Introdução à Economia/Introductory Economics

6. Economy, environment and climate change

(adapted from CORE, The Economy. Based on Unit 20)

2021/2022

3rd Quarter (P3)

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Context

Living standards increased significantly due to technological progress and globalization.

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

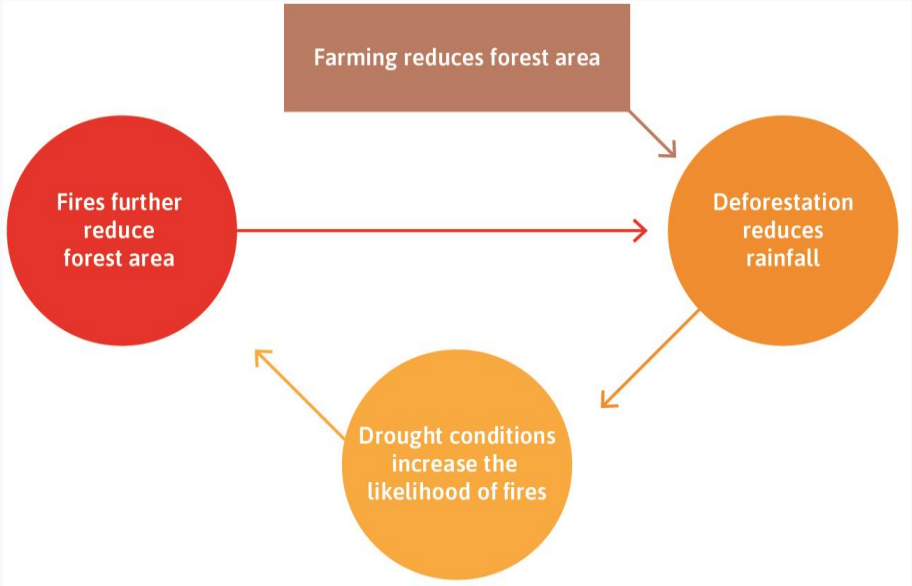
- What are the future consequences of our actions?
- How can we lessen our impact on the environment?
- What are the limitations of these approaches?

Context

The supply of **natural resources** (raw materials in the Earth's crust) is vast.

That is why world commodity prices (inflation adjusted) have not changed much over the long run – growing demand pushes prices up, but cheaper extraction technology pushes prices down.

- Economic growth is a challenge to natural resource management.
- Changes (e.g., overfishing, deforestation) may become self-reinforcing due to **feedback processes**.

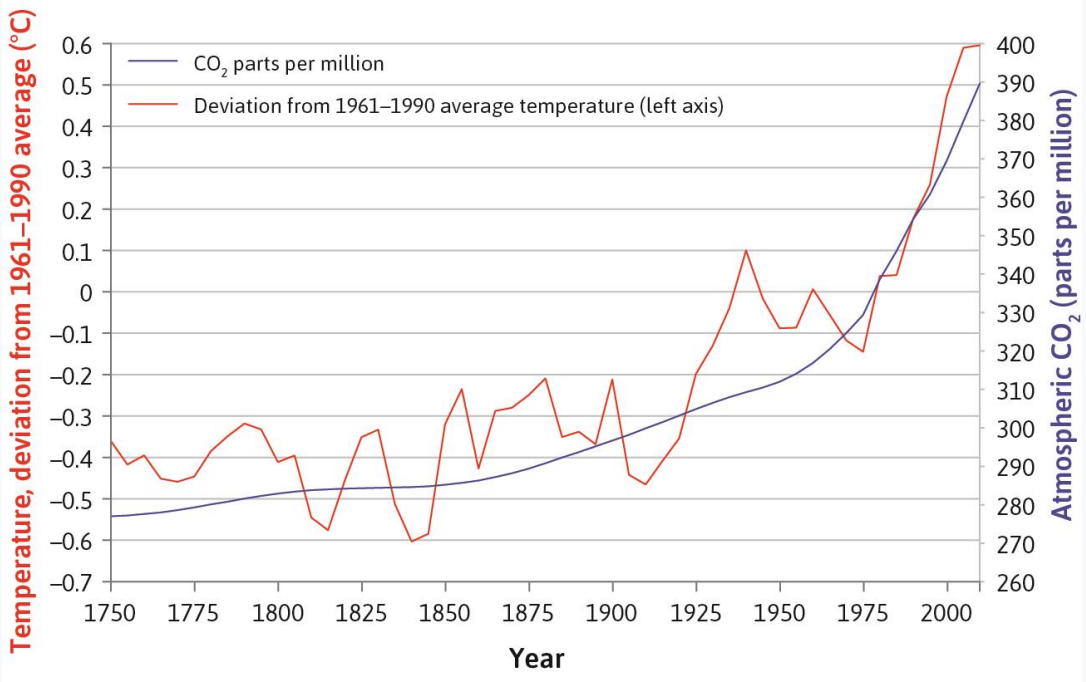


Climate Change

Climate change is a particularly difficult environmental problem to handle, for various reasons:

- Capping emissions is not enough (stock of CO_2 matters, not the flow)

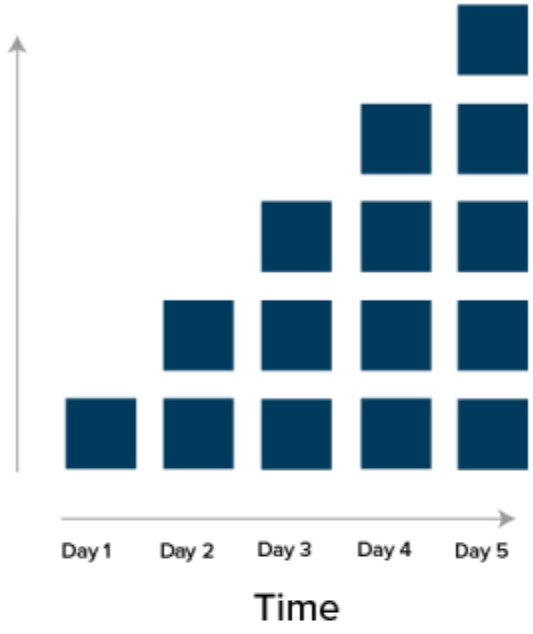
The greenhouse effect, and in turn climate change, depends on the concentration of greenhouse gases in the atmosphere – the **stock** – while the thing humans can control as a response is the rate at which additional greenhouse gases are emitted – the **flow**.



