Fondazione
Eni
Enrico Mattei

Climate Change
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Incentives for the adoption of carbon free technologies

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Technology development and mitigation

- In order to meet climate change mitigation targets, significant changes in technological portfolio are needed
- Low or zero carbon technologies currently have limited range of application
- Significant investment in Research and Development of carbon free energy technologies
- Yet investment in energy R&D have declined dramatically since the peak of the early 80s
- Policy question: how to induce and manage a rapid increase in energy related R&D?

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Research questions

1. How can technological innovation be stimulated? → The role of carbon price signals
2. What is the role or technological innovation in reducing stabilization costs? → The role of breakthrough technologies
3. Is a low-carbon world a world with a lower or higher rate of technical innovation → Crowding out effects and the the macroeconomic cost of energy R&D
4. Do we need special policies and institutions to answer R&D needs? → A Global R&D Fund
5. Could technological innovation policies alone stabilize GHG concentrations? → Technological innovation as a “stand alone” policy

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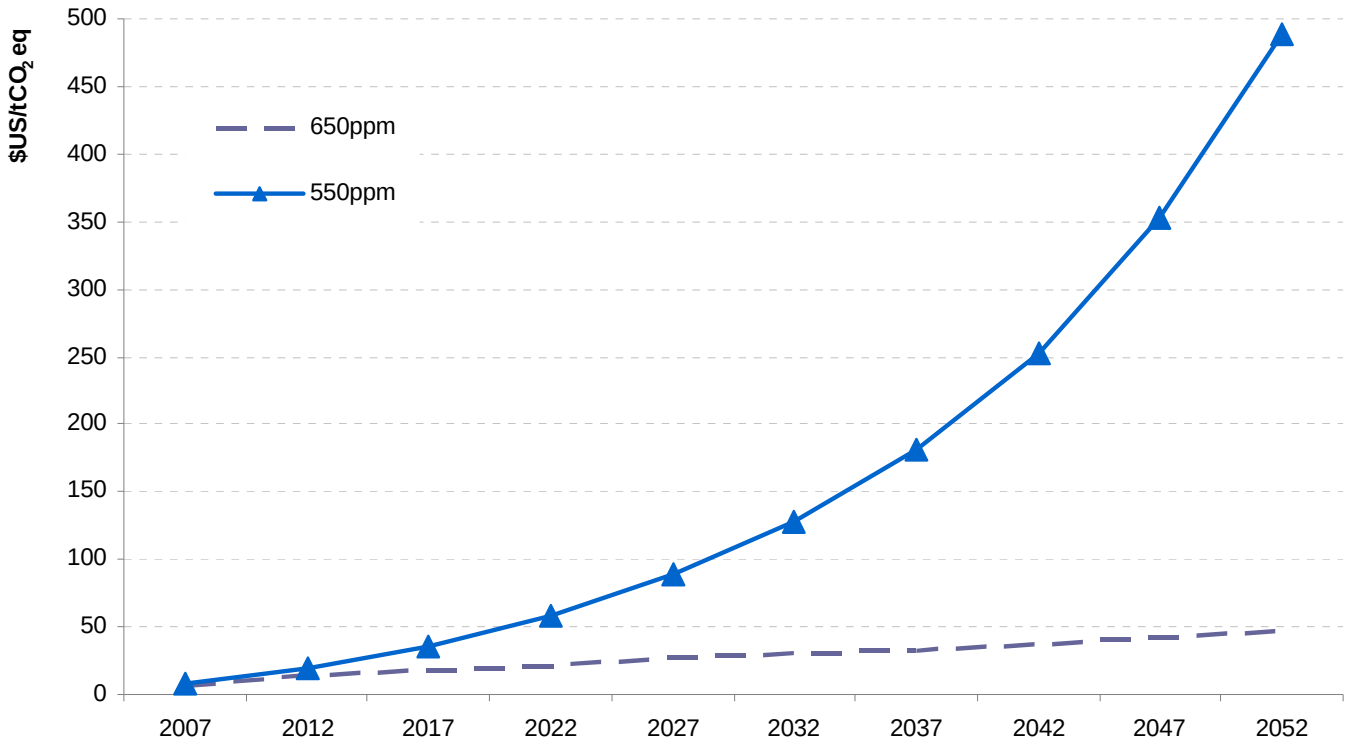
Step 1:
The role of carbon price signals

