What corrective tax rate on energy in 2050 if we want to avoid the end of the world?

Stern Report

March 31^{st} 2010

What is so special with Greenhouse gases ?

Greenhouses gases (GHG) emissions release in atmosphere triggers climate changes and global warming creating bad externalities.

1. Global externality :
   - Damage is broadly the same regardless where they are emitted;
   - Impacts are felt unevenly across the world.
2. Impacts are not immediately tangible:
   - But are likely to be felt some way into the future;
   - Once released, CO_2 remains in the atmosphere for up to 100 years.
3. Huge uncertainty about :
   - The scale and Timing of the impacts;
   - When irreversible damage will occur

Principles of a Tax on Energy

A policy is required because market alone doesn't internalize externalities created by GHG emissions.

1. Tax on polluters:
   - Emitters face the full social cost of their emissions;
   - Carbon price should reflect damages caused by emissions.
2. But also :
   - Quantity restrictions;
   - Property rights can be allocated among polluters andor polluted;
   - A regulation authority.

Taxing on Energy instead of Carbon emissions

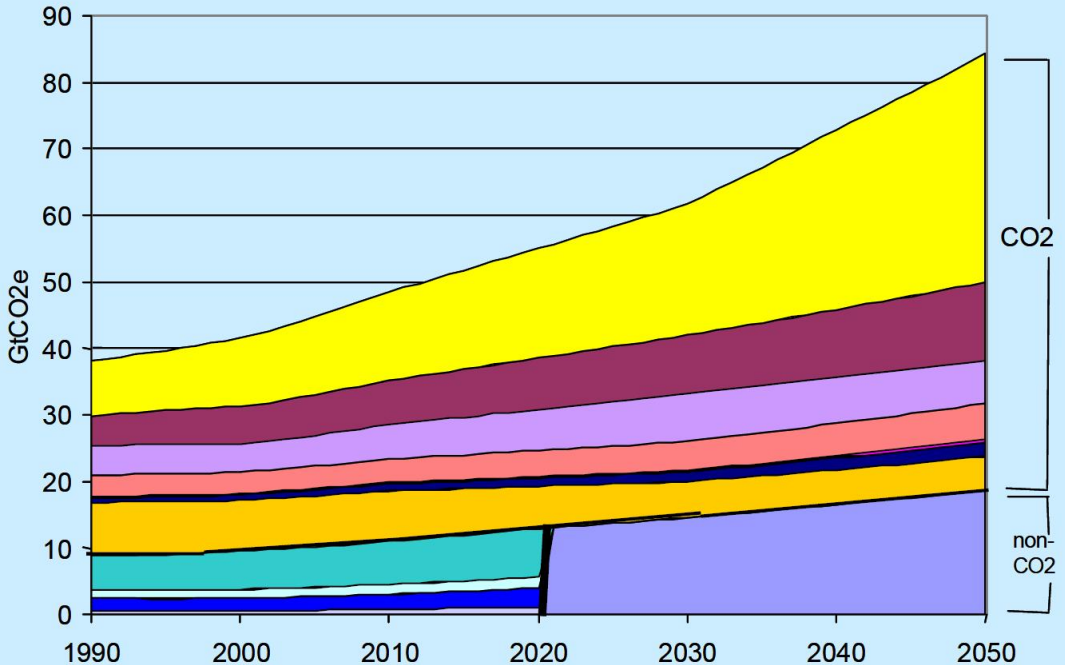
Carbon emissions are main drivers of GHGs emissions and come from energy production and use across various sectors :

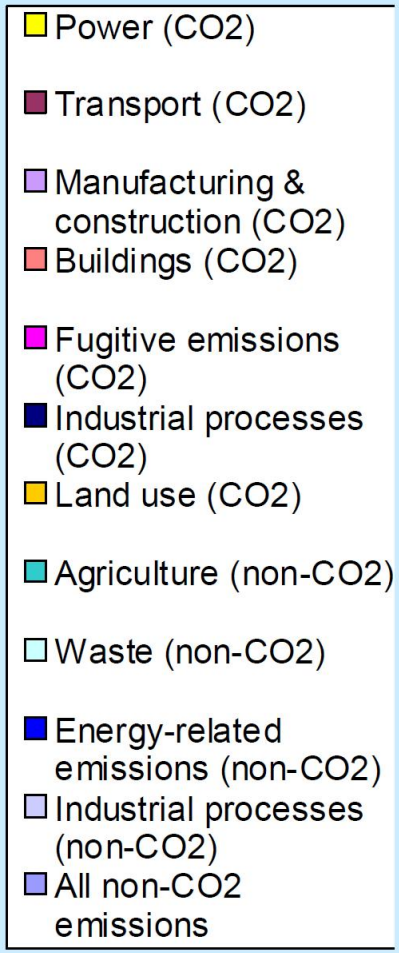
- Power
- Industry
- Transport
- Buildings

