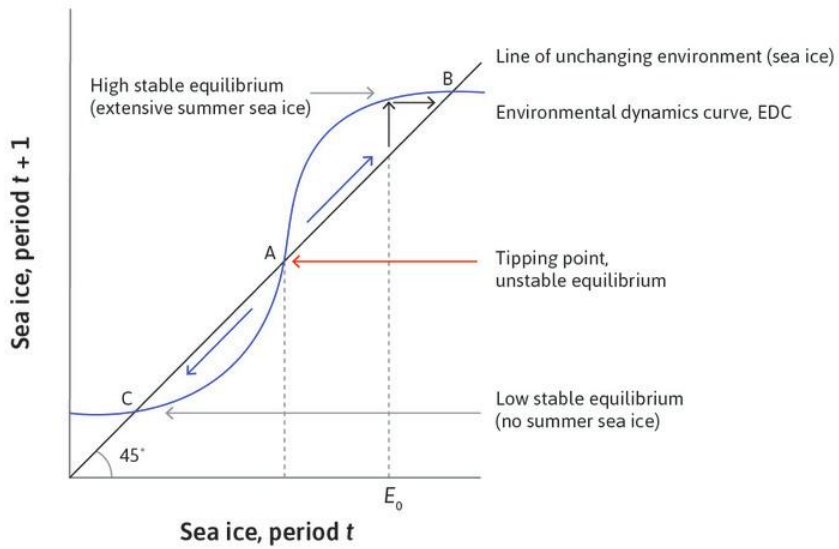
Taxes can create lifestyle changes that improve well-being by changing how much consumers value goods.



- A tax on air travel reduces the feasible set *(income effect)* and encourages greater consumption of free time *(substitution effect)*.
- Overall effect is a sum of income and substitution effect

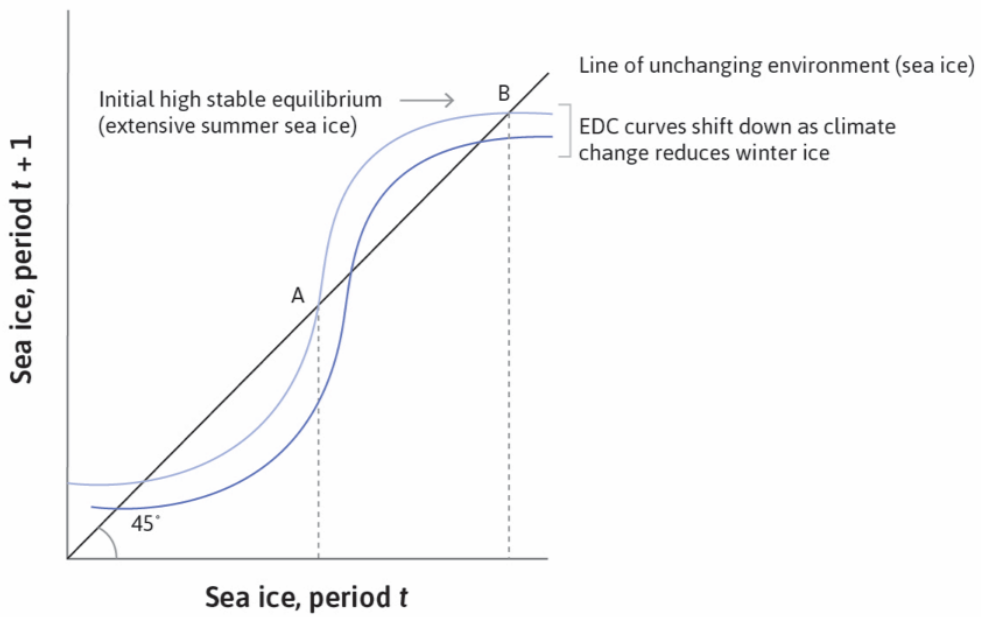
Environmental Dynamics Curve





Modelling environmental dynamics

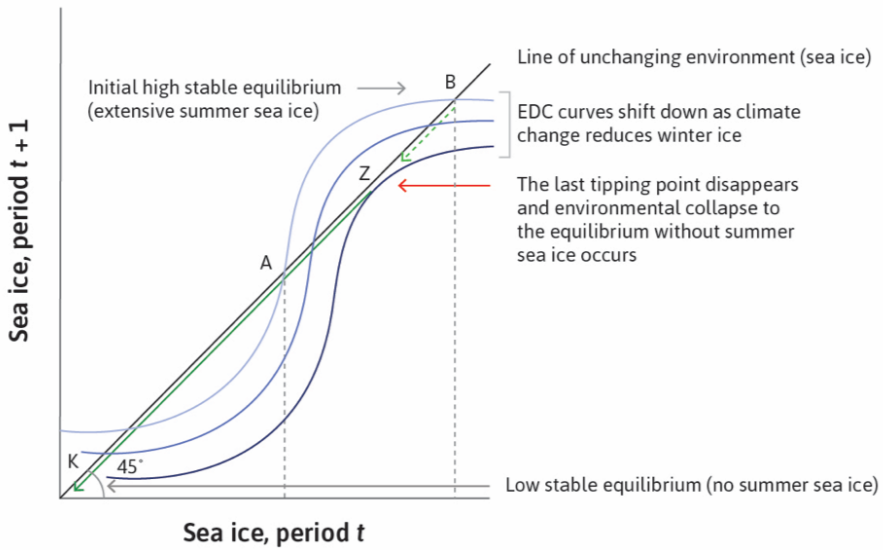
A *healthy environment* and *degraded environment* are both equilibria. The *disequilibrium process* is the movement from one equilibrium to another.



