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Scenarios for Global Warming Mitigation and Sustainable Development - ALPS Scenarios

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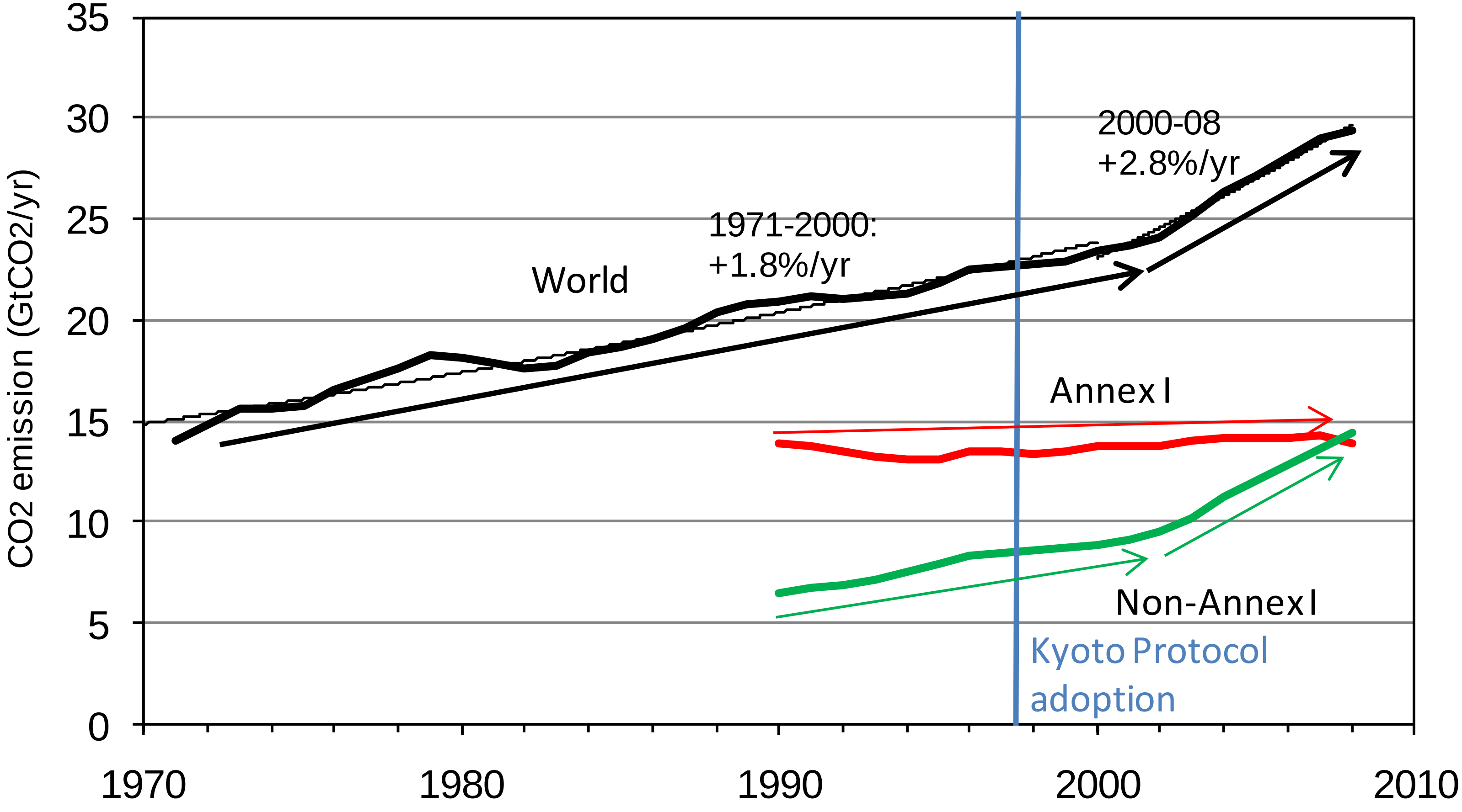
Contents

【Today’s Topic】

Considering possible measures to achieve deep cuts of global GHG emissions in a real world through historical evidences and model analyses

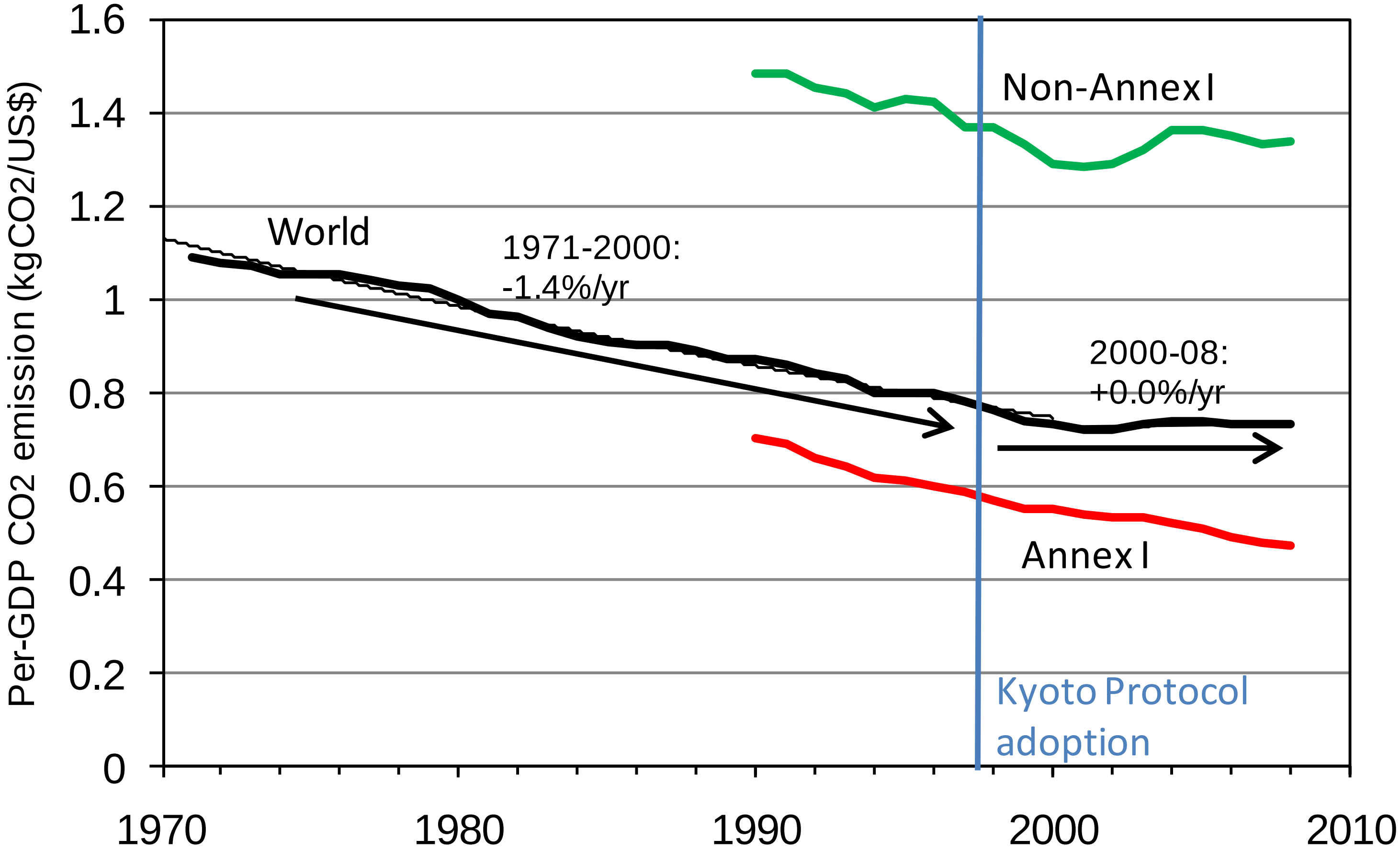
1. Historical Trend of GHG Emissions

Historical Emissions of Energy-related CO_2



Increase rate of global CO2 emission was +1.8%/yr between 1971-2000 and after 2000 the rate was +2.8%/yr. The emission in Annex I has slightly increased after around 2000.

Historical Per-GDP CO2 Emission



Increase rate of global per-GDP CO2 emission was -1.8%/yr between 1971-2000 and after 2000 the rate was 0%/yr, while that in Annex I has continuously decreased.

