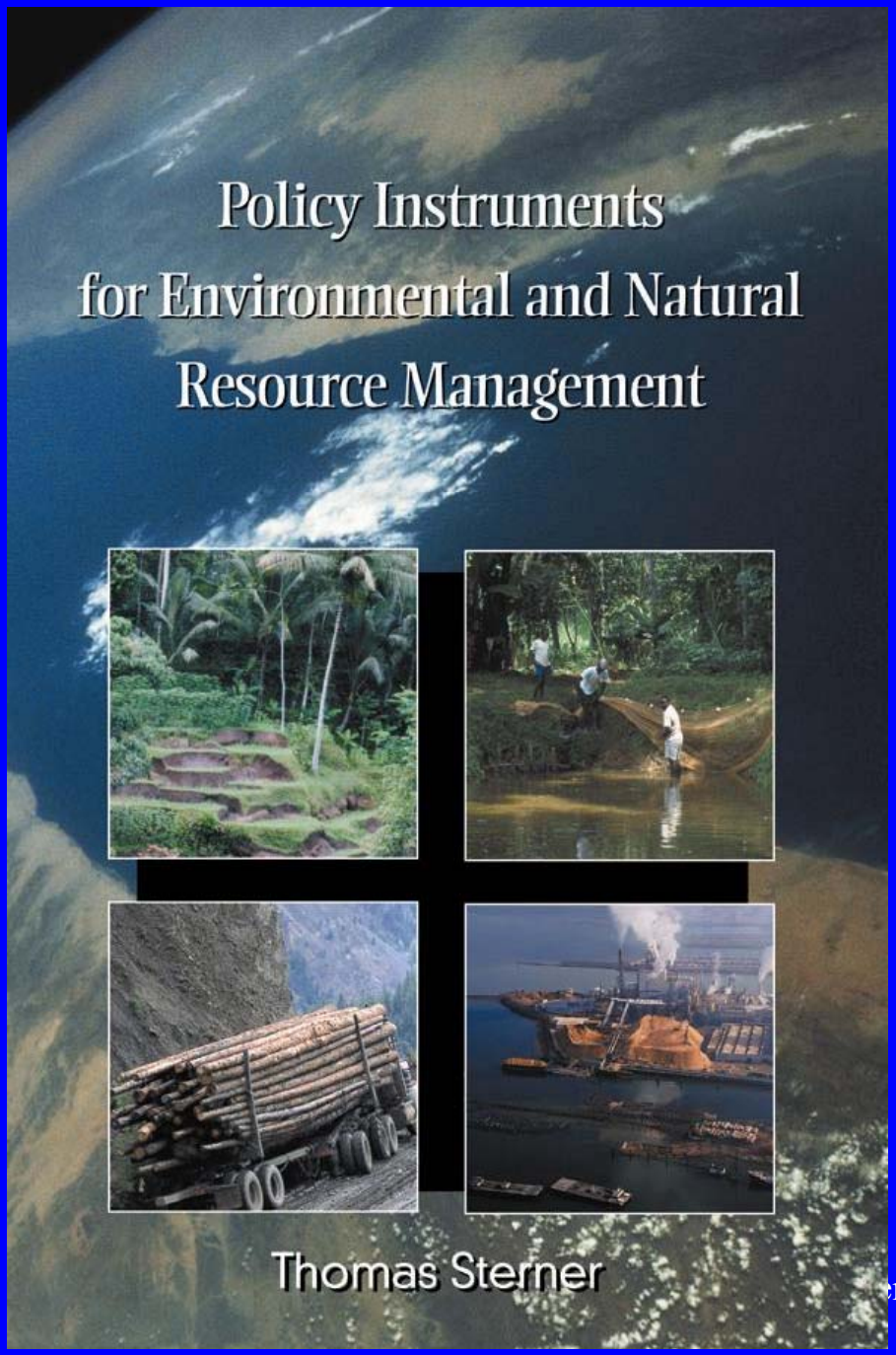
Efficient Environmental Regulation and its impacts

Prague November 2009

Thomas Sterner



Published by RFF & World Bank.

1. The need for policy
2. The menu of instruments
3. Theory of Instrument selection and design
4. Application to Transport
5. Application to industry
6. Application to natural resources

Covers both US, Europe, other OECD, developing and transitional countries

Policy Instruments

PRICE-TYPE	RIGHTS	REGULATION	INFO/LEGAL
Taxes	Property rights	Technological Standard	Public participation
Subsidy (Reduct.)	Tradable permits	Performance Standard	Information disclosure
Charge, Fee/Tariff	Tradable Quotas	Ban	Voluntary Agreement
Dep-Ref REP	Certificate	Permit	Liability
Env Tax REFORM	CPR	Zoning	

Criteria

- Effectiveness
- Static Efficiency
- Dynamic Efficiency
- Fairness (Distrib of costs/benefits)
- Political feasability

Conditions (Ecol. or economic)

- Heterogeneity in abatement costs
- Heterogeneity in damage
- Uncertainty/Risk
- Asymmetric information
- Monopoly or oligopoly
- Synergies or ecological thresholds
- Non-point pollution

Property Rights are Fundamental

- Property is a bundle of rights: Access, productive use, management, exclusion, lease, sale, destruction. Extent varies.
- ”Real” Property from King →Feudalism
- Enclosure and Common Property

Property Rights II

- Who has rights to water, air, ecosystems:
- Land owner, State, First user/polluter, citizens.
- Water rights: Riparian or Prior Appropriation
- The rights of the tiller …and of squatters
- Ecosystem rights
- The Coasian Perspective

HETEROGENEOUS ABATEMENT COSTS →MBI

2 polluters 20 t each. Total to be cut in ½. $MC_1 = a_1$ and $MC_2 = 4a_2$

1. Equal abatement of 10 units each costs 250$

(½ 10*10 + ½ 10*40)

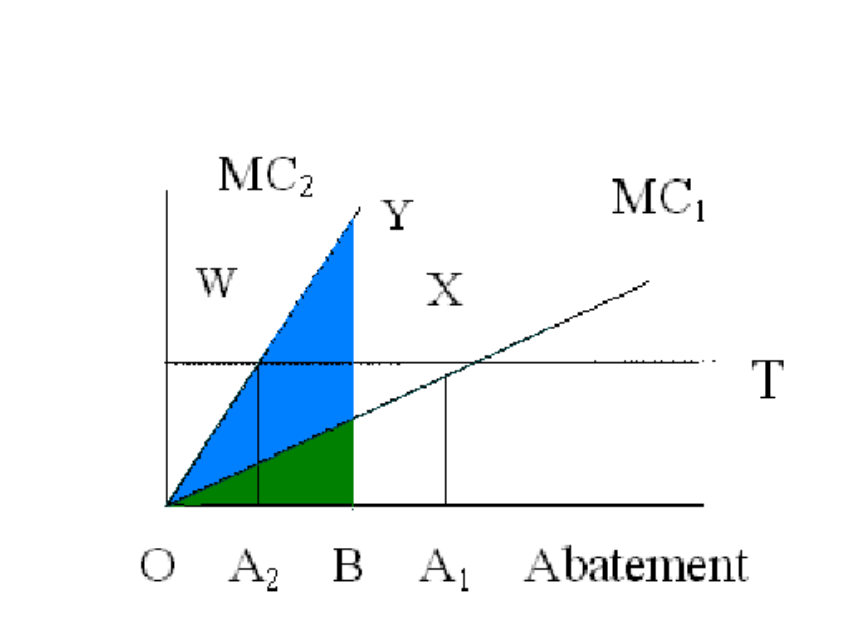
2. Equal MC due to trading means firm one will sell 6 rights to firm 2. Firm 1 abates 16 and firm 2 abates 4. Cost is 160 $ (saving 36%)

(½ 16*16 + ½ 4*16)

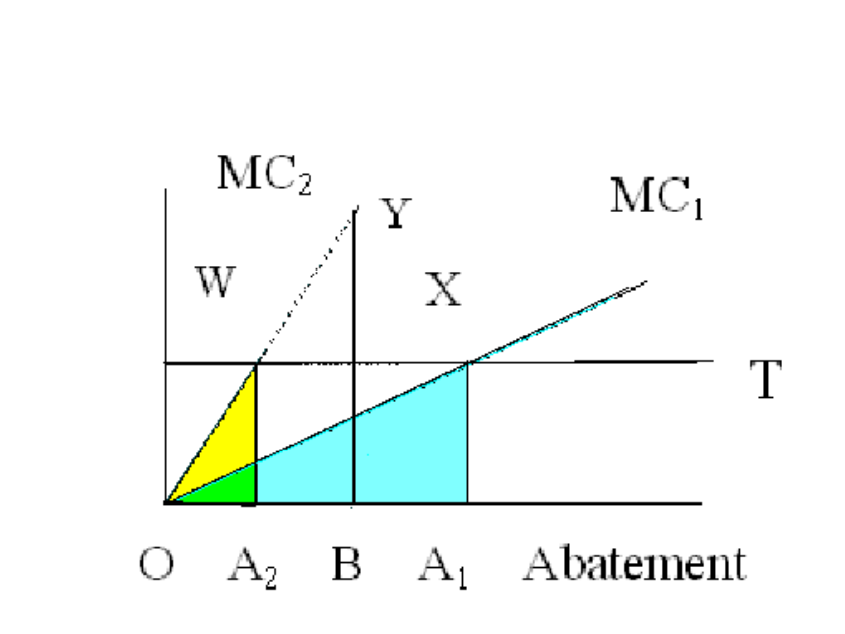
3. This can also be achieved by a tax of 16

Cost savings due to equal MC

- Equal abatement



- Efficient abatement



Heterogeneous MC (2)

Heterogeneity	Saving by MBI
1	0
1.5	4%
2	~11%
4	36%
9	64%
99	~96%

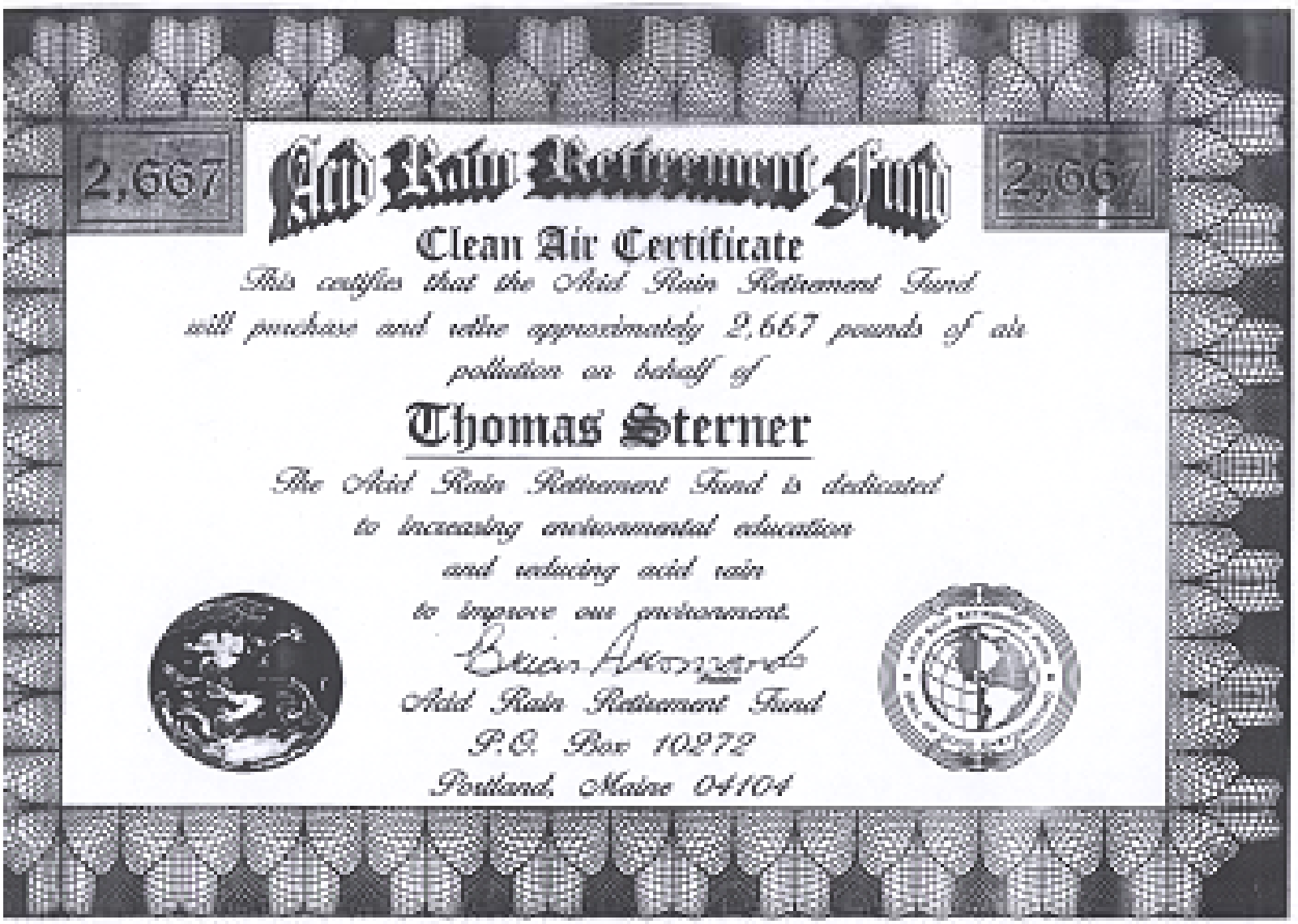
- When are costs heterogeneous??
- If Abatement takes time
- If firms with different scale or different business emit same pollutant

Heterogenous Damage

- MBI less relevant: The idea of equalizing MC makes no sense with hot spots
- **Zoning** is an appropriate instrument
- Natural reserves
- MBIs can be designed to vary geographically (and temporally)

Climate Change

- Are costs heterogeneous?
- Can we have a single World price of carbon?



