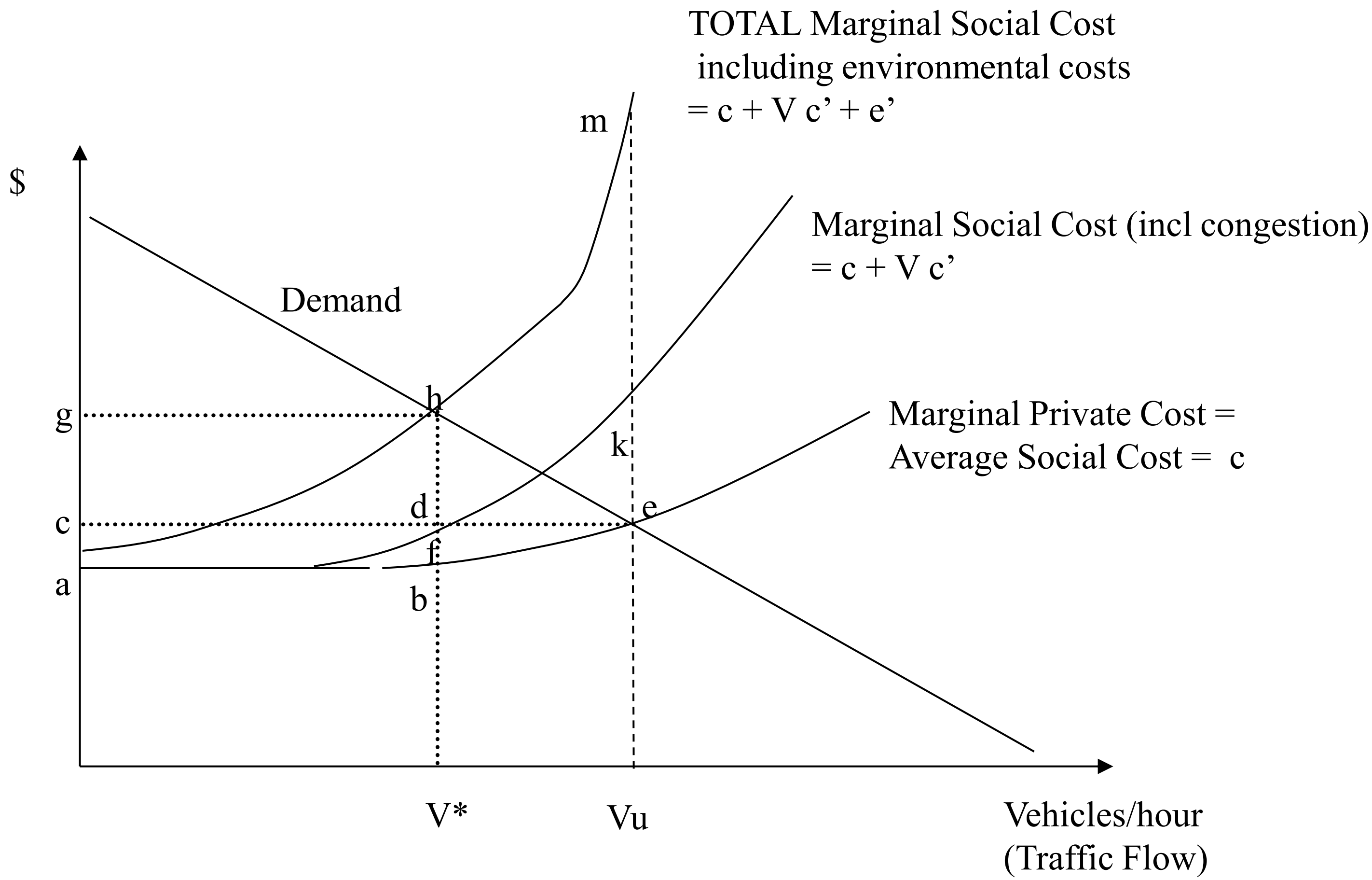
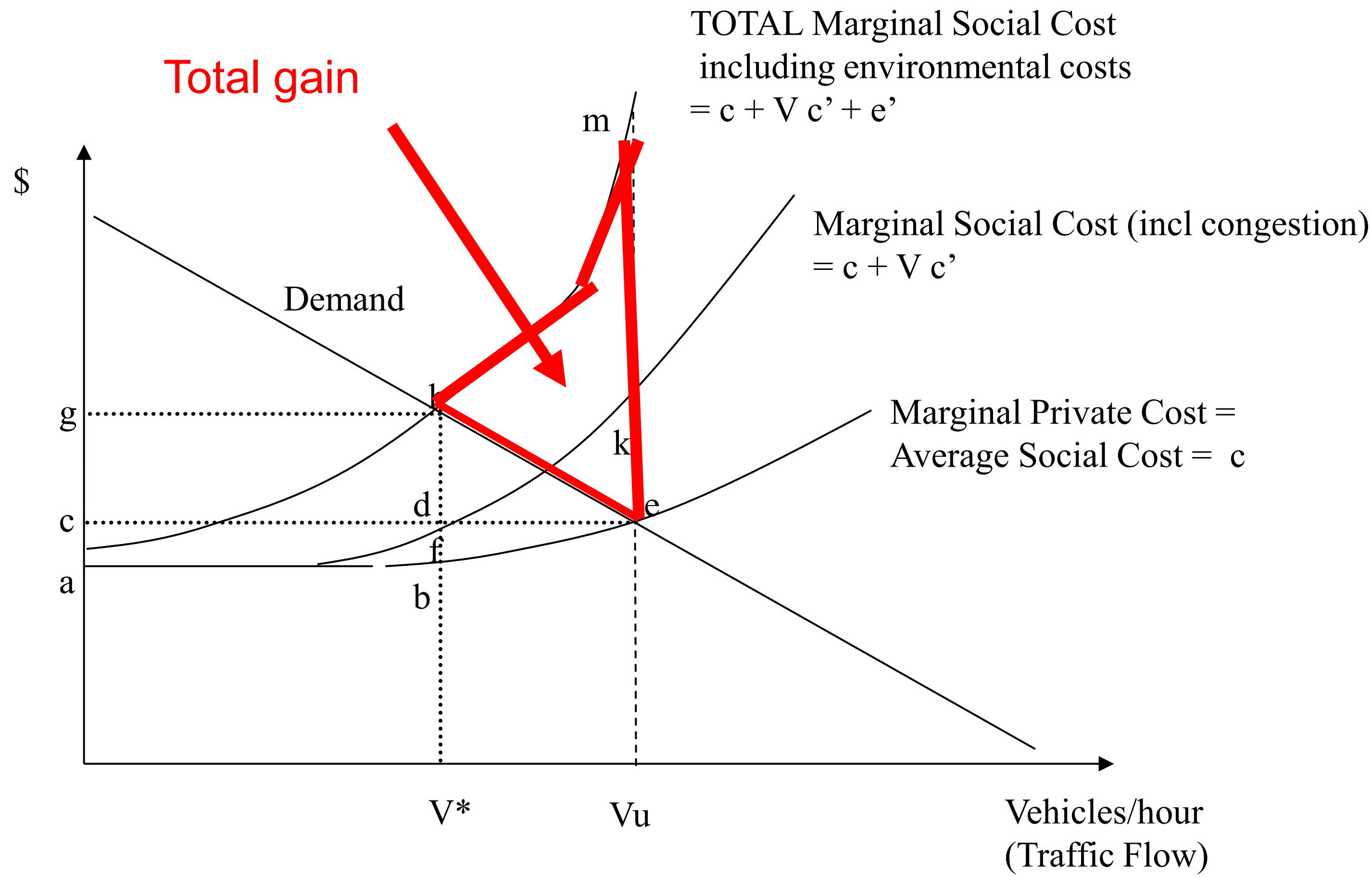
# Policy Instruments for Road Transportation, Energy, Climate

Lecture 16

# Congestion and Pollution



# Congestion and Pollution

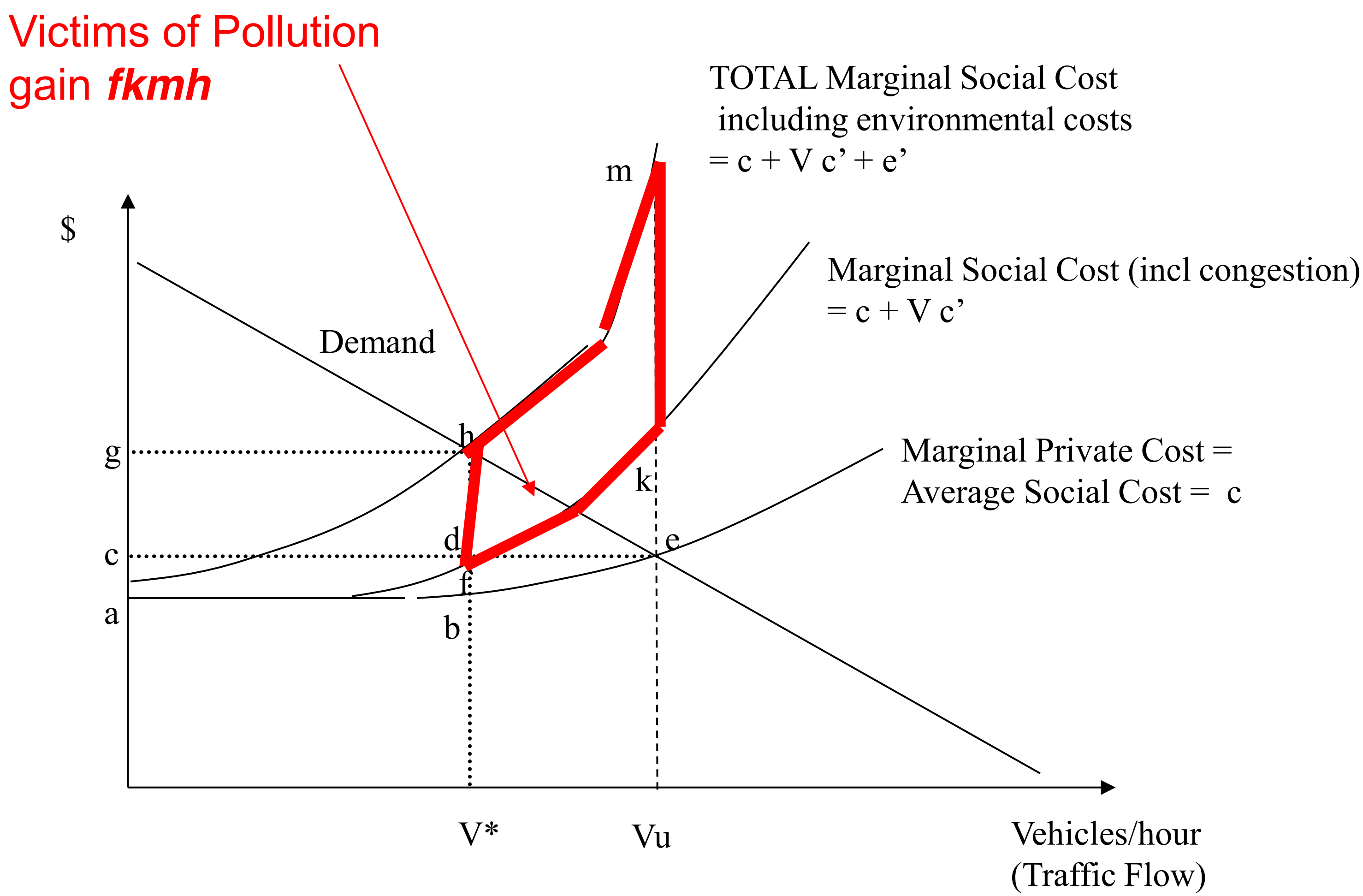


# The DISTRIBUTION of costs and benefits

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

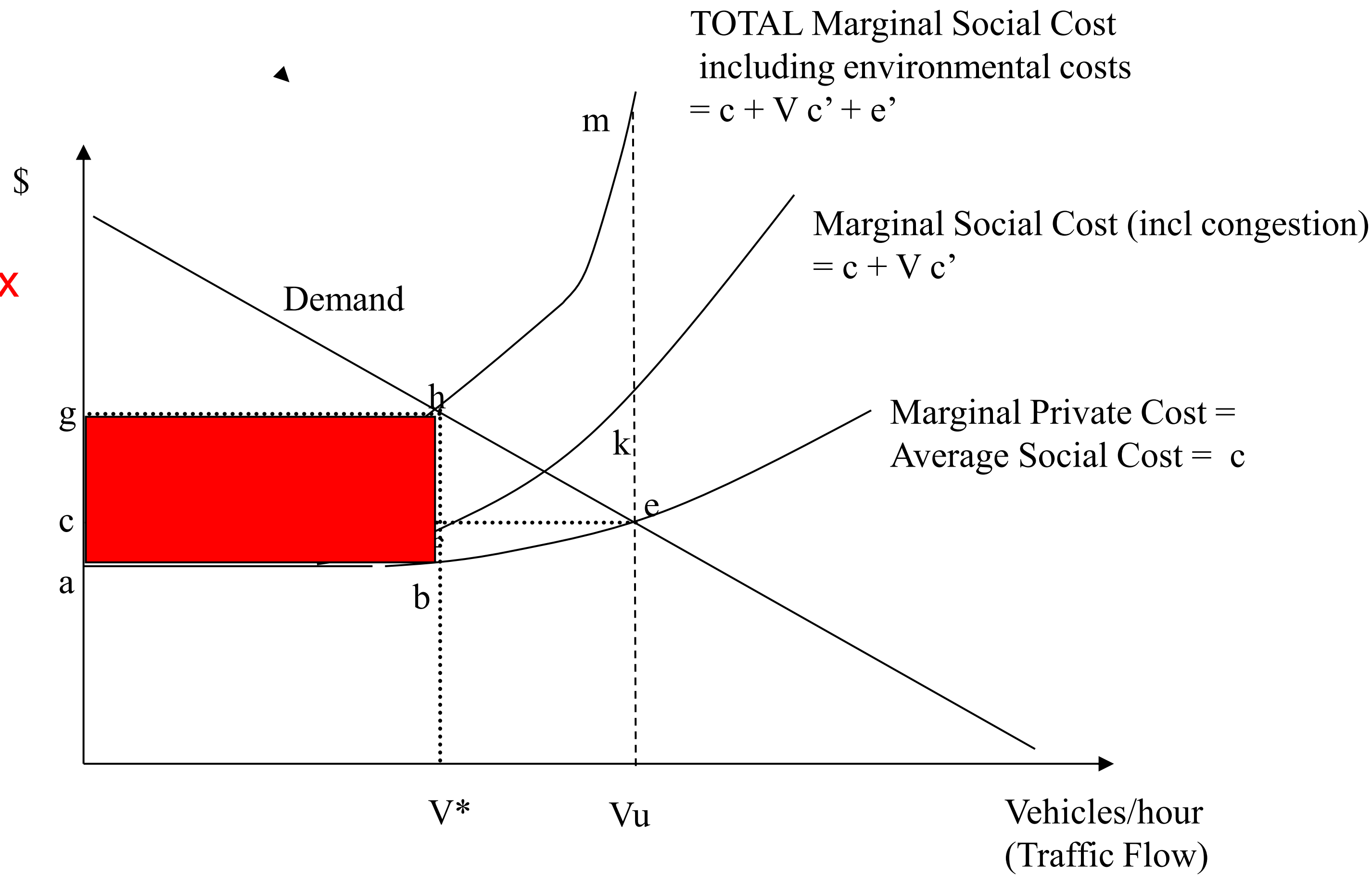
- **COSTS**
- Motorists who continue driving gain time but pay tax ***abdc-abhg =***
- ***Loss of -cdhg***
- Motorists who stop driving lose CS ***–beh***

# Congestion and Pollution



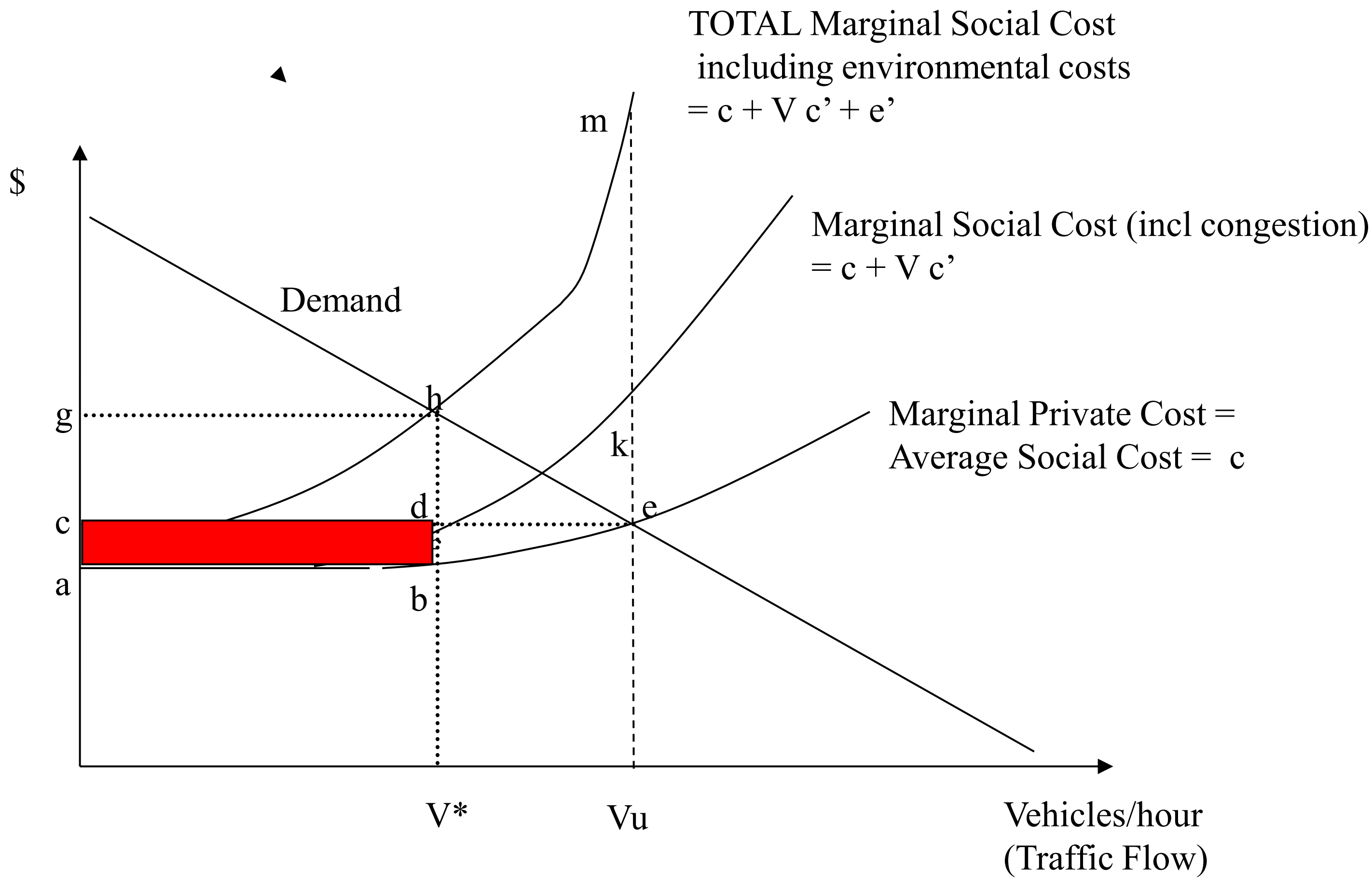
# Congestion and Pollution

State gains Tax revenue ***abhg***



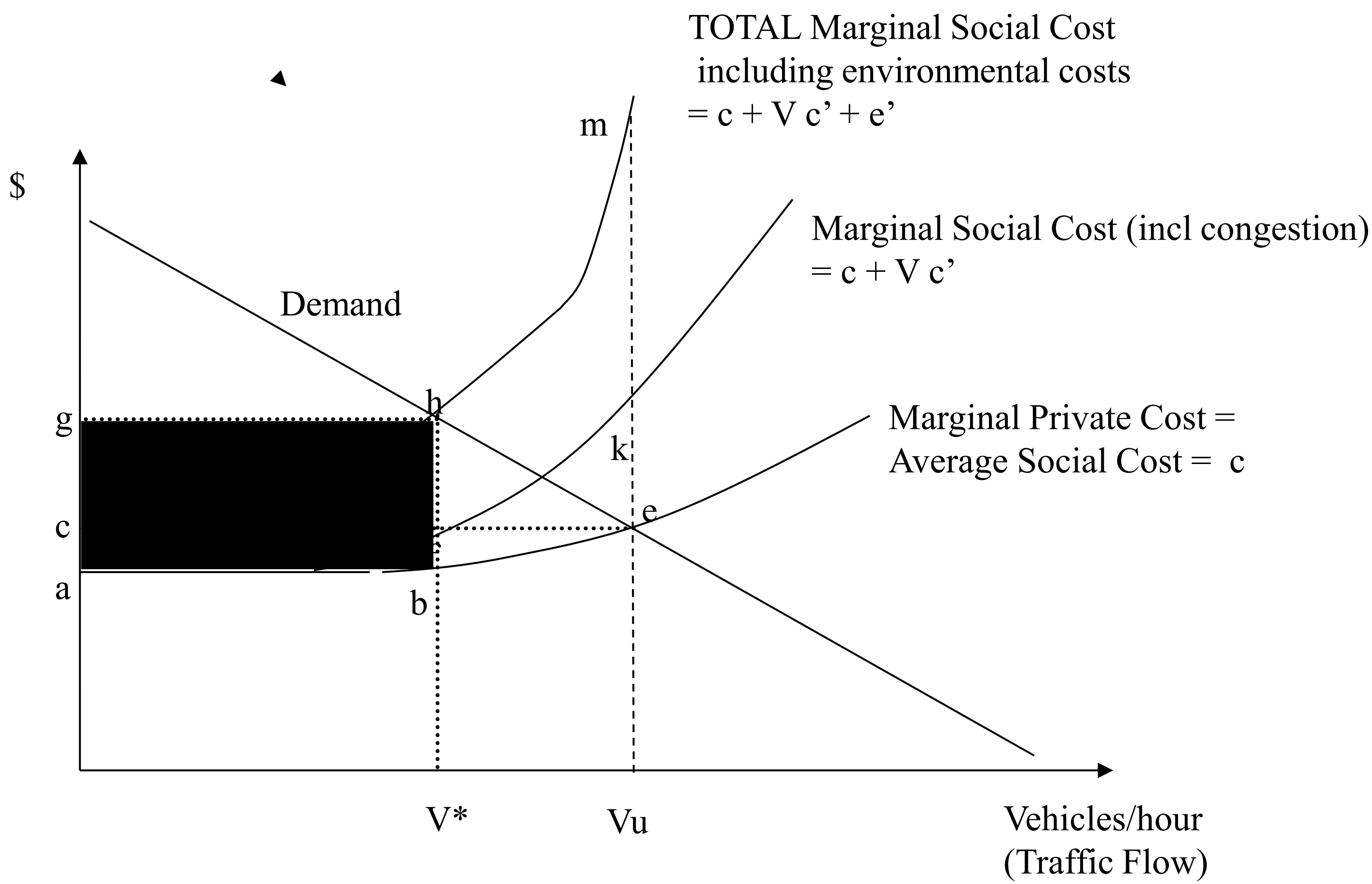
# Congestion and Pollution

Motorists gain time



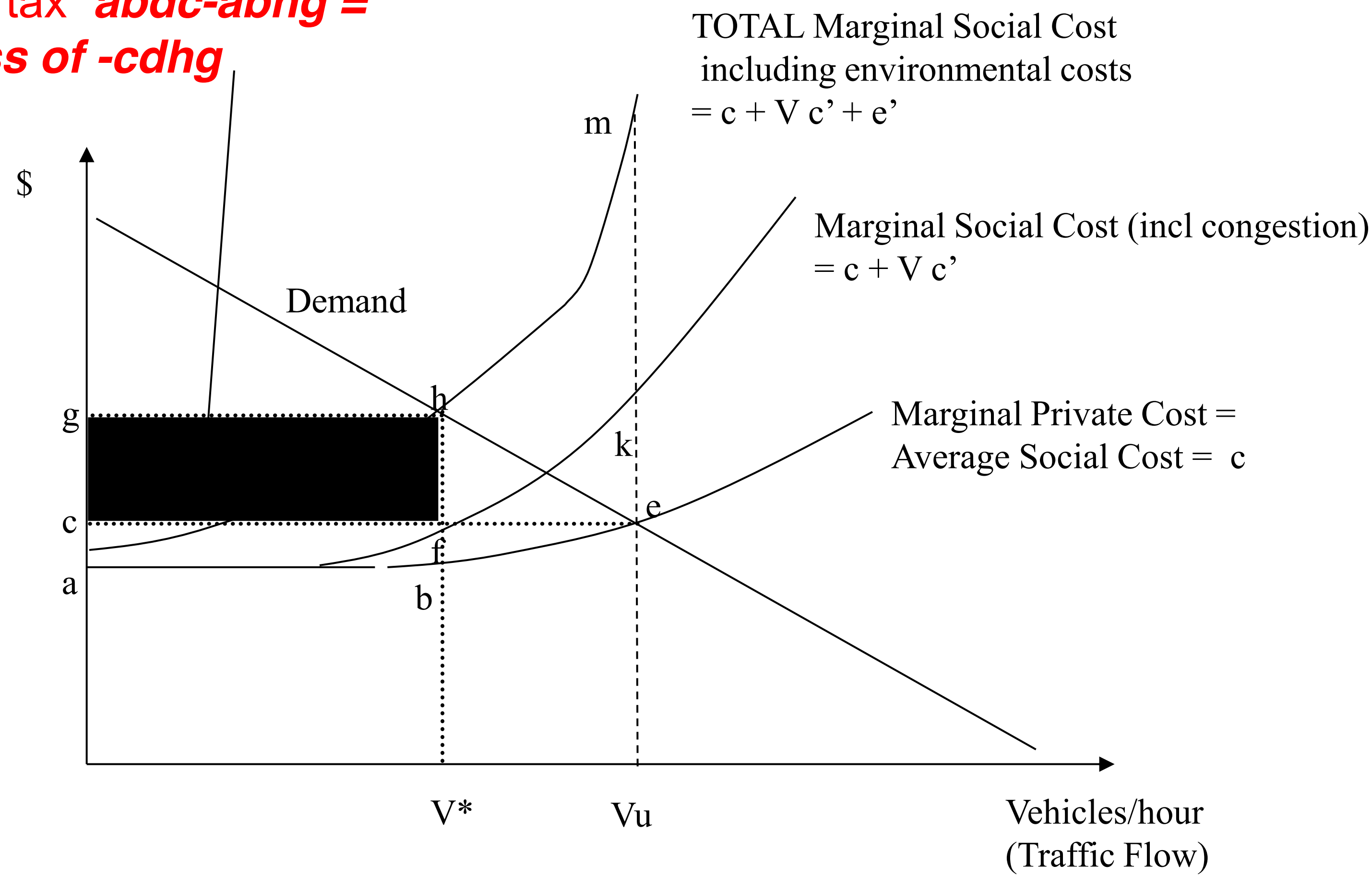
# Congestion and Pollution

Motorists pay
Tax ***abhg***



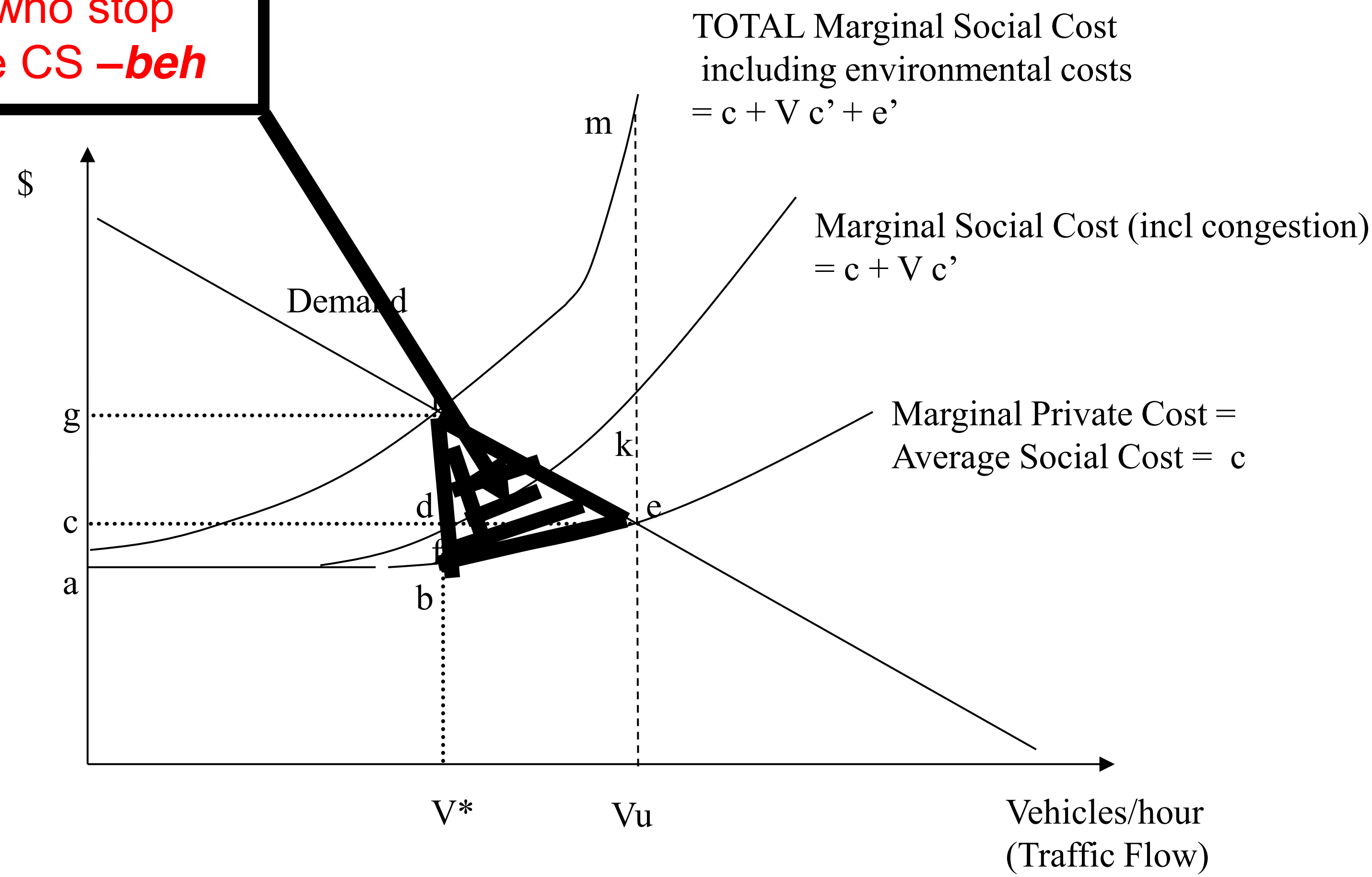
# Congestion and Pollution

Motorists who continue driving gain time but pay tax ***abdc-abhg = Loss of -cdhg***



# Congestion and Pollution

•Motorists who stop driving lose CS –***beh***



| | VOC g/km | NOx g/km | Pm mg/km |
|---|---|---|---|
| | Gasoline (Otto) cars | | |
| 1988 | 2,5 | 1,53 | 37 |
| 1996 | 0,89 | 0,26 | <13 |
| 2010 | 0,08 | 0,04 | 1,2 |
| | Diesel cars | | |
| 1988 | 0,67 | 1,14 | 451 |
| 1996 | 0,13 | 0,63 | 56 |
| 2010 | 0,02 | 0,04 | 16 |
| | Alcohol powered (Otto) | | |
| 1988 | 4,22 | 1,38 | - |
| 1996 | 0,82 | 0,07 | - |
| 2010 | 0.03 | 0.01 | - |

# Be a good Environmentalist: Buy a new car!

# 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 |

# And other factors like temperature, population density

| Temp | CO 1st Km | Warm engine | VOC 1st km | Warm engine |
|---|---|---|---|---|
| 22 | 21 | 0,12 | 2,6 | 0,02 |
| -7 | 123 | 0,8 | 15,7 | 0,25 |

All figures g/km

# Near Ideal Policy Instrument (=?)

- Ideal unattainable!
- T = v * g * t * w
- V = vehicle characteristics (1 for electric

10 for old polluting)

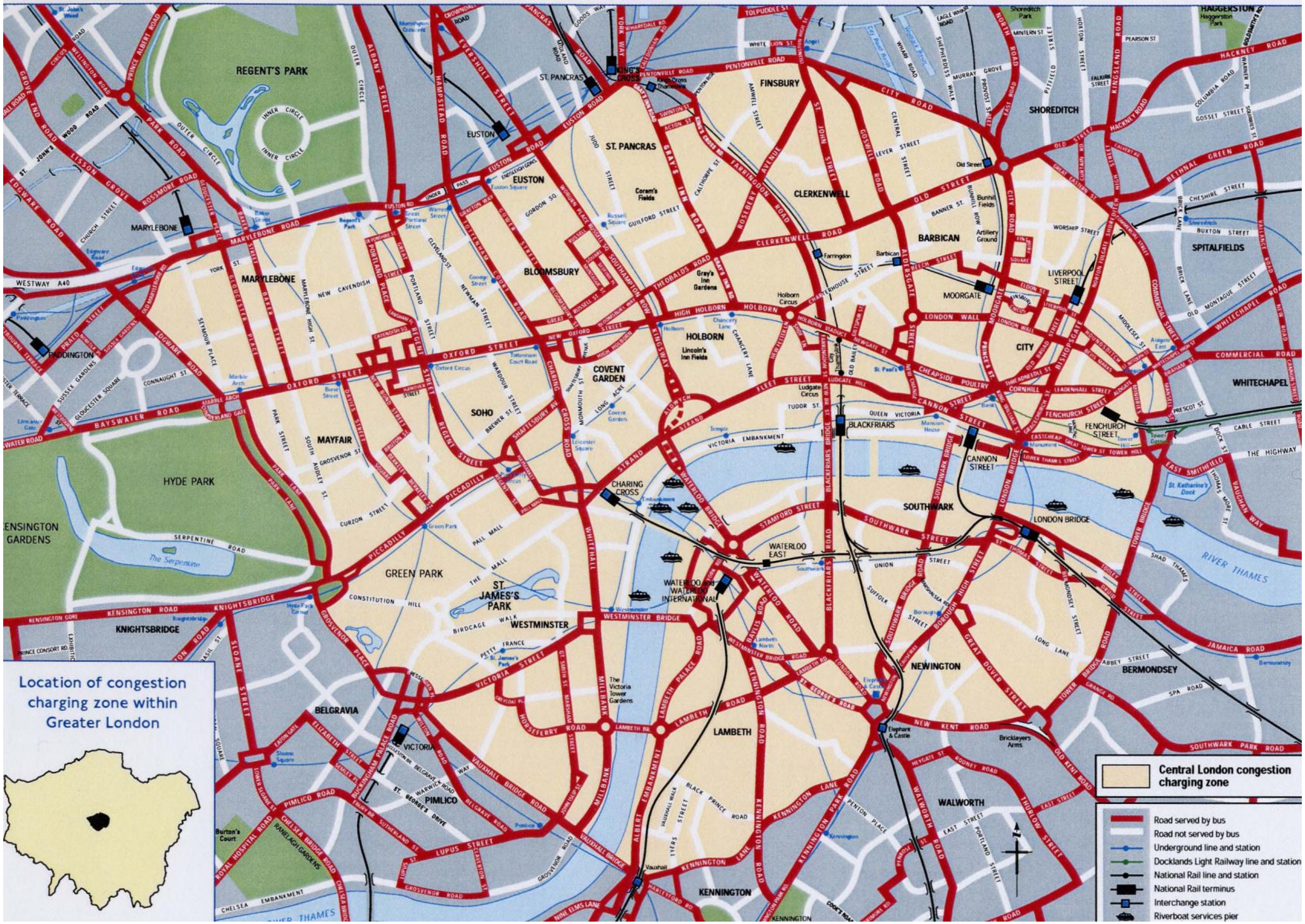
- G is geogr. Location: 1 for country 10 city
- T is time; 10 for rush hour (1 for rest of d)
- W for weather (10 for inversion/smog epis)
- Use this for local and then have gasoline tax for global – or integrate the two?