Set up

- We use insights from scenarios generated using the WITCH model (World Induced Technical Change Hybrid)
- Assess impact of carbon pricing on induced technical change (ICT)
- Two (intertemporally optimal) carbon price paths consistent with:
  - 450ppm (550ppm all gases)
  - 550ppm (650ppm all gases)
- R&D only improves energy efficiency (efficiency of existing technologies)

Carbon Price under two stabilisation scenarios



➢ Non linearity in abatement cost as a function of concentration target (550 or 650 ppm all GHG included) → increasing difference over time

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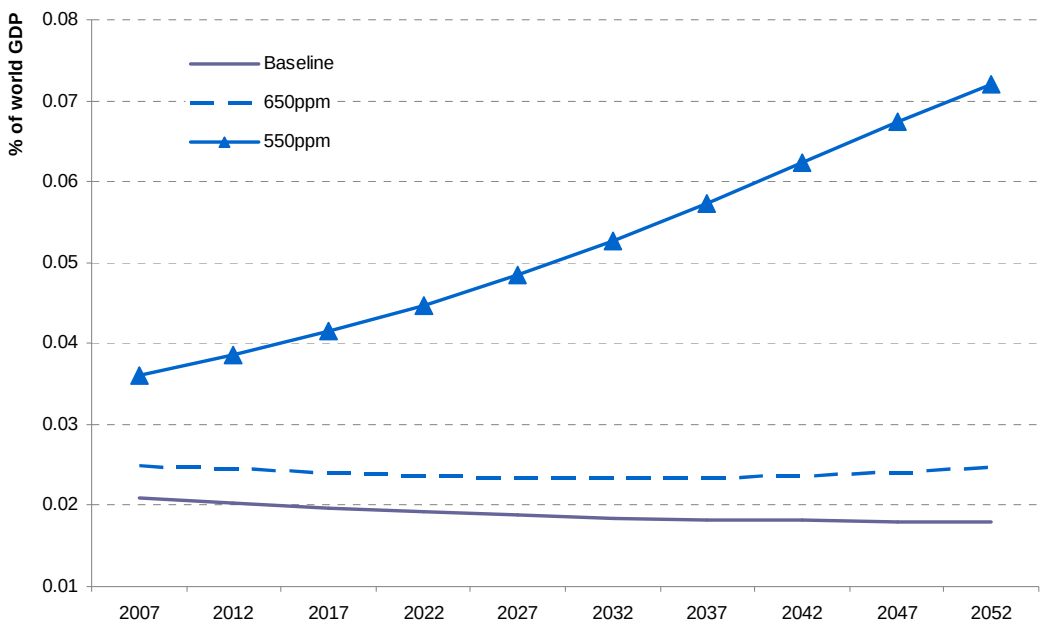
Energy efficiency R&D



➢ Investments in energy efficiency R&D are significantly higher with just a strong carbon price signal

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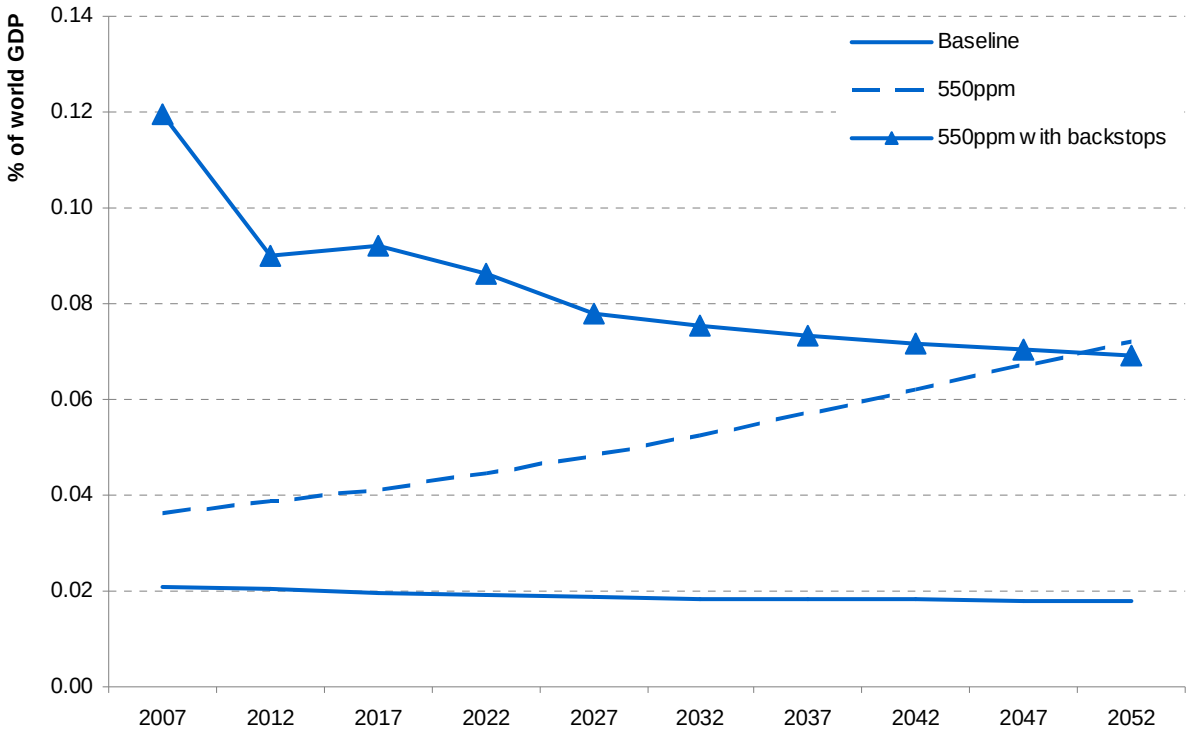
Step 2:
The role of breakthrough technologies

