The energy balance system- Needs and possibilities for improvements

By Ann Christin Bøeng
Statistics Norway

I. Energy balances and energy accounts; one integrated system

The needs for the energy balances system

The purpose with the energy balance is to show in one table the supply, transformation and consumption of each energy bearer utilized in the country. The energy balance is among other things used as:

- Background information for energy planning,
- A source for calculating value figures for energy in the National Accounts,
- Basis for emission calculations,
- Input in energy related research and work with energy indicators
- Public information in general.

It is important that the energy balances gives a good picture of the countries' energy situation, and provide consistent time series for energy. It's also important that the information is as clear and unambiguous as possible, and that it contains all relevant aspects.

Two systems make it difficult to understand the tables

In Norway and perhaps also other countries, two similar kinds of energy balances are prepared and published simultaneously. We call it the energy balance / energy balance sheet[1] and energy account, and both are published since 1976. Both these systems show the physical flow of supply, energy transformation and consumption of the different energy bearers, but there are some differences in the principles and definitions.

The purpose with preparing and publishing two systems for the energy flow for a country is to serve different statistical needs. However, having two sets of energy balances confuse the users of the energy balance/accounts, and we spend much time on explaining the differences between these kinds of balances.

Equal input figures

The input figures in the energy account and energy balances are equal except from about 5 (big) figures that mainly concern the energy consumption in international shipping and air traffic. However, different principles and definitions imply that most of the consumption figures differ in these two types of balances.

Is it necessary to publish both?

We have had a critical review of our traditions for preparing both these type of energy balance systems. The two systems have both important, but partially different purposes. Its' not an alternative for us to just stop producing one of them because we don't want to loose any of the aspects. The energy accounts is mainly elaborated for getting a closer link between the National accounts and the energy statistics. However, information from both of the systems is in fact relevant for several similar purposes. Both tables are for example relevant for energy planning purposes and emission calculations. But there are difficult for the users to utilize the information from both the systems when they not fully understand the differences. The most appropriate solution from our point of view is to merge the information from both of them into one table.

[1] **The energy balance and energy balance sheet is the same system, but measured in different units. The unit in energy balance is Petajoule (also GWh since 2006) while the energy balance sheet is measured in the energy bearers natural unit, (tonnes for oil products, GWh for electricity etc.)**

Principles in the energy accounts:
The energy account follows the energy consumption in Norwegian economic activity in the same way as the National accounts. Energy used by enterprises and households in Norway, excl. foreign transport industries and tourists, is to be included. Energy used by Norwegian transport trades and tourists' abroad is also included. Both the energy balance and energy accounts follow an aggregated version of the NACE classification for economic activity.

Background for the energy accounts

- The background for the energy account is that we wanted to have a closer link between the energy balance and the National Accounts.
- The energy account was originally a claim from the Research Department in Statistics Norway. They use figures from both the National accounts and energy accounts in their economic models for making analyses, and it is important that these systems are consistent.
- Figures from the energy accounts are used in emission calculations because it gives necessary information about energy used as raw materials and for transport purposes by sector.
- The energy account is suitable for preparing energy indicators, as energy consumption per unit of the value added, because these energy figures in principle are consistent with the figures from the National accounts.

Differences between the energy balance and energy accounts

- The energy sources balances sheet follows the flow of energy within the country, and is set up according to international recommendations. It is therefore used for international reporting of energy statistics. The figures in the energy balance include energy sold and used in the country, regardless of the user's nationality. Energy used by Norwegian transport trades and tourists' abroad is not included, while this is included in the energy accounts. This involves different figures in the energy sources balance sheet and the energy account, mainly for international aviation and shipping.

- Different treatment of energy used for transport, and for non-energy purposes (use of energy bearing raw materials) is another source for discrepancies between the energy balance and energy accounts. The energy accounts places energy on the sector that uses it, regardless of the consumption refers to transport, raw materials or stationary consumption. The energy balance place all energy used for transport on the transport sector. Energy used as raw materials is deducted from other energy consumption and shown in a separate row. In the Norwegian energy balance, this is excluded from the net domestic consumption of energy.

On the supply side in the energy accounts, most figures are the same as in the energy balance, but placed in a different succession and with different terminology. This does in fact not give any additional information; it is mainly another source for confusion.