Sterner Environmental Policy Making

Allocation of permits

- Permits can be allocated in proportion to:
- Historical pollution: Grandfathering
- (Historical/)current production: Output allocation or benchmarking.
- Equally
- By WTP ie through an auction
- NB Duration, bankability, updating…

Weitzman P vs Q

If uncertainty in MC abatement

- The Marginal Damage of pollution is steep →**QUANTITY-type**.
- IF MC abate steeper → **PRICE-type** instruments.

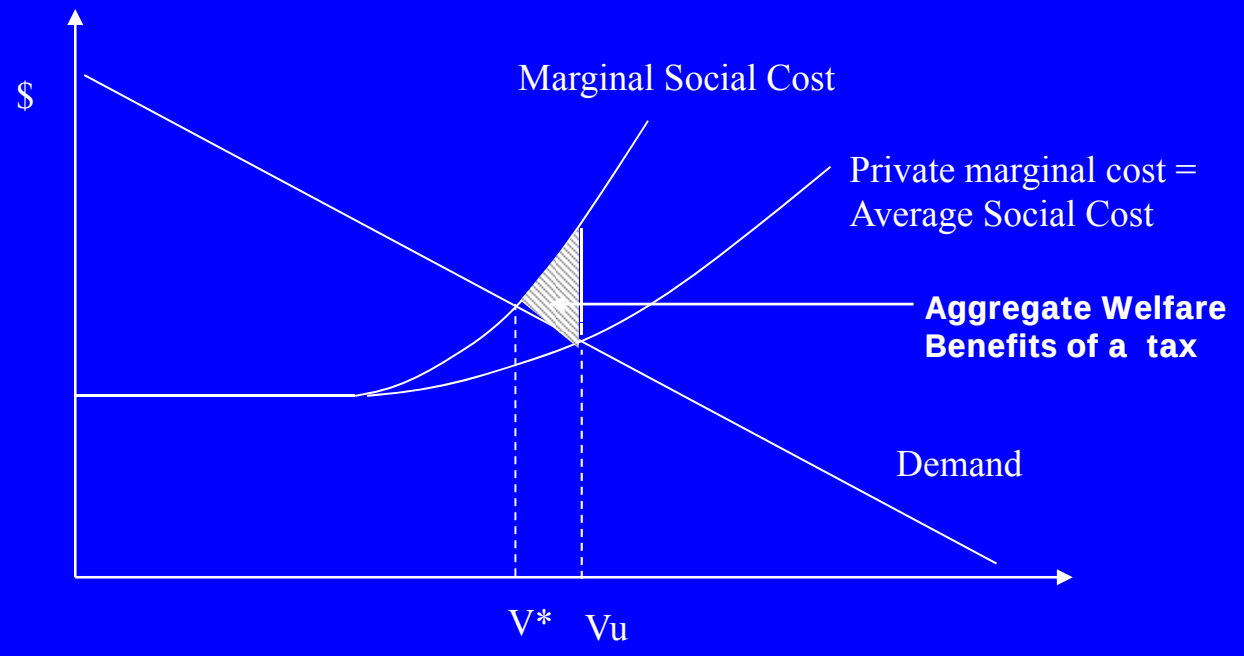
Some other rules of Instrument selection and design 1

- If abatement possibilities limited →
- **Price/Output effect**

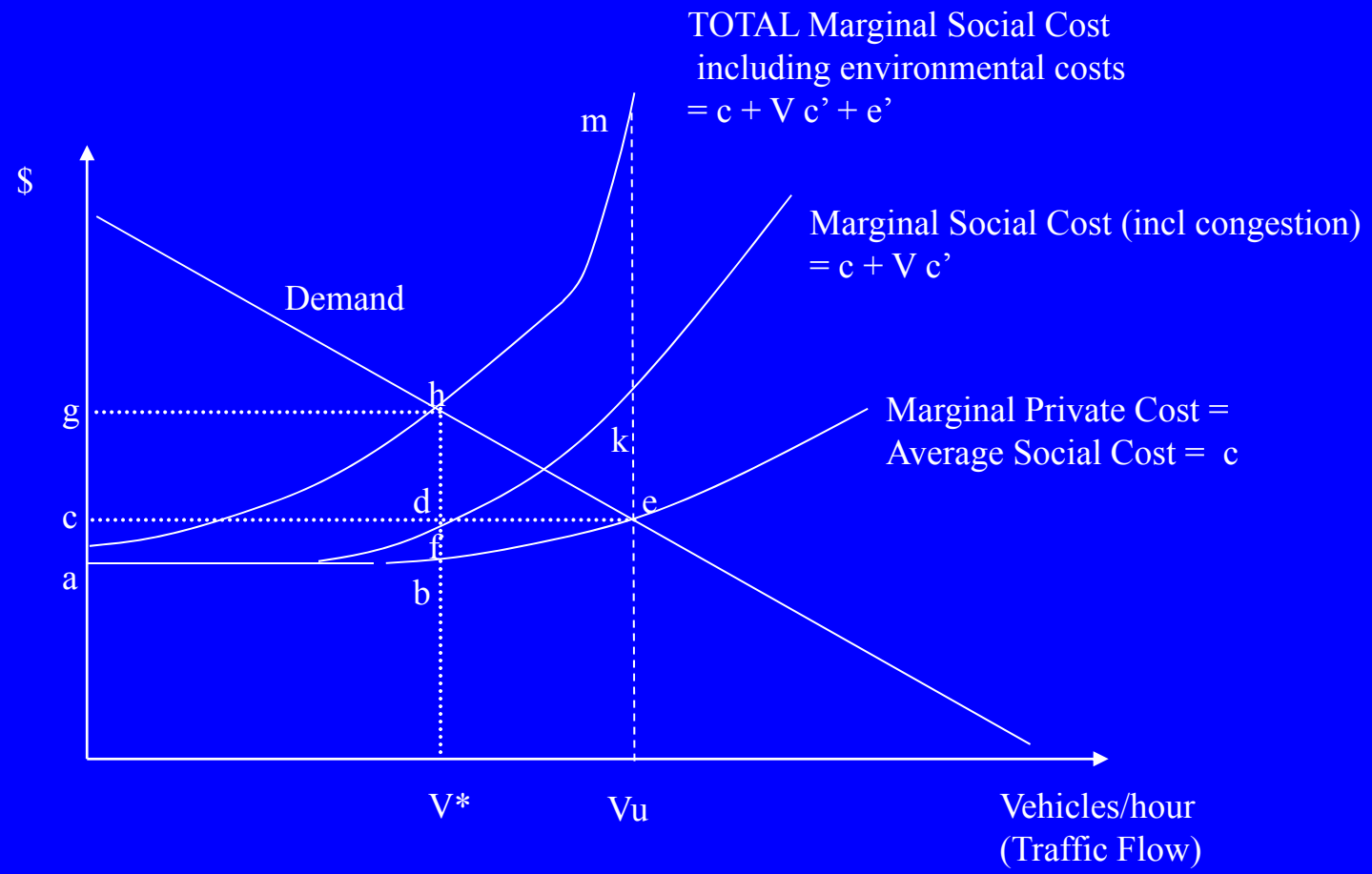
- Except in small open economies → imports

- Monopolies: taxes perverse prices too high.

The Economics of Congestion



Congestion and Pollution



Sterner Environmental Policy Making

The DISTRIBUTION of costs and benefits

- Benefit to society of regulation is avoided welfare loss ***hem*** but note DISTRIBUTION
- ***BENEFITS***:
- Victims of Pollution gain ***fkmh***
- State gains Tax revenue ***abhg***

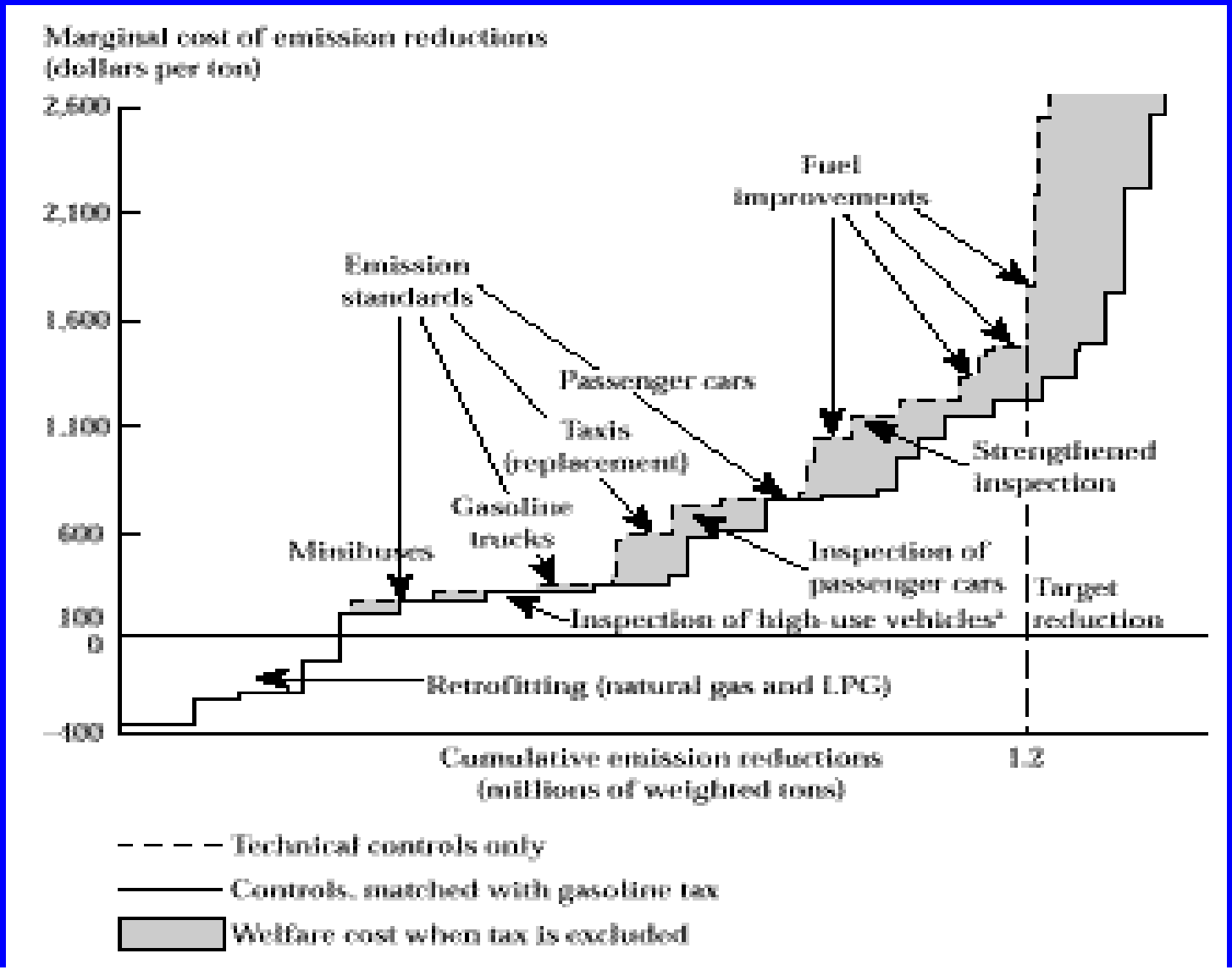
- **COSTS**
- Motorists who continue driving gain time but pay tax ***abdc-abhg =***
- ***Loss of -cdhg***
- Motorists who stop driving lose CS ***–beh***

Special Environmental Considerations

- Emissions depend very strongly on technology!

