



# Investments and Financial Flows Induced by Climate Mitigation Policies

Sustainable Development Programme, Fondazione Eni Enrico Mattei

The Challenge of Financing Low-Carbon Growth

Climate Policy Initiative, Fondazione Eni Enrico Mattei and  
International Center for Climate Governance

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# Introduction & Motivations

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Studies on optimal mitigation strategies usually deal with overall macroeconomic costs.

**Focus on investments** and **pure financial flows** needed to support the required low-carbon transformations of the economies (i.e. only mitigation, no adaptation).

- Some studies **mix the two concepts**: investments are often referred to as costs of the climate policy.

But, costs and investments inform **on two very different aspects** of climate policy and should not be confused.

## Introduction

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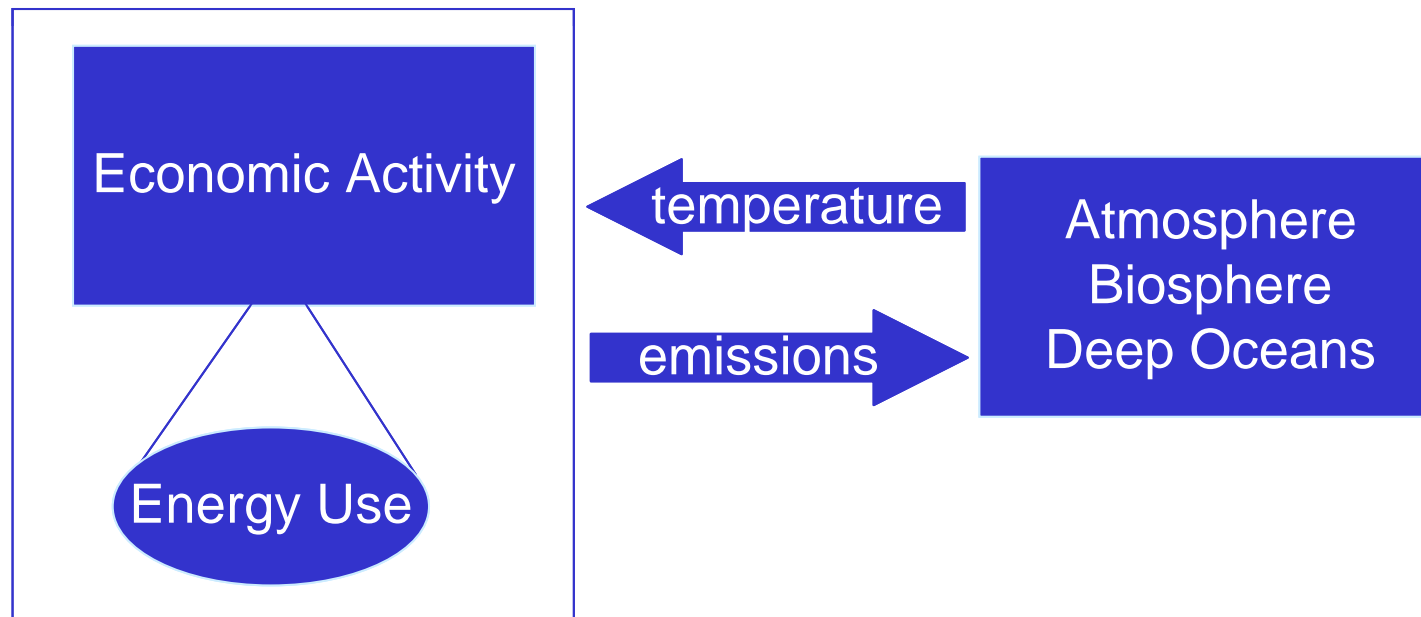
- **Investments**: expenditures to increase productive capital that imply a financial transfer from one agent to another.
  - If investments are re-distributed among capital assets that have the same productivity (i.e. that yield the same output per unit of investment), the level of macroeconomic activity is not affected.
- **Pure financial flows**: transfers that do not result in productive capital investments (e.g. transactions on the carbon markets, revenues from carbon taxes).
- **Macroeconomic costs**: (e.g. a lower level of output) arise only when investments are redistributed from more productive uses to less productive uses.

