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# **Environmental Performance Indicators for Energy Sector Industry**

**A thesis presented in fulfilment of the requirements  
for the degree of**

**Masters in Applied Science  
in  
Natural Resource Management**

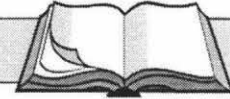
**at**

**Massey University, Turitea Campus,  
New Zealand**

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**2000**

## Abstract



Mounting evidence regarding the degradation of our environment and a growing sense of shared responsibility has provided the impetus to develop multilateral environmental agreements to address global environmental problems. Concerns regarding unsustainable energy consumption and production patterns have also underscored the need to improve environmental monitoring.

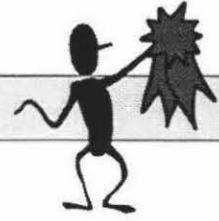
This research provides an analysis of the role and status of environmental performance indicators for energy sector industry in New Zealand. The environmental indicators considered are those that are directly aligned to energy consumption and production patterns.

In order to be able to identify and isolate the range of issues associated with energy consumption and production patterns, it is necessary to understand both the factors that influence energy use and the effects that arise. Factors that can be utilised as environmental indicators include, energy efficiency, energy intensity, energy fuel mixes and energy prices, and the carbon dioxide emissions associated with energy use.

Much progress has been made at a national and international level in the development and use of environmental indicators for energy sector industry. The UN, OECD, and Natural Resources Canada all utilise the above-described environmental indicators to assess energy consumption and production patterns. This progress provides useful insight for the MfE in the development of their national energy indicators.

The MfE's energy indicators when introduced will prove a fundamental monitoring tool for policy makers in New Zealand. Environmental indicators will enable policy makers at either a local, national or international level to be able to accurately monitor and evaluate the environmental consequences associated with energy consumption and production patterns (including those of energy sector industry). From this monitoring, policy makers will be able to assess the effectiveness of their environmental policy frameworks. In doing so, policy makers will avoid misinterpreting or inappropriately responding to their environmental policy frameworks or obligations.

## Acknowledgements



I wish to express my sincere thanks to the regional authority representatives and industry survey respondents that provided input to my research. I specifically wish to acknowledge the following persons that have mentored and/or provided encouragement and critique to this research:

<i>Mr. Mark Robinson</i>	<i>Hyprotech, Canada</i>
<i>Dr. John Holland</i>	<i>Massey University</i>
<i>Mr. Nigel Jollands</i>	<i>Ministry for the Environment</i>
<i>Mr. Ted Jamieson</i>	<i>Energy Efficiency and Conservation Authority</i>
<i>Mr. Robin Brassell</i>	<i>Consultant</i>
<i>Mr. Brian Rawson</i>	<i>Voluntary Challenge and Registry Inc., Canada</i>
<i>Ms. Elizabeth Yeaman</i>	<i>Energy Efficiency and Conservation Authority</i>
<i>Mr. Gary Ironside</i>	<i>Environment Canada</i>
<i>Mr. Wayne Hennessey</i>	<i>Coal Research Institute</i>
<i>Mr. Michael Taylor</i>	<i>Ministry of Commerce</i>

Each of these above named persons has endowed me with open, thoughtful and invaluable comments. Not only has this interaction provided me with valuable knowledge but, I have been additionally blessed with the warmth of both establishing and extending many existing friendships. I also wish to acknowledge my youngest but by no means smallest, reviewer – my beautiful daughter Ashleigh. I never cease to be impressed by her wonderfully inquisitive mind, tireless patience and support, particularly through my internment in Canada. Not only does she know how important it is for each of us to strive to create a sustainable environment, but she is now also empowered with the knowledge of what environmental indicators can achieve.

