CIGS China-Japan Expert Meeting on Climate Change

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Mid- and Long-term Emission Reduction Targets and the Realizing Scenarios in Japan

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Introduction

- Deep reductions of global greenhouse emissions are required.
- Japanese government is now developing the emission reduction target for 2030 (or 2025) (“intended nationally determined contribution”).
- The outlooks of energy and CO2 emissions developed by four major research institutes (i.e., CIGS, IEEJ, NIES, RITE) are compared.

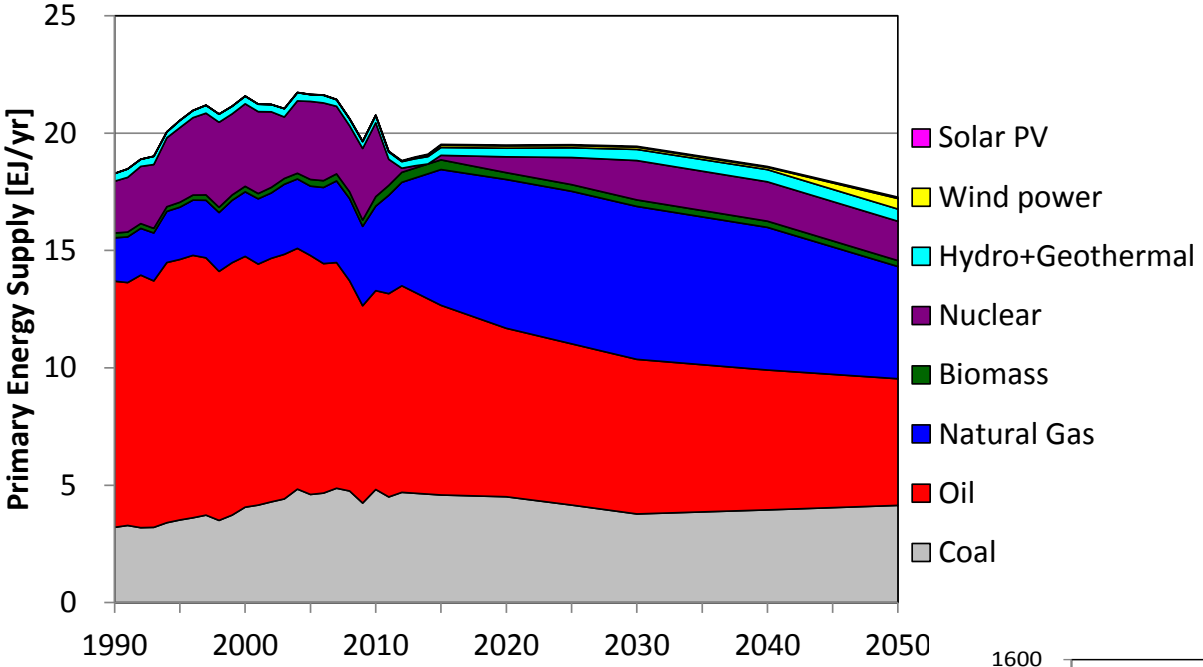
Major Assumptions of the RITE Model (DNE21+)

For Japan

	2010	2020	2030
Population (million)	127	124	118
Real GDP (billion US$/yr in 2000 price)	5065	5981 (+1.7%/yr between 2010 and 2020)	6791 (+1.3%/yr between 2020 and 2030)
Electricity in Baseline* (TWh/yr)	1108.7	1205.1	1284.4

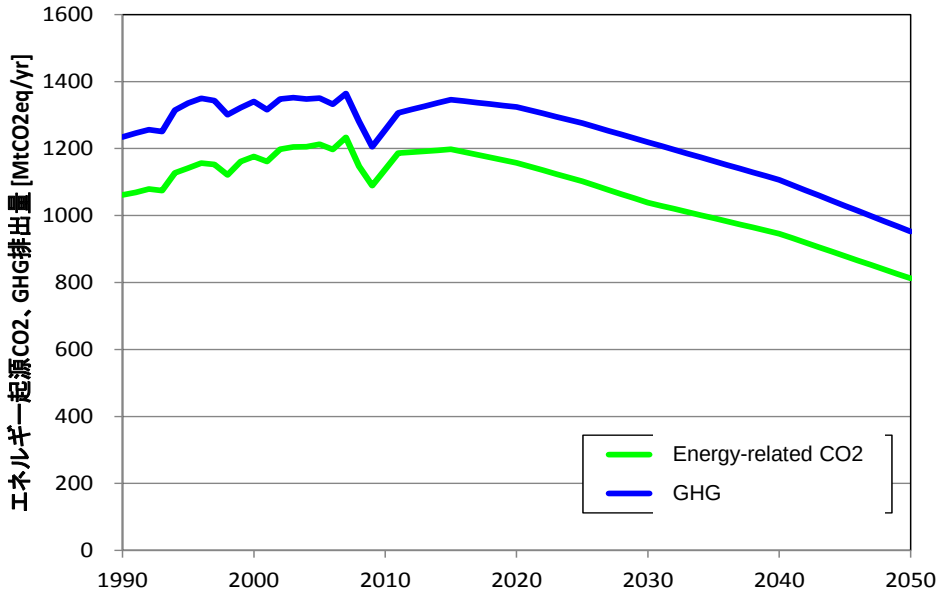
* The electricity is estimated within the model. But the electricity elasticity of GDP is around 0.5 (the elasticity between 2000 and 2010 was 1.0.).

Primary Energy Supply and CO2 Emissions in Baseline



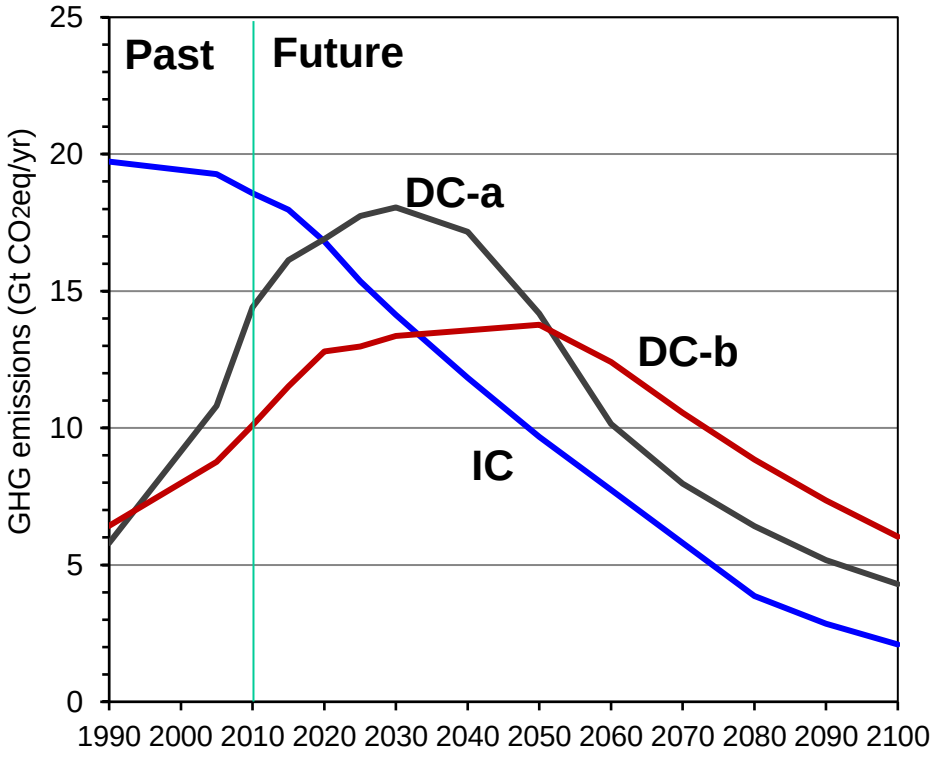
In the case that nuclear power will be about 15% of total electricity by 2030.

Current level of climate policies (e.g. measures below about 60$/tCO2) are considered.

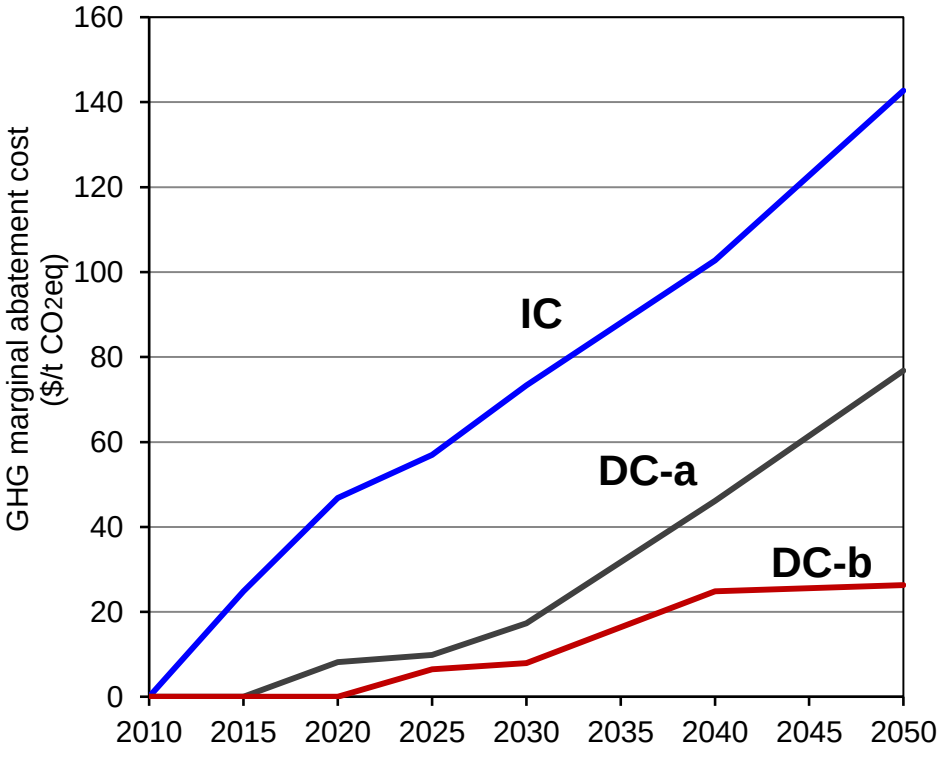


GHG Emission Trajectory and Marginal Abatement Cost for Three Groups (Kaya Proposal)

