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Reduction Costs for CO2 Emissions

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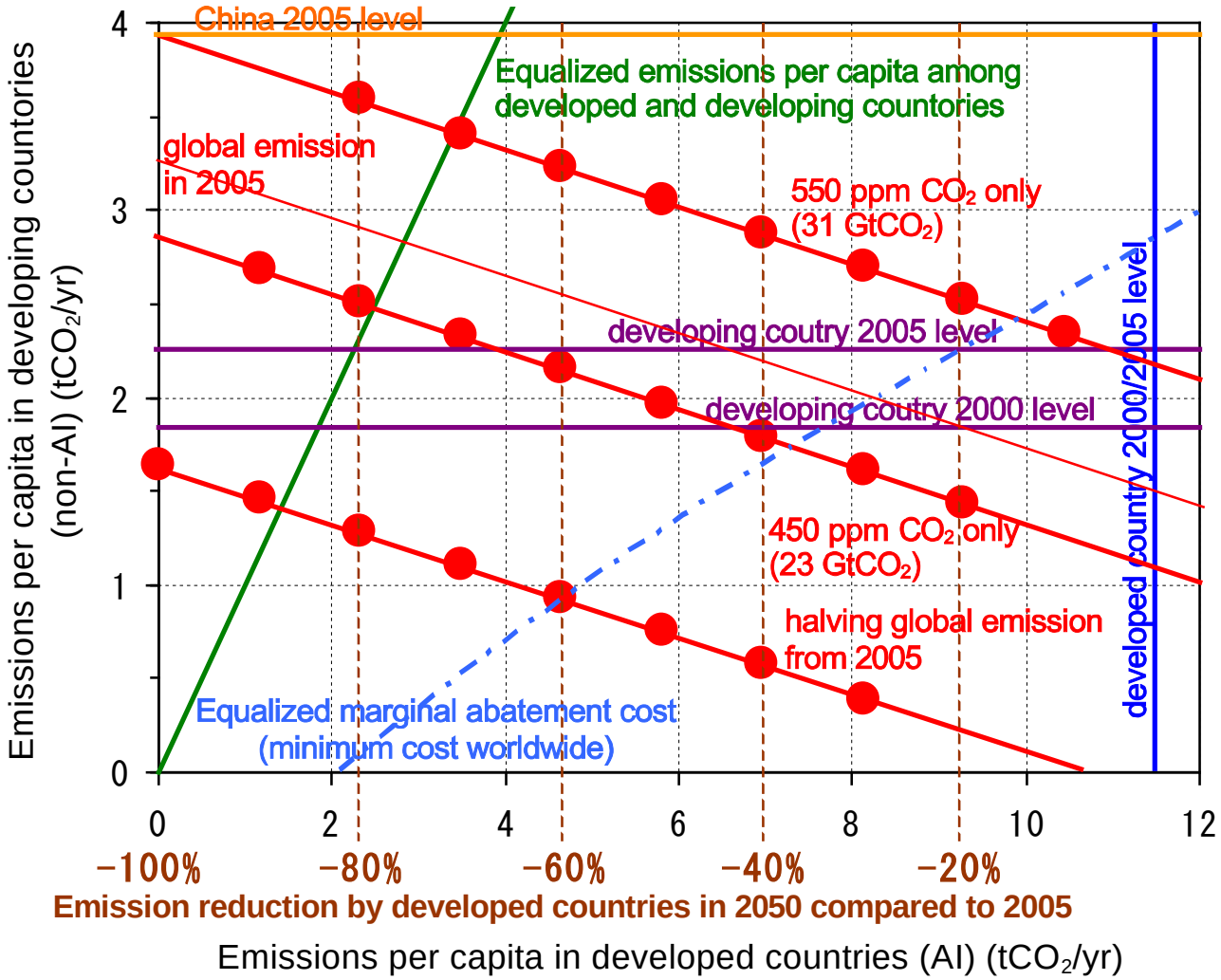
About this paper

- It is desirable to minimize the impact of global warming, however, the more emission reductions are aimed at, the higher costs increase to implement the goal.
- Emission reduction costs spread toward the end consumer steadily. Consumers may ultimately pay the increased costs of energy and many products, though there could be various forms of cost burden, in some cases in the form of tax. Except for the tax, it must be considered that they later realize to have borne the costs.
- Though a variety of numerical targets for emission reductions has been discussed, this paper aims to make them more constructive discussion and to achieve numerical targets for the various emission reductions. The results estimated by DNE21 + model, a detailed model which has been developed by RITE is summarized in this paper.
- In addition, the estimates will vary depending on model assumptions The numbers here should be considered arbitrarily to a certain extent
- As the model assumes substantial technology advances, the estimated reduction costs here are is reasonable to be considered optimistic, while the costs range in the value.