My sincere thanks to all

Jo Kissick

## Definitions



**Consumer energy (observed and calculated), end use energy, energy-sector industry, primary energy, secondary energy, total final consumption, total primary energy supply and useful energy** are terms that are used throughout this document. The following provides an interpretation of these terms, as used within the context of the agencies or individuals listed below:

**Consumer energy (calculated)** = total primary energy +/- total energy transformed (to another type of energy, e.g. gas to electricity) - non-energy uses (primary energy used for other purposes e.g. bitumen for roads, natural gas as feedstock to produce methanol and ammonia urea).

*Statistics New Zealand*

**Consumer energy (observed)** = agriculture consumer energy + industrial consumer energy + commercial consumer energy + domestic consumer energy + transport consumer energy

*Statistics New Zealand*

**End use energy** is similar to secondary energy but does not include non-energy uses or uses and losses by the energy industry itself.

*Minister of the Environment, Canada*

**Energy sector industry** (for the purposes of this thesis) is defined as including energy generators, transformers and consumers within the industrial sector, and excludes the residential, commercial, agricultural and transport sectors.

*Kissick*

**Primary energy** sources include non-renewable sources such as coal, oil and gas and renewable sources such as hydroelectricity, wood, solar and wind energy.

*Canterbury Regional Council*

**Primary energy** is delivered energy plus losses incurred in converting energy resources into purchased heat and electricity.

*International Energy Agency*

**Primary energy** is energy as it is first produced. “Primary Energy” represents the total requirement for all users of energy in Canada, including energy used by the final consumer, intermediate uses of energy in transforming one energy form to another (e.g. coal to electricity), energy used by suppliers in providing energy to the market (e.g. fuel for pipeline compressors), and also imported energy minus exported energy.

*Environment Canada*

**Primary energy** is the total requirements for all uses of energy, including energy used by the final consumer, non-energy uses, intermediate uses of energy, energy in transforming one energy form to another and energy used by suppliers in providing energy to the market.

*Natural Resources Canada*

**Secondary energy** is the energy available for use by the residential, commercial, and industrial sectors and for transformation into other forms of energy. Secondary energy also includes hydrocarbons, like oil, that is used for non-energy purposes, such as petrochemical feedstocks. Secondary energy is less than primary energy because of losses in conversion and distribution.

*Environment Canada*

**Secondary energy** is energy used by final consumers for residential, agricultural, commercial, industrial and transportation purposes.

*Natural Resources Canada*

**Total final consumption** is the sum of consumption by the different end-use sectors. In final consumption, petrochemical feedstocks are shown under industry, while non-energy use of such oil products as white spirit, lubricants, bitumen, paraffin waxes and other products are shown under non-energy use, and are included in total final consumption only. Backflows from the petrochemical industry are not included in total final consumption.

*International Energy Agency/OECD*

**Total primary energy supply** is the amount of energy available for use in New Zealand for energy conversion and end use. Primary energy = indigenous production + imports – exports +/- stock change – international transport.

*Statistics New Zealand*

**Total primary energy supply** is formally defined as indigenous production + imports - exports - international marine bunkers  $\pm$  stock changes. In the Outlook, however, the regional TPES exclude marine bunkers, whereas the world TPES includes international marine bunkers.

*International Energy Agency/OECD*

**Useful energy** is delivered energy minus losses assumed to occur in boilers, furnaces, water heaters and other equipment in buildings; used for estimates of heat provided in space and water heating and cooking.

