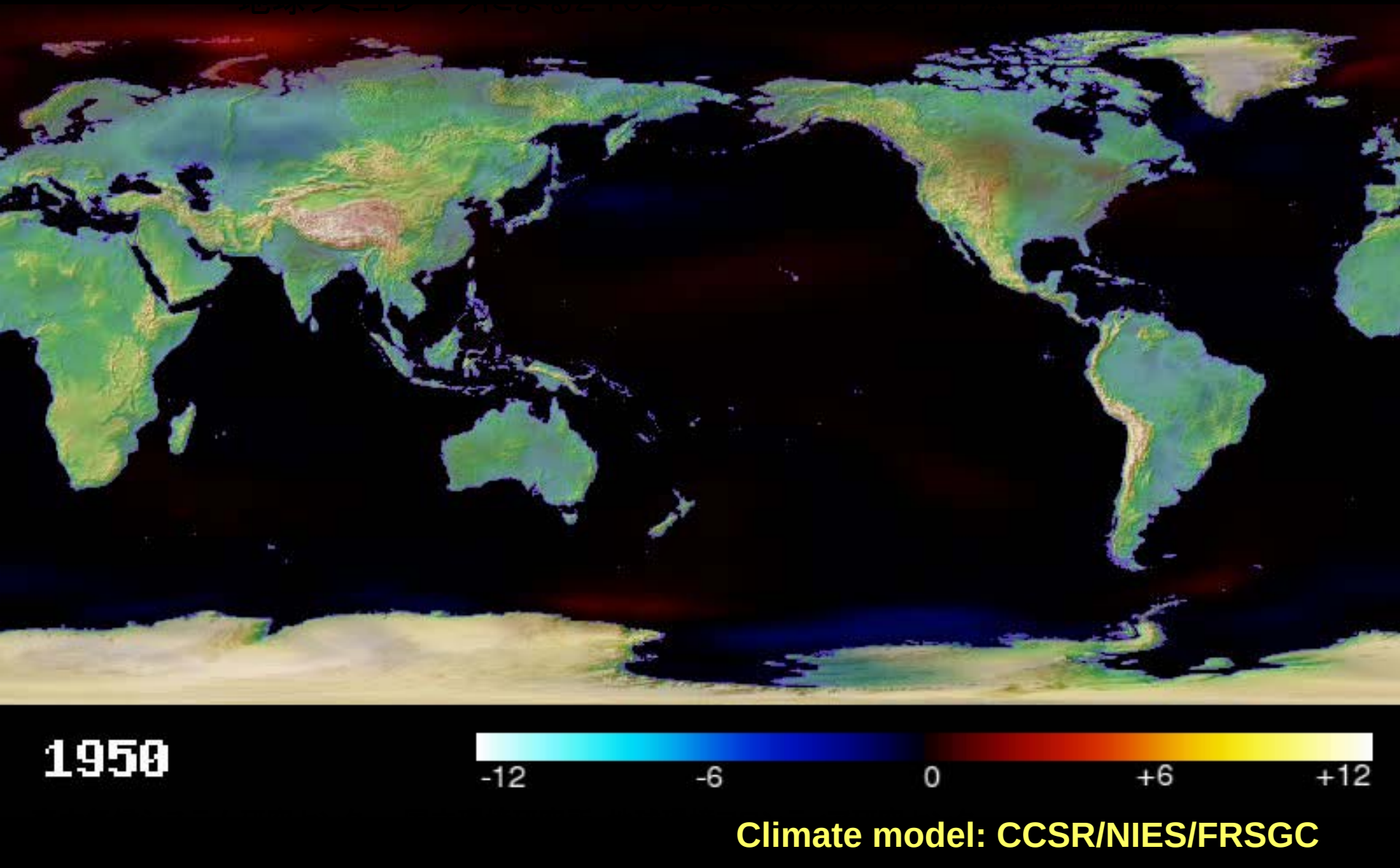
A Dozen Frequently Asked Questions from decision makers to modelers: Japan's case

- What happens without climate policy ?
- How much reduction needed ultimately ?
- How to set world reduction target ?
- Options of country's reduction target: long/mid- term
  - Should industrial structure change ?
  - How much reduction potential each sector has ?
  - How to change land use ?
  - How much is the cost of reduction ?
  - What policy options exist to attain the goal ?
  - How much is the impact to country's economy ?
  - Can we win in international technology competition ?
- How Japan can contribute internationally?

Asian Modeling Meeting, 18 Sept, 2009 Tsukuba
Shuzo Nishioka National Institute for Environmental Studies (NIES)

Q1: What happens without climate policy ?

Projection of surface temperature from 1900

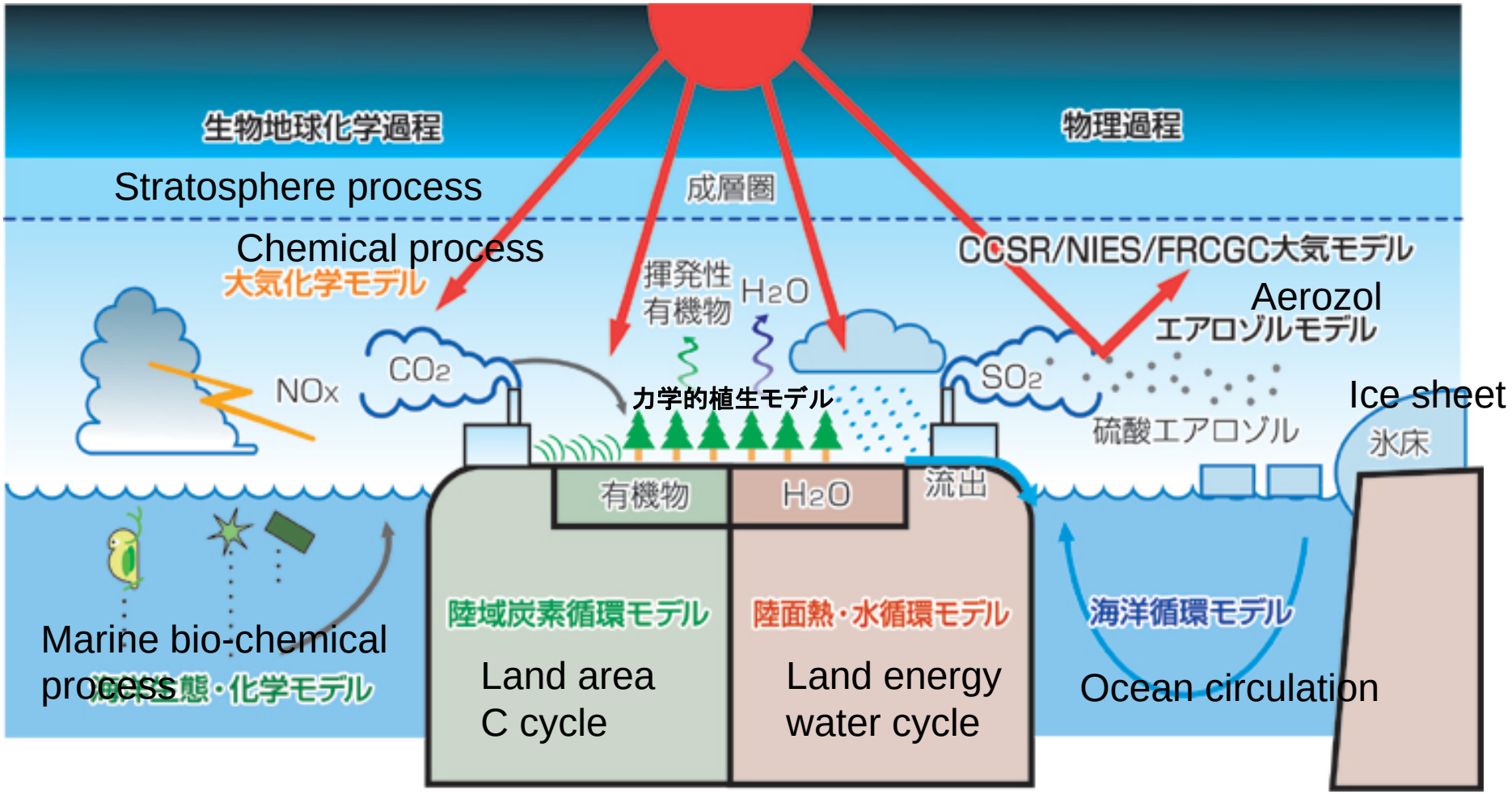


Climate model: CCSR/NIES/FRSGC

Q2: How much reduction needed ultimately ?

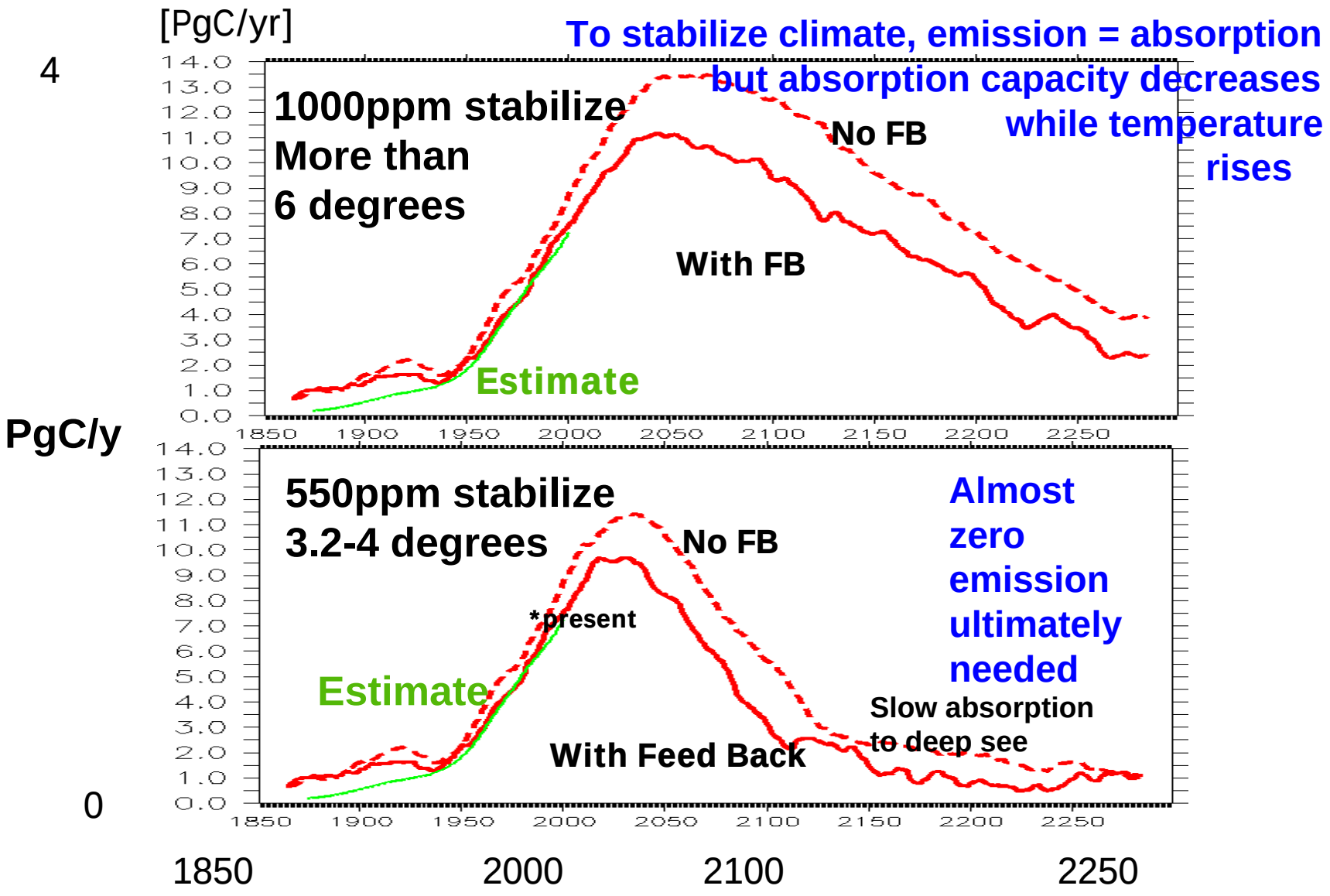
Earth System Integrated Model:

climate +carbon cycle model



Kakushin (Innovation)Program (07-12)

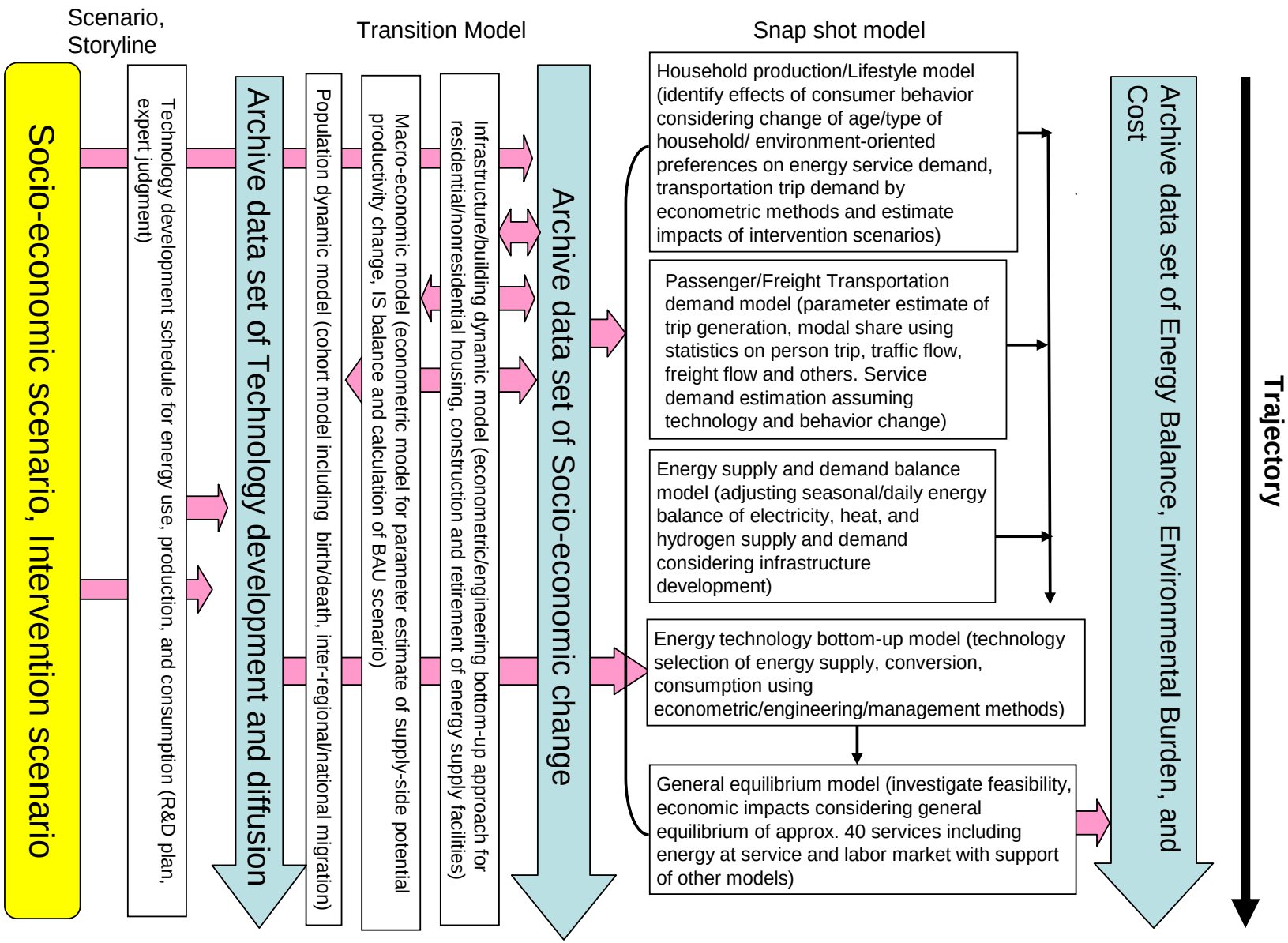
Q2：How much reduction needed ultimately ?



