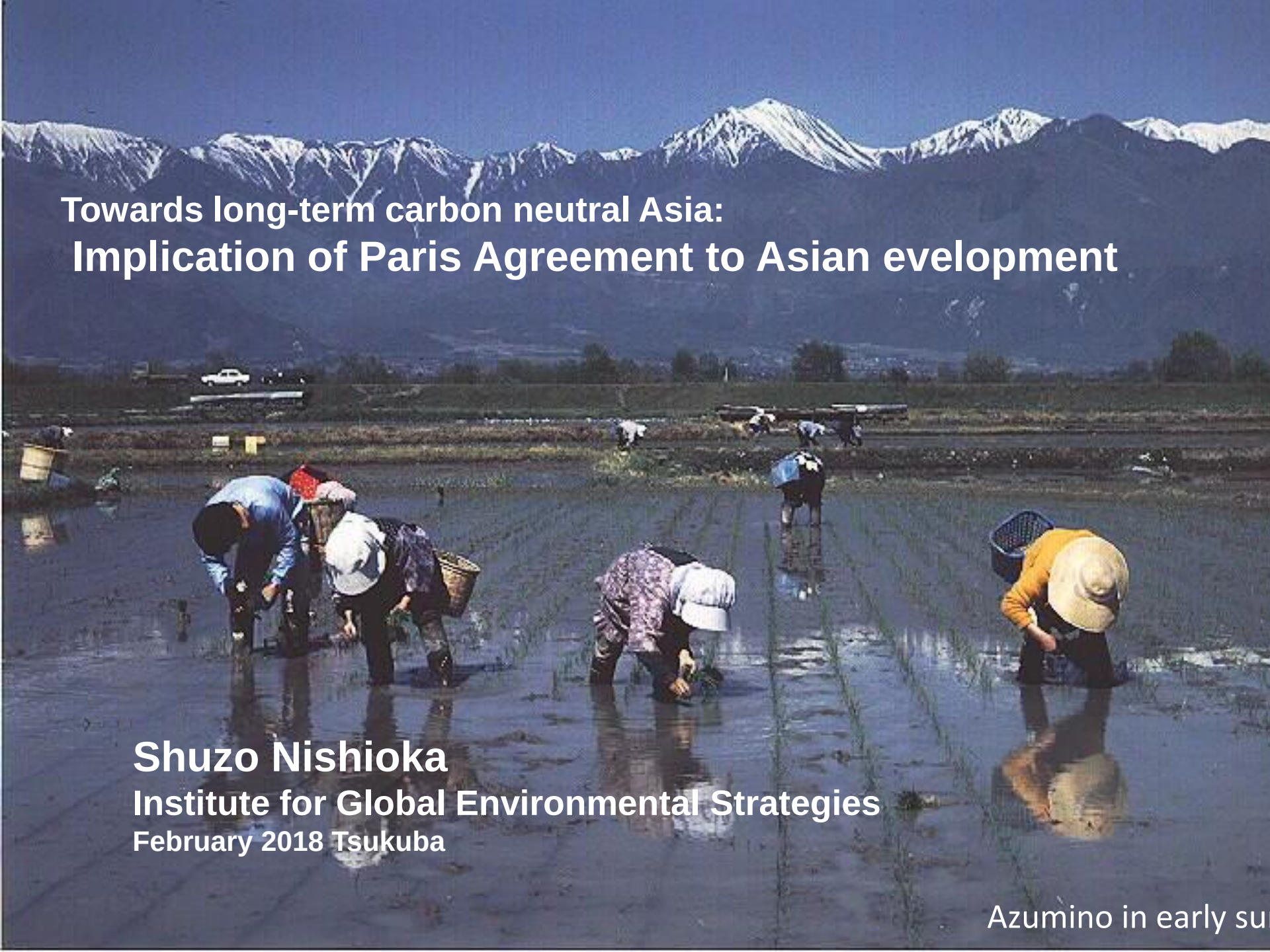


Towards long-term carbon neutral Asia:
Implication of Paris Agreement to Asian evelopment

Shuzo Nishioka
Institute for Global Environmental Strategies
February 2018 Tsukuba

Azumino in early su

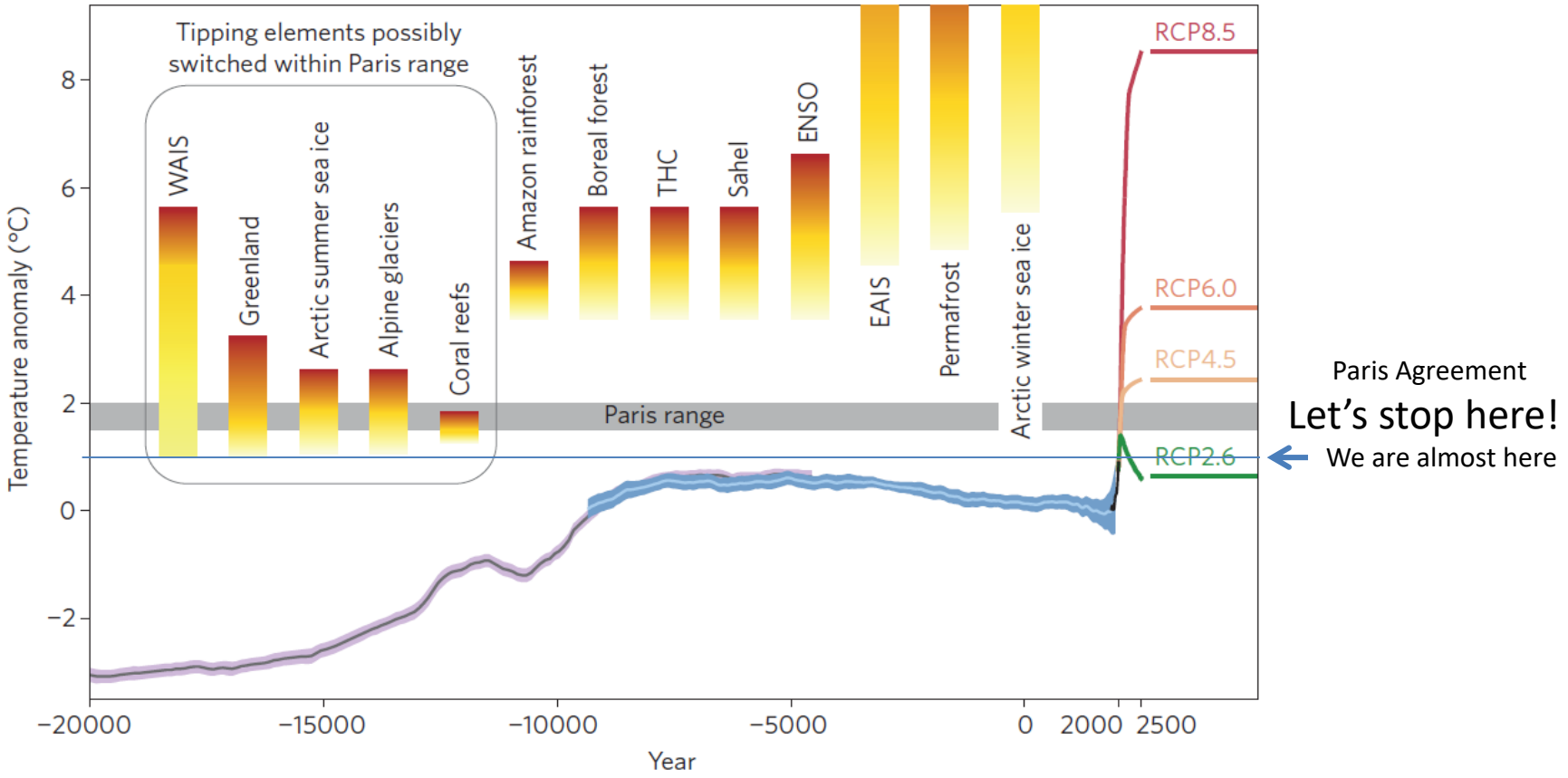
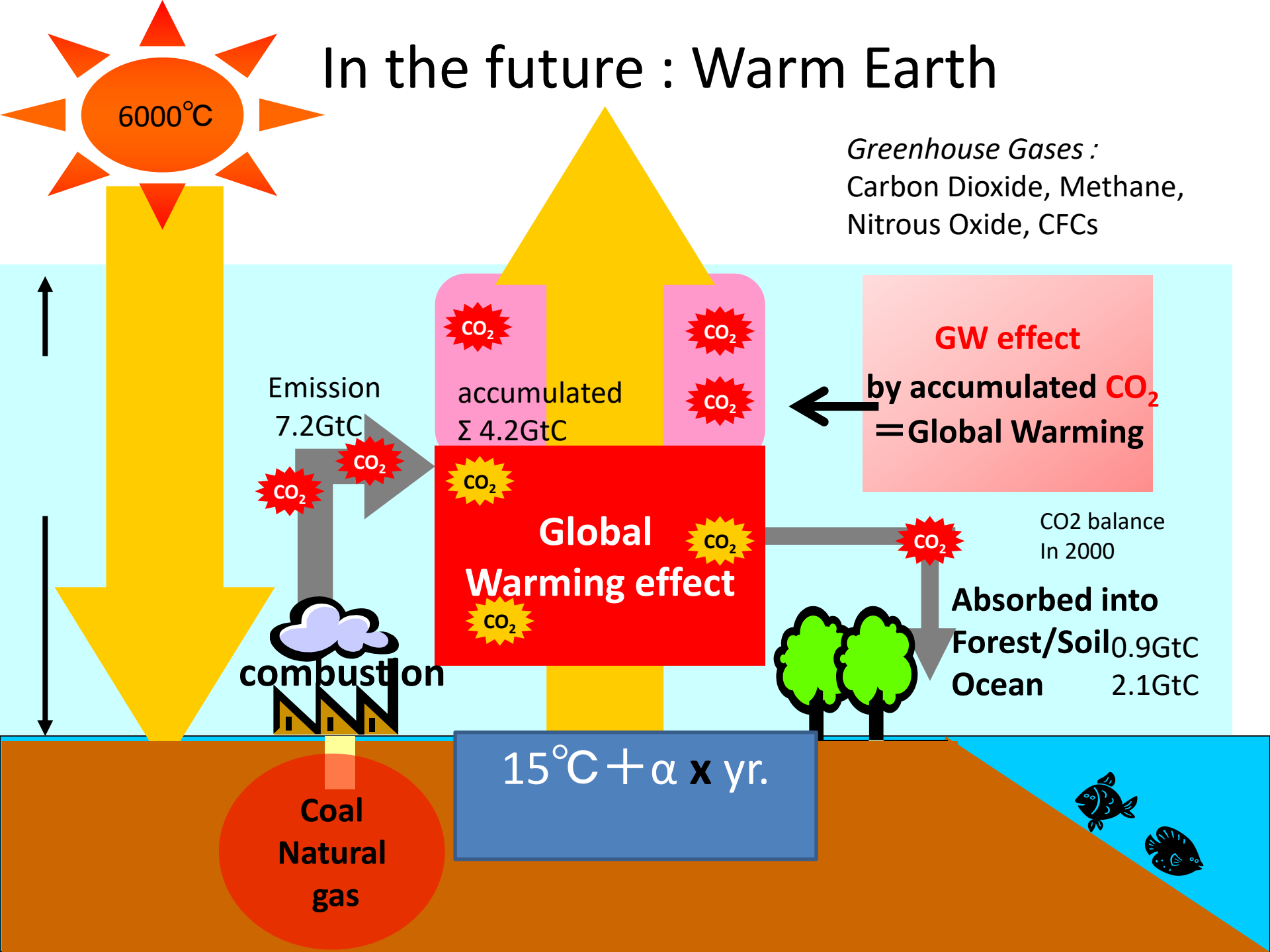


Figure 1 | Tipping elements in context of the global mean temperature evolution. Shown is the global-mean surface temperature evolution from the Last Glacial Maximum through the Holocene, based on palaeoclimatic proxy data35,36 (grey and light blue lines, with the purple and blue shading showing one standard deviation), instrumental measurements since 1750 ad (HadCRUT data, black line) and different global warming scenarios for the future (see ref. 37 for the latter). Threshold ranges for crossing various tipping points where major subsystems of the climate system are destabilized have been added from ref. 8, 14 and 37–40.

出典：Hans Joachim Schellnhuber, Stefan Rahmstorf and Ricarda Winkelmann, Why the right climate target was agreed in Paris, COMMENTARY: NATURE CLIMATE CHANGE, VOL 6, JULY 2016 , 649-653

Note: WAIS:West Antarctic Ice Sheet, THC: Thermohaline circulation

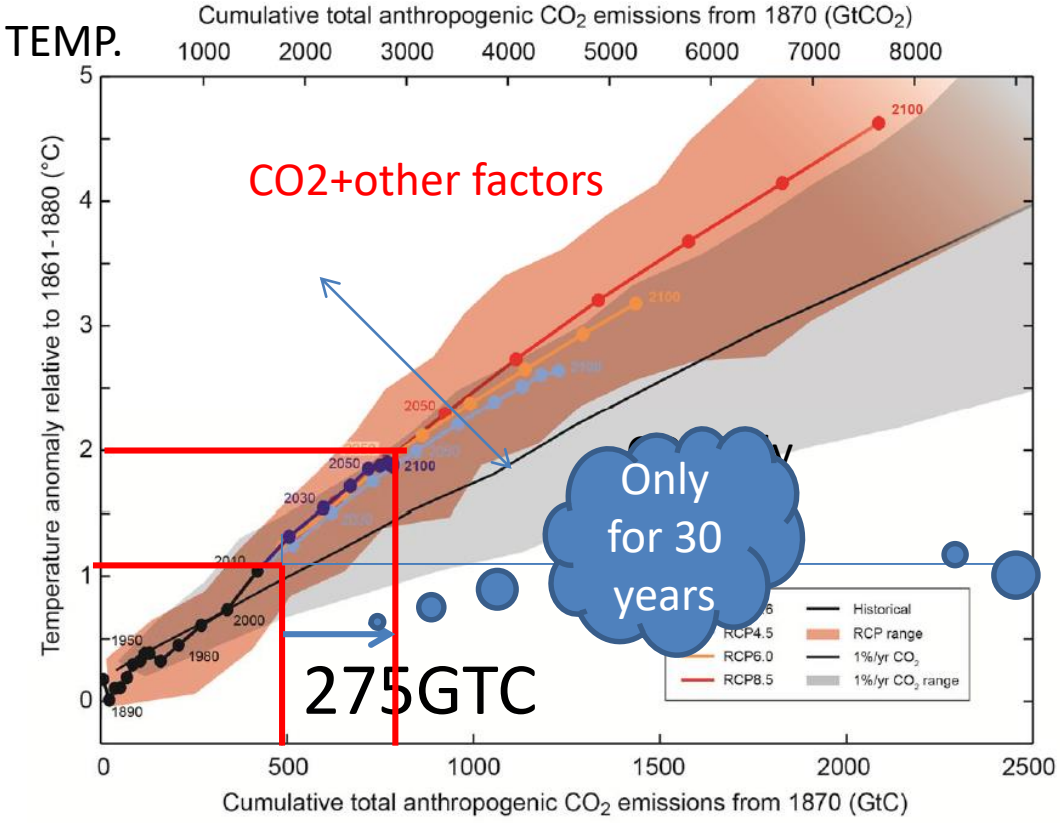
In the future : Warm Earth



Temp. rises in relation with cumulative GHG emission

⇒Temp. rises as long as emission continues

⇒ Zero emission is only one ultimate solution to stabilize climate



Cumulative total anthropogenic CO2 emission from 1870 (GtCO2)

