Vattenfall Capital Markets Day 2007

Presentation by

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Stockholm, 24 September 2007

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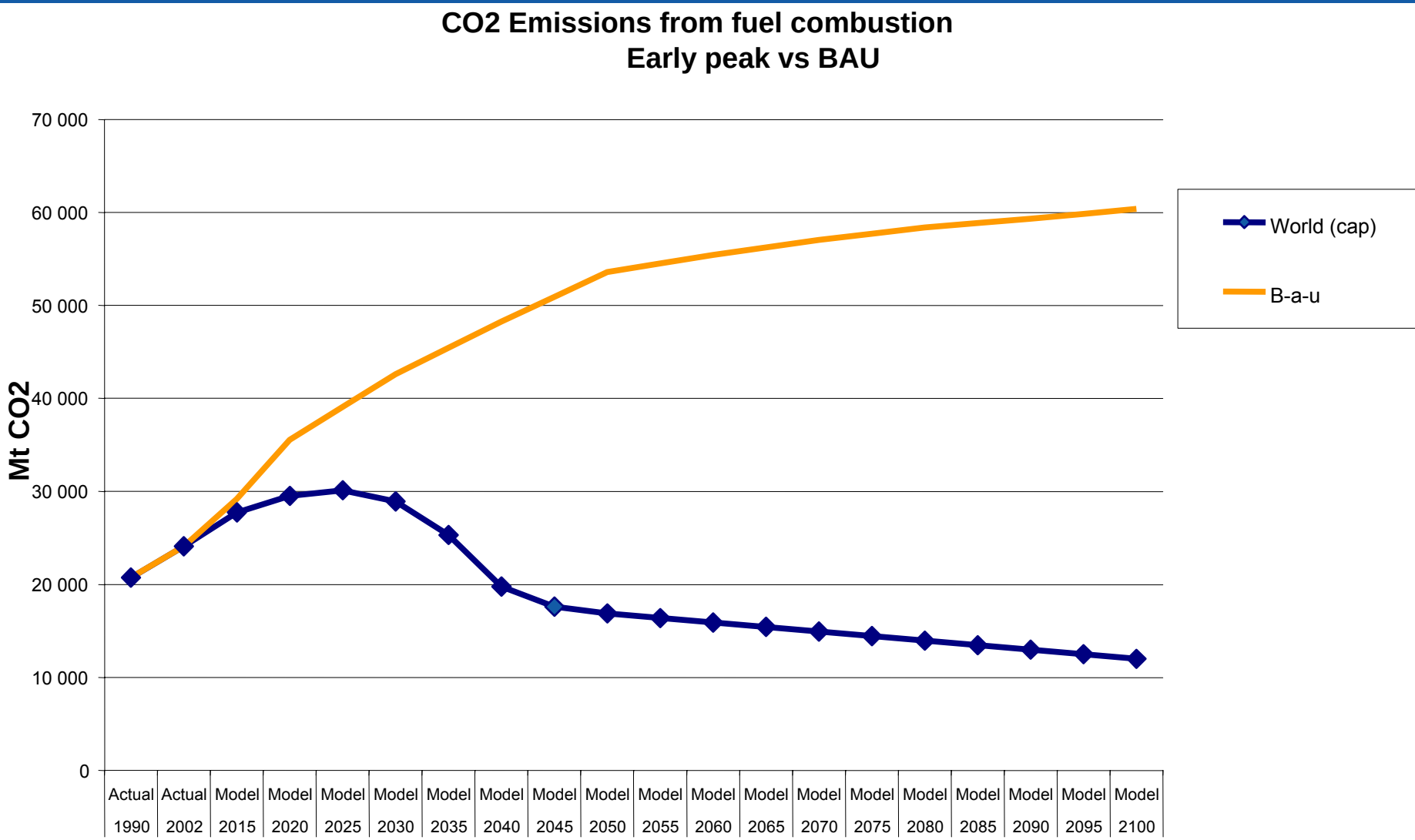
Currently we are diverging