Carbon Price of Emission Trading Scheme

		Carbon price
EU-ETS	Phase II (historical)	Around 8-30 €/tCO_2
	Phase III (estimates by EC*)	32 €/tCO_2 (before the economic crisis) 16 €/tCO_2 (after the economic crisis)
US	RGGI of the east 7 states (historical) Currently 10 states	Around 2-3 $/$tCO_2$
	The American Power Act (Kerry-Lieberman) Currently there are little possibility to approve it.	12-25 $/$tCO_2$ in 2013

*) Source: EC, Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage, May 2010

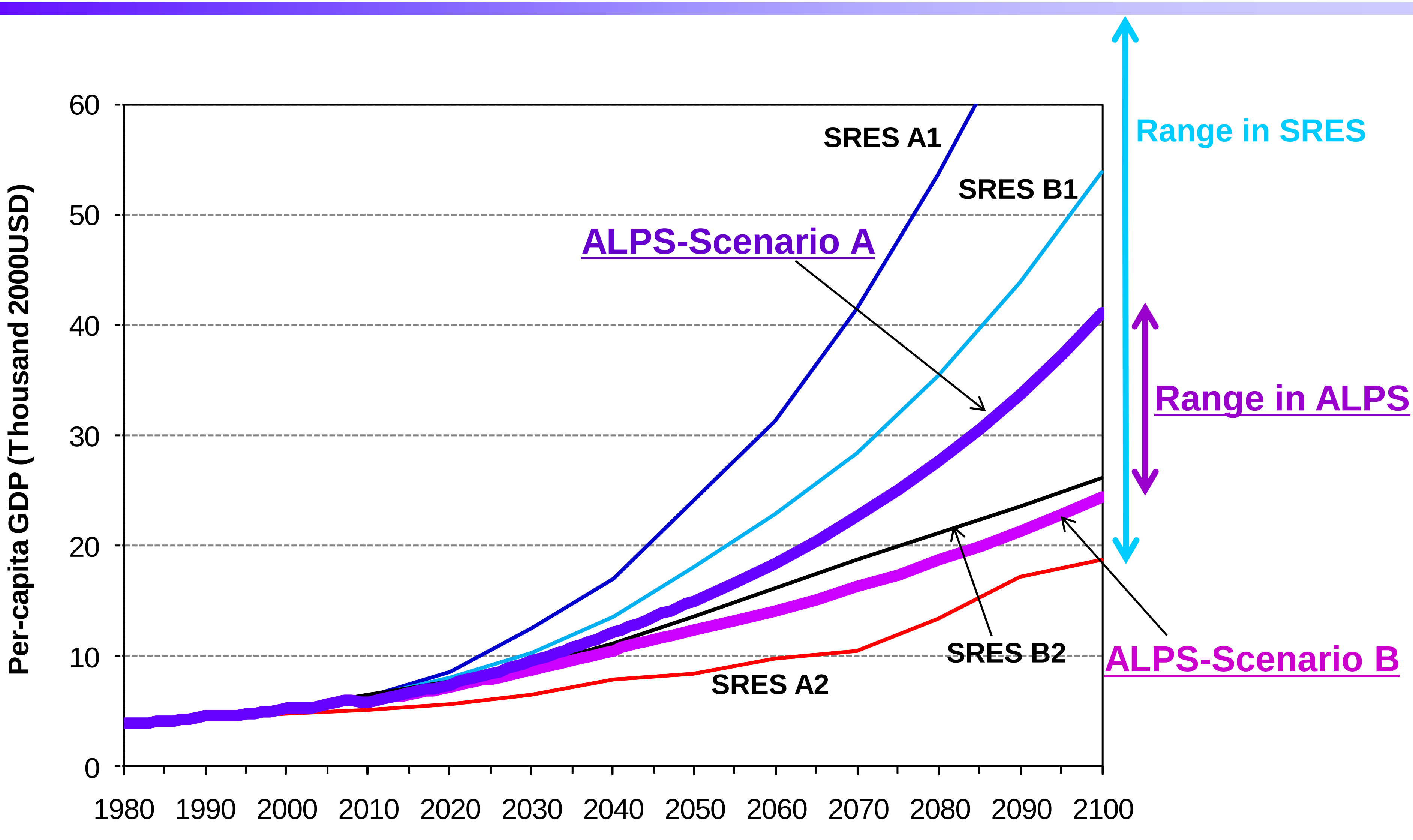
It is difficult to achieve high explicit carbon price in a real world, and the price is below 50$/$tCO_2$ (mostly 20-30$/$tCO_2$)

From Historical Evidences of Emission Reductions

- The Kyoto Protocol is a framework to set 'cap' for country and to allow flexible mechanism, e.g., emission trading.
- If marginal abatement costs (carbon price) were almost equal among all countries and the price were high, the framework could induce large global emission reductions.
- However, this conditions are unexpected to be satisfied even in 2050.
- Only a part of the countries will be under the cap in a real world, and high carbon prices will induce carbon leakages. It will be impossible to achieve large emission reductions economically and politically.
- The Kyoto style framework will never induce large emission reductions in a real world.

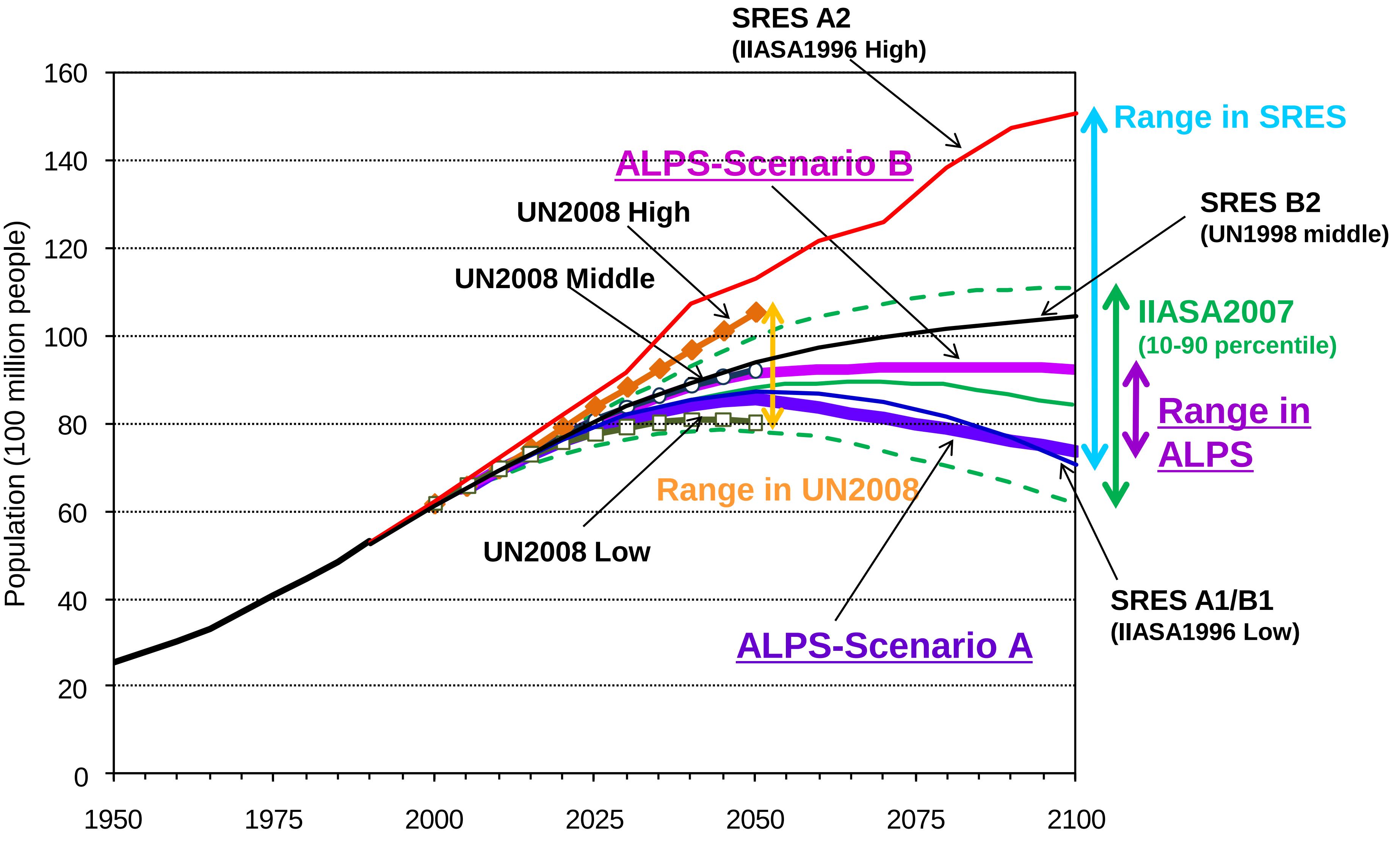
2. Socioeconomic and GHG Emission Outlook

Outlook of Global Per-Capita GDP (ALPS Scenarios)