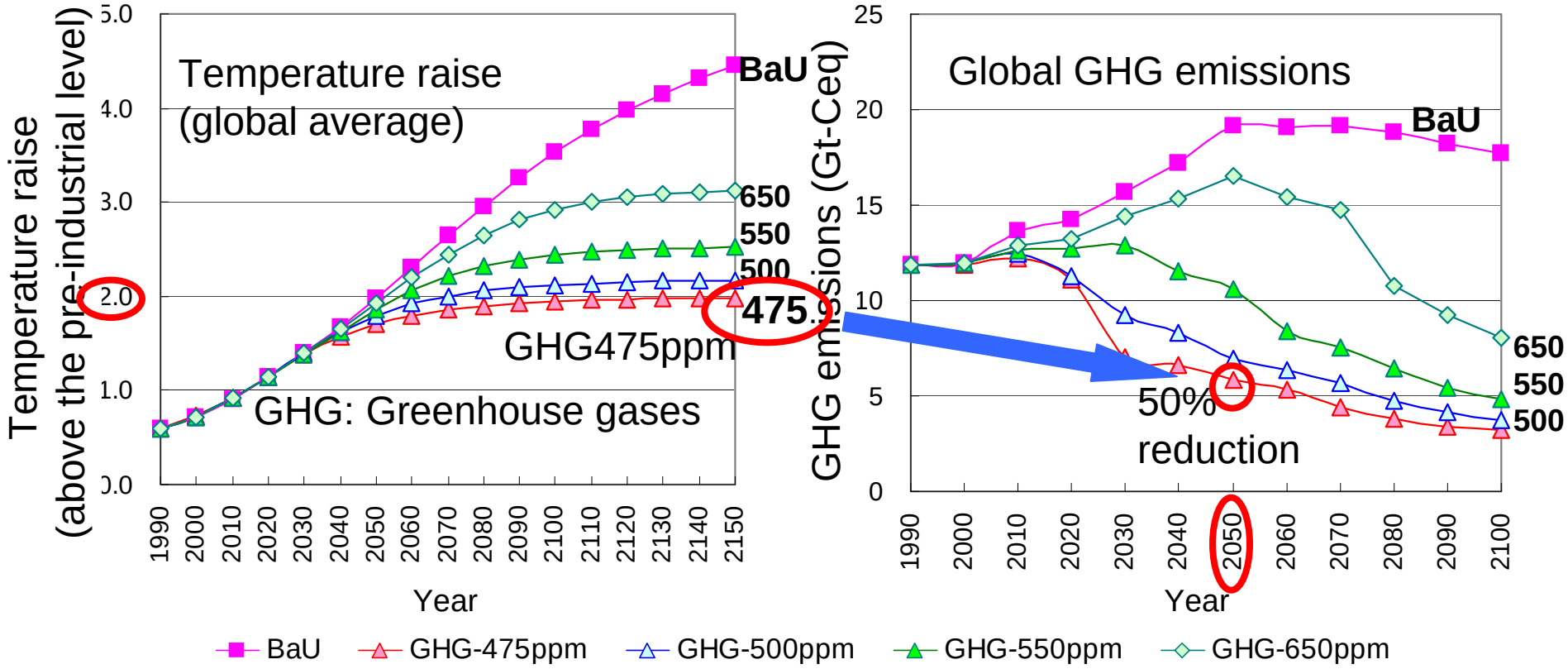
Interim research findings of "Innovative" Earth System Model

JAMSTEC(2007)

Element models for
Japan low carbon society project developed by Prof. Matsuoka (Kyoto Univ.)



http://2050.nies.go.jp



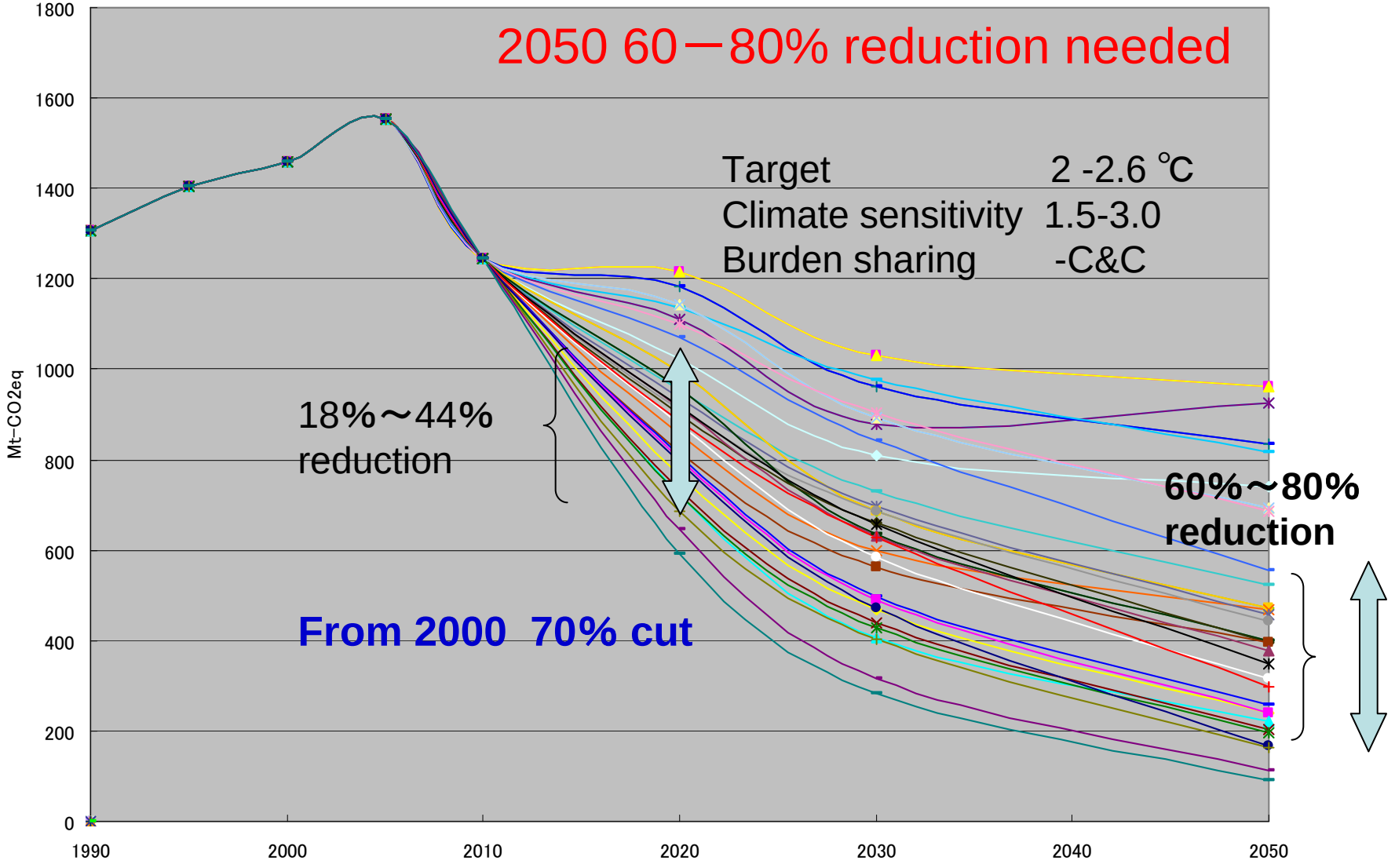
Q3:How to set world reduction target ?

- **to avoid temperature rise of 2℃ from pre-industrial era, 50% GHG reductions in 2050 is required**

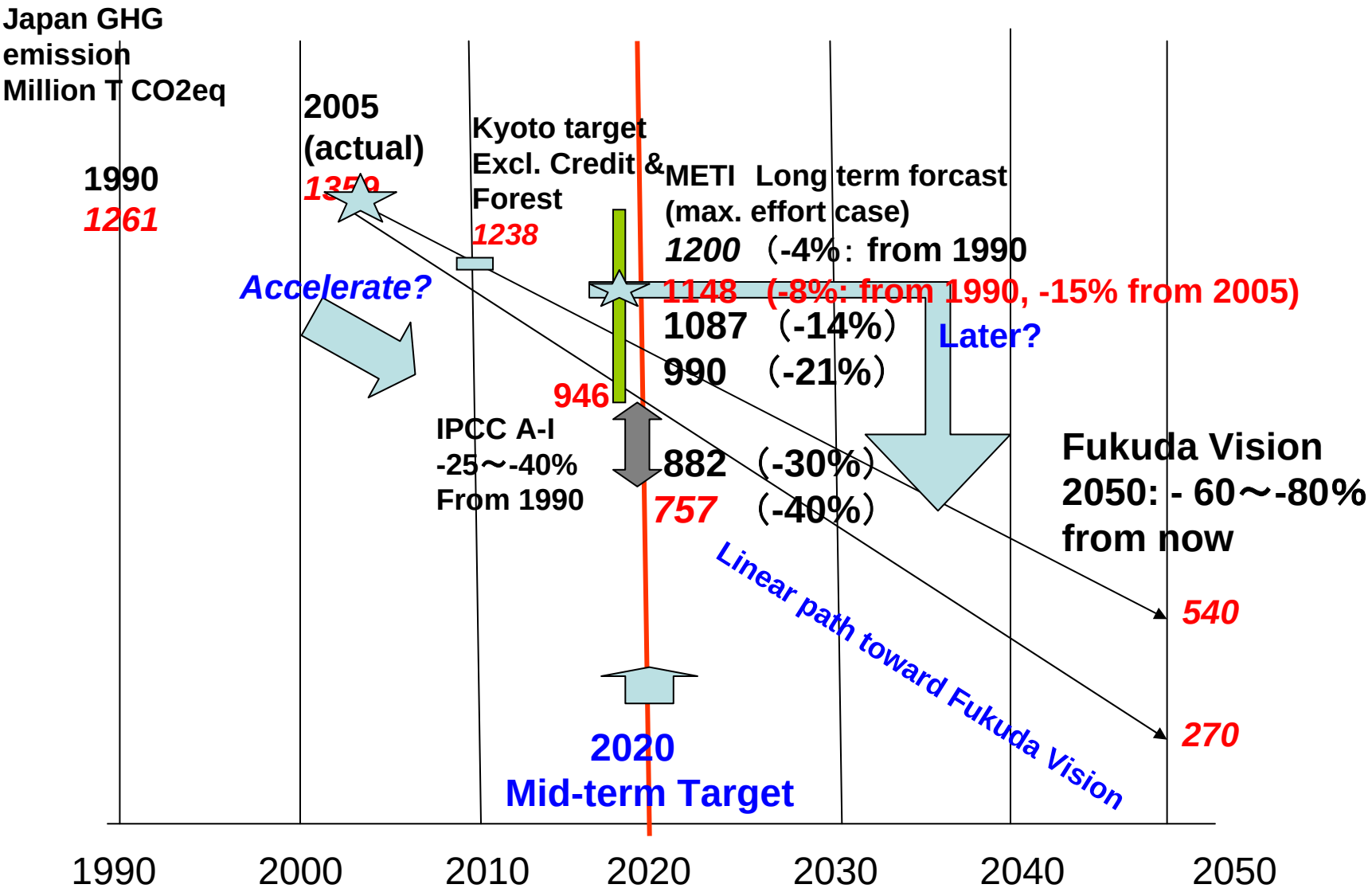
Calculated by AIM/Impact [policy] Model: NIES

http://2050.nies.go.jp

Q4：Japan’s reduction target ?: long- term

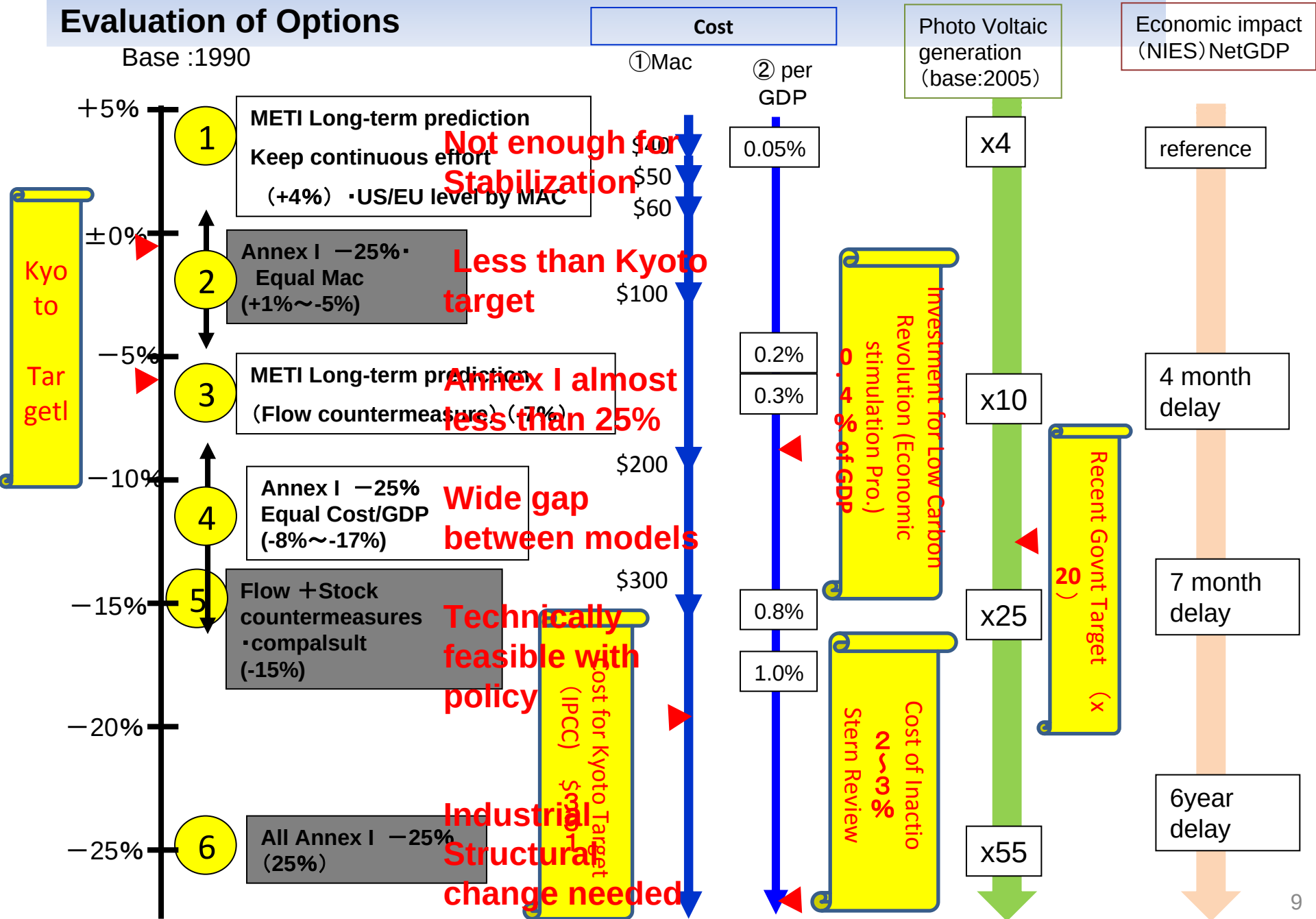


Q4：Japan's reduction target ?: mid- term

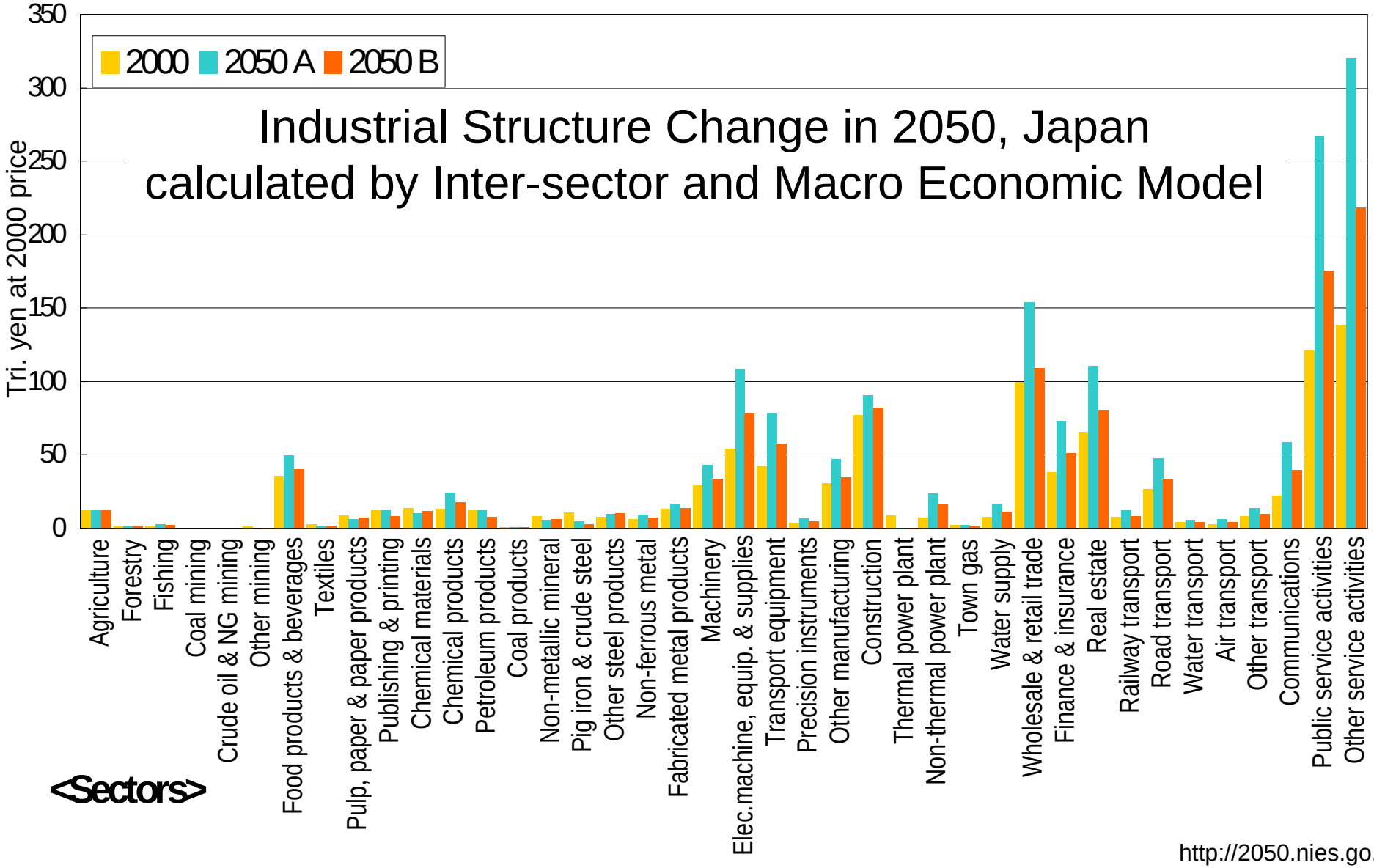


Q4：Japan's reduction target ?: mid- term

Evaluation of Options



Q5: Should industrial structure change ?



http://2050.nies.go.jp

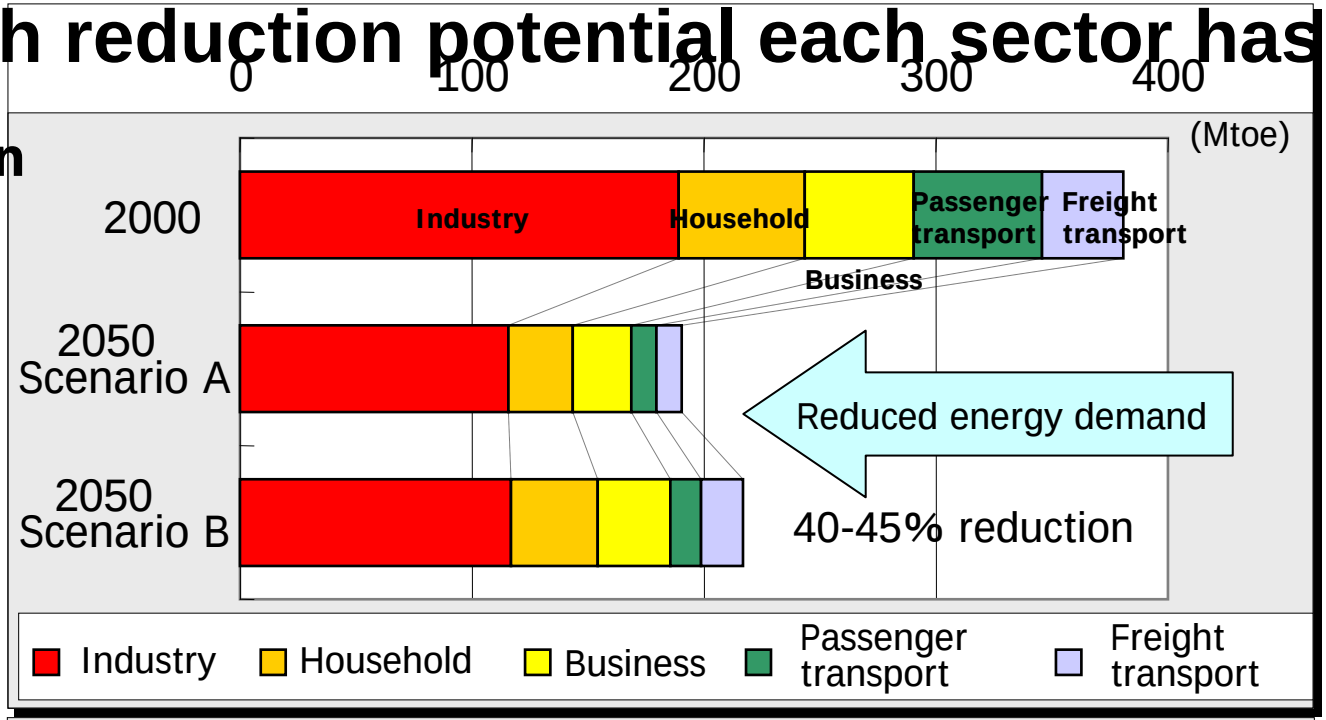
Q6: How much reduction potential each sector has ?

