Chapter 4b: Data Sources and data collection

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## Introduction

The aim of this chapter is to provide examples of typical data collection methods used for energy statistics. The choice of the specific data collection method to use depends on a number of factors including ‑ but not limited to ‑ data availability, human and financial resources. The clear identification of what needs to be collected and what needs to be disseminated, and the review of the necessary methodological concepts (together with the consistency with international and national standards) are important elements that lead to the choice of the data collection methods and instruments that best fit the purpose.

The actual choice of the data collection method is specific to the national situation. A review of the data already available in the country (whether or not in the same institution or in other institutions in the country) is often a first step. If data are already available and can be used for energy statistics, there is little justification to embark on a new data collection. It is important however to have information on how the data are collected (e.g. administrative data or existing statistical surveys) as it affects the fit to use for statistical purposes.

Classical examples include the use of administrative data from public or private registers or data collected through an existing survey designed for different purposes. A typical example of the latter are data on diesel consumption for agricultural purposes that are collected through an existing agricultural statistics survey. If this is the case, these data should be used in any way for several reasons such as resource saving or reduction of response burden.

If no data are available in the country from other sources and a new data collection method has to be put in place (whether adding questions to an existing survey or designing a new survey), additional work needs to be carried out to identify the respondents and the needed human and financial resources.

This chapter focuses on the description of four types of data collection methods typically used in energy statistics: administrative data, statistical surveys (censuses or sample surveys), modelling and in-situ measurements. The chapter provides examples of typical data collection methods used for specific types of energy statistics (for example, trade, consumption, production etc.).

## Data sources and data collection

Four types of data sources and data collection methods are distinguished in this section – in particular, administrative data, statistical surveys, modelling and in-situ measurements.

Administrative data refer to the set of data derived from an administrative source, that is by an “organisational unit responsible for implementing an administrative regulation (or group of regulations), for which the corresponding register of units and the transactions are viewed as a source of statistical data”.[[1]](#footnote-1)

Statistical surveys refer to both sample surveys and censuses. They refer to an investigation about the characteristics of a given population by means of collecting data from a sample of that population (sample survey) or from the whole population (census) and estimating their characteristics through the systematic use of statistical methodology. It should be noted that the census refers to a complete enumeration of the units in the population, which is usually expensive; however in energy statistics it is often a feasible option in the cases where the number of units in the population is low. This can be the case when looking at the refineries in countries where there are only a few and it may be more accurate to collect the data from all of them rather than from a sample.

Modelling here refers to the estimation of a variable/data item which cannot be measured directly, but is estimated based on measurable and observable data. A typical example is the estimation of the production of electricity through solar photovoltaic panels. Often this quantity is estimated based on the number of solar photovoltaic panel in use and average weather conditions.

In-situ measurement refers to techniques to collect detailed consumption data based on a measuring device which for example can be installed at the point of final consumption.

Each of these data sources has some advantages and disadvantages. Ideally the objective is to collect data by the most efficient means possible. Therefore if data are already available from an administrative source, or an existing survey (and they can be used for your purposes), then there would be no apparent need to embark on a new data collection process. If no such information of suitable quality is available then adding questions to existing surveys or a new survey could be considered. Often production of energy is a licensed activity, so production data may be available within administrative systems, and existing trade data collection may provide suitable information on energy imports and exports.

There is a clear trade-off between cost and quality; the larger the sample size, the more expensive, but the lower the standard error. Such decisions need to be based on the desired quality, though with reference to the available budget. If the population is fairly homogeneous then a smaller sample may suffice, whilst if heterogeneous then larger sample sizes will be required. In general, energy surveys are repeated so the sample sizes can be amended over time based on levels of variation among companies. In addition to the direct cost to the organisation, the response burden of the survey on the businesses should also be considered. This burden should be measured and minimised.

The frequency of data collection also needs to be considered. For example, if the same statistic is being measured on a monthly and annual basis – a smaller sample to produce the monthly data may be considered with a larger sample at the year end. Also it may be that only more restricted data, such as total usage of a fuel, is available on a monthly basis, while on an annual basis information may be sought by detailed industrial sectors.

For surveys on energy supply where in most cases the number of respondents is low and the competence of the respondents is high, censuses can be feasible solutions. In contrast, for final energy consumption, the population of (potential) respondents is huge and their knowledge on the topics mostly relatively low. Therefore for consumption sample surveys conducted as interviews may be the preferable solution.

Table 4.1 gives an overview of strengths and weaknesses of the discussed data sources.

**Table 4.1: Summary of advantages and disadvantages related to statistical techniques**

|  |  |  |
| --- | --- | --- |
|  | **Advantages** | **Disadvantages** |
| **Statistical Surveys** | * Comprehensive information on all fuels supplied and used
* Good data quality
* Can be used directly and as an input for model calculations
* Good response rates when surveys are covered by legislation
 | * Resource intensive and expensive
* Time consuming
* High survey burden
* If voluntary, response rates can be low
* Data validation required
* Reporting of non-metered fuels, often purchases not used
 |
| **Administrative data** | * Low survey burden
* Greater number of records allows more detailed breakdowns
* Avoids duplication by making use of existing data
* No sample error
 | * Dependency on third parties
* Definitions and information may not match statistical needs
* Often requires substantial effort to set up and may be legal barriers to use
 |
| **Modelling** | * Allows quantification of variables that which cannot be directly measured or observed
* Save resources (money and staff)
* Low survey burden
* Quick results
* Can be used to adapt or improve survey results
* Can be used to reduce survey frequency
 | * Worse data quality compared to surveys
* No Stand-alone methodology: cannot be calculated without input data
* Quality of results depend on accuracy of input data and the design of the model
 |
| **“In situ” measurements** | * Detailed information on individual appliances, information on patterns of use of the equipment
* High quality of the results
* Input data for surveys and/or modelling
 | * Invasive for respondents: difficulties in finding respondents willing to participate
* High burden in terms of time and human resources
* Expensive, so often small samples, and less representative
* Constraints in monitoring equipment: limitation in the number of metering devices and monitoring incidences
 |

It is often the case that different data sources are used to collect different types of data in energy statistics. Table 4.2 shows the typical data sources used in energy statistics for different groups of data items.