Allowable budget

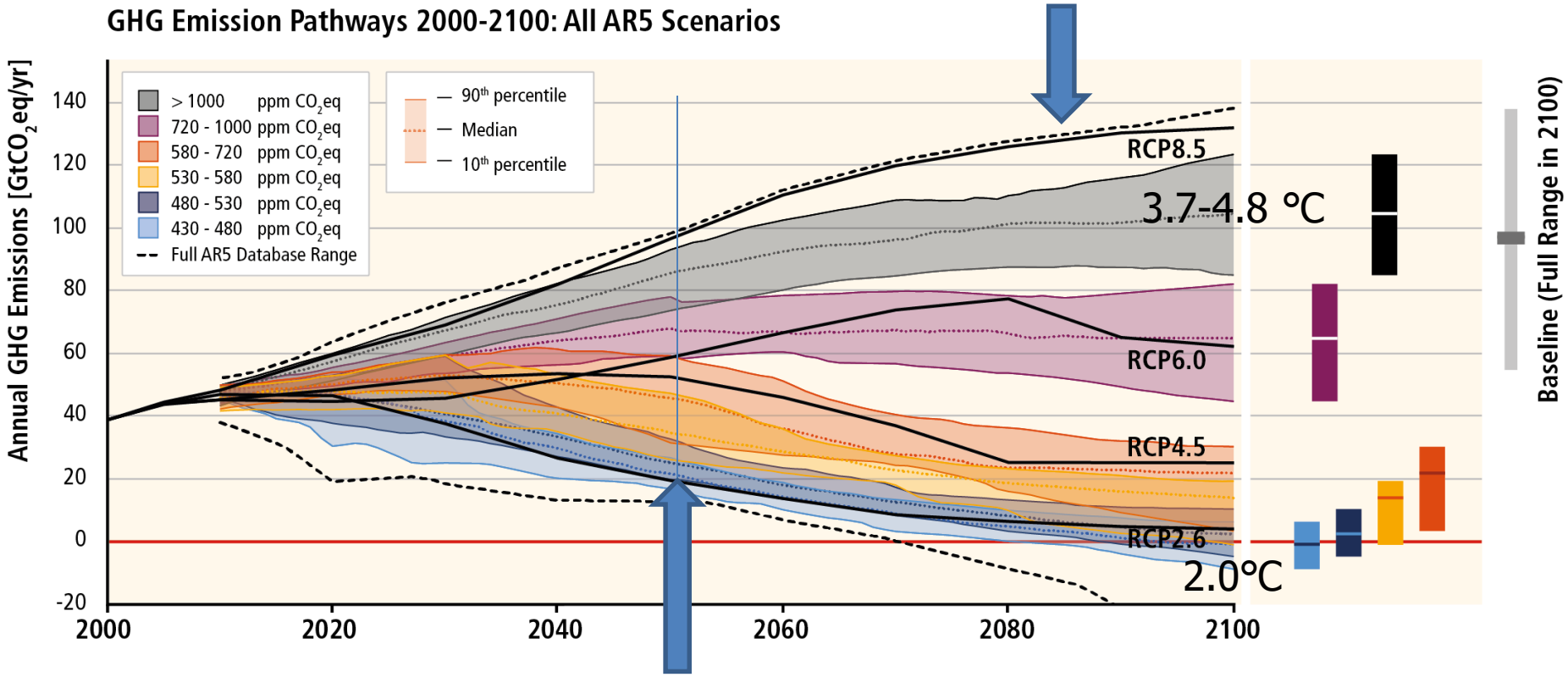
- 2℃ ⇒ 790 GtC
- 515GtC emitted already
- only 275GtC remained
- 2013 emission= 9.9GtC

Transition to low carbon society within 50-100 yr.

(IPCC AR4 and Emori, NIES)

Global target: Halving current emission by 2050

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



To avoid 2 degree rise, path of passing 50% reduction from now in 2050 is feasible and reasonable .

IIPCC AR5 2013

Major Decision of Paris Agreement at COP21 (2015)

- **Set target of less than 1.5/ 2.0 degree temperature rise from pre-industrial period**

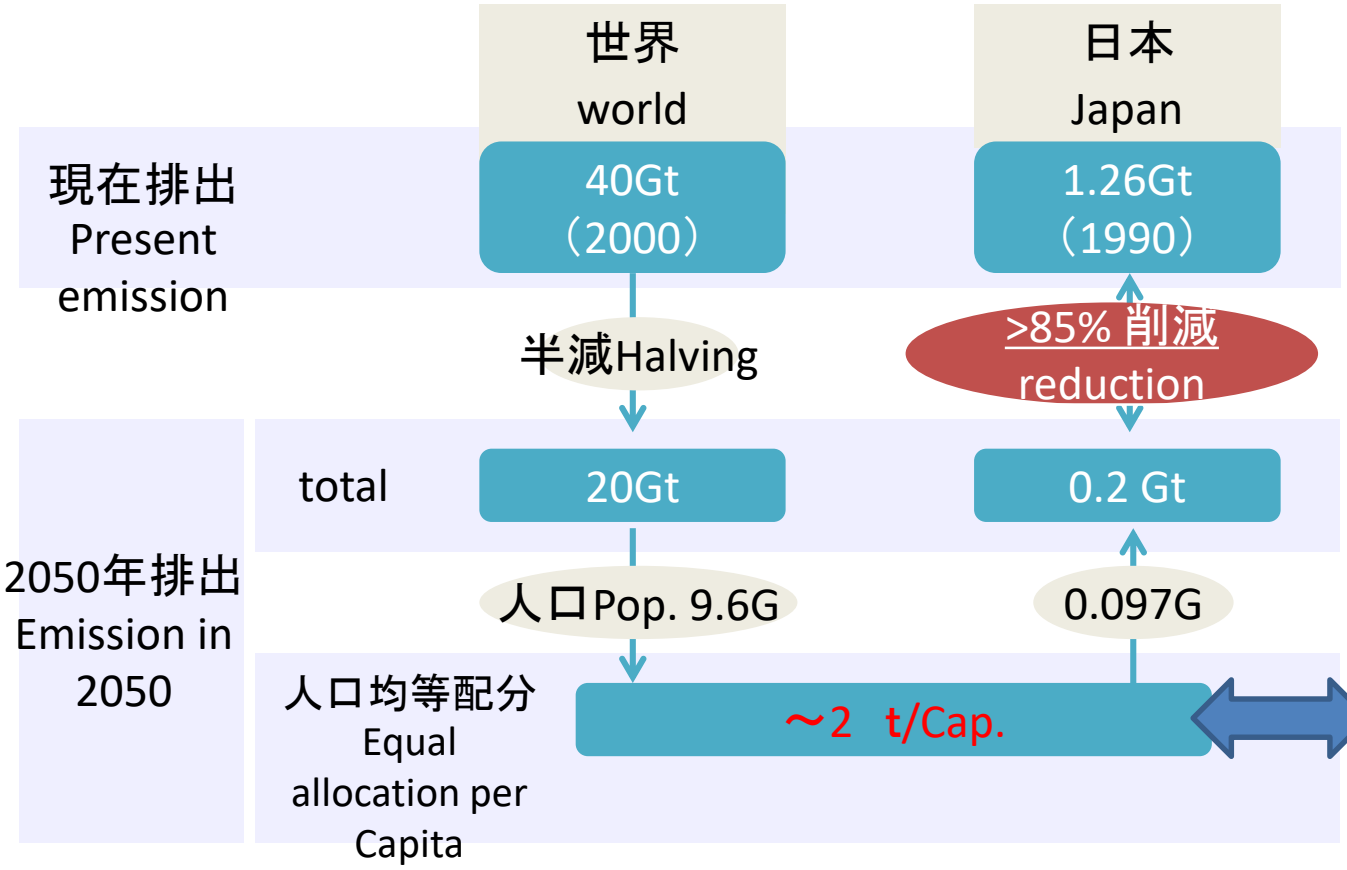
- **All parties participate to take action under NDC**

⇒Transform to Zero-emission society by the end of this century

- **Strengthen cooperation for capacity building in mitigation and adaptation**

- **Mobilize stakeholders in all levels to act immediately**

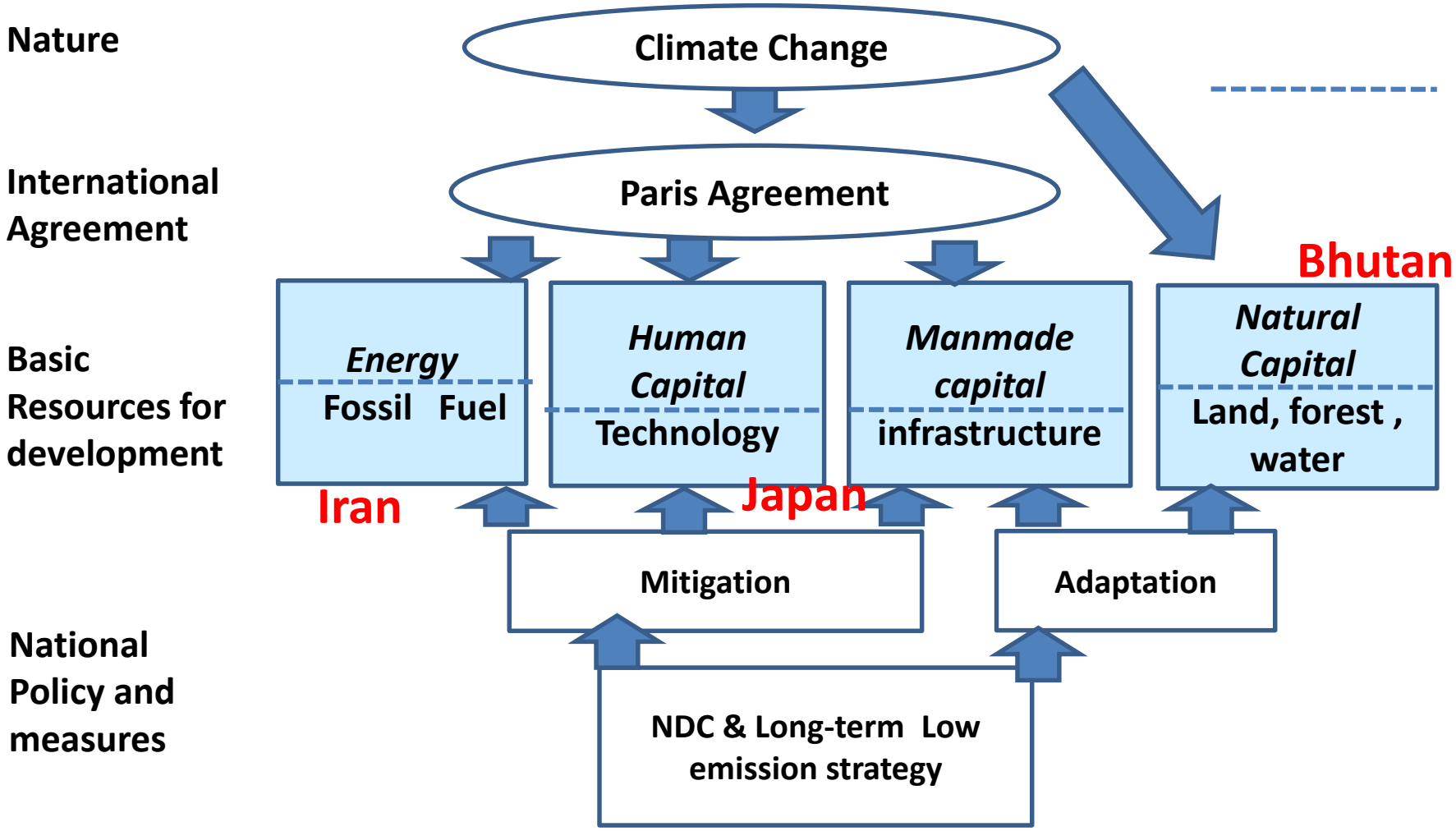
2050 halving from now: 2ton/Capita World
Japan: more than 80% reduction（base year 1990）
Asia: already more than 2ton/ Capita