Taxing energy instead of excise tax levied per carbon ?

- should not matter as long as energy taxes are redesigned in line with $C0_2$ excises by type of energy.
- But other issues arise such as losses of competitiveness, other taxes previously levied, low and high-emission diesel fuels are taxed at the same level ...
- Much easier to consider tax levied per carbon in first step

GHGs Emissions by sector





Source: WRI (2006), IEA (in press), IEA (2006), EPA (forthcoming), Houghton (2005).

An almighty social planner

Here, there is an elite which decides what is the best policy stance to adopt to maximize social welfare of today and future generations

$$U\left(c\left(t\right)\right) = \frac{c\left(t\right)^{1-\eta}}{1-\eta} \tag{1}$$

Each generation chooses optimal consumption and investments into physical and natural capital paths subject to available income reduced by the costs of climate change (residual damages, mitigation costs).

$$W = \int_0^{\infty} U\left(c\left(t\right)\right) e^{-\rho t} dt \tag{2}$$

Drivers of Damage Costs

Damages are highly speculative but are driven by impacts on:

- Environment :
  - Higher temperatures
  - Increased weather variability : cyclones, hurricanes, tornadoes, ice storms, blizzards, rain storms and heatwaves
  - Sea-level rise
- Income/Consumption:
  - Impact on agriculture : Not clear
  - Riskier environment : Property losses
- Health
  - Deaths associated with Heatwaves
  - Availability of drinking water
  - Transmission of the disease (diarrhea and malaria)
  - Widespread and persistent famine

Damages amount to a loss of 5% to 20% of global GDP each year, now and forever.