We have tried to develop a system where information from both the energy balance system and energy accounts is merged in one table. A simplified version of this table is shown below.

Suggestion for a "merged" table:
This is a simplified model, and the energy products are not shown, only the suggested classification for supply and consumption of each fuel.

Supply side; Production+ imports, -exports, -bunkering, -stock changes ,- transformation+ production of derived energy bearers, - losses - statistical differences (as in the energy balance)

---

1. Net domestic consumption, everything included
- ***1.1 Energy used as raw material***
- ***1.2 Energy for transport purposes***

1.3 Stationary consumption

2. Total consumption including energy used for transport purposes and as raw materials, by sector
Industry,
Services,
Transport
Households

3. Energy used as raw materials (by sector)
The different industry sectors

4. Energy used for transport purposes (as in the energy balance)
Railway and subways
Land transport
Air transport
Coastal shipping

5. Total, stationary consumption by sector (excluding raw materials and transport)
Industry,
Services
Households

Additional lines in the table that cover the Energy account principles.
a. Direct purchased abroad
b. Foreign purchases in Norway
c. Total net domestic consumption, including direct purchases abroad, excluding foreign purchases in Norway
d. Total transport, including direct purchases abroad, excluding foreign purchases in Norway
Fishing
Ocean transport
Air transport

Explanation of the table:
Part 1-5
Figures for total energy consumption (also by purpose), are shown in part 1 in the table, while consumption by user groups is shown in part 2- 5. Part 2, "total energy consumption by sector" shows the energy account approach that distribute all the energy, including transport energy and raw materials, on sector as the energy accounts does.
Part 3- 5 in the table show energy used as raw materials, transport purposes and stationary energy consumption separately, as the energy balance does.

Total stationary consumption is total energy consumption excl. energy used for transport and raw material, and is widely use for analyses purposes. This cover energy for heating, lighting, electrical appliances, processes in the manufacturing industries etc., and is getting more affected of changes in energy prices, temperature, economic activity etc. than the other purposes.

Row a-d: The territorial boundary principle in energy accounts
Energy consumption that concerns the territorial boundaries in the energy accounts, are shown in some additional rows in the bottom of the table (row a-d). An alternative is to show these aspects in a smaller additional table that only contains these differences. However, this aspect affects only a few numbers. For Norway, these figures are the following: Marine gas oil in fishing and foreign shipping, heavy fuel oil used in foreign shipping and jet kerosene in air transport.

Row C shows the total consumption of energy when the territorial boundary principles in the energy account are used. By integrating these principles in the same table, one get a better understanding of why the consumption in the energy account approach differ from the energy balances approach, than if the tables are published separately.
Another factor, is that the figures for direct consumption abroad usually are very uncertain, and its' therefore proper to present this as additional information in the bottom of the table, with a footnote that explains the data source and uncertainty.

In principle, the energy accounts approach also affects energy consumption in households, because Norwegian tourists energy consumption abroad should be included, while foreign tourists in Norway should be deducted. In the Norwegian energy accounts, we have assumed that these figures are equal, and therefore, it doesn't imply any differences in the energy accounts and the balance.

Aggregation level in the table
The proposed table will become larger than in the present system, but hopefully easier to understand. To avoid a too large table it might be adequate to choose an aggregation level on the consumption figures that not are too detailed. In Norway, we have a Statistics bank, where its' possible to download detailed data. If the “merged energy balance / account” system is getting implemented in Norway, we will probably publish figures on a rather aggregated level in the annual releases of the energy balances, but give the users opportunity to download more detailed figures in the Statistics bank.

Is it relevant for other countries to set up a “merged energy balance / account” ?
Most countries and international organization do only set up one kind of energy balance. However, other countries have similar needs as Norway for energy statistics in emission calculations, National accounts, energy planning etc. Therefore, we assume that other countries also can benefit from integrating information that the energy accounts and energy balances provide, in their energy statistics. – If they not already have this information from other sources.

Relevance for developing countries - and their challenges

One of the aims for the Oslo group is to recommend energy statistics systems that can be used worldwide. Someone will perhaps ask it this system can be used in a country that is going to start from scratch in making energy statistics. We think it is possible to follow this system. A merged energy account / energy balances doesn’t require more data than the traditional energy balances approach (except from some few estimates on energy purchases abroad etc.) The detailing level in the energy balance will of course depend on the available input data, but a simpler variant of the table is possible to prepare for most countries.