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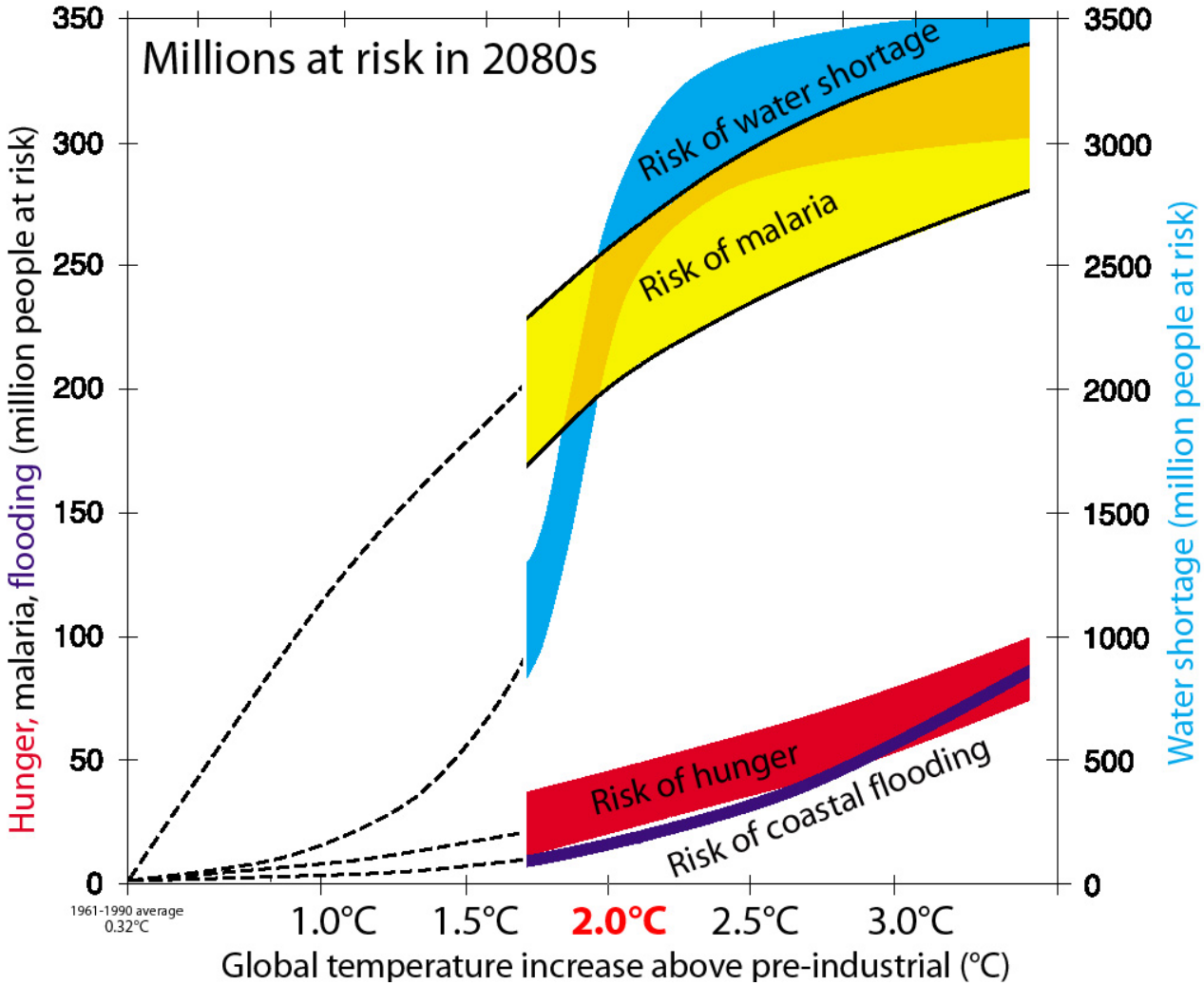
Global warming – millions at risk in 2080s



The EU has decided on 2ºC as the maximum prudent global warming level

Source: Parry (2001)

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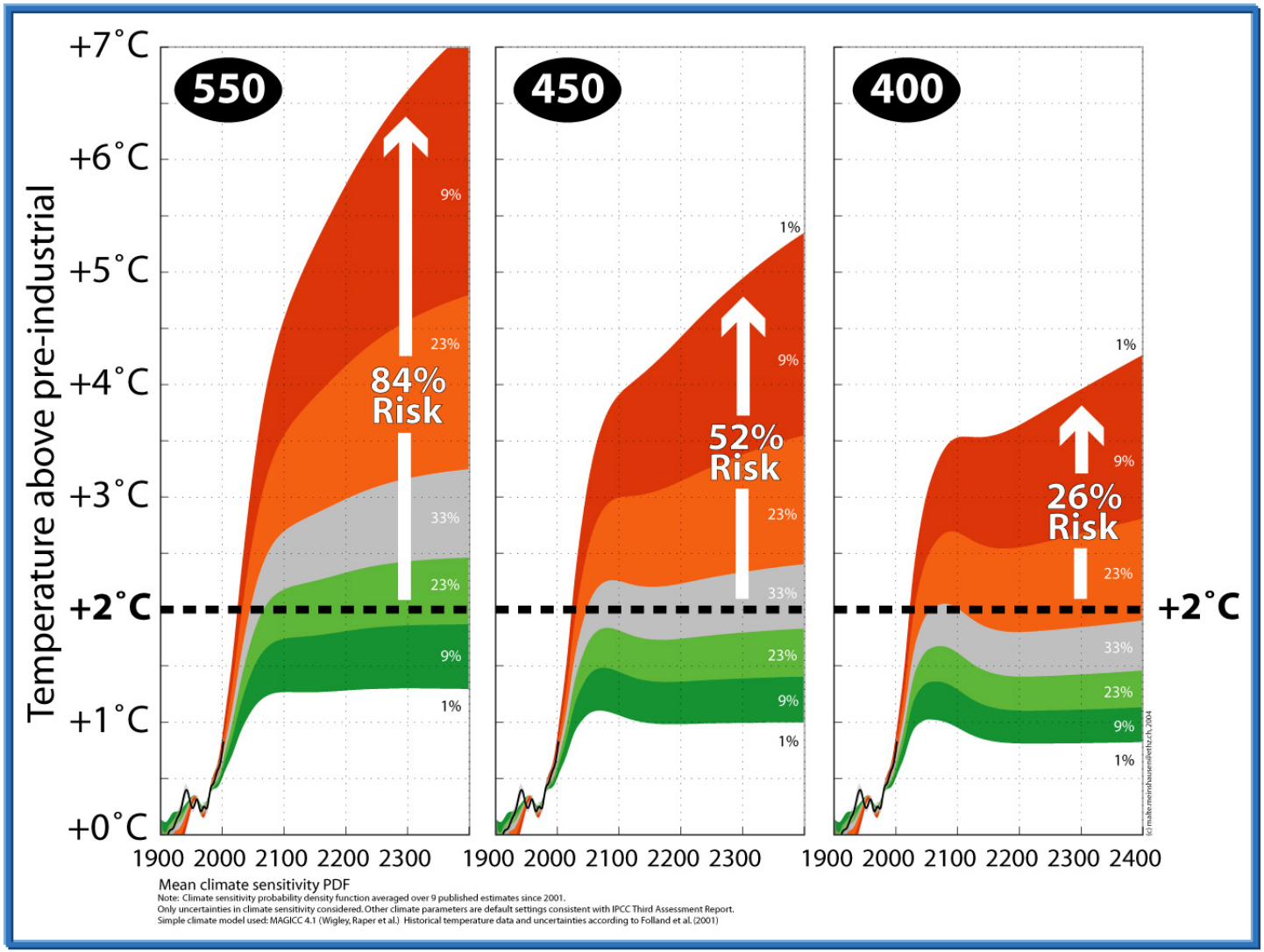
The 2ºC warming target - risks at different CO2e concentration levels