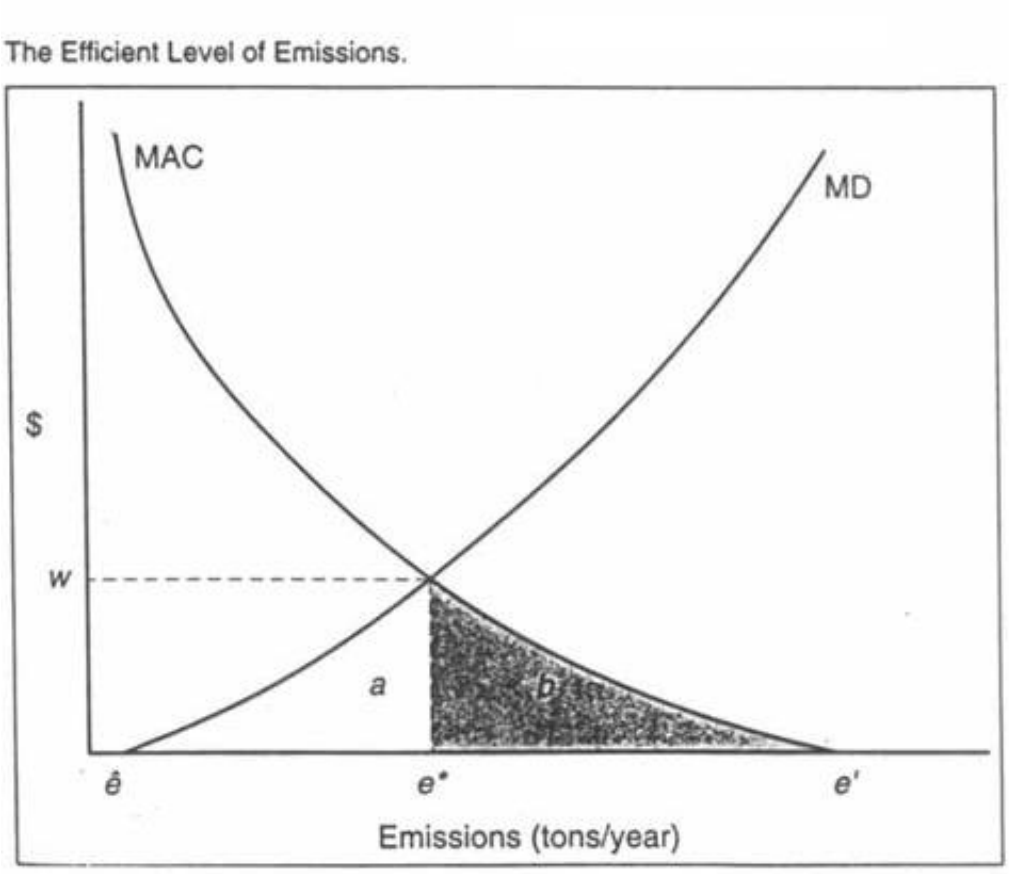
Drivers of Abatement Costs

- Prices of oil, gas and coal;
- Rates of innovation;
- Location :
  - Renewable energy sources such as wind, solar energy, marine resources and biomass;
  - Availability of land for biofuels, opportunities for sequestering carbon; nuclear waste disposal issues and costs
- The supply methods chosen.
- The weights of each technology in the supply mix

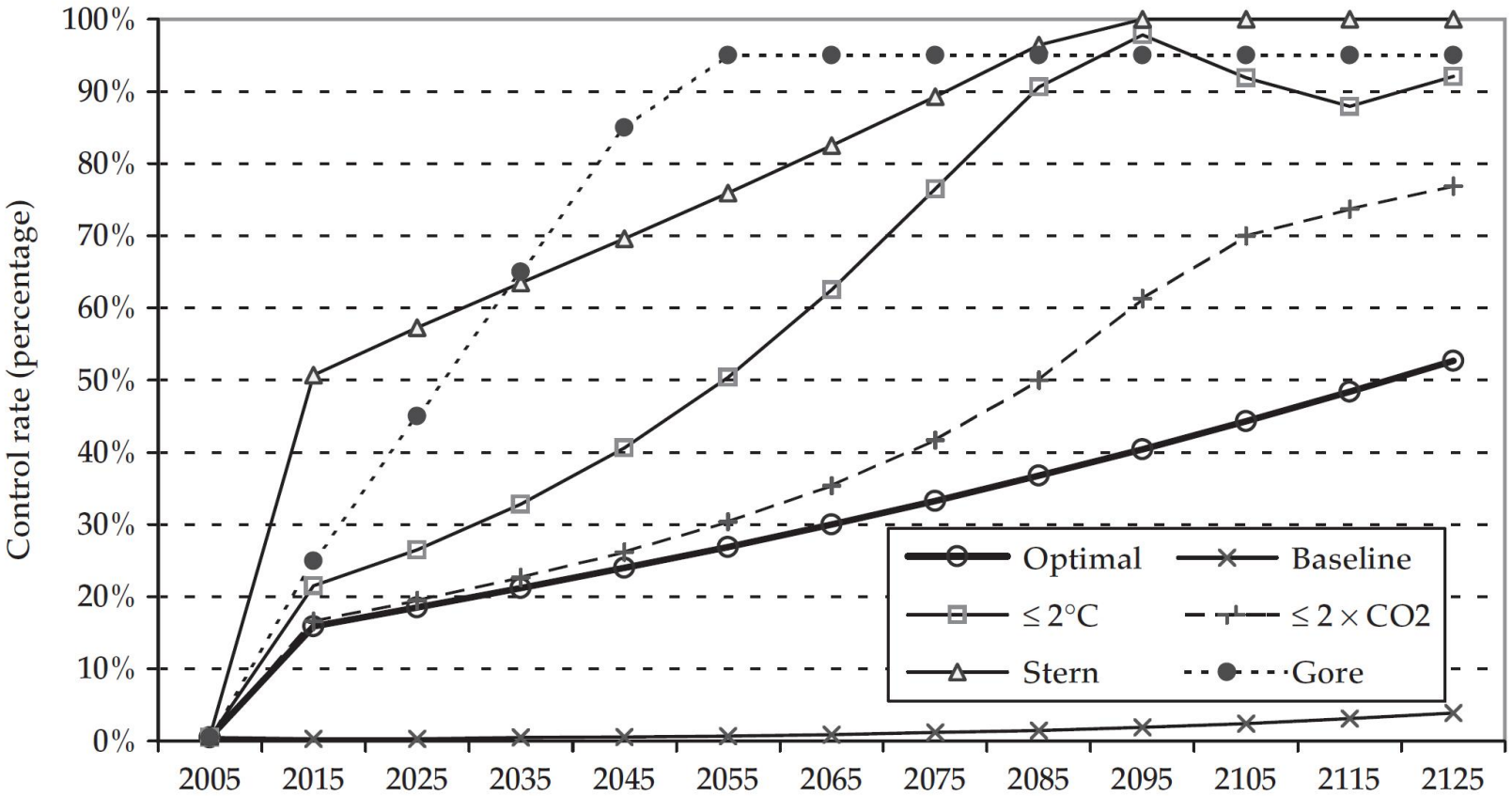
Mitigation costs represent in average 1% of today's global GDP.

