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SEEA/Environmental accounting's user needs with regards to renewable energy

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Introduction

The main question from an environmental perspective with regards to energy commodities/products focuses on what is the information that is needed from the energy statistics to understand the environmental effects of energy use and production?

On the one hand measures such as energy intensity, energy savings and more effective use of energy are important indicators that are used to evaluate policies. On the other hand evaluations of the environmental impacts of certain infrastructures used in the supply and use of energy products/commodities need to be made. And identifying the trade offs between different energy mixes in an economy can also be of interest. To make these types of analyses information regarding the energy supply and use in the economy needs to be available and especially with regards to the sources of production and for example the transformation of energy from one type (fossil/biofuels) to another (thermal or electricity).

To answer questions about energy use and environmental consequences it is necessary to know about the use of energy products/commodities broken down by industry and by the different energy products/commodities and see how this changes over time. Identifying changes over time in the energy mix for a country or an industry together with information regarding specific environmental consequences of the energy use – for ex. fossil energy leads to CO_2 and other types of emissions, hydropower leads to loss of biodiversity (for ex. fish kill, loss/change of land area use, CH_4 emissions from newly submerged organic matter, etc.), wind power leads to loss of birds/migrating birds and landscape, biodiesel requires additional crops, land use changes, potential increases in oil palm plantations in previous rainforest areas, etc. – can be used to identify the changes in the environmental consequences and trade offs when there is a shift in use from one energy commodity to another.

[1] The authors would like to thank colleagues from the Division of national accounts and the Division for energy and industrial production statistics and Mr. Olav Ljones, Director of Economic Statistics, for their helpful comments in the preparation of this paper.

In addition to the general industry and energy commodities breakdowns, there is also a need to identify the 'green' portion of some types of energy commodities, for example, 'clean' electricity production/use and biofuels as a portion of total transportation fuels. This type of breakdown is not so common to find in current statistical systems.

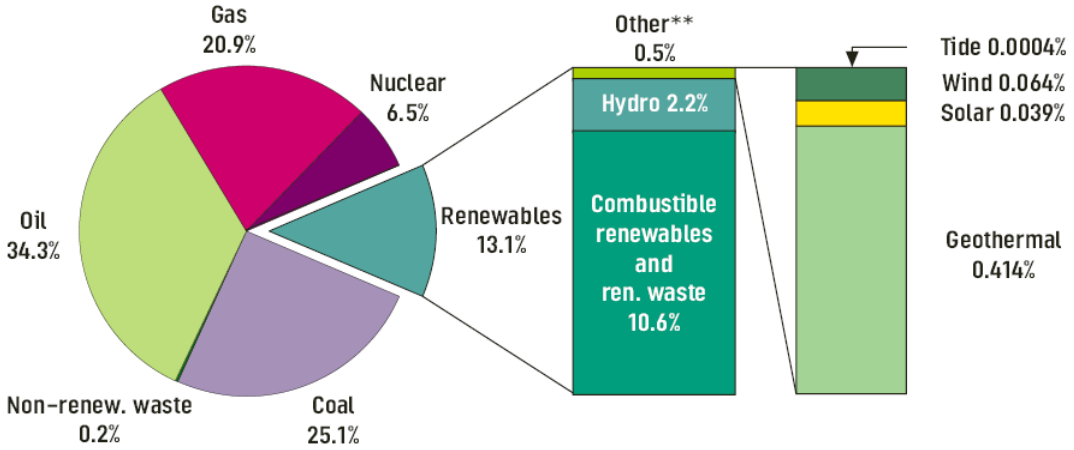
The need for identifying "cleaner" production and use systems of energy commodities has been enforced as the needs for industries to decrease their emissions to air have grown stronger. Therefore, the focus in this paper will be put on emissions to air as an environmental effect of energy production and use. The environmental accounts user needs with respects to renewable energy will be discussed.

General improvements to energy statistics such as including energy related ancillary activities[2] and including production for own final use[3] are not the focus of this paper. Here the focus is specifically on the environmental accounts needs with respect to renewable energy and to try to identify areas that should show consistency between different statistics such as waste statistics and energy statistics with regards to waste used for energy production.

