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ENERGY AND EMISSION INDICATORS

International inventory and assessment

P.G.M. Boonekamp

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Abstract
In this report an extensive inventory of international monitoring activities in the field of energy and emissions is provided. Information has been gathered about the organisations involved, monitoring scopes and topics, available data and relevant publications, etc. Based on this information a list of often used variables and indicators has been composed, followed by a global assessment of the different sources of information. The present opportunities and needs with respect to monitoring have been investigated in order to determine new or improved monitoring activities. Finally a number of new indicator types are proposed on differences between the Netherlands and the EU, capability for further action, policy intensity, policy integration, early change, fundamental shifts and climate rebound effects. The report also gives an overview of the information (sources) gathered.

CONTENTS

SUMMARY

Better use of monitoring
Despite the growing activities in the field of monitoring of energy use and emission trends the use of the results by policy makers and other actors has not been fully satisfying. The role of monitoring in White Papers on energy and environment is limited, nor do monitoring results play a decisive role in policy decisions taken. One reason for not using monitoring information might be the lack of policy-relevant information in current monitoring activities, or a poor translation of the information into a policy-relevant form.

To find better ways to supply relevant monitoring information a literature search has been performed. Via the internet the international activities in the field of energy and emission monitoring have been mapped. The accent in the inventory has been on all kind of energy and emission indicators, which provide insight in historic trends, different aspects and policy effects. The analysis of the information gathered has led to the proposition of a number of new types of indicators. These are meant to serve Dutch and international energy and emission policy making.

Results of the inventory
The search on internet has resulted in a list of institutions, actively contributing to energy and emission monitoring, and their:

- databases on energy use and emission figures,
- sets of indicators on energy or related emissions,
- explaining factors, such as policy measures and energy prices,
- reports on methodological issues and indicators,
- assessments of energy and emission developments.

The scope of the information ranges from country level to the whole world. The organisations have been split up into those providing information on energy and/or emissions in general and those with a limited covering: certain energy sectors, specific aspects, methodological issues, etc. The most extensive sources of trend information and indicators are the UN (UNSD, UNEP, CSD), the OECD (IEA) and the EU (Eurostat, EEA and Odyssee).

On the basis of this information an overview is given of often-used variables and indicators related to, and focused on, energy use and CO_2 emissions. The variables and indicators are grouped as much as possible according to the cause-effect chain, e.g. Driving forces, State and Responses. Driving forces lead to direct and indirect consequences ('Trends') and than to responses, meant to influence the developments ('Policies').

Criteria for new indicators
To propose new activities the way indicators are currently used must be analysed first. Important issues are:

- the different purposes of indicator use, e.g. identify priorities, facilitate reporting, understanding aggregated trends, comparison (benchmarking) or performance of policies,
- integration into a DSR-framework,
- use of an aggregated indicator (for instance Human Development Indicator) versus a group of indicators,
- the time frame for the indicators, both for the availability (yearly) and the use (short term signals or long term trends),
- the comparability of indicators, especially between countries.

In addition a number of considerations with respect to choices to make are given, such as the present policy issues, the relevant scope and time frame, etc.

Proposed new sets of indicators

The proposed new indicators are thought to be attainable but it has not been proven that all information needed to compose them is already available. The proposed sets are:

A. Difference-indicators NL-EU on trends and aspects.
   These indicators describe policy relevant differences between the Netherlands (NL) and other EU countries or the EU-mean.
B. Capability indicators on energy use and -system.
   These describe the (theoretical) possibilities, left in the present situation, for less energy use and less CO_2 emissions. For instance the fraction of total energy use where substitution between energy carriers is possible in a certain period (for EU countries). This indicator is useful with respect to emission reduction and security of supply.
C. Indicators of policy intensity.
   These indicators describe the amount of effort exercised to influence energy use and emissions, relative to other countries. Examples are the amount of government expenditures on energy/CO_2 policy compared to GDP.
D. Policy integration indicators.
   These indicators combine different aspects of energy and environmental policy, such as costs, security of supply and market liberalisation. Policy integration indicators can be used for one country to monitor trends, or for a comparison with other countries. An example is the distance between the costs of environmental benign options and the costs of fossil based supply options. This indicator combines the environmental and the economic aspect.
E. Early change indicators.
   These indicators are meant to give early signs of new, and possibly, important changes with respect to a more sustainable energy system. The effects on aggregated national or sectoral levels could be hardly visible yet. For instance the participation of existing energy companies in clean energy sources, energy carriers or processes
F. Fundamental shifts indicators.
   These indicators are coupled to new or sustained trends for driving forces behind energy use and emissions: population growth, substitution between the production factors labour, capital and energy, changes in lifestyle or a shift to other locations of certain activities. An example is the saturation in personal transport. Till now the mean distance travelled from home to work has increased. A reversed trend, because of higher perceived burden of the time for travel of because of technical developments (telework, etc.) could lead to a saturation in energy use.
G. Climate rebound effects on energy.
   Climate changes due to CO_2 emissions could have adverse effects on energy use. An example is the decreasing number of heating degree-days due to less cold winters. This will lower energy demand for heating of houses and offices.

Retrieval of the information used

The appendix provides a list of all sources of information and the internet location where the cited information can be found.

1. INTRODUCTION

During the last decade the Dutch government has become increasingly interested in the monitoring of historical trends in energy use and emissions. To meet this demand the unit Policy Studies of ECN has developed a monitoring tool (Boonekamp, 1999a), elaborated on methodological issues (Boonekamp, 2001) and executed various studies, both national (Boonekamp, 2002; Boonekamp, 1999b; Boonekamp, 2000a; Boonekamp, 2000b) and international (Uyterlinde, 2000; Uyterlinde, 1999; Boonekamp, 1997).

However, supplying the results to policy makers and other actors has not been fully satisfying. There is relatively little interest in monitoring results; in White Papers on energy and environment, e.g., it is less mentioned than results of outlooks for the future. Only a very minor fraction of the outlays in money and manpower for policy measures is devoted to the evaluation of the results. And finally, the decision to change policies is often not based on lessons learned from monitoring.

One reason for not using monitoring information could be the lack of a user friendly presentation of results. Results are often presented in the form of a large number of graphs and tables with limited explaining power. The same holds for much aggregated information such as regression results for the relationship between national energy use and economic development. The MONIT approach, a monitoring tool developed by ECN Policy Studies (Boonekamp, 1999), intends to mitigate this problem of presentation.

Another reason for not using monitoring information might be the lack of policy-relevant information in current monitoring activities or a poor translation of the information in policy-relevant conclusions.

This report describes the results of a search for new and more policy relevant ways of monitoring the trends in energy use and CO_2 emissions, both for the Netherlands and for international cases. For this purpose the international activities in the field of energy and emission monitoring has been mapped.

In Chapter 2 the ways to monitor the energy developments and the accents in the inventory are described. Chapter 3 gives an overview of international monitoring activities and the kind of information or data these activities deliver. In Chapter 4 this information is used to make a list of variables and indicators related to energy and emission monitoring. In the final Chapter 5 the considerations for using indicators are described and new approaches to monitoring for policy purposes are proposed.

Almost all inventory information has been taken from internet sites. Instead of composing a list of references of all the reports mentioned in Chapter 3, the appendix gives a list of all sources of information and the internet location where this information can be found.

2. MONITORING AND INDICATORS

How to monitor trends

Monitoring of trends in energy use and CO_2 emissions is done for different reasons, at different levels of energy use and at a different geographic scale (see also Chapter 4). Generally, monitoring is meant to answer the following questions:

- what has happened,
- how it has happened,
- why it has happened,
- what are the side effects.

For the first answer information is needed on trends in energy use and (sustainable) supply and energy related emissions. Depending on the scope the relevant level of observation is global, world regions, countries, sectors or sub sectors and in some cases split up further into a number of different fuel uses. The trends can be expressed in absolute terms (PJ) or as indices with respect to a base year.

For the second question trends in energy use or emissions must be related to trends in societal activities for which energy is needed. In case activities are expressed in the form of economic variables this leads to 'energy intensities' (MJ per economic unit of production or consumption). When relating energy use to physical production trends the 'specific energy use' is found (MJ per kg steel or vehicle-km, etc.). Also inputs and outputs of industrial processes can be compared, providing trends in the 'efficiency of conversion'. Comparing trends in fuels used for the same purpose (e.g. transport or electricity production) gives insight in substitution between energy carriers. Comparing energy use and CO_2 emission trends leads to a 'CO_2 intensity of energy use'. In general, relating an energy trend to a socio-economic trend produces an indicator that can be used to describe how energy use and emissions changed. However, such indicators only partly explain the energy trend.

The answer to the third question must supply a more complete explanation of changes in energy use and emissions. This asks for specifying a relation with influencing factors, such as autonomous technical trends, energy prices and energy policy measures. System-specific information, e.g. capacities of power stations, could also help explain why changes (do not) occur.

The last question demands information about all sorts of energy-related socio-economic variables, such as investments, costs, risks and other influences due to (changes in) energy use and emissions.

Focus of the inventory

Figures on energy use and emissions are amply available in developed countries, although in some cases the quality is poor. In general one could say, however, that answering the 'what' question does not give real problems.

In the field of the 'how' question a lot of work has been done already but, as mentioned earlier, there is a need for further progress. Therefore the focus of the inventory should be aimed at international activities in the field of 'how energy has changed'. Information on prices and policy measures is often available. However, it proves to be very difficult to show the effect of these influencing factors on the actual trends. So, answering the 'why' question seems a bridge too far for the moment.

The inventory concentrates on all kinds of indicators used in different (international) studies and policy analysis projects. It is mainly directed at sources of information with respect to the defi-

nition, the calculation and the actual values of relevant indicators. When available the sources of the underlying trends in energy use, emissions and other variables are also registered. The same is done for information about explaining variables, such as prices, policy measures and system information, such as capacities of power stations and reserves.

Side effects and other analysis work

Side effects of *policy responses* are of concern since they can be influenced by policy makers. For instance, the effect of energy taxes on the income of poor households might lead to a loss of political support. These side effects have to be taken into account when choosing policy relevant indicators. The choice of relevant side effects depends very much on the actual situation.

In some cases organisations have already used indicators to analyse the trends and to draw policy conclusions. The latter is not part of the inventory, but the indicators used will be studied.

Finally, some sources of literature concentrate on the different methods to monitor and analyse developments, e.g. the Driving force, State and Response (DSR) concept (see also Chapter 5). This information is, when considered to be useful, also gathered during the inventory.

3. INVENTORY OF INTERNATIONAL ACTIVITIES

3.1 Overview of main information sources

In Table 3.1 the most relevant organisations and their information items are shown. Some organisations have been split up into different sources (e.g. the EU and UN). All these organisations provide information on energy and/or emissions in general. The contributions of sector oriented international organisations have been described separately (see Paragraph 3.3). A list of all organisations found in the search is given in the appendix.