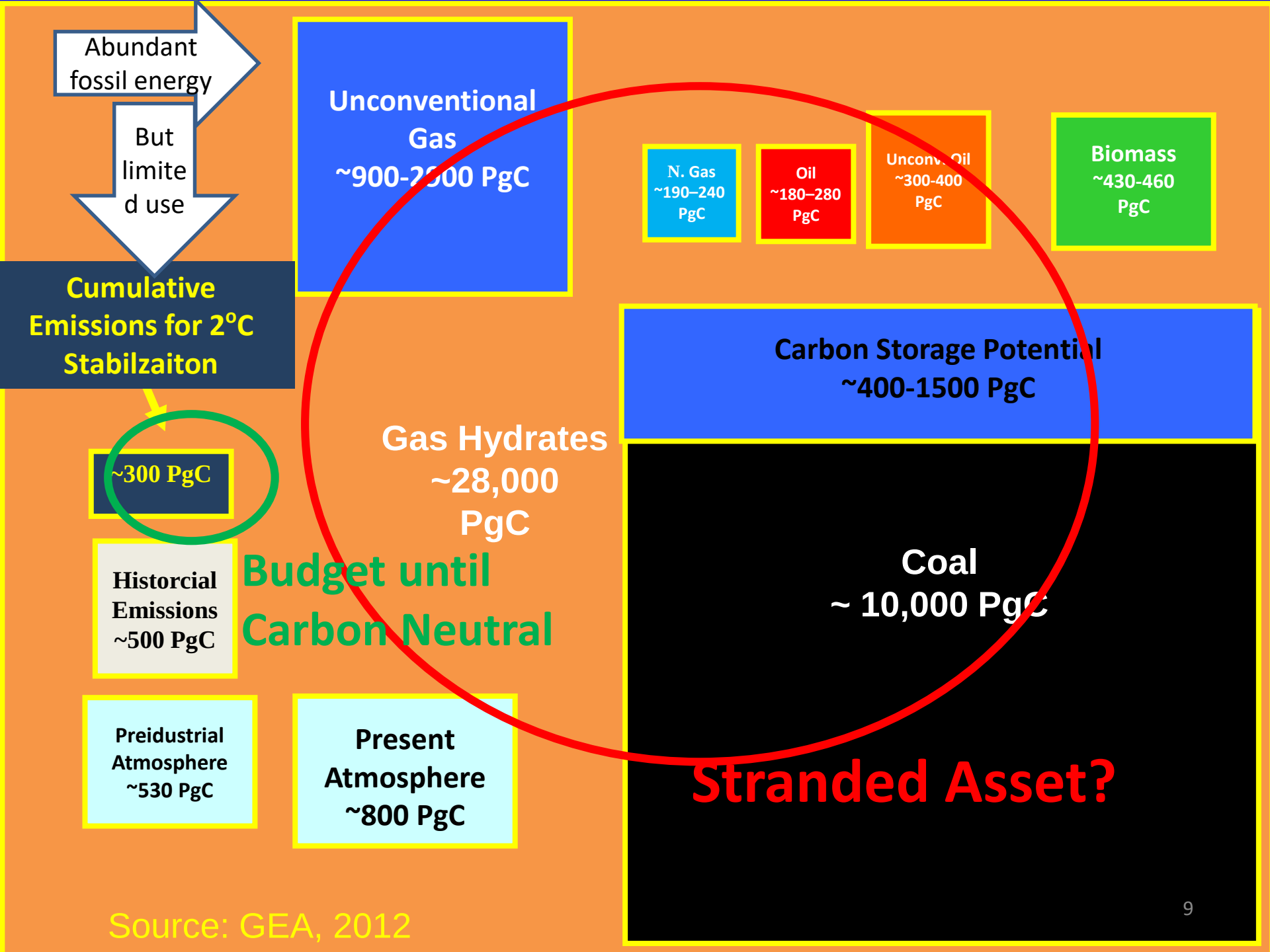


2010年	Per capita CO2 (tCO2/人)
USA	17.4
China	5.55
India	1.35
Indonesia	1.63
Thailand	3.25
France	5.34
Germany	8.92
UK	7.92
Japan	9.05

※世界の人口は国連「World Population Prospects, the 2012 Revision」より、日本の人口は社人研「日本の将来推計人口（平成24年1月推計）」より

Climate Change Impacts
Values of National Development Resources





Source: GEA, 2012

Petroleum resource countries

- Climate Change policy imposes extremely great impacts

- "only 1000 Gt CO_2 GHG =(300GtC) can be emitted for an under 2℃ target"
  ⇒ majority of fossil fuels reserved cannot be used
  (unless without big absorption sources as CCS)

- Balance of C demand and supply (GtC)
  - Allowable total carbon emission 300
  - Fossil fuel reserve
    - Natural gas 190-240 , unconventional gas 900-2900 , Gas hydrate 28,000
    - Oil reserve 180-280 , unconventional oil 300-400
    - Coal 10,000-
    - Biomass 430-460
    - Carbon storage potential 400-1500

- Low carbon priority: (relative carbon intensity (carbon/calorie)
  - 0 biomass, nuclear, renewable energy
    (solar, wind, wave, hydro,: geothermal, tidal)
  - 2 Natural gas
  - 3 Oil
  - 4 Coal

Natural resource & its management in Bhutan

Hydro-Power

Forest for Biomass & absorption Soil

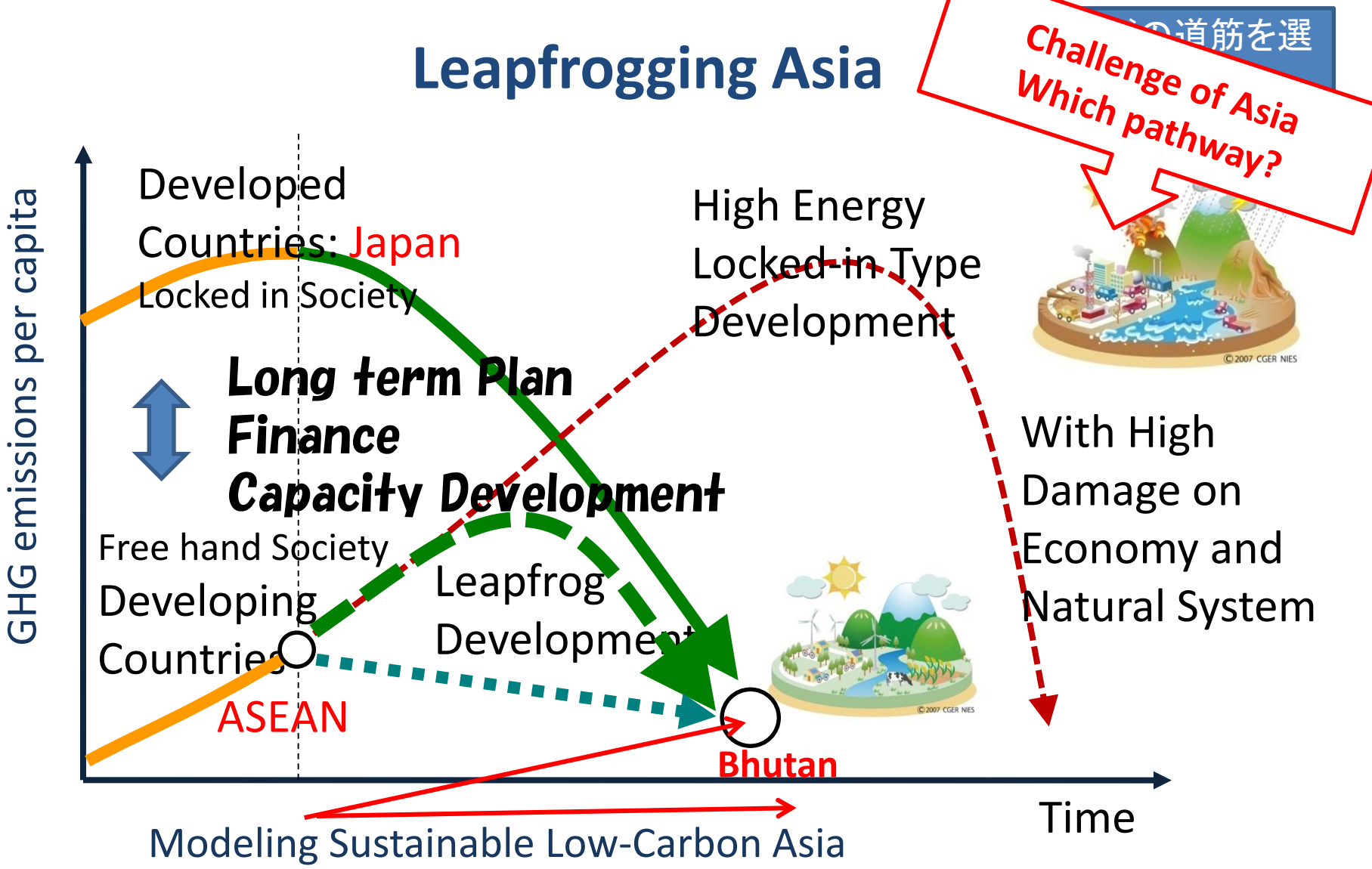
Biodiversity

Power line reaches 97% of residence

National Park shares half of land area

National survey of carbon stock of forest and soil

Leapfrogging Asia



"Asian Low-Carbon Society Scenario Development Study" FY2009-2013, funded by Global Environmental Research Program, MOEJ

http://2050.nies.go.jp/index.html

What about Asian countries?

Asia (China, ASEAN, India, Japan,,) :

- Half of global emission in 2050 (BaU)
- Center of global economic growth, High investment in infrastructure & industry⇒lock-in to conventional high-energy consuming technologies, in coming next 30-50 years
- Already exceeded 2 ton/capita

- "leapfrogging": new development pathways?
- A good example: China's late comer's advantage

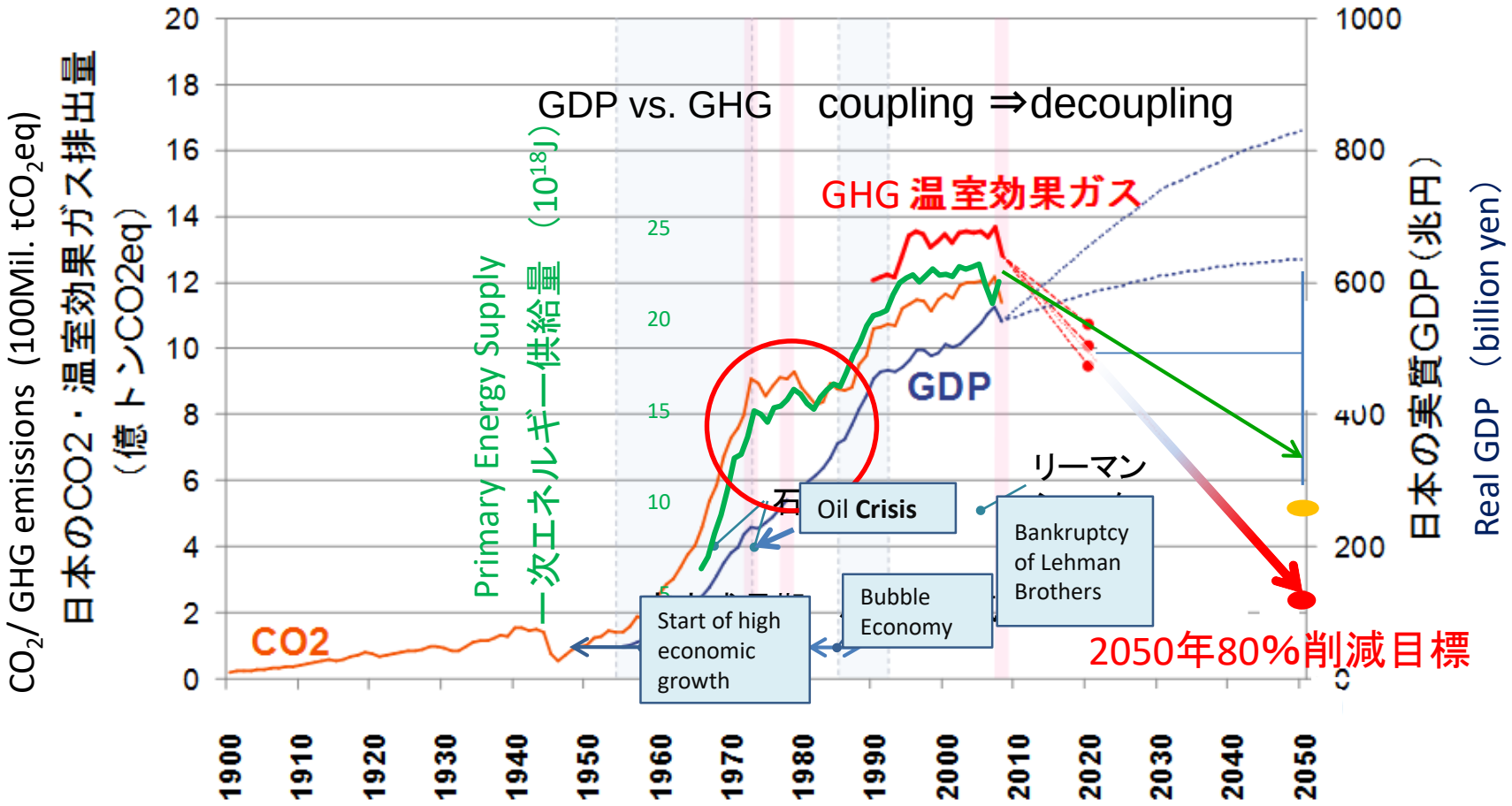
➢ Mobil-phone: difficulty in wired telephone, IT age, ⇒No.1 user and producer of mobile phone

➢ Renewable energy: vast national territory, low-carbon trends, energy security, air pollution by coal use⇒No.1 in the world producer of renewable energies and devices

➢ Electric Bike in Shanghai (good engineering capability, engine technology needed, air pollution, potential market in Asia

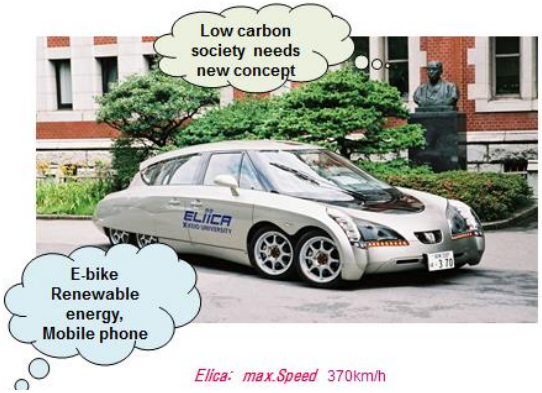
➢ Subway in Shanghai: 14 route after International Exhibition in 2010

Japan 1970's in Oil crisis vs. China 2010's in climate change: Transient period to mature economy

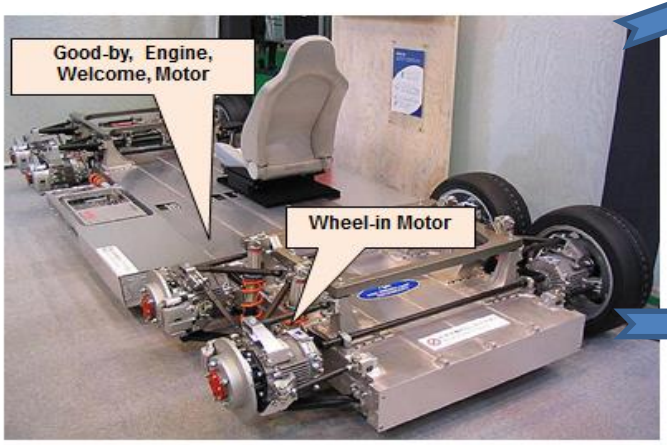


）GDPの将来値は国立環境研究所 脱温暖化2050プロジェクト A･Bシナリオの想定値

Climate change brought innovation



Shanghai E-bike to ASEAN big market?