Equilibrium

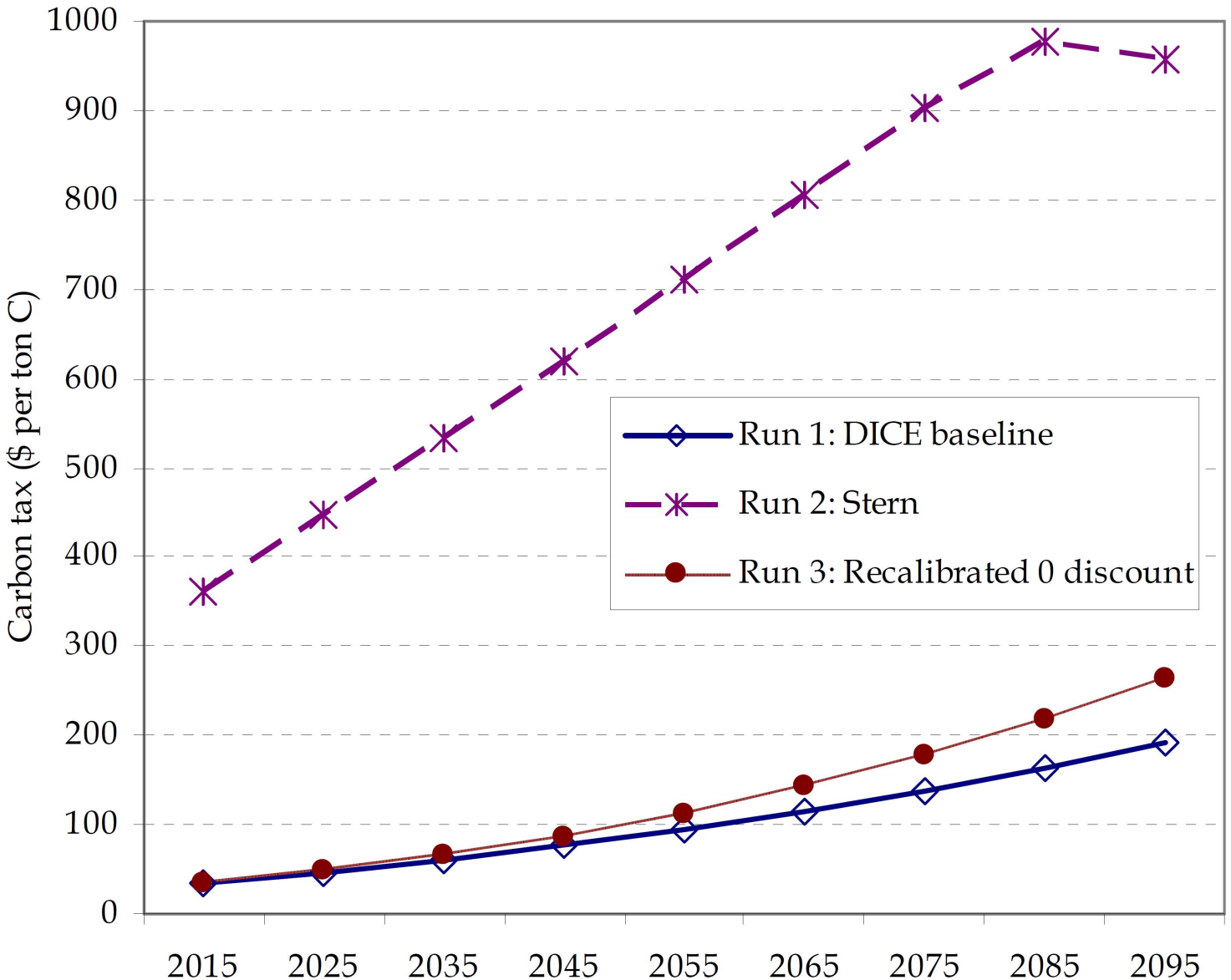
At the optimum emission levels, marginal damage cost of additional ton of CO_2 equal Marginal abatement cost of additional ton of CO_2:



