First Results from New Zealand's National Energy Efficiency and Conservation Strategy

Ivan Petroff
Department of Management and International Business,
Massey University, Albany
Address: 31 A, Jellicoe Rd., Murrays Bay, Auckland 1311, New Zealand
Phone: (+649) 4794705, Fax: (+649) 4418109
E-mail: ivpetroff@hotmail.com

Abstract

The purpose of this paper is to present first results from the implementation of the New Zealand's National Energy Efficiency and Conservation Strategy (The Strategy) and to discuss some methodological problems of monitoring and data interpretation.
Energy intensity as a key indicator of energy efficiency is presented at the national level - measured by "the total primary energy supply (TPES) to GDP" ratio; and measured by "the total consumer energy (TCE) to GDP" ratio.
The paper suggests that data collection on end-consumers level will facilitate the energy efficiency monitoring and analyses. Reliable assessment of energy efficiency trends on industrial and national level can be made in the long term only (5-10 year period). The systems approach should be applied, taking into consideration all major factors, such as market conditions and pricing of energy, local energy sources, structure of the national economy, local climate, living standards, etc.

Keywords

Energy Policies, Energy Efficiency, Energy Intensity

1. The Strategy

The improvement in energy efficiency and reducing green house gas emissions is of common concern of governments, businesses, non-governmental organizations and individuals. All parties are introducing various policy options, such as financial incentives, voluntary agreements, market reforms, research and development, and others (Geller, 2003). A national strategy, developed and promoted by the government, can be powerful booster for energy efficiency and uptake of renewable energy.

Lack of progress in improving energy efficiency during the past decade was the major reason for the development of the Strategy. Between 1990 and 1999 the GDP has increased by 22.57 percent, and the total primary energy supply (TPES) has increased also by similar rate – 22.53 percent. International monitoring organizations, such as International Energy Agency (IEA) and World Resource Institute, point out that the efficiency of energy use in New Zealand is relatively low. "New Zealand's manufacturing structure has become more energy intensive and efficiency of energy use is low" (IEA, 2001).

The Strategy (EECA, 2001) was officially released in September 2001. A draft Strategy was released in March 2001 with more than 20 public presentations throughout the country. The draft received 339 written submissions. Many suggestions put forward by these submissions have been incorporated in the final text. The purpose is to promote energy efficiency, energy conservation and renewable energy and move the country towards a sustainable energy future. It will help the country to meet its obligations under the Kyoto Protocol.

The Strategy has two high level targets relating to energy efficiency and renewable energy:

- At least 20 percent improvement in economy-wide energy efficiency by 2012.
- Increase renewable energy supply to provide a further 30 PJ of consumer energy by 2012.

These targets are considered to be moderate and reasonable. Twenty percent improvement in energy efficiency by 2012 means an average annual efficiency improvement target of about 1.8 %. For comparison, a recent European Commission study (EC, 2001) predicts an average annual decrease in total energy consumption intensity in the EU member states of around 2.0 % per year between 2000 and 2010. Achieving the Strategy's 20 % energy efficiency target could save the country up to 100 PJ a year.

The Strategy consist of a number of generic policy measures, applied as appropriate to address barriers and meet specified sector needs. The policy measures are structured into eight categories: Information, Education and training, Pricing, Financial assistance, Institutional commitments, Rules and plans, Standards, Research.

The Strategy is organized into five programmes as follows:

- Central and local government,
- Energy supply,
- Industry (including agriculture),
- Buildings and appliances,
- Transport.

Each programme has core objectives, a series of proposed measures, timeframes, and institutional responsibilities. The implementation of the programmes is supported by action plans, providing detailed information on each measure and specific actions, how achievements will be measured, key milestones, and lead/support agencies (EECA, 2001).

The Strategy involves a large number of players – government departments, crown agencies, local authorities, Maori groups, educational institutions, energy businesses and trusts, consumer interests, professional and trade bodies, through to the vast array of energy users. Most organizations have not yet built Strategy commitments into their own policies and plans. Further consultation between government agencies and these key players is necessary to develop agreement and firm institutional commitment (EECA, 2001). This is a vital condition for successful Strategy implementation.
The government and its agencies supported actively the Strategy implementation by adopting a range of measures, such as Minimum Energy Performance Standards and mandatory energy performance labelling.

2. Implementation and Results

In 2003 the New Zealand's Energy Efficiency and Conservation Authority (EECA) published first results from the implementation of the Strategy (EECA, 2003). The report outlines the country's progress at the start of the Strategy's second year. In 2001 (end March 2002) nationwide energy efficiency improved by 1.9 percent. Within this period 536,000 tonnes less carbon dioxide were emitted in New Zealand.

