

# Japan 2050 Low Carbon Navigator

*Possible application for assessing climate policy impacts*

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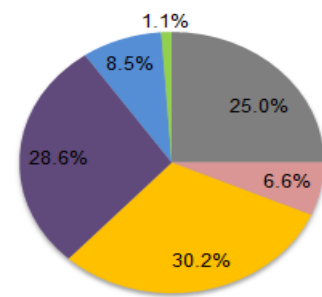
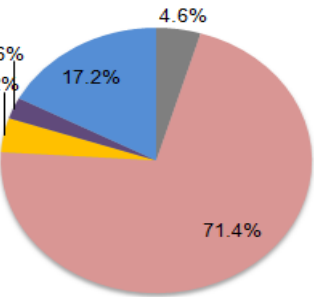


# Background: Energy situation

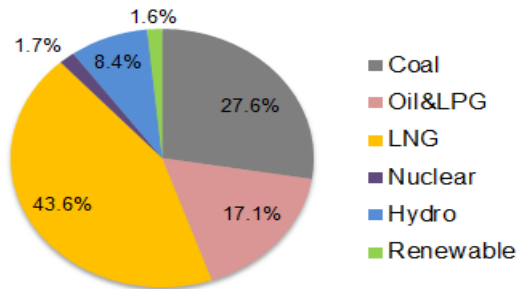


FY1973 (Oil crisis, 76%)

FY2010 (Before the Great Earthquake, 61%)

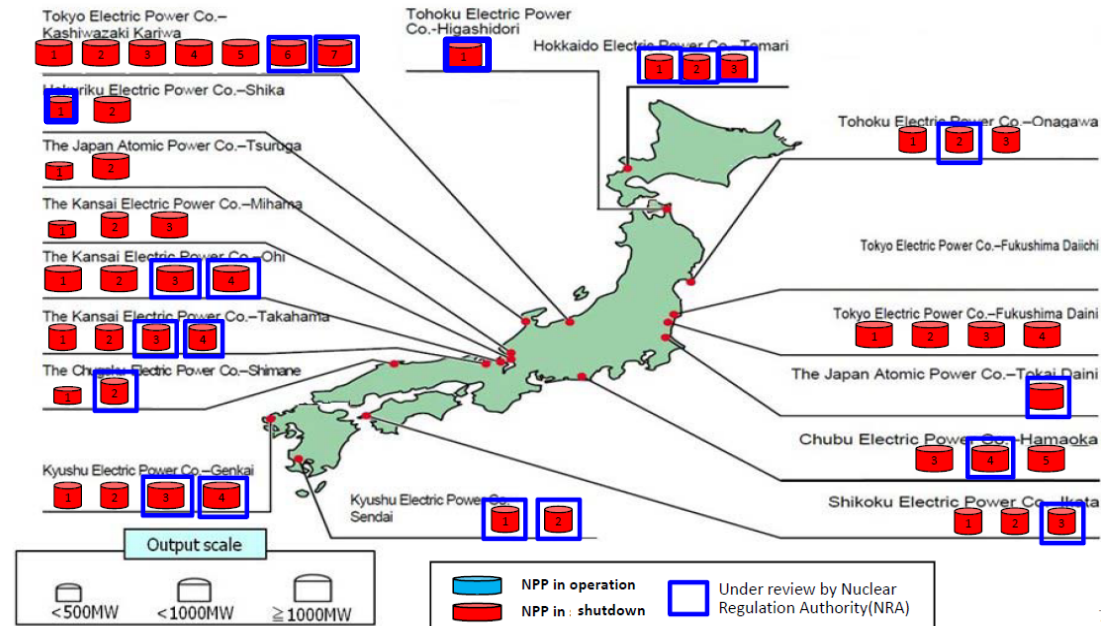


FY2012 (Latest available data, 88%)



High dependency on overseas fossil fuels for power supply

## Nuclear power plants in Japan



# Background: Energy policy



## The 4<sup>th</sup> Strategic Energy Plan (April 11<sup>th</sup>, 2014)

- ⊕ Basic viewpoints of energy policy (3E + S);
- ⊕ Energy mix will be announced soon
  - ☞ *Nuclear as an important base-load power source, restart of NPPs;*
  - ☞ *Promotion of high efficient and low-carbon coal power generation;*
  - ☞ *Expansion of renewable energy (13.5% by 2020 and 20% by 2030).*
- ⊕ Electricity System Reform
- ⊕ Introduction of energy management system for energy conservation

# Background: Climate policy



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## ⊕ Mitigation target setting

- ☞ *Kyoto target: 8.4% reduction from 1990 achieved against 6% target;*
- ☞ *2020 target: -3.8% from 2005 vs. -25% from 1990 (CPH pledge)*
- ☞ *Post 2020 target: --18%26% from 2013 by 2030, (equivalent to -18% from 1990 by 2030)*
- ☞ *2050 target: 80% reduction from current levels (4<sup>th</sup> BEP)*

## ⊕ Policy measures

- ☞ *FIT for renewable energy;*
- ☞ *Carbon tax;*
- ☞ *Tokyo emissions trading system*