Vintage	VOC	Nox	Pm
1988	2,5	1,53	37
2000	0,46	0,17	7
2010	0,08	0,04	1,2

Transport in MegaCities



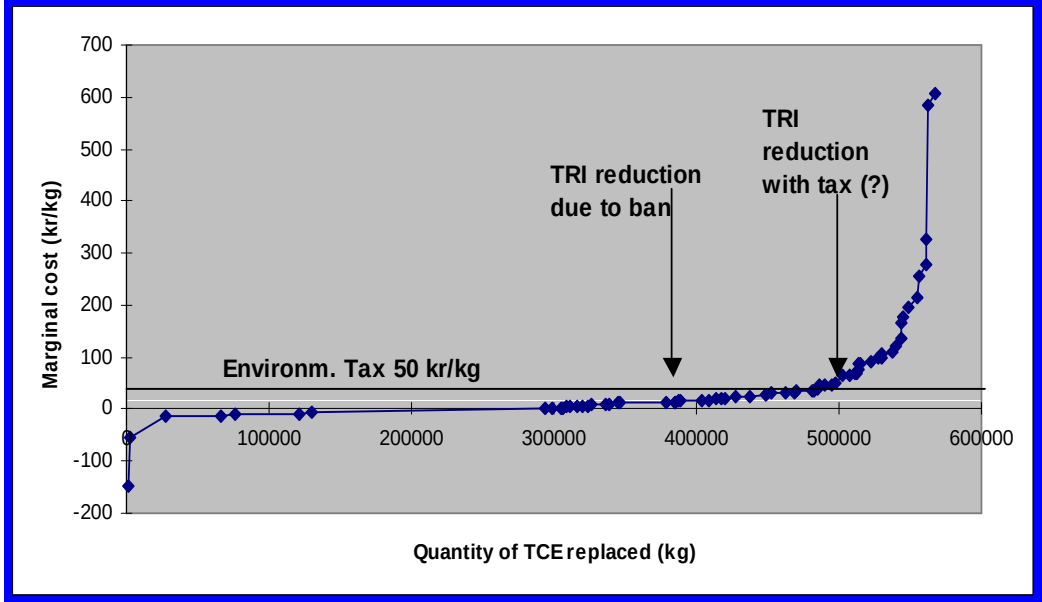
Industrial Pollution

- Information and regulation
- Then moves to MBI, taxes/permits & Liability
- Prohibition not necessarily best!

Phase out of Trichloroethylene

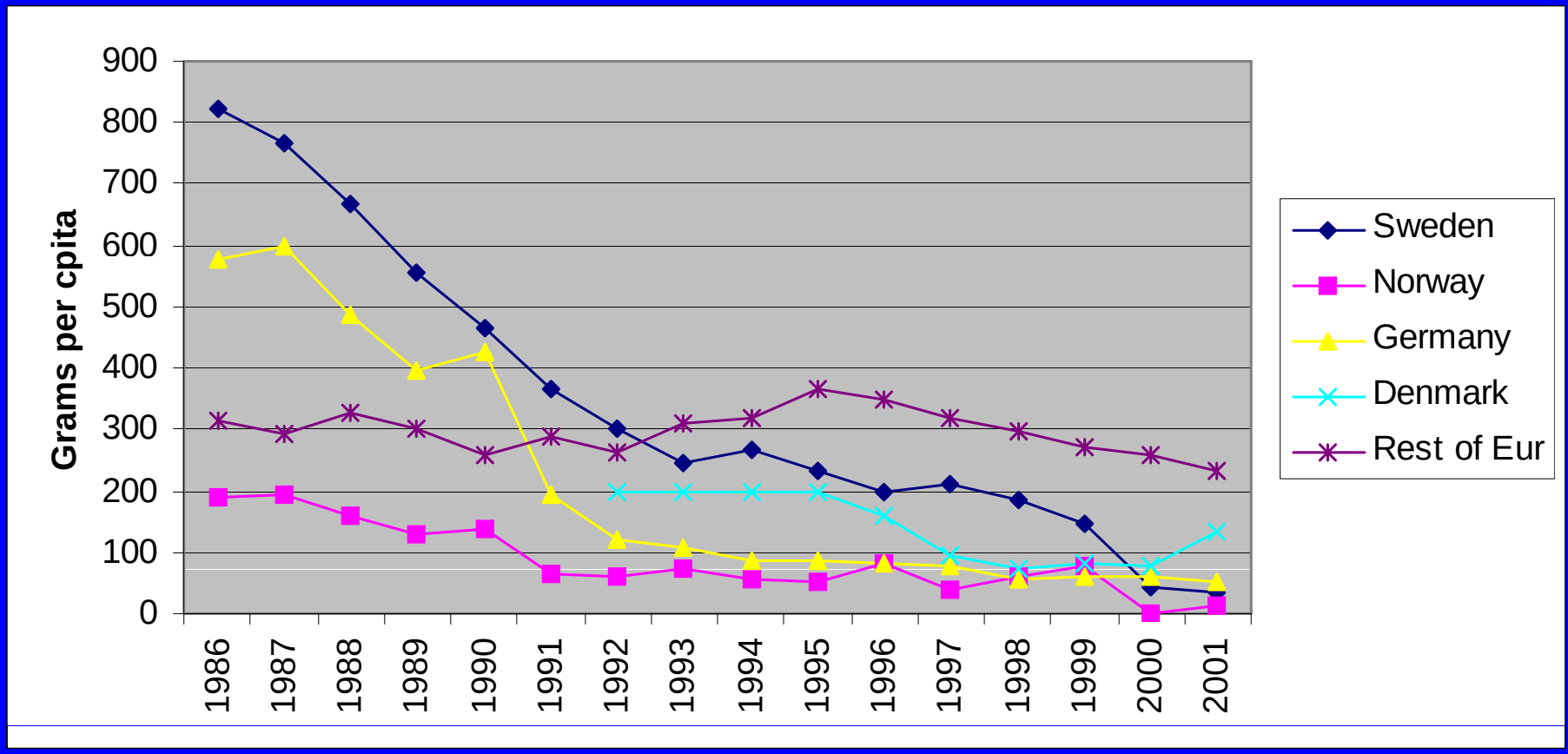
- (C_2HCl_3). Good Fat solvent…
- Working Environment hazard
- Forbidden in Sweden since 1991
- Taxed in Norway
- Heavily regulated in Germany.

Phase out of Trichloroethylene



- MC of abatement very flat
- Most firms substitute
- Some firms find it impossible & litigate
- Why not use P instrument
- Norway did!

Phase out of Trichloroethylene



Industrial Pollution: Permits vs Taxes

- Success in abatement of S in US
- -50% in CAAA. 19-10 Gtons
- Estimated costs 600-1000 $/t.
- Actually P= 100-150!

In Sweden tax. T=1500 $/t

Swedish Nox Policy

- Very high tax desired but not politically feasible.
- Refunded emission Payment!
- -40% in emissions
- Now <<< other countries

REP

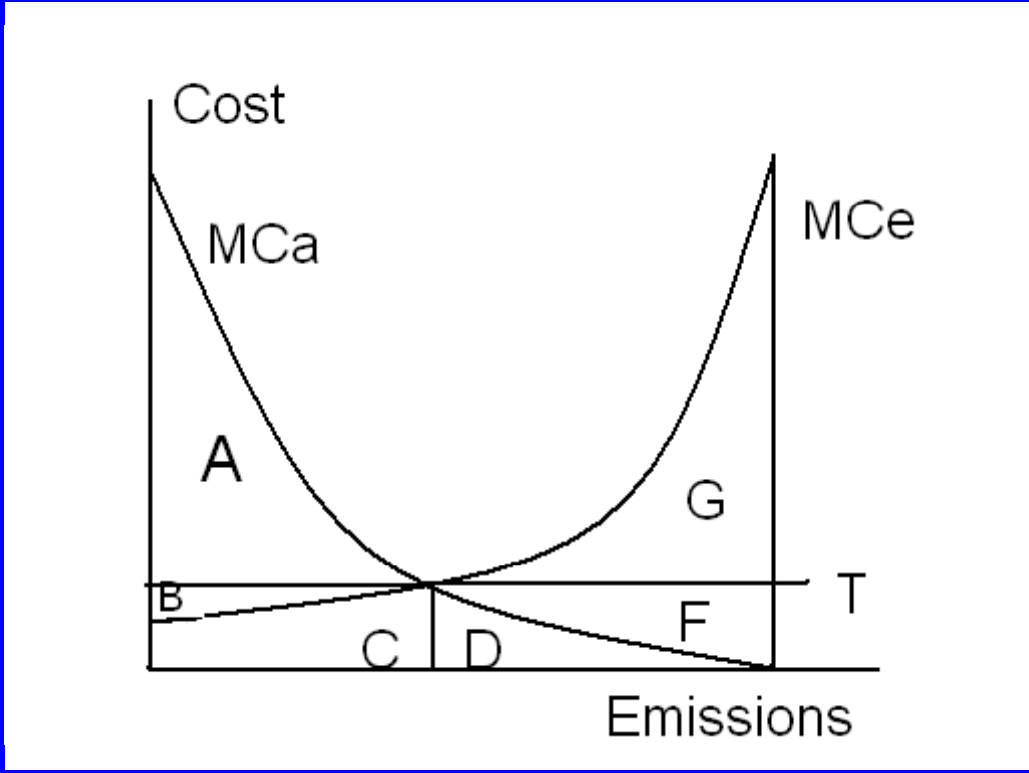
- Each company pays fee and gets refund
- $Pq_i - c_i(q_i, a_i)$
- $- Te_i(q_i, a_i) + q_i/(\Sigma_i q_i)T[\Sigma_i e_i(q_i, a_i)]$

- FOC are
- $P = c'_q + Te'_q(1 - \sigma_i) - T(E/Q)(1 - \sigma_i)$
- $c'_a = -Te'_a\ (1 - \sigma_i)$

PROPERTIES OF REP

- Somewhat similar to tax on excess pollution
- Or tax-subsidy (tax above ê, subsidy below)
- Or to fees that go to earmarked funds
- Very useful when output effect **not** wanted
- Small open economy (competitivity issues)
- Targetting of only some industries
- Compact lobby of powerful polluters

