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WORKSHOP ON
INDICATORS FOR SUSTAINABLE ENERGY DEVELOPMENT

13 - 17 May 2002

ISED
Methodology Sheets

These are preliminary lecture notes, intended only for distribution to participants.

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Indicators for Sustainable Energy Development

ISED
Methodology Sheets

May 2002

POPULATION: TOTAL AND PERCENTAGE IN URBAN AREAS		
Dimension **Economic**	Agenda 21 **Chapter 5. Demographic dynamics and sustainability;** **Chapter 7. Promoting sustainable human settlement development: Promoting sustainable energy and transport systems in human settlements**	Placement in the CSD Theme/Sub-theme **Social/Population/Population change/** *Population growth and Population of Urban Formal and Informal Settlements*

1. INDICATOR (#1)

(a) **Name:** Population: total and percentage in urban areas.

(b) **Brief Definition:** The whole number of people or inhabitants in a country or region; and the ratio of population living in defined urban areas to total country population.

(c) **Unit of Measurement:** million for total population and % for its percentage in urban areas.

(d) **Correspondence with other ISD:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
TSD EI: *Population growth*	MPTMSE: *Population growth rate (SOC20)*	*None*

2. POLICY RELEVANCE:

(a) **Purpose:** The indicator is a basic socio-economic indicator and measures the size of population in a country or region. Knowing the size of a country's population, its changing rate, and share of urban population is important for evaluating the welfare of the country's citizens, assessing the productive capacity of its economy, and estimating the quantity of goods and services produced per each inhabitant. Thus governments, businesses, and anyone interested in analyzing economic performance must have accurate population estimates; and in particular its share in urban area, which measures the size of formal and informal urban settlements by their population.

(b) **Relevance to Sustainable/Unsustainable Development:** Change in population size defines the population growth, which according to Agenda 21 is identified as one of the critical elements affecting long-term sustainability. Total population, at both national and sub-national levels, represents a fundamental indicator for national decision makers.

Agenda 21 calls as well for a balance between urban and rural development patterns. Urban areas have distinctive characteristics reflecting the social fabric and density of their population, and the nature and scale of economic activities. Urbanization has profound socioeconomic implications that extend beyond the urban boundaries. It affects environmental and developmental problems such as housing shortages, traffic congestion, air and water pollution, and waste. Urban areas promise economic efficiency and potential for development deriving from concentration of population, business and industries.

(c) **International Conventions and Agreements:** None.

(d) **Linkages to other indicators:** There are close linkages between the total population and other demographic and social indicators (for example Population growth rate), as well as all

indicators expressed in per capita terms (for example, GDP per capita, energy consumption per capita).

As far as the percentage of population in urban areas is concerned it is linked to some of with economic and social indicators such as shares of sectors in value added, distance traveled per capita, fractions of households heavily dependent on non-conventional energy and without electricity. Urbanization is also linked to some environmental indicators, ambient concentration of pollutants in urban areas are of particular relevance to urban settings.

(e) **International Targets/Recommended Standards:** No international targets have been established for this indicator.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Total population of an economy may comprise either all usual residents (de jure population) or all persons present in the country (de facto population) at the time of the census regardless of legal status or citizenship— except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Some particular groups, such as the armed forces or other populations living in institutions, nomadic people, etc. may be excluded. For purposes of international comparisons, the de facto definition is recommended.

By definition, the percentage of population in urban areas is calculated as the population of urban areas divided by total population of a country or area. The demarcation of urban areas is usually defined by countries as part of census procedures, and is usually based on the size of localities, classification of areas as administrative centers, or classification of areas according to special criteria such as population density or type of economic activity of residents

(b) **Measurement Methods:** Population estimates are usually based on national population censuses, but the frequency and quality of these vary by country. Most countries conduct a complete enumeration no more than once a decade. Pre-census and post-census estimates are interpolations or extrapolations based on demographic models. Errors and undercounting occur even in high-income countries; in developing countries such errors may be substantial because of limits on the transport, communications, and other resources required to conduct a full census.

The number of inhabitants in formal and informal settlements is generally measured in censuses. Informal settlements do not cover dwelling units which have been regularized, that is those units for which land titles, leases or occupancy permits have been granted. They should only include those units which presently occupy land illegally and/ or housing units which are not in compliance with current regulation.

(c) **The Indicator in the DSR Framework:** It is assigned as Indirect Driving Force of Economic dimension, but it also could serve as a demographic State indicator of Social Dimension.

(d) **Limitations of the Indicator:** More-over, the international comparability of population indicators is limited by differences in the concepts, definitions, data collection procedures, and estimation methods used by national statistical agencies and other organizations that collect population data. The correctness of a census, along with the availability of complementary data from surveys or registration systems, is one of many objective ways to judge the quality of demographic data. In some European countries registration systems offer complete information on population in the absence of a census. Current population estimates for developing countries

that lack recent census-based data, and pre- and post-census estimates for countries with census data, are provided by national statistical offices, the United Nations Population Division, or other agencies. The standard estimation method requires fertility, mortality, and net migration data, which are often collected from sample surveys, some of which may be small or limited in coverage. These estimates are the product of demographic modeling and so are also susceptible to biases and errors because of shortcomings of the model as well as the data. The quality and reliability of official demographic data are also affected by the public trust in the government, the government's commitment to full and accurate enumeration, the confidentiality and protection against misuse accorded to census data, and the independence of census agencies from undue political influence.

(e) Status of the Methodology: Under development.

(f) **Alternative Definitions/Indicators:** A variation of the indicator could be the annual growth of total population, which is derived by computing the annual or period growth rate of population.

4. ASSESSMENT OF DATA

(a) Data Needed to Compile the Indicator: Data from census data and calculation from registration data (births, deaths and migrants). The United Nations recommends that countries take censuses every 10 years. In recent decades most countries have carried out censuses and is widely available. For example, 204 countries or areas carried out a census during the 1990 census decade (1985 to 1994). Data on births, deaths and migrants may come from national registration systems or from special questions in demographic surveys and censuses.

(b) **National and International Data Availability:** National and sub-national census data, as well as data on births, deaths and migrants, are available for the large majority of countries from national sources and publications; as well as from special country questionnaires sent to national statistical offices from the Statistical Division, UN Department of Economics and Social Information and Policy Analysis (DESIPA). For all countries, census and registration data are evaluated and, if necessary, adjusted for incompleteness by the Population Division, DESIPA as part of its preparations of the official United Nations population estimates and projections.

(c) **Data Reference:** Past, current and projected total population numbers rates are prepared for all countries by the Population Division, DESIPA and appear in the United Nations publication, *World Population Prospects: The 1998 Revision* (see item 6, below).

The World Bank's population estimates are produced by its Human Development Network and Development Data Group in consultation with its operational staff and resident missions. Important inputs to the World Bank's demographic work come from the following sources: census reports and other statistical publications from country statistical offices; demographic and health surveys conducted by national agencies, Macro International, and the U.S. Centers for Disease Control and Prevention; United Nations Statistics Division, Population and Vital Statistics Report (quarterly); United Nations Population Division, World Population Prospects: The 1998 Revision; Eurostat, Demographic Statistics (various years); South Pacific Commission, Pacific Island Populations Data Sheet 1999; and U.S. Bureau of the Census, International Database.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead organization are (1) The United Nations Department for Economic and Social Information and Policy Analysis (DESIPA). The contact point is the Director, Population Division, DESIPA; fax no. (1 211) 963 2147; and (2) The United Nation Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat); fax no. (254 2) 623080.

(b) **Other Contributing Organizations:** World Bank

6. REFERENCES

(a) **Readings:**

DESIPA. *(1993), Demographic Yearbook.* Statistical Division. United Nations Sales No.E/F.95.XIII

DESIRA. *World Population Prospects: The 1994 Revision.* United Nations publication Sales No E.95.XIII.16, New York, 1995

DESIPA (2000), *World Population Prospects. The 2000 Revision* (United Nations publication, forthcoming)

DESIPA (1995), *World Urbanization Prospects: The 1994 Revision.* Population Division. United Nations Sales No. E.95.XIII.12. New York,.

World Bank, (1993), *Housing: Enabling Markets to Work.* A World Bank Policy Paper. TheWorld Bank, Washington D. C.

UNCHS (Habitat) and The World Bank (1993), *The Housing Indicators Programme.* Report of the Executive Director (Volume I). UNCHS, Nairobi.

UNCHS (1995), *Habitat Monitoring the Shelter Sector. Housing Indicators Review.* UNCHS, Nairobi.

(b) **Internet site:**
UN: http://www.un.org/Depts/unsd/index.htm;

http://www.un.org/esa/population

http://www.un.org/Depts/unsd/social/hum-set.htm

UNCHS (Habitat)home page: http:// www. urbanobservatory.org/indicators/ database;

GDP PER CAPITA		
Dimension **Economic**	Agenda 21 **Chapter 2: International cooperation to accelerate sustainable development in developing countries and related domestic policies**	Placement in the CSD Theme/Sub-theme list **Economic Structure/ Economic Performance**: *GDP per capita*

1. INDICATOR (#2)

(a) **Name:** Gross domestic product (GDP) per capita.

(b) **Brief Definition:** Levels of GDP per capita are obtained by dividing annual or period GDP both at current market prices and/or prices based on purchasing power parity by population. A variation of the indicator could be the growth of real GDP per capita which is derived by computing the annual or period growth rate of GDP in constant basic producers' or purchasers' prices divided by corresponding population.

(c) **Unit of Measurement:** $US of the base 1990 year per capita.

(d) **Correspondence with other ISD:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
TSD EI: *GDP, in total and per capita*	MPTMSE: *Per capita GDP (ECON1)*	*None*

2. POLICY RELEVANCE

(a) **Purpose:** The indicator is a basic economic growth indicator and measures the level and extent of total economic output. It reflects changes in total production of goods and services.

(b) **Relevance to Sustainable/Unsustainable Development:** Growth in the production of goods and services is a basic determinant of how the economy fares. By allocating total production to each unit of population, the extent to which the rate of individual output contributes to the development process can be measured. It indicates the pace of per capita income growth and also the rate that resources are used up. As a single composite indicator of economic growth, it is a most powerful summary indicator of the economic state of development in its many aspects and the economic wellbeing of their residents. It does not directly measure sustainable development but it is a very important measure for the economic and developmental aspects of sustainable development, including people's consumption patterns and the use of renewable resources.

(c) **International Conventions and Agreements:** The 1993 System of National Accounts (SNA) provides international standards for national accounts.

(d) **International Targets/Recommended Standards:** National targets are generally oriented towards priorities, availability of resources and, in large measure, to historical economic performance. International targets are most often established by financial institutions and international organizations only for the purposes of inter-country comparison of economic performance in determining the direction of aid distribution or resource allocation projects. Country groupings to form economic entities, for example, the European Community, Organization of Petroleum Exporting Countries (OPEC), and the Benelux countries, also set international targets among constituent members to serve as guidelines in national policy priority setting. Moreover, the United Nations uses average world per capita income as a threshold in

setting the level of relief allowance for countries with large population in its formulation of the scale of assessments of member states.

(e) **Linkages to Other Indicators:** As a highly aggregated composite measure, this indicator has close links with many, more disaggregated indicators. Examples would include population growth, other GDP indicators, shares of sectors in GDP value added

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** GDP as defined in the 1993 SNA can be defined in three ways: Firstly, it is the sum total value- added of all production units including all taxes and subsidies on products which are not included in the valuation of output. It is also equal to the sum of final uses of goods and services (except intermediate consumption) measured in purchasers' prices, less the value of imports of goods and services. Finally, it can be measured as the sum of primary incomes distributed by resident producer units. Gross domestic product is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

(b) **Measurement Methods:** The current price estimates of GDP (Nominal GDP) are adjusted to GDP at constant prices in base year (Real GDP) with the use of price deflators. The 1990 is chosen as a base year. Population estimates enable the conversion of total GDP to per capita levels, while exchange rates and other conversion factors are used to arrive at values based on a common unit of currency. Real GDP is derived by extrapolating total value- added in the base year with production indicators in physical terms or by deflating current price values by a price deflator.

(c) **The Indicator in the DSR Framework:** GDP per capita deals with the processes and patterns of economic forces. As such, it is recognized as a composite Indirect Driving Force indicator of Economic dimension. However, it can also be regarded as a measure of the State of a country's economy in relation to population.

(d) **Limitations of the Indicator:** As a necessary condition to being a key economic performance indicator of sustainable development, one of the often-cited limitations of GDP is that it does not account for the social and environmental costs of production; it therefore is not a good measure of the level of over-all well being. For example, GDP per capital reveals nothing concerning energy and material interactions with the environment. GDP is also not considered a good measure of sustainable consumption because it does not allow for the capital used up in the production process. There may exist some differences in national accounting and demographic reporting procedures and practices between countries. One other possible drawback could lie in the comparability of price information used in deflating current price data and technical differences in the choice of base year for the original data. Additionally, a considered basic limitation lies in the conversion of GDP into a common denomination as a result of current misalignments in exchange rates for some countries vis-a-vis the comparator currency (US dollar) particularly for those countries in transition whose market exchange rates produce unrealistic levels of GDP, making any meaningful inter-country interpretation difficult.

The conversion rates used by the UN Statistics Division (UNSD) are normally the market or blended rates of exchange obtained from the International Monetary Fund (IMF). In some cases, use is made of UN operational rates which are established primarily for the settlement of administrative transactions between host countries and the UN. In many unique circumstances

the use of purchasing power parities (PPP) or price-adjusted rates of exchange (PARE) is necessary. The World Bank also uses a special exchange rate where the official exchange rate produces distortion in the dollar levels of GDP.

(e) **Status of the Methodology:** The 1993 System of National Accounts (SNA) provides international standards for national accounts. There may exist some differences in national accounting and demographic reporting procedures and practices between countries. One possible drawback could lie in the comparability of price information used in deflating current price considered basic limitation lies in the conversion of GDP into a common denominations a result of current misalignments in exchange rates for some countries vis-à-vis the comparator currency (US dollar) particularly for those countries in transition whose market exchange rates produce unrealistic levels of GDP, making any meaningful inter-country interpretation difficult.

(f) **Alternative Definitions/Indicators:** Economic indicators that measure the achievement of higher levels of goods and services more efficiently are better indicators of sustainable development. Consumption trends are better reflected by such indicators as Personal Consumption expenditures as used in the USA. This indicator can be derived from the SNA. Gross national product is another alternative of GDP, while GNP = GDP + Net factor income from abroad.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** The conversion rates used by the UN Statistics Division (UNSD) are normally the market or blended rates of exchange obtained from the International Monetary Fund (IMF). For international comparisons, economic indicators are converted from local currencies into a common currency, such as dollars. Traditionally, market exchange rates are used to make these conversions. In theory, exchange rates adjust through the action of the market so that the local currency prices of a group of identical goods and services represent equivalent value in every nation. In practice, however, such adjustments can lag far behind rapidly changing economic circumstances. Government actions, such as currency controls, influence over interest rates, import tariffs, and export subsidies, may further distort the accuracy of market- based exchange rates at any given time. Moreover, many goods and services are not traded in international commerce; market-based exchange rates may not reflect the relative values of such goods, even in theory. Thus, international comparisons based on market exchange rates can greatly over- or understate the value of a nation's economic activity.

An alternative approach is based on estimates of the purchasing power of different currencies, rather than their market exchange rates. On the basis of comparisons of prices and expenditures for several hundred goods and services by the International Comparison Project (ICP) in a large number of participating countries, the relative values of local currencies are adjusted to reflect PPP or equivalence. In effect, the PPP currency values reflect the number of units of a country's currency required to buy the same quantity of comparable goods and services in the local market as one U.S. dollar would buy in an average country.

The World Bank now presents estimates of per capita GDP converted to a common currency using PPP equivalents, in addition to values converted using market exchange rates. GDP values measured in dollars tend to be higher for developing and transitional countries than market-based exchange rates (i.e., their currencies are undervalued), while some developed countries' currencies appear to be overvalued relative to the U.S. dollar. From a PPP perspective, the

developing world's share of economic activity is larger than is reflected in market-based exchange rates (although market-based measures may be more relevant for some purposes, such as assessing trade potential). For purposes of cross-country comparisons the use of PPP or price-adjusted rates of exchange (PARE) is necessary.

(b) **National and International Data Availability:** The indicator has no serious limitations in terms of data availability. The principal data elements for a majority of countries are mostly and regularly available from national and international sources on a historical basis. Internationally accepted conceptual guidelines, are also available to assist with the compilation of the indicator. Annual GDP data in current and constant prices are generally reported by national statistical offices or central banks in the United Nations (UN) National Accounts questionnaire and supplemented by estimates prepared by the UN as well as other international organizations such as the World Bank and the IMF. The Organization for Economic Co- operation and Development (OECD) compiles quarterly GDP estimates for its Members. Population data are mainly obtained either through censuses or surveys. These are supplemented by growth estimates prepared by the UN Population Division.

(c) **Data Reference** Comprehensive national accounts statistics are published by the UN in the series *National Accounts Statistics: Main Aggregates and Detailed Tables.* A historical series of GDP is available from the national accounts database of the UN Statistics Division. Population data and projections are available in the World Population Prospects published by the Population Division of the UN Department of Economic and Social Affairs. Exchange rates are published by the IMF in *International Financial Statistics.*

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (DESA)

(b) **Other Contributing Organizations:** None

6. REFERENCES

(e) **Readings**: The 1993 SNA provides international standards on national accounts and is the product of collaborative efforts between EUROSTAT, IMF, OECD, UN and the World Bank; 3.

The World Bank (1993), *Purchasing Power of Currencies: Comparing National Incomes Using ICP Data* (Socio-Economic Data Division, International Economics Department, The World Bank, Washington, D.C.

(f) **Internet site:**

United Nations Statistics Division: http:/www.un.org/Depts/unsd

ENERGY PRICES		
Dimension **Economic**	Agenda 21 **Chapter 4: Changing Consumption Patterns**	Placement in the CSD Theme/Sub-theme List **None**

1. INDICATOR(#3)

(a) **Name:** End-use energy prices with and without tax/subsidy.

(b) **Brief Definition:** Actual prices paid by final consumer for energy.

(c) **Unit of Measurement:** US dollars using PPP per unit of energy (different units).

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
IIECEP: *Real energy price and taxes per fuel type* TSD-EI: *Energy prices for industry and households, with changes in real energy end-use prices*	None	*Energy price as percentage of full cost*

2. POLICY RELEVANCE:

(a) **Purpose:** This indicator reflects the extent to which energy becomes more or less expensive over time. In the developed world this should measure the disincentive to increase consumption, but for the developing world it would be a measure of affordability of energy, on the one hand, and of incentive for energy conservation and efficiency improvement, on the other.

(b) **Relevance to Sustainable/Unsustainable Development:** Consumption of fossil fuels is a major contributor to global warming and air pollution. Fossil fuel resources should also be conserved to support long-term development. Energy prices can be regulated to internalize environmental and social costs, to manage demand, and to encourage development of alternative renewable energy sources.

For developing countries there is a need to increase energy availability and affordability, in particular for the lower income groups of the population, so as to improve social and economic development. At the same time, the energy use practices in the developing counties are generally less efficient and often wasteful. Appropriate pricing mechanism may be used to overcome these deficiencies.

(c) **International Conventions and Agreements**: None

(d) **International Targets/Recommended Standards:** No international targets have been established. However, it is widely accepted that external costs of energy production and consumption should be internalized.

(e) **Linkages to Other Indicators:** Related indicators of economic dimension are: annual energy consumption per capita, intensity of energy use, energy mix, emissions of greenhouse gases. It is linked to the indicator of Social dimension, such as Ratio of daily disposable income/private consumption per capita of 20% poorest population to the prices of electricity and major household fuels to disposable income.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** This indicator should reflect the actual price paid by final consumers for various energy products. Prices should include all regular charges linked to the supply of energy to the customer. For example, for electricity and gas, the data should include not only the price per kWh or cubic meter, but also any standing charges and meter rental charges. Initial charges for connection to the electricity or gas network should not be included. For other products, any delivery charge should be included.