With regard to the information provided a distinction is made between energy, CO_2 emissions and other aspects of sustainable development. For energy and CO_2 emissions a further distinction is made between:

- T: trends for energy use and CO_2 emissions
- I: development of all kind of indicators
- S: system information, capacities, etc.
- P: energy prices
- M: policy measures
- E: policy evaluations: effects and assessment.

The scope of the information is also given; it ranges from country level to global level.

Table 3.1 *Overview of main international monitoring activities on energy and emissions*

Organisation	Energy use	CO_2 emissions	Sustainability	Scope
EU				
- Eurostat	T, I, S, P	T, I	n.a.	EU(15), MS, CS, world
- Odyssee	I, P, M	I	n.a.	EU(15), MS
- EEA	T,I,P,M	T,I,M,E	I	EU + EEA + CS (29 countries)
- EC	I	I	n.a.	Availability of information EU
OECD-IEA	T,I,S,P,M,E	T,I,M,E	n.a.	OECD, 26 countries, world
UN				
- Statistics	T	T	I	World, countries
- UNFCCC	(T,M,E in NC)	T (M,E in NC)	n.a.	World, countries
- UN-EP/ESA	I	I	I	World, countries (ESA)
- UN-CSD	I	I	I	World, countries
IPCC	n.a.	I	n.a.	Methods
BP-Statistics	T,S,P	n.a.	n.a.	World, region (incl. reserves)
WB	T,I	T,I	I	World, countries
IISD	n.a.	n.a.	n.a.	Method, overview activities
WRI	T,I	T,I,E	I	World, countries/regions
WEF	n.a.	n.a.	I	Aggr. ESI/EPI per country
WEC	T,I,S,M	T	n.a.	World, countries
IAEA	I,S	I	n.a.	Extensive on nuclear
DOE-EIA	T,I,P,M,E	T	n.a.	USA/international

3.2 General monitoring activities per organisation

In this section for each organisation, information supplemental to Table 3.1 is provided, complemented with the most important publications.

EU, European Union
EUROSTAT
EUROSTAT is the official statistics bureau of the EU that harmonises and publicises the data which have been collected by the national statistical organisations, in collaboration with agencies and central banks.

EUROSTAT gives:
- trends in energy use per energy carrier and sector for all EU countries,
- secondary data, e.g. intensities and indicators,
- a set of indicators on integrating environment in energy policy,
- a general set of 60 pressure indicators on 10 themes,
- information on system capacities,
- energy prices.

EUROSTAT also gives some data on Candidate Countries and EFTA countries and for the world as a whole. The EU institutions also circulate other information, collected by EUROSTAT, such as subsidies, expenditures on environment and energy investments.

Publications/products:
[1] EUROSTAT Yearbook 2001.
[2] Environmental statistics (on CD ROM).
[3] Energy Database (on CD ROM).
[4] Energy, yearly statistics 19.. (EU, Luxembourg).
[5] Indicators of sustainable development, a pilot set following UNCSD, 1997.
[6] Integration - indicators for energy 1985-1998 (EC, 2001).
[7] Energy and transport in figures (DG Energy).
[8] Towards Environmental Pressure Indicators for the EU (2000, see EC, 1999).
[9] Annual synthesis report of the Commission (42 structural indicators).
[10] Prices in the network industries (gas and electricity).
[11] Panorama of the European Union, measuring progress to a more sustainable Europe.

ODYSSEE
This European project of 15 national Efficiency Agencies and Eurostat on energy efficiency indicators started in 1992 and is co-ordinated by the French agency Ademe. The French ENERDATA assists in compiling indicators and distributes the results (see ENERDATA).

Odyssee gives information on:
- energy intensities relating an energy consumption to a macro-economic variable,
- unit consumption relating to a physical activity,
- energy saving indicators, an assessment of quantities of energy saved, in absolute values,
- adjusted indicators for cross-country comparisons,
- CO_2 indicators to translate energy efficiency in terms of CO_2.

Additional work has been done on policy instruments for energy and environment. New indicators on diffusion of energy options and on targets are proposed.

Publications:
[1] Definition of Odyssee indicators.
[2] Energy Efficiency in the European Union 1990-2000.
[3] Energy Efficiency in the EU (1990-2000): overview indicators.
[4] Monitoring tools for Energy Efficiency in Europe.
[5] Energy Efficiency Indicators: The European Experience (ADEME, 1999).
[6] 2001 Review of Energy Efficiency CO2 and Price Policy and Measures in EU countries.
[7] 2000 Review of Energy Efficiency Policy in EU countries.
[8] Energy Efficiency Trends by Country.

ENERDATA
ENERDATA is a French organisation for collection and dissemination of energy use data with a central role in the ODYSSEE activities of the EU.

Information is provided on:
- indicators (see ODYSSEE),
- database World Energy Statistics and Information, filled with data from other sources.

EEA, EUROPEAN ENVIRONMENTAL AGENCY
EEA focuses on assessing the state of the environment across Europe and the pressures upon it. The Agency both gathers and distributes its data through the European environment Information and Observation Network (EIONET). The agency currently has 29 member countries, including 13 countries in central and eastern Europe and the Mediterranean. The EEA has developed the DPSIR-concept (Driver, Pressure, State, Impact, Response) to describe the relationship between societal activities and the environment.

Available information:
- many indicators on environment,
- some on energy use,
- some intensities and efficiencies,
- CO_2 emissions,
- some CO_2 indicators.

EEA also has a special database on policy instruments (STAR database).

Publications:
[1] Environmental Signals 2002 (regular indicator report).
[2] EC and MS GHG emission trends 1990-… (yearly report), Topic Report no. 6, 10, etc.
[3] Energy and environment in the European Union, ES-No 31, 2002.
[4] Annual EU GHG Inventory 1990-2000 and Inventory Report 2002, TS-No 75.
[5] Reporting on environmental measures-Towards 'sound and effective' EU policies, ES-No 25.
[6] Environmental taxes - Recent developments in tools for integration. ES-No 18.
[7] Common framework for sector-environment integration indicators (EPRG, 2000).
[8] Questions to be answered by a state-of-the-environment report - The first list. TS-No 47.
[9] Environmental indicators: Typology and overview, TR-No 25, Copenhagen, 1999.
[10] Material flow based indicators in environmental reporting. EI-No 14, 1999.

REC, REGIONAL ENVIRONMENTAL CENTRE
This Centre for Eastern European Countries is not focused on data, but on capacity building. However, the REC has published one very interesting report about access to data in all EU countries 'Doors to democracy, Pan-European assessment of Trends in Public Participation in Environmental Matters' (1998).

EC, EUROPEAN COMMISSION

The EC and the relevant DG's (DG-TREN and DG ENV) formulate the energy and environmental policies in the form of Green Papers and White Papers. Specific measures are described in directives. Results of EU institutions are sometimes published by the EC as well. The CELEX and EUR-lex databases contain all information on existing energy and environmental legislation. Prelex gives information on legislation in preparation.

Publications:

[1] Towards environmental pressure indicators for the EU, 1999.
[2] Integration indicators for efficiency, 1999.
[3] Indicators on transport and environment integration in the EU, Copenhagen, 1999.
[4] Indicators for integration of environmental concerns into common agricultural policy, 2000.
[5] Indicators for Monitoring Integration of Environment and Sustainable Development in Enterprise Policy, 1999-502550.
[6] Electricity liberalisation indicators in Europe (DG TRE, October 2001).
[7] Energy in Europe 19.., annual energy review.
[8] Eurobarometer special report 88 - Europeans and the environment.
[9] Eurobarometer special report 79 - European Opinion on Energy matters.
[10] Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change - Bottom-up Analysis of Emission Reduction Potentials and Costs for Greenhouse Gases in the EU (study for the European Commission), ECOFYS, 2001.

OECD, Organisation for Economic Co-operation and Development

The OECD has 26 Member Countries, mainly the western world and including Japan and Korea. They have an extensive database on all socio-economic issues, containing also data for non-OECD countries but less detailed. They also provide a broad set of 50 environmental indicators and several sets of sectoral indicators. Also the Pressure State Response (PSR) model to describe the economy-environment relation was developed by OECD.

OECD provides information on:

- Agriculture
- Demography
- Industry and services
- International trade
- Labour
- National accounts
- Prices of goods and services
- Public management
- Social and welfare
- Territorial aspects
- Transport
- Energy and environment.

Of special interest is the Environmental database with environmental taxes.

Publications:

[1] Aggregated Environmental Indices - Review of Aggregation Methodologies in Use.
[2] Indicators to Measure Decoupling of Environmental Pressure from Economic Growth (OECD, 2002).
[3] Towards sustainable development - environmental indicators (OECD, 1998).
[4] OECD Environmental Indicators: Towards Sustainable Development (OECD, 2001).

IEA, INTERNATIONAL ENERGY AGENCY

The IEA is an autonomous agency, linked with the OECD, that focuses on energy aspects. Main topics are oil supply emergencies, information for co-ordinated energy policies and development of new energy technologies by Implementing Agreements. Another activity is the assessments of worldwide developments and regular evaluations of country policies. IEA's own regular indicators are very limited in scope. Schipper has published many IEA reports on energy indicators on a detailed level.

IEA has databases on:

- key world energy statistics,
- monthly electricity/gas oil survey,
- monthly price statistics,
- energy indicators per country,
- energy technology R&D statistics,
- CO_2 data from 1971-1999, available on CD-ROM,
- policies & measure per country.

IEA provides information on:

- World energy use per fuel and region,
- Production, trade and use per region/country for coal, oil, gas, nuclear, hydro and electricity,
- Capacities of refineries and power stations,
- Final consumption per fuel, region and sector,
- International energy prices for coal, oil and gas,
- Retail prices electricity and fuels for industry, transport and consumers (selected countries),
- CO_2 emissions per fuel and region,
- Indicators per region/country: TPE, CO_2 and electricity use per capita or GDP, CO_2/TPE,
- Electricity production per fuel OECD countries,
- Gas Balance OECD countries,
- Oil and products balance OECD countries, incl. stock levels,
- End user prices and taxes per oil product and OECD country,
- Energy intensity per sector (country reports),
- Environmentally related taxes,
- Labels and standards in OECD countries.

Publications:

[1] Energy statistics of OECD countries/non-OECD countries.
[2] Energy balances of OECD countries/non-OECD countries.
[3] Key world energy statistics (also in GEO-2).
[4] 'Toward Solutions: Sustainable Development in the Energy Sector', May 2002.
[5] 'World Energy Outlook 2001: Assessing Today's Supplies to Fuel Tomorrow's Growth'.
[6] CO_2 Emissions From Fuel Combustion (IEA, 2001).
[7] Energy Prices and Taxes: First Quarter 2002.
[8] Domestic Policies and Measures to mitigate GHG emissions: Sector-Specific Options, 1999.
[9] Energy Policies of IEA Countries Review (IEA, 2001).
[10] Energy efficiency update, policies per country (IEA, 1999-2002).
[11] Energy efficiency initiative, general and country profiles (IEA, 2000?).
[12] Dealing With Climate Change, Policies and Measures in IEA Member Countries.
[13] Indicators of energy use and efficiency, understanding the link between energy and human activity (IEA/OECD, 1997).
[14] Indicators of Energy Use and Carbon Emissions: Explaining the Energy Economy Link (IEA-LS, 2001).
[15] The IEA Energy Indicators: Understanding the Energy Emissions Link (IEA-LS, 2000).
[16] Manufacturing energy use in OECD, decomposition of long term trends (EP-LS, 1999).

