

わが国の地球温暖化対策とエネルギー政策 Climate Change Response and Energy Mix from a Japanese Perspective

山地憲治 (Kenji YAMAJI)

(公財)地球環境産業技術研究機構(RITE)理事・研究所長

Director-General,

Research Institute of Innovative Technology for the Earth

第48回原産年次大会

The 48th Annual Conference of JAIF

April 13, 2015 @Tokyo

National initiatives for global warming mitigation in the past decade

2005 : enforcement of the Kyoto Protocol (February) and cabinet decision about the Kyoto Protocol Target Achievement Plan (April)

May 2007 : 'Cool Earth 50' proposal of a GHG emissions reduction by 50% by 2050

Change of government: shift to DPJ

September 2009: Prime Minister Hatoyama declared the 2020 target to be a 25% emissions reduction compared to 1990 level

June 2010 : the Third Strategic Energy Plan stipulates that the 2030 should be 70% zero-emission technologies (50% nuclear, 20% renewable energies)

Fukushima nuclear accident

April 2012 : the Environment Plan set the 2050 target to an 80% greenhouse gas emissions reduction target

Government back to LDP–Komeito coalition

September 2013 : Settlement of the Energy and Environment Technology Innovation Plan

November 2013 : Considering the reduction in nuclear power supply, the 2020 target was revised to be a 3.8% emissions reduction compared to 2005 level as a temporary target

April 2014 : Cabinet Decision for the Fourth Strategic Energy Plan

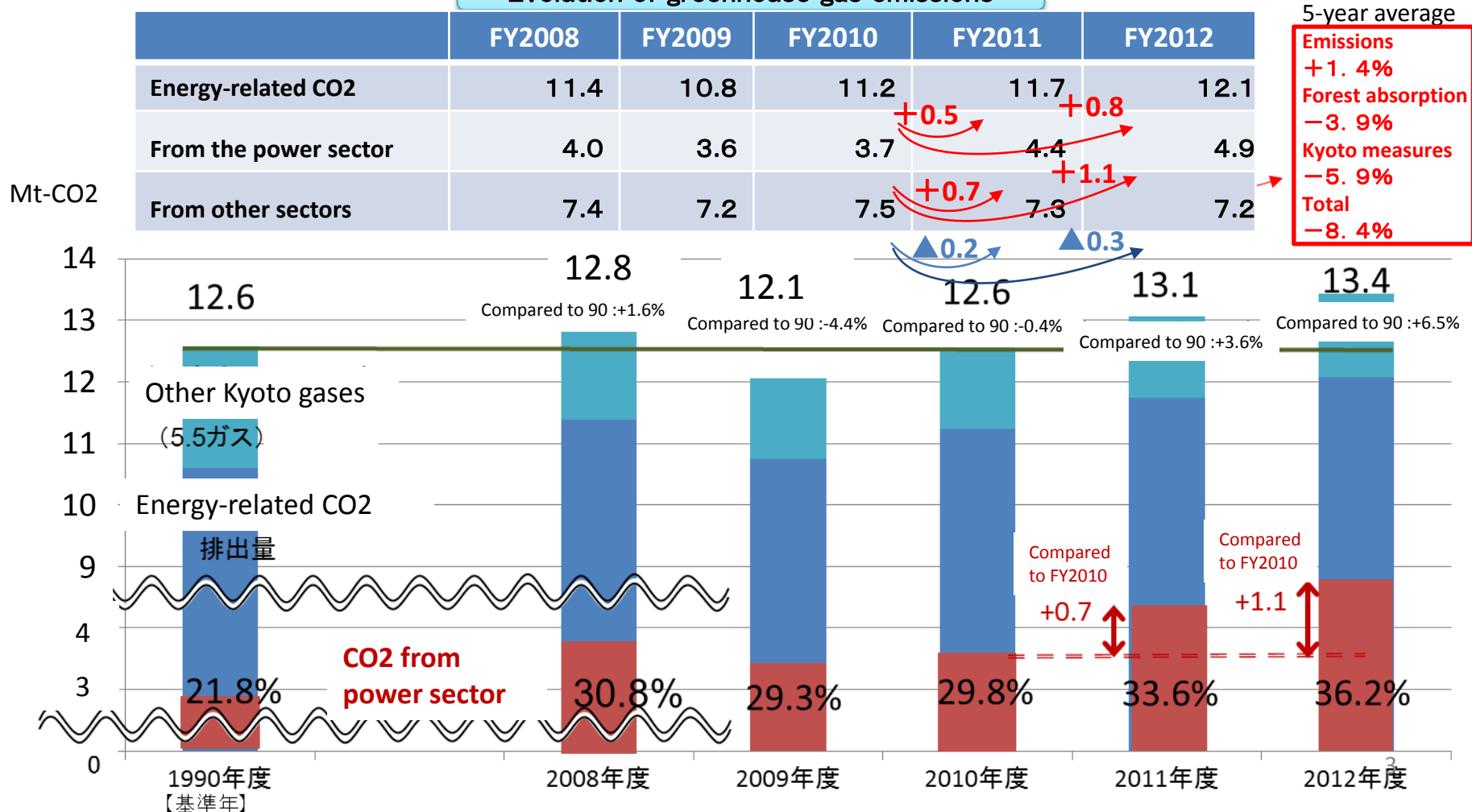
October 2014 : ICEF(Innovation for Cool Earth Forum) was held in Tokyo

The Kyoto Protocol goals (First Commitment Period) were overachieved, but...

Rapid increase of greenhouse gas emissions

- As a result of shutting down nuclear power plants, greenhouse gas emissions from the power sector rose by 110 MtCO₂eq compared to 2010, which represents about 10% of Japan's yearly emissions. On the other hand, emissions from the power sector aside, greenhouse gas emissions in Japan have fallen from 30 MtCO₂ compared to 2010.