*International Energy Agency*

## Abbreviations



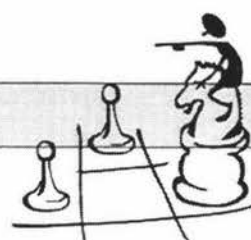
ANZMEC	Australian and New Zealand Minerals and Energy Council
APEC	Asia-Pacific Economic Co-operation
ARC	Auckland Regional Council
ARMF	Auckland Regional Monitoring Forum
ASM	Annual Survey of Manufacturers
BPRC	Bay of Plenty Regional Council
C/kWh	cents per kilowatt hour
CCC	Christchurch City Council
CDES	Century Drilling and Energy Services
CEPA	Canadian Environmental Protection Act
CESD	Commissioner of the Environment and Sustainable Development (Canada)
CH <sub>4</sub>	Methane
CIEEDAC	Canadian Industrial Energy End-Use Data and Analysis Centre
CIPEC	Canadian Industry Programme for Energy Conservation
CMA	Crown Minerals Act, 1991 (New Zealand)
CMG	Crown Minerals Group (New Zealand)
CO <sub>2</sub>	Carbon Dioxide
CPFE	Consumption of Purchased Fuel and Electricity
CRC	Canterbury Regional Council
CSD	Commission on Sustainable Development (United Nations)
DUS	Delta Utility Services
EC	Environment Canada
ECNZ	Electricity Corporation of New Zealand
EECA	Energy Efficiency and Conservation Authority (New Zealand)
EIR	Electricity Industry Reform Act, 1998 (New Zealand)
EPI	Environmental Performance Indicator
ESC	Economic and Social Council (United Nations)
ESMU	Energy Statistics and Modelling Unit (New Zealand)
EU	European Union
EWCC	Energy Wise Companies Campaign (New Zealand)
EWCPP	Energy-Wise Councils Partnership Programme (New Zealand)
FCCC	Framework Convention on Climate Change
FCP	Fletcher Challenge Paper



GC	Government of Canada
GDC	Gisborne District Council
GDP	Gross Domestic Product
GEMS	Global Environmental Monitoring System
GEO	Global Environmental Outlook
GJ	Gigajoule
GRID	Global Resource Information Database
GRP	Gross Regional Product
GWh	Gigawatt hours
HASNO	Hazardous Substances and New Organisms Act, 1996 (New Zealand)
HBRC	Hawke's Bay Regional Council
HFCs	Hydrofluorocarbons
ICE	Industrial Consumption of Energy Survey (Canada)
IEA	International Energy Agency
IEP	International Energy Programme
IERDP	Industry Energy Research and Development Programme (Canada)
MCC	Manakau City Council
MDC	Marlborough District Council
MEA	Multilateral Environmental Agreement
MEPS	Minimum Energy Performance Standards
MfE	Ministry for the Environment (New Zealand)
MMTI	Minerals and Metals Technologies Initiative (Canada)
MoC	Ministry of Commerce (New Zealand)
MoE	Minister of the Environment (Canada)
MWRC	Manawatu-Wanganui Regional Council (Horizons-m.w.)
N <sub>2</sub> O	Nitrogen Oxides
NAPCC	National Action Programme on Climate Change (Canada)
NCC	Nelson City Council
NEUD	National Energy Use Database (Canada)
NRC	Northland Regional Council
NRCan	Natural Resources Canada
NTREE	National Round Table on the Environment and Economy (Canada)
NZG	New Zealand Government
NZGECA	New Zealand Government Executive Coalition Agreement
NZGO	New Zealand Government Online
NZRC	New Zealand Refinery Company
OECD	Organisation for Economic and Co-operation Development

OEE	Office of Energy Efficiency (Canada)
OPEC	Organisation of Petroleum Exporting Countries
ORC	Otago Regional Council
PCE	Parliamentary Commissioner for the Environment (New Zealand)
PFCs	Perfluorocarbons
PJ	Petajoule
PSR	Pressure-State-Response Model
QRES	Quarterly Report on Energy Supply and Demand (Canada)
RER	Regional Environmental Report
RES	Regional Energy Strategy
RMA	Resource Management Act, 1991 (New Zealand)
RNB	Resources and Networks Branch (New Zealand)
RPS	Regional Policy Statement
SEC	Specific Energy Consumption
SER	State of the Environment Report
SF <sub>6</sub>	Sulphur Hexafluoride
SIC	Standard Industrial Classification System (Canada)
SNZ	Statistics New Zealand
SOE	State Owned Enterprises Act, 1986 (New Zealand)
SRC	Southland Regional Council
TAI	The Aspen Institute
TCC	Taranaki Combined Cycle (Power Station)
TDC	Tasman District Council
TEC	Total Energy Consumption
TES	Total Energy Supply
TFC	Total Final Consumption
TOE	Tonnes of Oil Equivalent
TPES	Total Primary Energy Supply
TRC	Taranaki Regional Council
TWB	The World Bank
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VA	Voluntary Agreement Programme (New Zealand)
VCR	Voluntary Challenge Registry Programme (Canada)
WBCSD	World Business Council for Sustainable Development