Long term: 2050

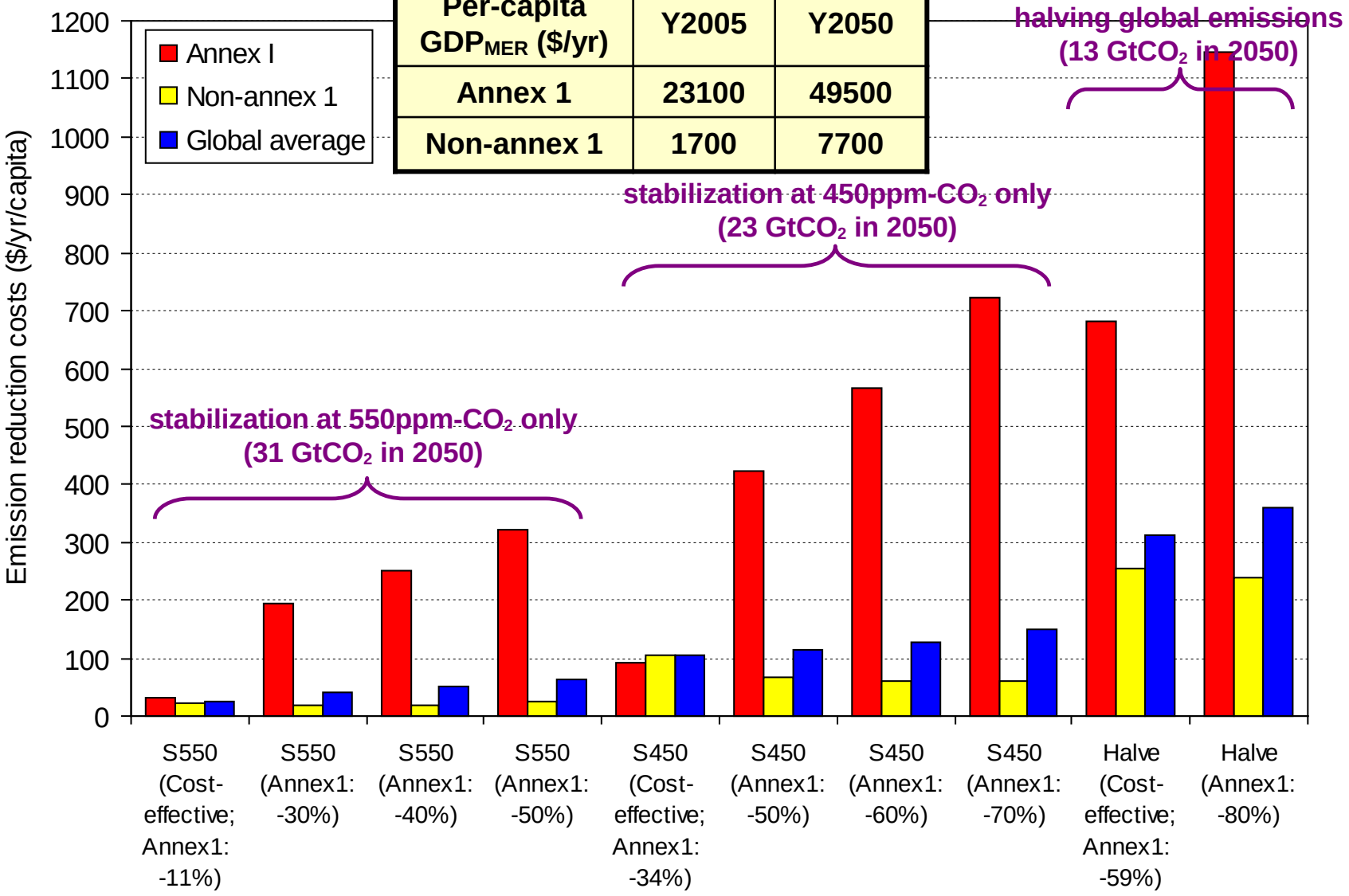
Allocations to A1 and non-A1 countries in 2050 -from the viewpoint of emissions per capita-



The most allocations to A1 and Non-A1 Countries are between the line of equal emissions per capita and the line of marginal abatement costs.