Platform of SIM-Drive

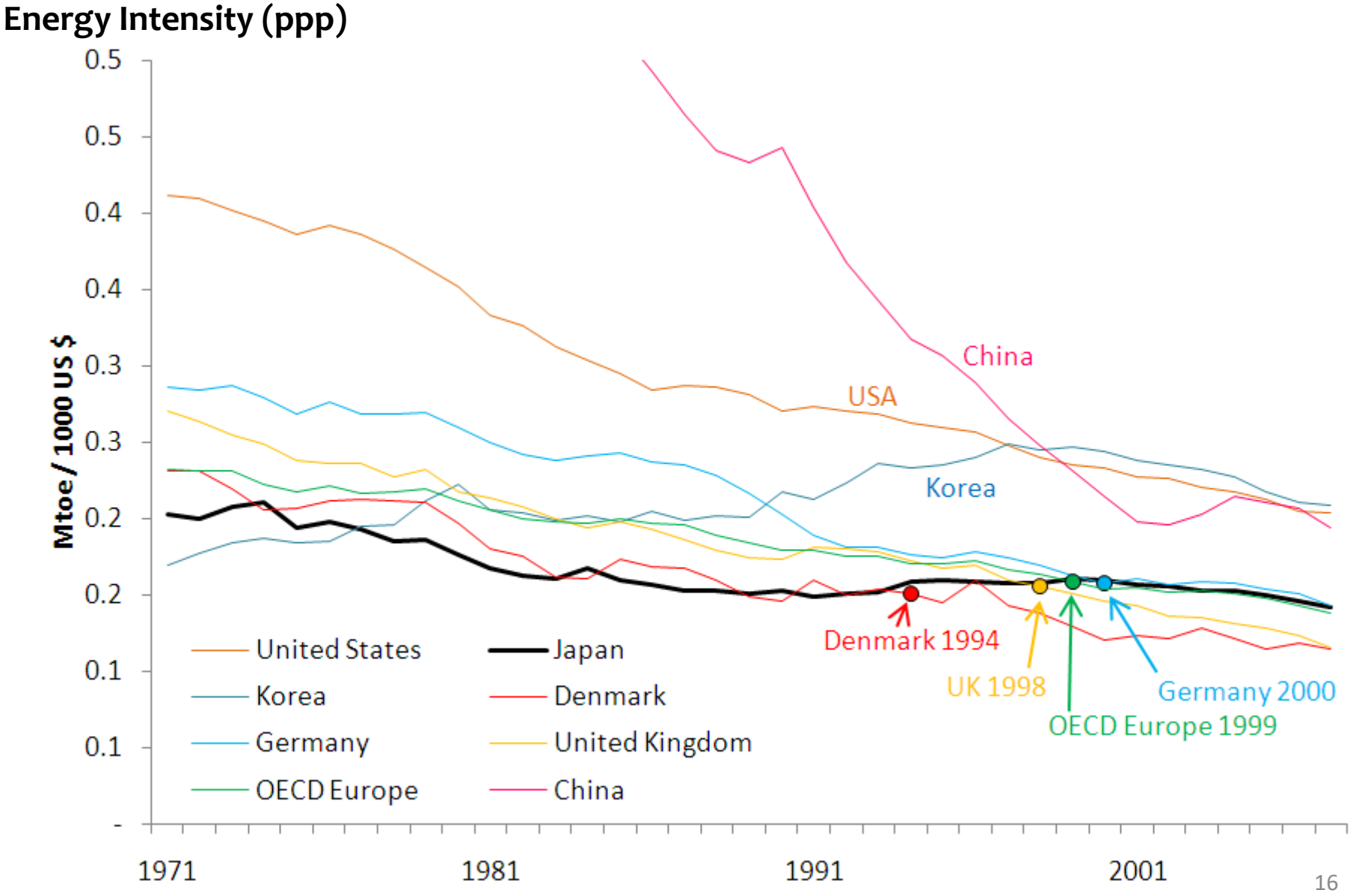
New energy-mobility infrastructure in Berlin

Clear Sky

Easy slow mobilization

Morocco

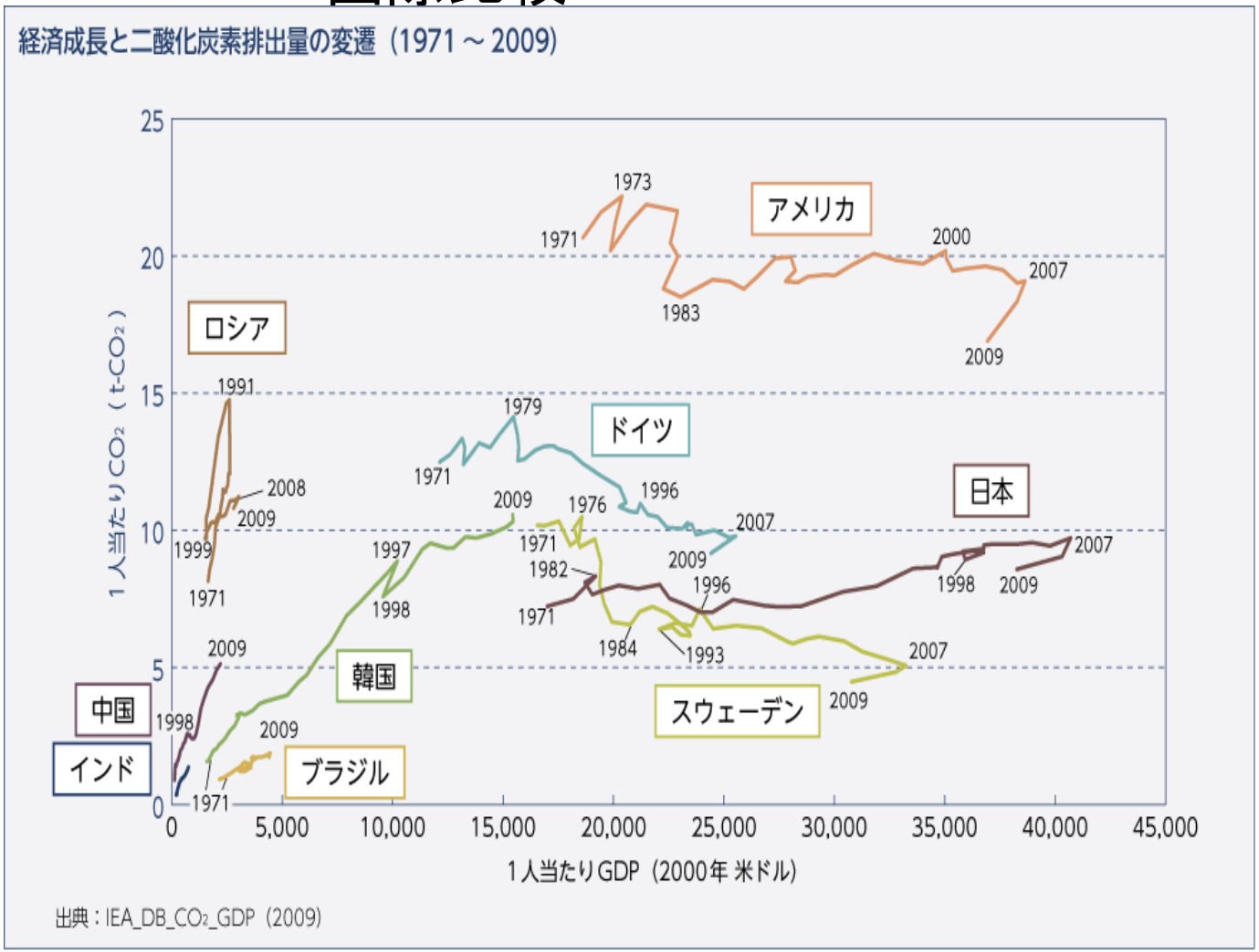
Glory of the past
"Japan as saving-energy frontrunner"



Original Data: IEA (2009) CO_2 Emissions from Fuel Combustion - Highlights

デカップリング（経済成長と環境負荷の切り離し）

―――国際比較―――



環境白書2012年版

	1	2	3	4	5
POWER					
Renewable power (incl. hydro)	**China**	United States	Brazil	Germany	Canada
Renewable power (not incl. hydro)	**China**	United States	Germany	Japan	India
Renewable power capacity *per capita* (among top 20, not including hydro[3])	**Denmark**	Germany	Sweden	Spain	Portugal
Biopower generation	**United States**	China	Germany	Brazil	Japan
Geothermal power capacity	**United States**	Philippines	Indonesia	Mexico	New Zealand
Hydropower capacity[4]	**China**	Brazil	United States	Canada	Russian Federat.
Hydropower generation[4]	**China**	Brazil	Canada	United States	Russian Federat.
CSP	**Spain**	United States	India	Morocco	South Africa
Solar PV capacity	**China**	Germany	Japan	United States	Italy
Solar PV capacity *per capita*	**Germany**	Italy	Belgium	Japan	Greece
Wind power capacity	**China**	United States	Germany	India	Spain
Wind power capacity *per capita*	**Denmark**	Sweden	Germany	Ireland	Spain
HEAT					
Solar water heating collector capacity[5]	**China**	United States	Germany	Turkey	Brazil
Solar water heating collector capacity *per capita*[5]	**Austria**	Cyprus	Israel	Barbados	Greece
Geothermal heat capacity[6]	**China**	Turkey	Japan	Iceland	India
Geothermal heat capacity *per capita*[6]	**Iceland**	New Zealand	Hungary	Turkey	Japan

Characteristics of Old and New "Mission-Oriented" Projects

Source: Soete and Arundel (1993, p. 51)

Old: Defence, Nuclear and Aerospace	***New: Low Carbon Technologies***
The mission is defined in terms of the number of technical achievements with little regard to their economic feasibility	The mission is defined in terms of **economically feasible technical solutions** to particular environmental problems.
The goals and the direction of technological development are defined in advance by a small group of experts	The direction of technical change is **influenced by a wide range of actors** including the government, private firms and consumer groups
Centralised control within a government administration	**Decentralised control** with a large number of involved agents
Diffusion of results outside the core of participants is of minor importance or actively discouraged	**Diffusion of the results** is a central goals and is actively encouraged
Limited to a small group of firms that can participate owing to the emphasis on a small number of radical technologies	An emphasis on the **incrementalist** development of both radical and incremental innovations in order to permit a large number of firms to participate
Self-contained projects with little need for complementary policies and scant attention paid to coherence	**Complementary policies vital** for success and close attention paid to coherence with other goals

Japan's energy and climate policies

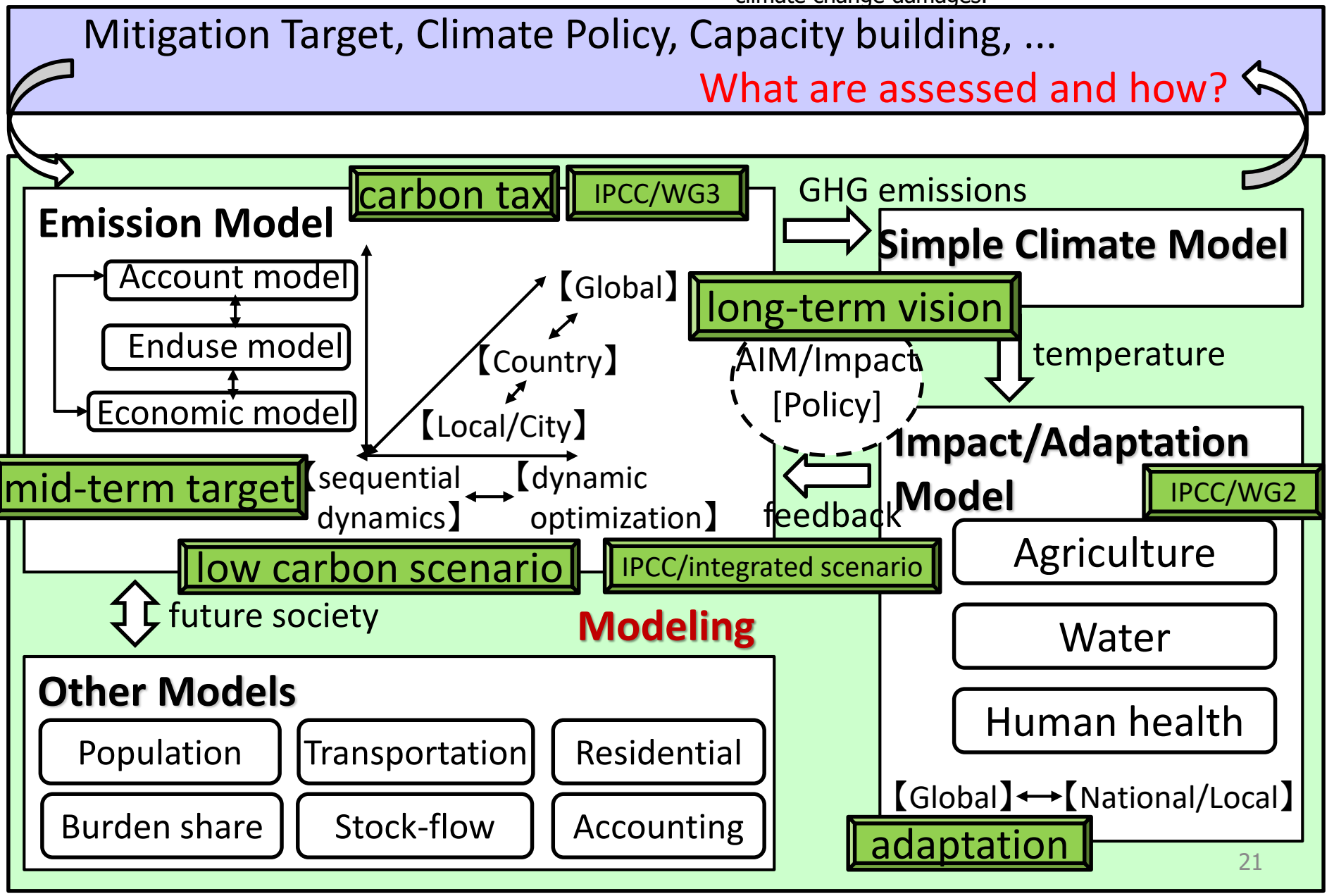
- 2007 Heiligendamm G8 Summit, PM Abe: "Cool Earth 50" concept of halving global emissions by 2050
- 2008 Toyako Summit, PM Fukuda: 60-80% reduction by 2050, concept of low carbon society
- 2014 Basic Environment Plan: Set 2050 target at an 80% reduction

- 2015 COP21 Summit PM Abe announced "Actions for Cool Earth 2.0 (ACE2.0)"
  Japan's INDC:
  - 26% GHG reduction in 2030 compared to 2013
  - Energy conservation: 13% reduction from BaU
  - 35% improvement in energy efficiency (=E/GDP)
  - Reduce dependency on nuclear power as low as possible

- Global Warming Prevention Headquarters (cabinet members) decided:
  - Formulate a global warming response implementation plan by spring of 2017
  - Enhance public movements, support developing countries and encourage technological innovation
  - Strengthen "climate security" including "energy security" through contributing to climate change measures around the world
  - Reduce energy demand as much as possible
  - Promote shift to low-carbon energy/ enhance electrification

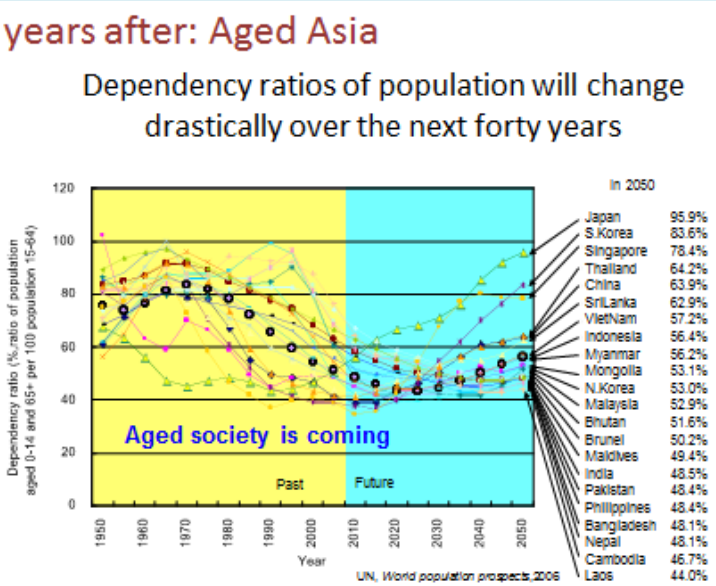
Integrated Assessment Model

AIM (Asia-Pacific Integrated Model) is an integrated assessment model to assess mitigation options to reduce GHG emissions and impact/adaptation to avoid severe climate change damages.