(Comparing a stock gas to a flow gas is an apples-to-oranges comparison that distracts from real climate change solutions.)

= Pulse of CO_2

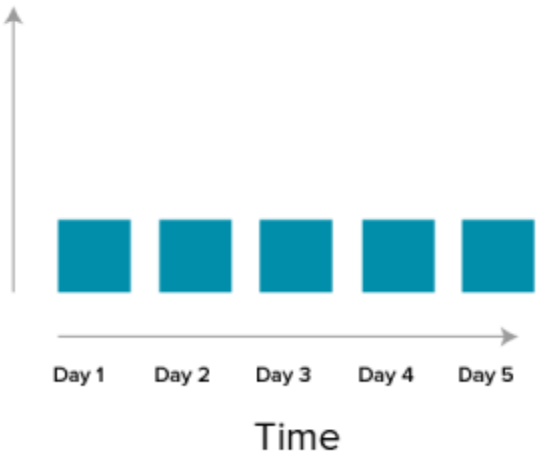
Stock Gas
Carbon dioxide (CO_2)



Stock gases will accumulate over time, because they stay in the environment.

= Pulse of CH_4

Flow Gas
Methane (CH_4)



Flow gases will stay stagnent, as they are destroyed at the same rate of emission.

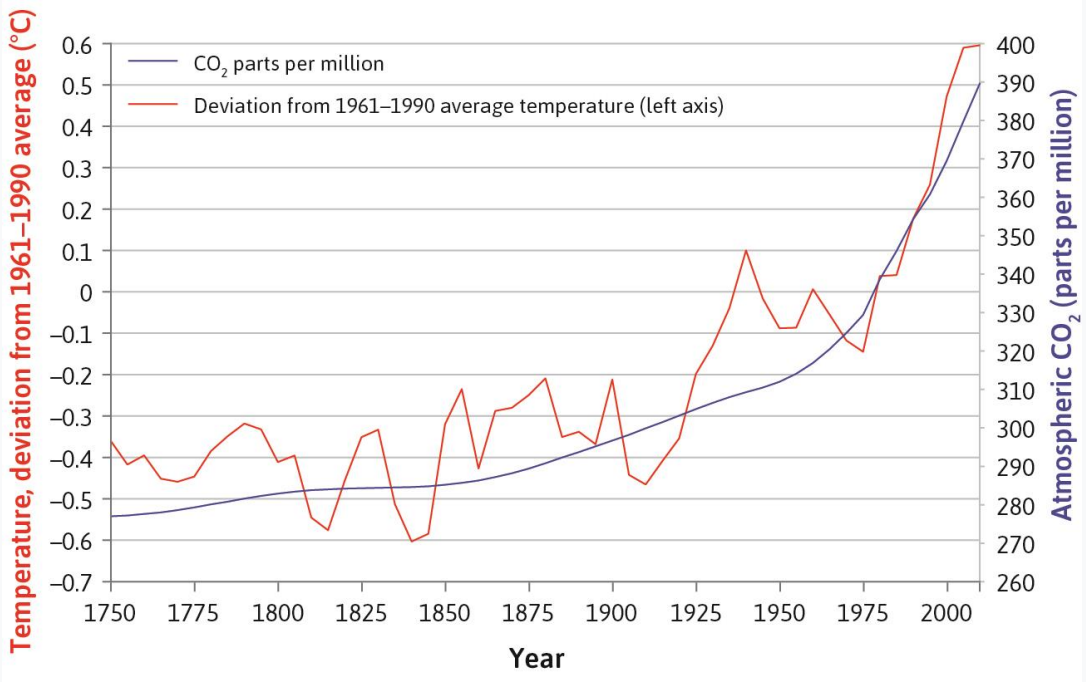
UCDAVIS CLEAR Center

Based on research by Myles R. Allen, Keith P. Shine, Jan S. Fuglestvedt, Richard J. Millar, Michelle Cain, David J. Frame & Adrian H. Macey.
Read more here: https://rdcu.be/b1t7S

Climate Change

Climate change is a particularly difficult environmental problem to handle, for various reasons:

- Capping emissions is not enough (stock of CO_2 matters, not the flow)
- May be irreversible
- Requires global cooperation
- Conflicts of interest (between/within countries and generations)
- Worst-case scenario is catastrophic



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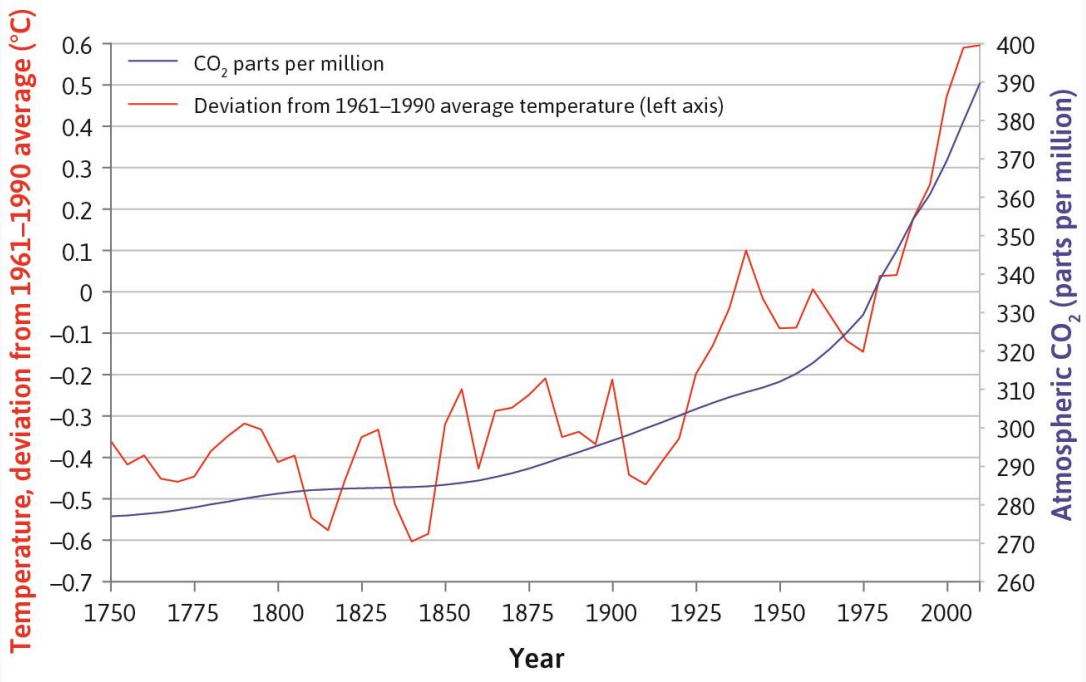