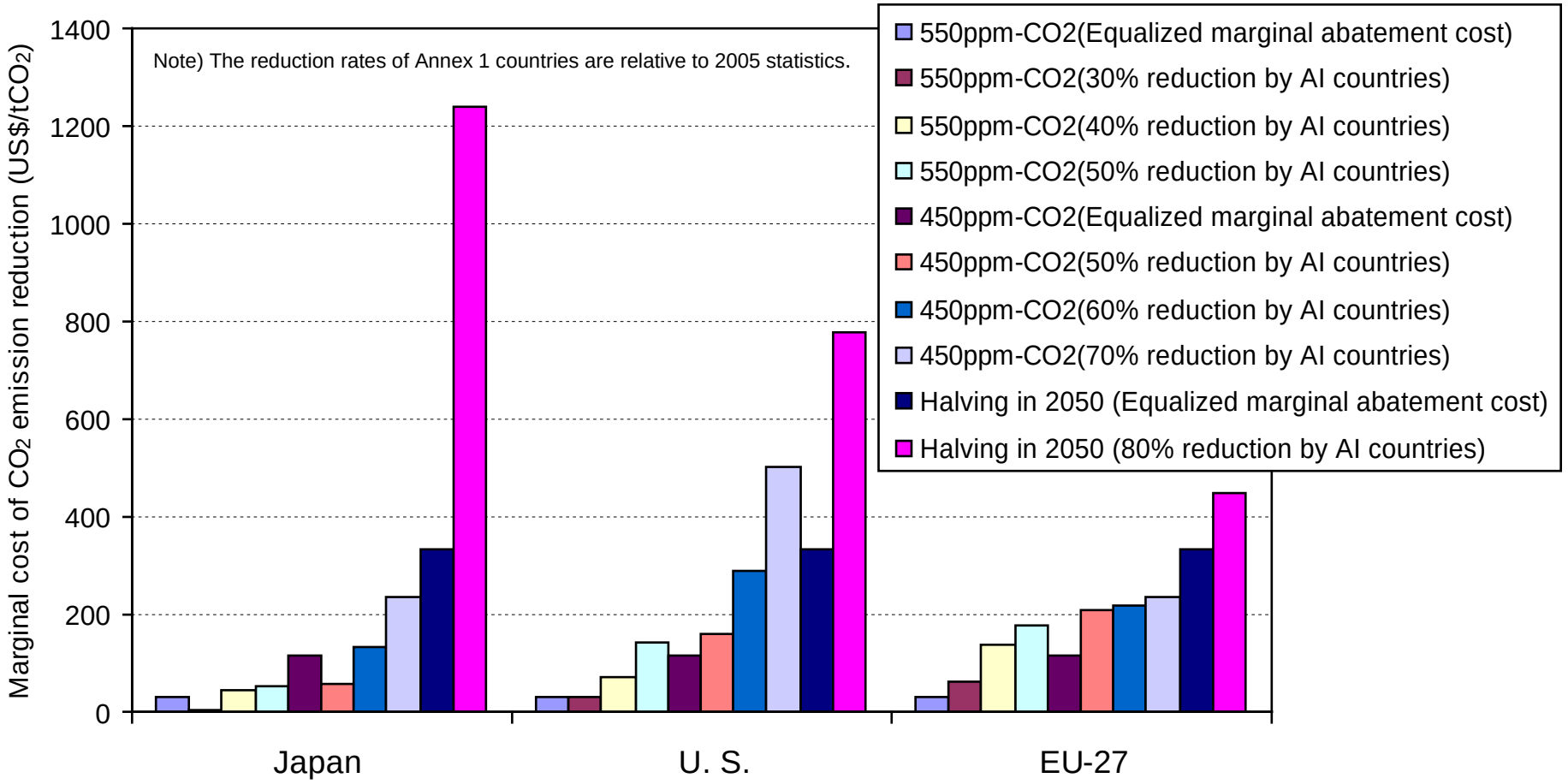
Emission reduction costs in 2050 required to achieve Each scenario (reduction costs per capita per year)

Per-capita GDP_{MER} ($/yr)	Y2005	Y2050
Annex 1	23100	49500
Non-annex 1	1700	7700



Note) The reduction rates of Annex 1 countries is relative to 2005 statistics.

Marginal costs of CO2 emission reduction in 2050



- **Japan's marginal reduction costs in 2050 are not so high as the US and EU, but rather low due to population decrease.**
- **In case of 80% reduction relative to 2005, Japan's marginal reduction cost in 2050 tends to increase rapidly, because the potentials of renewable energy and CCS are low.**

Mid-term: 2020

Mentioned reduction level of Annex 1 countries at COP/MOP3

COP/MOP3 AWG

[…], the AWG recognized that the contribution of Working Group III to the AR4 indicates that achieving the lowest levels assessed by the IPCC to date and its corresponding potential damage limitation would require Annex I Parties as a group to reduce emissions in a range of 25–40 per cent below 1990 levels by 2020, through means that may be available to these Parties to reach their emission reduction targets.