Source: Meinshausen (2004); European Environment Agency

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Vattenfall's Global Climate Impact Abatement Map

Abatement cost = additional cost of a low emission technology/ opportunity compared to business-as-usual (operational cost + depreciation)

- 6 sectors: power, industry, transportation, buildings, forestry, agriculture
- 6 regions: North America, Western Europe, Eastern Europe incl. Russia, other industrialized countries, China, Rest of World
- 3 time frames: 2010, 2020, 2030

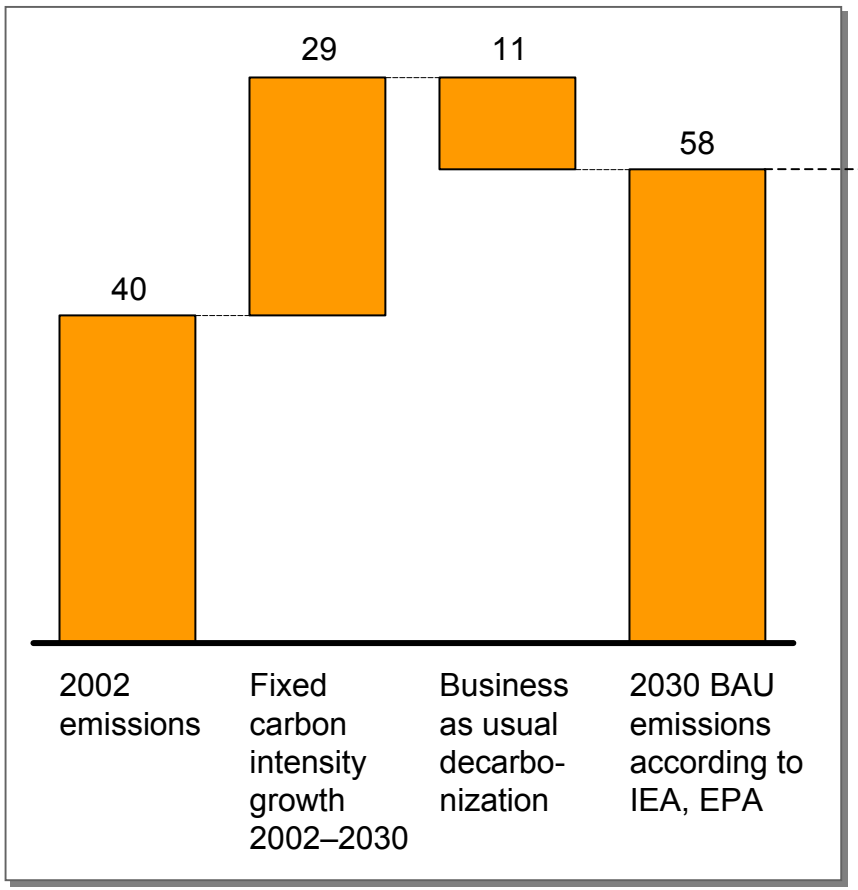
The report shows realistic abatement *potentials*, not *forecasts!*

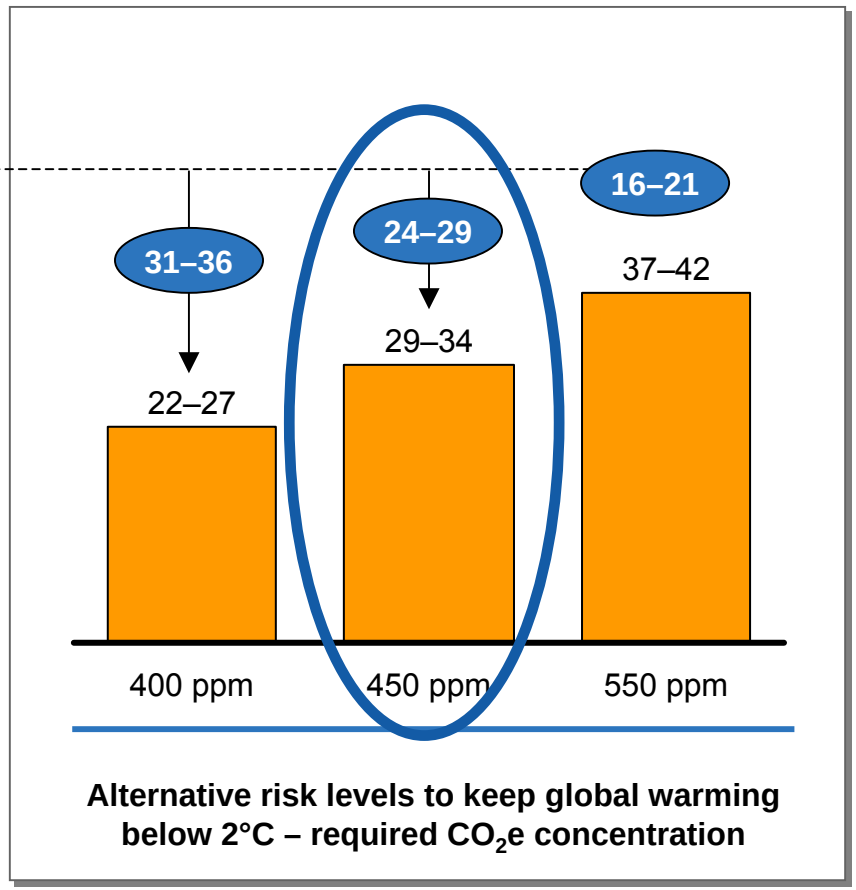
What's needed by 2030 to contain global warming below 2°C?