GHG emissions

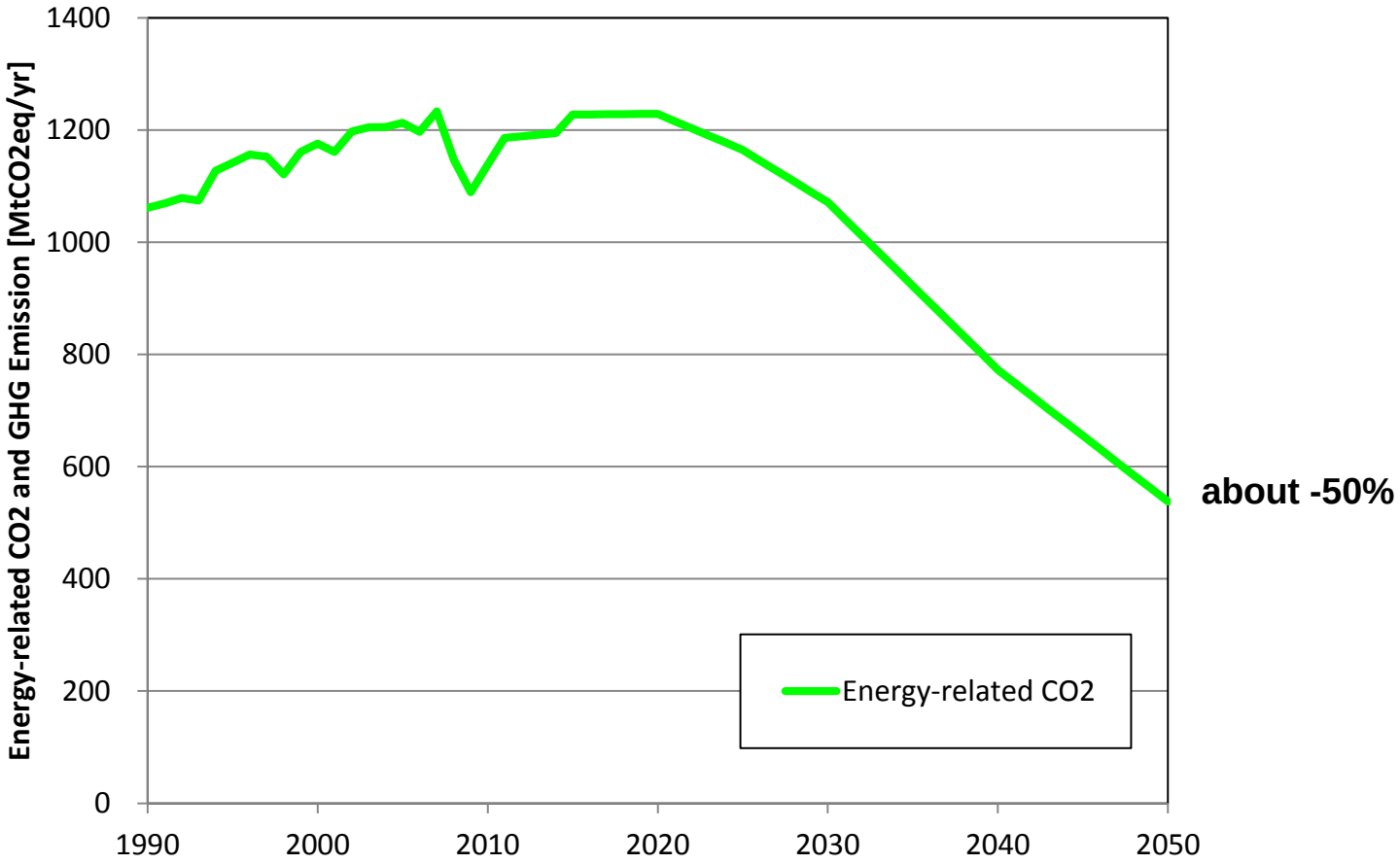


Marginal abatement costs



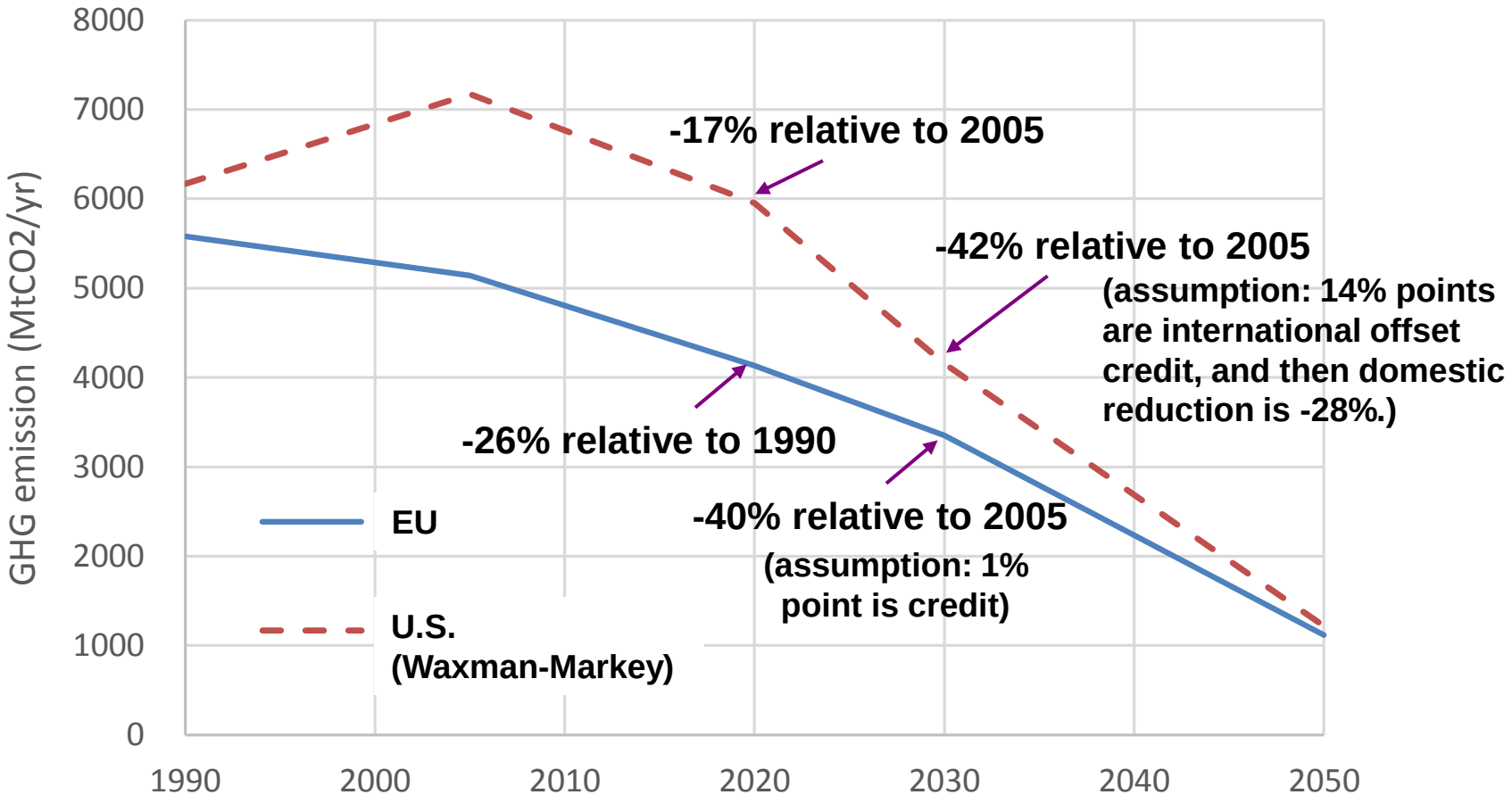
IC: Industrial country (developed country): halving emissions by 2030
DC-a: China, India and Brazil: peaking in 2030
DC-b: Other developing countries: peaking in 2040

Primary Energy Supply and CO2 Emissions in Japan for the Kaya Proposal



Note: In this analysis, large deployments of nuclear power are assumed to be allowed also in Japan.

Assumed Emission Pathways for Estimating the Efforts of Emission Reductions.



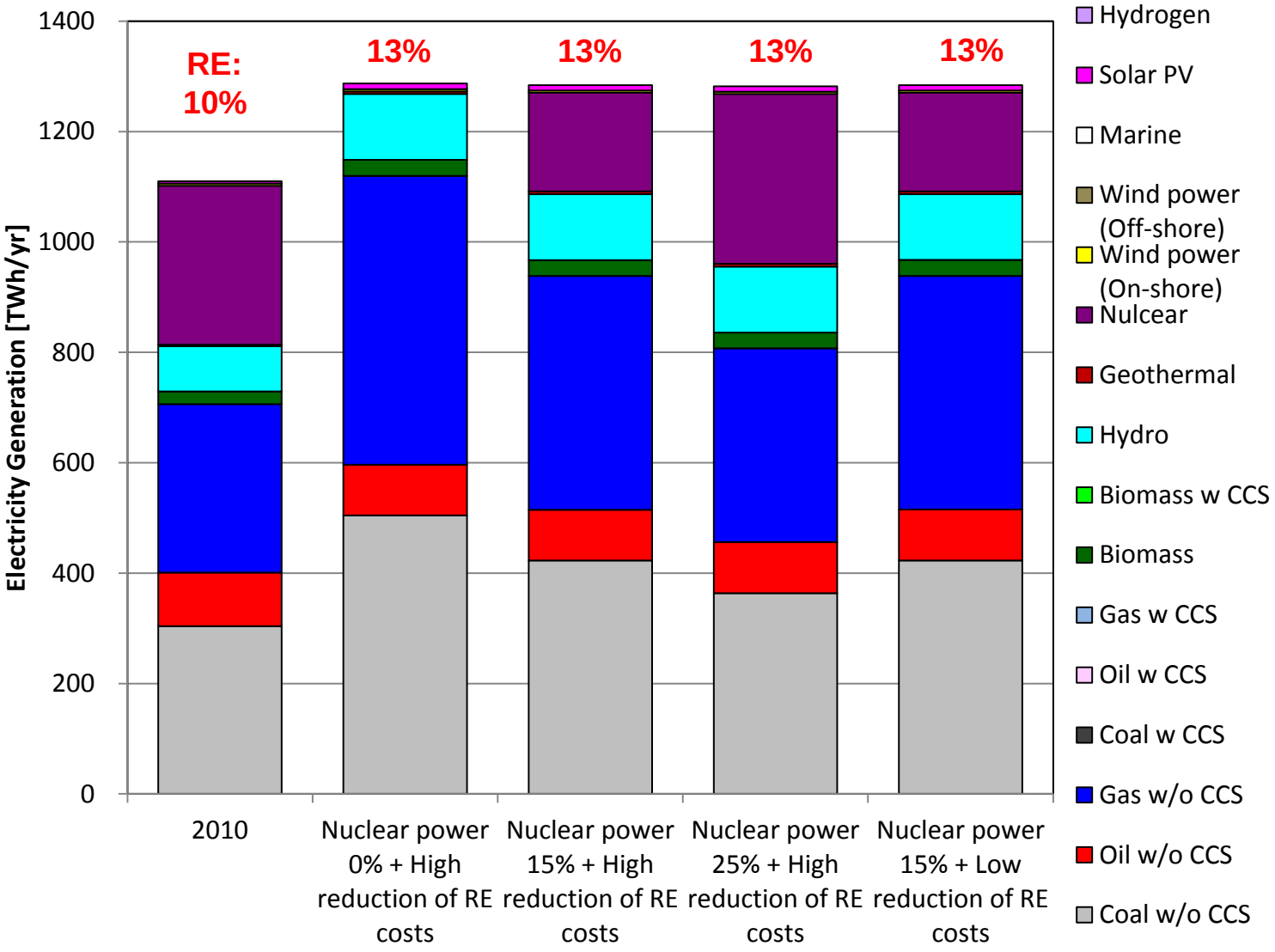
Marginal Abatement Costs of Emission Reduction Targets of EU and U.S. in 2030

	EU27 (-40% relative to 1990)	U.S. (Waxman-Markey) (-42% relative to 2005)
MAC in 2030	**160$/tCO2**	**88$/tCO2**
	(Reference case of -32%: 73$/tCO2)	

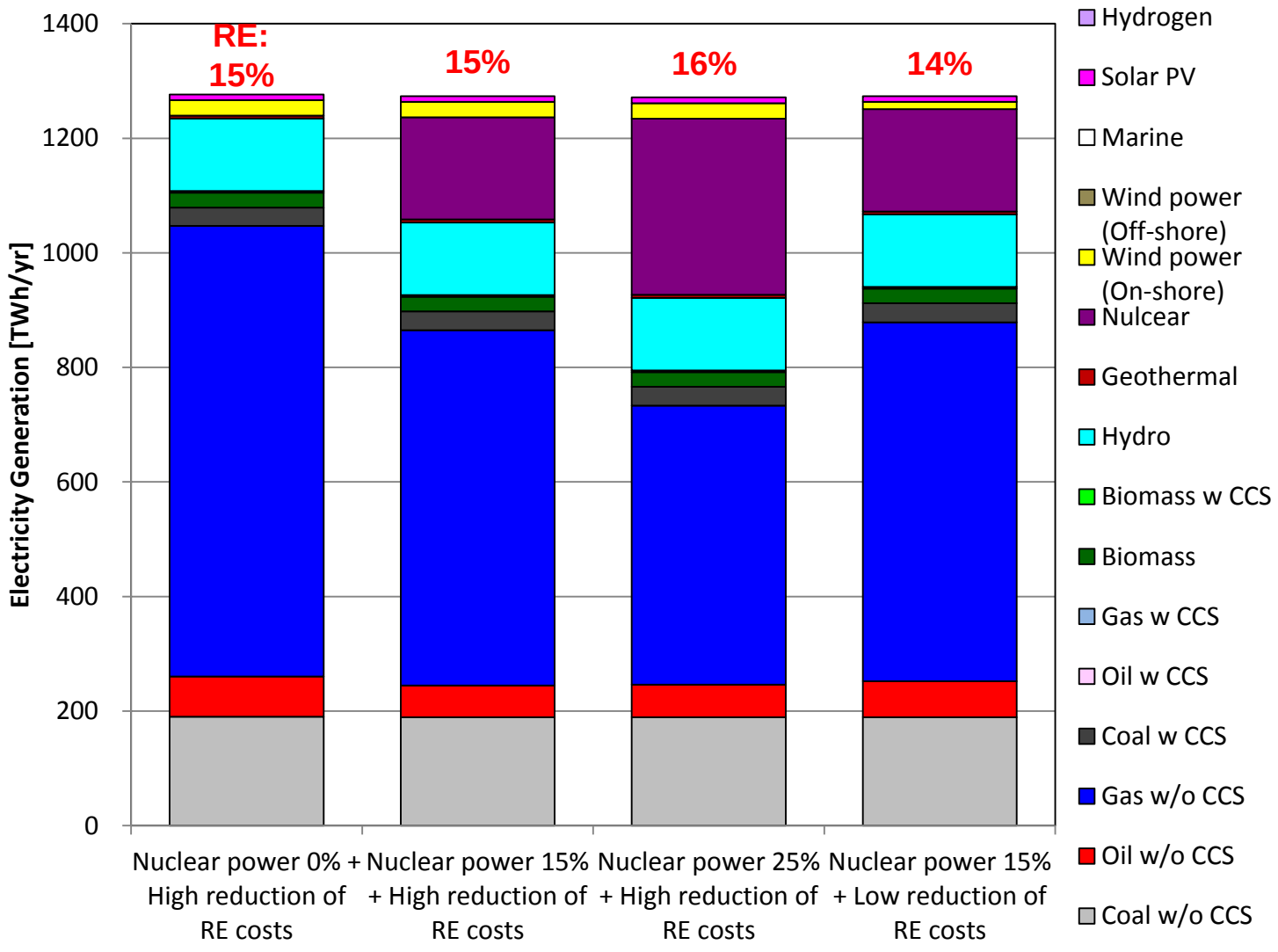
The MACs were estimate by RITE DNE21+ model.