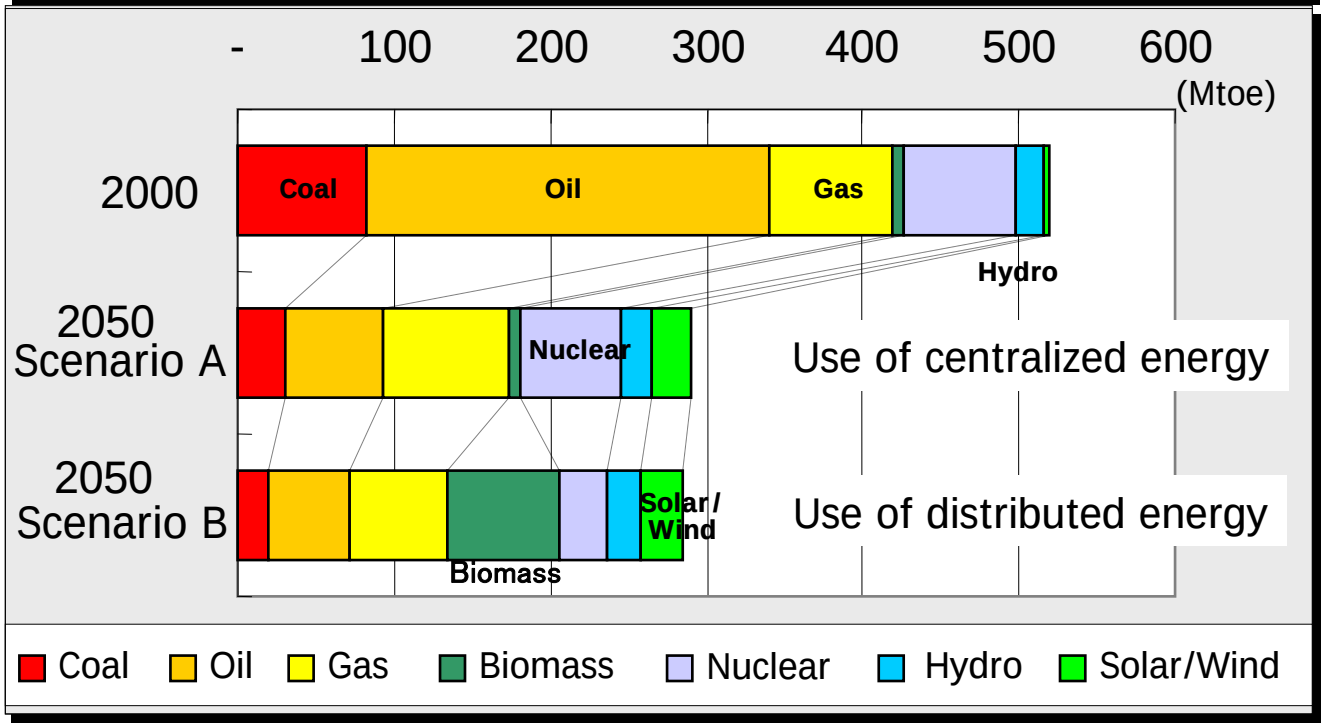
70% CO_2 reduction feasible

Smart consumer choices can reduce energy consumption by as much as 40-45%!

Equal effort by demand & supply side

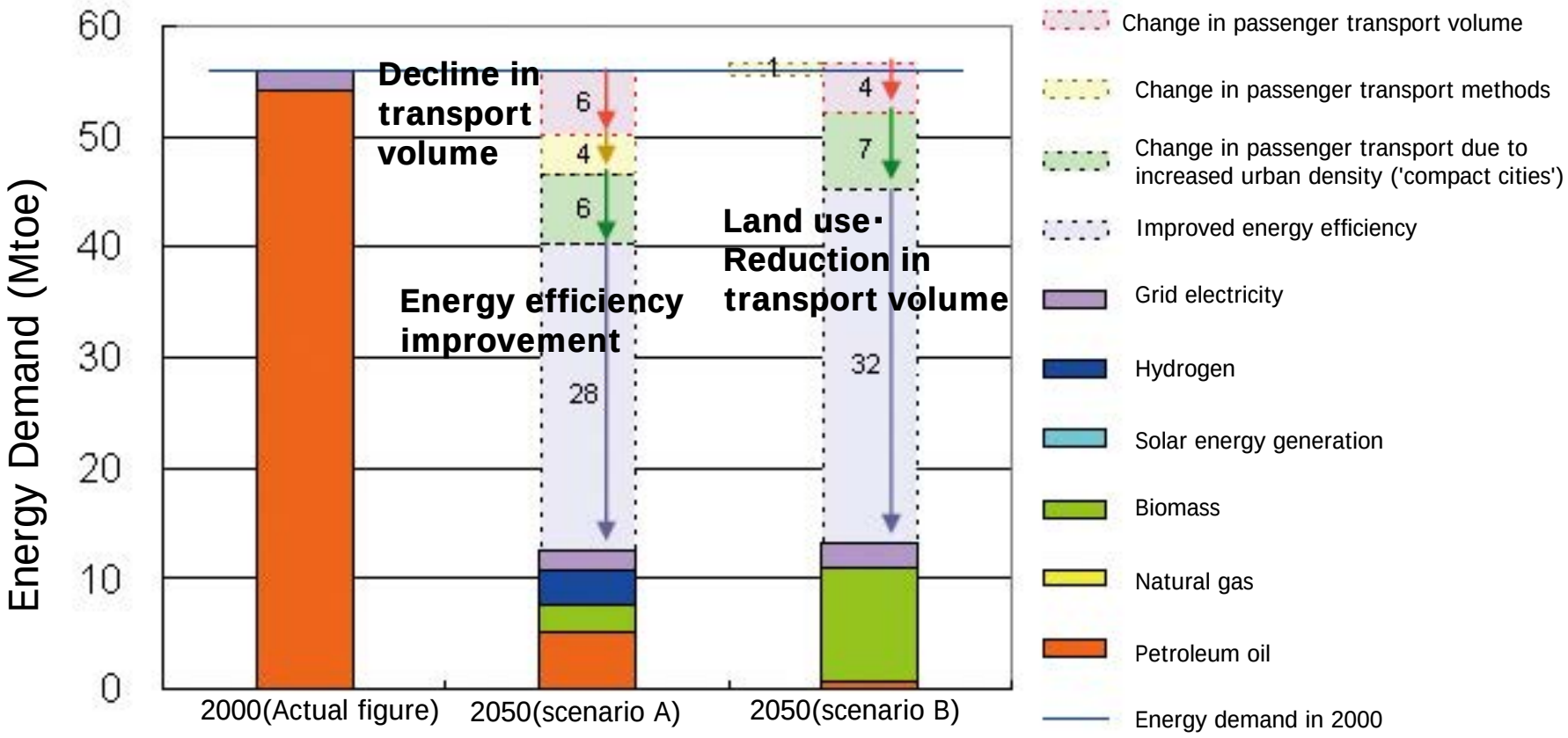
Low carbon shift in primary energy sources via introduction of renewable energies





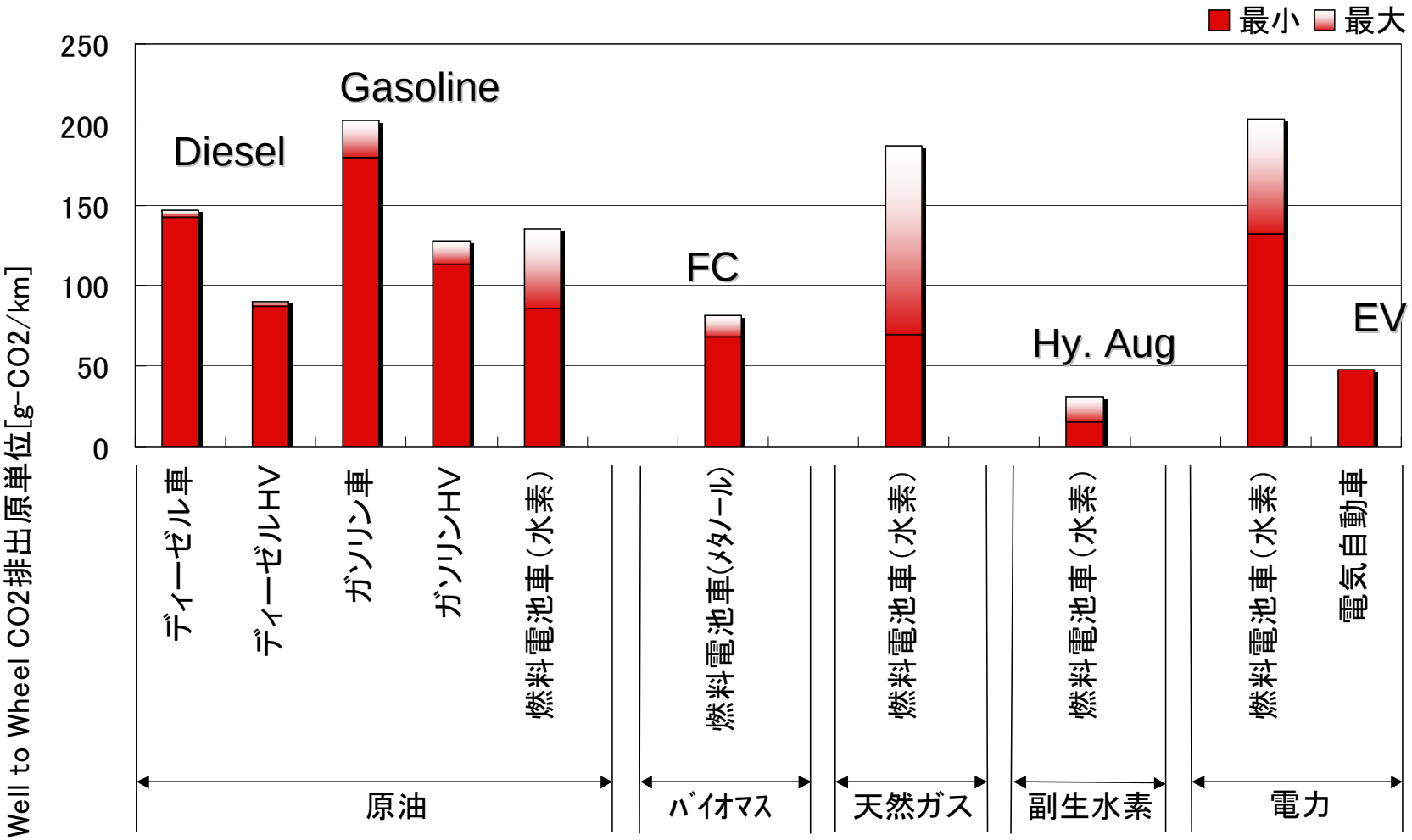
Q7: How to change land use ?

Passenger transport sector can achieve 80% reduction in energy demand via improved energy efficiency & suitable land use



Change in passenger transport volume: reduction in total movements due to population decline
Change in passenger transport methods: modal shift using public transport system (LRT etc.)
Change in passenger transport due to increased urban density ('compact cities'): reduced travel distance due to proximity of destination
Improved energy efficiency: improvements in automobiles & other passenger transport devices (hybrids, lightweight designs etc.)

Technical solution
Car CO_2 Emission/km:　EV: Gasoline= 1:4

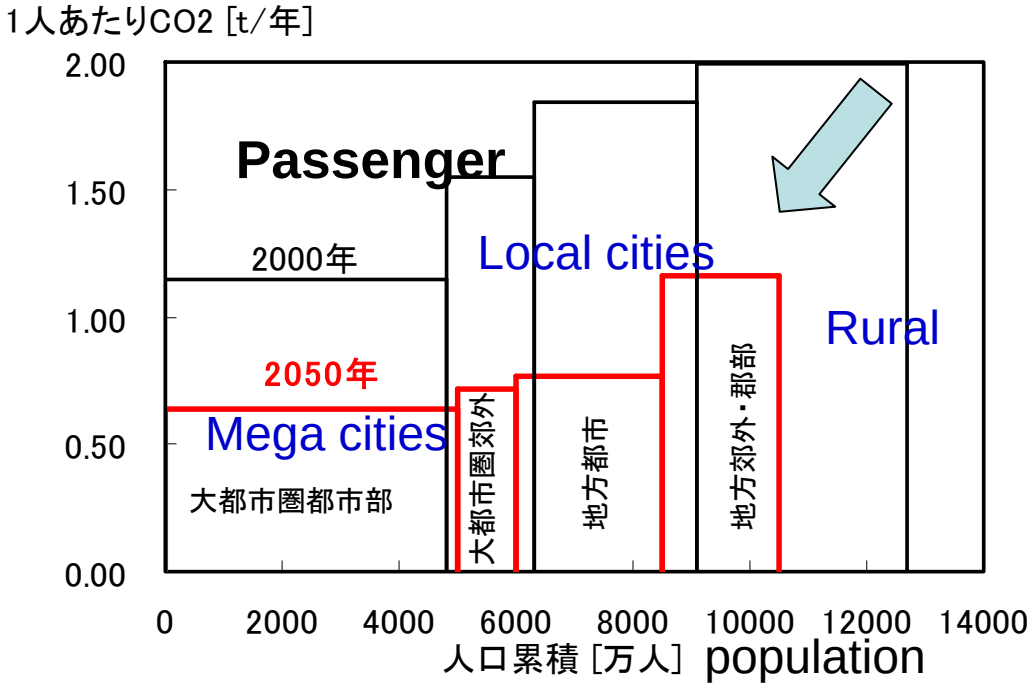


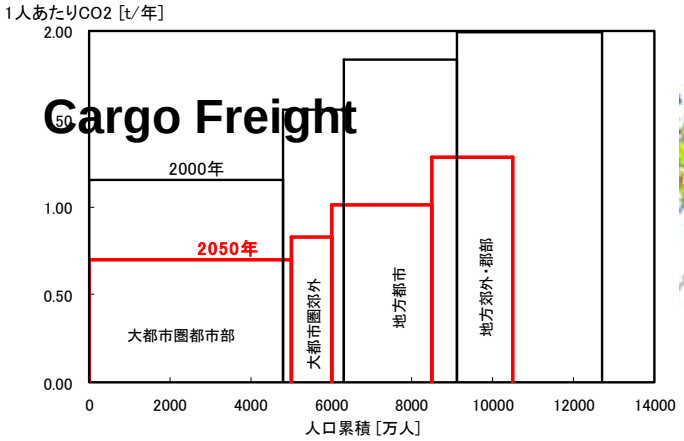
※HV：ハイブリッド車の省略形　　※電力：日本の平均電源構成
※燃料電池車：回生エネルギーを二次電池で回収　　※水素：圧縮水素を仮定

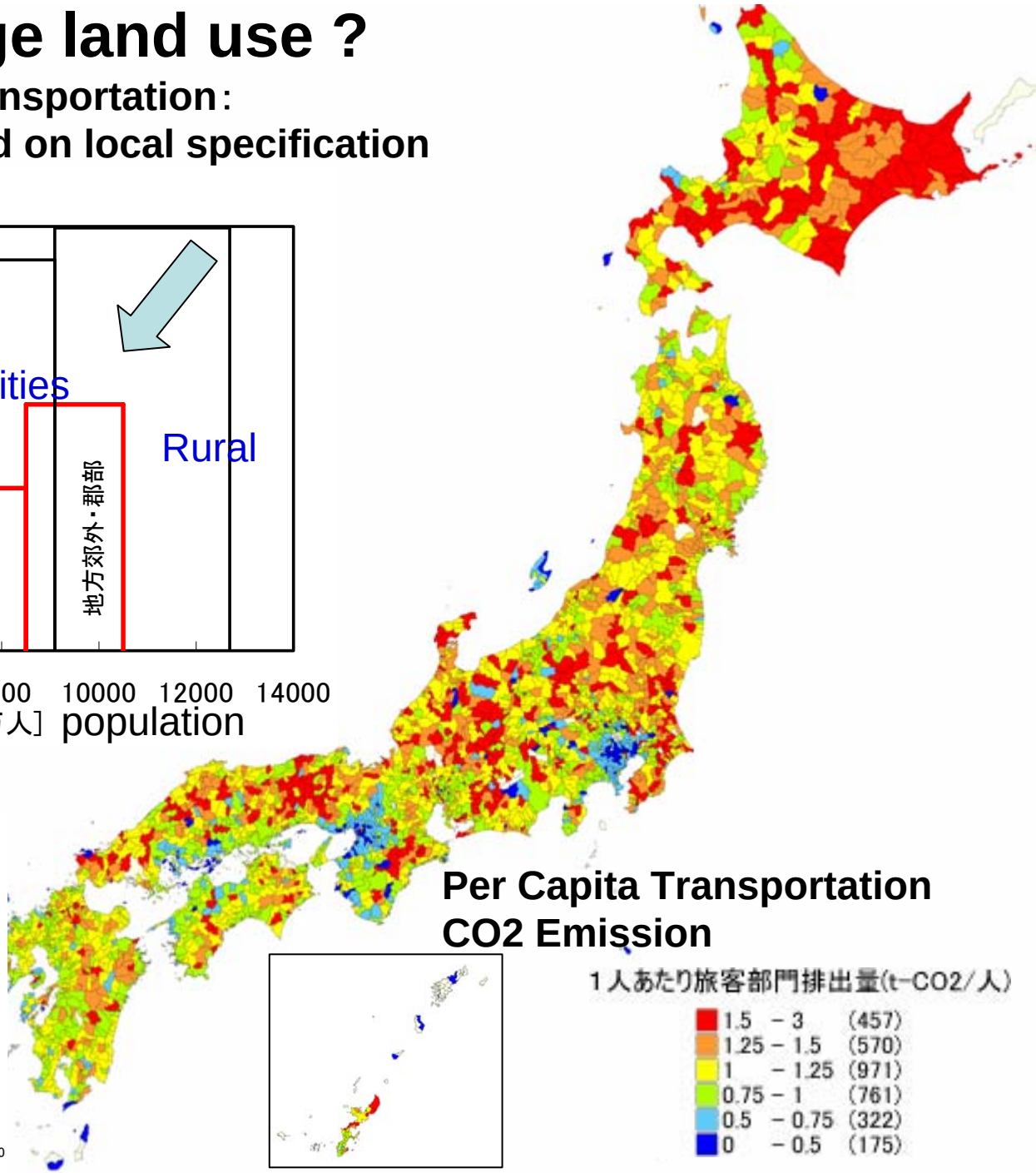
脱温暖化2050研究
交通チーム　工藤

Q7:How to change land use ?