# Estimates of environmental costs

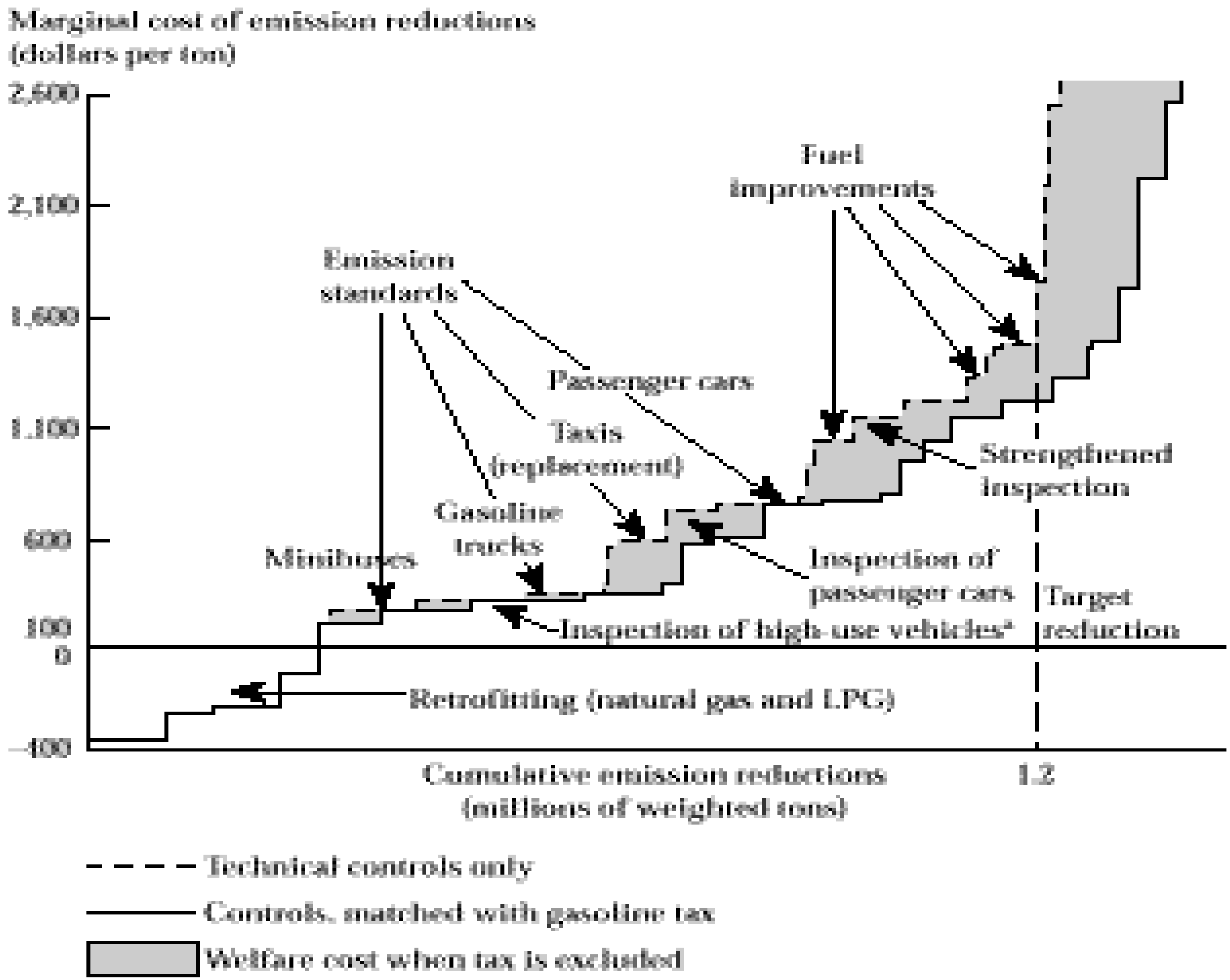
- 1988 car:
- 12 €/1000 km in the country-side but over 130€ in city centre
- 2010 car had figures of 0,3 and 4 respectively.

- Car turnover important
- Get worst cars out of city centres
- Differentiated envir. Congestion pricing
- I&M
- Cut smog – reporting
- Parking?? and others

# Boundary of the central zone



# Transport in MegaCities

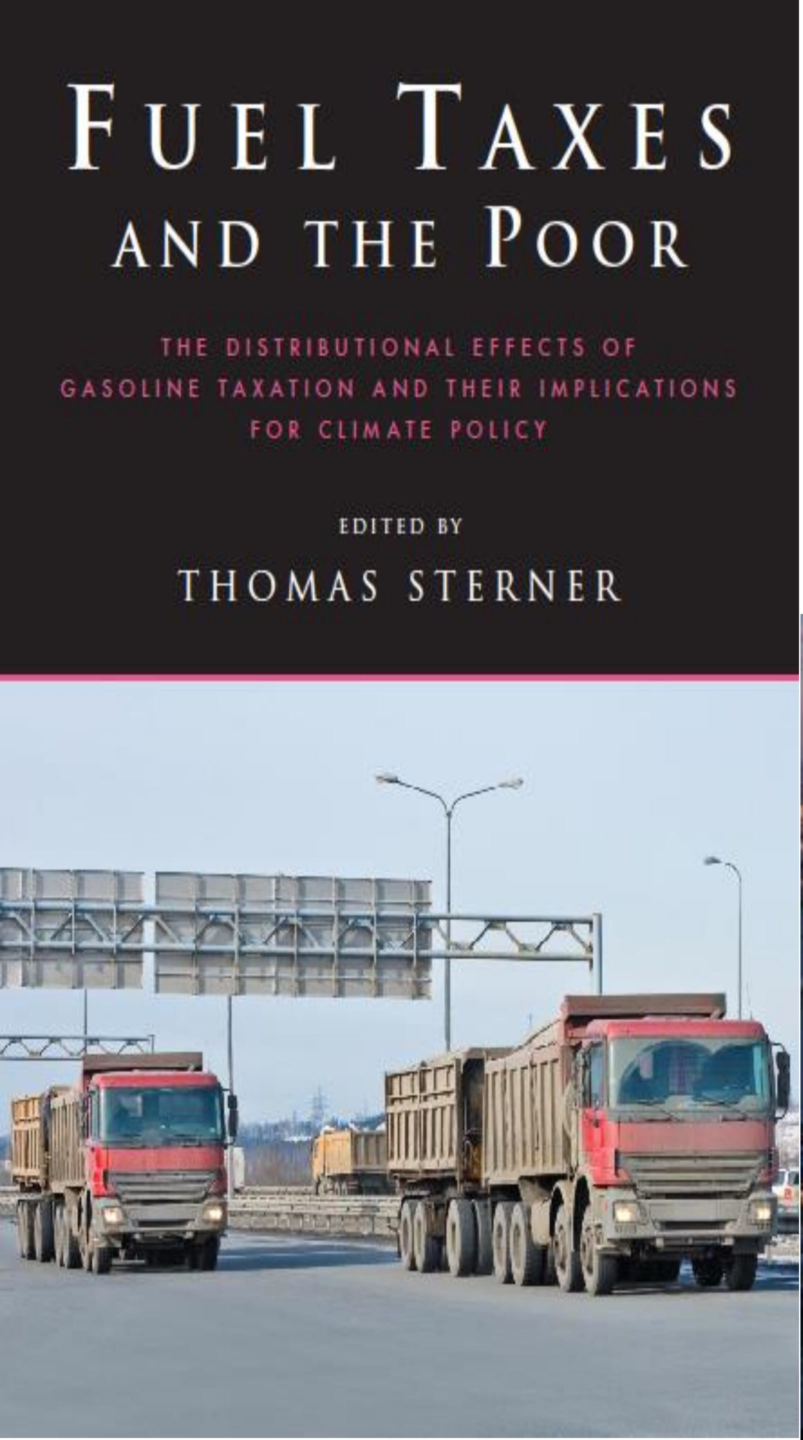


# Singapore scheme

| | *Restricted zone (Nicoll Hwy)* | | | *Restricted zone (remaining areas)* | | | *Portsdown to Alexandra* | | |
|---|---|---|---|---|---|---|---|---|---|
| *Time* | *Car* | *MC* | *Bus* | *Car* | *MC* | *Bus* | *Car* | *MCs* | *Bus* |
| 7:30–8 | 0.50 | 0.25 | 0.75 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8–8:30 | 2.50 | 1.25 | 3.75 | 2.00 | 1.00 | 3.00 | 0.50 | 0.25 | 0.75 |
| 8:30–9 | 2.50 | 1.25 | 3.75 | 2.50 | 1.25 | 3.75 | 1.50 | 0.75 | 2.25 |
| 9–9:30 | 2.00 | 1.00 | 3.00 | 2.00 | 1.00 | 3.00 | 0 | 0 | 0 |

# CURITIBA

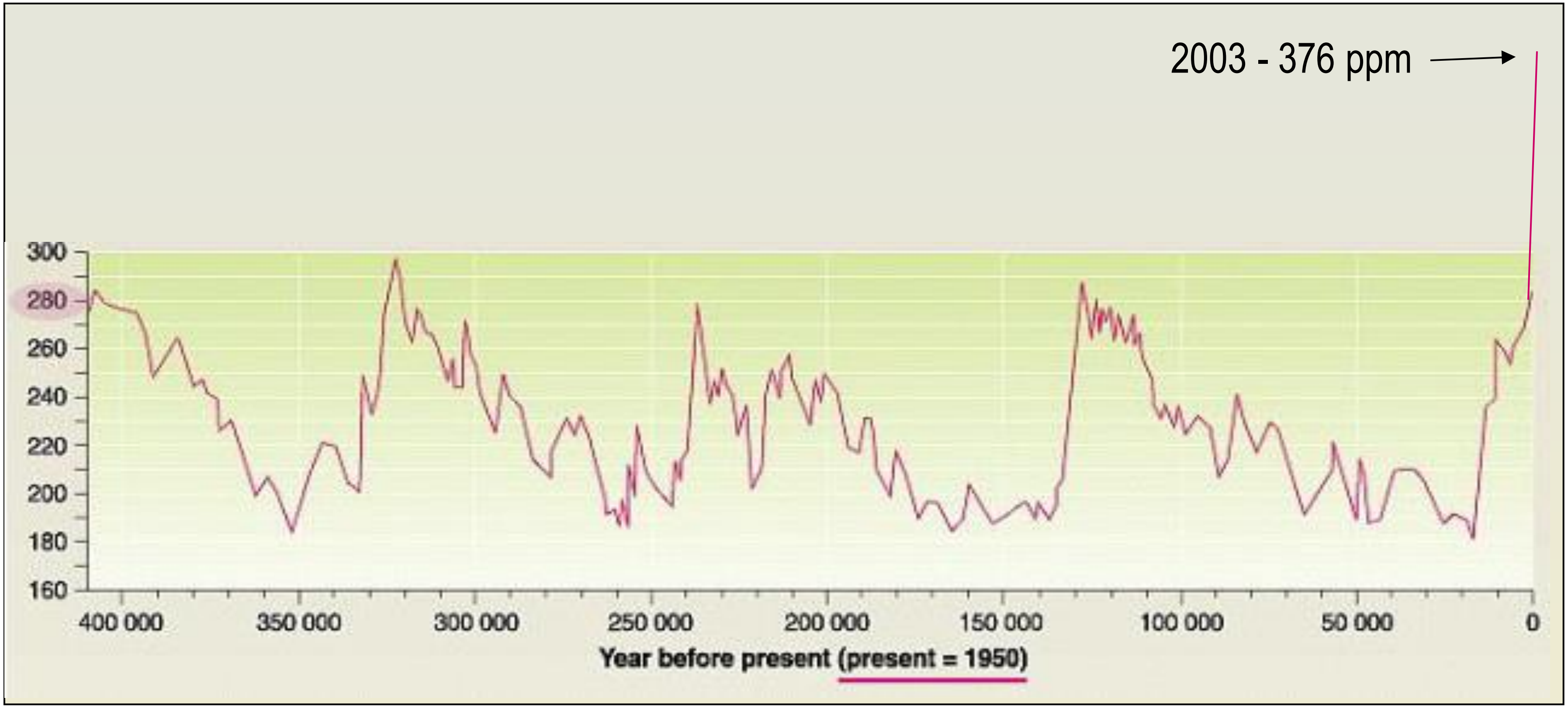
Thomas Sterner
Handels Forskarfrukost



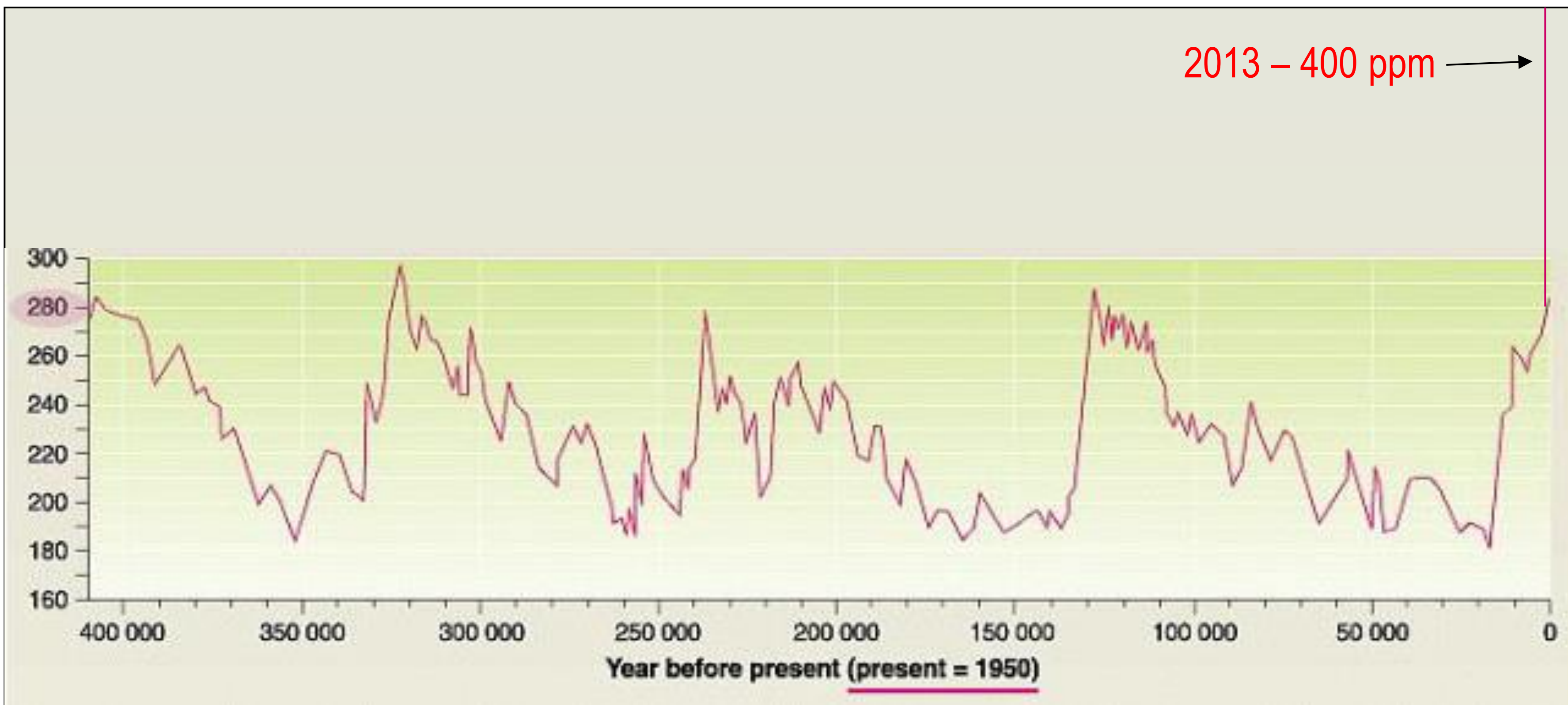

London (+6m havsnivå)

# Nigeria abolished fuel subsidy Jan 1

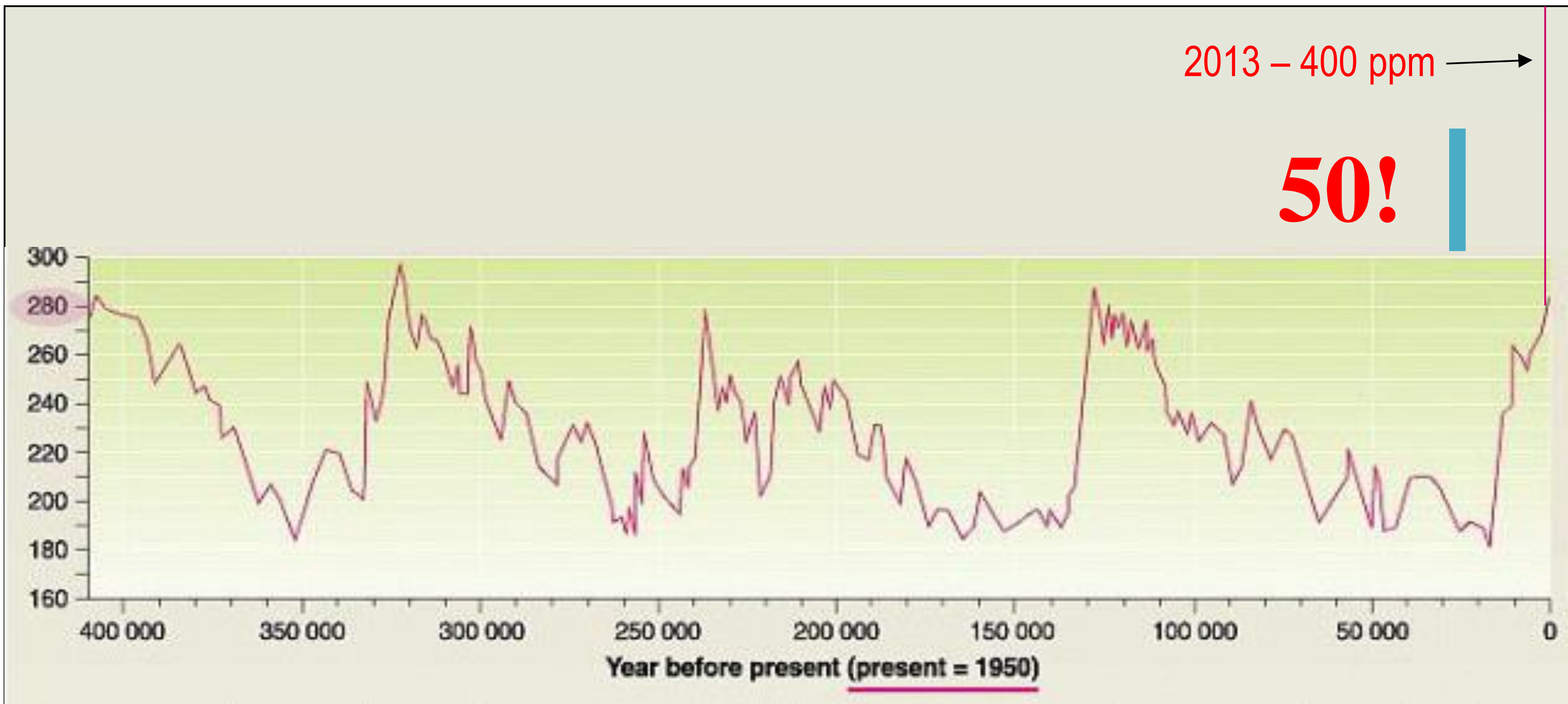
# Historical variation of atmospheric $CO_2$-concentration

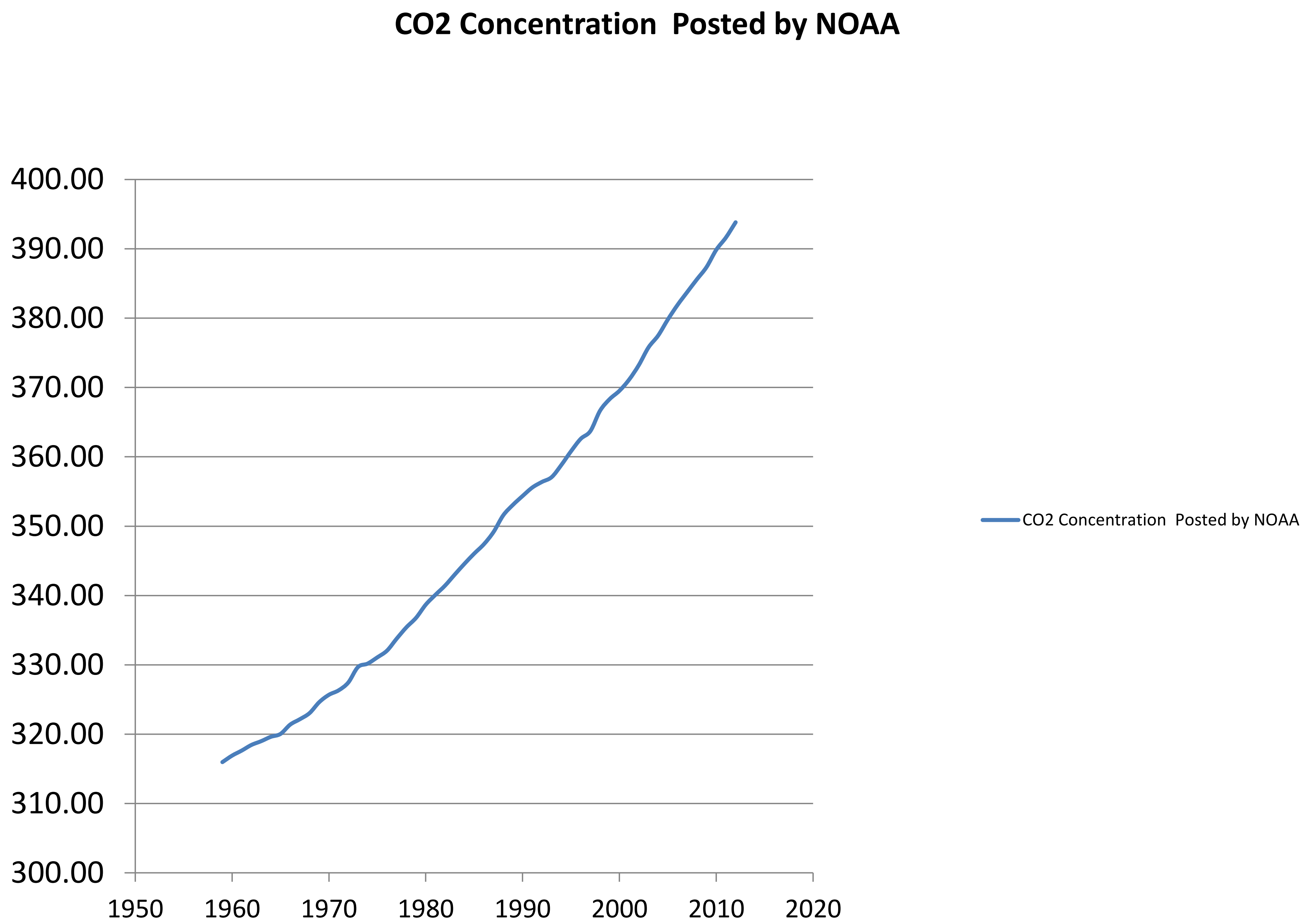


# Historical variation of atmospheric $CO_2$-concentration

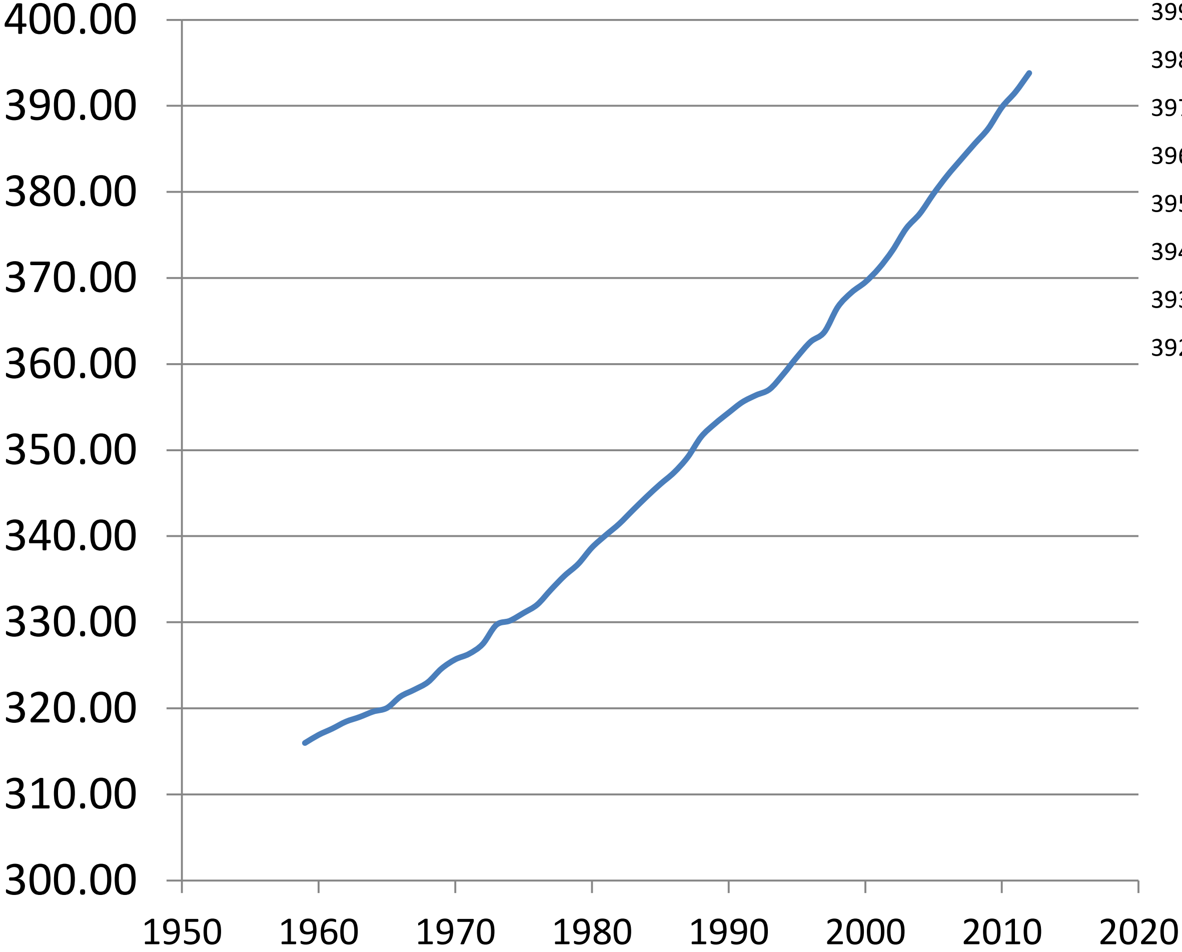


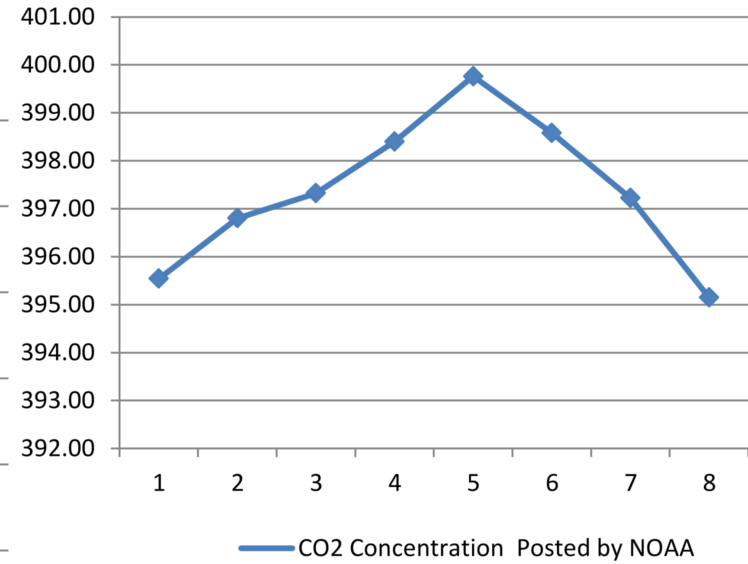
# Historical variation of atmospheric $CO_2$-concentration




CO2 Concentration  Posted by NOAA
400.00
390.00
380.00
370.00
360.00
350.00
340.00
330.00
320.00
310.00
300.00
1950
1960
1970
1980
1990
2000
2010
2020
CO2 Concentration  Posted by NOAA

# CO2 Concentration Posted by NOAA



# How Warm is Too Warm?

The ultimate objective (of 1992 UN) Convention ...is to achieve...*stabilization of greenhouse gas concentrations …*

# Continental Ice Sheets vulnerable beginning at 1-2$^{0}$C threshold?

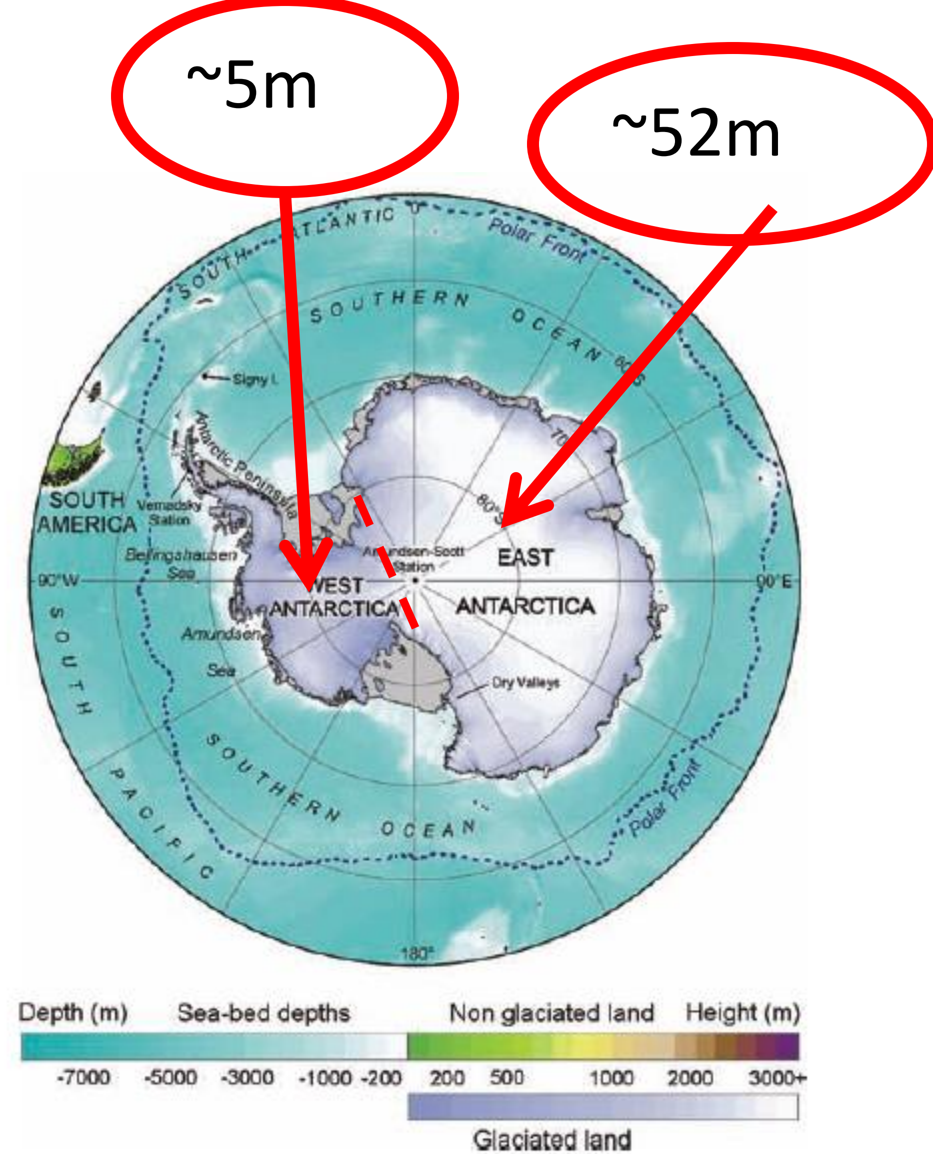
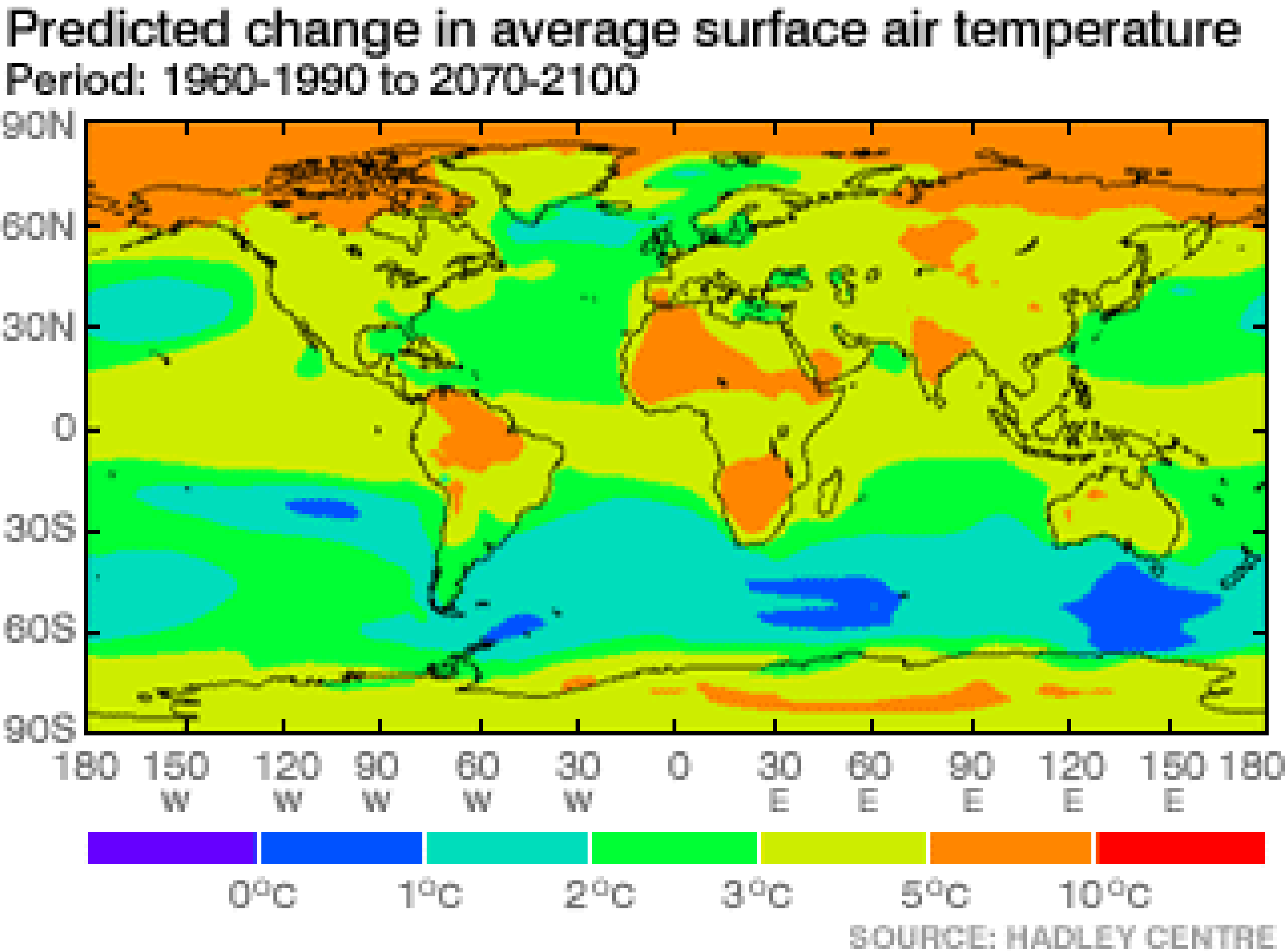
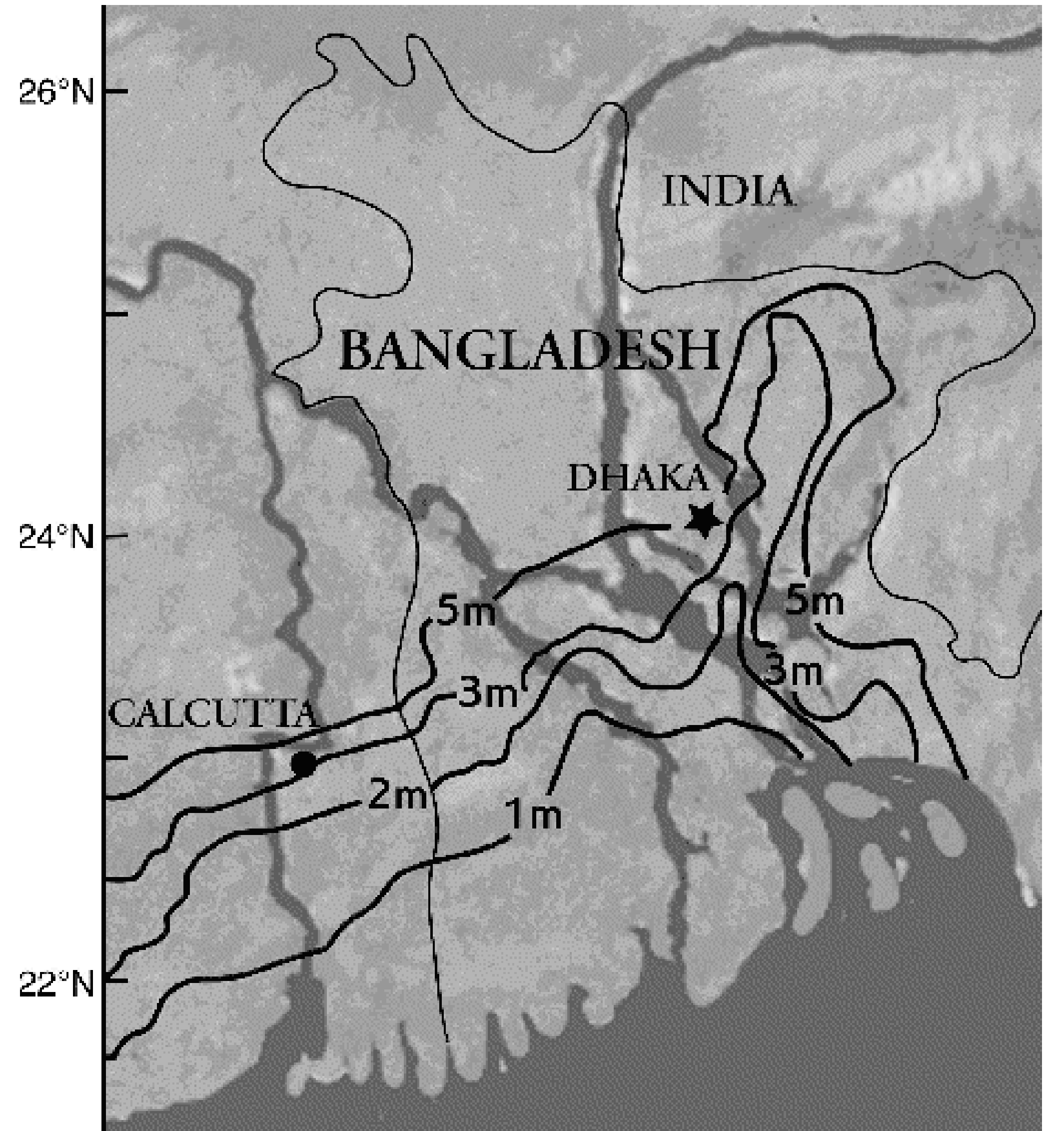



