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PREPARATION OF THE GUIDELINES ON THE APPLICATION OF THE CORE SET OF ENVIRONMENTAL INDICATORS FOR EASTERN EUROPE, THE CAUCASUS AND CENTRAL ASIA

Working Document 9[1]

Energy
EE

[1] Informal translation from Russian. Descriptions of indicators were prepared by Ms. Irina Atamuradova (Turkmenistan) at the request of the UNECE Secretariat. Comments should be forwarded to the author (atamuradova@yandex.ru) and the Secretariat (mikhail.kokine@unece.org).

NUCLEAR WASTE

1. General description

(a) **Code: EE15**

(b) **Brief definition:** Volume of nuclear waste generated as a result of the nuclear energy production as well as of other types of activities related to the nuclear fuel cycle, radioisotope production and use in the health care, agriculture, industry and research.

(c) **Unit of measurement:** Cubic meters per year (m^3/year)

(d) **Presence in the UNCSD indicator list:** The indicator is present in the list.

(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** General objective is to submit information on annual volumes of various nuclear waste streams. Quantitative values of these volumes affect making decision concerning distribution of the respective resources (including financial, human, etc. resources) for appropriate management of this waste. Inappropriately managed nuclear waste may directly affect human health and the environment through the effects of the ionizing radiation. In order to ensure protection of the human health and of the environment, it is necessary to use proper strategies and technologies of the waste management. Fundamental principles of the nuclear waste management include minimization of the waste generation and systematic undertaking measures on waste processing and transportation, as well as on establishing appropriate conditions for the waste storage and distribution.

Minimizing the waste generation reduces its impact on the environment and cuts down the number of closed natural objects. The waste management strategy implies limitation and retention of radionuclids within the system of projected and natural borders in order to avoid any emission in the environment.

(b) **International agreements:** The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management is open for signing; it has not yet been put into effect due to the lack of ratification documents obtained from the signatory countries. The Convention commits the Parties to manage the spent fuel and radioactive waste based on sustainable methods of the waste management.

(c) **International targets, standards or guidelines:** The International Atomic Energy Agency (IAEA) has introduced the Safety Standards (Basic Principles, Requirements and Guidelines), applied to the nuclear waste management as well as the Basic Safety Concepts aimed at human protection of ionizing radiation that comply with the recommendations of the International Committee on radiological protection.

(d) **Linkages to other indicators:** Direct linkages: to generation of hazardous toxic waste, transboundary movements of hazardous waste and to land use for landfills, waste dumps, tailing pits, refuse heaps (WMF13 rev, WMF20a, WMF17a rev). Indirect linkages to: total energy consumption by fuel (EE24); since most of the radioactive waste, which is an outcome of the practical nuclear fuel cycle, is related to significant electric power production by nuclear means and hence to a respective reduction of other energy sources environmental impacts. This implies reduction of the pollutants, particularly, of GHG in the air, which facilitates air protection (CC1 rev, CC2 rev, CC5b, CC5a, APE5b, APE6b).

3. Methodological description

(a) **Underlying definitions and concepts:** Major principles of the future generations protection are formulated in the Basic Safety Concepts of the International Atomic Energy Agency. The IAEA definitions and categories of the radioactive waste are given in the respective standards. Each of the EECCA countries has developed and put into effect its own "Radiation Safety Standards" that comply with the existing sanitary standards and regulations. In these standards, the major definition of "activity" has been adopted as "a measure of radioactivity of a certain quantity of radionuclide in a given energy state at a certain point of time, with 'Bq' as a unit of nuclear activity.

(b) **Measurement methods:** The actual volume of the container in cubic meters (m^3) should be deemed to be the volume of appropriately packed nuclear waste. The volume of nuclear waste that by the end of the year appears to be in an inappropriate form should be determined based on special methodologies established to ensure appropriate conditions for further distribution of waste.
(c) **Availability of internationally-agreed methodology:** The existing method of the radiological threat assessment of nuclear waste distribution is a relatively advanced one and therefore it's used as basis for regulatory decisions in many countries.

