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Green innovation policies

Economics and climate change

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Economics.
For Society.

Live presentation and Q&A, 24 March 2022

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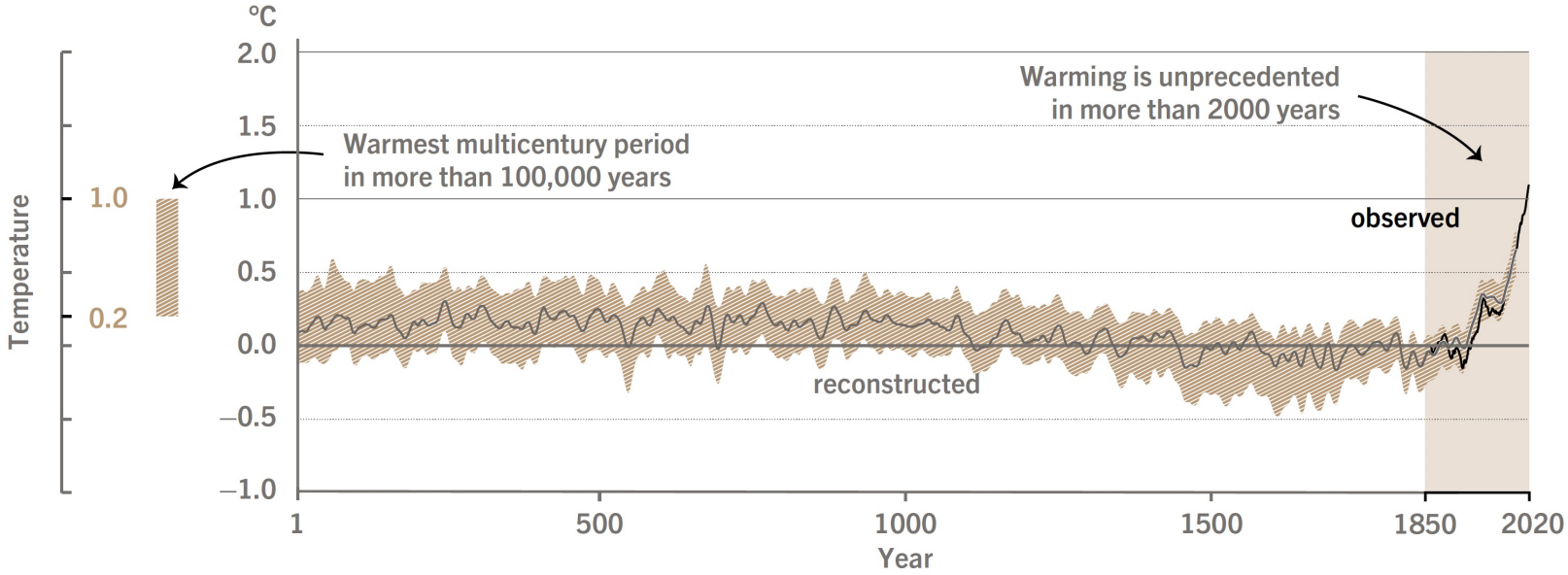
Climate Change is underway