Emission levels



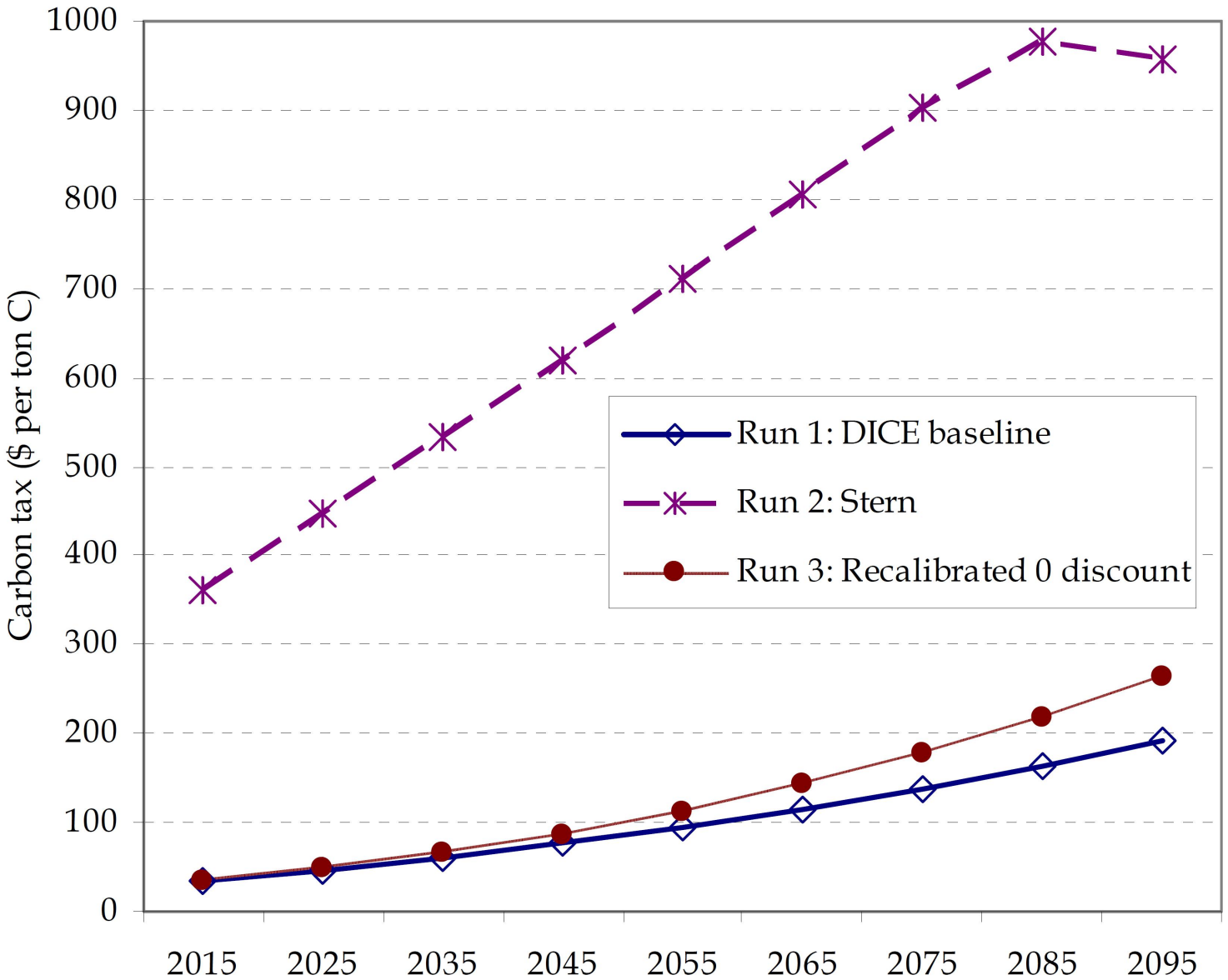
Carbon Tax


Carbon tax ($ per ton C)
1000
900
800
700
600
500
400
300
200
100
0
2015
2025
2035
2045
2055
2065
2075
2085
2095
Run 1: DICE baseline
Run 2: Stern
Run 3: Recalibrated 0 discount

Carbon taxes per capita in France (2005 Euros)

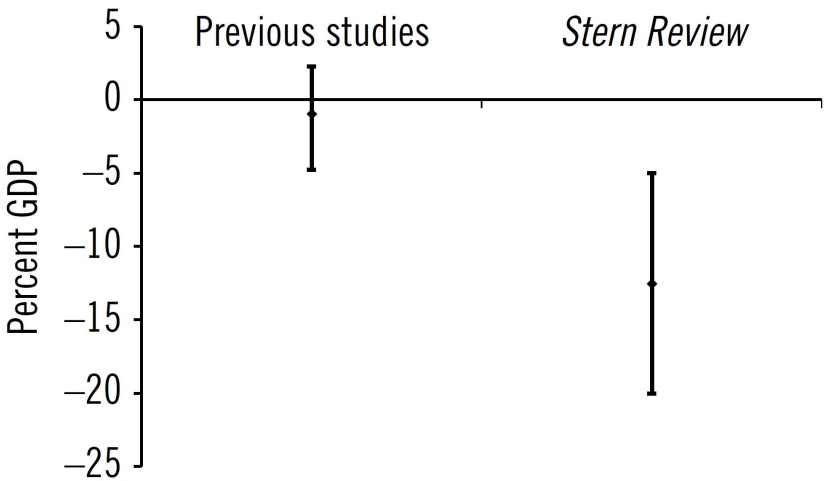
Year	Stern	DICE	CO_2 cap 560 ppm
2005	382	42	45
2015	517	65	70
2025	629	82	90
2035	739	102	116