Land-use planning and transportation:
Reduction strategy depend on local specification





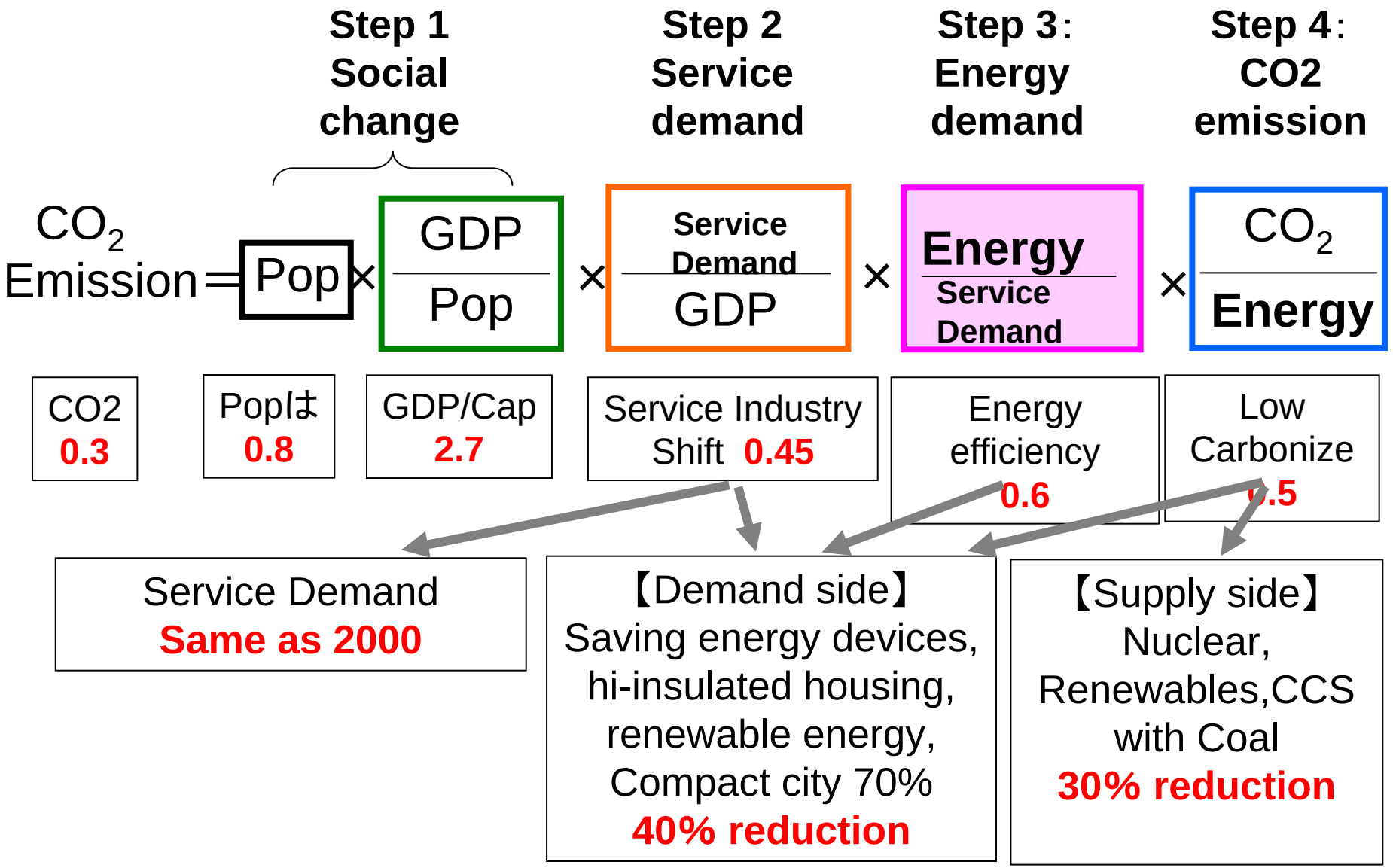


Per Capita Transportation CO2 Emission

1人あたり旅客部門排出量(t-CO2/人)

1.5	– 3	(457)
1.25	– 1.5	(570)
1	– 1.25	(971)
0.75	– 1	(761)
0.5	– 0.75	(322)
0	– 0.5	(175)

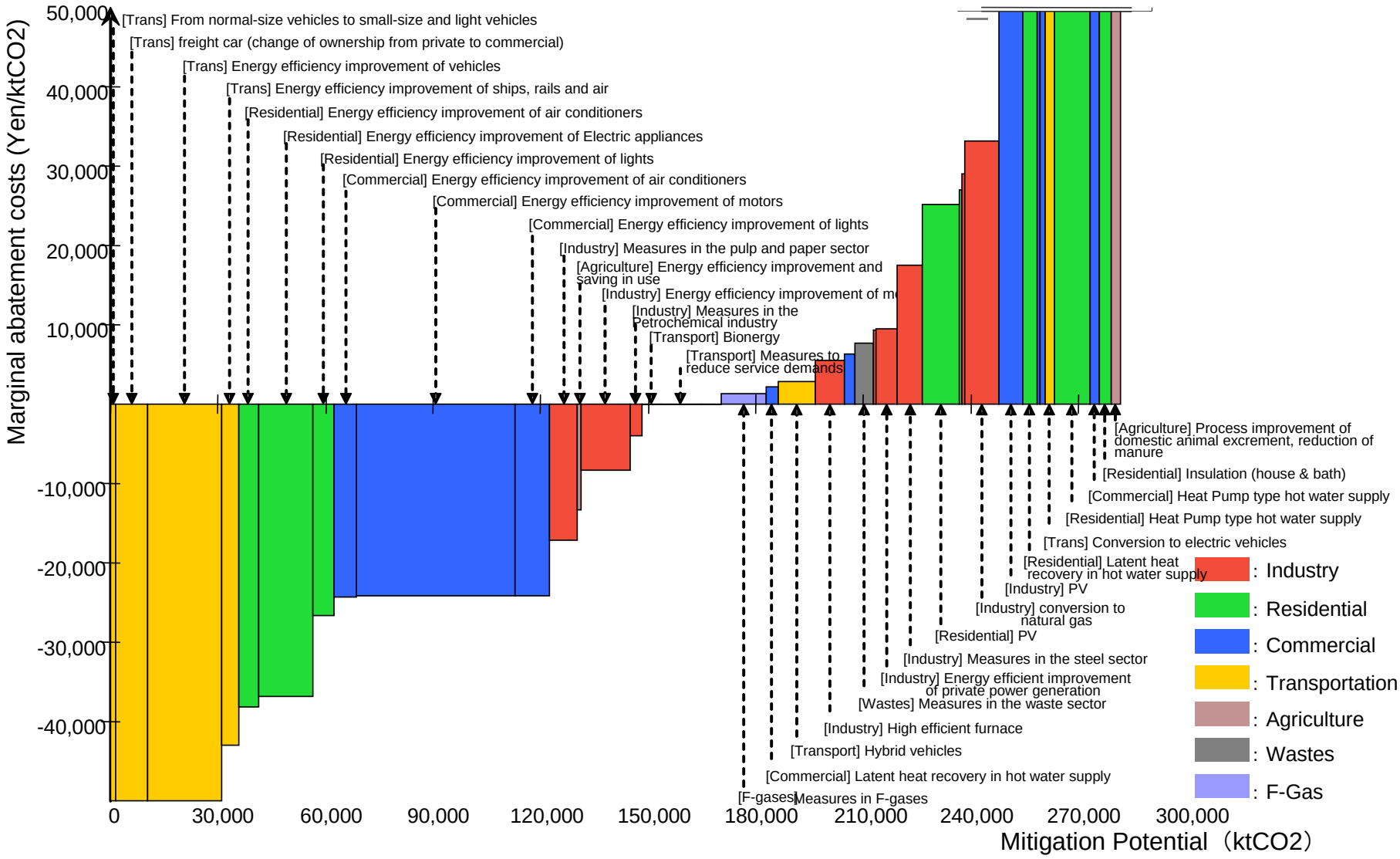
Energy Efficiency is the key, but not enough



2050 Japan LCS Scenario

Q8: How much is the cost of reduction ?

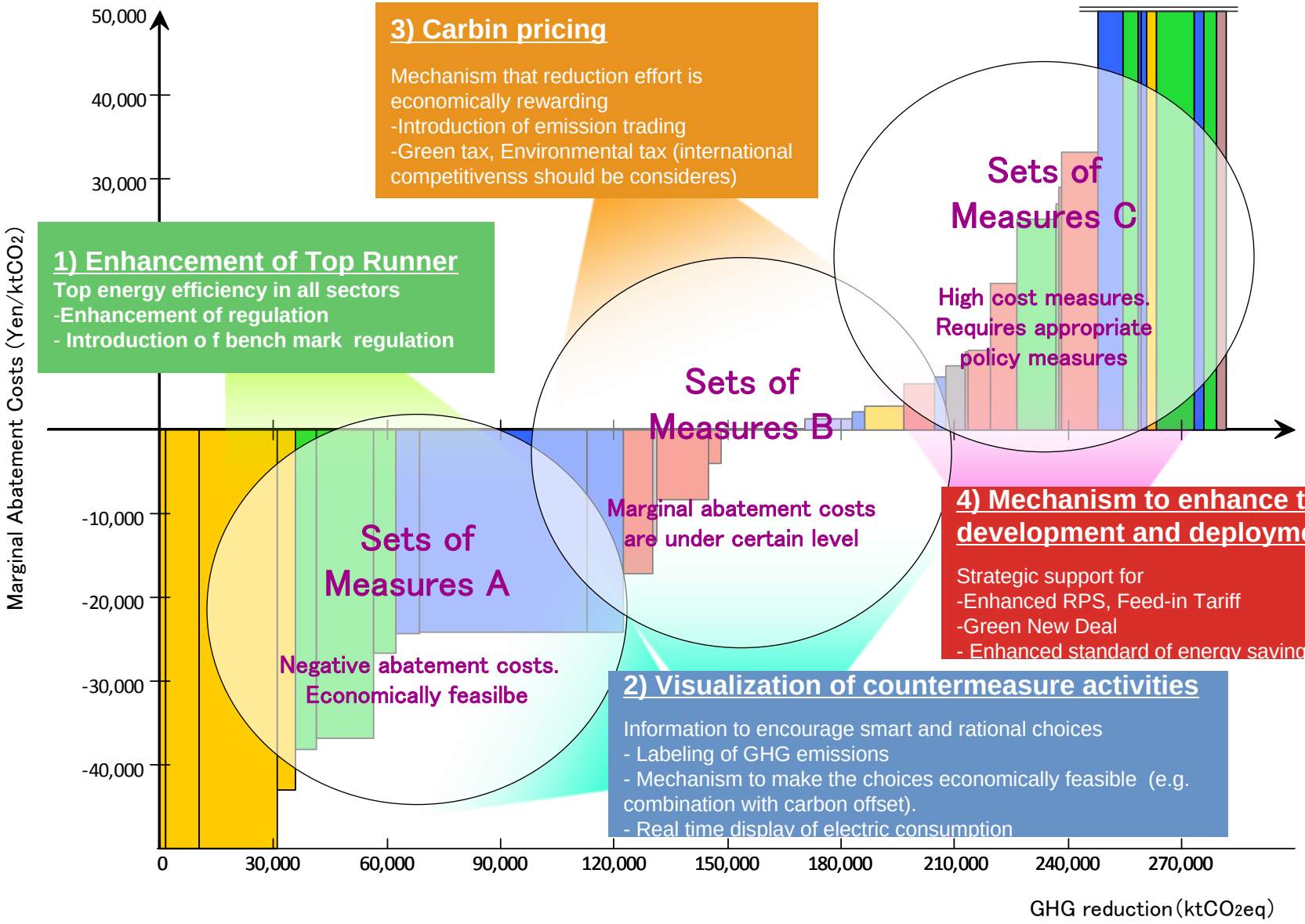
Marginal Abatement Cost to Reduce GHG emissions in 2020



Note: MCII, Payback time is 3 years except 10 years in Insulation and PV. Mitigation potential is compared to the emissions in Frozen Case

Q9: How much is the cost of reduction ?

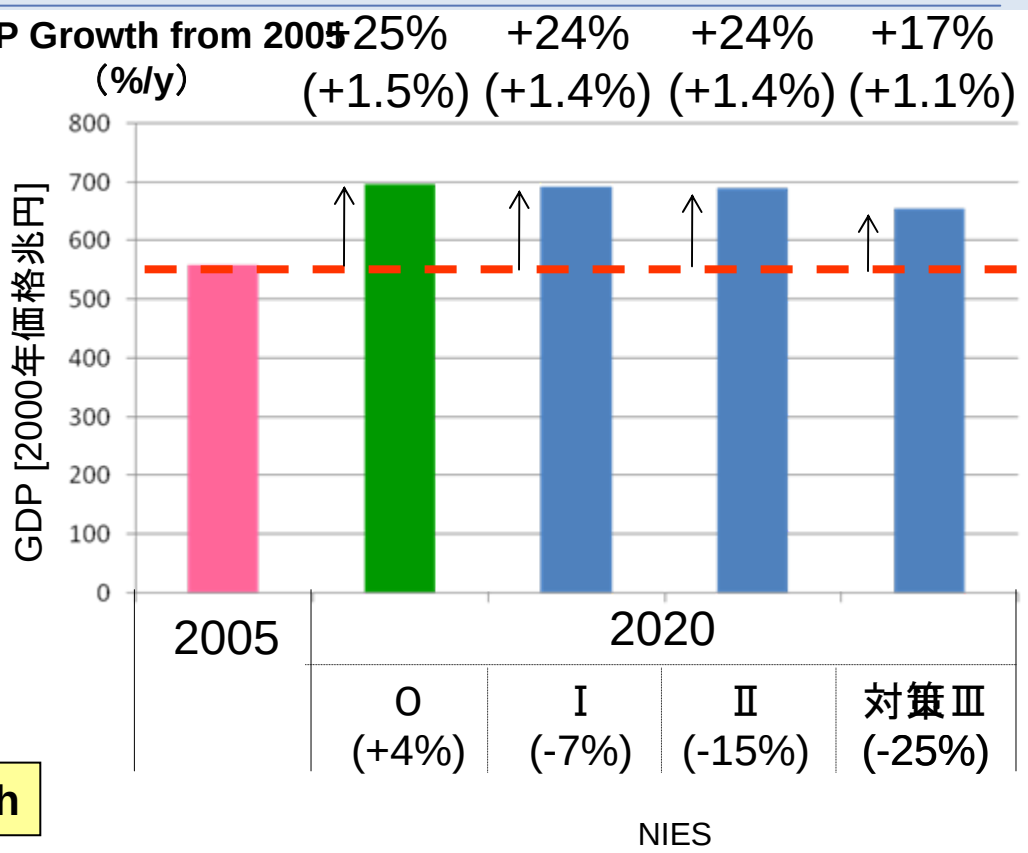
Feasible with Four sets of countermeasures to achieve the target of 2020

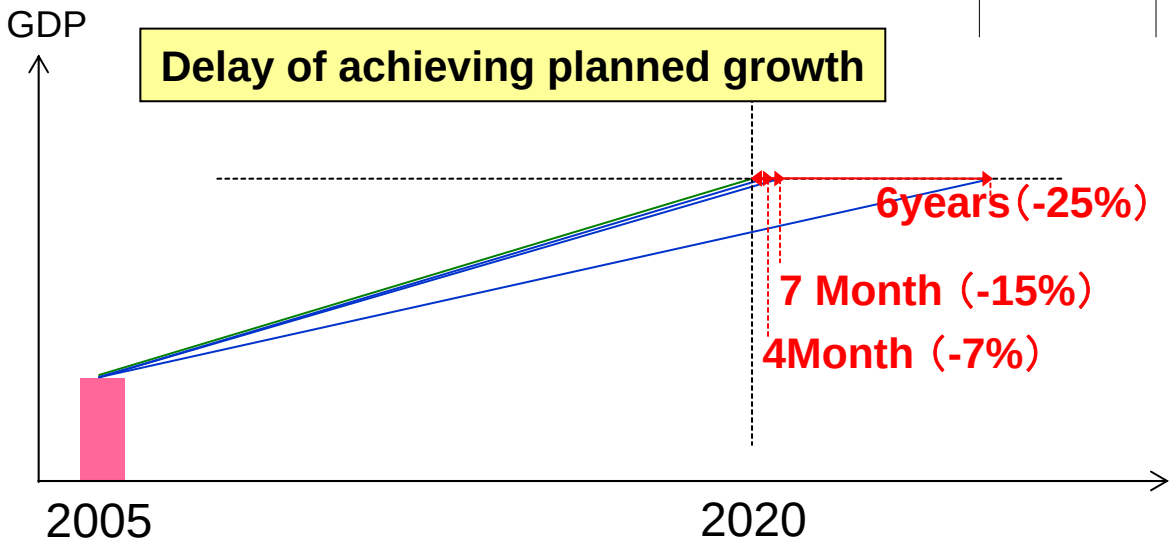


Q10: How much is the impact to country's economy ?