IPCC WG3 AR4 Box 13.7

Box 13.7 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2-eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2-eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2-eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and MIddle East, East Asia

Notes:

[a] The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

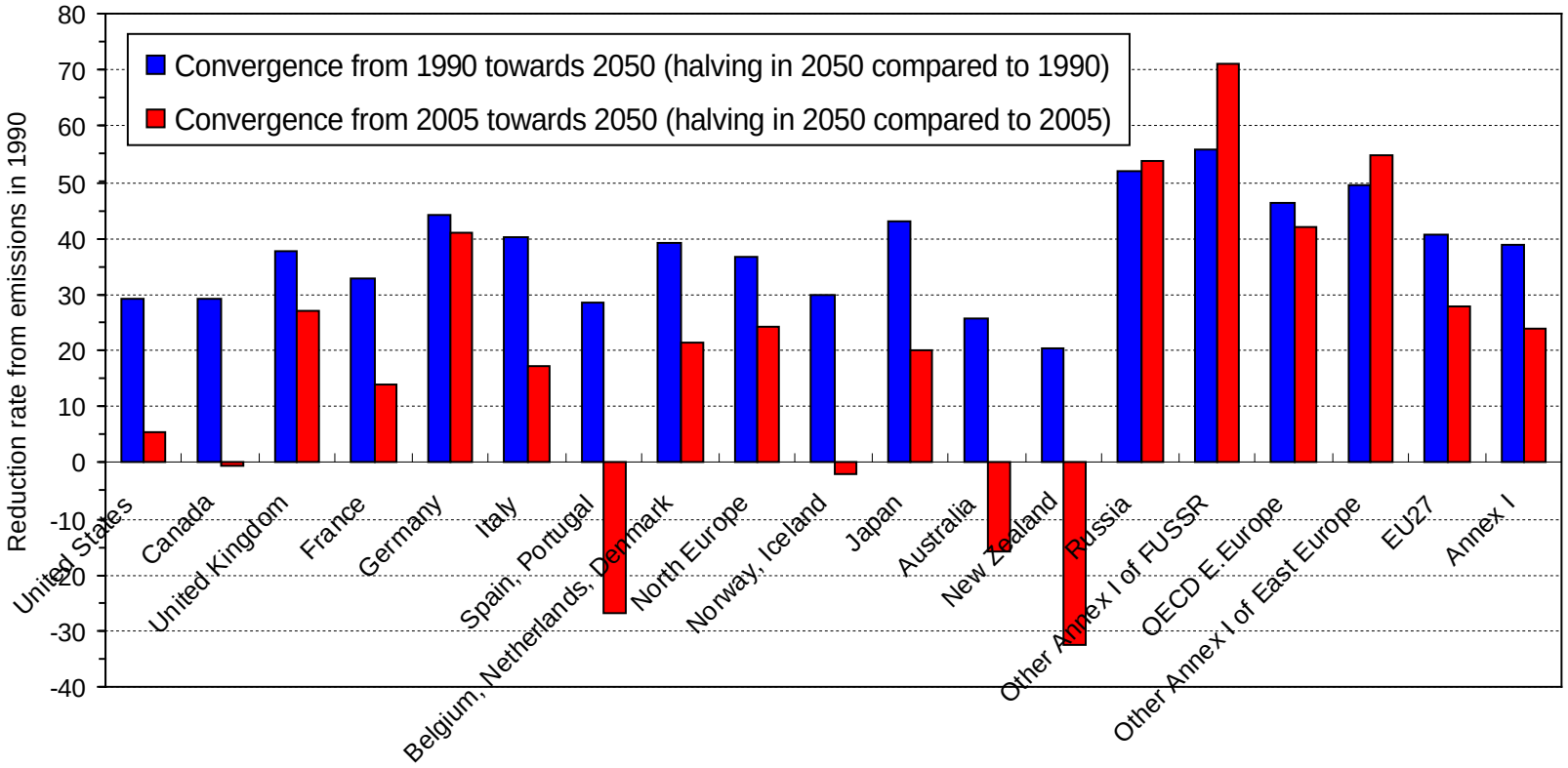
[b] Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (See Den Elzen and Meinshausen, 2006).