## ⊕ Building Low Carbon Society

# Analytical tool

## *Japan 2050 Low Carbon Navigator*



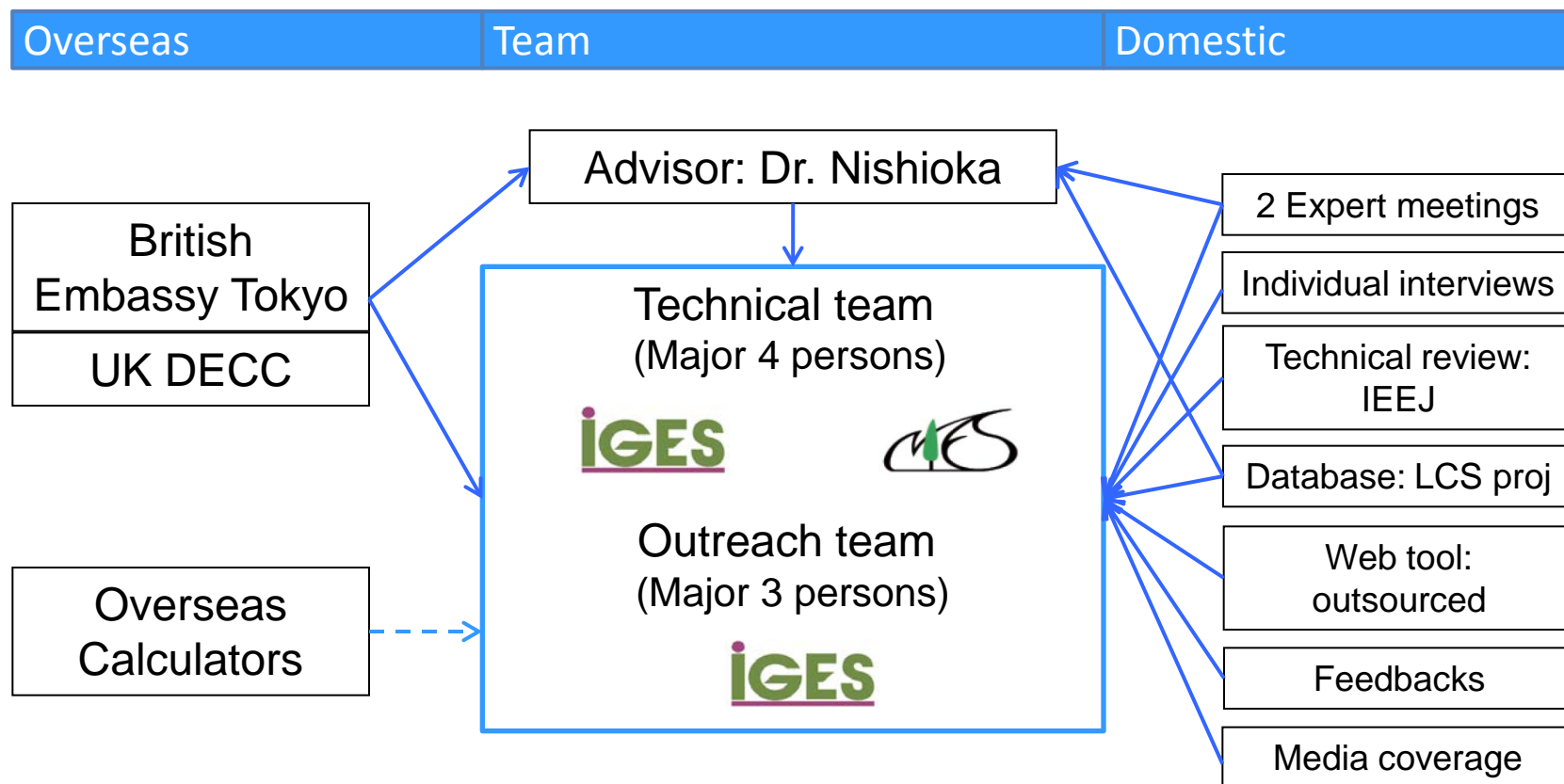
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- **What is the Japan 2050 Low Carbon Navigator**
  - ✓ Japanese version of the UK 2050 Pathways Calculator;
  - ✓ Simulation model for energy system and emissions;
  - ✓ An interactive simple to communicate tool that allows:
    - To answer the fundamental questions of how far we can reduce emissions and meet energy needs;
    - To develop your own combination of change in different technologies and sectors up to 2050;
    - To outline, in minutes, the results of energy and emissions in a transparent and evidence-based way.
  - ✓ Developed jointly by IGES and NIES during May 2013 – July 2014;
  - ✓ Japan is placed at a crossroads in deciding on its future energy structure. In addition, Japan recently submitted its INDC.
    - We believe that the Low Carbon Navigator can be used as a handy tool for engaging domestic policy dialogues as well as for educational purposes

# How the tool was developed: *Teamwork and working mechanism*



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# Analytical tool

## *Japan 2050 Low Carbon Navigator*



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Navigator

### Box 1: Questions that the Low Carbon Navigator can address

- *How far can Japan reduce emissions while meeting energy needs?*
- *How much energy can we supply from different energy technologies?*
- *How much energy do different sectors use and how can we change this?*
- *Which sectors are the ones we should focus on? Which are less important?*
- *What could happen to our energy dependency and security?*
- *Without nuclear, what will be the energy mix for Japan to achieve the 80% emissions reduction target by 2050?*
- *How much CO<sub>2</sub> reduction can be achieved using the most ambitious renewable energy scenarios? At what cost?*
- *What is the full potential of CO<sub>2</sub> reductions in Japan? At what cost? What does the low-carbon pathway look like?*