Lesson 1: Delay is Costly, So Make Mitigation a Priority, Now

Lesson 2: Find Ways to Get Citizens on Board (policy design must overcome biases in human judgment)

Lesson 3: Inequality can be exacerbated without timely action

Lesson 4: Global Problems Necessitate (Global/International) Collaboration

Lesson 5: Scientific Policy Advice is Never Value-Free

Environmental and Resource Economics (2020) 76:751–778
https://doi.org/10.1007/s10640-020-00453-w

Five Lessons from COVID-19 for Advancing Climate Change Mitigation

David Klenert[1] · Franziska Funke[2,3] · Linus Mattauch[3,4] · Brian O'Callaghan[3]

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Abstract
The nexus of COVID-19 and climate change has so far brought attention to short-term greenhouse gas (GHG) emissions reductions, public health responses, and clean recovery stimulus packages. We take a more holistic approach, making five broad comparisons between the crises with five associated lessons for climate change mitigation policy. First, delay is costly. Second, policy design must overcome biases to human judgment. Third, inequality can be exacerbated without timely action. Fourth, global problems require multiple forms of international cooperation. Fifth, transparency of normative positions is needed to navigate value judgments at the science-policy interface. Learning from policy challenges during the COVID-19 crisis could enhance efforts to reduce GHG emissions and prepare humanity for future crises.

Keywords COVID-19 · Climate change · Climate policy · Public support · Psychological bias · Inequality · Role of scientists · Global cooperation

1 Introduction

Increasing anthropogenic influence on the natural environment over many centuries (Goudie 2018) has led to significant global challenges at the nexus of planetary and human health, of which COVID-19 may just be the latest manifestation.[1] Although the COVID-19

[1] Climate change and a surge in zoonosis pandemics such as COVID-19 both result from human interference with natural environments (Semele et al. 2020). In fact, the occurrence of new pathogens such as

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

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https://link.springer.com/article/10.1007/s10640-020-00453-w

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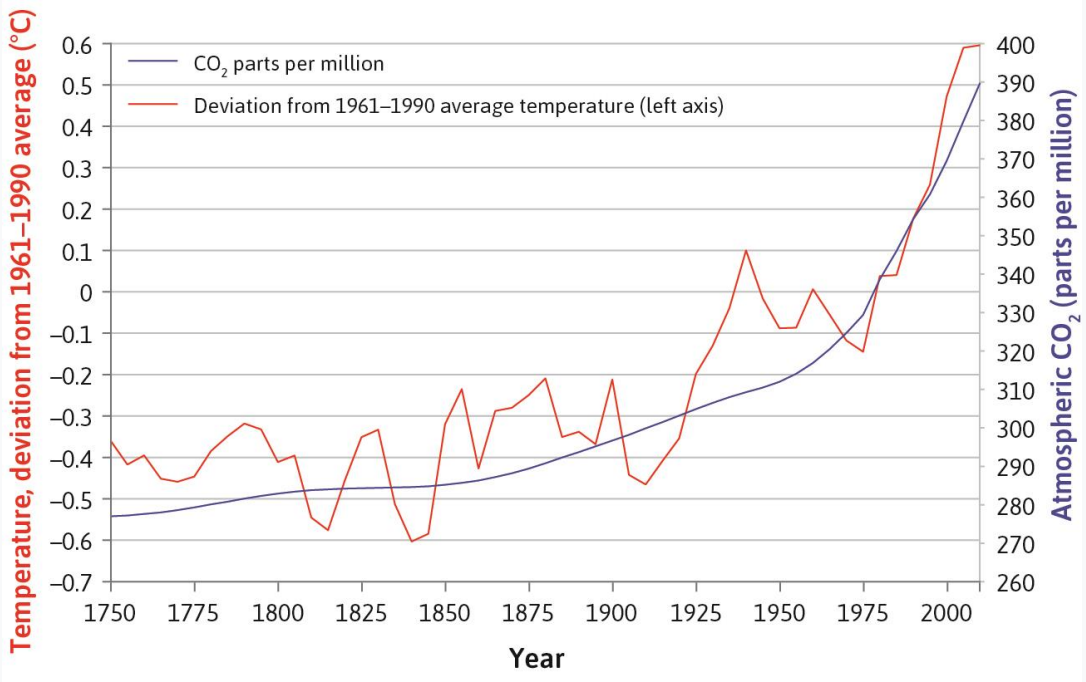