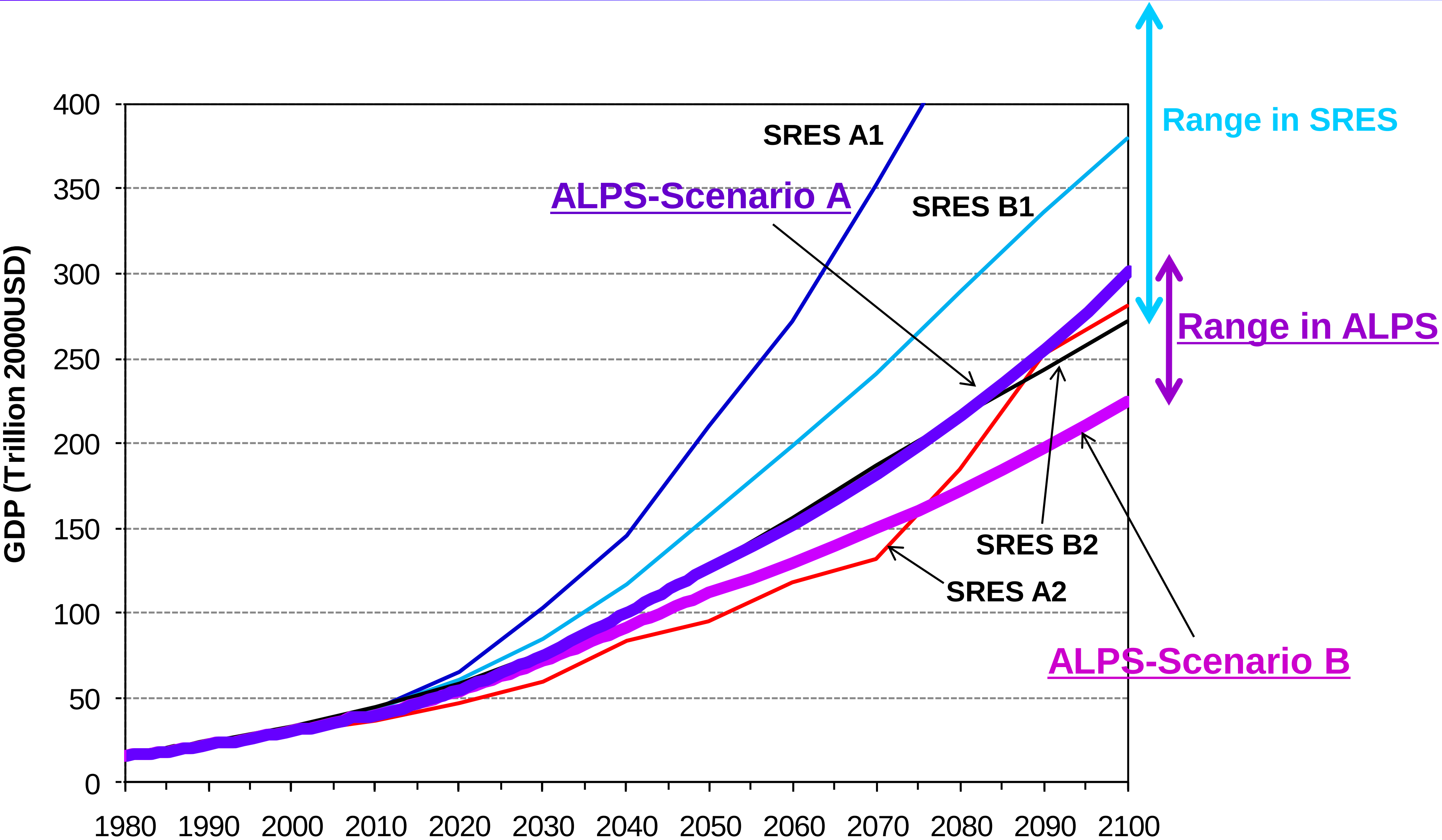


Note: GDP of SRES scenarios are adjusted to the price in 2000 from that in 1990.

Outlook of Global Population (ALPS Scenarios)

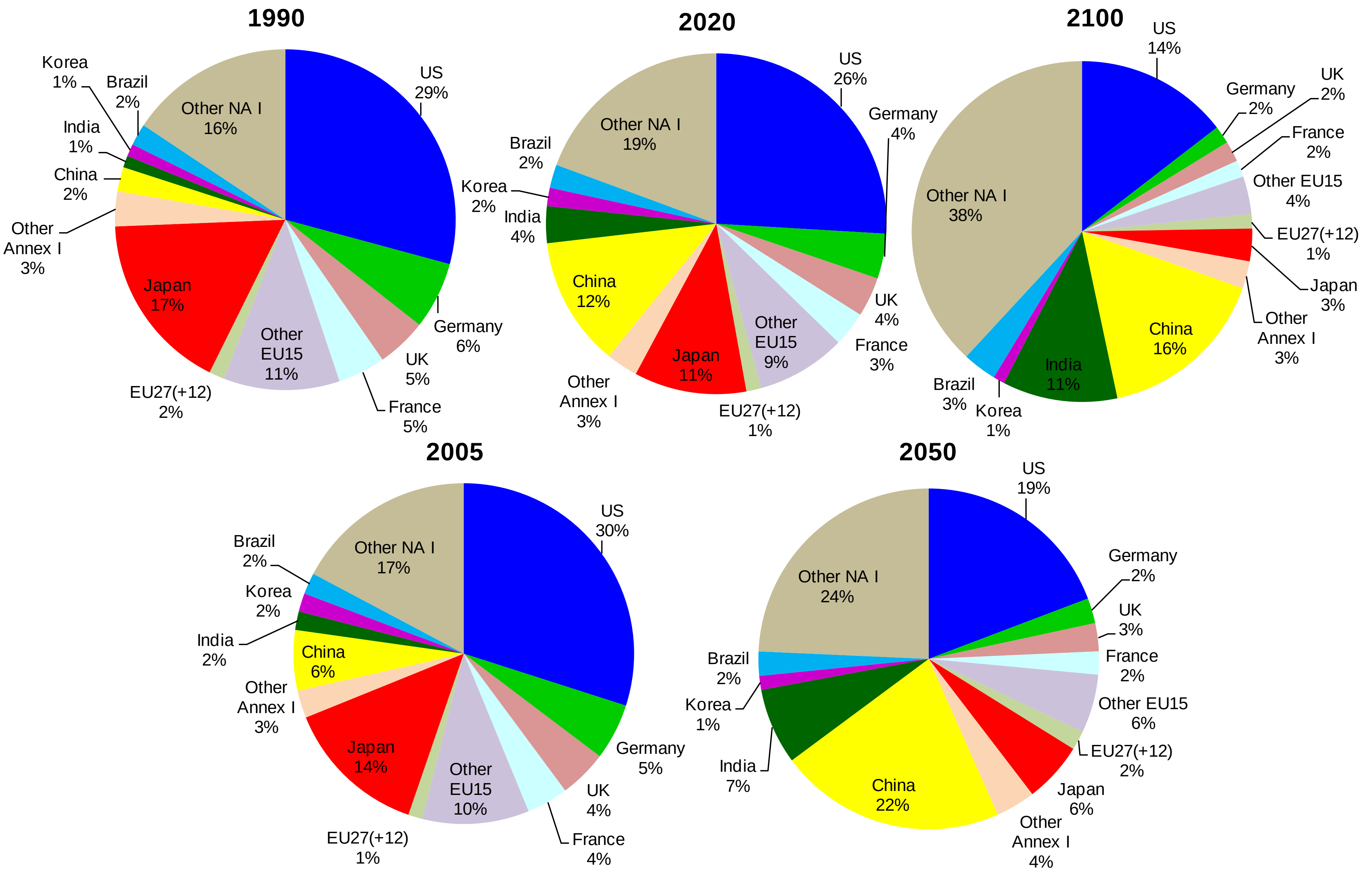


Outlook of Global GDP (ALPS Scenarios)

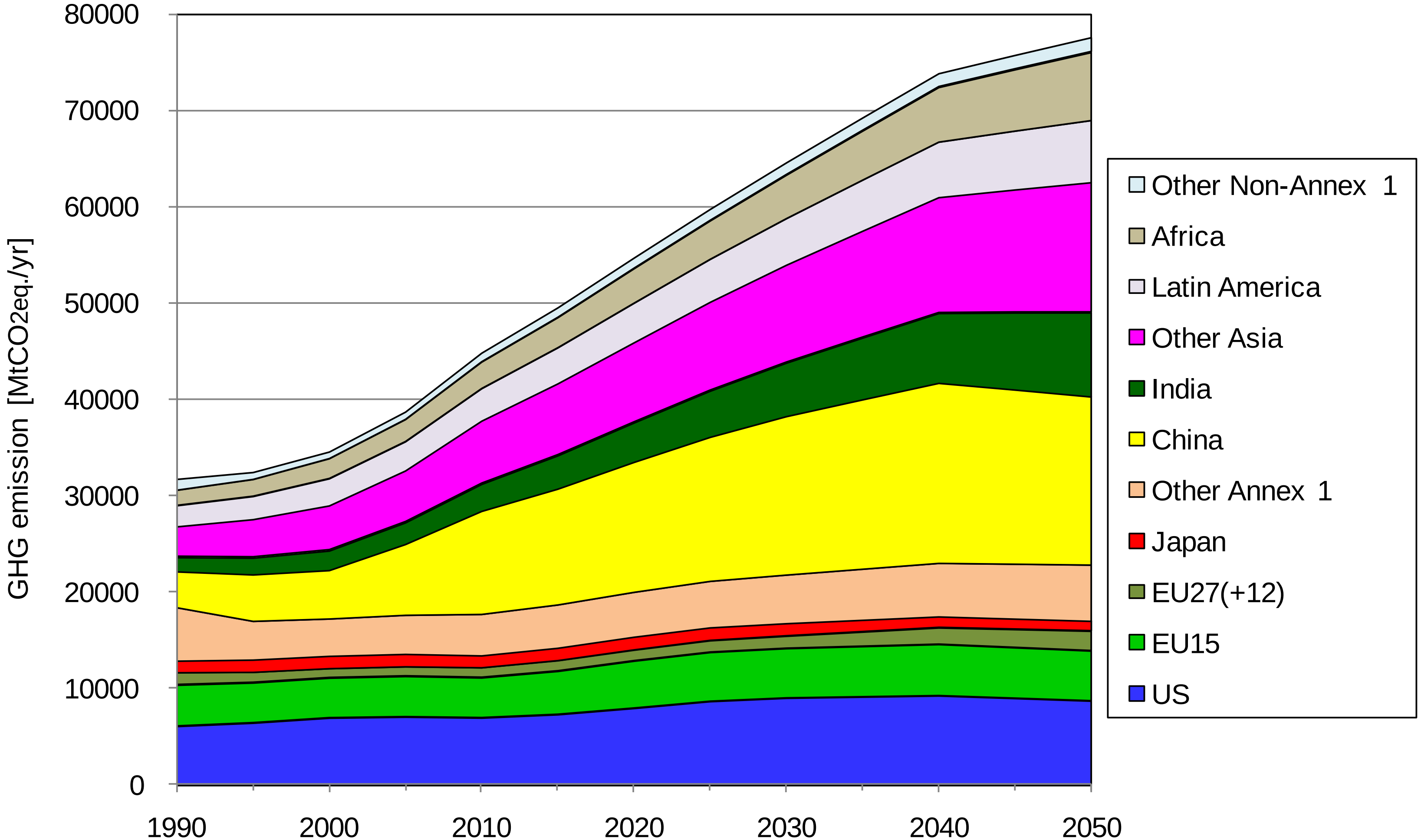


Note: GDP of SRES scenarios are adjusted to the price in 2000 from that in 1990.

