Green Innovation Policies
Economics and Climate Change

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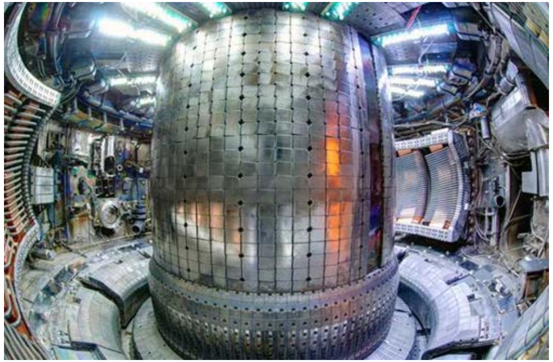
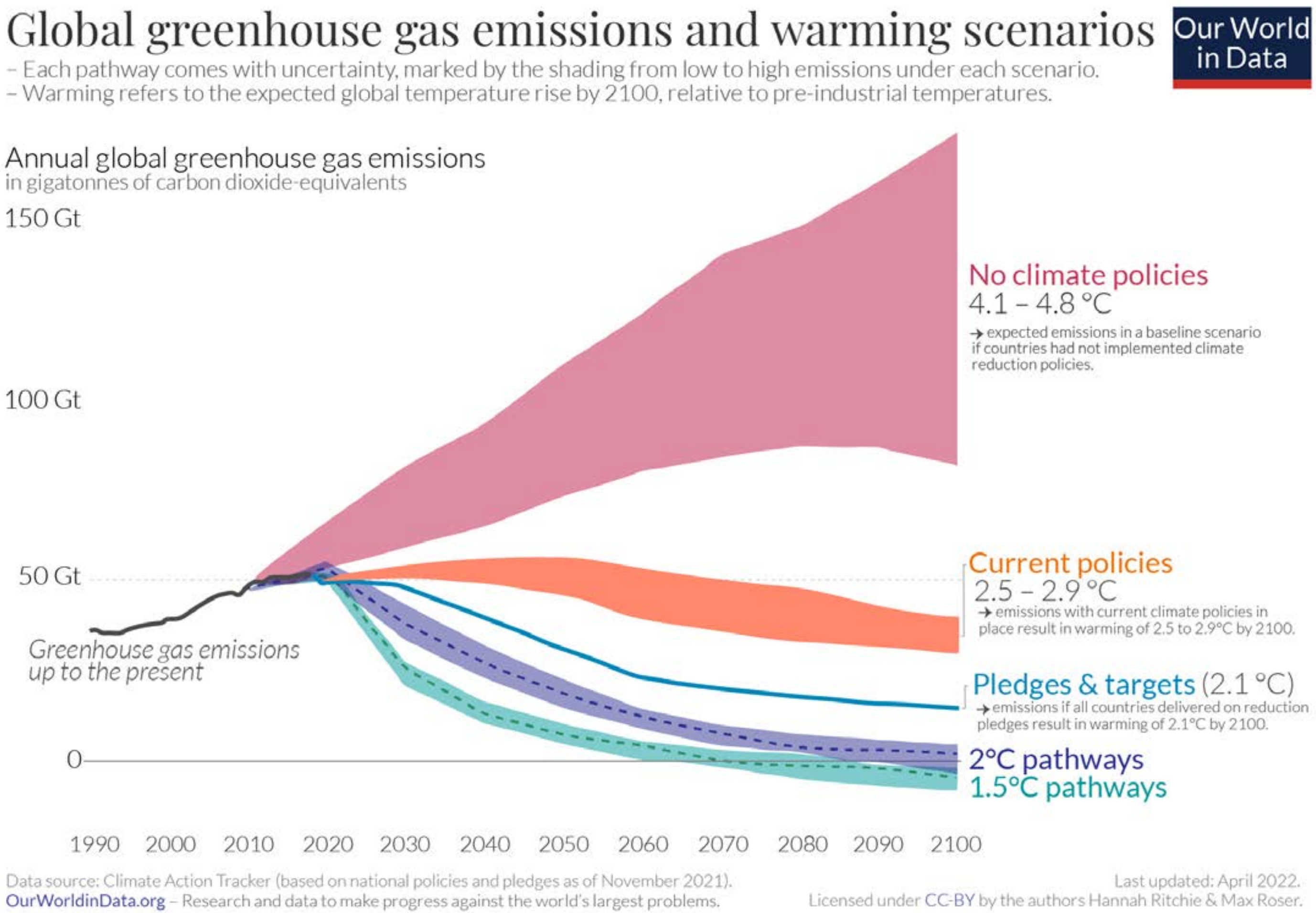
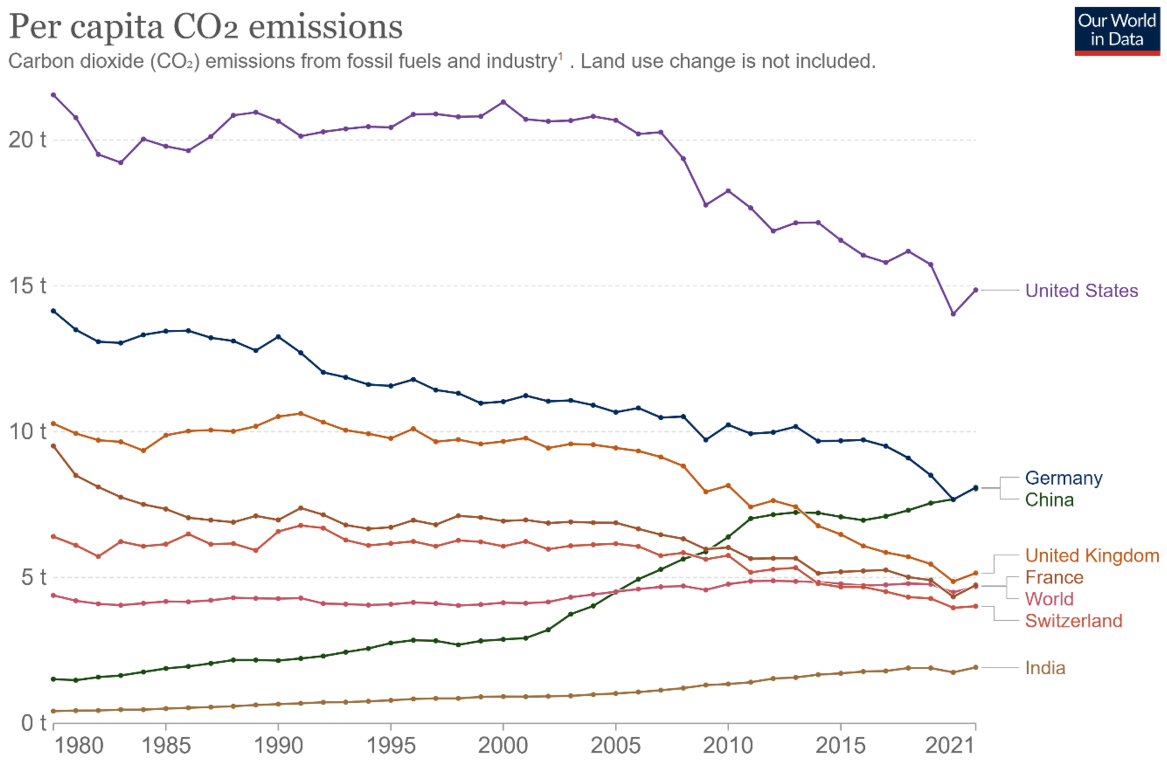
Economics and Climate Change