Different prices are often charged to different types of consumers. Therefore prices data should be collected for the main fuels, which may differ from one country to another, and for different types of consumer, e.g. domestic or industrial.

An underlying principle of tracking price data over time is that the product for which the price is tracked remains the same throughout the period. This is clear in the case of, say, gasoline, where the data to be collected is always the price at the pump of one liter or gallon of gasoline. However for other products such as electricity or gas it is less straightforward, as the price per kWh paid will vary depending on the amount delivered. Therefore it is necessary to define one or more standard consumers, representative of consumers in that country, whose consumption pattern does not vary from one year to another, in order to track changes in price paid.

(b) **Measurement Methods:** Because prices change through the year, the data collected must refer to a fixed date: 1 January of each year is proposed.

Three price levels should be distinguished: prices including all taxes; prices excluding deductible taxes (normally only deductible for industry); and prices excluding all taxes. If possible, subsidies for different consumers should also be identified, though in practice this can prove to be extremely difficult, as the subsidies are often hidden in complicated tariff systems.

In general, prices are collected in national currencies and converted to a common unit, usually US dollars. Exceptions would be fuels such as aviation fuel, which is often billed directly in US dollars. A further refinement is to deflate prices to allow for inflation. In order to deflate the price series, the Consumer Price Indices should be used for household prices, including pump prices of gasoline and diesel, and the Industrial Price Indices (or GDP, as an alternative, if Industrial Indices are not available) should be used for industrial prices.

Prices should be collected for the following products, in so far as these are commonly available on the market in the country.

Petroleum products

Units:

- *Automotive fuel*

  Premium unleaded gasoline (95 RON)

  Premium leaded gasoline (95 RON)

  Automotive gasoil (diesel): international dollars/1000 litre
- *Heavy fuel oil (residual fuel oil), for industry: international dollars/tonne*
- *Light fuel oil (heating gasoil), for households: international dollars/1000 litre*
- *Kerosene, for households: international dollars/1000 litre*
- *Liquefied petroleum gas (LPG), for households: international dollars/1000 litre.*

Measurement: Average price charged by the main distributors on 1 January.

Prices for gasoline and diesel should be pump prices. For heating gasoil and residual fuel oil, a standard offtakes or delivery must be defined since in general the price is cheaper for larger deliveries. Standard offtakes should be defined for domestic consumers and for industrial consumers; for example in the EU countries, prices are collected for

- Heating gasoil: deliveries of 2,000 to 5,000 litres,
- Heavy fuel oil: offtakes less than 2,000 tonnes per month or less than 24,000 tonnes per year.

▪ **Coal**

Units:

- *Steam coal, for industry and for households: international dollar/tonne*
- *Coking coal, for industry: international dollar/tonne.*

Measurement: In many countries the main users of coal are electricity generators and the steel industry. These often directly import coal to meet their own needs, in which case it is sufficient to collect data on coal import prices.

Coal producing countries often have more extensive domestic markets for coal, in which case average prices should be collected for typical deliveries for domestic and industrial consumers, in the same way as proposed for petroleum products.

• **Electricity, district heat, and piped gas**

For electricity, heat, and gas, a similar alternative is to use industry and household surveys to collect information on quantities of electricity, heat, and gas purchased and amounts charged, and to calculate average expenditure per unit purchased. This is strictly speaking not a true price, but rather a weighted price, where the weighting varies from one year to another. However it is preferable to the average revenue method, below.

The average revenue method, commonly used for lack of a better alternative, is based on data from utilities on average revenue per unit delivered. However it is generally not possible to distinguish sales to domestic or industrial customers, and data is skewed towards industry as the major consumers. Moreover, revenue data often includes charges for connecting new customers to the network and for repairs, as well as income from sales of appliances.

Units:

- *Electricity, for industry and for households: international dollars/kWh*
- *Natural Gas, for industry and for households: international dollars/1000 cub.m*
- *Heat, for industry and for households: international dollars/GJ.*

(c) **The Indicator in the DSR Framework:** This indicator represents an Indirect Driving Force within economy.

(d) **Limitation of the Indicator:** The wide variety of energy products available on the market means a large number of prices need to be collected. For example for road transport, leaded and unleaded 95 octane petrol, leaded and unleaded 98 octane petrol, diesel fuel, LPG and liquefied natural gas can all be found on the market. Normally only a selection of those considered most representative can be taken into account.

Further problems include differing prices for different locations throughout the country, e.g. prices in remote rural areas are often much higher than in major cities. As mentioned above, for some forms of energy, in particular electricity and gas, the price per unit will depend on a variety

of delivery conditions. The indicator can therefore only be indicative of the price paid by a typical or standard consumer and cannot reflect the full spectrum of consumer types and locations.

(e) **Status of the Methodology:** Not available.

(f) **Alternative Definitions / Indicators:**

- **Petroleum Products and Coal**

In practice the method proposed above may prove difficult for industry when no 'list price' exists, and industries negotiate individual supply contracts with the coal producer or oil company. In this case, the only solution is to carry out a sample survey of industry costs and to calculate average unit prices defined as total cost/quantity purchased.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Energy prices.

(b) **National and International Data Availability:** For coal and petroleum products, except aviation fuel, prices in developed countries are generally available, both nationally and internationally (OECD, Euros tat). For gas and electricity the availability of price data varies from one country to another.

(c) **Data References:**

OECD: *Energy Prices, annually*

Eurostat: *Energy Prices*, 1980-1997

Eurostat: *Electricity Prices,* 1990-1997

Eurostat: *Gas Prices* 1990-1997

Eurostat (1997): *Electricity Prices: Price systems*

Eurostat (1997): *Gas Prices: Price systems*

IEA: Energy Prices & Taxes, quarterly/

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** Eurostat (the Statistical Office of the European Communities). The contact point is Mr. Mario Ronconi (e-mail: mario.ronconi@eurostat.cec.be; tel. 0035 2 4301 35532, fax 0035 2 4301 37316)

(b) **Other Contributing Organizations:** The IAEA.

6. REFERENCES

a) **Readings:**

OECD (1998): *Towards sustainable Development- Environmental Indicators*

b) **Internet site:**

Eurostat: http://europa.eu.int/eurostat.html

OECD: http://www.oecd.org

IEA: http://www.iea.org

ADDENDUM TO THE METHODOLOGY SHEET: ADDITIONAL INFORMATION

1. TREND INDICATORS

To allow the analysis over time, some trend indicators could be selected, using real price series as a basis:

(a) Prices versus consumption

A simple analysis between price and consumption trends of each commodity can be carried out by comparing the variations in the reference period and measuring how the consumption changes relative to price changes. The usual measure for this is "price elasticity," which is defined as the percentage change in consumption for one percent change in price, provided that income remains constant.

Price elasticity measures the impact of price variations on the quantities demanded or consumed. Normally, it has a negative value and a higher consumption should be expected when prices fall and a lower consumption should be expected when prices rise.

Broadly speaking, an inverse relationship can be expected between prices and consumption: the higher the price, the lower consumption and vice versa. However, there is a point where further price increases do not reduce the energy consumption if the "minimum level" needed for normal functioning of the economic system is reached. Energy consumption is also influenced by other factors (for example: climate variations, possibility to substitute energy sources, etc.).

The taxes levied by product can be included by using in the Price Elasticity formula the variations of prices with and without taxes and comparing the results.

2. SPECIFIC PATTERNS OF ENERGY MARKETS

(a) Quality differences by product:

Variations in qualitative features determine several unit prices for the same energy product.

(b) "Administrative price" and "Taxation price" pattern

In some countries, energy prices are fixed administratively and do not reflect effective market prices. Normally, administrative price fixing implies application of specific administrative components (negative and/or positive) to a price reflecting production factors and market demand ("economic price"). The so-called "taxation price" concept, i.e. the amount of tax levied per unit, could also be applied to most energy prices. Ideally, at the macro level of economic accounts, three distinct price components should be considered:

- Taxes on products: Prices have to be reported including and excluding all taxes and, in the case of industrial prices, excluding only deductible taxes (e.g. VAT).

- Subsidies on products (applied in order to facilitate the supply to specific categories of consumers, e.g. industries or households); information on subsidies per unit price could be difficult to obtain;

- VAT on product

(c) Other criteria of price fixation

It is useful to consider also the following patterns, which directly influence consumption and effective prices for energy (and interact with the administrative fixation pattern):

price discrimination: different prices by sellers to different purchasers for identical goods

parallel markets: as a result of reaction to shortages or administrative controls.

SHARES OF SECTORS IN GDP VALUE-ADDED		
Dimension	Chapter in Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Changing Consumption And Production Patterns**	**None**

1. INDICATOR (#4)

(a) **Name:** Shares of sectors in GDP value added.

(b) **Brief Definition:** This indicator measures the contribution of the various economic sectors in total production. It is obtained by dividing the value added in a specific sector by the total GDP value-added at the constant 1990 prices.

(c) **Unit of Measurement: %.**

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
TSD EI: *Structure of GDP*	MPTMSE: Value added by main sector (ECON3)	

2. POLICY RELEVANCE:

(a) **Purpose:** The relative size of sectors is a significant indicator of the state of the economy. The relative size of manufacturing also hints at basic driving forces associated with sustainable development.

(b) **Relevance to Sustainable/Unsustainable Development:** The sectoral shares of economic output reflect the stage of country development in terms of availability of human resources and capital, both essential requirements in the drive towards sustainable development. Economic activities also draw from a wide range of energy and other resources and, like them, may deplete fossil fuel and degrade natural assets. Share of manufacturing is an important indicator of economic development and it is seen as a key indicator of sustainable development progress by many developing countries.

(c) **International Conventions and Agreements:** Not available.

(d) **International Targets/Recommended Standards:** National targets for the share of sector to GDP, in particular manufacturing, are usually included in policy making as a basis for budgets, funding programmes, and for priority-setting exercises.

(e) **Linkages to other indicators:** This indicator is closely related to other economic and environmental indicators reflecting the level of development and use of energy resources, such as share of energy intensive industries in manufacturing, depletion of energy resources. In developing countries it is also linked to the indicators reflecting dependence on non-commercial fuel.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Data on sectoral value-added (output) are presently compiled in accordance with the UN International Standard Industrial Classification (ISIC) revision 3. The following sectors have to be distinguished:

(i) **Agriculture**. An energy-consuming sector that consists of all facilities and equipment

engaged in growing crops and raising animals. It includes fishing and forestry and refers to ISIC Categories A,B, divisions 1,2,5;

(ii) **Manufacturing**. An energy-consuming sub-sector of the industry that consists of all facilities and equipment engaged in the mechanical, physical, chemical or electronic transformation of materials, substances or components into new products, whether the work is performed by power-driven machines or by hand, whether it is done in a factory or in the worker's home, and whether the products are sold at wholesale or retail. It refers to industries belonging to Category D, divisions 15-17;

(iii) **Commerce & Services**: An energy-consuming sector that consists of service-providing facilities and equipment of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. It corresponds to ISIC Categories G, H, J-Q, divisions 50-55, 65-99;

(iv)**Transportation**: An energy-consuming sector that consists of all vehicles whose primary purpose in transporting peoples and/or goods from one location to another. Included are automobiles, trucks, buses, motorcycles, trains, subways, and other rail vehicles, aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use. In ISIC classification it corresponds to Category I (transport, storage and communications), divisions 60-65.

Further details on the conceptual definition of GDP are contained in the SNA. National account statistics are published in the series *National Accounts Statistics: Main Aggregates and Detailed Tables.* The classification of sectors is covered in the UN *International Standard Industrial Classification of All Economic Activities, Revision 3*. Concepts and definitions are in accordance with the international Recommendations for Industrial Statistics, published by the United Nations.

(b) **Measurement Methods:**

(c) **The Indicator in the DSR Framework**: It is assigned as an Indirect Driving Force of Economic dimension.

(d) **Limitations of the Indicator:** This indicator has no serious limitations because data on sectoral activities in the System of National Accounts are guided by the framework recommended in the ISIC, and generally coherent between countries. It should be taken into account that in some national statistics, in particular in the US, agriculture is considered as a sub-sector of the industrial sector.

(e) **Status of the Methodology:** None.

(f) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator**:

(i) Gross domestic product at purchasing power parity as the sum of gross value added by all resident producers in the economy plus any taxes and minus any subsidies not included in the value of the product;

(ii) Value added in various sectors as net output after adding all outputs and substracting intermediate inputs. The industrial origin of value added is determined by the International Standard Industrial Classification revision 3.

(b) **National and International Data Availability and Sources:** Data on sectoral value-added and GDP are generally reported by national statistical offices or central banks to the UN National Accounts questionnaire. These are supplemented by estimates prepared by the United Nations Statistical Division (UNSD), as well as other international organizations such as the World Bank and the International Monetary Fund (IMF). These estimates are largely based on indicators of output obtained either from national sources or the United Nations Industrial Development Organization (UNIDO).

When using both UNSD and UNIDO data it is important to keep in mind the differences in measurement concepts between data derived from national accounts and industrial statistics.

When using World Bank data it should be kept in mind that Services includes transportation sector (ISIC I, 60-65) referring to ISIC divisions 50-99. World Bank's data on value added in industry additionally to manufacturing comprises mining, construction, electricity water and gas outputs. For some countries data in the UNIDO "International Yearbook of Industrial Statistics" are presented in accordance with Revision 2 of ISIC

(c) **Data Reference:**

UNIDO: *International Yearbook of Industrial Statistics 2001* (published biennially)

OECD: *Main Economic Indicators*, (monthly);

World Bank: *World Development Indicators, 2000 and 2001*;

UN: *National Accounts Statistics: Main Aggregates and Detailed Tables*;

UN Monthly Bulletin of Statistics;

UN-DESA (2001): *World Statistics Pocketbook,* No21.

EUROSTAT (2000): *Economic Accounts of the European Union 1998.*

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency for the development of this indicator is the United Nations Industrial Development Organization (UNIDO). The contact point is the Chief, Industrial Statistics Branch, Information and Research Division, UNIDO; fax no. (43 1) 232 156. As the official compiler of national accounts statistics, the United Nations Statistical Division could also be a principal contact point in terms of SNA and ISIC references.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

UN (1990): *International Standard Industrial Classification of all Economic Activities, Third*

Revision.

Srinivasan T.N., "*Database for Development Analysis: An overview*" Journal of Development Economics, 44(1), 3-28, 1994.

Heston Alan, "*A brief review of some problems in using National Accounts data in level of output comparison and growth studies*", Journal of Development Economics, 44(1), 29-52, 1994.

(b) **Internet site:**
World Bank: http://www.worldbank.org/data
UNIDO: http://www.unido.org
UN-DESA: http://esa.un.org/unsd/cr/registry/regs.asp

DISTANCE TRAVELLED PER CAPITA: TOTAL AND BY URBAN TRANSPORT		
Dimension **Economic**	Agenda 21 **Consumption and Production Patterns**	Placement in the CSD Theme/Sub-theme list **Economic/ Consumption and Production Patterns/ Transportation**

1. INDICATOR(#5)

(a) **Name:** Distance travelled per capita: total and by urban transport.

(b) **Brief Definition:** The number of kilometres travelled per person in a given year in total and by urban transport, and in particular by electrically driven vehicles in urban public transport.

(c) **Unit of Measurement:** Kilometres per year per capita for travelled distances; % for share of electrically driven vehicles in urban public transport.

(d) **Correspondence with other ISD:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
TSD EI: *Road traffic and vehicle intensities* IIEC Transport Policy:	MPTMSE: *Passenger transport by mode* (ECON19)	*Number of passenger km par capita by mode of transport*

2. POLICY RELEVANCE

(a) **Purpose:** This indicator can contribute to monitor fuel consumption for travelling and the environmental impact of the systems for personal mobility in a particular country or area.

(b) **Relevance to Sustainable/Unsustainable Development:** Travel is an essential part of the economic and social life of a country. As economies develop, the demand for mobility and hence passenger transport increases. Increasing in distance travelled and changes in the mix of travel modes result in a changing picture with regard to road fuel mix and environmental impacts. Non-motorised hence has low environmental impact. Motorised travel is the only suitable means of travelling longer distances, but causes higher demand for energy and consequently has greater environmental and social impacts, such as urban pollution, global warming, and accidents. Sustainability implies using the most appropriate mode of transport for the journey in question. Policies are needed which reduce the need for travel, support a shift towards less environmentally damaging means, such as electrically driven vehicles, provide incentives for changes in lifestyle, increase safety, and improve the standard of public transport (transit).

(c) **International Conventions and Agreements:** Not applicable.

(d) **International Targets/Recommended Standards:** No international targets have been established.

(e) **Linkages to other indicators:** This mobility indicator is linked to economic indicators, such as GDP per capita, shares of sectors in GDP value added, energy intensity of transportation and passenger travel, automotive fuel consumption per capita, and road fuel prices and taxes. It is associated with percent of population in urban areas. The indicator is also linked to some environmental indicators: quantities of air pollutant emissions, quantities of GHG emissions, ambient concentration of pollutants in urban areas.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The aim of this indicator is to quantify the use of

different modes of transport by people (passengers). The indicator should be broken down into the urban public transport modes, notably into electrically driven vehicle (trams, trolleybus, trains, metro etc.) A further breakdown by various modes and purpose would provide useful additional information.

(b) **Measurement Methods:** Total and urban public transport passenger- kilometres travelled per year divided by the total population.

(c) **The Indicator in the DSR Framework:** The indicator is assigned as an Indirect Driving Force of Economic dimension.

(d) **Limitations of the Indicator:** The reliability of passenger- kilometre statistics, with the exception of bus and train, leaves much to be desired. The indicator has an inbuilt bias against the longer distance modes of transport, especially planes. To some extent this can be offset by splitting the indicator by purpose (shopping, travel to school or work, professional travel, pleasure). Ideally, the indicator would measure the distance travelled by the population of a country both within and outside their country. In practice, national passenger- kilometre statistics normally include movements of all people within the national territory (regardless of their normal place of residence), and exclude movements outside their territory. This indicator measures only distance travelled by passengers and does not cover goods transport. In order to monitor efficiency changes in the transport sector, an indicator such as transport performance divided by vehicle performance (tonne- kilometres/ vehicle- kilometres) could be considered.

(e) **Status of the Methodology:** An agreed methodology at the international level concerning passenger transport statistics has not yet been established and no specific projects on this direction are known at present. National definitions are being used.

(f) **Alternative Definitions/Indicators:** An alternative would be to use number of trips for different purposes. This would counter the bias against longer distance modes.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Total passenger- kilometre data;

(ii) Passenger-kilometre data by urban public transport means;

(iii) Share of electrically driven vehicles in urban public transport;

(ii) Population.

(b) **National and International Data Availability:** Passenger- kilometer data for at least some modes of transport are regularly available for most countries at the national level; and for some countries, at the sub- national level. But the data quality differs by mode. Passenger cars have considerable uncertainties due to lack of complete information of vehicle-kilometres and the occupancy rates. Data are compiled by and available from national statistical offices and various professional organizations.

(c) **Data Reference:**

Eurostat: Transport Annual Statistics.

ECMT: Statistical Trends in Transport.

UNECE: Annual Bulletin of Transport Statistics for Europe. International Road Federation: World Road Statistics.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is Eurostat (the Statistical Office of the European

Communities). The contact point is Ms. Inger Oehman, fax no. (35-2) 4301 37278.

(b) **Other Contributing Organizations:** Other Contributing Organizations: Other organizations involved in the development of this type of indicator include: International Road Transport Union (IRU) and the United Nations Economic Commission for Europe (UNECE

6. REFERENCES

(a) **Readings:** EU Commission (1999), *EU transport in figures*, Statistical Pocketbook.

Commission for EU (2000), *Transport and Environment - Statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union.*

European Environment Agency (2000), *Are we moving in the right direction? Indicators on transport and the environment integration in the EU.*

Commission for EU (2001), *WHITE PAPER European transport policy for 2010: time to decide* Brussels, 12/09/2001, COM(2001) 370

(b) **Internet site:** http://europa.eu.int/com./ eurostat

FREIGHT TRANSPORT ACTIVITY: TOTAL, BY MODE		
Dimension **Economic**	Agenda 21 **Consumption and Production Patterns**	Placement in the CSD Theme/Sub-theme list **None**

1. INDICATOR (#6)

(a) **Name:** Freight transport activity: total, by mode.