Regional GDP: ALPS Scenario B



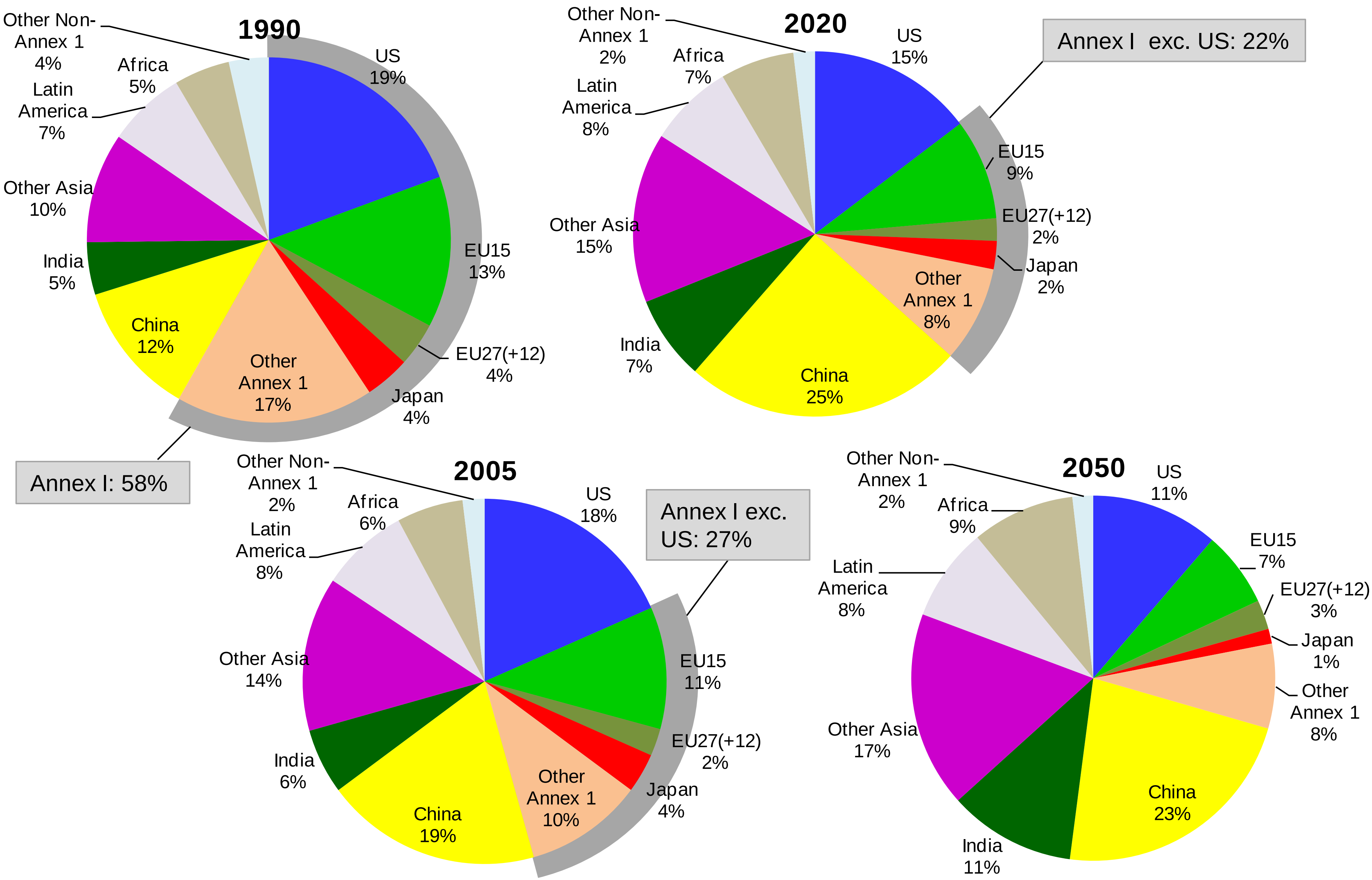
Outlook of Global GHG Emission: ALPS Scenario B



The Kyoto six kinds of GHGs excluding LULUCF

Global GHG emission was 32 and 37 $GtCO_2$ in 1990 and 2005, respectively. The emission will be 55 and 78 $GtCO_2$ in 2020 and 2050, respectively.

Regional GHG Emission: ALPS Scenario B



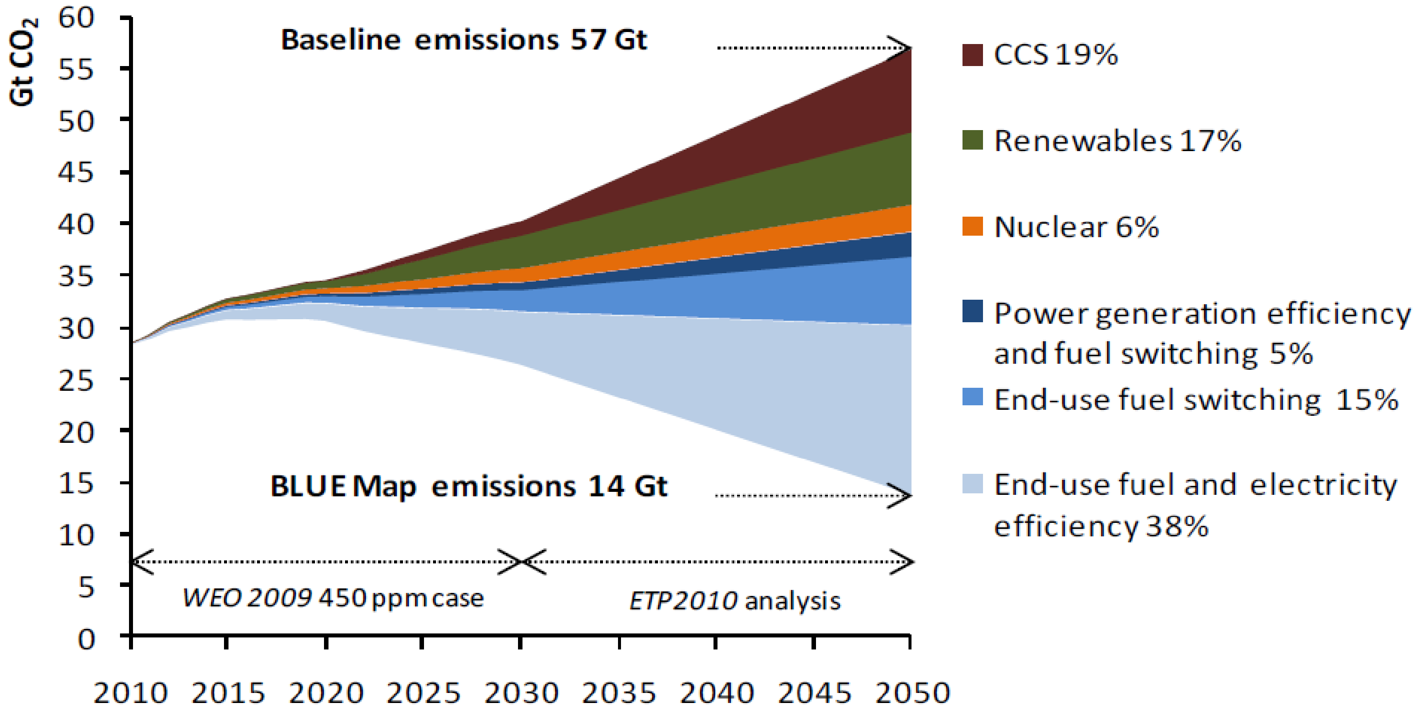
From Socioeconomic and GHG Outlook

- High GDP growth by 2050 in many developing countries particularly of East to South Asian countries are estimated.
- Per-GDP emissions will decease, but higher GDP growth induce increase in global GHG emissions, and the global emission in 2050 will be double of current level under baseline scenarios.
- Effective emission reductions of all major emitting countries is necessary. However, different measures are also important considering different stage of economic growth, emission reduction potentials etc.

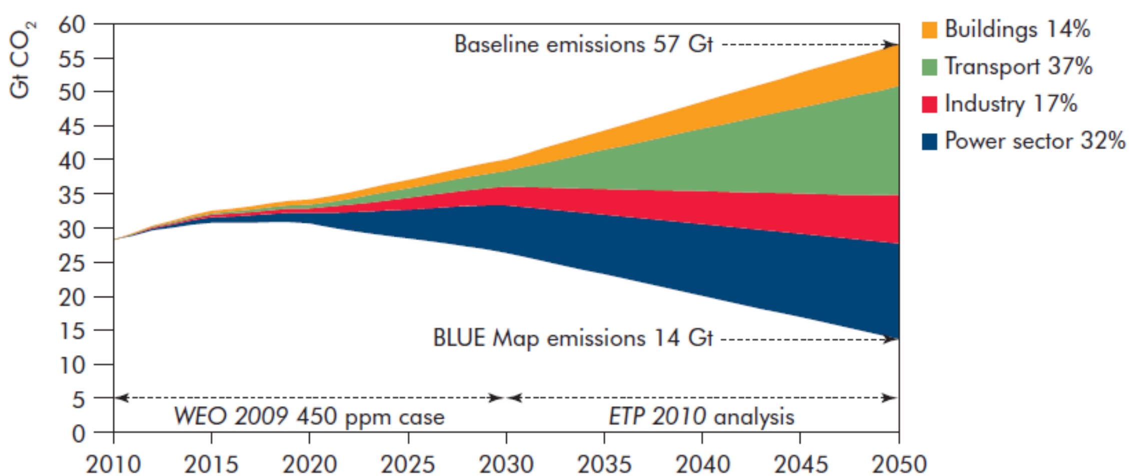
3. Outlook of Deep Emission Cuts Of Global Emissions