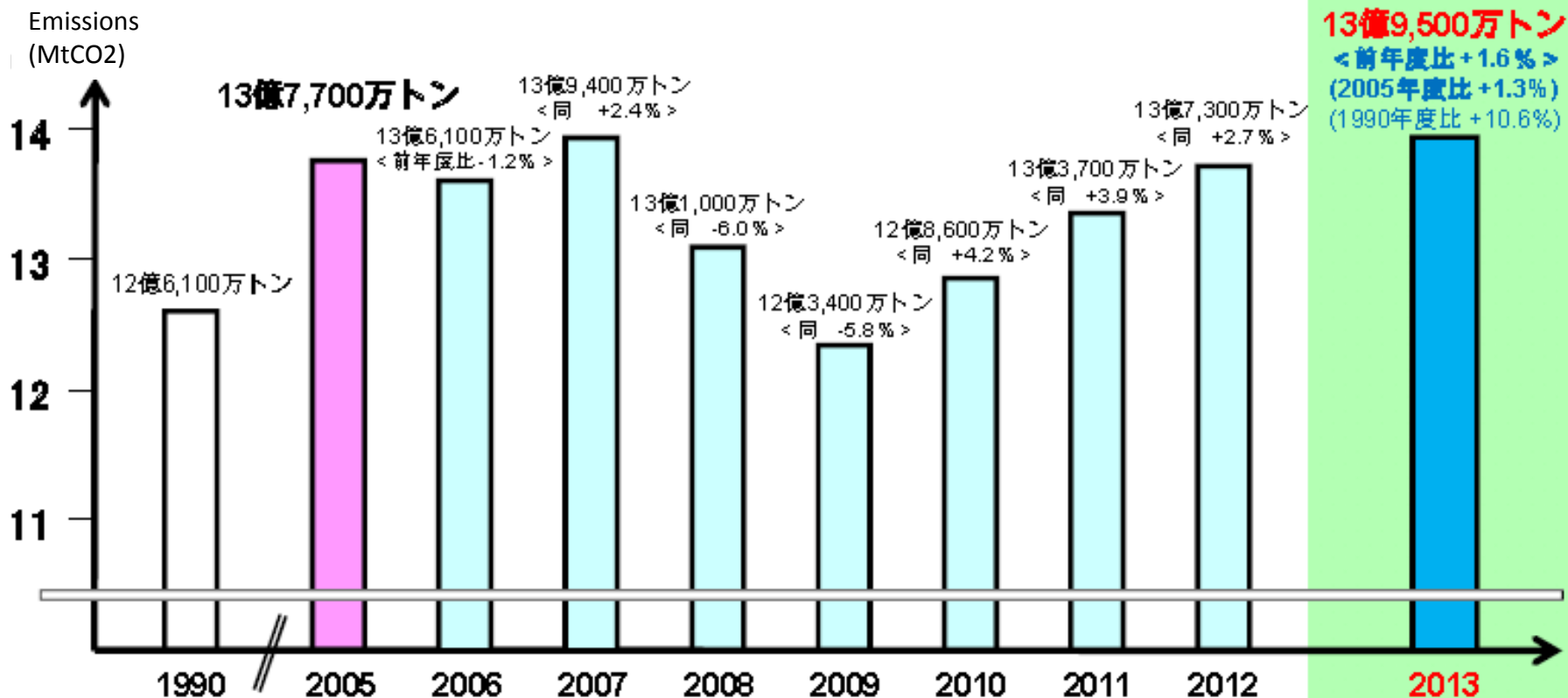
Evolution of greenhouse gas emissions



National greenhouse gases emissions

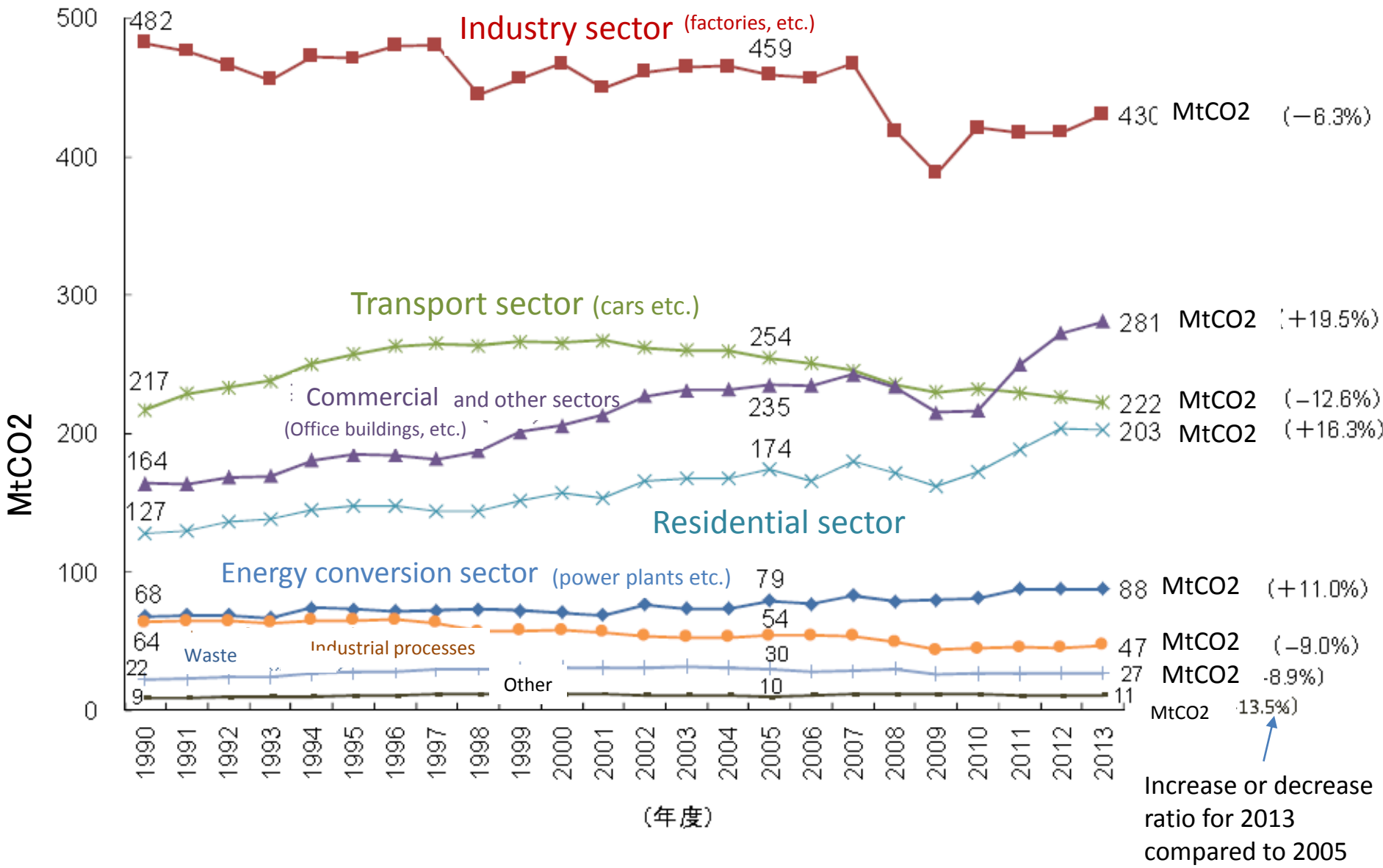
Emissions in 2013 were 13.95 MtCO₂ :

+1.6% compared to the previous year, +1.3% compared to 2006 and +10.8% compared to 1990. The reason is mainly the use of coal and high energy consumption in the industry (rejecting other GHG gas such as HFC in addition to CO₂)