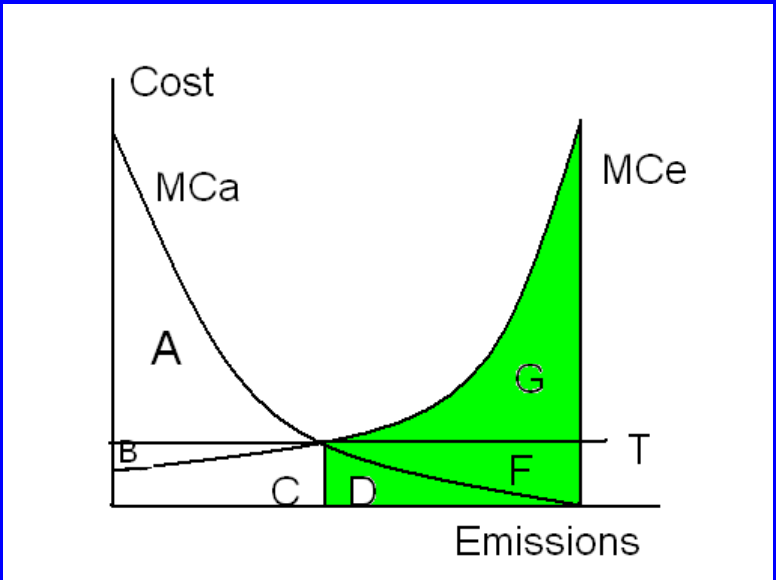
The Distribution of Costs

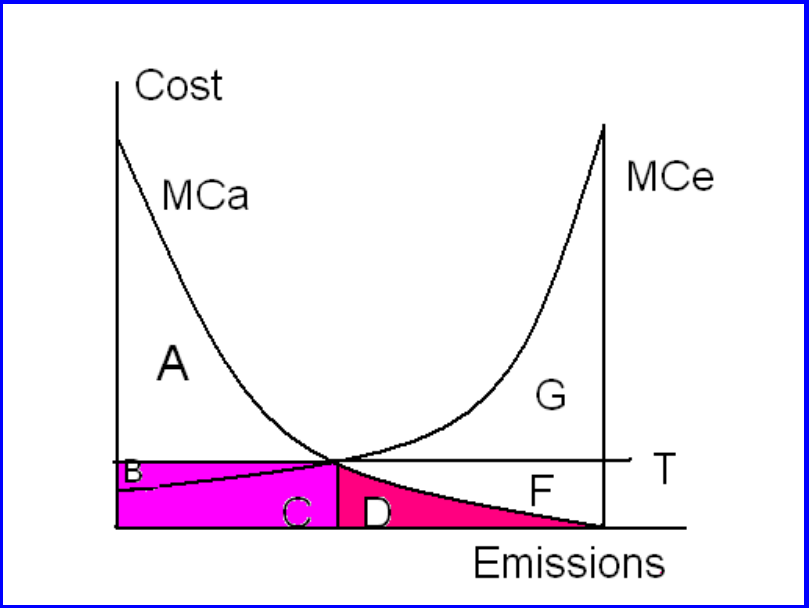


The Distribution of Costs

- Environmental benefits are D+F+G

- Abatement costs D
- Tax imply extra cost
- of B+C

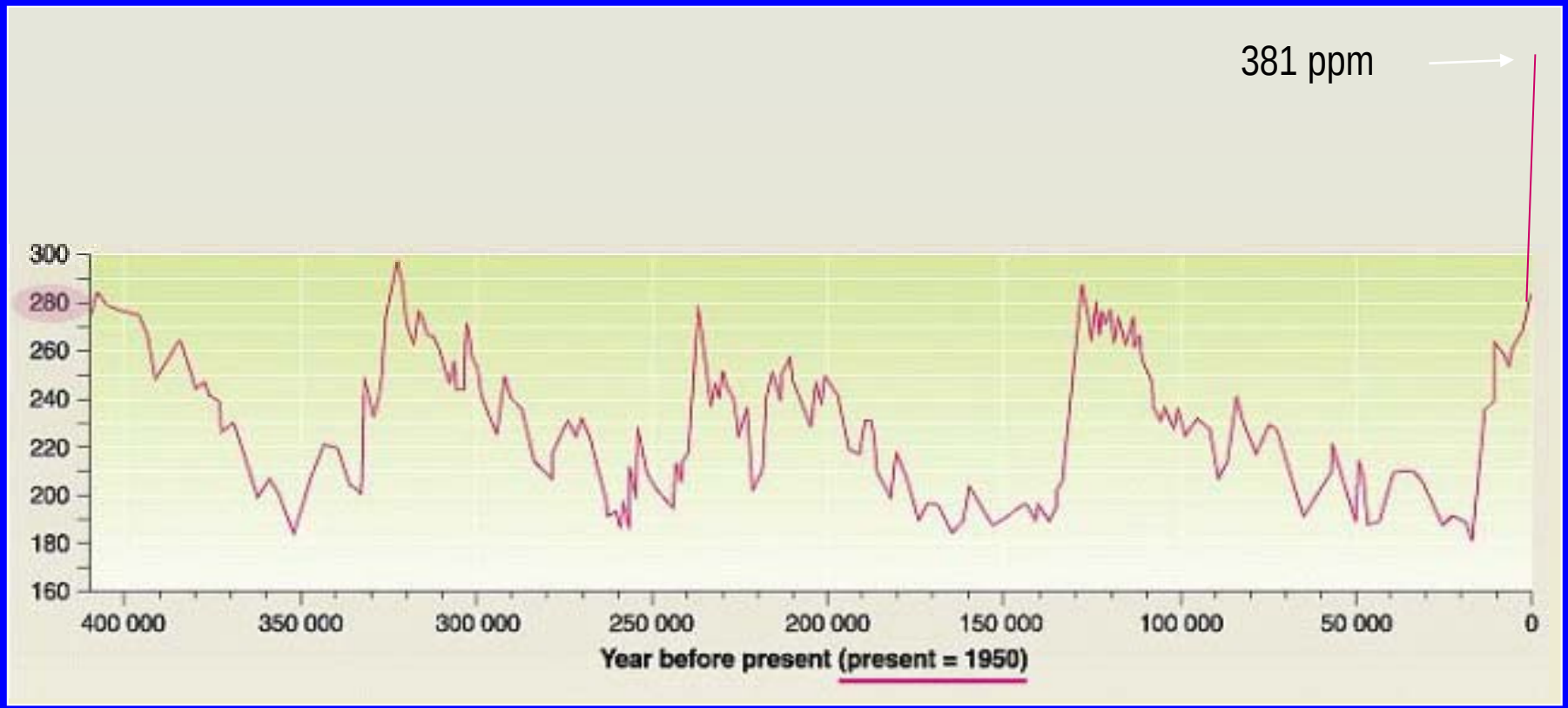




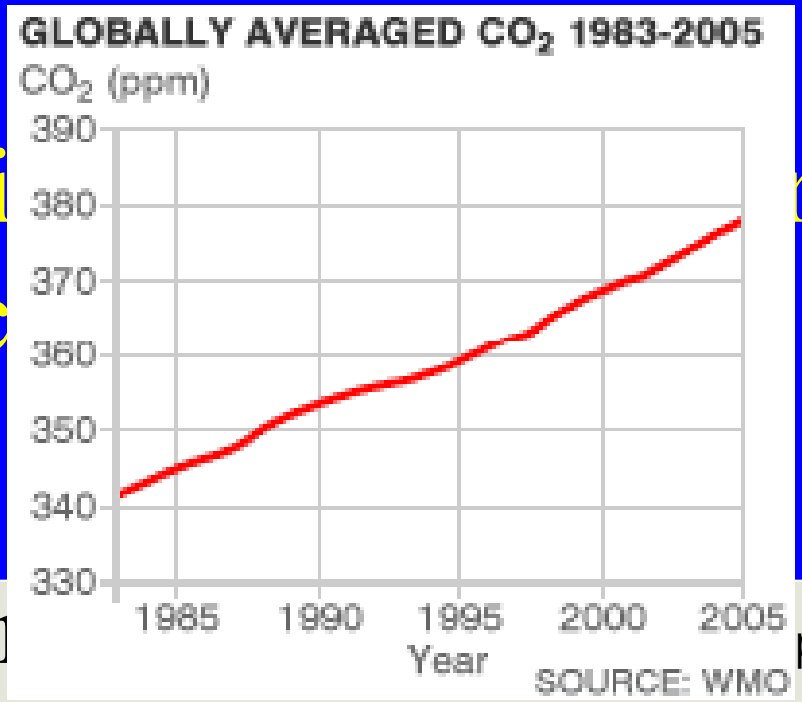
	Ownership rights to the environment				
	Polluter (absolute)		*Polluter (relative)*	*Mixed*	*Victim (PPP)*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
	Burden of costs				
Environm BENEFIT	D + F + G		D + F + G		
Polluter costs	**F**	**0**	**-D**	**-C-D**	-B-C-D
Society	**-D-F**	**-D**	**0**	**C**	**B+C**

	***Ownership** rights to the environment*				
	Polluter (absolute)		*Polluter relative)*	***Mixed***	*PPP*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Type of instrument					
Q-type	Public cleanup		CAC VA free TEP	Hybrid	TEP auction
Mixed			Hybrid	Hybrid	Hybrid
P-type	Subsidies		REP Tax-subsidy	Partly REP	Tax DRS

Historical variation of atmospheric CO_2-concentration



Historical vari… …ric CO_2-c…



This is the pe… we usually call ”History”

Radical goals for the future ?

800

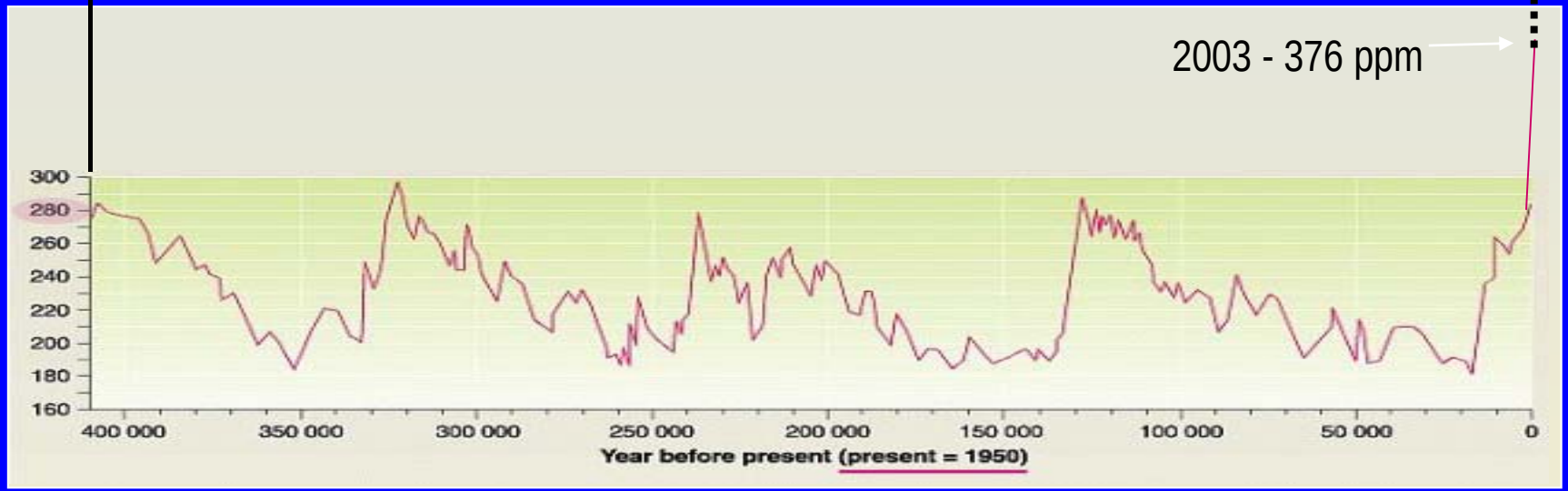
700

600

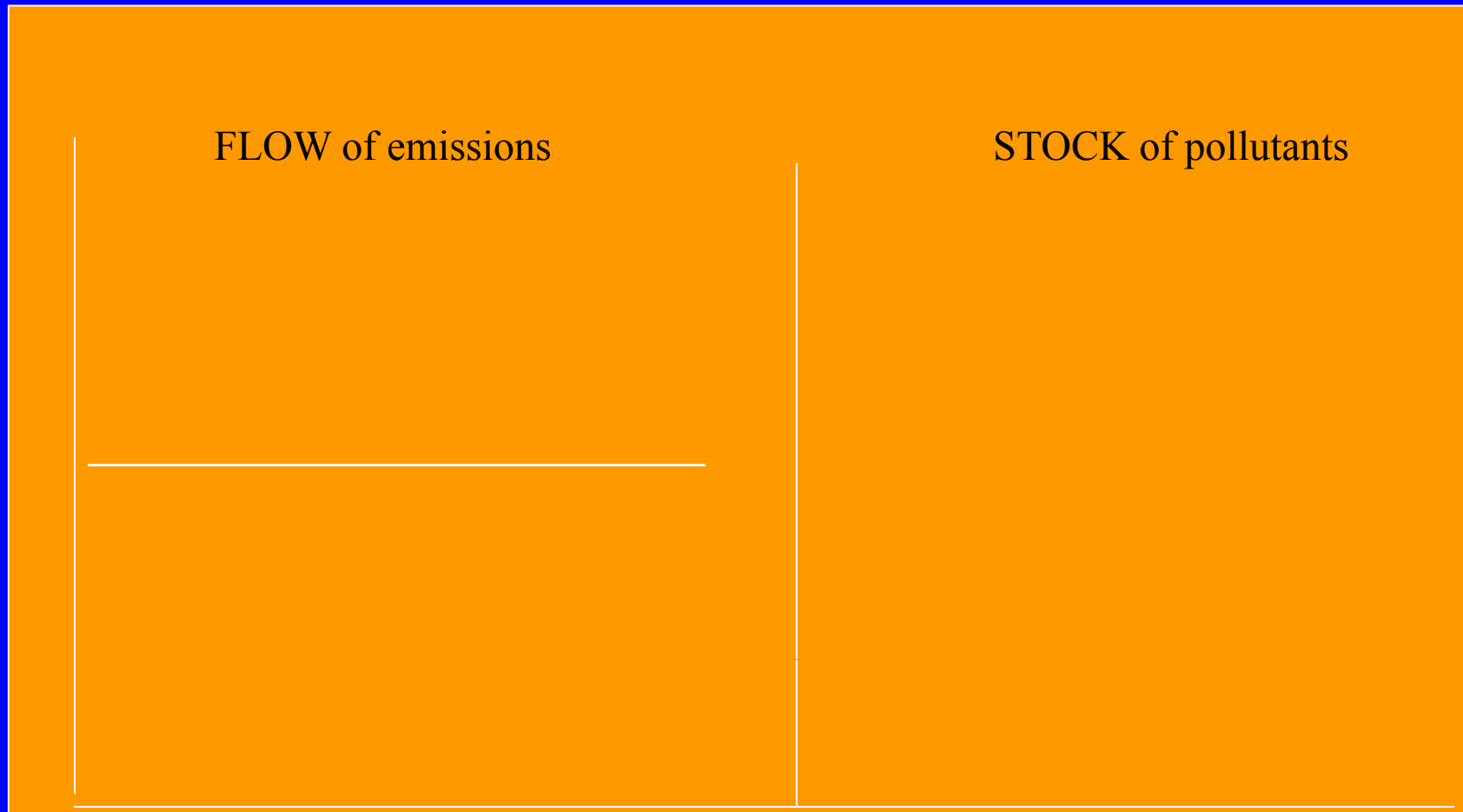
500

400

EU goal (?)