Renewable energy as part of world total primary energy supply: Mouse or elephant?

Figure 1 shows data for 2004 from the IEA (International Energy Agency) showing that renewables were responsible for 13.1 per cent of the world's reported total primary energy supply (TPES) and of this portion, combustible renewables and renewable waste accounted for the majority (81 per cent of total renewables). Hydro accounted for 2.2 per cent of TPES whereas tidal, wind, solar and geothermal taken together accounted for only 0.5 per cent of TPES. The major portion of the use of renewables comes from renewable waste and solid biofuels such as wood, charcoal, and dried animal dung which are used to a large extent in developing countries in non-commercial applications such as household cooking and heating.

Figure 1. 2004 Fuel shares of world total primary energy supply*



*Total primary energy supply (TPES) is calculated using the IEA conventions (physical energy content methodology). It includes international marine bunkers and excludes electricity/heat trade. The figures include both commercial and non-commercial energy.
** Geothermal, solar, wind, tide/wave/ocean. Totals in graph might not add up due to rounding.
Source: Renewables in global energy supply: An IEA Fact Sheet, page 3.

[2] Ancillary activities are supporting activities undertaken within an enterprise in order to create the conditions within which the principal or secondary activities can be carried out. For example the use of biogas from a waste water treatment plant that is used to produce electricity that is in turn used to cover part of the energy use in the waste water treatment plant instead of purchasing its total electricity requirements from the power grid.

[3] This typically refers to energy products that are gathered by households that are not obtained or purchased on the market, for example wood gathering and drying and burning animal dung.

In some countries' statistical systems non-renewable waste is also classified as part of renewables often because it is difficult to separate the non-renewable portion of the total waste amounts used in energy production. If this wider definition is used, then the portion of TPES coming from renewables including all types of waste increases to 13.3 per cent of TPES.

If an increased focus on renewable energy from tidal, wind, solar and geothermal is important from an environmental accounts perspective, the context and size of these different energy sources needs to be considered. Although these are important from an environmental perspective, these are only of minor importance (0.5 per cent of TPES) when considering where to make improvements to the overall system of energy statistics. The errors in the data for oil, coal, and natural gas statistics can easily out-weigh any improvements made in this portion of the renewables statistics.

The issue of data quality should be kept in mind when focusing on only these minor types of renewable energy – renewables are a minor component and wind, tidal, solar and geothermal are only a very small proportion on a global perspective. In industrialized countries these types of energy commodities may be more important and worth extra focus in the data collection. In developing countries one of the big challenges is to improve the quality of the data for combustible renewables. Much of this energy arises from outside the market since it is often gathered/obtained by households for own final use and is not included in industrial production statistics.

Distinguishing between the amounts of renewable energy that enter the market and the amount that is obtained by households for own final use is important when combining energy statistics with the economic statistics from the national accounts.

Identifying changes in energy use and identifying the environmental needs in the renewable energy classifications

Although renewables are only a small part of the overall energy supply picture, it is expected that these sources will become more important in the future and to be able to identify and track these changes happening in the future will be important. To be able to observe changes over time, categories for energy production and use for both renewables and non-renewables are important. If only total amounts of energy production and use are available then it is not possible to observe the changes in the energy mix as these develop over time.

Already there is a demand for identifying the amount of total electricity production (and use) that comes from 'clean' or 'green' production systems such as hydro, wind, tidal, and solar. This distinction will also be important in the import and export statistics for electricity.