[17] Renewable Energy Policy in IEA Countries, Volume 2: Country Reports (IEA, 1998).
[18] Energy and Labels and Standards (including country overview) (IEA, 2001).

UN, United nations

UN-SD, STATISTICS DIVISION

This division disseminates data on energy use for more than 190 countries. Data on developed countries come from IEA/OECD, other data come from national statistical offices or from own UN-SD sources. Relevant sections are the Environment Statistics Section and the Energy and Industry Statistics Section.

Information is given on:

- Energy Statistics Database (ESD) with energy balance data per country from 1950 on,
- electricity profiles, for OECD countries and a limited number of developing countries,
- millennium Indicators, information per country on 48 social and economic indicators, including energy use per $ GDP and CO_2 emissions per capita,
- monthly oil statistics, in collaborating with IEA, EUROSTAT, OLADE, OPEC and APERC (recent activity),
- SEEA, System of integrated Environmental Economic Accounting, revised in collaboration with UNEP.

Publications:

[1] Statistical Yearbook.
[2] World Statistics Pocketbook.
[3] Energy statistics yearbook (based on ESD).
[4] Energy Statistics: Definitions, Units of Measure and Conversion Factors, Series: F, No.44.
[5] Concepts and Methods in Energy Statistics, with Special Reference to Energy Accounts and Balances--A Technical Report, Series: F, No.29.
[6] Energy Balances and Electricity Profiles l998, Series: W, No.10.
[7] Glossary of Environment Statistics, Series: F, No.67.
[8] Concepts and Methods of Environment Statistics--Natural Environment, Series: F, No.57.

UNFCCC, FRAMEWORK CONVENTION ON CLIMATE CHANGE

The FCCC receives from participants to the Kyoto Protocol the National Communications on GHG with information on emissions, targets, policies, etc. FCCC co-ordinates methodological issues related to reporting emissions in collaboration with IPCC. FCCC has no own set of indicators. Information is available on sectoral GHG emissions via an online database, for Annex-I countries and part of Annex-II countries.

Publications:

[1] Guidelines on reporting and review.
[2] National communications to the FCCC.
[3] Greenhouse Gas Inventory Database (see also IPCC).

UNEP, ENVIRONMENTAL PROGRAMME

UNEP promotes sustainable development in general, with a number of bodies:

- UCCEE, UNEP Collaborating Centre on Energy and Environment specialises on developing countries. UCCEE is sponsored by UNEP, Danida and Risoe.
- DEWA, Division of Early Warning and Assessment, concentrates on decision-making on sustainable human development, such as vulnerability issues.
- DEPI, Division of Environmental Policy, co-ordinates policy implementation.
- DEC, Division on Environmental Conventions, co-ordinates conventions, incl. GHG.
- WCMC, World Conservation Monitoring Centre, concentrates on biodiversity.
- GEF, Global Environmental Fund, founded by WB, UNDP and UNEP. Finances sustainable projects and is working on programme performance indicators.

There is also The Energy Programme, but information on energy and CO_2 emissions, and indicators, are not found with UNEP itself or the bodies within. UN-Earthwatch co-ordinates all environmental monitoring of the UN-organisations but has no own indicator system.

UNEP has information on:
- GEO, Global Environmental Outlook, the central document of UNEP,
- GEO Data Portal, contains 300 variables but no indicators on energy or CO_2,
- Human Development Indicator (HDI).

Publications:
[1] Global Environmental Outlook-2000, Indicators (UNEP).
[2] Global Environmental Outlook-3 (2002), Chapter 1: The data issue, Chapter 2: State of the Environment 1972-2002, Indicators (no energy or CO_2).
[3] Annual evaluation report.
[4] Sustainable indicators (SCOPE/UNEP, 1997).
[5] An overview of environmental indicators (RIVM/UNEP, 1994).
[6] Agenda 21: Information for decision making (UNEP).
[7] Tools and Methods for Integrated Resource Planning (UCCEE).
[8] The GHG Indicator: UNEP Guidelines for Calculating GHG Emissions for Businesses and Non Commercial Organisations (UNEP Financial Services Initiatives, June 2000).
[9] The indirect costs and benefits of greenhouse gas limitations (UCCEE).
[10] Trans boundary Movement of Airborne Pollutants: A Methodology for Integrating Space borne Images and Ground Based Data, Data report (DEWA).

UN-ESA, DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
ESA and the Division on Sustainable Development (DSD) have as objective sustainable development in a broad sense. Information is available on:
- set of 43 indicators on changes in production and consumption patterns including some on energy or environment (see also Millennium Indicators),
- lifetime of fossil reserves (part of indicators).

Publications:
[1] Measuring changes in consumption and production patterns (DSD, 1998).
[2] Indicators of sustainable development, framework and methodologies (DSD, 1999).
[3] Item 2001 (DSD).
[4] Report to the CG to identify themes and core indicators of SD (DS, 2000).

UN-WPISD, WORKING PROGRAMME ON INDICATORS OF SUSTAINABLE DEVELOPMENT
This is a joint activity of UN bodies, which has produced the DSR concept (Driving Force, State and Response) for analysing the socio-economic development and environment relation. WPISD has set up a core set of 59 core indicators on sustainable development.

UN-CSD, COMMISSION ON SUSTAINABLE DEVELOPMENT
One of the activities of the CSD has been the introduction of 'Indicators towards Sustainable Development (ISD)'.

The CSD provides information on:
- Indicators for four dimensions and 38 (sub)themes: social, economic (incl. theme energy), environmental (incl. theme GCC) and institutional. Frequently used indicators are emission of GHG and energy consumption. Institutional indicators comprise national strategies and international agreements.
- A database of ISD figures for 22 countries.

Publications:
[1] Indicators of sustainable development, framework and methodologies (DSD, 1996).
[2] Report on the aggregation of indicators for SD, CSD9, April 2001.

IPCC, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
The IPCC has been established by WMO and UNEP. The IPCC produces Assessment Reports, Special Reports, Technical Papers, Guidelines and Methodologies, and Supporting Material on GHG and CC. IPCC has no own database system.

Publications:
[1] Climate Change 2001: The Scientific Basis.
[2] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (NGGIP).
[3] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (3 Volumes).
[4] Emissions Scenarios. 2000.
[5] IPCC Second Assessment - Climate Change 1995.

BP-STATISTICAL REVIEW
BP-Statistics concentrates on energy use in world regions. Information is given on:
- reserves of fuels,
- reserve/production-ratios for coal, oil and gas,
- capacities on the supply side,
- world energy prices.

This information is not interpreted or translated into indicators.

Publications:
[1] The statistical review of World Energy 2001, June 2002.

WB, World Bank
The department Environmental Economics and Indicators (EEI) presents many studies on methods to construct and use indicators, mainly for developing countries. Also studies have been done on much aggregated country SD indicators.

Information is provided via:
- online 'Indicators on the Web': limited information on emissions from the energy sector and nothing on industry or transport,
- 'World Development Indicators': some information on energy and emissions,
- 'Little Green Databook': information on energy and emissions.

Publications:
[1] World development indicators 2002.
[2] The Little Green Data Book, 2001, incl. energy and emissions for 200 countries.
[3] Energy Efficiency and Conservation in the Developing World, February 1993.
[4] Energy Investments and the Environment, May 1993.
[5] Energy in Europe and Central Asia: A Sector Strategy for the World Bank Group, 2002.
[6] A Review of Country Case Studies on Climate Change, February 1994.
[7] Environmental performance indicators: a second edition note, Working Paper.
[8] Citizen complaints as environmental indicators: evidence from China, Policy Research WP.
[9] Expanding the measure of wealth: indicators of environmentally sustainable development, 1997.

IISD, International Institute of Sustainable Development
IISD is a Canadian entity for sustainable development that promotes the use of sustainable indicators. IISD has also created a compendium with 500 indicator initiatives, of which 50 on the global level. IISD has no own database of indicators. Together with UNEP-Earthwatch the Dashboard of Sustainability indicator software is made available for free to construct ones own indicators.

WRI, World Resources Institute
WRI is an environmental think tank with also publications on greenhouse issues and policies. One of the products is GHG-accounting guidelines for business. Relevant information is 'Earth trends', online environmental data, including climate and energy & resources, and also country profiles.

Publications:
[1] The GHG Protocol: A corporate accounting and reporting standard. October 2001.
[2] The U.S., developing countries, and climate protection: Leadership or stalemate?, 2001.
[3] Contributions to climate change: Are conventional metrics misleading the debate?, 1998.
[4] Climate protection and the national interest: The links among climate change, air pollution, and energy security (1997).
[5] Environmental indicators (1995).

WEF, World Economic Forum
The WEF is an international organisation funded in 1971 by 1000 corporations, to discuss key issues on the global agenda. Information on indicators includes ESI, a much aggregated Environmental Sustainability Index for all countries.

Publications:
[1] The Environmental Sustainability Index (WEF, Yale and CIESIN).

WEC, World Energy Council
The WEC is the main global energy organisation, with Member Committees in over 90 countries, which covers all types of energy. Every four years the WEC has a world meeting accompanied by the presentation of a global energy view. Part of the WEC is the Energy Data Centre that provides information per country on energy use from the survey on energy resources and other input. The WEC is one of the few organisations with data on system capacities and technology.

Publications:
[1] WEC Annual Report 2000.
[2] Energy Efficiency Policies and Indicators, WEC report 2001.
[3] Survey of Energy Resources (2001).
[4] Values Added: Ethical Experiences in the Energy Sector (2001).
[5] Energy Technologies for the Twenty-First Century.
[6] Performance of Generating Plant (2001).
[7] Global Energy Perspectives (1998).

IAEA, International Atomic Energy Agency
IAEA is a large organisation with official control tasks in the nuclear field. However, analysis for Sustainable Energy Development, and the CSS approach (Cause, Symptom and Solution), have been done by the Department of Nuclear Energy, Planning & Economic Studies Section (PESS).

Information is given on:

- The 41 ISED indicators. Important indicators are floor area per capita, implementation of abatement technology, ratio of energy costs/income, land area for the energy system and fatalities per fuel chain. Specific for IAEA are the seven indicators on nuclear energy.
- IAEA's Reference Data Series No. 1, Energy, Electricity and Nuclear Power Estimates up to 2020, all national plans for nuclear expansions, extensions or retirements.
- Energy and Economic Databank, 187 countries, energy and economic statistics 1960/70/80EU pol90, 1996 and 1997.
- INIS, International Nuclear Information System, database on nuclear and energy literature.
- Outlook on nuclear developments, also with historic data on production, capacities, etc.
- PRIS, Power Reactor Information System, covers general and design information and information about operating experience of all reactors in the world.