Emission Reduction Scenario for Halving Global Emissions in 2050 by IEA ETP

By Technology

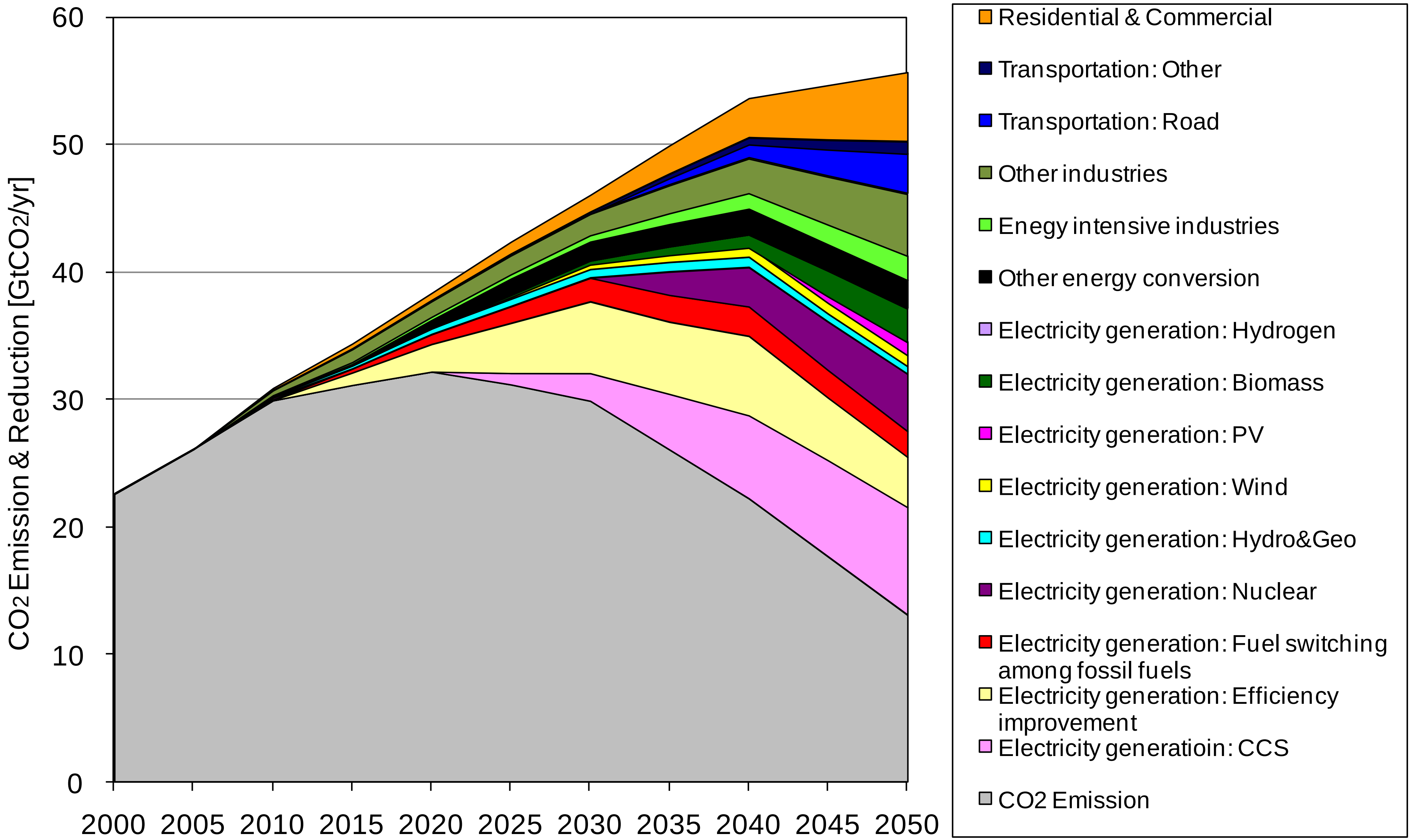


By Sector



Source: IEA ETP 2010

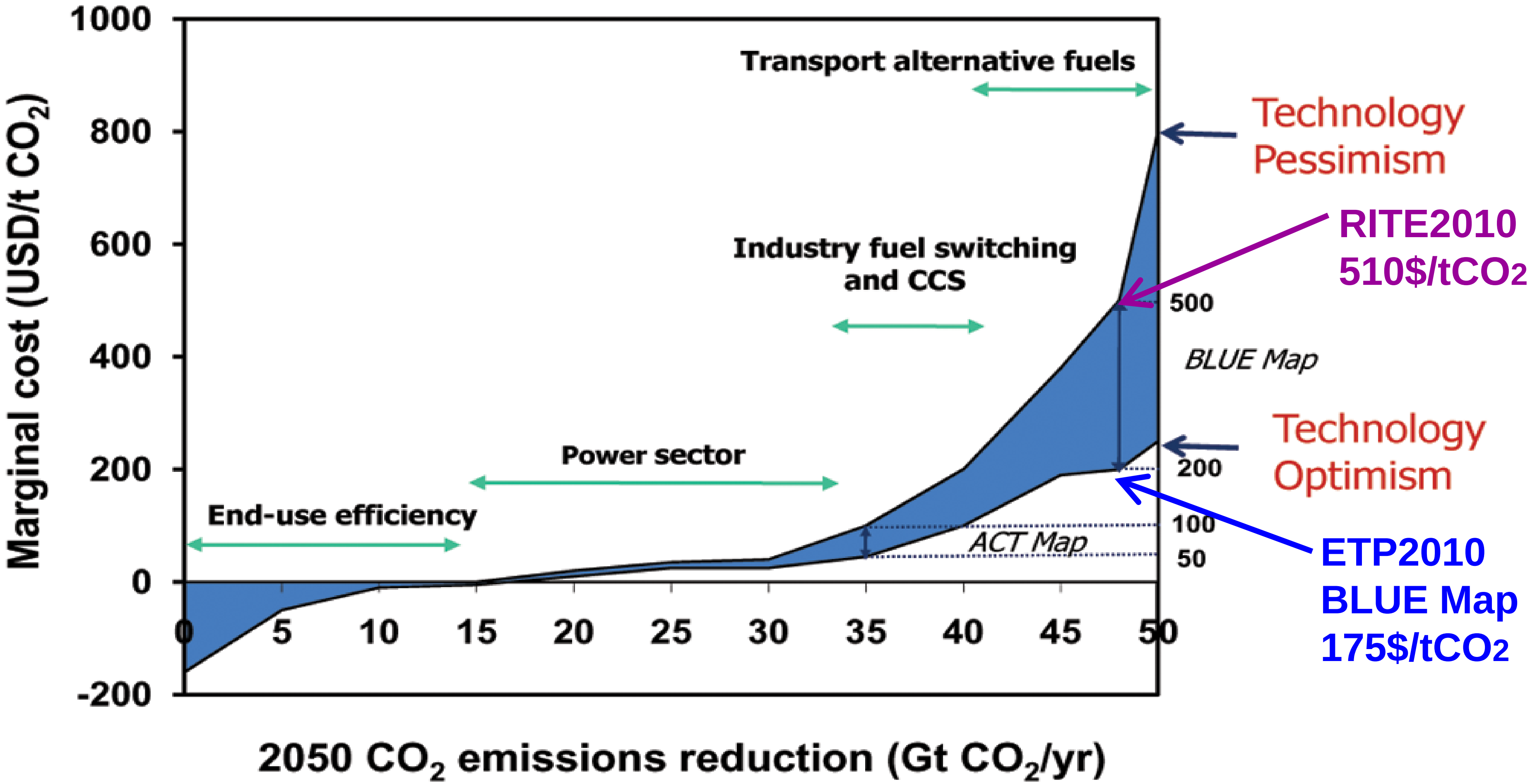
Emission Reduction Scenario for Halving Global Emissions in 2050 by RITE



