STATISTICS AUSTRIA
The Information Manager

Wolfgang Bittermann
Directorate Spatial Statistics

Beijing
23 - 25 May 2018

Data collection on energy consumption of households

Data collection activities

- Two surveys
  - Household energy consumption survey: two yearly, all fuels used on the main residence, since 1974 as personal inteview and 2004 as CATI, breakdown by thermal purposes
  - Electricity and natural gas journal: four yearly, electricity and natural gas consumption by purposes, since 2008
- Two modelling exercises
  - Energy consumption in second homes
  - Statistical matching of Household energy consumption survey and Electricity and natural gas journal 2008,2012 and 2016

Content

- Household energy consumption survey
  - Survey design
  - Sample and method
  - Questionnaire
  - Questions
  - Preparation
  - Data validation
  - Calculation of tTED (**t**heoretical **T**hermal **E**nergy **D**emand)
  - Grossing up
- Electricity and natural gas journal
  - Goal
  - Outline
  - Procedure
  - Questionnaire (examplary)
- Statistical matching

Survey design

- Voluntary survey attached to the obligatory Labour Force Survey (LFS)
- 2-year term
- Observation units are households on their principal residence
- Some data needed are taken from the LFS like:
  - Floor space
  - Heating system
  - Number of persons
- For all fuels used in households quantities and expenditures as well as purposes of use are asked
- Austria and its provinces are covered

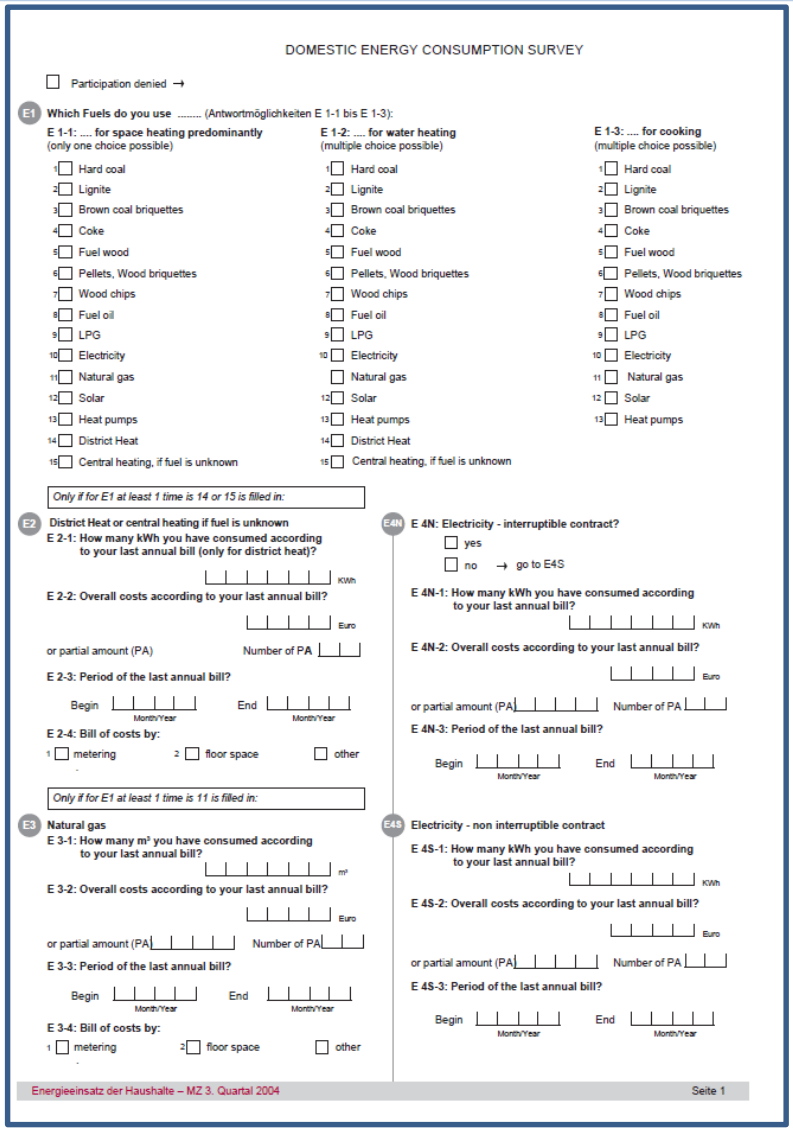
Sample and method

- Household sample
- Drawn from the central register of residents
- Random sample stratified by provinces
- Sample size is around 14,000 households
- Equal sample size for all provinces except Vienna (larger sample because of smaller households) and Burgenland (smaller because of the little household number)
- **C**omputer **A**ssisted **T**elephone **I**nterview (CATI)
- Conducted by a contractor
- Not finalized before 8500 interviews are completed