4. Primary data

(a) **Requirements to monitoring and data collection:** Data on annual volumes of various types of nuclear waste in cubic meters per year (m^3/year) is required. Governmental bodies on the national (or state) level can be used as primary sources of such data. Databases supported by the international bodies, such as the International Atomic Energy Agency (IAEA) or OECD/IEA, can also be used as complementary sources of this data.
(b) **Difficulties and limitations:** The volume of nuclear waste can only reflect its approximate threat value. Special analysis of the waste location with the account of the isotope and chemical contents of the waste may be needed to determine the waste actual impact on human health and on the environment.
(c) **Reference to international databases:** At the national level, information on the volume of generated nuclear waste can be obtained from the reports supported by various waste producers or, in a more unified form, from the national regulating bodies. Almost one third of the countries, IAEA members, have their national systems of the nuclear waste registration. Once put into effect, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management will commit the Parties to establish and maintain national inventories of the nuclear waste.

5. International bodies

(a) **Lead institution:** the International Atomic Energy Agency (IAEA).
(b) **Other organizations and agencies:** Governmental and intergovernmental bodies, as well as EU, OECD/IEA and UNEP.

6. References

(a) **Readings:**

- IAEA's Safety Guides (Safety Series No. 111-G-1.1), 1994. *Classification of Radioactive Waste*.
- IAEA's Safety Standards (Safety Series No. 111-S-1), 1995. *Establishing a National System for Radioactive Waste Managemen*t.
- IAEA's Safety Fundamentals (Safety Series No. 111-F), 1995. *The Principles of RadioactiveWaste Management.*
- IAEA's Safety Standards (Safety Series No. 115), 1996. *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources.*
- ICRP Publication 46, 1996. *Radiation Protection Principles for the Disposal of Solid*
- *Radioactive Waste*, Pergamon Press, Oxford.
- ICRP Publication 60, 1991. *1990 Recommendations of the International Commission on Radiological Protection.* Annals of the ICRP 21 (1- 3), Pergamon Press, Oxford.
- *The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Managemen*t, as adopted in September 1997.

(b) **Internet sites:**

- http://www.iaea.org
- http://www.iea.org
- http://www.unep.org

FINAL ENERGY COMSUMPTION

1. General description

(a) **Code: EE18**
(b) **Brief definition:** Energy consumption by transport, industry and by other sectors (services, agriculture and households).
(c) **Unit of measurement:** toe (tons of oil equivalent) or Mtoe (10^6*toe)
(d) **Presence in the UNCSD indicator list:** The indicator is not present in the list.
(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** The indicator is used for making assessments of the energy consumption trends at the final stage. These assessments could be carried out by use of the power intensity, i.e., of final energy consumption per unit of GDP. The lower the power intensity is, the less energy is consumed per unit of welfare. The policy objective is to work out and implement particular measures in certain sectors of economy aimed at increasing efficiency of the energy consumption (or at reducing power intensity), and hence, at reducing negative environmental impact. Thus, for instance, industry related strategies include reasonable efficiency standards, financial incentives and liberalization of energy prices. Activities in the household sector are mainly focused on application of energy efficiency standards at construction of new housing, energy price formation reform and raising public awareness campaigns.
(b) **International agreements:** The UN Framework Convention on Climate Change and the Kyoto Protocol thereto urge to introduce limitations in regard to total greenhouse gas (GHG) emissions, the major share of which is the CO_2 emission as a result of burning fossil fuels.
(c) **International targets, standards or guidelines:** There are no particular targets for final energy consumption. The Kyoto Protocol sets forth limitations on total GHG emissions for industrially developed countries and for the transition economies.
(d) **Linkages to other indicators:** The indicator is directly linked to the indicators specifying total energy intensity (EE20), transport final energy consumption (TERM1 rev), GHG emission, projected HGH emission, GHG emissions of key source sectors (CC1rev, CC2rev, CC5b), and indirect links to the indicators specifying air pollution: energy related pollutant emissions and transport air emissions (APE5b, APE6b, APE8b, APE4b rev).

3. Methodological descriptions

(a) **Underlying definitions and concepts:** Final energy consumption includes consumption of transformed energy (i.e., electric power, public heating, petroleum products, coke, etc.) and of primary fuels, like natural gas or renewable energy sources (for instance, solar energy, biomass) and is expressed in cumulative annual total. Final energy consumption excludes petrochemical raw materials for the industry.
(b) **Measurement methods:** Figures on the final energy consumption in the country on the whole and by sectors may be obtained from the national energy balances. The indicator is calculated based on the reporting data provided by various companies and organization. Normally, these reports would first be processed on the local level, after which they would be further processed by the national statistical agency for a countrywide assessment purposes. For instance, for the "Transport" sector, which is the major fossil fuels consumer, measurement of the energy consumption is based on the data concerning solid, liquid and gas fuels as well as on the electric energy consumption by mode: road, air (domestic aviation), water (river and domestic marine navigation), railroad and pipeline transport. Data on the transport energy consumption are included in the special statistic report forms that are distributed among all types of companies and organizations irrespective of their organizational and legal structure and type of ownership and are usually due for submitting on a quarterly and annual basis. Energy consumption in "Households" covers energy consumed by the

households, including urban and rural houses, apartment buildings, dormitories and private sector. The major data sources for energy consumption measurement are special forms of statistical reports submitted by the heating, electric energy and utilities suppliers. Electric power and gas bills, as well as those for the supplied heating and fuel may serve as additional data sources.