# The WITCH Model - [www.witchmodel.org](http://www.witchmodel.org)

WITCH: World Induced Technical Change Hybrid model

Hybrid I.A.M.:

- **Economy:** Ramsey-type optimal growth (inter-temporal)
- **Energy:** Energy sector detail (technology portfolio)
- **Climate:** Damage feedback (global variable)



## Scenarios

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- Reference/BaU Scenario: there is no policy to reduce global warming
- Policy scenario (550 ppm CC): stabilization of GHGs concentrations at 550 ppm CO<sub>2</sub>-eq at 2100. Full immediate co-operation among countries
- Policy tool: international carbon market, no limit on international offsets.

# Transforming the Power Sector



## Key Facts:

- Cumulative global investments in the power sector changes modestly
- Important changes in the distribution of investments...
  - ... across time
  - ... across regions
  - ... across technologies

## Transforming the Power Sector: Overview

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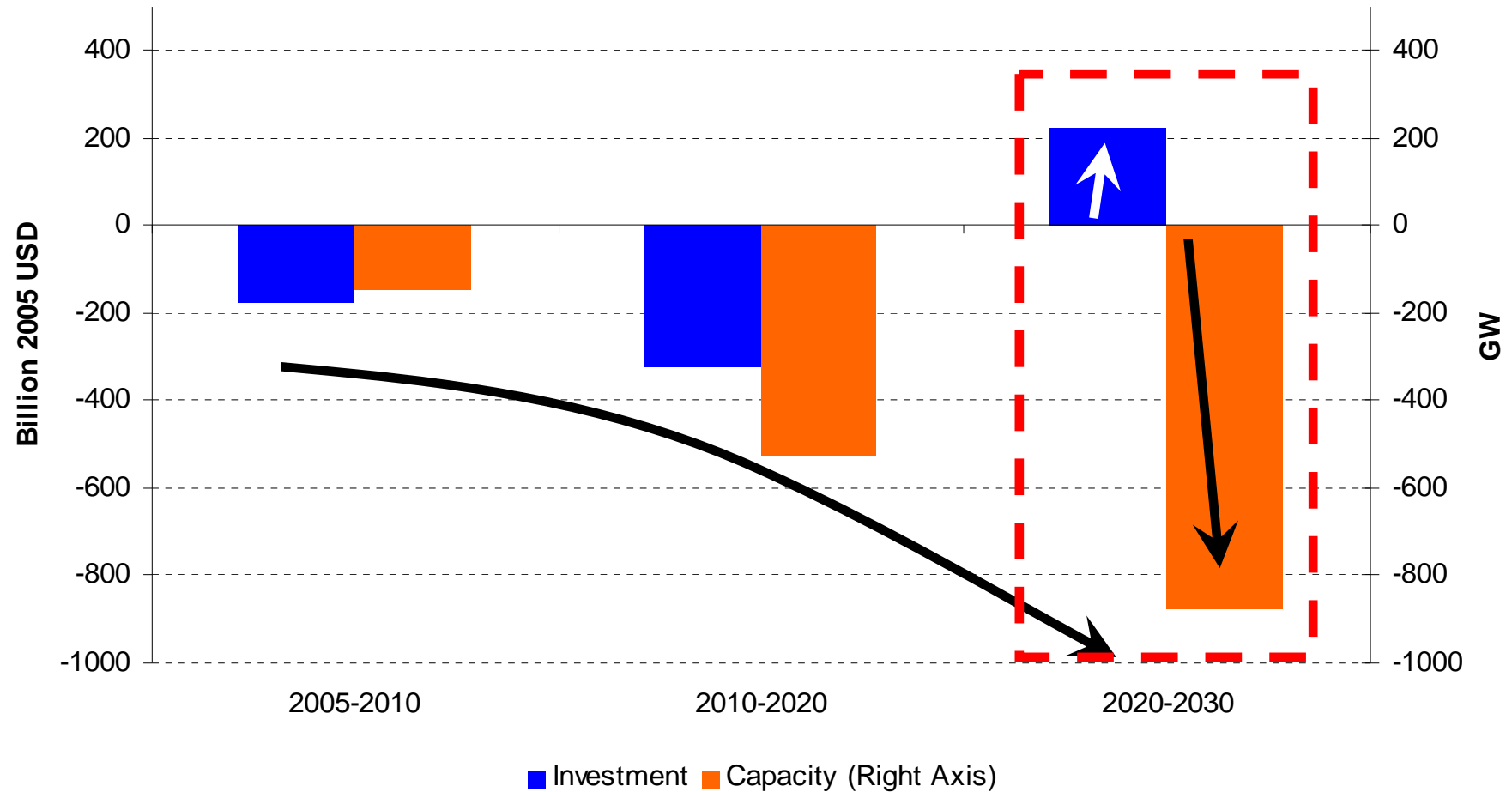
- Financial requirements to transform the power sector and to scale-up R&D activities in the energy sector.
- No investments in transmission grids.