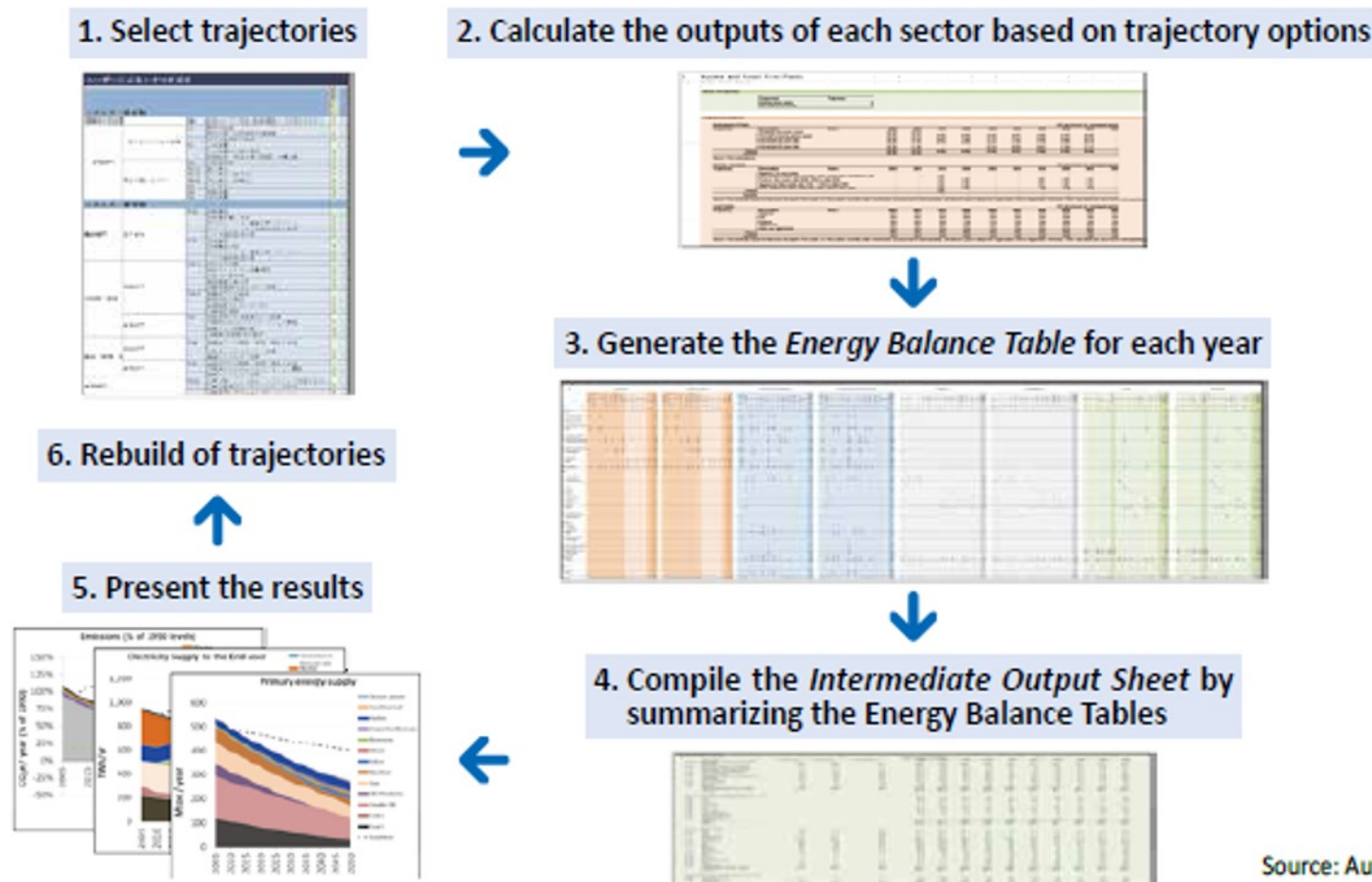
# Analytical tool II

## Japan 2050 Low Carbon Navigator



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### How it works



Source: Authors.



# Analytical tool II

## Japan 2050 Low Carbon Navigator



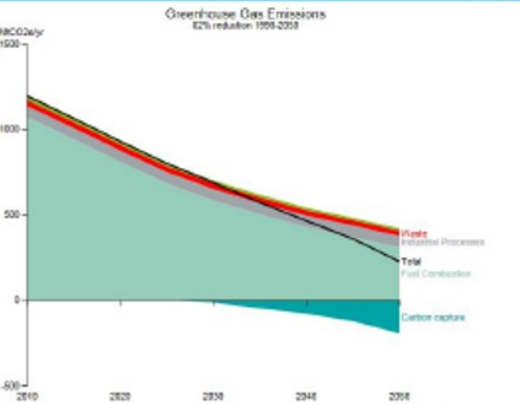
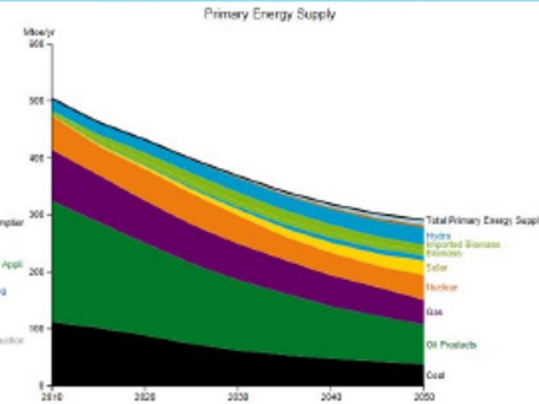
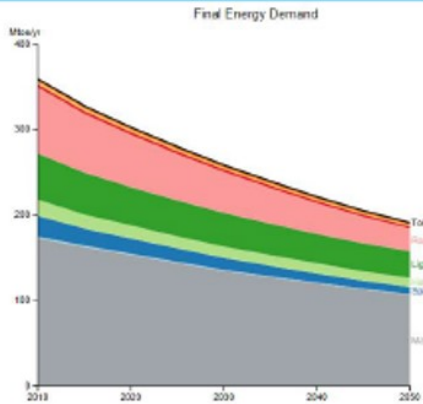
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### How it works



Scenario Selector: **Research and Development (RD) society** | Made-in-Japan (MI) society | Service and Brand (SD) society | Resource Independent (RI) society | Share society

Energy | Electricity | Security | Flows | Costs | Share | Example



Passenger Transport Behaviour	1	2	3	4	5
Passenger Transport: Shift to Zero Emission	1	2	3	4	5
Passenger Transport: Choice of FCV or EV	1	2	3	4	5
Passenger Transport: Electric Bicycling	1	2	3	4	5
Freight Transport Behaviour	1	2	3	4	5
Freight Transport: Shift to Low Emission	1	2	3	4	5
Freight Transport: Bunkai Bunking	1	2	3	4	5
Home Energy Management Level (for residential space heating, cooling and hot water)	1	2	3	4	5
Residential Heating and Cooling: Home Insulation	1	2	3	4	5
Residential Heating and Cooling: Electrification	1	2	3	4	5
Residential Heating and Cooling: Energy Efficiency	1	2	3	4	5
Residential Hot Water Supply: Technology Choice	1	2	3	4	5
Residential Hot Water Supply: Energy Efficiency	1	2	3	4	5
Residential Hot Water Supply: Solarthermal Boilers	1	2	3	4	5
Commercial Energy Service Demand for Heating, Cooling and Hot Water	1	2	3	4	5
Commercial Heating, Cooling and Hot Water: Building Insulation	1	2	3	4	5
Commercial Heating, Cooling and Hot Water: Technology Choice	1	2	3	4	5
Residential Appliances: Energy Demand per Household (Behaviour)	1	2	3	4	5
Residential Appliances: Energy Efficiency	1	2	3	4	5
Commercial Appliances: Energy Demand per Floor space (behaviour)	1	2	3	4	5
Commercial Appliances: Energy Efficiency	1	2	3	4	5
Industry: Energy Intensity per Industrial Output	1	2	3	4	5
Industry: Energy mix in the industry	1	2	3	4	5