Estimated by RITE DNE21+ model, 2011

Marginal Abatement Cost of CO_2 in 2050

IEA ETP2008



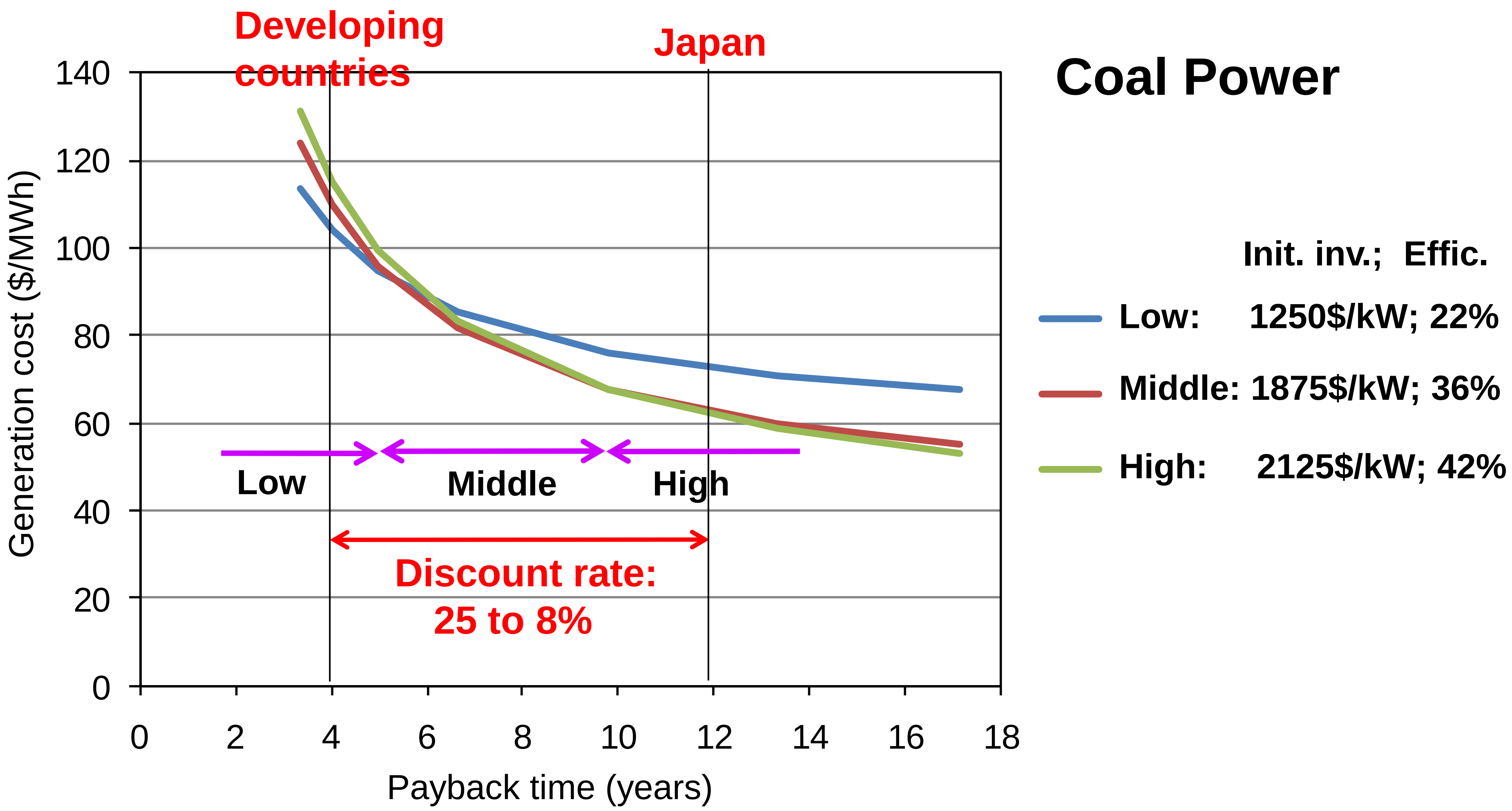
Model analyses for halving global emissions presume achievement of high marginal abatement cost (carbon price) in a real world.

From Model Analyses for Halving Emissions in 2050

- Halving global emissions in 2050 is technologically possible.
- However, high marginal abatement costs are inevitable to achieve it.
- It will be difficult to achieve carbon price over 50$/t$CO_2$ particularly by explicit carbon price, i.e., cap & trade scheme, carbon tax, in a real world.
- In order to achieve large emission reductions in 2050, other measures should be taken.

4. Barriers of Technology Diffusion

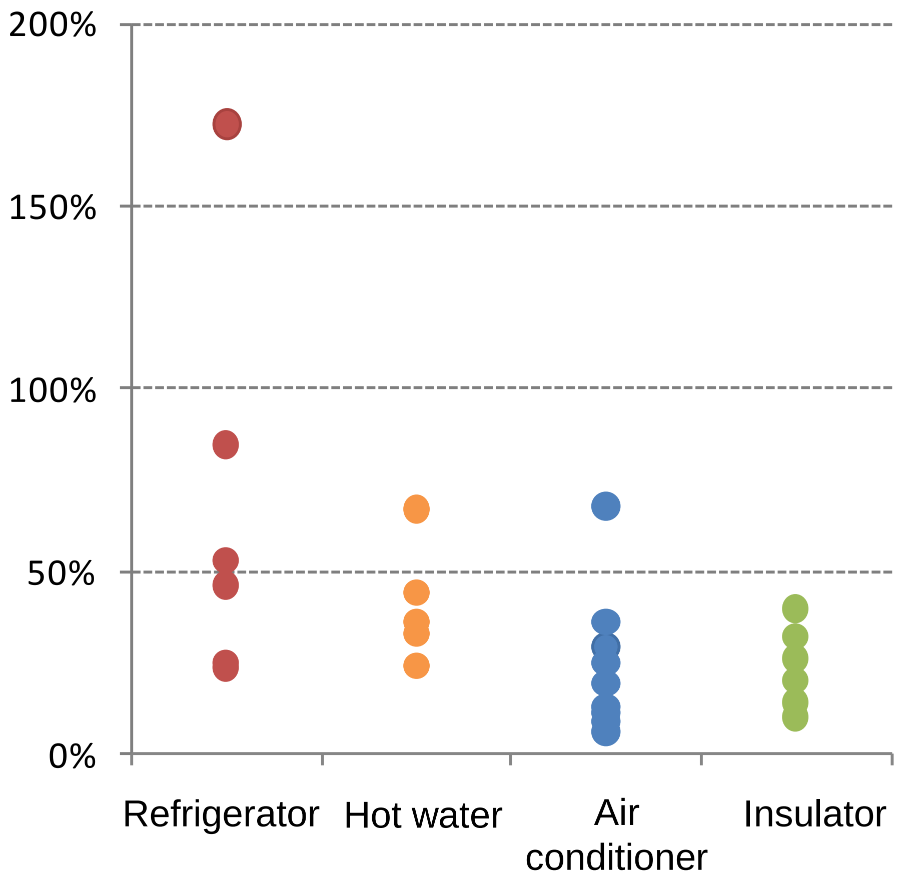
Payback Time and Technology Choice



Note: rate of operation: 75%

- **Cost efficient technologies are different under different payback time (discount rate).**
- **Countries having short payback time for investments prefer to low initial investment costs.**

Discount Rate for Technology Choice



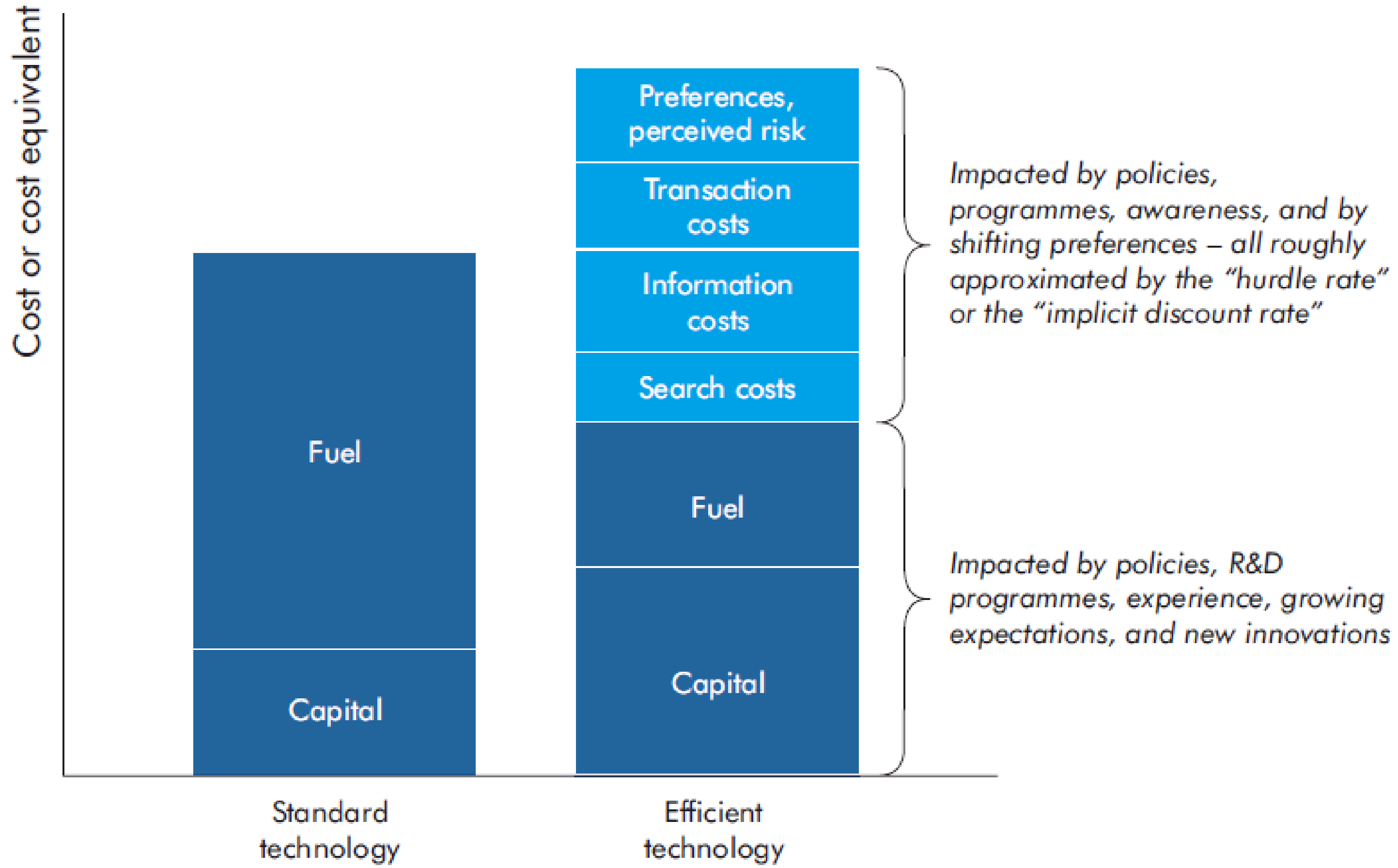
Source: summarized by Wada (RITE) based on Soren (2002) and Dubin (1992)

- Discount rates for technology choice in residential and commercial sectors are particularly high.
- There are large barriers to diffuse high energy efficiency technologies.
- Other attractive points than high energy efficiency are also important.