Implementation of the climate policy has two effects:

- **Effect 1:** Adoption of low carbon generation technologies implies higher investment costs per unit of installed capacity (w.r.t. traditional power plants).
- **Effect 2:** Higher energy efficiency (w.r.t. Reference) implies reduced demand for energy (w.r.t. Reference).
- The two effects roughly compensate each other.

**Result:** Financial requirements of the power sector do not change significantly

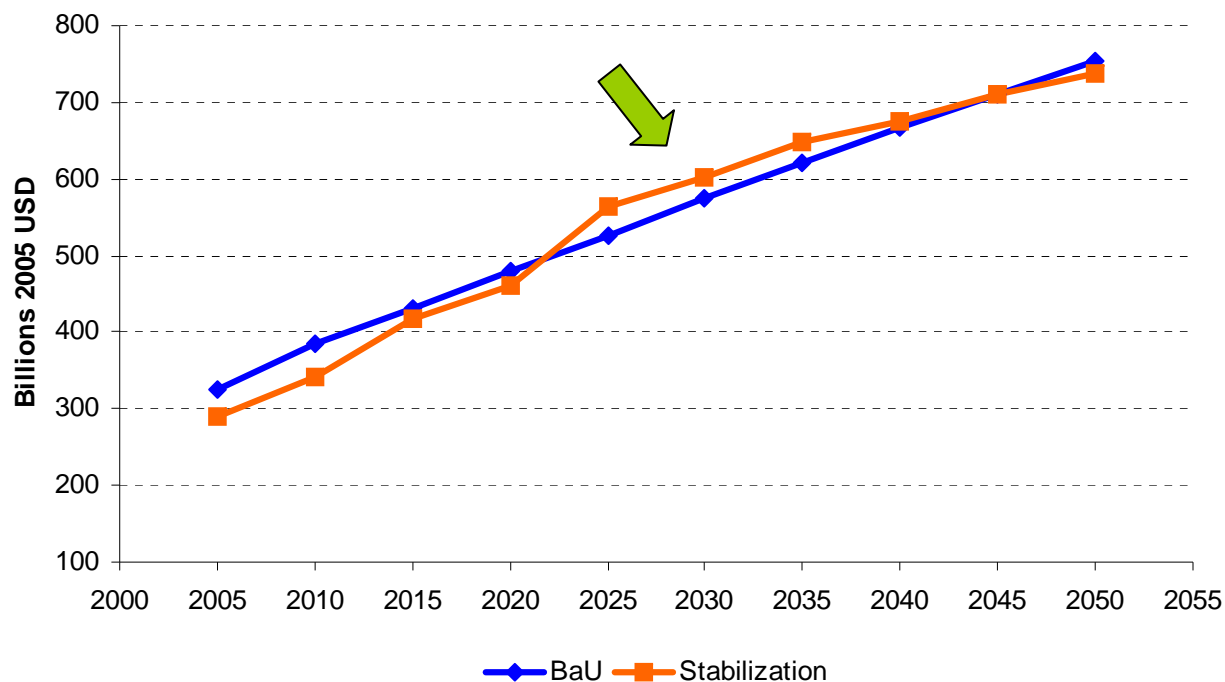
# Transforming the Power Sector: Capacity vs Investments