Endurable loss in GDP growth:?

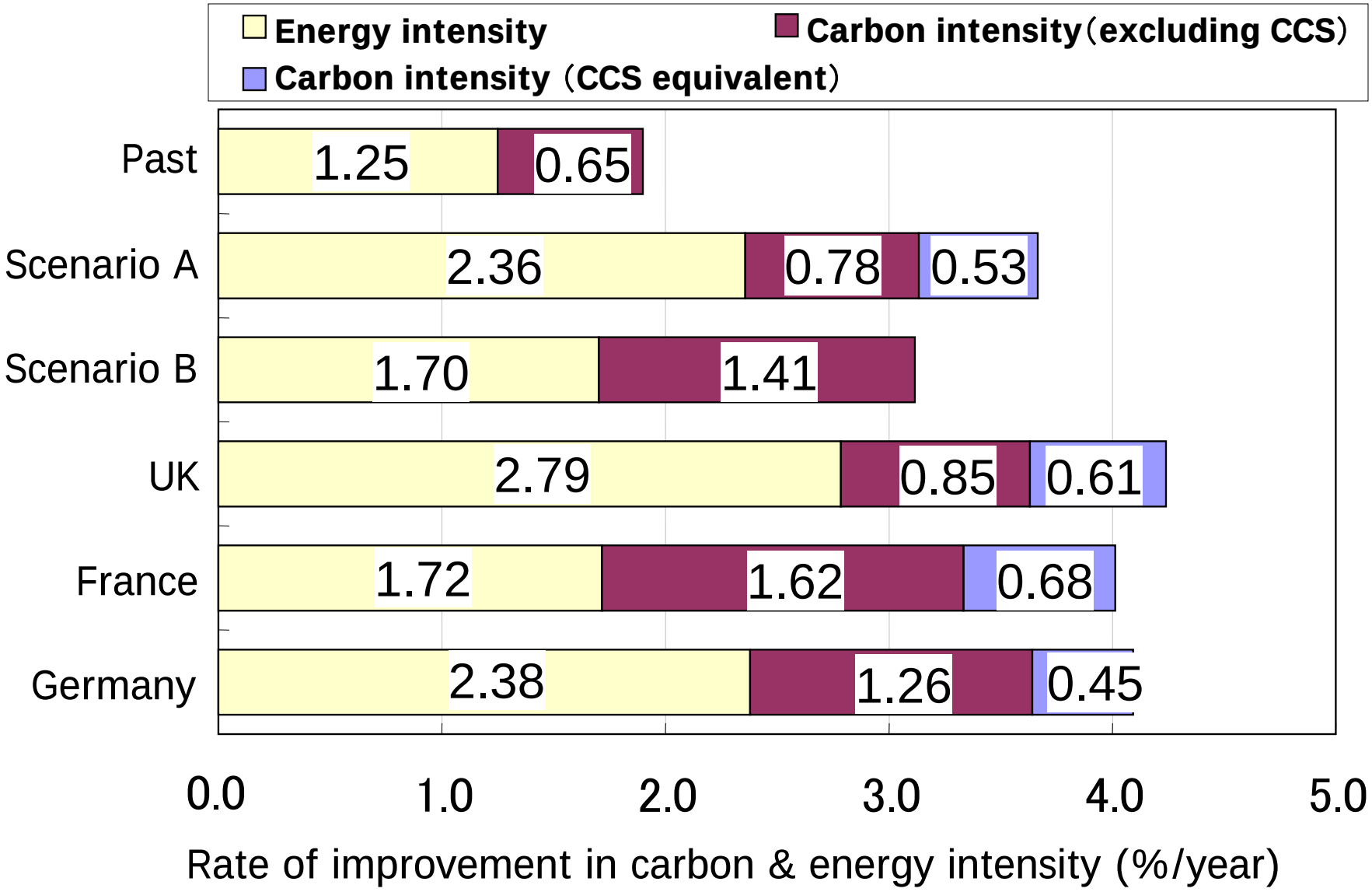
- 7%～15% reduction from 1990 effect little to GDP
- 25% reduction from 1990 can secure 1.1%/y growth



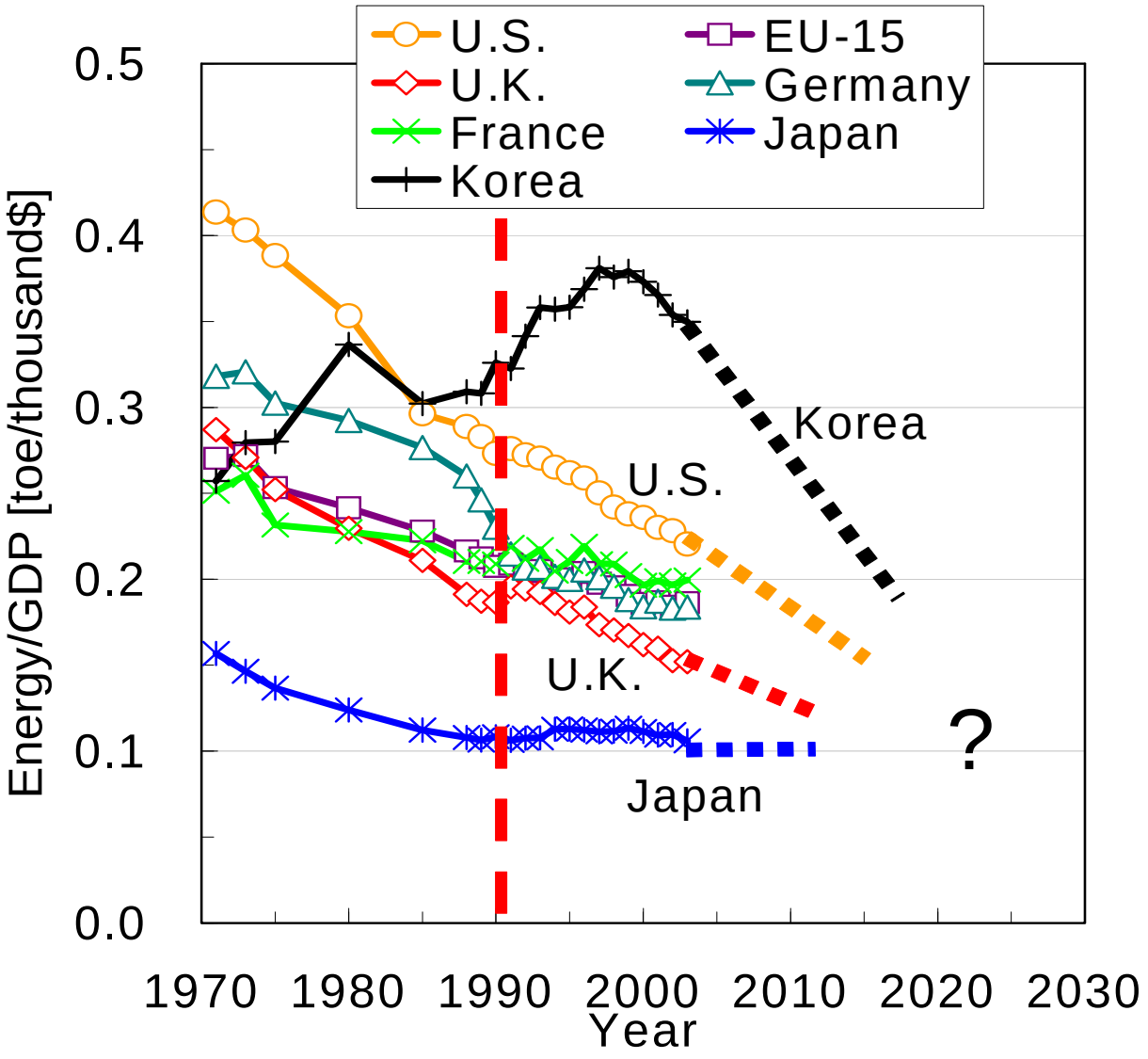


Q11: Can we survive in international technology competition ?

Acceleration of Technology Essential to Realize a Low Carbon Society



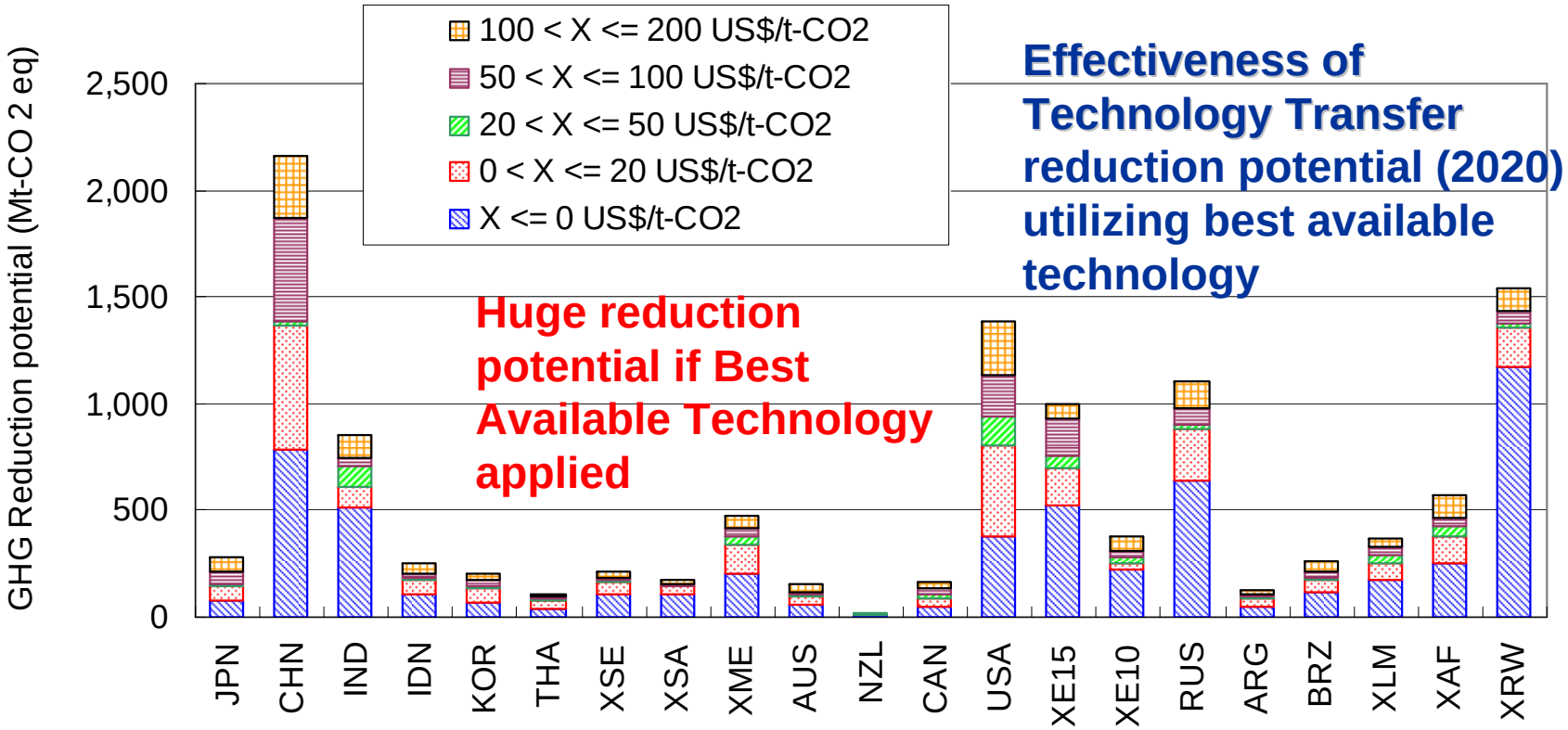
International Energy Intensity Competition



Japan almost caught up by European countries

IEA Energy statistics

Q12: How Japan can contribute internationally?



- **China, US, India, Western Europe and Russia are major 5 regions where there are large reduction potentials, and it accounts for 63 % of total reduction potentials in the world. Top 10 regions account for about 80 % of total reduction potentials.**


Thank you for your attention!
Can you feel the blessings of climate?

Ministry of the Environment
Japan

Establishment of the Committee

Cabinet Office

The Council on the Global Warming Issue

- Established in February 2008
- Discuss a variety of issues toward a low-carbon society
- Chair: Mr. Hiroshi OKUDA (former TOYOTA president)

The Mid-term Target Committee

- Established in October 2008
- Consider Japan's mid-term target from a scientific viewpoint and offer options
- Chair: Mr. Toshihiko FUKUI **(former governor of the Bank of Japan)**

Ministry of the Environment
Japan

Process of the Consideration

Establishment of
Mid-term Target Committee

Scientific examinations and analysis of options in the Committee

Concluded on 14 April

Public Comments ～16 May

The Japanese Government will choose the mid-term target from the options and announce it by June.

Ministry of the Environment
Japan

Prime Minister Aso's Speech

" We are currently examining our mid-term target based on scientific analysis, considering the environment, the economy, and energy in an integrated manner, and I intend to announce the target by June. This target should not be a declaration without backing; I intend for this to be viable from an economic perspective and serve as a contribution to global warming countermeasures for the entire planet."

From the Special Address by Prime Minister Aso in Davos (January 31, 2009)

Ministry of the Environment
Japan

Japan's policy on mid-term targets

- **Set quantified national emissions reduction targets**
- **Ensure comparability based on mitigation potential analysis**
- **Evaluated with regard to domestic mitigation efforts**
- **Use of flexibility mechanisms as a supplementary measure**
- **Include land use, land use change and forestry (LULUCF) as part of the national commitment**

Ministry of the Environment
Japan

Techno-Economic Models Applied for Analysis

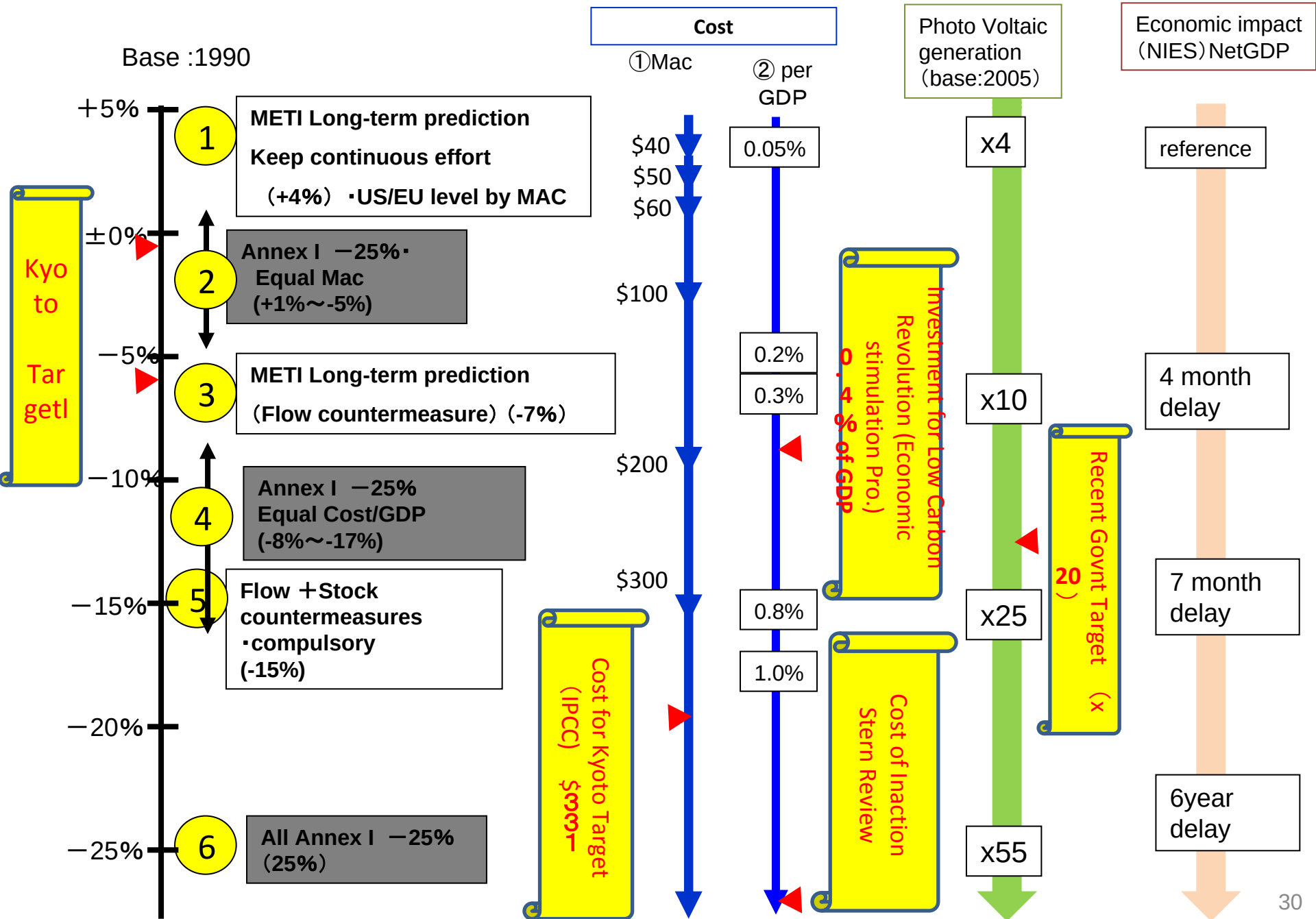
- **International Comparability: MAC (marginal abatement cost) and Cost/GDP analysis models by:**
  - **National Institute for Environmental Studies (NIES)**
  - **Research Institute of Innovative Technology for the Earth (RITE)**
- **Domestic Reduction: Bottom-up technology-based analysis models by:**
  - **National Institute for Environmental Studies (NIES)**
  - **Institute of Energy Economics Japan (IEEJ)**
- **Economic Evaluation: General Equilibrium / Macro-economic models by:**
  - **Japan Center for Economic Research (JCER)**
  - **National Institute for Environmental Studies (NIES)**
  - **Keio University**