CO_2e emissions per year, Gton

Abatement required by 2030 compared to the BAU

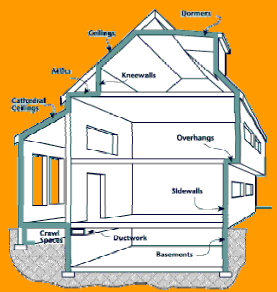
Emissions growth through 2030 in the business as usual forecast





Alternative risk levels to keep global warming below 2°C – required CO_2e concentration

Examples of negative cost abatement opportunities

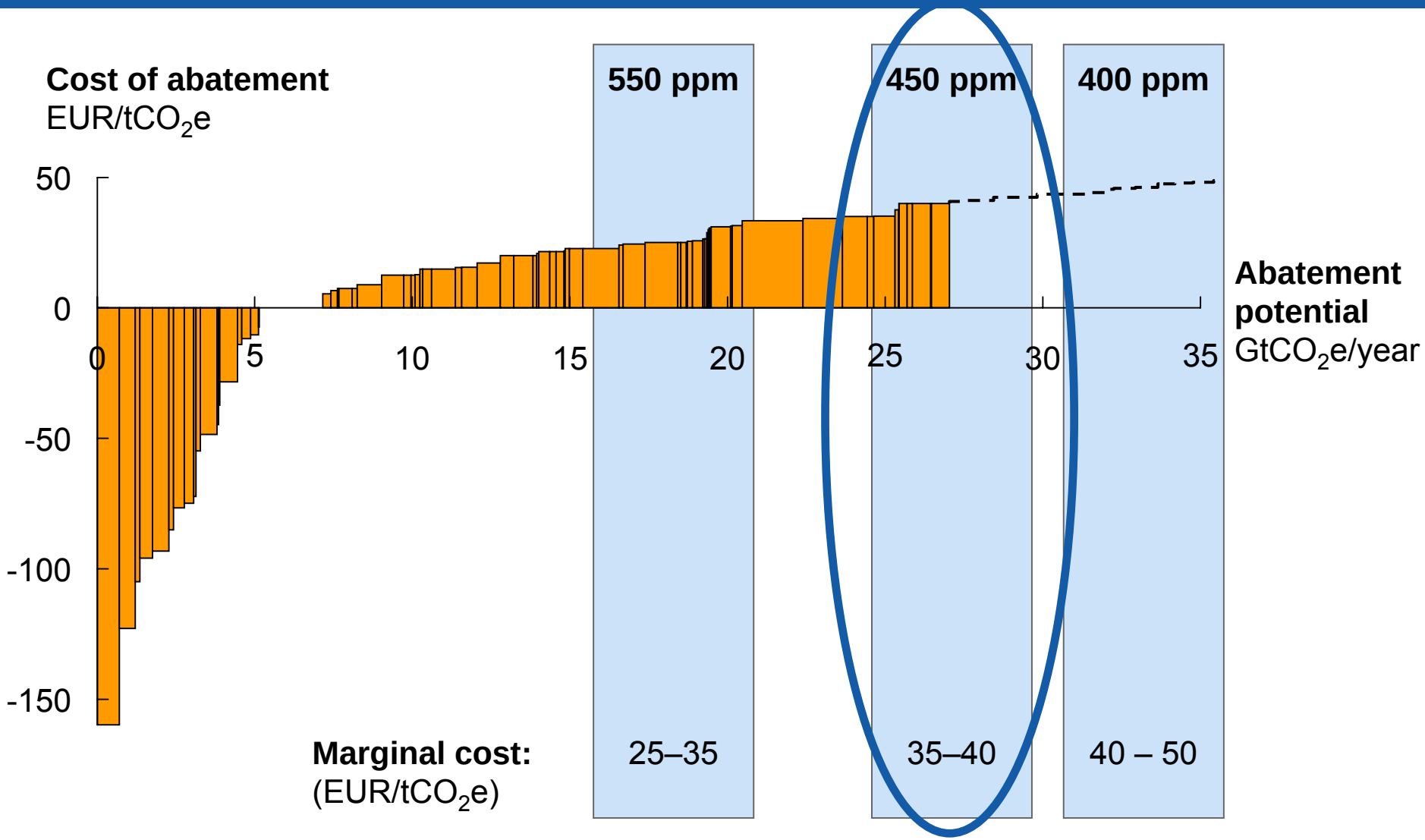
	Opportunity	Barriers
Improved insulation 	• 25% less energy for heating versus BAU • 60% lower lifecycle heating cost* • Average abatement cost: -130 EUR/t CO_2e • Total abatement opportunity: 1.6 $GtCO_2e$	**Misaligned incentives:** • Builders minimize upfront building costs – not life-cycle cost • Buyers typically not involved in specifying insulation levels
Compact Fluorescent Lamp 	• 80% reduced energy consumption • 41% lower lifecycle cost for consumer • Average abatement cost: -90 EUR/t CO_2e • Total abatement opportunity: 0.2 $GtCO_2e$	**End-user behavior:** • Lacking awareness of opportunities • Savings low compared to total household budget • Require very short payback times