# Transforming the Power Sector: the Time Pattern

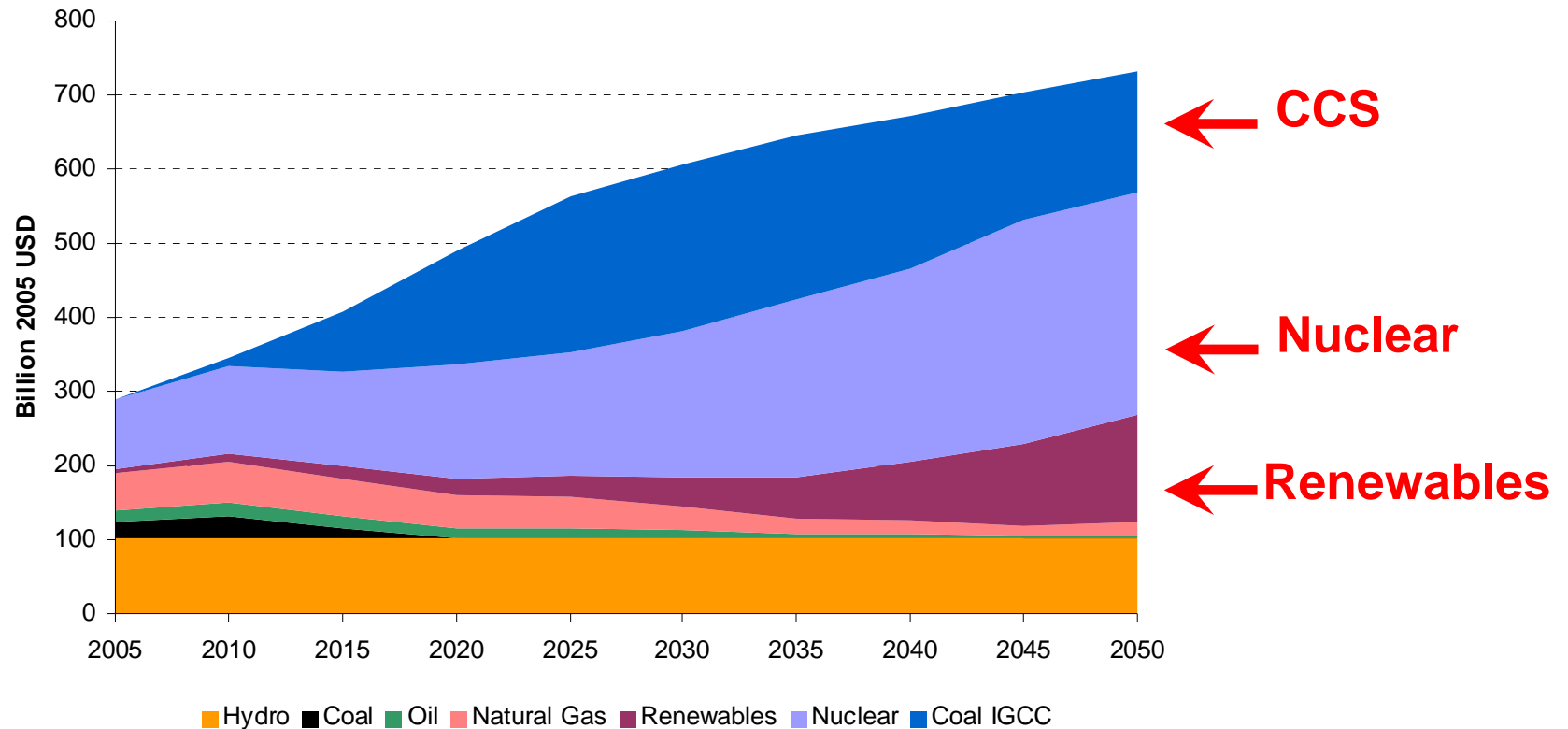
World investment in the power sector, 2005-2050



- Patterns in BaU and Stabilization are similar and converging
- Tackling climate change requires additional effort over a short period of time (2020-2045)

# Transforming the Power Sector: Technologies

Total investment in the power sector 2005-2050, by production technology



The decarbonisation of energy supply asks for a completely new energy mix:

- Conventional fossil fuels power plants are progressively substituted by nuclear, coal power plants with CCS and renewables

## Transforming the Power Sector: Criticalities

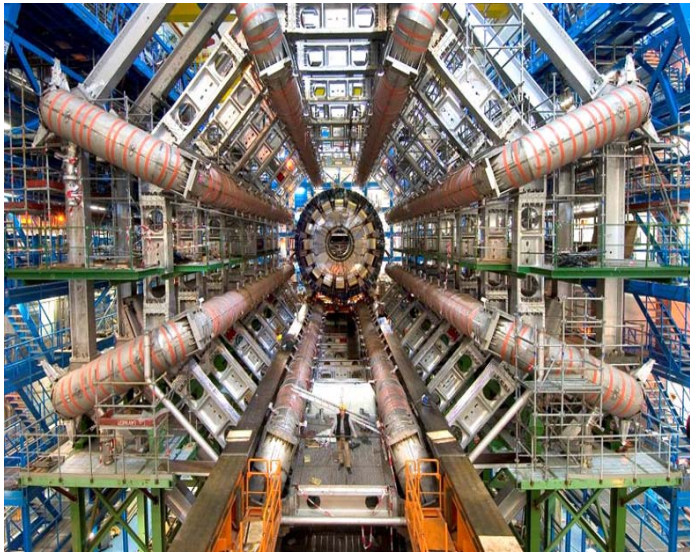
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- The investments needed seem to be affordable from a macroeconomic point of view
- Are they also manageable?