Investment in R&D with breakthrough technologies



- Breakthrough technologies can only become available with substantial investments in R&D
- Energy R&D expenditures increase to about 0.12% of GDP, vs. 0.02% in the BAU

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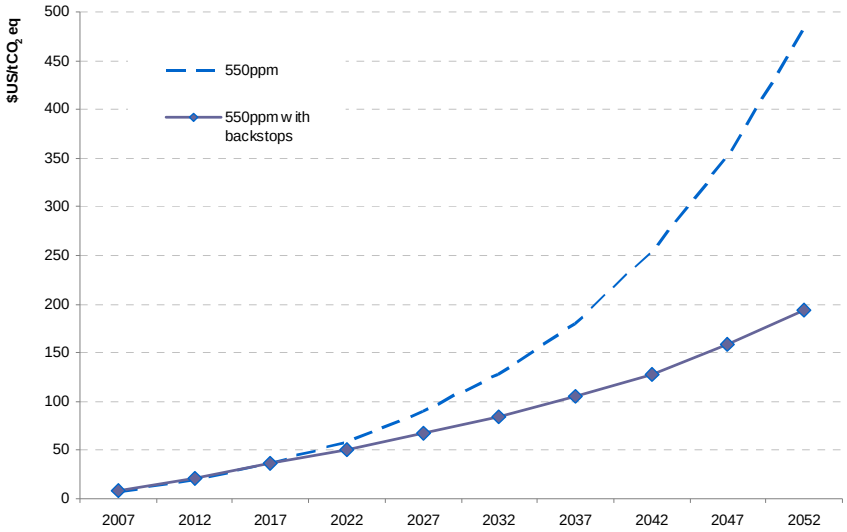
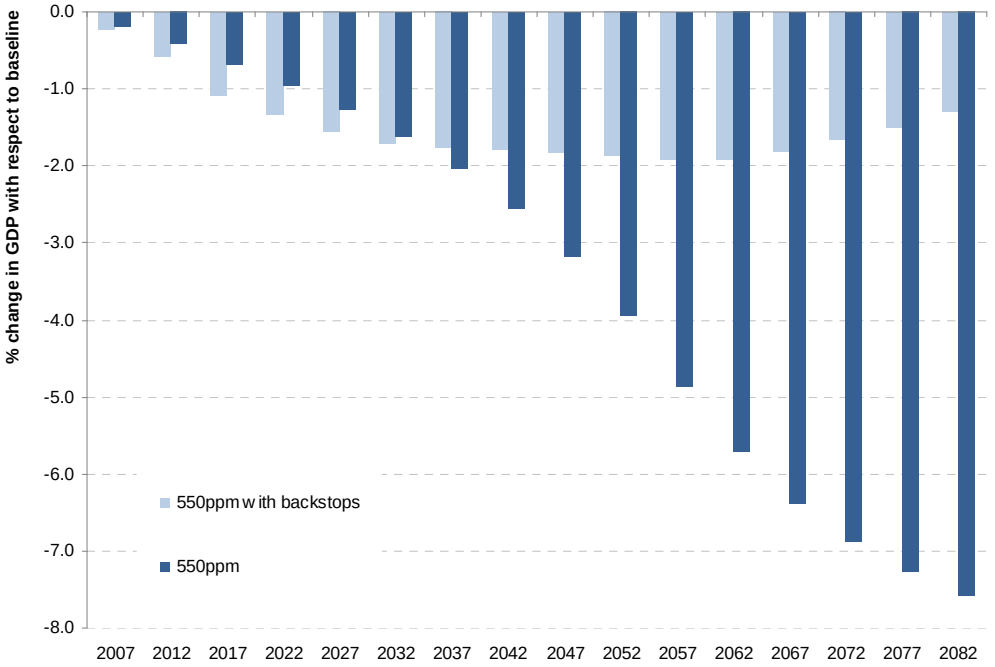
Mitigation costs with the backstop technologies