* Example for typical house in mild region with electrical heating

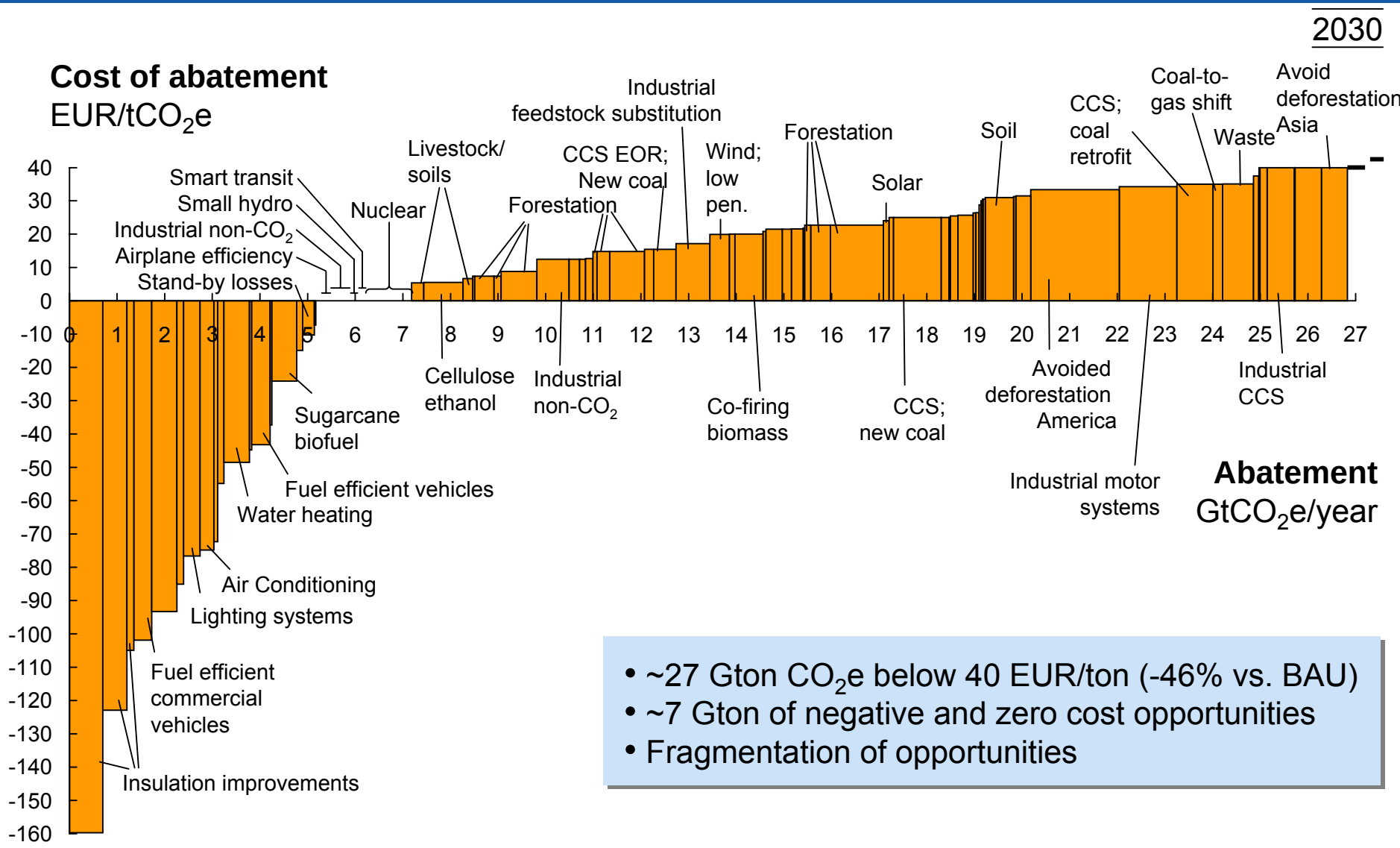
Examples of abatement cost calculations – power sector

	Opportunity	Barriers
Wind power 	• Average abatement cost: – 21 EUR / tCO2e – Of which 5 EUR / tCO2e is cost induced by the high penetration • Total abatement opportunity: 0.5 $GtCO_2e$	**Environmental impact:** • Wind mill sites are often perceived as obstacles • At higher penetration rates, intermittency becomes a costly issue
Carbon capture & storage 	• Potentially installed on 55% of all coal plants by 2030 • Abatement cost: 20 – 30 EUR/tCO_2e in 2030 • Total abatement opportunity: 3.1 $GtCO_2e$	**Storage:** • Storage alternatives still need to be tested and approved **Technological development:** • Technology currently existing but needs to be proven at scale in integrated solutions

Marginal abatement cost in the different demand scenarios 2030



Global cost curve of GHG abatement opportunities beyond business as usual



- ~27 Gton CO_2e below 40 EUR/ton (-46% vs. BAU)
- ~7 Gton of negative and zero cost opportunities
- Fragmentation of opportunities

All sectors and regions will have to contribute to emissions reductions – global cooperation is key to the low carbon economy

$GtCO_2e$, 2030

	Regions						
Sectors	**US + Canada**	**OECD Europe**	**Eastern Europe** (incl. Russia)	**Other Industrial***	**China**	**Rest of world****	**Total**
Power	1.3	0.8	0.3	0.7	1.7	1.0	**5.9**
Industrial	0.8	0.6	0.7	0.8	1.5	1.5	**6.0**
Transportation	1.2	0.5	0.1	0.4	0.3	0.4	**2.8**
Buildings	0.8	0.5	0.4	0.5	0.7	0.8	**3.7**
Forestry	0.2	0	0	0	0	6.5	**6.7**
Agriculture	0.2	0.1	0.1	0.1	0.3	0.8	**1.5**
Total	**4.4**	**2.5**	**1.6**	**2.5**	**4.6**	**11.1**	**26.7**

* Australia, New Zealand, Japan, Singapore, South Korea, Taiwan, UAE, Saudi Arabia, Qatar, Oman, Kuwait, Israel, Bahrain, Mexico
** Africa, South and Central America excl. Mexico, Asia excl. China and countries included in “Other industrialized” (see previous note)