(b) **Brief Definition:** The indicator reflects production aspects of transportation and is defined as the number of tonnes of freight transport multiplied by the distance transported, by different modes of transport, such as truck, train, inland water, and pipelines.

(c) **Unit of Measurement:** Billion tonne-km per year for total freight activity, and percentage for share of different modes.

(d) **Correspondence with other ISD:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
TSD EI: *Road traffic and vehicle intensities* IIEC Transport Policy:	MPTMSE: *Freight transport by mode* (ECON20)	Freight traffic by mode of transport

2. POLICY RELEVANCE

(a) **Purpose:** This indicator can contribute to monitor fuel consumption for freight transport and the environmental impact of the systems for freight activity in a particular country or area.

(b) **Relevance to Sustainable/Unsustainable Development:** Transport of freight is an essential part of the economic life of a country. As economies develop, the demand for freight transport increases. Increases in both number of tonnes of freight transported and distances as well as the changes in the mix of travel modes result in a changing picture with regard to environmental impacts. The different modes have significantly different impacts. Water transport and pipelines are more efficient in energy terms than rail, which is in turn more energy efficient than road. On the other hand, if one considers the delivery time road still remains the most efficient mode. The trend towards containerisation of freight has speeded up the transfer of freight from one mode to another.

Sustainability implies using the most appropriate mode of the freight and promoting the intermodal and combined transport, as well as the revitalisation of shipping, railways and inland waterways. Policies are needed which reduce the need for freight activity, support a shift towards more energy efficient and less environmentally damaging means, provide incentives for changes in lifestyle, increase safety, and improve the standard of freight transport.

(c) **International Conventions and Agreements:** Not applicable.

(d) **International Targets/Recommended Standards:** No international targets have been established.

(e) **Linkages to other indicators:** This mobility indicator is linked to economic indicators, such as GDP per capita, shares of sectors in GDP value added, energy intensity of transportation and freight transport, automotive fuel consumption per capita, and road fuel prices and taxes. The indicator is also linked to some environmental indicators: quantities of air pollutant emissions, quantities of GHG emissions, and ambient concentration of pollutants in urban areas.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The aim of this indicator is to quantify the use of different modes of transport for freight. The indicator should be broken down into the following modes of transport: train, inland water, and pipelines urban public transport modes, notably into electrically driven vehicle

(b) **Measurement Methods:** The number of tonnes of freight transport, the distance transported, by different modes of transport, such as truck, train, inland water, and pipelines.

(c) **The Indicator in the DSR Framework:** The indicator is assigned as an Indirect Driving Force of Economic dimension.

(d) **Limitations of the Indicator:** The reliability of tonne-km data, with the exception of train and ships, leaves much to be desired. This indicator measures only distance travelled by freight and does not cover passenger travel. In order to monitor efficiency changes in the transport sector, an indicator such as transport performance divided by vehicle performance (tonne-kilometres/ vehicle- kilometres) could be considered.

(e) **Status of the Methodology:** An agreed methodology at the international level concerning passenger transport statistics has not yet been established and no specific projects on this direction are known at present. National definitions are being used.

(f) **Alternative Definitions/Indicators:** An alternative would be to use road freight vehicles-km.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Total freight tonne- kilometre data;

(ii) Freight-kilometre data by different freight transport means.

(b) **National and International Data Availability:** Tonne-kilometre data for different modes of freight transport are regularly available for most countries at the national level; and for some countries, at the sub- national level. But the data quality differs by mode. Road tracks have considerable uncertainties due to lack of complete information of vehicle-kilometres and the load factor. Data are compiled by and available from national statistical offices and various professional organizations.

(c) **Data Reference:**

Eurostat: Transport Annual Statistics.

ECMT: Statistical Trends in Transport.

UNECE: Annual Bulletin of Transport Statistics for Europe. International Road Federation: World Road Statistics.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is Eurostat (the Statistical Office of the European Communities). The potential contact point is Ms. Inger Oehman, fax no. (35-2) 4301 37278.

(b) **Other Contributing Organizations:** Other Contributing Organizations: Other organizations involved in the development of this indicator include: International Road Transport Union (IRU) and the United Nations Economic Commission for Europe (UNECE

6. REFERENCES

(a) **Readings:**

EU Commission (1999), *EU transport in figures*, Statistical Pocketbook.

Commission for EU (2000), *Transport and Environment - Statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union.*

European Environment Agency (2000), *Are we moving in the right direction? Indicators on transport and the environment integration in the EU.*

Commission for EU (2001), *WHITE PAPER European transport policy for 2010: time to decide* Brussels, 12/09/2001, COM (2001) 370

(b) **Internet site:** http://europa.eu.int/com./ eurostat.

FLOOR AREA PER CAPITA		
Dimension **Economic**	Agenda 21**Chapter 7: Promoting Sustainable Human Settlement Development**	Placement in the CSD Theme/Sub-theme List **Social/ Housing/ Living Conditions/** *Floor Area per Person*

1. INDICATOR (#7)

(a) **Name:** Floor area per capita.

(b) **Brief Definition:** Defined as the median usable living space per person.

(c) **Unit of Measurement:** sq. m per person.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
	MPTMSE: *Number of rooms per capita (SOC17)*	None

2. POLICY RELEVANCE:

(a) **Purpose:** This is a key indicator of housing quality, which measures the adequacy of living space in dwellings. A low value for the indicator is a sign of overcrowding.

(b) **Relevance to Sustainable/Unsustainable Development:** This is a key indicator measuring the adequacy of the basic human need for shelter. Human settlement conditions in many parts of the world are deteriorating mainly as a result of a low level of investment, although such investment has been shown to generate considerable public and private sector investment. Housing policies, particularly in urban areas, greatly affect the living conditions of people. In low income settlements, reduced space per person can be associated with certain categories of health risks.

(c) **International Conventions and Agreements:** This indicator is one of ten "key" housing indicators approved by the Commission on Human Settlements (Resolution 14/13), to be collected in all countries and in a number of cities in each country, to measure progress towards meeting the objectives of the Global Shelter Strategy. Countries are to use the indicators to provide the basis for their country reports to the Second United Nations Conference on Human Settlements. Also, the Habitat Agenda, endorsed at the Second United Nations Conference on Human Settlements (Habitat II), explicitly mentions 'provision of sufficient living space and avoidance of overcrowding', as part of the commitments of UN member states, to be measured by this indicator. This indicator has also been selected for the Common Country Assessment (CCA) indicators' framework prepared by the UNDG for evaluation, advocacy and policy dialogue at the country level.

(d) **International Targets/Recommended Standards:** No targets have been developed for this indicator.

(e) **Linkages to other indicators:** This indicator is linked to several other economic indicators with which it should be considered, including energy consumption per capita, energy intensity in

residential sector.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The floor area should include all living space, along with bathrooms, internal corridors and closets. Covered semi-private spaces such as corridors, inner courtyards or verandas should be included in the calculation if used by the household for cooking, eating, sleeping, or other domestic activities. Floor area refers to a housing unit, defined as a separate and independent place of abode intended for habitation by one household at the time of the census or other inquiry.

(b) **Measurement Methods:** The median floor area of a unit should be divided by the average household size. If data from household surveys or from a recent census are available, these can be used. In the absence of better data, the floor area of the median priced dwelling may be used as an approximation, although this may not be an accurate estimate. If the median cannot be estimated, then the average should be provided.

(c) **The Indicator in the DSR Framework:** This indicator is a measure of housing quality, an outcome of housing demand and in particular of energy demand in residential sector. As such, this indicator is a Indirect Driving Force of Economic Dimension in the DSR Framework

(d) **Limitations of the Indicator:** Results for this indicator may vary considerably if collected at the city, national, urban/rural levels, given the variations in land availability and types of human settlements and activities. Informal settlements in particular are likely to have much less space per person, as are disadvantaged groups. Various levels of data collection are necessary to provide a full picture of this specific housing outcome. Housing size and housing quality are usually but not necessarily linked, and floor area per person may not give a complete picture of living conditions. Cultural values affect sensitivity to crowding. For these reasons, interpretation of this indicator is difficult, and should be completed in conjunction with related indicators

(e) **Status of the Methodology:** Not Available.

(f) **Alternative Definitions:** Alternative measures of crowding have been the subject of data collection and reporting in international statistical compendia. The two most common are persons per room and households per dwelling unit, each of which was included among data collected during the first phase of the Housing Indicators Programme (UNCHS, World Bank, 1992). Surveys have shown that floor area per person is more precise and policy-sensitive than the other two indicators. Habitat, the United Nations Cent re for Human Settlements (UNCHS) has developed and tested a series of crowding indicators in low- income settlements. They include, among others, percentage of housing units with more than one household, in- house living area per person, percentage of housing units with more than three persons per room, number of households per building and per housing unit, number of persons per building.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Median floor area of housing units; average number of persons per household.

(b) **National and International Data Availability and Sources:** The data are generally available at the country level. This indicator was collected in 52 countries (one city per country) by the Shelter Sector Performance Indicators Programme in 1992 (UNCHS, World Bank). It has been collected worldwide by the UNCHS Indicators Programme in preparation for the Habitat II

Conference (1996). Results are available from the following Habitat website: www.urbanobservatory.org/indicators.

(c) **Data References:** Primary data sources include censuses or household surveys. The indicator is reported in *the Housing Indicators Programme* report listed in section 6 below.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Centre for Human Settlements (Habitat). The contact point is the Head, Urban Secretariat, UNCHS (Habitat); fax no. (254 2) 623080.

(b) **Other Contributing Organizations:** The World Bank.

6. REFERENCES

(a) **Readings:**

World Bank, (1993): *Housing: Enabling Markets to Work.* The World Bank, Washington D.C. A World Bank Policy Paper).

UNCHS (Habitat), World Bank, (1993): *The Housing Indicators Programme.* Report of the Executive Director (Volume I). UNCHS, Nairobi,.

UNCHS (Habitat), (1995):*Monitoring the Shelter Sector.* Housing Indicators Review. UNCHS, Nairobi.

UNCHS (Habitat), (1995): *Human Settlement, Interventions Addressing Crowding and Health Issues*,

UNCHS (Habitat), (2001):. *Cities in a Globalizing World: Global Report Human Settlements,* UNCHS, Nairobi.

(b) **Internet site:**

UNCHS (Habitat) home page: http://www.urbanobservatory.org/indicators/database.

http://www.UNCHS.org/documents/
http://www.bestpractices.org/

MANUFACTURING VALUE ADDED BY SELECTED ENERGY INTENSIVE INDUSTRIES		
Dimension	Chapter in Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Changing Consumption And Production Patterns**	**None**

1. INDICATOR (#8)

(a) **Name:** Manufacturing Value Added by Selected Energy Intensive Industries.

(b) **Brief Definition:** This indicator measures the contribution of the various manufacturing energy intensive industries in total manufacturing output. It is obtained by dividing the value added in a specific manufacturing branch by the total net value-added in manufacturing at the constant 1990 prices.

(c) **Unit of Measurement: %.**

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
None	None	None

2. POLICY RELEVANCE:

(a) **Purpose:** Indicator is designed to monitor the relative size of energy intensive industries in manufacturing. The relative size of energy intensive industries also hints at basic driving forces associated with level of energy use per unit of GDP.

(b) **Relevance to Sustainable/Unsustainable Development:** The shares of economic output of industrial branches reflect the level of energy needs to drive economy.

(c) **International Conventions and Agreements:** Not available.

(d) **International Targets/Recommended Standards:** National targets for the share of industries to manufacturing, are usually included in policy making as a basis for economy restructuring, budgets, funding programmes, and for priority-setting exercises.

(e) **Linkages to other indicators:** This indicator is closely related to other economic and environmental indicators reflecting the level of development and use of energy resources, such as share of energy intensive industries in manufacturing, depletion of energy resources, air pollution emissions, etc.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:**

The energy intensive industries have to be specified for the manufacturing of:

(i) **Iron and steel,** in classification ISIC refers to Group 271;

(ii) **Non-ferrous metals,** refers to ISIC Group: 272 "Manufacture of basic precious and non-ferrous metals";

(iii) **Basic Chemicals,** corresponds to ISIC Group 241, which in turn comprises the following

Classes: 2411 – "Manufacture of basic chemicals, except fertilizers and nitrogen compounds"; 2412 – "Manufacture of fertilizers and nitrogen compounds"; 2413 – "Manufacture of plastics in primary forms and of synthetic";

(iv) **Non-metallic minerals,** corresponds to ISIC Group 269 – "Manufacture of non-metallic mineral products", Class 2694 - Manufacture of cement, lime and plaster is of primary interest. The Class includes manufacture of (1) hydraulic cements, including portland, aluminous slag and superphosphate, whether or not in the form of clinkers; (2) quicklime, slaked lime and hydraulic lime; (3) plasters consisting of calcined gypsum or calcium sulphate.

(v) **Paper and pulp,** corresponds to ISIC Group 210. This Group comprises several Classes, among them the desirable one to be addressed is 2101 – "Manufacture of pulp, paper and paperboard", if data on it is available;

(vi) **Refined Petroleum Products**: In ISIC classification it corresponds to Group 232

Data on manufacturing branches value-added (output) are presently compiled in accordance with the UN International Standard Industrial Classification (ISIC) Revision 3. Details on the conceptual definition of manufacturing and its branches are contained in the in the System of National Accounts (SNA). National account statistics are published in the series *National Accounts Statistics: Main Aggregates and Detailed Tables.* The classification of sectors is covered in the UN *International Standard Industrial Classification of All Economic Activities,* Revision 3. Concepts and definitions are in accordance with the international Recommendations for Industrial Statistics, published by the United Nations.

(b) **Measurement Methods:**

(c) **The Indicator in the DSR Framework**: It is assigned as an Indirect Driving Force of Economic dimension.

(d) **Limitations of the Indicator:** This indicator has no serious limitations because data on manufacturing structure in the System of National Accounts are guided by the framework recommended in the ISIC, and generally coherent between countries.

(e) **Status of the Methodology:** None.

(f) **Alternative Definitions/Indicators:** None.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator**:

(i) Value added in manufacturing as the sum of gross output less the value of intermediate inputs used in production for industries classified in ISIC major division (See the Methodological Sheet for Shares of sectors in GDP value added);

(ii) Value added in various branches of manufacturing as net output after adding all outputs and substracting intermediate inputs. The industrial origin of value added is determined by the International Standard Industrial Classification, Revision 3.

(b) **National and International Data Availability and Sources:** Data on the distribution of manufacturing value added by manufacturing activities branches are provided the United Nations Industrial Development Organization (UNIDO). Value-added is generally reported by national

statistical offices or central banks to the UN National Accounts questionnaire. These are supplemented by estimates prepared by the United Nations Statistical Division (UNSD), as well as other international organizations such as the World Bank (WB) and the International Monetary Fund (IMF).

The ISIC emphasizes commonalities in the production process and is explicitly not intended to measure output. For output measuring there is a newly developed Central Product Classification (CPC). Nevertheless, the ISIC views an activity as defined by " a process resulting in a homogeneous set of products"

When using the WB data it should be noted that the classification of manufacturing industries coincides with the ISIC revision 2. For some countries data in the UNIDO "International Yearbook of Industrial Statistics" are presented in accordance with Revision 2 of ISIC

(c) **Data Reference:**
UNIDO: *International Yearbook of Industrial Statistics 2001* (published biennially);

OECD: *Main Economic Indicators*, (monthly);

World Bank: *World Development Indicators 2000 and 2001*;

UN National Accounts Statistics: Main Aggregates and Detailed Tables;

UN Monthly Bulletin of Statistics.

UN-DESA: **World Statistics Pocketbook**, No21, 2001.

EUROSTAT: *Economic Accounts of the European Union 1998*, 2000.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency for the development of this indicator is the United Nations Industrial Development Organization (UNIDO). The contact point is the Chief, Industrial Statistics Branch, Information and Research Division, UNIDO; fax no. (43 1) 232 156. As the official compiler of national accounts statistics, the United Nations Statistical Division could also be a principal contact point in terms of SNA and ISIC references.

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

UN (1990): *International Standard Industrial Classification of all Economic Activities*, Third Revision.

Srinivasan T.N., *"Database for Development Analysis: An overview"* Journal of Development Economics, 44(1), 3-28, 1994.

Heston Alan, *"A brief review of some problems in using National Accounts data in level of output comparison and growth studies"*, Journal of Development Economics, 44(1), 29-52, 1994.

(b) **Internet site:**
World Bank: http://www.worldbank.org/data
UNIDO: http://www.unido.org

UN-DESA: http://esa.un.org/unsd/cr/registry/regs.asp

ENERGY INTENSITY: MANUFACTURING		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Consumption and Production Patterns**	**Consumption and Production Patterns/ Energy Use/** *Intensity of Energy Use: Manufacturing*

1. INDICATOR (#9-1)

(a) **Name:** Energy Intensity in Manufacturing.

(b) **Brief Definition:** Energy consumption per unit of manufacturing output.

(c) **Unit of Measurement:** Tonne of oil equivalent (toe) of final energy and kWh of electricity per unit of output in manufacturing sector converted to constant international US dollars using purchasing power parity rates (toe/1000$ and kWh/$).

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
	MPTMSE: *Energy intensity of manufacturing (ECON12)*	*Energy intensity of manufacturing*

2. POLICY RELEVANCE:

(a) **Purpose:** The manufacturing sector is a major consumer of energy. This indicator is a measure of the efficiency of energy use in the sector that can be used for analysing trends and making international comparisons in energy efficiency, particularly when the indicator can be disaggregated to specific branches of manufacturing.

(b) **Relevance to Sustainable/Unsustainable Development:** Sustainable development requires increases in energy efficiency in order to reduce fossil fuel consumption, greenhouse gas emissions and related air pollution emissions.

(c) **International Conventions and Agreements:** Although there are no specific international targets regarding energy use or energy efficiency, many industrialized countries have targets for reducing energy use and carbon emissions from manufacturing branches.

(d) **Linkages to other indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, agriculture, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for shares of sectors in value added, manufacturing value added by selected energy intensive products, total energy and electricity consumption, greenhouse gas emissions, and air pollutant emissions.

(e) **International Targets/Recommended Standards**: UNFCCC and its Kyoto Protocol.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Energy consumption per unit of value added is one way of measuring energy requirements and energy efficiency in manufacturing. While energy

consumption per unit of physical output is a better indicator of energy efficiency in specific manufacturing processes, energy use per unit of economic output is more useful both for relating energy efficiency to economic activity and for aggregating and comparing energy efficiency across manufacturing sectors or across the entire economy.

(b) **Measurement Methods:**

⇒ **Energy Use**: Energy use is usually measured at the point of consumption, i.e., the factory or establishment. "Own energy" (including internal use of hydropower, biofuels, or internal waste heat) should be combined with purchased energy at useful heating values.

For combined production of heat and electricity, no simple method exists for dividing the total energy consumed between these two outputs. Where excess heat or electricity is sold or provided to outside establishments or a grid, the energy required for this out-going supply should not be allocated to the product of the establishment or branch and the income or apparent value added from these sales should be excluded from output value.

In some cases, it may be preferable to measure total primary energy consumption, including losses incurred in the external production and distribution of the purchased electricity and heat, since these losses would occur if the establishment or branch used the primary energy directly. Primary energy consumption is a better measure of the total energy burden on the economy of a unit of output from an industry. Generally, the energy loss from converting primary energy to electricity is estimated by the average ratio for electricity production in the economy.

Complications in interpreting energy intensity data arise from the fact that some branches of manufacturing may be concentrated in regions of a country rich in certain kinds of power or heat sources, such that those branches constitute a lower energy burden on the economy than the indicator would suggest. Interpretation is also complicated when a particular branch has significant internal energy resources, such as captive hydro, biofuels or coal. There are various conventions for calculating the primary energy corresponding to electricity produced by nuclear, hydro or geothermal sources.

It is also possible to measure total energy consumption, internal and external, for any final product by using input-output tables to measure the energy embodied in materials and intermediate products. This is much more data intensive, because the input-output tables are complex. Such tables are not produced regularly, so this approach is difficult to follow, except at long intervals.