An example for the US:

- A total of USD 355 billions is the additional cumulative investment from 2010 to 2050 to transform the power sector in the USA
- Interstate Highway System, whose construction took 35 years (46,876 miles), required USD 425 billion of investment

# Financing Innovation



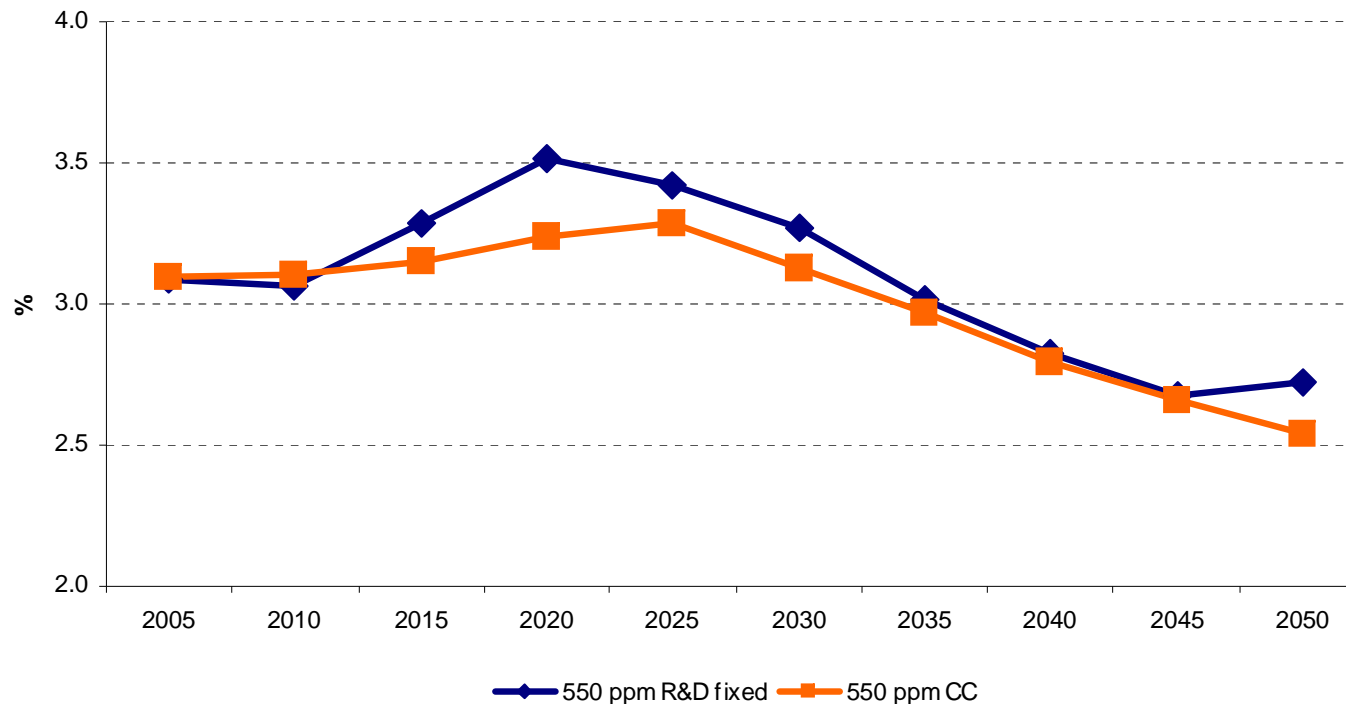
## Key facts:

- R&D investments reduce the need of investments in the energy sector
- R&D investments are modest in monetary terms but require fast expansion
- Revenues from auctioning carbon allowances can be a major source of income for R&D investments

# Investments in R&D and in the Energy Sector

- Higher investments in R&D will imply lower cost of breakthrough technologies and faster substitution of fossil fuels
- The percentage of investments directed to the energy sector is higher when R&D investments are forced to remain the same as in the Reference scenario