Stock goal and flow goal



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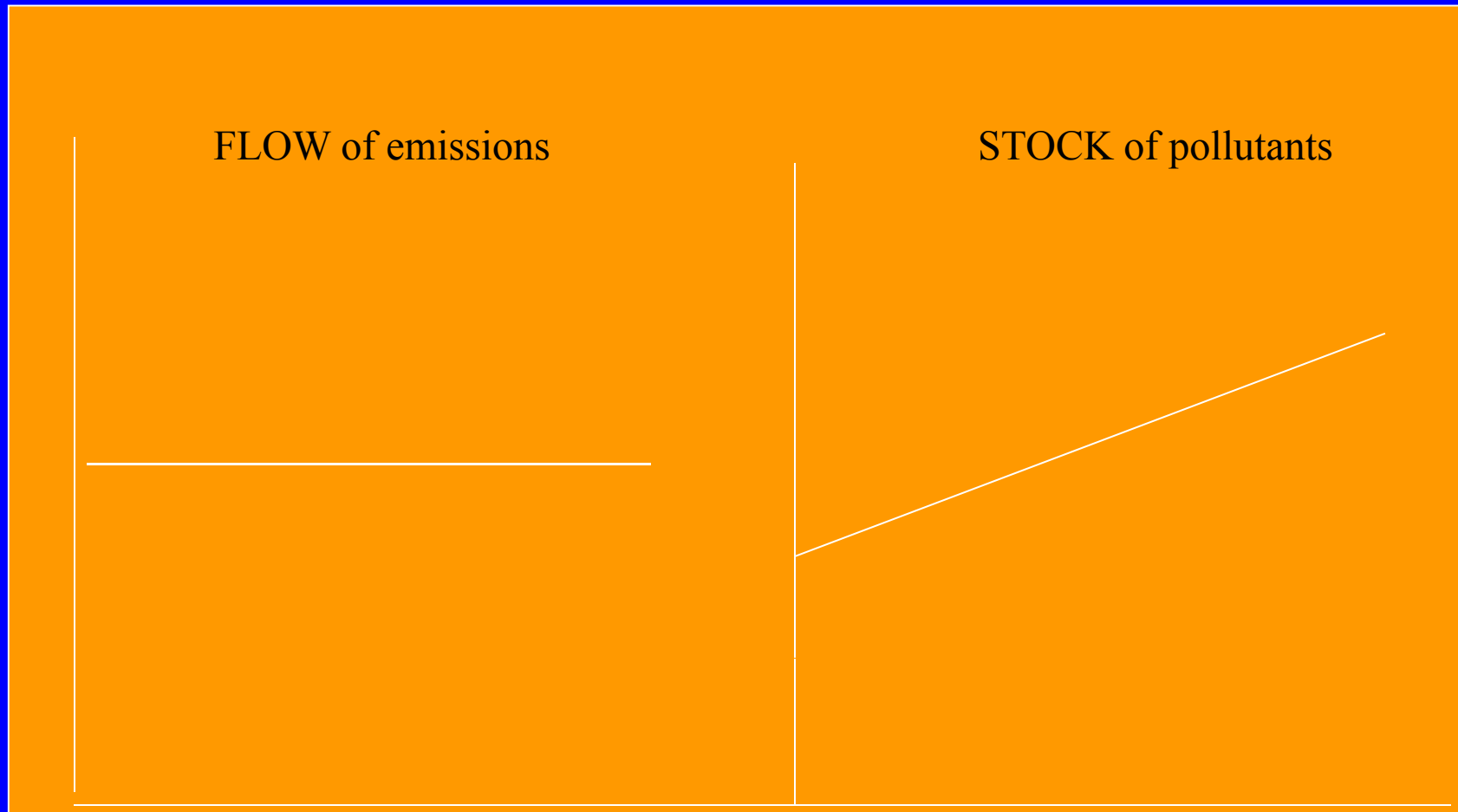

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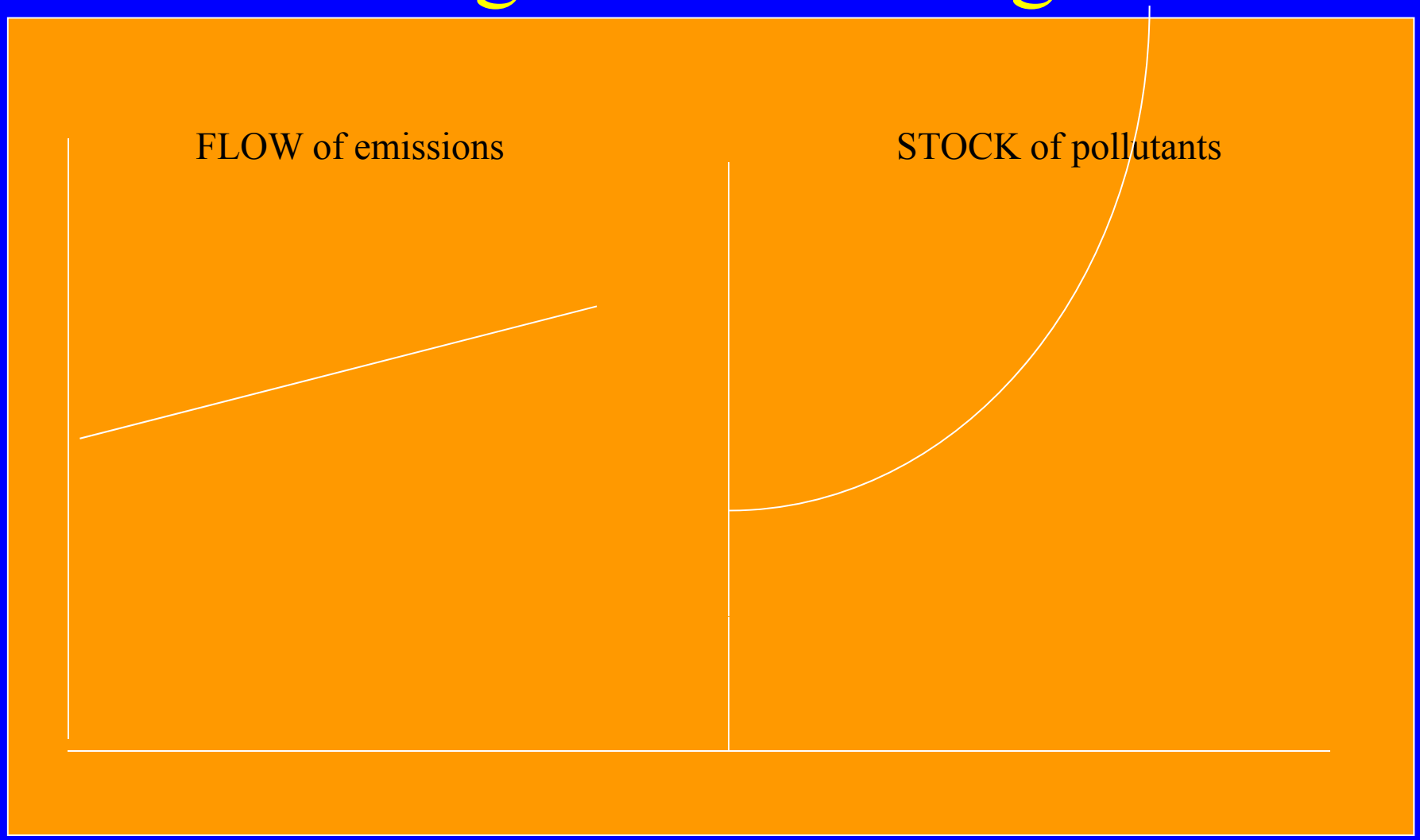

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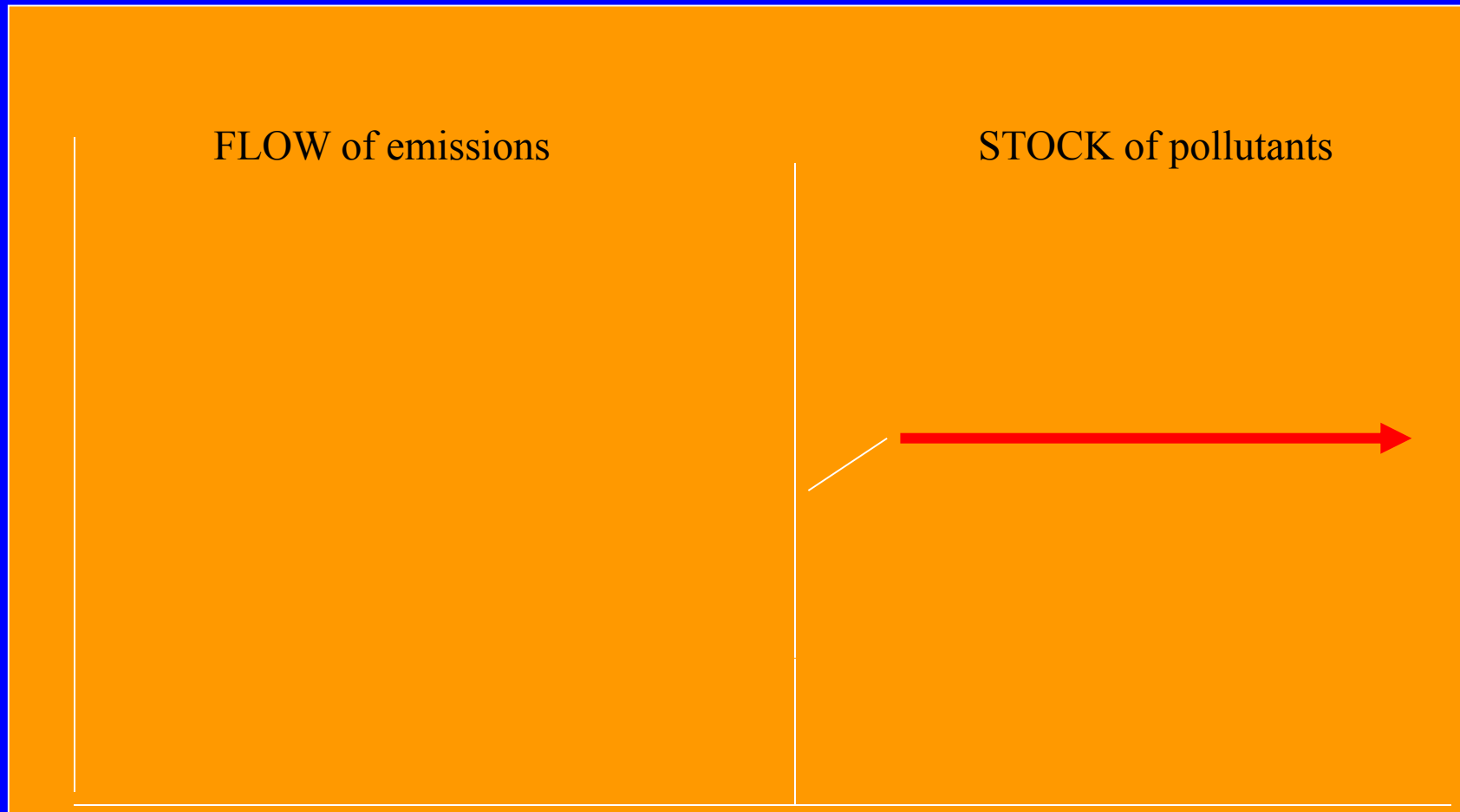