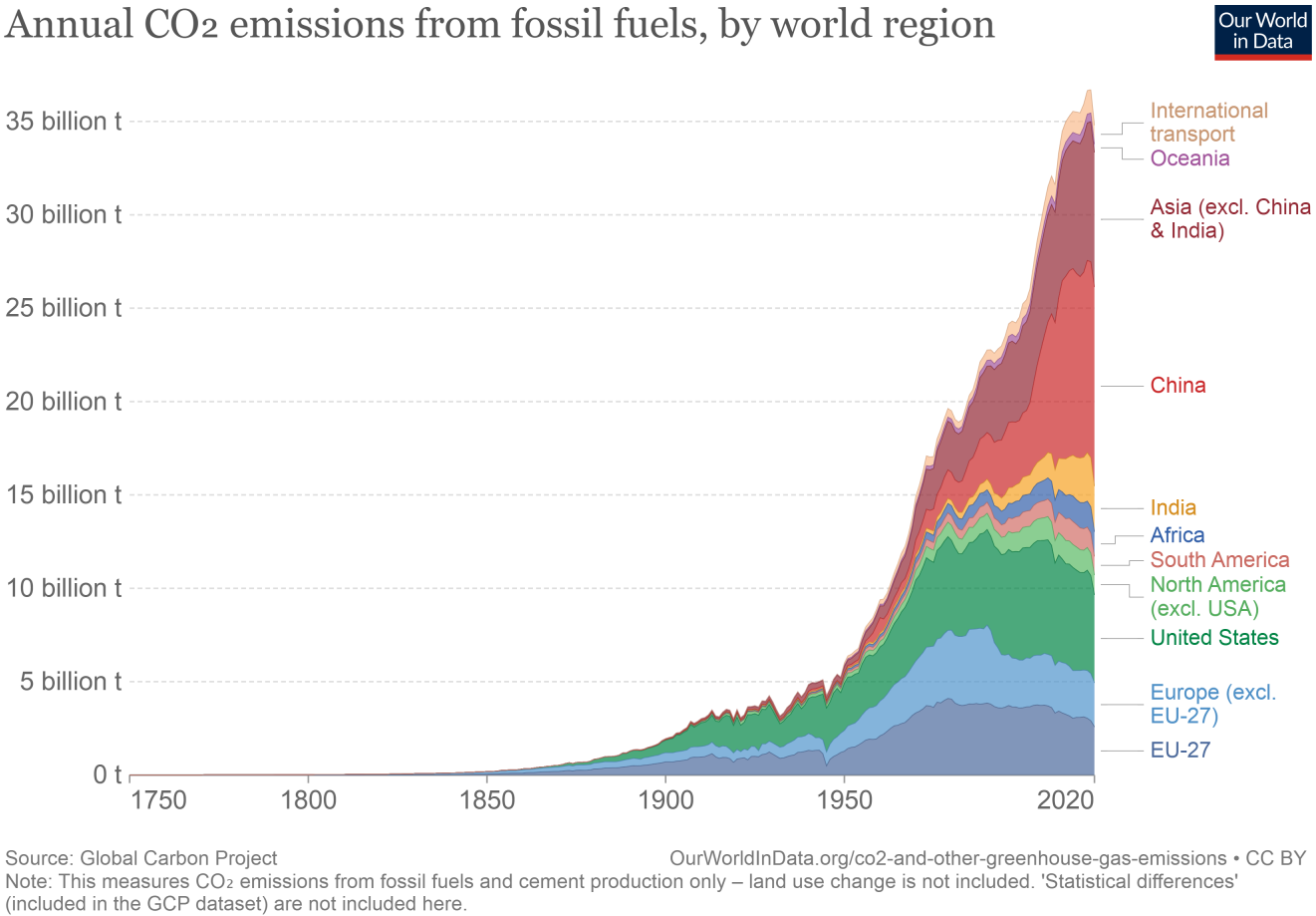
Fig. 1 **Changes in global surface temperature relative to 1850–1900**



Notes: Change in global surface temperature (decadal average) as reconstructed (1–2000) and observed (1850–2020)