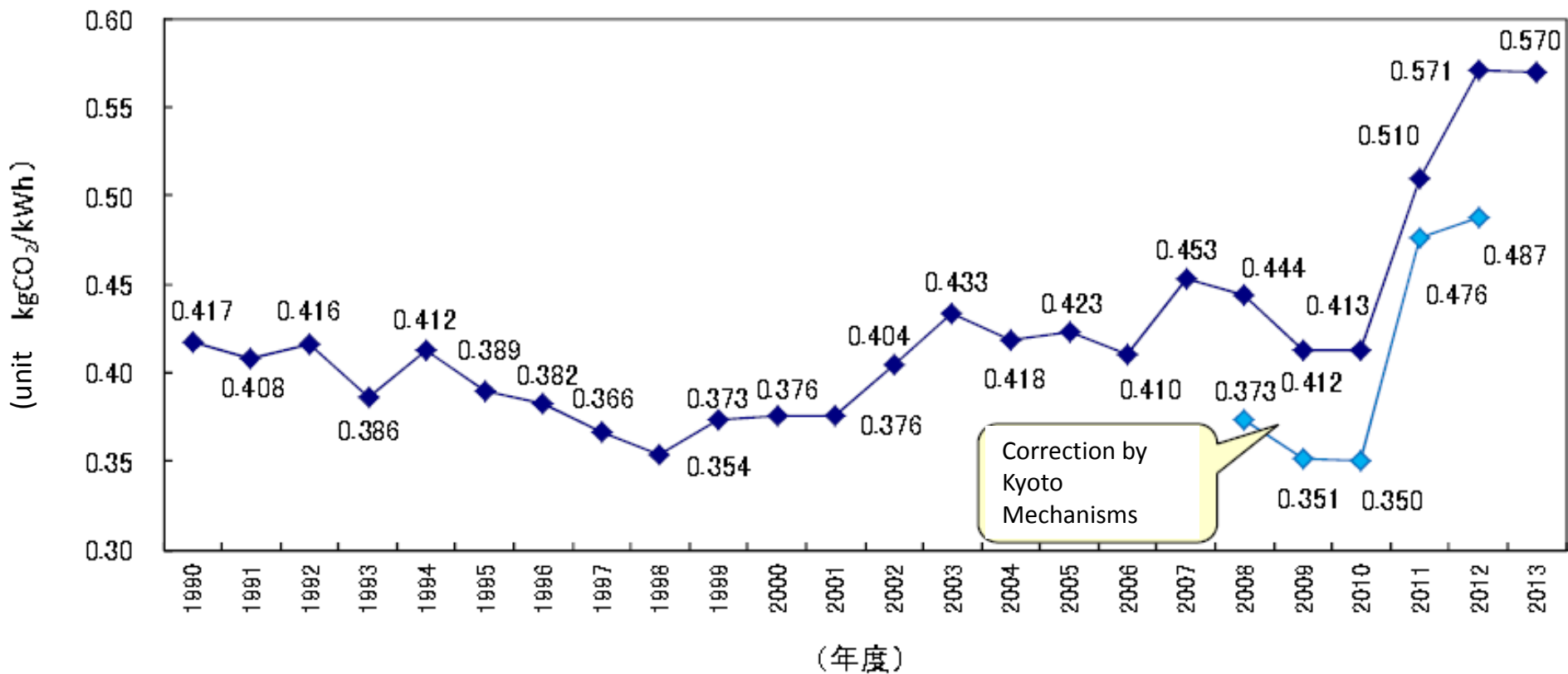


※1 今回とりまとめた2013年度速報値の算定にあたっては、国連気候変動枠組条約の下で温室効果ガス排出・吸収目録の報告について定めたガイドラインが改訂されたことを受け、対象ガスの追加、排出源の追加、算定方法の変更及び地球温暖化係数の変更を行った。追加・変更後の算定方法を用いて2012年度以前の排出量も再計算しており、2012年度確定値(2014年4月15日公表)との間で差異が生じている。

※2 2013年度速報値の算定に用いた各種統計等の年報値について、速報値の算定時点で2013年度の値が未公表のものは2012年度の値を代用している。また、一部の算定方法については、より正確に排出量を算定できるように見直しを行っている。このため、今回とりまとめた2013年度速報値と、来年4月に公表予定の2013年度確定値との間で差異が生じる可能性がある。なお、確定値では、森林等による吸収量についても算定、公表する予定である。