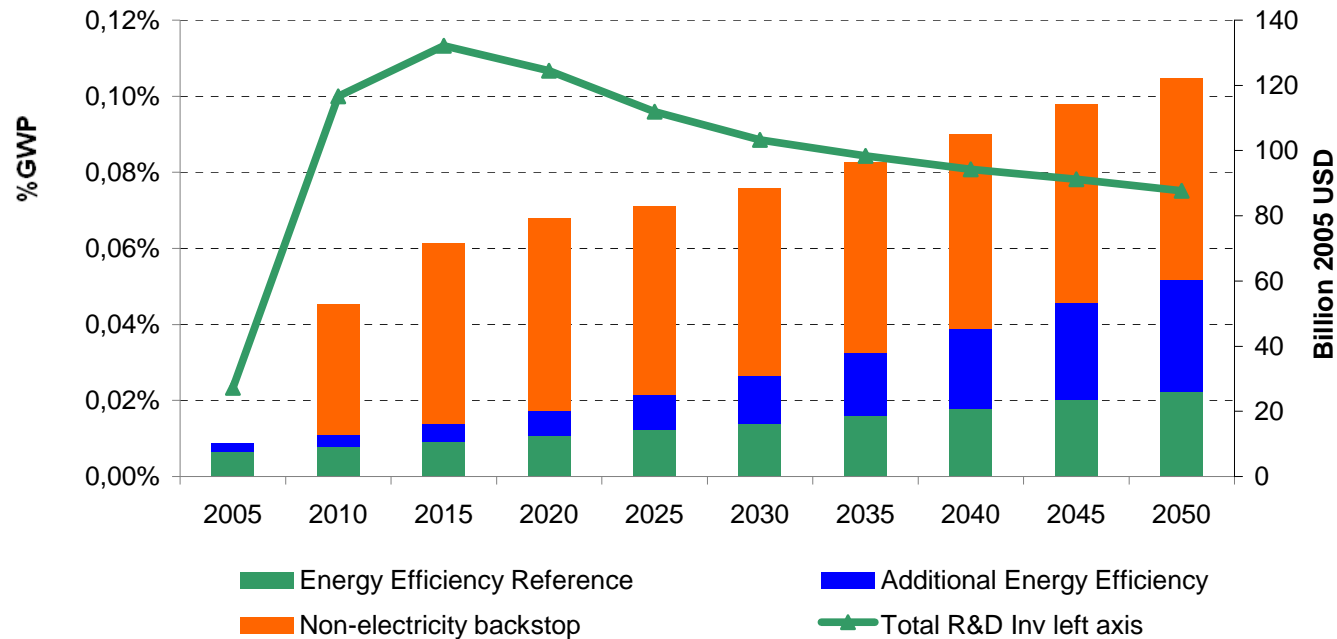
Investment in the Energy Sector as % of Total Investment