Units: Preferable units for measuring final energy is tonne of oil equivalent and for electricity is kWh.

⇒ **Output**. There are different approaches for measuring output in manufacturing. For some purposes, physical output would be preferable, but this is not possible using the energy consumption statistics available in many countries, and there are many sectors for which aggregate physical output cannot be easily defined.

There are two basic alternatives for measuring economic output. In either case, we use real local currency, deflated by the deflator for the sector or branch to a base year. This step is

crucial, so that the weight of each sector or branch reflects the correct weight in the base year. The value of output is then converted to a common international currency, usually US dollars using purchasing power parities (PPP). One alternative is to calculate the total value of production or shipments. This measures literally the total output from an industry, and is defined for most countries. The other alternative is to calculate the value-added or contribution to GDP, representing only the increase in economic output produced by the sector or branch in question.

The total value of output tends to be more stable over time, but has the disadvantage that it cannot be aggregated to total output, because of double counting: inputs to one branch may be the outputs of another branch. Value added can be aggregated, but may have greater fluctuations from year to year if input costs or output prices change, which is common for many basic raw materials, particularly crude oil. Unfortunately, there is no simple correspondence between the two measures of output.

Unit: Constant international US dollars. Market value of output in real local currency deflated to a base year using GDP deflators. Local currency is converted to US dollars, using purchasing power parity for the base year.

(c) **The Indicator in the DSR Framework**: This indicator is assigned as an Indirect Driving Force indicator of the Economic dimension.

(d) **Limitations of the Indicator:**

The aggregate indicator for the manufacturing sector reflects both the energy intensity of various branches of manufacturing and the composition of the manufacturing sector. Changes in the aggregate indicator can therefore be due either to changes in energy intensity or to changes in relative branch output. Similarly, differences between countries may be due either to differences in energy efficiency or differences in the structure of the manufacturing sector. A country with large energy-intensive industries, such as pulping, primary metals or fertilizers, for example, will have a high energy intensity, even if the industry is energy efficient. For this reason, it is desirable to disaggregate energy intensity by branch of manufacturing.

Detailed calculations such as total energy consumption for particular products, using input-output tables, while desirable, are very data intensive and difficult to update regularly.

(e) **Status of the Methodology:** The methodology is in use in many developed countries.

(f) **Alternative Definitions/Indicators:** In the context of climate change, it has become increasingly desirable to convert energy consumption to carbon emissions per unit of production. The fuels consumed can be converted to carbon emissions using IPCC coefficients. Carbon emissions will therefore change both with changes in energy efficiency and changes in fuel type.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Energy consumption by manufacturing sector;
(ii) Electricity consumption by manufacturing sector;
(iii) Real output of the sector.

(b) **National and International Data Availability and Sources:**

The United Nations compiles value added at the two or three digit level for developed and developing countries. Value added in manufacturing at the three and four digit ISIC level for most

OECD countries is now compiled by OECD as part of its STAN data base. The European Union produces data on value added at the two and three-digit level in the NACE system, and suitable bridges exist to translate NACE into ISIC.

One persistent data problem at the aggregate level is distinguishing between "industry" (ISIC C, D, F and even E) and manufacturing (ISIC D). Some countries also lump agriculture, forestry and fishing (ISIC A, B) in the aggregate "industry" classification. For these reasons, it is strongly recommended that data be checked to ascertain exactly what sectors are covered. Manufacturing is the preferable aggregate, since inclusion of the other sectors mentioned can distort time series analysis and comparisons among countries.

(c) **Data Reference:**

IEA: *Energy Balances of Member Countries and Energy Balances of non-Member Countries*, annually;

Eurostat: Energy Balances;

The Latin American Energy Organization /Organizacion Latinoamericana de Energia (OLADE);

Asia Pacific Energy Research Centre (APERC);

UN: Industrial Statistics, National Accounts;

OECD: STAN database (structural analysis database);

EU: NACE system.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations:** OECD and IEA have collected detailed value added and energy consumption data at the four-digit level in the ISIC database. Less detailed two-digit data are also available. IEA now collects two-digit energy consumption data for manufacturing for about half of the developing countries as well.

6. REFERENCES

(a) **Readings:**

Energy Policy, June/July 1997 issue, Elsevier Science Limited, various articles in this issue discuss the physical and monetary measures of output and various problems associated with indicators of manufacturing energy use and intensity.

Phylipsen, G.J.M, Blok, K., and Worrell, E., 1997. *Handbook on International Comparison of Energy Efficiency in the Manufacturing Industry.* Utrecht: Dept. of Science, Technology, and Society.

IEA, 1997. *Indicators of Energy Use and Energy Efficiency.* Paris: OECD.

(b) **Internet site:**

International Energy Agency: http://www.iea.org

World Bank: http://www.worldbank.org/data

ENERGY INTENSITY: AGRICULTURE		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Changing Consumption and Production Patterns;** **Chapter 14: Promoting Sustainable Agriculture and Rural Development**	**None**

1. INDICATOR (#9-2)

(a) **Name:** Energy Intensity: Agriculture.

(b) **Brief Definition:** Energy consumption per unit of agricultural output.

(c) **Unit of Measurement:** Tonne of oil equivalent (toe) of final energy and kWh of electricity per unit of output in agricultural sector converted to constant international US dollars using purchasing power parity rates (toe/1000$ and kWh/$).

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
None	None	*Energy intensity of agriculture*

2. POLICY RELEVANCE:

(a) **Purpose:** The agriculture is an important consumer of energy. The purpose of the indicator is to provide a measure of the efficiency of energy use in the sector that can be used for analyzing trends, particular in non-commercial energy consumption, and making international comparisons in energy efficiency.

(b) **Relevance to Sustainable/Unsustainable Development:** Energy is essential for most human activities, including agriculture. The availability of energy is a key factor to increase agricultural productivity and to achieve food security and improve rural livelihoods Too little energy makes it difficult to realize decent productivity and meet food requirements. Too much energy signifies waste, global warming, and other stress on the environment. The indicator can guide policies and investments regarding (i) energy requirements in all stages of agricultural production in order to measure agricultural productivity and, (ii) energy efficiency, to reduce energy intensity. The indicator is relevant to promote an increase in energy efficiency in order to reduce fossil fuel consumption, greenhouse gas emissions and air pollutant emissions with a parallel increase in agricultural production. Renewable energies such as solar, wind and bioenergy can contribute strongly, together with other environmental technologies, to increased labour efficiency and diversified economic activities in rural areas.

It is worth to note, that the specific functions of agriculture as an energy producer and agroecosystem regenerator is an other essential component of sustainability.

(c) **International Conventions and Agreements:** No binding agreements exist. Agenda 21 makes reference to the need to promote energy efficiency.

(d) **Linkages to other indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, agriculture, commercial/services and residential),

with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. Also, it is linked to indicators for shares of sectors in value added, total energy, non-commercial energy and electricity consumption, greenhouse gas emissions, and air pollutant emissions.

(e) **International Targets/Recommended Standards**: No international targets exist or apply. At the national level targets could be developed, depending on the country's range of agricultural products.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Energy consumption per unit of value added is one way of measuring energy requirements and energy efficiency in the agricultural sector. While energy consumption per unit of physical output is a better indicator of energy efficiency in specific agricultural processes, energy use per unit of economic output is more useful both for relating energy efficiency to economic activity and for aggregating and comparing energy efficiency across agricultural sectors or across the entire economy. Total energy consumption in agriculture derives from the energy inputs in all the stages of agricultural production and processing, that is land preparation, mechanization, fertilization, irrigation, harvesting, transport, processing, and storage. Each of these stages use different forms of energy (mechanical, electrical, thermal) which can be aggregated in equivalent units. Total agricultural production is an established concept and needs no further elaboration.

(b) **Measurement Methods:**

Energy Use: Annual energy inputs for each stage in agricultural production and processing are determined and converted into equivalent units and aggregated as total energy. Annual agricultural production figures are collected for all products. Energy use is usually measured at the point of consumption, i.e., the farm, factory or establishment. "Own energy" (including internal use of hydropower, biofuels, or internal waste heat) should be combined with purchased energy at useful heating values.

Units: Preferable units for measuring final energy is metric ton (tonne) of oil equivalent (toe) of oil equivalent and for electricity is kWh.

Output. Net economic output is measured in agriculture value added (ISIC, Division A). Sector comprises crops and livestock production, agricultural services and both forestry and fishing/hunting/trapping. For some purposes, disaggregated physical output would be preferable, and such statistics are provided by FAO. But it is not possible to find out the energy consumption in various forms of agricultural activities, which is required for evaluation of specific energy intensities.

Unit: Constant international US dollars. Market value of output in real local currency deflated to a base year using GDP deflators. Local currency is converted to US dollars, using purchasing power parity for the base year.

(c) **Limitations of the Indicator:** The aggregate indicator for the agricultural sector (ISIC, Division A; groups 01,02,07,08,09) reflects the energy intensity of various agricultural activities (crop and livestock productions, forestry, fishing, etc.) Changes in the aggregate indicator can therefore be due either to changes in energy intensity or to changes in relative activity output. Similarly, differences between countries may be due either to differences in energy efficiency or differences in the structure of the agricultural sector.

Agricultural production is affected by factors other than energy inputs (for example, climate,

availability of other inputs). These factors are less distorting if comparative values are collected for consecutive years. Data for energy use in agriculture at the present time are not considered to be very reliable. Special surveys could generate sound data, but would be expensive, and may not be a priority for statistical agencies.

(d) **The Indicator in the DSR Framework**: This indicator is an Indirect Driving Force of Economic dimension. It can guide a response action especially if normative targets for increase of agricultural production or energy intensity are established.

(e) **Status of the Methodology:** The methodology is in use in many developed countries.

(f) **Alternative Definitions/Indicators:** Alternative indicator is energy intensity per unit of physical output. While data for production is available it is problematic to find data on energy consumption disaggregated for specific form of agricultural activities. The indicator includes combustible renewable and waste (CRW) but not such non-commercial energy inputs, as human and animal power. Human power quantification methodologies might need to be further elaborated. The relevance of this alternative to sustainable development is questionable.

In the context of climate change, it has become increasingly desirable to convert energy consumption to carbon emissions per unit of production. The fuels consumed can be converted to carbon emissions using IPCC coefficients. Carbon emissions will therefore change both with changes in energy efficiency and changes in fuel type.

4.ASSESSMENT OF DATA

a) **Data Needed to Compile the Indicator:**

(i) Total final energy consumption by agricultural sector;
(ii) Electricity consumption by agricultural sector;
(iii) Real output (value added) of the sector.

(a) **National and International Data Availability and Sources:** Some data are available for most countries, although reliable and comprehensive statistics to enable time-series analysis are elusive. Agriculture value added and physical outputs are compiled by World Bank. Agricultural production figures are available from agriculture ministries. The Food and Agriculture Organization (FAO) has processed and compiled considerable data in agricultural sector outputs in physical terms. The United Nations compiles value added at two and three digit level in agricultural sector. The Energy Balances of the IEA include energy consumption in agriculture. Energy balances are prepared by energy ministries or other competent national authorities

Data Reference:

IEA: *Energy Balances of Member Countries and Energy Balances of non-Member Countries*; annually

Eurostat: Energy Balances;

The Latin American Energy Organization /Organizacion Latinoamericana de Energia (OLADE);

World Bank: *World Development Indicators 2000 and 2001*,

FAOSTAT 2001 CD-ROM. FAO Statistical Databases. Bases de Données

FAO (2001), Statistiques de la FAO. Bases de Datos Estadísticos de la FAO.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the Food and Agricultural Organization (FAO). The contact point is the Assistant Director-General, Sustainable Development Department, FAO; fax No. (39 6) 5225 3152.

(b) **Other Contributing Organizations:** The United Nations Development Programme (UNDP), The World Bank, and UN Regional Commissions could be involved in further development of this indicator. OECD and IEA have collected detailed value added and energy consumption data of OECD counties. IEA now collects data on energy consumption by an agricultural sector of many non-OECD countries as well.

6. REFERENCES

(a) **Readings:**

FAO (1988): *Energy conservation in agriculture.* Report and proceedings of technical consultation, Helsinki (Finland), ". CNRE Bulletin 23.

FAO and African Development Bank (1995): *Future Energy Requirements for Africa's Agriculture.*

FAO (1995): *State of Food and Agriculture.*

WEC: World Energy Council Developing Country Committee Publications (1993-1998).

FAO (1995): *Forests, Fuels and the Future - Wood energy for sustainable development.*, FAO Forestry Topics, Report No.5.

(b) **Internet site:**

Food and Agricultural Organization of the UN: http://www.fao.org

International Energy Agency: http://www.iea.org

World Bank: http://www.worldbank.org/data

ENERGY INTENSITY: COMMERCIAL&SERVICE SECTOR		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Consumption and Production Patterns**	**Consumption and Production Patterns/ Energy Use/** *Intensity of Energy Use: Commercial &services*

1. INDICATOR (#9-3)

(a) **Name:** Energy Intensity in Commercial & Service Sector.

(b) **Brief Definition:** Energy consumption per unit of commercial & service sector (value added) output.

(c) **Unit of Measurement:** Tonnes of oil equivalent (toe) of final energy and kWh of electricity per unit of output in commercial & service sector converted to constant international US dollars using purchasing power parity rates (toe/1000$ and kWh/$).

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
	MPTMSE: *Energy Intensity of commercial& services (ECON12)*	*Energy intensity of services*

2. POLICY RELEVANCE:

(a) **Purpose:** This indicator is used to monitor trends in energy consumption in the commercial/service sector, which is the largest sector of most economies.

(b) **Relevance to Sustainable/Unsustainable Development:** The service sector is less energy intensive than manufacturing, and the growth of the sector relative to manufacturing contributes to the long-term reduction in the ratio of total energy consumption to GDP. The sector, however, is a large consumer of electricity, generation of which contributes to many local or global environmental problems. In general sustainable development requires increases in energy efficiency in order to reduce fossil fuel consumption, greenhouse gas emissions and related air pollution emissions.

(c) **International Conventions and Agreements:** There are no international agreements. Some countries are promulgating energy-efficiency standards for lighting, office equipment or other devices, while others are negotiating voluntary agreements to reduce energy consumption per square meter of floor space.

(d) **International Targets/Recommended Standards**: There are no international targets or standards. Many industrialized countries have previously set targets for reducing the space-heating component of service-sector energy consumption per unit of floor area. Now, many countries are trying to reduce electricity consumption for cooling, lighting, and information systems.

(e) **Linkages to other indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, agriculture, commercial&service and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. The indicator is also linked to indicators for total energy and electricity consumption, greenhouse gas emissions, and air pollutant emissions.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Energy consumption per unit of value added or per unit of floor area in the commercial/service sector is one way of measuring energy requirements and trends in the sector. As with the manufacturing sector, the commercial/service subsectors are diverse and difficult to classify. They include subsectors that require a great deal of electricity per unit of output (retail trade), those that use large quantities of fuel for water and space heating (health care establishments), and those that by their nature consume little energy (warehousing, parking). Energy efficiency in this sector is more directly related to the efficiency of general energy services (lighting, ventilation, computing, lifting, etc.) than to the efficiency of the particular sectoral activities. But there are almost no data on actual energy service outputs per unit of energy input (lumens of light, cubic meters of air moved, computing power or use, tonnes raised in lifts, etc.). Hence, the usual measure of energy intensity, toe per unit of output in economic terms (toe /1000$), can be a useful indicator provided it is clear that this summarizes many processes and types of buildings. Because of the differences in processes, it is very important to separate electricity from fossil fuel and purchased heat.

It is often difficult to measure and interpret energy intensities per unit of value added within subsectors (private services, public service, etc.) because different activities often take place in the same building, hence, the real partition of energy use between activities is uncertain. In such cases, intensities expressed per unit area disaggregated by building type may be more easily related to real energy efficiencies. However, these have the similar problem that a variety of activities may take place in a particular type of building. A hospital, for example, will contain space for food preparation or laundry services, as well as for health care.

Energy consumption per unit of value added is one way of measuring energy requirements and energy efficiency in commercial sector. While energy consumption per unit of physical output is a better indicator of energy efficiency in specific commercial sector processes, energy use per unit of economic output is more useful both for relating energy efficiency to economic activity and for aggregating and comparing energy efficiency across commercial sector or across the entire economy.

(b) **Measurement Methods:**

$\Rightarrow$ **Energy Use**: Energy Consumption (plus district heating) and electricity intensities recorded separately Energy consumption is usually measured at the point of use, i.e., the building or enterprise. Data for buildings must be collected through surveys of building owners, operators, or tenants, while data for enterprises are usually collected through the enterprise's normal accounting of expenditures or consumption of energy. Note, however, that the correspondence between enterprise and building type can be very loose.

In a few countries, energy consumption in buildings is measured or imputed by surveys of actual buildings (United States, France and Japan, and Sweden for space and water heating only). Where these data exist, they can be used to represent real efficiencies. Heating energy consumption per sq. meter of floor area heated is an important example of such a measure. Electricity use per sq. meter is important to measure, but it is difficult to disaggregate into heating, cooling, water heating/cooking, lighting, etc., without recourse to detailed surveys. Some colder countries (e.g., Norway) have very high energy intensities, which are clearly dominated by electric heating, while

others (e.g., Canada, Finland) have very high intensities, yet do not have much electric space heating. Similarly, warmer countries have substantial amounts of space that are fully air-conditioned. For many countries, the amount of air-conditioned space is unknown.

Despite all these uncertainties, fuel intensities give useful indicators of space/water heating/cooking on the one hand and electricity services on the other. Primary energy use should be used to aggregate electricity and fuel consumption (see methodology for manufacturing sector).

Units: Preferable units for measuring final energy is tonne of oil equivalent and for electricity is kWh.

$\Rightarrow$ **Output**. There are different approaches to measuring output in the commercial/service sector, with value added as the most direct measure of economic output. However, for estimating energy efficiency, physical area is preferred because most energy services (heating, cooling, lighting, etc.) are related to the floor area and size of the building. Surveys of floor area by building type have been carried out in many IEA countries. Often, the building type is specifically related to the activity of the enterprise, e.g., school (education), hospital (health care), or restaurant (food services). However, in many cases, particularly for offices and restaurants, buildings contain a mix of activities and enterprises, each with its own energy system and with considerably different energy use patterns.

Unit: Constant international US dollars. Market value of output in real local currency deflated to a base year using GDP deflators. Local currency is converted to US dollars, using purchasing power parity for the base year. For floor area, sq. metres of built space is usually the unit, but in some colder countries, sq. meters of occupied or heated space is recorded. The difference, which can be significant (up to 10%), reflects unheated spaces, garages and stairwells, etc.

(c) **The Indicator in the DSR Framework**: This indicator is assigned as an Indirect Driving Force indicator of the Economic dimension.

(d) **Limitations of the Indicator:**

(e) **Status of the Methodology:** The methodology is in use in many developed countries.

(f) **Alternative Definitions/Indicators:** An alternative indicator is energy consumption relative to floor area (in sq. meters), which is a good measure of the total amount of physical activity for the sector.

In the context of climate change, it has become increasingly desirable to convert energy consumption to carbon emissions per unit of production. The fuels consumed can be converted to carbon emissions using IPCC coefficients. Carbon emissions will therefore change both with changes in energy efficiency and changes in fuel type. Since in many countries more than half of all final energy consumed in this sector may be in the form of electricity, accounting for the emissions from electricity generation is extremely important.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Energy consumption by commercial sector

(ii) Electricity consumption by commercial sector

(iii) Real value added of the sector; and/or

(iv) Built areas or occupied space (sometimes, heated space).

(b) **National and International Data Availability and Sources:** Value added or GDP in one-digit service sector branches is available for almost every country. More detailed data exist for OECD countries, both from national sources and from the OECD national accounts.

Energy consumption data at the sector-wide level are available from almost all OECD countries and most others, but there are some important caveats. First, one must check the residential sector data from the same source to determine whether liquid and solid fuels have been divided between these sectors. In many of the IEA time series, this division is not done, and one sector or the other has all of the liquid or solid fuels. For developing countries, this split is a problem for gas as well, which is often entirely allocated to either residential use or services rather than being split.