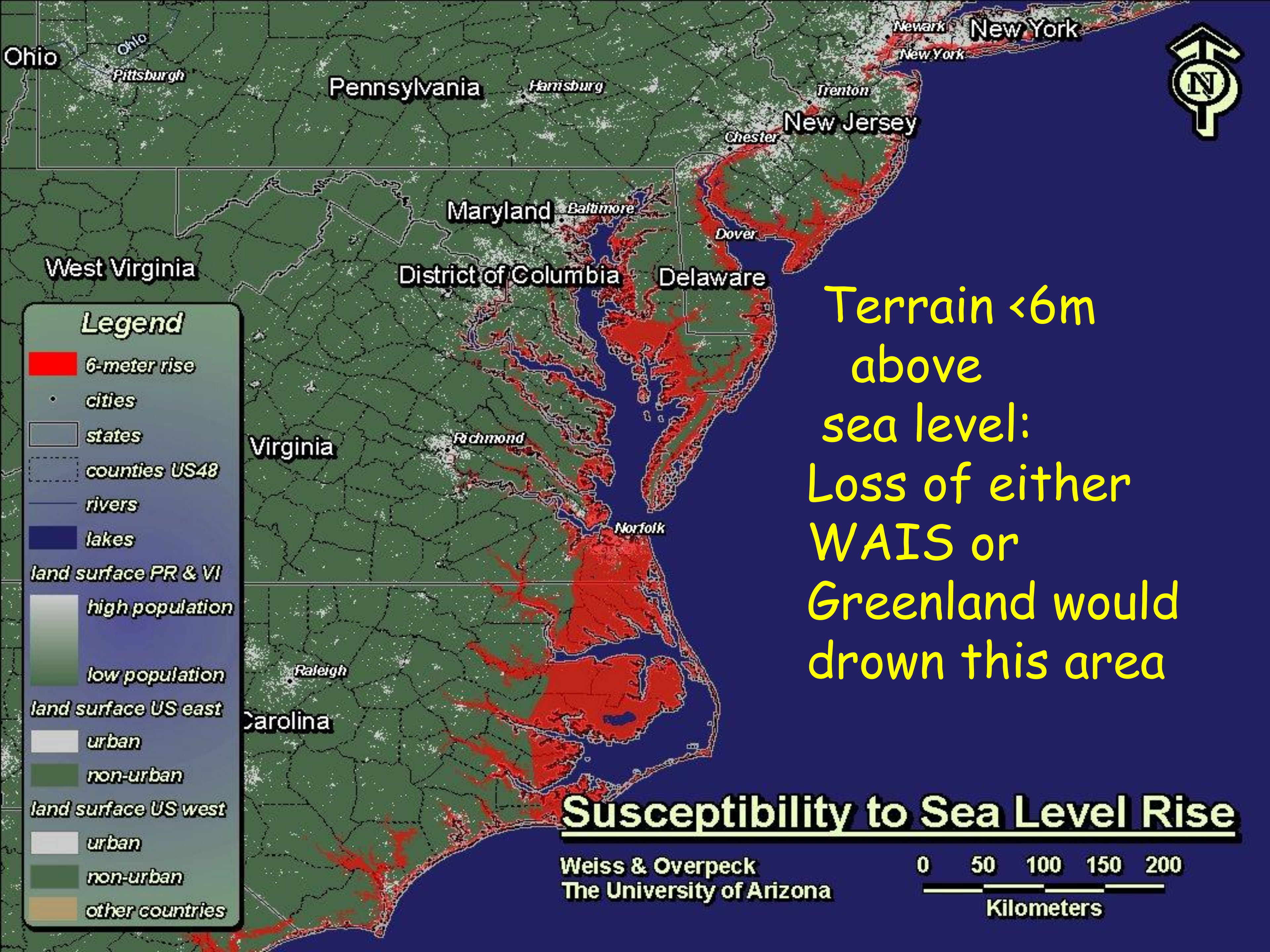

**Figure 15.1.** *Location maps of the North and South polar regions, including place names used in the text. The topography of glaciated and non-glaciated terrain is shown by using different shading schemes. The polar fronts shown are intended to give an approximate location for the extent of cold, polar waters but are, in places, open to interpretation and fluctuations. (This and other maps were drawn by P. Fretwell, British Antarctic Survey.)*

# Changing Climate



# Sea Level Rise






Terrain <6m above sea level: Loss of either WAIS or Greenland would drown this area

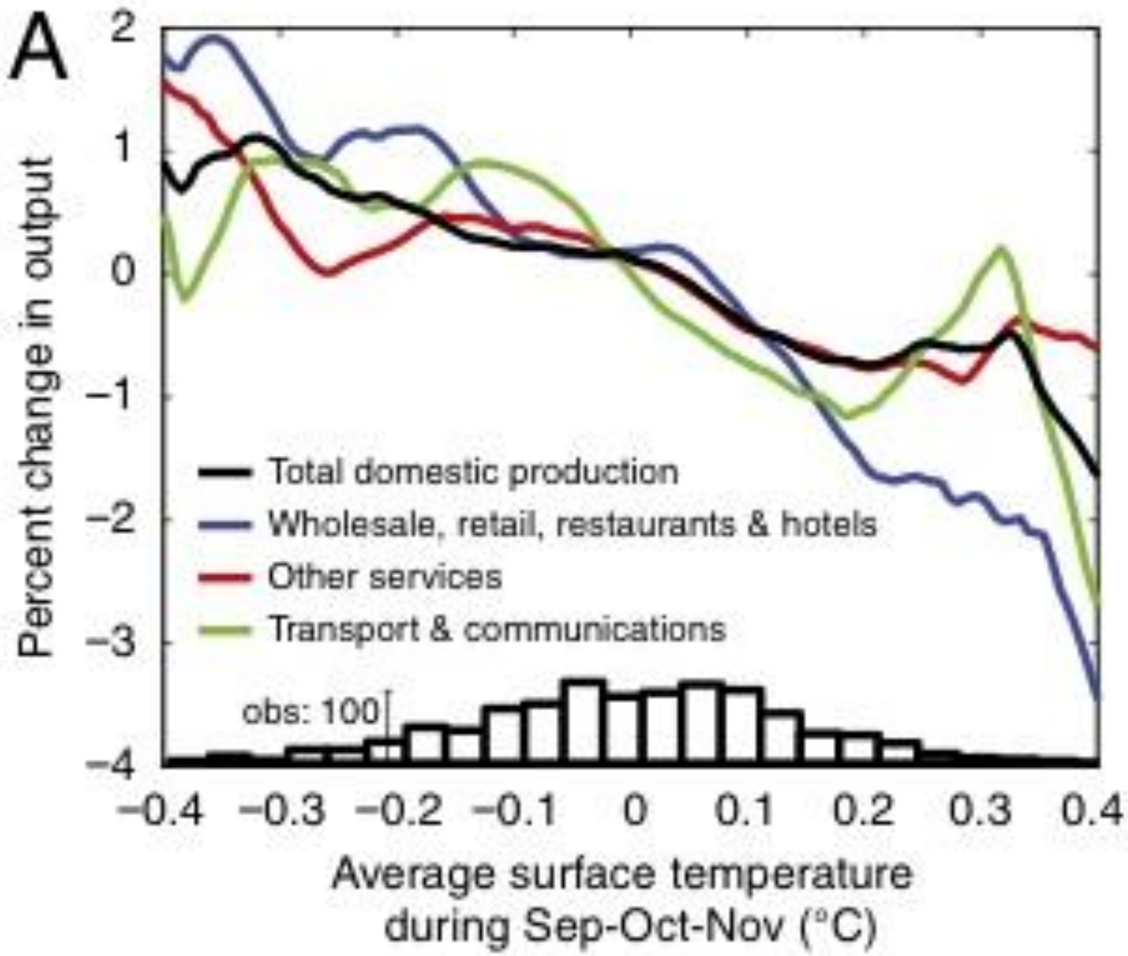
# Warmer Temp --> less growth

+1C decreases GDP by 3.5%

- in **poor** countries!

- (Horowitz, 2009; Dell et al 2009)

# Hsiang (PNAS)




Output in "non-vulnerable" industries fall. People less productive when hot. Not included in previous estimates of cost (!)

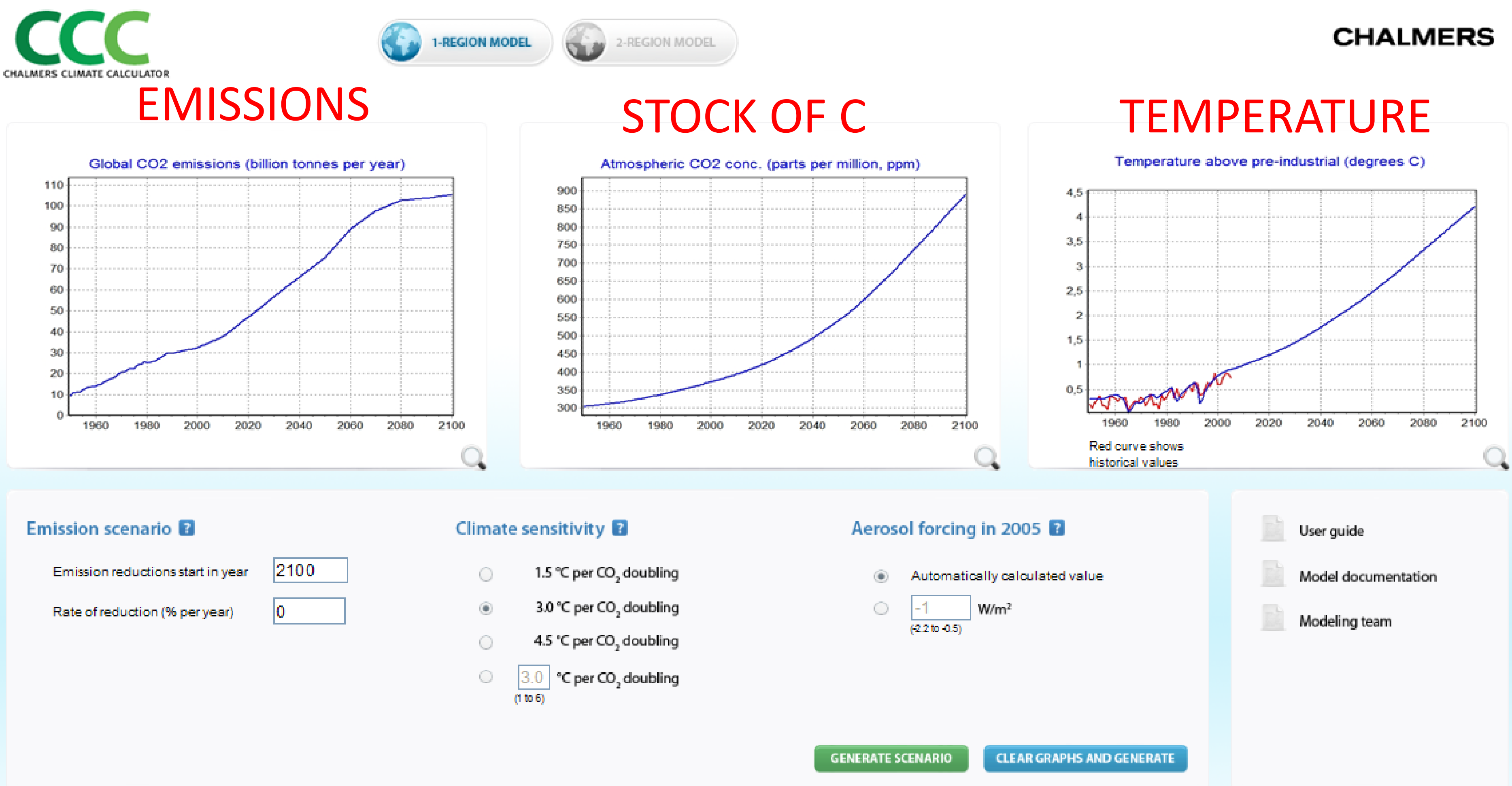
# Rise in T --> Conflicts

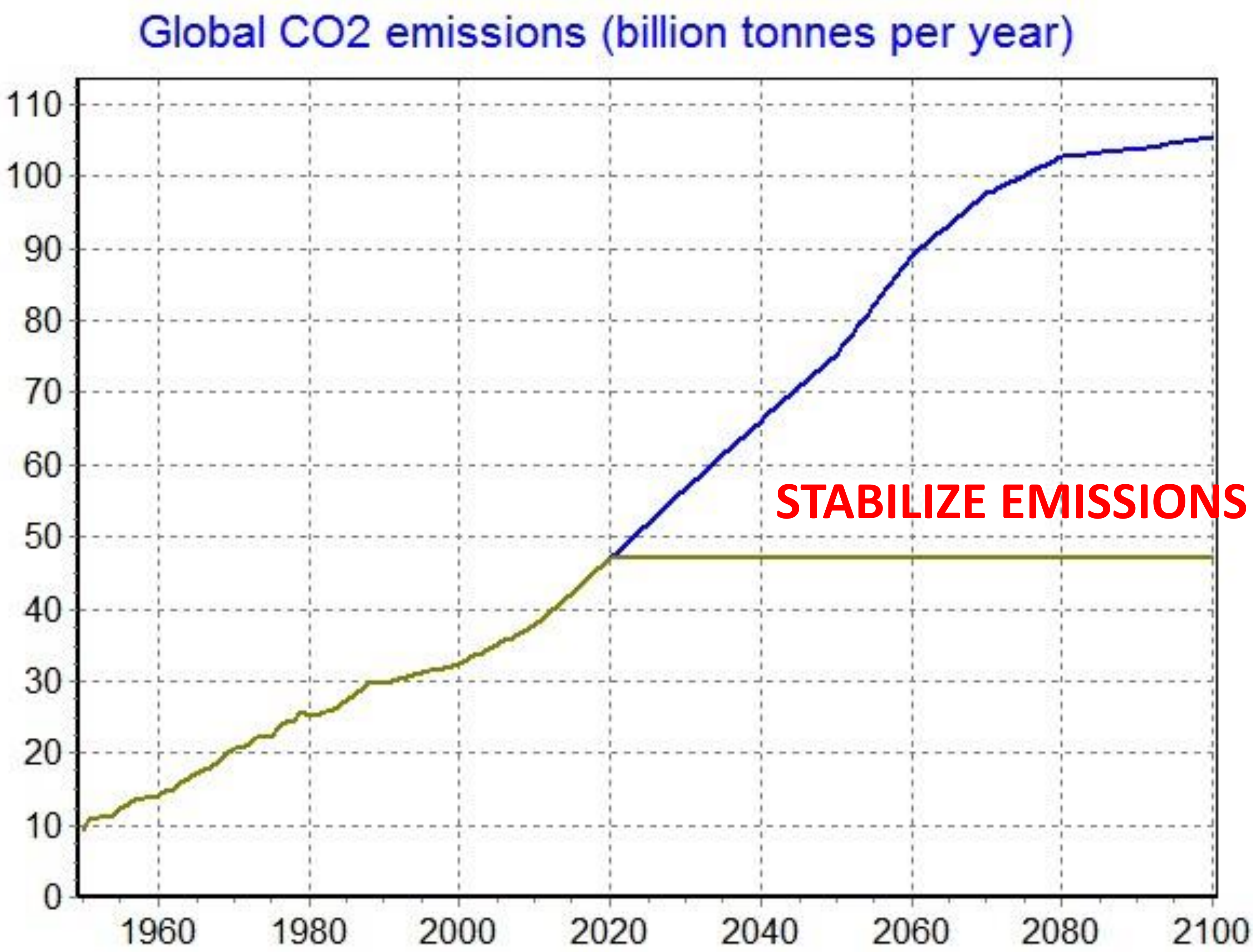
- Probability of new civil conflicts in tropics doubles during El Niño years relative to La Niña years. ENSO had role in 21% of all conflicts

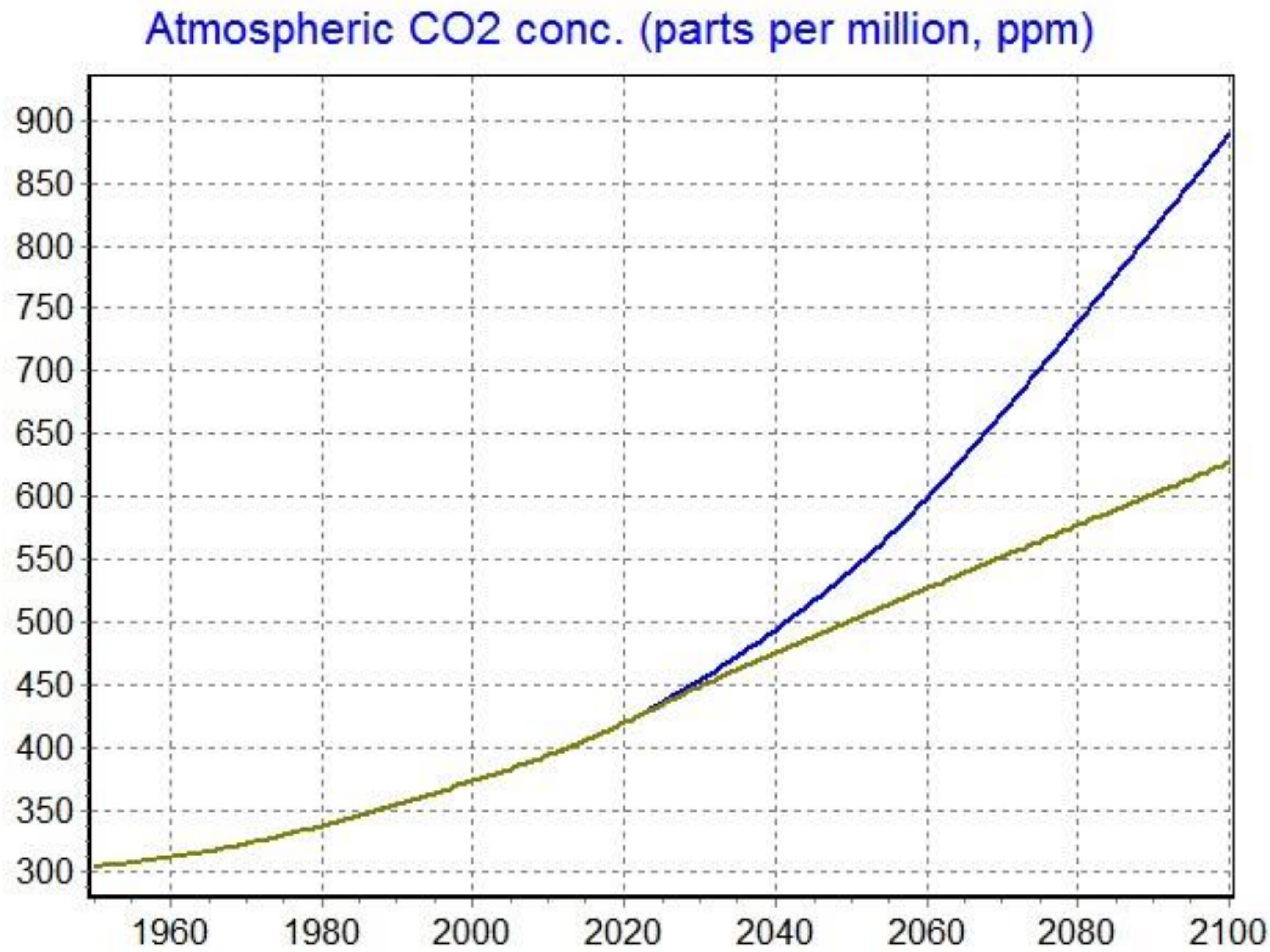
- **Hsiang, Meng & Cane, Nature Letters**

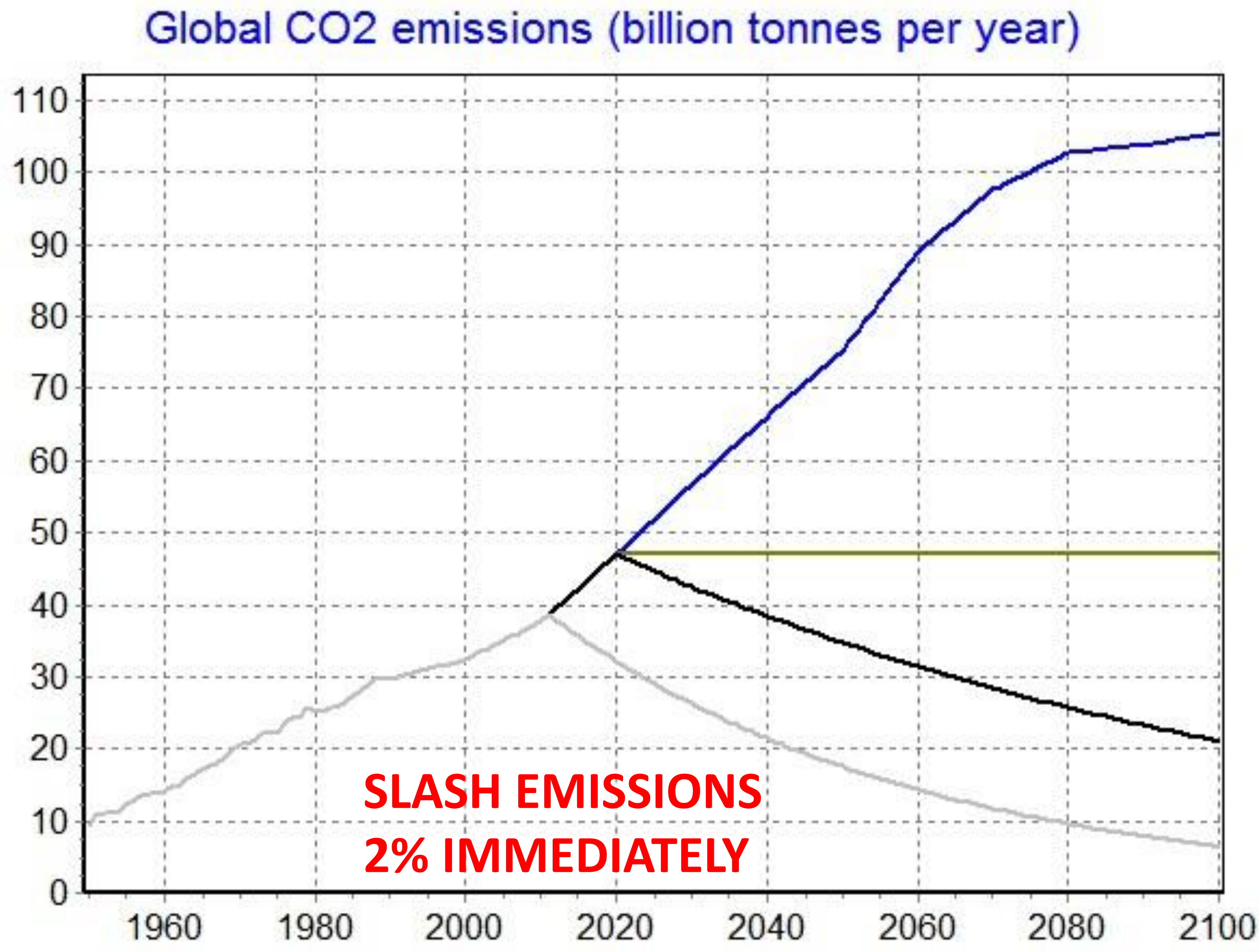
# CHALMERS CLIMATE CALCULATOR

Christian Azar, Daniel Johansson (Frt) (1 region vs)




Global CO2 emissions (billion tonnes per year)
STABILIZE EMISSIONS
110
100
90
80
70
60
50
40
30
20
10
0
1960
1980
2000
2020
2040
2060
2080
2100


Atmospheric CO2 conc. (parts per million, ppm)
900
850
800
750
700
650
600
550
500
450
400
350
300
1960
1980
2000
2020
2040
2060
2080
2100

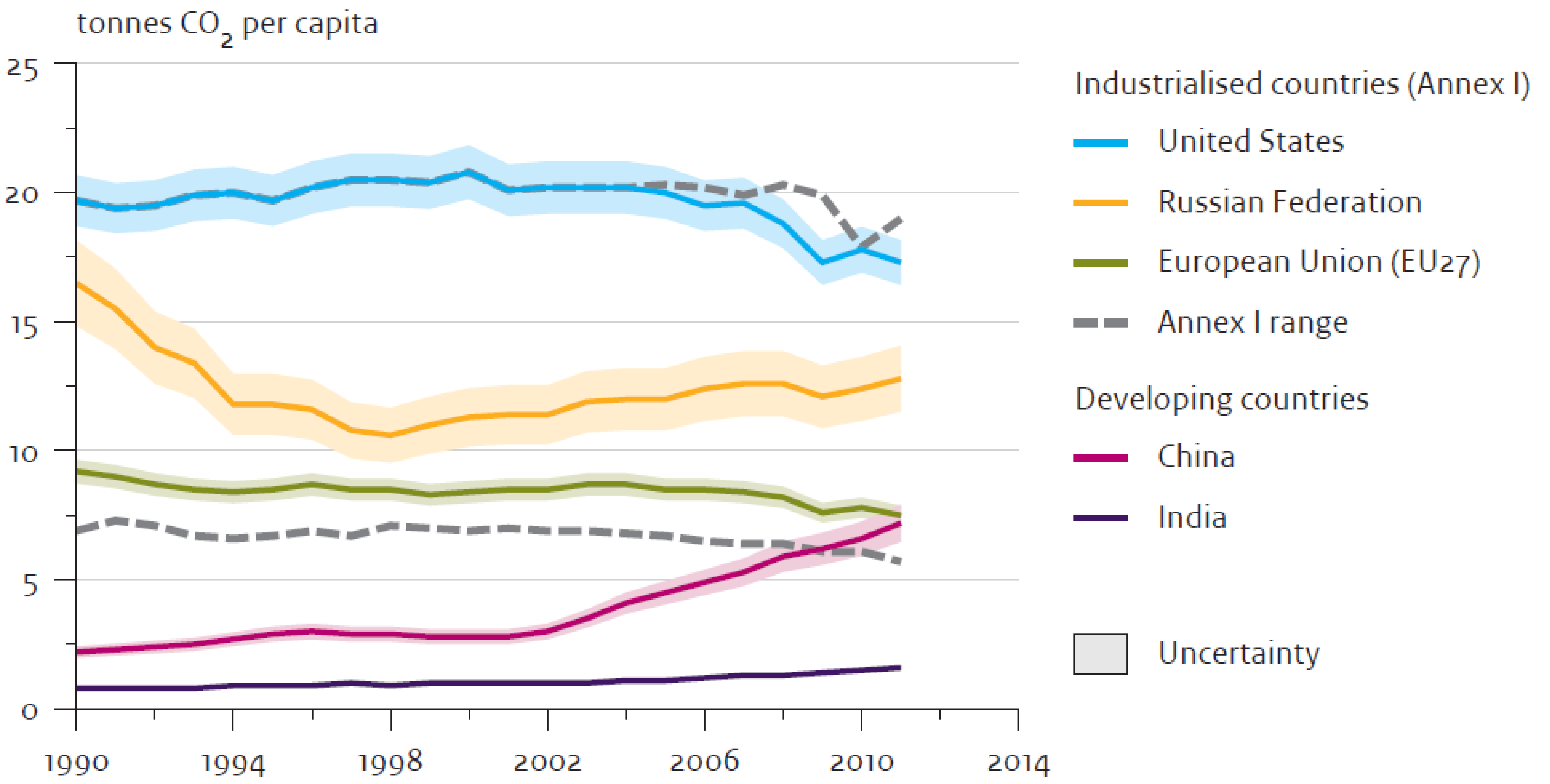


Global CO2 emissions (billion tonnes per year)
110
100
90
80
70
60
50
40
30
20
10
0
1960
1980
2000
2020
2040
2060
2080
2100
SLASH EMISSIONS
2% IMMEDIATELY

# Or wait 10 years

And then slash by3% /year

# $CO_2$ per capita very unequal




Source: Olivier et al (2012)

# INSTRUMENTS

- IPCC WGIII AR5
- Many new instruments....
- But none is stringent enough!
- Cap and trade in EU, California, Australia, NZ, Korea, China, ....
- Carbon taxes in N Europe. Gas taxes in EU + J..
- No international **treaty** in sight.
- But FIT and RPS etc

# CONCLUSIONS

- 2 degrees very hard
- 2.5 much better than 3
- ADAPTATION
- CCS  FRACKING
- GEOENGINEERING
- RENEWABLES

# 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

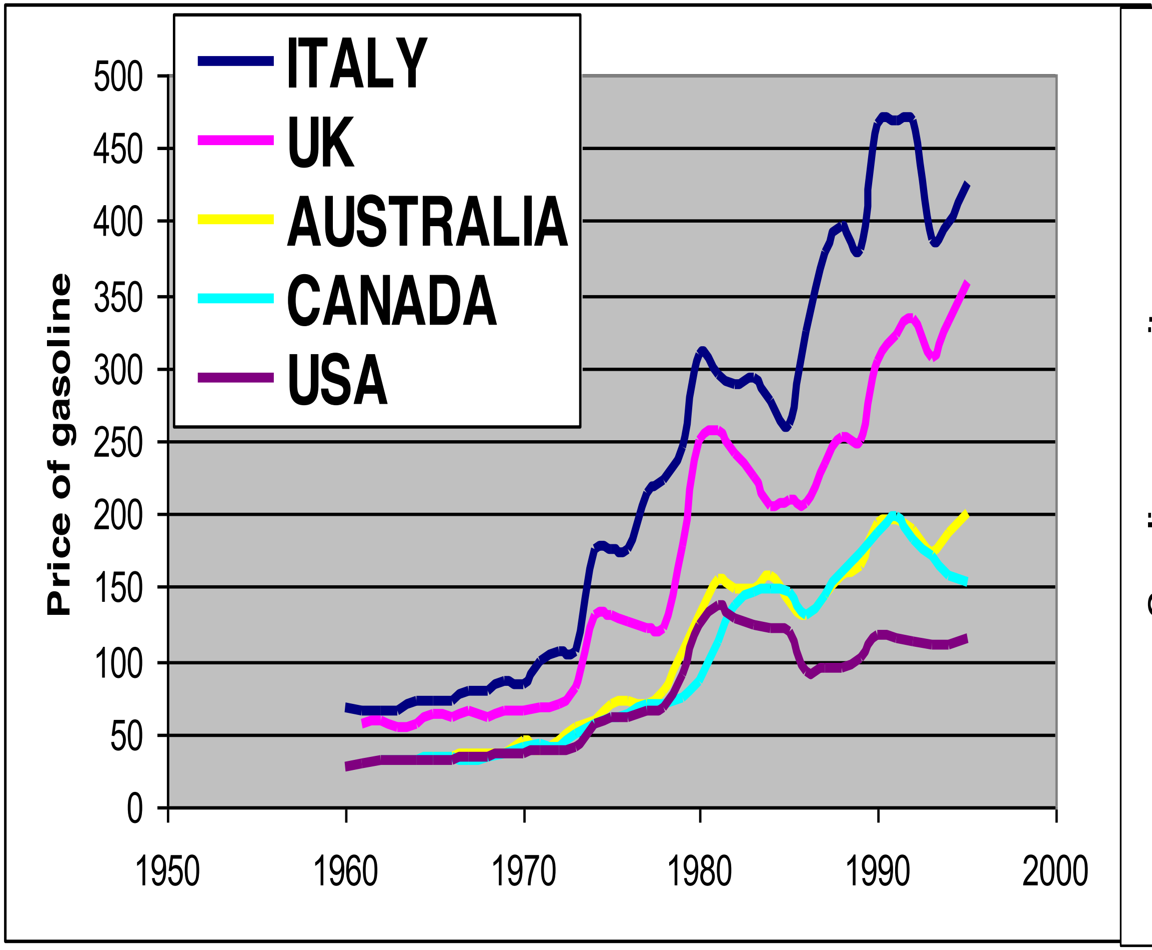
# Just raise fuel price 300% !

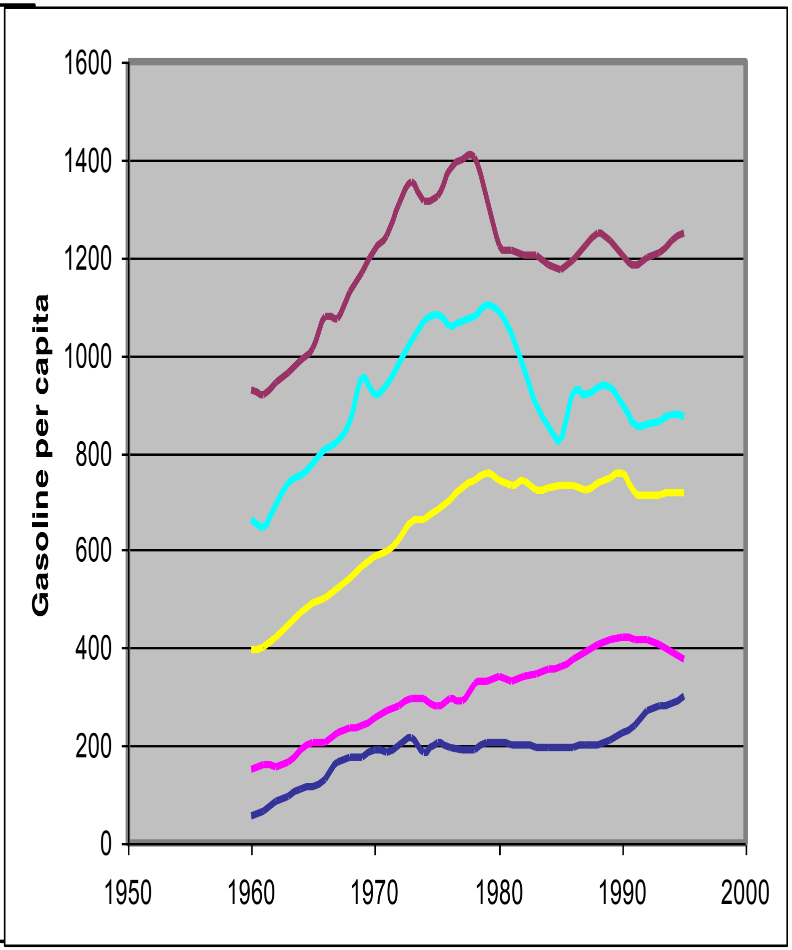
- Because $P = (0.5/1.5)^{-1/0.8} = 3.95$

# 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% |

# Reactions?

SET US FREE
WITH MORE
UNITED STATES OIL
When Trucks Stop
AMERICA STOPS!
When Trucks Stop
AMERICA STOPS!