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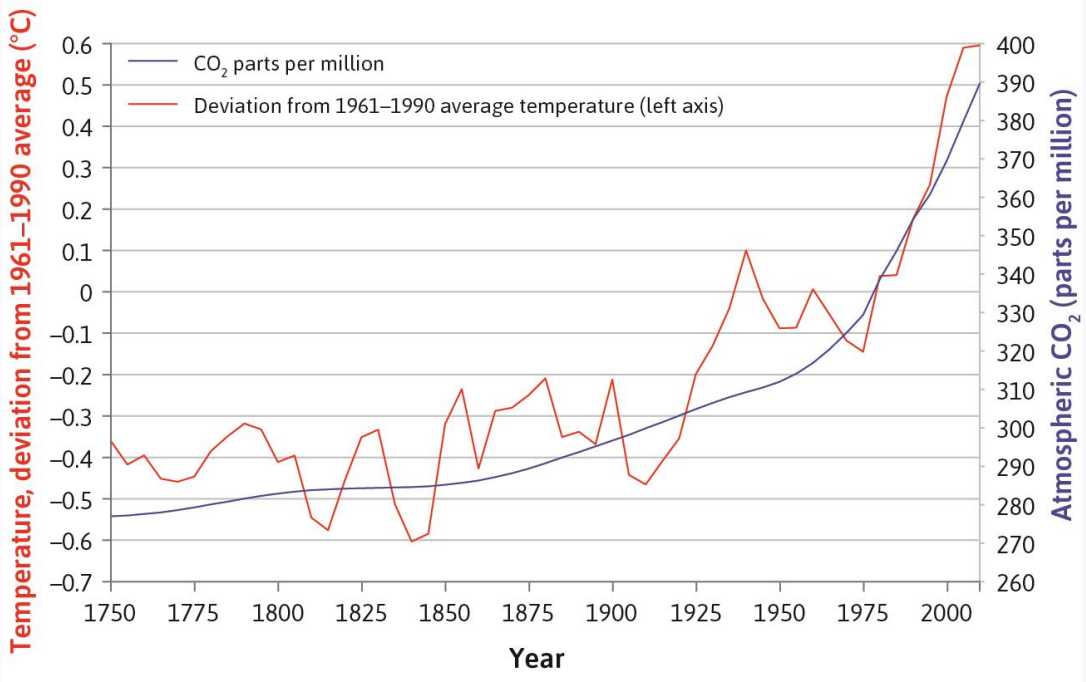

Abatement cost curve

Abatement policies [Políticas de Redução de emissões poluentes] can address climate change.

The degree of abatement chosen depends on the relative costs and benefits.

Optimal abatement choice depends on

1. Citizens' value for the environment, and
2. (Economic) Costs of abatement.

Conflicts of interest

1. Costs of abatement are not equally shared across society.

Polluter pays principle [Princípio do poluidor-pagador]: those responsible for external effects should pay for these damages.

However, this is not always the best policy:

- **Fairness** – polluters may be low-income families (e.g., burning wood, burning charcoal to cook).
- **Effectiveness** – subsidies/taxes may be less costly than tracking down the polluters.

<u>Rich countries have long exported waste to poor countries.</u>

Not just clothes, busted sofas, and twisted metal, but also **toxic wastes**, which are later **burned to create energy**.

China, India, and African nations are the main recipients.

<u>Who should pay for the pollution generated from burning this waste?</u>

Forbes

MARKETS

China Doesn't Want The World's Trash Anymore. Including 'Recyclable' Goods.

Kenneth Rapoza

Senior Contributor

I write about global business and investing in emerging markets.

Nov 29, 2020, 08:00am EST

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Plastics

'Waste colonialism': world grapples with west's unwanted plastic

Germany and UK are big exporters of plastic, much of which lies rotting in ports in Turkey, Vietnam and other countries

Ruth Michaelson

Fri 31 Dec 2021 12.58 GMT

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You are reading an older article which was published on **Mar 07, 2019**

India Imposes Complete Ban on Solid Plastic Waste Imports

A loophole that was apparently responsible for plastic waste imports quadrupling was closed, the environment ministry said.

Mar 07, 2019 | The Wire Staff

One in three will still use polluting cooking fuels in 2030

Many people, particularly in sub-Saharan Africa, use biomass to cook with

Almost one in three people around the world will still be mainly using polluting cooking fuels and technologies– a major source of disease and environmental destruction and devastation – in 2030, new research has warned.

This rises to more than four in five in Sub-Saharan Africa, where the number of people mainly using polluting fuels is growing at what researchers have called “an alarming rate”.

Conflicts of interest

2. Benefits of abatement are also not equally shared across society. Unlike citizens, polluters may not have to experience pollution.

Distribution of mutual gains from abatement depends on relative bargaining power of groups.

Bargaining power depends on:

- Verifiable information (ability to detect pollution)
- Consensus among citizens about environmental quality
- Lobbying by the firm
- Legal entitlement to pollute (e.g., pollution permits)
- Enforcement capacity

Types of abatement policies

How can we achieve the desired level of abatement?

Policymaker's aim: achieve the desired amount of effective abatement (e.g., units of CO_2) at minimum cost.

There are 2 types of abatement policies:

1. **Price-based policies** use taxes and subsidies to affect prices
   - Aim to internalize the external effects of individual choices
2. **Quantity-based policies** use bans, caps, and regulations

Cap and Trade

Environmental external effects arise because of missing markets.

Cap and trade [Mercado de licenças de emissão de CO2] creates a market for emissions:

- Government sets a limit (cap) on the desired pollution and creates enough permits to meet this cap [business-as-usual emissions exceed this cap & the cap is reduced over time].