Non-nuclear information is retrieved from other sources.

Publications:

[1] Tools for tracking progress, bulletin (IAEA, 2000).
[2] Indicators for Sustainable Energy Development (IAEA/IEA 1999).
[3] Energy, Electricity and Nuclear Power Estimates for the Period up to 2020, Reference Data Series No. 1, July 1998 (nuclear reactors).
[4] Health and Environmental Impacts of Electricity Generation Systems: Procedures for Comparative Assessment, Technical Reports Series No. 394, 1999.
[5] Operating Experience with Nuclear Power Plants in Member States, published since 1971.
[6] Nuclear Power Reactors in the World, Reference Data Series No.2, published since 1981.

DOE-EIA, Energy Information Administration

DOE executes surveys on residential and service sector energy use every 3-5 years. The EIA evaluates the energy situation in the USA, but also in the world. Moreover forecasts and analysis per (EU) country are made.

Their information sources encompass:

- RECS, residential energy consumption survey (7000 households),
- item service sector energy use survey,
- data on energy use for US states, per fuel/electricity and per sector,
- data for other countries in the world, per fuel/electricity and per sector,
- energy prices,
- CO_2 emissions.

Publications:

[1] Energy in North America, June 2002 (web).
[2] Inventory of Non utility Power Plants in the U.S. 2000, July 2002.
[3] Annual Energy Review 2001, September 2002.
[4] Emissions of Greenhouse Gases in the United States 2000 (2001).
[5] Impacts of the Kyoto Protocol on Energy Markets and Energy Markets and Economic Activity.
[6] Regional Indicators: European Union (EU), October 2001.
[7] Energy Perspectives: Trends and Milestones 1949-2000.
[8] Energy in the United States: 1635-2000.

3.3 Partial monitoring activities per organisation

In this section an overview is given of organisations having only incidental activities in the field of monitoring, focusing on a specific sector and/or publishing only results based on information of other organisations. The organisations are arranged as follows:

- devoted to energy sectors,
- devoted to world regions,
- concentrating on certain aspects of energy,
- active in the field of indicators in general.

OPEC, Organisation of the Petroleum Exporting Countries

The OPEC publishes studies and policy papers on energy, especially all aspects of oil supply and demand. OPEC provides some general information on the economy-oil-use relation and specific information, which could help explain energy trends.

Information is available via a database with market indicators:

- spot prices,
- production of oil,
- stocks of oil products,
- economic growth rates for regions,
- freight rates,
- exchange rates.

EURELECTRIC

The Union of the Electricity Industry deals with all aspects of the European electricity system: production, fuel use, restructuring, prices, capacities, imports, tariffs, etc. for all EU- and accession countries. EURELECTRIC has been active on indicators for liberalisation. Some are of interest for energy and emissions, e.g. cross border electricity flows. For energy and emission indicators no database is available on the Internet.

Publications:

[1] Statistics and prospects for the European electricity sector (1980-1998, 2000-2020).
[2] Towards a pan-European Energy Market: Electricity Sector Reform in the Candidate Countries.
[3] Abatement of Greenhouse Gases: Non-Use of Emissions Trading Mechanism Leads to Higher Compliance Costs, GETS3 Project.
[4] Towards a European Strategy for the Security of Energy Supply 12/07/2001.

COGEN-Europe

The European Association for the Promotion of Cogeneration analyses the trends in cogeneration in EU Member States and Accession countries. They gather information on current statistics as well as tariff and price data, the barriers, policy development and market prospects.

Information is available in the form of a:

- database on small scale cogeneration: installations, equipment and performance,
- review with statistics for European countries.

Publications:

[1] European Cogeneration Review, August 1999.
[2] The Future of CHP in the European Market - The European Cogeneration Study, current status, future markets, conditions and scenarios for 28 European countries, 2001.

WCI, World Coal Institute

The World Coal Institute is a non-profit, non-governmental association of coal producing and coal consuming enterprises. The Information Centre publishes statistics on coal world wide and for different countries. WCI does not provide information on coal prices or indicators. They do provide information on:

- world and regional coal production,
- coal trade 1996-2000 and steam coal imports,
- fuel shares of global electricity generation,
- world energy related CO_2 emissions,
- aircraft & shipping CO_2 emissions,
- carbon emissions,
- cement and steel industry coal usage 1996,
- total world primary energy consumption and electricity generation.

Publication:

[1] Coal - Power for Progress - Fourth Edition, March 2000.

IGU, International Gas Union

This is a worldwide non-profit organisation in the field of technical and economic aspects of the gas industry. The information on actual development in the gas industry selected countries could be of relevance.

Publications:

[1] 2000 IGU World Review.
[2] 'Report on Actual Developments in the Gas' (per country).

CONCAWE

CONCAWE is the oil companies' European organisation for environment, health and safety, with emphasis on oil refining, distribution and marketing in Europe. They have information on:

- European oil pipelines performance statistics,
- vehicle emission regulations and fuel specifications.

Publications:

[1] A review of European gasoline exposure data for the period 1993-1998, Feb-2000.
[2] Western European cross-country oil pipelines 30 year performance statistics, Jan-2002.
[3] Motor vehicle emission regulations and fuel specifications - part 2: detailed information and historic review (1970-1996), 1997.

ESA, EURATOM Supply Agency

ESA's mission is to ensure a regular and equitable supply of nuclear fuels. Therefore they possess information on the supply of nuclear fuel and enrichment capacities.

Publication:

[1] Euratom Supply Agency: Annual Report 2001.

APERC, Asean Pacific Energy Research Centre

APERC is part of the Institute of Energy Economics in Japan and co-ordinates studies for 21 Asean Pacific countries (China, Indonesia, Philippines, Canada, USA, etc.). APERC uses data from the IEA, WB, IMF, UN and ADB to analyse energy trends. Overviews are made of energy indicators and energy prices, but no reports are available through internet.

Publications:
[1] APERC Energy Pricing Practices, May, 2001.
[2] Energy Supply Infrastructure Development, May, 2001.
[3] Energy Efficiency Indicators Part 1 and 2, May, 2001.

OLADE, Organizacion Latin Americana de Energia
This organisation co-ordinates data gathering for Latin America and the Caribbean. Probably of interest is their information in the database SIEE on energy use and prices.

Publications:
[1] Energía y Desarrollo Sustenable: Evolución de Indicadores (CEPAL, 2001).
[2] Energy and Sustainable Development in Latin America and the Caribbean: Guide for Energy Policymaking (OLADE/CEPAL/GTZ, Julio 2000).

RD, Redefining Progress
This institute is devoted to the construction of general indicators of progress that are assumed better than the presently used GDP-indicator. They publish figures on the corrected GDP in collaboration with PEMBINA, the so-called 'Genuine Progress Indicator (GPI)'.

RFF, Resources for the Future
RFF calls itself a socio-economic think tank on energy, environmental and natural resources issues. RFF specialises in policy measures (e.g. emission trading), effects and costs.

Publications:
[1] An Evaluation of the U.S. Pollution, Control Regulatory System.
[2] Environmental Impacts of the Service Sector (2000).
[3] Research on the Cost of Environmental Regulation (1999).
[4] Energy-Saving Technological Change: The Effects of Economic Incentives and Direct Regulation (2000).
[5] Environmentally and Economically Damaging Subsidies: Concepts and Illustrations (2000).

PEW, Pew Centre on Global Climate Change
PEW wants to provide credible information and innovative solutions to address GCC. They have reported about the opinion of US leaders on the GHG problem and recently published 'Facts and Figures on Climate Change'.

Publications:
[1] An Overview of Greenhouse Gas Emissions Inventory Issues, 2000 (companies).
[2] Facts and Figures on Climate Change.

DJSGI, Dow Jones Sustainability Group Indexes
This organisation has been founded by Dow Jones Indexes and SAM Sustainability Group. The DJSGI is calculated like the Dow-Jones index but is combined with a methodology for identifying sustainability-driven companies by five criteria. They publish DJSGI's on the global level, for the USA and for world regions.

Publication:
[1] Guide to the Dow Jones Sustainability Group Indexes, Version 1.0, 1999.

EF, Earth Forum
Goal is promoting discussion on sustainable development issues. One of the focus points is subsidies that are detrimental to a more sustainable energy supply and environment.

Publication:
[1] Key issues in Subsidy Policies and Strategies for Reform (paper prepared for the UN Fourth Expert Group Meeting on Financial Issues of Agenda 21, January 1997, Chile), A.P.G. de Moor, Institute for Research on Public Expenditure (EF, 1997).

Thinkquest-library
Non-profit organisation for advanced education. They have a library with an overview of SO_2 emissions worldwide.

CLASP, Collaborative Labelling and Appliance Standards Program
Founded by LBNL, the Alliance to Save Energy and IIEC, CLASP provides information on standards and labels in different countries, which could help explain energy trends.

Publications:
[1] International Needs Survey: Information on energy efficiency standards and labelling, 1999.

IW, Infrastructure World
IW delivers services in relation to infrastructure projects, including (paid for) information.
Information is given on:
- infrastructure agencies, companies, etc.,
- projects and tenders.

Eurosif, European Sustainable and Responsible Investment Forum
A European non-profit membership organisation for promoting the concept, practice and development of sustainable and responsible investment. Eurosif has country information on measures and results.

LSE, London School of Economics
Two units work on indicators: the Economist Intelligence Unit (EIU) and the Centre for Economic performance (CEP). The CEP studies the determinants of economic performance at the level of the company, the nation and the global economy. They provide information on:
- local sustainability indicators (EU-Pastille project),
- EIU CountryData: economic indicators from 117 countries world wide, from1980-2005: GDP, fiscal indicators, debt and trade figures,
- EIU Country Indicators is a database of global market indicators for the period 1990-2005 for 60 industrial nations: economic, industrial, demographic and consumption trends. (not available to external visitors).

Publication:
[1] Pastille report 'Indicators into Action: local sustainability indicators in their context', 2002.

HELIO International
This is an international non-governmental network, working from France, to assess and monitor the contribution of energy policies. Information of interest is a set of eight indicators to reflect four aspects of sustainability at the national level.

Publications:
[1] Global Energy Observatory (GEO) till 1998 (per country).
[2] Sustainable Energy Watch (SEW) after 1998 (per country).

IIASA, International Institute for Applied Systems Analysis
IIASA is a non-governmental research organisation for studies on environmental, economic, technological and social issues, sponsored by its National Member Organisations. Information of interest could be:

- ERD database (European Rural Development project) with some general, but mostly rural, variables,
- database/extract system for scenarios, e.g. energy use and some indicators, per scenario and per world region (from IIASA/WEC Global Energy Perspectives study),
- CO_2 DB-database, detailed data on 1800 carbon mitigation technologies and diffusion.