(c) **Availability of internationally-agreed methodology:** Final energy consumption, as well as energy consumption by sectors is widely used, however there does not exist any standard methodology.

4. Primary data

(a) **Requirements to monitoring and data collection:** Data on the final energy consumption by sector is available in the national energy balances, as well as in the national statistical Year-Books.

(b) **Difficulties and limitations:** Statistical reporting usually covers larger and medium size enterprises, whereas small businesses and non-commercial institutions, as a rule, remain beyond this statistics. They however do not stay beyond gross energy consumption statistics that reflect total energy consumption in the country. Sometimes approximate assessments are used for measuring the indicator. Thus, for instance, if no data is available on transport final energy consumption by mode, assessments could be made based on the data on the number of vehicles registered in the country, average annual mileage and rate of transport energy use by mode. Values obtained as a result of such an assessment are very approximate since they do not account for the amount of the registered vehicles that are non-functional or out of use.

(c) **Reference to international databases:** The International Energy Agency supports the most comprehensive databases on energy balances and assessments primarily based on the national data collected from reliable regional agencies. The IEA energy data is actually available on all the developing countries.

5. International bodies

(a) **Lead institution:** The International Energy Agency (IEA).

(b) **Other organizations and agencies:** Key agency involved in a more detailed indicator development is the EU Statistical Bureau. The IEA handles parallel activities in special directions for the non-EU-member-countries.

6. References

(a) **Readings:**

- IEA: Energy balances:
  - Energy balances of the countries, members of IEA
  - Energy balances of the countries, non-members of IEA
- The EU Statistical Bureau: Energy balances
- IEA, Indicators of Energy Use and Efficiency: Understanding the Link Between Energy and Human Activity (OECD, Paris) 1997
- IEA, Key World Energy Statistics, 2003

(b) **Internet sites:**

- http://www.iea.org
- http://www.oecd.org
- http://www.worldbank.org

TOTAL ENERGY CONSUMPTION BY FUEL

1. General description

(a) **Code: EE24**
(b) **Brief definition:** Energy resources – liquid, solid, gas fuels available during the year in the country.
(c) **Unit of measurement:** toe (metric tons of oil equivalent) or Mtoe (10^6*toe)
(d) **Presence in the UNCSD indicator list:** The indicator is not present in the list.
(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** The indicator reflects primary energy supply or gross domestic energy consumption and serves as a unit of measurement for power inputs in the economy; it is widely used for measurements of various fuels use. Energy is a key factor in the industrial development and providing of essential services. Traditionally, energy is considered to be a key element of the economic progress. However, current practices of production and energy consumption lead to major negative impact on the environment. And it's the energy source that is the determining factor of this impact. For instance, use of coal as a fuel has a major impact due to an extremely high level of pollutants emission whereas the natural gas is one of the most environmentally appropriate fossil fuels; however, its production and transportation appear to be a huge source of GHG emission. Renewable energy sources have lesser environmental impact.
Long-term objective – continuous increase of the energy efficiency at higher than energy consumption increase rates, and switching to consumption of environmentally appropriate renewable energy resources.
(b) **International agreements:** The UN Framework Convention on Climate Change and the Kyoto Protocol thereto urge to introduce limitations in regard to total greenhouse gas (GHG) emissions, the major share of which is the CO_2 emission as a result of burning fossil fuels.
(c) **International targets, standards or guidelines:** The Kyoto Protocol sets forth limitations on total GHG emissions for countries included in Annex 1 (industrially developed countries and transition economies).
(d) **Linkages to other indicators:** The indicator is directly linked to the indicators specifying renewable energy consumption (EE26), GHG emission, projected HGH emission, GHG emissions of key source sectors (CC1rev, CC2rev, CC5b), and indirect links to the indicators specifying air pollution: energy related pollutant emissions and transport air emissions (APE5b, APE6b, APE8b, APE4b rev).