Source: See references listed in first paragraph of Section 13.3.3.3

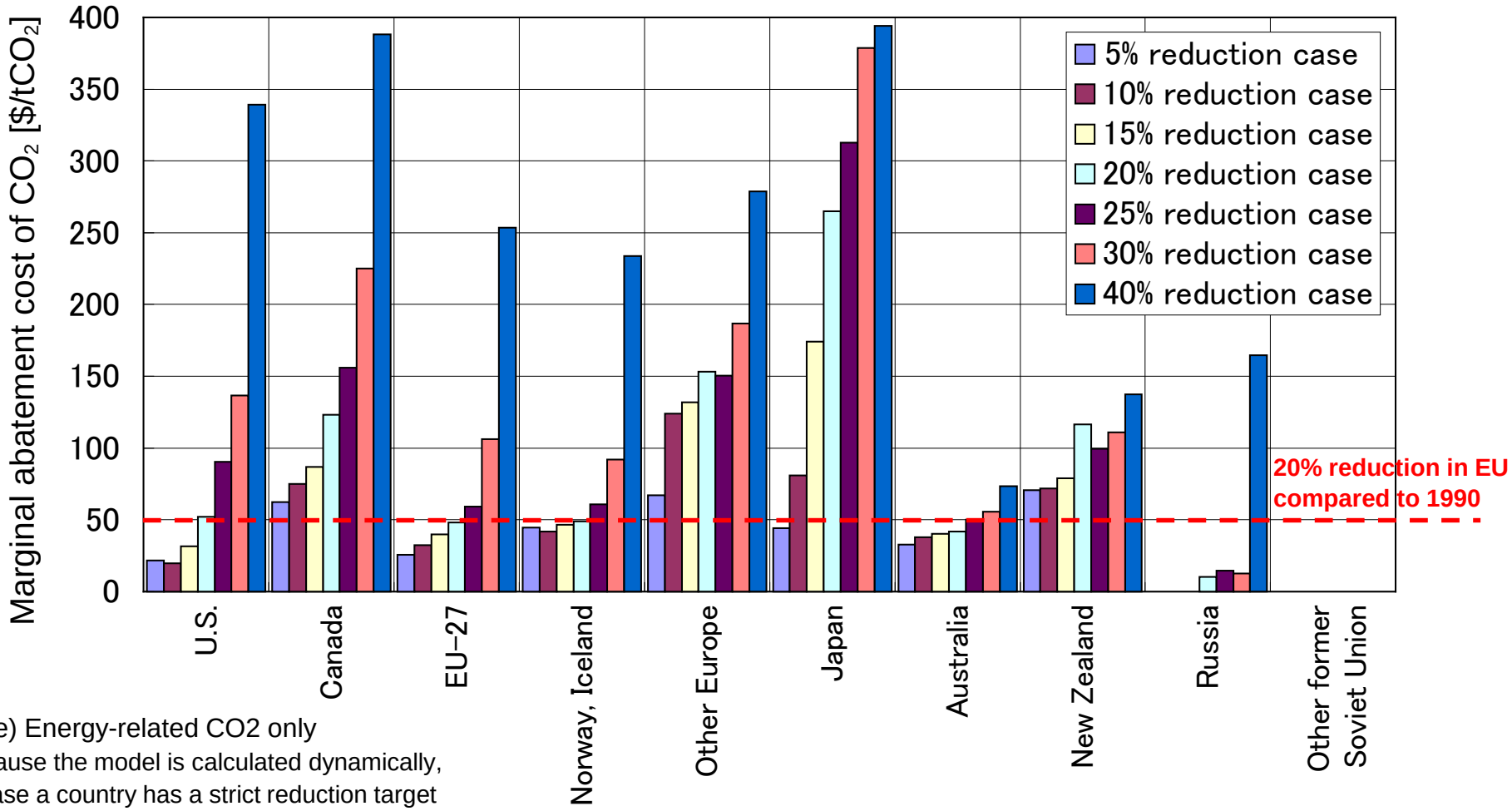
IPCC WG3 AR4 Box 13.7–

- Calculation basis of IPCC WG3 AR4 Box 13.7 is obscure. But the case that per capita emissions converge can be concluded to have a major impact on this number.
- Assuming that global emissions would be halved by 2050 from 1990 and 2005 and that per capita emissions in 2050 would converge (emissions remaining linear), the reduction rate of 2020 Annex I emissions is estimated 24-44%, the almost same level as IPCC WG3 AR4 Box 13.7
- In this case, the reduction rate in 2020 in Japan would be 20-43% compared to 1990

Sharing reductions for Annex I Parties in 2020 when per capita emissions converge