What do we need to do?



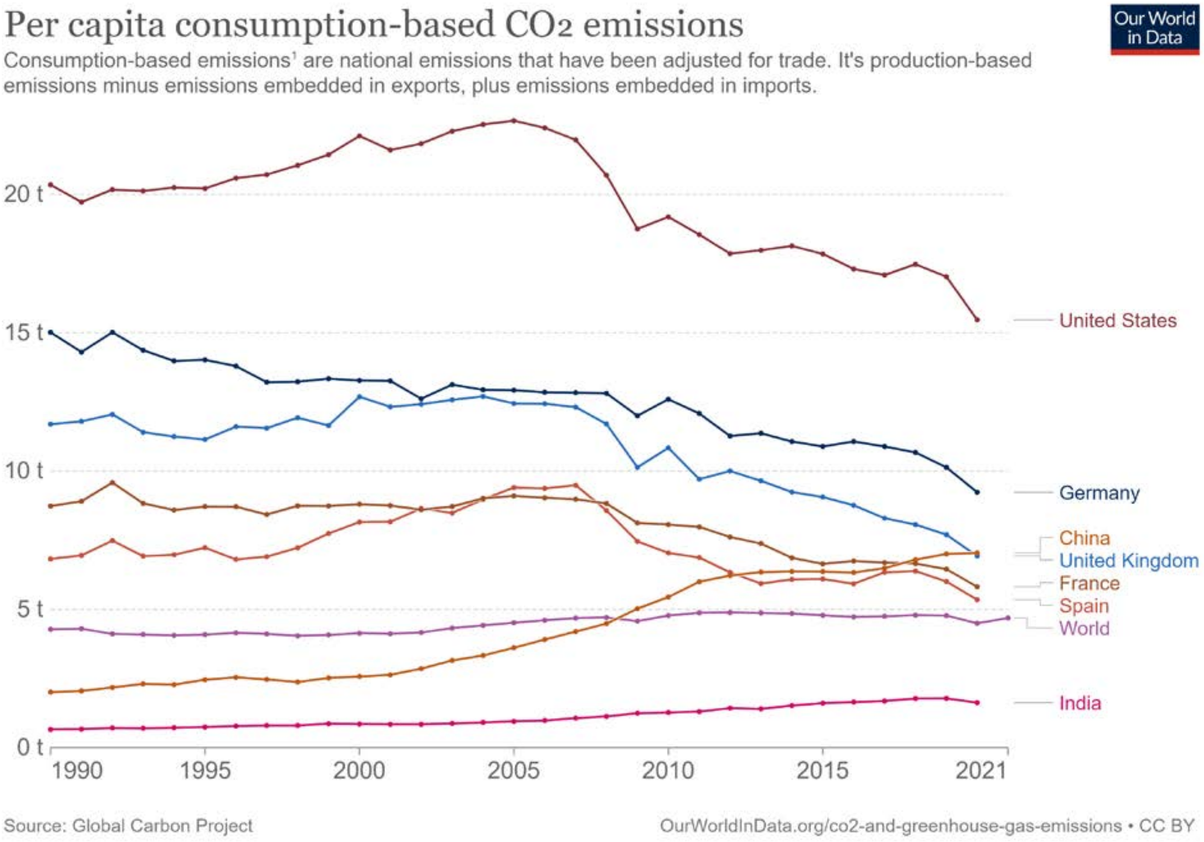
There are huge variations across countries



Source: Our World in Data based on the Global Carbon Project (2022) OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

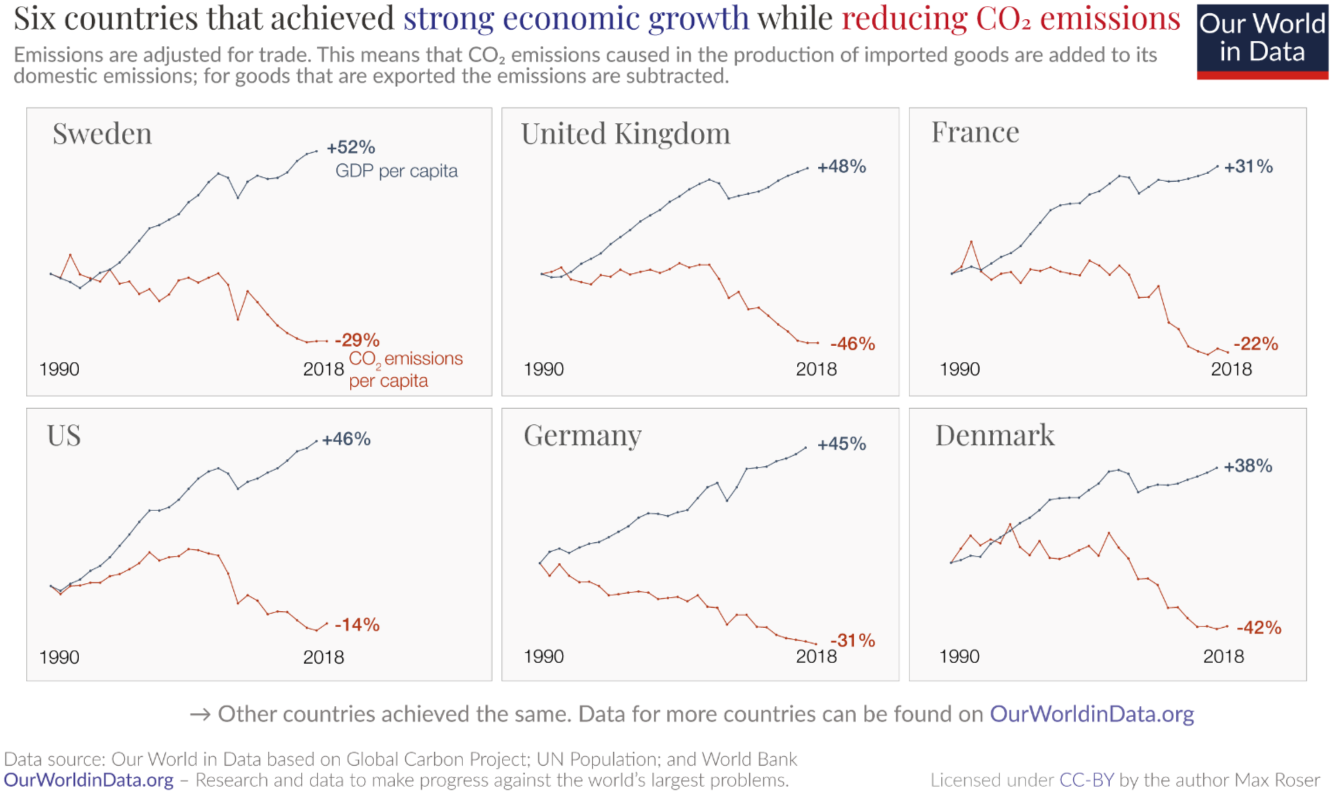
1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Consumption-based emissions show similar *trends*