2045	853	125	148
2055	974	150	188
2065	1107	179	242
2075	1250	212	318
2085	1407	248	430
2095	1473	288	610
2105	1445	334	760

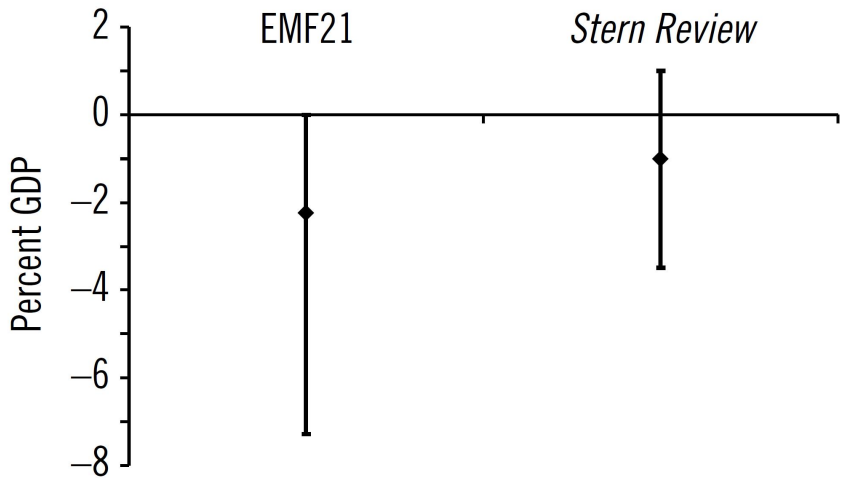
What values for ρ and η



Pessimistic damage costs and Optimistic mitigation costs

Estimates of the damage costs of climate change (left panel) and the costs of emission reduction (right panel) according to the *Stern Review* and according to previous studies





Thank You !!!