Evolution of CO₂ emissions by sector (after power and heat distribution

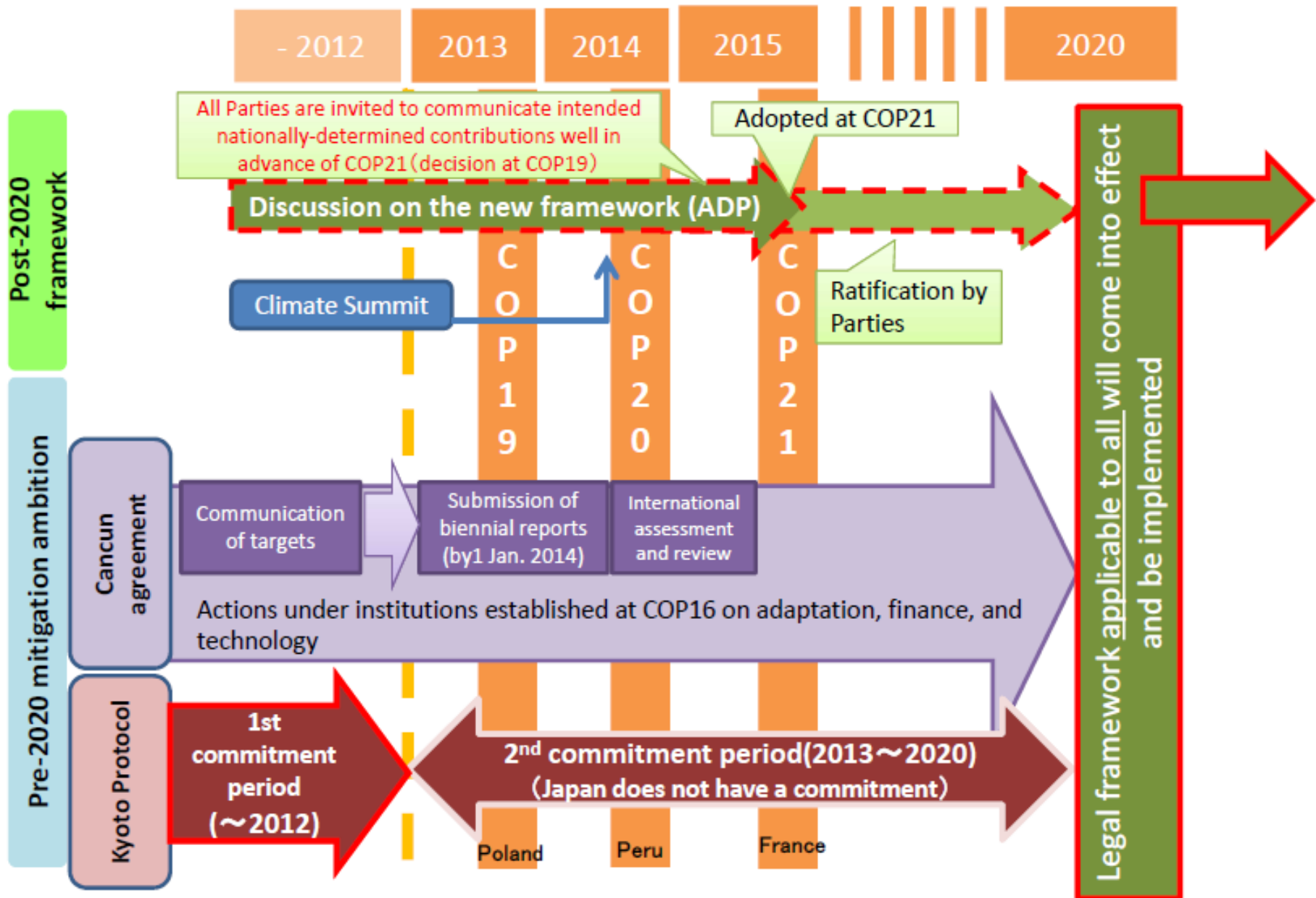


Source: 電源開発の概要 (資源エネルギー庁)、

「電気事業における環境行動計画」(電気事業連合会、2014年9月)、

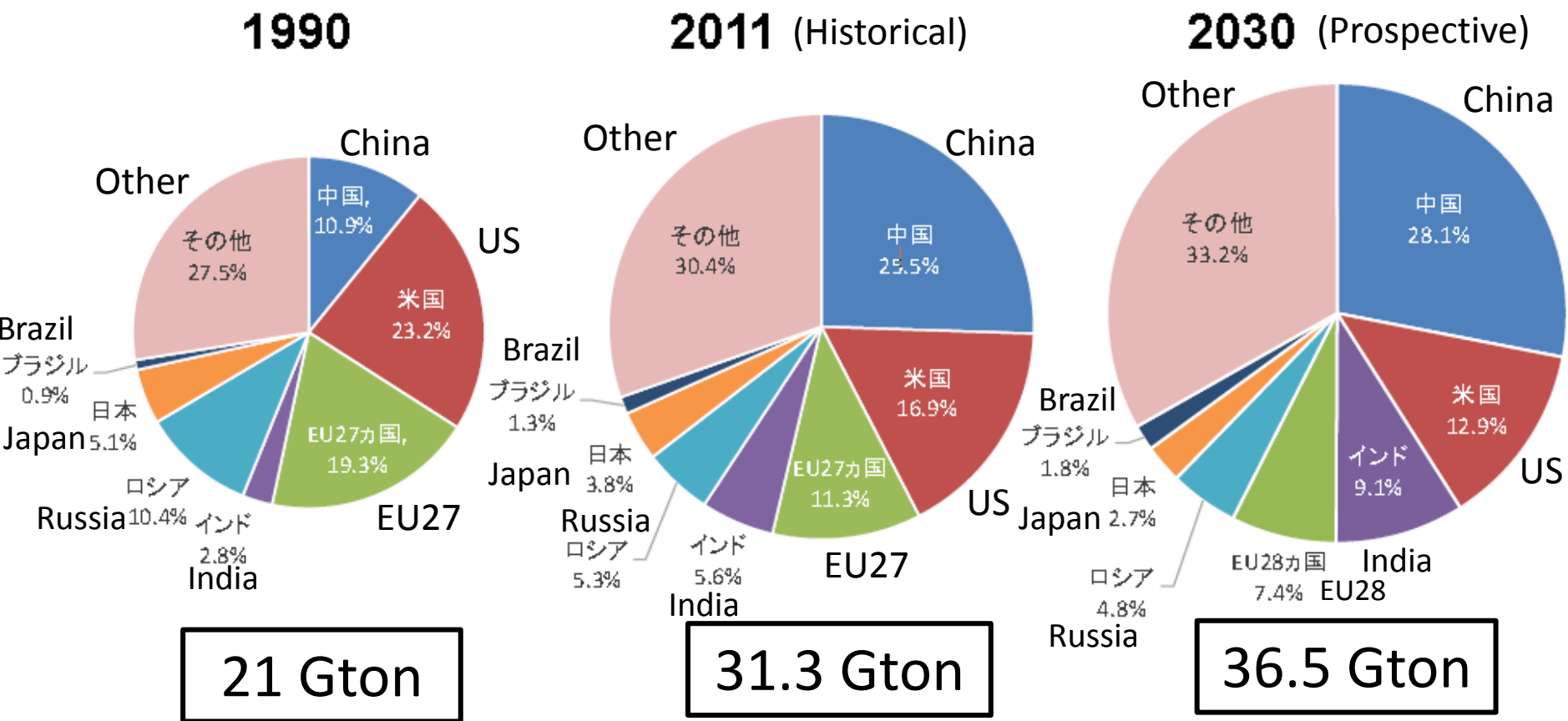
Evolution of CO₂ emission per power unit (estimates based on data from 10 power companies, purchased power included)

Timeline of International Negotiations



Evolution of world energy-related CO2 emissions

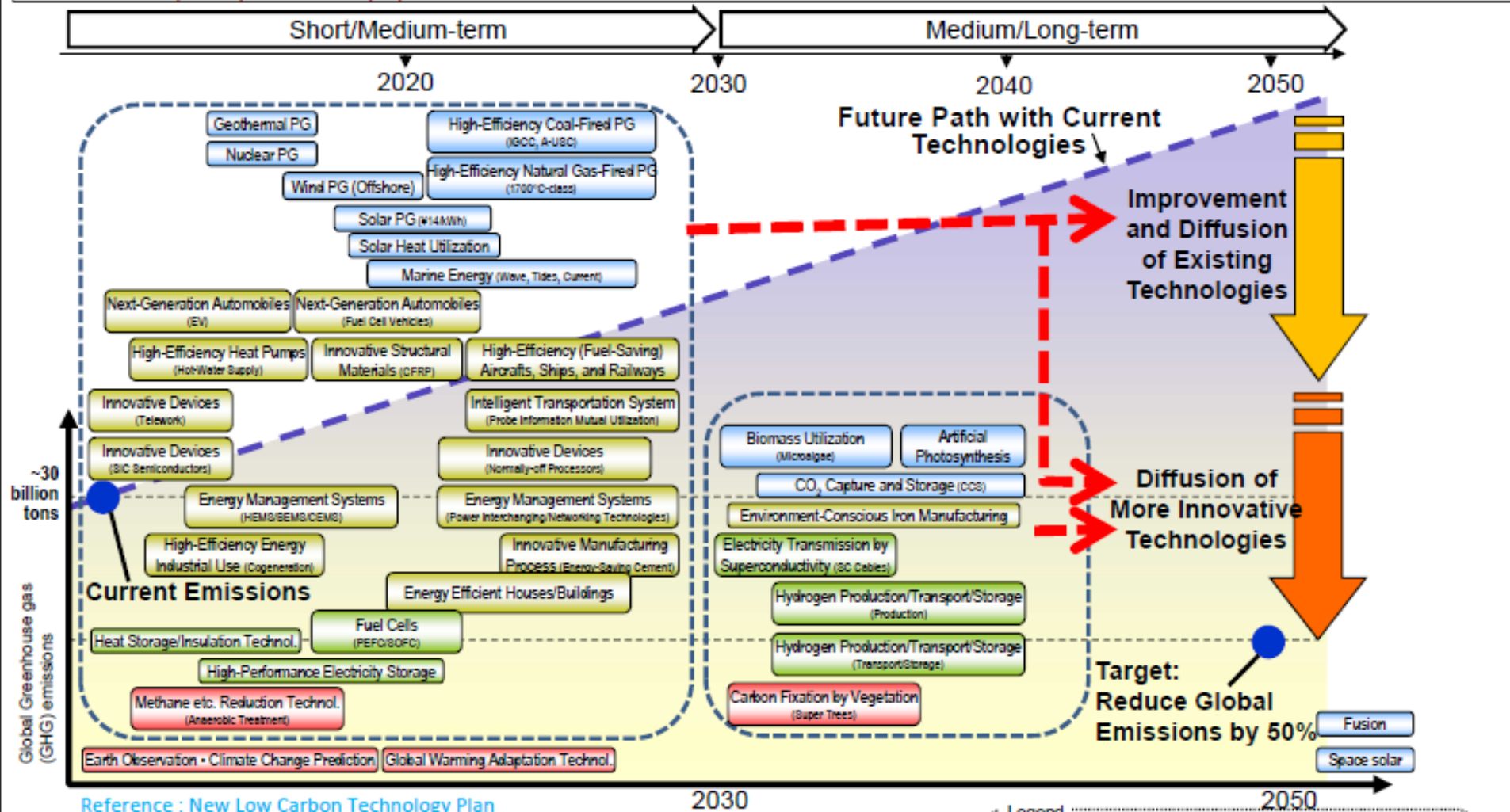
- ◆ China and the United States represent more than 40% of world total GHG emissions.
- ◆ As for upcoming emissions, the share from emerging countries is expected to grow.



IEA「CO2 emissions from fuel combustion」World Energy Outlook (2013 Edition)

Global Contribution of Japan's Environmental and Energy Technologies

- Japan will continue to develop advanced environmental and energy technologies in the short/medium-term to medium/long-term, and will contribute to halving global greenhouse gas emissions by 2050 through global diffusion of such technologies.
- Steadily implement the revised Low Carbon Technology Plan as well as globally cooperate to develop and diffuse the technologies to cover approximately 80% of the reduction needed to halve global GHG emissions by 2050.
- Aim to invest USD110 billion of both public and private finance over five years on the premise of achieving national and regional primary balance surplus by Fiscal Year (FY) 2020.