Marginal abatement costs in 2020 by reduction rate compared to 1990

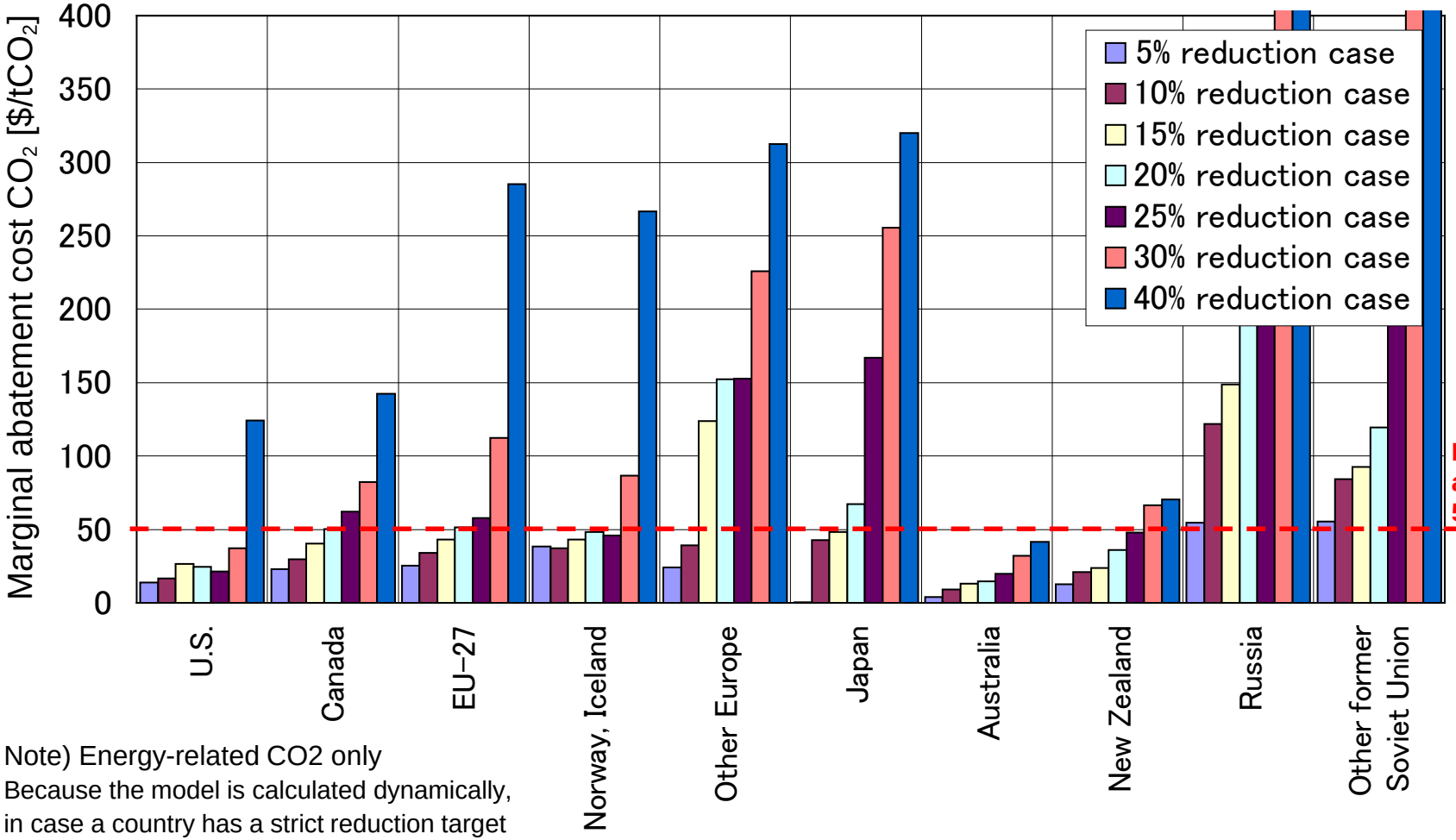


Note) Energy-related CO2 only
Because the model is calculated dynamically, in case a country has a strict reduction target on the timing of facility replacement, the reduction cost in the reference year might be estimate cheap with its rebound. Case estimated that only Annex I countries would reduce.

Reduction potential compared to 1990 of Annex I when the marginal abatement cost is $50/tCO2 : 2.9GtCO2 (21% reduction)

- **At the same abatement cost required EU27 to attain 20% reduction compared to 1990, Japan could reduce 5% at most.**