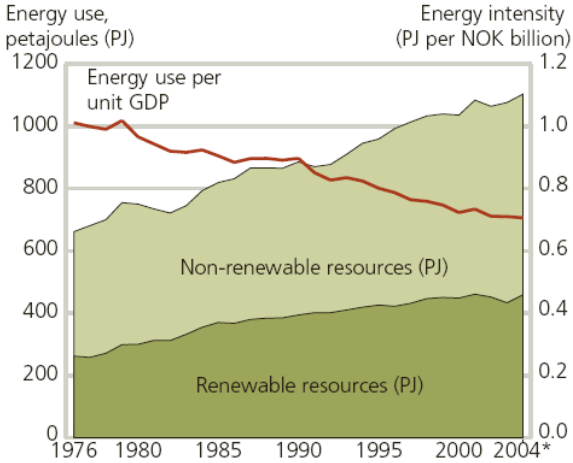
The amount of liquid biofuels used in transportation fuels will also be important information to develop. Some European countries (The Netherlands, Germany and the UK) have developed national biomass action plans and the EU has set targets of 20 per cent renewable energy and 10 per cent biofuels targets by 2020. The focus on the amounts of liquid biofuels to be used in transportation fuels is also a separate goal so appropriate statistical classifications need to be developed to track the development of these types of energy commodities.

Changes over time regarding the energy commodity mix are also important. To be able to identify how and when there are switches between the use of different types of energy commodities requires that the energy commodity classifications are stable over time and are detailed enough to show when there is a switch between different types of energy commodities that have different types of environmental consequences (air emissions, biodiversity impacts, etc.).

Currently there is a need to report energy use that results in air emissions and total energy use in the 2006 NAMEA-air reporting tables to Eurostat. NAMEA reporting in this context focuses on the use side of energy and splitting energy use into emissions and non-emissions categories.

Distinctions between renewable and non-renewable energy in national totals are also important as the following Norwegian sustainable development indicator shows:

Figure 2. Energy use per unit GDP[1] and total energy use (PJ) for renewable and non-renewable energy sources. 1976-2004*



[1] GDP at constant 2002 prices.
Source: Statistics Norway.

In this case it is important to identify which national energy commodities are considered "renewable" and use this consistently over time.

To be able to construct these types of indicators it is important to have the necessary types of detail in the basic statistics. Identifying what details in the classification systems are needed will be discussed in the following section.

Evaluation of existing renewable energy classifications in view of environmental accounts classification systems

The Renewable Energy Working Party of the International Energy Agency set down the following broad definition:

> Renewable Energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly or indirectly from the sun, or from heat generated deep within the earth. Included in the definition is energy generated from solar, wind, biomass, geothermal, hydropower and ocean resources, and biofuels and hydrogen derived from renewable resources. (IEA 2007b, Page vii)

Renewable energy commodity categories

The IEA/Eurostat questionnaire uses this definition and includes the following renewable energy commodities: hydro (large, medium and small), geothermal, solar photovoltaic, solar thermal, tide, wave, ocean, wind, solid biomass, gases from biomass, liquid biomass and renewable municipal waste. See box below for more details about renewable energy commodity categories.

And excludes the following: industrial waste, non-renewable municipal waste, nonspecified combustible renewables and waste, waste heat, net heat 'created' due to heat pumps, and electricity

generated with hydro pumped storage. Industrial waste, non-renewable municipal waste and nonspecified combustible renewables and waste are excluded from the category "renewables" largely because they are not biodegradable.

Renewable energy commodity categories

Combustible Renewables and Waste (CRW)*:

Solid Biomass: Covers organic, non-fossil material of biological origin which may be used as fuel for heat production or electricity generation.

***Wood, Wood Waste, Other Solid Waste*:** Covers purpose-grown energy crops (poplar, willow etc.), a multitude of woody materials generated by an industrial process (wood/paper industry in particular) or provided directly by forestry and agriculture (firewood, wood chips, bark, sawdust, shavings, chips, black liquor etc.) as well as wastes such as straw, rice husks, nut shells, poultry litter, crushed grape dregs etc.

Charcoal: Covers the solid residue of the destructive distillation and pyrolysis of wood and other vegetal material.

Biogas: Gases composed principally of methane and carbon dioxide produced by anaerobic digestion of biomass and combusted to produce heat and/or power.

Liquid Biofuels: Bio-based liquid fuel from biomass transformation, mainly used in transportation applications.

***Municipal Waste (renewables)**:* Municipal waste energy comprises wastes produced by the residential, commercial and public services sectors and incinerated in specific installations to produce heat and/or power. The renewable energy portion is defined by the energy value of combusted biodegradable material.