The progress has been measured by a national energy efficiency index, which is based on TCE/GDP and it comprises indicators for sectoral and sub-sectoral monitoring. The development of this index followed the recommendations of the APEC expert group on energy efficiency and conservation. Since there is no single universally acceptable indicator/measure of energy efficiency, there is a need to use a "basket of indicators", based on the energy intensity pyramid, in which a national energy efficiency index needs to be linked to sectoral indicators, as well as sub-sectoral indicators. It is also important to decompose energy intensity into structural activity and technical factors (APEC, 2002). A similar index is used successfully by the Canadian Office of Energy Efficiency (OEE, 2004, p.10). Further research is needed on the components (e.g. market conditions and pricing of energy, local energy sources, structure of the national economy, local climate, living standards, etc.) to ensure that this index continue to improve as means of energy efficiency measurement. Another problem is energy data availability for sectoral and sub-sectoral monitoring.

The sectoral results are presented in Table 1. The energy efficiency has improved remarkably in the transport sector (3.5%), and it has declined slightly in the primary (- 0.4 %) and residential (- 0.3 %) sectors.

Table 1: Energy efficiency changes in the sectors of New Zealand's economy in 2001

Sector	*Share of energy consumption*	*Energy efficiency change*
Transport	41 % (190 PJ)	3.5 %
Industrial	30 % (137 PJ)	1.0 %
Residential	13 % (59 PJ)	- 0.3 %
Commercial	9 % (43 PJ)	2.1 %
Primary production	7 % (34 PJ)	- 0.4 %

Source: EECA New Zealand, 2003

Overall, the use of energy by transport sector increased, but it was used more efficiently (EECA, 2003). Freight transport contributed an energy improvement of 3.9 PJ (a 5.8 % improvement, mostly in road freight), while passenger transport contributed 2.7 PJ (a 2.2 % improvement). The industrial sector incorporates the activities in the economy, which manufacture products, such as pulp and paper, metal products, chemicals, construction, food processing. Energy efficiency improved by 1.0 %, saving about 1.4 PJ. Performance by this sector was a reversal of the year 2000 pattern, when it used 2.1 PJ extra as a result of worsening energy efficiency. Explanations for residential sector's decrease in energy efficiency include changing demographics. New Zealand is trending towards larger homes with fewer family members living in them. The energy is used mainly for water and home heating and appliances. The commercial sector includes a broad range of activities such as retail and wholesale trade, finance, government, health, education, tourism, and other similar services. Most of the energy used is for environmental control in large buildings i.e. lighting, heating, ventilation and air conditioning. The primary sector includes farming, forestry,

mining, fishing, crops and other agriculture. Although its overall energy efficiency declined, there were still important gains in various sub-sectors, such as forestry and dairy farming.

There is not much reliable data on energy end-use that can allow the causes for these changes to be determined. The International Energy Agency (IEA, 2001) recommends a special support of data collection on energy end-use by funding and regulation. As far as possible, the greenhouse gas emissions benefits and associated costs of the components of the Strategy to be quantified. A specially designed data collection system, corresponding to targets, that are measurable, reasonable and practicable, will improve the process of identification of the causes behind the results. This will improve the progress monitoring and the design of cost-effective measures to bridge the gap between targets and results.

3. Energy Intensity Analysis

The Strategy implementation results can be complemented by analysis of the country's energy intensity for a longer period. The energy intensity has been conventionally perceived as a synthetic indicator on efficient energy use (IEA, World Resource Institute – WRI; Alcantara, Duro, 2004)

Energy Intensity, measured by energy consumption per GDP PPP in 1995 international dollars is defined as the amount of primary energy used per unit of income generated by a country's economy (WRI, 2004). Consumption equals indigenous production plus imports minus exports plus stock changes minus energy delivered to international marine bunkers. IEA refers to these data as Total Primary Energy Supply (TPES). Energy losses from transportation, friction, heat, and other inefficiencies are included in these totals. All sources of energy (coal, nuclear, hydroelectric, etc.) are included here. Gross Domestic Product (GDP), PPP in constant 1995 international dollars is gross domestic product converted to international dollars using Purchasing Power Parity (PPP) rates, and rescaled to 1995 to give a common reference year.

In this paper two key indicators of energy efficiency are used at the national level:

- Energy intensity, measured by "the total primary energy supply (TPES) to GDP" ratio;
- Energy intensity, measured by "the total consumer energy (TCE) to GDP" ratio.

The dynamics of the national energy intensity indicators between 1994 and 2002 are presented in Table 2. In that period of time energy intensity (TPES/GDP) has improved by 8.5 percent and (TCE/GDP) – by 8.7 percent. But as it can be seen, there is no sustainable trend upwards or downwards for the whole period;

Table 2: Energy intensity indicators for New Zealand (1994-2002)

Year (March end)	*TPES (PJ)*	*TCE (PJ)*	*GDP (Billion NZD, 1995-96 prices)*	*Energy Intensity (TPES/GDP)*	*Energy Intensity (TCE/GDP)*
1994	655.89	417.3	84.447	7.77	4.94
1995	676.39	424.3	88.963	7.60	4.77
1996	700.72	422.5	92.679	7.56	4.56
1997	721.56	429.3	95.502	7.56	4.50
1998	721.55	439.0	97.256	7.42	4.51
1999	774.47	445.7	97.369	7.95	4.58
2000	760.50	460.0	102.519	7.42	4.49
2001	769.25	462.7	105.177	7.31	4.40
2002	773.16	490.4	108.777	7.11	4.51

Sources: Statistics New Zealand, MED New Zealand, 1997, 2000, 2004

Other researchers, slightly shifting the observation period, can obtain different rate of improvement. "For technological sustainability, we look at the amount of primary energy needed to produce a unit of gross domestic product. This indicator has declined (become more favourable) by 13 % in the decade from 1990 to 2000" (Melhuish, 2002).