Second, one must ascertain whether the commercial/service sector contains data from other sectors. Data from Germany for the sector ("Kleinverbraucher") contained significant amounts of both agriculture and construction through the early 1990s. Other countries may include street lighting and even non-energy utilities like water and waste disposal. Some countries include other items that cannot be classified elsewhere.

Reliable time-series energy data disaggregated at the subsectoral level exist for only a few countries, namely, the United States, France, Japan, and Sweden (heating only).

IEA sent a questionnaire to OECD countries asking for data on floor area and energy use, but few responses on floor area were received. The IEA will pursue this and expects to report data for floor area in its future energy indicators.

(c) **Data Reference:**

IEA: *Energy Balances of Member Countries and Energy Balances of non-Member Countries*, annually;

Eurostat: Energy Balances;

The Latin American Energy Organization /Organizacion Latinoamericana de Energia (OLADE);

Asia Pacific Energy Research Centre (APERC);

UN: Industrial Statistics, National Accounts;

OECD: STAN database (structural analysis database);

EU: NACE system.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations:** None.

6. REFERENCES

(a) **Readings:**

Krackeler, Tom and Lee Schipper, 1998. *"Carbon Dioxide Emissions in OECD Service Sectors. The Critical Role of Electricity use"*. Energy Policy (February).

Schipper, L., and Steve Meyers, 1986. "*Energy Use in the Service Sector. An International Comparison*". Energy Policy (June).

Meyers, S., Ed., 1986. Electricity Use in the Service Sector. Report of An International Workshop. Palo Alto, CA: Electric Power Research Institute

(b) **Internet site:**
International Energy Agency: http://www.iea.org.

ENERGY INTENSITY: TRANSPORTATION		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Consumption and Production Patterns**	**Consumption and Production Patterns/ Energy Use/** *Intensity of Energy Use: Transportation*

1. INDICATOR (#9-4)

(a) **Name:** Energy intensity in transportation.

(b) **Brief Definition:** Energy consumption for transportation per unit of transportation sector output and relative to the amount of freight or passengers carried and the distance traveled.

(c) **Unit of Measurement:** toe of final energy and kWh of electricity per unit of output in transportation sector converted in constant international UD dollars using purchasing power parity rates (toe/1000$ and kWh/$); goe and kWh per tonne-kilometer (goe/tonne-km, kWh/tonne-km) for freight; and goe and kWh per passenger-kilometer (goe/passenger-km and kWh/passenger-km) for passengers.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
IIECEP: *Energy intensity/ transport*	MPTMSE: *Energy Intensity of transport (ECON12)*	*Energy intensity of transport*

2. POLICY RELEVANCE:

(a) **Purpose:** Transportation is a major consumer of energy, mostly in the form of fossil fuels, and the share of transportation in energy consumption is generally increasing. The indicator is a measure of how efficiently energy is used for moving goods and people. The indicator can be used to monitor trends in energy consumption for transportation and for international comparisons. Separation of freight and passenger travel is essential.

(b) **Relevance to Sustainable/Unsustainable Development:** Transportation serves economic and social development through distribution of goods and services and through personal mobility. However, energy consumption for transportation also leads to air pollution and climate change. Reducing energy intensity (increasing energy efficiency) in transportation can reduce the environmental impacts of transportation while maintaining the economic and social benefits.

(c) **International Conventions and Agreements:** Many industrialized countries have targets for reducing energy use and carbon emissions from transportation, for which these energy intensities are key indicators. UNFCCC and its Kyoto Protocol. The European Union voluntary agreement on greenhouse gas (GHG) emissions from automobiles (to which Japanese and Korean producers have also agreed) require reductions in GHG emissions per kilometer from new automobiles

(d) **Linkages to other indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for total energy consumption, greenhouse gas emissions, and air pollution emissions. This indicator is also linked to both the indicator for distance traveled per capita by means of transport and indicator for freight transport activity.

(a) **International Targets/Recommended Standards**: Many industrialized countries have

targets for reducing energy use and carbon emissions from transportation, for which these energy intensities are key indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Energy consumptions per unit of transportation sector output and per unit of activity are a key measure of how efficiently transportation systems convert energy into human mobility and goods distribution. As for activity because it is not meaningful to add freight and passenger travel, these types of transportation must be disaggregated. Separating the two activity measures is generally not difficult, but separating the energy consumption is often complicated.

(b) **Measurement Methods:**

⇒ **Energy Use**: Energy consumption should be measured for each kind of vehicle, including two-wheelers, automobiles, busses, small trucks, heavy trucks, and miscellaneous road vehicles, as well as trains, ships and aircraft for domestic transport, and even pipelines. In general, however, national energy balances are only disaggregated by fuel and broad traffic type: road, rail, water, air and pipeline. Considerable work is required to disaggregate road fuels consumed by vehicle type. It is important to take into account the different energy content and carbon emissions in different fuels and not simply add the weights or volumes of different fuels consumed (e.g., tonnes, or cubic metres in the case of natural gas). International air or marine transportation should not be included. Electric power consumption for rail, subway and trams, as well as electric road vehicles, should be converted to primary energy consumption, although there is no standard method for such conversion.

⇒ **Output or Activity:** Transportation sector output is measured as a fraction of GDP value added in real US dollars. Concerning activity there are two different measures. Vehicular activity, in vehicle-km, provides a measure of traffic that is important for transport policy and road and infrastructure planning. Most often these data can be divided further into basic vehicle types. However, economic and human activity is better measured in passenger-km and tonne-km, taking into account utilisation or load factors. A bus carrying 20 passengers for 10 km (200 passenger-km) is less energy intensive (more energy efficient) than the same bus carrying 5 passengers for the same distance (50 passenger-km). Similarly, a fully-loaded truck is less energy intensive than the same truck carrying a partial load.

In passenger travel it is meaningful to distinguish separately both the distance travelled by urban public transport and share of electricity driven vehicles in urban public transport.

⇒ **Indicators:**

i) **Vehicle Intensities:** Energy consumption per vehicle-km by vehicle and fuel type is an important indicator, as many standards for air pollution (and more recently, goals for CO_2 emissions reduction) are expressed in terms of vehicle characteristics, i.e., emissions per vehicle-km.

ii) **Modal Intensities:** Energy use per passenger-km or tonne-km should be disaggregated by vehicle type, i.e., two-wheeler, car/van, bus, air, local and long-distance rail, subway, tram, ship or ferry for passengers; and truck, rail, ship, air pipelines for freight.

Note: Aggregate energy intensity for travel or freight is a meaningful summary indicator, the value of which depends on both the mix of vehicles and the energy intensities of particular types of vehicles. The energy intensities of public train and bus transportation per passenger-km are commonly 60 to 80 per cent less than the energy intensities for cars or air transportation. For freight, rail and ship transportation are commonly 65 to 90 per cent less than the energy intensive for trucking per tonne-km. These differences between modes are of the same order of magnitude as the differences between the lowest and highest energy intensities of transportation within each mode. It should also be noted that fuel consumption per vehicle-km also depends on traffic conditions as well as vehicle characteristics.

The energy intensity for a vehicle type depends on both capacity and capacity utilisation. A large vehicle that is fully loaded generally has a lower energy intensity per tonne-km than a fully-loaded smaller vehicle, but a small vehicle fully loaded will have a lower energy intensity than a large vehicle with the same load. Typical load factors for private cars are 1.5 people per car. Typical load factors for rail and bus vary from well below 10 per cent (e.g., United States city busses on average) to over 100 per cent of nominal capacity at peak times, and in many developing countries during most of the day. Typical load factors for trucking might be 60 to 80 per cent of weight capacity when loaded, but trucks commonly run 20 to 45 per cent of their kilometers empty, yielding a relatively low overall load factor. Under-utilized transport capacity means more pollution and road damage (and other impacts) per unit of transport service delivered, hence capacity utilisation itself is an important indicator of sustainable transportation.

(c) **The Indicator in the DSR Framework**: This indicator is assigned as an Indirect Driving Force indicator of Economic dimension.

(d) **Limitations of the Indicator:** Data availability may limit the disaggregation of the indicator to the desired level. Considerable work is often required to disaggregate energy balances into various modes of transportation.

Some countries' transportation energy statistics include fuel consumed by domestic airlines or shipping lines in international transportation. Efforts should be made to exclude such transportation and energy consumption from the indicators.

(e) **Status of the Methodology:** The methodology is in use in many developed countries.

(f) **Alternative Definitions/Indicators:** An alternative, simpler, broad measure of energy intensity for transportation could be average fuel consumption per vehicle for all vehicles, but the results would be strongly influenced by the mix of vehicles, which varies enormously among countries and over time. In particular, it would be influenced by the number of two- and three-wheelers.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Energy consumption by mode of transportation, vehicle type and fuel;
(ii) Share of transportation sector output in GDP value added;
(iii) Distance traveled by vehicles, passengers and freight, including load factors;
(iv) Distance traveled by urban public transport and a share of electrically driven vehicles in that.

(b) **National and International Data Availability and Sources:** Energy use by fuel type in each branch of road transport, rail, ship, and air transport is published by most transport ministries in

OECD countries. National energy balances (as well as present IEA/OECD Energy Statistics) do not disaggregate road transport by mode. Few sources of energy data separate fuel consumption for rail or shipping into that for passengers and that for freight, but national or private rail and shipping organizations often do this. Energy consumption for local electric transport (commuter rail, subways, trams) is often published separately by national authorities.

Eurostat is a lead agency for collecting data on vehicle, passenger, and tonne-kilometers in Europe. Ministries of Transport in the United States, Canada, Japan, Australia and other countries, often through their statistical agencies, publish similar data. In developing and transitional countries, fewer data are available.

(c) **Data Reference:** Eurostat: Transport Annual Statistics

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** International Energy Agency
(b) **Other Contributing Organizations:** None

6. REFERENCES

(a) **Readings:**

Schipper, L. and Marie-Lilliu, C., 1999. *Carbon Dioxide Emissions from Transport in IEA countries: Recent lessons and long-term Challenges*. KFB Meddelande 1999:11. Stockholm.

Schipper, L., Figueroa. M.J., Price, L., and Espey. M., 1993. "Mind the Gap: The Viscious Circle of measuring automobile fuel use". *Energy Policy* (October).

Samaras. Z., et al. 1999. *Study on Transport Related Parameters of the European Road Vehicle Stock.* Prepared for Eurostat and DG-7. Thessalonikai: Laboratory of Applied Thermodynamics, Aristotle University.

Schipper, L., and Tax, W., 1994. "Mind the Gap". *Transport Policy.*

(b) **Internet site**: IEA: http://www.iea.org;

EU, General Directorate Transport & Energy:
http://europa.eu.int/comm/dgs/energy_transport/index_en.html

ENERGY INTENSITY: RESIDENTIAL SECTOR		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Consumption and Production Patterns**	**Consumption and Production Patterns/ Energy Use/** *Intensity of Energy Use: Residential Sector*

1. INDICATOR (#9-5)

(a) **Name:** Energy Intensity in the Residential Sector.

(b) **Brief Definition:** Amount of energy used per person or household and for space heating per unit of home area in the residential sector.

(c) **Unit of Measurement:** toe of final energy and kWh of electricity per capita or per household; toe of energy used for space heating per unit of home area.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
IIEC EP: Energy intensity: residential	*Intensity of energy use in households (ECON12)*	*Total energy per household*

2. Policy Relevance

(a) **Purpose:** The indicator is used to monitor energy consumption in the residential sector.

(b) **Relevance to Sustainable/Unsustainable Development:** The residential sector is a major consumer of energy with a distinctive pattern of usage. Reducing energy consumption contributes to reducing air pollution and climate change. Many policies addressing energy efficiency and savings have been formulated for this sector. In colder countries, for example, the space heating component has been the focus of many energy-saving policies, while in almost all countries, the electric-appliance and lighting component is still the focus of many policies.

(c) **International Conventions and Agreements:** None specifically for this sector.

(e) **International Targets / Recommended Standards:** None as such. However, thermal standards for new homes are in effect in almost all OECD and Eastern European countries, China and some other countries in colder climates. Efficiency standards for boilers are also important in many countries. Efficiency standards on new electrical appliances are important in the United States and indirectly in Canada, and voluntary programmes have been important in Japan and Europe.

(f) **Linkages to Other Indicators:** This indicator is one of a set for energy intensity in different sectors (manufacturing, transportation, commercial/services and residential), with the indicator for energy use per unit of GDP as an aggregate energy intensity indicator. These indicators are also linked to indicators for home area per capita, total energy and electricity consumption, greenhouse gas emissions, and air pollutant emissions.

3. Methodological Description

(a) **Underlying Definitions and Concepts:** Household or residential energy use encompasses energy used in residential buildings, including urban and rural free-standing houses, apartment dwellings, and most collective dwellings such as dormitories and barracks. These energy uses

typically include cooking, water heating, space heating and cooling, lighting, major appliances for refrigeration, washing and drying, TV and communications, computers, conveniences like food machines, vacuum cleaners, etc, as well as a myriad of small appliances. Household or residential energy use should exclude energy for farm processes, small businesses or small industry. The household sector must be separated from the commercial/services sector, although data for many IEA countries did not separate these two sectors in the past. The energy sources should include not only commercial (purchased) energy, but also gathered (non-commercial) energy such as fuelwood or other biomass and miners' coal. The electricity is to be distinguished separately.

(b) **Measurement Methods**:

- **Energy Use:** Purchased energy for residences/households is usually recorded in the energy statistics of a country with data provided by electric, gas, or heat utilities according to customer definitions that correspond to "households". Data on purchases of LPG, other oil products, coal or similar fuels and wood are not always recorded correctly since suppliers may not know where or how these fuels are being used.

Alternatively, household/residential energy use can be measured through household surveys. The most direct surveys collect detailed information on both fuels consumed and energy-consuming equipment owned or used. The most accurate surveys also obtain permission from households to ask energy suppliers for quantities consumed, or they leave fuel-use diaries for households to record what they consume. They measure usage in a variety of appliances and in heating equipment using miniature data loggers. Less detailed surveys estimate the use of each fuel for each major purpose through regression analysis over a large number of households.

Unit: Energy is measured in tonne of oil equavalent (toe) (net calorific value). In most cases, electricity and purchased heat are counted at final or delivered value. Electricity consumption itself is counted in kWh. In some cases, primary energy is recorded. (See methodology for manufacturing sector.)

- **Residential unit:** Energy consumption is calculated on a per capita or per household basis. In general, energy consumption depends both on the physical size and characteristics of the dwelling and on the number of people. As the number of people in a household declines, energy consumption per household declines, while the energy consumption per capita increases. As a rule of thumb, energy use for water heating, cooking and many appliances tends to vary with the square-root of household size.

For developing countries with large rural sectors or large numbers of homes without access to electricity, the share of homes in the urban sector and the share in each sector connected to grid electricity is an important factor in total residential energy consumption. The shares of homes using different kinds of CRW are also important.

(c) **The Indicator in the DSR Framework:** The indicator is assigned as an Indirect Driving Force of Economic dimension.

(d) **Limitations of the Indicator:** When energy consumption by end-use is not known, energy use per household is a valuable indicator of energy intensity, but it does not measure energy efficiency. Some important conclusions can be drawn, however, if the average winter temperature, ownership of energy-consuming appliances, and dwelling size are known. In a country with cold winters and high penetration of central heating systems, a low total

consumption of energy for all purposes, relative to total home (floor) area and the severity of winter climate, probably implies efficient heating practices. Conversely, high energy use relative to floor area in a country with mild winters may imply inefficiencies. However, since energy consumption habits vary so much, both among countries and among end-uses, few conclusions about "efficiency" can be drawn from the indicator on "residential energy use per household." (See alternative definitions / indicators below.)

(e) **Status of the Methodology:** The indicator, with some variations in the methodology, is used in many OECD countries. It is not widely used in developing or transitional countries.

(f) **Alternative Definitions /Indicators:**

- **Measurement of Efficiency:** A true energy efficiency can be expressed as energy use per unit of energy service. Examples of true energy efficiency would be litres of refrigerated volume at a given temperature divided by electricity use, lumens of light per watt of power consumed, or computer tera-flops per second divided by power consumption. In practice, these are not measured for large populations. Specific energy requirements for particular services, taking into account equipment efficiency and the time the service is used, are easier to estimate since these can be summed for a given household and compared with actual consumption.

- **Output (services provided):** Ideally, output units would be in energy services delivered, such as lumens of lighting, meals cooked, area and time heated, litres of hot water provided, litres refrigerated, kilogrammes of clothes washed, etc. In practice such data are rarely available, even for individually metered homes. A suitable proxy for each service may be either the area heated (or lit), the number of people in the household receiving meals or hot water, and the average number of appliances, by type, per household or per capita.
- **Energy requirements:** If both energy use and equipment ownership for each major service is known, then specific energy requirements can be developed as follows:
  - Space heating: energy use per sq. meter heated floor area or per sq. meter per degree day;
  - Energy use per capita for water heating and cooking; and
  - Energy use per year for each major appliance: refrigerator, freezer, clothes washer, dryer, dishwasher, TV, etc.

These specific energy requirements are related to, but not identical to, energy efficiencies. They differ in that they do not measure accurately the service provided, since, for example, a large refrigerator gives more service than a smaller one.

5. Assessment of Data

(a) **Data Needed to Compile the Indicator:**

(i) Energy use in the residential sector (as indicated in section 3(b) above)
(ii) Number of population and/or households
(iii) Home are per capita.

(b) **National and International Data Availability and Sources:** Until the early 1980s, the residential or household sector was not well distinguished from the commercial/service sector in a majority of OECD member country energy statistics, particularly for liquid and solid fuels. In OECD countries, this distinction is now common. In developing countries, data often distinguish

residential and commercial consumption of electricity and natural gas, but users of liquid and solid fuels are often not accurately identified. Many national energy balances thus fail to distinguish between the residential and commercial/service sectors. Such problems are indicated when data show electricity and natural gas consumption for both the residential and commercial/service sectors, while liquid and solid fuel consumption is shown for only one of the two sectors.

The other major challenge is to estimate the use of non-commercial fuels, such as CRW (biomass) of all kinds in developing countries. This is important in almost all developing countries, even in urban areas.

Because of these two problems, aggregate national or international statistics must be used with caution.

Data on equipment are usually developed by electric and gas utilities, as well as by trade associations representing electric and gas appliance manufacturers. These have generally not been compiled in an internationally compatible form. No single agency collects all the data, except in a few IEA countries (United States, France, Netherlands) where detailed household surveys are undertaken. The World Bank has sponsored many one-time household surveys in developing countries, focusing either on rural or urban areas. As noted above, national or private energy companies often undertake marketing surveys. Oil industry sources in most IEA countries often compile data on oil-equipment sales and ownership.

(c) **Data References:**

IEA: Energy Balances of Member countries, annually.
Energy Statistics of non-Member countries, annually.

5. Agencies Involved in the Development of the Indicator

(a) **Lead Agency**: International Energy Agency.

(b) **Other Contributing Organizations:** None.

6. References

(a) Readings:

Schipper, L., Ketoff, A., and Kahane, *A. "Estimating Residential Energy Use from Bottom-Up, International Comparisons.* Ann. Rev. Energy 10. Palo Alto CA: Ann. Revs., inc. 1985.

(b) Internet sites:

International Energy Agency: http://www.iea.org

World Bank: http://www.worldbank.org/html/fpd/energy/

FINAL ENERGY INTENSITY OF SELECTED ENERGY INTENSIVE PRODUCTS		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme Set
Economic	**Chapter 4: Consumption and Production Patterns**	**None**

1. INDICATOR (#10)

(a) **Name: Final** Energy Intensity of Selected Energy Intensive Products.

(b) **Brief Definition:** Energy consumption for production of tonne of energy intensive products, such as: Iron&steel, Non-ferrous metals, Chemicals, Petroleum Refining, Non-metallic minerals, Cement, and Paper&pulp.

(c) **Unit of Measurement:** Tonne of oil equivalent (toe) of final energy per metric tonne of selected products (toe/tonne).