1. **Consumption-based emissions**: Consumption-based emissions are national or regional emissions that have been adjusted for trade. They are calculated as domestic (or 'production-based' emissions) emissions minus the emissions generated in the production of goods and services that are exported to other countries or regions, plus emissions from the production of goods and services that are imported. Consumption-based emissions = Production-based – Exported + Imported emissions

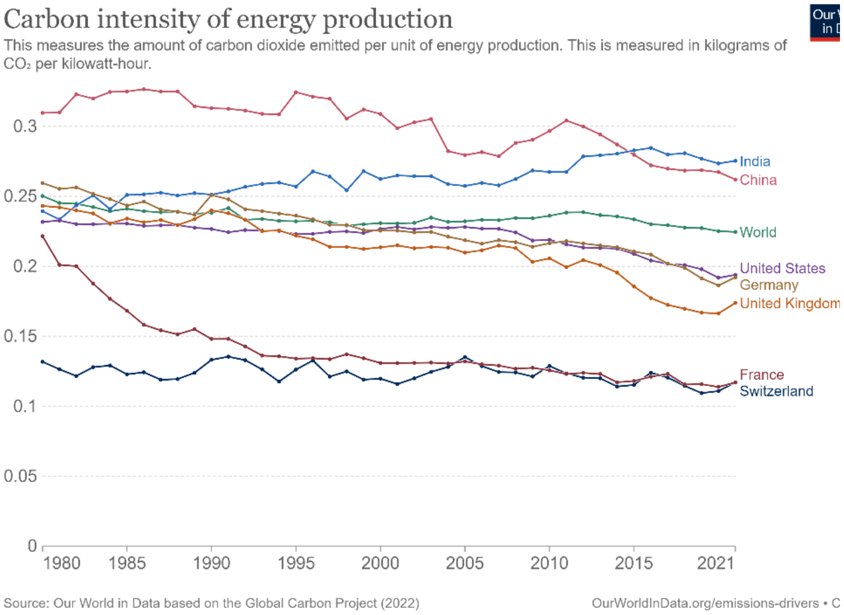
Decoupling is possible …

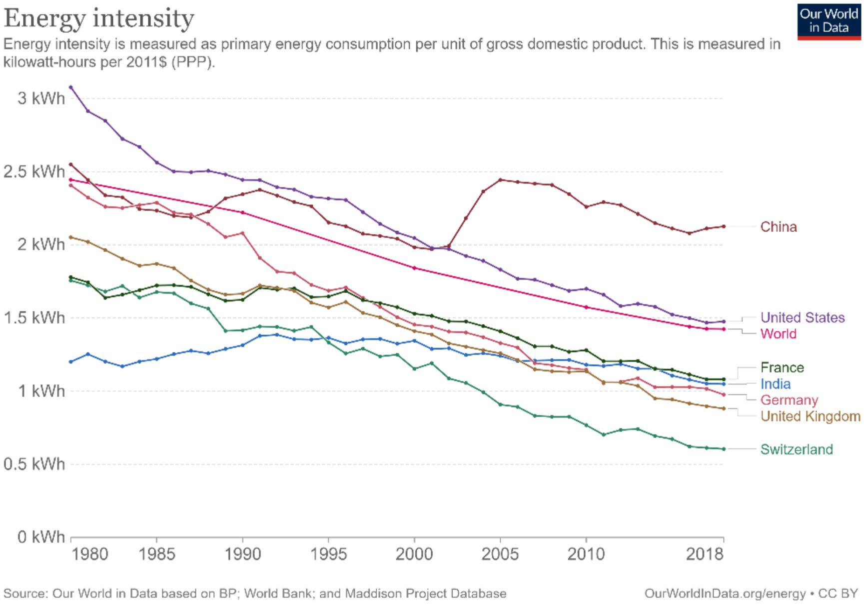


- … which does not mean that it is free!

A simple decomposition