Hydropower: Potential and kinetic energy of water converted into electricity in hydroelectric plants. It includes large as well as small hydro, regardless of the size of the plants.

Geothermal Energy: Energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam. It is exploited at suitable sites for electricity generation after transformation, or directly as heat for district heating, agriculture, etc.

Solar Energy: Solar radiation exploited for hot water production and electricity generation. Does not account for passive solar energy for direct heating, cooling and lighting of dwellings or other.

Wind Energy: Kinetic energy of wind exploited for electricity generation in wind turbines.

Tide/Wave/Ocean Energy: Mechanical energy derived from tidal movement, wave motion or ocean current, and exploited for electricity generation.

*Some of the waste (the non-biodegradable part of the waste) is not considered renewables as such. However, proper breakdown between renewables and non-renewables is not always available.

Source: IEA (2007a) Renewables Fact Sheet – page 23

All other energy commodities not in the list in the box are considered to be non-renewable according to the IEA definition.

Here the classification of these non-renewable wastes can be seen as being treated slightly differently from how this type of waste is classified in waste statistics with regards to "recycling." In waste statistics if the waste is incinerated and the energy from the incineration is used in district heating or in the generation of electricity then the waste amounts used for this type of energy production is classified as "recycled." If the incinerated waste is not part of a system to produce useable forms of energy then it is not classified as having been recycled. Because of these definitional differences it would be difficult to combine the information of renewable and non-renewable waste from an energy perspective with the recycled and non-recycled waste from a waste statistics perspective. However there should be a correspondence between the amounts of waste incinerated in the national waste statistics and the total of renewable and non-renewable waste from the energy statistics.

It is also important to keep in mind that although the energy statistics definition of renewable vs. non-renewable waste may be theoretically correct, it is not always possible to observe or measure the renewable or non-renewable amounts of waste so that often the figures reported are only estimates.

Again, distinguishing between the amounts of renewable energy commodities that enter the market and the amount that is obtained by households for own final use is important when combining energy statistics with the economic statistics from the national accounts. Improving the coverage of the energy statistics dealing with these types of energy commodities obtained and used by households is of particular importance in developing countries.

The only apparent problem with regards to this classification appears to be the problem with renewable vs. non-renewable waste which is already recognized in the energy statistics and the consistency between waste statistics and the energy statistics covering waste.

Three groups of flows vs. first and second generation bioenergy vs. first, second and third generation technologies

There is some confusing terminology regarding definitions of technologies and fuels to be found in energy statistics and the use of these statistics. This is an area that the Oslo Group for Energy Statistics is actively working. Since this group is not finished its deliberations with regards to terminology some observations from an environmental accounts perspective maybe helpful to their work.

In the IEA/OECD-Eurostat-UNECE manual (2005) renewables are classified into three groups according to how the energy flows into the energy supply.

> *Group I:* includes products which need to be transformed into electricity in order to be captured (such as hydro or solar photovoltaic).
> *Group II:* includes products which are produced and then can be input for multiple uses in the transformation and final consumption sectors (such as geothermal or solar thermal). Because of their nature, these products cannot be stored in a conventional sense, and therefore are production for which no stock data can be reported.
> *Group III:* includes products which are produced and used for multiple purposes in the transformation and final consumption sectors (such as wastes, fuelwood, biogas and liquid biofuels). Because of their nature they can be stored in a conventional sense and are products for which stock change data can be reported.