WCC	Wellington City Council
WCRC	West Coast Regional Council
WRC	Wellington Regional Council
WRC-EW	Waikato Regional Council (Environment Waikato)



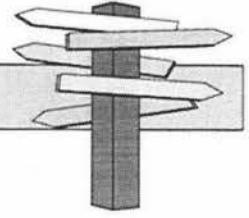
## List of Figures

Figure 1:	The Information Pyramid	7
Figure 2:	The Pressure-State-Response Model	23
Figure 3:	Integration of Socio-Economic Indicators with the OECD Core Environmental Indicators	26
Figure 4:	Framework of OECD Sets of Sectoral Indicators	26
Figure 5:	The Energy Indicators Pyramid	37
Figure 6:	RMA Framework for Integrated Resource Management	59
Figure 7:	Generic Process for Developing Indicators	75
Figure 8:	Energy Initiatives Conducted by Industry within the last Two Years	146
Figure 9:	Industry Energy Related Targets	151
Figure 10:	Industries that have Produced Environmental Policy Statements, Environmental Reports and/or Environmental Performance Indicators	152
Figure 11:	Flow of Information from Organisations with Energy-Environment Related Responsibilities to Industry	157
Figure 12:	Industry Rating of Advice/Information Provided by Organisations with Energy-Environment Responsibilities	158
Figure 13:	Industry Rating of Frequency that Information is Supplied to Organisations with Energy-Environment Responsibilities	160
Figure 14:	Links for Energy Consumption	173
Figure 15:	Links for Climate Change	176
Figure 16:	The Relationship Between Secondary Energy Use and Carbon Dioxide Emissions	190
Figure 17:	Industrial Sector Indicator Pyramid	193

## List of Tables

Table 1:	Country Commitments for Greenhouse Gas Emissions Under the Kyoto Protocol: Period 2008-2012	19
Table 2:	New Zealand Contribution to Emissions and Removals of Greenhouse Gases for the Period 1990 to 1995	50
Table 3:	Industrial Environmental Performance Indicators	154

# Table of Contents



Abstract	ii
Acknowledgements	iii
Definitions	iv
Abbreviations	vii
List of Figures and Tables	xi
Table of Contents	xii

<b>Executive Summary</b>	<b>1</b>
--------------------------	----------

## **Section 1**    **The Research Project and Environmental Performance Indicators**

1.0	Introduction	3
1.1	Overview to Research Project	3
1.2	What is an Environmental Performance Indicator?	6
1.2.1	What Environmental Performance Indicators Can and Should Achieve	8
1.2.2	Limitations to the Use of Environmental Performance Indicators	10
1.2.3	Indicators Come in Different Categories	12

## **Section 2**    **The Global Context**

2.0	Introduction	13
2.1	New Zealand and its Multilateral Environmental Agreements	14
2.2	International Institutional Structures	15
2.3	Rio Earth Summit	15
2.3.1	The Rio Declaration on Environment and Development	16
2.3.2	Agenda 21	17
2.3.3	The Framework Convention on Climate Change, the Berlin Mandate and the Kyoto Protocol	18
2.4	Organisation for Economic Co-operation and Development	20
2.4.1	Environment Directorate	21
2.4.2	The Pressure-State-Response Framework and Environmental Indicators	22