© PA


ALISIN!
12% VAT
SA LAHAT NG
PRODUKTONG
PETROLYO
PRODUKTONG
PETROLYO
KRUDO!


CPI(M)
RSF
© Reuters


T.K.
LOGISTICS
PTS
SCANIA
ISUZU
© EPA

# Why are they so angry?

# S Africa

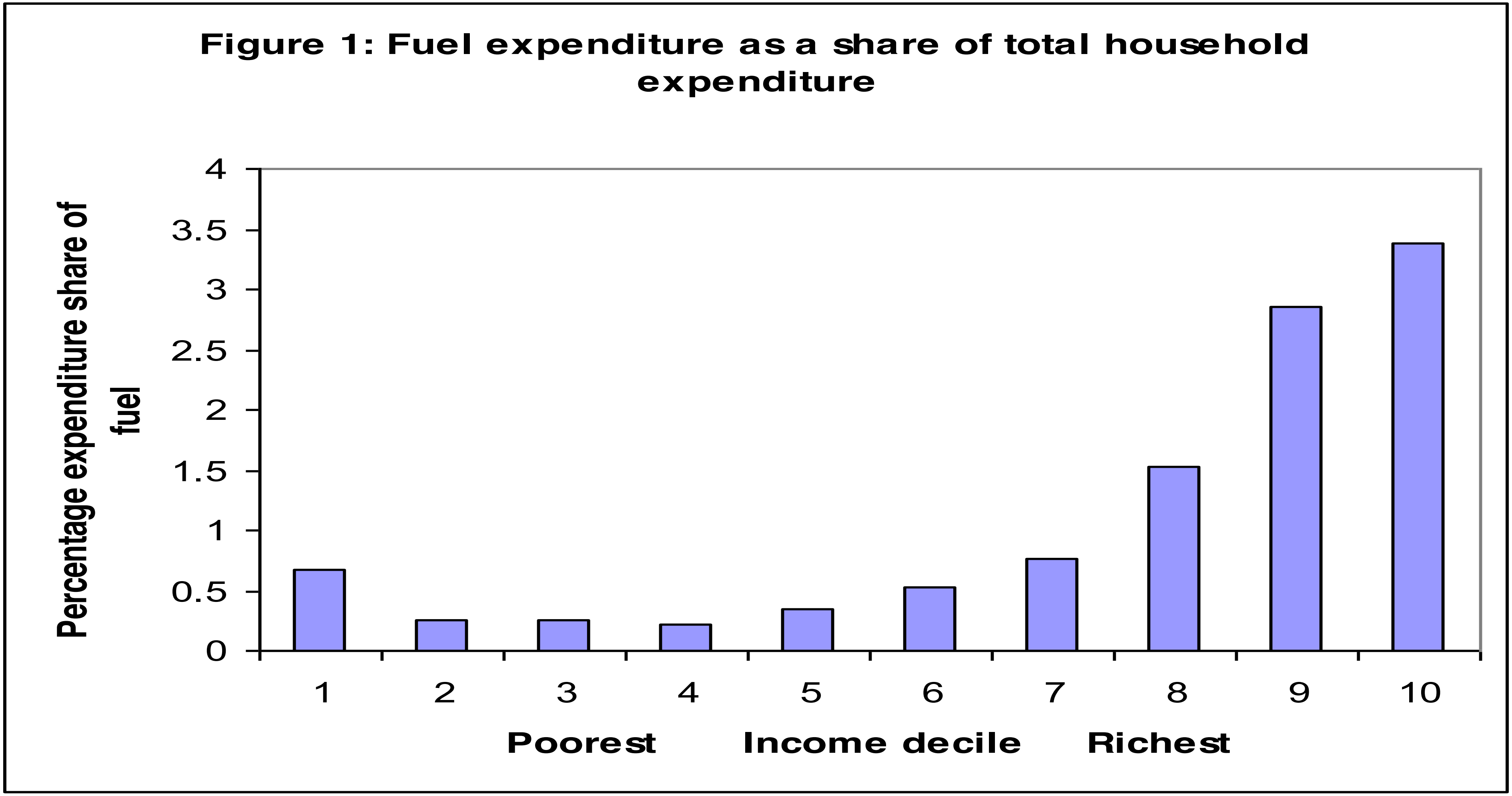
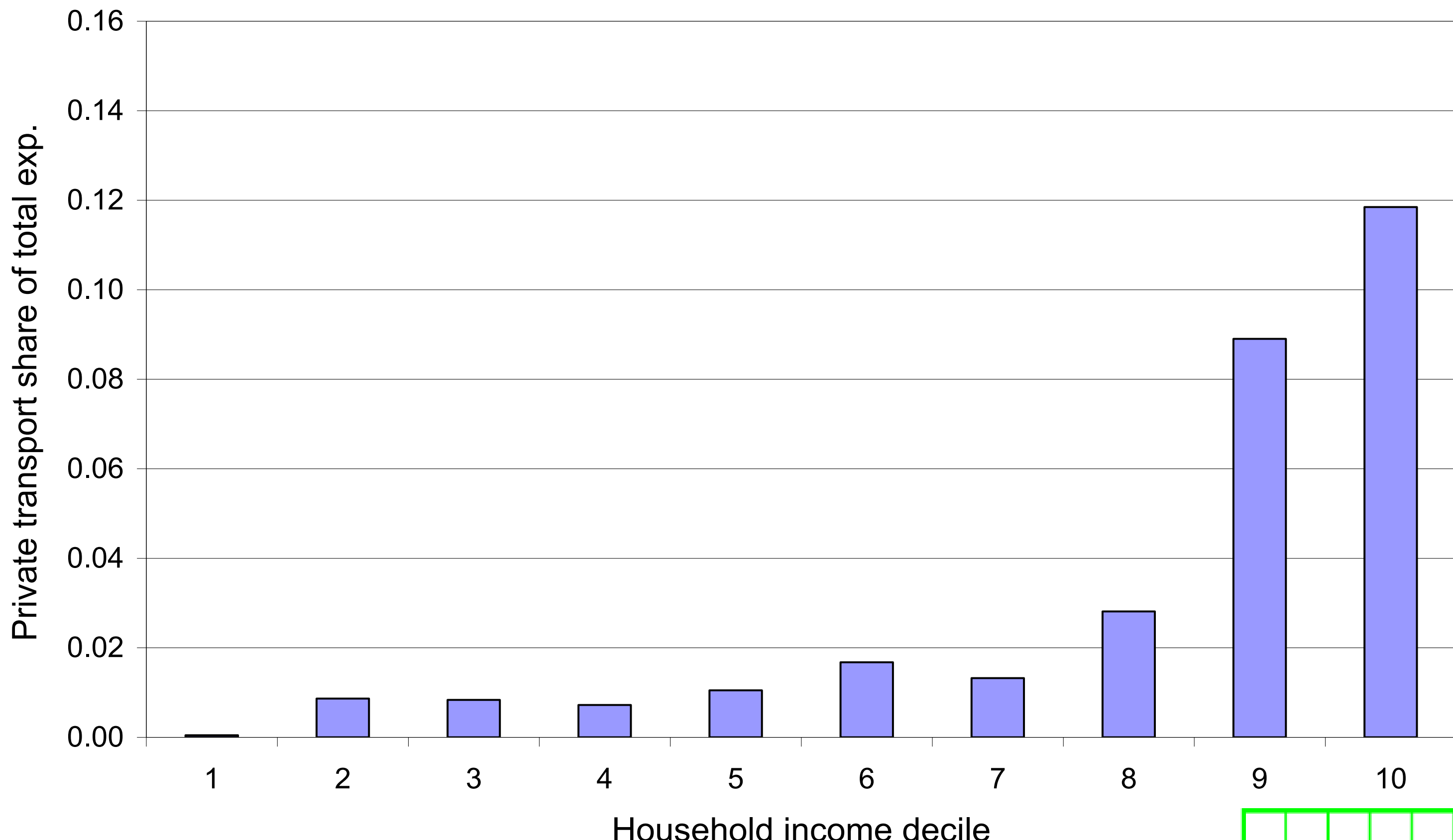


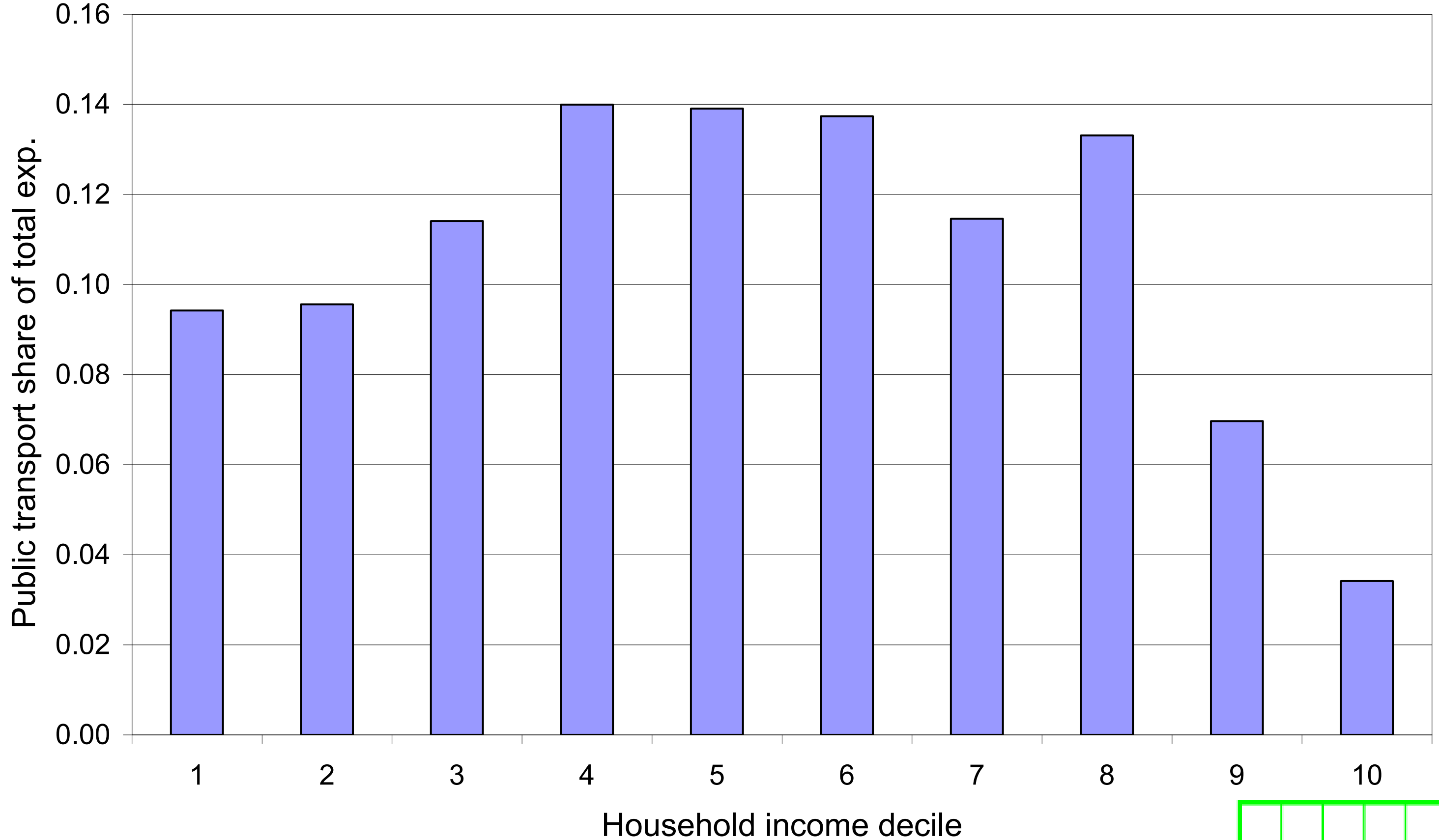
Figure 1: Fuel expenditure as a share of total household expenditure
Percentage expenditure share of fuel
4
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
6
7
8
9
10
Poorest
Income decile
Richest

# Private transport expenditures as share of total household expenditures




The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

# Public transport expenditures as share of total household expenditures

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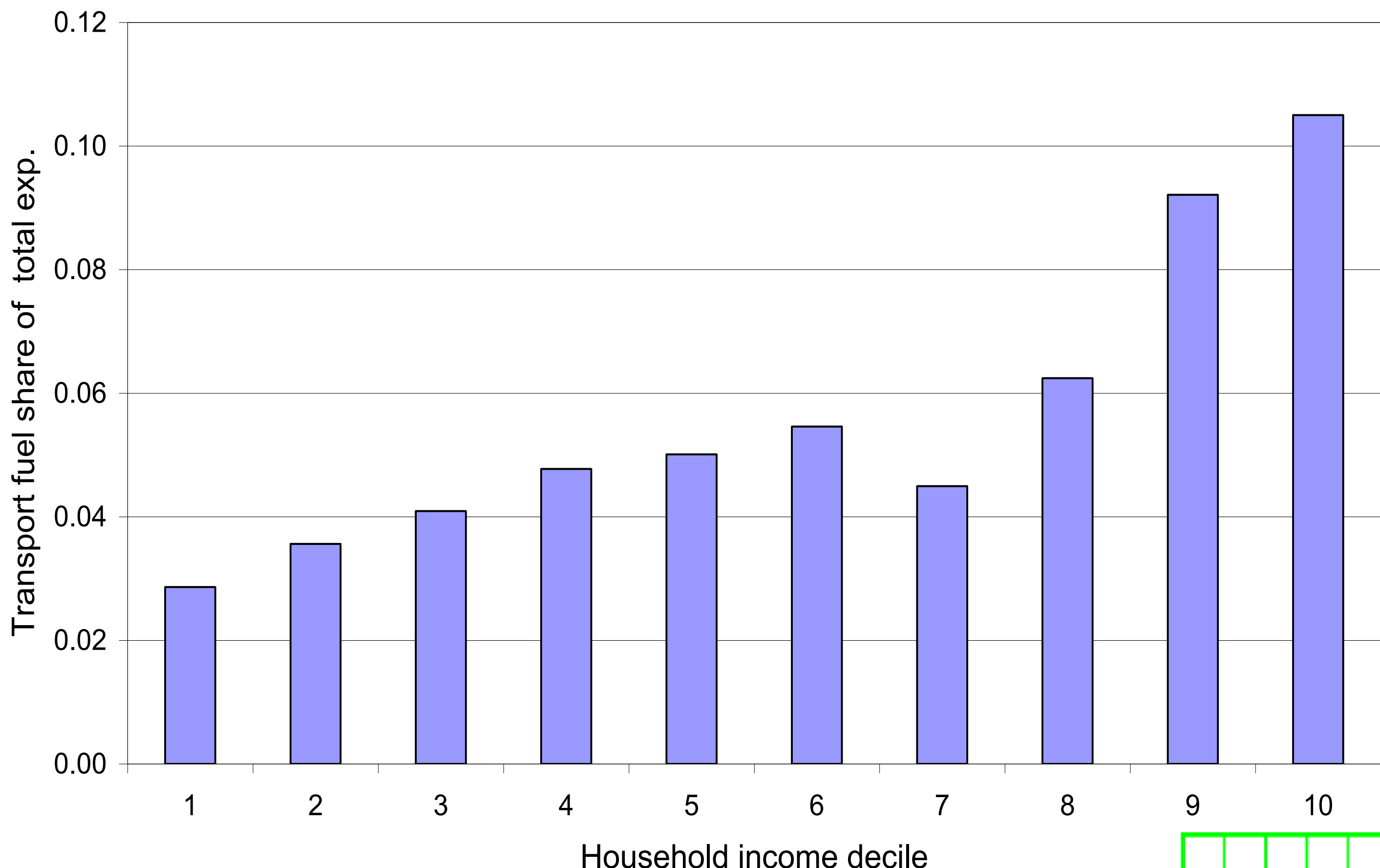
# Transport fuel expenditures as share of total household expenditures

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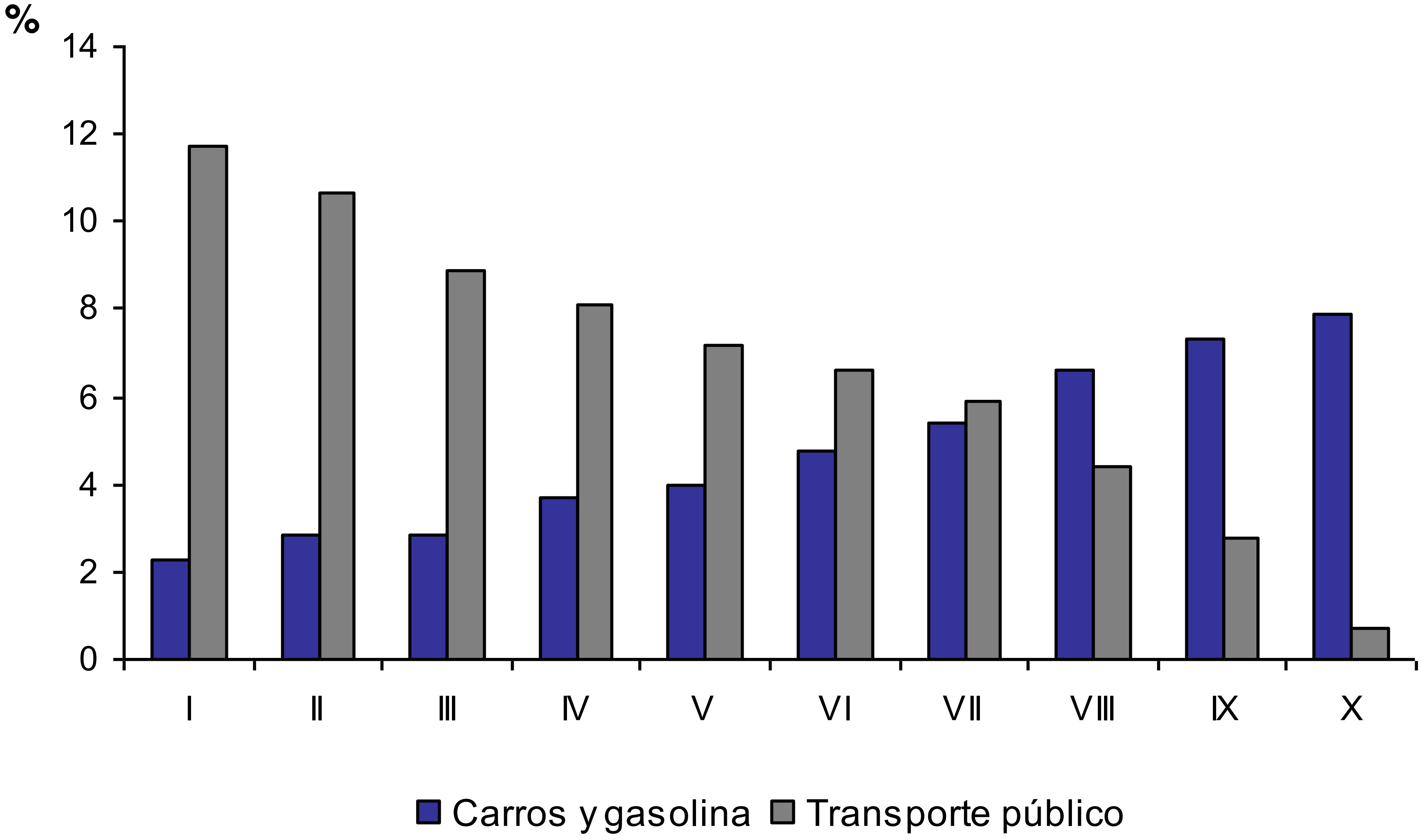
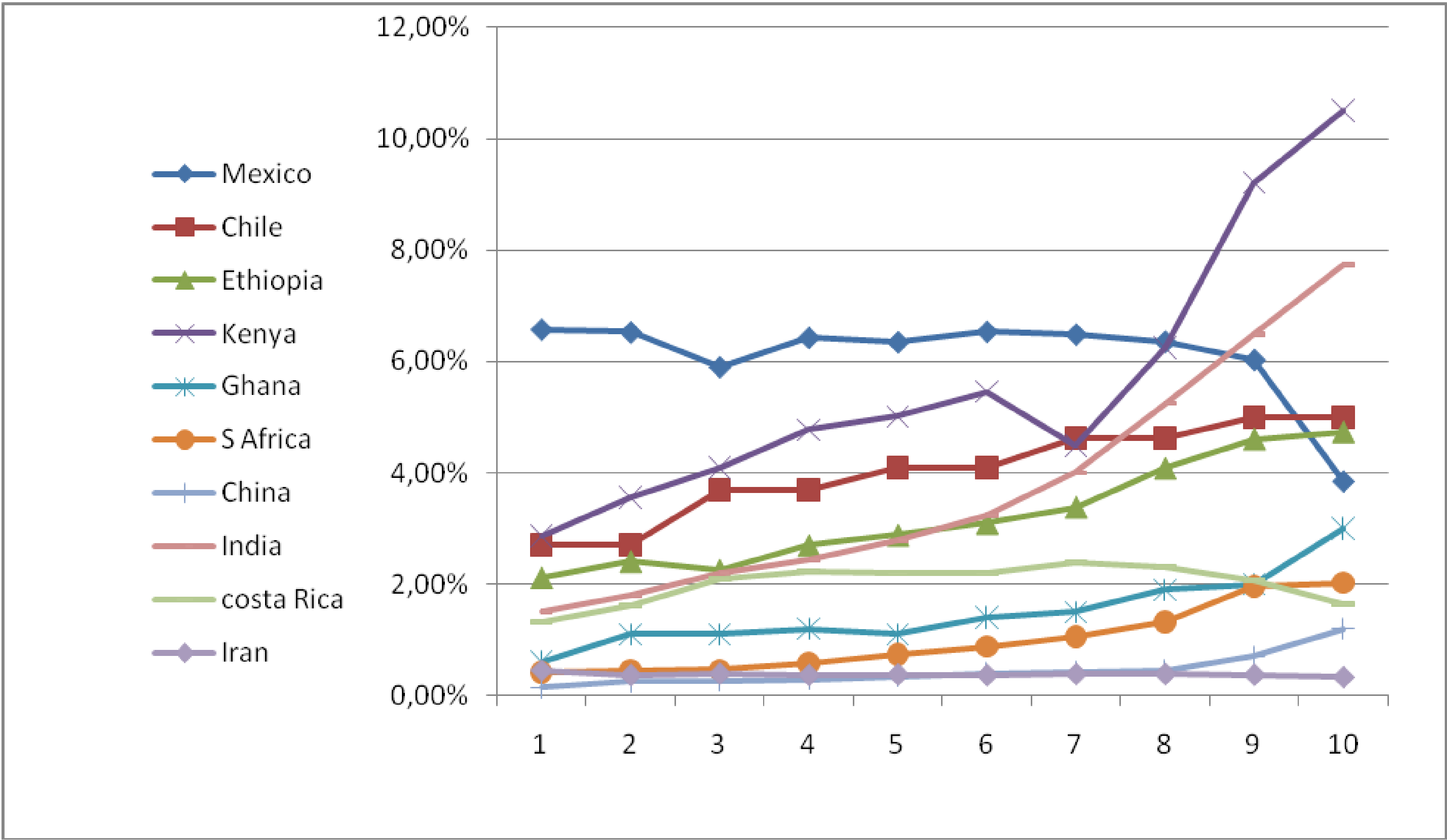
# Mexico



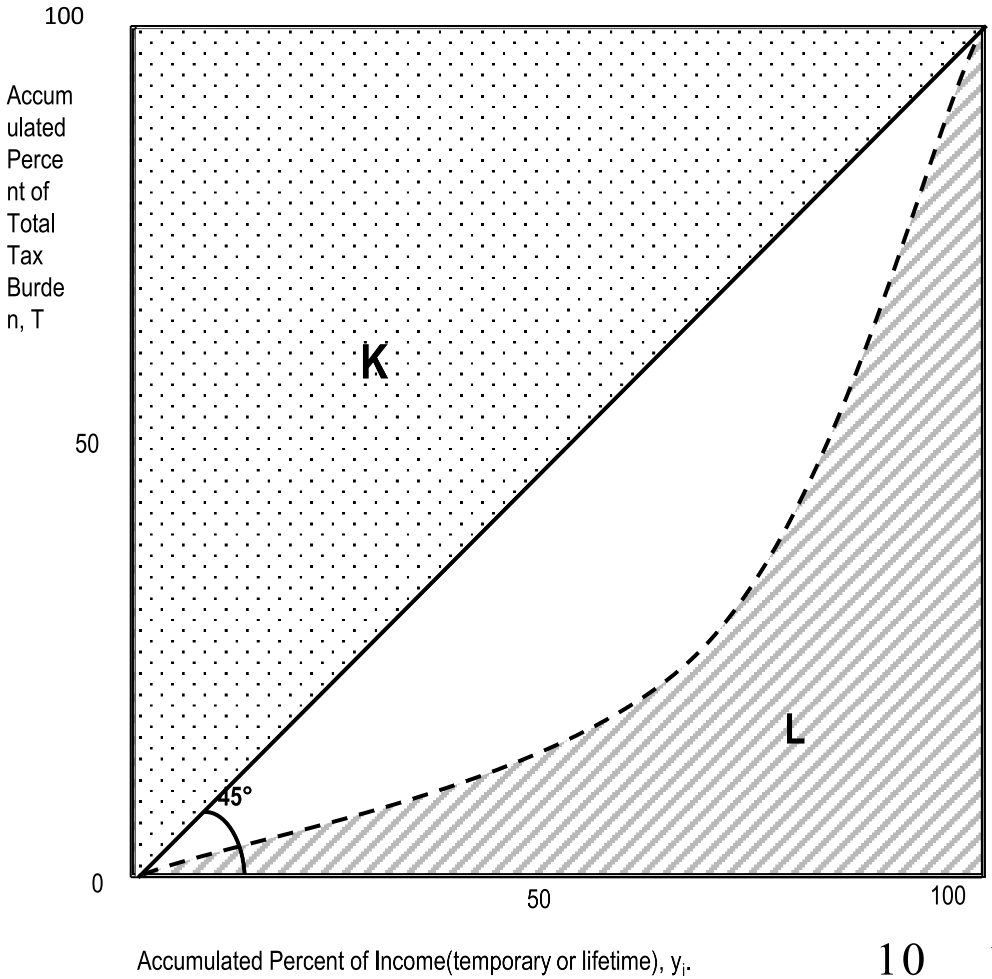
%
14
12
10
8
6
4
2
0
I
II
III
IV
V
VI
VII
VIII
IX
X
Carros y gasolina
Transporte público

# Most developing: Progressive



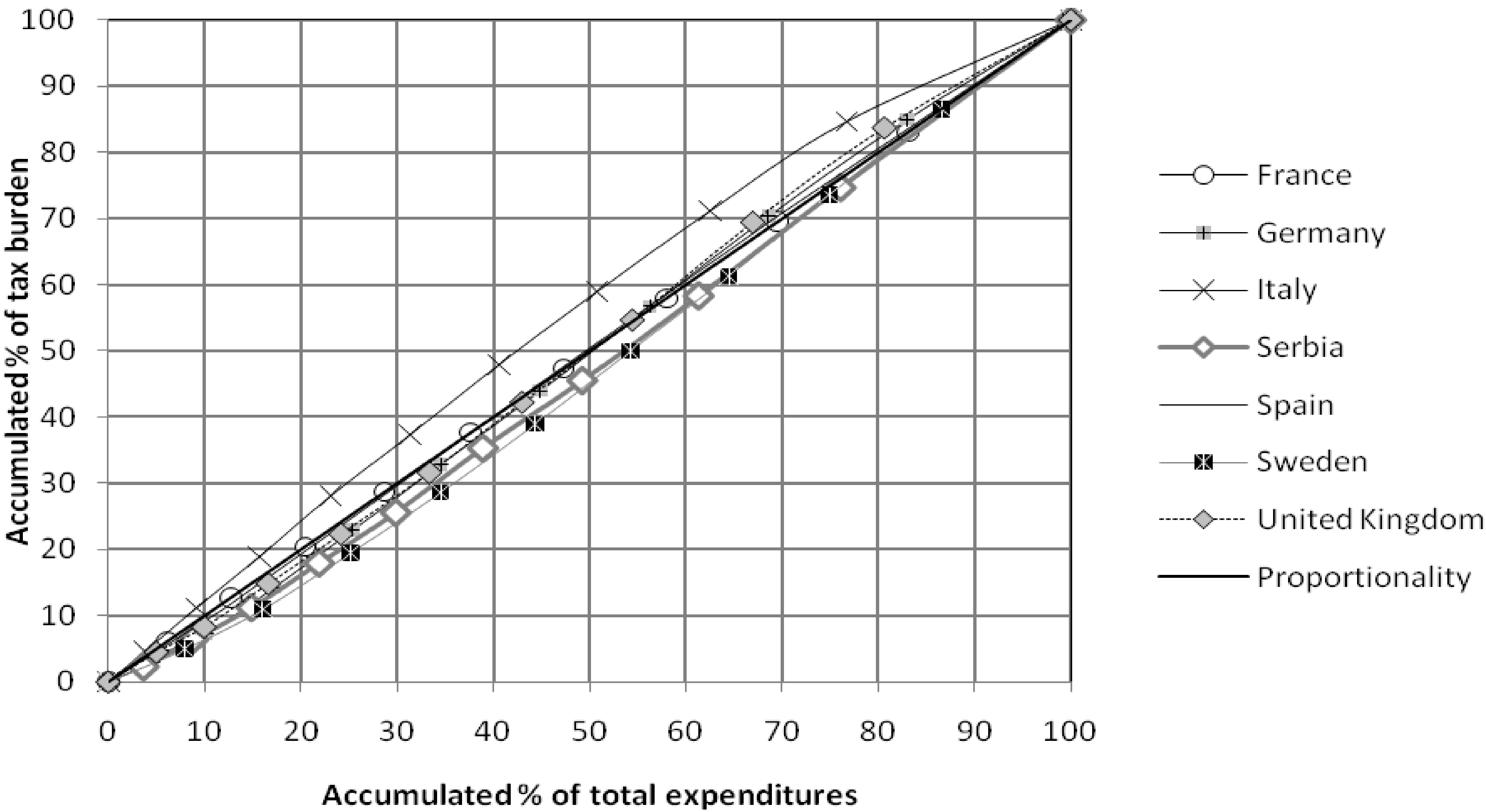
# A summary measure….

# Calculating Suits (1-L/K)

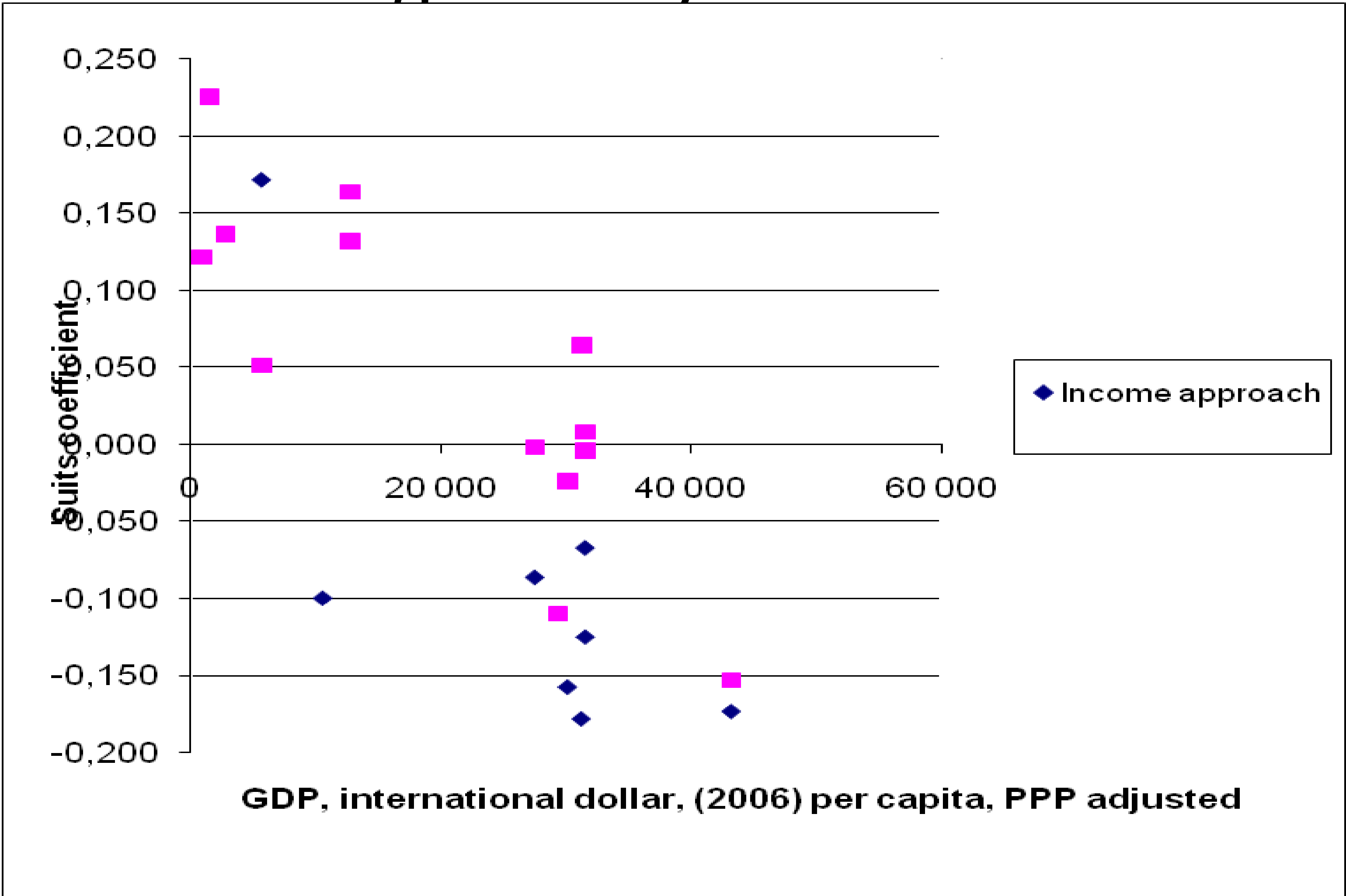



$$S \approx 1 - \frac{\sum_{i=1}^{10} \frac{1}{2} \left[T(y_i) + T(y_{i-1})\right]\left(y_i - y_{i-1}\right)}{5000}$$