Ministry of the Environment
Japan

Elements of Options and Evaluation

1. Level of targets
   - GHG: Energetic-origin CO_2 emissions ＋ Non-CO_2 GHGs
   - International Comparability: Marginal Abatement Cost (MAC) & Cost /GDP
2. Emission reduction scenarios to satisfy the level of targets
   - Fuel shares of electricity generation
   - Primary energy supply by fuel
   - Level of required measures (supply and demand side)
   - Activity data
3. Macro-frame fixed (Iron & Steel Production, Nuclear power, Traffic Volume, GDP growth)
4. Economic and social influence with the level of targets
   (economic growth, employment, energy security etc.)
5. Checked by
   - Compatibility with UNFCCC consideration (Annex I: 25-40%reduction)
   - The path to 2050 (Fukuda Vision of 60-80% reduction in 2050
   - Cost of inaction
6. In addition, following elements are to be considered later as final decision for negotiation
   - carbon sink,
   - carbon credits

Evaluation of Options



Result

- **Big gap remains between feasibility vs. global requirement**

- **Sufficient consideration done?**
  - **Limitation of the modeling**
    - **Fixed industrial structure**
  - **Policy not fully integrated**
  - **Cost of inaction not fully considered**

- **Need more Indicators for comparative effort**
  - **Effectiveness: Equal MAC (Marginal Abatement Cost)**
  - **Capability: Equal cost /GDP**
  - **Responsibility: Equal Per capita, Past emission**
  - **EU: mix of four Index**

Issues

- **Endurable economic impact to business, Industry and household?**
  - **～0.5 % GDP of additional cost**
  - **Industrial structure change necessary**
  - **Energy security (cost of $200 Tri./y to domestic investment)**

- **Sufficient international contribution to stabilize climate?**

- **Ambitious enough?**
  - **To pull out innovations to Low Carbon Future**
  - **To encourage big emitter countries to participate**
  - **Green investment?**

Economic Evaluation of Six Options for Japan's Mid-term Target (3)

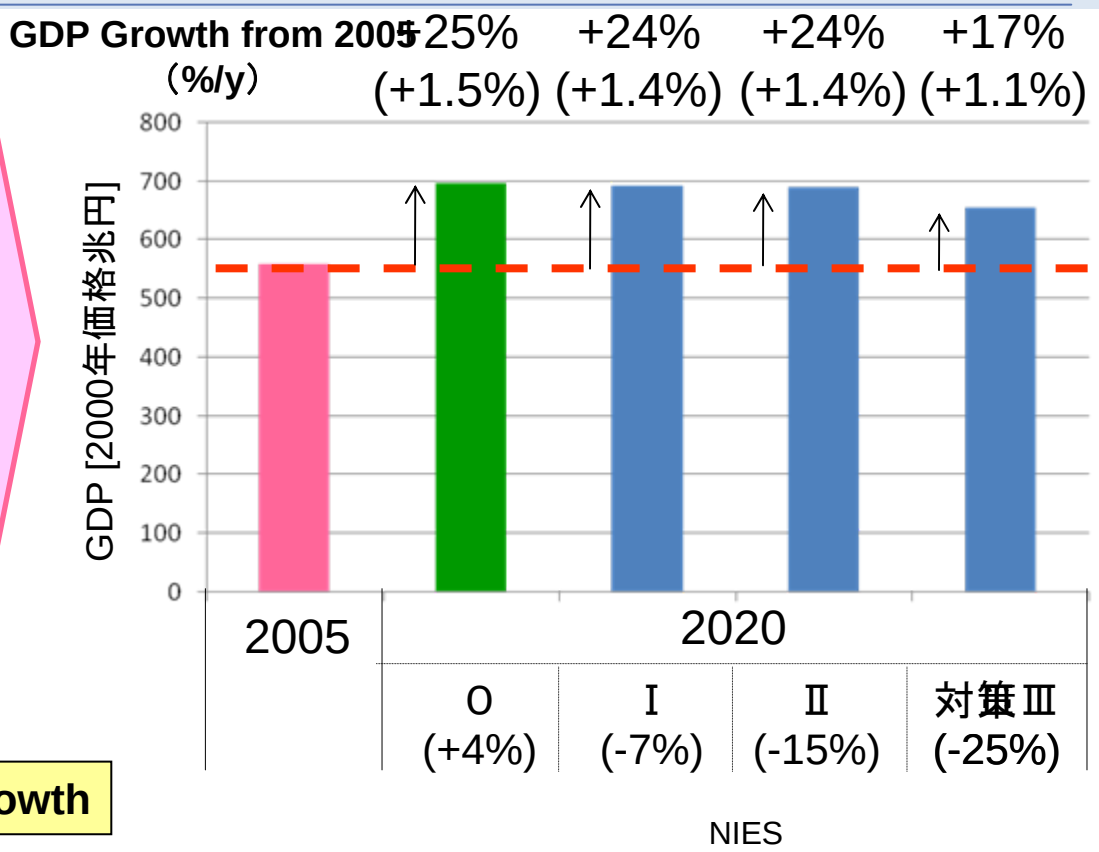
	Impacts on Economy (as deviations from reference case in 2020)				
	Percent GDP on a cumulative basis by 2020	Private investment in 2020	Unemployment rate in 2020	Disposable income per household in 2020	Lighting and heating expenses per household in 2020
1	1.3%/y Growth		Reference Case		
2					
3	-0.6 ～ -0.5%	-0.8 ～ +3.4%	+0.2 ～ +0.3%	-150～-40 thousand JPY (-3.1 ～-0.8%)	+20～30 thousand JPY (+13 ～20%)
4					
5	-2.1 ～ -0.8%	-0.2 ～ +7.9%	+0.5 ～ +0.8%	-390～-90 thousand JPY (-8.2 ～-1.9%)	+60～80 thousand JPY (+35 ～45%)
6	-6.0 ～ -3.2%	-11.9 ～ +12.5%	+1.3 ～ +1.9%	-770～-220 thousand JPY (-15.9 ～-4.5%)	+110～140 thousand JPY (+66 ～81%)

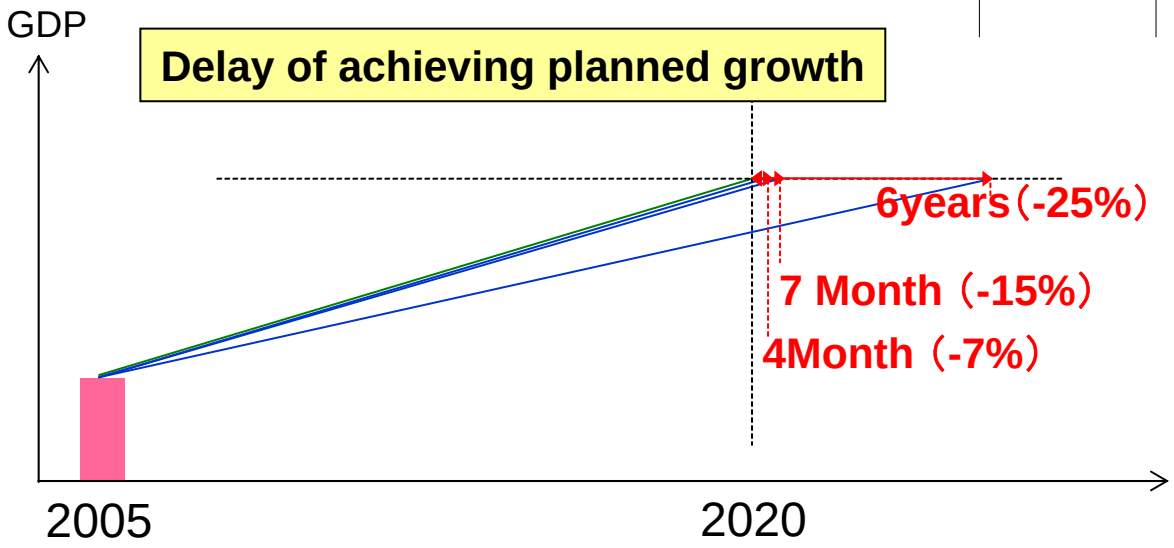
Financial stimulus packages such as "Green New Deal" are not included in the model analyses.

- Cost of inaction should be considered as well.

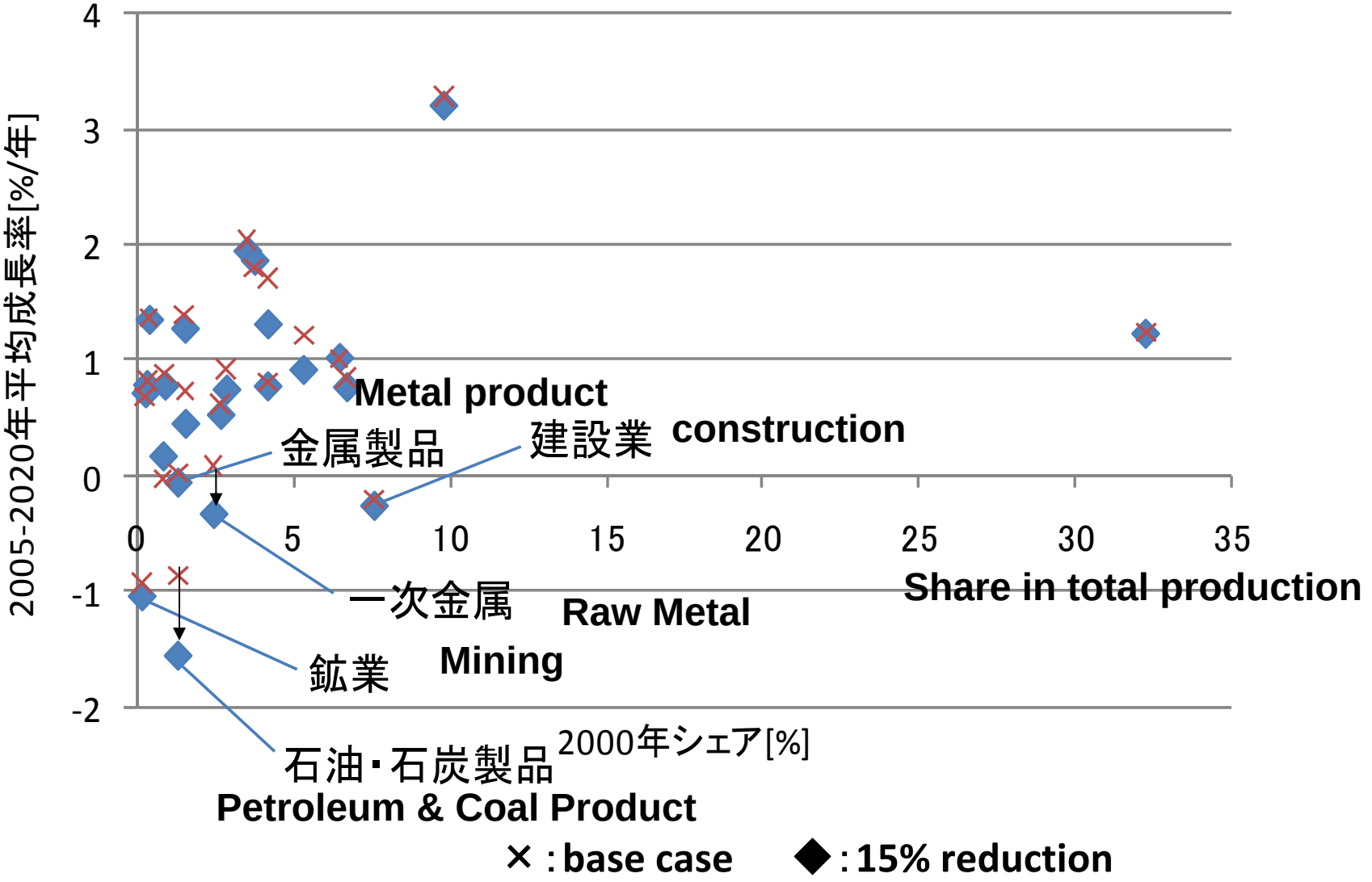
Endurable loss in GDP growth:?

- 7%～15% reduction from 1990 effect little to GDP
- 25% reduction form 1990 can secure 1.1%/y growth





Additional impact to sectors' gross production



Shares are relatively small in sectors affected by 15%reduction

Limitation of modeling work：
Flexibility of structure change and policy introduction are limited under fixed Macro frame

	Common assumption for modeling analysis
Net GDP Growth rate	2006～2020 average 1.3%/year
Population	World: UN Middle Estimation（2020:12,449million） Japan: National Inst. for Population Middle Estimation (2020: 12,281Million）
Oil Price (Nominal)	56$/Bbl（2005）⇒121$/Bbl（2020）
Raw Iron Production	113Million ton（2005）⇒120Million ton（2020）
Transportation Volume	Passenger level off from 2005 towards 2020 Cargo 10%increase in 2020 from 2005
Nuclear Power	437.4Bil.kWh (9 Nuclear newly build、LF: 80%)

International Comparability of Six Options for Japan's Mid-term Target (2)

	Allocation approach	Comparability (Reduction in 2020)							
		% above / below 1990				% above / below 2005			
		All Annex I Parties	Japan	U.S.	EU	All Annex I Parties	Japan	U.S.	EU
1	Equivalent in marginal abatement cost	-18 ～ -9%	+4%	-5 ～ +6%	-19～ -14%	-14 ～ -6%	-4%	-18～ -7%	-14 ～ -9%
2	Equivalent in marginal abatement cost	-25%	-5 ～ +1%	-24 ～ -19%	-27 ～ -23%	-23 ～ -22%	-12 ～ -6%	-33 ～ -30%	-23 ～ -18%
3	Equivalent in marginal abatement cost	-29 ～ -25%	-7%	-24～ -23%	-27 ～ -26%	-26 ～ -23%	-14%	-34 ～ -33%	-23 ～ -21%
4	Equivalent in abatement cost per Total GDP	-25%	-17 ～ -8%	-18 ～ -7%	-31 ～ -30%	-23 ～ -22%	-23 ～ -13%	-28 ～ -19%	-27 ～ -25%
5	Equivalent in marginal abatement cost	-39 ～ -29%	-15%	-39 ～ -29%	-33 ～ -29%	-36 ～ -27%	-22 ～ -21%	-47 ～ -38%	-28 ～ -25%
6	25% reduction	---	-25%	---	---	---	-30%	---	---

Allocation under various criteria

(2020 from 1990)

		Japan	US	EU25	Russia	Annex I	China	India	Non – Annex I	World
Existin reserach Höhne, N., D. Phylipsen, Moltmann, S., 2007: Factors underpinning future action 2007 update, For the Department for Environment, Food and Rural Affairs (DEFRA), UK	Multi-stage[1]	-31%	-38%	-36%	-52%	-41%	62%	235%	89%	9%
	C & C(response)[2]	-31%	-18%	-34%	-48%	-32%	62%	168%	76%	10%
	Common but Differential responsibility(CDC)[3]	-33%	-9%	-35%	-47%	-29%	48%	180%	72%	10%
	Triptyk(Combined)[4]	-29%	-8%	-31%	-45%	-26%	65%	103%	69%	10%
AIM Analysis	MAC (Efficiency)[5], [10]	-5%	-24%	-27%	-32%	-25%	-	-	-	-
	Cost/GDP (capability[6], [10]	-17%	-18%	-31%	-31%	-25%	-	-	-	-
AIM and others	Cost/GDP Converge (Efficiency)[7], [10]	- 3%	-10%	-26%	-52%	-25%	114%	65%	74%	14%
	C&C responsibility)[8], [10]	-16%	-13%	-26%	-46%	-25%	72%	98%	74%	14%
	Emission/GDP equal rate reduction (efficiency)[9], [10]	-30%	-19%	-33%	-21%	-25%	160%	81%	74%	14%

International Negotiation

Non AnnexI

China

Require China's Meaningful Participation

Will not participate without Annex I Cos' 25～40% reduction

IPCC

US

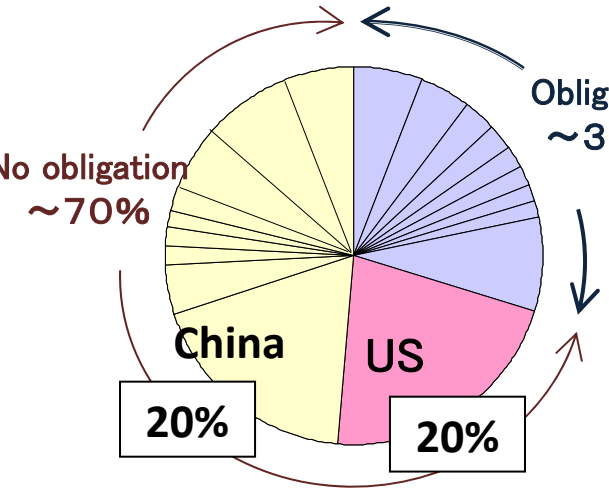
Japan

Annex I

Stabilization of Category I requires 2540% reduction for Annex I Countries

Ambitious target necessary

Global CO2 Emission（2006）



Participation of China and US is essential

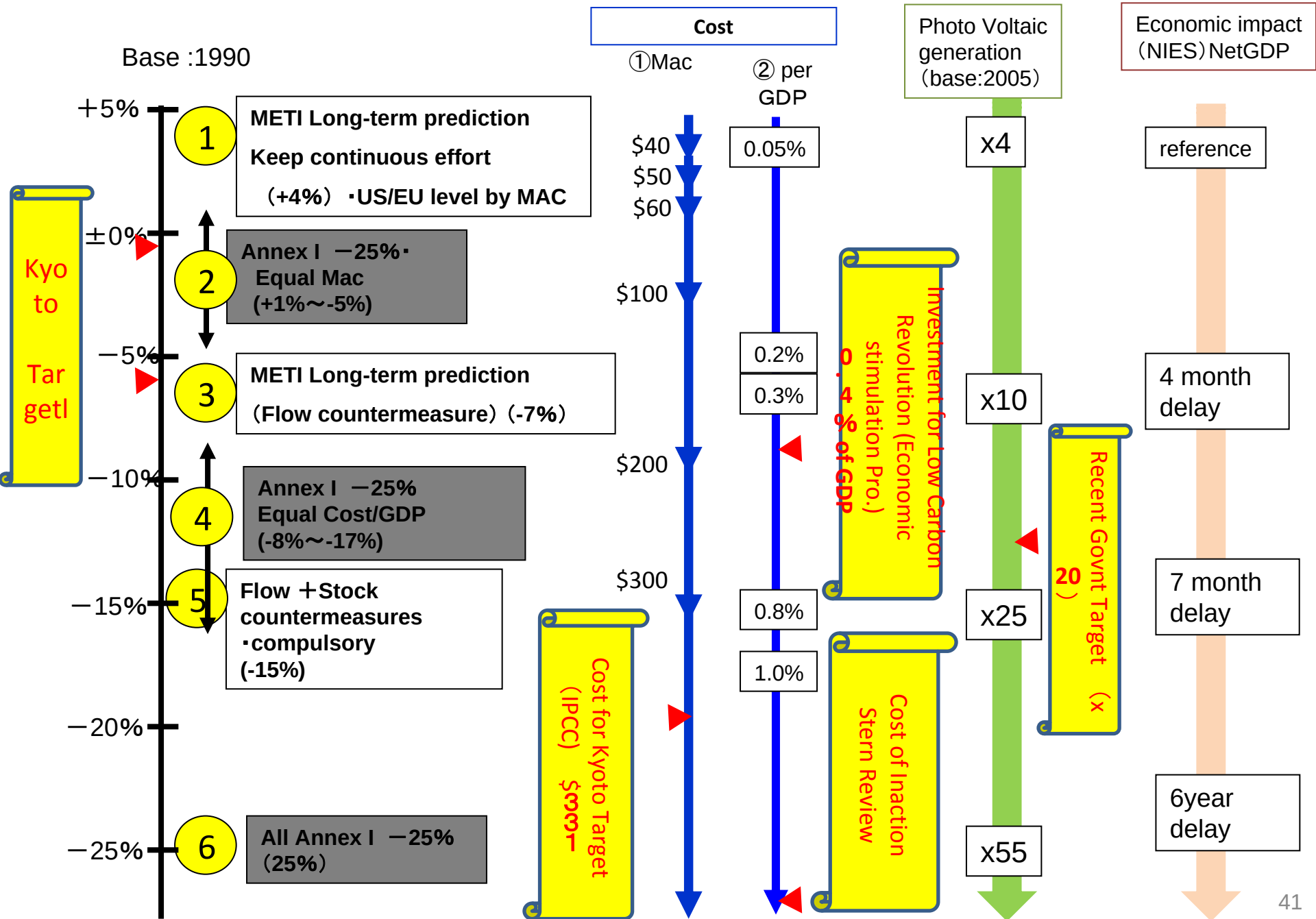
- **Debate carrying on**
  - **Business as a whole: opportunity for domestic economic stimulation**
  - **Industry: Iron and Steel, Electric Power: strongly support ＋4% worrying for losing international competitiveness**
  - **Media: Nikkei/ Asahi: ambitious target for future innovation**