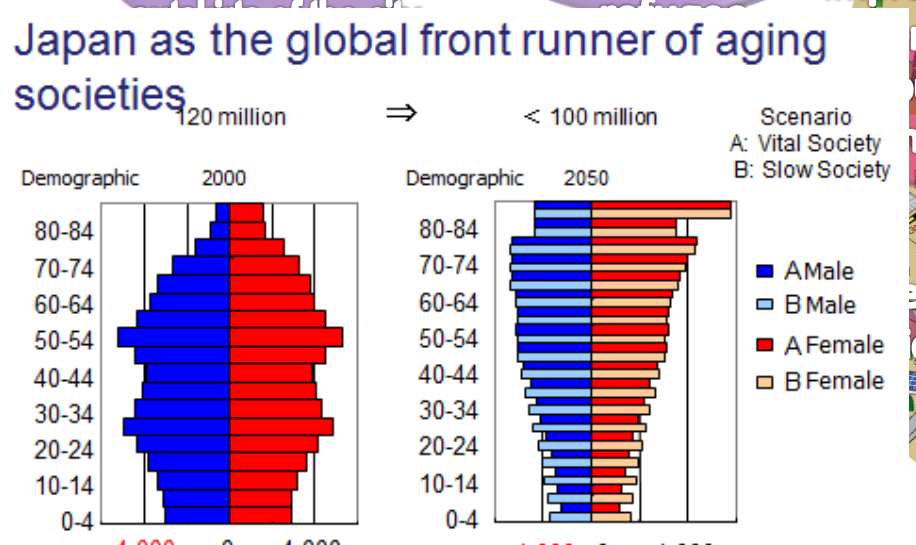


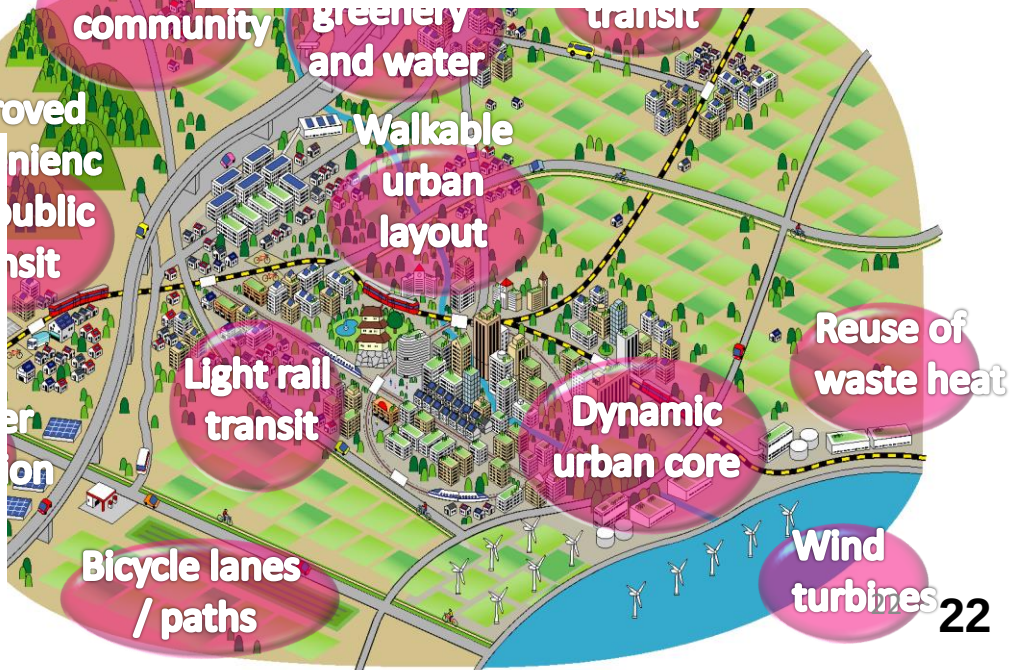
Japan now: hi-energy locked-in and aged society