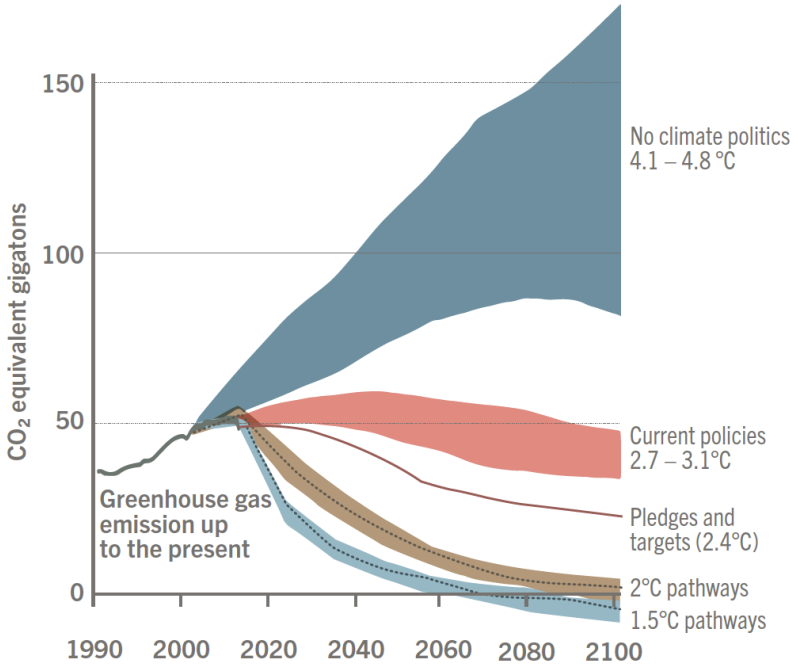
Source: IPCC report

CO2 emissions have increased dramatically



What do we need to do?

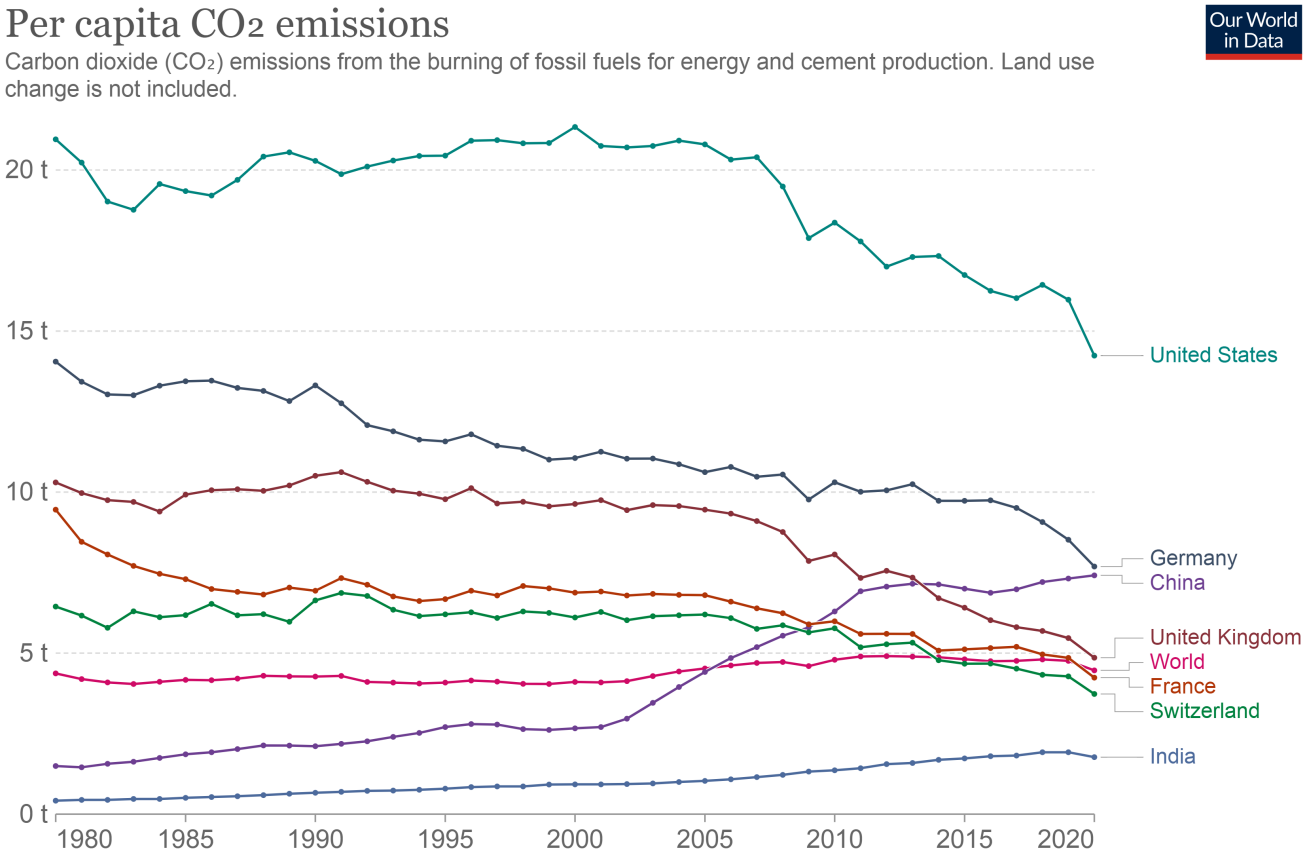
Fig. 4 **Global greenhouse gas emissions and warming scenarios**



Notes: Each pathway comes with uncertainty, marked by the shading from low to high emissions under each scenario. Warming refers to the expected global temperature rise by 2100, relative to preindustrial temperatures.

