		Dissipation rate	Non dissipated stock	Per Unit Env Cost			Discount rate
		0.02	0.98	0.001			0.1
# years	year	Emissions	Stock	Damage ($bn)	Cost E=0 ($bn)	Net Benefit ($bn)	Net Present Value
	2024	100	100	0.100	1.5	-1.400	
1	2025	100	198	0.198	1.5	-1.302	-1.184
2	2026	100	294	0.294	1.5	-1.206	-0.997
3	2027	100	388	0.388	1.5	-1.112	-0.835
101	2125	100	4,363	4.363	1.5	2.863	**0.000**
						-5.019	**Present discounted value of the annual net benefits**

		Dissipation rate	Non dissipated stock	Per Unit Env Cost			Discount rate
		0.02	0.98	0.001			0.05
# years	year	Emissions	Stock	Damage ($bn)	Cost E=0 ($bn)	Net Benefit ($bn)	Net Present Value
	2024	100	100	0.100	1.5	-1.400	
1	2025	100	198	0.198	1.5	-1.302	-1.240
2	2026	100	294	0.294	1.5	-1.206	-1.094
3	2027	100	388	0.388	1.5	-1.112	-0.960
101	2125	100	4,363	4.363	1.5	2.863	**0.021**
						0.958	**Present discounted value of the annual net benefits**

		Dissipation rate	Non dissipated stock	Per Unit Env Cost			Discount rate
		0.02	0.98	0.001			0.01
# years	year	Emissions	Stock	Damage ($bn)	Cost E=0 ($bn)	Net Benefit ($bn)	Net Present Value
	2024	100	100	0.100	1.5	-1.400	
1	2025	100	198	0.198	1.5	-1.302	-1.289
2	2026	100	294	0.294	1.5	-1.206	-1.182
3	2027	100	388	0.388	1.5	-1.112	-1.079
101	2125	100	4,363	4.363	1.5	2.863	**1.048**
						69.431	**Present discounted value of the annual net benefits**

What discount rate R should be used?

- **social rate of discount** Opportunity cost to society of receiving an economic benefit in the future rather than the present.

In principle, the social rate of discount depends on three factors: (1) the expected rate of real **economic growth**; (2) the extent of **risk aversion** for society as a whole; and (3) the "rate of pure **time preference**" for society as a whole.

With rapid economic growth, future generations will have higher incomes than current generations, and if their **marginal utility of income is decreasing**, their utility from an extra dollar of income will be lower than the utility to someone living today; that's why **future benefits provide less utility** and should thus be discounted.

In addition, even if we expected no economic growth, people may simply prefer to receive a benefit today than in the future (the rate of pure time preference).

GLOBAL WARMING

Emissions of carbon dioxide and other greenhouse gases have increased dramatically over the past century as economic growth has been accompanied by the greater use of fossil fuels, which has in turn led to an increase in atmospheric concentrations of GHGs.

GHG emissions could be reduced from their current levels—governments, for example, could impose stiff taxes on the use of gasoline and other fossil fuels—but this solution would be costly. The problem is that the costs occur today, but the **benefits would be realized only in some 50 or more years**.

Is the present discounted value of the likely benefits of such policies simply too small? Although there is considerable uncertainty over the economic impact of higher temperatures, the consensus view is that the impact could be significant, so that there would be a future benefit from reducing emissions today. The cost of reducing emissions (or preventing them from growing above current levels) can be assessed as well, although here too there is uncertainty over the numbers.
Whether a policy to restrict GHG emissions makes economic sense clearly depends on the rate used to discount future costs and benefits.

Highlights - topics

- Meaning of negative and positive externalities and their impact on market equilibrium and social welfare
- How to deal with natural resources characterized by non rivalry and non excludability
- Mechanics, pros and cons of fiscal policies vs regulation
- Cap-and-trade system: ETS – development, mechanics, sectors involved, pros and cons
- Recycling: examples and theoretical model
- Stock externality and how it differs from a standard externality
- Factors affecting the social discount rate

Highlights – open ended questions / problems

- Find the optimal quantity given the demand, and the private and external marginal cost.
- Find the DWL caused by a negative externality.
- Find the tax vs the subsidy given the demand, supply and negative vs positive externality function.
- Find the tax and the standard given the marginal abatement cost and the external marginal costs of emissions.
- Find the cost reduction of adopting a tax instead of a standard when dealing this firms having different abatement costs.
- Preferability of a standard over a tax when the marginal social cost and the marginal abatement costs are uncertain.
- Find the optimal refundable deposit bringing to the optimal quantity of waste material.