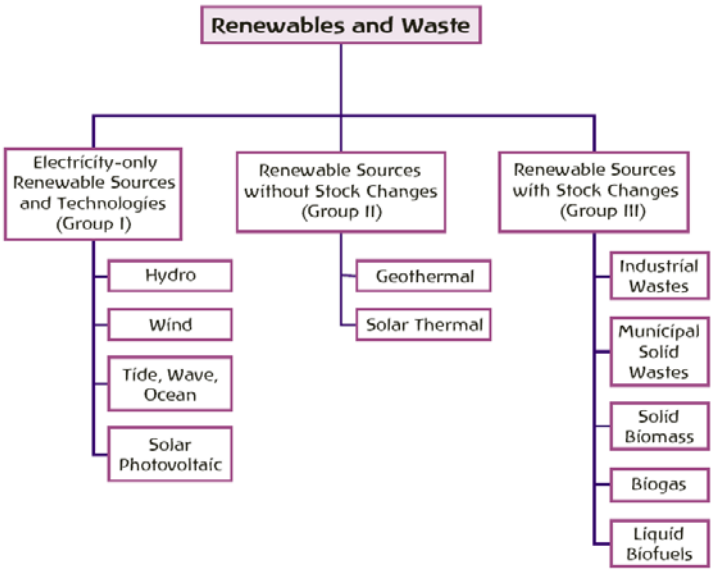
The following IEA/OECD-Eurostat-UNECE figure shows these 3 categories. The figure does not make it clear however, if there is one or two steps in this system. It appears that there is only one step and that there is a clear method for classifying into the three groupings. But in reality the classification is first a split between electricity-only (Group I) vs. renewables that can lead to electricity production and other types of energy such as heat (Groups II and III) and then this second grouping (Group II and III) are split into energy sources that can (Group III) and cannot (Group II) have changes in stock/inventory.

Another issue relates to the treatment of water reserve basins used for hydro power generation. Without these water reserve basins the possibility for generating electricity is greatly reduced. Therefore hydro could also be considered part of Group III if this is a one step classification since there are stock changes with respect to the level of the water in the water reserves basins. So this Group I-II-III classification has some problems especially with regards to how to classify and treat water reserve basins.

This also points out that the boundary between assets and flows for renewable energy is not clear. Water reserve basins and forests could be considered “renewable energy resource assets” and exactly how to include these assets into energy assets is not clear. Without these energy-rich renewable assets the energy flows from these sources are not possible therefore they are energy assets. The problem however, is that these assets are used for other purposes as well such as wood for building materials and irrigation and drinking water.

This problem illustrates that there is an overlap between the energy assets, water assets and forestry assets and how the different system boundaries are defined. These three asset accounting systems need to be coordinated to avoid double counting but at the same time reflect the asset base properly. If the forest accounts show that some of the harvested wood is used for energy production then those amounts need to be the same as the amounts of wood shown as being used in the energy statistics.

Figure 3. Renewables and waste classification into 3 Groups



Source: IEA/OECD-Eurostat-UNECE (2005), page 116.

There is also a difference in the terminology between the national accounts and the energy statistics with regards to the terms stocks/inventories/reserves.

The IEA website also has a definitions section which is informative and gives more details regarding specific renewable energy commodities/products (http://www.iea.org/Textbase/stats/defs/sources/renew.htm).

On the other hand UN-Energy has more of a technology focus and uses the term bioenergy and defines it as "biomass that may be burned directly or further processed into densified and dried solid fuels or converted into liquids or gaseous fuels using so-called first- or second-generation technologies. 'First-generation' fuels refer to biofuels made from sugar, starch, vegetable oil or animal fats using convention technology. 'Second-generation' fuels are made from lignocellulosic biomass feedstock using advanced technical processes" (http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf).

This distinction is also apparently used by the EU (see for example http://www.euractiv.com/en/energy/biofuels-generation/article-165951):

> Generally, a distinction is made between **first-generation biofuels** (mainly produced from crops such as sugar beet and rapeseed and include vegetable oil, biodiesel, bioalcohol, butanol, bioethanol, biomethanol, biogas, solid biofuels – wood, charcoal, excrement) and **second-generation biofuels** (from ligno-cellulosic or 'woody' sources and via new technologies to convert biomass to liquid (BTL)). The two main first-generation biofuels are bio-ethanol and bio-diesel.

Given the goals set by the EU regarding biofuels amounts in transportation fuels, this way of classifying biofuels may be important in the future.