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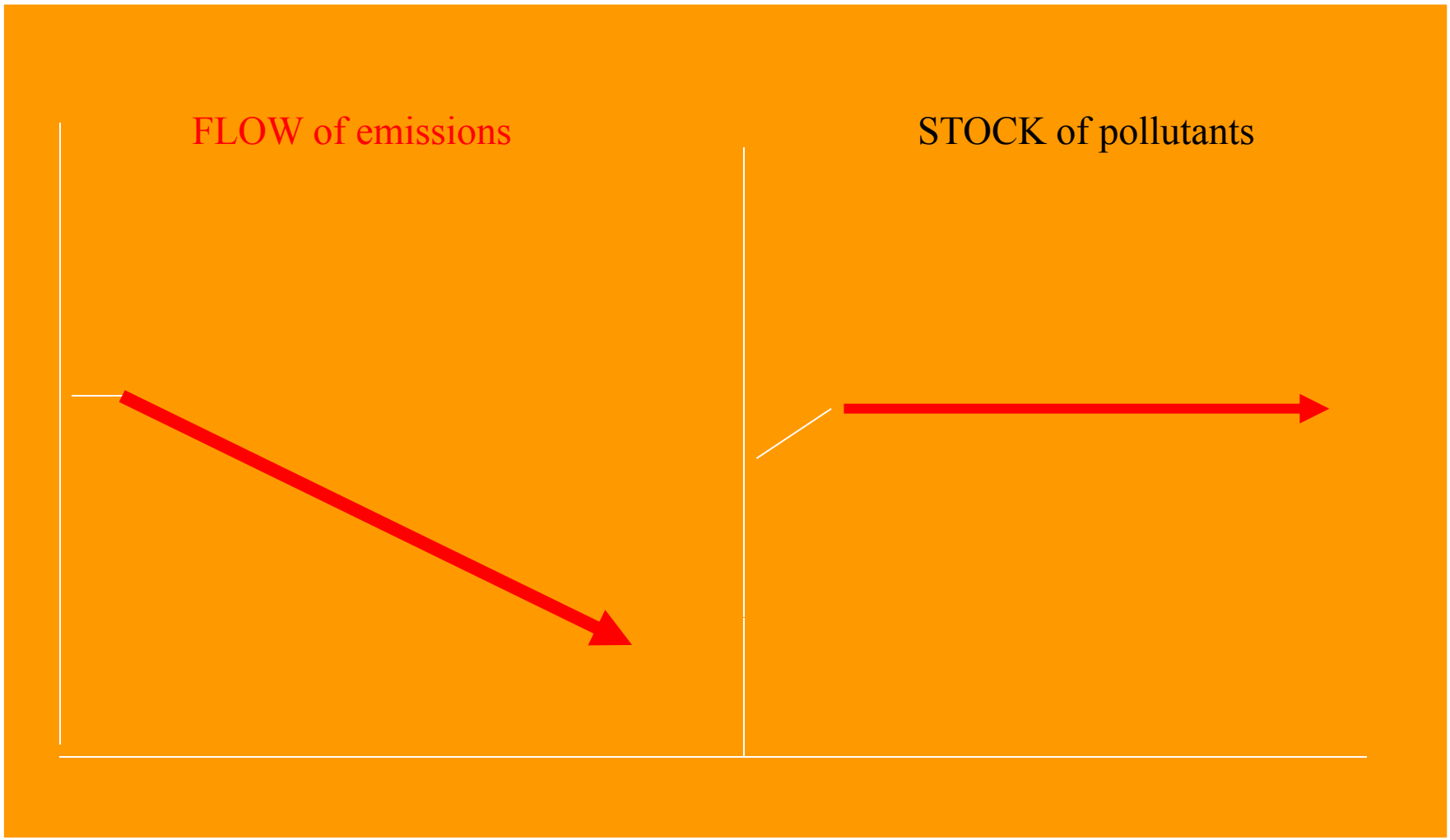
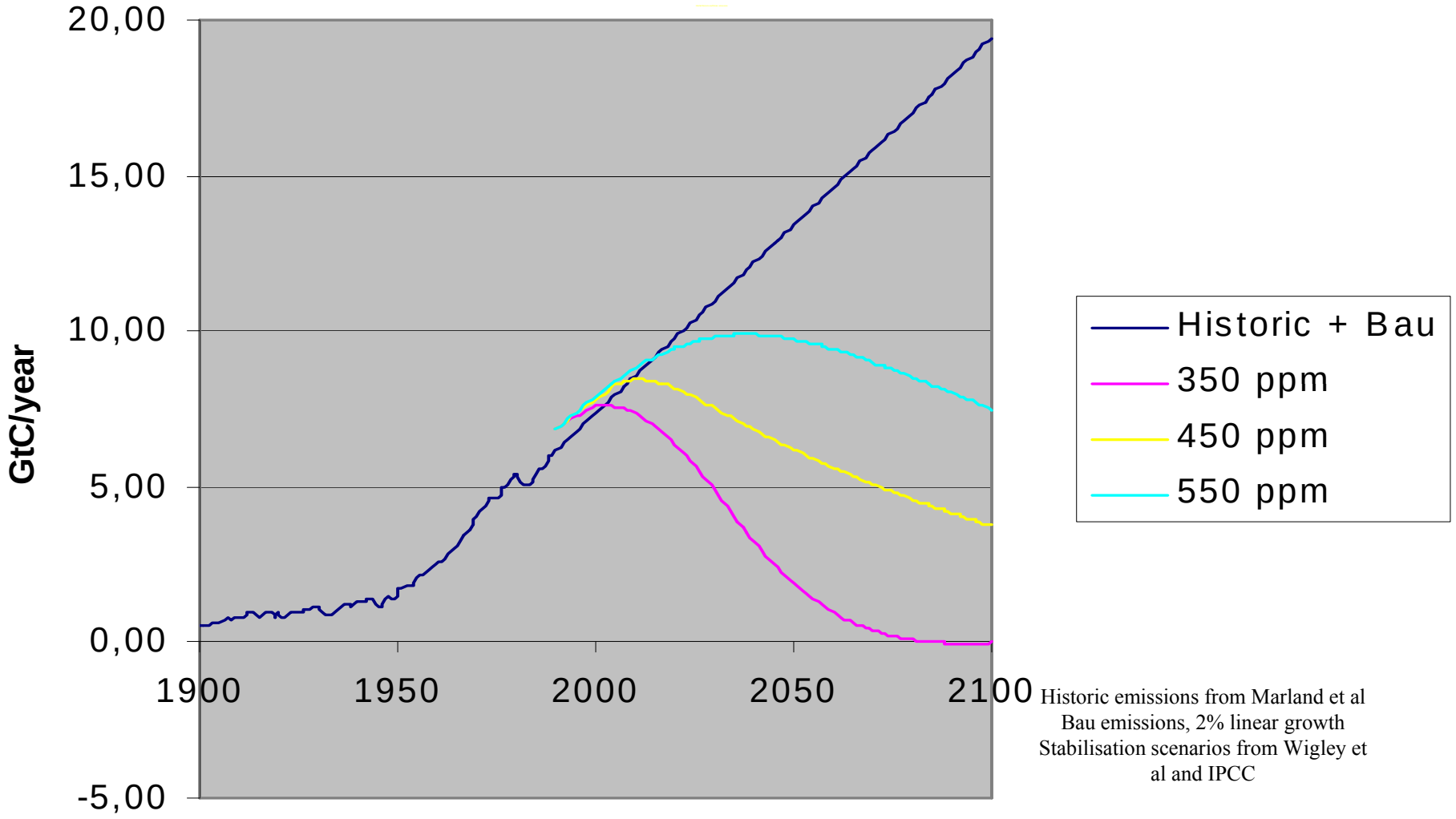
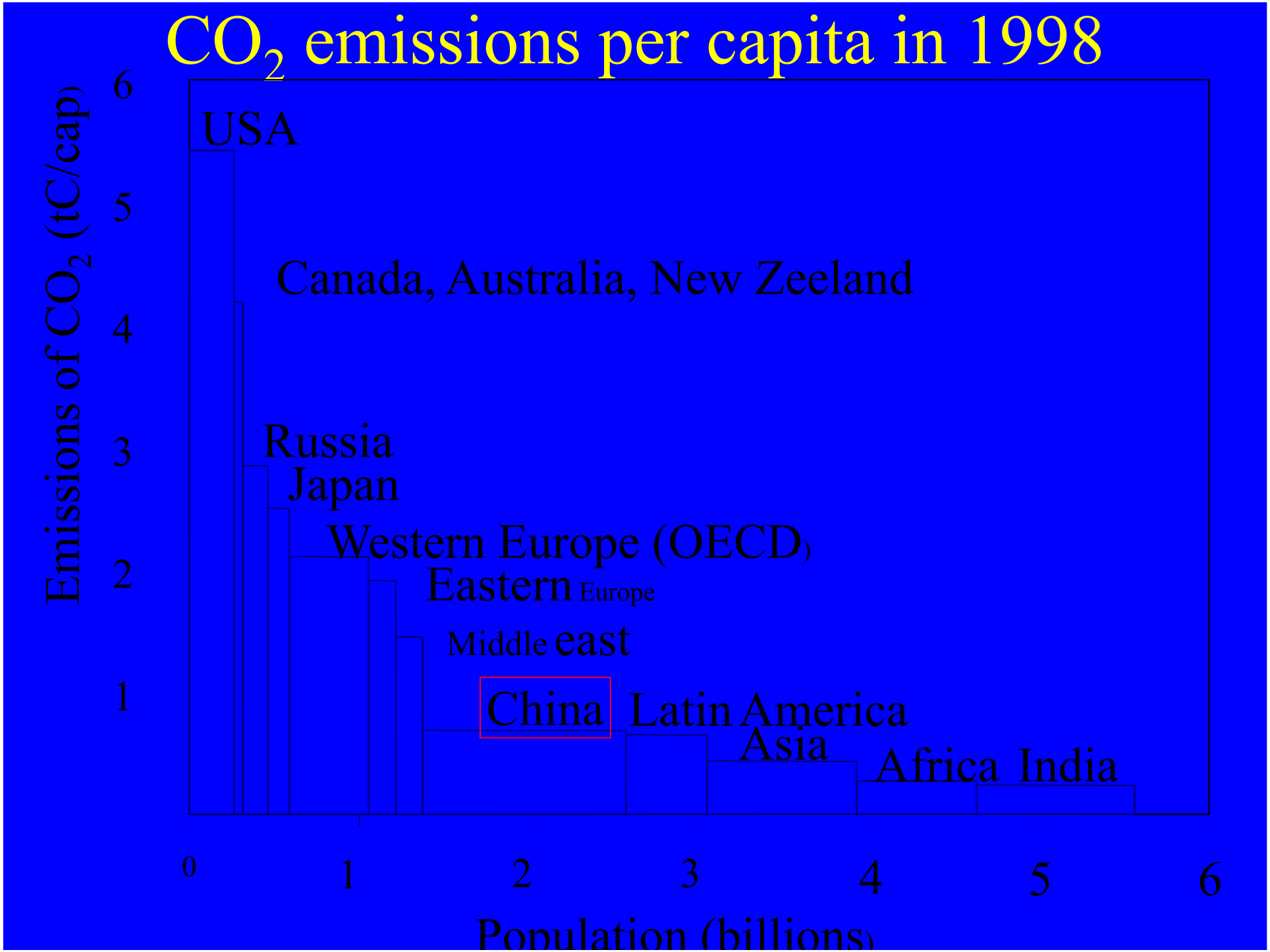
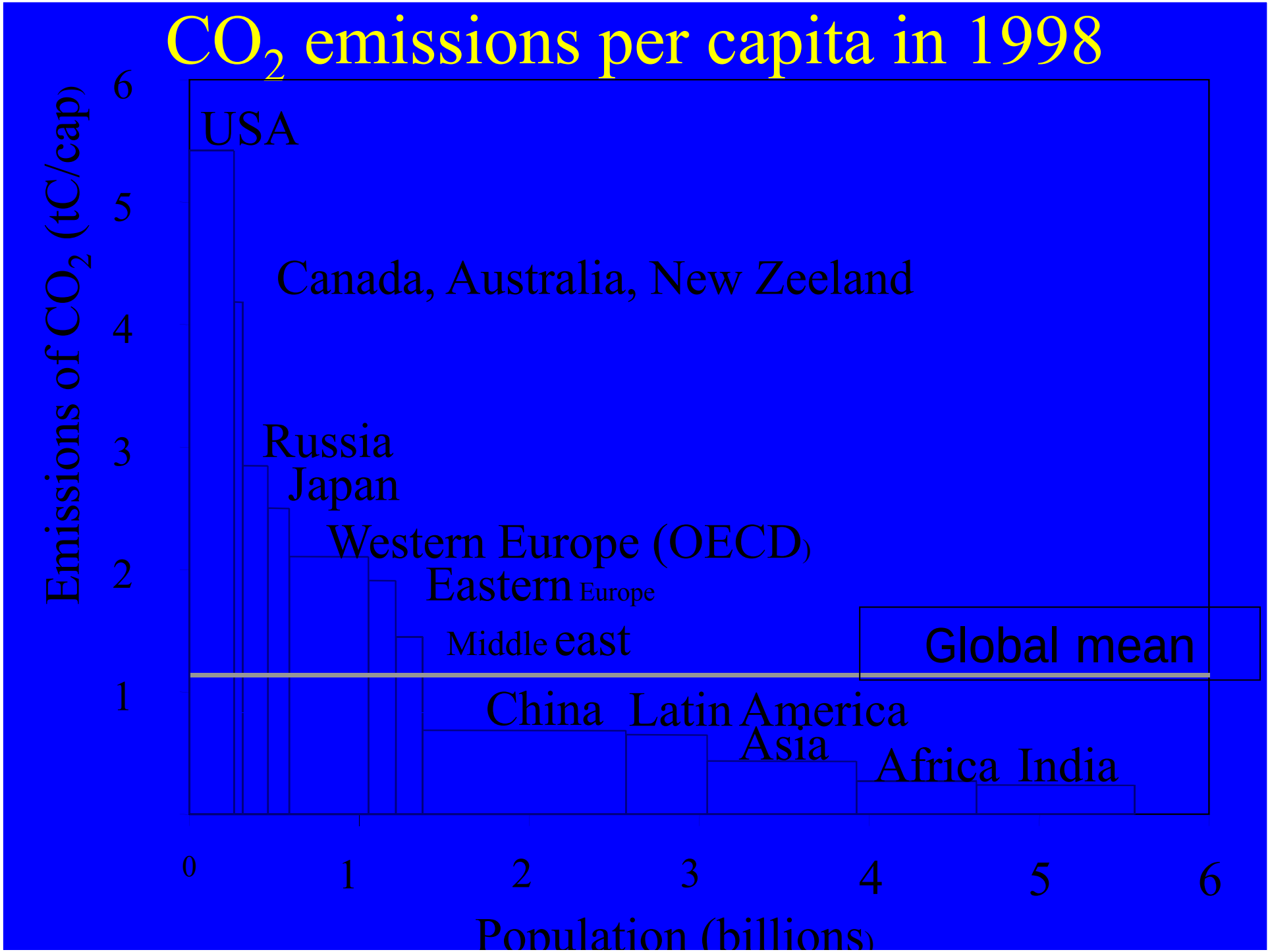