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





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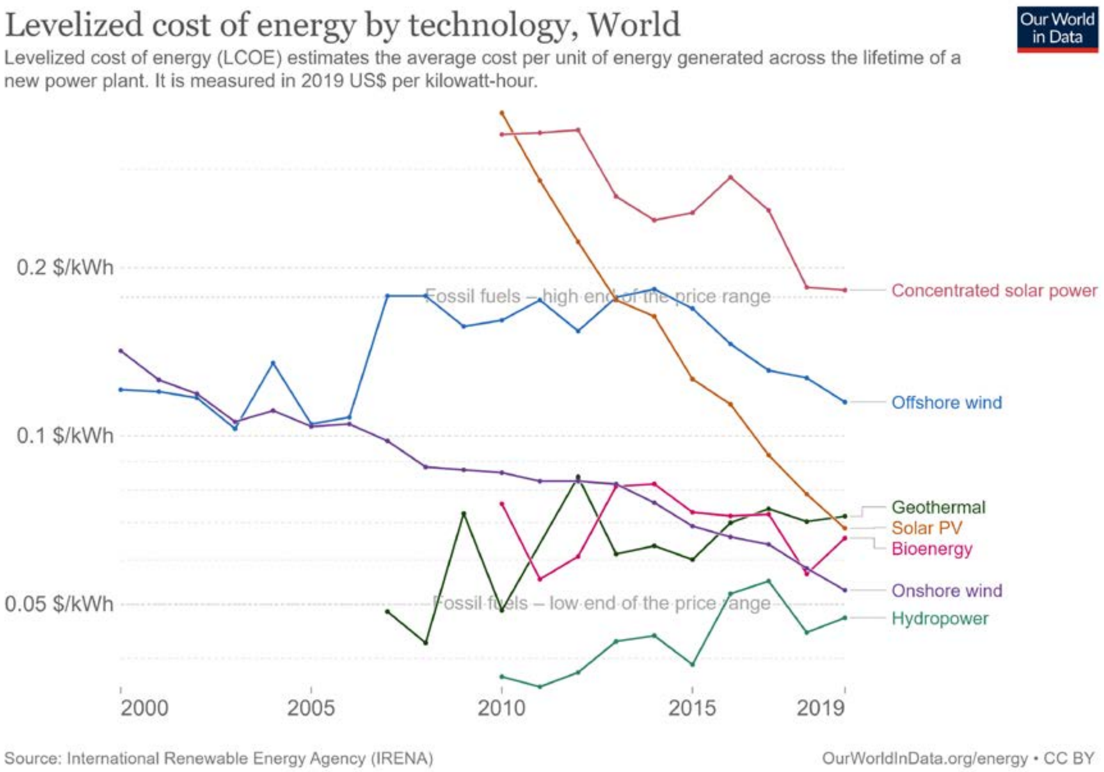
Recent trends in energy costs (up to 2019)



Careful: this does not take into account the intermittency of renewables.

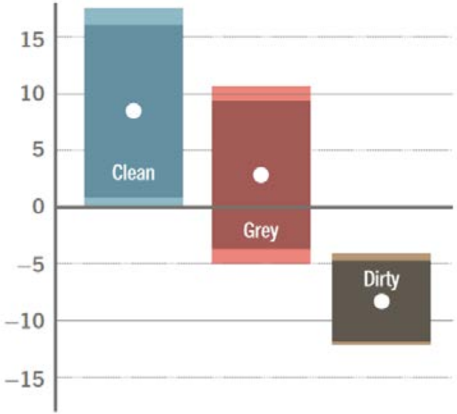
Taking stock

- "Technology'' in a broad sense allows to reduce CO2 emissions without large reductions in GDP:
  - Consumption-adjusted CO2 emissions per capita in the US are 68% higher than in Germany;
  - Consumption-adjusted CO2 emissions per capita in Germany are 59% higher than in France.
  - 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?