3. Methodological description

(a) **Underlying definitions and concepts:** Total energy consumption (gross domestic energy consumption) is a key element of the energy balances and relates to the "revealed" consumption, i.e., it envisions use of data on revealed and not on the actual consumption, and is calculated based on the formula taking into account production, export, import, storage bin and change of fuel stocks. Production (or primary production) means production of primary types of fossil fuels, like coal, crude oil, natural gas, renewable energy. International trade of energy products is based on the "general trade" system, i.e., when all goods delivered in to the country or shipped out of it are correspondingly registered as export and import. Data on the change of stocks mean data of the change of stocks with producers, importers and/or industrial consumers as of the beginning and of the end of the year. Bins are usually related to the fuel delivered to the vessels and aircrafts for international sea and air shipping irrespective of whether or not they belong to the state. Export, import, bin and change of stock include data both on the primary and on the secondary products (fuel products, like petrol and lubricants produced from the primary fuels)

(b) **Measurement methods:** Balance calculation based on the total consumption by fuels data is carried out according to the following scheme:

i. For each fuel type it is necessary to measure consumption volume according to the following formula: Primary production + Import - Export - Bin + /- Change of stock

ii. Then, using the conversion multiplier factor for each fuel type, convert the obtained volume values in the common energy units.

iii. Adding up all consumption values on each fuel type results in the total energy consumption (gross domestic energy consumption)

(c) **Availability of internationally-agreed methodology:** The indicator is widely used, however there does not exist any standard methodology. Various international recommendations are available.

4. Primary data

(a) **Requirements to monitoring and data collection:** Data on various fuels consumption is available in national statistical agencies; part of the data is also available in national statistical Year-Books. In addition to the national sources of information, a number of international sources of information on energy are available.

(b) **Difficulties and limitations:** The revealed energy consumption value does not always reflect the actual gross domestic consumption. In other words, calculation of the total energy consumption does not necessarily provide precise data on the secondary fuel consumption neither does it give a full picture of actual consumption of specifics fuels and fuel products. Actual value of the indicator is strongly influenced by a number of economic, social and geographical factors.

(c) **Reference to international databases:** The International Energy Agency in Paris and the UN Statistical Office in New York provide publication of energy statistics catalogues based on the reports of various countries. These catalogues are composed of the reports submitted to these organizations by the governments of the member-countries.

5. International bodies

(a) **Lead institution:** UN Department on the Economic and Social Affairs (DESA).

(b) **Other organizations and agencies:** The International Energy Agency (IEA), the Organisation for Economic Co-operation and Development (OECD/IEA) and the Statistical Office of the European Communities (Eurostat).

6. References

(a) **Readings:**

- UN: Statistical Year-Books on Energy.
- UN: Energy Balances.
- 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. IEA, 2003.
- Revised Guidelines concerning GHG inventories, IPCC, 1996.

(b) **Internet sites:**

- http://www.un.org/Depts/unsd
- http://www.iea.org
- http://www.iaea.org
- http://www.oecd.org.

TOTAL ENERGY INTENSITY

1. General description

(a) **Code: EE20**
(b) **Brief definition:** Total energy intensity per unit of GDP
(c) **Unit of measurement:** toe/$ (tons of oil equivalent per US$) or Mtoe/$ (10^6*toe/$)
(d) **Presence in the UNCSD indicator list:** The indicator is present in the list.
(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** Final energy consumption trend per unit of GDP indicates general correlation between energy consumption and economic development and serves grounds for approximate assessment of energy consumption and its environmental impact as a result of the economic growth. One of the possibilities to protect environment of hazardous impact caused by energy consumption is to reduce the needs in energy consuming services or to deliver such services by using more efficient technologies. The policy objective is to improve energy efficiency and to weaken the correlation between the economic growth and energy consumption, particularly fossil fuels consumption. However, energy intensity by sector indicators should also be used by politicians when making decisions in the energy sector.
(b) **International agreements:** The UN Framework Convention on Climate Change and the Kyoto Protocol thereto urge to introduce limitations in regard to total greenhouse gas (GHG) emissions, the major share of which is the CO_2 emission as a result of burning fossil fuels.
(c) **International targets, standards or guidelines:** There are no particular targets for energy intensity. The Kyoto Protocol sets forth limitations on total GHG emissions for countries included in Annex 1 (industrially developed countries and transition economies).
(d) **Linkages to other indicators:** The indicator is directly linked to the indicators specifying final energy consumption (EE18), transport final energy consumption (TERM1 rev), GHG emission, projected HGH emission, GHG emissions of key source sectors (CC1rev, CC2rev, CC5b), and indirect links to the indicators specifying air pollution: energy related pollutant emissions and transport air emissions (APE5b, APE6b, APE8b, APE4b rev).