ISI-FhG, Fraunhofer Institute for Systems and Innovation Research
ISI is active in the total field of energy and emissions analysis, including evaluations, both national and European. Indicator work concentrates on technology implementation. Their relevant information items are:
- sustainable indicators,
- indicators of technology diffusion.

Publications:
[1] Society, Behaviour, and Climate Change Mitigation, Kluwer AP, 2000.
[2] Normen als Indikatoren für die Diffusion neuer Technologien, ISI, 2002.

SPRU, Science and Technology Policy Research University of Sussex
They execute policy research on science, technology and innovation and economic, social and environmental implications. SPRU concentrates on environmental performance indicators for the industry, including integration indicators, linking economic objectives to social and environmental objectives. They have developed a set of 32 indicators including: materials use, a trade balance in environmental technology, the amount of eco-label products and the part of public spending with environmental assessment.

Information is available on:
- indicators: headline, integration and process,
- EPI for six industry sectors.

Publications:
[1] Measuring the Environmental Performance of Industry (MEPI). Final report, 2001.
[2] Indicators for monitoring integration of environment and sustainable development in enterprise policy, 2001.

LBNL, Lawrence Berkeley National Laboratory
The division Global & National Energy and Greenhouse Gas Emission Analysis focuses on evaluation of mitigation options in the buildings, industrial and transport sectors, both U.S. and world. GNEGEA is developing an energy demand database covering the major energy-consuming countries and driving forces of industrial and buildings energy use. Also they have compared trends by sector for key developing countries.

Information is provided on:
- global and regional energy and CO_2 trends,
- various indicators.

Publications:
[1] Evaluating Impact of Appliance Efficiency Labelling Programs/Standards (in EIJ), 2001.
[2] Sector trends and driving forces of global energy use and greenhouse gas emissions: focus in industry and buildings, 1999 (Worrell).
[3] Building Energy Measurement and Performance Analysis, Indicators of Energy Efficiency in Cold Climate Buildings, 2001.
[4] Residential Energy Demand in OECD countries and Efficiency Improvements: Evidence from the period, 1970-1993. Energy Economics, 20, 1998.

[5] Past and Future Trends in CO_2 Emissions from Energy Use: The Indicator Approach. ENER-Bulletin, 1998.
[6] Manufacturing Energy Use in OECD Countries: Decomposition of Long Term Trends. (IAEE, Rome), 1999.
[7] CO_2 Emissions from Travel and Freight in IEA Countries: Past and Future, 1997.
[8] Free Rider Estimation: Refining the Use of Surveys (in Energy-IJ), 1992.

WBCSD, World Business Council for Sustainable Development
This is a coalition of 160 companies for economic growth, ecological balance and social progress. WBCSD focuses on eco-efficiency in production, an integrated indicator on the micro-level.

4. OVERVIEW OF ENERGY (RELATED) INDICATORS

The sources of information mentioned in Chapter 3 specify a great number of variables and indicators on human activities and the related energy use and environmental consequences. In the following an overview is given of often-used variables and indicators related to, and focused on, energy use and CO_2 emissions. Other environmental issues and the impact of emissions (e.g. CO_2 concentrations and temperature rise) are not covered.

4.1 Overview of variables and indicators

In Table 4.1 the variables and indicators are grouped as much as possible according to the cause-effect chain (see Paragraph 5.1). Driving forces lead to direct and indirect consequences ('Trends') and than to responses, meant to influence the developments ('Policy goals' and 'Policies'). Most of the indicators can be specified at different levels, e.g. sector, country, region or world. In some cases, indicated with a (number) in the table, further information is provided next to the table.

4.2 Main sources of information

Table 4.1 also specifies which indicators are used by the different organisations, on a world scale in the second column and on the European level in the third column. The main sources of trends and indicators are the OECD (IEA) and the EU (Eurostat, EEA and Odyssee). The EU organisations focus mainly on the EU level and member states. The Odyssee-programme is the main producer of indicators in the field of energy use for DG-TREN of the European Commission. The focus of EEA is broader, but because of the climate change problem considerable work is done on energy. The IEA covers all OECD countries and, to a certain degree, the other world regions and countries as well. The Office of Energy Efficiency, Technology and R&D of the IEA (Lee Schipper) focuses on energy and emission indicators on a detailed level.

Other sources are of less importance from the perspective of ECN Policy Studies (see also considerations in Chapter 5). Most of the UN evaluation activities are very broad in nature and scope, but with few information on energy use and emissions, and often only on the national level. The UN-data are meant to compare trends in all countries in the world; however the evaluation activities of ECN Policy Studies concentrate on comparing the developed countries. UN-FCCC concentrates on methods for calculating the GHG emissions per country and sector, without analysing the developments or actually using indicators. The DOE-EIA has extensive information on the US developments but has no own information on other countries. The other sources of information concentrate on sectors or aspects of the energy and environmental system, or use information from other information sources.

Table 4.1 *Overview of available variables and indicators on energy use and CO_2*

Indicator	World	EU
Driving factors		
Population	OECD, UN, WB, etc.	Eurostat
GDP	OECD/IEA(16), UN	Eurostat
Labour force	OECD	Eurostat
Dwellings	n.a.	Eurostat
Transport activity, per mode	OECD	Eurostat
GDP/capita	IEA, UN	ODYSSEE
Sector share in GDP	OECD	ODYSSEE
Physical production E-intens. industry	UN	ODYSSEE
Stocks (building/vehicles/systems)	n.a.	ODYSSEE
Floor space/employee	n.a.	ODYSSEE
Persons/dwelling or household	n.a.	EEA, ODYSSEE
Floor area/capita	IAEA	
Distance travelled/capita	IEA	Eurostat
Freight transport per mode	IEA	Eurostat
Prices energy carriers	IEA, BP, OPEC (fuels)	Eurostat (incl.electricity)
Taxes on energy, per carrier	OECD/IEA	EEA
Prices industry/households/transport	IEA	Eurostat, EEA
Trends		
Total use (TPE), per sector	IEA, UN, WB	Eurostat
Use per fuel, per sector	IEA, UN-SD	Eurostat
Energy per end use type	n.a.	ODYSSEE
Indigenous production, per fuel	IEA(18), WCI, ESA	Eurostat
Net energy imports, per fuel	IEA, WCI	Eurostat
Contribution renewable	IEA	Eurostat, EEA, ODYSSEE
Total GHG emission, per sector	IEA, UN, IPCC	Eurostat, EEA
Total CO_2 emission, per sector	IEA(17), UN, WB, WCI	Eurostat, EEA
Relative trends		
Primary total intensity (TPE/GDP)	IEA, UN	Eurostat, ODYSSEE (1)
Energy intensities per sector	IEA	Eurostat, ODYSSEE (2)
Unit consumption (physical output)	IEA	ODYSSEE
Unit consumption per vehicle	IEA	ODYSSEE (3)
Specific consumption per pkm or tkm	IEA	ODYSSEE (4), EEA
Use per dwelling	IEA	ODYSSEE (5)
Specific consumption per appliance	n.a.	ODYSSEE (6)
Energy use per employee	n.a.	ODYSSEE(final electricity)
Fuel mix, per sector	IEA, UN, WCI	ODYSSEE
Supply efficiency	IEA	ODYSSEE (7)
Total CO_2 intensity (CO_2/GDP)	IEA, UN	Eurostat, EEA
CO_2 intensities per sector	IEA	ODYSSEE, EEA (8)
CO_2 factors per fuel	IEA	ODYSSEE
Energy savings, per sector	LBNL	ODYSSEE
Technical savings (eff. conversion)	n.a.	ODYSSEE (9)
Structural changes, per sector	IEA(19)	ODYSSEE, EEA(13)
Substitution effect	IEA	ODYSSEE
Security trends		
Import dependence	IEA(20)	Eurostat, EEA(14)
Origin of imports	IEA	Eurostat
Reserves	BP, IAEA, UN-ESA	n.a.
R/P-ratio	BP	ODYSSEE?
Stocks of fuels	IEA, OPEC	Eurostat(15)

-continued-

Indicator	World	EU
System trends		
Capacities refining/power stations	IEA,BP,IAEA,WEC,IW	Eurostat
Technology implementation	WEC,IIASA,COGEN,ISI	EEA (10), ODYSSEE?
Performance technologies	IAEA, WEC	EEA
Penetration of saving options	n.a.	ODYSSEE, EEA
Amount of infrastructure	IEA	EEA(11)
Economic trends		
Investment in energy system	EIA-DOE, Eurosif	n.a.
Production of energy systems	SPRU	n.a.
Balance of Payments energy	n.a.	n.a.
Environmental costs, per sector	n.a.	Eurostat, EEA
Energy costs/income	IAEA	n.a.
Costs of renewable/saving options	IEA	ODYSSEE
Other environment		
SO_2, NO_x and particle emissions	OECD, Thinkquest	EEA, Eurostat
Accidents energy chains	IAEA	EEA
Surface water temperature	n.a.	
Waste from energy system	OECD(21)	EEA
Policy goals		
Distance to target	n.a.	EEA
Policies		
Policies & measures	IEA, WEC	ODYSSEE, EEA
Standards & labels	CLASP, IEA, CONCAWE	EU, CLASP
Taxes and subsidies, etc.	IEA, UNEP, EF	EU
Energy/environmental legislation	n.a.	EU
R&D expenditures	IEA	Eurostat
Green investments	n.a.	Eurosif
Total policy costs	n.a.	?
Institutions and actors	UN-CSD	EEA(12)
Cost/reduction per option	IEA	EU
Society trends		
Opinions of leaders	PEW	n.a.
Opinions of general public	WB	EU, EEA

Remarks to some items in the table:

(1) Primary total intensity (TPE/GDP) is also calculated with climate correction, constant structure of the economy, reference structure of EU and purchasing power parity.

(2) Energy intensities per sector are calculated for primary and final energy use and for constant structure, reference structure and purchasing power parity.

(3) The unit consumption per vehicle is calculated for gasoline and diesel, for equivalent vehicles, for cars and trucks.

(4) The specific consumption per km is calculated for average vehicles, new vehicles, vehicles with certain fuels, for cars, light vehicles and heavy vehicles, for road, rail, water and air transport, for all persons or goods transportation, for constant modal split and for reference EU modal split.

(5) Use per dwelling is calculated for energy and electricity, per m^2, with climate correction, with EU climate correction, for space heating, for final use or end use, for average and new dwellings, for constant heating structure (local/central heating) and for appliances.

(6) Specific consumption per appliance is calculated for average, new and best appliances.

(7) The supply efficiency is calculated as the improvement in the ratio between primary use and final use.

(8) The CO_2 emission per sector is further des-aggregated by Odyssee to space heating (households), physical production (industry) and mode (transport). EEA des-aggregates the mode of transport further into pkm and ton-km.