Questionnaire

- For all fuels used in households **quantities and expenditures** as well as purposes of use are asked
- Only **absolutely necessary** questions are asked
- Only questions the respondents can answer are asked
- Different units are allowed

Questions



DOMESTIC ENERGY CONSUMPTION SURVEY

☐ Participation denied →

E1 Which Fuels do you use ..... (Antwortmöglichkeiten E 1-1 bis E 1-3):

E 1-1: .... for space heating predominantly (only one choice possible)	E 1-2: .... for water heating (multiple choice possible)	E 1-3: .... for cooking (multiple choice possible)
1 ☐ Hard coal	1 ☐ Hard coal	1 ☐ Hard coal
2 ☐ Lignite	2 ☐ Lignite	2 ☐ Lignite
3 ☐ Brown coal briquettes	3 ☐ Brown coal briquettes	3 ☐ Brown coal briquettes
4 ☐ Coke	4 ☐ Coke	4 ☐ Coke
5 ☐ Fuel wood	5 ☐ Fuel wood	5 ☐ Fuel wood
6 ☐ Pellets, Wood briquettes	6 ☐ Pellets, Wood briquettes	6 ☐ Pellets, Wood briquettes
7 ☐ Wood chips	7 ☐ Wood chips	7 ☐ Wood chips
8 ☐ Fuel oil	8 ☐ Fuel oil	8 ☐ Fuel oil
9 ☐ LPG	9 ☐ LPG	9 ☐ LPG
10 ☐ Electricity	10 ☐ Electricity	10 ☐ Electricity
11 ☐ Natural gas	☐ Natural gas	11 ☐ Natural gas
12 ☐ Solar	12 ☐ Solar	12 ☐ Solar
13 ☐ Heat pumps	13 ☐ Heat pumps	13 ☐ Heat pumps
14 ☐ District Heat	14 ☐ District Heat	
15 ☐ Central heating, if fuel is unknown	15 ☐ Central heating, if fuel is unknown	

Only if for E1 at least 1 time is 14 or 15 is filled in:

E2 District Heat or central heating if fuel is unknown

E 2-1: How many kWh you have consumed according to your last annual bill (only for district heat)? ____ KWh

E 2-2: Overall costs according to your last annual bill? ____ Euro

or partial amount (PA) Number of PA ____

E 2-3: Period of the last annual bill?

Begin ____ (Month/Year) End ____ (Month/Year)

E 2-4: Bill of costs by:

1 ☐ metering 2 ☐ floor space ☐ other

Only if for E1 at least 1 time is 11 is filled in:

E3 Natural gas

E 3-1: How many m³ you have consumed according to your last annual bill? ____ m³

E 3-2: Overall costs according to your last annual bill? ____ Euro

or partial amount (PA) ____ Number of PA ____

E 3-3: Period of the last annual bill?

Begin ____ (Month/Year) End ____ (Month/Year)

E 3-4: Bill of costs by:

1 ☐ metering 2 ☐ floor space ☐ other

E4N E 4N: Electricity - interruptible contract?

☐ yes

☐ no → go to E4S

E 4N-1: How many kWh you have consumed according to your last annual bill? ____ KWh

E 4N-2: Overall costs according to your last annual bill? ____ Euro

or partial amount (PA) ____ Number of PA ____

E 4N-3: Period of the last annual bill?