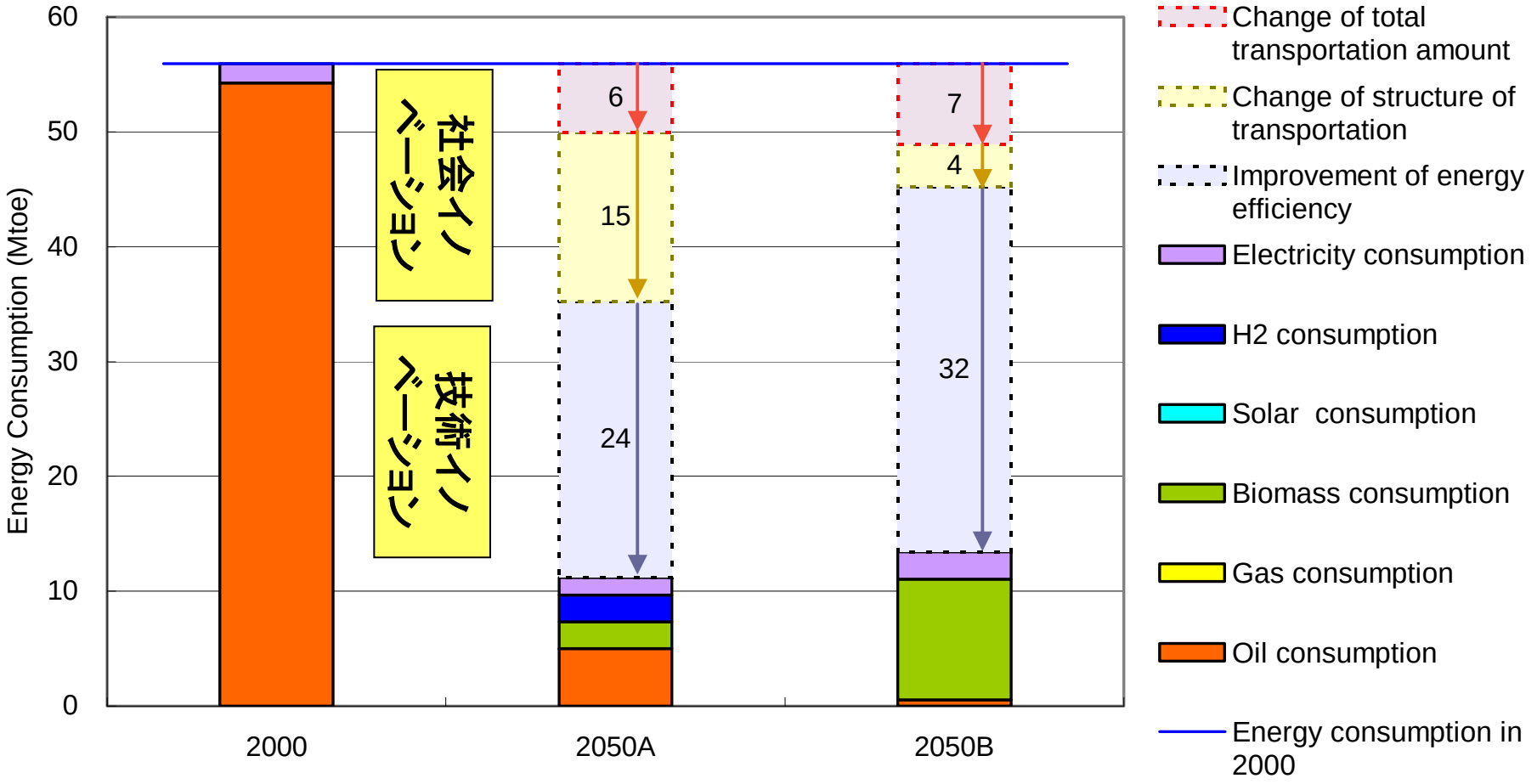
    Sankei: Strongly support ＋4%
  - **Environmental NGOs: support deep reduction**

Decision (domestic reduction ＋absorption ＋credit?) is now matter of political will

- **Prime Minister announce in June**
  - **Congress Election until September**

Evaluation of Options





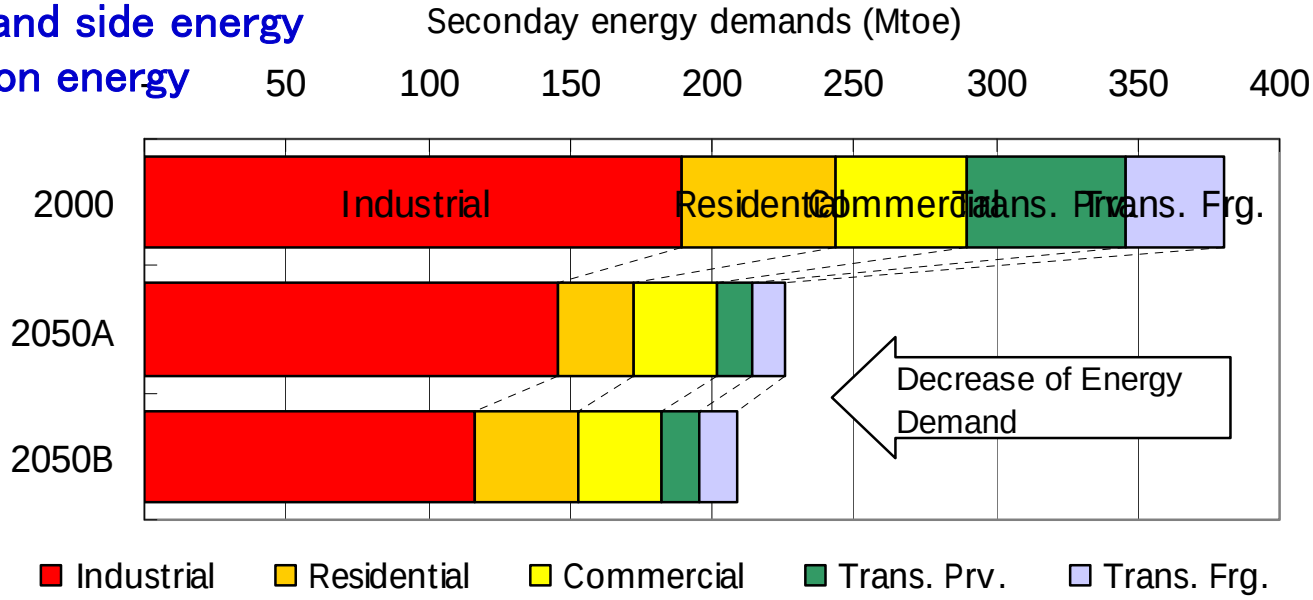
削減要因：運輸旅客輸送量の減少
人口配置やモーダルシフトによる交通手段構成の変化
輸送機器のエネルギー効率向上と低炭素燃料使用

運輸旅客部門
人口配置・自動車燃費向上、低炭素燃料使用により、70－80%の削減

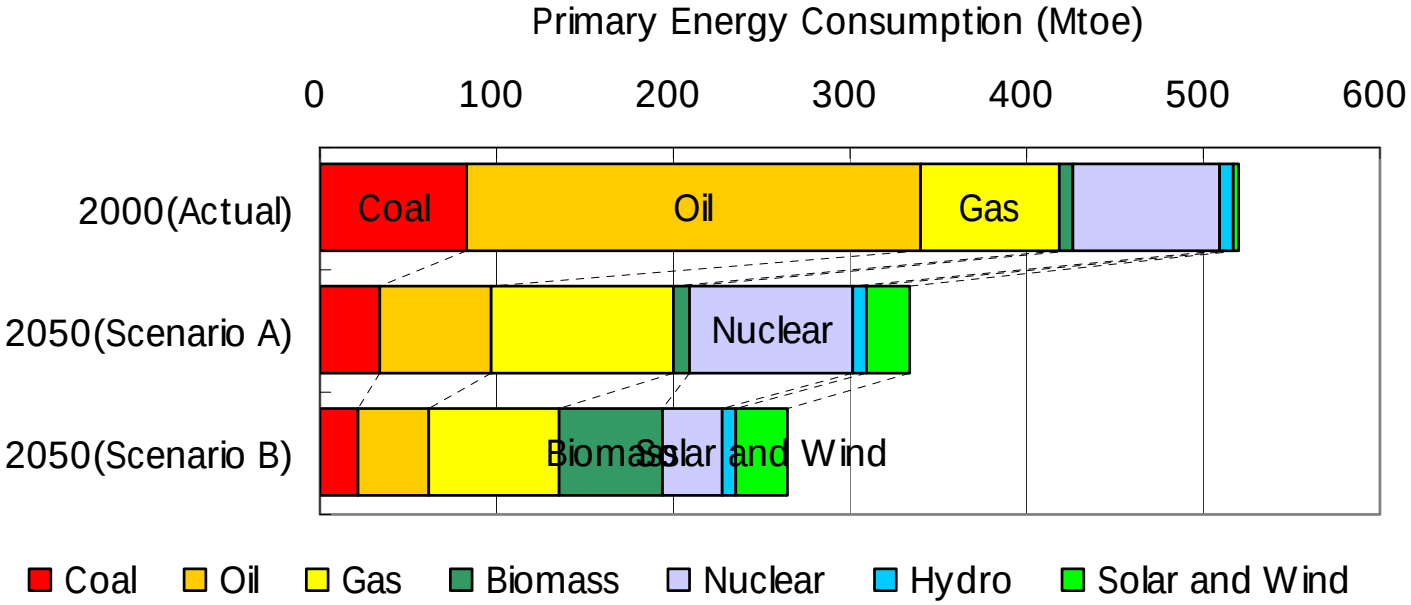
Conclusion: 70% reduction feasible: Direct cost: 1% of GDP/Y

Combination of demand side energy reduction ＋low carbon energy

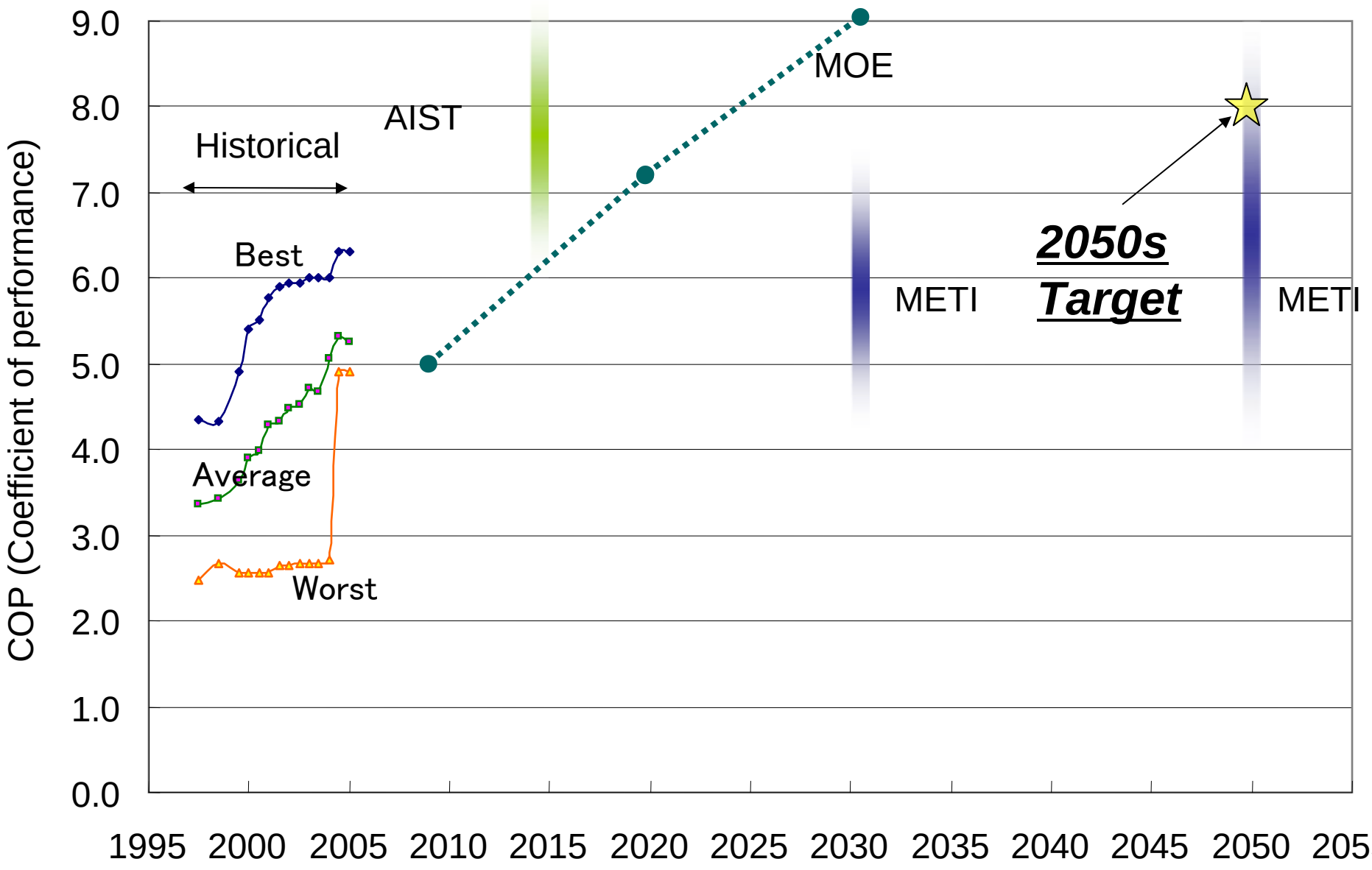
Final energy demands



Primary energy supply



Projected energy efficiency improvement: Air-conditioners for cooling and heating

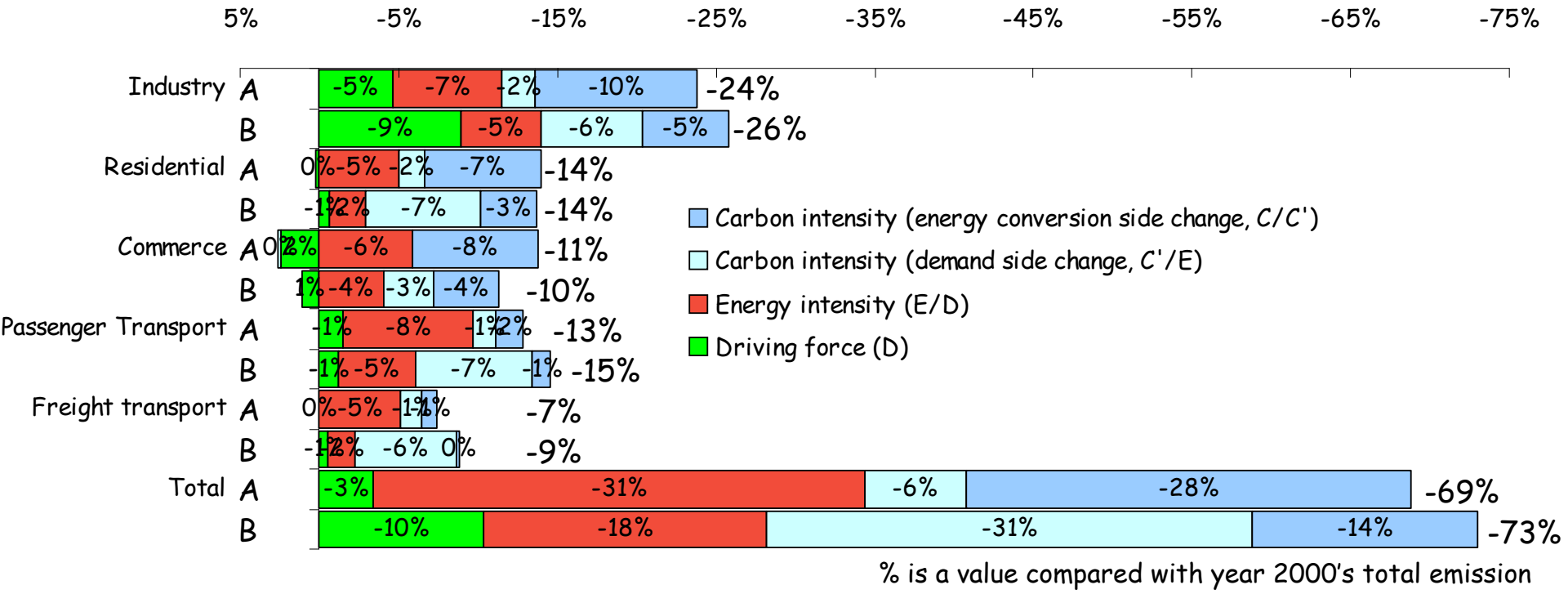


Factor decomposition of CO_2 emission reduction in 2050

$$C = D \times \frac{E}{D} \times \frac{C'}{E} \times \frac{C}{C'}$$

$$\frac{\Delta C}{C} = \frac{\Delta D}{D} + \frac{\Delta(E/D)}{(E/D)} + \frac{\Delta(C'/E)}{(C'/E)} + \frac{\Delta(C/C')}{(C/C')}$$