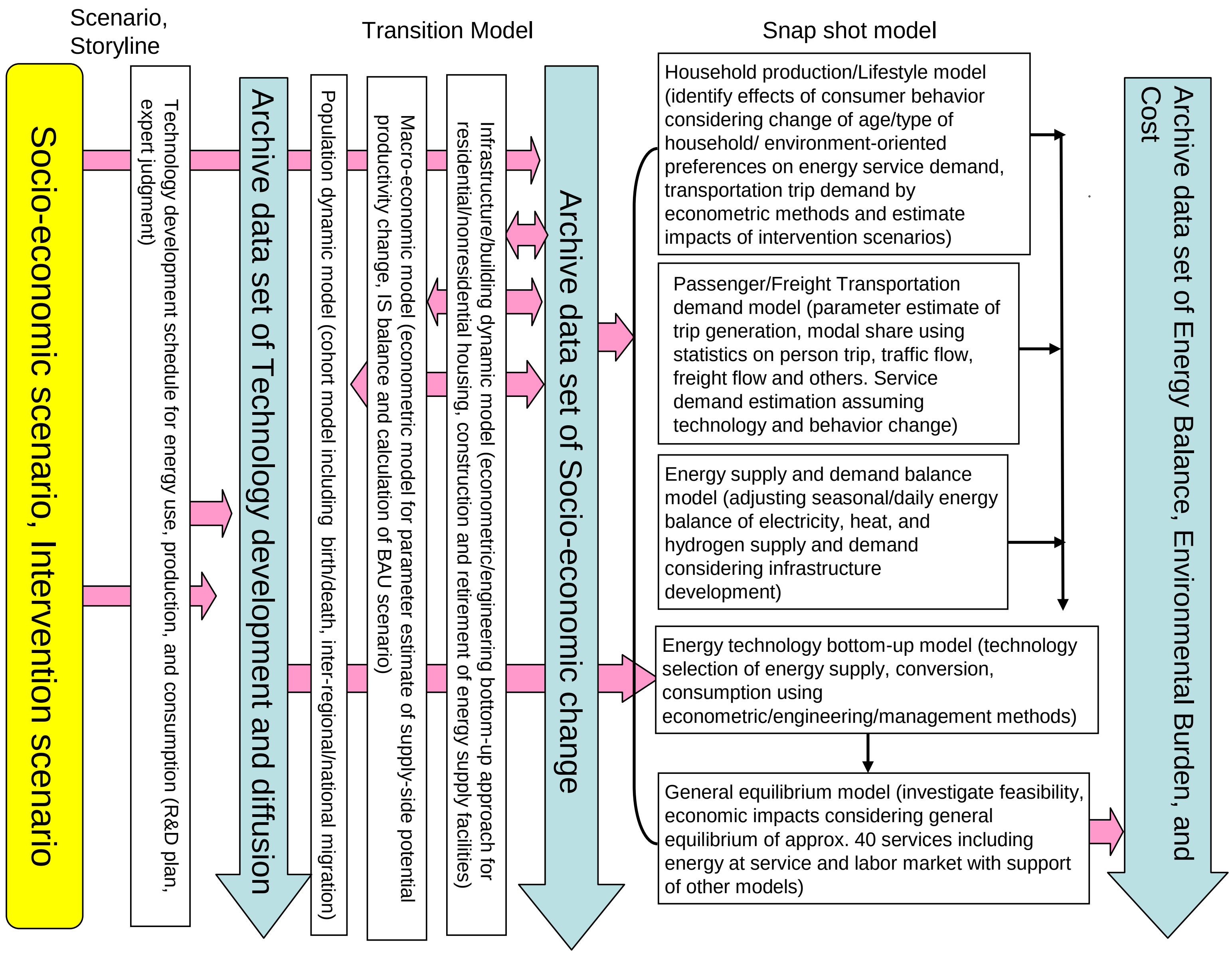
Now restoring to compact city



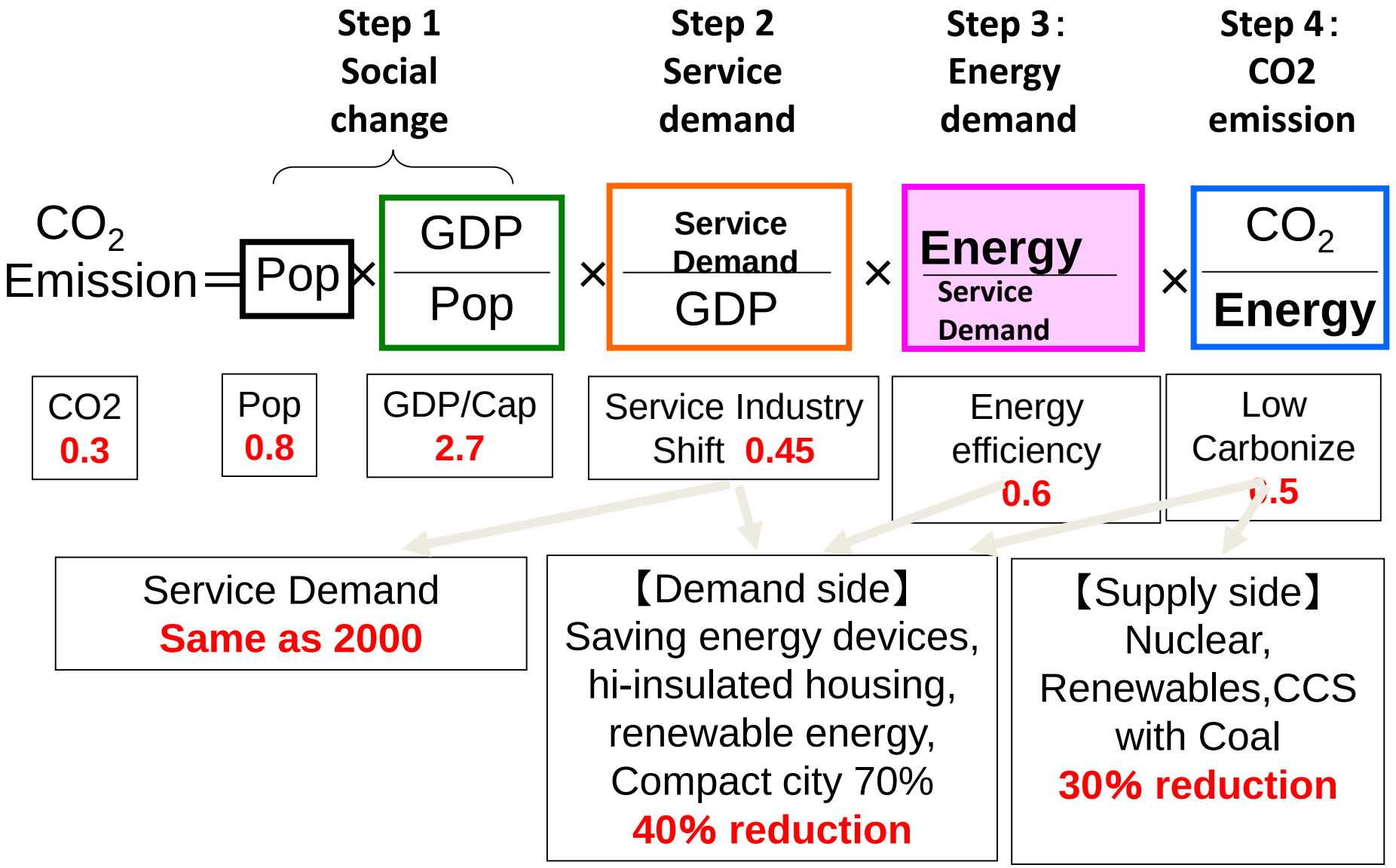
From Matsuoka, 2009





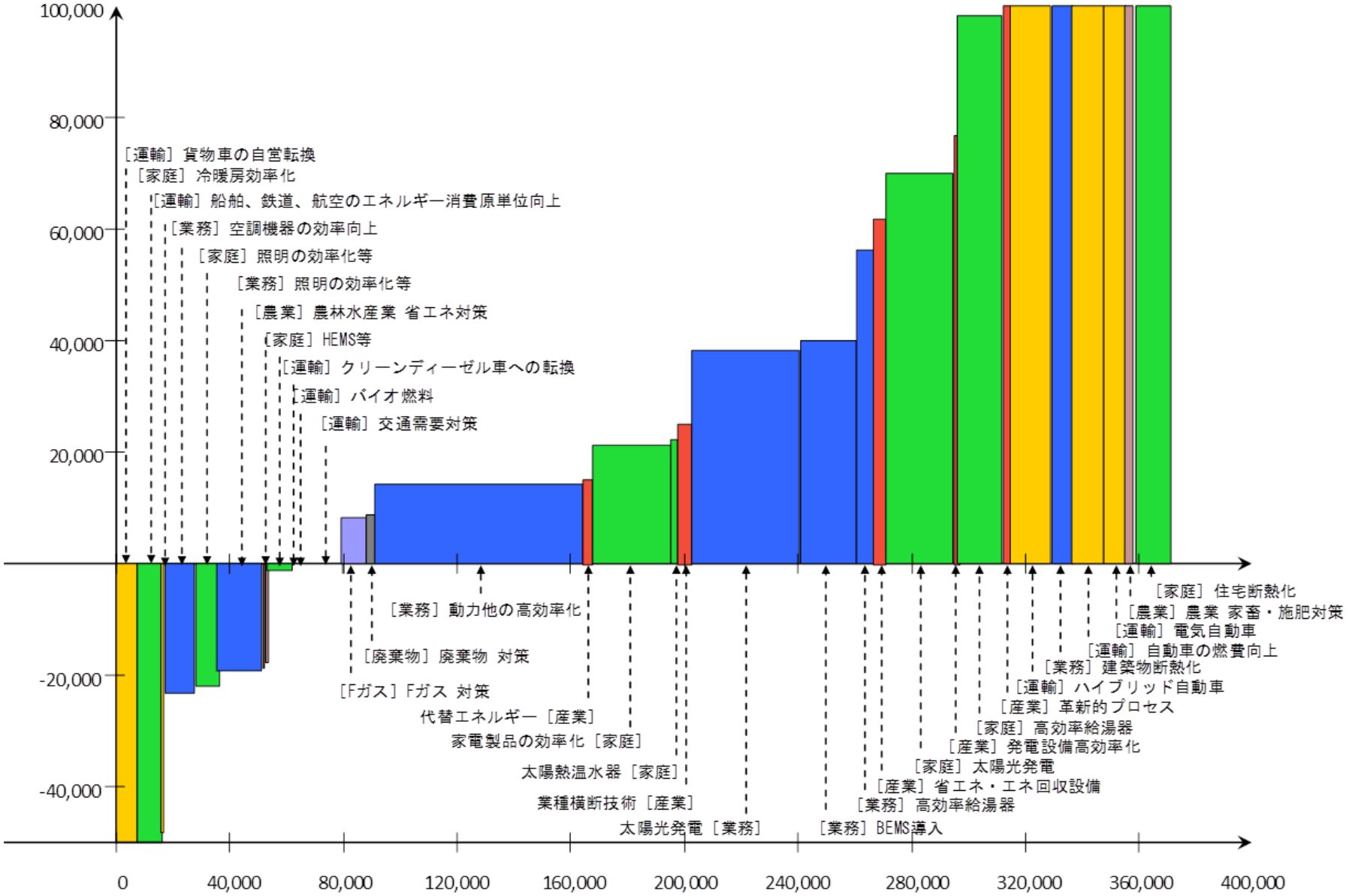

Scenario, Storyline
Transition Model
Snap shot model
Socio-economic scenario, Intervention scenario
Technology development schedule for energy use, production, and consumption (R&D plan, expert judgment)
Archive data set of Technology development and diffusion
Population dynamic model (cohort model including birth/death, inter-regional/national migration)
Macro-economic model (econometric model for parameter estimate of supply-side potential productivity change, IS balance and calculation of BAU scenario)
Infrastructure/building dynamic model (econometric/engineering bottom-up approach for residential/nonresidential housing, construction and retirement of energy supply facilities)
Archive data set of Socio-economic change
Household production/Lifestyle model (identify effects of consumer behavior considering change of age/type of household/ environment-oriented preferences on energy service demand, transportation trip demand by econometric methods and estimate impacts of intervention scenarios)
Passenger/Freight Transportation demand model (parameter estimate of trip generation, modal share using statistics on person trip, traffic flow, freight flow and others. Service demand estimation assuming technology and behavior change)
Energy supply and demand balance model (adjusting seasonal/daily energy balance of electricity, heat, and hydrogen supply and demand considering infrastructure development)
Energy technology bottom-up model (technology selection of energy supply, conversion, consumption using econometric/engineering/management methods)
General equilibrium model (investigate feasibility, economic impacts considering general equilibrium of approx. 40 services including energy at service and labor market with support of other models)
Archive data set of Energy Balance, Environmental Burden, and Cost
Trajectory

Systematic Reduction of CO_2: Wider scope to Low Carbon Society

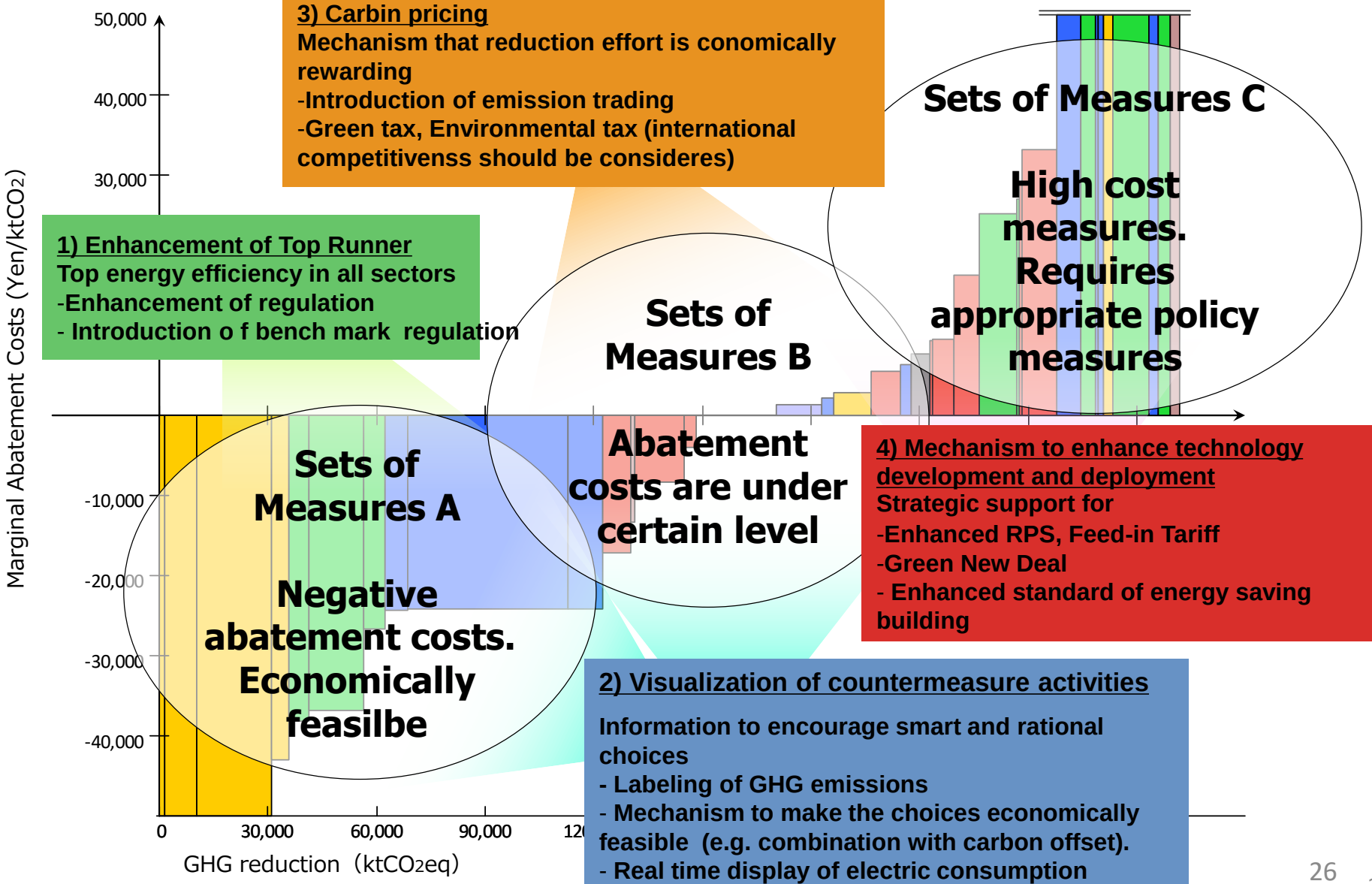


2050 Japan LCS Scenario

Low carbon technology ; cost and reduction potential



Ex) Recommended Countermeasures



3) Carbin pricing
Mechanism that reduction effort is conomically rewarding
-Introduction of emission trading
-Green tax, Environmental tax (international competitivenss should be consideres)

1) Enhancement of Top Runner
Top energy efficiency in all sectors
-Enhancement of regulation
- Introduction o f bench mark regulation

4) Mechanism to enhance technology development and deployment
Strategic support for
-Enhanced RPS, Feed-in Tariff
-Green New Deal
- Enhanced standard of energy saving building

2) Visualization of countermeasure activities

Information to encourage smart and rational choices
- Labeling of GHG emissions
- Mechanism to make the choices economically feasible (e.g. combination with carbon offset).
- Real time display of electric consumption

Based on Report on Mid-/Long-term Roadmap

26

Case of Japan: 70% reduction feasible: Combination of demand side energy reduction ＋low carbon energy

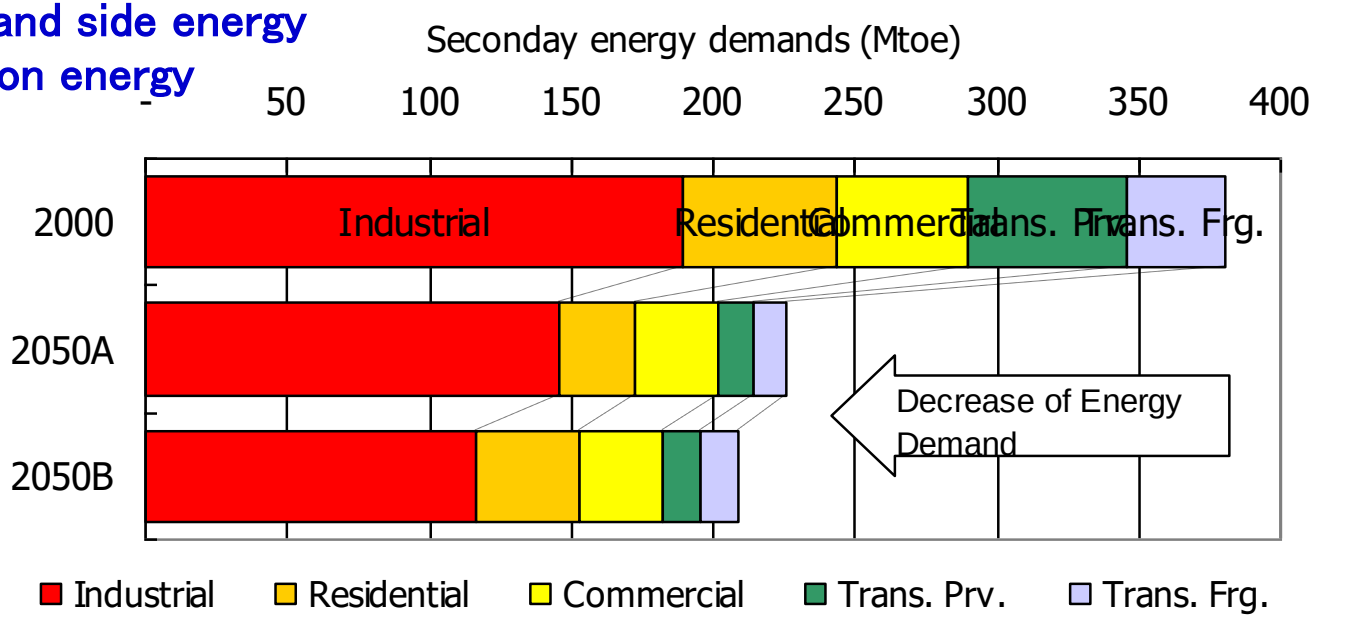
Energy Consumption

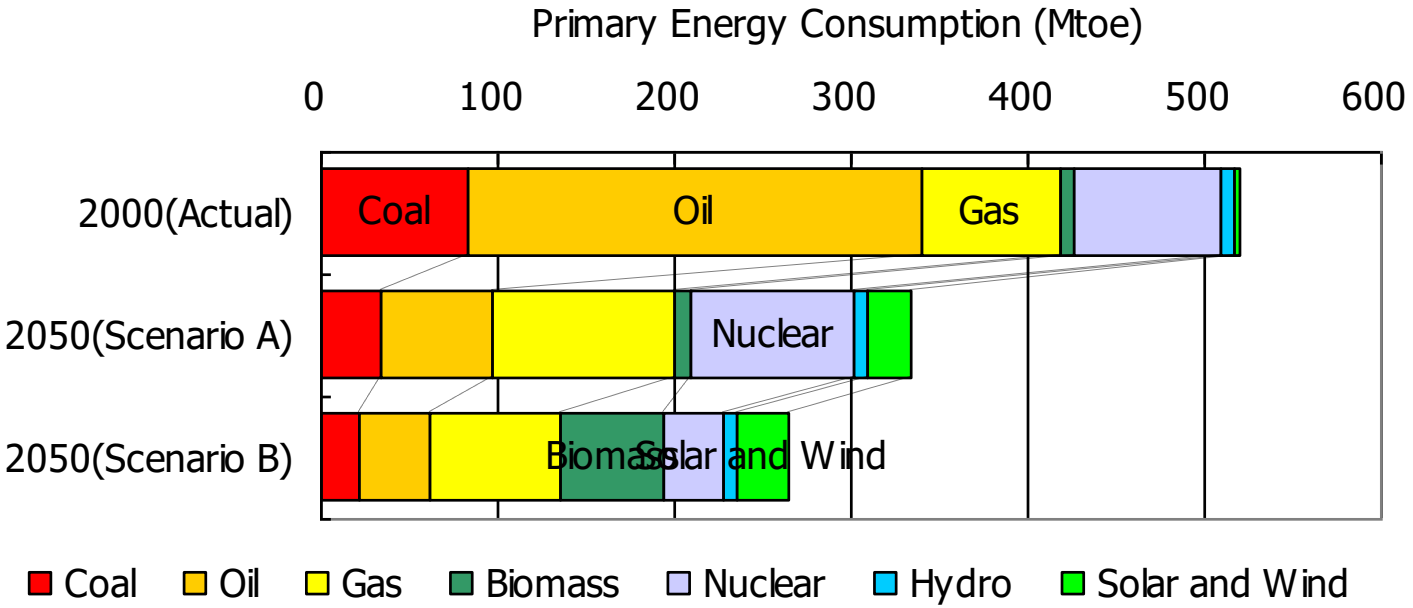
40% reduction

＋

Energy Supply

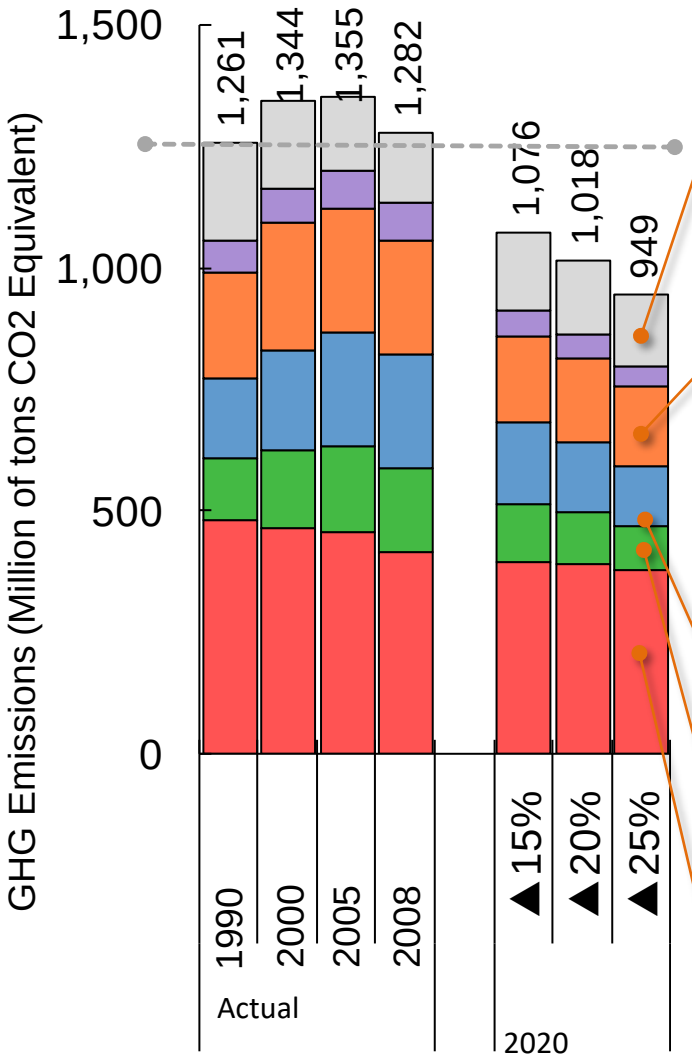
Low Carbon Energy





What are the Countermeasures to be implemented to attain the CO2 Reduction Target? (1/2)

Specialist WG discussions incorporating the results of interviews with concerned parties concluded that it is possible for Japan to achieve its reduction targets by building up existing technologies expected to be used in countermeasures.