Gas prices and innovation in the car industry

- Car industry is a good example where clean alternatives to fossil fuels exist.
- 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.

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



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

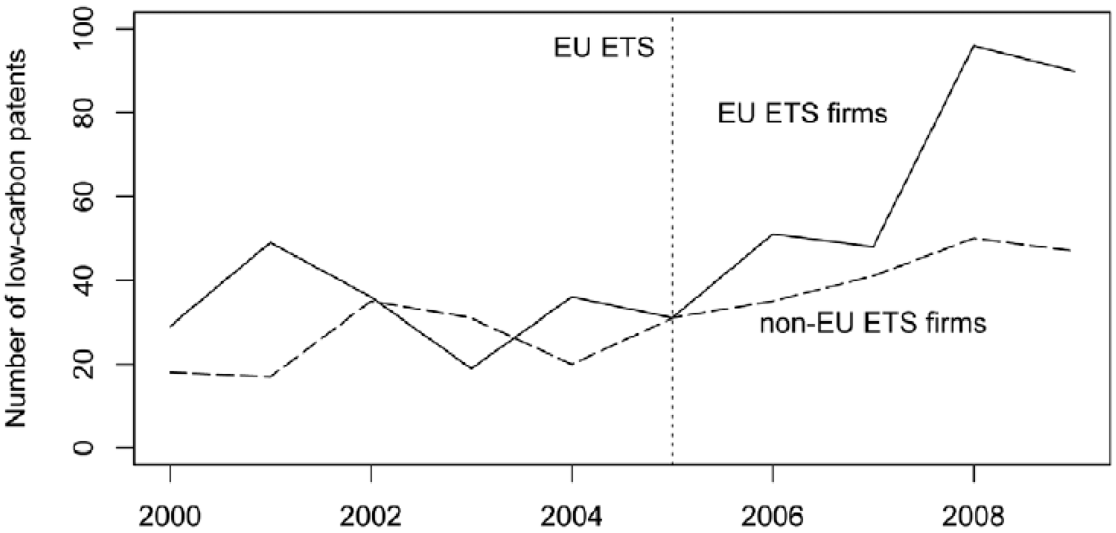
Source: Aghion, Dechezleprêtre, Hémous, Martin, and van Reenen (2016)

EU – ETS effect

Calel and Dechezleprêtre (2016): EU-ETS increased green innovation by 10%

- EU-ETS is the carbon cap and trade system in Europe.
- Only sufficiently large establishment are subject to it.
- They compare firms subject to EU-ETS with similar firms not subject to EU-ETS.

FIGURE 5.—LOW-CARBON PATENTS BY MATCHED EU ETS AND NON–EU ETS FIRMS



Taking stock and next steps

- Is it possible to induce more green innovation?