Split of opportunities according to abatement cost

$GtCO_2e$, 2030

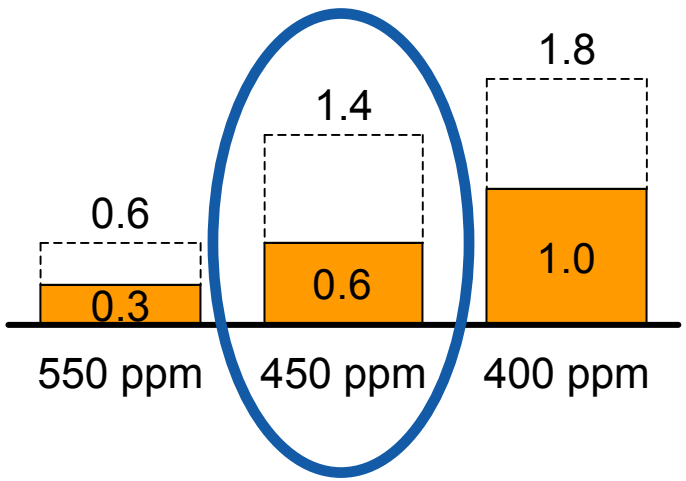
Abatement cost EUR/t CO_2e	Regions: US + Canada	OECD Europe	Other Industrial*	Eastern Europe (incl. Russia)	China	Rest of World**	Total
≤0	1.5	1.1	1.0	0.7	1.0	1.8	**7.1**
0–20	1.2	0.5	0.5	0.3	1.2	3.4	**7.1**
20–40	1.6	0.9	1.1	0.6	2.4	5.9	**12.5**
Total	**4.3**	**2.5**	**2.6**	**1.6**	**4.6**	**11.1**	**26.7**

- ~50% of negative cost opportunities are in industrialized world (buildings, transportation)
- ~40 % of 20–40 EUR/ton opportunities are in Rest of the World, largely driven by forestry opportunities

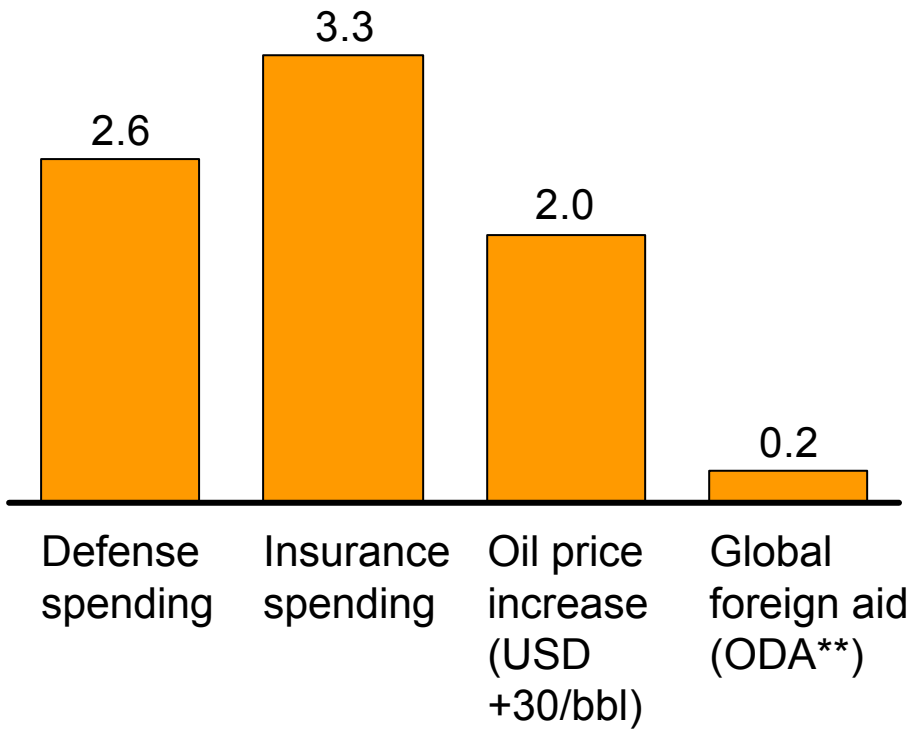
* Australia, New Zealand, Japan, Singapore, South Korea, Taiwan, UAE, Saudi Arabia, Qatar, Oman, Kuwait, Israel, Bahrain, Mexico
** Africa, South and Central America excl. Mexico, Asia excl. China and countries included in "Other industrialized" (see previous note)