**Table 4.2: Suitable instruments and respondents depending on
identified information needs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Information areas** | **Data collection methods** | **Data sources** | **Potential data observed** |
| **Energy supply: Primary production of solid, liquid and gaseous energy products** | administrative data | data owners | coal production  |
| crude oil production |
| census/ sample survey | entities in the mining industry (coal, oil, gas) | natural gas production |
| entities in the forestry, agriculture or other related industries | biofuel production |
| **Energy supply:****Primary electricity, primary heat** | administrative data | data owners | electricity generation from hydro, wind, tide, etc. |
| geothermal heat |
| census/sample survey | entities in the energy industries[[2]](#footnote-2) | heat from chemical processes |
| other energy producers |  |
| **Energy supply:****Solar electricity, solar heat and ambient heat** | administrative data | data owners | solar heat production (metered) |
| PV electricity generation (metered) |
| census/sample survey | entities in the energy industries | electricity generated from solar heat (metered) |
| other energy producers |  |
| modelling | traders, installers | sales of solar heat and PV panels, and heat pumps[[3]](#footnote-3) |
| **Imports/exports** | customs data | customs/ministry of finance | imports by country of origin and exports by country of destination |
| census/sample survey | main importers/exporters |
| **Energy stocks****(levels and flows)** | administrative data | data owners | stock levels and flows for coal, oil, natural gas |
| census/sample survey | entities in the energy industries, | stock levels and flows for biofuels |
| other stock keeping entities (mining and big industrial entities) | water content of storage hydro power plants |
| **International Bunkers** | census | traders | sales to nondomestic ocean carriers and airlines  |
| domestic ocean carriers and airlines | use of fuels for international shipping and aviation |
| **Energy transformation and Secondary production****(**power-plants, CHP-plants, district heating plants, refineries…)[[4]](#footnote-4) | administrative data | data owners | transformation input/lossestransformation output |
| census/sample survey | entities in the energy industries |
| other energy producers |
| **Energy industry own use** | census/sample survey | entities in the energy industries | own use of energy products in energy industries |
| other energy producers |
| **Final consumption** | business data from energy industries | data owners, resellers/distributors | final energy consumption (incl. transport) |
| sample surveys | consumers[[5]](#footnote-5) | non energy consumption |
| **Energy prices** | census/sample survey | suppliers/traders or consumers | expenditures/costs/taxes |
| modelling |

# Administrative data sources[[6]](#footnote-6)

Administrative data means all data sets publicly or privately owned that are collected for non-statistical purposes. Examples of administrative data are public registers such as population or building registers, or private registers such as billing registers of electricity supply companies.

In many countries the legal background allows the institutions in charge with statistics to use such registers and apply legal force to obtain the data, at least from public registers. If legislation enables the use of administrative data, it can be a first choice data source for the following reasons:

1. Data are already available and will be available in the future
2. No additional resources for data collection are needed
3. No additional burden for respondents

On the other hand, there are some restrictions which should be noted:

1. The definitions used in the register normally do not match the definitions used in energy statistics
2. Periodicity may be different from that needed
3. Missing metadata

There are many potential sources of data that can be used, if not for producing statistics then at least for providing error-checking information, or for matching with other variables in order to make certain breakdowns. This could include administrative sources such as:

* Buildings register or cadastral register (may contain information on location, age, type of dwelling, and heating system)
* Renewable energy subsidy/grant register (often has information on the installed capacity and number of renewable energy installations in a given year)
* Database on Energy Performance of Buildings (may contain detailed information on heating equipment, insulation, and other energy efficiency characteristics) such as the one set up for EU Directive 2002/91/EC of buildings
* Sales records of vendors or manufacturers of appliances or heating equipment
* Records of insulation installed from insulation fitters for homes
* Records of chimneys swept
* Sales records of central heating and heat pump vendors or manufacturers
* Registry of premiums paid for scrapping/recycling of appliances
* Address register
* Population register
* Business register
* Taxation register

The energy-related variables that at the time of writing are collected from administrative sources in EU countries include:

* Annualised consumption of gas and electricity at household level
* Various aspects of energy performance of buildings (insulation, heating equipment, etc.)
* Housing stock characteristics (number of households, composition, dwelling types, etc.)

The use of administrative data sources often is combined with modelling, to adopt the information obtained from them to the format, reference period etc. needed.

**Use of administrative data in Statistics Canada**

Using administrative records presents a number of advantages to a statistical agency and to analysts. Administrative data, because they already exist, do not incur additional cost for data collection nor do they impose a further burden on respondents, provided the coverage and the conceptual framework of the administrative data are compatible with the target population or the collection of administrative data is not terminated.

On the other hand, one must be careful in using administrative data as there are a number of limitations to be aware of including (i) the level or the lack of quality control over the data, (ii) the possibility of having missing items or missing records (an incomplete file), (iii) the difference in concepts which might lead to bias problems, as well as coverage problems, (iv) the timeliness of the data (the collection of the data being out of the statistical agency’s control, it is possible that due to external events, part or all of the data might not be received on time), and (v) the cost that comes with administrative data: for instance, computer systems are needed to clean and complete the data in order to make it useful.

The use of administrative records may raise concerns about the privacy of the information when these are linked to other sources of data requiring agencies to provide all respondents with information on the confidentiality protection measures, the record linkage plans and the identity of the parties to any agreements to share the information provided by those respondents.

The use of administrative data may require the statistical agency to implement only a subset of the survey steps discussed in the other sections. Furthermore, any decisions related to the use of administrative data must be preceded by an assessment of such records in terms of their coverage, content, concepts and definitions, the quality assurance and control procedures put in place by the administrative program to ensure their quality, the frequency of the data, the timeliness in receiving the data by the statistical agency and the stability of the program over time. The cost of obtaining the administrative records is also a key factor in the decision to use such records

Source: Statistics Canada (2009). Statistics Canada Quality Guidelines. Statistics Canada, Fifth Edition, Ottawa. Available at <http://www.statcan.gc.ca/pub/12-539-x/2009001/administrative-administratives-eng.htm>.

***Country example Netherlands:*** *Use of the client registers for energy statistics: consumption by dwellings and businesses*

The basic idea behind the client registers project was to compile statistics on the consumption of electricity and gas by energy consumers for the overall energy balance, identifying consumption of households as well as of businesses by branch of industry. The client registers, however do not contain the information needed to determine if a connection is owned by a household or a business, let alone branch of industry.

In order to reach this goal the client registers are matched with a register of dwellings and the business register, using the address, postal code, house number, and house number suffix as a matching key[[7]](#footnote-7). While matching with the business register was obviously required to identify businesses, this also assisted in identifying false positives (about 2% of the positive matches in our case) in the population of household connections. From the beginning of the project it was clear that matching the client registers with the business register was the biggest challenge. Only about 50% of the business addresses initially matched to one or more addresses of connections in the client registers, both for electricity and for gas.

