Japan's "3E+S" Energy Policy Objectives

Recognising the importance of rethinking Japan's energy and power supply policies in the post-Fukushima era, the Government of Japan adopted an updated Strategic Energy Plan (the 4th Basic Energy Plan) in April 2014. This Plan provides a new course for Japan's energy policy. Two basic principles are reflected in this Plan (Hiranuma, 2014). First, it reiterates the so-called "3E+S" focus of the nation's energy policy, emphasising energy security, economic efficiency, and environmental protection without compromising safety. Second, it emphasises the need to look at both supply and demand side options by creating a supply-demand structure that is multi-layered, diversified, and flexible (METI, 2014b).

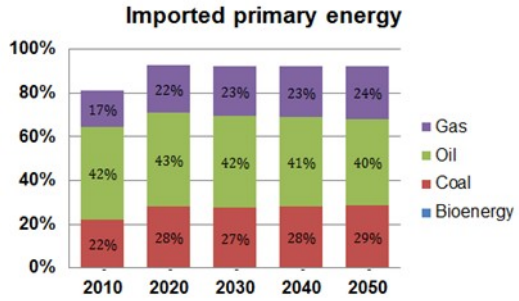
The Low Carbon Navigator can communicate on how Japan's policies related to energy and climate change can impact on the country's pronounced "3E+S" objectives. It can reinforce the "3E+S" objectives explicitly included in the Basic Energy Plan. A dedicated section in both the Excel model and the Web Tool provides options for the users to see how their chosen pathways affect these "3E+S" objectives. How the Low Carbon Navigator helps analyse these four issues is explained below and briefly outlined in Table 1.

Japans' **Energy Security** aspect is presented through two indicators. The first indicator explains Japan's dependency on imported energy in terms of percentage of imported energy (including coal, oil, gas and bioenergy) in total primary energy. Figure 1 shows imported primary energy under two example pathways. It can be seen in 2050, dependency on imported energy will substantially decrease under the Pathway of "All at level 4" compared with those under

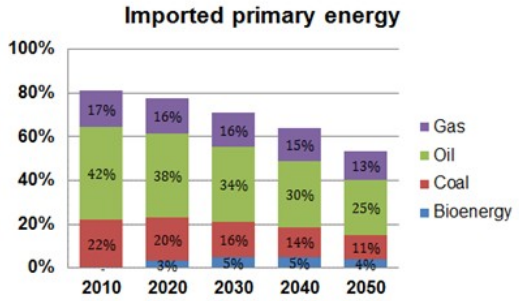
Table 1 The Low Carbon Navigator reinforces "3E+S" objective

2014 Basic Energy Plan's 3E+S objectives				
	Energy security	Economic efficiency	Environmental protection	Safety
Indicators in the Low Carbon Navigator	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.



Example pathway of "All at level 1"

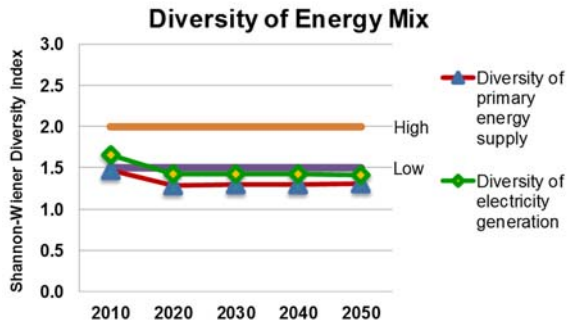


Example pathway of "All at level 4"

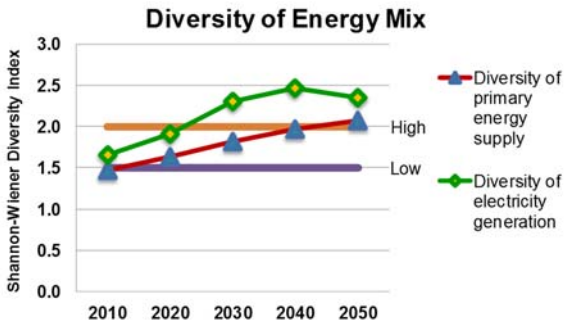
Figure 1 Imported primary energy under two example pathways

the Pathway of "All at level 1", due mainly to the introduction of renewable energy. The second indicator shows the country's diversification of energy sources using the Shannon-Wiener Diversity Index[i], *H*, indicating both abundance of types and evenness of energy resources in the energy mix. *H* is usually between 1.5 and 2, and lower than 1.5 indicates low diversity and higher than 2 indicates high diversity in energy resources. *H* increases in line with both the richness of types and the evenness of energy resources in the energy mix. Figure 2 shows *H* under two example pathways. For both diversity of primary energy supply and diversity of electric generation, *H*s are much higher under the Pathway of "All at level 4" compared with those under the Pathway of "All at level 1" due to the introduction of renewable energy which increases both the richness and evenness of energy resources in the energy mix.