## **Section 2** The Global Context, continued.....

2.4.3	The OECD's Core Environmental Indicators	24
2.4.4	1998 Core Set of Environmental Indicators	25
2.4.5	Sectoral Indicators	25
2.4.6	Limitations to the Use of Environmental Indicators	28
2.4.7	The OECD's State of the Environment Review	
	– International Context	30
2.4.7.1	Effective Environmental Policies	31
2.4.7.2	Early Integration of Environmental Concerns in Sectoral Policies	31
2.4.7.3	Strengthened International Co-operation	31
2.4.7.4	Towards Sustainable Development: Fostering the Integration of Government Policies	32
2.4.7.5	Towards Sustainable Development: A Greater Role for Market Forces	32
2.4.7.6	Improving the Cost Effectiveness, Openness and Accountability of Environmental Policies	33
2.4.8	The OECD Environmental Performance Review of New Zealand	33
2.4.9	International Energy Agency	34
2.4.10	The IEA's Approach to the Development of Energy Indicators	35
2.4.11	The IEA's 1997 Review of New Zealand's Energy Policies	38
2.5	United Nations	42
2.5.1	Economic and Social Council	43
2.5.2	The UN's Environmental Indicators for Consumption and Production Patterns	44
2.5.3	Review of Changing Consumption and Production Patterns for UN Countries	46
2.5.4	New Zealand's Reporting to the UN on Agenda 21 for Energy and the FCCC	49

## **Section 3** The National Context

3.0	Introduction	51
3.1	New Zealand Government	52
3.2	Parliamentary Commissioner for the Environment	53

### **Section 3** The National Context, continued.....

3.3	Governmental Policy Directive for Energy and Environment in New Zealand	54
3.4	New Zealand Legislation	55
3.4.1	The Environment Act 1986	56
3.4.2	Resource Management Act 1991	57
3.4.3	The Commerce Act 1986	60
3.4.4	Electricity Industry Reform Act 1988	61
3.4.5	State Owned Enterprises Act 1986	61
3.4.6	Gas Act 1992 and Gas Regulations 1993	61
3.5	Strategies for Integrating the Environment with Energy-Sector Industry in New Zealand	61
3.6	Energy Sector Reforms	64

### **Section 4** Central Government Context

4.0	Introduction	65
4.1	Ministry for the Environment	66
4.1.1	National Policy Statements and National Environmental Standards	66
4.1.2	Environment 2010 Strategy	67
4.1.3	The State of New Zealand's Environment	69
4.1.4	Environmental Performance Indicators Programme	72
4.2	Ministry of Commerce	77
4.2.1	Voluntary Agreements Programme	78
4.3	Energy Efficiency and Conservation Authority	81
4.3.1	The 10-Point Strategy for Improving Energy Efficiency	82
4.3.2	Energy Wise Companies Campaign	83
4.3.3	Energy Wise Councils Partnership Programme	84
4.4	Statistics New Zealand	86

### **Section 5** The Local Context

5.0	Introduction	89
5.1	Regional Policy Statements	91
5.1.1	Northland	92
5.1.2	Auckland	95
5.1.3	Waikato	98

## **Section 5** The Local Context, continued.....

5.14	Bay of Plenty	100
5.1.5	Gisborne	103
5.1.6	Taranaki	105
5.1.7	Manawatu-Wanganui	108
5.1.8	Hawke's Bay	110
5.1.9	Wellington	112
5.1.10	Nelson	116
5.1.11	Marlborough	118
5.1.12	Tasman	120
5.1.13	West Coast	122
5.1.14	Canterbury	124
5.1.15	Otago	127
5.1.16	Southland	130
5.2	Energy Sector Industry and Regional Authorities	134
5.2.1	Energy Issues in the Regional Policy Statements	134
5.2.2	Objectives and Policies of the Regional Policy Statements	136
5.2.3	Methods of Implementation	137
5.2.4	Monitoring of the RPS in Respect of Energy Sector Industry	138
5.3	State of the Environment Reports	138
5.3.1	Canterbury Regional Council	139