The MAC in 2030 is 73 $/tCO2 for the developed countries of the Kaya proposal. The MACs of EU and U.S. proposals are higher than the estimated MAC for the Kaya proposal, although the reality for the achievement of EU and U.S. proposals.

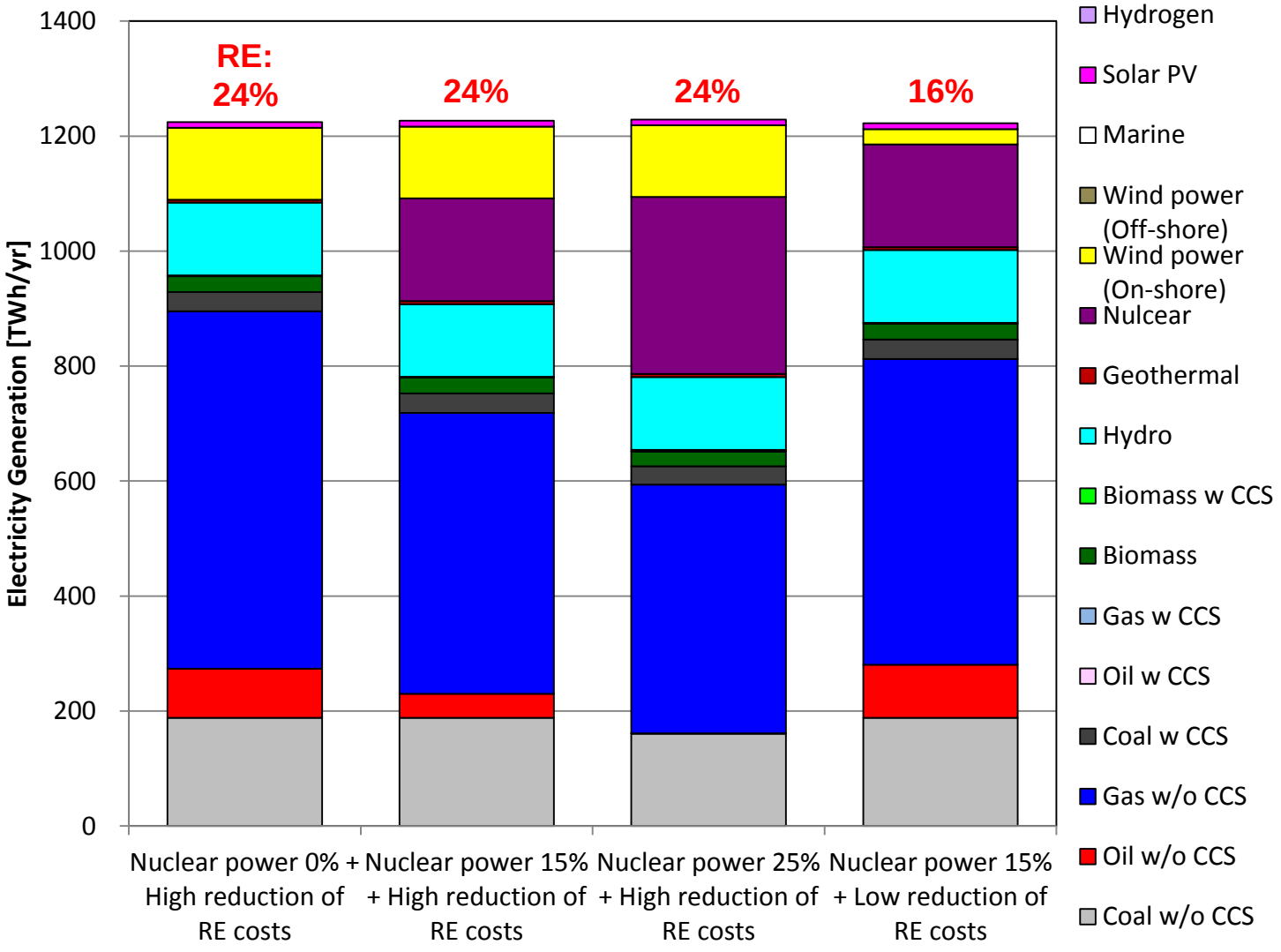
Electricity Supply in 2030 in Baseline



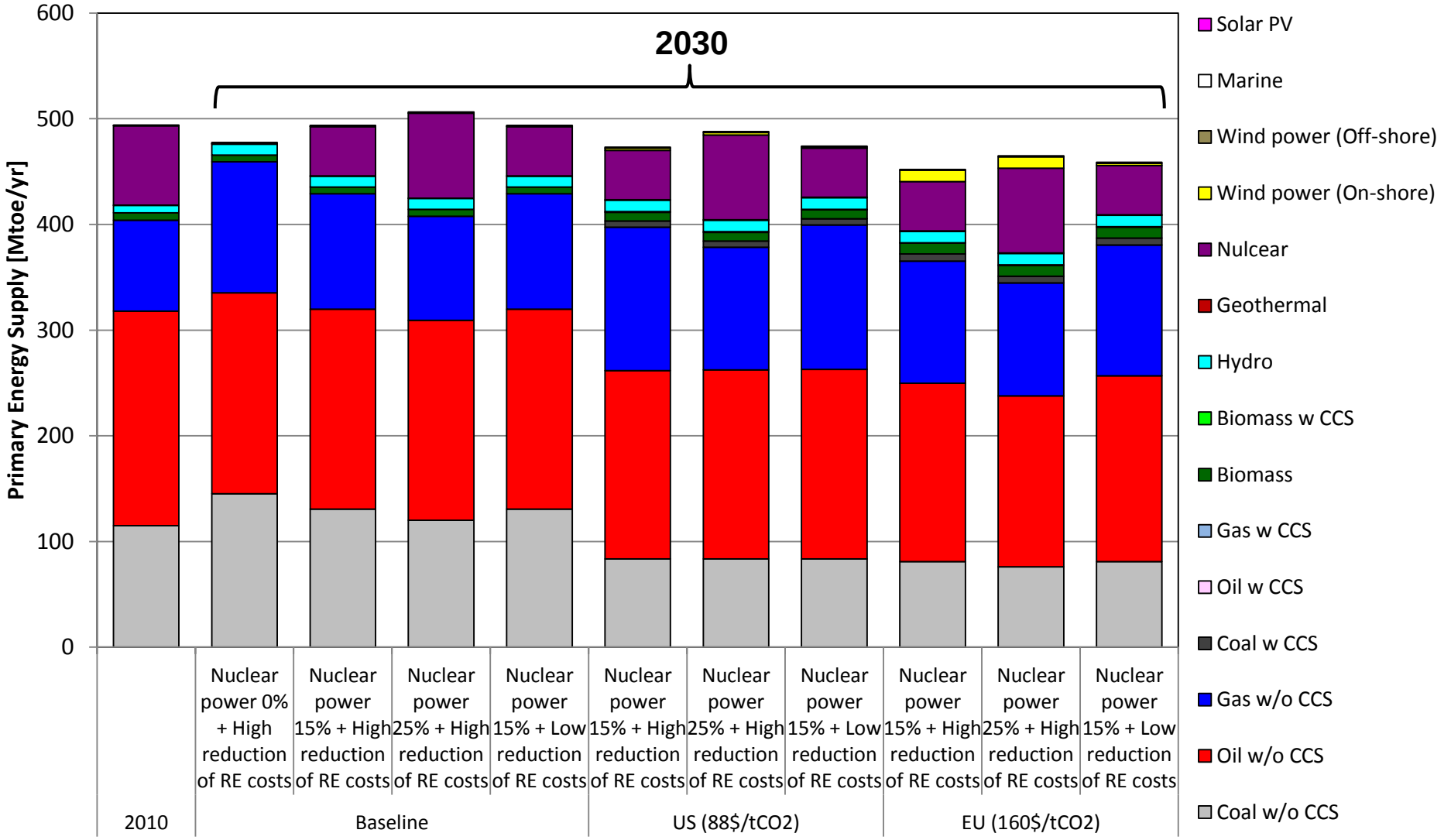
Electricity in 2030 for the MAC Corresponding to the U.S. target



Electricity in 2030 for the MAC Corresponding to the EU target



Primary Energy in 2030 for Baseline and the MACs Corresponding to the U.S. and EU targets



GHG Emission Reductions in 2030 in Japan

Relative to 2005 (parenthesis numbers are relative to 1990)

	Nuclear 0%+ High rate of cost reduction of renewables	Nuclear 15%+ High rate of cost reduction of renewables	Nuclear 25%+ High rate of cost reduction of renewables	Nuclear 15%+ Low rate of cost reduction of renewables
BAU (0$/tCO2)	＋9%（＋17%）	＋2%（＋9%）	▲2%（＋4%）	＋2%（＋9%）
US level (88$/tCO2)	▲7%（▲1%）	▲12%（▲6%）	▲15%（▲10%）	▲12%（▲6%）
EU level (160$/tCO2)	▲13%（▲7%）	▲18%（▲13%）	▲23%（▲18%）	▲15%（▲10%）

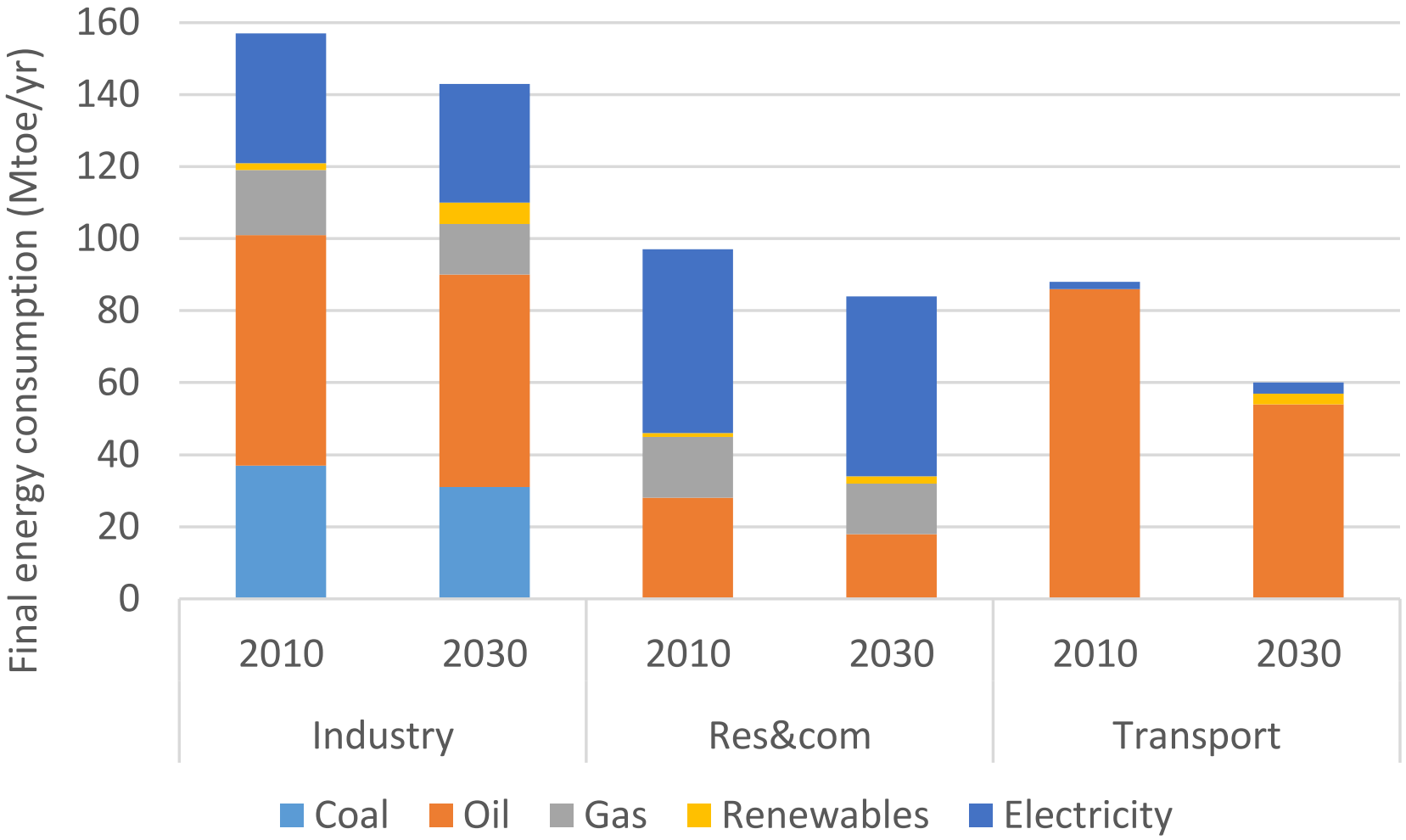
In reality, electricity share of nuclear power will be very challenging to reach 25% in 2030 , and will be around 20% at maximum.
The realistic target of Japan in 2030 will be around 15% reduction relative to 2005 (10% reduction relative to 1990). In this case, nuclear power share will be required to be 15% at minimum.