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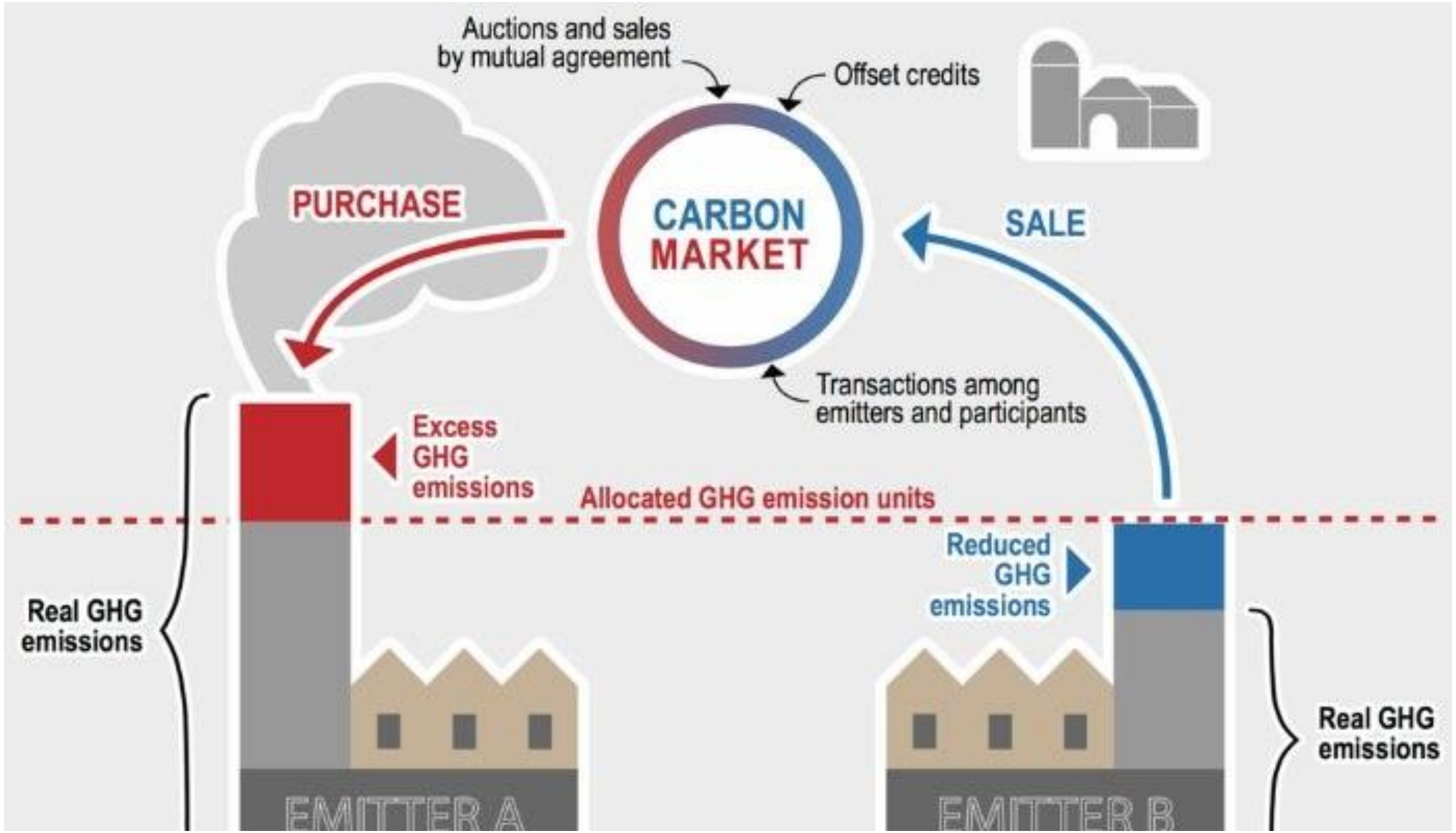
- Cap and trade is a combined (quantity- and price-based) policy.


Auctions and sales by mutual agreement
Offset credits
PURCHASE
CARBON MARKET
SALE
Transactions among emitters and participants
Excess GHG emissions
Allocated GHG emission units
Reduced GHG emissions
Real GHG emissions
Real GHG emissions
EMITTER A
EMITTER B

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Commodity	Forex	Index	Stock	Bond	Crypto

	Actual	Chg	%Chg
Crude Oil	102.1500	▲ 2.88	2.90%
Brent	106.7900	▲ 2.4	2.30%
Natural gas	5.7870	▲ 0.067	1.17%
Gasoline	3.1989	▲ 0.0454	1.44%
Heating Oil	3.5165	▲ 0.0925	2.70%
Gold	1931.65	▲ 7.35	0.38%
Silver	24.517	▼ 0.093	-0.38%
Copper	4.7635	▲ 0.081	1.73%
Soybeans	1597.2500	▲ 14.5	0.92%
Wheat	1008.5000	▲ 24.25	2.46%
Coal	258.75	▼ 5.25	-1.99%

https://tradingeconomics.com/commodity/carbon

Cap and Trade

- Given that firms vary in their production technologies, how will the total amount of required abatement be divided among them?

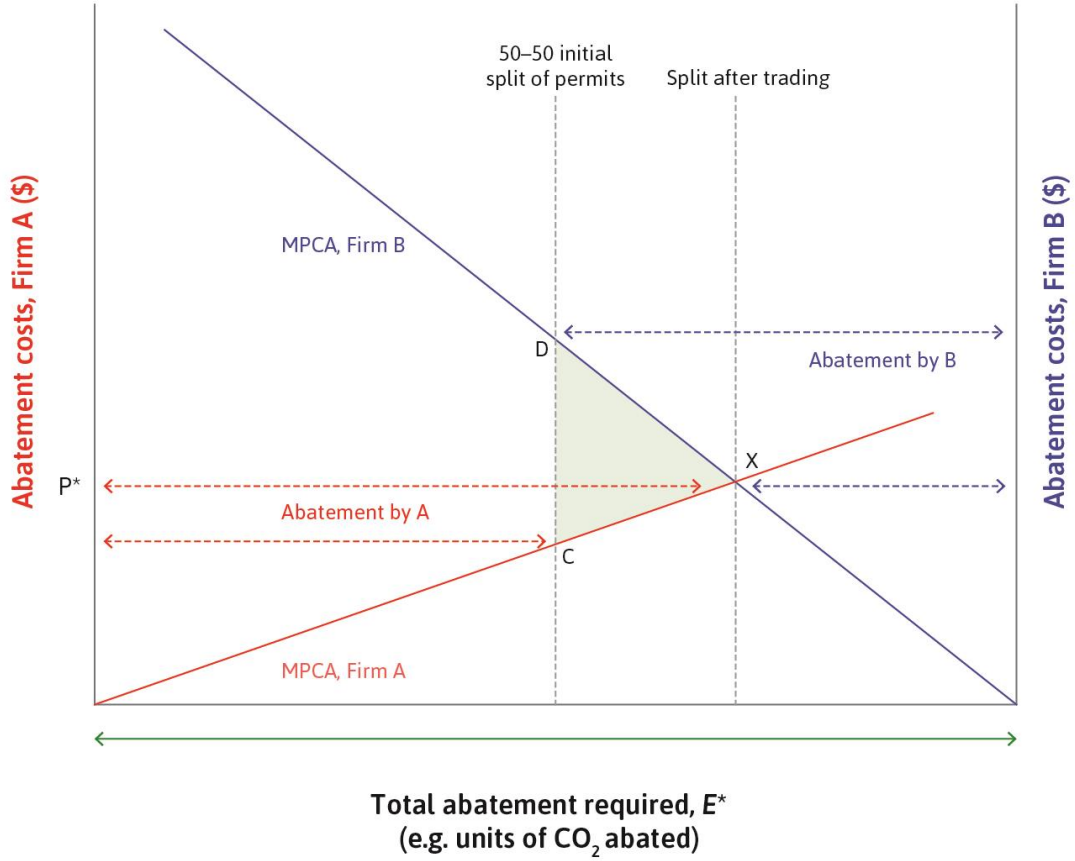
- The objective of a scheme for trading permits is that the abatement should be done by the firms for which this is least costly because this saves scarce resources that can be used elsewhere.