Matching the records of the client registers of electricity to the dwellings register is less problematic, although not straightforward. Not every match with the dwelling register is a dwelling, and some household connections do not match to the dwelling register (about 3% of the connections in our case). The biggest challenge is matching dwellings with unusual house number suffixes, followed by the challenges of identifying dwellings with block heating and businesses within dwellings. These challenges are explained in subsequent sections.

The dwellings register contains variables characterizing the dwellings, for example dwelling type (whether it is an apartment, a villa, etc.), province, town, town district and neighbourhood (see example in Table 4.2.2 and the graphical representation in Figure 4.2.2). This enables producing statistics on electricity and gas consumption, per dwelling type and quarter/neighbourhood. Statistics Netherlands does this since 2008.

From a base of knowing essentially only the name and address of each connection, Statistics Netherlands eventually succeeded in attributing household or branch of industry (21 branches at the highest level according to ISIC Rev.4) to >96% of all electricity and gas consumptions included in the client registers of 2010.

Table 1: Sample output: Average gas consumption (m3) of dwellings in Rotterdam Overschie

|  |
| --- |
| Year |
| By dwelling type |
| Apartment | Terraced (Row) | End-terraced (Corner) | Semi-detached | Detached |  |
| 2004 | 1300 | 1650 | 1950 | 2600 | 3500 |  |
| 2005 | . | . | . | . | . |  |
| 2006 | 1250 | 1600 | 1850 | 2350 | 3350 |  |
| 2007 | . | . | . | . | . |  |
| 2008 | 1300 | 1650 | 1950 | 2500 | 3250 |  |
| 2009 | 1250 | 1600 | 1950 | 2400 | 3300 |  |
| 2010 | 1550 | 1900 | 2300 | 2900 | 3600 |  |

*source:* [*http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=70904ned&D1=56-64&D2=10990&D3=0-6&HD=130123-1504&HDR=T&STB=G1,G2&P=T*](http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=70904ned&D1=56-64&D2=10990&D3=0-6&HD=130123-1504&HDR=T&STB=G1,G2&P=T) *.*

**Figure 1.:** Geomapping of data: average gas consumption of apartments



With this information in hand, local governments can target their efforts at reducing local energy consumption by quickly identifying the areas or buildings with the highest gas or electricity consumption (darker colours in the graphic).
*Source: Statistics Netherlands 2012.Based on statistical register of energy consumption of households.*

*The challenge of suffixes*

Matching addresses in the client files with those in other registers is not as trivial as was first thought initially; the matching rate for the dwellings was only about 80%, for a number of reasons.

The first one is that the addresses in the client registers may be wrong (e.g. non-existing in the postal code register) or simply different (e.g. where the names clearly indicate the same business) from addresses in the business or dwellings register.

More importantly, the addresses in the client registers are far from standardized. The address variables that uniquely identifies an address are postal code, house number and the suffix. But, in the client registers the suffix is used in many different ways. Common examples are A, B, C, 1, 2, 3, I, II, III, 1st fl, 2nd fl, 3rd fl., 015, 025, 035, but unusual cases also occur like ”next”, ”near”, ”across”, ”2 – 3”, but also ”garage”, or ”traction”, and even worse. These suffixes can hardly be expected to match with more standardized suffixes used in a dwellings or business register.

To overcome the problems, two important steps were taken:

* Standardisation of the suffix to the house number, for example by dropping characters like ”/”, changing all lower case characters into upper case, etc.
* Change the suffix in the client registers into ”blank” for those addresses that did not initially match and try to match again.

After these steps the matching rate was eventually improved to over 96%.

*The challenge of block and district heating*

For gas consumption it was a challenge to identify dwellings using block or district heating; each about 4% of all dwellings.

Block heating is the situation where a number of dwellings are heated by a shared heating system. Individual dwellings may either have their own gas connection, which is usually only used for cooking and may therefore have very low gas consumption, or have no gas connection at all. The problem with these dwellings is that the gas consumption of the households living there are underestimated because gas used for heating is attributed to another connection that may not even be considered a dwelling. To solve the problem information was used from the department of environmental and spatial statistics of Statistics Netherlands. They are able to provide information on the precise location of the blocks and of the addresses within these blocks (see Figure 4.2.3 below). In this way it is possible to identify blocks of dwellings according to two criteria for each block:

1. The block includes a number of individual dwellings with zero to very low gas consumption.
2. The block has one address, supposed to be the address(es) of the block heating system, with very high gas consumption.

With this information, the high quantity of gas can be redistributed over the dwellings with low gas consumption, resulting in more realistic gas consumptions reflecting the gas used for heating.

Knowing which dwellings make use of district heating is valuable primarily because it can explain why a particular area has very low gas consumption, which is valuable information for local policymakers. Identifying dwellings making use of district heating is relatively simple, and was achieved by matching the addresses in the register with a list received from the energy suppliers including all addresses receiving district heating.

*The challenge of identifying businesses in dwellings*

In about 3% of the dwellings there is also a business, and Statistics Netherlands excludes this from household consumption. Three separate steps were taken to identify these.

First, the customer name for each connection initially attributed to dwellings was scanned with text recognition software. By looking for common combinations of letters or words usually designating a business (such as B.V. in the Netherlands), many connections could be attributed to business users.

Second, each address was matched to another register, one used by local governments for the purpose of building taxation. This register contains information on the value of every building and crucially also a code designating the legal use/purpose of the building. The latter was used to identify business use.

Third, each address was matched to a register with data of small shops, bars and restaurants, enabling even more businesses to be excluded.

**Figure 2..:** Identifying dwellings using block heating by coupling connections with the dwellings register using Geographical Information Systems (GIS)



With information from the dwellings register, dwellings with zero gas consumption but within a building with one gas connection with a gas consumption many times that of a single household can be identified. These are then likely to share that single connection supplying the whole block with heat, and the gas consumption can be distributed among the individual households. This entire process can be automated.

 *Source: Statistics Netherlands 2012. (unpublished register information).*

*Plausibility checks*

During the studies doubts arose whether matches with a very low or very high electricity or gas consumption had to be accepted as consumption by households. It happened for example that the lighting of a bus shelter with a low kWh-consumption matched with an address in the dwellings register. And a very high consumption of electricity could be due to a business started in an ordinary house. It was therefore assumed that electricity consumption needed to be in a certain range in order to be considered as consumption of households. Initially a consumption greater than ten thousand kWh was excluded, but this was later adapted to exclude only the top 1% in each dwelling type category. No lower limit is used. For natural gas, consumption lower than 400 m3 would mostly be excluded, except for dwellings identified as users of district heating. As for electricity, the top 1% (by dwelling type) is excluded.