Nuclear: Restart Existing Power Plants	1	2	3	4	5
Nuclear: Building of New Power Plants	1	2	3	4	5
Fossil Fuel Power Plants: Fuel Mix	1	2	3	4	5
Solar PV	1	2	3	4	5
Offshore Wind	1	2	3	4	5
Onshore Wind	1	2	3	4	5
Floating Wind	1	2	3	4	5
Small-Scale Hydro Power	1	2	3	4	5
Geothermal Power	1	2	3	4	5
Ocean Power	1	2	3	4	5

Fossil Fuel Power Plants: Availability of CCS: 1 2 3 4 5

Based on [IGES/REN21](#). For inquiries, please contact the Green Scenario Desk, IIGES, E-mail: [gs@iges.or.jp](mailto:gs@iges.or.jp)

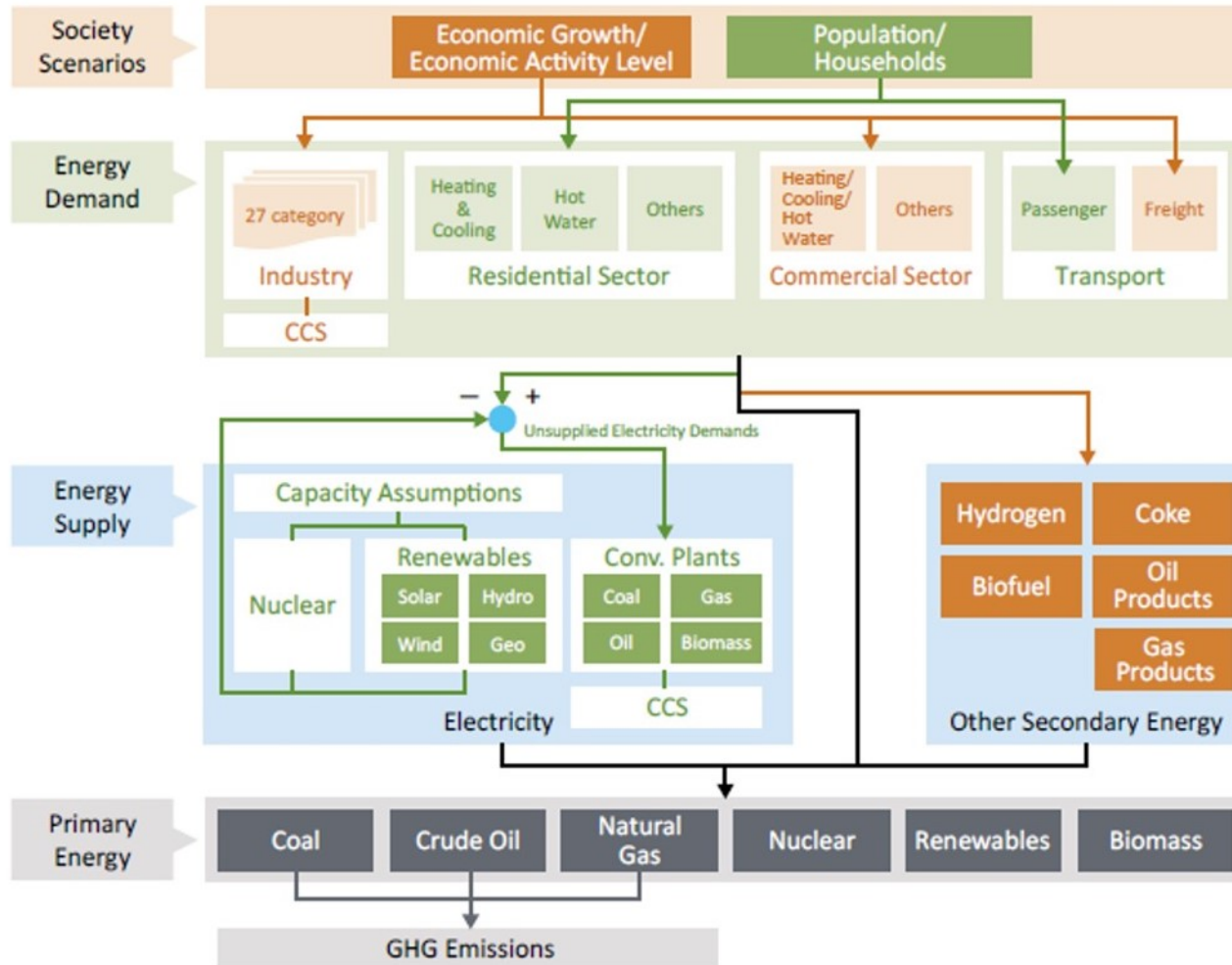


# Analytical tool II

## Japan 2050 Low Carbon Navigator



### Structure of the model



# Analytical tool

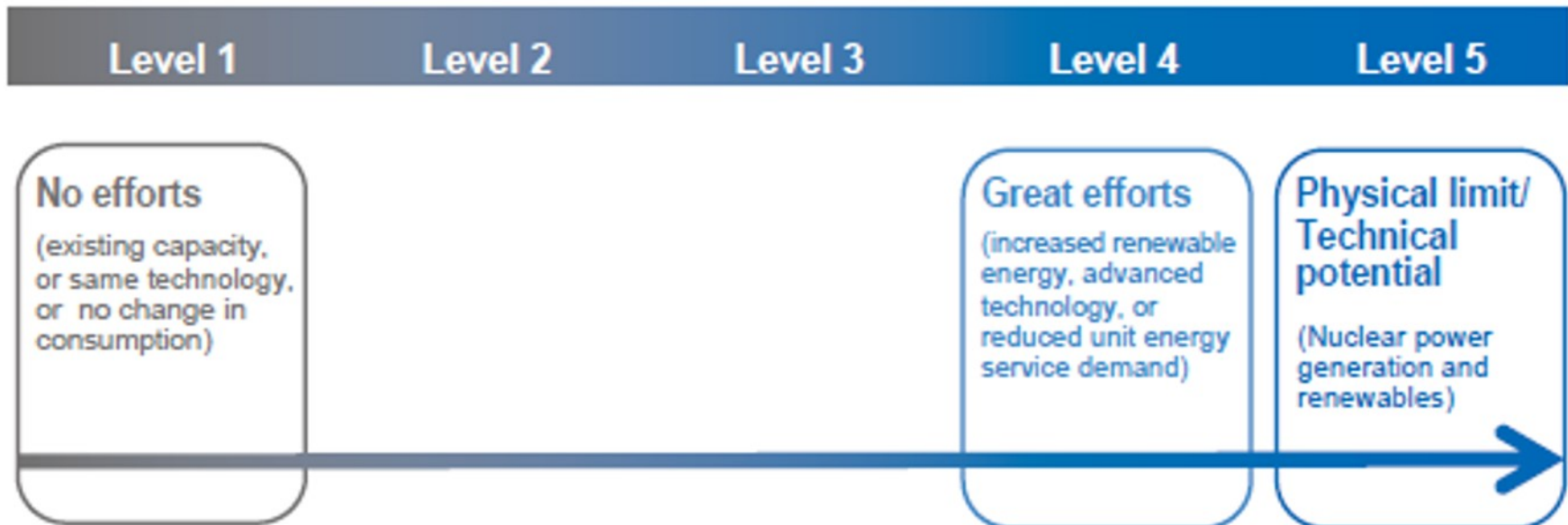
## Japan 2050 Low Carbon Navigator



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Low Carbon  
Navigator

### Levels/trajectories setting

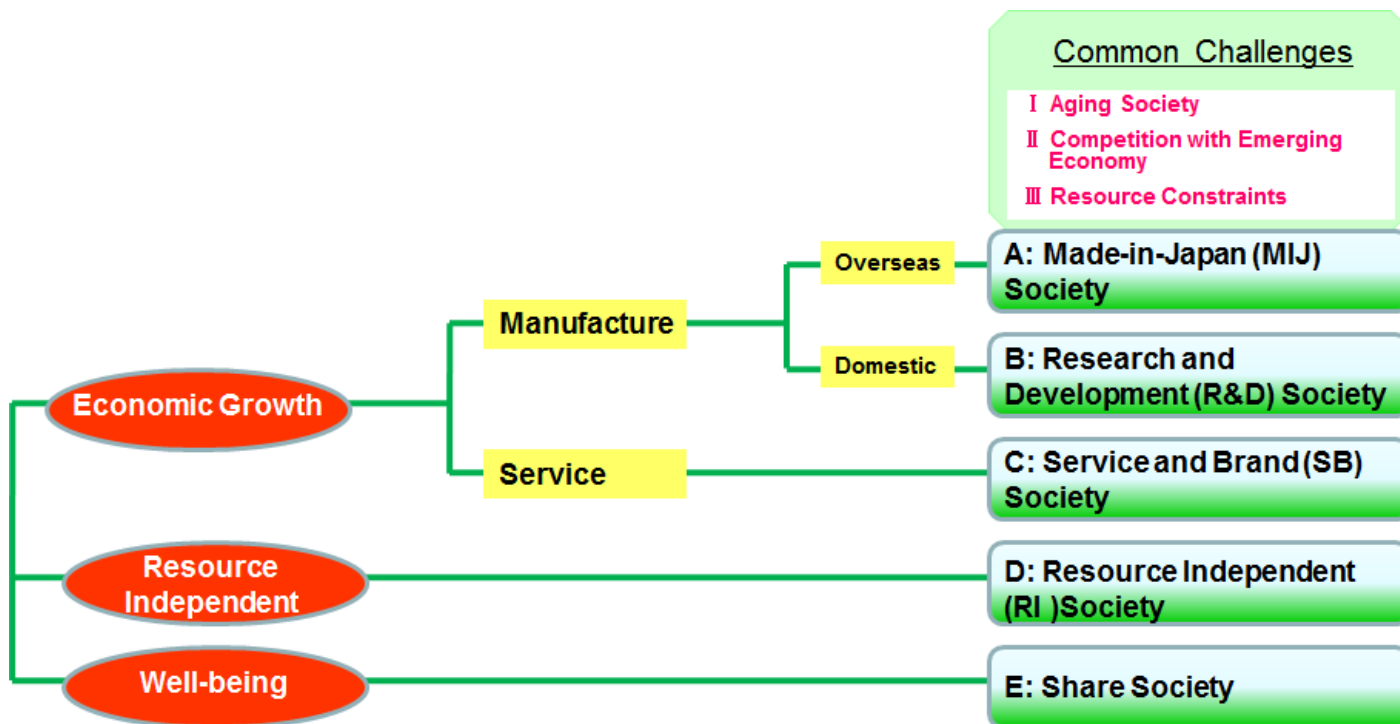
*The Low Carbon Navigator sets out four or five (renewable energy and nuclear power) trajectories reflecting the whole range of potential future scenarios.*



# Five Society Scenarios



- R & D** 
- MIJ** 
- SB** 
- RI** 
- Share** 



# 3E+S Policy

## *The 4<sup>th</sup> Strategic Energy Plan*



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# 3E+S Policy In the Low Carbon Navigator



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- The Low Carbon Navigator can communicate on how Japan’s policies related to energy and climate change can impact on the country’s pronounced 3E+S objectives.
- A dedicated section in both the Excel model and the Web Tool provides options for the users to see how their chosen pathways affect these 3E+S objectives.

*The Low Carbon Navigator reinforces “3E+S” objective*

4 <sup>th</sup> Strategic Energy Plan’s 3E+S objectives				
	Energy security	Economic efficiency	Environmental protection	Safety
<b>Indicators in the Low Carbon Navigator</b>	Dependency on imported energy Diversification of energy sources	Total costs per capita Per capita sectoral costs	TotalGHG emissions Emissions intensity of electricity	Share of nuclear in power mix

Source: Low Carbon Navigator development team.