<Demand Sector Image>

Non-Energy

- Popularize refrigerating machines that use natural refrigerants, etc.

Transport

- 40-50% improvement of passenger vehicle efficiency (ownership basis; including EV/HV)
- EV/HV: 1 out of every 2 new car sales
- Car sharing utilization rate: Increase from 0.3% to 1% of urban population
- Eco-driving in practice: 20 to 30%

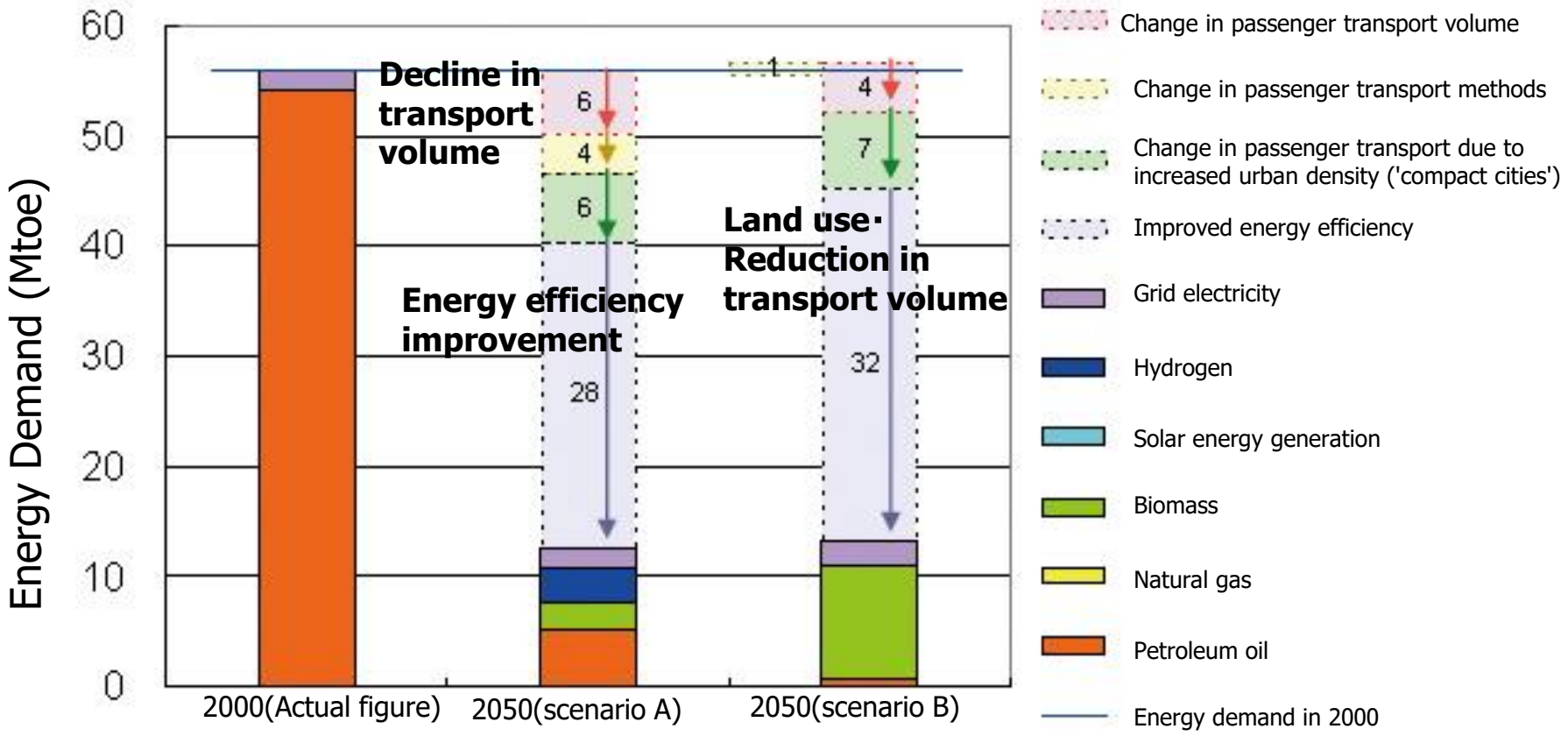
Commercial / Residential

- Ensure all newly built homes and buildings use advanced insulation and energy saving designs/features
- 50 to 70% penetration of high-efficiency water heater in households
- 30 to 40% penetration of building energy control systems
- 10 to 20% penetration of PV power in households

Industry

- Steadily popularize state of art best-available-technology in the world
- Fuel conversion to natural gases

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

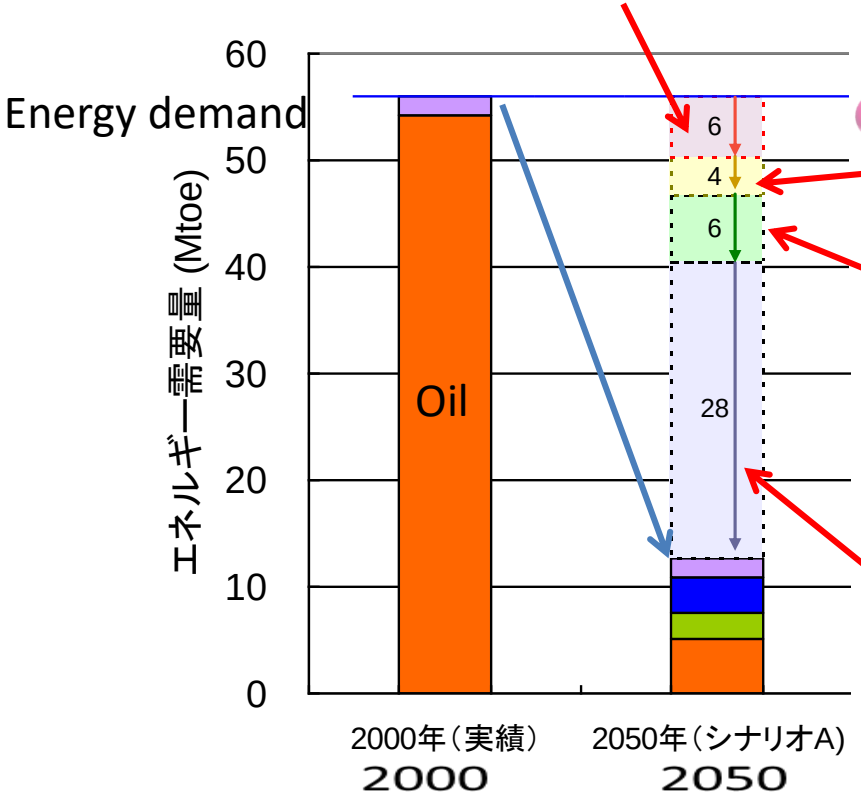


Change in passenger transport volume: reduction in total movements due to population decline
Change in passenger transport methods: modal shift using public transport system (LRT etc.)
Change in passenger transport due to increased urban density ('compact cities'): reduced travel distance due to proximity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

Deployment of technology 80% reduction measures in passenger sector

Compact city
Reduction of mobility volume
Re-vitalization of city center, Pedestrian oriented
car free
green city

Population decrease/ aged society

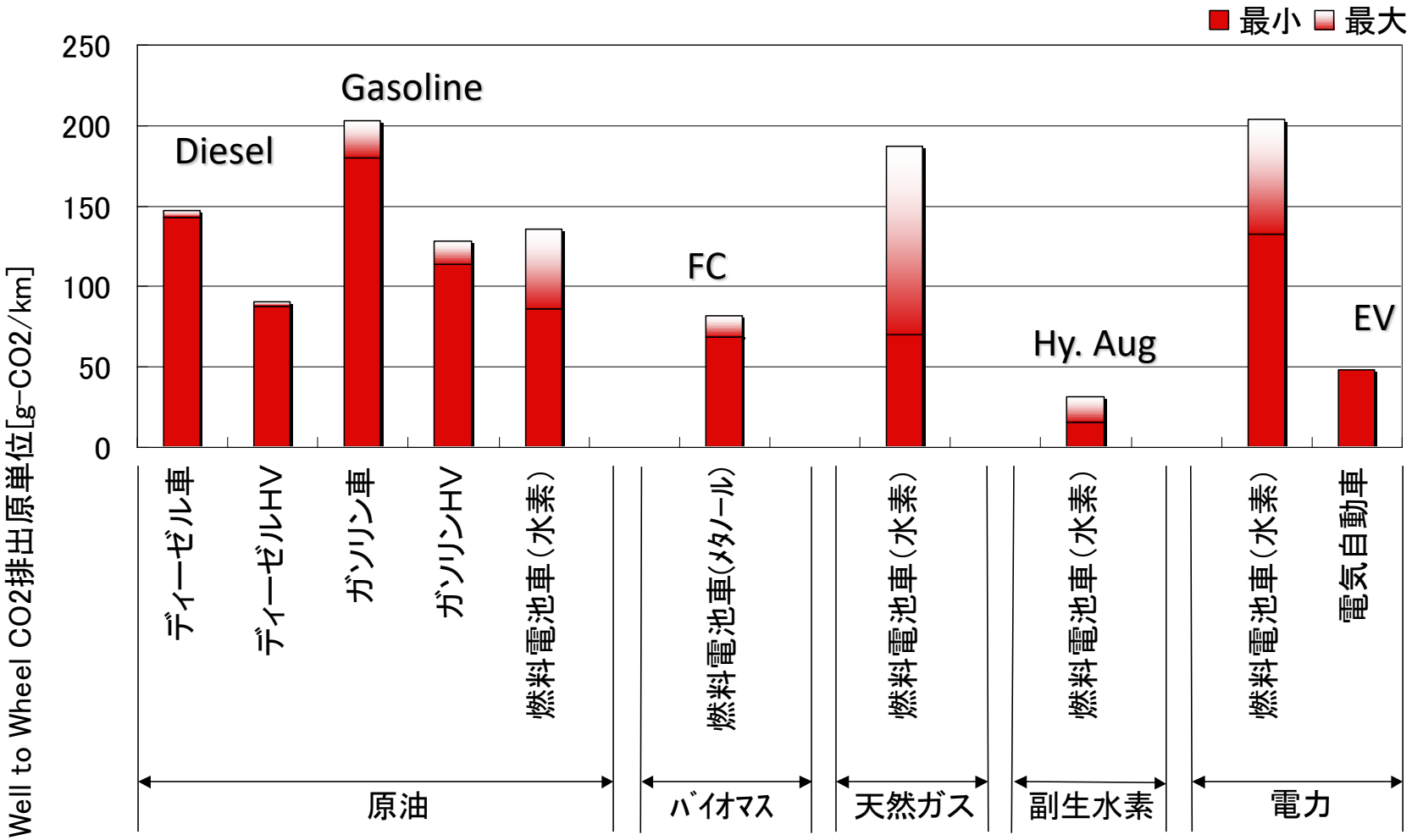


Eliica 370km/h Shimizu

Modal shift
Public transportation as city backbone
Toyama city

Innovation
EV/FCV
New industry

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

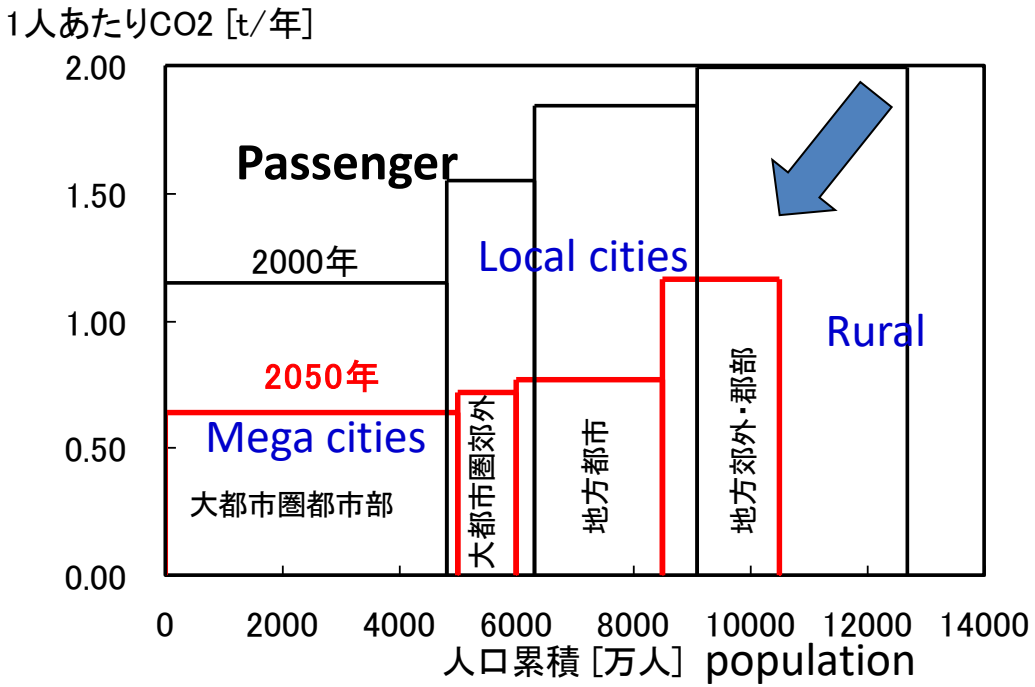


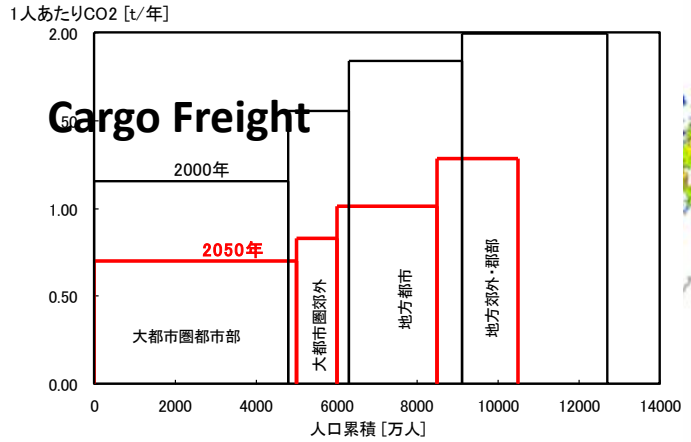
※HV：ハイブリッド車の省略形　　※電力：日本の平均電源構成
※燃料電池車：回生エネルギーを二次電池で回収　　※水素：圧縮水素を仮定