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
None		

2. POLICY RELEVANCE:

(a) **Purpose:** The branches manufacturing sector are major consumer of energy. This indicator is a measure of the efficiency of energy use for production of various energy intensive products. The indicator can be used for evaluating energy efficiency technological potential, analyzing trends, and making international comparisons in energy efficiency.

(b) **Relevance to Sustainable/Unsustainable Development:** Sustainable development requires increases in energy efficiency in order to reduce fossil fuel consumption, greenhouse gas emissions and related air pollution emissions.

(c) **International Conventions and Agreements:** Although there are no specific international targets regarding energy use or energy efficiency, many industrialized countries have targets for reducing energy use and carbon emissions from manufacturing branches.

(d) **Linkages to other indicators:** This indicator is linked to indicators for manufacturing value added by selected energy intensive products, energy intensity in manufacturing, and to energy use per unit of GDP as an aggregate energy intensity indicator. The indicator is also linked to environmental indicators, notably to greenhouse gas emissions, air pollutant emissions, and depletion of energy resources.

(e) **International Targets/Recommended Standards**: UNFCCC and its Kyoto Protocol.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:**

The energy intensive industries have to be specified for the manufacturing of:

(i) **Iron and steel,** in classification ISIC refers to Group 271;

(ii) **Non-ferrous metals,** refers to ISIC Group: 272 "Manufacture of basic precious and non-ferrous metals";

(iii) **Basic Chemicals,** corresponds to ISIC Group 241, which in turn comprises the following Classes: 2411 – "Manufacture of basic chemicals, except fertilizers and nitrogen compounds"; 2412 – "Manufacture of fertilizers and nitrogen compounds"; 2413 – "Manufacture of plastics in primary forms and of synthetic";

(iv) **Non-metallic minerals,** corresponds to ISIC Group 269 – "Manufacture of non-metallic mineral products", Class 2694 - Manufacture of cement, lime and plaster is of primary interest. The Class includes manufacture of (1) hydraulic cements, including portland, aluminous slag and superphosphate, whether or not in the form of clinkers; (2) quicklime, slaked lime and hydraulic lime; (3) plasters consisting of calcined gypsum or calcium sulphate.

(v) **Paper and pulp,** corresponds to ISIC Group 210. This Group comprises several Classes, among them the desirable one to be addressed is 2101 – "Manufacture of pulp, paper and paperboard", if data on it is available;

(vi) **Refined Petroleum Products:** In ISIC classification it corresponds to Group 232.

(b) **Measurement Methods:**

Energy use is usually measured at the point of consumption, i.e., the factory or establishment. "Own energy" (including internal use of hydropower, biofuels, or internal waste heat) should be combined with purchased energy at useful heating values.

Complications in interpreting energy intensity data arise from the fact that some branches of manufacturing may be concentrated in regions of a country rich in certain kinds of power or heat sources, such that those branches constitute a lower energy burden on the economy than the indicator would suggest. Interpretation is also complicated when a particular branch has significant internal energy resources, such as captive hydro, biofuels or coal.

It is also possible to measure total energy consumption, internal and external, for any final product by using input-output tables to measure the energy embodied in materials and intermediate products. This is much more data intensive, because the input-output tables are complex. Such tables are not produced regularly, so this approach is difficult to follow, except at long intervals.

(c) **The Indicator in the DSR Framework**: This indicator is assigned as an Indirect Driving Force indicator of the Economic dimension.

(d) **Limitations of the Indicator:**

Detailed calculations such as total energy consumption for particular products, using input-output tables, while desirable, are very data intensive and difficult to update regularly.

(e) **Status of the Methodology:** The methodology is in use in many developed and developing countries.

(f) **Alternative Definitions/Indicators:** In the context of climate change, it has become increasingly desirable to convert energy consumption to carbon emissions per unit of physical production. The fuels consumed can be converted to carbon emissions using IPCC coefficients. Carbon emissions will therefore change both with changes in energy efficiency and changes in fuel type.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Final energy consumption by different selected manufacturing branches;

(ii) Real physical output (tones) of selected manufacturing branches.

(b) **National and International Data Availability and Sources:** Data on physical output of the selected products are available in national statistics. Final energy consumption data is compiled by the IEA in the Energy balances for OECD and non-OECD countries.

(c) **Data Reference:**

IEA: *Energy Balances of Member Countries and Energy Balances of non-Member Countries*, annually;

Eurostat: *Energy Balances*;

The Latin American Energy Organization /Organizacion Latino Americana de Energia (OLADE);

Asia Pacific Energy Research Centre (APERC);

UN: Industrial Statistics, National Accounts;

OECD: STAN database (structural analysis database);

EU: NACE system.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations: None.**

6. REFERENCES

(a) **Readings:**

Energy Policy, June/July 1997 issue, Elsevier Science Limited, various articles in this issue discuss the physical and monetary measures of output and various problems associated with indicators of manufacturing energy use and intensity.

Phylipsen, G.J.M, Blok, K., and Worrell, E., 1997. *Handbook on International Comparison of Energy Efficiency in the Manufacturing Industry.* Utrecht: Dept. of Science, Technology, and Society.

IEA, 1997. *Indicators of Energy Use and Energy Efficiency.* Paris: OECD.

(b) **Internet site:**

International Energy Agency: http://www.iea.org

World Bank: http://www.worldbank.org/data

ENERGY MIX		
Dimension **Economic**	Agenda 21 **Chapter 4: Changing consumption and production patterns**	Placement in the CSD Theme/Sub-theme List **Consumption and Production Patterns/Energy Use:*Share of consumption of renewable energy resources***

1. INDICATOR (#11)

(a) **Name:** Energy mix.

(b) **Brief Definition:** The structure of energy supply in terms of shares of energy sources in final energy consumption, primary energy supply, and electricity generation.

(c) **Unit of Measurement: %**

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA provisional core list for Chapter 4
IIECEP: *Energy use by fuel type* TSD-EI: *Energy mix, i.e. the structure of and changes in energy*	TERI: *Energy consumption by fuel; Electricity from renewable sources* MPTMSE: *Share of consumption of renewable energy sources*	*Share of consumption of renewable/non-renewable energy sources*

2. POLICY RELEVANCE:

(a) **Purpose:** This indicator measures the structure of energy consumption, the proportion of energy mix between fossil fuel, renewables, and nuclear energy sources.

(b) **Relevance to Sustainable/Unsustainable Development:** The energy supply mix has a major effect on environmental performance because the environmental impact of each energy source differs greatly from one source of energy to another, and include the following: (i) traditional local or regional atmospheric pollution related to the combustion of fossil fuels (e.g., urban smog, acid rain); (ii) global climate change related to the emission of GHG generated by fossil fuel production, transport and use; (iii) land use for a range of energy activities, and notably for mining and for hydroelectric reservoirs; (iv) risks attributed to various fuel chain cycles (fires, explosions, spill, disposal of high level radioactive wastes, etc). Energy mix indicates ratio of non-renewable to renewable energy sources, and in this context dependence on non-renewable resources can be regarded as unsustainable in the long term. Regarding economic dimension energy supply mix is a key determinant of energy security. This implies that the "right energy mix" relies on a well-diversified portfolio of domestic, or imported, or regionally traded fuels and sources of energy.

(c) **International Conventions and Agreements:** Not available.

(d) **International Targets/Recommended Standards:** In some countries there is a target for percentage of energy supply from renewable sources.

(e) **Linkages to other indicators:** Interpretation of this indicator is enhanced when combined with annual indigenous energy production, annual energy consumption per capita, net energy

import dependence, and lifetime of proven energy reserves. It is also closely linked to some of the environmental indicators such as air pollutant and greenhouse gas emissions, generation of solid and radioactive wastes, land area taken by energy facilities, etc.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** A disaggregation of energy supply by fuel sources in respect to: (i) final consumption, (ii), primary energy supply, and (iii) electricity generation. The elements comprising this indicator are consumption of various fossil fuel (coal, crude oil, petroleum products, gas); primary electricity and heat; non-combustible renewables; and combustible renewables & wastes all converted into toe.

Regarding the final energy consumption mix sources to be specified are: Coal; Crude oil; Petroleum products; Gas; Electricity; Heat; and Combustible renewables &wastes (CRW).

Regarding the primary energy supply mix, sources to be specified are: Coal; Crude oil; Gas; Nuclear power; Hydro power; Non-combustible renewables; and Combustible renewables &wastes (CRW). Electricity net import is to taken into account as well.

Regarding electricity generation sources to be specified are: Coal; Petroleum products; Gas; Nuclear; Hydro; Non-combustible renewables; and Combustible renewables & wastes (CRW).

Coal includes all coal, both primary hard coal and lignite, and derived fuels (including patent fuel, coke, oven coke, gas coke, coke oven gas and blast furnace gas). Peat is also included in this category. But coal derived secondary fuels is not a part of primary mix.

Crude oil comprises crude oil, natural gas liquids (NGL), and oil from unconventional hydrocarbon sources.

Petroleum products comprise refinery gas (1.15), ethane (1.13), LPG (1,13), naphtha (1.075), motor gasoline (1.07), jet fuels (1.06), kerosene (1.04), gas/diesel oil (1.03), heavy fuel oil (0.96), and other petroleum products (0.96). In brackets average specific net calorific values are given in toe/tonne.

Gas includes natural gas (excluding natural gas liquids) and gas works gas, while the latter is not in primary energy mix. Gross calorific value of natural gas varies in range of 0.8- 1 toe/1000 cub.m between different producing counties (Netherlands-0.8; Uzbekistan-0.90; Russia, US, Canada, and Saudi Arabia – 0.91; UK-0.94; Indonesia-0.98, Algeria and Norway - 1.0).

Hydro shows the energy content of the electricity produced in hydro power plants. Hydro output excludes output from pumped storage plants. Hydro-electricity production are accounted for using 1 TWh = 0.086 Mtoe.

Nuclear shows the primary heat equivalent of the electricity produced by a nuclear power plant with an average thermal efficiency of 33 per cent, i.e. 1 TWh = 0.086:0.33 = 0.261 Mtoe.

Non-combustible renewables includes geothermal, solar, wind, tide, and wave energy. Unless the actual efficiency of the geothermal process is known, the quantity of geothermal energy entering electricity generation is inferred from the electricity production at geothermal plants assuming an average thermal efficiency of 10 per cent. For solar, wind, tide and wave energy, the quantities entering electricity generation are equal to the electrical energy generated. Electricity is accounted for at the same heat value as electricity in final consumption (i.e. 1 TWh = 0.086 Mtoe). Direct use of geothermal and solar heat, and heat from heat pumps, that is extracted from ambient

environment are also included here.

Combustible renewables & waste (CWR) comprises biomass (fuelwood, bagasse, vegetal waste, ethanol) and animal products (animal materials/wastes and sulphite lyes), municipal waste (wastes produced by the residential, commercial and public service sectors that are collected by local authorities for disposal in a central location for the production of heat and/or power) and industrial waste. The share of fuelwood in CRW has to be specified.

Electricity Import and Export comprise amounts having crossed the national territorial boundaries of the country. Electricity net import is a difference between amounts of electricity import and export.

(b) **Measurement Methods:** This indicator is computed by calculating the ratio of consumption of specific energy sources identified above to total energy consumption in respect to:

(i) final consumption;

(ii) primary energy consumption; and

(iii) electricity generation.

Consumption of energy sources is measured in a term of heat contents based on their specific net calorific values (NCV).

(c) **The Indicator in the DSR Framework:** The Indicator is assigned as an Indirect Driving Force of Economic Dimension.

(d) **Limitations of the Indicator:**

(e) **Status of the Methodology:** Not available.

(f) **Alternative Definitions/Indicators:** In some ISD sets only share of consumption of renewable energy resources is monitored.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Final energy consumption, both total (TFC) and by specified final energy sources;

(ii) Primary energy supply, both total (TPES), and specified primary energy sources. The difference between TPES and TFC is mainly accounted for losses in conversion of primary sources to final energy commodities such as electricity, by transportation and distribution losses and by use of fuels for non-energy purposes;

(iii) Electricity generation, both total and by fuel.

(b) **National and International Data Availability:** Data on energy supply by fuel are available from national statistical offices and country publications, and various international sources (IEA, World Bank).

(c) **Data Reference:**

IAE: *Energy Balances of OECD Countries*, 1990-2001

IAE: *Energy Statistics and Balances of Non-OECD Countries*, 1990-2001

United Nations: *Energy Statistics Yearbook and Energy Balances and Electricity Profiles.*

World Bank: *World Development Indicators 2000, 2001.*

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** None

(b) **Other Contributing Organizations:** The agencies involved in the development of this indicator are the International Energy Agency, the International Atomic Energy Agency.

6. REFERENCES

(a) **Readings:**

United Nations (1982), *Concepts and Methods in Energy Statistics with Special Reference to Energy Accounts and Balances.*

United Nations (1987), *Energy Statistics: Definitions, Units of Measure and Conversion Factors.*

United Nations (1991), *Energy Statistics: A Manual for Developing Countries.*

IEA (2001), *Key World Energy Statistics from the IEA*, 2001 Edition.

World Bank, *World Development Indicators 2000, 2001*, Washington D.C.

(b) **Internet site:**
United Nations Statistical Division: http://www.un.org/Depts/unsd/
UN Commission on Sustainable Development: http://esl.jrc.it/envind/sip/en/sip_en01.htm
IEA: http://www.iea.org
WB: http://www.worldbank.org/data

ENERGY SUPPLY EFFICIENCY		
Dimension **Economic**	Agenda 21 **Chapter 4: Changing consumption and production patterns**	Placement in the CSD Theme/Sub-theme List **None**

1. INDICATOR (#12)

(a) **Name:** Energy supply efficiency.

(b) **Brief Definition:** Efficiency of transformation of primary supplied energy to final energy curriers which are delivered to consumers; fossil fuel efficiency for electricity generation; efficiency of oil refining; losses occurring during electricity transmission & distribution, and gas transportation & distribution; and electricity supplies from combined heat power plant as percentage of total electricity generated by TPP.

(c) **Unit of Measurement:** %.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
IIECEP: Fossil fuel efficiency for electricity generation	*None*	None

2. POLICY RELEVANCE:

(a) **Purpose:** The indicator measures the efficiency of energy industries in total and efficiencies of various chains of energy supply and losses occurring during gas and electricity transportation & distribution in particular.

(b) **Relevance to Sustainable/Unsustainable Development:** Energy is essential for economic and social development, but consumption of fossil fuels is the major cause of air pollution and climate change. Improving energy supply efficiency and elimination of losses occurring during the energy transformation and transportation are essential to sustainable development.

(c) **International Conventions and Agreements:** Currently, there are no conventions or agreements specifically referring to the regulation and/or limitation of energy supply efficiency per GDP. However, Agenda 21 calls for considering how economies can grow and prosper while reducing the losses during various chains of fuel cycle and encouraging greater efficiency in the use of energy, in particular at the supply side. At the regional level calls were made for the prudent and rational use of energy (Article 130 of the Treaty on the European Union - Maastricht, 1992), energy efficiency (The Energy Protocol of Lisbon, 1994).

(d) **International Targets/Recommended Standards:** No specific target for energy intensity. The Kyoto Protocol sets targets for total greenhouse gas emissions for Annex I (developed) countries.

(e) **Linkages to other indicators:** The indicator is closely linked with other indicators of the economy such as indigenous energy production, energy mix, status of deployment of pollution abatement technology, total primary energy supply, import dependency, energy use per unit of GDP; with environmental indicators such as GHG emission, air quality, acidification land area,

waste generation.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The indicator comprises the following entries:

(i) *Ratio of total final energy consumption* (TFC) by the different end-use sectors to total primary energy supply (TPES), both expressed in tonnes of oil equivalent. Total primary energy supply is made up of indigenous production + imports - exports - international marine bunkers ± stock changes.

(ii) *Fossil fuel efficiency for electricity generation,* defined as gross production of electricity relative to fossil fuel inputs (NCV). The reasons for the significant improvements in the average efficiency of the TPP include fuel switching, the commissioning of new, high efficiency generating plants and decommissioning of older inefficient plant. In particular, there was a move from coal towards gas as a more efficient fuel, often using high efficiency combined gas-steam cycle.

(iii) *Electricity transmission and distribution losses*, defined as ratio of final electricity consumption to electricity supply. Electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage. Production plus net import less transmission and distribution losses, own-use, and transformation losses is equal to end-use electricity consumption.

(iv) Gas *transportation and distribution losses*, defined as ratio of final gas consumption to primary gas supply. Gas transportation and distribution losses include losses in transportation between sources of supply and points of distribution, including own-use gas consumed by gas pumping systems, and in the distribution to consumers. Production plus net import less transportation and distribution losses, own-use, and transformation losses is equal to end-use gas consumption.

(v) *Oil refining efficiency* defined as average percentage of finished light products output per unit of crude oil fed at the refineries. Light oil products comprise aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, naphtha, white spirit, and LPG.

(vi) *Electricity supplies from combined heat power plant as percentage of total electricity generated by TPP.* Combined heat and power plants refers to plants which are designed to produce both heat and electricity. UNIPEDE refers to these as co-generation power stations. Both public and autoproducer plants are included here.

(b) **Measurement Methods:** The amount of energy produced, supplied and consumed can be derived from the energy statistics published by each country or various international or regional organisations (e.g. the International Energy Agency, EUROSTAT). The amounts of all primary energy sources such as fossil fuel, electricity, heat, and CRW must be considered.

(c) **The Indicator in the DSR Framework:** It is considered as an Indirect Driving Force of Economic dimension.

(d) **Limitations of the Indicator:**

(e) **Status of the Methodology:** The ratio of TFC to TPEC, as well as fossil fuel efficiency for electricity generation; outputs from refineries; gas and electricity transportation and distribution

losses are in widespread use, but without a standardized methodology.

(f) **Alternative Definitions/Indicators:**

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Energy commodity data for production and consumption (energy balances); refineries light oil product output; and structure of electricity supplies.

(b) **National and International Data Availability:** Energy commodity data for production and consumption (energy balances) are regularly available for most countries at the national level; and for some countries, at the sub- national level. Both types of data are compiled by and available from national statistical offices and country publications.

Internationally, the International Energy Agency maintains the most thorough set of energy balances and energy accounts, based primarily on national data or data collected from reliable regional agencies.

(c) **Data Reference:**

United Nations: *Energy Statistics Yearbook.*

United Nations: *Energy Balances and Electricity Profiles*;

IEA/OECD: *Energy balances and Energy statistics for OECD countries and non-OECD countries, annually.*

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** None.

(b) **Other Contributing Organizations:** The International Atomic Energy Agency is interested in development of this methodology sheet.

6. REFERENCES

(a) **Readings:**

United Nations (1982). *Concepts and Methods in Energy Statistics with Special Reference to Energy Accounts and Balances.*

United Nations (1987), Energy Statistics: Definitions, Units of Measure and Conversion Factors..

United Nations (1991), *Energy Statistics: A Manual for Developing Countries.*

The IEA, (2001), *Key World Energy Statistics from the IEA*, 2001 Edition,.

WB, *World Development Indicators 2000,2001*, the World Bank, Washington, D.C.

Eurostat (2001), *Integration – indicators for energy Data 1985-98*, European Commission, 2001 Edition.

(b) **Internet site:**

United Nations Statistics Division: http://www.un.org/Depts/unsd

International Energy Agency Statistics: http://www.iea.org/statist/index.htm.

IEA: http://www.iea.org

WB: http://www.worldbank.org/data

STATUS OF DEPLOYMENT OF POLLUTANT ABATEMENT TECHNOLOGIES		
Dimension **Economic**	Agenda 21 **Chapter 9: Protection of the Atmosphere**	Placement in the CSD Theme/Sub-theme List None

1. INDICATOR (#13)

(a) **Name:** Status of deployment of pollutant abatement technologies.

(b) **Brief Definition:** The indicator measures the extent of use of pollutant abatement technologies for abatement of SO_2, NO_x and particulates; and average emission reduction efficiency of the abatement technologies (the capture efficiency of the abatement control system) in term of SO_2, NO_x and particulates removal.