The **Economic Efficiency** objective in "3E+S" is reflected in the Low Carbon Navigator through

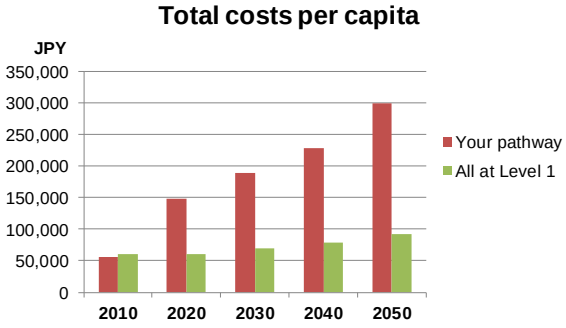


Example pathway of "All at level 1"



Example pathway of "All at level 4"

Figure 2 Shannon-Wiener Diversity Index under two example pathways



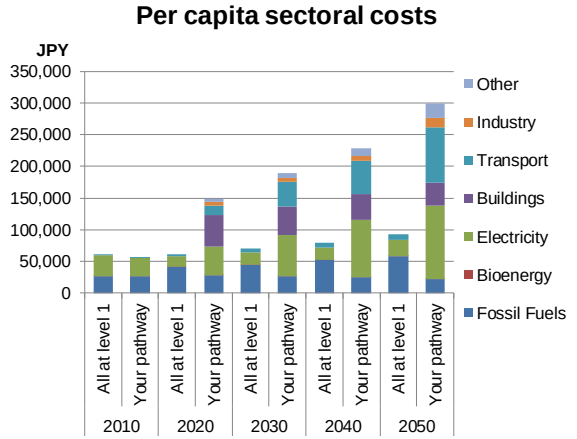


Figure 3 Total costs per capita and per capita sectoral costs under "All at level 4" pathway compared with "All at level 1" pathway

[i] **Shannon-wiener Diversity Index**: Defined as $H = -\sum_{i=1}^{s} P_i \times \ln P_i$, where H: the Shannon Diversity Index; P_i: fraction of the entire population made up of species i; s: number of species encountered. Shannon-wiener Diversity Index is commonly used to characterize species diversity in a community, which accounts for both abundance and evenness of the species present. It increases as both the richness and the evenness of the community increase.

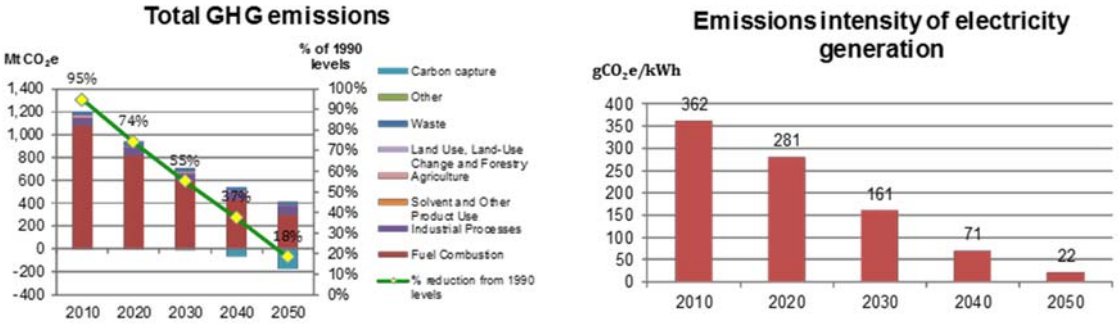


Figure 4 Total GHG emissions and emissions intensity of electricity generation under "All at level 4" pathway

two indicators, namely *"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 (see example in Figure 3).

The **Environmental Protection** objective of the 2014 Basic Energy Plan can be discussed using the Low Carbon Navigator through 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 (Figure 4), 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.

Finally, the last of the "3E+S" objectives—**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 (see Figure 5). 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.

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.

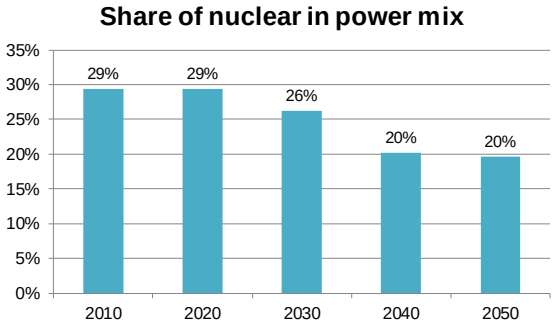


Figure 5 Share of nuclear in power mix under "All at level 4" pathway