# Using expenditures



# Progressivity vs Income



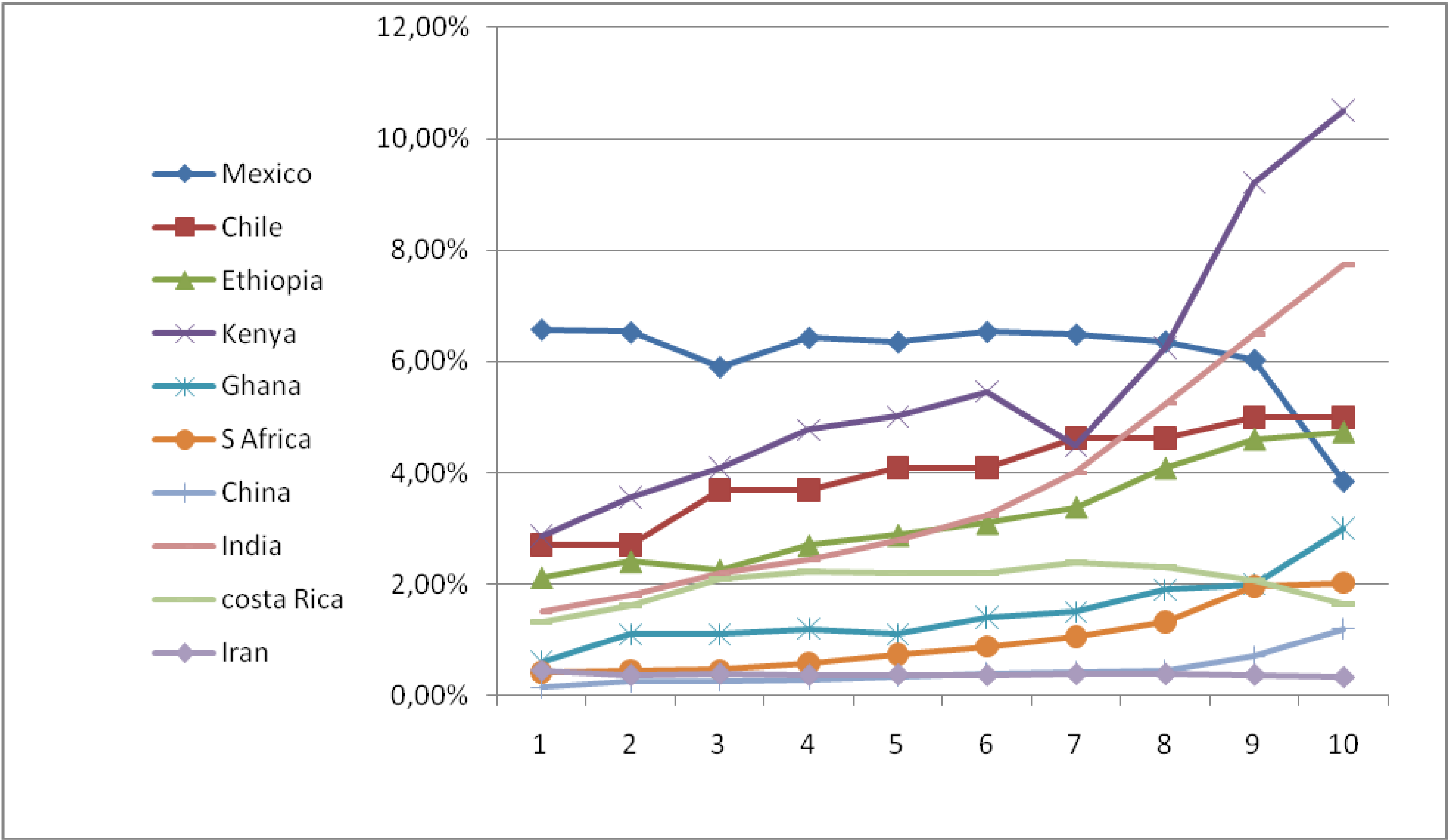
BFT
Business & Financial Times
SPECIAL FEA

# Debate on fuel subsid

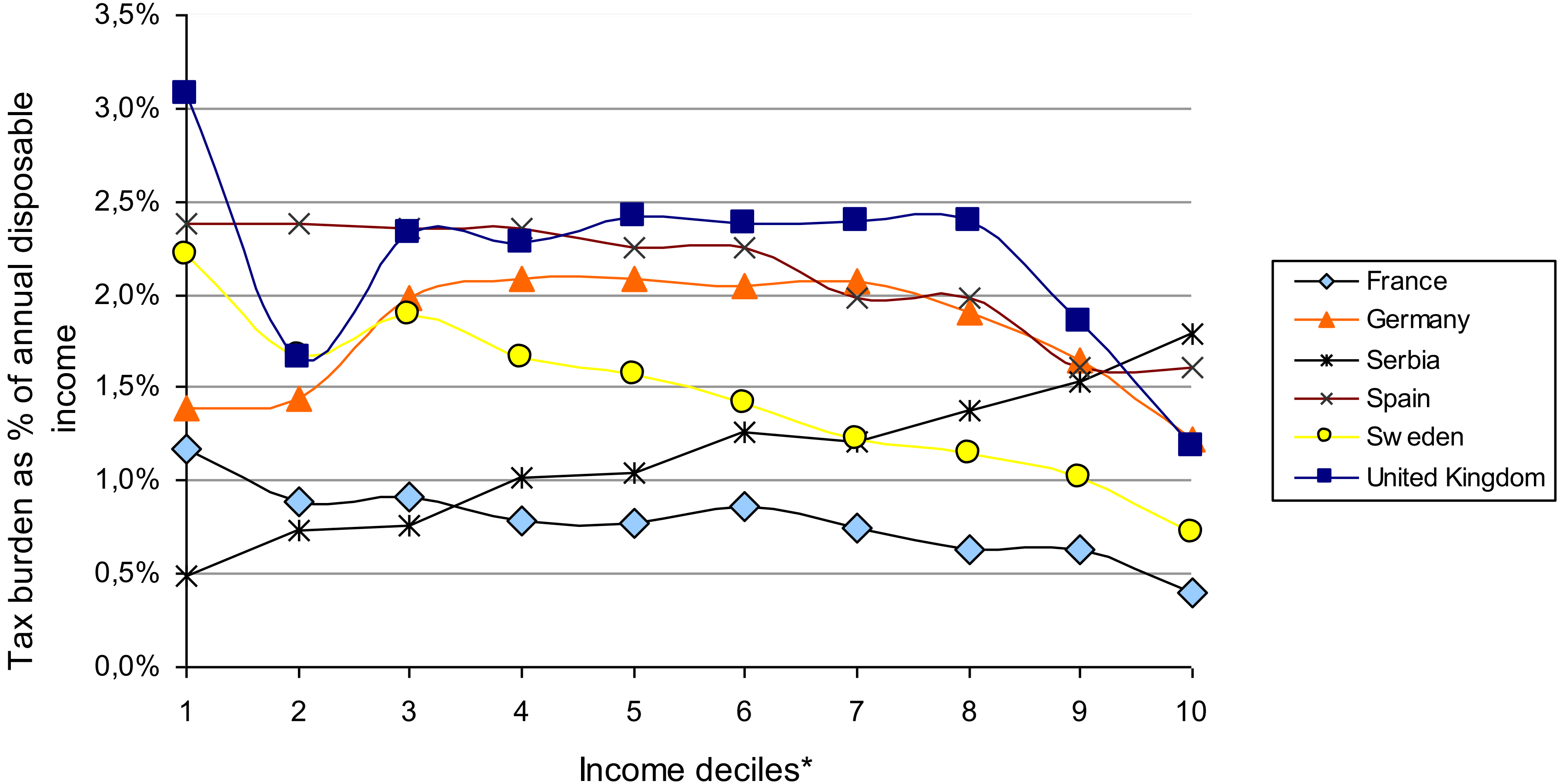
*If you really care about poverty you should subsidis*
*things the poor need the most - and that is surely not*

When fuel prices jumped 30% at the pump, increasing from GHc0.857 (US$0.60) to GHc1.11 (US$0.78) per litre for petrol, the initial response by many was to ask

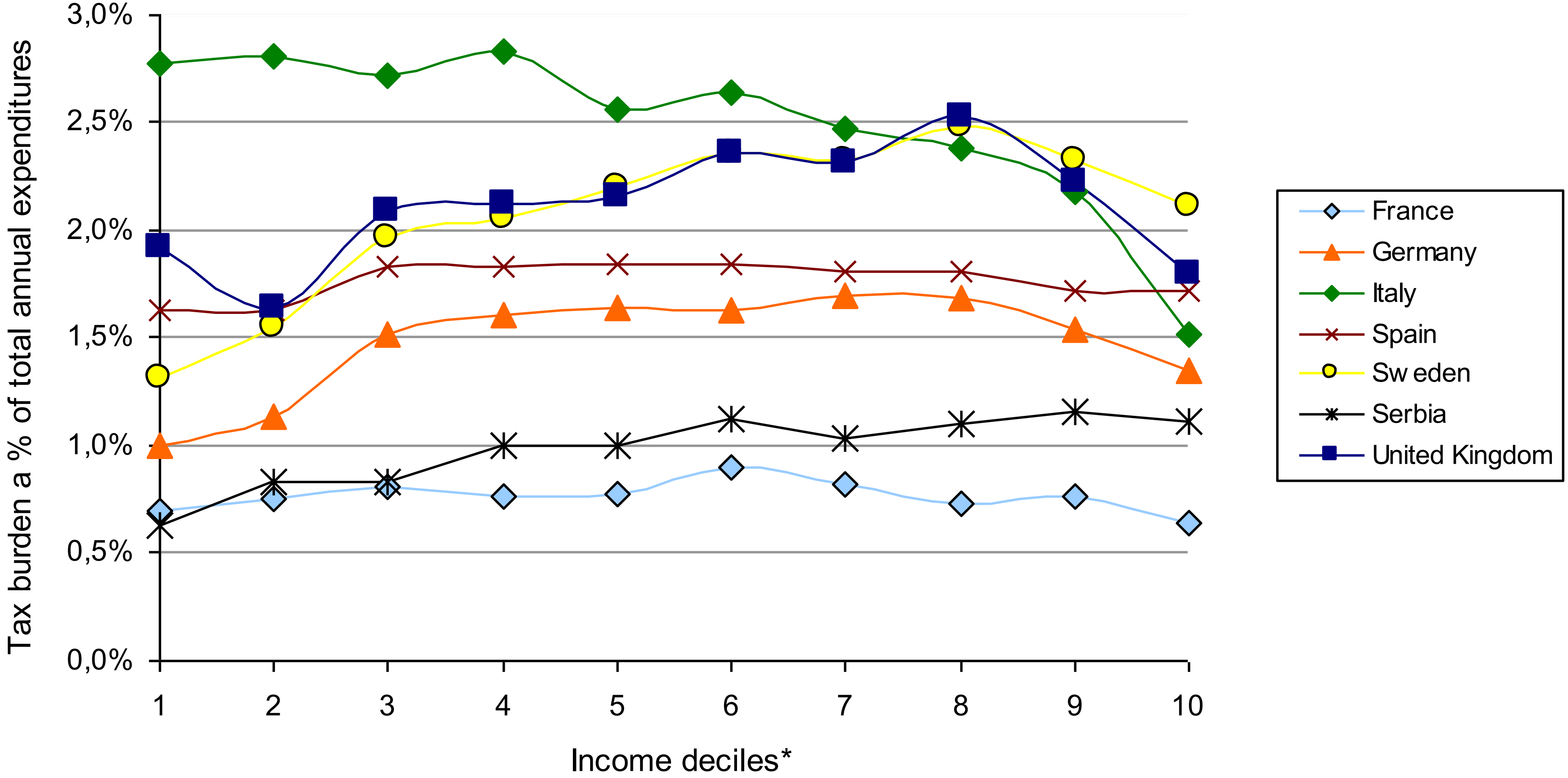
# Most developing: Progressive



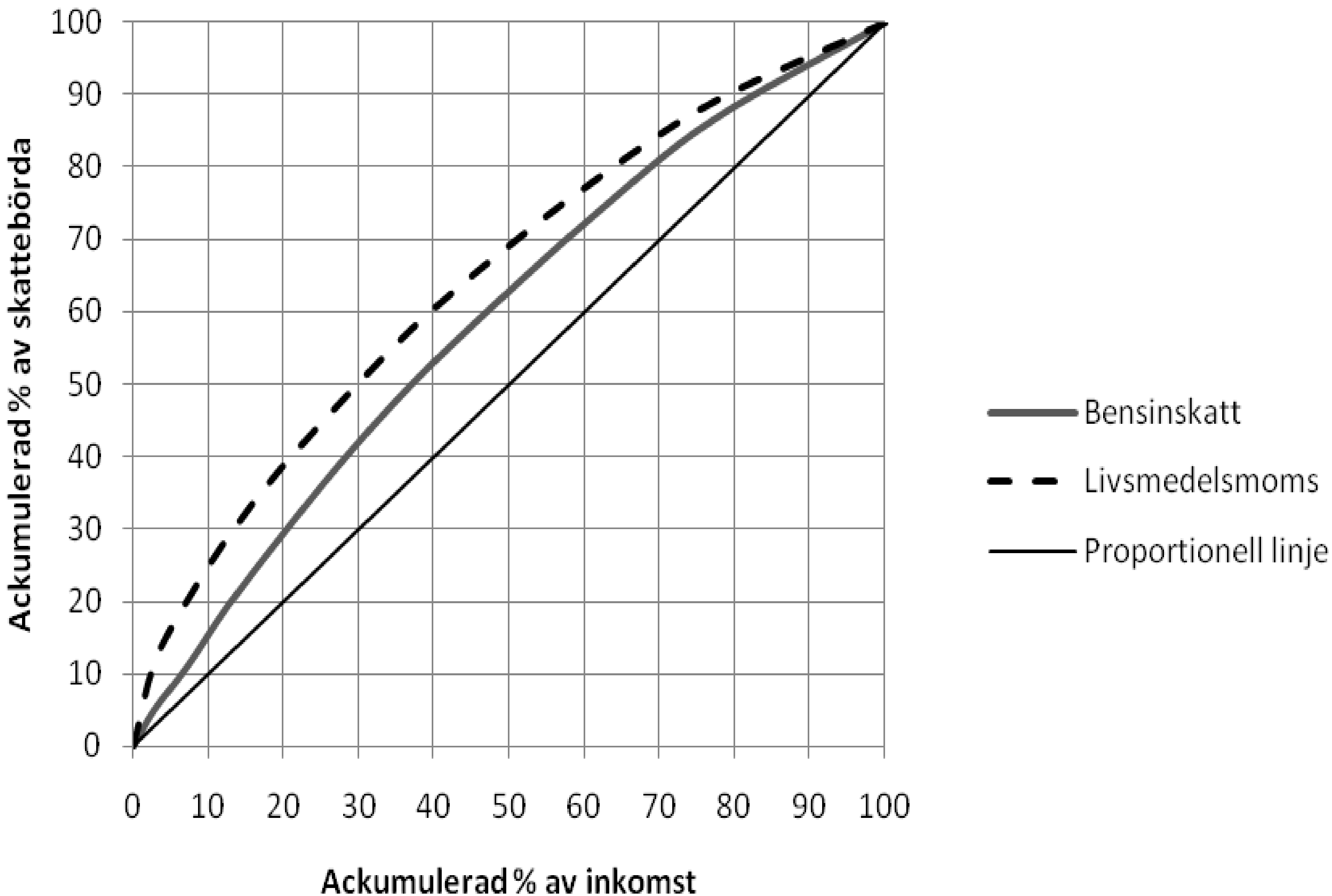
# Using Income



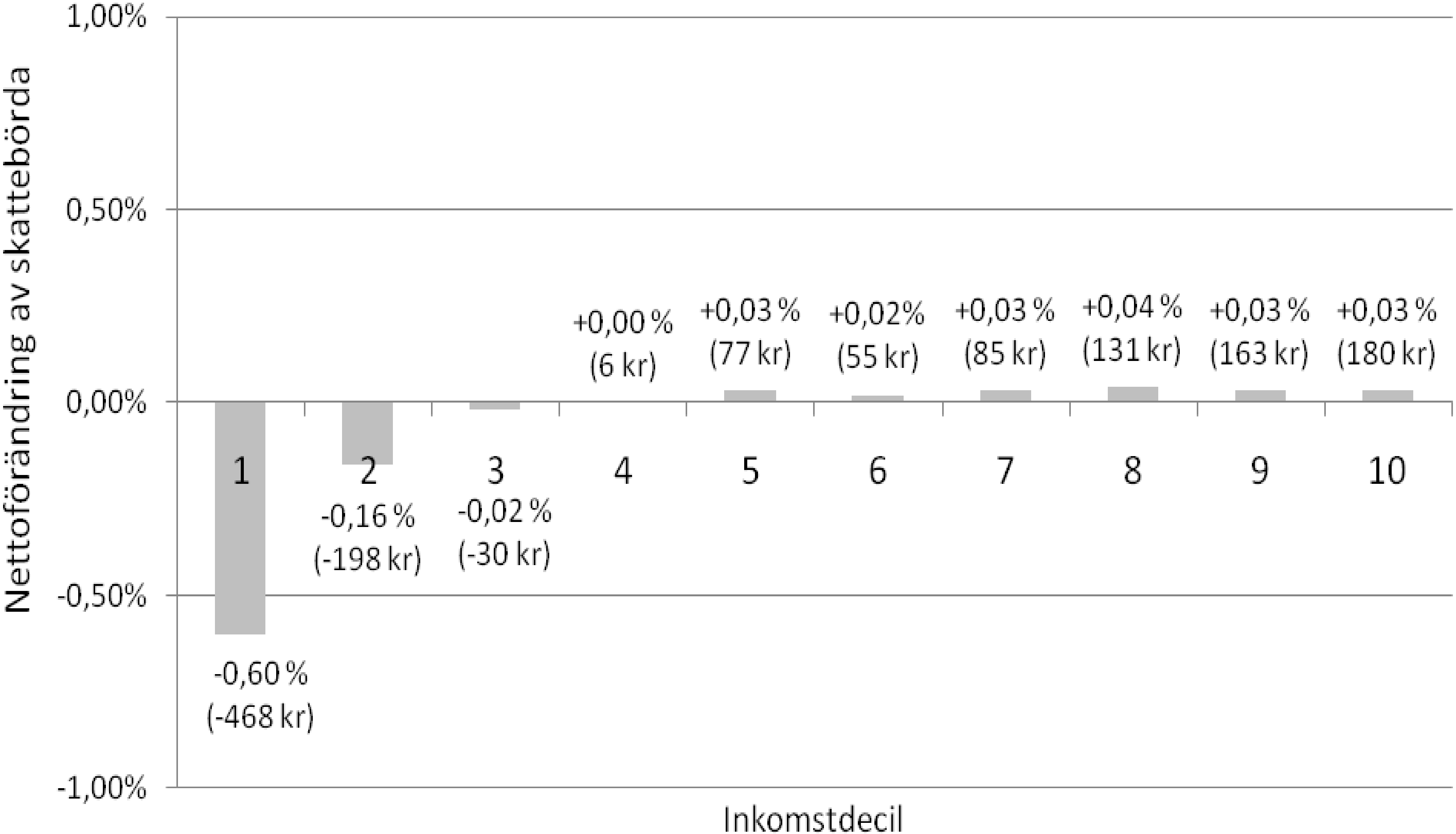
# Using Expenditure



# Tax Reform → more possibilities



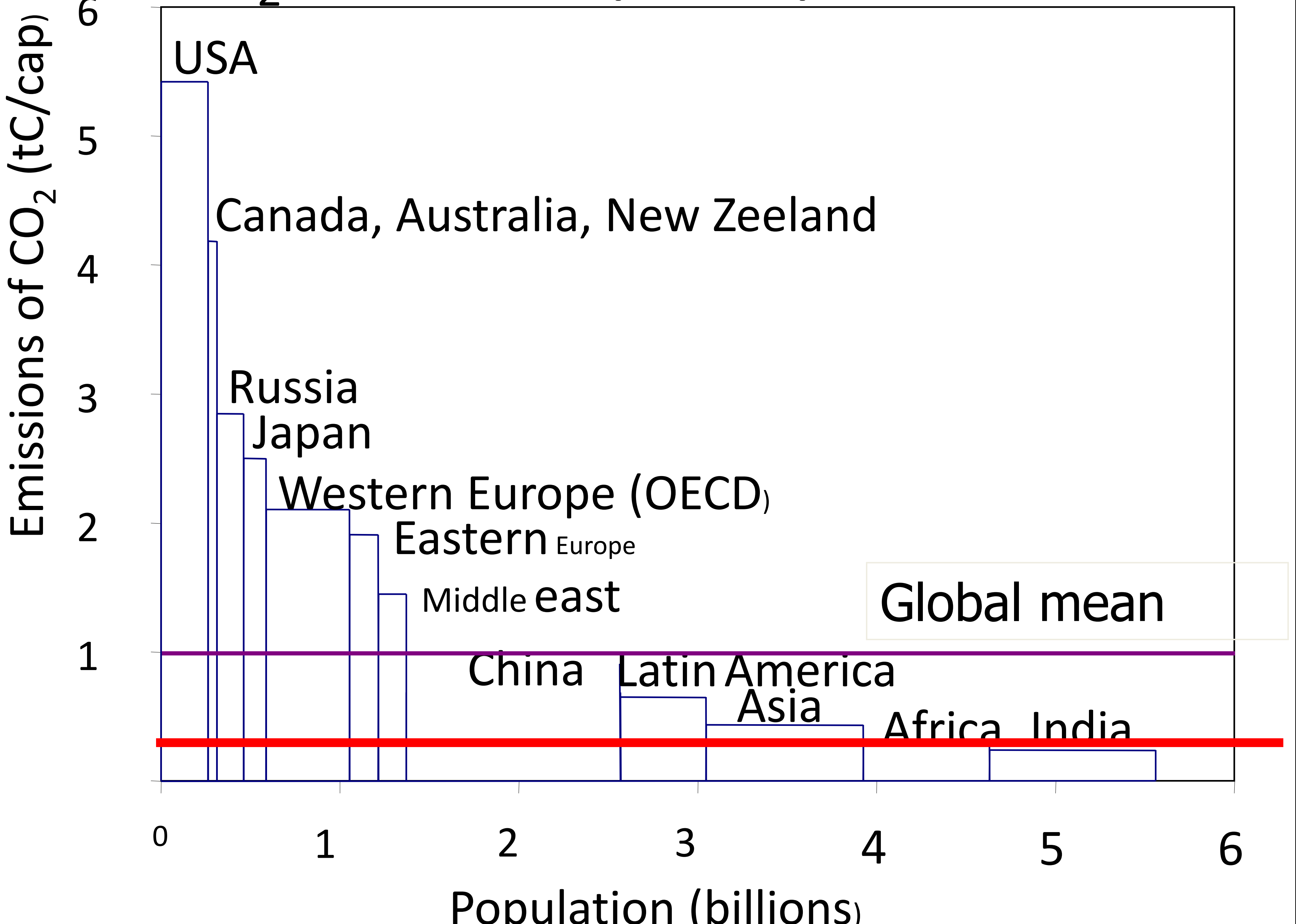
# Skatteväxling 70 öre/l mot sänkt matmoms



# Progressivt netto resultat

| Förändring | West & Williams-koefficient |
| --- | --- |
| Höjning av bensin- och dieselskatt | -0,046 % |
| Sänkning av livsmedelsmoms | + 0,074 % |
| Nettoförändring | + 0,028 % |

# $CO_2$ emissions per capita (as C)



# The right to emit **valuable**
# 20 Gtons $CO_2$ à 50 $/t = 1000 B$

| | Grand father | Per capita |
|---|---|---|
| INDIA | 4% | 16% |
| USA | 16% | 4% |

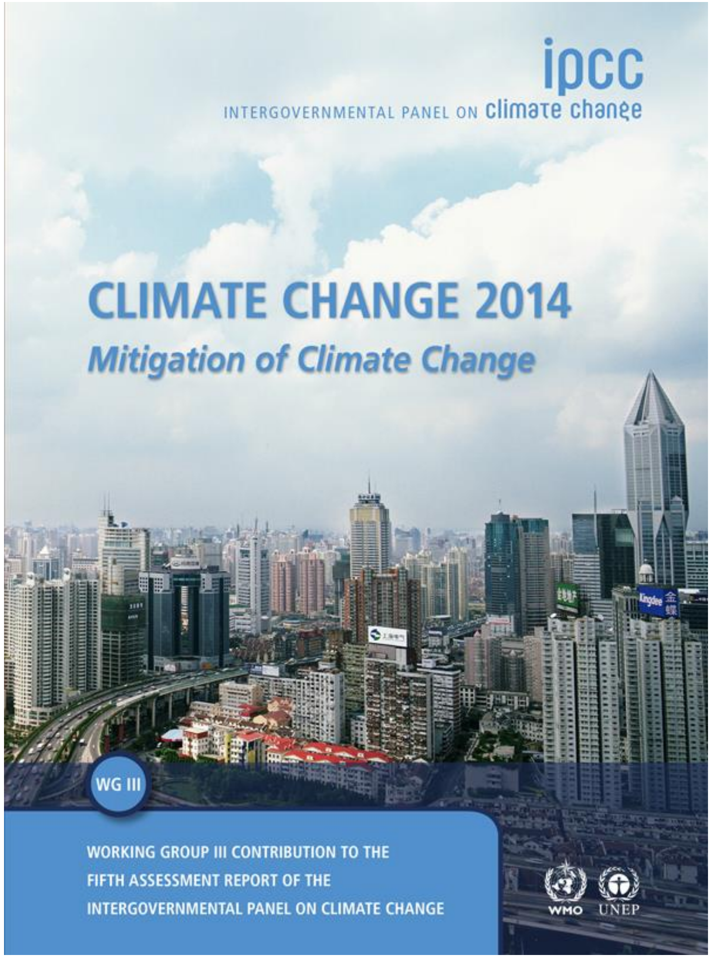
# Nigeria abolished fuel subsidy Jan 1


IPCC WORKING GROUP III
12TH SESSION
IPCC PLENARY
39TH SESSION
Berlin, 7 – 12 April 2014
ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP

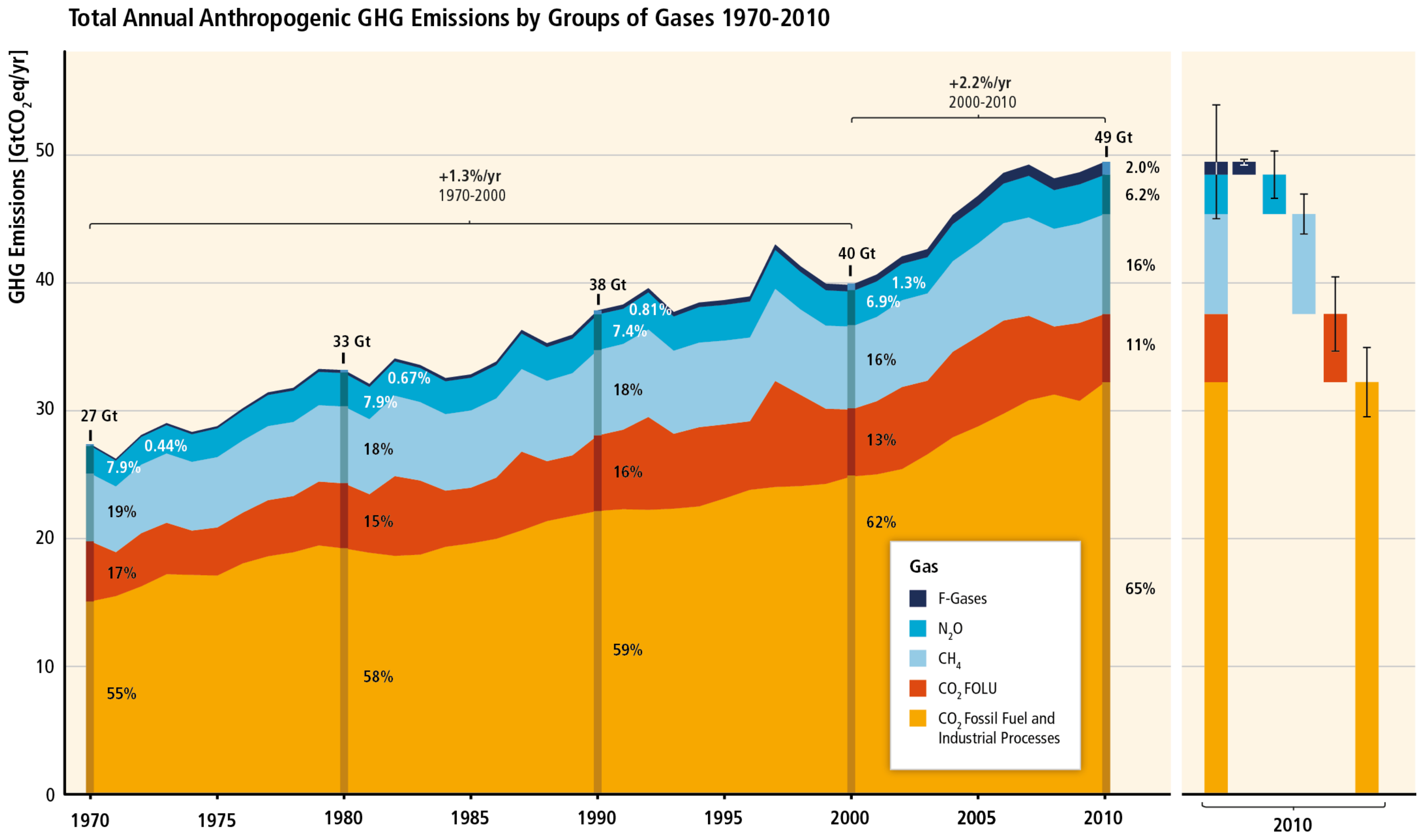
**IPCC reports are the result of extensive work from scientists around the world.**

**1** Summary for Policymakers
**1** Technical Summary

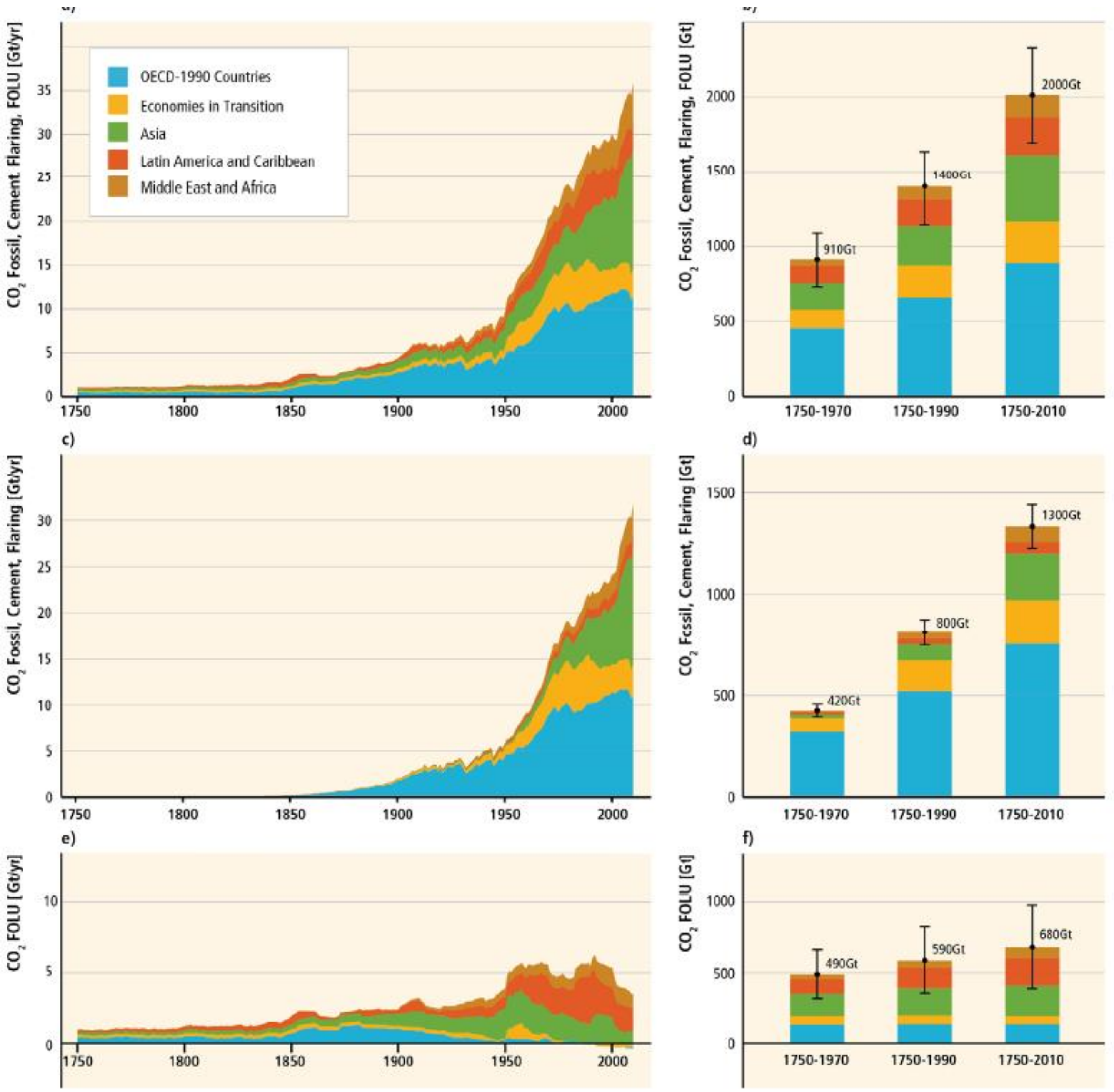
**16** Chapters
**235** Authors
**900** Reviewers
More than **2000** pages
Close to **10,000** references
More than **38,000** comments



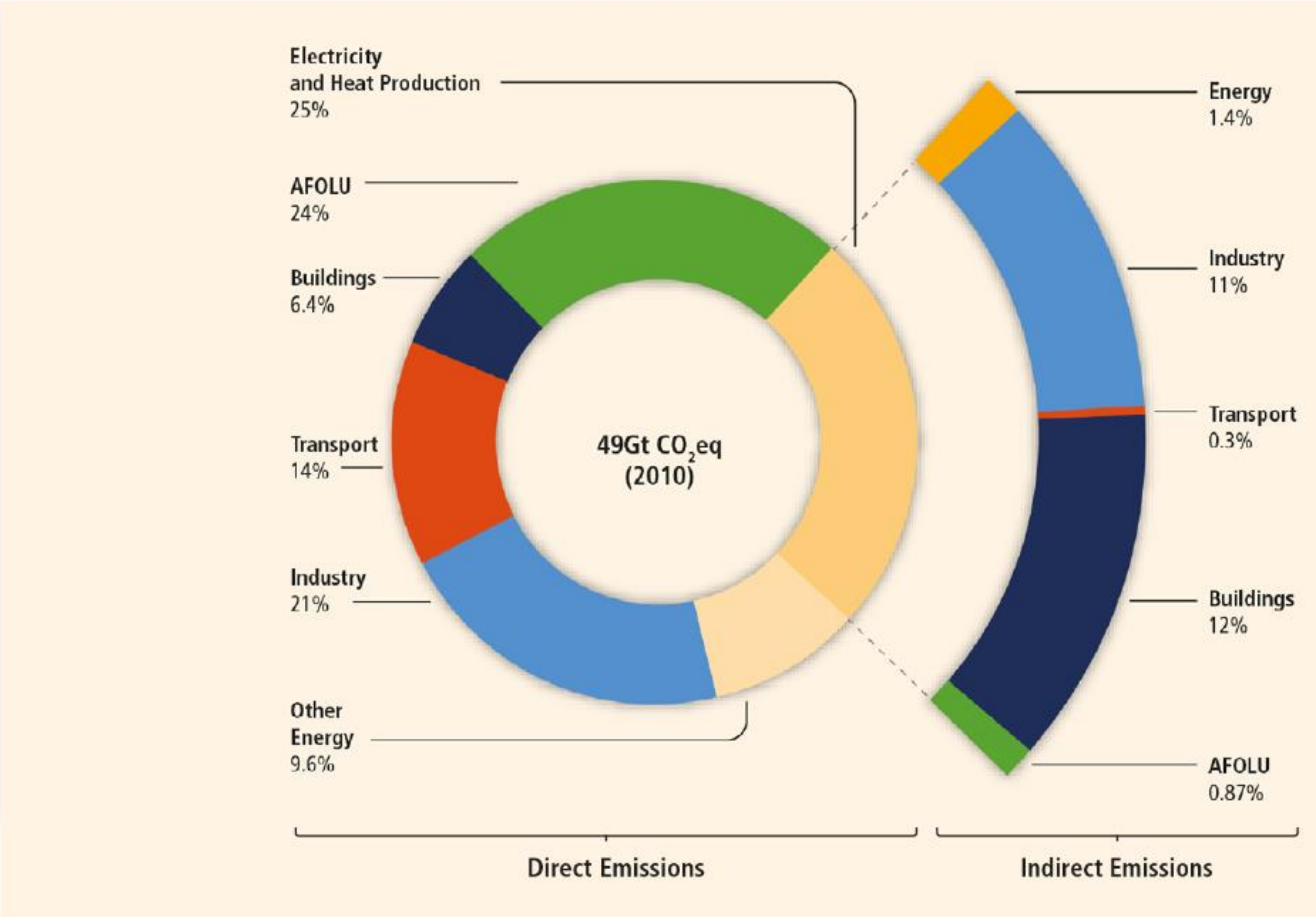
# GHG emissions accelerate despite reduction efforts. Most emission growth is $CO_2$ from fossil fuel combustion.