# Surveys[[8]](#footnote-8)

The terminus “survey” covers a wide range of activities starting with small scale data collection with only one respondent and very few data items e.g. production of coke oven coke in a country with only one coke oven operator, or a comprehensive survey on final energy consumption.

In designing a new survey a number of considerations should be taken into account such as formulating simple questions, identifying a clear structure for the questionnaire, providing incentives to potential respondents to join the survey voluntarily (even if there is a legal obligation), possibly including data validation checks in the questionnaire (e.g. to ask physical quantities and the corresponding expenditures), etc. While all these aspects are useful in the discussion of data sources for energy statistics, they are not addressed in this chapter: there is a vast literature on how to design a questionnaire and the reader is encouraged to review the XXX.

For new surveys special attention has to be given to the units used. Units that are used in billing, with which the respondents are familiar, should be preferred, e.g. in case of gasoline litre instead of kilogram. In cases where different units are commonly used in the markets (e.g. stere or kg in case of fuelwood) the respondent should have the possibility to choose the unit e.g. by ticking a respective box. The same method can be used to distinguish between gross and net expenditures for energy commodities as demonstrated in the country example below.

**Country example** for a well-accepted paper questionnaire by respondents used in Austria. The separation of distinct blocks with different colours assists the respondents to fill in the questionnaire correctly



For any cases in which surveys are necessary, two possibilities exist:

1. Adding additional questions to an already existing survey
2. Implementing a new survey

There are also some common rules which energy statisticians should recognize:

* Ask only the **must have** and eliminate the **nice to have**
* Keep the questionnaires and questions **as simple as possible**
* Ask only questions the respondents can answer
* Give the respondents a **comprehensive explanation** of why and for what the data is needed
* Be comprehensive **to fulfil all information** **needs** e.g. to compile energy balances and energy accounts
* Use **international classifications** as far as possible (ISIC, PRODCOM, CPA, CN)
* Implement elements for **data validation** e.g. ask quantities and expenditures or revenues, heated and cooled area in m²

Supply surveys are normally fuel specific surveys, which means they focus on a specific fuel e.g. electricity or on a closely linked fuel group characterised by a specific supplier e.g. refineries for oil products or coal mines for coal.

There are at least three good reasons to ask suppliers for data, whenever it is legally possible and the information requested can be provided:

* The respondents are familiar with the topic
* Data are often available in business registers
* The small population makes surveys cheaper

One problem linked with supply surveys is the danger of double counting due to resellers. Therefore questions on sales have to focus clearly on sales to final consumers. **Country example is needed!**

If more detailed information (e.g. consumption by economic sectors or by purpose) is needed, suppliers – normally energy industries – have no sufficient data and consumer surveys have to be conducted.

Consumption surveys typically focus on all energy carriers used by the specific target group the survey focus on e.g. manufacturing industry or private households. **Country example is needed!** Exceptions are detailed surveys on consumption purposes and consumption pattern of electricity in a specific sector. Such detailed data collection is restricted because it’s extremely expensive due to its complexity and the high effort of respondents care needed.

Energy use for *households* may come from energy suppliers (oil, electricity distributors etc.) or from household surveys. Results from the sample surveys could be grossed up by using population figures for households (if this exists) or for the total number of persons. Energy surveys for households are in some countries carried out as an additional survey to the household budget studies. Households often have reliable information on energy costs, but not on their energy use in physical units (e.g. kWh). Asking in the survey for receipts from the energy suppliers could therefore be necessary.

Country example: Austria: Electricity and natural gas consumption of households by purpose

The survey "Electricity and natural gas consumption of households by purpose" is a primary data collection. The voluntary survey covers the consumption of electricity and natural gas in private households, broken down by consumption purpose. With five questionnaires, the households recorded data about their electrical appliances equipment as well as data on space heating, water heating and lighting in three runs. A portable energy cost meter was given to the contributing households to measure the specific electrical consumption, and an allowance of 100 € was paid to every household, which filled in the five questionnaires. One third of the data was sent by email and two thirds were transferred by regular mail.

If sector specific energy consumption surveys are planned it is helpful to know the main end uses driving the consumption and the frequently used fuels of the respective sector. These drivers can be widely differ from sector to sector and region to region. For example, in a Central European Country some 80% of energy consumption of manufacturing industry is used for production while a similar share in the residential sector is used for space heating. In a country with tropical climate the industry sector may be similar but the main drivers for private households are completely different. For **country example of India see** <http://www.indiaenvironmentportal.org.in/files/file/Energy%20Sources%20of%20Indian%20Households.pdf>

If results from both supply and consumption surveys are available, their comparison is a good instrument for data validation and verification. This normally is the case for all traded energy carriers and is of outstanding importance for compiling energy balances and energy accounts. Fossil fuels like oil, coal and natural gas, as well as electricity and traded heat, can be checked sufficiently in this way.

For non-traded or on informal (grey) markets, traded energy carriers like biomass (e.g. wood, bagasse or dung) used by private households, or energetically used residuals from production processes of manufacturing industries, information is available only from consumer surveys. A further disadvantage of these kinds of fuels is their heterogeneous composition and water content, which can result in widely differing energy contents. This means that the collection of data with sufficient quality for these fuels is much more difficult. For a guidance concerning wood fuel surveys given by FAO see <http://www.fao.org/docrep/005/Y3779E/Y3779E00.HTM>

A detailed description of the problems linked to fuelwood and potential solutions are provided in the “[Quality standard for statistics on wood fuel consumption of households](http://www.ca-res.eu/index.php?id=244)” developed by Working group 2: Calculation Methodology of the Concerted Action on Renewable Energy Sources (CA-RES).

In gathering data on stocks, it is important to note that stocks may be held by producers, importers, governments, industries, and other consumers. However, it may not be possible to collect stock data from all consumers. Since it is often difficult to measure the stock level and stock changes held by consumers, stock changes should at least be collected from large producers, such as oil companies and refineries. Stocks for coal, coke and petroleum coke could also be collected from large industrial consumers of coal.

When surveying data on energy prices, it should be noted if the prices have to be reported on a net or gross basis, and which price components have to be reported separately if necessary (e.g. fuel specific taxes, recoverable taxes, network fees, metering fees). Furthermore it makes sense to focus of specific energy carriers e.g. for electricity or natural gas on the respective supply companies or of groups of fuels by origin (e.g. for oil products on refineries) or use (e.g. transport fuels on filling station operators).