## **Section 6** Energy Sector Industry

6.0	Introduction	142
6.1	Energy Sector Industry in New Zealand	142
6.2	Survey of Energy Sector Industry in New Zealand	143
6.3	Survey Participants	145
6.3.1	Energy Efficiency	146
6.3.2	Energy Conservation	147
6.3.3	Energy Audits and Energy Benchmarking Studies	148
6.3.4	Monitoring and Reporting	149
6.3.5	Interactions with Organisations with Responsibilities for Energy and the Environment	156
6.3.6	Energy Consumption	162
6.4	The Electricity Corporation of New Zealand Limited	163



## **Section 7** Case Study - Canada

7.0	Background	165
7.1	Federal and Provincial Governments and the Constitution	166
7.2	Environmental Legislation	167
7.3	Policy Implementation	169
7.4	Eco-Efficiency Indicators	171
7.5	Federal Government Agencies	172
7.5.1	Environment Canada	172
7.5.1.1	National Environmental Indicators	173
7.5.1.2	Energy Consumption	173
7.5.1.3	Climate Change	175
7.5.2	Natural Resources Canada	177
7.5.2.1	Climate Change	179
7.5.3	Industry Initiatives	180
7.5.3.1	Voluntary Challenge and Registry Programme	181
7.5.3.2	Dofasco's Response to Climate Change under the VCR	182
7.5.3.3	The Canadian Industry Programme for Energy Conservation	182
7.5.3.4	Industrial Energy Innovators Initiative	183
7.5.4	National Energy Use Database	184
7.5.5	The Canadian Industrial Energy End-Use Data and Analysis Centre	185
7.5.6	The Industry Energy Research and Development Programme	185
7.5.7	National Indicators	186
7.5.8	Data Development	186
7.5.9	CIEEDAC – Energy Intensity Indicators	187
7.5.10	Energy Efficiency Indicators	189
7.5.10.1	Types of Indicators	190
7.5.10.2	Methodology and Data Sources for the Energy Use Factorization Analysis	192

## **Section 8** Discussion

8.0	Introduction	195
8.1	The Importance of Internationally Based Forums	196
8.2	Multilateral Environmental Agreements	196

## **Section 8**      **Discussion, continued.....**

8.3	Introducing Accountability	197
8.4	But is Accountability Synonymous with Credibility?	198
8.5	Deregulation, Privatisation and the Globalisation of Energy Market's	199
8.6	Energy Sector Reforms in New Zealand	201
8.7	Creating Incentives for Change in Energy in New Zealand	202
8.8	Voluntary Agreements	203
8.9	Energy Efficiency – Not just an Initiative, but also a Standard!	204
8.10	A National Policy Statement	205
8.11	The Energy Efficiency and Conservation Authority	206
8.12	Access to Technical Expertise	207
8.13	Environmental Indicators of the UN and OECD	208
8.14	The Ministry for the Environment's Environmental Performance Indicators Programme	210
8.15	Environmental Indicators	211
8.15.1	Applying Energy Intensity to Energy Efficiency	211
8.15.2	Energy Intensity	214
8.15.3	Energy Mix	215
8.15.4	Energy Prices	217
8.15.5	Emissions of Greenhouse Gases	218
8.16	What's Happening Locally?	220
8.17	Energy Sector Industry	222
8.18	The Canadian Example	223

## **Section 9**      **Conclusion**      227

### **Appendices**

**Appendix 1**      New Zealand Voluntary Agreement Signatories and their Commitment Reductions

**Appendix 2**      Regions within New Zealand and the Status of their Respective Regional Policy Statements

**Appendix 3**      Regional Authority Survey Responses

**Appendix 4**      Approximated Industrial Energy Consumption in New Zealand by Region and the 1998 Energy Balance

## Appendices, continued.....

- Appendix 5** Industry Survey Responses
- Appendix 6** BHP Environmental Strategic Plan 1999-2004
- Appendix 7** Natural Resources Canada (Office of Energy Efficiency) Initiatives 1998-1999
  
