The Socioeconomic Footprint of the Energy Transition in Japan

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Overview

Japan is one of the world's most economically and industrially advanced nations. Nevertheless, it faces future challenges because of its ageing population (presently 127 million), shrinking workforce and shrinking space for innovation – all of which have the potential to slow economic growth. Japan is also one of the world's largest consumers and importers of energy. Lacking own fossil fuel resources, it relies on imports for nearly all of its supply. Import dependence increases vulnerability to volatile prices and lower energy security. Nuclear power was one domestic source, until 2011 came with a devastating tsunami and related accidents at the Fukushima Daiichi nuclear plant. Closing nuclear power in response led to a 30% gap in electricity supply (METI, 2020), which then was partly covered by energy efficiency and conservation measures and partly by increased imports of fossils and increasing renewables.
On 26 October 2020, the newly appointed Prime Minister Yoshihide Suga expressed Japan's commitment to reducing its long-standing reliance on coal-fired power generation and to achieving carbon neutrality by 2050. His initial statement was revised, reiterated and strengthened in the Leaders Summit on Climate in April 2021, which resulted in a higher, much more ambitious target to reduce the country's greenhouse gas emissions 46% by 2030 (compared to 2013 levels) – up from the previous target of only 25% (Reuters et al., 2021).
Achieving such targets will require enormous efforts and will involve structural changes across the economy. How will these changes affect the well-being and overall welfare of the Japanese people? Can this transition in the energy mix help address the above-mentioned challenges? The paper addresses these questions and gives answers.

Methods

The results are based on a scenario comparison using a macroeconometric modelling approach. IRENA (2020) has developed two scenarios, one based on the then current global pledges and plans, including the NDCs and other national energy plans. The second scenario increases ambition and aims at meeting the target of limiting global warming to 2 degrees and below. Both scenarios are complete in the sense that energy supply and demand is projected, the energy mix based on global potentials, and the respective investment pathways necessary to attain the energy transition. For Japan, the more ambitious scenario aligns well with the latest plans published for the country with non-fossil fuel sources accounting for roughly 60% of the power supply by 2050, more than double the current mix. Renewables are to account for 36-38% of this, with 1% coming from hydrogen/ammonia. By 2050, nuclear is expected to contribute 20-22%. LNG, coal and oil will contribute 20%, 19% and 2%, respectively.
This set of energy economic drivers and investment pathways is then implemented in the environmental-energy-economy model E3ME. E3ME has been developed by Cambridge Econometrics (Pollitt et al. 2021). The model version used to produce the results analysed in this paper has been developed and tailored for this analysis[1]. The macroeconomic model consistently describes the annual inter-industry flows between economic sectors, their contributions to personal consumption, government, equipment investment, construction, inventory investment, exports as well as prices, wages, output, imports, employment, labor compensation, profits, taxes, etc. for each sector as well as for the total economy. In the behavioral equations, decision routines are modeled that are not explicitly based on optimization behavior of agents but are founded on bounded rationality. The parameters are estimated econometrically from time series data. Producer prices are the result of mark-up calculations of firms. Output decisions do not stem from an optimization process but follow observable historic developments, including observed inefficiencies. The economic simulation gives results for economic indicators such as employment, GDP or production under the new circumstances of the scenario. The differences of these indicators for different simulation runs can be attributed to the differences between the pathways outlined in the transition scenarios. The Japanese economy is one of 72 countries and regions in the model explicitly addresses. Hence, the results fro the economic effects of the energy transition in Japan are highly Japan specific on the one hand, but also reflect trade aspects from being part of the global modelling exercise and the global scenario.