Primary Energy and CO_2 Emissions in 2030 proposed by CIGS

	Fossil fuel	Renewables	Nuclear	CO2 (MtCO2)
Primary energy				
2010	83%	5%	12%	1,200
2030 proposal by CGIS (-16% relative to 2010)	75%	11%	14%	950 (-21% relative to 2005)
Electricity				
2010	72%	2%	26%	-
2030 proposal by CGIS	56%	20%	24%	-

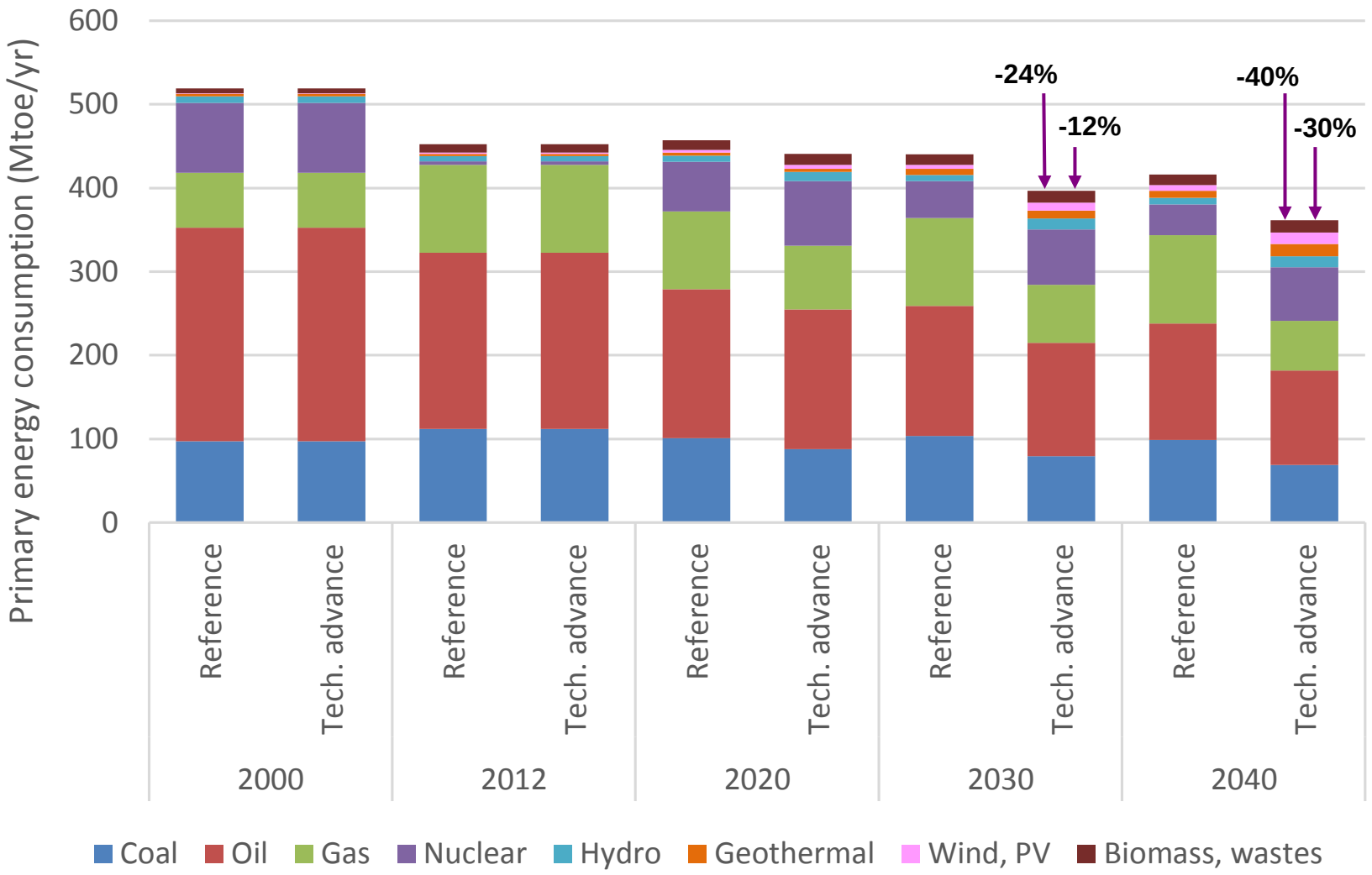
The emission reduction level in 2030 proposed by CGIS are not greatly different from that proposed by RITE.

Final Energy by Sector in 2030 (CIGS Scenario)

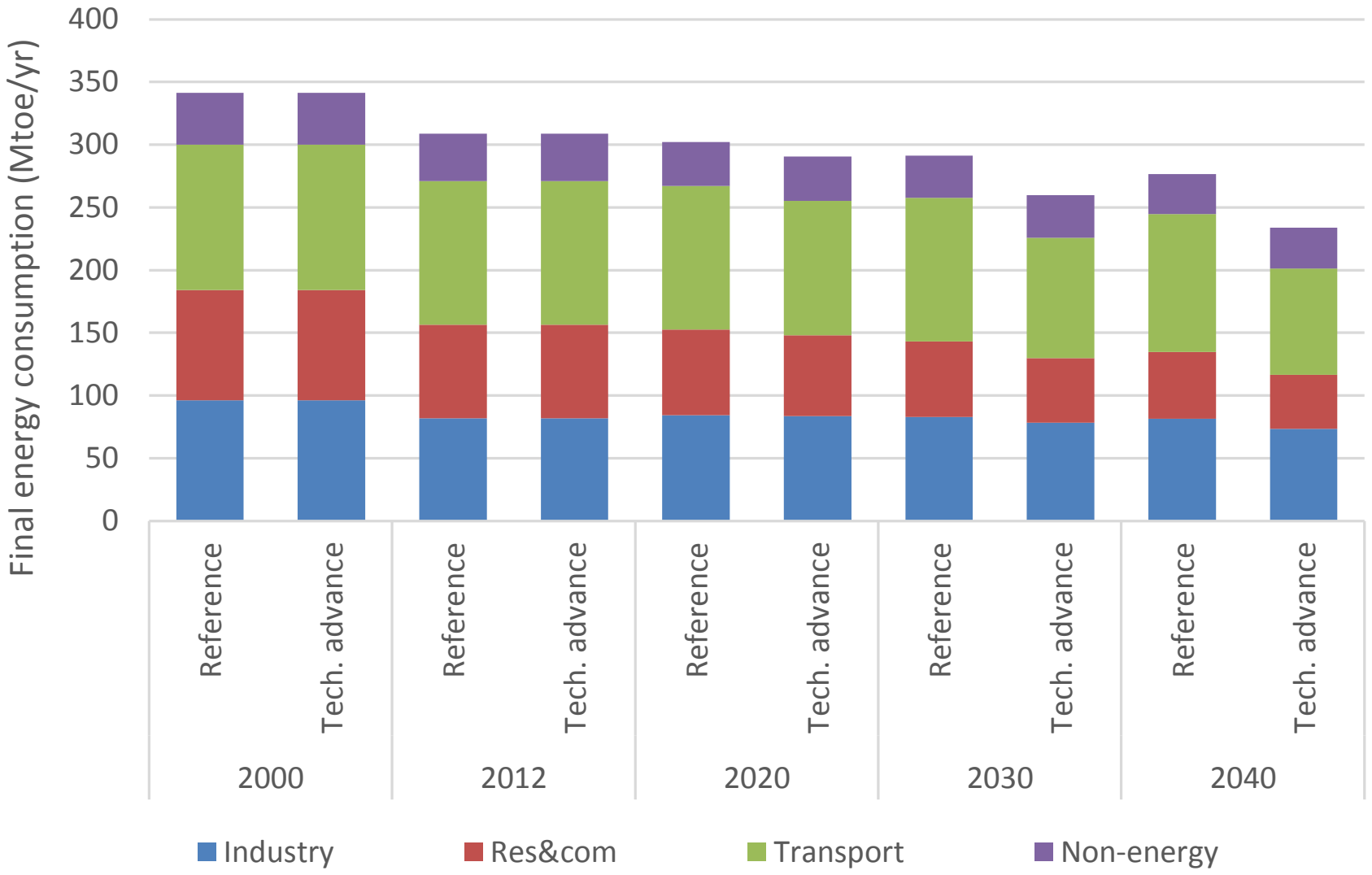


Primary Energy by Sector in 2030 (IEEJ Scenario)

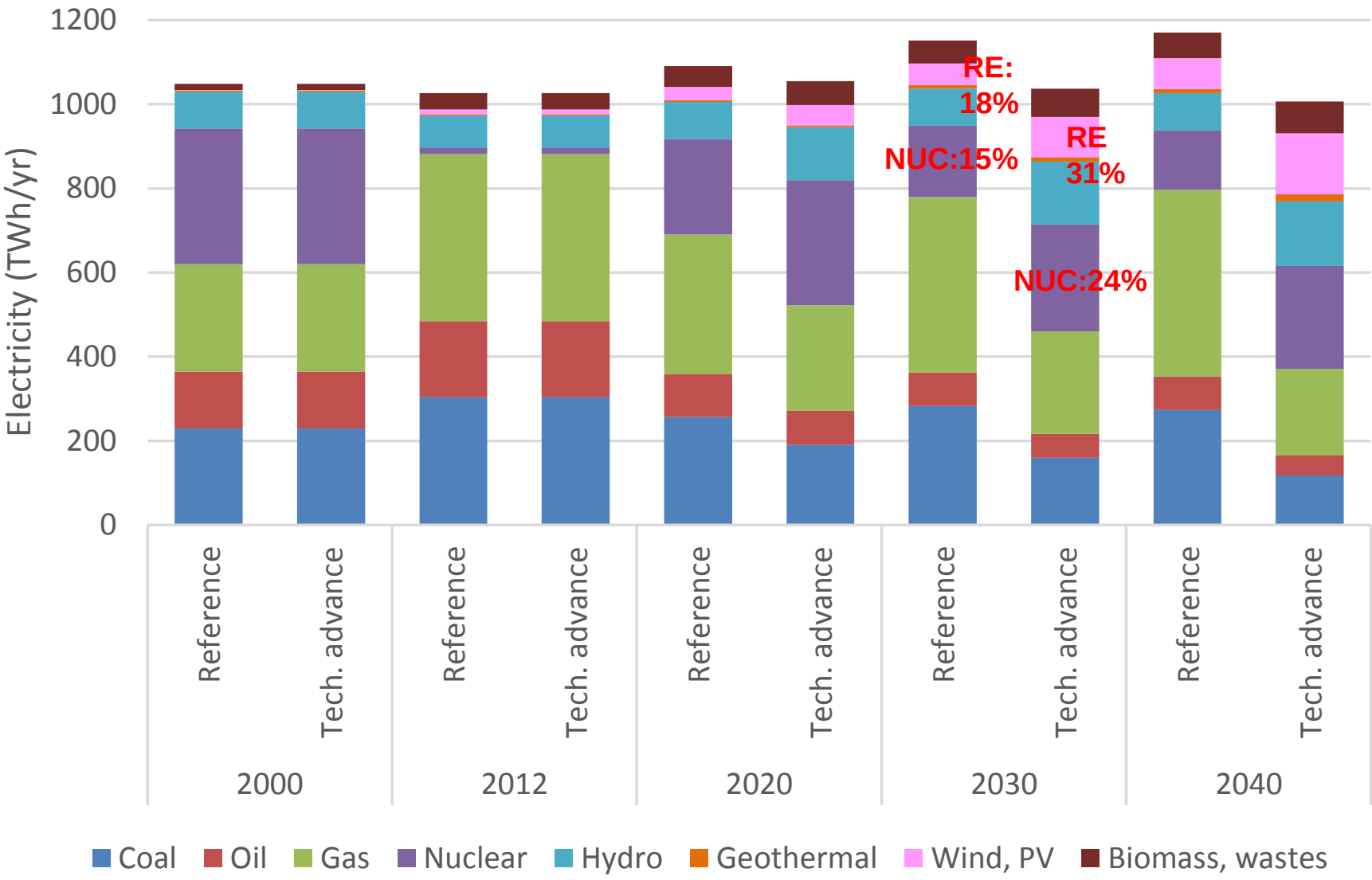
GDP: 1.9%/yr (2010-20), 1.3%/yr (2020-30)