Determinants of decision on payback period

■ Factors related to investors	
Funds	Financial surplus, fund-raising capacity
Rate of return for companies	The rate of return on investment (ROI) ranges from 10% to 20% in general. A large divergence from this range will be a barrier against the implementation of investment.
Pure rate of time preference	Not only manager's rate of time preference but also the manager's term of office will affect the payback period. (Incentive inconsistency problem; Investment cannot be recouped during one's term of office.)
Subjective risk preferences	Subjective risk preferences by investment decision makers.
Costs of access to information and organization of information	Costs of access to information and organization cannot be ignored in the case of small-scale investment.
Bounded rationality	Appropriate choices cannot be made due to a limitation of examination capability.
■ Factors related to equipment and appliances	
Uncertainty about lifetime of equipments	This uncertainty will lead to a barrier against an introduction of new equipment if its credibility is considered to be low due to lack of its performance.
Expectation for technological progress on equipments	There is an expectation that better equipment/appliances will be available in the future.
Resistance and sense of rejection towards new equipments	Familiar equipment/appliances tend to be preferred on site.
Low priority for energy savings	
■ Factors related to external environment	
Uncertainty about energy prices	Investment decisions are influenced by the probabilities of increases in energy prices.
Market interest rate	Market interest rates have an impact on funding.
Stockholder's expectation for profits	Stockholders' decisions depend on whether they expect profits in the short time or in the long term.

Cost structure relating to technology choices

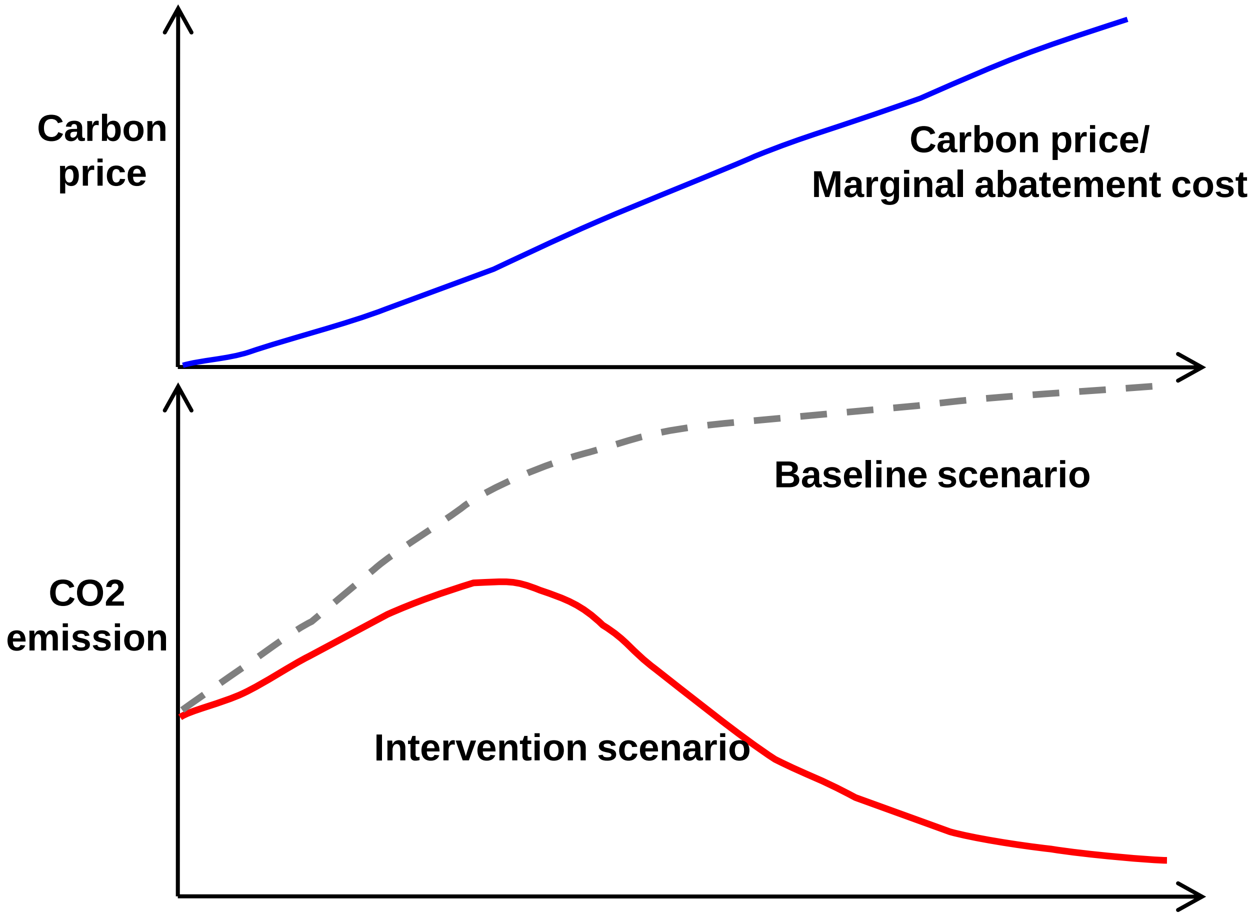


Source: Laitner (2009).

Source: IEA ETP 2010

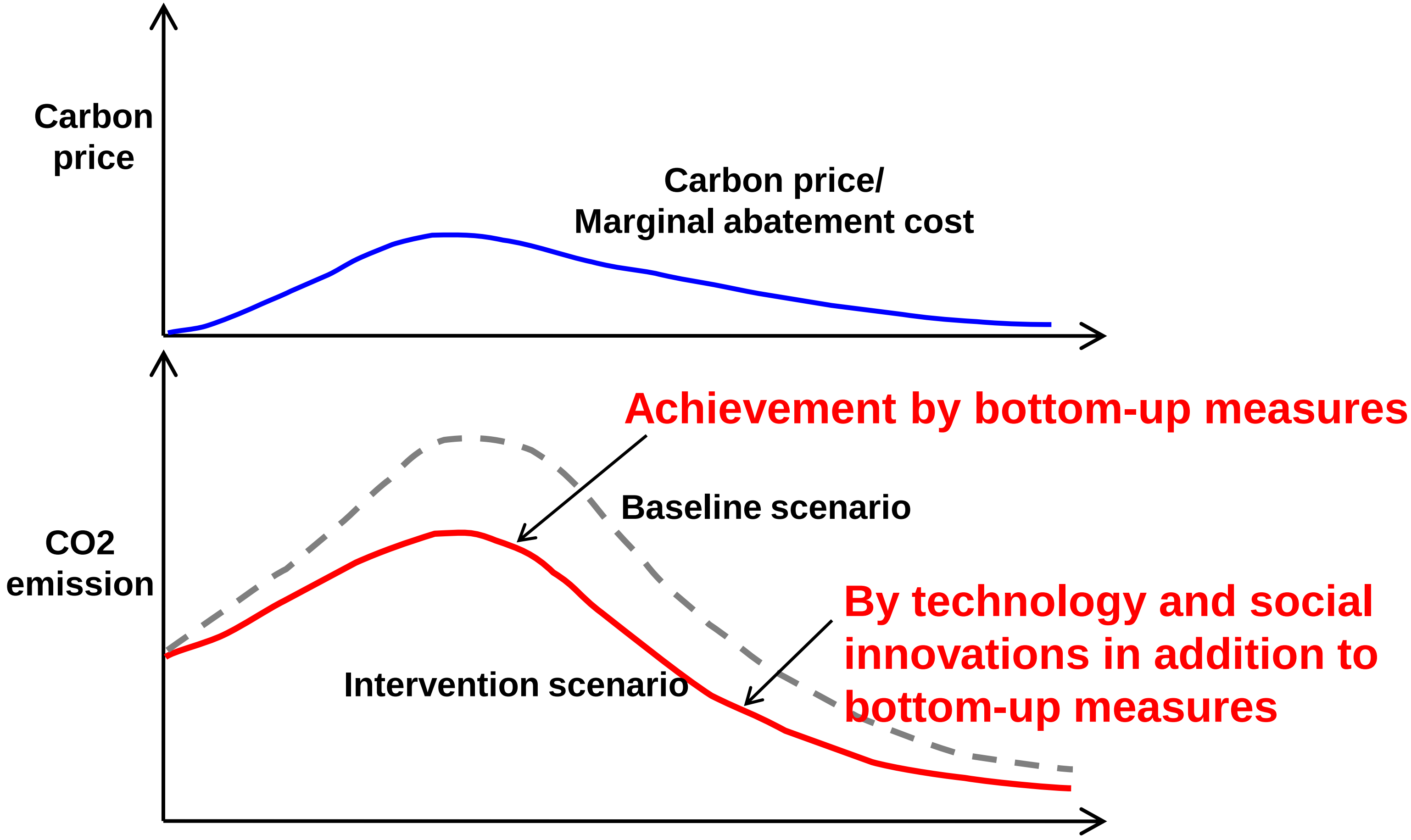
5. Toward Deep Emission Cuts

Image of Standard Scenarios for Deep Cuts



This situations cannot be expected in a real world. Particularly explicit high carbon prices such as over 200$/tCO2 are unexpected.