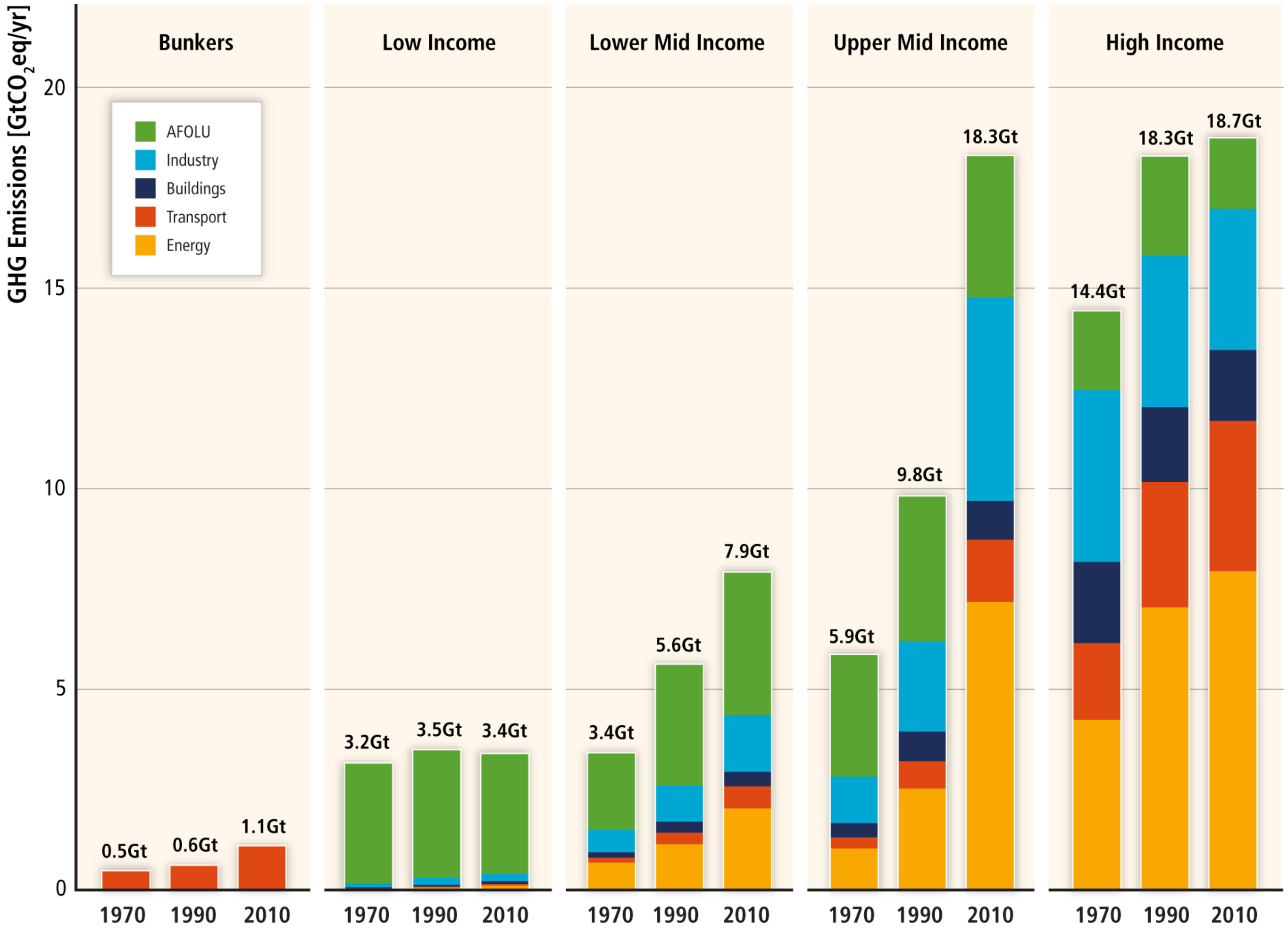
**Total Antropogenic CO2 Emissions from Fossil fuel combustion, flaring, Cement, Forestry and other land use (FOLU)**



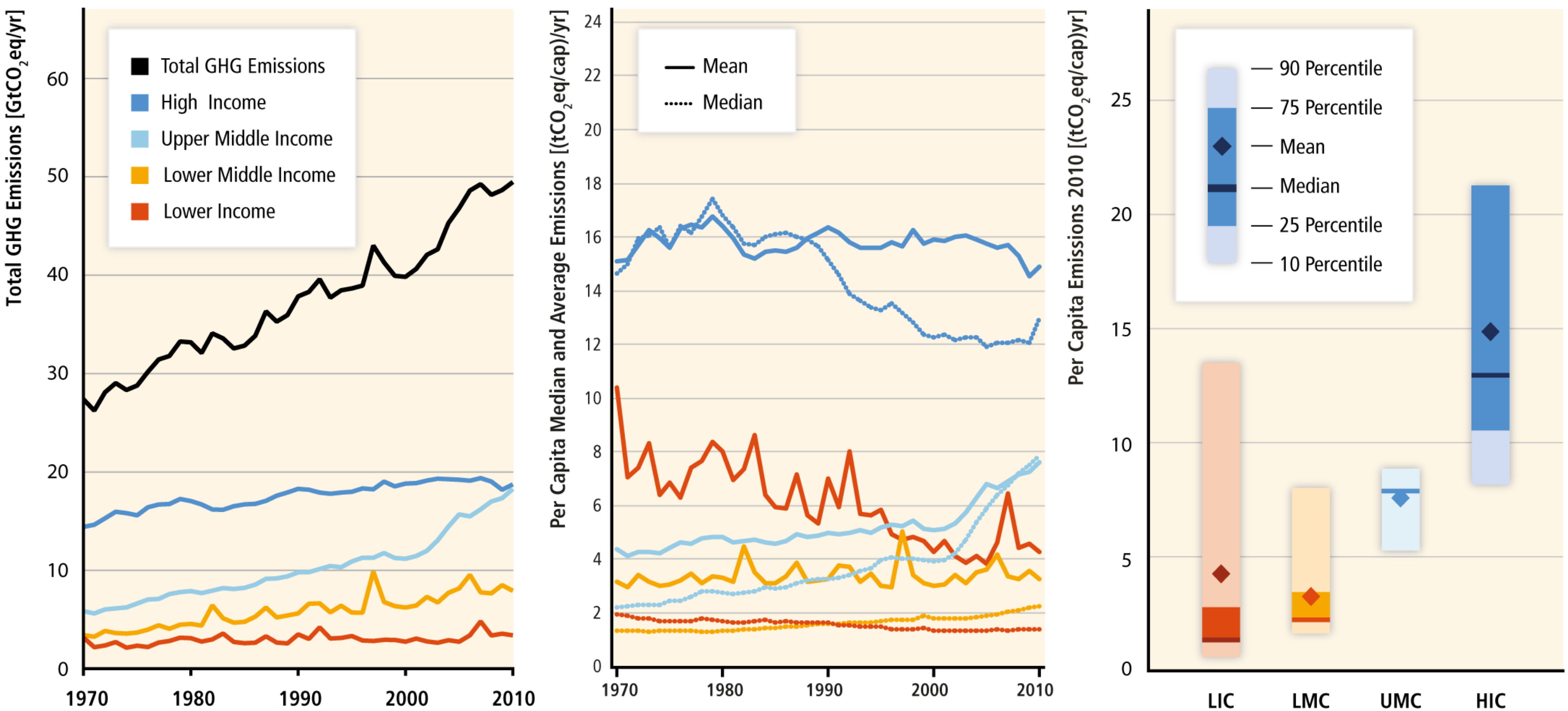
## Greenhouse Gas Emissions by Economic Sectors and Country Income Groups



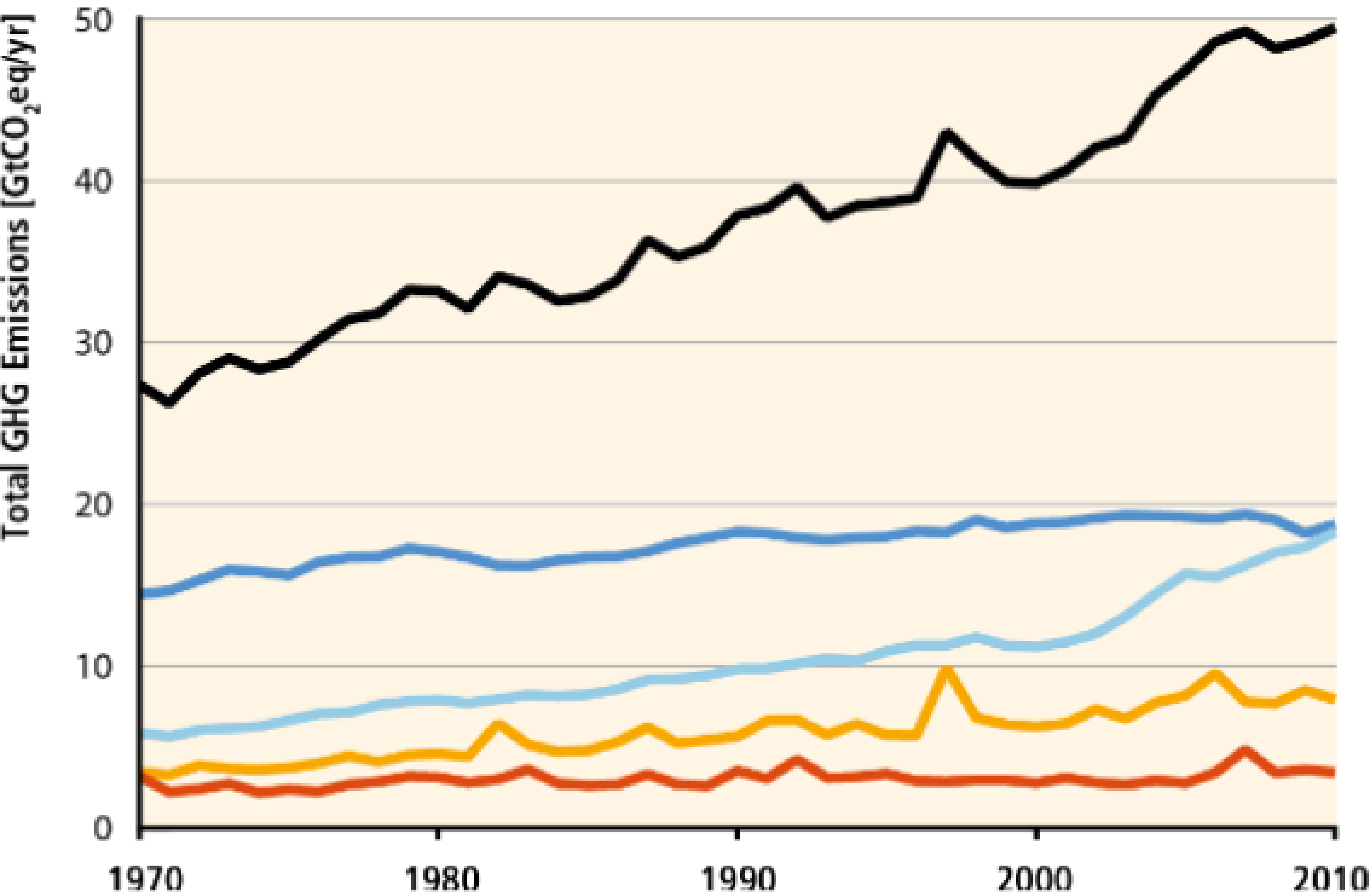
# Regional patterns of GHG emissions are shifting along with changes in the world economy.



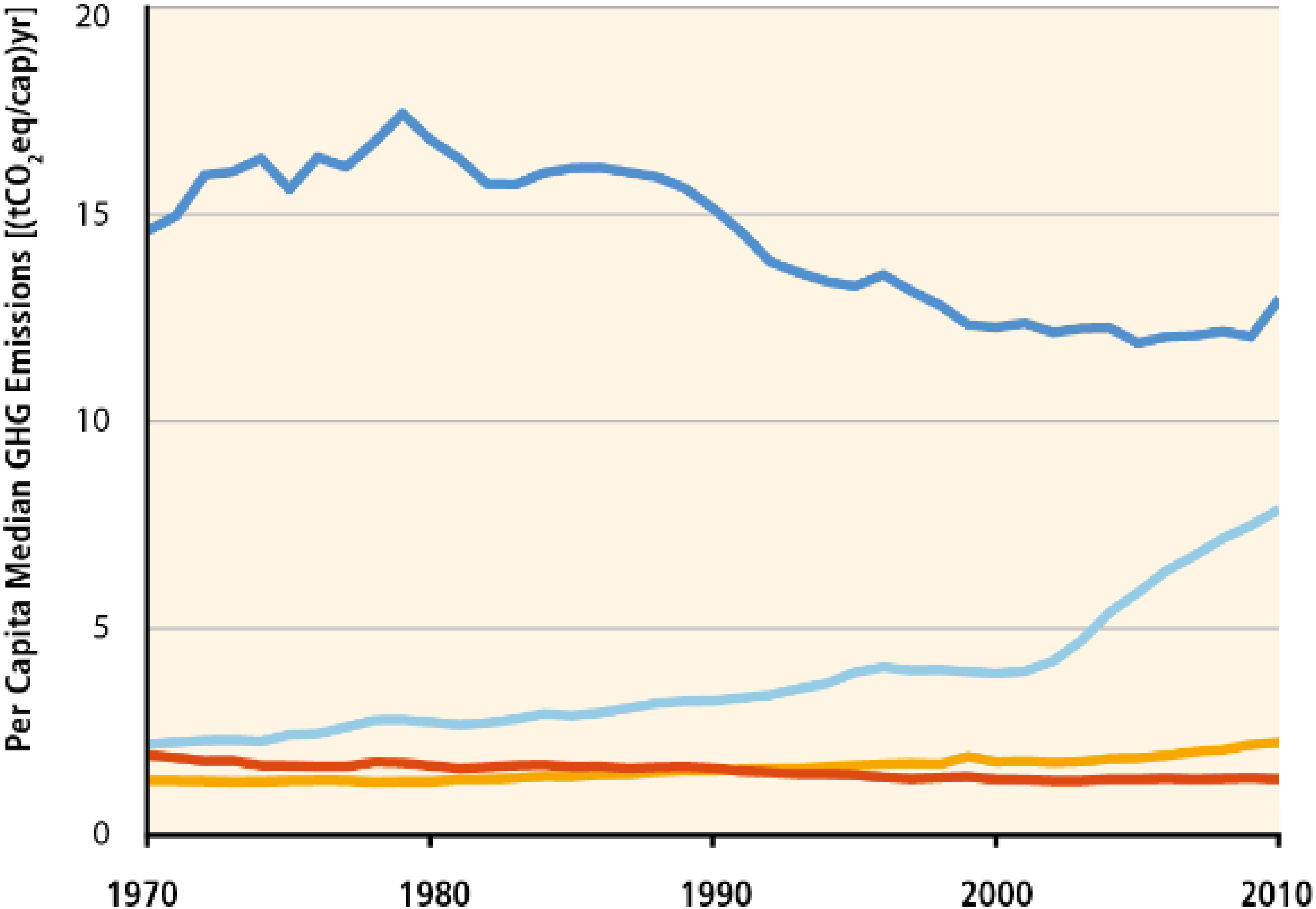
# National per-capita GHG emissions are highly variable within and between income groups.



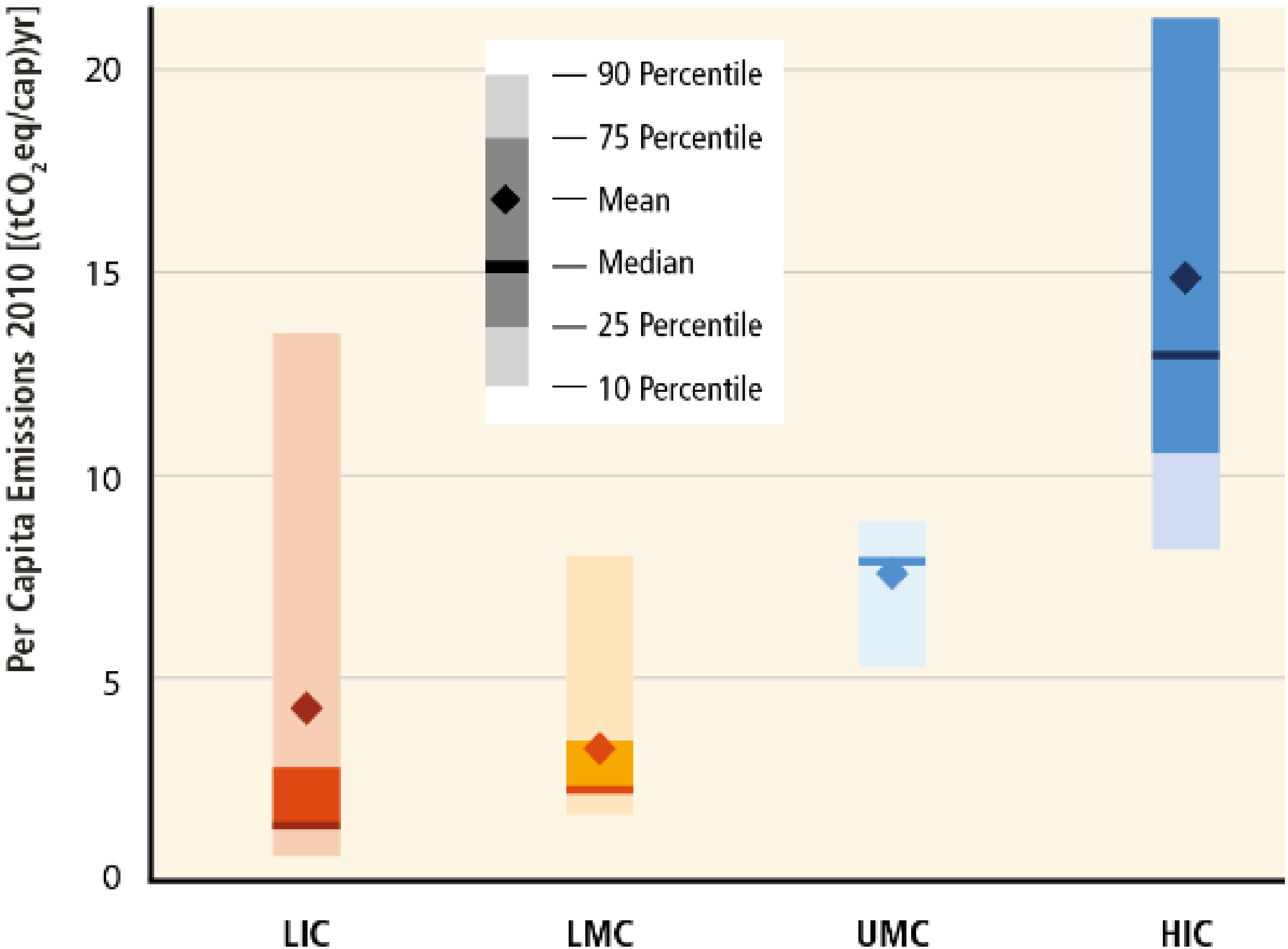
# TOTAL GHG GtCO2eq, Total, High Y, Upper M, Lower M Low



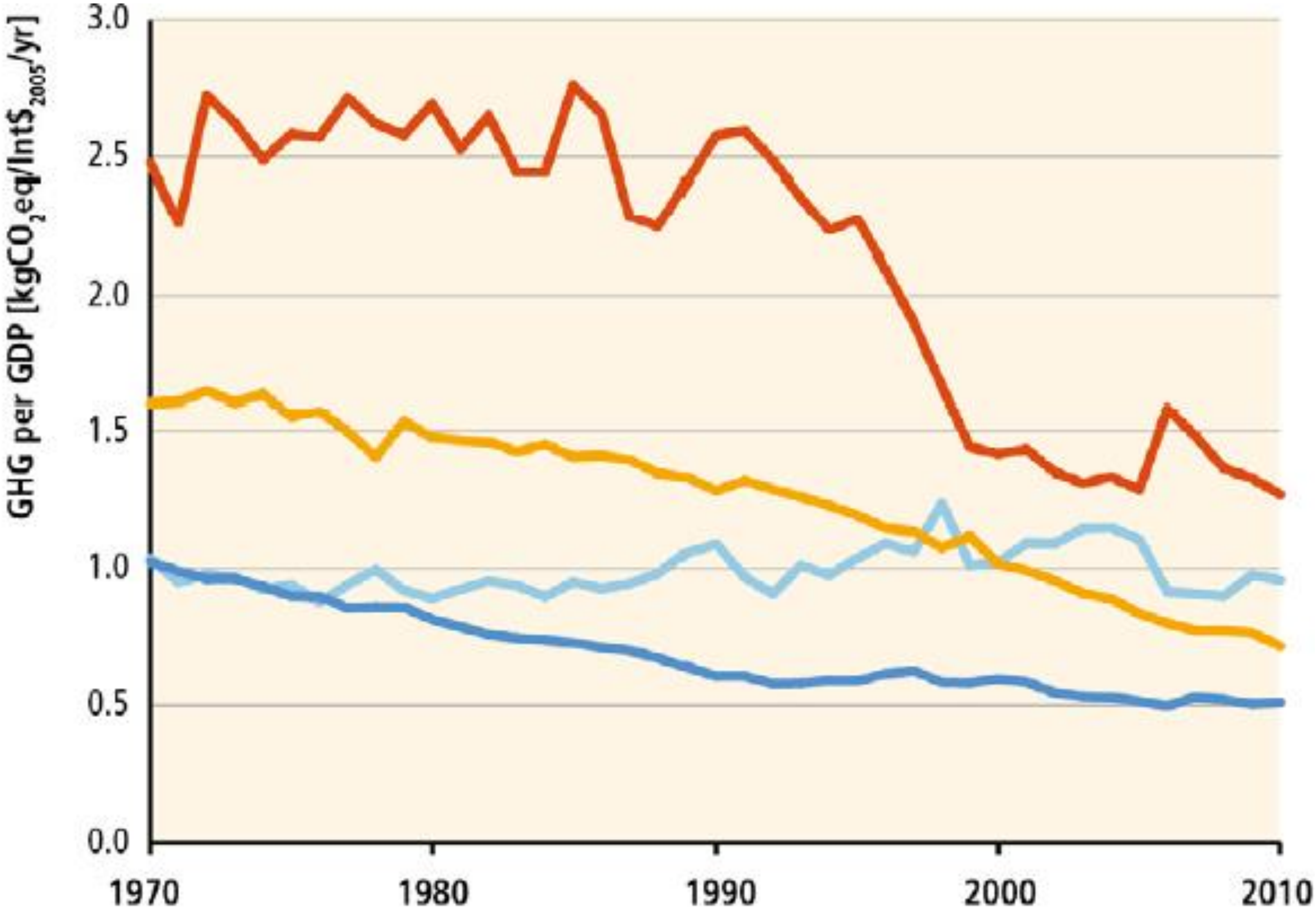
# Per Capita emissions High, Upp M. Low M and Low



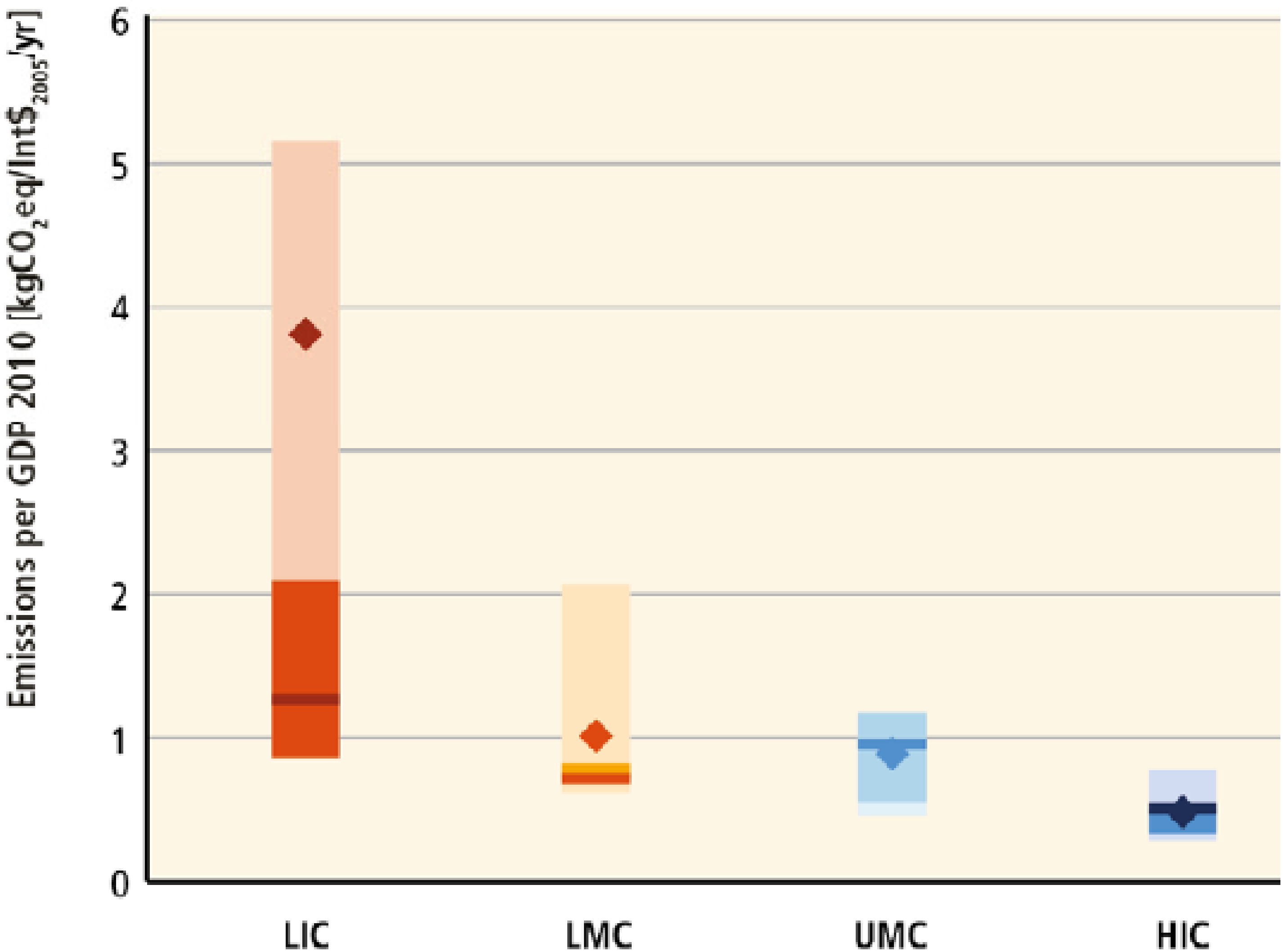
# Variation within the country groups

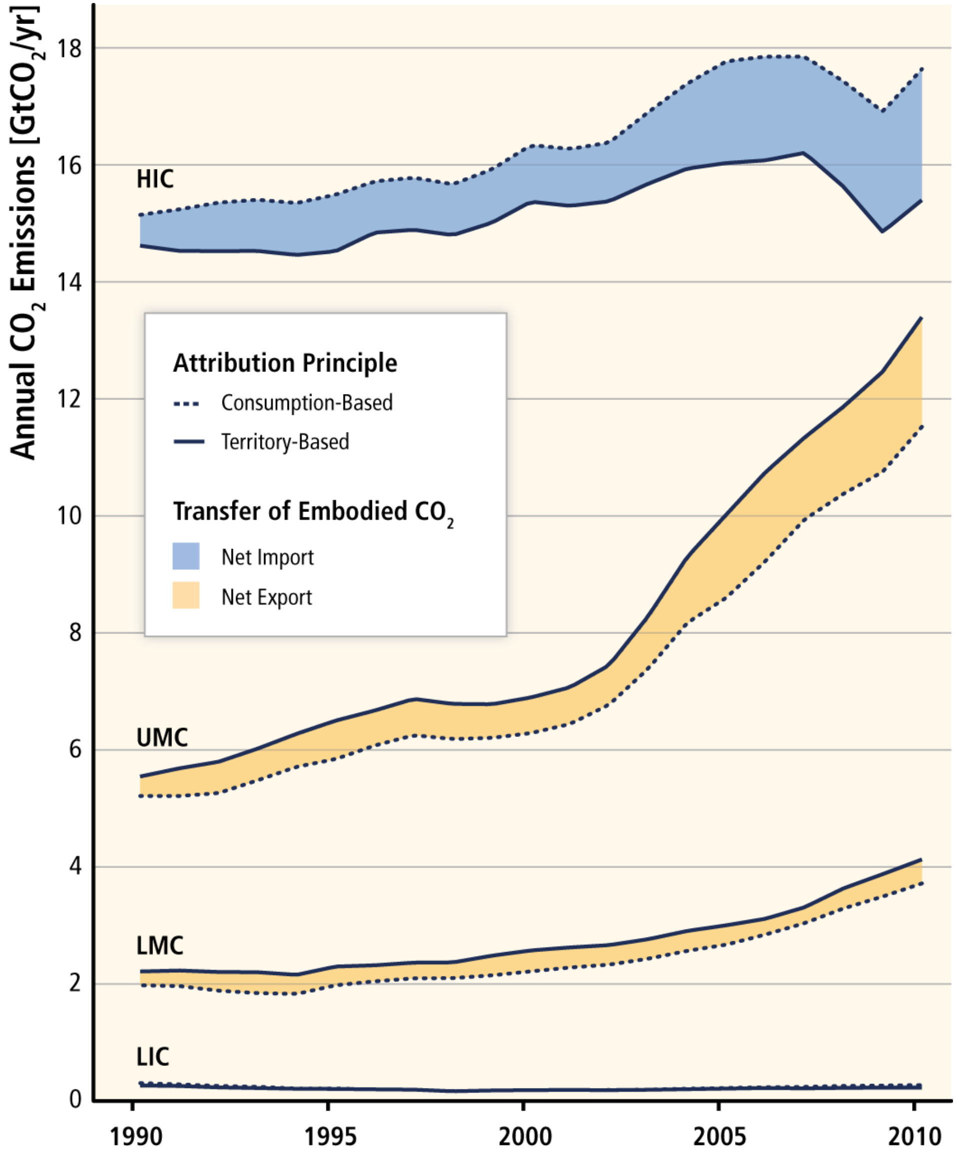


# Emissions per $ GDP Low, LowM, UppM, High Income



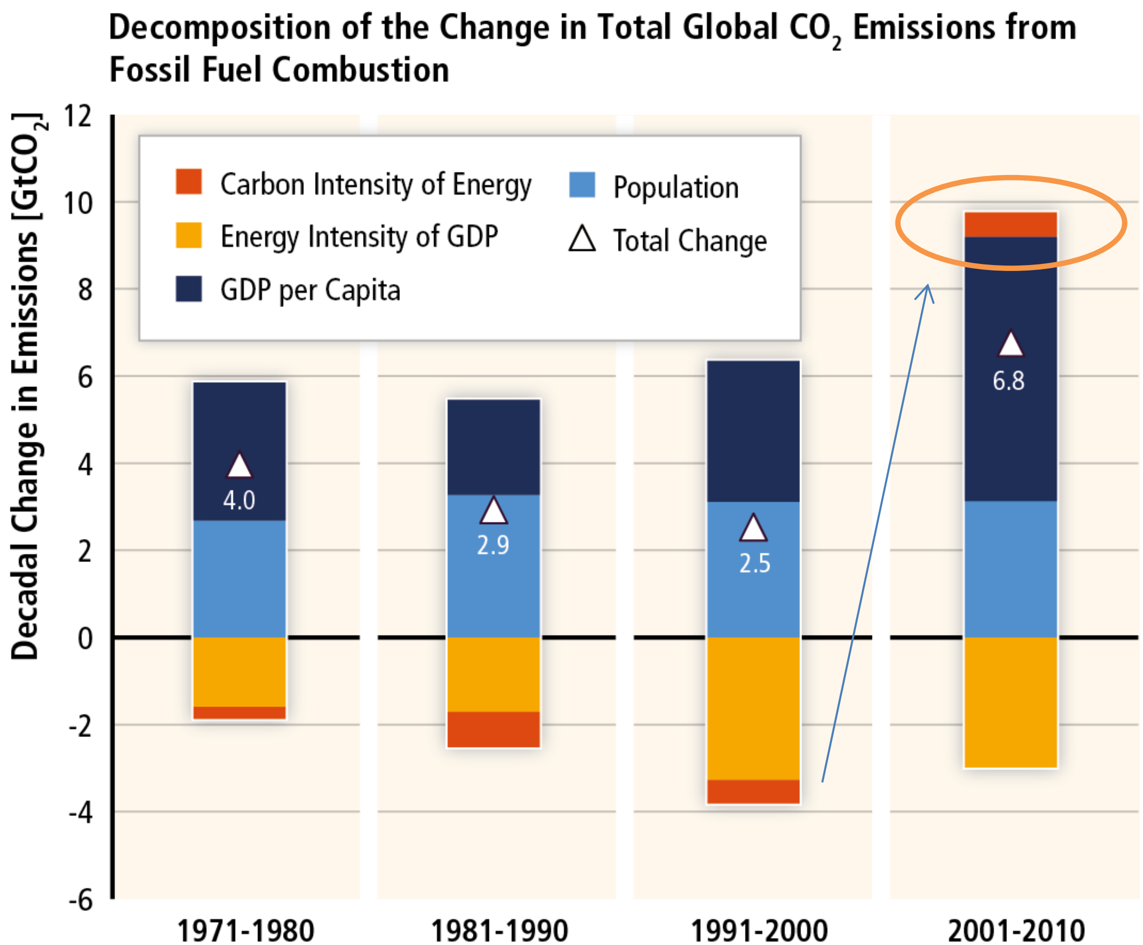
# Spread in emissions/$ GDP within Country groupings



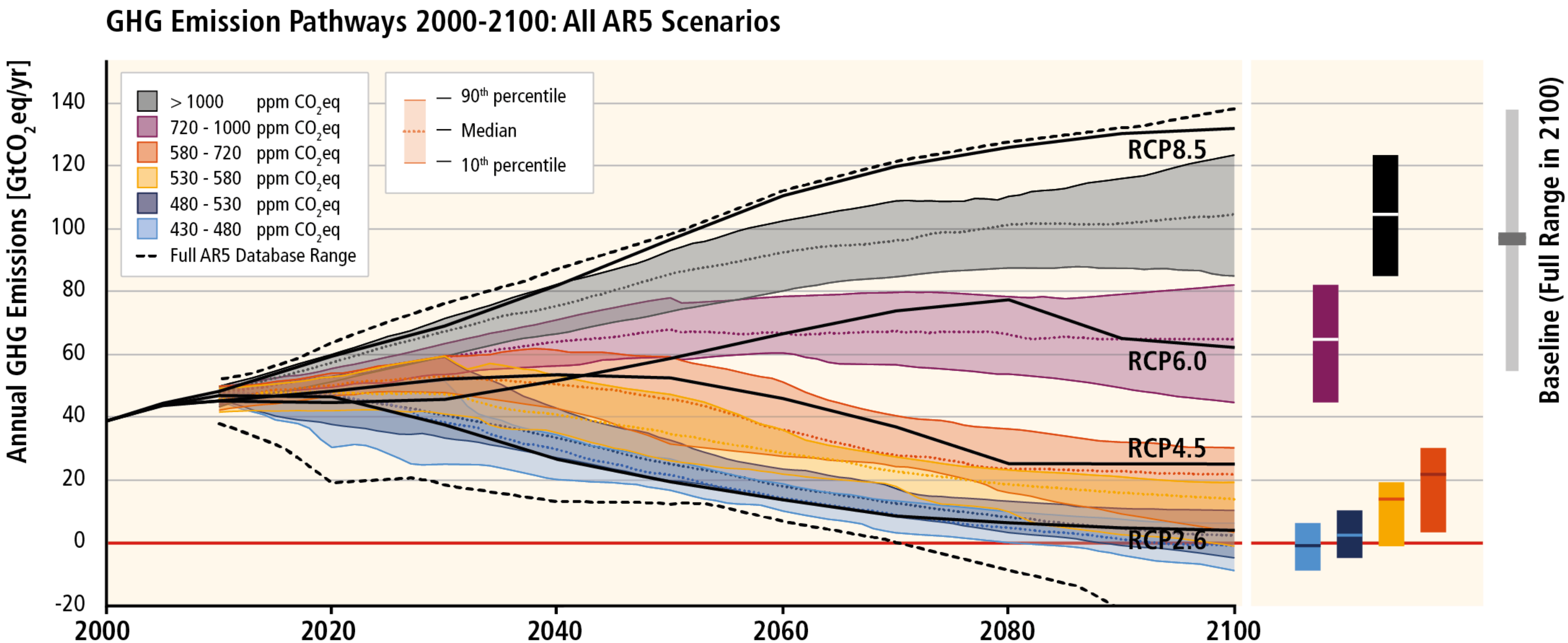



**A growing share of $CO_2$ emissions from fossil fuel combustion and industrial processes in low and middle income countries has been released in the production of goods and services exported, notably from upper-middle income countries to high income countries.**

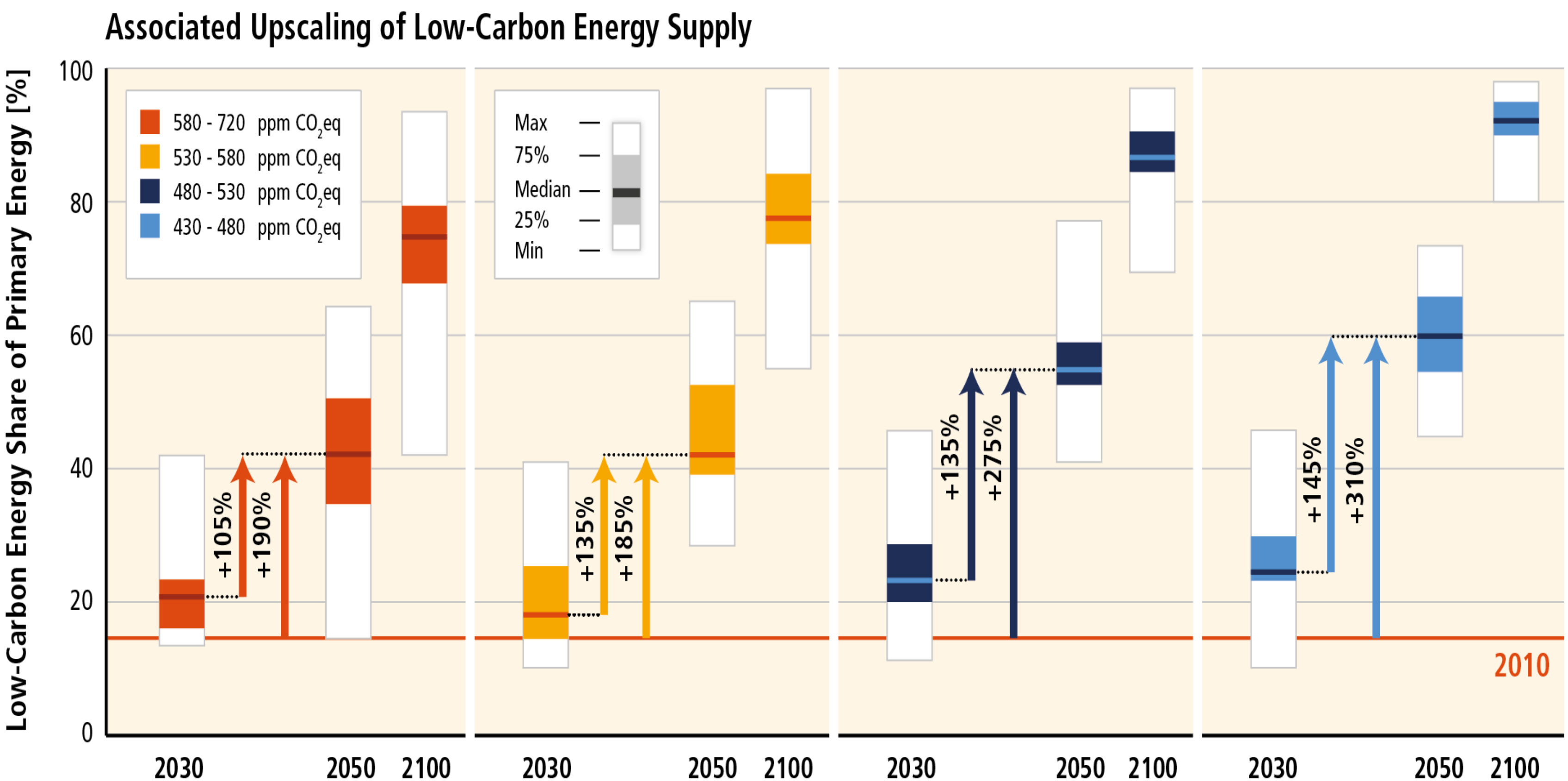
# GHG emissions rise with growth in GDP and population; long-standing trend of decarbonisation of energy reversed.