# 3E+S Policy: Energy Security In the Low Carbon Navigator



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Society Scenario **Research and Development (R&D)** Made-In-Japan (MIJ) Service and Brand (SB) Resource Independent (RI) Share Society

日本語 English

Summary(3E+S) Energy Electricity Security Flows Costs Share

Examples

3E + S ? Energy security Economic efficiency Environment Safety

GHG emissions reduction from 1990 levels (2050)

8 %

Imported primary energy (2050)

92 %

Share of renewables in power mix (2050)

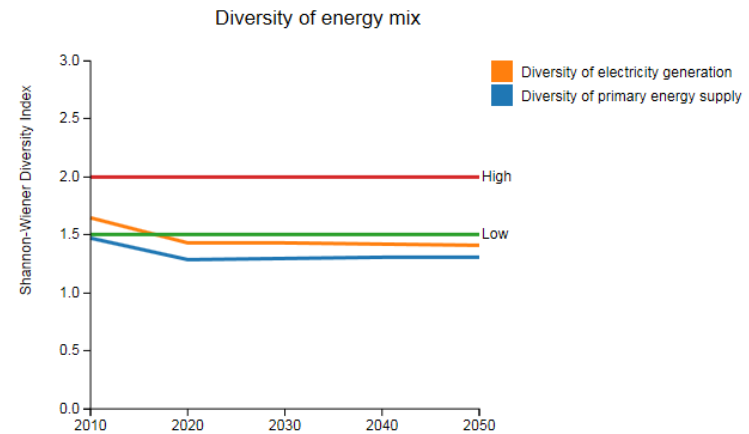
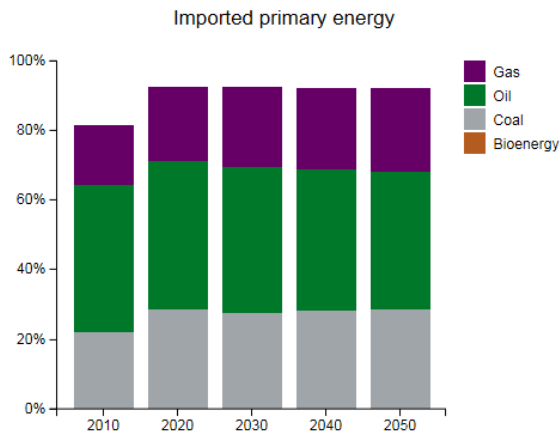
13 %

Share of nuclear in power mix (2050)

0 %

## All at Level 1

### Energy security



### Transport

Passenger Transport Behaviour	?	1	2	3	4
Passenger Transport: Shift to Zero Emission	?	1	2	3	4
Passenger Transport: Choice of FCV or EV	?	A	B	C	D
Passenger Transport: Biofuel Blending	?	1	2	3	4
Freight Transport Behaviour	?	1	2	3	4
Freight Transport: Shift to Low Emission	?	1	2	3	4
Freight Transport: Biofuel Blending	?	1	2	3	4

### Nuclear

Nuclear: Restart Existing Power Plants	?	A	B	C	D	E
Nuclear: Building of New Power Plants	?	A	B	C	D	E

### Fossil fuels

Fossil Fuel Power Plants: Fuel Mix	?	1	2	3	4
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### CCS

Fossil Fuel Power Plants: CCS	?	1	2	3	4
Industry: CCS	?	1	2	3	4

# 3E+S Policy: Energy Security In the Low Carbon Navigator



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Navigator



Society Scenario **Research and Development (R&D)** Made-In-Japan (MJ) Service and Brand (SB) Resource Independent (RI) Share Society

日本語 English

Summary(3E+S) Energy Electricity Security Flows Costs Share

Examples

3E + S ? Energy security Economic efficiency Environment Safety

GHG emissions reduction from 1990 levels (2050)

82 %

Imported primary energy (2050)

53 %

Share of renewables in power mix (2050)

63 %

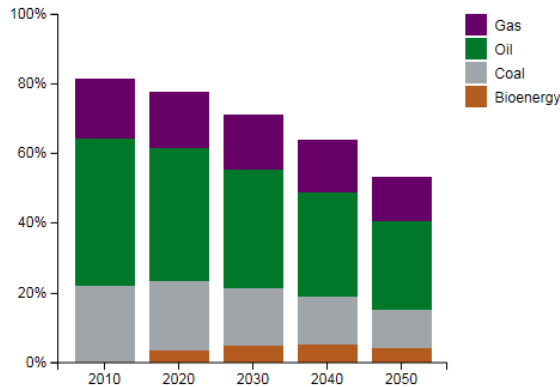
Share of nuclear in power mix (2050)

20 %

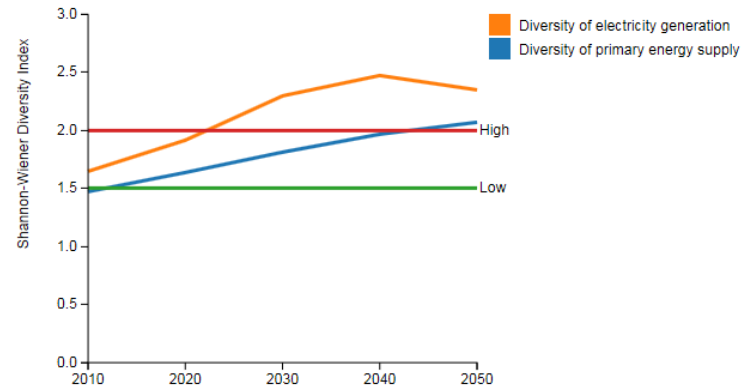
## All at Level 4

Energy security

Imported primary energy



Diversity of energy mix



### Transport

1 2 3 4

Passenger Transport Behaviour	?	1	2	3	4
Passenger Transport: Shift to Zero Emission	?	1	2	3	4
Passenger Transport: Choice of FCV or EV	?	A	B	C	1
Passenger Transport: Biofuel Blending	?	1	2	3	4
Freight Transport Behaviour	?	1	2	3	4
Freight Transport: Shift to Low Emission	?	1	2	3	4
Freight Transport: Biofuel Blending	?	1	2	3	4