- Appendix 8** Canada's Champion Reporting Checklist from VCR Inc., Registration Guide, 1999
  
- Appendix 9** Statistics Canada Quarterly Report on Energy Supply and Demand
  
- Appendix 10** Statistics Canada Standard Industrial Classification (SIC) System
  
- Appendix 11** New Zealand's Energy Data Sources

## Bibliography

## Executive Summary



Historically, governments have been primarily concerned with ensuring that adequate and secure supplies of energy exist. However, mounting evidence regarding the degradation of our environment, and a growing sense of shared responsibility has provided the impetus to develop wider institutional structures in which to address global environmental problems. In particular, concerns regarding unsustainable energy consumption and production patterns have underscored the need to improve environmental monitoring.

This research provides an analysis of the role and status of environmental performance indicators for energy sector industry in New Zealand. The environmental indicators considered are those that are directly aligned to energy consumption and production patterns.

In order to be able to identify and isolate the range of issues associated with energy consumption and production patterns, it is necessary to understand the factors that influence energy use and the impacts that arise, but also the effectiveness of relevant policy frameworks. This demands that policy makers face two ways: inwards towards activities that are occurring at a local or sectoral level, and outward towards national and international environmental frameworks and obligations.

In response to the above-described need organisations such as the UN and OECD have developed environmental indicators for energy. Environmental indicators provide a simple, but timely and analytically valid means of integrating a host of information to reveal trends or changes in a particular environmental condition.

Many countries are adopting the use of environmental indicators. Whilst there are currently no national environmental indicators for energy in New Zealand, the MfE is well on the way towards collating its inaugural toolbox of national environmental indicators, including those for energy under the aegis of the Environmental Performance Indicators (EPI) programme.

Whilst the MfE's indicator for CO<sub>2</sub> emissions is a climate change indicator, it will be as relevant to energy and energy sector industry, as the national energy indicators that the MfE will eventually develop. However, this indicator captures just one of the many effects that can arise from the activities of energy sector industry. Of particular concern also should be indicators that can measure the intensity of energy use, how efficiently energy is being utilised, the distribution of energy types,

and energy prices. Each of these measures has been internationally recognised as having the potential to be utilised as an environmental indicator.

Whilst the development of the MfE's inaugural energy indicators will not be idealistically perfect, the process of indicator development is iterative, and thus perfection is not a realistic expectation either. Impedance's that currently inhibit the development of the MfE's energy indicators include gaps in existing information, inconsistent approaches in the collection of energy-environment information and low level reporting requirements impeding the wider use of some energy data. Coincident with indicator development is the need for an integrated environmental network system to co-ordinate, collate and systematically draw together and transfer indicator data between the various stakeholders.

Opportunities also exist to improve the process of developing national energy indicators. The MfE should target large energy sector industries in New Zealand for input to indicator development to both improve the supply of information to industry regarding the EPI programme and to improve the feedback from industry on the EPI programme.

A comparative case study of Canada shows a clear commitment by the Canadian Government to implement energy efficiency programmes and regulations, and to monitor the effects of its energy use. New Zealand whilst moving at a much slower pace appears to be adopting a similar approach to that of Canada, however further improvements can be made. These include, establishing EECA as a governmental organisation and improving the affiliation between EECA and the MfE to ensure energy is firmly placed within the context of its environmental effects.

Much progress has been made at a national and international level in the development and use of environmental indicators for energy sector industry and this provides useful insight to the MfE in the development of their national energy indicators. National energy indicators when introduced, will prove a fundamental monitoring tool for policy makers in New Zealand. By developing and using environmental indicators, policy makers at either a local, national or international level will be able to accurately monitor and evaluate the environmental consequences associated with the actions of energy sector industry (and other energy sectors). From this monitoring, policy makers will be able to assess the effectiveness of their environmental policy frameworks. In doing so, policy makers will avoid misinterpreting or inappropriately responding to their environmental policy frameworks or obligations.