(c) **Unit of Measurement:** %.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
None	None	None

2. POLICY RELEVANCE:

(a) **Purpose:** The indicator provides a measure of the status of the deployment of pollutant abatement technologies to meet air quality standards with respect to selected pollutants. Since large combustion plants are the major source of the considered pollutants emissions the indicator focuses on the status of the pollutant abatement technologies at the existing TPP in regard to (1) share of installed capacities of TPP that are equipped with corresponding flue gas clean-up systems (industrial precipitators, desulphurisation and denitrification facilities); and (2) average SO_2, NO_x and particulates emission reduction efficiency of the pollutant abatement technologies.

(b) **Relevance to Sustainable/Unsustainable Development:** There is a growing concern related to higher concentration of various air pollutants, mainly arising from energy use, notably from fossil fuel combustion. The air emissions are influenced by a country's energy supply pattern and its standards of pollution abatement and control, and consequently by the status of use of pollution abatement technologies. Countries' efforts to abate air pollutant emissions are reflected in national policies and international commitments. Among various concrete pollution control actions, a deployment of pollutants abatement systems plays an important role in reducing pollutant emissions and prevents exceeding limits for sulphur dioxide, nitrogen oxides, and particulates in ambient air. The indicator can be used, therefore, to evaluate the environmental performance of national policies in relation to energy production, notably related to fossil fuel combustion, and to monitor levels of compliance with air quality standards.

(b) **International Conventions and Agreements:** None.

(a) **International Targets/Recommended Standards:** No direct standards exist for this indicator. However World Health Organization (WHO) air quality guidelines exist for all the pollutants of this indicator. Many countries have established their own air quality standards for many of these pollutants.

(b) **Linkages to other indicators:** The indicator is linked to economic indicators, such as Energy consumption per capita, Energy mix, and Energy supply efficiency, and Expenditure on air pollution abatement. It is closely linked to some environmental indicators: Quantities of air pollutant emissions, Ambient concentration of pollutants in urban areas.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The quantities of air pollutants from all anthropogenic activities is directly related to the combustion of fossil fuels for energy. The term "air pollution" is used to describe substances that are artificially introduced into the air from energy related activities, in particular from fossil fuel combustion facilities. Air pollution stems from acid gases such as SO_2, NO_x, and airborne particulates which, in excess, are harmful to human health, buildings and ecosystems. There are various technological options to prevent release of air pollutants into atmosphere, in particular those which clean-up combustion flue gases at the "end-of- pipe" from pollutants already generated. Among such "end-of-pipe" pollutant abatement technologies, such as electrostatic precipitator, bag filter, are widely deployed for particulates removal. In turn wet scrubbers are used for SO_2 removal, and selective catalytic reduction is used to clean-up gases from NOx. The extent of use of pollutant abatement technologies is defined as a share of thermal power plant TPP install capacities equipped with the appropriate facilities for abatement of SO_2, NO_x, and particulates.

Average emission reduction efficiency of the abatement technologies determines the reduction in emissions of generated pollutants by the corresponding abatement control systems (the capture efficiency of devices) deployed at the stationary combustion facilities, notably at the thermal power plants.

(b) **Measurement Methods:** The extent of use of pollutant abatement technologies for abatement of SO_2, NO_x and particulates on existing TPP may be evaluated from data of national utilities and energy agencies.

Average emission reduction efficiency of the abatement technologies is to be evaluated through direct sampling pollutant emissions levels in flue gases flow upstream and downstream of representative abatement control system.

(c) **The Indicator in the DSR Framework:** The indicator is considered as an Indirect Driving Forces within energy sector.

(d) **Limitations of the Indicator:**

(a) **Status of the Methodology:** Not available.

(b) **Alternative Definitions/Indicators:** The indicator may be extended to cover not only thermal power plant but also all the stationary combustion facilities.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Total number of installed capacities of thermal power plant.

(ii) Number of TPP installed capacities which are equipped with abatement technologies for SO_2, NO_x and particulates removal at the "end-of-pipe"

(iii) Average reduction of SO_2, NO_x and particulates by the corresponding pollutant abatement technologies deployed at the TPP.

(b) **National and International Data Availability:** International data sources do not exist. Data presumably are available at the national level compiled by utilities and energy agencies.

(c) **Data Reference:**

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** None.

(b) **Other Contributing Organizations:** The IAEA.

(c) **6. REFERENCES**

(d) **Readings:**

(e) **Internet site:**

ENERGY USE PER UNIT OF GDP		
Dimension **Economic**	Agenda 21 **Chapter 4: Changing consumption and production patterns**	Placement in the CSD Theme/Sub-theme **Economic/Consumption and Production Patterns/ Energy Use:** *Energy use per unit of GDP*

1. INDICATOR (#14)

(a) **Name:** Energy use per unit of GDP.

(b) **Brief Definition:** Ratio of the energy consumption to GDP in real US dollars.

(c) **Unit of Measurement:** toe per 1000 $UD and KWh per $UD for electricity.

(d) **Correspondence with other ISD:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
TSD EI: *Energy supply per unit of GDP* IIECEP: Total *energy supply per unit of GDP*	MPTMSE: *Intensity of energy use (ECON12)*	*None*

2. POLICY RELEVANCE

(a) **Purpose:** Trends in overall energy use relative to GDP indicate the general relationship of energy consumption to economic development and provide a rough basis for projecting energy consumption and its environmental impacts with economic growth. For energy policy-making, however, sectoral or sub-sectoral energy intensities should be used.

(b) **Relevance to Sustainable/Unsustainable Development:** Energy is essential for economic and social development, but consumption of fossil fuels is the major cause of air pollution and climate change. Improving energy efficiency and delinking economic development from energy consumption, particularly of fossil fuels, is essential to sustainable development.

(c) **International Conventions and Agreements:** Currently, there are no conventions or agreements specifically referring to the regulation and/or limitation of energy use per GDP. However, Agenda 21 calls for considering how economies can grow and prosper while reducing the use of energy and materials and encouraging reducing the amount of energy and materials used per unit in the production of goods and services. At the regional level calls were made for the prudent and rational use of energy (Article 130 of the Treaty on the European Union - Maastricht, 1992), energy efficiency (The Energy Protocol of Lisbon, 1994) and switch to cleaner forms of energy.

(d) **International Targets/Recommended Standards:** No specific target for energy intensity. The Kyoto Protocol sets targets for total greenhouse gas emissions for Annex I (developed) countries.

(e) **Linkages to Other Indicators:** The ratio of energy use to GDP is an aggregate of sectoral energy intensity indicators and is thus linked to the energy intensities for the manufacturing, transportation, commercial/services and residential sectors, for which separate methodology sheets have been prepared. This indicator is also linked to indicators for total energy consumption, greenhouse gas emissions and air pollution emissions.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The ratio of energy use to GDP is also called "energy intensity". The term "energy intensity" is better used for sectoral or sub-sectoral ratios of energy use to output. The indicator could be called "aggregate energy intensity" or "economy-wide energy intensity". The ratio of energy use to GDP indicates the total energy being used to support economic and social activity. It represents an aggregate of energy consumption resulting from a wide range of production and consumption activities. In specific economic sectors and sub-sectors, the ratio of energy use to output or activity is the "energy intensity" (if the output is measured in economic units) or the "specific energy requirement" (if the output is measured in physical units such as tonnes or passenger-kilometers). Due to the limitations described in section 3 (c) below, total energy use should be disaggregated into components, by sector (manufacturing, transportation, residential, commercial/services, industry, agriculture, construction, etc.) or sub-sector. For each sector or sub-sector, energy use can be related to a convenient measure of output to provide a sectoral or sub-sectoral energy intensity. Examples include energy use for steel-making relative to tonnes of steel produced; energy consumption by passenger vehicles relative to passenger- or vehicle-kilometers; energy consumption in buildings relative to their floor area. (See separate methodology sheets for manufacturing, transportation, commercial/services, and residential sectors). The energy intensity of a process (energy consumed per unit of output) is the inverse of the "energy efficiency" of the process (output per unit energy consumed).

(b) **Measurement Methods:**

- **Energy Use:** Total primary, conventional energy and electricity consumption are obtained from national energy balances and International statistical sources as well. TPES and Conventional energy are measured in Mega tonne of oil equivalent (Mtoe); Electricity use is measured in TWh.
- **Output:** GDP should be measured in US dollars, converted from real local currency at purchasing power parity for the base year (1990) to which local currency was deflated.

(c) **The Indicator in the DSR Framework:** It is considered as a Direct Driving Force in Economic dimension.

(d) **Limitations of the Indicator:** The ratio of aggregate energy use to GDP, often called "energy intensity" or the "energy ratio", is not an ideal indicator of energy efficiency, sustainability of energy use, or technological development, as it has been commonly used. The aggregate ratio depends as much on the structure of the economy as on the energy intensities of sectors or activities, and changes in the ratio over time are influenced almost as much by changes in the structure of the economy as by changes in sectoral energy intensities.

Measurement and interpretation of energy intensities are complicated by differences among products within a category, such as size (e.g., automobile weight or refrigerator capacity), features (power steering and automatic transmission in cars, freezer compartments in refrigerators), and utilization (hours per year a stove is used, vehicle occupancy if passenger-km is the measure of output).

Comparison among countries of the ratio of energy use to GDP is complicated by geographical factors. Large countries, for example, tend to have high levels of freight transportation as many goods are distributed nationwide. Compared with countries with moderate climates, cold countries may consume as much as 20 per cent more energy per capita due to demand for space heating, while hot countries may use 5 per cent more energy per capita, due to demand for air conditioning. Countries with large raw materials industries may use twice as much energy per

unit of manufacturing output compared to countries that import processed materials, due to the high energy intensity of raw material processing. Canada, for example, has a high ratio of energy use to GDP, due in part to that fact that it is a large, cold country with a large raw materials processing sector. In Japan, the climate is milder, raw materials are limited, and high population density results in smaller residential units and less distance travelled, contributing to a lower ratio of energy use to GDP.

Interpreting the ratio of energy use to GDP in terms of environmental impact or sustainability is also complicated by differences in environmental impact among energy sources. Canada, for example, has substantial hydropower, nuclear power and natural gas, all of which have lower environmental impacts than coal or oil.

Given the large number of factors that affect energy consumption, the ratio of total energy consumption to GDP should not be used as an indicator of energy efficiency or sustainability for policy-making purposes.

(e) **Status of the Methodology:** The ratio of energy use to GDP, as well as sectoral and sub-sectoral energy intensities, are in widespread use, but without a standardized methodology.

(f) **Alternative Definitions/Indicators: Energy intensity.** The ratio of sectoral or sub-sectoral energy use to the output or activity of the sector or sub-sector provides a more useful indicator of energy intensity. Four separate methodology sheets have been prepared for manufacturing, transportation, commercial/services, and residential sectors

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Real GDP in US dollars of a base year and energy consumption, while the last to be specified for total primary energy (TPES), Primary conventional energy and Electricity.

(b) **National and International Data Availability and Sources:** The International Energy Agency maintains the most thorough set of energy balances and energy accounts, based primarily on national data or data collected from reliable regional agencies. For OECD countries, the OECD maintains the most reliable set of national accounts with a breakdown of GDP by sector and sub-sector. IEA energy data now cover virtually all developing countries.

GDP and value-added by industry are published in the United Nations National Accounts Statistics. The IMF "International Financial Statistics" provides nominal and real GDP for most countries. Data on components of GDP are often available from regional development banks or national sources.

(c) **Data Reference:**

IEA: *Energy Balances of Member Countries; Energy Balances of Non-Member Countries*, annually;

Eurostat: *Energy balances*; annually

Latin American Energy Organization/ OrganizacRon Latinoamericana de EnergRa (OLADE);

Asia Pacific Energy Research Centre (APERC)

UN: *National Accounts Statistics*;

IMF: *International Financial Statistics*;

WB: *World Development Indicators 2000 and 2001.*

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the International Energy Agency (IEA).

(b) **Other Contributing Organizations:** Virtually every national and international energy agency uses the ratio of total energy use to GDP, often inappropriately. Key agencies involved in more detailed development of sectoral and sub-sectoral indicators, including energy intensity and energy efficiency indicators, are Eurostat and the Directorate-General for Energy and Transport of the European Commission. The IEA has a parallel effort with a particular focus on non-EU countries. Work is also being done by APERC, with a focus on the Asia-Pacific Region, and OLADE for Latin America.

6. REFERENCES

(a) **Readings:**

EUROSTAT (2001), *Integration – indicators for energy*, 2001 edition

(b) **Internet site:** International Energy Agency: http://www.iea.org

EXPENDITURE ON ENERGY SECTOR		
Dimension **Economic**	Agenda 21 **Chapter 33: Financial Resources and Mechanisms**	Placement in the CSD Theme/Sub-theme List *Expenditure on R&D as a percent of GDR* under Institutional/Institutional capacity/Science and technology

1. INDICATOR (#15)

(a) **Name:** Expenditure on energy sector.

(b) **Brief Definition:** Expenditure on energy sector refers to economic resources spent by public sector and industry in forms of investments and current expenditures to secure national energy supply in an environmentally benign manner. From a point of view of environmental concern important components are shares of the above expenditure aimed at reducing the pressures on the environment arising from energy systems, such as expenditures on (i) air pollution control, (ii) waste management, and (iii) hydrocarbon exploration and development in regard to energy source depletion. Additionally, ratios of expenditures on both RD&D for energy technology, and energy net import expenses/revenues over GDP are worth to be specified.

(c) **Unit of Measurement:** Million 1990 US dollars in PPPs for total expenditure; % for shares on environmental protection; and % for RD&D expenditure, and energy net import expenses/revenues both as percentage of GDP.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
	MPTMSE*: Environmental protection expenditures* (ECON21)	

2. POLICY RELEVANCE:

(a) **Purpose:** The indicator provides an indication of a level of the efforts undertaken by a country to secure national energy supply. Alternatively, it can be interpreted as a measure of the economic cost or financial overburden imposed by a society to match its energy demand in near and long terms.

Relevance to Sustainable/Unsustainable Development: Financial resources are obviously needed for the attainment of sustainable development. Agenda 21 calls for the monitoring of the provision of financial resources, particularly in developing countries, so that the international community can take further action on the basis of accurate and reliable data. However essential financial resources (investments and current expenditures) are required to secure sustainable energy supply, in particular for energy importing countries. A part of resources spent for energy use comprises the environmental expenditure, since energy services create major pressure on ecosystems in terms of air emissions, waste streams generation and resources depletion. The energy expenditure represents a considerable overburden on a national economy. Diminishing these expenses would free up financial resources, which could be allocated for the resolving other societal needs. On the other hand, less expenditure in the energy sector might result in reductions

of energy cost to the public, favoring both the economic growth and affordability, in particular for low income population in the developing world, where limited access to energy is a serious constraint to development.

RD&D expenditure for developing energy system

(b) **International Conventions and Agreements:** None.

(c) **International Targets/Recommended Standards:** None.

(d) **Linkages to other indicators:** The indicator is linked to economic indicators, such as GDP per capita, energy prices, annual energy consumption per capita, net energy import dependence. Also through corresponding chains, it affects the indicators of economic dimension: quantities of air pollutant emissions, ambient concentration of pollutants in urban areas, Generation of solid and radioactive waste, accumulated quantity of solid waste to be managed, accumulated quantity of radioactive waste awaiting disposal, lifetime of proven fossil fuel reserves, etc.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Environmental protection expenditures are defined in Chapter XXI of the System of National Accounts (SNA), in the System of Integrated Environmental and Economic Accounting (SEEA) (United Nations 1993), and in SERIEE (Eurostat 1994) as those expenses, which are an immediate response to effects caused by production and for which environmental protection is the main objective. The Classification of Environmental Protection Expenditures (CEPA) is contained in UNECE/CES/822 (1994).

Regarding energy net import expenses/revenue, it is a standard item in the balance of payments and national accounts. Apart, it could be computed as a sum of products of volume of imported net energy sources by corresponding energy commodity price.

(b) **Measurement Methods:** See section 3a above.

(c) **The Indicator in the DSR Framework:** It is considered as a Direct Driving force of Economic Dimension.

(d) **Limitations of the Indicator:** Comparable data are not readily available, and may be based on incomplete estimates. In most cases the available data on expenditures on environmental protection or R&D are aggregated for all sectors and it is not possible to identify which part of total expenditure is spent for energy sector.

(e) **Status of the Methodology:** Not available.

(f) **Alternative Definitions/Indicators:**

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

(i) Total Expenditure on energy use, except for energy imports, and its break down by types of expenditures such as: air pollution abatement, waste management, hydrocarbon exploration and development, RD&D for energy technology;

(ii) Energy net import expenses/revenue;

(iii) Gross Domestic product.

(b) **National and International Data Availability:** There is no international data on energy related expenditure and its break down by various types of expenditures. Data on expenditure of fuel and power producing sectors (companies) can be obtained from industrial statistics and by means of questionnaires to the energy companies. Data on government energy expenditures can be found in financial statistics.

Data on RD&D expenditure can be obtained through UNESCO's international surveys on scientific research and experimental development; however, sectoral break down is a rather complicated task.

(c) **Data Reference:**

UNESCO Statistical Yearbook for data on R&D.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** *None.*

(b) **Other Contributing Organizations:** The IAEA. The World Bank may be interested in the development of this indicator.

(c) **6. REFERENCES**

(d) **Readings:**

Eurostat, (1998): *Environmental Protection Expenditure in Member States.*

Eurostat, (1994): *SERIEE European System of Recording Information of the Economy on the Environment*.

OECD(1993):. *Pollution Abatement and Control Expenditures in OECD Countries*. Environment Monograph No. 75.

DESIPA. (1993*): System of National Accounts.* Inter-secretariat Working Group on National Accounts. 1993.

(e) **Internet site:**

ENERGY CONSUMPTION PER CAPITA		
Dimension	Agenda 21	Placement in the CSD Theme/Sub-theme set
Economic	**Chapter 4: Changing Consumption Patterns**	**Economic/Consumption and Production Patterns/Energy Use**

1. INDICATOR (#16)

(a) **Name:** Energy consumption per capita.

(b) **Brief Definition:** The per capita amount of energy – coal, oil, petroleum products, gas, combustible energy &waste, electricity, and heat converted into oil equivalent - available in a given year in a given country or geographical area.

(c) **Units of Measurement:** Toe per capita; regarding electricity - kWh per capita.

(d) **Correspondence with other ISD:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
Core ENV: *Energy supply per capita*	MPTMSE: *Per capita gross inland energy consumption* (ECON10)	*Annual energy consumption per capita*

2. POLICY RELEVANCE

(a) **Purpose:** The indicator is a widely used measure of access to and use of energy, individual and industrial energy consumption patterns and the energy intensity of a society.

(b) **Relevance to Sustainable/Unsustainable Development:** Energy is a key factor in industrial development and in providing vital services that improve the quality of life. Traditionally energy has been regarded as the engine of economic progress. However, its production, use, and byproducts have resulted in major pressures on the environment, both from a resource use and pollution point of view. The decoupling of energy use from development represents a major challenge of sustainable development. The long- term aim is for development and prosperity to continue through gains in energy efficiency rather than increased consumption and a transition towards the environmentally friendly use of renewable resources. On the other hand, limited access to energy is a serious constraint to development in the developing world, where the per capita use of energy is less than one sixth than that of the industrialized world.

(c) **International Conventions and Agreements:** Currently, there are no conventions or agreements specifically referring to the regulation and/or limitation of energy consumption per capita. However, calls have been made for the prudent and rational use of energy (Article 130 of the Treaty on the European Union -Maastricht, 1992), energy efficiency (The Energy Protocol of Lisbon, 1994) and switch to cleaner forms of energy. UNFCC and the Kyoto Protocol call for limitations on total greenhouse gas emissions, which are dominated by CO_2 from the combustion of fossil fuels.

(d) **International Targets/Recommended Standards:** The Kyoto Protocol sets targets for total greenhouse gas emissions for Annex I (developed) countries.