# R&D Investments: Monetary and Temporal Dimension

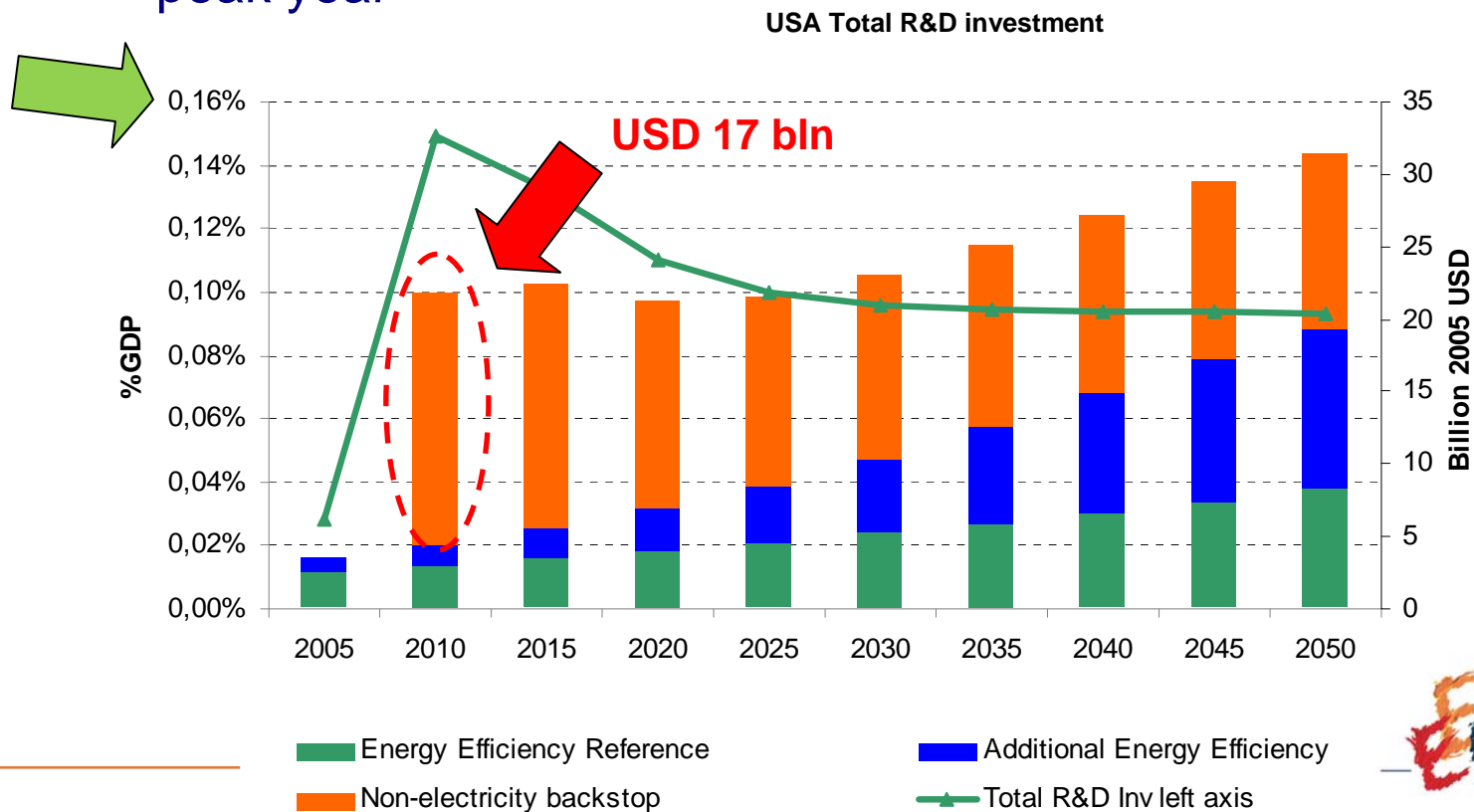
- Fast expansion
- Modest in GWP terms
- A managerial effort rather than a purely financial effort

Total R&D investment under different scenarios



# Past Experience: the USA and the Apollo Programme

- The 1960s NASA Apollo Space Programme 97.9 billion over 13 years (around USD 7.5 bln per year)
- Apollo investments 0.4% of the average national GDP during the peak year



## Financing Innovation

- Suppose all permits are auctioned: we compute the share needed to cover investments in R&D
- Initially low carbon price and high R&D spending require about three quarters of permits to be auctioned
- In 2030 the share declines to a modest 5% mainly because the price will increase substantially after 2020

Years	OECD		USA		Europe	
	% of permits auctioned	R&D investments = auctioning revenue (Billion 2005 USD)	% of permits auctioned	R&D investments = auctioning revenue (Billion 2005 USD)	% of permits auctioned	R&D investments = auctioning revenue (Billion 2005 USD)
<b>2010</b>	76%	48.128	71%	21.906	75%	15.296
<b>2015</b>	28%	51.151	27%	22.453	27%	15.494
<b>2020</b>	14%	49.917	13%	21.278	13%	15.380
<b>2025</b>	9%	50.634	8%	21.541	8%	15.540
<b>2030</b>	5%	53.686	5%	23.005	5%	16.270



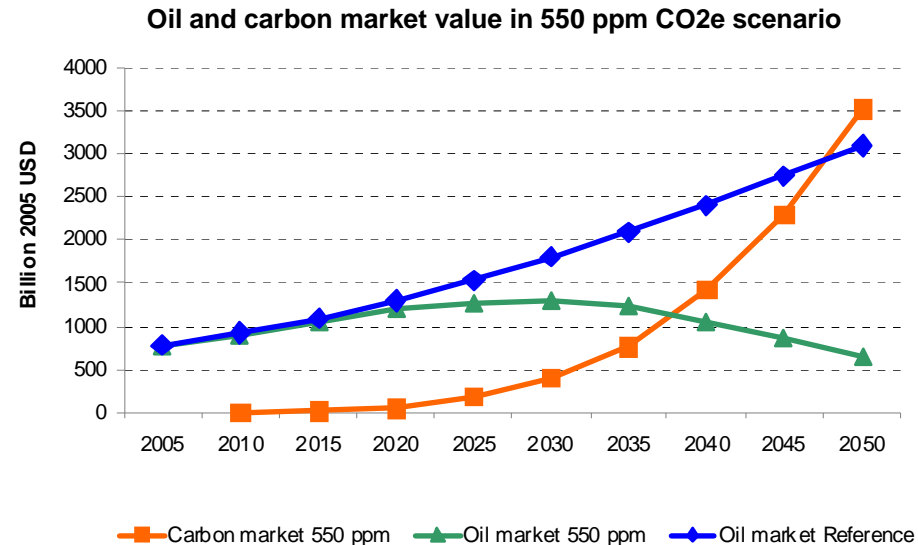
# From “Fossil Finance” to “Carbon Finance”