Possible Deep Cuts Scenario in a Real World



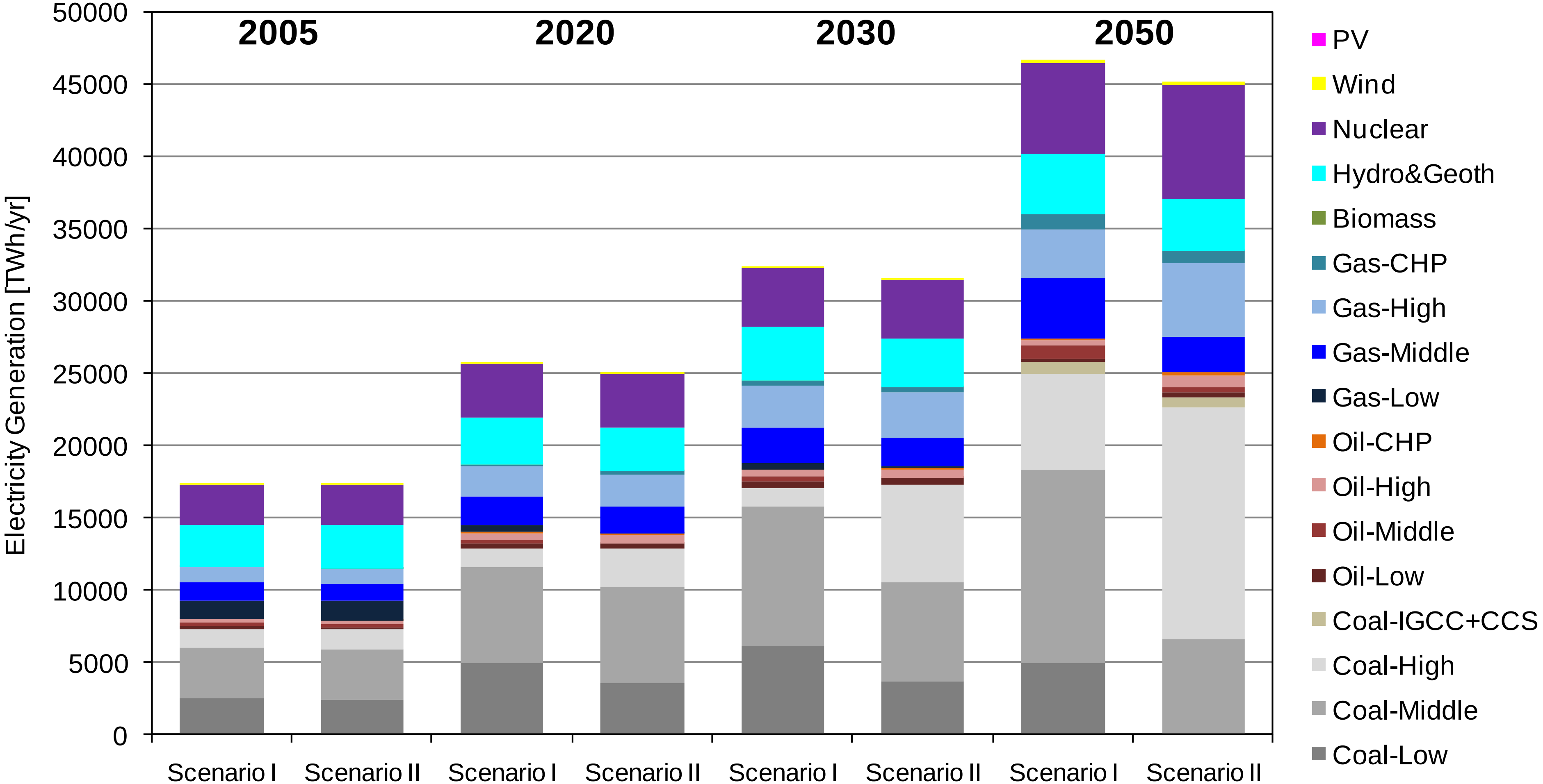
Mitigation measures avoiding explicit carbon pricing and technology and social innovations inducing low carbon prices are key for deep emission cuts.

Social Situation Scenarios for Climate Policy

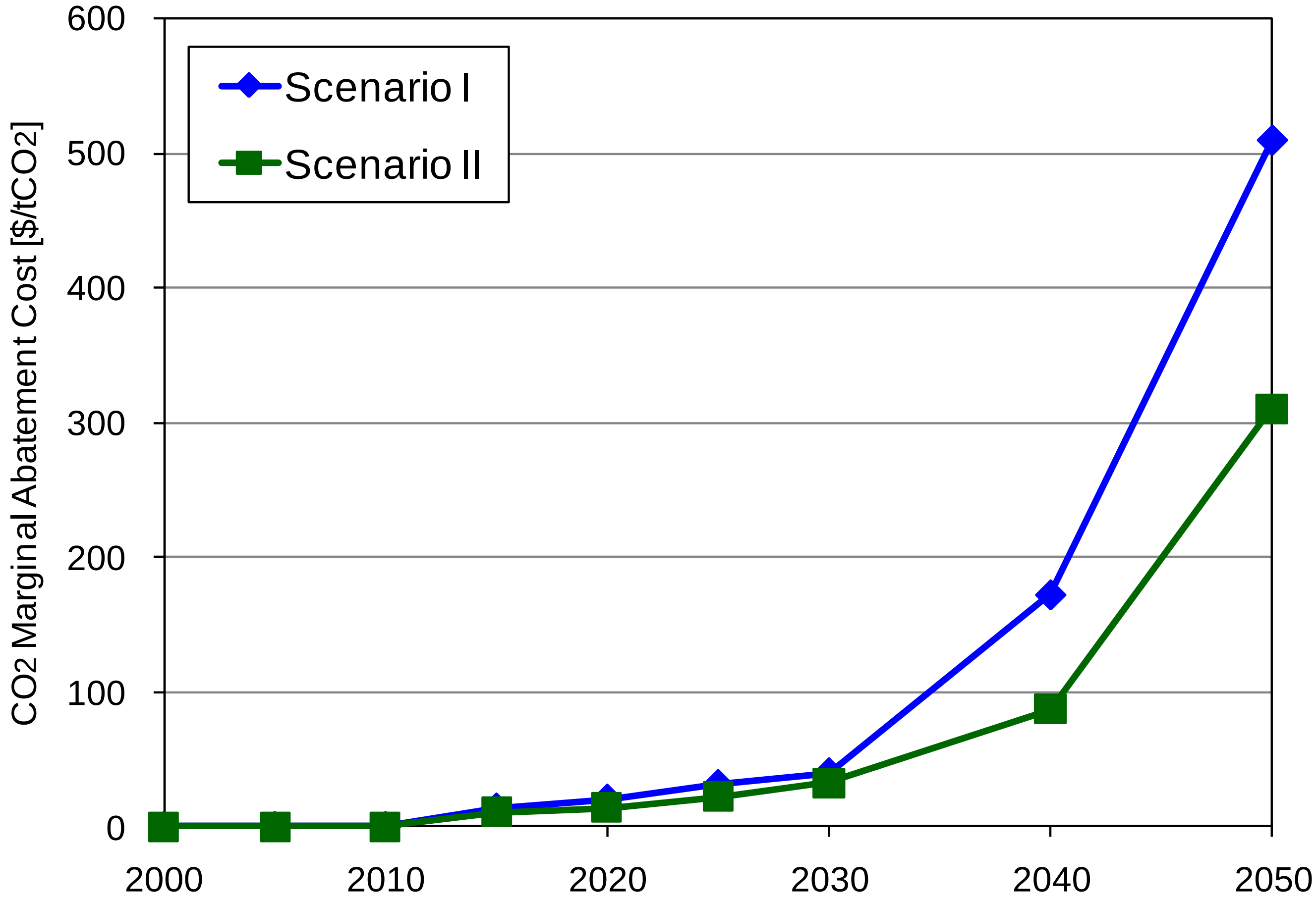
	Scenario I Payback time observed in a real world		Scenario II Idealistic payback time for global warming mitigations	
	Upper	Bottom	Upper	Bottom
Power sector	10.0	6.7	15.0	11.7
Other energy conv.	6.7	3.3	12.0	9.7
Energy intensive sector	6.7	3.3	15.0	11.7
Transport sector	3.3	2.0	10.0	8.3
Res. & Com. Sector	3.1	1.7	8.0	7.0

Note: the range depends on country and time points.

Baseline Global Electricity Generation in Different Social Situation Scenarios



Marginal Abatement Cost for halving global Emissions in 2050 in Different Social Situation Scenarios for Climate Policy



The marginal cost in the Scenario II world is much lower than that in the Scenario I.

Co-benefit Measures

- **In order to decrease net cost for emission reductions and economic damage, co-benefit measures should be pursued.**

Example 1: High level of transportation systems using IT, which can mitigate traffic jams, traffic accidents etc.

Example 2: Comfortable urban planning with low carbon emissions

Example 3: Enhancement of energy securities by nuclear power, which can induce long-term welfare increases）

Example 4: Smart grids providing new services with value added

Required Measures toward Deep Emission Cuts

- **Explicit carbon pricing policies, e.g., cap & trade, carbon tax, require high carbon prices (e.g., over 200 \$/tCO_2), in order to achieve deep cuts of emissions, where the Scenario I world dominates.**
- **It is not expected to achieve such high explicit carbon price in all 200 world countries due to economic and political difficulties.**
- **The following three measures are important to overcome the difficulties for deep cuts: 1) bottom-up measures avoiding price signals, which avoid the dominants of Scenario I, 2) social innovations in long-span to chose long payback time (toward the Scenario II), and 3) Development of innovative technologies including co-benefit measures and stimulating social changes, and net cost reductions through these innovations.**

6. Conclusion

Conclusion

- **Emission reduction frameworks using 'cap' by top-down will not be able to achieve deep emission cuts in a real world.**
- **In order to achieve deep cuts of global emissions, other measures should be taken**
- **The emission reduction actions are dominated by payback time which is observed in a real world under explicit carbon pricing measures. High explicit carbon prices are needed for deep emission cuts, but this is unrealistic.**
- **Bottom-up measures which remove technology diffusion barriers are important, considering country, sector and technology specific conditions.**
- **In addition, innovations of technologies and societies are needed. It is important to conduct system measures including co-benefit measures, to decrease net costs.**
- **The ALPS project generates integrated scenarios for global warming measures and sustainable development to support better decision making for these complex issues.**

Appendix

Per-GDP GHG Emissions by Region

Scenario B