3. Methodological description

(a) **Underlying definitions and concepts:** Relation between energy consumption and GDP is called “energy intensity”. This term suits perfectly to determine correlation between energy consumption by sectors and sub-sectors to the volume of output (goods or services). The indicator can also be called “aggregated energy intensity ” or “energy intensity in economy scales ”.
Final energy consumption to GDP ratio determines total energy used to create a unit of welfare and presents aggregated value of energy consumption, which is a result of variety of activities on production and consumption. In some sectors of economy the energy consumption to the volume of output ratio reflects “energy consuming intensity” (provided the product can be measured in economic units) or “energy intensity per unit” (provided the volume of production is measured in physical units, such as tons or scat-kilometers).
According to the above, final consumption should be split into components by sector (industry, transport, households, services, agriculture, etc.) or sub-sector in order to determine energy intensity of sectors (sub-sectors) taking into account the fact that energy consumption of a certain sector may be linked to the respective unit of measurement of the final product. For instance, energy consumption for steel production is linked to tons of produced steel; passenger transport energy consumption is linked to scat-kilometers; energy consumption for construction – to the total area of the construction site.
Energy intensity of the process (energy consumed per unit of output product) is a value inverse to the “energy efficiency” of the process (volume of output per unit of consumed energy).

(b) **Measurement methods:** Energy consumption: Data on final energy consumption and on energy consumption by sector can be obtained from the national energy balances.
Unit of measurement: Energy is measured in metric tons of oil equivalent (toe) or in its derivatives (Mtoe).
Output (production): GDP components should be presented in comparable prices of the base (reference) year in US$ and should be summed up.
Unit of measurement: GDP is measured in US$, therefore the national currency should be converted in US$ based on the purchasing power parity of the base (reference) year.
Total energy intensity = Final energy consumption/GDP
(c) **Availability of internationally-agreed methodology:** Total energy intensity, as well as energy intensity by sector is widely used, however no standard methodology is available.

4. Primary data

(a) **Requirements to monitoring and data collection:** To be able to measure the indicator, following data will be required:

i. Final energy consumption or energy consumption by sector;
ii. Actual GDP in US$.

Data on the final energy consumption by sector is available in national balances, whereas GDP components could be found in national statistical Yearbooks of most of the countries.
(b) **Difficulties and limitations:** Aggregated energy consumption per unit of GDP, oftentimes called "energy intensity" or "energy ratio", is not an ideal indicator of energy efficiency, sustainability of energy consumption or technological development. Aggregated ratio depends both on the structure of the economy and on the energy intensity of the sectors, i.e., change of structure of the economy affects indicator change within a certain period of time almost in the same manner as change of energy intensity by sector does.
Calculation and interpretation of the energy intensity is further complicated by different units of measurement applied for determination of the output (production) volume, like overall dimensions (for instance, truck load or refrigerant volume), special features (steering control or automatic transmission of vehicles, freezers of the refrigerants), and usage criteria (number of hours of oven use per year, use of a vehicle if it's the scat-kilometers that are the unit of measurement of the final production).
Country comparison of energy consumption per unit of GDP becomes difficult due to a number of geographical factors. Large countries with vast territories, for instance, have high freight turnover. Compared to countries with moderate climate, countries of cold climate zones may encounter a 20% extra consumption of energy per capita for heating purposes, whereas hot climate countries may need some 5% of extra energy consumption per capita for air conditioning. Countries with larger raw materials sectors may consume twice as much energy per unit of processed raw material due to higher energy intensity of raw materials processing compared to countries importing processed materials.
Energy consumption per unit of GDP interpretation in terms of its environmental impact is also difficult due to differences in environmental impact produced by various energy sources. For instance, economy may be energy consuming, however it may minimize CO_2 emissions due to renewable energy consumption and at the same time ensure GDP growth.
Given a huge number of factors affecting energy consumption, final energy consumption per unit of GDP should not be used as an indicator of energy efficiency in making decisions. Correlation between energy consumption by sectors or sub-sectors and output (production) or services delivered volumes can be a much better indicator of energy intensity.
(c) **Reference to international databases:** The International Energy Agency supports the most comprehensive databases on energy balances and assessments primarily based on the national data or on the data collected by reliable regional agencies. IEA energy data is available on actually all the developing countries.
Data on GDP and value added for the industry is published in the UN Statistics of the national economic balances. IMF "International Financial Statistics" contains data on the nominal and actual

GDP for most of the countries. Data on GDP components may be obtained from the Regional Banks of Development or from the National Statistical Yearbooks.