### Nuclear

A B C 1 E

Nuclear: Restart Existing Power Plants	?	A	B	C	1	E
Nuclear: Building of New Power Plants	?	A	B	C	1	E

### Fossil fuels

1 2 3 4

Fossil Fuel Power Plants: Fuel Mix	?	1	2	3	4
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### CCS

1 2 3 4

Fossil Fuel Power Plants: CCS	?	1	2	3	4
Industry: CCS	?	1	2	3	4



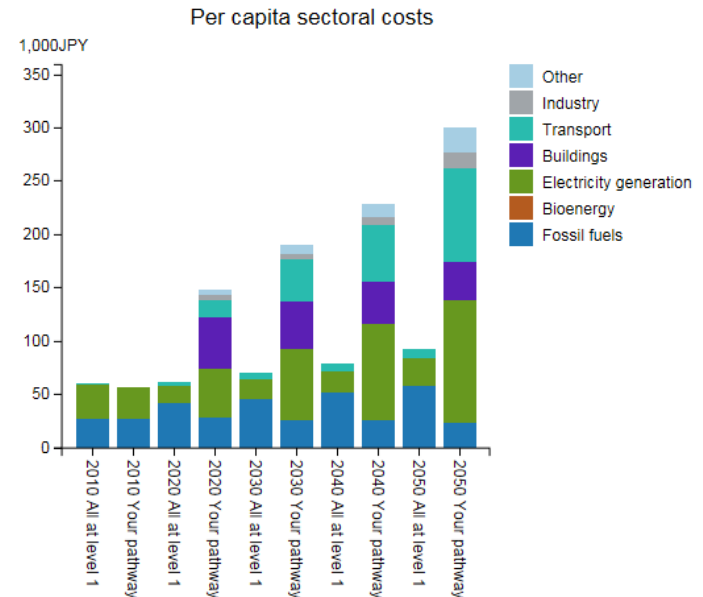
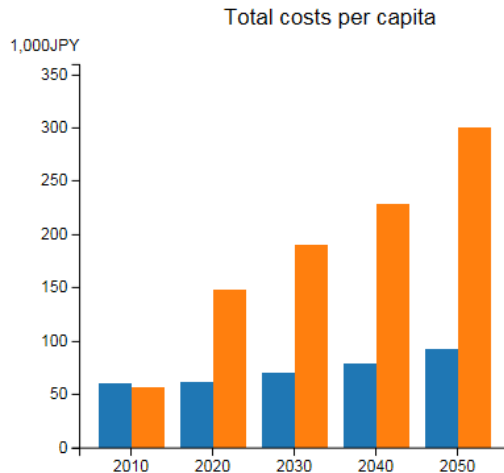
# 3E+S Policy: Economic Efficiency In the Low Carbon Navigator



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- Two indicators: “total costs per capita” and “per capita sectoral costs”.
- Under both indicators, users can see graphical comparison of associated total costs per capita and per capita sectoral costs of their chosen pathway against a “no effort” (i.e. All at level 1) pathway.

## Economic efficiency



Total costs per capita and per capita sectoral costs under “All at level 4” pathway compared with “All at level 1” pathway

# 3E+S Policy: Environmental Protection In the Low Carbon Navigator



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Low Carbon  
Navigator

- Two emissions indicators: “total GHG emissions as percentage of 1990 levels” and “emissions intensity of electricity generation”.
- For example, in the “All at level 4” pathway, emissions in 2050 are expected to be around 18% of 1990 levels, which otherwise suggest that it is possible for Japan to achieve the country’s previously- committed 80% emissions reduction target.

Total GHG emissions and emissions intensity of electricity generation under “All at level 4” pathway

GHG emissions reduction from 1990 levels (2050)

82 %

Imported primary energy (2050)

53 %

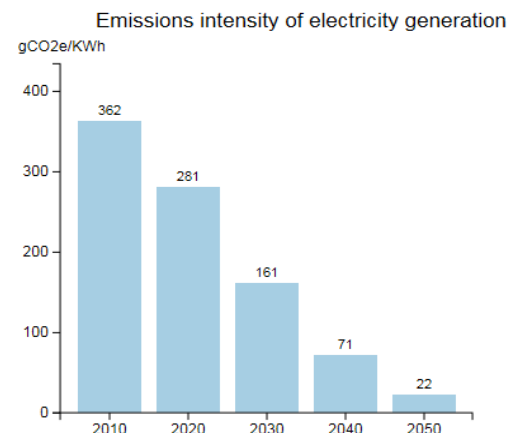
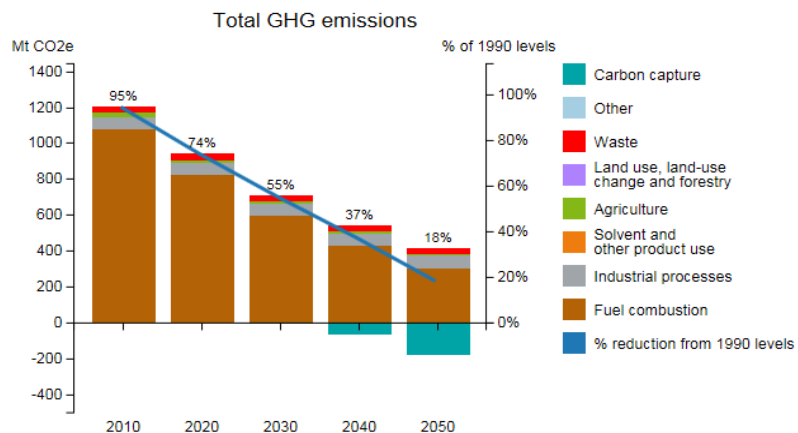
Share of renewables in power mix (2050)

63 %

Share of nuclear in power mix (2050)

20 %

## Environment



# 3E+S Policy: Environmental Protection In the Low Carbon Navigator



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- Safety—is reflected in the Low Carbon Navigator through various options for nuclear power generation.
- Although there is no agreed metric for “safety”, the “share of nuclear in power mix” is used as a proxy indicator.
- The shares are derived from the users’ inputs on two levers under the nuclear sector, namely, restarting of existing nuclear power plants and building of new plants