Last but not least one should be aware that a survey has to be conducted at least three times to obtain reliable results. The first data collection gives obviously good results in any way, because no comparable information is available. The second survey cycle – especially in case of sample surveys – often delivers contradictory results and at least a third cycle is needed to resolve the problems. In the case of the household energy consumption survey in Austria (see country example below) four survey cycles were needed to establish a satisfying data validation procedure.

**Additional questions to existing surveys**

This solution will be a good choice if the information needed is specific with restricted data volume, the complexity is low (self-explaining questions), or a specific target group should be surveyed, e.g. the residential sector.

It is cheaper than an exclusive survey and the respondent burden is normally lower. Typical widespread surveys that can be used to implement specific energy consumption related questions are household expenditure surveys or agricultural censuses.

*Country example*

***Austria:*** *Implementation of the voluntary household energy consumption survey as an integrated module into the obligatory labour force survey.*

*The Household Energy Consumption survey is an independent module with voluntary response, appended to the Labor Force Survey which is mandatory every second year. This, in turn, is collected 1/5 by Computer assisted personal interviews (CAPI, face to face) and 4/5 via a Computer assisted telephone interview (CATI). Since 2006 the energy consumption survey is conducted by CATI only. The energy data, supplemented with basic data from the Labor force survey such as size of dwelling and building, construction period of the building, heating system and number of persons living in the household are transmitted in electronic form upon completion of the survey.*

*The advantages in this case are the higher response rate (50 to 60%) and the lower costs compared to an independent household energy consumption survey.*

Other country cases

**UK?, Canada?, Australia?, Ghana?, Azerbaijan?, Sweden?, Denmark?, Finnland?, South Africa?, Russia?, India?, Norway?, Malaysia?, Ireland?, Netherlands?**

**Implementing a new survey**

**Surveys on energy supply and transformation**

Censuses are the best choice for surveys on energy supply and energy production because on the one hand the number of actors is normally manageable and on the other hand the actors often are not comparable, e.g. in the case of oil supply refineries with blenders, where grossing up procedures would produce wrong results.

**Energy consumption surveys**

As already mentioned above sample surveys normally are the choice for surveying energy consumption, because of the large number of potential respondents.

*Country example:*

***Azerbaijan*** *household energy consumption survey*

*The State Statistical Committee of the Republic of Azerbaijan conducts sample surveys among 18.5 thousand households since 2007 for the purpose to study the processes in energy sector of the country and reflect energy real consumption and the volume of energy consumed by households in consumption sector of energy balance.*

*The sample survey questionnaire consists of 38 questions. Here the indicators on quantity and value of electricity, natural gas, liquefied petroleum gases, wood (for heating purpose), wood coal, kerosene, diesel fuel, motor gasoline, local boiler houses and other items consumed for centralized heating are covered.*

*The survey covers proportionally all regions of the country based on quarterly random sample. The data for last three months are indicated in the questionnaire separately by months.*

*The survey results were used for compilation of energy balance. The provided information on consumption was précised based on current survey and used for balance compilation.*

Country example

Germany: Panel survey: Energy consumption of private households

In an on-going effort to establish an energy panel in Germany, the most recent documented survey covers the energy consumption of approximately 7,000 households nationwide for the years 2009 and 2010, with earlier survey waves covering the years since 2003. Data for the years 2011 and 2012 will be gathered at the outset of 2014, with additional improvements on the questionnaire and survey design currently in progress.

The samples of participating households are drawn from the population of German-speaking residents aged 14 to 69, with the aim of assembling a representative panel.

Each participating household is equipped with an interface that projects the questions on the respondent’s television screen and allows an easy implementation of complex questionnaires by filter techniques and visual assistance. Respondents may answer the questions at any time of their choosing; they are not under time pressure and are not obligated to complete the questionnaire in a single session. The forsa tool, which immediately saves the collected information on a server, further allows for automatic consistency and validity checks during the data input by the participant. This ensures that the collected data is of high quality.

The survey gathers information about the energy consumption of various fuels of private households as well as the corresponding expenditures. In addition, households also disclose the use of renewable energies, socio-economic characteristics, and their ownership of electrical appliances.

With a participation rate of approximately 70%, the often encountered problem of a low participation rate poses no issue. However, there exist two groups of survey participants for which we seek to improve the number of observations: low income households and households that predominantly employ district heating.

Other country cases

**UK?, Canada?, Australia?, Ghana?, Azerbaijan?, Sweden?, Denmark?, Finnland?, South Africa?, Russia?, India?, Norway?, Malaysia?, Ireland?, Netherlands?**

# Modelling

Besides the use of already existing information, modelling is another possibility to reduce costs – especially with energy consumption surveys – either by lowering survey frequency or by reducing extent and complexity of a data collection exercise by using additional sources to obtain all information needed.

Because of the complexity of energy consumption, the responses have to be validated intensively and carefully. Such data validation/adjustments are normally based on default values that are used to check the reliability of the responses. Therefore it can be stated that the survey is the first step, and **a model based** data validation is the necessary second step to get realistic consumption figures, as shown in the example of Austria.

Other typical cases for modeling beneath data validation are[[9]](#footnote-9):

* consumption breakdown by purpose if a fuel is used for more than one purpose (e.g. electricity)
* fuel shares if more than one fuel are used for one purpose (e.g. for space heating)

Austrian model based data validation procedure for the household energy consumption survey

The new approach for model based data validation was implemented the first time in 2004. Up to and including the 2000 survey, only the individual energy sources themselves were checked for plausibility, any missing data were calculated (quantity-value pairs) and substitutions were made if necessary. Such routines continue to be used, but with the additional step that the total of the reported energy consumption is then checked against a calculated (modelled) overall consumption. This modelled consumption for each individual household is calculated from basic data for that household, on the one hand (floor space, number of people in household) and pre-set parameters for the individual types of use (space heating, water heating and cooking), on the other hand. To identify the right “reported” energy consumption per household in this way involves some quite complicated plausibility routines, because one or more alternative quantities have to be calculated if the quantity-value pairs do not match and these alternative quantities then, when variably applied, lead to a number of different calculated overall energy consumption figures. The modelled standard value is then used to select the quantity-value pairs that appear most probable.