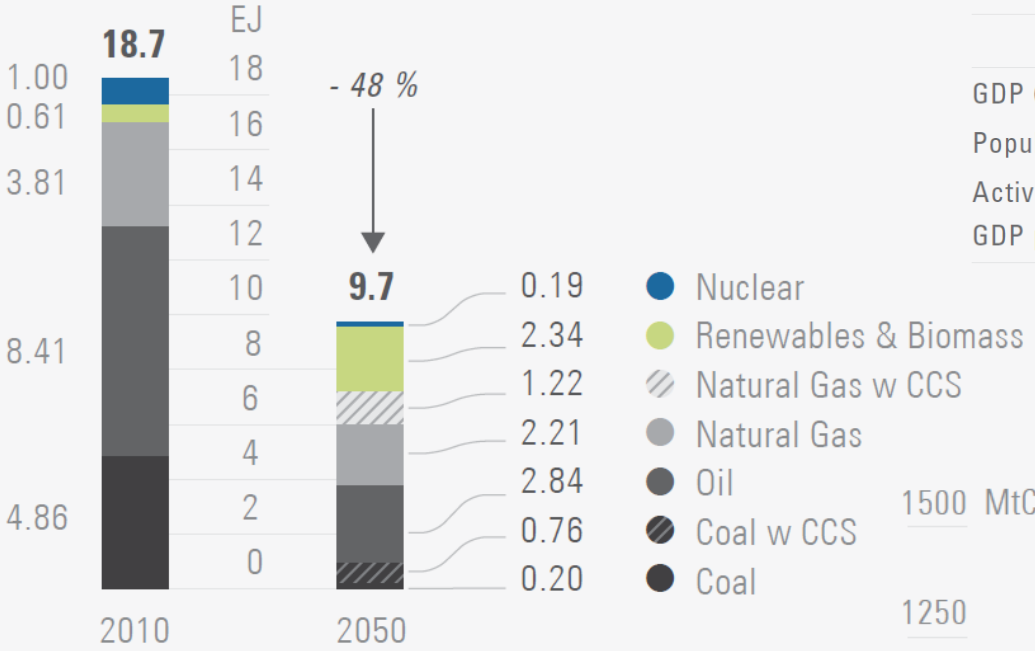
Final Energy by Sector in 2030 (IEEJ Scenario)



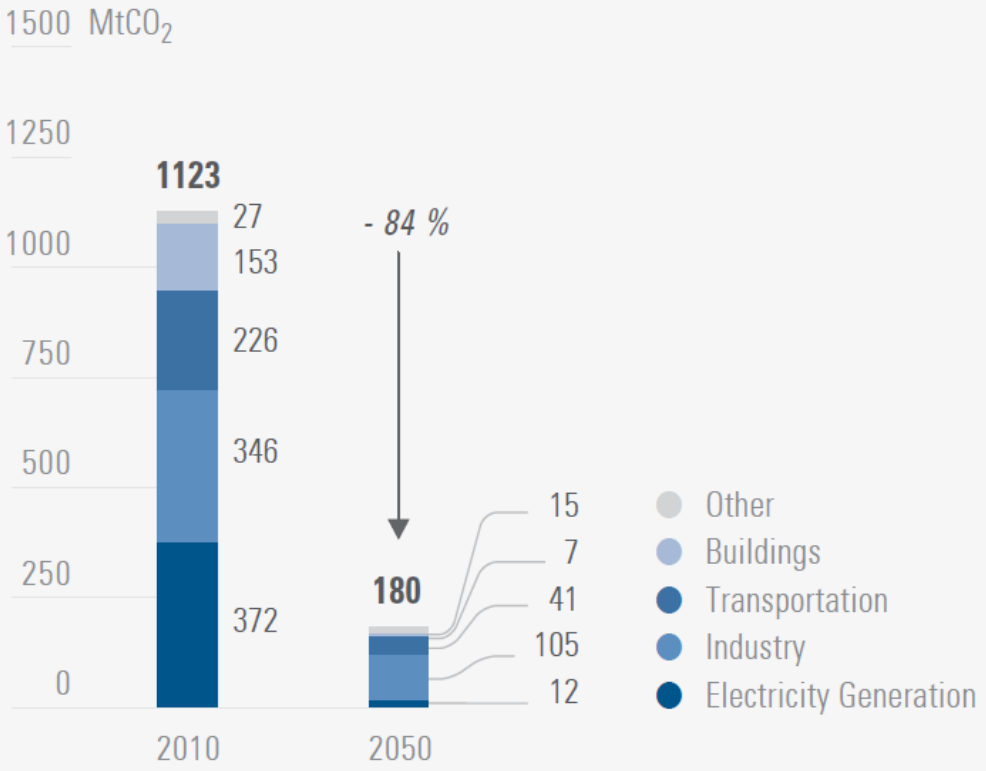
Electricity in 2030 (IEEJ Scenario)



CO_2 Emission Reduction Outlook by NIES



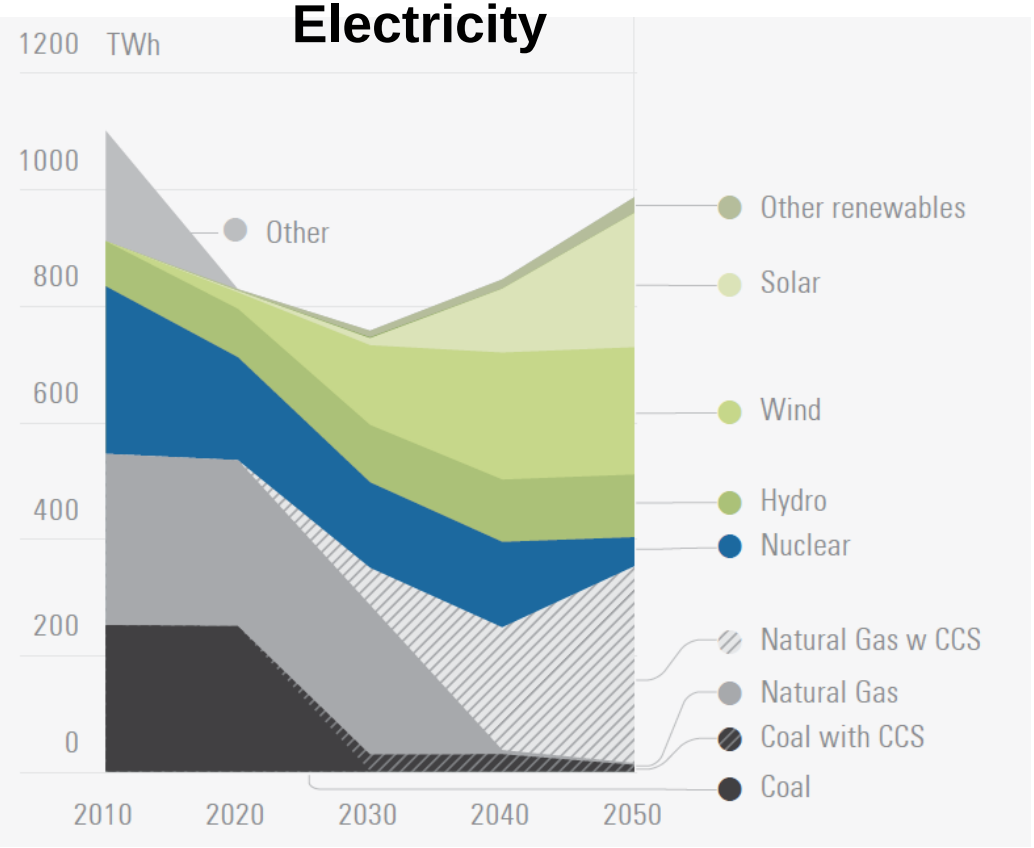
	2010	2050	Variation 2010/2050
GDP (trillion JPY_{2000})	538	837	+56%
Population (million)	128	97	-24%
Active population (Million)	82	50	-39%
GDP per capita (US$/cap)	38003	82116	+116%