5. International bodies

(a) **Lead institution:** The International Energy Agency (IEA).

(b) **Other organizations and agencies:** Key agencies involved in a more detailed indicator (including, on energy intensity and energy efficiency) development by sector are the Statistical Office of the European Communities (Eurostat) and the Directorater for Energy and Transport of the European Commission. The IEA handles parallel activities in special directions for the non-EU-member-countries.

6. References

(a) **Readings:**

- IEA: Energy balances:
  - Energy balances of the countries, members of IEA
  - Energy balances of the countries, non-members of IEA
- The Statistical Office of the European Communities (Eurostat): Energy balances
- UN Statistics of the National Economic Balances.
- IMF - International Financial Statistics
- IEA, Indicators of Energy Use and Efficiency: Understanding the Link Between Energy and Human Activity (OECD, Paris) 1997
- IEA, Key World Energy Statistics, 2003

(b) **Internet sites:**

- http://www.iea.org
- http://www.oecd.org
- http://www.worldbank.org

END-USER ENERGY PRICES BY FUEL

1. General description

(a) **Code: EE28 rev**
(b) **Brief definition:** Domestic prices for primary energy resources, electric power, heating.
(c) **Unit of measurement:** national currency
(d) **Presence in the UNCSD indicator list:** The indicator is not present in the list.
(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** Primary energy resources, electric power and heating prices are one of the major factors used to determine energy consumption in the country and, hence, the pollutants (including GHG) emissions. To ensure effectiveness of the energy sector and economics in general it is especially important that the prices include long-term maximum costs (LTMC). In many transition economies prices for centralized distribution of energy services (electric power, gas and heating supplies) – especially for the households – are oftentimes much lower than the LTMC. Industrial energy tariffs are also relatively low. The difference between prices and LTMC is covered by subsidies. Some of the subsidies may be quite acceptable: actually, any subsidy can be justified provided its return in regard to improvement of the public welfare and general environment situation exceeds the net economic costs. Long-term objective should include bringing prices for various categories of consumers in line with the LTMC provided that the prices would go up gradually, and provided protection is guaranteed to the most vulnerable layers of population that may appear to find themselves in an extremely unfavorable situation in the process of this transition.
(b) **International agreements:** N/A.
(c) **International targets, standards or guidelines:** N/A
(d) **Linkages to other indicators:** The indicator is directly linked to the indicators specifying total energy consumption by fuel (EE24), GHG emission, projected HGH emission, GHG emissions of key source sectors (CC1rev, CC2rev, CC5b), and indirect links to the indicators specifying air pollution: energy related pollutant emissions (APE5b, APE6b, APE8b).

3. Methodological description

(a) **Underlying definitions and concepts:** Prices for all kinds of products, inclusive of energy, should also embrace production and distributions costs, as well as the profits allowing to cover capital costs. Energy is the same type of product as any other type of goods. Energy prices, as a rule, should also include long-term maximum costs (LTMC) of the production, transmittance and distribution of energy, including reasonable profitability of investments. Maximum costs shall be determined as cost of the production of an additional unit of product by use of the existing capital stock. Long-term maximum costs (LTMC) – is the maximum operating costs plus costs of the additional facilities needed to increase production volumes. To be able to determine the size of LTMC it is necessary to calculate exact value of all the elements of energy supply system for various types of consumers with the account of differences in the load parameters. In many countries prices set forth for the end-users are oftentimes subsidized. Energy subsidy can be determined as a measure undertaken by the state that is primarily related to the energy sector and that leads to decreasing of the energy production cost, increasing of revenues obtained by energy producers or to reducing of the price paid by consumers. Market prices and expenses (costs) should be used as reference point in this case.
(b) **Measurement methods:** In transition economies, prices for energy related products and services are usually set forth by a state authority, based on some broader economic considerations like protection of certain industries (e.g., mining operations), or maintenance of certain level of employment and import reduction, as well as on some social considerations like maintenance of a certain income level for indigent households. Primary fuels and energy services prices for various

categories of consumers are fixed; data on these fixed prices can be obtained from the national energy ministries or statistical agencies.

(c) **Availability of internationally-agreed methodology:** The indicator has no standards methodology.