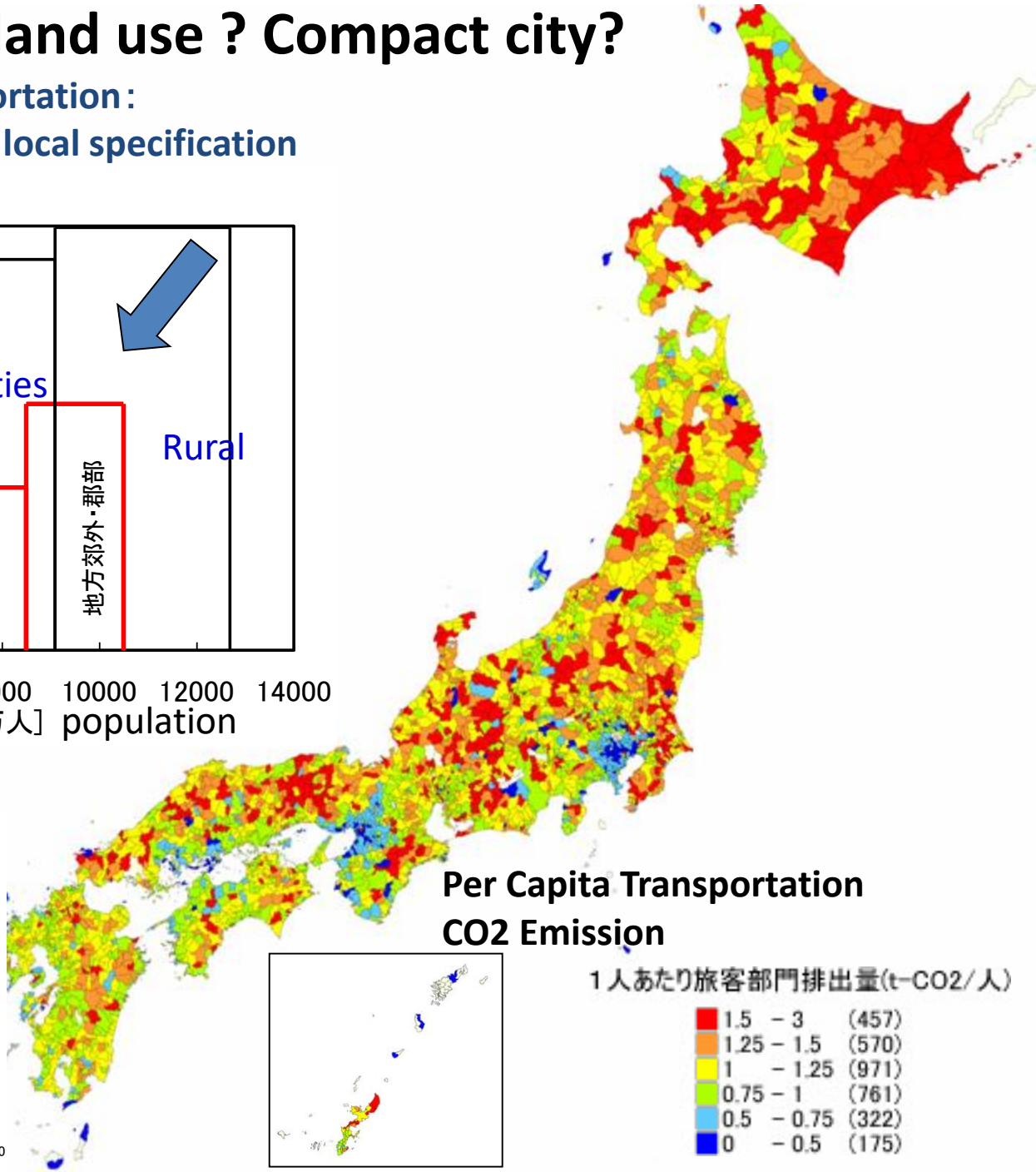
脱温暖化2050研究
交通チーム　工藤

Q7:How to change land use ? Compact city?

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



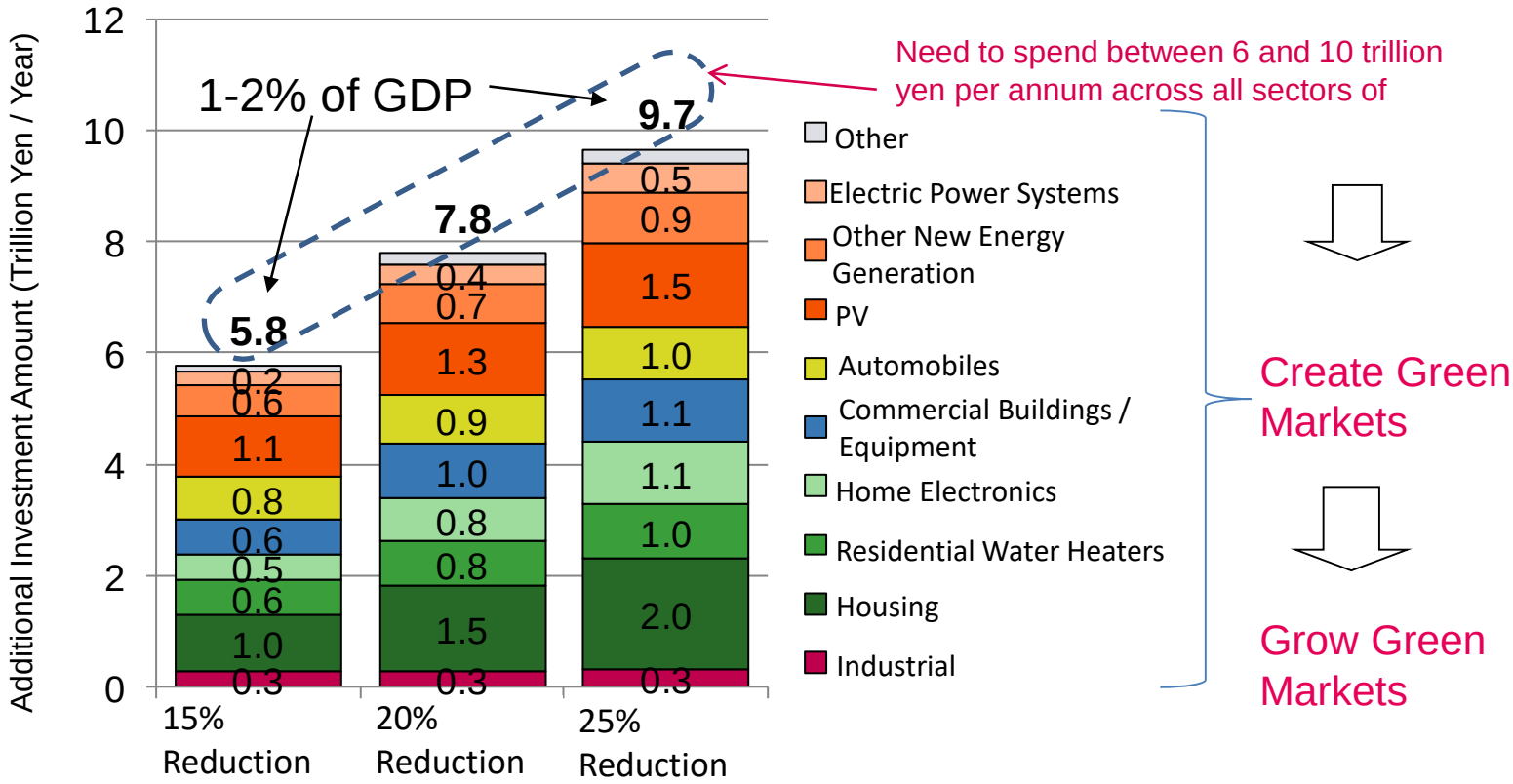




Huge green business opportunity accompanied by transition to low carbon society

Japan needs to invest on average 6 to 10 trillion yen per annum in additional funds to achieve a ▲15% to ▲25% by 2020. If this spending is not spread across all sectors of society, Japan will face difficulty in implementing the necessary countermeasures to achieve this target. Yet, this also means Japan will need to create new markets on par with this spending.

[Additional Investments Required to Achieve CO2 Reduction Target]



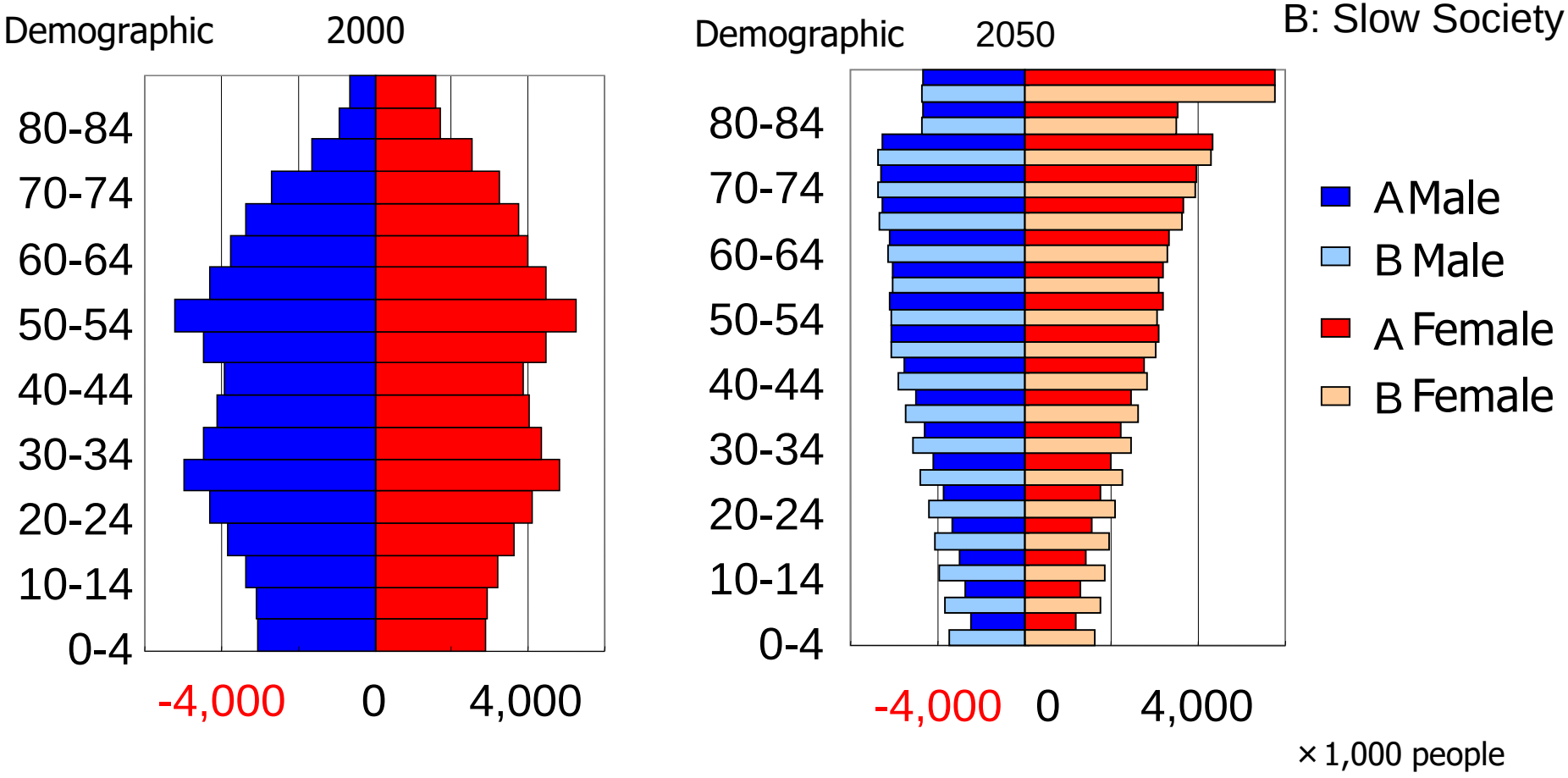
Comments from the Roadmap Subcommittee

- Japan needs to develop policies that reward consumers who chose and companies that manufacture low-carbon products.
- Japan needs to proactively move forward with investments that contribute to green innovation.

Japan as the global front runner of aging societies

120 million ⇒ ＜100 million

Scenario
A: Vital Society
B: Slow Society



Co-benefit of low carbon development

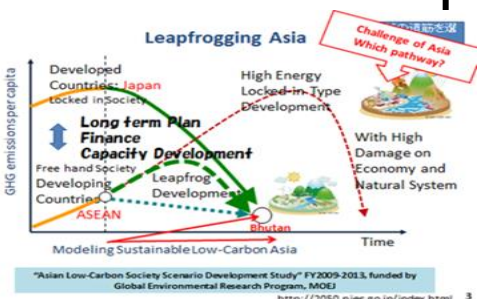
Case of City of Kita-Kyushu: Before and after 1970s'transition :

Switch from coal to oil & gas, improve energy efficiency to cope with oil crisis and innovation in pollution control technology

The atmosphere in Kitakyushu, Japan: before and after the clean up (SOE2000).

Can Bhutan leapfrog? Some leading runners, leverage, tailwind

Issue	*Country*	*Internal factors*	*External factors*
Industrial structure	India: '90s IT industry, Bangalore	Education/ human resources	Soft technology start Globalization
Energy structure	Japan: '70s Low energy intensity	Technology Rapid growth /pollution	Oil crisis Energy security
Bioenergy	Brazil: '70s Bioethanol	Sugar cane Scarce oil	Oil crisis Energy security
Information technology	China: '00s- Mobile phone	Rapid economic growth, Weak telephone-grid	IT technology Gobalization
Renewable energy / EV	China: '00s Wind/solar energy/EV	Big land area Technology/ pollution	Decarbonizing trend Climate change
Develop-ment path?	Bhutan ～2050s High dependence to external fund High transportation cost Inadequate infrastructure	Political stability Natural and Pristine environment Competitively pricing energy Nation of GNH Wide use of English language * 8	Carbon neutral world International cooperation climate finance capacity building



Thank you very much for your attention!

LCS-RNet/LoCARNet Secretariat
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