(9) Technological savings from more efficient conversion are calculated for cars, insulation and power production (with variants for constant fuel mix, hydropower and co-generation).

(10) Technology implementation: EEA specifies the fraction of electricity from co-generation, cars meeting emission standards or with cleaner fuels and the implementation of environmentally friendly products (appliances?).

(11) The EEA indicator on infrastructure is about the amount of transport infrastructure.
(12) The EEA indicator on institutions and actors is about the degree of co-operation between bodies inside the national government.
(13) The consumption pattern of households also belongs to the EEA-indicators on structural changes per sector.
(14) The EEA-indicator on import dependence defines the relative use of both foreign and inland sources.
(15) Eurostat publishes energy use figures including changes in stocks with producers and end-users.
(16) GDP is given for OECD countries in nominal national currency, US dollar, with deflator and expressed in purchasing power parity.
(17) Total CO_2 emission, per sector and per fuel, are given for the period 1971-1999 for 140 countries.
(18) Energy production, use and trade, per fuel, are also collected for 100 non-OECD countries from data collected by UN-SD, OLADE, etc.
(19) Structural changes and substitution effects are only given for OECD countries.
(20) Data on import dependence are given for oil and gas.
(21) Waste from the energy system is produced in different phases: mining, construction and operation of systems and after discarding old systems. Indicators cover volume of solid and nuclear waste.

5. IMPROVED MONITORING WITH INDICATORS

The gathering of information in this report is meant to improve the existing monitoring activities and propose new activities. For this purpose the way indicators are currently used is analysed first. In addition a number of considerations with respect to choices to make are given and, finally, a number of sets of new indicators are proposed.

5.1 Indicator use in general

Different purposes of indicator use
Indicators can be used for different purposes, such as:
- translate sustainability in a practical sense or highlight specific problems,
- shaping the political agenda and promote national dialogue,
- identify priorities,
- facilitate reporting,
- preparation and monitoring of plans,
- understanding aggregated trends,
- compare with other sectors, countries (benchmarking),
- assess performance of environmental, and other, policies,
- revision of goals and targets,
- focus available budgets.

Most indicators serve both as a communication and an evaluating instrument. The accent depends on the kind of actor:
- Policy makers
- (Environmental) stakeholders
- Media/public.

If indicators should help policy makers to influence current trends, they should provide links with the actors involved, the causes of changes and instruments to influence trends. An example: the Dutch policy to enhance the efficiency of household appliances needs indicators on the energy use of A-label appliances recently bought from companies selling to households.

Extensive versus narrow definition of sustainable development
Indicators are often used as a means to assess the realisation of sustainable development. The narrow definition of sustainability accounts only for environmental aspects. The extensive definition of sustainable development has an economic, social and environmental dimension. The economic dimension encompasses activity levels, energy production, supply and consumption, energy pricing, taxation and subsidies, energy supply efficiency and energy security. The social dimension means accessibility of energy, affordability of energy and energy disparities. The environmental dimension contains global climate change, air, water and soil pollution, energy resource depletion, wastes and accident risks.

For developed countries the further increase in welfare must be weighted against improvement of the environment and living conditions. Therefore a sustainable path concentrates on a better environment with a given economic growth. For developing countries a lack of economic development often forces people to harm the environment more than acceptable. Here, a sustainable path means fast socio-economic progress with minimal environmental damage. In general, sustainability should be defined in a broader sense for developing countries then for developed countries. It is therefore that the UN uses a more extensive definition then the EU.

Coupling to a DSR-framework

Following the concept of causality, human activities exert pressure on the environment, the quality is decreasing and then society responds to restore the original situation. This is described in concepts, such as:

- UN: Driving force, State and Response (DSR)
- IAEA: Cause, Symptom and Solution (CSS)
- EEA: Driving factors, Pressure, State, Impacts, Responses (DPSIR).

Taking the EEA-chain as an example, for each part of the chain indicators can be defined:

- Drivers: socio-economic performance, e.g. GDP, comfort and convenience.
- Pressures: energy use, emissions of acidifying substances, etc.
- State: energy reserves, ozone concentrations, area unprotected from acidification, number of efficient conversion systems, etc.
- Impacts: health effects on humans, etc.
- Response: specific policy measures taken, such as standards, taxes, laws.

In practice the situation is more complicated than the simple chain-concept suggests. Some driving forces (GDP-growth) have effects, which then serve as another driving force (more transportation activities). In some cases there are interactions between driving forces or between different items of 'state' (energy reserves and amount of efficient energy systems). Furthermore, it is often difficult to clearly specify the response in the form of an indicator; the number of measures alone does not quantify the response.

Grouping of indicators

Apart from the DSR-scheme indicators can be grouped according to different criteria, e.g.:

- Economic (driver)
- Social (driver)
- Environmental (pressure, state or impact)
- Institutional (response)
- Integration.

The last one combines different aspects, e.g. an intensity indicator relates energy use to economic performance and thus facilitates integrated economic-environment policy integration. Another distinction can be made between descriptive and performance or distance-to-target.

Indicators can also be attributed to different items:

- physical flows: energy use, emissions,
- energy systems: market diffusion, penetration levels,
- policy goals: emission relative to a target.

Aggregated indicator versus a group of indicators

Policy makers prefer very few and aggregated indicators. However, analysts need a great number of indicators on a des-aggregated basis to describe the state of complex systems and to understand aggregated developments. Therefore aggregated indicators normally are composed of a set of underlying 'simple' indicators. Examples of aggregated indicators are:

- the HDI (Human Development Indicator) of UNEP, all aspects of whole society,
- the GPI (Genuine Progress Indicator) of RD, welfare of a whole society,
- Eco-efficiency, relative score of all aspects of a product chain,
- Ecological Footprint, aspects translated to a common unit (area).

The first is a broad mixture of separate economic and social improvements; with the second other aspects are translated to the economic domain, leading to corrected GDP. The third concentrates on a specific product or service in consumption. The fourth one also looks at the total chain, but for total consumption in a country.

Comparability of indicators
Using the same indicators for different countries raises questions about the comparability. The problem depends on the purpose of comparing countries. For a factual description of the situation few correction are needed. To understand short-term trends certain technical corrections are needed, e.g. for yearly climate variations. When an (implicit) assessment is made about the situation, e.g. the total energy-intensity of countries, a correction for the presence of geographical differences (much hydropower, sparsely populated areas, etc.) has to be made. When the evaluation is used to determine a target per country one has also to look at environmental results already obtained and the remaining possibilities. In case the results of policies of countries are compared some more corrections are needed: international traffic through a country, refining for foreign consumers, bigger houses, etc. However, because of data problems not all differences can be corrected for. Sometimes corrections are not needed because a country has chosen to take responsibility anyway.

If the environmental, economic and social conditions per country vary very much, it does not make much sense to define comparable indicators. Comparing is only useful for national decision making when countries have more or less the same conditions.

State or rate of change indicators
For situations with a large difference between the actual and the proposed situation the rate of improvement is more important than the absolute level itself. However, if the actual level is close to the proposed level, the rate of change will be of less importance. Actual levels give information about the need for action; the rate of change gives information about the progress of actions.

Time frame for indicators
Some indicators are used to look at short-term changes, e.g. the success of certain policy measures on the penetration of more efficient energy systems. Most indicators are used to assess the trend towards 2010, when a CO_2 target has to be met. Other indicators such as the reserve/production-ratio are important in the longer run.

Governance and institutions
Governance means laws, rights, democratic decisions and an effective public administration. Institutions means a civil society, knowledge centres, free media, platforms of representatives, etc. Both are not physical but can have a big influence on all kind of trends, including the environment. Government policies for the accelerated European integration, the end of the cold war and the accession of eastern Europe and the Kyoto arrangements have influenced energy and emission trends. The WTO-framework for trade, the environmental institutions and organisations, environmental education and capacity building, the agencies for implementation of sustainable options, the GEF for loans, the Global Reporting Initiative, etc. all do influence energy and emission trends.

5.2 Considerations for new indicator work

The following considerations with respect to indicator activities by ECN are made:

- Given the discussion about the Dutch contribution to the Kyoto emission reduction target for the OECD countries the international indicator activities of ECN should concentrate on the countries that are comparable with the Dutch situation. This means EU countries or ultimately OECD countries.

- Therefore the extensive definition of sustainability, with many social and economic aspects, can be narrowed down to the environmental aspects which are the most relevant for countries with high living standards.
- Given the working field of ECN Policy Studies the environmental aspects are limited further to energy and GHG emission issues. The most important purpose of indicator work should be the evaluation of the performance of GHG-policies.
- In the GHG-policy field a great number of indicators are already available, but the relation with actual policies is weak. With respect to the DPSIR concept (EEA) the work should concentrate on better indicators to describe responses and the connection between these and the indicators on pressure, state and impact.
- Ultimately the work on indicators should facilitate decision making on the actions to be taken (see also EEA). Therefore indicator activity should start with determining the most important policy issues and stakeholders, then choose appropriate indicators and finally check availability of data.
- For new energy policy items (e.g., liberalisation and security of supply) appropriate indicators have to be formulated. Analyses of trends on security of supply and liberalisation of markets should be integrated with those of energy and environment.
- There is a need for integration indicators which combine in themselves environmental aspects with other important issues, such as security of supply, costs, liberalisation of energy markets, etc.
- Given the increasing role of EU policies, the relative position of the Netherlands compared to other EU- or OECD countries will become more important. Therefore indicators should be made comparable with respect to the goal of the comparison. Corrections for different driving factors could take the form of intensity-indicators, such as CO_2 emission per capita in stead of the CO_2 emission itself. Corrections with pressure/state/impact-indicators are possible with indices or relative position to the mean value. Response-indicators should at least be corrected for the results already obtained.
- In a dynamic situation, as is the case with renewable sources, indicators on the relative rate of change are more important then indicators on the precise level. For total CO_2 emissions the absolute level is more relevant.
- Next to indicators that describe slowly changing long-term trends, there is also a need for indicators which describe upcoming changes in trends. In this way policy makers can evaluate policies in the usual political time frame of four years.
- Indicators should be designed according to the actors they address and the purpose they aim at. For the general public the indicator should either be compelling or linked to real personal opportunities to act. For policy makers it could be an informative distance-to-target indicator or a judgement of a certain policy measure. Indicators should be defined in such a way that they influence the actors who might induce changes.
- The indicator on the highest aggregation level should be consistent with sub-indicators on a lower aggregation level (e.g. efficiency per sector and national efficiency or CO_2 reductions per country and that for the EU in total).
- The system of indicators must be linked to already existing policy evaluation or decision making procedures.