¹ The horizontal position of environmental and energy technologies indicates approximate time of practical diffusion based on the roadmap of each technology.

² "Future path with current technologies" indicates approximate transition of global GHG emissions assuming no change in efficiencies for existing technologies (e.g., generating efficiency of coal-fired generation)

³ The downward arrows for "Improvement and diffusion of existing technologies" and "Diffusion of innovative technologies" indicate both contributions are required to reduce global GHG emissions; they do not specify the amount of reduction by each contribution.

Legend

Production • Supply	Consumption • Demand
Distribution • S/D Integration	Other Technologies

¹ Center of bars indicates approximate time of practical diffusion.

² Parentheses show technology examples. Refer to the full text for details.

Commitment to a Low Carbon Society

- In December 2009, Keidanren determined the basic principles for the Commitment to a Low Carbon Society, which would succeed the Voluntary Action Plan. Embracing 36 industries which had already formulated action plans, the Keidanren Commitment to a Low Carbon Society was announced in January 2013.
- The Commitment to a Low Carbon Society not only comprises emission reduction targets for domestic corporate activities but also contributions to reductions in other sectors through the diffusion of low-carbon products and international contribution through technology transfer.
- The Commitment to a Low Carbon Society covers 80% of CO2 emissions from the industrial and energy conversion sectors, amounting to a ratio comparable to coverage by the Voluntary Action Plan, excluding the Federation of Electric Power Companies of Japan (FEPC), which is currently unable to set targets based on projections of a future energy mix

	Voluntary Action Plan on the Environment (-fiscal 2012)	Commitment to a Low Carbon Society (-fiscal 2020)
Participant industries	114 industries	90 industries *as of end of June 2014. Urging of non-participant industries to formulate plans to be continued.
Coverage ratio * Based on actual CO2 emissions of energy origin in fiscal 2012	50% of total emissions in Japan 80% of emissions from industrial and energy conversion sectors	50% of total emission in Japan 80% of emissions from industrial and energy conversion sectors
Substance of plans	Industry-specific emission reduction targets (average of fiscal 2008-2012 levels)	[Commitment] 1) Industry-specific emission reduction targets (as of 2020) + [Reduction potential] 2) Development and diffusion of low-carbon products (contribution to emission reductions in transport and business/commercial sectors) 3) International contribution through technology transfer, etc. (transfer of energy-saving technologies and know-how to developing countries by utilizing bilateral offset mechanisms, etc.) 4) Development of innovative technologies (commercialization in 2030-2050)

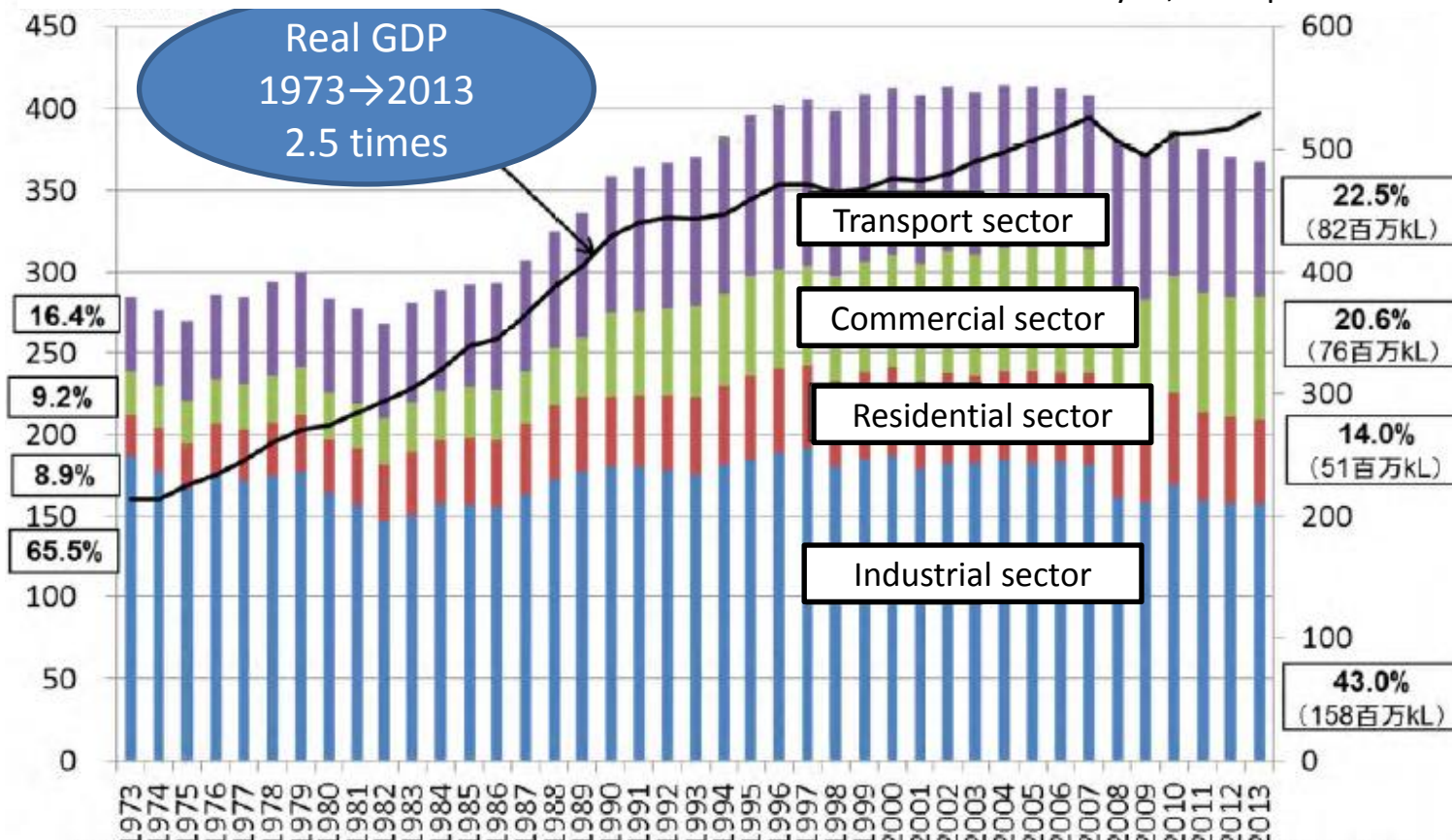
Current status of energy consumption in Japan

- Since oil crisis, GDP increased to 2.5 times, but energy consumption in industrial sector decreased by about 20%. Energy consumption in private sector largely increased (2.9 times in commercial sector, 2.0 times in residential sector)
- Energy consumption in industrial sector still accounts for 40% of the whole.

Petroleum equivalent in million tons

Trillion yen, 2005 price

Real GDP
1973→2013
2.5 times



Final energy consumption	
1973→2013	2012→2013
1.3 times	▲0.9%
1.8 times	▲3.7%
2.9 times	+1.9%
2.0 times	▲3.0%
0.8 times	+0.1%

(注)部門別最終エネルギー消費のうち、業務部門及び産業部門の一部(非製造業、食品製造業、他業種・中小製造業)については、産業連関表(2005年実績が最新)及び国民経済計算等から推計した推計値を用いており、統計の技術的な要因から、業務部門における震災以降の短期的な消費の減少は十分に反映されていない。

【出所】総合エネルギー統計、国民経済計算年報、EDMCエネルギー・経済統計要覧。

Summary of Energy Conservation Law

Manufacturing plants & business locations

Obligation for business operators to make an effort and public disclosure of judgment standards

○ Specified business operators and specified chain business operators

(Energy consumption of 1,500kl per year)

- Obligation to appoint Energy Managers, etc.
- Obligation to periodically report on energy consumption status.
- Obligation to submit medium and long term plans.