# Without more mitigation, global mean surface temperature might increase by 3.7° to 4.8°C over the 21st century.



# Mitigation requires major technological and institutional changes including the upscaling of low- and zero carbon energy.

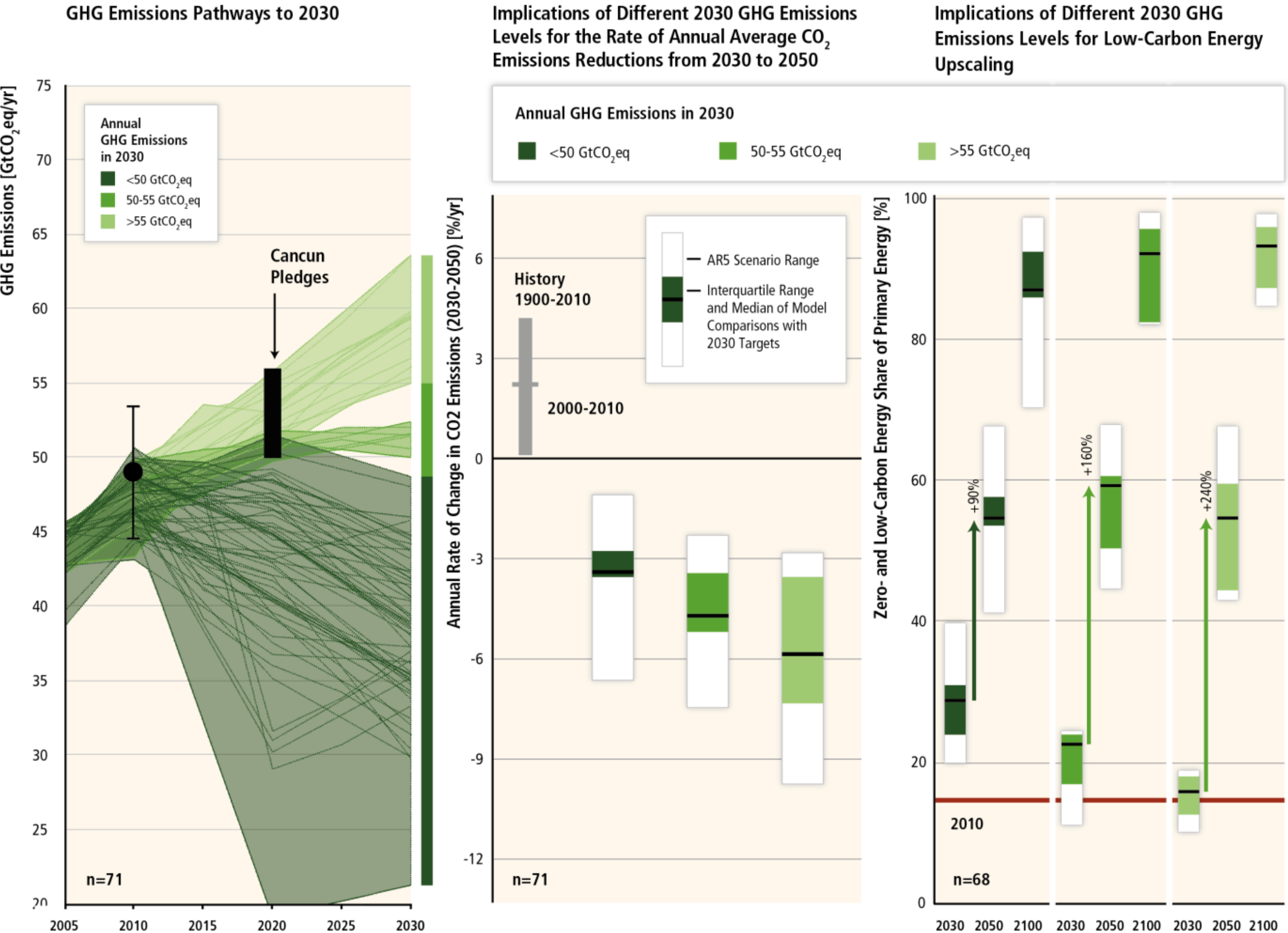


# Likelihoods of staying under X degrees Celsius

**Table SPM.1.** Key characteristics of the scenarios collected and assessed for WGIII AR5. For all parameters, the 10th to 90th percentile of the s
shown[1]. Source: [Table 6.3] – [TABLE REVISED]

| $CO_2$eq Concentrations in 2100 ($CO_2$eq) Category label (conc. range) | Subcategories | Relative position of the RCPs | Cumulative $CO_2$ emission[3] ($GtCO_2$) 2011-2050 | Cumulative $CO_2$ emission[3] ($GtCO_2$) 2011-2100 | $CO_2$eq emissions in 2050 (% of 2010 emissions)[4] | $CO_2$eq emissions in (% of 2010 emissions)[4] | Temperature (relative to 1850-1900)[6,7,8] 2100 Temperature (degrees C) | Likelihood of staying below 1.5 degrees C | Likelihood of staying below 2 degrees C | Likelihood of staying below 3 degrees C | Likelih staying degr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| < 430 | *Only a limited number of individual model studies have explored levels below 430 ppm CO2eq* | | | | | | | | | | |
| 450 (430 – 480) | Total range[10] | RCP2.6 | 550 – 1300 | 630 – 1180 | 28 – 59 | -18 – 22 | 1.5 - 1.7 (1.0 - 2.8) | More unlikely than likely | Likely | Likely | Lik |
| 500 (480 – 530) | No overshoot of 530 ppm $CO_2$eq | | 860 – 1180 | 960 – 1430 | 43 – 58 | -7 – 27 | 1.7 - 1.9 (1.2 - 2.9) | Unlikely | More likely than not | | |
| | Overshoot of 530 ppm $CO_2$eq | | 1130 – 1530 | 990 – 1550 | 45 – 75 | -14 – 10 | 1.8 - 2.0 (1.2 - 3.3) | | About as likely as not | | |
| 550 (530 – 580) | No overshoot of 580 ppm $CO_2$eq | | 1070 – 1460 | 1240 – 2240 | 53 – 81 | 19 – 41 | 2.0 - 2.2 (1.4 - 3.6) | | More unlikely than likely[9] | | |
| | Overshoot of 580 ppm $CO_2$eq | | 1420 – 1750 | 1170 – 2100 | 84 – 107 | -83 – 14 | 2.1 - 2.3 (1.4 - 3.6) | | | | |
| (580 – 650) | Total range | RCP4.5 | 1260 – 1640 | 1870 – 2440 | 62 – 124 | -34 – 50 | 2.3 - 2.6 (1.5 - 4.2) | | | | |
| (650 – 720) | Total range | | 1310 – 1750 | 2570 – 3340 | 89 – 117 | 46 – 79 | 2.6 - 2.9 (1.8 - 4.5) | | Unlikely | More likely than not | |
| (720 – 1000) | Total range | RCP6.0 | 1570 – 1940 | 3620 – 4990 | 118 – 154 | 93 – 172 | 3.1 - 3.7 (2.1 - 5.8) | Unlikely (+) | | More unlikely than likely | |
| >1000 | Total range | RCP8.5 | 1840 – 2310 | 5350 – 7010 | 152 – 195 | 174 – 278 | 4.1 - 4.8 (2.8 - 7.8) | | Unlikely (+) | Unlikely | More u than l |

# Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.



**Estimates for mitigation costs vary widely.**

- Reaching 450ppm $CO_2$eq entails consumption losses of 1.7% (1%-4%) by 2030, 3.4% (2% to 6%) by 2050 and 4.8% (3%-11%) by 2100 relative to baseline (which grows between 300% to 900% over the course of the century).

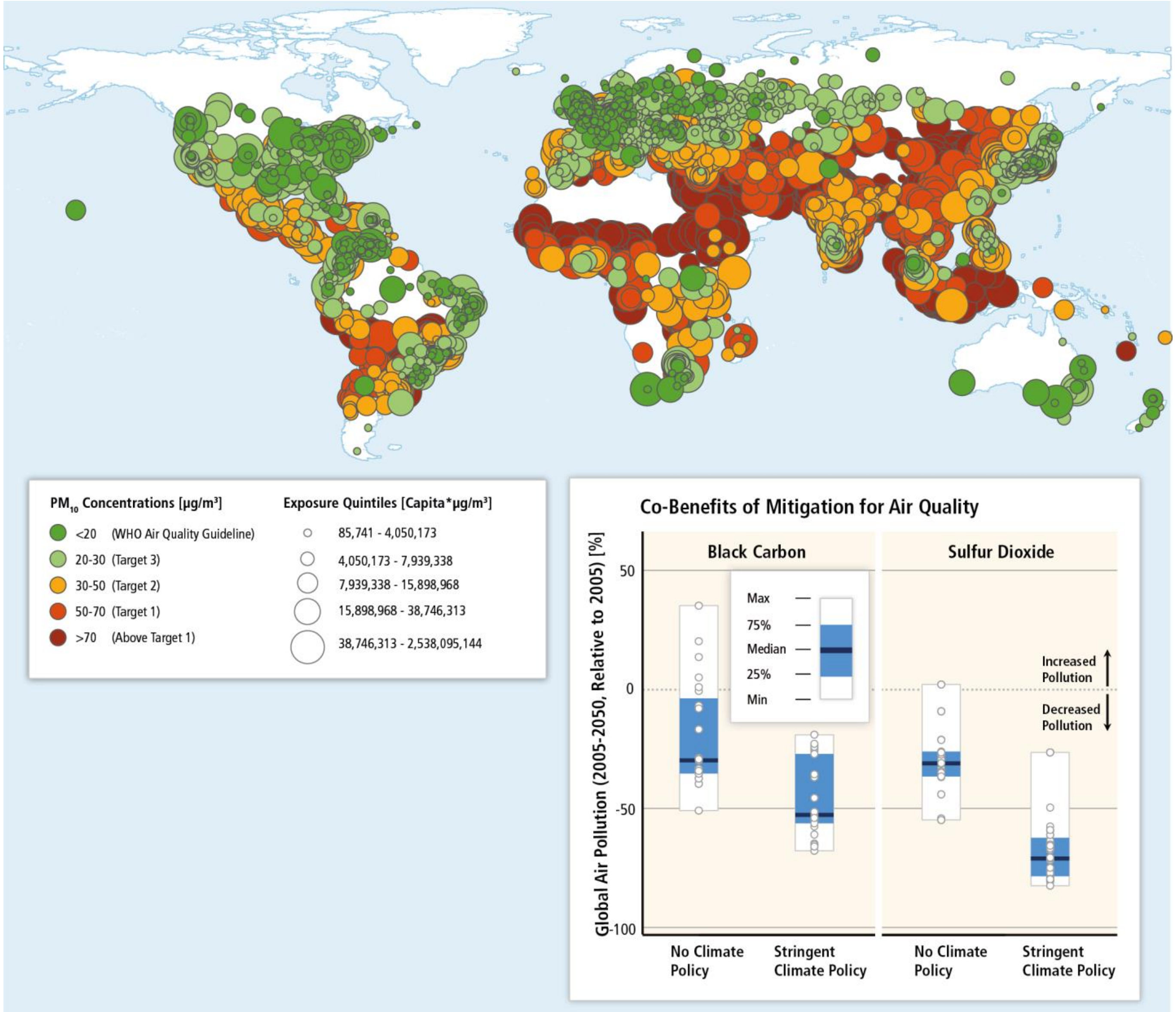
- This is equivalent to a reduction in consumption growth over the 21st century by about 0.06 (0.04-0.14) percentage points a year (relative to annualized consumption growth that is between 1.6% and 3% per year).

- Cost estimates exlude benefits of mitigation (reduced impacts from climate change). They also exclude other benefits (e.g. improvements for local air quality).

- Cost estimates are based on a series of assumptions.

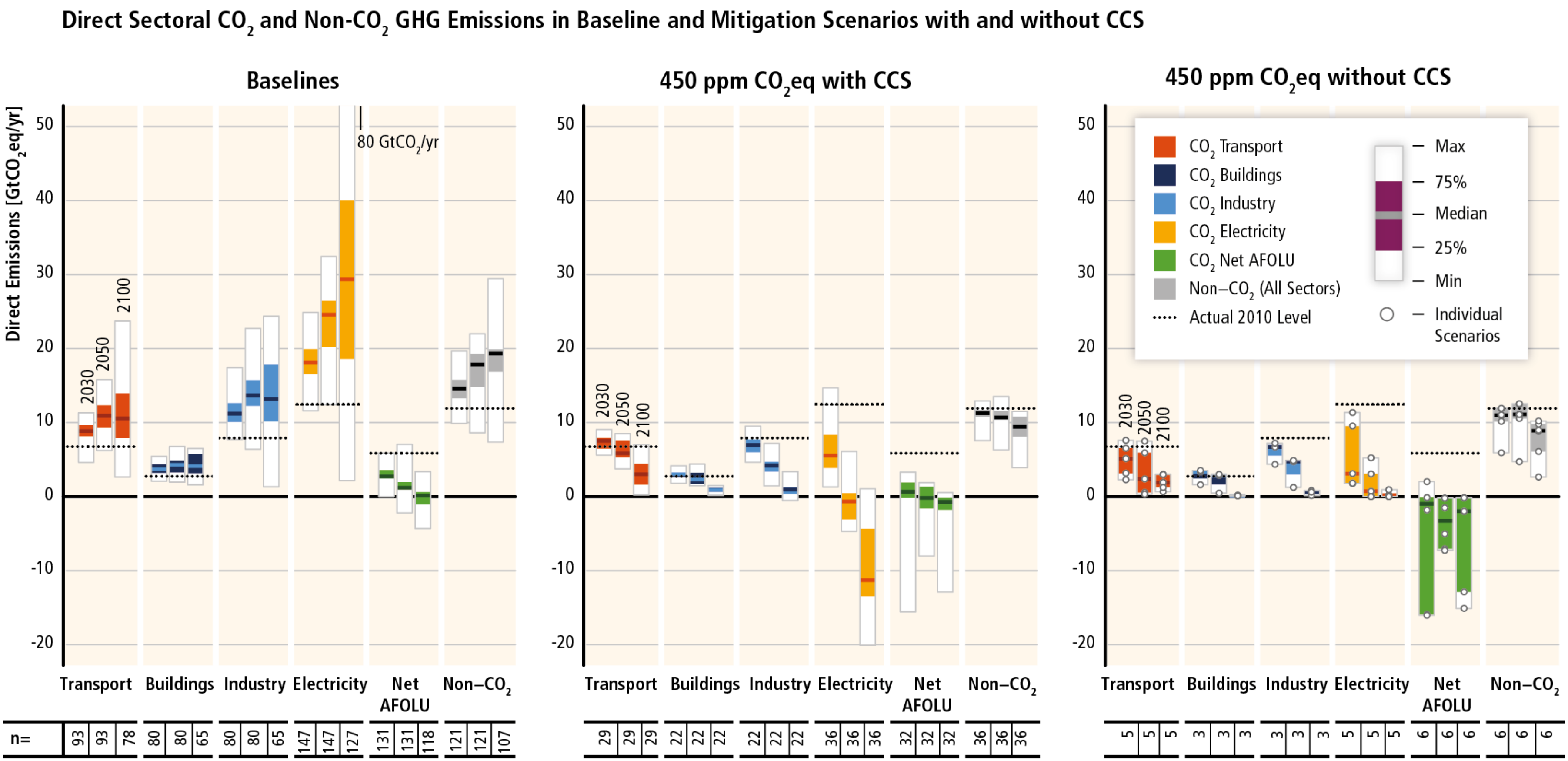
# Mitigation costs and their increase with other restrictions

| | Annual mitigation costs in cost-effective implementation scenarios [% reduction in consumption relative to baseline] | | | Increase in total discounted mitigation costs in technology constrained scenarios [% increase in total discounted mitigation cost (2015-2100) relative to default technology assumptions] | | | |
|---|---|---|---|---|---|---|---|
| 2100 Concentration (ppm $CO_2$eq) | 2030 | 2050 | 2100 | No CCS | Nuclear phase out | Limited Solar / Wind | Limited Bio-energy |
| 450 (430-480) | 1.7 (1.0- 3.7) [N: 14 (10)] | 3.4 (2.1-6.2) | 4.8 (2.9-11.4) | 138 (29-297) [N: 4 (4)] | 7 (4-18) [N: 8 (6)] | 6 (2-29) [N: 8 (6)] | 64 (44-77) [N: 8 (6)] |
| 500 (480-530) | 1.7 (0.6-2.1) [N: 32 (24)] | 2.7 (1.5-4.2) | 4.7 (2.4-10.6) | | | | |
| 550 (530-580) | 0.6 (0.2- 1.3) [N: 46 (32)] | 1.7 (1.2-3.3) | 3.8 (1.2- 7.3) | 39 (18-78) [N: 11 (9)] | 13 (2-23) [N: 10 (8)] | 8 (5-15) [N: 10 (8)] | 18 (4-66) [N: 12 (10)] |
| 580-650 | 0.3 (0-0.9) [N: 16 (12)] | 1.3 (0.5-2.0) | 2.3 (1.2- 4.4) | | | | |

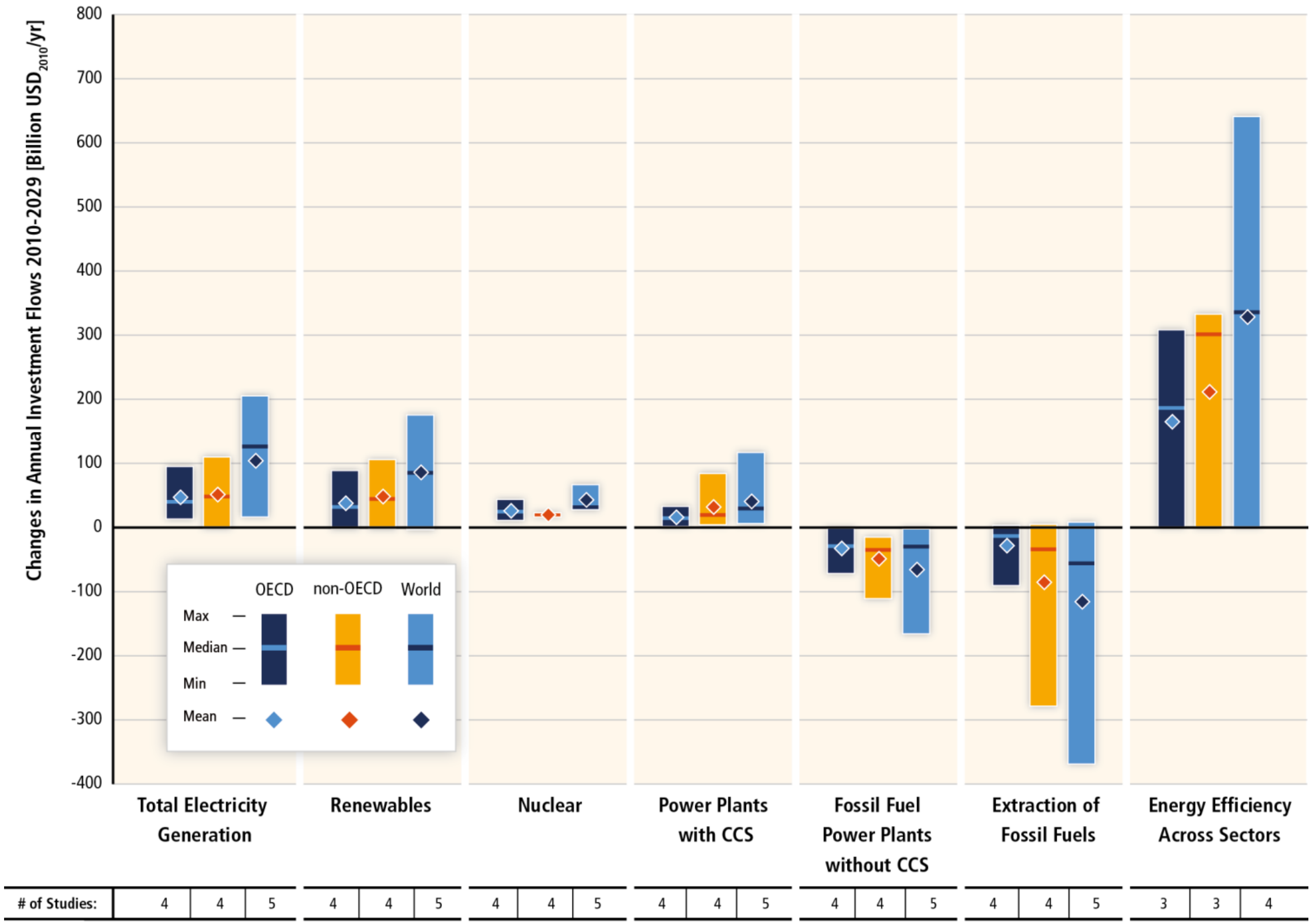



# Mitigation can result in large co-benefits for human health and other societal goals.

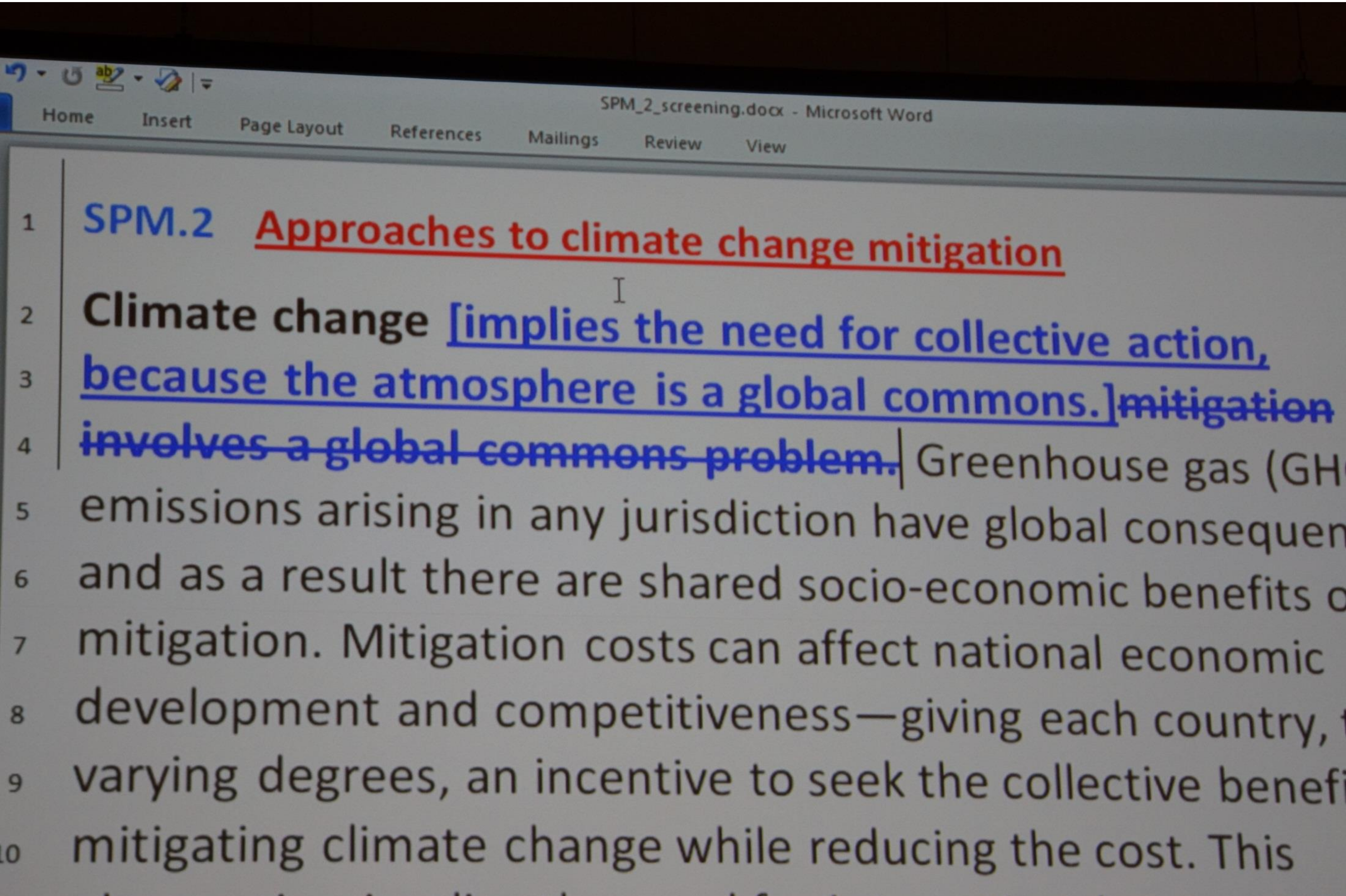
# Mitigation requires changes throughout the economy. Efforts in one sector determine mitigation efforts in others.



# Substantial reductions in emissions would require large changes in investment patterns.



# A Difficult Process



# I wonder if the Climate can be seen as a Global Commons?

IPCC PLENARY
39TH SESSION
Berlin, 7 – 12 April 2014
economic development and competitiveness [Sections 1.2.4,
3.2, 4.2, 13.2.1]. The literature also adopts a variety of other
complementary perspectives, such as approaching mitigation
policy as a problem of technological transition. That
perspective, for example, implies the importance of
ITALY
UZBEKISTAN
UNITED KINGDOM
UNITED STATES OF AMERICA

## Policy Instruments

## Since AR4, there has been an increased focus on policies designed to integrate multiple objectives, increase co-benefits and reduce adverse side-effects.

- Sector-specific policies have been more widely used than economy-wide policies.
- Regulatory approaches and information measures are widely used, and are often environmentally effective.
- Since AR4, cap and trade systems for GHGs have been established in a number of countries and regions.
- In some countries, tax-based policies specifically aimed at reducing GHG emissions–alongside technology and other policies–have helped to weaken the link between GHG emissions and GDP
- The reduction of subsidies for GHG-related activities in various sectors can achieve emission reductions, depending on the social and economic context.

”Comments” from the delgates: Take out subsidies?

**Effective mitigation will not be achieved if individual agents advance their own interests independently.**

- Existing and proposed international climate change cooperation arrangements vary in their focus and degree of centralization and coordination.
- Issues of equity, justice, and fairness arise with respect to mitigation and adaptation.
- Climate policy may be informed by a consideration of a diverse array of risks and uncertainties, some of which are difficult to measure, notably events that are of low probability but which would have a significant impact if they occur.

- **Cap and trade systems for GHGs are being established in a growing number of countries and regions. Their short-run environmental effect has been limited as a result of loose caps or caps that have not proved to be binding** (*limited evidence, medium agreement*). This was related to factors such as the financial and economic crisis, changes in fossil fuel markets, interactions with other policies and regulatory uncertainty. In principle A well-designed cap and trade system can be cost-effective. (national circumstances) Though earlier programmes relied almost exclusively on grandfathering (free allocation of permits), auctioning permits is increasingly applied. If allowances are auctioned, revenues can be used to address other investments with a high social return, and/or reduce the tax and debt burden. [14.4.2, 15.5.3]

- (In some countries)**Tax-based policies, some specifically aimed at reducing energy consumption or emissions–alongside technology and other policies–have helped to weaken the link between GHG emissions and GDP** in some countries (*high confidence*). In a large group of countries, fuel taxes (although not necessarily designed for the purpose of mitigation) have effects that are akin to sectoral carbon taxesTable 15.2. The demand reduction in transport fuel associated with a 1% price increase is 0.6% to 0.8% in the long run, although the short-run response is much smaller [15.5.2]. In some countries revenues are used to reduce other taxes to render policies more politically feasible. This illustrates the general principle that mitigation policies that raise government revenue generally have lower social costs than approaches which do not. While it has previously been assumed that fuel taxes in the transport sector are regressive, there have been a number studies since AR4 that have shown them to be progressive, particularly in low-income countries (*medium evidence, medium agreement*). [3.6.3, 14.4.2, 15.5.2]

- **The reduction of subsidies** to fossil fuels **(for GHG related activities) can achieve emission reductions at negative social cost depending on the social and economic context** (*high confidence*). Since AR4 a small but growing literature has quantified emission reductions from subsidy reform and suggests that complete removal of subsidies to high emission technologies in all countries could cut global emissions from (depending on circumstnces and definities) a few percent to as much as 18% (*low evidence, medium agreement*) [14.3.2, 15.5.2]. Although political economy barriers are substantial, some countries have reformed their tax and budget systems to reduce fuel subsidies. To help reduce possible adverse effects on lower income groups who often spend a large fraction of their income on energy services, many governments have utilized lump-sum cash transfers or other mechanisms targeted on the poor. [15.5.2]

**Bolivia**

- **Within an appropriate enabling environment, the private sector can play an important role in mitigation** *(medium evidence, high agreement)***.** The share of total mitigation finance from the private sector, acknowledging data limitations, is estimated to be on average between two-thirds and three-fourths on the global level (2010-2012) (*limited evidence, medium agreement)*. In many countries, public finance interventions by governments and national and international development banks direct

**Bolivia**

- In many countries the private sector plays central roles in the processes that lead to emissions ….**Within an appropriate enabling environment, the private sector can play an important role in mitigation** *(medium evidence, high agreement)***.** The share of total mitigation finance from the private sector, acknowledging data limitations, is estimated to be on average between two-thirds and three-fourths on the global level (2010-2012) (*limited evidence, medium agreement)*. In many countries, public finance interventions by governments and national and international development banks direct

***SPM.5.2 International cooperation***

- **International cooperation on climate change has diversified over the past decade**. The United Nations Framework Convention on Climate Change (UNFCCC) remains a primary THE MAIN international forum for climate negotiations, and is seen by many as the most legitimate international climate policy venue due in part to its virtually universal membership [13.3.1, 13.5]. However, other institutions organized at many different scales have risen in importance due to the inclusion of climate change issues in other policy arenas and growing awareness of the co-benefits that can arise from linking climate mitigation and other issues [13.3, 13.4, 13.5].