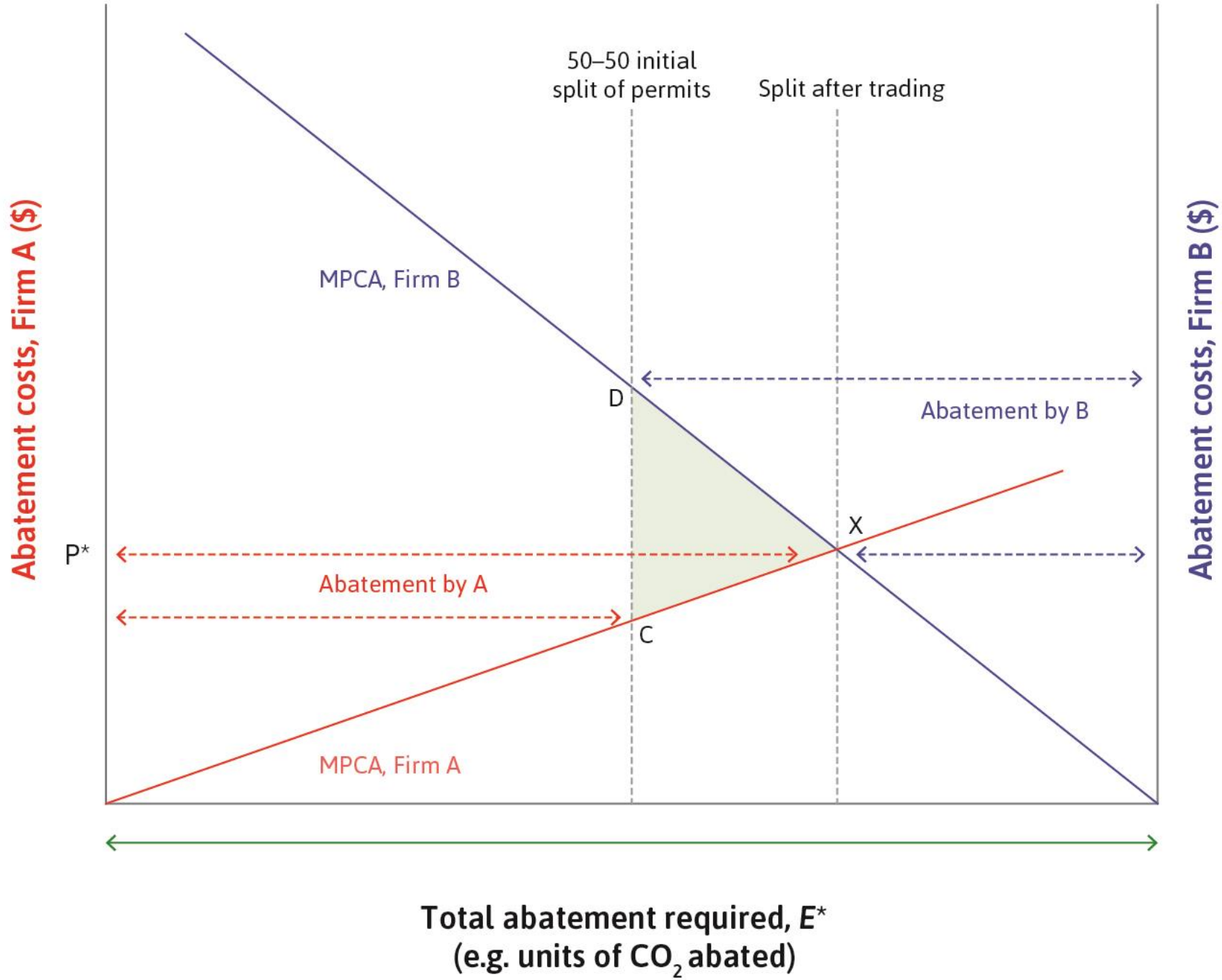
Cap and Trade: Model

Firms trade until **permit price = MC of abatement** (Pareto-efficient outcome, because we cannot improve the situation of one agent without deteriorating the other's).

Figure: The Government emits permits compatible with the total abatement required (length of the horizontal axis). At the initial split of permits (points C and D), firm B has a higher marginal private cost of abatement (MPCA) than Firm A, so there is room for B to pay A to abate more (and B less), since B is willing to pay more for that than A demands.

- Both firms benefit from buying/selling permits until the MPCA is equalized across firms (benefit = triangle area). The point where they equalize is the equilibrium price in the market for permits.
- In this way the objective of cap and trade (that abatement is done by the firms for which this is least costly) is attained.




50–50 initial
split of permits
Split after trading
MPCA, Firm B
D
Abatement by B
X
P*
Abatement by A
C
MPCA, Firm A
Abatement costs, Firm A ($)
Abatement costs, Firm B ($)
Total abatement required, E*
(e.g. units of CO2 abated)

Cap and Trade: Issues

- Policymakers need to set the correct total level of abatement (the cap) – not easy to determine
- Putting a price on pollution may send the wrong signal to firms (e.g., making pollution profitable)

Example: EU Emissions Trading Scheme set too large a cap. The price of polluting permits fell dramatically after the 2008 crisis, associated with this large supply and also with lower electric power demand due to the economic crisis, providing little incentive to abate (because the price of polluting was low).