Estimates of total global cost for society

Estimates of total abatement cost for the global society*
% of global GDP 2030



Comparables
% of global GDP 2005

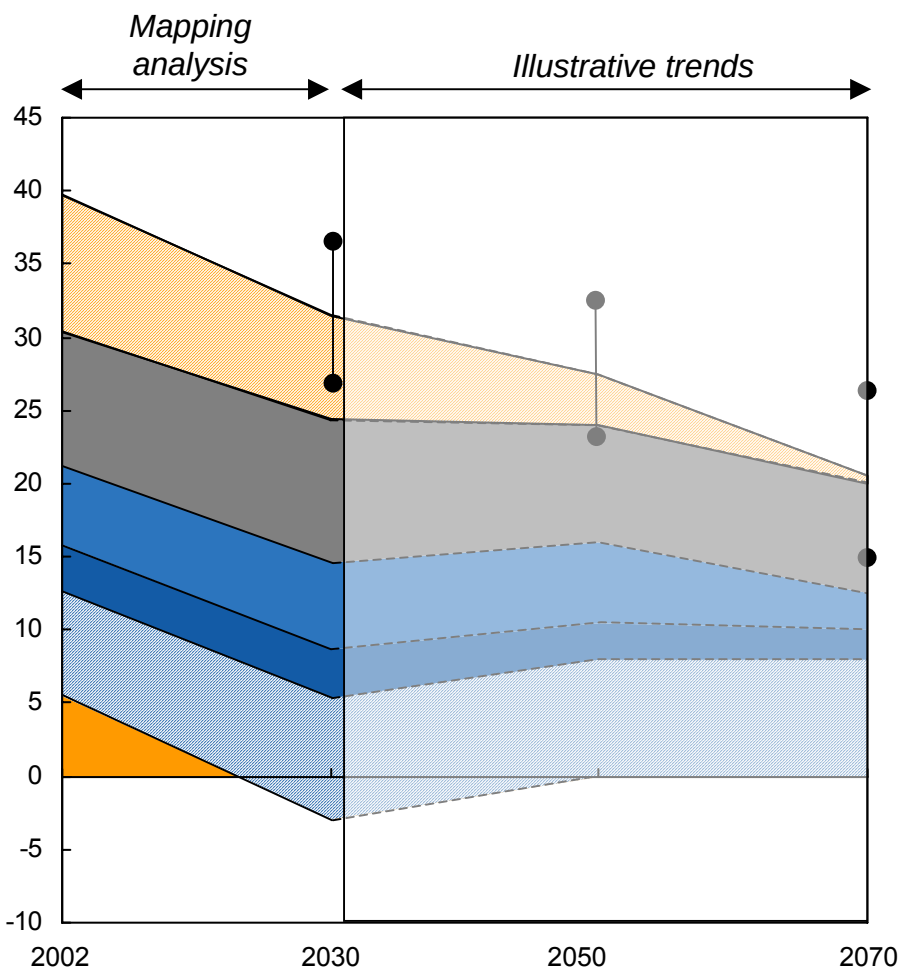


* Lower boundary: Opportunities addressed in order of increasing cost and negative costs are set to zero; upper boundary: Average cost EUR 40/ton

** Official Development Assistance from OECD countries; does not include humanitarian aid or private donations

Possible long-term development of emissions per sector – illustrative trends

$GtCO_2e$ per year



Emissions to maintain 450 ppm CO_2, Gt CO_2e

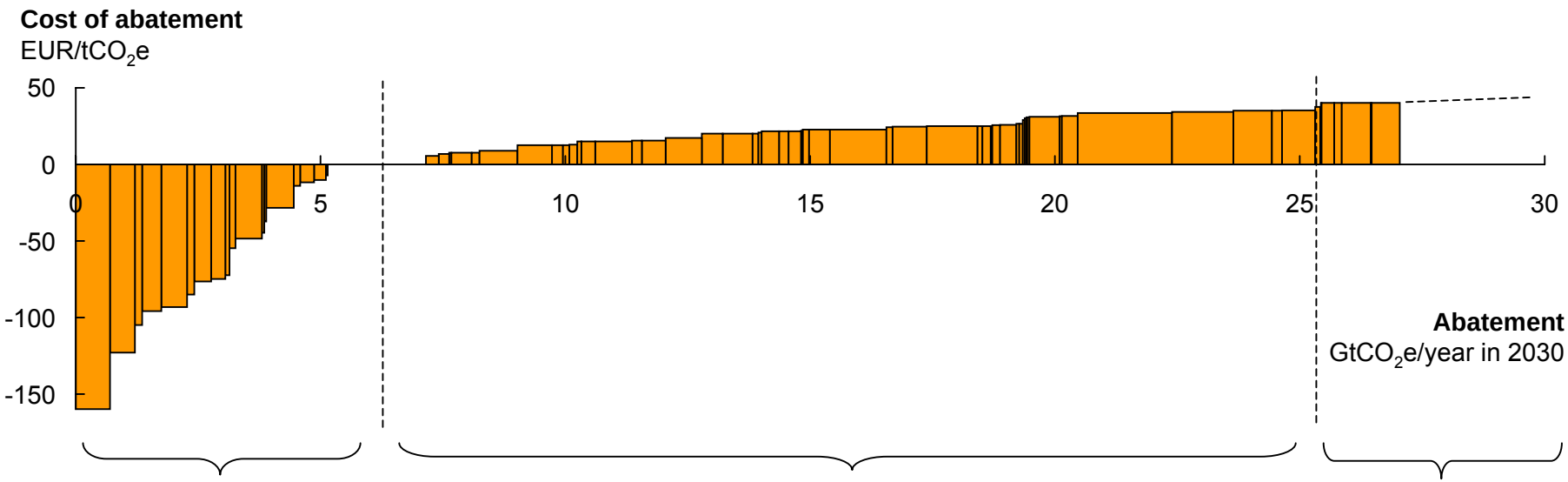
Potential long term trends

- **Power: Zero;** long term if all fossil fuel plants are equipped with CCS
- **Industry: stable;** reduction at large emitters (e.g., via CCS) balanced by new, small emitters
- **Transport: stable/decreasing;** more bio fuels, hybrids and plug-ins balance increased transportation need
- **Buildings: stable;** efficiency improvements balance population growth, further reduction through electrification
- **Agriculture/Waste: stable;** improvements in carbon efficiency balance population increase
- **Forestry: zero;** deforestation and forestation reaches equilibrium

Three different types of sectors

	2030 abatement potential		Key characteristics
	$GtCO_2e$	EUR/tCO_2e	
Power and industry 	11.9	15–40	• Mainly industrialized countries • Small number of large, rational emitters • High cost • Minor consumer implications • Competitive distortion issues
Transpor-tation and buildings 	6.6	<5 (often negative)	• Mainly industrialized countries • Billions of small emitters • Low/negative cost • High consumer implications
Forestry , agriculture, waste 	8.2	10–40	• 60+% developing countries • Billions of small emitters • Medium/high cost • Big social implications • Hard to measure & monitor
TOTAL	**26.7**		