In contrast the IEA classifies renewables according to technologies in the following way:

> *First generation technologies:* hydropower, biomass combustion and geothermal power and heat.
> *Second generation technologies:* include solar heating and cooling, wind power, modern forms of bioenergy and solar photovoltaics which are now entering the markets.
> *Third generation technologies:* still under development and include concentrating solar power, ocean energy, enhanced geothermal systems and integrated bioenergy systems.

These different ways of looking at the connection between energy commodities and technology or energy commodities and how it enters into the energy supply can be confusing.

Liquid biofuels

There is an increasing interest in liquid biofuels especially with the implementation of specific biofuel goals set by governments, for example, at the March 2007 European Council, EU leaders committed to raising the share of biofuels in transport to 10 per cent by 2020.

However, it has been noted in a communication from the Council of the European Union regarding the EU strategy for biofuels that:

> "As there is no specific customs classification for biofuels, the exact amount of imported ethanol, oilseeds and vegetable oil ultimately used in the transport sector cannot be quantified.
>
> The Commission will assess the advantages and disadvantages, as well as the legal implications, of putting forward a proposal for separate nomenclature codes for biofuels.[16]
>
> [16]This assessment will have to specify whether the focus should be on CN codes (internal EU) or on international HS codes. Creating a new HS code requires international negotiation, while a new CN code may be appropriate for EU statistical purposes."
>
> Page 14, Brussels, 8.2.2006, COM(2006) 34 final, Communication from the Commission: An EU Strategy for Biofuels

The only apparent information about biofuels comes from the production side and figures for biodiesel and bioethanol in the EU and world production of bioethanol are presented in Annex 4 of the strategy.

In addition to this critique of the current HS and related CN classification systems the EU strategy document also includes the following glossary of biofuels which could be interpreted as some type of classification system that will need to be combined and coordinated with the HS and CN classification systems:

Biofuels Glossary

Biofuel	Liquid or gaseous fuel for transport produced from biomass
Biomass	Biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste
Synthetic biofuels	Synthetic hydrocarbons or mixtures of synthetic hydrocarbons produced from biomass, e.g. SynGas produced from gasification of forestry biomass or SynDiesel
Liquid biofuels	
Bioethanol	Ethanol produced from biomass and/or the biodegradable fraction of waste, for use as biofuel E5 contains 5% ethanol and 95% petrol E85 contains 85% ethanol and 15% petrol

Biodiesel	A methyl-ester produced from vegetable oil, animal oil or recycled fats and oils of diesel quality, for use as biofuel (PME, RME, FAME). B5 is a blend of petroleum-based diesel (95%) and biodiesel (5%) B30 is a blend of petroleum-based diesel (70%) and biodiesel (30%) B100 is non-blended biodiesel
Biomethanol	Methanol produced from biomass, for use as biofuel
Bio-ETBE	Ethyl-Tertio-Butyl-Ether produced from bioethanol. ETBE is used as a fuel additive to increase the octane rating and reduce knocking. The percentage volume of bio-ETBE calculated as biofuel is 47%.
Bio-MTBE	Methyl-Tertio-Butyl-Ether produced from biomethanol. MTBE is used as a fuel additive to increase the octane rating and reduce knocking. The percentage volume of bio-MTBE calculated as biofuel is 36%.
BtL	Biomass to liquid
Pure vegetable oil	Oil produced from oil plants through pressing, extraction or comparable procedures, crude or refined but chemically unmodified, which can be used as biofuel when compatible with the type of engine involved and the corresponding emission requirements.
Gaseous biofuels	
Bio-DME	Dimethylether produced from biomass, for use as biofuel
Biogas	A fuel gas produced from biomass and/or the biodegradable fraction of waste, which can be purified to natural gas quality for use as biofuel or wood gas.
Biohydrogen	Hydrogen produced from biomass and/or the biodegradable fraction of waste for use as biofuel.
Other renewable fuels	
	Renewable fuels other than biofuels which originate from renewable energy sources as defined in Directive 2001/77/EC and are used for transport purposes

Annex 1, Page 18, Brussels, 8.2.2006, COM(2006) 34 final, Communication from the Commission: An EU Strategy for Biofuels

Unfortunately it is not always possible to accommodate the needs of a specific user of a classification system. It becomes particularly difficult when groupings are determined in a political sense – such as the definition of 'other renewable fuels used for transport purposes' based on a European Commission Directive.