- A price floor on permits can mitigate this issue

Measuring environmental costs/benefits

1. **Contingent valuation:** Use surveys to assess the value of nonmarket resources

- This is a **stated preference** approach - assumes respondent's statements indicate their true preferences

2. **Hedonic pricing:** Uses prices of market goods to infer the economic value of unpriced attributes (e.g., environmental qualities)

- This is a **revealed preference** approach – uses behaviour as an indication of preferences

Effect of technological improvement

Technological improvements may make abatement more efficient (increase the marginal productivity of abatement expenditure) or reduce the environmental costs of consumption.

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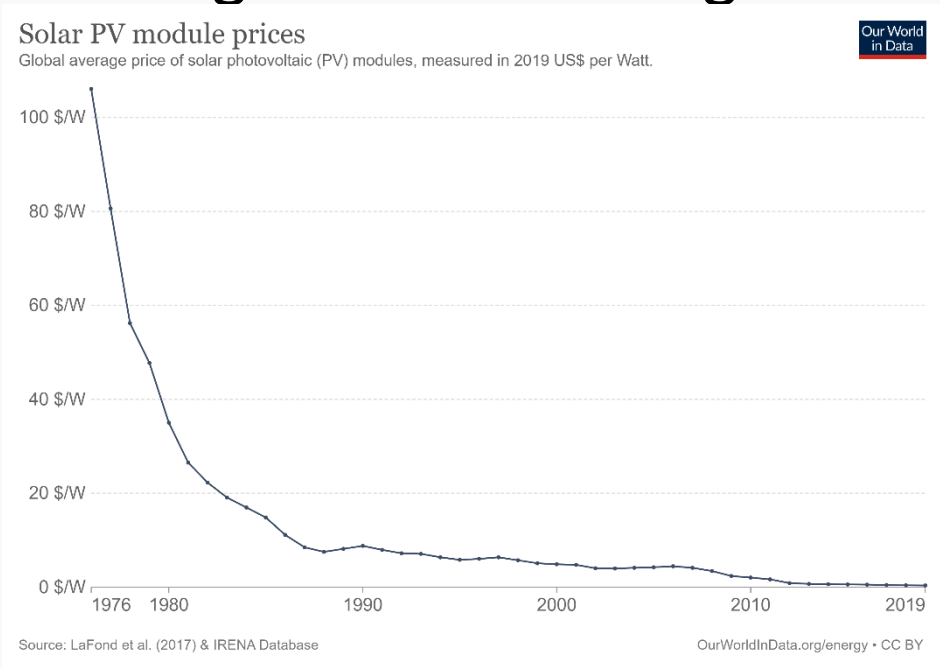
Example: Renewable energy production

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

- Subsidies to firms that produce solar panels have 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.

Example: Without a tax, coal-intensive technology is cheaper, but a tax on coal makes solar-intensive technology cheaper.

Taxes on firms may make renewable sources of energy relatively more profitable, but also make adoption necessary to stay competitive.

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Example: A tax on air travel

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Taxes are not just incentives; they are also a source of information about the need to change behaviour.

Modelling environmental dynamics

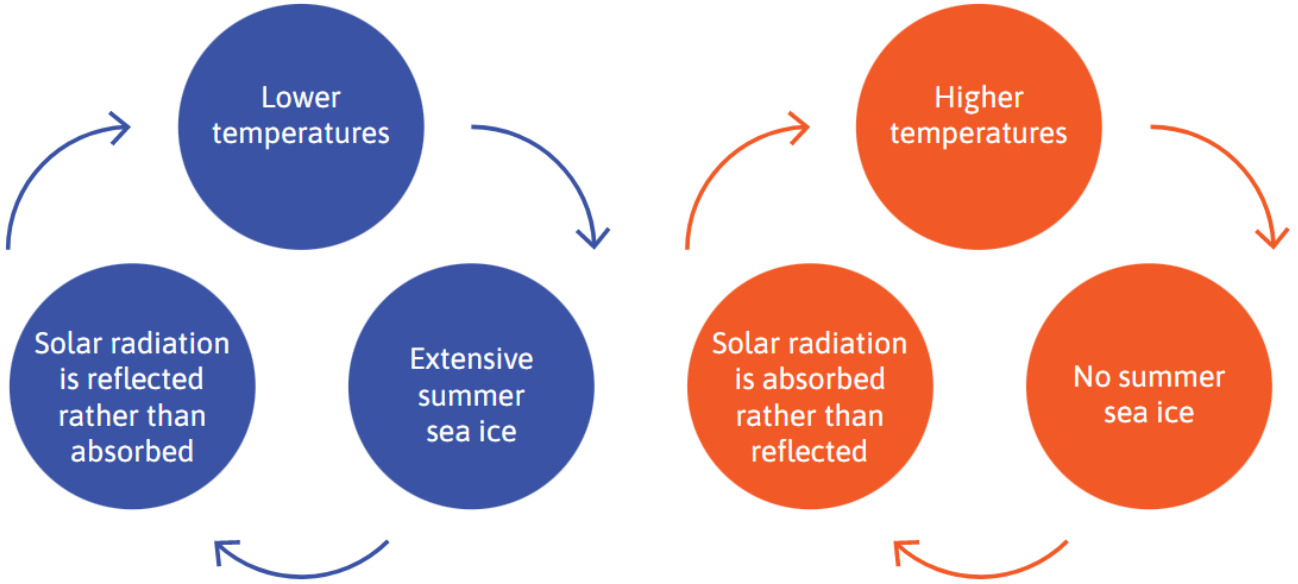
A healthy environment and degraded environment are both possible equilibria of this game.

- On the one side, processes of environmental degradation are self-limiting
  - E.g., expand agriculture in ways that deplete soils, waste freshwater, kill pollinators, and increase desertification & deforestation. Efforts to keep increasing food production will eventually prove to be self-limiting.

- On the other side, they are self-reinforcing.

Example: Arctic sea ice

There are two stable equilibria (a lot of ice or no ice).