As it can be seen from Table 2, in 2001, the first year of the launch of the Strategy, TPES/GDP improved by 1.48 %, and TCE/GDP – by 2.00 %. These results are similar to the reported 1.9 % by EECA. In year 2002 TPES/GDP improved by another 2.7 %, but TCE/GDP increased (got worse) by 2.5 %. According to these data, the next EECA annual report should state, that in 2002 nationwide energy efficiency declined by about 2.4 percent. A conclusion could be drawn that sustainable trends in energy efficiency changes at a national level can be identified only in the long term.

Many different factors affect the levels of energy intensity and can explain the differences across the energy-consuming sectors (Bernstein et al., 2003). Some of these factors, which are typical for New Zealand, are presented below.

The energy retail prices are relatively low. For example, some 2002 prices were: Electricity for industry – 0.0354 USD/kWh, Electricity for households – 0.0705 USD/kWh, Unleaded premium – 0.512 USD/l (IEA, 2003). For that reason the demand side of the market is not working effectively.

Domestic transport accounts for more than 40 percent of consumer energy use, and it continues to grow fast. Growth in transport has exceeded the growth in economic activity (GDP). New Zealanders have the second highest car ownership in the world. Cars use 58% of all transport energy and 23% of all consumer energy used in New Zealand.

There is a big potential for further improvements in domestic space and water heating. A few big industrial consumers, such as an aluminium smelter and a steel plant, can easily distort the national picture. The renewables contribute about 30 percent of TPES. There are no significant government policies to support new renewables development.

There are some technical problems in measurement and presentation of energy efficiency to make it comparable nationally and internationally.

There is no internationally accepted list of the sectors of the national economy, which to be used in the sectoral analysis. For example, the New Zealand list includes: Transport, Industrial, Residential, Commercial, and Primary production. The Canadian list (OEE, 2004) includes: Transport, Industrial, Residential, Commercial, Agriculture, and Electricity generation. The energy measurement system of the Strategy is based on Joule (Peta Joules), while the international data, provided by organizations such as the IEA, the World Bank and WRI, present energy in metric tons oil equivalent (toe). Such type of problems could be resolved by development of internationally accepted guidelines for energy efficiency monitoring.

4. Conclusions

4.1. The accuracy of the assessment of the Strategy results can be improved by using a set of indicators representing the complex market, economy, climate and demographic conditions.

4.2. A specially designed data collection system will improve the process of identification of the causes behind the results.

4.3. Sustainable trends in energy efficiency changes at a national level can be monitored only in the long term (5-10 years). This is an obstacle for fast assessment and corrective actions.

4.4. The introduction of internationally recognised guidelines for national energy efficiency monitoring could facilitate the compatibility of the results and international comparisons.

Acknowledgements

The author is thankful to the staff members of the Energy Efficiency and Conservation Authority in Wellington, New Zealand, for providing data and valuable opinions, included in this paper.

References

Alcantara, V., Duro, J., 2004. Inequality of energy intensities across OECD countries: a note. Energy Policy, Volume 32, Issue 11, July 2004, 1257-1260.

APEC, 2002. Report on Completed Projects: Supporting High Quality Energy Efficiency Indicator Developments. APEC Expert group on energy efficiency and conservation meeting, Mexico, April 2002.

Bernstein, M., et al., 2003. State-Level Changes in Energy Intensity and Their National Implications. RAND, Santa Monica, CA.

Energy Efficiency and Conservation Authority (EECA), 2001. National Energy Efficiency and Conservation Strategy. Wellington, New Zealand.

EECA, 2003. The Year Two Report on the National Energy Efficiency and Conservation Strategy. Wellington, New Zealand.

European Commission (EC), 2001. Economic Evaluation of the Sectoral Emission Reduction Objectives for Climate Change. Report by Acofys, AEA Technology.

Geller, H., 2003. Energy Revolution: Policies for a Sustainable Future. Island Press, Washington, DC, Chapter 3.

International Energy Agency (IEA), 2001. Energy Policies of IEA Countries, "In-Depth Review": New Zealand.

IEA, 2003. Key World Energy Statistics. www.iea.org.

Melhuish, M., 2002. Energy and Sustainable Development in New Zealand. A report to HELLIO International. http://www.helio-international.org/Helio/Reports/2002/English/NewZealand/

Office of Energy Efficiency (OEE), 2004. Energy Efficiency Trends in Canada, 1990 to 2002. Natural Resources Canada, Ottawa.

World Resources Institute (WRI), 2004. Energy Intensity, Technical Notes. http://earthtrends.wri.org/searchable_db/index.cfm?theme=6