Statistics Norway has long traditions for international statistical cooperation and statistical assistance in developing countries, and has among other things assisted developing countries on establishing a system for setting up the energy balances. From our experiences we have learned that much can be done with few data, if you have a good methodology. Many countries have good figures for production, imports and exports of energy are often available, while figures for consumption by user group are missing. By using the top-down method (from the supply-side) a rough total consumption figure can be calculated. But there will still be some "gaps" on the demand side in the balance.

II. Some other points for discussion concerning data input and methodology

The quality of the energy balance depends a great deal on the data input. Goods methods and principles are not always enough to guarantee a satisfactory quality of the balance
Some of the intention for the Oslo group is also to improve methods for collecting or calculating primary energy statistics, and to discuss how to treat new energy technologies etc. For some user groups, the most appropriate method is to use sample surveys for energy consumption. This, combined with register data, can be used to calculate the total consumption for the user group.

In some cases its' not possible to collect input data; and it has to be calculated. This is the case with f.ex. solar energy and energy from heat pumps. The following points are meant to be threads for discussion, and has also been mentioned on the Oslo groups' discussion forum / web-site on energy statistics.

Heat pumps. Heat pumps can transfer heat from natural sources like seawater, air, earth heat etc. Its' run by a high-grade energy source, usually electricity, and the heat pump normally gives and amount of energy equivalent to about 2 and 4 times the energy supply from the high-grade energy source. As energy prices rise, several invest in heat pumps - or other energy reduction efforts. Energy produced by heat pumps is usually not included in the energy statistics, but it reduces the needs for high-grade energy to heating purposes. It is interesting to study how much high-grade energy we save due to several heat pumps, but it is not obvious how this should be calculated. The energy from heat pumps depends on outdoor temperature, type of heat pump, capacity, how much it is used during the year and if it's used for cooling in the summer. It is therefore difficult to calculate this exactly.
However, if statistics for the number of, and total capacity in heat pumps installed in the country is available, this can be used as a basis for making a rough estimate of the energy savings (or "energy production") from heat pumps. Some countries (f.ex. Finland) include figures for this in their energy statistics. Another alternative is to study the development in electricity consumption together with changes in installed heat pump capacity in the country, and see if there is a connection.

Solar energy: Solar energy, as the use of sun collectors or solar cells, is an important part of the energy supply in some countries but only used in small degree in other countries. In countries where this is of minor importance its' often not included at all in the energy statistics. Should this be included independent of the importance for the total energy supply, and what is the best way to measure this?

Biomass: This is in large degree a non-commercial energy sources, and difficult to collect good data on. However, in many countries, it's the basic energy sources in households, and in order to get a good picture of the energy situation, its important to have good methods for calculating this.

Challenges in oil and gas statistics
Statistics for oil products is a challenge because of all the different oil types, as kerosene, light heating oil, gasoline, heavy fuel oil etc. The traditions for how to classify, aggregate and convert these products vary between countries and organizations. How should we classify f.ex. liquid petroleum gas (LPG)? Is it gas or oil? Is petrol coke an oil product or coke? In the Norwegian energy balance, this is classified as coke, while other classify this as an oil product. Is NGL crude oil or not? Some countries include lubricants in the energy statistics, while others don't. What should be the rule for this?
The basis units for oil products are usually tons. In the energy balance, it is converted to a joint unit (f.ex. joule or toe), on basis of a theoretical energy contents. These values vary between different oil fields, oil products, countries and organizations. Should the national figures for theoretical energy contents in oil products be harmonized, or is it correct that this vary in different countries?

Gross or net calorific values. According to international guidelines, energy consumption should be presented in net calorific values. Still, natural gas is often presented in gross value, probably because net values are more uncertain. The difference is about ten per cent, and the use of gross or net values is of great importance for the results.

For reflection
There are many challenges in the energy balances system both as regards to principles, methods and input data. A fully harmonization of the energy balance between countries and organizations is difficult, but a discussion of best methods is a good starting point for getting closer to this aim. The intention for the Oslo group is that the discussion can contribute to a new manual for energy statistics. A joint, more user-friendly manual with approved recommendations for the energy balances system, will hopefully also contribute to improved and more harmonized energy statistics in the countries.