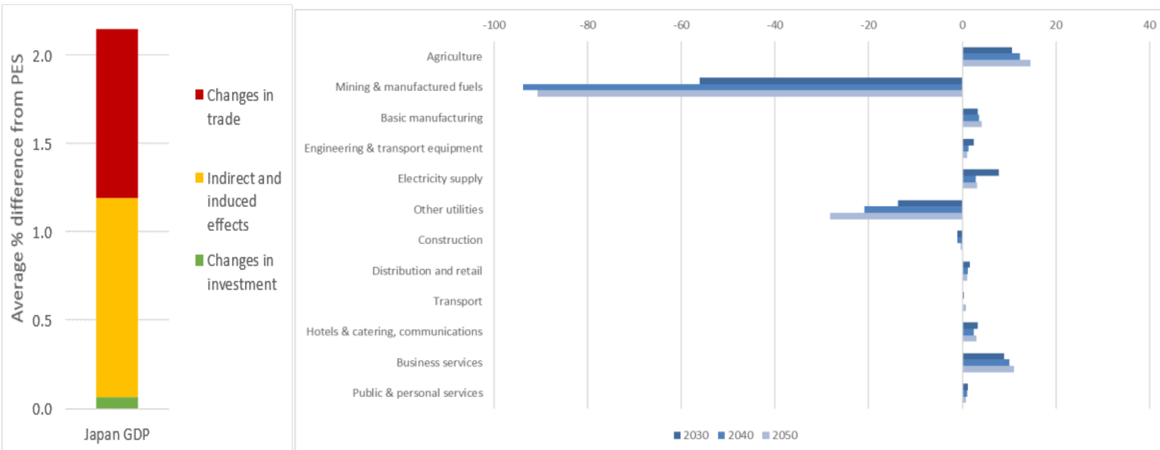
Results

Under the more ambitious scenario, Japan's economy is estimated to perform better: GDP is 2.14% higher, on average, during the 2020-2050 period. In 2050, for example, GDP is 2.6% higher and in cumulative terms, the country will be adding USD 4.8 trillion to the GDP path followed with less ambition. This additional GDP has various drivers, such

[1] In particular with the suppprt of Xavier Casals, Rabia Ferroukhi (IRENA).

as trade, investment, and energy prices. Trade features largely, since the pathway of the more ambitious energy transition frees resources currently bound in imports. Energy prices are higher in the very early stages of the transition to the reflect renewable energy and efficiency to become increasingly economical. Carbon pricing increases governments revenues and frees resources for income tax decreases with positive impacts on consumption and GDP (left side of Figure). To gain insights into the structural elements underpinning the socio-economic footprint, IRENA's macroeconomic analysis disaggregates the outcomes by sector (right side of Figure 1).

Figure 1: Relative differences between the scenarios, averaged for GDP and by decade for sectoral output.



Other sectors in the wider economy – such as basic manufacturing, engineering and transport equipment, and construction – experience positive impacts due to transition-related investments. If additional measures were introduced, more domestic value could be captured for Japanese industry, for instance reclaiming its early leadership in renewable energy (Kimura, 2019).

Conclusions

IRENA's report on the socioeconomic footprint of the energy transition in Japan is very timely and the results are encouring. To reflect these latest commitments, in 2021 the Ministry of Economy, Trade and Industry (METI) published a revised draft of the Strategic Energy Plan, which aligns with the more aggressive targets According to the plan, "maximum efforts will be made to introduce renewable energy based on the principle of top priority". Businesses, local governments, renewable energy industries and think tanks have called for setting a higher renewable energy target (of 40-50%), as they deem it feasible to scale up the adoption of renewables (REI, 2021).

Overall economic results, but also the contribution to innovation, digitalisation and addressing opportunities in rural regions are contained in the more ambitious pathway. With renewables abundantly available in Japan's countryside, the energy transition provides a unique opportunity to create jobs and encourage people to return to rural regions, addressing spatial re-alignment of the energy transition (for the concept of alignments and mismatches under the energy transition, see IRENA, 2020). Increasing digitalisation efforts in Japan will have an impact on the wider economy and in the energy sector. The digitalisation of health care, for example, can translate into better health services for rural residents. Access to rural areas can be improved through self-driving electric buses. For the wider economy, reducing import depence and increasing energy security provides large benefits.

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