- The price of carbon is much lower with breakthrough technologies
- Crucial role to decarbonize non-electric energy (transport)
- And therefore the costs of stabilisation are much lower, especially in the long term



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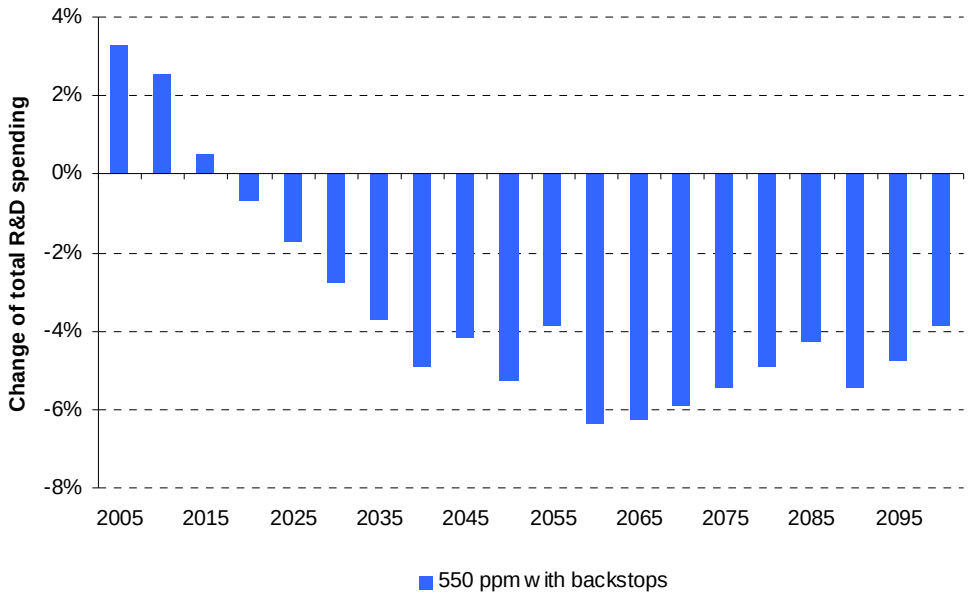
Step 3:

Crowding out effects and the macroeconomic cost of energy R&D

The true cost of energy R&D

- The macroeconomic cost of increased energy R&D spending
- Will higher R&D spending in the energy sector crowd out some investments in R&D in other sectors?
- Short term frictions may emerge but…
- … in the medium-long run, there is no constraint for societies to increase the supply of laboratories and scientists

Total R&D spending



- No direct crowding-out effect of energy R&D on non-energy R&D
- Climate policy induces a contraction of non-energy R&D spending
- Overall R&D activity is lower under climate policy
- Only in the short term there might be tensions in R&D market

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Step 4:

A Global R&D Fund

An international R&D fund

- 550 all GHG stabilization scenario
- International R&D spillovers
- International Fund to finance technology development
- Size of the Fund:
  - To fully internalize the externality in the R&D sector
  - Additionality of R&D spending

An international R&D fund: some results…

- When the Funds subsidizes investments in energy efficiency R&D, it has a limited impact on costs of meeting the mitigation target

- The Fund has more impact (although still limited) when used to "decarbonise" the economy

  - Subsidizes R&D in the backstops
  - Subsidies to deployment of existing low carbon technologies