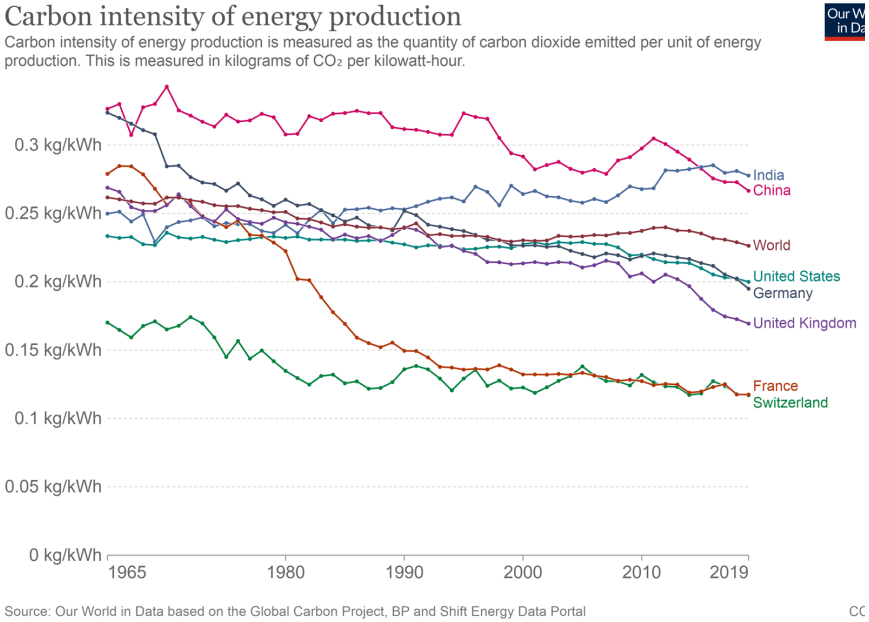
Source: Our World in Data based on Climate Action Tracker

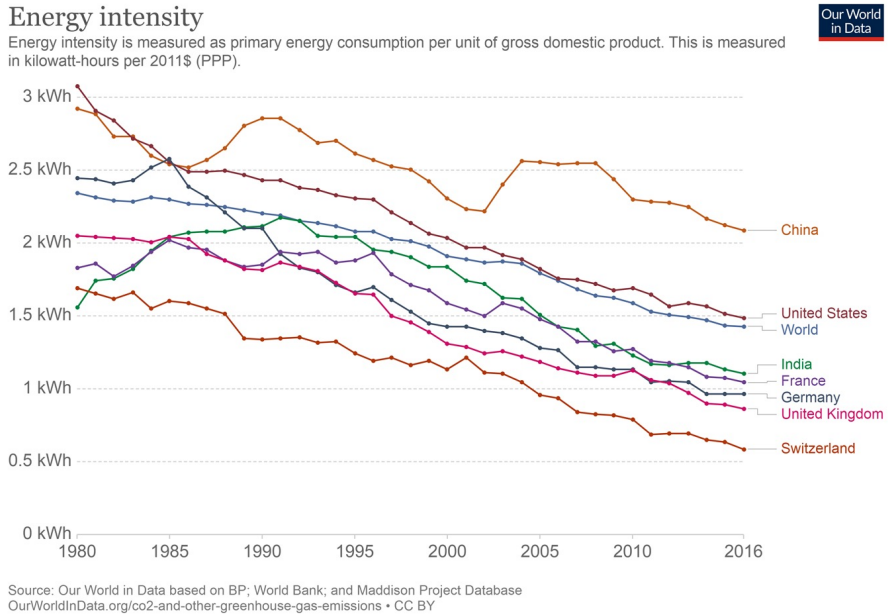
There are huge variations across countries