Transportation

Obligation for business operators to make an effort and public disclosure of judgment standards

○ Specified carriers (freight and passengers)

(Fleet of vehicles: At least 200 trucks or at least 300 railway cars for railroads, etc.)

- Obligation to submit medium and long term plans.
- Obligation to periodically report energy consumption status.

○ Specified consigners

(Annual transport volume of at least 30 million ton-km.)

- Obligation to submit plans.
- Obligation to periodically report consumption of energy related to consigned transportation.

Residential buildings and structures

Obligation for construction clients and owners to make an effort and public disclosure of judgment standards

○ Specified buildings

(Total floor area of at least 300m².)

- Obligations relating to the submission of notifications pertaining to energy conserving measures implemented by construction clients in relation to large scale modifications and obligations relating to reporting the status of overall maintenance.

○ Housing providers

(Annual supply of at least 150 units.)

- Obligation to observe targets for improving energy conservation performance of supplied ready built residential housing.

Provisions relating to machinery and equipment

Obligation for manufacturers and import business operators of energy consuming equipment to make an effort

Top Runner Standards (23 units)

- Standards for energy conservation of passenger cars, air conditioners, television sets, etc. To exceed the performance of most superior products that have been commercialized at the present time is required of each type of unit.

Provision of information

Obligation to make effort in providing information to general consumers

- Provision of information on energy conservation (annual electric power consumption, fuel economy, etc.) that is easy to understand at storefronts of retailers who sell household electrical appliances, etc.
- Popularization of energy conserving equipment and the provision of information, etc., by electric power and gas companies.

Overall Image for Energy Conservation Policies of Japan

Industrial sector

Consumer sector Commercial sector Household sector

Transportation sector

Regulatory measures

(Energy Conservation Law)

Business operators (energy consumption of at least 1,500kl): Energy conservation measures (periodical reports) and reduction efforts of 1% per year.

Residential buildings and structures (at least 300m²): Observation of Energy Conservation Standards at the time of construction (submission of notification).

Cargo owners and carriers (of specific minimum size): Energy conservation measures (periodical reports), etc.

Automobiles and household electrical appliances: Regulation by Top Runner Program, etc.

Household electrical appliances: Display of energy conservation performance, etc.

Support measures

(Budget and tax system, etc.)

Provision of subsidies and supplement of interests, etc., for implementation of energy conserving facilities.

Residential Eco Points, etc.

Provision of subsidies for implementation of Clean Energy cars, etc.

Tax system (accelerated depreciation) for implementation of energy conserving facilities or construction of energy conserving buildings.

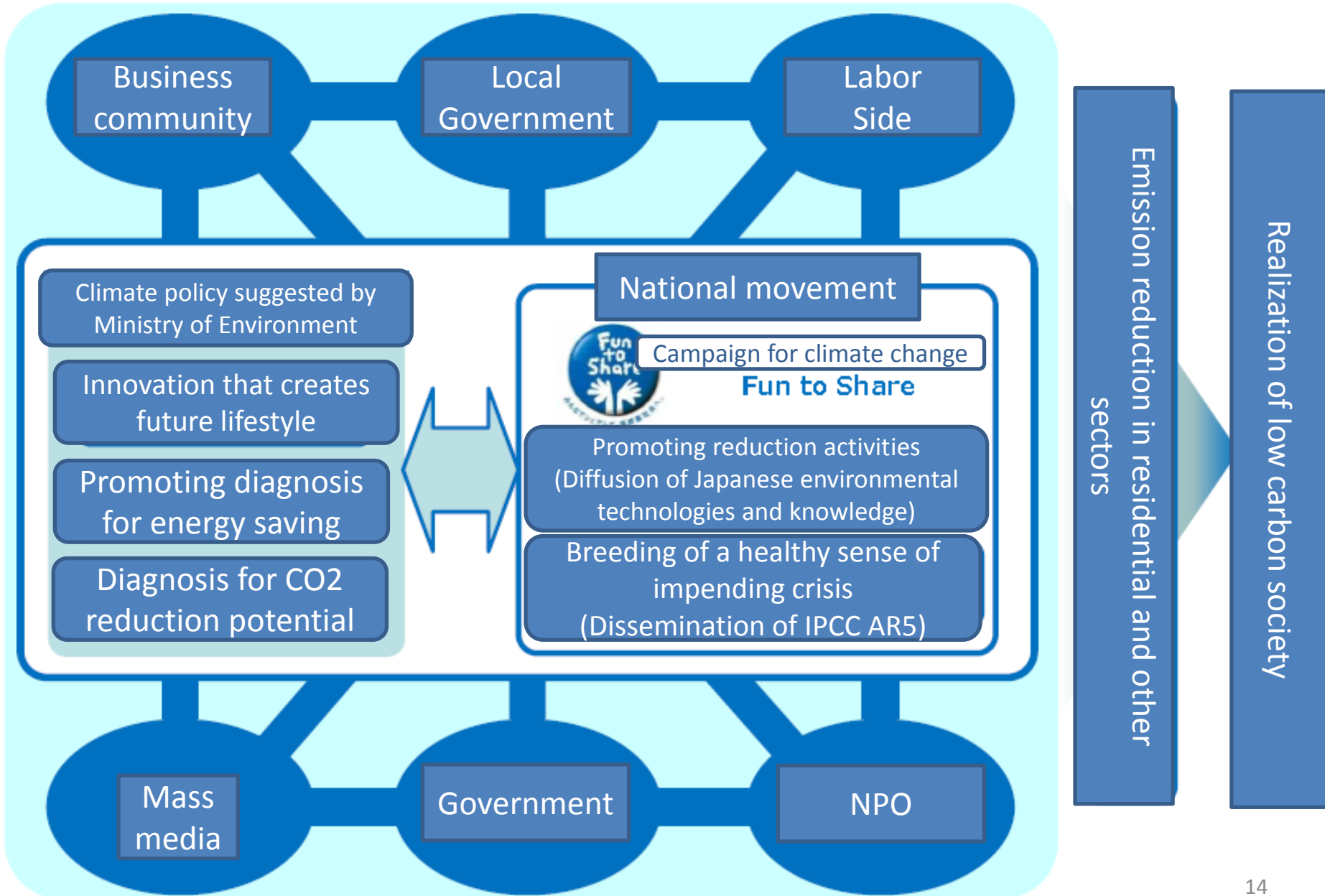
Residential renovation tax reductions, etc.

Eco Car tax reductions, etc.

Provision of subsidies for development of energy conserving technologies (high performance heat pumps, high performance thermal insulation materials, etc.)

Provision of information and promotion of nationwide activities (such as forum activities) intended to improve energy conservation awareness, etc.