Historic + future emissions



Historic emissions from Marland et al
Bau emissions, 2% linear growth
Stabilisation scenarios from Wigley et al and IPCC


CO_2 emissions per capita in 1998
Emissions of CO_2 (tC/cap)
6
5
4
3
2
1
USA
Canada, Australia, New Zeeland
Russia
Japan
Western Europe (OECD)
Eastern Europe
Middle east
China
Latin America
Asia
Africa
India
0
1
2
3
4
5
6
Population (billions)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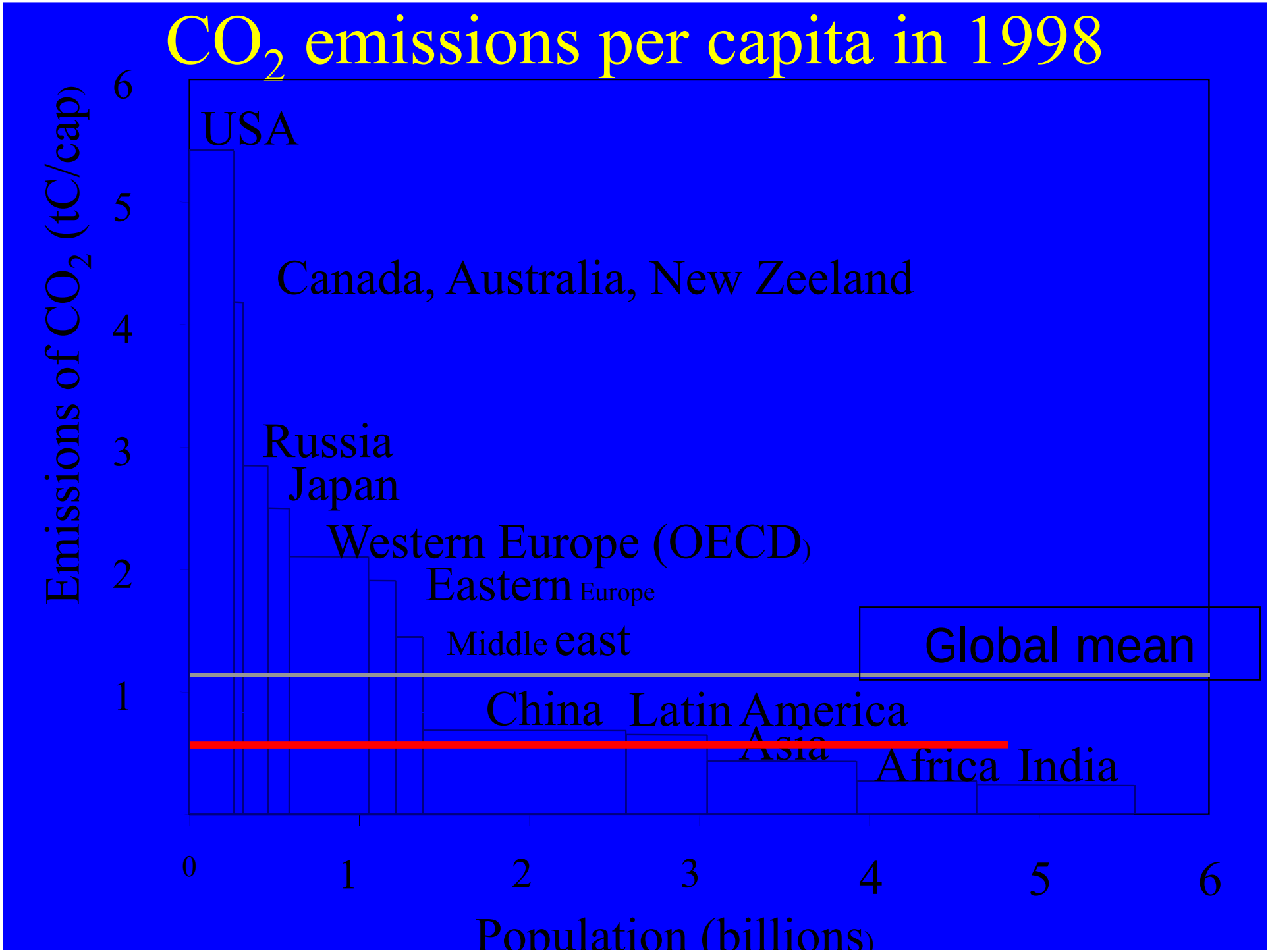
Population (billions)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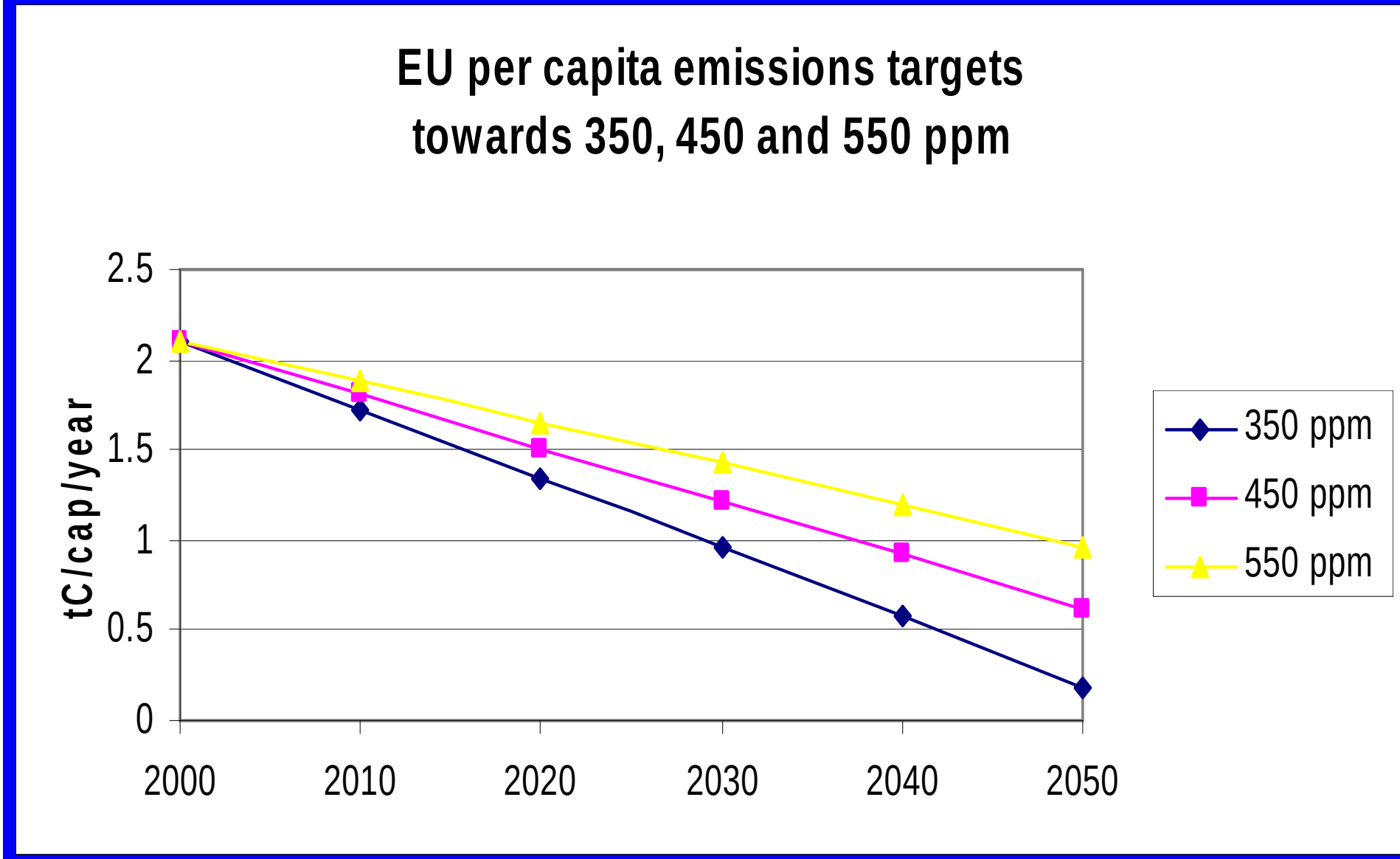
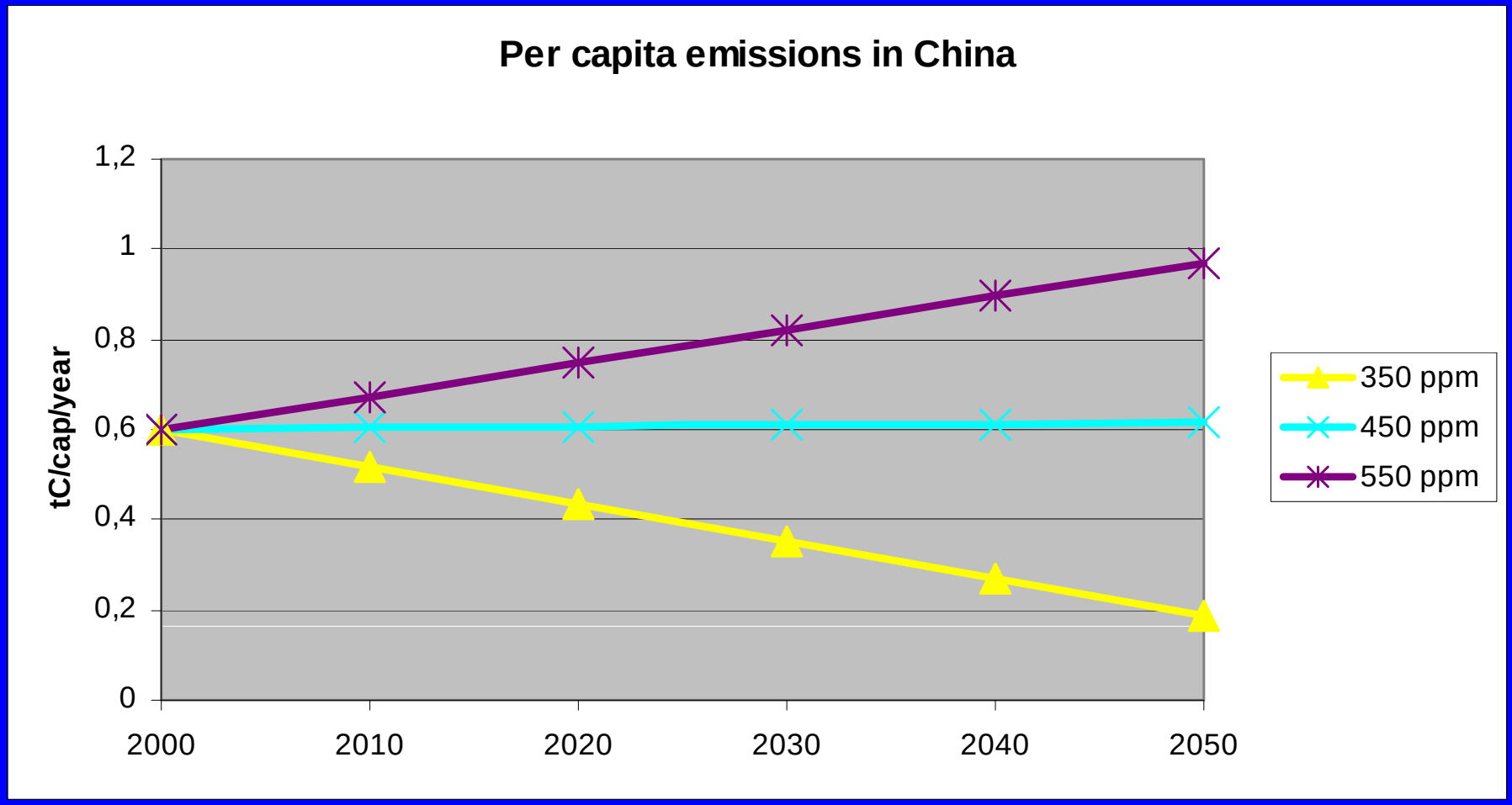
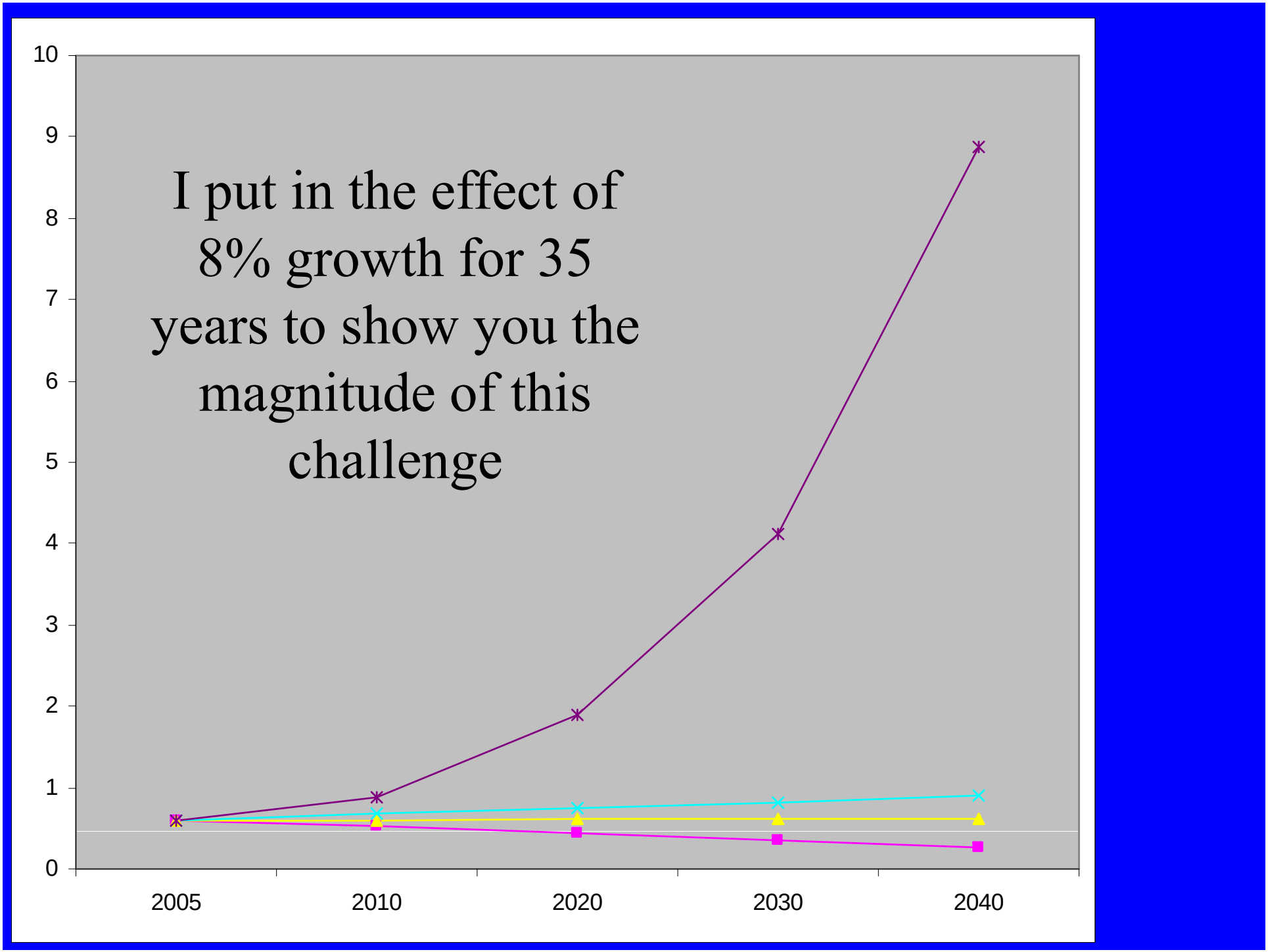
Eastern Europe
Middle east
Global mean
China
Latin America
Asia
Africa
India
0
1
2
3
4
5
6
Population (billions)