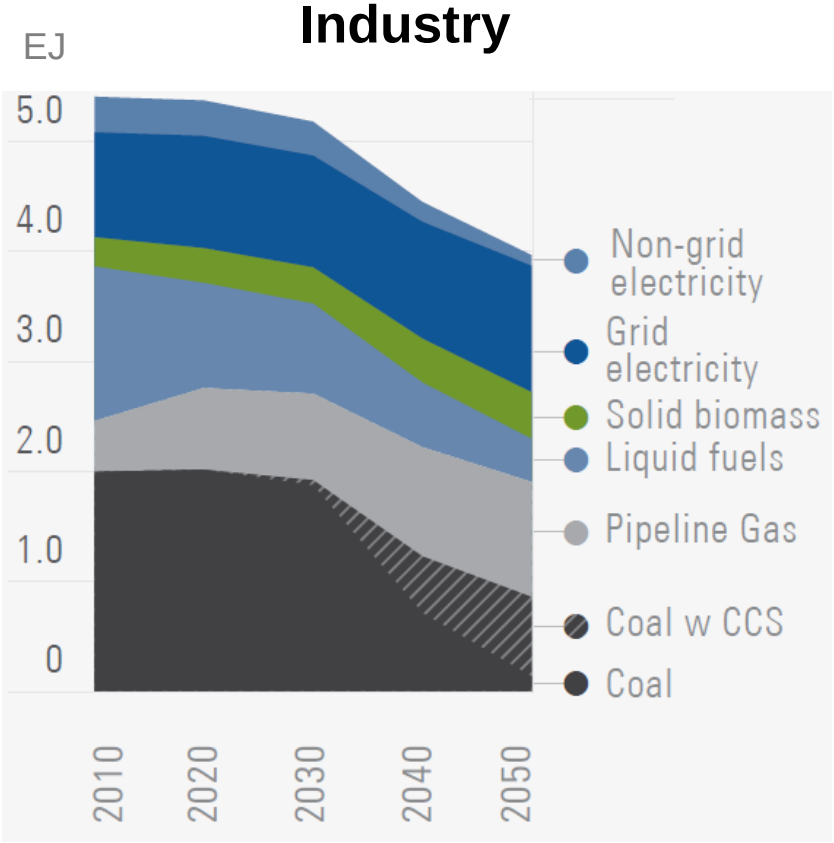
Source: DDPP, 2014

CO_2 Emission Reduction Outlook by NIES

Electricity



Industry

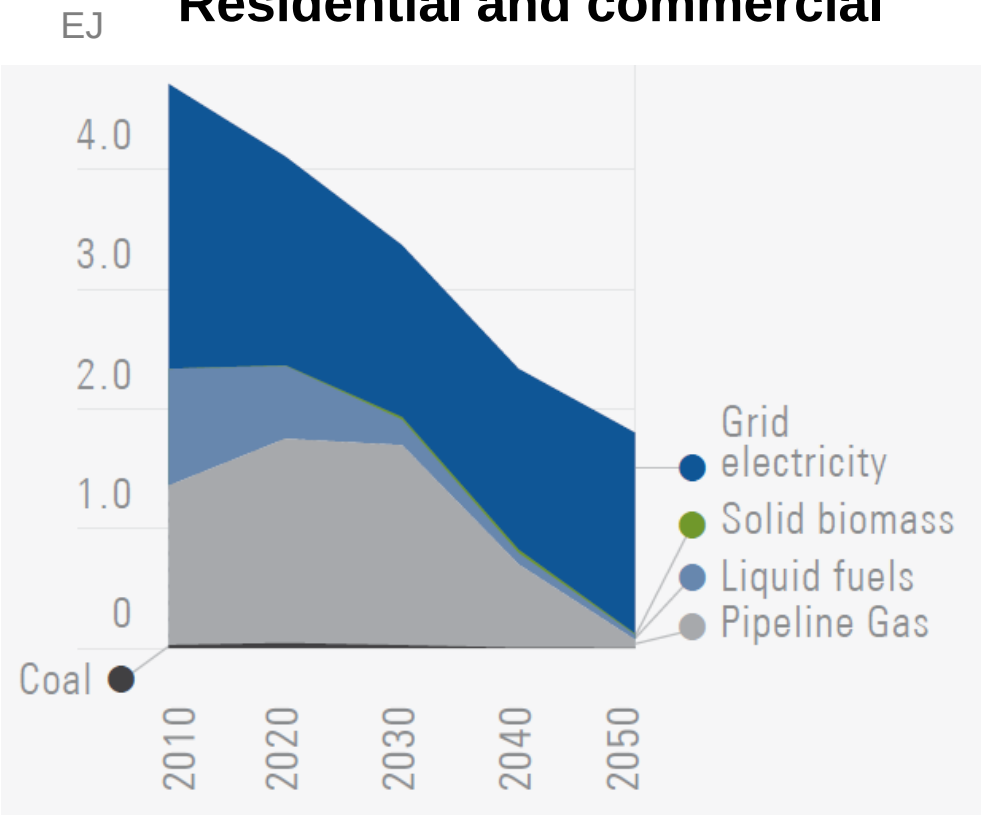


Source: DDPP, 2014

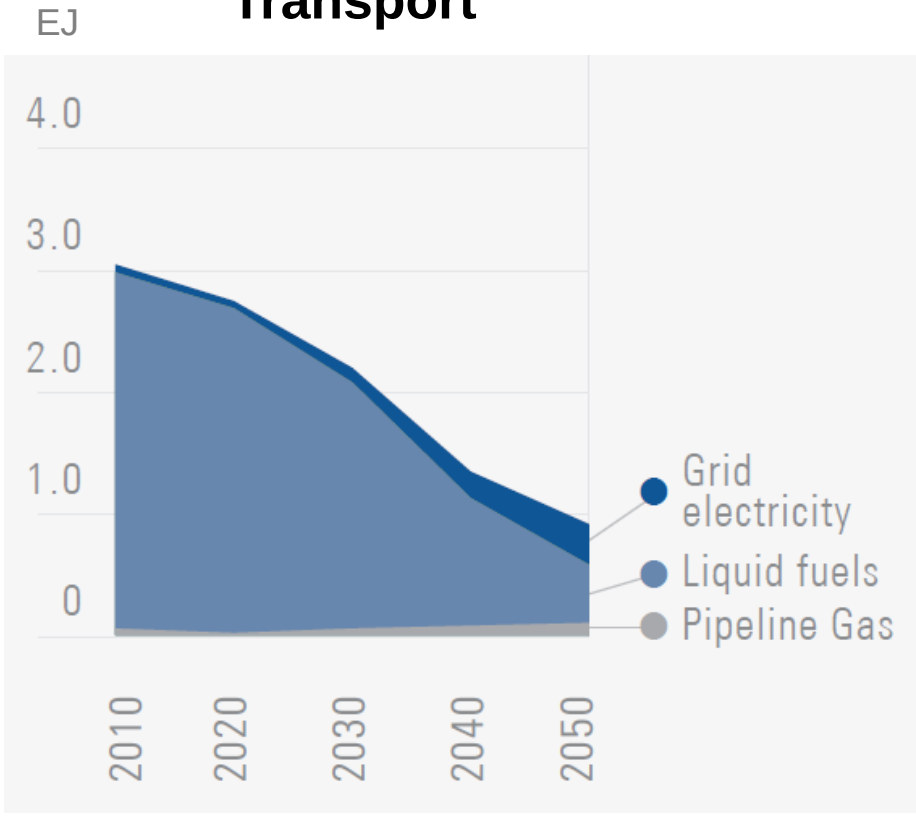
- Drastic reductions in electricity toward 2030 are estimated by NIES.
- Almost zero from coal power after 2030 excepting coal power with CCS were estimated.
- Coal and gas power with CCS in 2030 is around 50 TWh/yr and all the fossil power plants have CCS in 2050.

CO_2 Emission Reduction Outlook by NIES

Residential and commercial



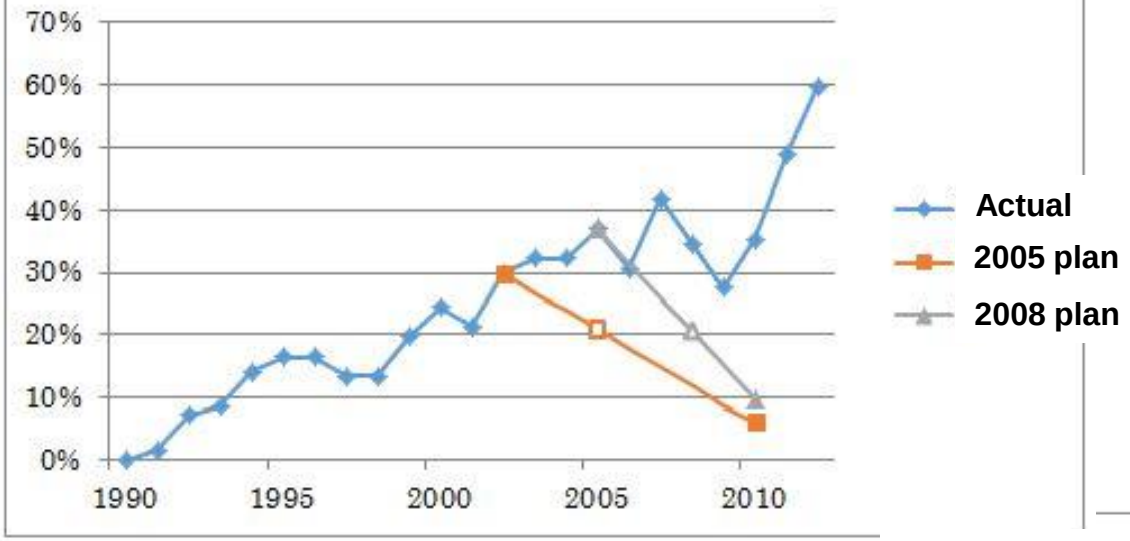
Transport



Source: DDPP, 2014

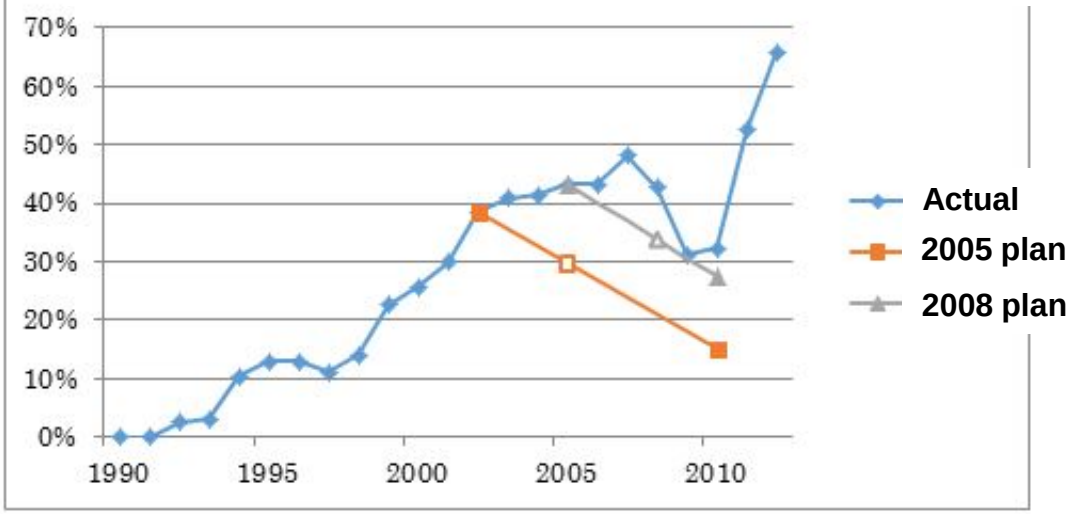
The Gap between Plan and Actual for Res. & Com. Sectors

CO2 Emission in Residential sector



There were large gaps between plans and actual emissions in residential and commercial sectors.

CO2 Emission in Commercial sector



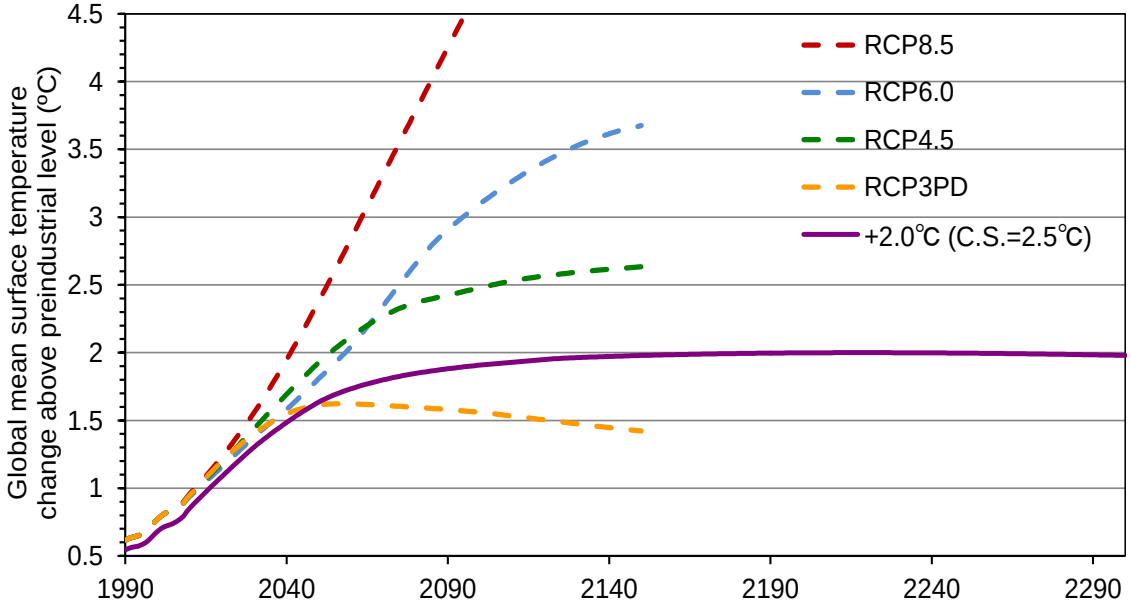
Source: T. Sugiyama (CRIEPI), IEEI, 2014

Conclusion

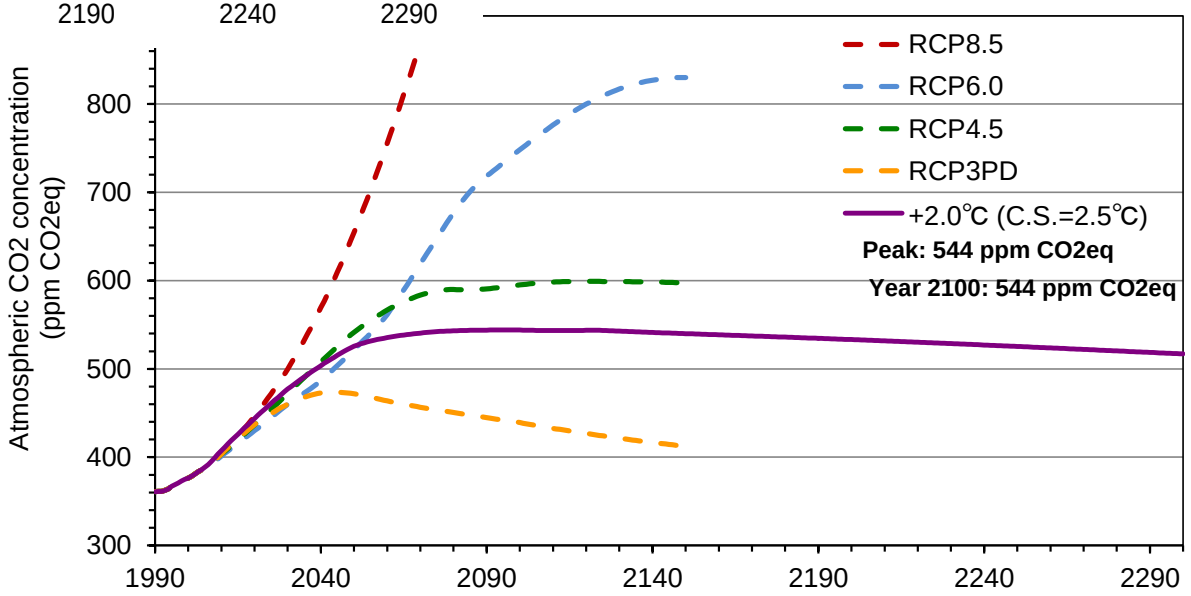
- Ambitious emission reductions are required both in the world and in Japan. However, the realistic target expected to be realized is also required.
- Halving emissions of Japan and developed countries by 2050 are also expected to be 2 °C target.
- CIGS proposes that the emission reductions of Japan were about 20% and 50% relative to 2005 in 2030 and 2050, respectively. They are reasonable according to the analyses of RITE and totally agreed. (However, 25% of nuclear power share in 2030 is highly challenging. Therefore, 20% reduction in 2030 is also a challenging target.)
- The emission of 80% by 2050 is unrealistic. Additional emission reduction contributes over 50% reductions should be conducted by deployments of several kinds of products having high energy efficiency in the world and development of innovative technologies to be expected to achieve additional reductions both in Japan and in the world.