National movement for measures in residential and other sectors



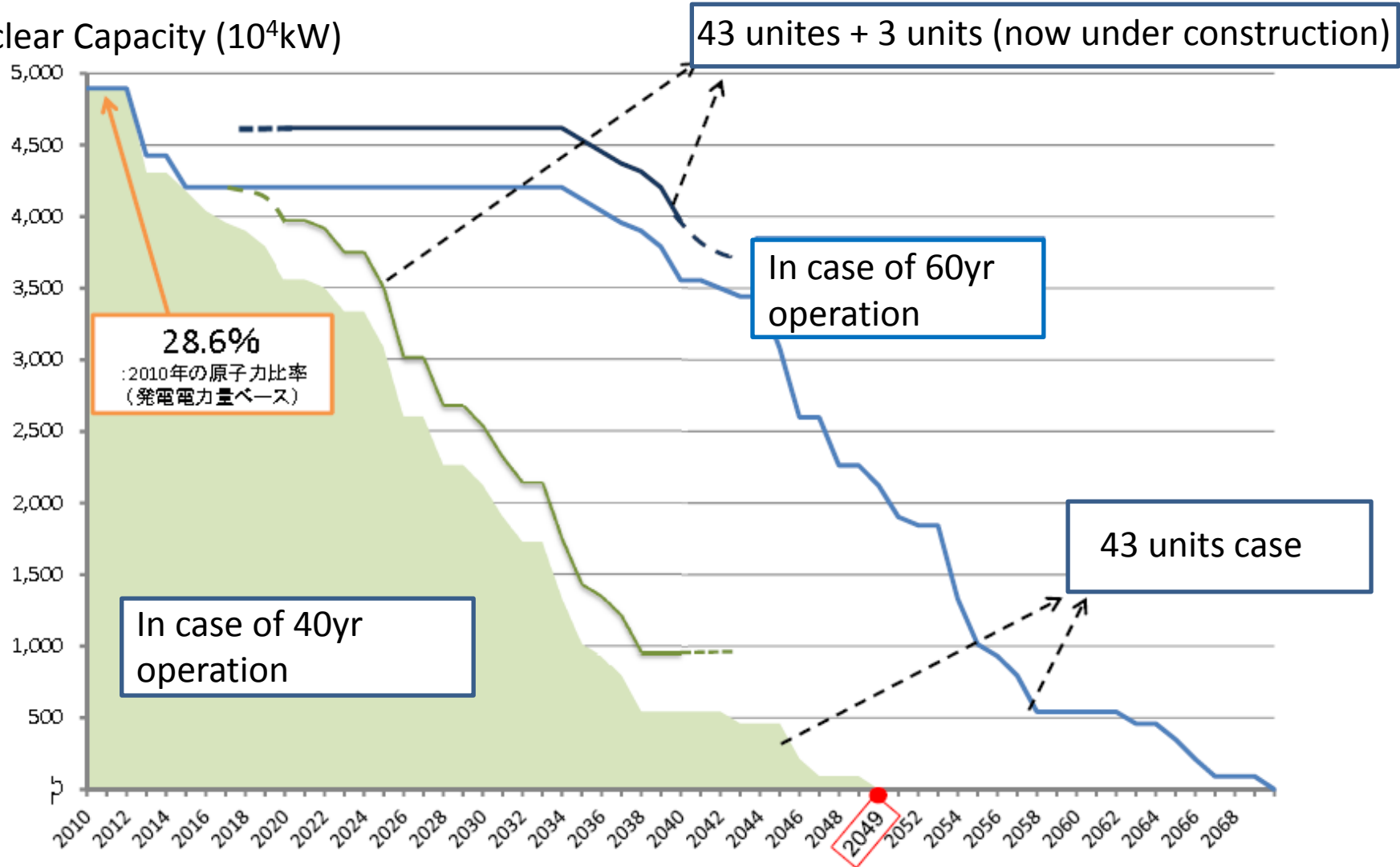
Status of nuclear power in current basic energy plan

1. An important base-load power source, contributing to stability of energy supply-demand structure, on the major premise of ensuring its safety
 2. In case that the conformity of nuclear power plants with the new regulatory requirements are confirmed, the judgment should be respected and the restart of the nuclear power plants will be proceeded.
 3. Dependency on nuclear power generation will be lowered to the extent possible. Under this policy, a volume of electricity to be secured should be examined.
- Development of institutions for decommissioning of reactor
 - Maintaining nuclear power under competitive environment
 - Cycle back-end problem
 - Technology, securing human resources
 - Building relations of trust with the public and local authorities
 - Contribution to peaceful use of nuclear power and non-proliferation worldwide

40年運転制限

- 現存する全ての原子炉が40年で運転終了するとすれば、2031年に設備容量が現在の半分、2038年に現在の2割を切り、2064年にはゼロとなる。

Nuclear Capacity (10⁴kW)



The status of renewable energy in current basic energy plan(1)

Chapter 2. Basic policy regarding measures concerning energy supply and demand

Section 2. Position of each energy source and policy timeframe

1. Renewable energy

It has various challenges in terms of stable supply and cost at this moment, but it is a promising, multi-characteristic and important energy source which can contribute to energy security as it can be domestically produced free of GHGs.

Chapter 3. Long-term measures regarding energy supply and demand in a comprehensive and systematic manner

Section 3. Accelerating the introduction of renewable energy: Toward achieving grid parity over the mid-to long-term

- The introduction of renewable energy should be accelerated as much as possible for three years since 2013 has been followed by continuous active promotion.
- “ Related Ministers’ Cabinet Meeting on renewable energy ” is established and cooperation among related ministries is promoted.
- The higher levels of introducing renewable energy than the levels which were indicated based on the former Strategic Energy Plans are pursued and it is taken into account when energy mix is considered.
- Appropriate management of the feed-in-tariff system and deregulation measures such as reducing the period of the environmental assessment will be promoted. Diligent efforts will be made to develop technologies for cost reduction and efficiency improvement, conduct development and demonstration projects for large storage batteries and build power grids.

1. Strengthening measures to accelerate the introduction of wind and geothermal power

[Wind] Acceleration of environmental impact assessment, operation of local transmission and interconnection lines, development of large storage batteries, technology development to achieve low costs

[Geothermal] Lowering risk of investment, acceleration of environmental impact assessment, sustainable development

The status of renewable energy in current basic energy plan(2)

Chapter 3. Long-term measures regarding energy supply and demand in a comprehensive and systematic manner

Section 3. Accelerating the introduction of renewable energy: Toward achieving grid parity over the mid-to long-term

2. Promotion of use of renewable energy in distributed energy systems

[Woody biomass etc.] Stable and efficient supply of unused materials promote generation and use of heat by woody biomass.

[Medium/small hydropower] A registration system has become simpler and easier to apply for river rights, which expands introduction of medium/small hydropower.

[Solar power] The popularization of photovoltaic generation proceeds in regions such as idle lands, roofs of schools and factories.

【Renewable heat】 Support will be provided for the introduction of heat supply facilities that use renewable energy-derived heat.

3. Feed-in-tariff system

- It is important to continue operating the program in a stable and appropriate manner so as to reduce risks involved in the program.
- The systems for promoting the use of renewable energy sources must be studied on the axis of developing policy combination which can balance both promotion of maximum use of renewable energy and mitigating people's burden.

4. Establishing Fukushima as a center of the renewable energy industry

- Demonstration research project regarding a large floating offshore wind power generation, et.