Marginal abatement costs in 2020 by reduction rate compared to 2005

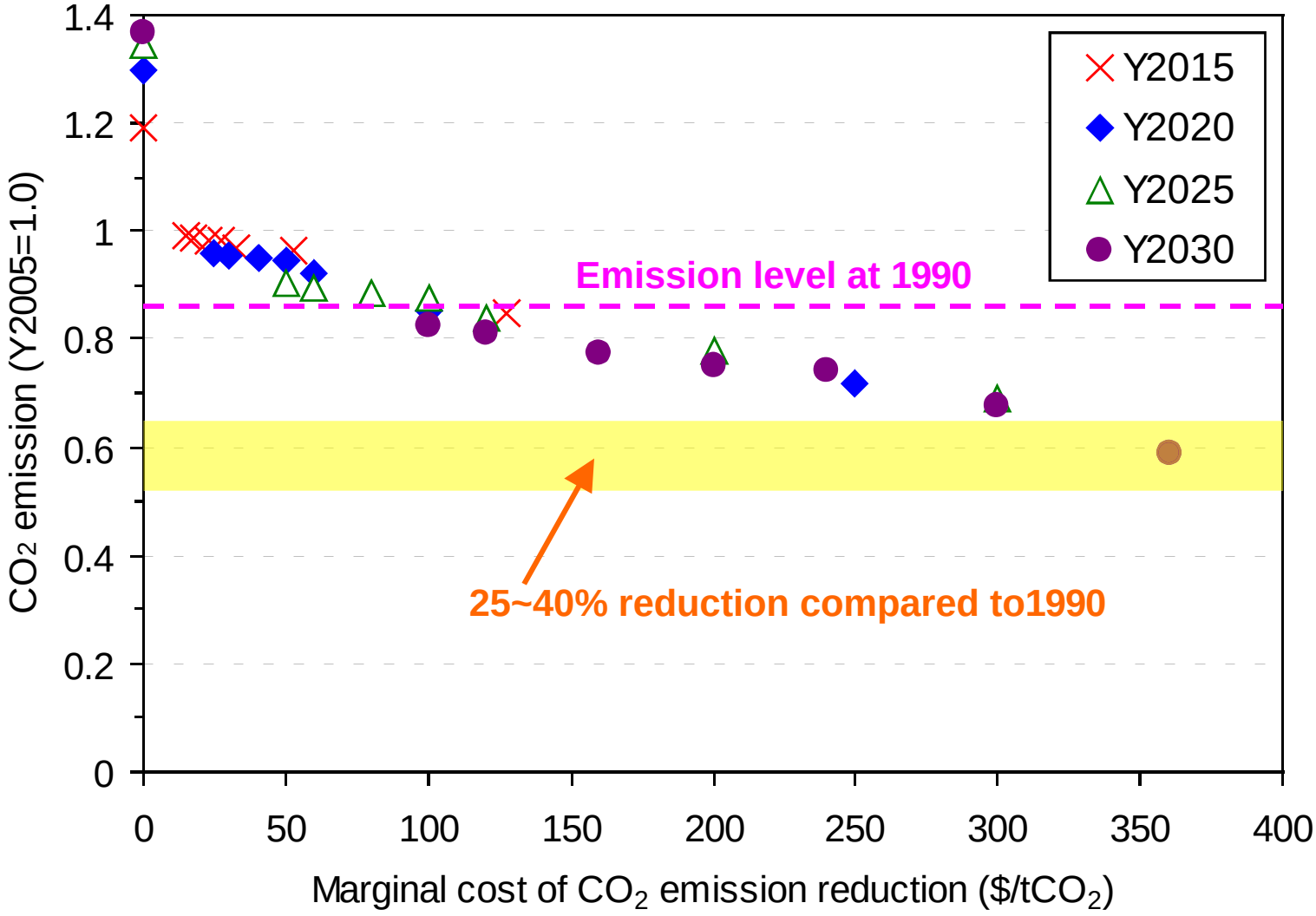


Note) Energy-related CO2 only
Because the model is calculated dynamically, in case a country has a strict reduction target on the timing of facility replacement, the reduction cost in the reference year might be estimate cheap with its rebound. Case estimated that only Annex I countries would reduce.

Reduction potential compared to 2005 of Annex I when the marginal abatement cost is $50/tCO2 : 3.1GtCO2 (22% reduction)

- **If the abatement cost is equal to $50/tCO2, the reduction rate of Japan would be about 15% compared to 2005.**

Estimated emission reduction potentials of Japan



Note) Japan's reduction potential is assumed when all countries of the world, including the non-Annex I countries would reduce CO2 at the same marginal cost. It should be noted that the calculation condition is different from the previous slide

Japan's 25% reduction in 2020 from the 1990 level

	Costs of domestic measures [$/yr/capita]	Costs of purchasing emission credits from overseas [$/yr/capita]	Total [$/yr/capita]
Pure domestic reduction efforts (MAC=$313/tCO2)	415 (¥6.2 trillion/yr)	0	415 (¥6.2 trillion/yr)
Domestic reduction efforts (MAC<$50/tCO2) and purchasing foreign credits for the remaining amount (357MtCO2 at $50/tCO2)	81 (¥1.2 trillion/yr)	143 (¥2.1 trillion/yr)	224 (¥3.4 trillion/yr)
Domestic reduction efforts (MAC=$100/tCO2) and purchasing foreign credits for the remaining amount (240MtCO2 at $100/tCO2)	158 (¥2.4 trillion/yr)	193 (¥2.9 trillion/yr)	351 (¥5.2 trillion/yr)

The numbers in parentheses are the abatement costs of Japan as a whole. Reduction potential of Japan in 2020 at MAC $50~100/ tCO2 are estimated using the estimated decrease of about 5-15% compared to 2005. （Relationships between MAC and reduction potential depends on reductions by other countries and reducing assumptions leading to the 2020