In the current Harmonised System (HS) for traded goods, biofuels are "hidden" in the chapters covering "Beverages, spirits & vinegar" (chapter 22) and " Miscellaneous chemical products" (chapter 38):

- Bioethanol denatured HS Code 22072000
- Bioethanol undenatured HS Code 22071000
- Biodiesel HS Code 38249099

There are several fora that are involved in discussing these categories, for example a Eurostat working group on renewable energy which first met in December 2007. There is also trade statisticians involved in these discussions as well as the Oslo Group. The London Group should coordinate with these other working groups and specify our user needs so that revisions that are proposed from these working groups also take into account the needs from an environmental accounts perspective.

The product classification systems such as HS/CPA/SITC are updated occasionally to include new products. With new biofuels coming on the market, these need to be included in these various product classification systems and preferably in a way that makes the identification of these biofuels easy to separate from other related products.

"Clean/Green/emissions free" electricity production, use, imports and exports

Clean/green or emissions free electricity production, consumption, imports and exports are all of interest from an environmental perspective and source information for the production and for imported electricity is required reporting by electricity suppliers to final customers in a European Parliament and Council directive. In addition, member states need to ensure that the information provided is reliable.

The European Electricity Directive 2003/54/EC of 26 June 2003 concerning common rules for the internal market in electricity includes required declaration of source information to customers from suppliers in Article 3, Paragraph 6:

> Member States shall ensure that electricity suppliers specify in or with the bills and in promotional materials made available to final customers:
>
> a) the contribution of each energy source to the overall fuel mix of the supplier over the preceding year;
>
> b) at least the reference to existing reference sources, such as web-pages, where information on the environmental impact, in terms of at least emissions of CO_2 and the radioactive waste resulting from the electricity produced by the overall fuel mix of the supplier over the preceding year is publicly available.
>
> With respect to electricity obtained via an electricity exchange or imported from an undertaking situated outside the Community, aggregate figures provided by the exchange or the undertaking in question over the preceding year maybe used.
>
> Member States shall take the necessary steps to ensure that the information provided by suppliers to their customers pursuant to this Article is reliable.
>
> Source: http://eur-lex.europa.eu/LexUriServ/site/en/oj/2003/l_176/l_17620030715en00370055.pdf

At least in Europe, the source information should be available from electricity suppliers and could in principle be incorporated into the national statistics on electricity production and imports. This would lead to splitting the category of "electricity" into different categories, for example electricity produced from sources that do not produce air emissions such as hydro, wind, tide, wave, ocean, solar photovoltaic (i.e. Group I renewables) and from geothermal and solar thermal sources (i.e. Group II renewables) and from sources that do produce air emissions such as wastes, wood, charcoal, landfill gas, sewage sludge gas, other biogas and liquid biofuels (i.e. Group III renewables). This splitting is of interest within the NAMEA-system.

Conclusion

The terminology used with regards to renewables is confusing and needs to be harmonized. This harmonization and revision to the classification of renewables is an area in which the Oslo Group is actively working. The observations made in this paper from an environmental accounting perspective can be helpful input into this revision process of the Oslo Group.

Although the product classification, system boundaries, break down by institutional units are all important, as has been described in more detail in the SEEA-user needs London Group paper by Hass and Kolshus (2007), what is different with regards to renewables is the need to identify how the energy is produced and/or transformed.

The product classification systems (HS/CPA/SITC) need to be updated and potentially new categories developed for those renewables that can be defined as products, for example new types of biofuels (for example, biodiesel, bioethanol).

In addition to today's energy statistics, there is a need for further information regarding the sources used when producing various types of energy commodities. For example, electricity can be produced both using renewable or non-renewable sources. Only including the production and use of electricity in the energy statistics, as it is today, does not reveal information regarding how this energy commodity has been produced.

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