

Dynamics in New Zealand's direct and embodied energy consumption between 2006/2007 and 2012/2013

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Overview

As a global processing crisis, climate change has caught more attention, especially in the last decade. Being an island country with a vast sea area, a stretch of the sea coast, and an economy relying extraordinarily on agriculture and international tourism, New Zealand faces a greater vulnerability to the resulting damage of climate change. Changes in climate, such as higher surface temperature, rising sea level and growing ocean acidification, have already been certainly posing a severe threat to New Zealand (Archie et al., 2018; Rouse et al., 2016). These changes are the consequences of the excessive emissions of GHGs (greenhouse gas) such as carbon dioxide, methane, and nitrogen oxide in the atmosphere. Despite accounting for less than 0.2% of the world's GHGs, New Zealand has a high level of emissions per capita and emissions per unit of GDP (gross domestic product) when compared with other industrialized countries. Thus the devoted efforts in mitigating climate change are the same important in New Zealand. On November 7, 2019, the Zero Carbon Bill was passed with near unanimity by New Zealand Parliament with one vote against, which enshrines New Zealand to net zero emissions by 2050 or sooner, along with a substantial reduction in other GHGs. Although agricultural emissions rank first in New Zealand's GHGs inventory (Diaz-Rainey and Tulloch, 2018), they are primarily offset by forest carbon sink. On the contrast, the emissions linked to energy consumption can go to zero through the nation's moving towards 100% renewable energy. Therefore, more in-depth insight into New Zealand's energy consumption would be beneficial for its transition to zero carbon.

The main contribution provided by this study consists of three aspects. Firstly, this study is the first attempt to conduct a decomposition analysis of energy consumption by New Zealand. By analyzing the evolution of New Zealand's energy consumption and unveil its influential factors, insights into the formulation of energy policy targeted at reducing the dependence of economic development on energy consumption could be provided. Second, this study makes an overall comparative analysis of direct and indirect energy flows in different economic sectors and different components of final demand. Thus, the primary source of New Zealand's energy consumption could be found. Third, decomposition analysis of New Zealand's energy consumption is made from various perspectives in this study to present a comprehensive overview of its influential factors. It not only decomposes the national and sectoral's energy consumption from the production perspective but also its each final demand component's energy consumption from the consumption perspective. Thus, the paper will identify what factors shape New Zealand's energy profile and evaluate whether the effects of these factors are consistent for different economic sectors and final demand categories.

Methods

1. environmentally-extended input-output (EEIO) analysis
2. structural decomposition analysis (SDA)

Results

- Six influential factors (the direct energy intensity, production structure, population scale, per capita consumption volume, demand structure, the changes in the direct energy consumption

from private consumption) contribute to the decrease in New Zealand's total direct energy consumption between 2006/2007 and 2012/2013.

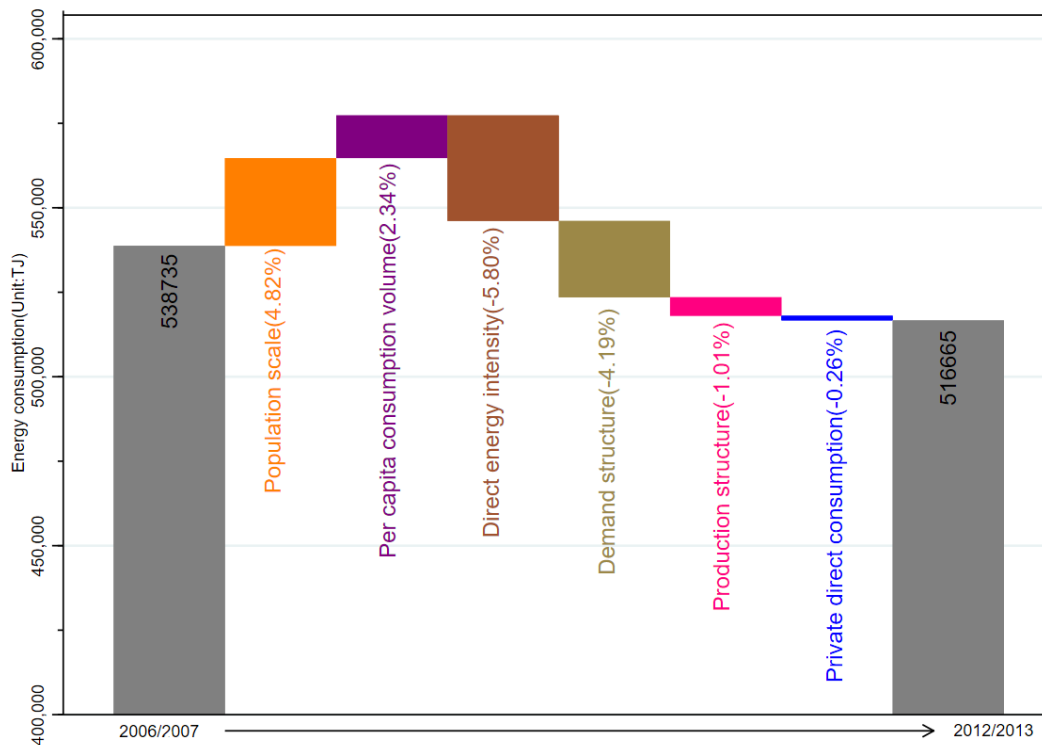


Figure 1. Contribution of each factor to the decreases in the total direct energy consumption between 2006/2007 and 2012/2013

- Among them, the growing per capita consumption volume and population served as accelerators to promote direct energy consumption, while the other factors acted as retardants to decrease direct energy consumption.
- The population has the largest promotion effect, while the direct energy intensity has the largest decreasing effect.
- The effect of each factor on direct energy consumption in different sectors varies differently. With a few exceptions, the affected directions of both demand structure and production structure to direct energy consumption in all sectors are negative. Moreover, the affected directions of both per capita consumption volume and population to direct energy consumption in all sectors are positive.

Conclusions

The findings of the paper help understand the direction in reshaping New Zealand's energy consumption profile and highlight significant policy implication. First, "Transport" was the primary source of direct energy consumption. Thus, New Zealand should gradually get rid of its reliance on fossil-fuel vehicles and enhance people's use of green transport. Integrated measures such as phasing out old vehicles, improving the public traffic problems and instituting strict emissions standards could be adopted. Second, private consumption and exports were the primary sources of embodied energy consumption. On the one hand, New Zealand needs to pay more attention to the household's energy utilization. Some measures aiming to adjust household energy consumption structure, guiding people's consumption behaviour and promoting the application of energy-saving products should be considered. On the other hand, New Zealand should optimize the mix of exports and raise the share of less energy-intensive products. Third, reducing direct energy intensity has been proven to be the most effective ways to restrict the growth of energy consumption. Thus for the sectors with higher direct energy consumption like "Transport", "Electricity Generation", "Pulp, Paper & Print" and "Food

Processing, Beverage & Tobacco”, more efforts like eliminating backward production facilities, improving energy structure and increasing the proportion of clean energy are required to be done to strengthen its energy efficiency management. While for these sectors with higher embodied energy consumption, New Zealand should put stress on improving their utilization efficiency to intermediate inputs and reducing their losses during the intermediate production process. Fourth, considering that changes in production structure leading to the decline in both the direct and embodied energy consumption, some measures targeted at optimizing production structure such as reducing the inputs from energy-intensive sectors and guiding more investment in high-tech industries could be implemented.

References

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