(e) **Linkages to Other Indicators**: The indicator is closely linked with other indicators of the economy such as energy intensities, energy net import dependency, with environmental indicators such as GHG emission, air quality, acidification land area, waste generation, and also with social indicators.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** Gross inland consumption of primary energy or Total primary energy supply (TPES) is a key aggregate in the energy balances.

TPES comprises: coal, crude oil, Petroleum products, Gas, Nuclear, Hydro, Other non-combustible renewables (excluding Hydro), electricity and heat.

Coal includes primary solid fuels, such as hard coal, lignite, and derived fuels (including patent fuel, coke oven coke, gas coke, BKB, coke oven gas and blast furnace gas). Peat is also included in this category.

Crude oil comprises crude oil, natural gas liquids, refinery feedstocks and additives as well as other hydrocarbons.

Petroleum products comprise refinery gas, ethane, LPG, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, heavy fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and other petroleum products.

Gas in common includes natural gas (excluding natural gas liquids) and gas works gas.

Hydro shows the energy content of the electricity produced in hydro power plants. Hydro output excludes output from pumped storage plants. Hydro-electricity production are accounted for using 1 TWh = 0.086 Mtoe.

Nuclear shows the primary heat equivalent of the electricity produced by a nuclear power plant with an average thermal efficiency of 33 per cent, i.e. 1 TWh = 0.086:0.33 = 0.261 Mtoe.

Non-combustible renewables include geothermal, solar, wind, tide, and wave energy. Unless the actual efficiency of the geothermal process is known, the quantity of geothermal energy entering electricity generation is inferred from the electricity production at geothermal plants assuming an average thermal efficiency of 10 per cent. For solar, wind, tide and wave energy, the quantities entering electricity generation are equal to the electrical energy generated. Electricity is accounted for at the same heat value as electricity in final consumption (i.e. 1 TWh = 0.086 Mtoe). Direct use of geothermal and solar heat, and heat from heat pumps, that is extracted from ambient environment are also included here.

Combustible renewables & waste (CRW) comprise biomass (wood, vegetal waste, ethanol) and animal products (animal materials/wastes and sulphite lyes), municipal waste (wastes produced by the residential, commercial and public service sectors that are collected by local authorities for disposal in a central location for the production of heat and/or power) and industrial waste. The share of wood in CRW has to be specified.

Consumption of energy refers to apparent consumption and is derived from the formula that takes into account indigenous production, exports, imports and stock changes. Production refers to the first stage of production. International trade of energy commodities is based on the general trade system, that is, all goods entering and leaving the national boundary of a country are recorded as export and imports. Bunkers refer to fuels supplied to ships engaged in international transport, irrespective of the carriers flag. In general, data on stocks refer to changes in stocks of producers, importers and/ or industrial consumers at the beginning and the end of the year.

(b) **Measurement Methods:** The indicator is calculated as the ratio of consumption of energy in a specific area/country/region to the mid- year population in that area/country/region. The following four different entries are to be specified for the numerator of the indicator, namely: Total primary energy; Automotive fuel; Combustible renewable and waste; and Electricity.

a. Total primary energy requirement (gross inland primary energy consumption, total primary energy consumption) is calculated from the following formula: "Primary indigenous production + Net import/Bunkers/+/- Stock changes = Total primary energy requirement".

b. Gross inland automotive fuel consumption is calculated from the following formula: "automotive fuel production + Imports/Exports/Bunkers/+/- Stock changes = Total automotive fuel requirement". Automotive fuel comprises: aviation gasoline, motor gasoline, jet fuels, gas/diesel oil, LPG.

c. Combustible energy and waste consumption is calculated from the following formula: "CRW + net import = Total CRW consumption".

d. Electricity consumption is calculated from the following formula: "Electricity production + Net imports = Total electricity requirement". Amounts are considered as imported or exported when they have crossed the national territorial boundaries of the country.

(c) **The Indicator in the DSR Framework:** A State indicator of the Economic Dimension.

(d) **Limitations of the Indicator:** Apparent consumption may in some cases represent only an indication of the magnitude of actual gross inland availability. The actual value of the indicator is strongly influenced by a multitude of economic, social and geographical factors. When using it as an indicator of sustainability the indicator has to be interpreted in connection with other indicators of economic development and energy use, as smaller or larger values of the indicator do not necessarily indicate more or less sustainable development.

(e) **Status of the Methodology:** The indicator is in a widespread use, but without a standardized methodology. International recommendations are available.

(f) **Alternative Definitions/Indicators:** Use of energy per capita.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Energy commodity data for production and consumption (energy balances) and mid- year population estimates.

(b) **National and International Data Availability:** Energy commodity data for production and consumption, and population data are regularly available for most countries at the national level; and for some countries, at the sub- national level. Both types of data are compiled by and available from national statistical offices and country publications.

(c) **Data Reference:** United Nations: Energy Statistics Yearbook. United Nations: Energy Balances and Electricity Profiles; IEA/OECD: Energy balances and Energy statistics for OECD countries and non-OECD countries.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** The lead agency is the United Nations Department of Economic and Social Affairs (DESA). The contact point is the Director, Statistics Division, DESA; fax no. (1 212) 963 9851. UN Commission on Sustainable Development.

(b) **Other Contributing Organizations:** Other organizations involved in the indicator development include the International Energy Agency of the Organisation for Economic Cooperation and Development (OECD/ IEA), and Eurostat.

6. REFERENCES

(a) **Readings:**

United Nations, (1982): *Concepts and Methods in Energy Statistics, with Special Reference to Energy Accounts and Balances*. Energy Statistics: Definitions, Units of Measure and Conversion Factors.

United Nations, (1987): *Energy Statistics: A Manual for Developing Countries*. United Nations, 1991.

(b) **Internet sites:**

United Nations Statistics Division: http://www.un.org/Depts/unsd
UN Commission on Sustainable Development: http://esl.jrc.it/envind/sip/en/sip_en01.htm
International Energy Agency Statistics: http://www.iea.org/statist/index.htm.

INDIGENOUS ENERGY PRODUCTION		
Dimension **Economic**	Agenda 21 **Chapter 4: Changing consumption patterns**	Placement in the CSD Theme/Sub-theme List **None**

1. INDICATOR (#17)

(a) **Name:** Indigenous energy production.

(b) **Brief Definition:** Amount of indigenous primary energy produced nationally in a given year in total and by fuel types, such as: coal, oil, natural gas, nuclear, hydro, all converted into oil equivalent, and combustible renewables & waste (CWR) all converted into oil equivalent; and amount of total electricity produced domestically from all primary energy sources.

(c) **Unit of Measurement:** Million tonnes of oil equivalent (Mtoe), and TWh for electricity.

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
IIECEP: *Indigenous energy production.*		None

2. POLICY RELEVANCE:

(a) **Purpose:** The indicator is a widely used measure of extent to which indigenous energy production is economically and environmentally competitive with imported energy in increasingly global energy market.

(b) **Relevance to Sustainable/Unsustainable Development:** In principl, using indigenous energy production rather than energy consumption, as an indicator, offers a better measure for the overall pressure applied to the environment, in particular regarding energy depletion. On a global scale, total energy production, which is equivalent to primary energy consumption (aside from some stock variations and statistical errors) is in fact the primary source of the majority of emitted pollutants into the atmosphere and the cause of a series of air pollution-related problems. On a regional scale, however, the production of different types of energy is associated with a greater or lesser significance for the occurrence of regional environmental problems. The production of electricity from the combustion of fossil fuels, irrespective of the amount finally exported, does indeed have a major regional contribution because the local release of air pollutants does affect their regional concentration levels. Over the last few years, it has become apparent that it will be virtually impossible to maintain the production of fossil fuels at current rates over the long term because of the related adverse environmental effects and the gradual depletion of fossil fuel reserves.

Regarding economic dimension indigenous energy production reflects the extent to which indigenous energy sources are economically competitive with imported energy unless the optimal level of energy security is provided.

(c) **International Conventions and Agreements:** Currently, there are no conventions or agreements specifically referring to the regulation and/or limitation of energy production/consumption. However, calls have been made for the rational use of energy, fuel efficiency improvements and the switch to cleaner forms of energy.

(d) **International Targets/Recommended Standards:** Not available.

(e) **Linkages to other indicators:** In the Economic dimension the level of indigenous energy production is closely linked with total primary energy consumption (TPES), the energy net imports dependency and expenditures on energy sector. Concerning the Environmental dimension, the energy production sector is responsible for the emissions of air pollutants and GHG and therefore, it is related to both the air pollution and the global climate change indicators. Energy production sector rather than energy consumption is also responsible for generation of solid and radioactive wastes, discharges into water basin, area of land taken up and fatalities due to accidents. In addition, the growing global energy needs add to the demand on fossil and uranium reserves, the depletion of which is dealt with indicators of energy resource depletion- life times of fossil fuels and uranium reserves.

3. METHODOLOGICAL DESCRIPTION

(a) Underlying Definitions and Concepts: Total indigenous production of energy is a key aggregate in the energy balances. Production refers to the first stage of production and is comprised by primary energy in the form of coal, crude oil, gas, nuclear, hydro, non-combustible renewables, and combustible renewables & waste (CRW). The total domestic electricity production is to be specified as well.

Coal includes primary solid fuels, such as hard coal, lignite, and peat.

Crude oil comprises crude oil and natural gas liquids. Refinery feedstocks and additives as well as other hydrocarbons are usually included but they are not part of indigenous production.

Gas in common includes natural gas (excluding natural gas liquids) and gas works gas, although the latter is not part of indigenous production.

Hydro shows the energy content of the electricity produced in hydro power plants. Hydro output excludes output from pumped storage plants. Hydro-electricity production is accounted for using 1 TWh = 0.086 Mtoe.

Nuclear shows the primary heat equivalent of the electricity produced by a nuclear power plant with an average thermal efficiency of 33 per cent, i.e. 1 TWh = 0.086:0.33 = 0.261 Mtoe.

Non-combustible renewables includes geothermal, solar, wind, tide, and wave energy. Unless the actual efficiency of the geothermal process is known, the quantity of geothermal energy entering electricity generation is inferred from the electricity production at geothermal plants assuming an average thermal efficiency of 10 per cent. For solar, wind, tide and wave energy, the quantities entering electricity generation are equal to the electrical energy generated. Electricity is accounted for the same heat value as electricity in final consumption (i.e. 1 TWh = 0.086 Mtoe). Direct use of geothermal and solar heat, and heat from heat pumps, that is extracted from ambient environment are also included here.

Combustible renewables & waste (CRW) comprises biomass (wood, vegetal waste, ethanol) and animal products (animal materials/wastes and sulphite lyes), municipal waste (wastes produced by the residential, commercial and public service sectors that are collected by local authorities for disposal in a central location for the production of heat and/or power) and industrial waste. The share of wood in CRW has to be specified.

For aggregation of fossil fuel into total indigenous energy production the amount of fuel produced

in physical terms (metric tones of coal and crude oil; cub.m of natural gas) should be converted into its heat content based on specific net calorific values for each source specified above. In general, specific net calorific values for different sorts of crude oil may be roughly estimated as 1 toe/tonne. Gross calorific values of natural gas produced in different countries vary in range of 0.8- 1 toe/1000 cub.m (Netherlands-0.8; Uzbekistan-0.90; Russia, US, Canada, and Saudi Arabia – 0.91; UK-0.94; Indonesia-0.98, Algeria and Norway - 1.0).

Note: The World Bank terms total indigenous primary energy production as commercial energy production, while CRW (excluding municipal waste and industrial waste) is termed as "traditional fuel". Prior to 1998 the IEA's terminology excluded CRW from primary energy sources. In ISED terminology total primary energy sources excludes CRW as a conventional energy source. Thus, total primary energy comprises both conventional sources and CRW.

(b) **Measurement Methods:** The amount of energy produced can be derived from the energy statistics published by each country or various international or regional organisations (e.g. the International Energy Agency, EUROSTAT). The amounts of all primary energy sources such as fossil fuel, electricity, heat, and CRW must be considered. Production is calculated after removal of impurities and converted to heat content base on specific net calorific values.

(c) **The Indicator in the DSR Framework:** It is assigned as a State indicator of Economic dimension.

(d) **Limitations of the Indicator:**

(e) **Status of the Methodology:** There is no standardized methodology. International recommendations are available.

(f) **Alternative Definitions/Indicators:** Commercial energy production; Energy production per capita, or per unit of GDP.

The World Bank uses an indicator "Energy depletion", which is defined as the product of unit resource rents and the physical quantities of energy extracted. It covers crude oil, natural gas, and coal.

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:** Energy commodity data for production both of primary energy by fuels and by electricity.

(b) **National and International Data Availability:** Energy commodity data for production and consumption are regularly available for most countries at the national level; and for some countries, at the sub- national level. Both types of data are compiled by and available from national statistical offices and country publications.

Internationally, primary energy and electricity production data are compiled by the International Energy Agency (IEA) and the United Nations Statistics Division (UNSD). IEA data for non-OECD countries are based on national energy data adjusted to conform with annual questionnaires completed by OECD member governments. UNSD data are primarily from responses to questionnaires sent to national governments, supplemented by official national statistical publications and by data from intergovernmental organizations. When official data are not available, the UNSD prepares estimates based on the professional and commercial literature. This variety of sources affects the cross-country comparability of data.

(c) Data Reference:

United Nations: *Energy Statistics Yearbook;*

United Nations: *Energy Balances and Electricity Profiles*;

United Nations: World Statistics Yearbook;

IEA: *Energy Statistics of OECD Countries, annually*;

IEA: *Energy Balance of OECD Member Countries, annually*;

IEA Energy Statistics and Balances and Non-OCED Member Countries, annually;

EUROSTAT: Energy Balances.

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** None.

(b) **Other Contributing Organizations:** Other organizations involved in the indicator development include the International Atomic Energy Agency (IAEA), the International Energy Agency of the Organization for Economic Cooperation and Development (OECD/IEA), and EUROSTAT.

6. REFERENCES

(a) **Readings:**

United Nations (1982). *Concepts and Methods in Energy Statistics with Special Reference to Energy Accounts and Balances.*

United Nations (1987), Energy Statistics: Definitions, Units of Measure and Conversion Factors..

United Nations (1991), *Energy Statistics: A Manual for Developing Countries.*

The IEA, (2001), *Key World Energy Statistics from the IEA*, 2001 Edition,.

WB, *World Development Indicators 2000,2001*, the World Bank, Washington, D.C.

Eurostat (2001), *Integration – indicators for energy Data 1985-98*, European Commission, 2001 Edition.

(b) **Internet site:**

United Nations Statistics Division: http://www.un.org/Depts/unsd

UN Commission on Sustainable Development: http://esl.jrc.it/envind/sip/en/sip_en01.htm

IEA: http://www.iea.org

WB: http://www.worldbank.org/data

ENERGY NET IMPORTS DEPENDENCY		
Dimension **Economic**	Agenda 21 **Chapter 4: Changing consumption patterns**	Placement in the CSD Theme/Sub-theme List **None**

1. INDICATOR (#18)

(a) **Name:** Energy net imports dependency.

(b) **Brief Definition:** The ratio of net import (imports minus exports) to consumption of primary energy in a given year in total and by fuel types such as: oil & petroleum products, gas, coal; and electricity in particular.

(c) **Unit of Measurement: %**

(d) **Correspondence with other ISD Sets:**

OECD	EU/EUROSTAT	UN-DSD/DESA Provisional list for Chapter 4
None	*None*	*None*

2. POLICY RELEVANCE:

(a) **Purpose:** This indicator measures the extent to which a country relies on imports to meet its energy needs.

(b) **Relevance to Sustainable/Unsustainable Development:** Maintaining a stable supply of energy is a core objective of policy in the pursuit of sustainable development. Importance of energy security in terms of the physical availability of supplies to satisfy demand at a given price for economic and social sustainability is paramount. Therefore energy supply interruptions constitute the sort of systematic risk that needs to be addressed by policies for sustainable development. It is noteworthy to say, that two different kinds of risk are involved: a quantity risk and a price risk. Both risks are related to level of a country reliance on imported energy, that is on its energy import dependence. Thus the general exposure to energy supply disruptions can be limited by decreasing the import dependency, which in turn could be achieved through policies to increase indigenous energy production, enhance energy efficiency, diversify fuel sources, optimize fuel mix, etc.

(c) **International Conventions and Agreements:** Not available.

(d) **International Targets/Recommended Standards:** In some countries there is a recommended level to which a country may rely on energy import.

(e) **Linkages to other indicators:** This indicator is closely linked to some of the economic indicators, such as indigenous energy production, energy consumption per capita, etc. It is also linked to such environmental indicator as lifetime of proven energy reserves.

3. METHODOLOGICAL DESCRIPTION

(a) **Underlying Definitions and Concepts:** The elements comprising this indicator are (i) primary energy in total, and by fuel (oil, gas, coal); and (ii) electricity.

Two optional methods exist for calculation of net energy imports.

First, Net energy import is calculated as import minus export, both measured in oil equivalents.

Imports and exports comprise amounts having crossed the national territorial boundaries of the country, whether or not customs clearance has taken place.

Oil: Quantities of crude oil and petroleum products imported or exported under processing agreements (i.e. refining on account) are included. Quantities of oil in transit are excluded. Crude oil, NGL and natural gas are reported as coming from the country of origin; refinery feedstocks and petroleum products are reported as coming from the country of last consignment.

Re-exports of oil imported for processing within bonded areas are shown as exports of product from the processing country to the final destination.

Coal: Imports and exports comprise the amount of fuels obtained from or supplied to other countries, whether or not there is an economic or customs union between the relevant countries. Coal in transit is not included.

Electricity: Amounts are considered as imported or exported when they have crossed the national territorial boundaries of the country.

Net import of total primary energy is calculated as a sum of energy sources specified above.

Second, Net import is estimated as energy consumption less production, both measured in oil equivalents.

In both methods a negative value indicates that the country is a net exporter.

(b) **Measurement Methods:** This indicator is computed by calculating the ratio of net import to consumption or to production if net import has negative value. All values are in oil equivalents.

For an importing country:

Indicator = 100 x net import/consumption = 100x(import-export)/consumption; or

= 100x(consumption-production)/consumption= 100x (1-production/consumption)

For an exporting country:

Indicator = 100x net import/production = 100x(import-export)/production; or

= 100*(consumption-production)/production = 100x (consumption /production-1).

The indicator is computed in respect to (i) primary energy in total and by fuel (oil, gas, coal); and (ii) electricity.

(c) **The Indicator in the DSR Framework:** Indicator is assigned as a State indicator of Economic Dimension.

(d) **Limitations of the Indicator:**

(e) **Status of the Methodology:** Not available.

(f) **Alternative Definitions/Indicators:**

4. ASSESSMENT OF DATA

(a) **Data Needed to Compile the Indicator:**

i. Primary energy import, export, production, and consumption in total; and by fuel: oil, gas, and coal.
ii. Electricity import, export, consumption, and production.

(b) **National and International Data Availability:** Data on energy imports, exports and on production consumption by fuel are available from national statistical offices and country publications, and various international sources (IEA, World Bank).

(c) **Data Reference:**
IEA: *Energy Balances of OECD Countries*, 1990-2001, annually.

IEA: *Energy Statistics and Balances of Non-OECD Countries*, 1990-2001, annualy.

United Nations: *Energy Statistics Yearbook and Energy Balances and Electricity Profiles.*

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) **Lead Agency:** None.

(b) **Other Contributing Organizations:** The agencies interested in the development of this indicator are International Energy Agency, International Atomic Energy Agency.

6. REFERENCES

(a) **Readings:**

Concepts and Methods in Energy Statistics with Special Reference to Energy Accounts and Balances. United Nations, 1982.

Energy Statistics: Definitions, Units of Measure and Conversion Factors. United Nations, 1987.

Energy Statistics: A Manual for Developing Countries. United Nations, 1991.

Key World Energy Statistics from the IEA, 2001 Edition, The IEA, 2001.

World Development Indicators 2000, 2001, the World Bank, Washington D.C.

(b) **Internet site:**
United Nations Statistical Division: http://www.un.org/Depts/unsd/
UN Commission on Sustainable Development: http://esl.jrc.it/envind/sip/en/sip_en01.htm
IEA: http://www.iea.org
WB: http://www.worldbank.org/data