Although the inventory has to serve new indicator work on an international scale it is also important to use it for an improvement of the national work. Therefore the choice of indicators should also take account of the specific (policy) problems of the Netherlands compared to relevant other countries:

- Relatively high environmental pressures because of the heavily populated surface and much activities with a great environmental impact (transport, chemical industry and agriculture),
- Fewer opportunities for environmental measures because of the already clean and efficient energy system (50% gas, much co-generation, etc.),
- Open economy and early start of restructuring of energy markets, compared to most EU countries,

- Little influence of national policy on energy use and emissions of internationally controlled industry (refineries, chemical industry, gas supply and base metal industry),
- A relatively stringent emission reduction target for 2010, given the points mentioned earlier.

5.3 New indicator types proposed

In the preceding paragraphs it has been described how indicators are currently used. Some considerations are put forward to improve the use of indicators. Based on this information a few new indicator types are proposed.

Difference-indicators NL-EU on trends and aspects
These indicators describe policy relevant differences between the Netherlands (NL) and other EU countries or the EU-mean. Preferably this should be done for the period from 1990 on. Proposed examples are:

- The fraction of all exposed sectors in total energy use (NL against EU-mean and some EU countries). Because the national influence on 'exposed' energy use is smaller than on 'sheltered' energy use, a relatively great fraction could pose a risk in attaining national targets.
- Ratio of GDP-deviation from EU-mean to intensity-deviation from EU-mean. It is important that the Dutch energy-intensity keeps in line with European trends. A correction has to be made for the difference in the growth rates because fast economic growth normally leads to a lowering of the intensity.
- Total Dutch energy use with EU-mean sector structure compared to the actual NL-trend. This indicator shows possible unfavourable trends in the Dutch economic structure with respect to energy-intensity.
- Ratio of non-process energy use to labour force, for the production sectors (NL against EU countries). This indicator shows differences in energy use (for office room and transportation) per full time employee (fte) and probably the effects of participation rate and part-time work.
- Ratio of relative GDP-level (EU-mean) to relative emission-target. Differences in this indicator indicate the relative burden of reduction policy, unless these differences reflect the country specific non-economic factors with respect to CO_2 emissions.
- Total extra costs for energy and CO_2 emission policy measures related to GDP (NL against EU countries). This indicator gives an impression of the relative burden for the Netherlands.
- Marginal costs for exposed sectors to reduce energy use and emissions (NL against some EU countries). This indicator highlights the position of Dutch industry in the burden sharing discussion and the trade in emission reduction permits.
- Ratio of standard tariffs for household to that for industrial users.

Capability indicators on energy use and -system
These describe the (theoretical) possibilities, left in the present situation, for less energy use and less CO_2 emissions. Examples are:

- Fraction of total energy use where substitution between energy carriers is possible in a certain period (for EU countries). This indicator is useful with respect to emission reduction and security of supply.
- Fraction of total energy use for which changes are mainly dependent on EU policies (for EU countries). This energy use comprises exposed sectors, transportation and appliances. The indicator sketches the 'span of control' of policy makers in different countries.
- Distance from world top for total 'exposed' energy use (for EU countries). This is an indicator of remaining efficiency opportunities.
- Fraction of total energy use devoted to exports of energy (for EU countries). This indicator gives information on the conversion losses made in favour of EU-energy supply.
- Ratio of total energy use to surface for trees (for EU countries). The ratio describes the (theoretical) possibilities for using biomass, which is not competing with food.

- Rate of renewal of housing stock, industrial capacity, vehicles and appliances stocks (EU countries). The faster these rates, the easier savings can be attained because new parts of a stock are generally more efficient than the mean of the stock.
- Rate of disposable space per person in the (second) house, office, recreational facilities, cure and care, etc. (EU countries). The more total floor space/capita, the less intensive this space is used given that persons can be at one place at a time. From the differences saturation levels with respect to energy for room heating could be determined.

Indicators of policy intensity
These indicators describe the amount of effort exercised to influence energy use and emissions, relative to other countries.

Examples:
- amount of government expenditures on energy/CO_2 policy compared to GDP,
- fraction of taxes in energy prices or different sectors,
- fraction of energy use subject to direct regulation,
- fraction of energy use falling under a Benchmarking system,
- fraction of energy use subject to a voluntary agreement,
- fraction of the total work force devoted to energy saving, renewable energy production or emission reduction.

These indicators describe the scope and the intensity of energy/CO_2 policies.

Policy integration indicators
These indicators combine different aspects of energy and environmental policy, such as costs, security of supply and market liberalisation. Policy integration indicators can be used for one country to monitor trends, or for a comparison with other countries.

Examples are:
- Distance between the costs of environmental benign options and the costs of fossil based supply options. This indicator combines the environmental and the economic aspect. If provided for most of the energy use this results in a CO_2 reduction versus cost graph which provides information on the total costs for achieving a cleaner energy supply system.
- Fractions of the total energy supply which can be seen as clean/secure, clean/dependent, fossil/secure and fossil/dependent. This set of indicators forms a combination of security of supply and environmental issues.
- Fraction of green financing in (energy) production systems. Economic and environmental aspects are combined in this indicator.
- Fraction of cross border electricity supply, a combination of the liberalisation and environmental issue.
- Dow-Jones indices for sustainable firms. This indicator combines economic performance with environmental performance.
- Fraction companies with ISO-14000. This indicator combines quality of management with care for the environment.

Early change indicators
These indicators are meant to give early signs of new, and possibly, important changes with respect to a more sustainable energy system. The effects on aggregated national or sectoral levels could be hardly visible yet.

Examples are:
- fraction of GHG-neutral households,
- fraction of GHG-neutral companies,

- participation of existing energy companies in clean energy sources, energy carriers or processes,
- changes in the legislation on CO_2, e.g. CO_2 as part of the set of harmful emissions, for which all kind of legal measures could be taken,
- extension of legal responsibility for past environmental behaviour. This could stimulate energy users to take early actions to avoid later claims,
- number of users which (partly) own an environmentally sound energy supply system. This indicator could inform about new trends in self-reliance of energy users.

Fundamental shifts indicators

These indicators are coupled to new or sustained trends for driving forces behind energy use and emissions: population growth, substitution between the production factors labour, capital and energy, changes in lifestyle or a shift to other locations of certain activities.

Examples:

- Amount of (elderly) people living (temporarily) abroad. If present trends continue more and more inhabitants of north-western countries spend part of their life in southern countries. Energy use is then decoupled from the number of inhabitants.
- Ratio of energy(service)costs to labour costs. An increase in wealth, as is foreseen in all scenarios, means that labour costs increase as well. If energy prices remain at the same level (in constant prices) it could become attractive to use more energy to replace labour. However, this will depend on the increases in labour productivity and energy productivity. Their ratio will decide if there will be a continuous trend to use more and more energy.
- An increasing fraction of sustainable farming. This means less use of fertilizers which are made from fossil fuels.
- Saturation in personal transport. Till now the mean distance travelled from home to work has increased. A reversed trend, because of higher perceived burden of the time for travel of because of technical developments (telework, etc.) could lead to a saturation in energy use.
- Downscaling of goods transportation. Here the growth trends are even more persistent than for persons. The transportation content of goods has increased because of internationalization of production chains. New trends to 'tailor made' production near the users could reverse this trend.
- Shift in location of e-intensive activities. In the past the Netherlands has become an attractive place for industries such as refineries and chemicals. If historic competition factors become less positive the departure of these industries would have a great influence on total energy use and the burden of the CO_2 target.

Climate rebound effects on energy

Climate changes due to CO_2 emissions could have adverse effects on energy use, Examples:

- Decreasing number of heating degree-days due to less cold winters. This will lower energy demand for heating of houses and offices.
- Increasing amount of rainfall which leads to more use of electricity for water pumping stations.
- Decreasing solar incidence because of more surface covered with clouds. This will have a negative effect on PV-production.

REFERENCES

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Boonekamp, P.G.M. (ECN), H. Mannaerts (CPB), H.J.J. Vreuls (Novem) and B. Wesselink (RIVM): *Protocol for Monitoring Energy savings - CBS, CPB, ECN, Novem and RIVM* (in Dutch). ECN-C--01-129, December 2001.

Boonekamp, P.G.M. (2000): *Effectiveness of energy premiums - Analysis for household use up to 2010* (in Dutch). ECN-C--00-062, 2000.

Boonekamp, P.G.M. et al (2000): *Environmental costs of saving measures* (in Dutch). ECN-C--00-045, 2000.

Boonekamp, P.G.M. et al (1999): *Monitoring energy use 1982-1996; Method, results and perspectives* (in Dutch). ECN-C--98-046, January 1999.

Boonekamp, P.G.M. (1999): Behaviour and household electricity use - Qualitative and quantitative analysis 1980-1997. ECN-C--99-057, 1999.

Boonekamp, P.G.M. et al (1997): *Energy use indicators for the Netherlands.* Dutch contribution to the IFA/OECD-programme on indicators, ECN-C--97-035, 1997.

Uyterlinde, M. et al (2000): *Monitoring Energy Efficiency Indicators in the Netherlands in 1999.* Dutch contribution to 'Cross country comparison on energy efficiency Phase 5', ECN-C--00-053, May 2000.

Uyterlinde, M. et al (1999): *Integrated Evaluation of Energy Conservation - National Report for the Netherlands.* ECN-C--99-005, 1999.

For all other publications mentioned in Chapter 3, see internet sites in Appendix A.

APPENDIX A INTERNATIONAL ACTORS ON MONITORING

ACE, Asean Centre for Energy
ACE Headquarters, Kuningan, Jakarta, Indonesia
Website: www.aseanenergy.org
ADEME, Agence de l'Environnement et de la Matrise de l'Energie (part of Odyssee-network)
Website: www.ademe.fr
AFREPREN, African Energy Policy Research Network
Elgeyo Marakwet Close, Kilimani, P.O. Box 30979, 00100 Nairobi GPO, Nairobi, Kenya
APERC, Asia and Pacific Energy Research Centre, Institute of Energy Economics
Shuwa-Kamiyacho Building, 4-3-13 Toranomon, Minato-ku, Tokyo 105-0001, Japan
Website: www.ieej.or.jp/aperc
ASE, Alliance to Save Energy
1200 18th Street, NW, Suite 900, Washington, DC 20036, USA
Website: www.ase.org
ASEAN, Association of South-East Asian Nations
Secretariat, 70A, Jalan Sisingamangaraja, Jakarta 12110, Indonesia
Website: www.aseansec.org
BP-Statistical Review of World Energy
Website: www.bp.com
CDIAC, the Carbon Dioxide Information Analysis Center (part of DOE)
CEPE, Centre for Energy Policy and Economics
ETH Zürich, Zürich, Switzerland
Website: www.cepe.ethz.ch
CLASP, Collaborative Labeling and Appliance Standards Program
(initiated by LBNL, ASE and IIEC)
Website: www.clasponline.org
COGEN, European association for the promotion of co-generation
Rue Guelledelle 98, B-1200 Brussels, Belgium
Website: www.cogen.org
CONCAWE
Boulevard du Souverain 165, B - 1160 Brussels, Belgium
Website: www.concawe.be
CREST, Centre for Renewable Energy and Sustainable Technology
1612 K Street, NW, Suite 202, Washington, DC 20006, USA
Website: www.solstice.crest.org
CTI, Climate Technology Initiative
Secretariat IEA, Office of EET and R&D, Division for ETC
(from 2003 NEDO, Japan and NERL, USA)
Website: www.climatetech.net
DJSGI, Dow Jones Sustainability Group Indexes GmbH
Tauni Sanchez, Signaustrasse 1 CH-8008, Zürich, Switzerland
E-mail: info@sustainability-index.com
DOE, US Department Of Energy
(see EIA-DOE)
Website: www.energy.gov
DSI, Data Service & Information
Kaiserstege 4, D-47495 Rheinberg, Germany
Website: www.statistischedaten.de