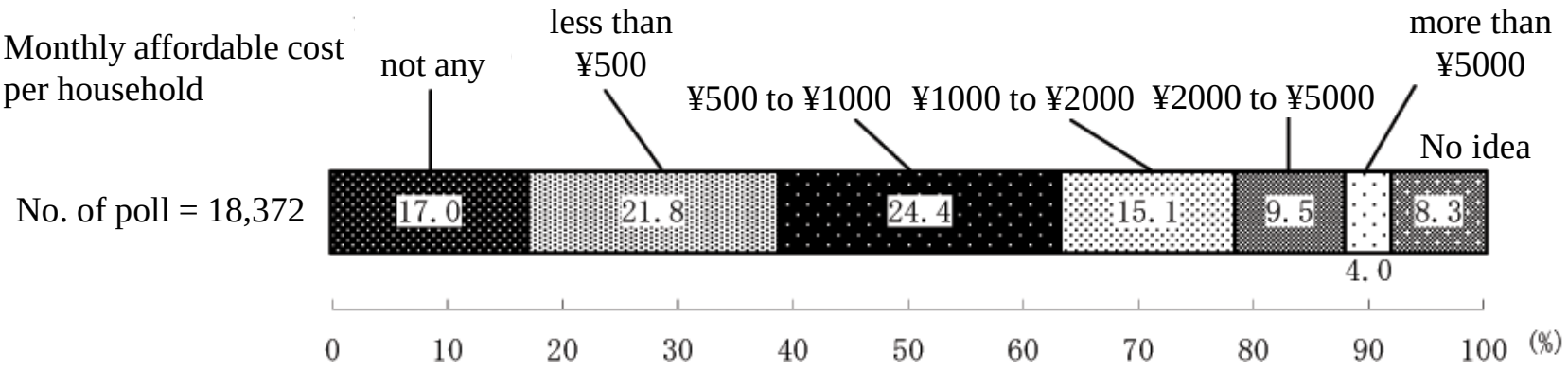
Japan's 40% reduction in 2020 from the 1990 level

	Costs of domestic measures [$/yr/capita]	Costs of purchasing emission credits from overseas [$/yr/capita]	Total [$/yr/capita]
Pure domestic reduction efforts (MAC=$394/tCO2)	854 (¥12.8 trillion/yr)	0	854 (¥12.8 trillion/yr)
Domestic reduction efforts (MAC<$50/tCO2) and purchasing foreign credits for the remaining amount (515MtCO2 at $50/tCO2)	81 (¥1.2 trillion/yr)	207 (¥3.1 trillion/yr)	288 (¥4.3 trillion/yr)
Domestic reduction efforts (MAC=$100/tCO2) and purchasing foreign credits for the remaining amount (399MtCO2 at $100/tCO2)	158 (¥2.4 trillion/yr)	320 (¥4.8 trillion/yr)	478 (¥7.1 trillion/yr)

The numbers in parentheses are the abatement costs of Japan as a whole. Reduction potential of Japan in 2020 at MAC $50~100/ tCO2 are estimated using the estimated 5-15% reductions compared to 2005. （Relationships between MAC and reduction potential depends on reductions by other countries and reducing assumptions leading to the 2020

The relationship between the household burden of climate change and the Cabinet Office poll

Cabinet Office, a special poll on a low-carbon society, ‘cost burdens on household for low-carbon society’, from May 22 to June 1, 2009



The gap is too large

	Cost burdens per household
Domestic reduction efforts (MAC<$50/tCO2)	¥2,000/month
Domestic reduction efforts (MAC<$100/tCO2)	¥4,000/month
25% reduction compared to 1990, complemented by purchasing foreign credits ($50～100/tCO2)	¥5,600~8,800/month
25% reduction compared to 1990, complemented by purchasing foreign credits ($50～100/tCO2)	¥5,600~8,800/month

Exchange rate: $1=120 yen

Summary

- The costs to halve global emissions by 2050 are considerably high. Though technologies are expected to advance significantly, per capita cost burdens in 2050 in developed countries are likely to be more than $1,000 a year
- In case of 80% reduction compared to 2005 in 2050, Japan is likely to have rapid increase in reduction costs.
- Domestic reduction efforts with the MAC range of $50~100 /tCO2 in 2020 are estimated potentially to reduce 5-15% compared to 2005 and cost burdens per capita are about $80~160/yr . (Japan as a whole; ¥1.2~2.4 trillion/yr)
- If Japan commits tentatively 'emission reductions in a range of 25~40 per cent below 1990 levels by 2020' cited in COP/MOP3, annual cost burdens per capita would be $220~480. (Japan as a whole; ¥3.4~7.1 trillion/yr, of which 2.1 to 4.8 trillion yen are spent to purchase foreign credits and outflow overseas. Without purchase of foreign credits, the per capita burdens would be increased more.)
- A good understanding of the cost burdens are required, and then we should consider the appropriate level of emission reductions.