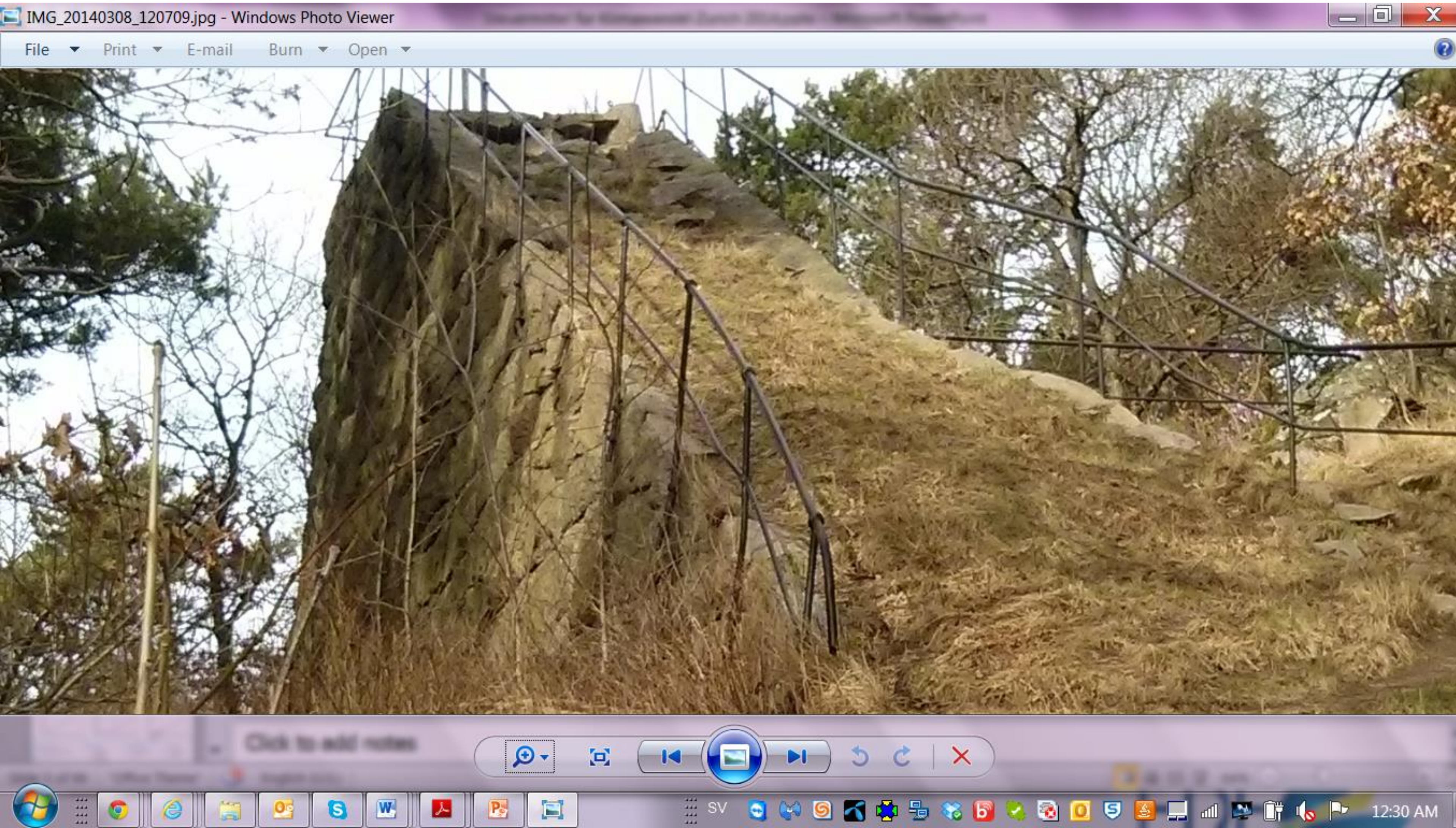
# Getting Late

## The 25 Japanese were always awake

# Is it POSSIBLE ?

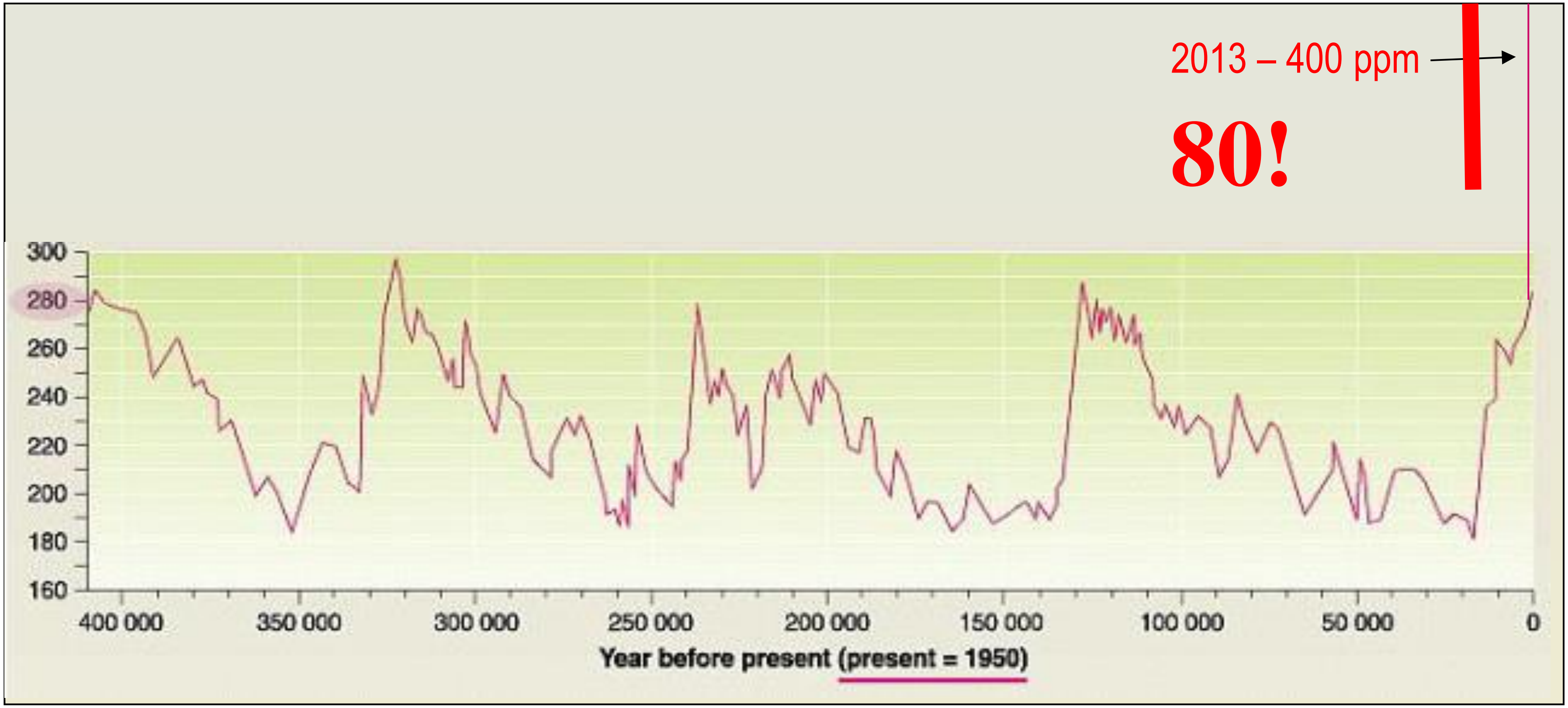
# A Maya Ruin in Slottskogen

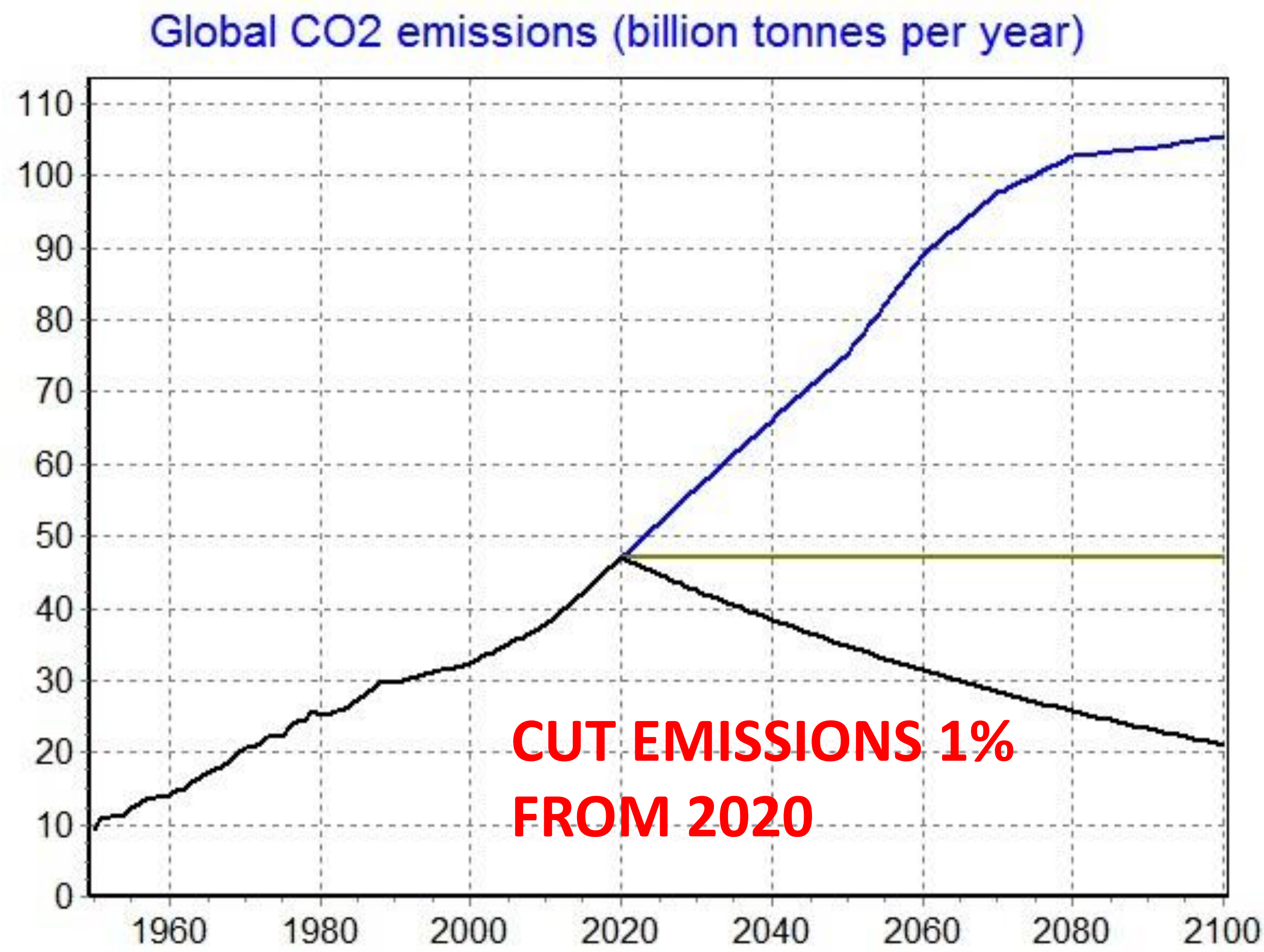
# Ski jump

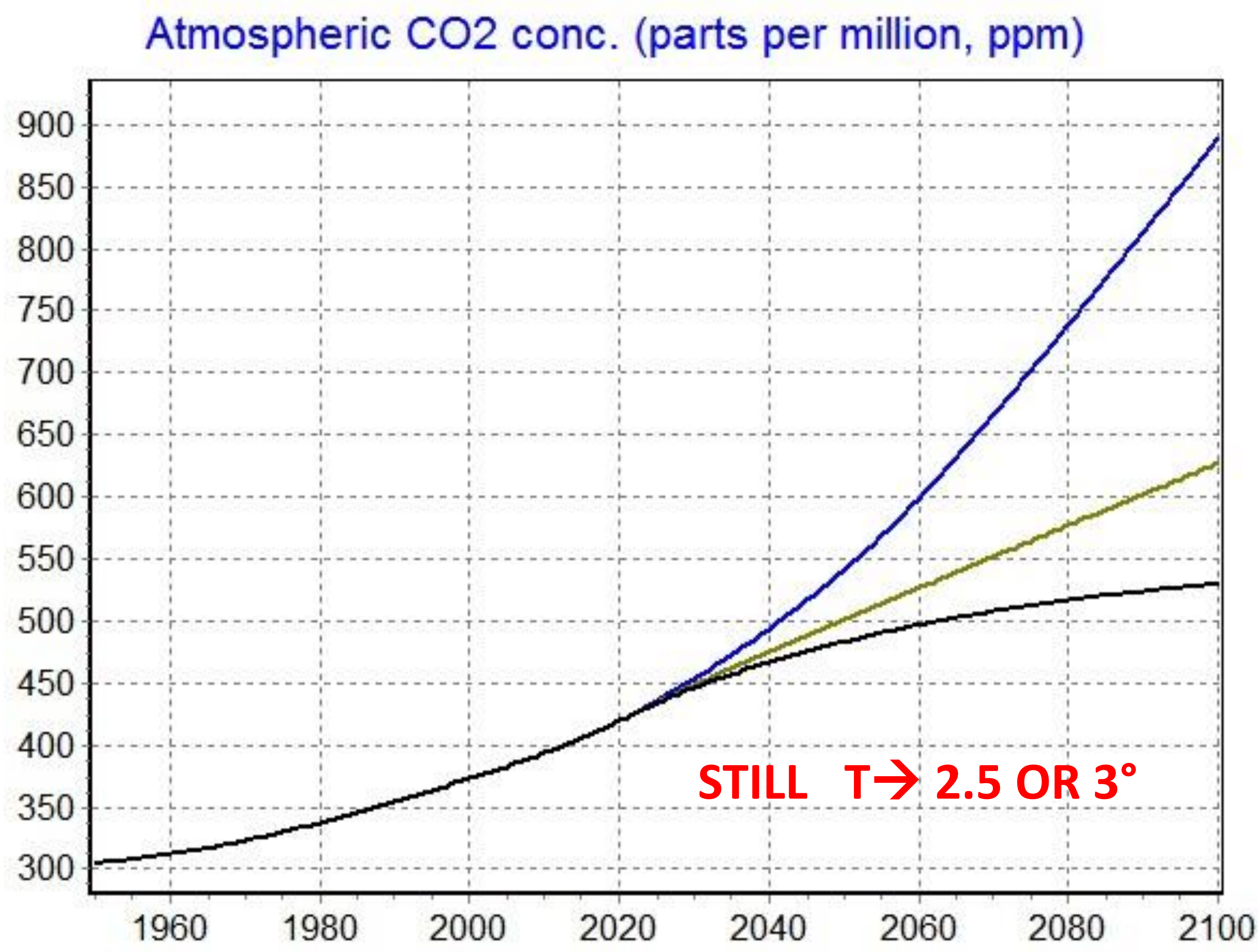


IMG_20140308_120709.jpg - Windows Photo Viewer
File
Print
E-mail
Burn
Open
SV
12:30 AM

# $CO_2$ i atmosfören




Global CO2 emissions (billion tonnes per year)
110
100
90
80
70
60
50
40
30
20
10
0
1960
1980
2000
2020
2040
2060
2080
2100
CUT EMISSIONS 1%
FROM 2020


Atmospheric CO2 conc. (parts per million, ppm)
900
850
800
750
700
650
600
550
500
450
400
350
300
1960
1980
2000
2020
2040
2060
2080
2100
STILL T→ 2.5 OR 3°

# IPCC WGIII AR5

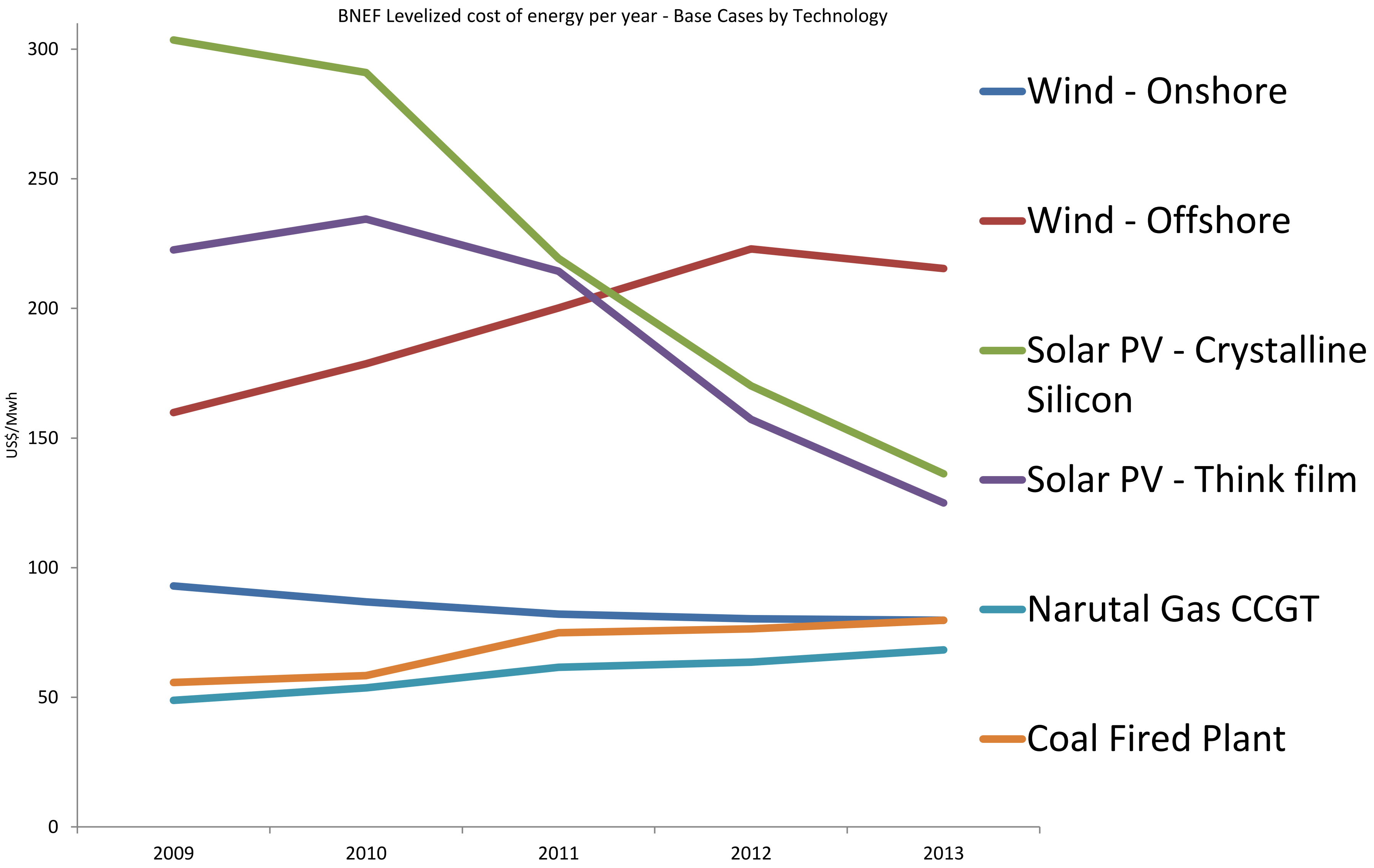
- = ?

# Climate treaty needed...

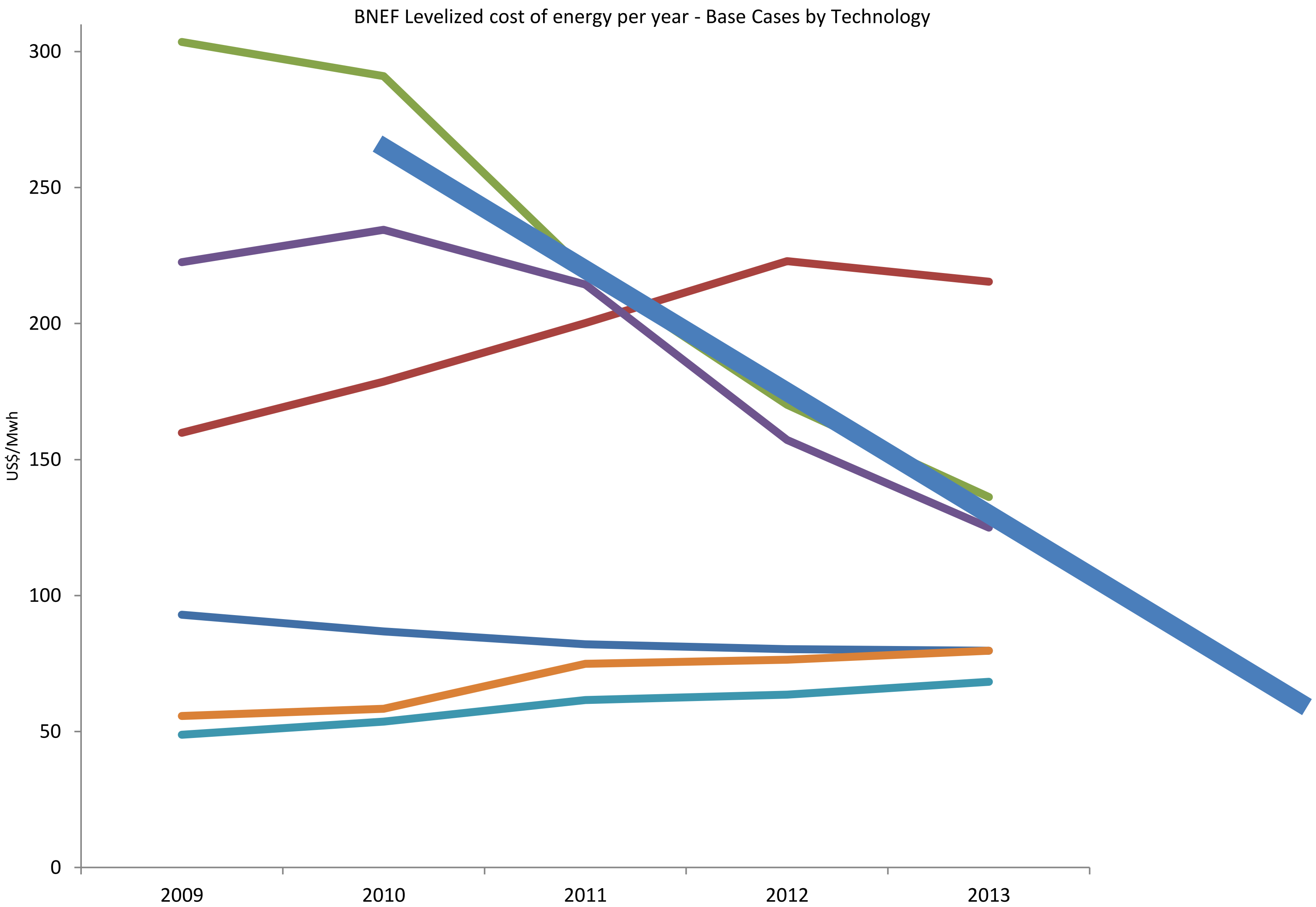

ETHYL
LUCY
EL BUSTO GAS COMPANY
Put an Idiot in Your Tank!
EL BUSTO GAS COMPANY
Put an Idiot in Your Tank!

# Even in Texas, wind...

# ERNEUEBARE ENERGIEQUELLEN

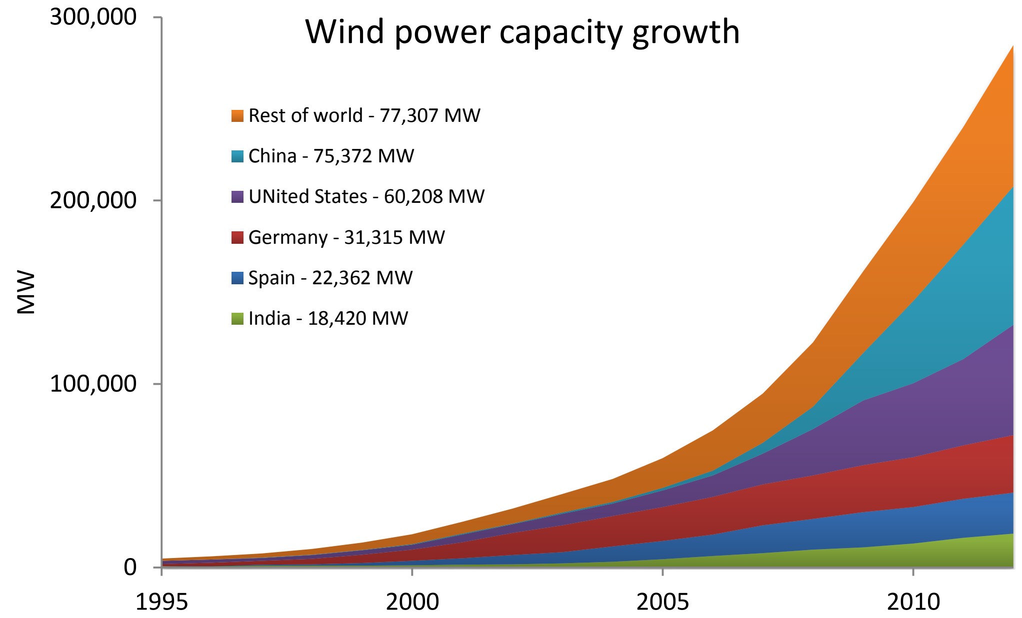


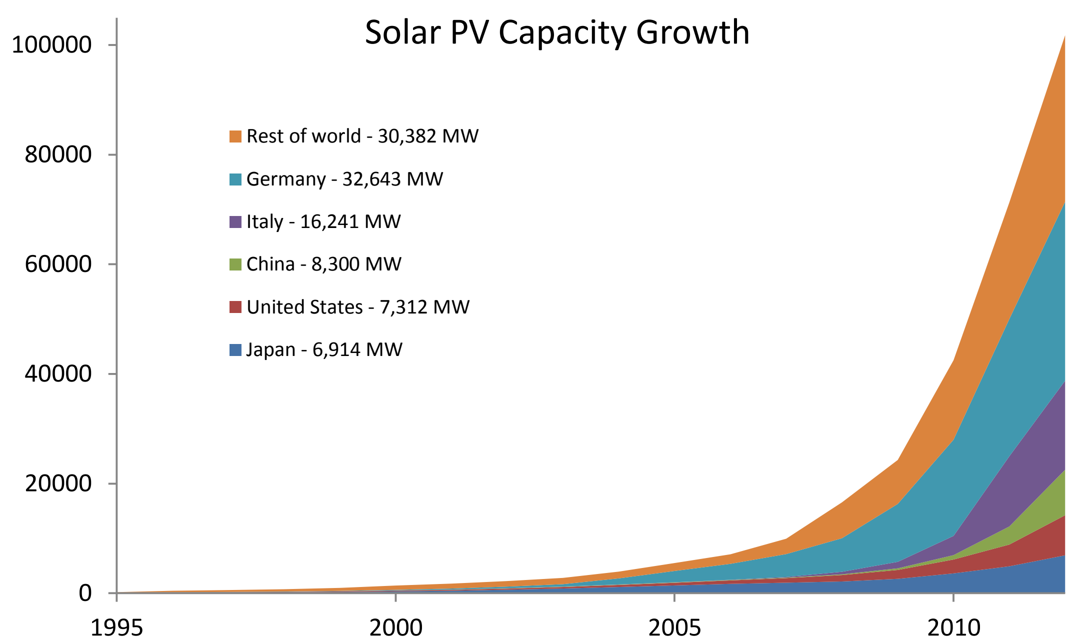
# ERNEUEBARE ENERGIE KOSTEN



# KONKLUSION

- 2° Schwierig
- 2.5 besser als 3
- Anpassung
- CCS
- GEOengineering
- ERNEUEBARE ENERGIE



# Mojave 377MW

# Have you ever thought about how much energy it takes to light up Superbowl?

## Lincoln Financial Field

- Home to Philadelphia Eagles
- > 11 000 solar panels
- 14 micro wind turbines
- Solar panel arrangements at entrance areas ensuring every visitors sees the teams commitment to sustainable energy.

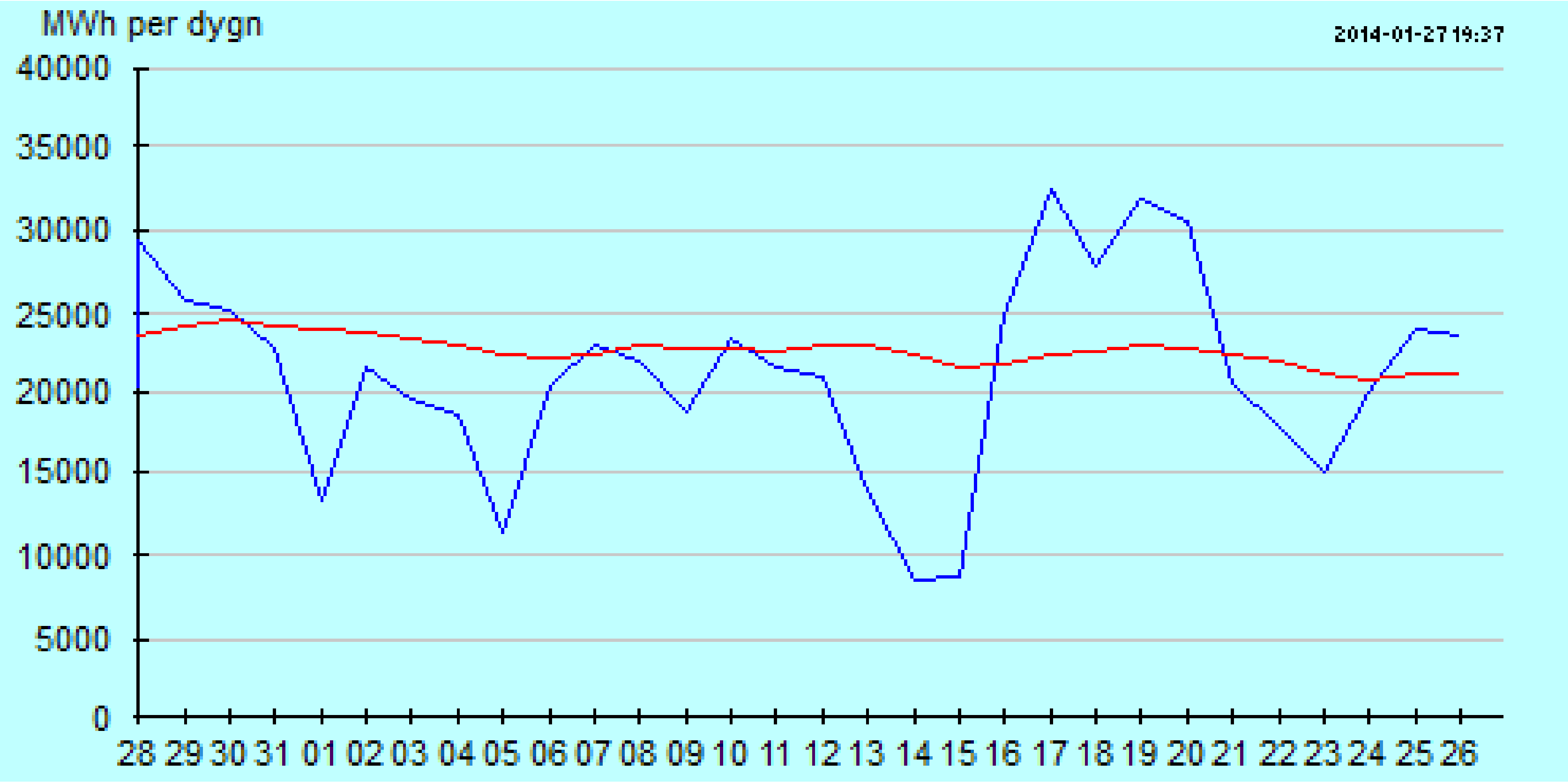

## MetLife Stadium

- Home to New York Giants and New York Jets
- 1350 solar panels

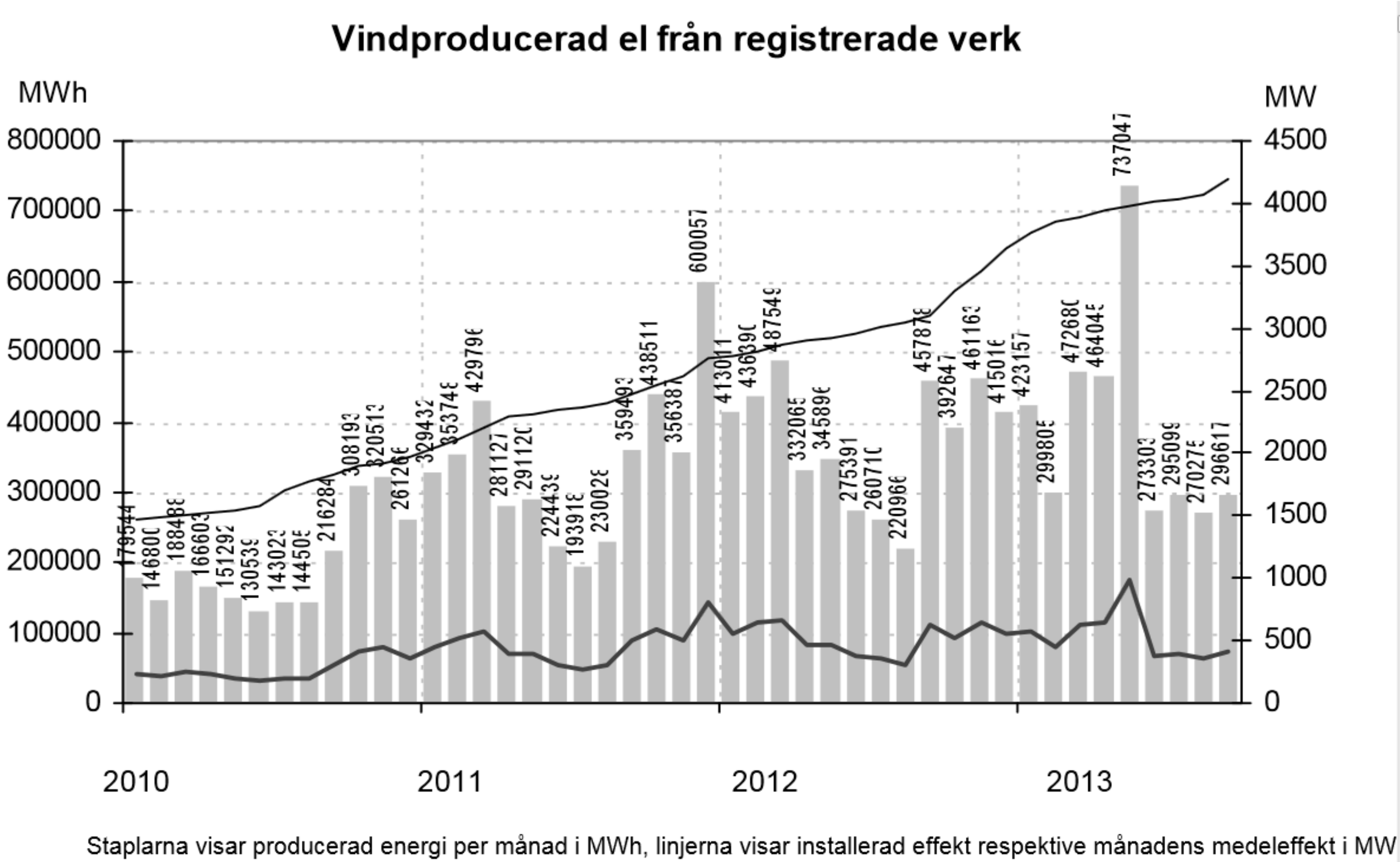
**Green initiative**:
- ✓ water conservation
- ✓ Recycling
- ✓ Composting
- ✓ increased energy efficiency
- ✓ donate leftover food
- ✓ etc


Source: nrgnergy.com, metlifestadium.com

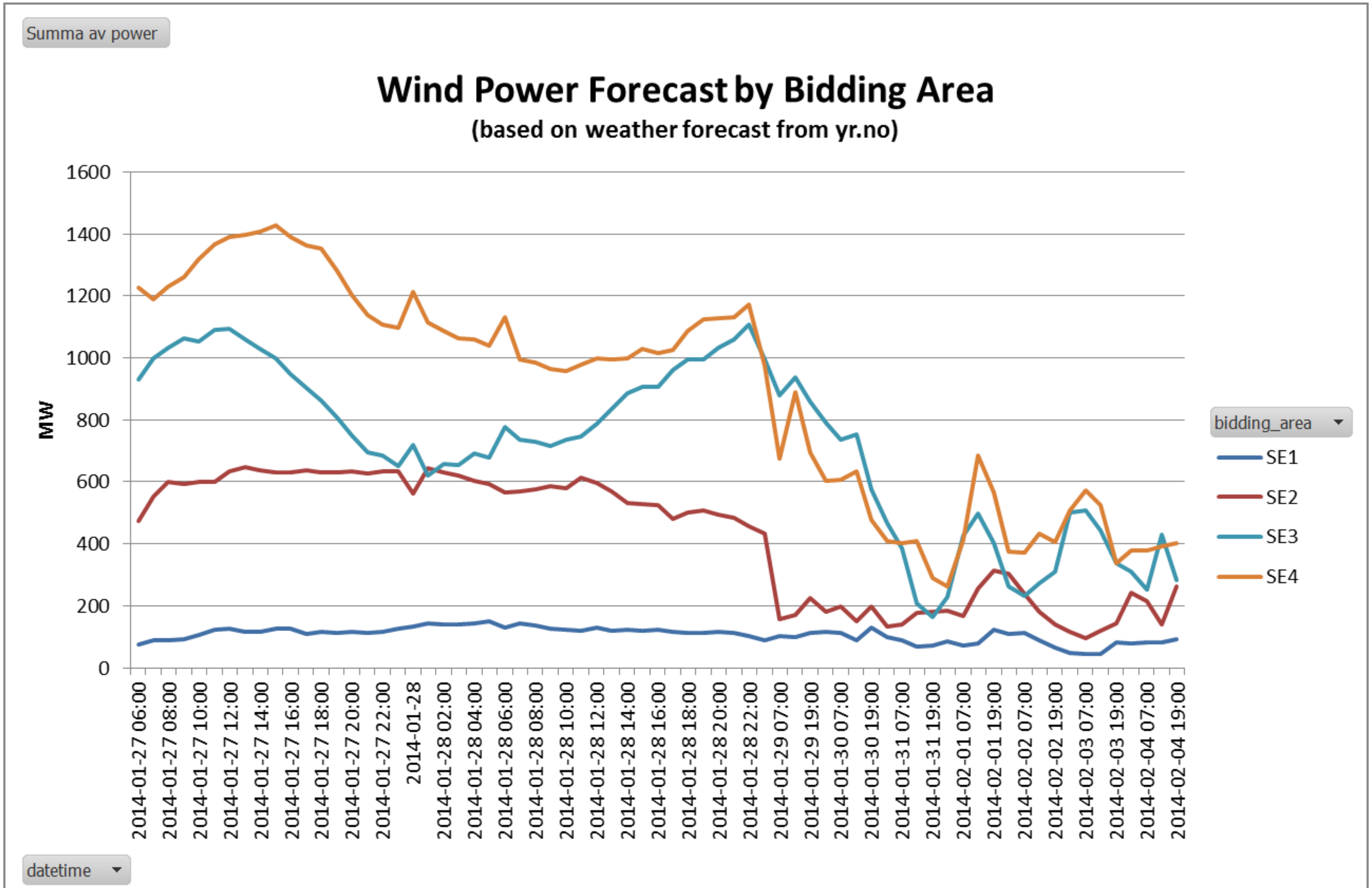
# Electricity Dec 28-Jan 26 2014



# Electricity per month 2010-2013



# Forecasts for a week



# Nuclear is also intermittent!

# What is the value of the electricity? Does it include transmission distr. etc – in what way and when?