Appendix

Global Mean Temperature Change and Atmospheric CO2eq Concentration Pathway (Kaya Proposal)

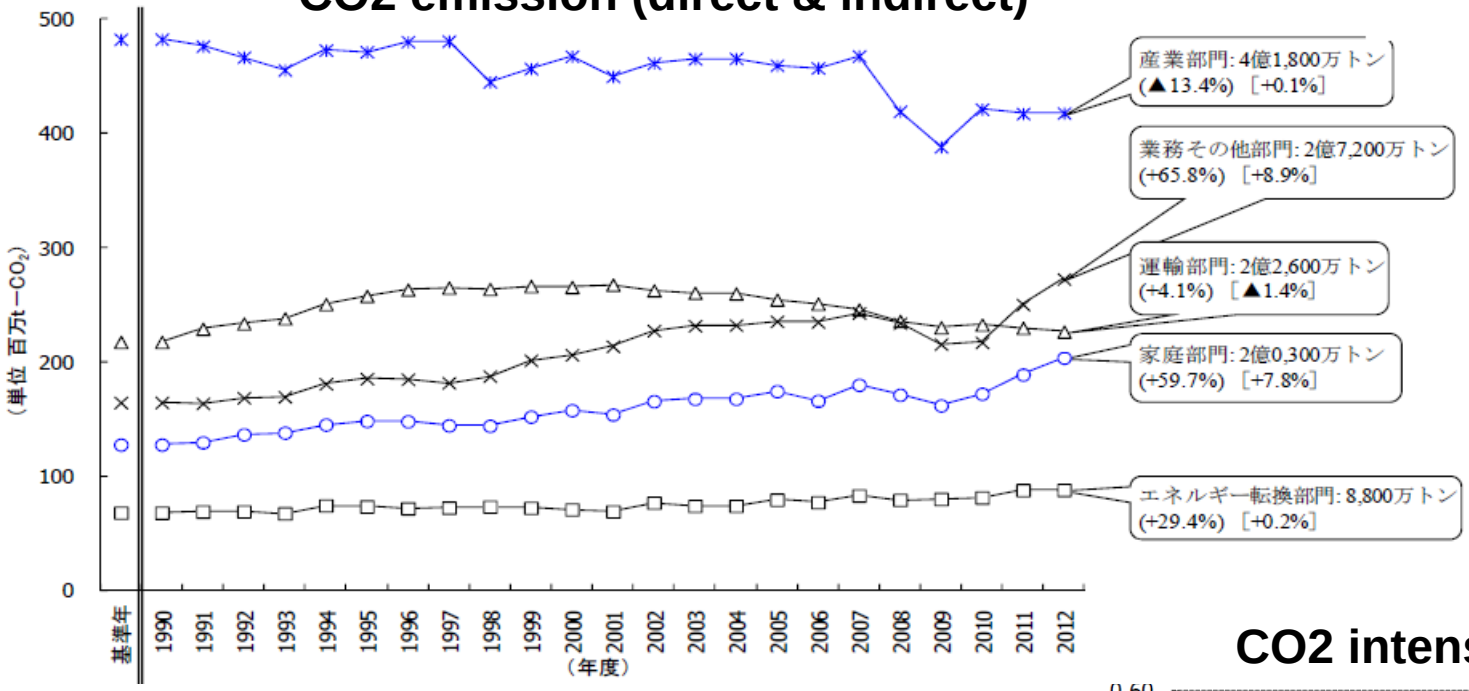


Climate sensitivity is very uncertain.
According to the IPCC AR5, equilibrium climate sensitivity (ECS) is 1.5-4.5 °C (ECS was 2.0-4.5 °C the best estimate was 3.0 °C according to the AR4.). The best estimate was not provided by the AR5.
The emission pathway can be expected to be below 2 °C when ECS is 2.5 °C.

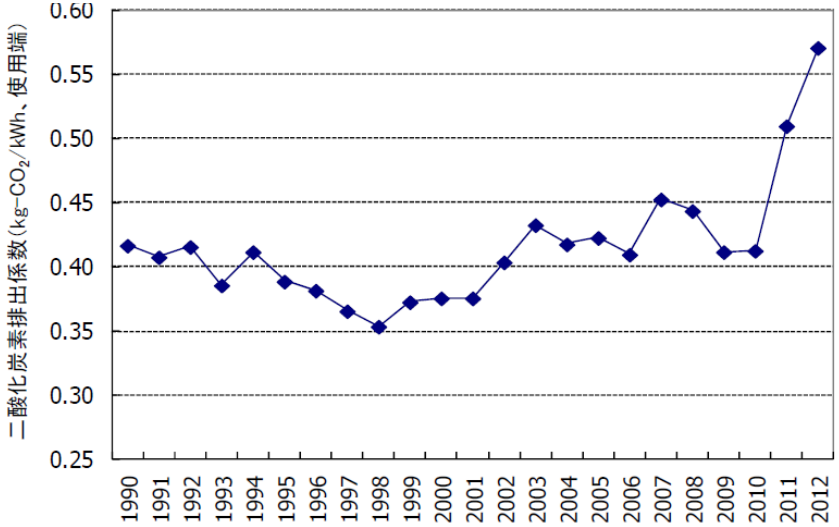


Historical CO2 Emissions by Sector in Japan

CO2 emission (direct & indirect)



CO2 intensity of electricity

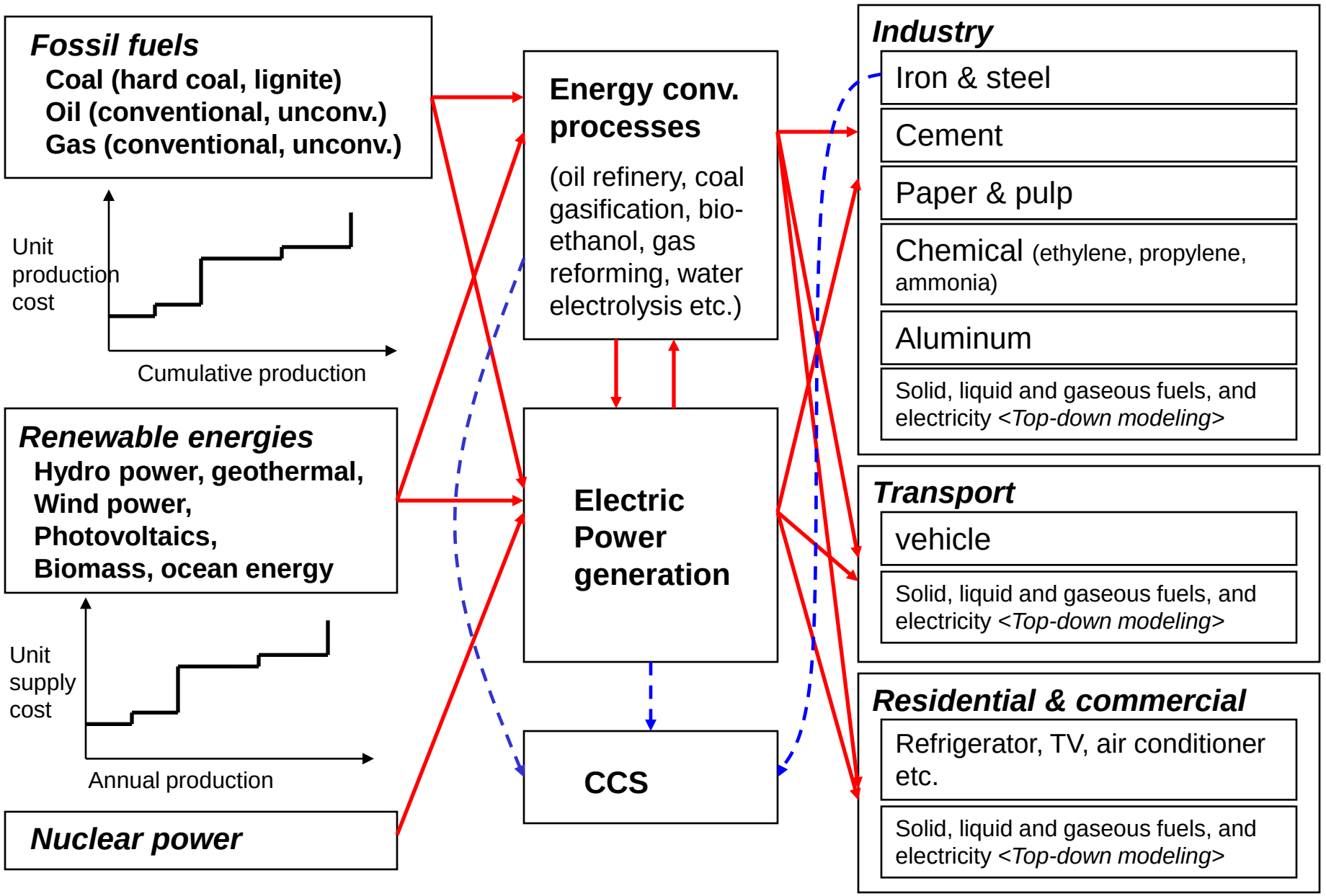


Energy Assessment Model: DNE21+

- Linear programming model (minimizing world energy system cost)
- Evaluation time period: 2000-2050
  Representative time points: 2000, 2005, 2010, 2015, 2020, 2025, 2030, 2040, 2050
- World divided into 54 regions
  Large area countries are further divided into 3-8 regions, and the world is divided into 77 regions.
- Bottom-up modeling for technologies both in energy supply and demand sides (200-300 specific technologies are modeled.)
- Primary energy: coal, oil, natural gas, hydro, geothermal, wind, photovoltaics, biomass, nuclear power, and ocean energy
- Electricity demand and supply are formulated for 4 time periods: instantaneous peak, peak, intermediate and off-peak periods
- Interregional trade: coal, crude oil, natural gas, ethanol, hydrogen, electricity and CO_2
- Existing facility vintages are explicitly modeled.

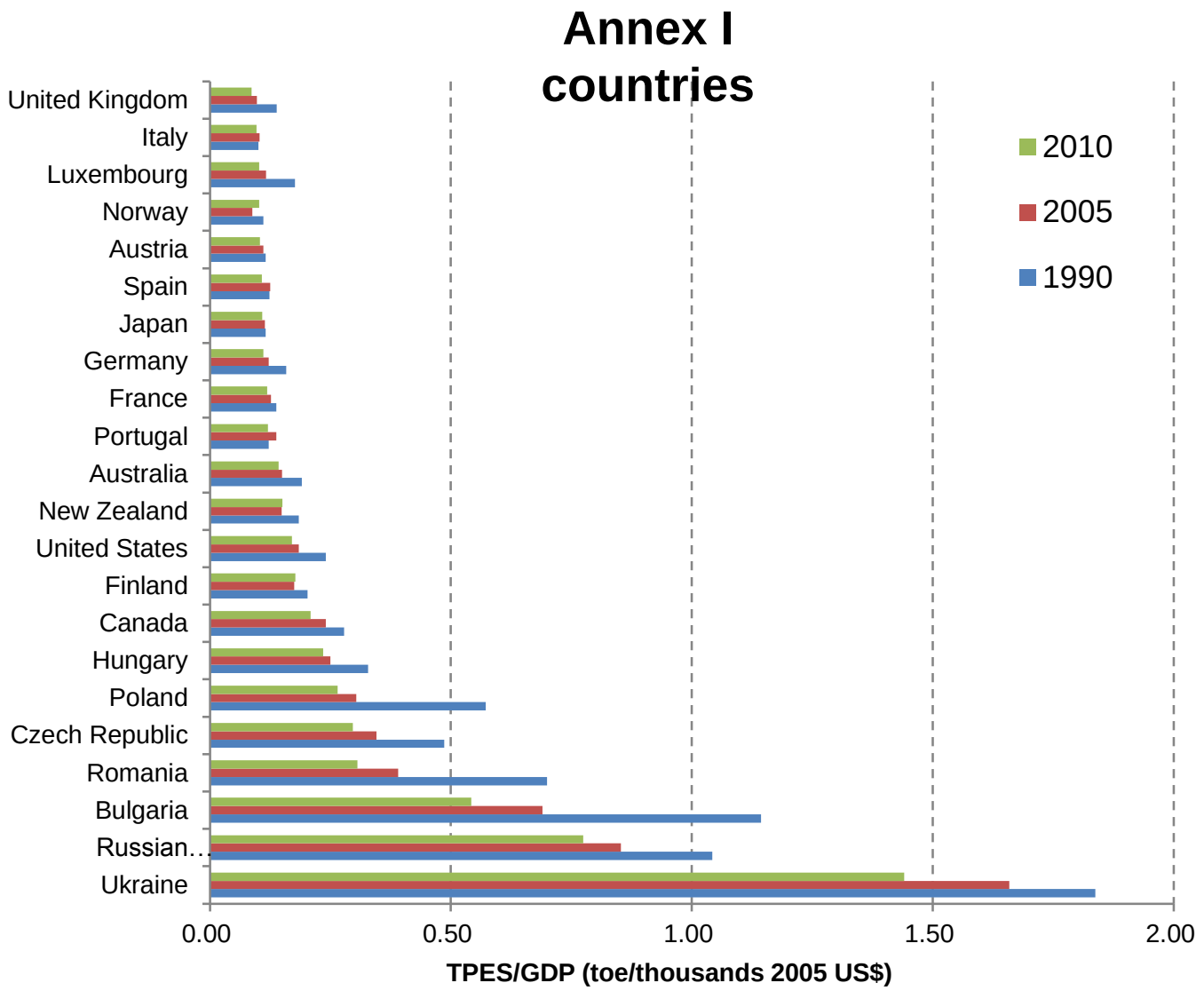
The model type of the DNE21+ is similar to the IEA ETP model.