Per capita targets (EU)



Per capita targets (China)




I put in the effect of 8% growth for 35 years to show you the magnitude of this challenge
10
9
8
7
6
5
4
3
2
1
0
2005
2010
2020
2030
2040

IPPC 4 and Stern

- Climate change anthropogenic
- Big Costs of doing nothing
- Climate change →costs ~[5-20%] of GDP

- Costs of action smaller ~ 1%

Breakdown by sector

- How much reduction for **transport**?
- 25-30%
- Fast Growing;

The most efficient pol Instrument?

- Kyoto
- ETS
- Agricultural policy
- Subsidies
- R&D – fusion, solar, wind….energy saving
- Chinese ”One Child” policy

The most efficient pol Instrument?

- Kyoto
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- **Gasoline Taxes!**

Growth and Environment 2020

- Can we increase income 50% & reduce fossil emissions 50% ?
- Take the transport sector: A simple modell for fuel demand is $\mathbf{Q = Y^a P^b}$
- Elasticities 1 for income Y, – 0.8 for price P

Simple-minded economist solves major problem:

- All you need is to raise price of fuel by 300% !

- Because $P = (0.5/1.5)^{-1/0.8} = 3.95$

300% !

- Is that **realistic**??
- What happens to Welfare?
-
- Isn’t there some **other way** ?

Is it **possible**?

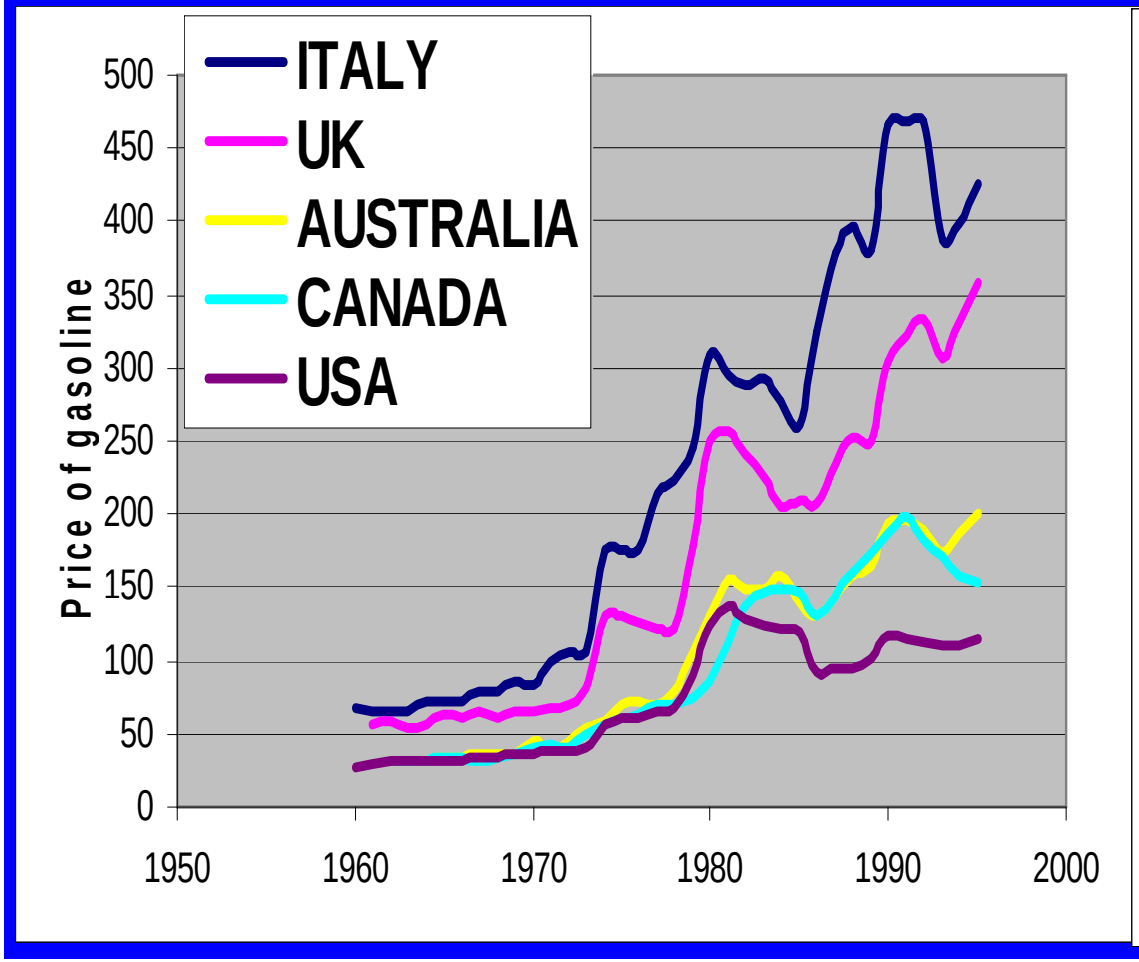
Is that POSSIBLE?

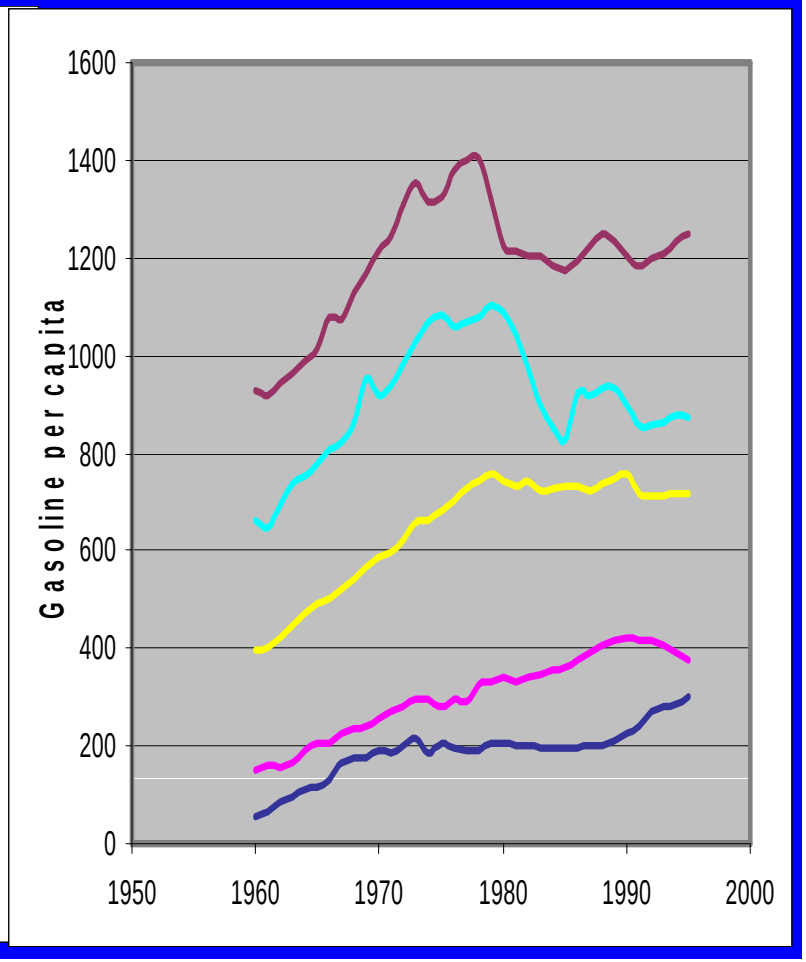
- Yes : Europe has already done it! International price of fuel is 0,3 $/l.
- If the Whole World had prices like UK or Italy a large share of the problem would be solved.
- Though only for transport. We haven't done much concerning industry and electricity yet…

Petrol

prices

Consumption/cap





Transport Fuel Use in OECD
Gtons fuel (and ~C*(12/14))

	Real	UK prices	US prices
Fuel use	**1,13**	0,72	1,47
		-36%	+30%

Thankyou

more on Climate Bargaining