GHG emissions reduction from 1990 levels (2050)

82 %

Imported primary energy (2050)

53 %

Share of renewables in power mix (2050)

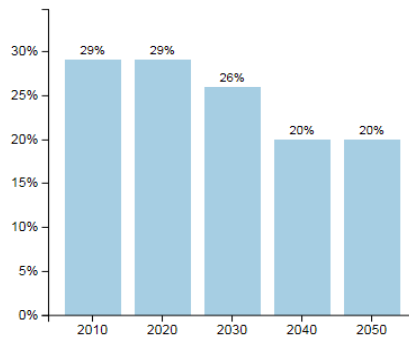
63 %

Share of nuclear in power mix (2050)

20 %

## Safety

Share of nuclear in power mix



Share of nuclear in power mix under “All at level 4” pathway

### Transport

1 2 3 4

Passenger Transport Behaviour  
Passenger Transport: Shift to Zero Emission

? 1 2 3 4  
? 1 2 3 4

### Nuclear

A B C D E

Nuclear: Restart Existing Power Plants  
Nuclear: Building of New Power Plants

? A B C D E  
? A B C D E

### CCS

1 2 3 4

Fossil Fuel Power Plants: CCS  
Industry: CCS

? 1 2 3 4  
? 1 2 3 4

# 3E+S Policy

## *In the Low Carbon Navigator*



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- The Low Carbon Navigator has been developed as a tool that gives the audience an option to look ahead to understand
  - what would happen and
  - what could be done.
- In this end, the inclusion of option to see how the chosen pathways affect governmental policies (i.e. the “3E+S” objectives), is unique and useful.
- 2050 LCN can also be used for assessing various pathways for achieving Japan’s NDC and associated additional costs.

# Measuring Japan's INDC using the Low Carbon Navigator



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- Energy-Originated CO<sub>2</sub> (INDC breakdowns for sectors)

Table 1 Estimated emissions of energy-originated CO<sub>2</sub> in each sector

	Estimated emissions of each sector in FY 2030	FY 2013 (FY 2005)
Energy originated CO <sub>2</sub>	927	1,235 (1,219)
Industry	401	429 (457)
Commercial and other	168	279 (239)
Residential	122	201 (180)
Transport	163	225 (240)
Energy conversion	73	101 (104)

[Value : million t-CO<sub>2</sub>]

Source: MOFA. <http://www.mofa.go.jp/mofaj/files/000090898.pdf>

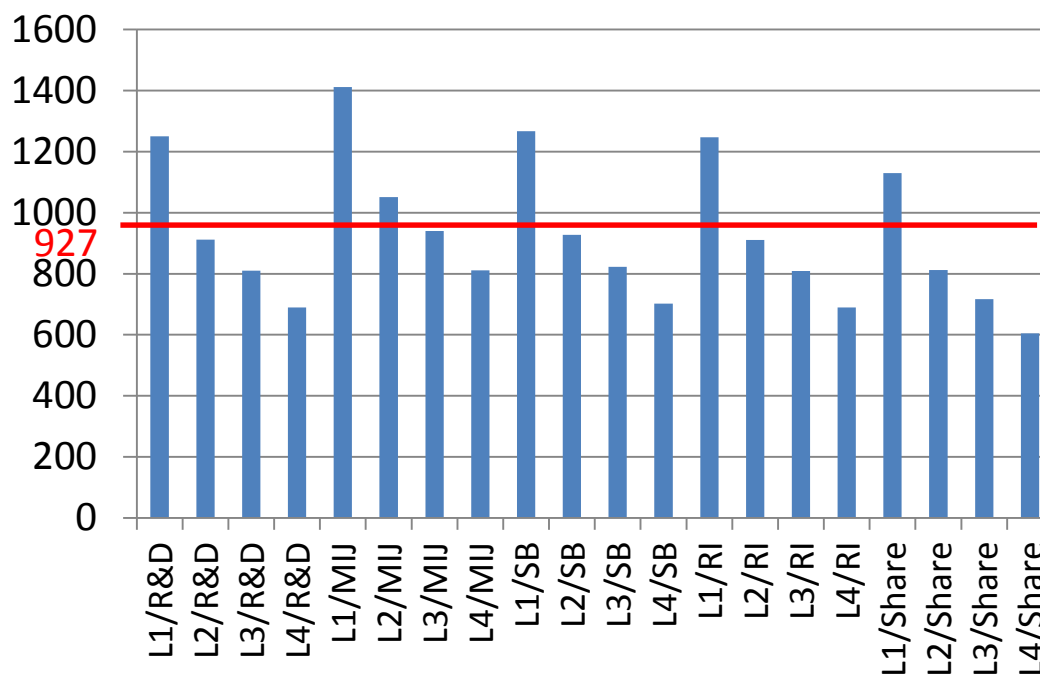
# Measuring Japan's INDC using the Low Carbon Navigator



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- 2030 pathways and those which can attain the 2030 INDC targets

2030 GHG emissions (MtCO<sub>2</sub>e/yr)



Note: Selected pathways (L1-L4 under five society scenarios) among many as example. Most L2-L4 under five society scenarios except for MIJ scenario can achieve the 2030 INDC target.

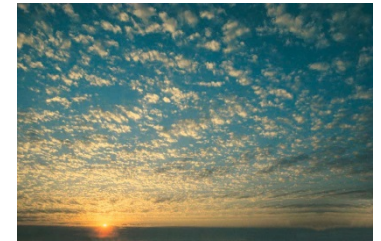
# Measuring Japan's INDC using the Low Carbon Navigator



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- Based on the sectoral breakdowns, this exercise can also be conducted for sectoral settings for transport sector, residential sector, commercial sector and industry to screen out those pathways which help achieve sectoral targets.
- Based on the available pathways, key elements or insights on how Japan can achieve her INDC can be derived, e.g. how important will renewable energy play, what is the role of nuclear energy supply, how important will be demand-side management, etc.
- If data on technology-related or sectoral employment is available, employment implications of different pathways can be estimated.

# Thank you!



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