Extensive summer sea ice

Virtuous cycle
Environmental Sustainability

No summer sea ice

Vicious cycle
Environmental Collapse

Addressing climate change: Challenges

Addressing climate change is difficult because:

1. People may value the economy more than the environment
    - Lack of adequate information and conflicts of interest

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   - **Discounting**: how much should we value the costs/benefits of our actions on future generations?

REUTERS

ENVIRONMENT

NOVEMBER 13, 2019 / 11:39 PM / UPDATED 2 YEARS AGO

Climate change exposes future generations to life-long health harm

By Kate Kelland

LONDON (Reuters) - A child born today faces multiple and life-long health harms from climate change - growing up in a warmer world with risks of food shortages, infectious diseases, floods and extreme heat, a major global study has found.

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Climate change: how bad could the future be if we do nothing?

Published: May 6, 2021 1.59pm BST

Mark Maslin, UCL

The climate crisis is no longer a looming threat – people are now living with the consequences of centuries of greenhouse gas emissions. But there is still everything to fight for. How the world chooses to respond in the coming years will have massive repercussions for generations yet to be born.

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How taking responsibility for future generations can spur action on climate change

Tackling climate change can feel like an uphill struggle.

Image: REUTERS/Yann Tessier

This article first appeared on

LSE Business Review

28 Aug 2021

Addressing climate change: Challenges

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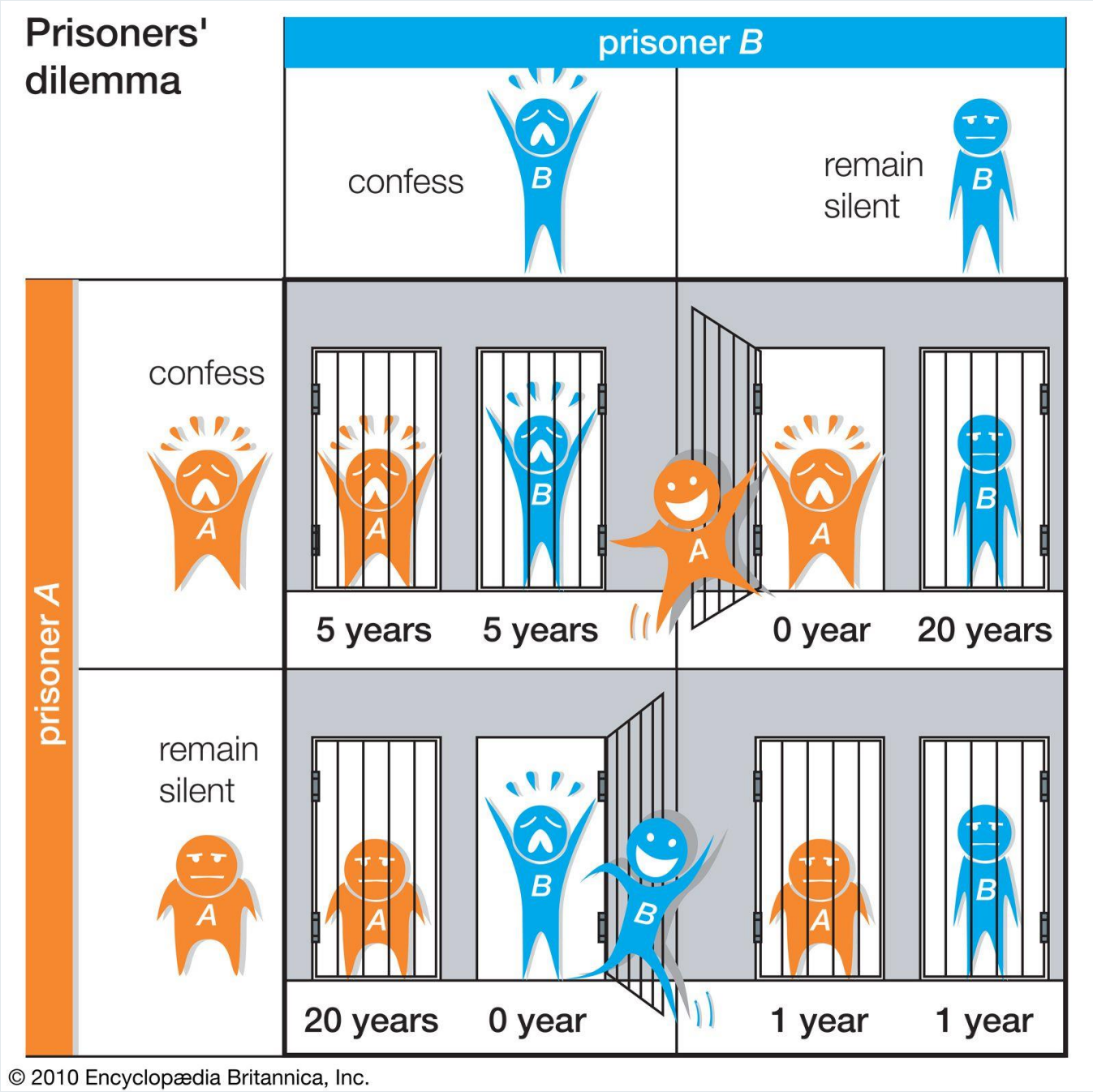
3. Requires international cooperation (Prisoner's Dilemma)

Prisoner’s Dilemma

- A prisoner’s dilemma is a game that illustrates the existence of conflict between private interests and social or group interests. In this game the equilibrium (solution) is “bad”, in the sense that each player/economic agent will pursue his/her own interests, at the expense of the community, and everyone will be worse-off.

- It applies to many real-life situations, namely in the environmental field.



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Win-win policies

However, there is not always a tradeoff between consumption and environmental quality:

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

Importance of energy efficiency for the low carbon transition (reduction in the demand for energy).

Additional Readings

- https://mpra.ub.uni-muenchen.de/106340/1/MPRA_paper_106340.pdf

- Klenert et al., 2020. Five Lessons from COVID-19 for Advancing Climate Change Mitigation. Environmental and Resource Economics volume 76, pages751–778. https://link.springer.com/article/10.1007/s10640-020-00453-w#article-info