A simple decomposition

$$\text{Emissions} = \underbrace{\frac{Emissions}{Energy}}_{\text{Substitution between clean and dirty energy}} \times \underbrace{\frac{Energy}{GDP}}_{\text{Energy efficiency; Energy sobriety; Substitution across sectors}} \times \frac{GDP}{Population} \times Population$$





Taking stock

- "Technology" in a broad sense allows to reduce CO2 emissions without large reductions in GDP:
  - US emissions would fall by 70% if the US used the same technologies as France (though the transition would be costly).
  - UK emissions per capita declined by 48% between 1990 and 2019 while GDP per capita increased by 52%.
  - So far energy-saving technical change / structural transformation have done most of the job… but to reduce emissions more, one needs to develop and adopt clean substitutes.
- Is it possible to induce more green innovation?
  - Look at an example in the car industry: where it is easy to identify clean alternatives to fossil fuels exist.

Gas prices and innovation in the car industry

- We analyze how an increase in gas prices favor clean innovation and hurts dirty innovation.
  - We measure innovations using patents and classify them
  - Showing a causal effect at the country level is impossible;
  - So we compare how firms in the car industry behave differently over time depending on the average gas price in the countries that they sell to.

Gas prices and innovation in the car industry

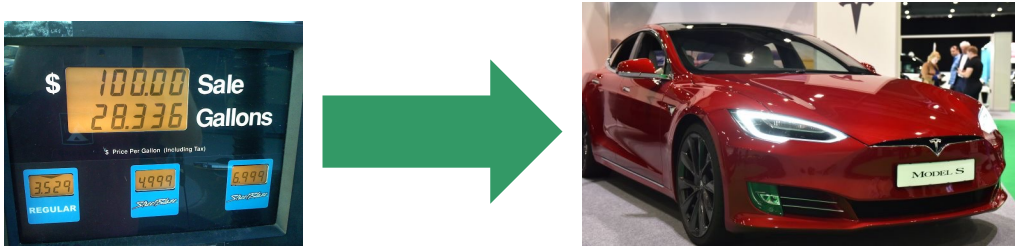
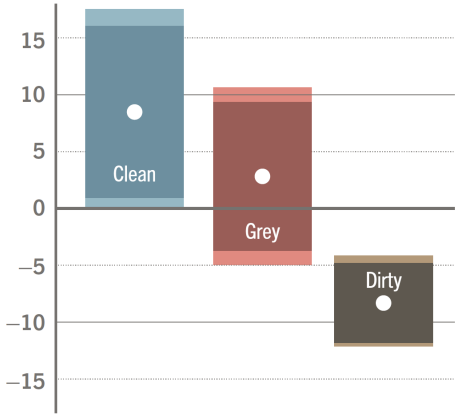


Fig.10 **Effect of a 10% increase in fuel prices**



Notes: The bars denote the 90% and 95% confidence interval.

Source: Aghion, Dechezleprêtre, Hémous, Martin, and van Reenen (2016)

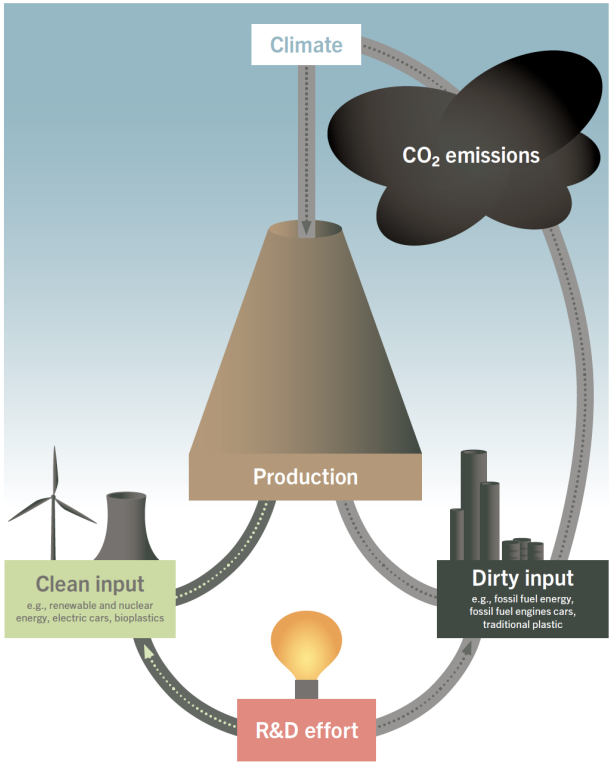
Taking stock and next steps

- Is it possible to induce more green innovation?
  - ➢ Yes
- What does this imply for climate policy?