FiT for renewable energies (except large-scale hydropower)

- From July 2012 to March 2013, 895.4 万kW were installed and 6 864万kW approved for installation
- Currently, the main issue is to provide detailed information about the planned installation in order to get the certification

March 2014: installed and planned installation of renewable energies capacities

Capacity installation (now in operation)			
Types of renewable energies	Before FiT introduction	After FiT introduction	
	Until June 2012	July 2012 – March 2013	From April 2013
Solar PV (residential)	4,7 GW	969 MW	1,3 GW
Solar PV (non-residential)	0,9 GW	704 MW	5,73 MW
Wind power	2,6 GW	63 MW	47 MW
Small & medium hydro	9,6 GW	2 MW	4 MW
Biomass	2,3 GW	30 MW	92 MW
Geothermy	0,5 GW	1 MW	0 MW
Total	20,6 GW	1,78GW	7,8 GW
		8,9 GW (6 1 9,7 0 1 件)	

Forecasted capacity
After FiT introduction
From July 2012 to March 2014
2,68 GW
63 GW
10,4 GW
298 MW
15,6 GW
14 MW
68,6 MW (1,199,482件)
19

最新データ(固定価格買取制度 情報公開用ウェブサイト)

■平成26年11月末時点の状況(平成27年2月23日更新)

	(1)導入容量 (万kW)		(2)買取電力量 (万kWh)		(3)買取金額 (億円)(※3)		(4)認定容量 (万kW)
	新規認定分 (※1)	移行認定分 (※2)	平成26年 11月分	制度開始から の累計	平成26年 11月分	制度開始から の累計	新規認定分 (※1)
太陽光 (住宅) (※4)	280 ----- +8	468	45,654 ----- -6,948	1,151,309	196 ----- -30	5,068	334 ----- +8
太陽光 (非住宅)	1,176 ----- +71	26	106,686 ----- -10,299	1,326,030	443 ----- -44	5,531	6,688 ----- +122
風力	22 ----- +2	253	41,288 ----- +2,281	1,019,503	91 ----- +5	2,195	143 ----- +8
中小水力	3 ----- +0	21	8,367 ----- +789	181,767	22 ----- +2	467	34 ----- +1
地熱	0 ----- +0	0	11 ----- -2	873	0 ----- +0	4	1 ----- +0
バイオマス (※5)	12 ----- +1	113	29,210 ----- +2,386	570,556	61 ----- +7	1,095	148 ----- +11
合計	1,493 ----- +82	881	231,215 ----- -11,794	4,250,038	813 ----- -60	14,360	7,349 ----- +150

Comparison of the installed capacity level and certification status in the Basic Energy Plan

- The tables below show the level of installed capacity by renewable source and delivered certification since the launching of the Basic Energy Plan
- Regarding the projects that did not get the certification or were abandoned, it is mostly likely that they could not proceed with the installation due to interconnections issues.

発電電力量(億kWh) ※括弧内は発電電力に占める割合	2013 (現在)	2020 (長期エネルギー見 通し(再計算))	2030 (2030年のエネル ギー供給の姿) (A)	認定済案件が運転開 始した場合 (2014年5月末時点) (B)	2030(2030年のエ ネルギー供給の 姿)との比較 (B/A)
Solar	92 (1.0%)	308 (2.9%)	572 (5.6%)	840 (8.2%)	147%
Wind	49 (0.5%)	88 (0.8%)	176 (1.7%)	65 (0.6%)	37%
Geothermy	26 (0.3%)	34 (0.3%)	103 (1.0%)	37 (0.4%)	36%
Hydropower	800 (8.5%)	805 (7.7%)	1,073 (10.5%)	822 (8.1%)	77%
Biomass	37 (0.4%)	179 (1.7%)	217 (2.1%)	254 (2.5%)	117%
Total	1,004 (10.7%)	1,414 (13.5%)	2,140 (21.0%)	2,018 (19.5%)	94%

※2013年における発電電力量については自家消費分は含まない。

設備容量(万kW)	2013 (現在)	2020 (長期エネルギー見 通し(再計算))	2030 (2030年のエネル ギー供給の姿)	認定済案件が運転開 始した場合 (2014年5月末時点)
Solar	1,432	2,800	5,300	7,431
Wind	271	500	1,000	372
Geothermy	52	53	165	53
Hydropower	4,745	4,925	5,560	4,777
Biomass	—	—	—	363
Total	6,500	8,278	12,025	12,995

※バイオマス・廃棄物は設備容量の試算が困難であったため、設備容量を想定していない。

Policy positioning for Feed-in-tariff system (FIT)

- Purchase at a price which is higher than a value of electricity generated and promote investment
- Drastic medicine: High impact on promotion, but high adverse effects
- Consumers bear the thin burden as levy.
(There are no large opposition forces.)
- Control of the quantity of introduction does not work
- If it is purchased at the equal price irrespective of the type of renewable energy, it theoretically equals to RPS.
(It is the same relationship between carbon price (equivalent to FIT) and emission trading scheme (equivalent to RPS).)

Challenges for promoting a diffusion of renewable energy

▪ Large-scale introduction and electric power system stabilization

- Maintenance and wide area use of transmission and distribution networks
 - Output adjustment by heat and the dam-style hydro power → Securing of capacity
 - Purchase after the electric power system reform → Retail business?, Power transmission and distribution business?, Whole sale market?
 - Utilization of battery and demand response
 - Output restraint of the naturally fluctuating electric power supply
- } → Smart grid

▪ Easing of regulations

- Acceleration of the Environmental Impact Assessment
- Relaxation of the land use limitation
- Standards for facilities and security, disclosure of the electric power system information

▪ Adequacy of the nation burden

- Upper limitation of the annual/accumulated introduction quantity of the naturally fluctuating electric power supply
- Upper limitation of the annual nation burden, etc.

▪ Promotion of effective diffusion

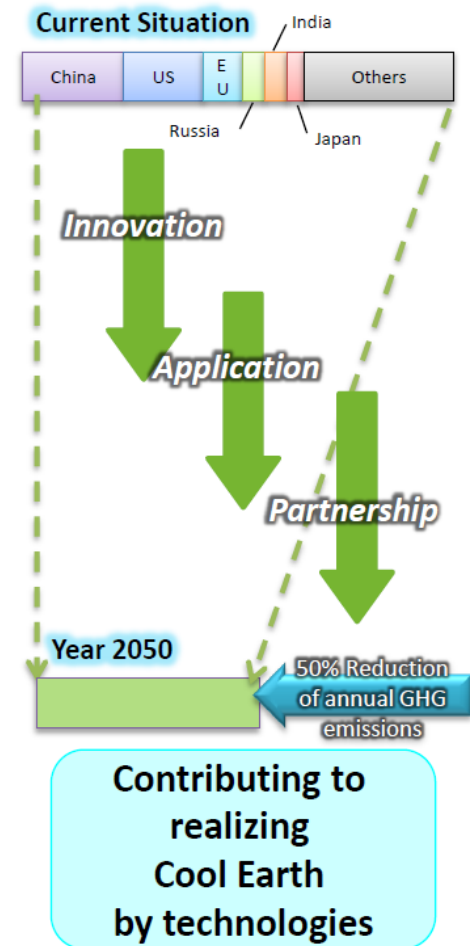
- Portfolio for renewable energy
- Autonomous diffusion under competitive environment, incentives for innovation, . . .

ACE: Actions for Cool Earth

Japan's Diplomatic Strategy for Countering Global Warming

Basic Concept

- Warming of the climate system is unequivocal. (IPCC Fifth Assessment Report)
- Concrete actions are needed for:
 - **50% reduction of global GHG emissions**
 - **80% reduction for developed countries by 2050**
- Actions for “Cool Earth” are:
 - Innovation of Low Carbon Technologies
 - Application of existing technologies
 - Partnership with various stakeholders
- Overcoming the aftermath of the Great East Japan Earthquake and the nuclear accident.



Thank you for your attention.

公益財団法人 地球環境産業技術研究機構

Research Institute of Innovative Technology for the Earth