This procedure described in detail below was implemented, because the survey results showed unreliable consumption pattern for several fuels and they were in contradiction to other information available. The results were analysed and discussed together with external experts mainly from Universities and the data validation methodology was developed together with these experts. Of course this model is continuously developing further and the default values used have to be adapted permanently to changing circumstances. The default values are derived from households using a single fuel for the respective purpose (water heating, cooking) and from internet research, for space heating they are based on research of the technical university of Vienna. The results now are in a reliable range for all fuels and can be used – together with other surveys’ results - to compile annual energy balances for Austria and its Laender (regions).

The data validation procedure is conducted in ACCESS-VBA. The processing is based on the original, untreated data-set.

For checking the plausibility of single data sets the following set of tables with factors as follows are used:

* Fuel specific conversion factors with corresponding calorific values,
* Fixed upper limits of fuel amounts and corresponding expenses,
* Laender specific prices for natural gas, non- interruptible and interruptible electricity,
* Average prices for the other fuels,
* Average annual energy consumption for water heating and cooking and
* Average annual energy consumption for space heating per m² depending on the dwelling´s age and size.
1. **Single Data Level**

At first, common plausibility checks and data validation in accordance with data correction are conducted on single data level – that means that all data reported on household level is used:

* Using upper thresholds concerning the annual energy consumption of every fuel; unrealistic amounts respectively costs are reduced.
* Checks on impossible fuel – purpose combinations and correction if necessary (e.g. district heat, solar energy and heat pumps cannot be used for cooking).
* Item non response in case of missing amount OR price: completion of pairs of varieties by use of average consumption amounts / prices. Item non response in case of missing amount AND price: calculation of pairs of varieties by use of average consumption depending on the purpose, the fuel and the number of persons in the household.

The plausibility checks are separated into two parts: Computer aided checks are run during the interview (software: BLAISE) on single plausibility items (e.g. fuel amounts above average, deviations beyond 50% of the market price). As the data validation can be suppressed during the interview to ensure finishing the survey, these checks have to be implemented in the second plausibility part again and checks or data-validation and - correction are conducted on the overall dataset by use of VBA-routines.

1. **Completion and Creation of Pair of Variables**

**Completion of Pair of Variables in Case of Missing Amounts OR Costs**

Incomplete pair of variables are completed by using average market prices as follows:

* Laender-specific prices for non-interruptible / interruptible electricity and natural gas are based on information given by the energy suppliers (local players) and information derived from annual bills or further sources (e.g. internet publications).
* Concerning other fuels such as coals or LPG, the average prices are calculated by using the extreme value-adjusted median derived from completely reported pair of varieties of the survey itself.

**Creation of Pair of Varieties in Case of Missing Amounts AND Costs**

In case of unknown amount and costs for a fuel used in the household, the fuel amount is calculated by summing up assumed default amounts for the announced end-use categories as follows:

**Calculation of the Share for Water Heating**

If a fuel is used for water heating and both the amounts and costs are unknown, the households need for water heating is calculated as a proportion of the average annual consumption based on the number of persons living in the household. In case of using more than one fuel for water heating, the calculated overall amount for water heating is divided by the number of all fuels reported for this end-use category.

**Calculation of the Share for Cooking**

In case of missing amounts and costs concerning the end-use category cooking, the amount and corresponding costs are computed as the proportion of average annual consumption based on the number of persons living in the household. In case of using more than one fuel for cooking, the calculated overall amount for cooking is divided by the number of all fuels reported for this end-use category.

**Calculation of the Share for Space Heating**

In contrast to the energy needs for water heating and cooking the energy consumption for space heating does not depend on the number of persons but is highly related to the dwelling´s size and age and the living space. Figures used are split into three construction periods and into three classes of dwelling size.

As the number of flats per dwelling as well as the size and the age of the building are provided for every household by means of the Labour Force Survey, the figures for space heating needs are directly applicable to each single data record. Compared with the former method of using Laender-specific averages of fuel-specific energy needs for space heating, the new approach provides much more precise results.

**Calculation of the Share for Space Heating in Case of more than one fuel used for Space Heating calculation**

In case of 2 or more fuels used for space heating, the calculation of the overall share for space heating in the household is much more complex and therefore expanded by the following factors:

* The 50% lower threshold of the assumed final energy consumption (FEC),
* The total of the reported FEC at this point of calculation,
* The heating system in forms of a single heater or central heating system and
* The predefinition of the share for space heating concerning the fuel predominantly used for space heating to 70% of all fuels used for space heating (the percentage of 30% is split in equal shares to the remaining fuels).

These factors are combined to calculate the share for space heating of one household as follows:

* If the sum of the calculated energy needs for water heating and cooking, all other reported amounts and 70% of the calculated share for space heating concerning the fuel predominantly used for space heating is less than 50% of the lower threshold of the assumed FEC, the calculated share for the fuel used predominantly for heating amounts to 70% whereas 30% account for the additional heating fuels with unknown amounts.
* If the sum (see above) is equal or above the 50% lower threshold, the share for space heating concerning the predominantly used heating fuel is not assumed to account for 70% but to 100%. Further shares for space heating of additional heating fuels are not calculated with the exception of natural gas, wood pellets, wood chips, solar heat and heat pumps.
* Shares for space heating of fuels that are NOT the predominantly heating fuel represent the remaining 30% and are split in equal parts.

After computing the single shares the overall fuel consumption and corresponding costs are calculated in the following order: water heating; cooking; space heating. If a particular fuel is allocated to more than one end-use category, the single shares are summed up and for this total the costs are calculated by use of the average market prices.

1. **Calculation of the annual Final Energy Consumption (FEC)**

The consumed amounts that are reported in various physical units are converted (standardized) to kWh by means of calorific values. Default values of the average annual consumption per end-use category (space heating, water heating, cooking) enable the allocation of consumption shares for fuels where the amount as well as the costs have not been reported. Furthermore, default values are used to calculate the assumed FEC (= average energy need for space heating + average energy need for water heating + average energy need for cooking) of one household.

Other country cases

**UK?, Canada?, Australia?, Ghana?, Azerbaijan?, Sweden?, Denmark?, Finland?, South Africa?, Russia?, India?, Norway?, Malaysia?, Ireland?, Netherlands?**

Other (frequent) reasons for modeling are:

* Conversion of the surveyed period to calendar years
* Climate adjustment
* Extrapolation with additional (administrative) data
* Matching survey results
* Data validation
* Estimation of non-metered consumption or non-purchased fuels like solar and ambient heat
* Estimation of consumption of non-standardized biofuels, mainly fuel wood
* Calculation of useful heat

Depending on the purpose different modeling parameters can be applied. Typical model assumptions used by a large number of countries are:

* Heating degree days are normally used in climate correction and extrapolation of heating shares of overall energy consumption. For the time being, a common agreed-upon approach does not exist. In the box below, the 15°/18° approach used by EUROSTAT is provided as an example.