Environmental tipping point: processes of environmental degradation are self-limiting, but *positive feedbacks lead to self-reinforcing degradation.*

Example: Arctic sea ice

There are *two stable equilibria* (a lot of ice or no ice), separated by an *unstable equilibrium* at A (tipping point).



Climate change shifts the entire S-shaped environmental dynamics curve (EDC) down, which at some point will make the good equilibrium and tipping point disappear. The system is locked in the bad (no-ice) equilibrium.

Addressing climate change: Challenges

Addressing climate change is difficult because:

- People value the economy more than the environment

  Lack of adequate information

  conflicts of interest

- Requires international cooperation

  Countries have committed to emissions cuts and submitted plans for doing so, but these plans are not consistent with the temperature stabilisation goal.

  Prisoner's Dilemma game between countries

Addressing climate change: Challenges

Addressing climate change is difficult because:

- Future generations are unrepresented
- Problems of determining discounting rate

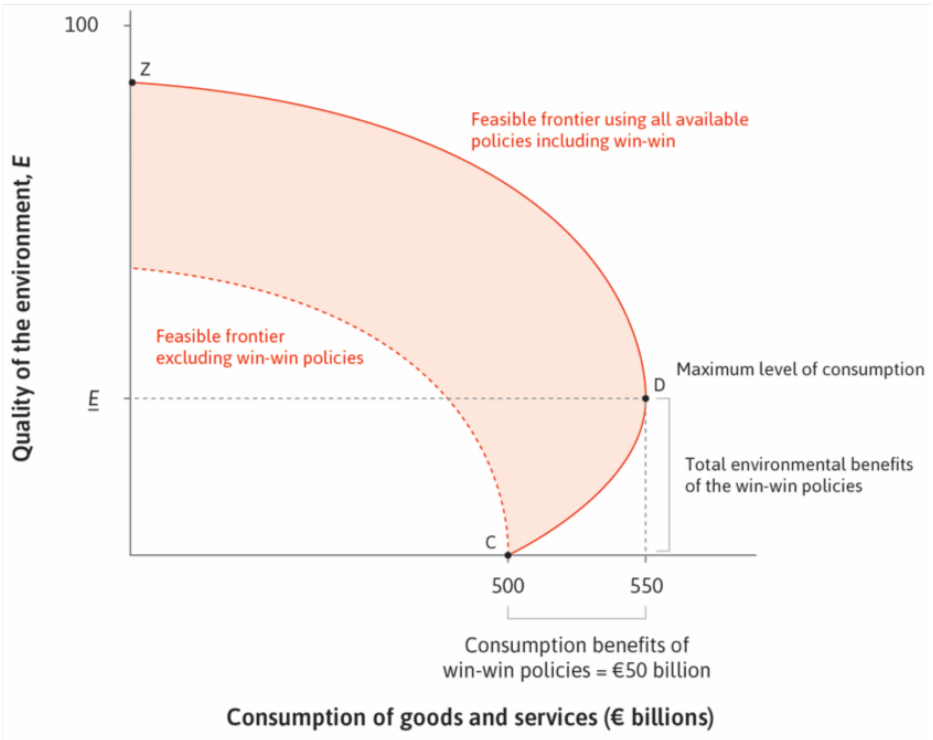
  how much should we value the costs and benefits of our actions on future generations?

  How much should be value the current poor vis-a-vis the future generations

Win-win policies

There is not always a *tradeoff* between *consumption* and *environmental quality*

Some technologies are cost-saving
e.g. fuel-efficient vehicles, insulation in houses.



This abatement potential means that part of the feasible frontier has a positive slope. These unexploited mutual gains *requires more than market incentives*.

Summary

Climate change: Why it is an issue and how to address it?

- Price-based and/or demand-based policies e.g. cap and trade, taxes, subsidies
- Measuring environmental costs and benefits
- Modelling environmental dynamics

Problems when addressing climate change

- Conflicts of interest – how to divide costs and benefits
- International cooperation required
- How to discount effects on future generations