## Key facts:

- Carbon market dominates oil market in terms of value
- Carbon market could act as a tangible indirect source of investments in the energy sector

# The Carbon Market Dominates the Oil Market

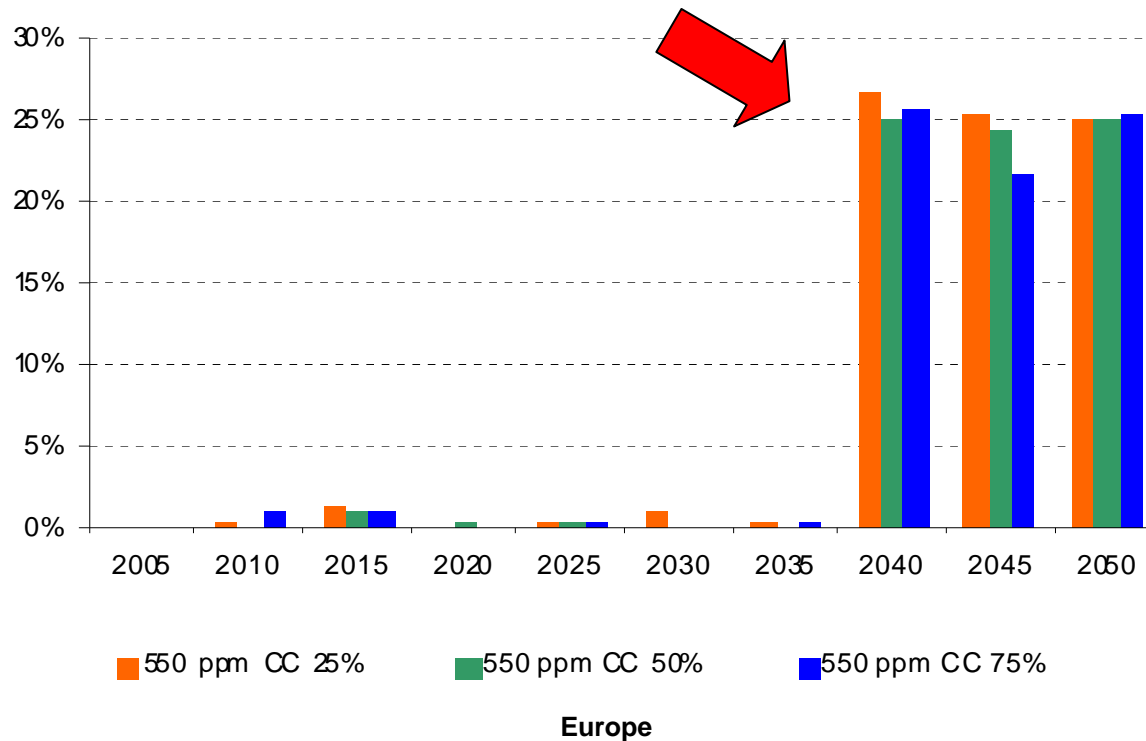


- Carbon market is larger than the oil market by a factor of 6 by 2050 with the take-over between 2035-2040
- The value of the carbon market increases exponentially reaching more than USD 3.5 trillion in 2050 for the combined effect of
  - larger trade of carbon permits
  - growing carbon price
- The financial flows associated to oil transactions will decline for
  - a contraction of demand
  - lower oil prices

# Impact on Investments in the Energy Sector

With limits to international offsets investments to decarbonize the energy sector will increase with respect to the Policy scenario without constraints:

- by 25% in Europe by 2040
- between 25-30% in the US by 2035





**[www.witchmodel.org](http://www.witchmodel.org)**

**[www.policysimulator.org](http://www.policysimulator.org)**