**Heating degree day** (HDD) = Sum of differences between a given indoor temperature (BT = 18° C) and the daily average outdoor temperature, if latter is lower than an assumed limit for heating of 15° C (Model 15/18).

**Heating degree** **total** = Sum of HDD of a given period.

This model 15/18 means that days with an average temperature (in a 24 hours period) over 15.0° C are not taken into account, but days with an average up to and including 15.0° C are included with their difference to 18.0° C.

In the following examples for four days are displayed:

1st day: ∅ temperature of – 6.0° C: 24.0 points

2nd day: ∅ temperature of + 1.5° C: 16.5 points

3rd day: ∅ temperature of +15.0° C: 3.0 points

4th day: ∅ temperature of +15.1° C: 0 points

* Due to technological developments and the increasing penetration of air conditioning, cooling degree days are of growing importance. For the time being, no generally agreed-upon methodology for cooling degree days is available.
* Default consumption quantities for space heating (by m² and depending on insulation measures as well as building age), water heating (by person) and cooking (by family size) can be used to break down energy consumption by purposes.
* Assumptions on the typical (regional/national) fuel wood mixture or on its water content can be used for modelling consumption quantities and energy content of fuelwood.
* Penetration of energy saving appliances, the composition of heating systems, and typical consumption behaviour (depending on socioeconomic parameters) can be used for modelling energy efficiency indicators.

All these model assumptions can be applied by their own, combined with each other, or with additional national or regional assumptions. This opens a broad field for modeling and can help energy statistic compilers obtain realistic estimations when surveys reach their limits.

In the worst case – if no information can be obtained from administrative sources and by conducting surveys – modelling based on experts’ assumptions may be the only possibility to make at least a “best estimate”. A typical case is the [IEA/ESTIF methodology](http://www.iea-shc.org/common-calculation-method) for estimating solar heat production as given in the following example. The big advantage of this estimation methodology is that both installed overall area or installed capacity can be used to calculate heat production. Both or at least one of these figures normally is well known by the respondents (as example how to collect the data needed see the implemented questionnaire in the country example from Austria above).

Figure 4.2: Solar heat and water heating system



All data needed is the installed collector area or collector thermal capacity, the type of system in case of glazed collector types, and the average annual global radiation of the region.

One possible calculation methodology is shown below:

**As a function of the installed solar collector area:**

|  |  |
| --- | --- |
| Un-glazed collectors: | 0.29 \* H0 \* Aa |
| Glazed collectors in DHW systems: | 0.44 \* H0 \* Aa |
| Glazed collectors in combi-systems: | 0.33 \* H0 \* Aa |

**As a function of the installed collector nominal thermal power:**

|  |  |
| --- | --- |
| Un-glazed collectors:  | 0.42 \* H0 \* Pnom |
| Glazed collectors in DHW systems: | 0.63 \* H0 \* Pnom |
| Glazed collectors in combi-systems: | 0.47 \* H0 \* Pnom |

H0: Annual global solar irradiation in kWh/m².

Aa: Collector aperture area (in m²), but used in the calculation without unit like a constant as shown in the example below.

Pnom : Nominal thermal power output of collector in (kW), but used in the calculation without unit like a constant as shown in the example below.

The following calculation example uses the global radiation of Graz (1126 kWh/m²) and typical solar panel parameters for a single family house (glazed collector 5.9 m² installed panel area or 5.12 kW installed capacity) and gives the annual yield of solar heat of this installation in kWh for DHW and combi systems.

DHW: 0.44\*1126\*5.9 = 2923 (kWh/a) = 0.63\*1126\*4.12

COMBI: 0.33\*1126\*5.9 = 2192 (kWh/a) = 0.47\*1126\*4.12

# In situ measurement

This data collection methodology is expensive but in case of grid connected energy carriers like electricity, natural gas and district heating/cooling it is often the only the only possibility to collect data on consumption by purpose. Because of it high costs the sample normally is small.

**Country case Austria**

In Austria the measurement action is part of the **“Survey on electricity natural gas consumption of households by purpose”**, but focus on electricity only.In contrast to the other countries the measurement is done by the households themselves.

The following general information was provided together with the meter to the households and was generally well accepted and clear.

**General information**

**We kindly ask you to return the questionnaire until end of May!**

**Consumption of firmly connected devices (e.g. electric ovens) cannot be metered!**

**Built-in appliances are excluded from metering, too!**

**The electricity consumption has to be metered for at least 1h (TV, computer), at least 24h (e.g. cooler, freezer) or by use (e.g. washing machine, dishwasher). For some devices it is necessary to note the power (e.g. vacuum cleaner) additionally. Please follow the requirements instanced in the questionnaire for the respective appliances.**

**Electricity cost meter**

|  |  |
| --- | --- |
| 32 |  Function Description  **Start function**: Time Function 1 Voltage (V) and frequency (Hz) Function 2 Current (A) and power factor (Cos Φ) **Function 3 Power (W)** **Function 4 Measurement time**  **Function 5 Consumption (KWh)**  Function 6 Costs in Euro Function 7 Price by kWh.  |

To move back to **start function** press the **CHANGE** button.

To move from the active function to the next one press the **FUNCTION** button.

To **reset the metered values** individually for the functions 4 – 6 press the **SET** button for 5 seconds while the respective function is active.

**Before using the Electricity cost meter the first time**

**1. Battery charge**

**Please plug in the electricity cost meter before the first use for 8h to charge the internal battery. This is necessary to activate the display.**

**2. Clock time adjustment**

Time adjustment is not necessary to meter your appliances, because the measurement device records the measurement time in any case. In case of interest please follow the instruction manual.

**3. Electricity price adjustment**

Electricity price adjustment to record energy costs is not necessary for that survey. In case of interest please follow the instruction manual.

**How to meter electricity consumption of your appliances**

**1. Plug the measurement device between the socket and the appliance.**

Firmly connected appliances like electric ovens or built in devices cannot or need not be metered respectively!

**2. Please reset the displays of measurement time and kWh after each measurement!**

To **reset the metered values** individually for functions 4 – 6 press **SET** for 5 seconds while the respective function is active. To reset all values press the **R** button with a pointed object e.g. a ballpoint pen.

**3. Switch on the appliance**

**4. Read power**

Choose function 3 – power **(W)** - by pressing the **FUNCTION** button. With this function the actual power consumption in W will be displayed. **Caution:** in case of appliances with discontinuing electricity consumption **0** can be displayed (e.g. Cooler, which has reached the adjusted temperature range). The measurement works from 7 Watt exactly, lower values (<5 W) are possibly not displayed.