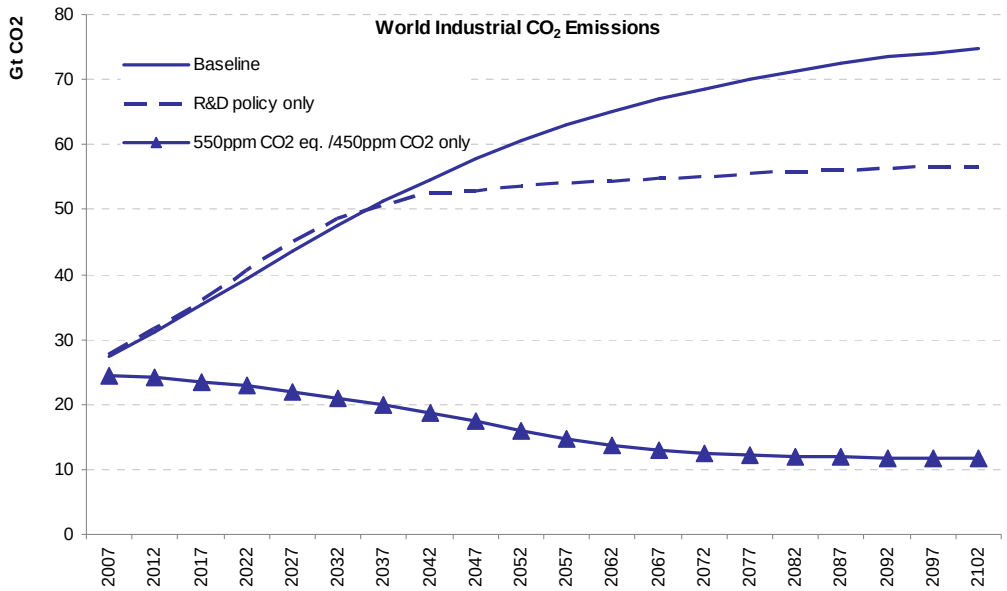
- The knowledge externality is internalized but the carbon price signal alone has significant impacts on energy services, so the additional R&D in energy efficiency has a low marginal effect

- Limited scope of international spillovers and lack of domestic spillovers

Step 5:

Technological innovation as a “stand alone” mitigation policy

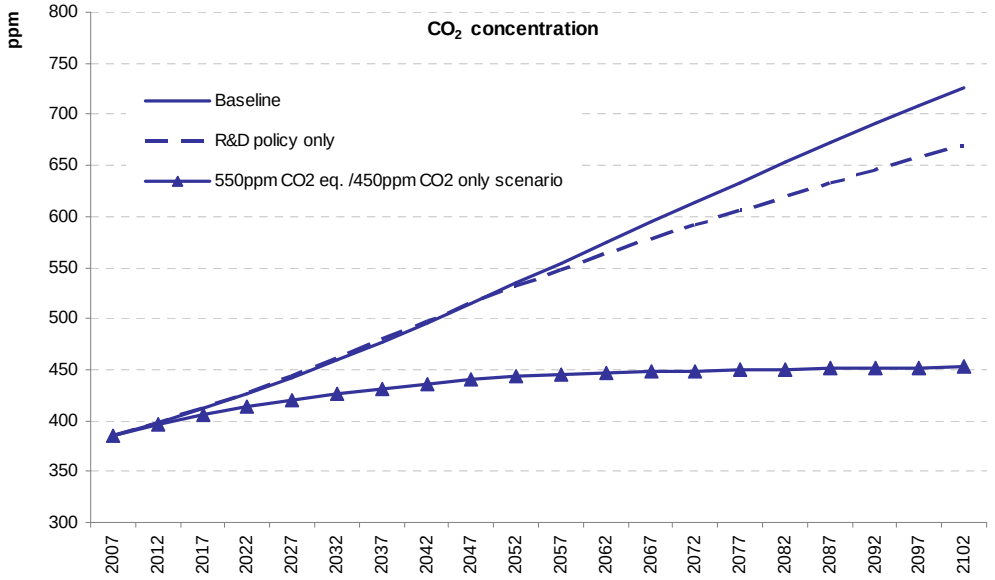
R&D subsidies to the backstop technologies as a stand alone policy



» Without a carbon price signal, the subsidies to backstop R&D stabilise emissions by mid-century

» The effect on concentration is negligible because of inertia in the system

» … GDP gains because the knowledge externality is internalized



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Summarising the main results…

Key messages - 1

1. Carbon price signals:
   - Extremely important
   - credible price signal is created by credible climate policy

2. Role or technological innovation in reducing stabilization costs:
   - Desperately looking for breakthrough technologies in non-electric energy

3. Pressures on the R&D market and crowding out:
   - Not a major issue, weak or no competition among R&D sectors

Key messages - 2

4. Global institutions to manage R&D:
   - The contribution to costs saving is limited; technological externality is dominated by the environmental externality

5. R&D Subsidies alone:
   - not a policy option to tackle climate change

Bottom line:

» Need for a credible policy that creates a credible long term price signal and induces high R&D spending, especially for non-electric breakthrough technologies

» Knowledge market externalities and frictions are not the primary problem

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THANK YOU!

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