EEA, European Environment Agency
Kgs. Nytorv 6, DK - 1050 Copenhagen K, Denmark
Website: www.eea.eu.int
EEF, European Energy Foundation
7, Avenue Ariane, 1200 - Brussels, Belgium, Phone +32.2.773 93 39
E-mail: fee@tractebel.com
EEN, European Energy Network
(association of European RD&D-organisations on efficiency and renewable energy)
E-mail: g.glaze@fz-juelich.de
EIA-DOE, Energy Information Administration
EI 30, 1000 Independence Avenue, SW, Washington, DC 20585, USA
Website: www.eia.doe.gov
ENER, European Network for Energy Economics Research
(sponsored by the Commission of the European Union)
E-mail: rq@isi-fgh.de
ENERDATA,
2, Avenue de Vignate, 38610 Gieres, Grenoble, France
Website: www.enerdata.fr
ESA, EURATOM Supply Agency
Wetstraat 200, B – 1049, Brussel, Belgium
Website: europe.eu.int/comm./euratom
EURELECTRIC, Union of the Electricity Industry (including former UNIPEDE)
Bd de Imperatrice 66, 1000, Brussels, Belgium
Website: www.eurelectric.org
EUROSTAT, European Statistical office
Bat. JeanMonnet, Rue Alcide de Gaspari, L-2920, Luxemburg
Website: europe.eu.int\comm\eurostat
EWEA, European Wind Energy Association
Rue du Trone 26, B-1000 Brussels, Belgium
Website: www.ewea.org
GEF, Global Environmental Facility (World Bank)
Secretariat, 1818 H Street, NW, Washington, DC 20433, USA
Website: www.gefweb.org
HELIO International
56, rue de Passy, 75016 PARIS, France
E-mail: helio@globenet.org
IAEA, International Atomic Energy Agency
P.O. Box 100, Wagramer Strasse 5, A-1400 Vienna, Austria
Website: www.iaea.or.at
IAEE, International Association of Energy Economists
28790 Chargrin Blvd., Suite 350, Cleveland, Ohio, 44122-4630, USA
E-mail: iaee@iaee.org
ICLEI, International Council for Local Environmental Initiatives
City Hall, West Tower, 16th floor, Toronto, ON M5H 2N2, Canada
Website: www.iclei.org
IEA, International Energy Agency
Statistics Division, 9, rue de la Fédération, 75739 Paris Cedex 15, France
Website: www.iea.org
IEFE, Istituto di Economia delle Fonti di Energia
(part of ENER-network)
Università Commerciale L. Bocconi, Milano, Italy
Website: www.iefe.uni-bocconi.it
IEPE, Institut d'Economie et de Politique de l'Energie
Université des Sciences Sociales de Grenoble, BP 47, 38040, Grenoble, France
Website: www.upmf-grenoble.fr/iepe

IEPF, Institut de l'énergie et de l'environnement de la Francophonie
subsidiaire de l'Agence intergouvernementale de la Francophonie, Québec, Canada
Website: www.iepf.org
IEW, Institute of Energy Economics
(part of ENER-network)
Vienna University of Technology, Vienna, Austria
IFIEC-Europe, International Federation of Industrial Energy Consumers
Chaussée de Charleroi, 119, B-1060 Brussels, Belgium
E-mail: www.ifiec-europe.be
IGES, Institute of Environment and Society/Center for Ocean-Land Atmospere studies
4041 Powder Mill Road, Suite 302, Calverton, MD 20705-3106, USA
Website: www@cola.iges.org
IGES, Institute for Global Environmental Strategies, Japan (incl. TSU)
Website: www.iges.or.jp
IGU, International Gas Union
P.O. Box 550, c/o DONG A/S, Agern Alle 24-26, 2970 Hoersholm, Denmark
Website: www.igu.org
IIASA, International Institute for Applied Systems Analysis
A-2361 Laxenburg, Austria
Website: www.iiasa.ac.at
IIEC, International Institute for Energy Conservation
(part of Civil Engineering Research Foundation)
WDC, 1015 15th Street, NW, Suite 600, Washington, DC 20005-2605, USA
Website: www.cerf.org/iiec
IISD, International Institute for Sustainable Development
161 Portage Avenue East, 6th Floor, Winnipeg, Manitoba, Canada R3B 0Y4
Website: www.iisd.org
IPCC, Intergovernmental Panel on Climate Change
C/O WMO, 7bis Avenue de la Paix, C.P. 2300, CH- 1211 Geneva 2, Switzerland
Website: www.ipcc.ch
IPCC-TFI, Task Force Inventories
E-mail: ipcc_sec@gateway.wmo.ch
ISI-FhG, Fraunhofer Institute for Systems and Innovation Research (ENER Network)
Breslauer Straße 48, 76139 Karlsruhe, Germany
Website: www.isi.fhg.de
ISIS, Institute of Strategic and International Studies
1 Persiaran Sultan Salahuddin, P.O. Box 12424, 50778 Kuala Lumpur, Malaysia
E-mail: webmaster@isis.po.my
IUCN, the World Conservation Union
Rue Mauverney 28, Gland, 1196, Switzerland
Website: www.iucn.org
IW, InfrastructureWorld
400 Oyster Point, Suite 410, South San Francisco, CA 94080, USA
Website: www.infrastructure.com
LBNL, Lawrence Berkeley National Lab
1 Cyclotron Road Mailstop, Berkeley, CA 94720, USA
Website: www.lbl.gov
LSE, London School of Economics
Dep. of Geography and Environment, Room S416, Houghton Street, London WC2A 2AE, UK
Website: www.lse.ac.uk
Lund, Department of Environmental and Energy System Studies (ENER-network)
University of Lund, Box 117, SE-221 00, Lund, Sweden
Website: www.lu.se

OLADE, Latin American Energy Organisation (WEC-indicators)
Occidental N5863, PO Box: 1711-06413, Quito-Ecuador
Website: www.olade.org.ec
OPEC, Organization of the Petroleum Exporting Countries
Obere Donaustrasse 93, A-1020 Vienna, Austria
Website: www.opec.org
PEMBINA, Pembina Institute for Appropriate Development
Green Economics Program, c/o 9847 - 90 Avenue Edmonton, Alberta, Canada T6E 2T2
Website: www.pembina.org
PEW, the Pew Centre on Global Climate Change
2101 Wilson Blvd., Suite 550, Arlington, VA 22201, USA
Website: www.pewclimate.org
PWT, Penn World Table (Centre for International Comparisons)
University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104-6297, USA
Website: pwt.econ.upenn.edu
Platts, Daily oil prices
Head Office: 2 Penn Plaza, 25th Floor, New York, NY 10121-2298, USA
Website: www.platts.com
REC-CEE, Regional Energy centre for Central and Eastern Europe (UN, EU, Hungary)
Szentendre, Hungary
E-mail: info@rec.org
RD, Redefining Progress
1904 Franklin Street, 6th Floor, Oakland, CA 94612, USA
Website: www.rprogress.org
RFF, Resources for the Future
1616 P Street NW Washington, DC 20036-1400, USA
Website: www.rff.org
RISØ National Laboratory, Systems Analysis Department (ENER-network)
Frederiksborgvej 399, P.O. 49, DK-4000 Roskilde, Denmark
Website: www.risoe.dk.
RMI, Rocky Mountain Institute
1739 Snowmass Creek Road, Snowmass, CO 81654-9199, USA
Website: www.rmi.org
SCOPE, Scientific Committee on Problems of the Environment
International Council for Science, 51, Bd de Montmorency, 75016, Paris, France
E-mail secretariat@icsu-scope.org
SPRU, Science and Technology Policy Research University of Sussex (ENER-network)
Falmer, Brighton, East Sussex, BN1 9RH UK
Website: www.sussex.ac.uk/spru
SRC International CS (ENER-network)
Pocernicka 96, 108 03 Prague 10, Czech Republic Prague, Czech Republic
Website: www.srci.cz
UNDP, Development Programme
304 East 45th Street, New York, NY 10017, USA
Website: www.undp.org
Thinkquest-library
Website: library.thinkquest.org
UNEP, UN Energy Programme
United Nations Avenue, Gigiri, PO Box 30552, Nairobi, Kenya
Website: www.unep.org
UNEP-ROE, Regional Office for Europe
Intern.Environment House, 15, Ch. des Anémones, CH-1219 Chatelaine, Geneva, Switzerland
E-mail: roe@unep.ch

UNEP-UCCEE, Collaborating Centre on Energy and Environment
Risoe NL, Bldg. 142, Frederiksborgvej 399, P.O. Box 49, DK 4000 Roskilde, Denmark
Website: www.uccee.org

UN-CSD, Commission on Sustainable Development
Website: www.uncsd.org

UN-FCCC, Framework Convention on Climate Change
Haus Carstanjen, Martin-Luther-King-Strasse 8, D-53175 Bonn, Germany
Website: www.unfccc.org

UN-Statistics Division
UN, New York, NY 10017, United States of America
Website: unstats.un.org/unsd

WB-EEIU, World Bank - Environmental Economics and Indicators Unit
1818 H Street, N.W., Washington, DC 20433, USA
Website: www.worldbank.org/environmentaleconomics

WBCSD, World Business Council for Sustainable Development
4 Chemin de Conches, 1231 Conches-Geneva, Switzerland
Website: www.wbcsd.ch

WCI, World Coal Institute
Cambridge House, 180 Upper Richmond Road, Putney, London SW15 2SH, UK
Website: www.wci-coal.com

WEA, World Energy Assessment (collaboration UNDP/UNDESA/WEC)
Website: www.undp.org/seed/eap/activities/wea

WEF, World Economic Forum
91-93 Route de la Capite, CH - 1223 Cologny/Geneva, Switzerland
Website: www.weforum.org

WEC, World Energy Council
5th Floor, Regency House, 1-4 Warwick Street, London W1B 5LT, United Kingdom
Website: www.worldenergy.org

WEC, World Environment Centre
(connected to UNEP)
419 Park Avenue South, Suite 500, New York, NY 10016, USA

WRI, World Resources Institute
10 G Street, NE (Suite 800), Washington, DC 20002 USA
Website: www.wri.org