**5. Read measurement time**

Choose function 4 – measurement time - by pressing the **FUNCTION** button. With this function the activity period will be displayed in hours and minutes. If the electricity consumption is too low to be metered, no time will be displayed.

**6. Read electricity consumption (Kilowatt-hours, KWh)**

Choose function 5 – **KWh** - by pressing the **FUNCTION** button, **KWh**. With this function the electricity consumption will be displayed in **kWh** continuously. The accuracy is 0.01 KWh.

**7. Fill the asked values into the questionnaire**

Please note – dependant on the type of the device – measurement time, power in Watt or kWh. **Please note the electricity consumption (kWh) always with the 2 decimals displayed by the measurement device**!

The advantage of this methodology is that it is cheap (some 10€ by meter) and although the accuracy of the meter itself is limited and most respondents were inexperienced in handling such meters, the quality of the results was good. In 2008 and 2012, 254 households and 264 households joint the action respectively.

Other country cases

**UK?, Canada?, Australia?, Ghana?, Azerbaijan?, Sweden?, Denmark?, Finnland?, South Africa?, Russia?, India?, Norway?, Malaysia?, Ireland?, Netherlands?,**

# Country cases - multi purpose approaches

This chapter also lists some country examples to show how different approaches can be combined to obtain all information needed with minimum resources.

**Austria: Modelling of electricity consumption in private households in Austria according to type of usage**

Within this project a method for linking data records relating to electricity consumption in private households from different surveys (Household Energy Consumption 2004, 2006, 2008 and 2010 surveys with the Electricity and Gas Journal 2008) by means of statistical matching was developed.

In addition to information about the heating system, overall electricity consumption, electricity consumption for space heating, water heating and cooking, the model also included socio-economic criteria (number of individuals in the household and legal relationship to the dwelling), property-related criteria (age of property, living area, number of dwellings in the property) and regional criteria (urban versus rural regions).

The data records were linked for the period 2003 to 2010 and a forecast was made for 2011. Time series were generated from this data for the specific uses of power in private households.

**Methodology**

The bases for development of a method for linking data records for household power consumption are the following two surveys:

* Household Energy Consumption: a voluntary survey with a gross sample size of approximately 19 000 households per survey and a response rate of over 60% that was conducted at two-year intervals for the reporting years 2004, 2006, 2008 and 2010.
* Electricity and Gas Journal: a voluntary survey with a gross sample size of approximately 500 households and a response rate of almost 51% that was first conducted for the reporting year 2008 and is to be repeated in future at intervals of several years (next survey due to be conducted in 2012).

Detailed information on the two surveys is available on the Statistics Austria website ([www.statistik.at](http://www.statistik.at)) in the form of standard documentation for each survey (Household Energy Consumption for the years 2004, 2006, 2008 and 2010; Electricity and Gas Journal for 2008) and as a project report for the Electricity and Gas Journal 2008.

Despite the relatively small sample size (254 responding households) the data quality of the Electricity and Gas Journal is good. The average annual power consumption of 4 417°kWh per household shows a good correspondence with the figure of 4 533 kWh for annual power consumption from the Household Energy Use survey for 2008 (12 399 responding households).

In a first step the information from the Electricity and Gas Journal was linked at individual data level with the results of the Household Energy Consumption surveys by means of statistical matching. The following variables (V1 to V11), which were present in all data records, were used for the matching, whereby the data records from the Electricity and Gas Journal served as the "donor data records" for the "recipient data records" of the Household Energy Consumption survey because of the detailed information they contained regarding power consumption for non-thermal uses:

* V1: Number of persons in the household (5 categories)
* V2: Number of dwellings in the property (5 categories)
* V3: Federal province (9 categories)
* V4: Age of property (8 categories)
* V5: Legal relationship to the dwelling (6 categories)
* V6: Use of solar heating (2 categories)
* V7: Primary heating system (5 categories)
* V8: Space heating with electricity (2 categories)
* V9: Water heating with electricity (2 categories)
* V10: Living area (m²)
* V11: Overall power consumption (kWh/a)

The quantitative variables V10 and V11 were standardised for the matching in all data records, i.e. they were changed so that average=0 and variance=1. For each data record in the Household Energy Consumption Survey a donor was sought from the data record of the Electricity and Gas Journal with the minimum distance. Where there was more than one donor with the same distance, one donor was randomly selected. In terms of the distance function, where the character of the recipient and potential donor did not match, the variables V1 to V9 were given the value 1, and where they did match, they were given the value 0. In the case of V10 and V11 the absolute difference between the standardised values of V10 and V11 is included in the distance function. This means that the 11 variables are included in the distance function with the same weighting.

The linked data records were then recalculated in accordance with the annual series of overall final consumption of electrical energy for private households in Austria up to 2003 and a forecast was generated for the year 2011, from which time series were generated for the detailed uses of electricity in private households.

In the concluding processing phase an analysis was performed on the generated time series with thermal and detailed non-thermal power consumption categories for 2004, 2006, 2008 and 2010 according to socio-economic and regional parameters at household level.

Household power consumption normally increases with the number of people. In order to investigate the potential effect of socio-economic parameters on power consumption, the power consumption was normalised for the relevant uses by dividing power consumption by the number of persons living in the household.

For each of the investigated socio-economic parameters, the average figures for power consumption per person in the household for each of the specified uses were then calculated and displayed in tables for the reporting years.

Other country cases

**UK?, Canada?, Australia?, Ghana?, Azerbaijan?, Sweden?, Denmark?, Finnland?, South Africa?, Russia?, India?, Norway?, Malaysia?, Ireland?, Netherlands?**

1. OECD Glossary of Statistical Terms http://stats.oecd.org/glossary/ [↑](#footnote-ref-1)
2. See IRES table 5.1 [↑](#footnote-ref-2)
3. As input for modelling the respective production [↑](#footnote-ref-3)
4. Full list see IRES section 5.64 [↑](#footnote-ref-4)
5. See IRES table 5.3 [↑](#footnote-ref-5)
6. See also IRES Chapter 7.D.2 Administrative data sources [↑](#footnote-ref-6)
7. Actually the data is matched to several registers to make up for coverage issues. [↑](#footnote-ref-7)
8. See also IRES Chapter 7.D.1 Statistical data sources that provides a survey breakdown by respondents. [↑](#footnote-ref-8)
9. See Country example Austria [↑](#footnote-ref-9)