Technology Descriptions in DNE21+

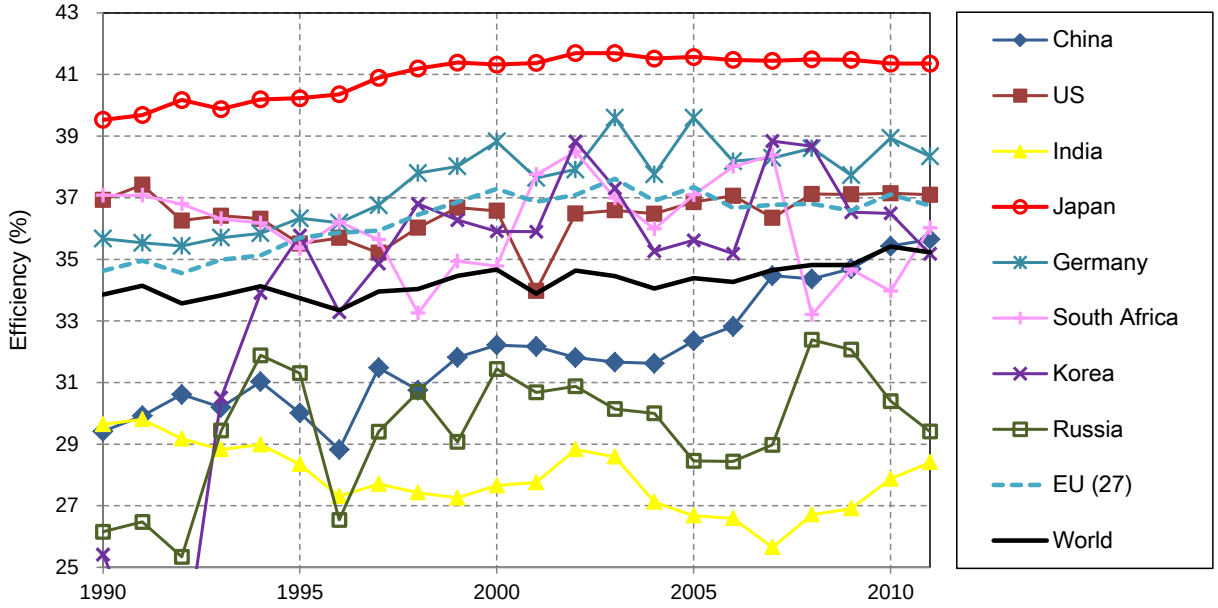


Comparison of Energy Intensity of GDP

The energy intensity of GDP depends not only on the efforts for energy saving but also on several factors, such as industrial structures, market exchange rate etc.
The intensity will be important for comparability of the efforts but other indicators are also required.



Energy efficiency comparison for major energy-intensive sectors (1/2)

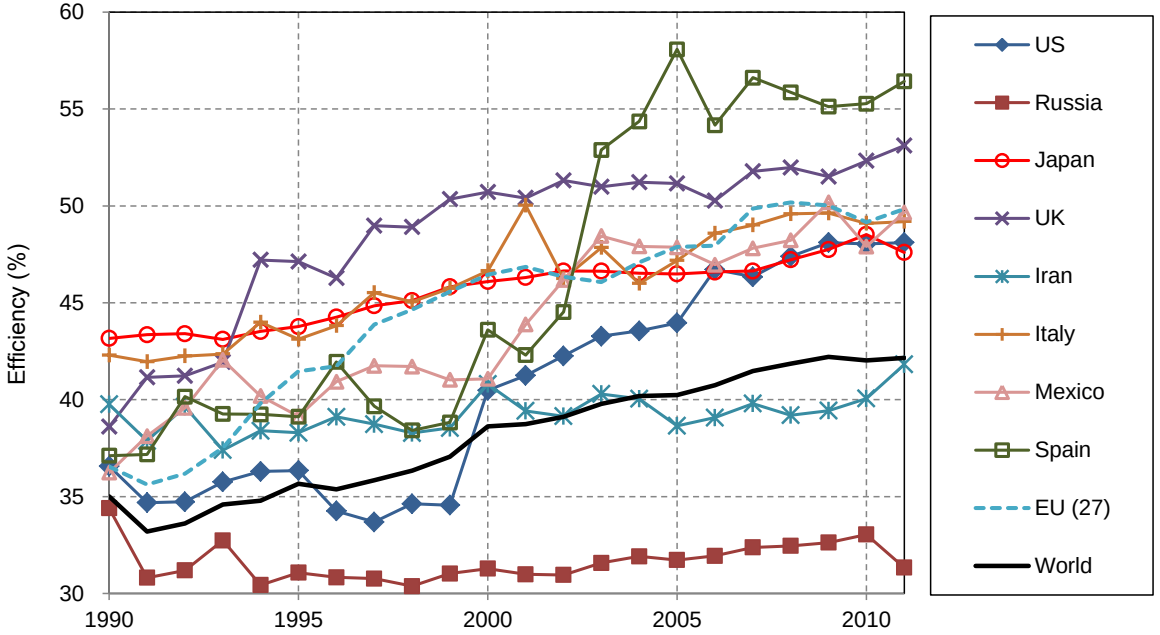


Coal power

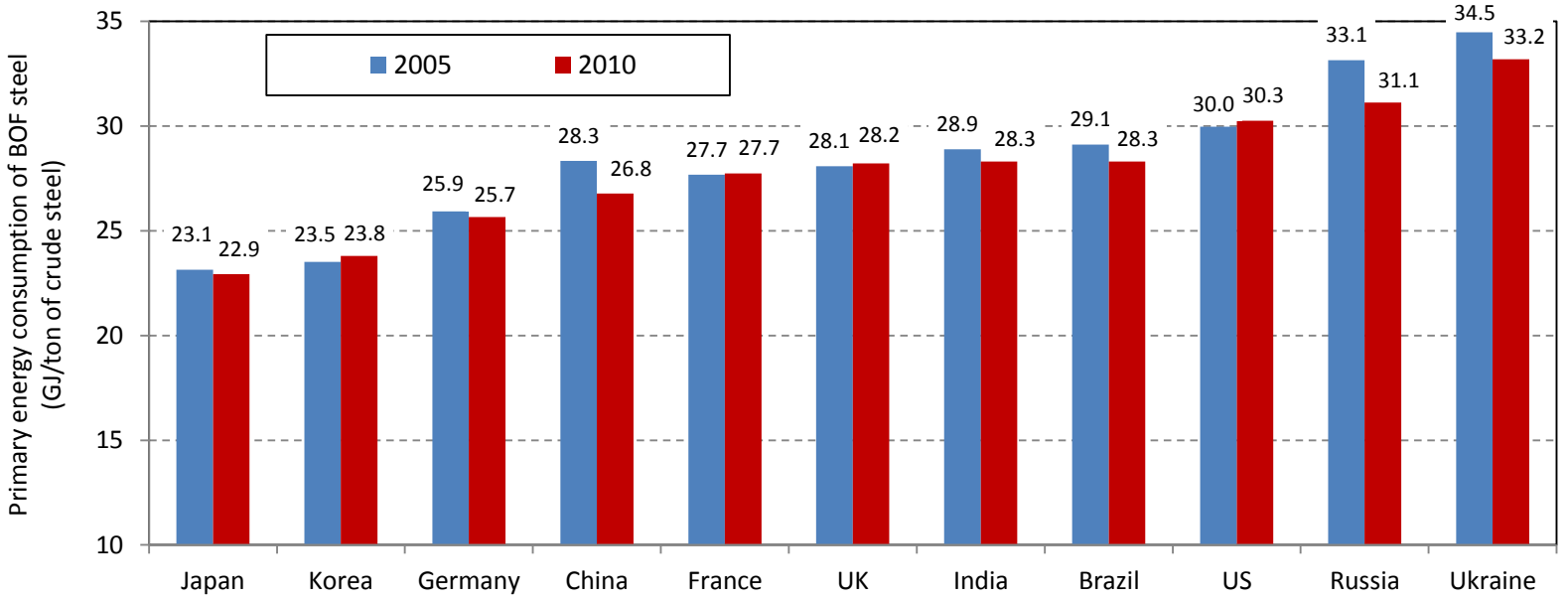
Source) RITE, 2014
based on IEA, 2013

Gas power

Source) RITE, 2014
based on IEA, 2013



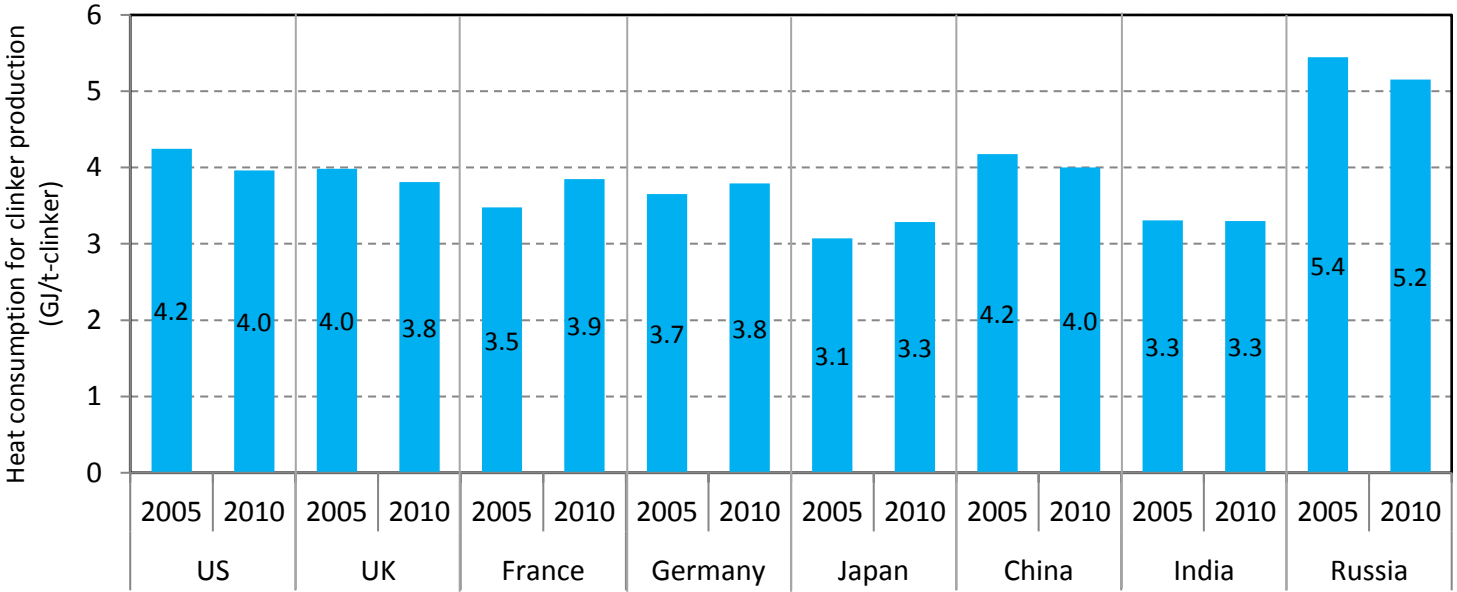
Energy efficiency comparison for major energy-intensive sectors (2/2)



Iron & steel (BOF steel)

Source) Oda et al. 2012; RITE, 2012

Cement



Ref） RITE estimates based on WBCSD/CSI, etc