4. Primary data

(a) **Requirements to monitoring and data collection:** Domestic prices on energy products and services are available in national energy balances and are also published in National Statistical Year-books of many countries.

(b) **Difficulties and limitations:** Comparability of the national data is limited due to the differences in energy production costs.

(c) **Reference to international databases:** UN Statistical Office and the International Energy Agency collect data and assessments based on the information from national and international sources.

5. International bodies

(a) **Lead institution:** International Energy Agency of the Organisation for Economic Co-operation and Development (OECD/IEA).

(b) **Other organizations and agencies:** the World Energy Council (WEC), UN Statistical Department (UNSTAT), UN Economic Commission for Europe (UNECE).

6. References

(a) **Readings:**

- UN Statistical Year-books and energy balances
- IEA: Energy balances:
  - Energy balances of the countries, members of OECD
  - Energy balances of the countries, non-members of OECD
- The Statistical Office of the European Communities (Eurostat): Energy balances
- The World Energy Council: Energy Resources Review
- Guidelines on Energy Price Formation Principles Reform and Subsidies in Energy Sector. UN ECE. 2003

(b) **Internet sites:**

- http://www.un.org/Depts/unsd
- http://www.iea.org
- http://www.worldenergy.org
- http://www.unece.org/ie/se

RENEWABLE ENERGY CONSUMPTION

1. General description

(a) **Code: EE26**
(b) **Brief definition:** Share of renewable energy (electricity) in gross energy consumption of the country.
(c) **Unit of measurement:** %
(d) **Presence in the UNCSD indicator list:** The indicator is present in the list.
(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** The indicator expresses quantitative ratio between renewable and non-renewable energy resources in the energy sector structure. Dependence of the economy on the non-renewable energy resources (fossil fuels) cannot be viewed as steady in the long run since natural fossil fuel resources are limited whereas renewable resources can ensure continuous energy supply. On the other hand, renewable energy sources can be viewed as the best option to reduce negative environmental impact as a result of energy production and consumption. Policy objective - safe energy supply by gradual replacement of fossil fuels by renewable energy sources.
(b) **International agreements:** N/A.
(c) **International targets, standards or guidelines:** N/A
(d) **Linkages to other indicators:** The indicator is directly linked to the indicators specifying gross energy consumption by fuel (EE24), GHG emission, projected HGH emission, GHG emissions of key source sectors (CC1rev, CC2rev, CC5b), and indirect links to the indicators specifying air pollution: energy related pollutant emissions (APE5b, APE6b, APE8b).

3. Methodological description

(a) **Underlying definitions and concepts:** The indicator includes the following elements: renewable energy and gross energy consumption. Renewable energy is the energy obtained from the energy streams of the environment. This definition includes energy produced from geothermal resources, solar energy, high and low tides, wind and waves, water resources and biogas, industrial and municipal waste. Renewable energy consumption relates to the "revealed" consumption, i.e., it envisions use of data on revealed and not on the actual consumption, and is calculated based on the formula taking into account production, export, import, and change of fuel stocks.
(b) **Measurement methods:** Gross energy consumption by fuels:

i. For major fuel types it is necessary to measure consumption volume according to the following formula: Primary production + Import - Export - Bin + /- Change of stock
ii. Then, using the conversion multiplier factor for each fuel type, convert the obtained volume values in the common energy units.
iii. Adding up all consumption values on each fuel type results in the total energy consumption (gross domestic energy consumption)
iv. Renewable energy share = (renewable energy consumption volume / gross energy consumption * 100.

(c) **Availability of internationally-agreed methodology:** The indicator does not have any standard methodology. Various international recommendations are available.

4. Primary data

(a) **Requirements to monitoring and data collection:** Data on consumption of energy produced from the renewable energy sources as well as data on gross energy consumption are required. Both types of data are available in the national energy balances, as well as in various international

sources of information on energy. National data and assessments on renewable energy resources are published in the National Statistical Year-books of many countries.

(b) **Difficulties and limitations:** Due to a huge variety of forms and usages of renewable energy resources data collection may create problems. Comparability of national data is limited due to the lack of standard methodologies. Renewable energy resources offer one of the most pure sources of energy, which however may have negative impact on the environment, like loss of the nature uniqueness, change of habitats, noise.

(c) **Reference to international databases:** UN Statistical Office and the International Energy Agency collect data and assessments based on the information from national and international sources.

5. International bodies

(a) **Lead institution:** UN Department on Economic and Social Affairs, Statistical Division.