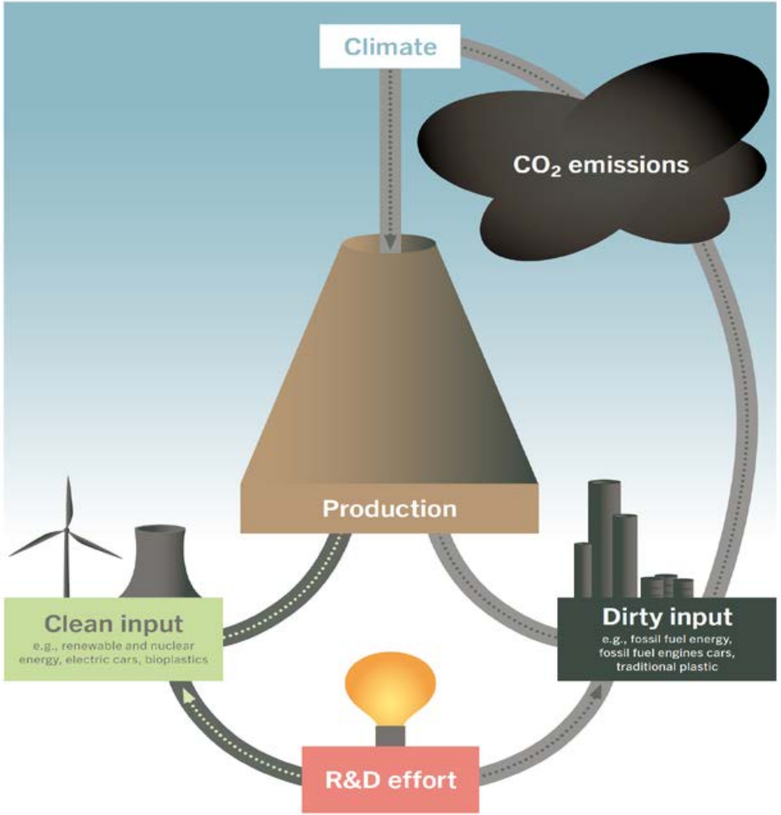
  - Yes

- What does this imply for climate policy?

- Most economic models of climate change (e.g. Nordhaus' DICE) assume exogenous technological progress (I.e. price of solar panels decreases by e.g. 2% a year regardless of policy) when computing optimal policy.
    - Focus is solely on carbon pricing.

Lessons from a model on climate and innovation (1)

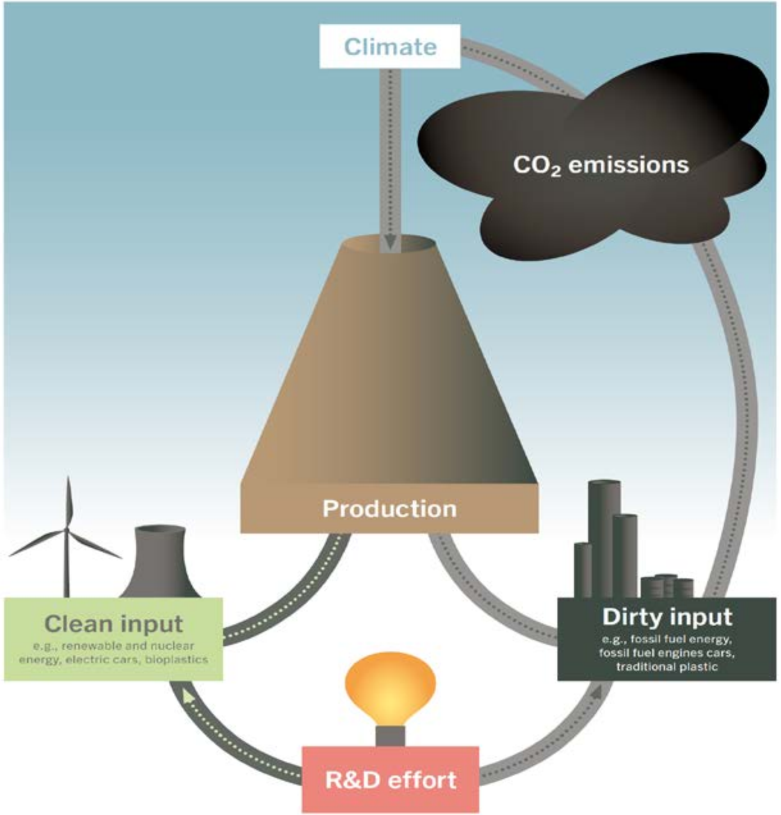
- 1st lesson: there is path dependence in innovation.
  - In laissez-faire, innovation would be directed toward dirty technologies.
- 2nd lesson: delaying intervention is costly.
  - A larger gap between clean and dirty technologies means that it will take more time for clean to catch.
  - Betting on innovation does not mean waiting for innovation to arrive.
  - Instead, policy needs to foster innovation.



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

Lessons from a model on climate and innovation (2)

- 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.
  - Carbon pricing is important but only 1 element of a successful green transition.



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?
  - The market for energy-intensive good becomes larger in the US which increases fossil fuel innovations there.
  - The market for energy-intensive good becomes smaller in Europe which decreases innovation in clean energy there.
- Consider instead a "Green industrial policy" which combines carbon pricing with carbon tariffs and subsidies to develop clean technologies:
  - Energy-intensive industries do not move as much to the US
  - Development of clean substitutes in the EU may spill over to the US leading to a decrease in emissions in both countries.

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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.

- For Switzerland:
  - Clear rationale for reducing emissions
  - Reinforcing existing European mechanisms (EU-ETS) is better than a patchwork of legislation.
  - Large potential for reducing emissions abroad through innovation (ex: Climeworks)