C: CO_2 emissions
D: Activity
E: Energy demand
C': CO_2 emissions (excluding energy conversion sector)



% is a value compared with year 2000's total emission

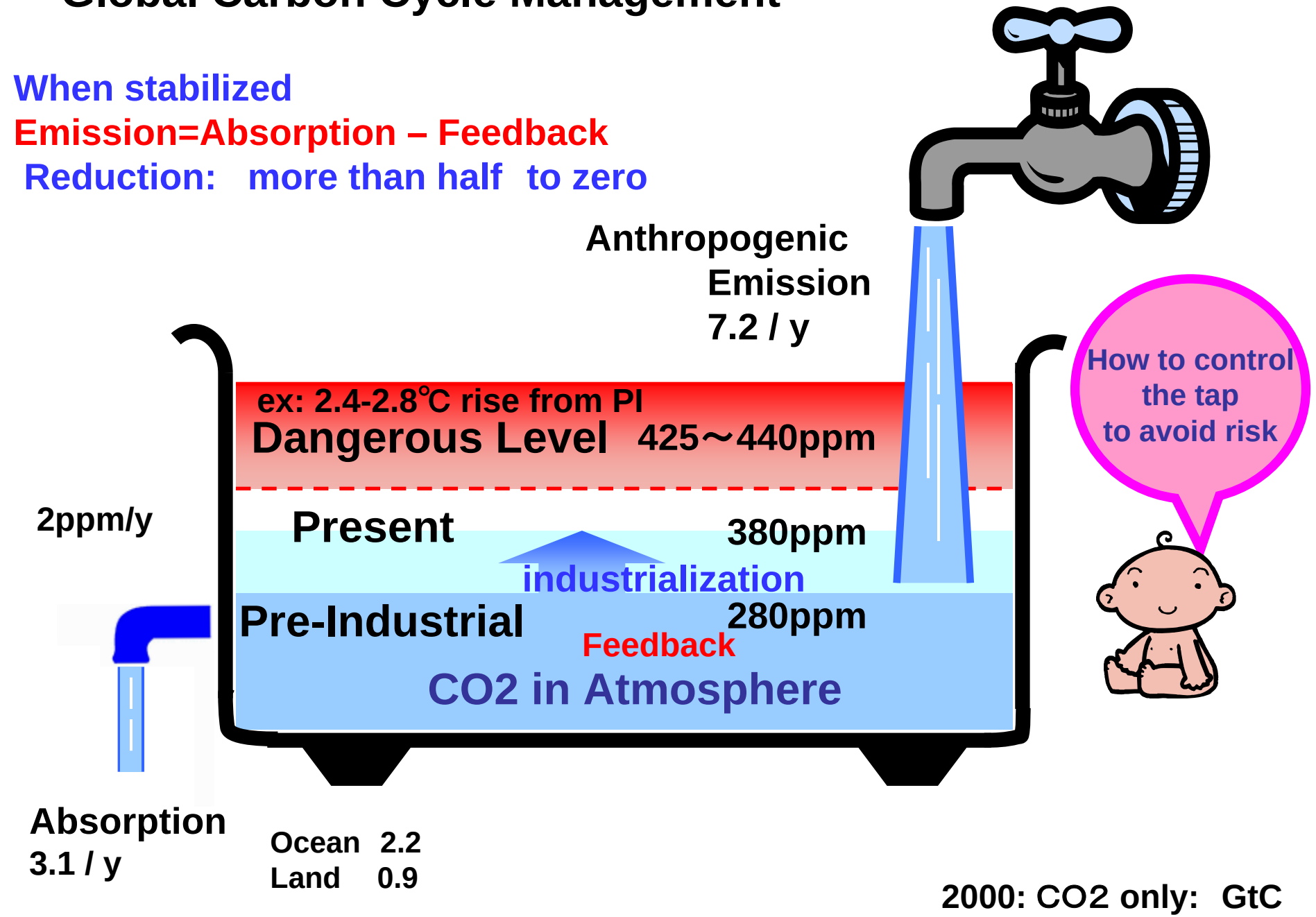
http://2050.nies.go.jp

Global Carbon Cycle Management

When stabilized

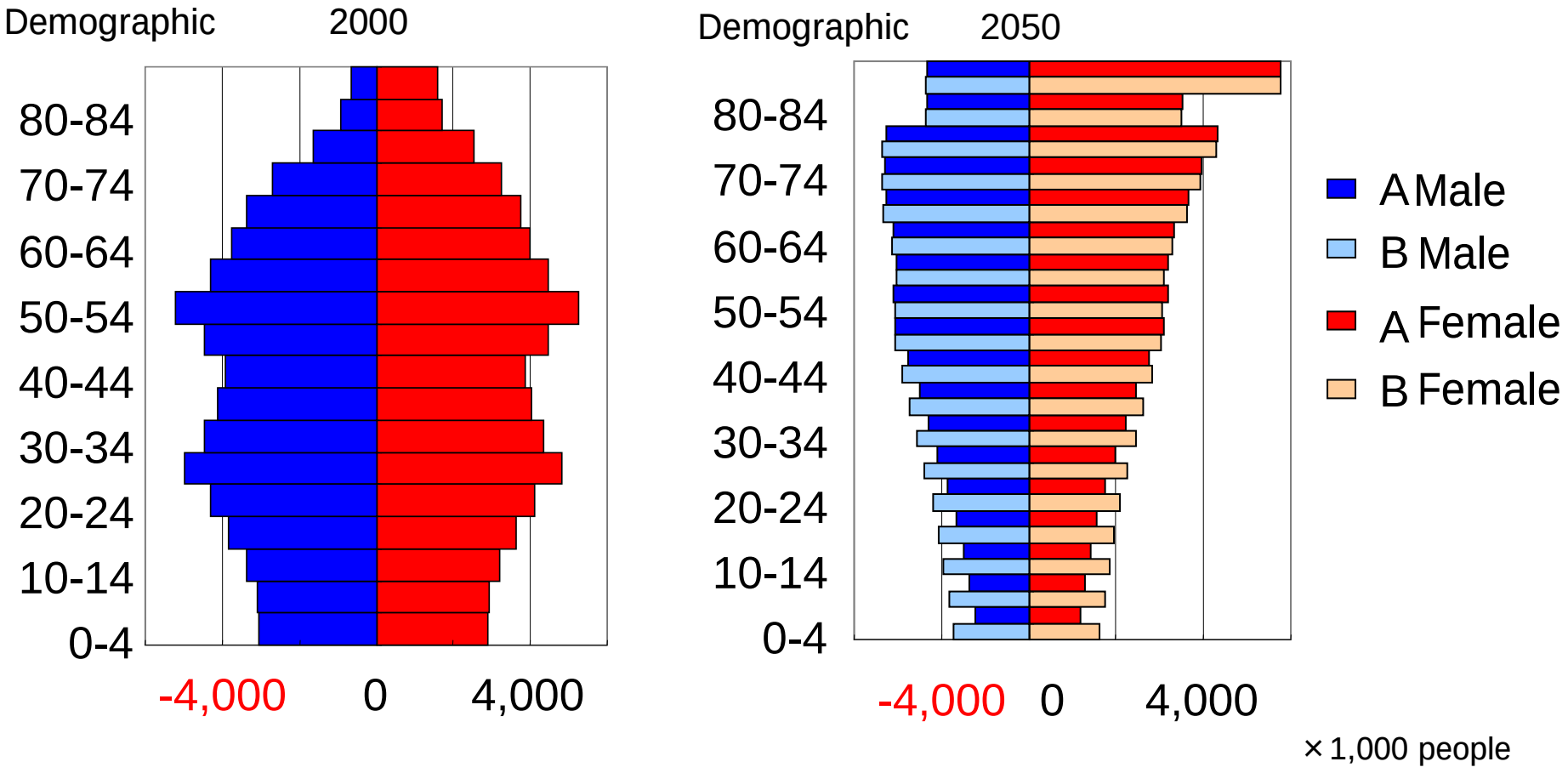
Emission=Absorption – Feedback

Reduction: more than half to zero



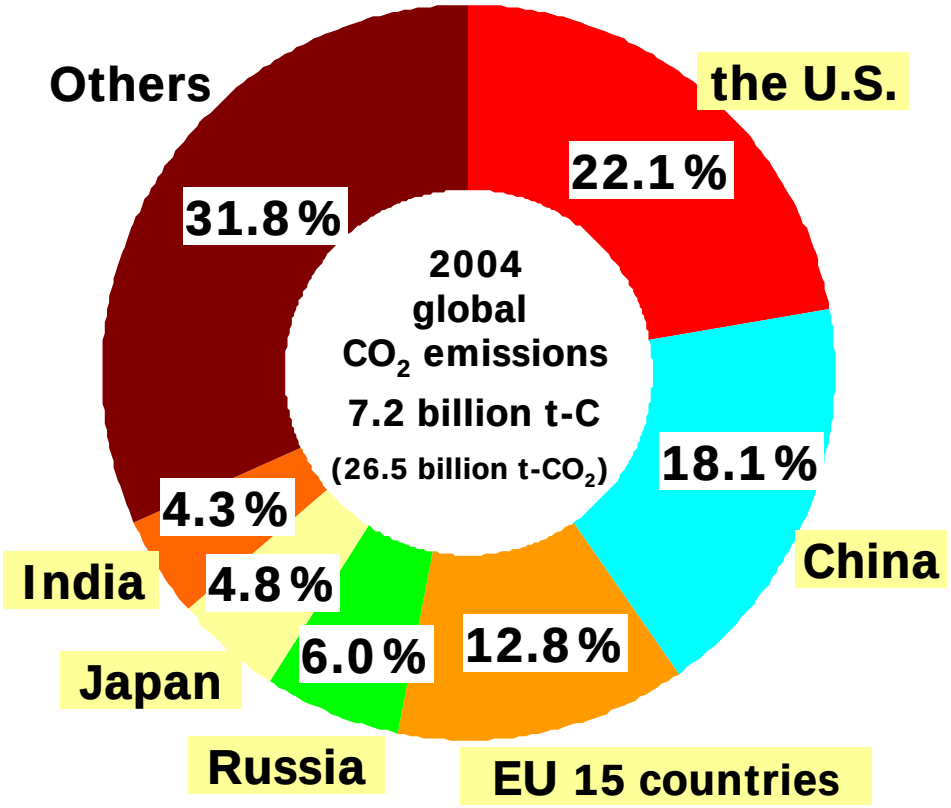
Japan: World Front Runner of Aged Society

What will Japan's population be in 2020?

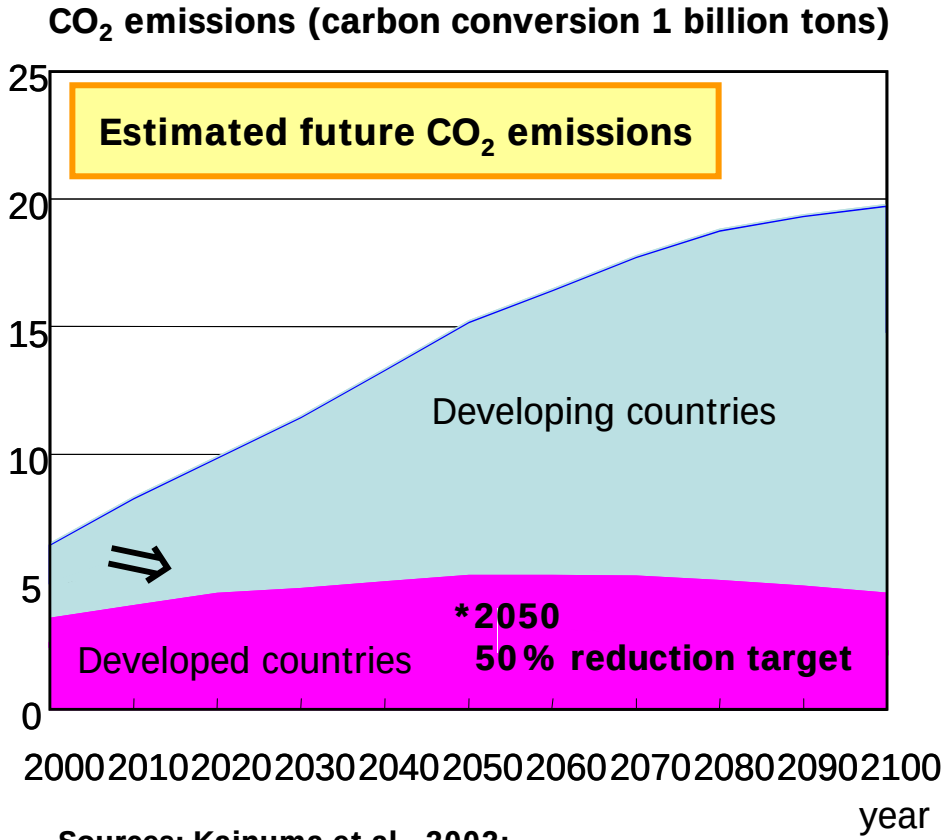


Cooperation with developing countries is the key issue

Current and estimated future total global CO_2 emissions
(significant worldwide reduction is essential)



Made by the Ministry of the Environment, Japan based on Energy & Economics Statistics in Japan (2007 version)

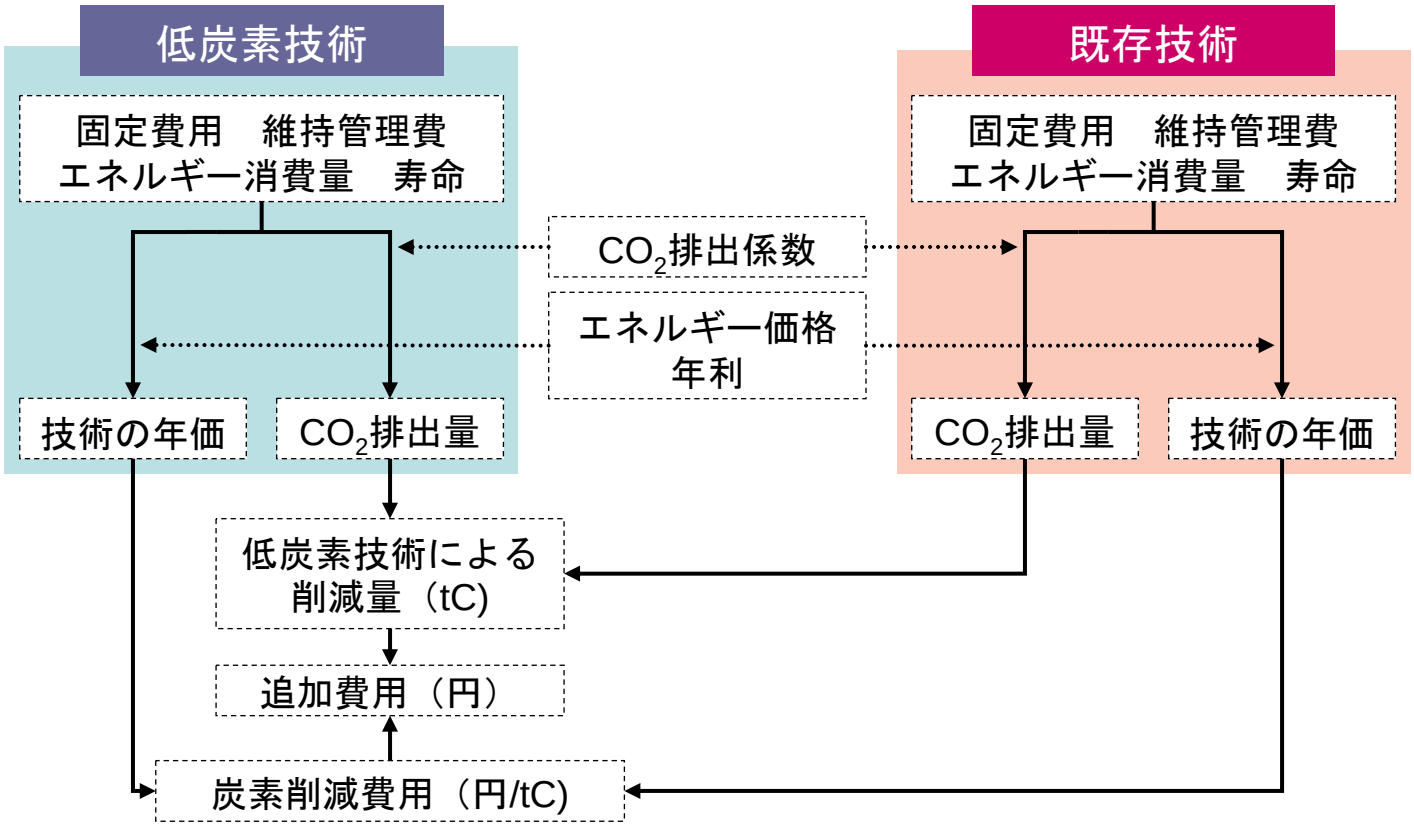


Sources: Kainuma et al., 2002:
Climate Policy Assessment, Springer, p.64.

Kyoto Protocol framework for period subsequent to first commitment period (2013 onwards)

- *An effective framework capable of promoting maximum efforts to reduce emissions by non-signatory U.S. and exempt developing major emitter nations such as India and China is needed.*

図6 70%削減実現に向けての技術対策の追加費用算定の考え方



技術の年価: M

$$M = \frac{\alpha(1+\alpha)^L}{(1+\alpha)^L - 1} \bullet P + OM + EN$$

P: 技術の固定費用（円）
OM: 技術の維持管理費（円/年）
EN: 技術のエネルギー費用（円/年）
A: 年利（4%）
L: 技術の寿命（年）