(b) **Other organizations and agencies:** the World Energy Council (WEC), International Energy Agency of the Organisation for Economic Co-operation and Development (OECD/IEA), Statistical Office of the European Communities (Eurostat) and the UN Economic Commission for Europe.

6. References

(a) **Readings:**

- UN: Statistical Year-books and energy balances
- International Energy Agency: OECD member-countries energy balances, OECD non-member countries energy balances
- World Energy Council: Energy Resources Review

(b) **Internet sites:**

- http://www.un.org/Depts/unsd
- http://www.iea.org
- http://www.worldenergy.org
- http://www.unece.org/ie/se.

ELECTRICITY PRODUCTION FROM RENEWABLE ENERGY RESOURCES

1. General description

(a) **Code: EE27**
(b) **Brief definition:** Share of renewable electricity in gross electricity production in the country
(c) **Unit of measurement:** %
(d) **Presence in the UNCSD indicator list:** The indicator is not present in the list.
(e) **Use in the *Kiev Assessment*:** Has been used in it.

2. Environmental Policy Relevance

(a) **Purpose:** The indicator reflects renewable energy contribution in the gross annual volume of produced electricity in the country. Evolution of the long-term renewable electricity production can indicate development trends of these energy resources.
Energy consumption is the major sources of anthropogenic environmental impact. Such impacts (e.g., GHG emission) at electric power stations could be reduced by means of switching to renewable energy resources. Technologies for utilization of such renewable resources as wind, sun, hydraulic stations will not only allow for reducing unfavourable environmental impact but will at the same time allow for independent electricity distribution beyond the centralized power supply network. Policy objective – wider use of environmentally appropriate biofuels, hydroelectric power, solar energy, winds and waves energy.
(b) **International agreements:** N/A.
(c) **International targets, standards or guidelines:** N/A
(d) **Linkages to other indicators:** The indicator is directly linked to the indicators specifying renewable energy consumption (EE26), GHG emission, projected HGH emission, GHG emissions of key source sectors (CC1rev, CC2rev, CC5b), and indirect links to the indicators specifying air pollution: energy related pollutant emissions (APE5b, APE6b, APE8b).

3. Methodological description

(a) **Underlying definitions and concepts:** The indicator contains gross annual volume of produced energy that includes electricity produced by power stations and smaller plants of the energy sector or by enterprises beyond the energy sector (for instance, electricity produced by small plant of a huge industrial enterprise producing energy for its own needs as well as for the neighbouring households). A unit of measurement of electric power is called a kilowatt-hour. Renewable energy is the energy obtained from the energy streams of the environment. This definition includes energy produced from geothermal resources, solar energy, high and low tides, wind and waves, water resources and biogas, industrial and municipal waste.
(b) **Measurement methods:** Data on the gross electric power output and renewable electricity production is based on the reporting of various energy units of the country.
Renewable energy share = (renewable energy consumption volume / gross energy consumption * 100.
(c) **Availability of internationally-agreed methodology:** The indicator does not have any standard methodology.

4. Primary data

(a) **Requirements to monitoring and data collection:** Data on electricity production from different kinds of energy resources are required. Such data are available in the national energy balances, as well as in various international sources of information on energy. National data and assessments on usage of renewable energy resources (including for the purposes of electricity production) are published in the National Statistical Yearbooks of many countries.

(b) **Difficulties and limitations:** Due to a huge variety of forms and usages of renewable energy resources data collection may create problems. Comparability of national data is limited due to the lack of standard methodologies. Renewable energy resources offer one of the most pure sources of energy, which however may have negative impact on the environment, like loss of the nature uniqueness, change of habitats, noise.

(c) **Reference to international databases:** UN Statistical Office and the International Energy Agency collect data and assessments based on the information from national and international sources.

5. International bodies

(a) **Lead institution:** UN Department on Economic and Social Affairs, Statistical Division.

(b) **Other organizations and agencies:** the World Energy Council (WEC), International Energy Agency of the Organisation for Economic Co-operation and Development (OECD/IEA), Statistical Office of the European Communities (Eurostat) and the UN Economic Commission for Europe.

6. References

(a) **Readings:**

- UN: Statistical Year-books and energy balances
- International Energy Agency: OECD member-countries energy balances, OECD non-member countries energy balances
- World Energy Council: Energy Resources Review

(b) **Internet sites:**

- http://www.un.org/Depts/unsd
- http://www.iea.org
- http://www.worldenergy.org
- http://www.unece.org/ie/se.