Lessons from a model on climate and innovation

- 1st lesson: there is path dependence in innovation.
  - In laissez-faire, innovation would be directed toward dirty technologies.
- 2nd lesson: delaying intervention is costly.
  - A larger gap between clean and dirty technologies means that it will take more time for clean technologies to catch up.
- 3rd lesson: optimal policy involves both a carbon tax and subsidies to clean research:
  - Current innovation in clean technologies will be very useful in the future.

Fig. 13 The AABH economic climate policy innovation framework



Source: own work

Innovation is endogenous and targets the sector with the largest profits.

What if only part of the world is willing to implement an environmental policy?

- If the EU imposes a high carbon price, “carbon leakage” is an important concern.
  - Energy-intensive manufacturing may move to countries with a lower carbon price (US, China,…).

VS

- But what about innovation?
  - ↑ market for energy-intensive good in the US → ↑ fossil fuel innovations in the US
  - ↓ market for energy-intensive good in Europe → ↓ clean innovation in Europe.
  - *Carbon leakage is an even bigger problem*.
- Consider instead a “Green industrial policy”: carbon pricing with carbon tariffs and subsidies to clean research;
  - Energy-intensive industries do not move as much to the US
  - Development of clean substitutes in the EU generates spillovers in the US → ↓ in emissions in both countries.
  - *Carbon leakage can be reversed*.

What are the implications for an intermediate technology (shale gas)?

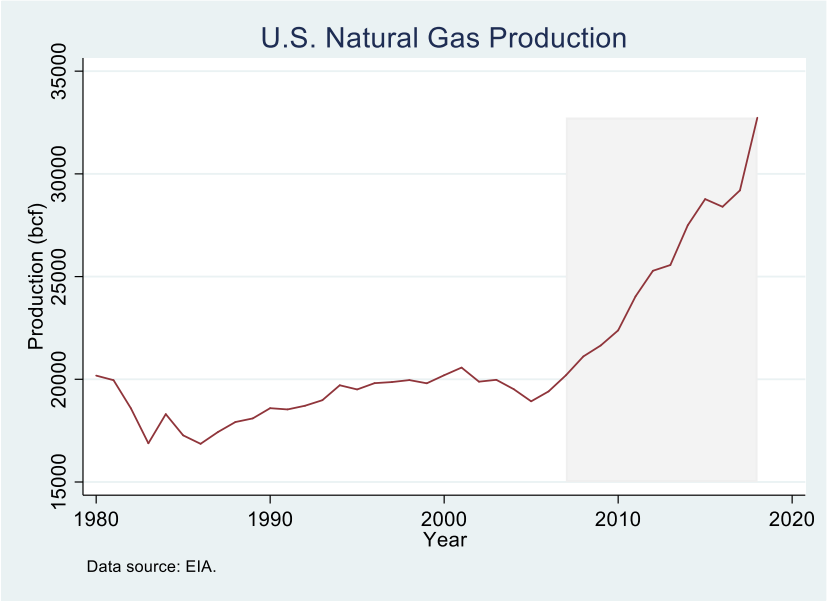
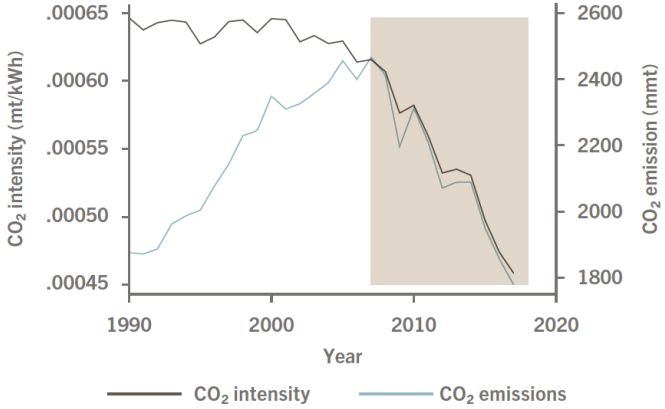