Key regulatory mechanisms identified in the abatement investigation



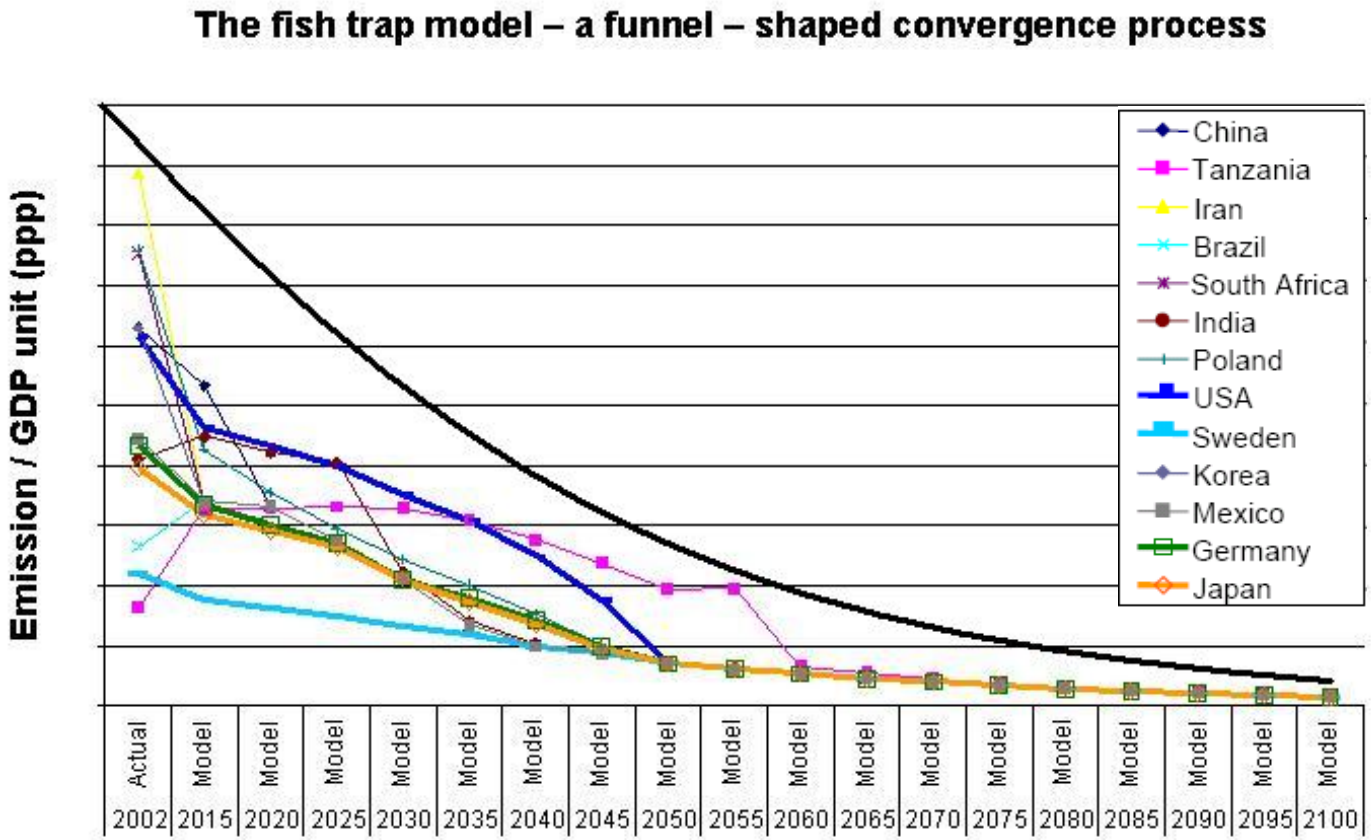
A **Policies/ standards for buildings and transportation, or a certificate system**

B **Long-term stable international system for power and industry**

D **International system for agriculture and deforestation**, linked to the overall developing world agenda

C **Mechanism to drive selected key technologies down the learning curve**

The core of any solution is convergence – market demand can be created



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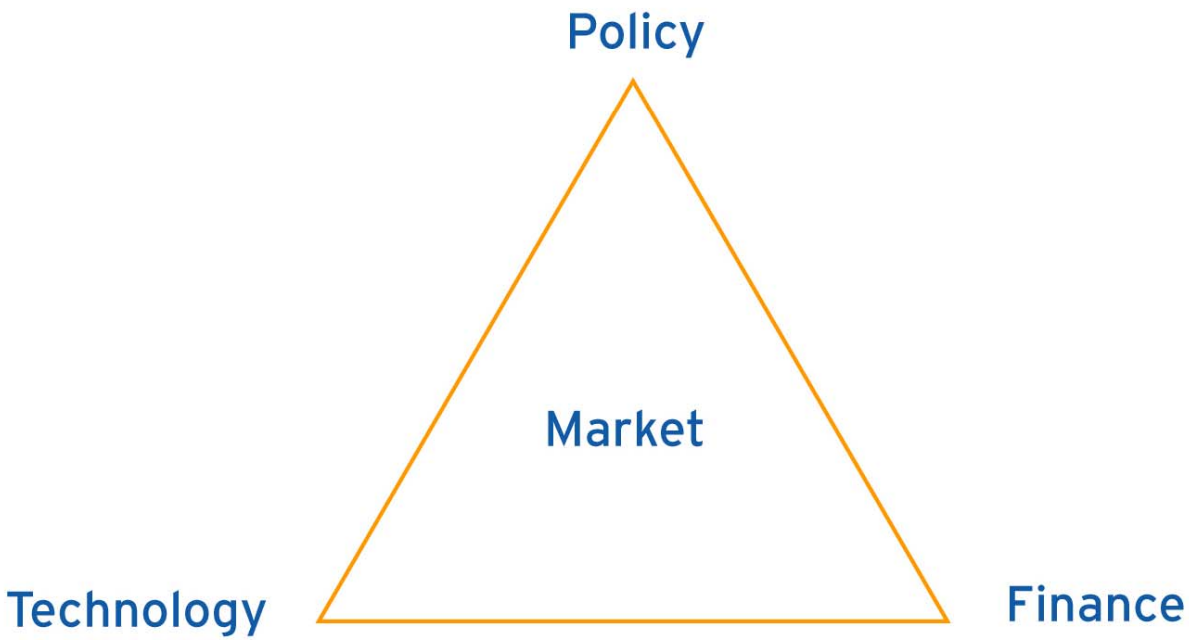
Supply and demand lead to market incentives



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