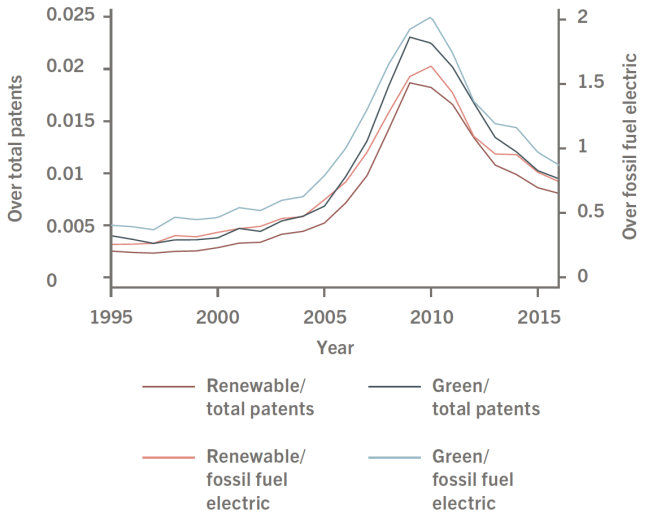
Fig. 16 CO_2 emissions in US electricity generation



Source: EIA and EPA

The collapse of green innovation

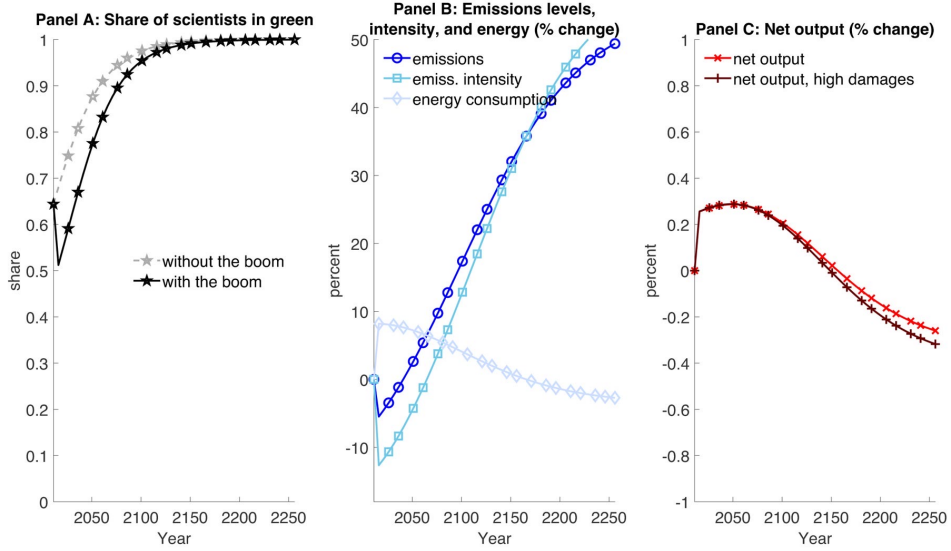
Fig. 17 Spectacular reversed trend in renewable and green patents in the US



Source: Acemoglu, Aghion, Barrage, and Hémous (2021)

- Number of patents in renewables has collapsed since the shale gas revolution.

Simulation results for the US economy



- We estimate that in the long-run, the shale boom will actually lead to an increase in emissions (unless policy reacts).
- Policy should react by increasing support to clean technologies.

Conclusions

- Innovation is key to tackle climate change;
  - Innovation responds to market incentives
  - But that is a call for more not less governmental action.
  - (Of course, it is not only about innovation).

- Taking into account the response of innovation:
  - Calls for research subsidies on top of carbon pricing;
  - Calls for an earlier interventions;
  - Favors a local green industrial policy over a simple unilateral carbon tax;
  - Calls for caution when deploying ``bridge'' technologies such as natural gas.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