Begin ____ (Month/Year) End ____ (Month/Year)

E4S Electricity - non interruptible contract

E 4S-1: How many kWh you have consumed according to your last annual bill? ____ KWh

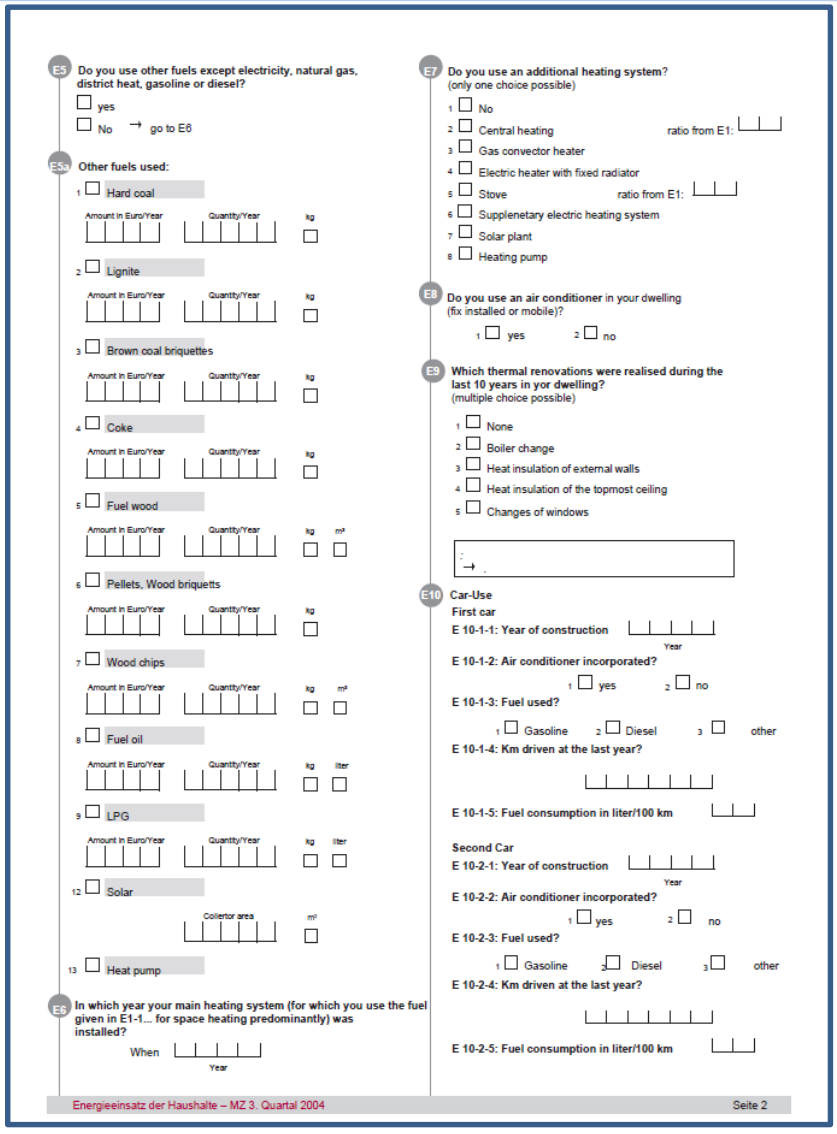
E 4S-2: Overall costs according to your last annual bill? ____ Euro

or partial amount (PA) ____ Number of PA ____

E 4S-3: Period of the last annual bill?

Begin ____ (Month/Year) End ____ (Month/Year)

Energieeinsatz der Haushalte – MZ 3. Quartal 2004 Seite 1



E5 Do you use other fuels except electricity, natural gas, district heat, gasoline or diesel?

☐ yes

☐ No → go to E6

E5a Other fuels used:

1 ☐ Hard coal — Amount in Euro/Year ____ Quantity/Year ____ kg ☐

2 ☐ Lignite — Amount in Euro/Year ____ Quantity/Year ____ kg ☐

3 ☐ Brown coal briquettes — Amount in Euro/Year ____ Quantity/Year ____ kg ☐

4 ☐ Coke — Amount in Euro/Year ____ Quantity/Year ____ kg ☐

5 ☐ Fuel wood — Amount in Euro/Year ____ Quantity/Year ____ kg ☐ m³ ☐

6 ☐ Pellets, Wood briquetts — Amount in Euro/Year ____ Quantity/Year ____ kg ☐

7 ☐ Wood chips — Amount in Euro/Year ____ Quantity/Year ____ kg ☐ m³ ☐

8 ☐ Fuel oil — Amount in Euro/Year ____ Quantity/Year ____ kg ☐ liter ☐

9 ☐ LPG — Amount in Euro/Year ____ Quantity/Year ____ kg ☐ liter ☐

12 ☐ Solar — Collertor area ____ m² ☐

13 ☐ Heat pump

E6 In which year your main heating system (for which you use the fuel given in E1-1... for space heating predominantly) was installed?

When ____ Year

E7 Do you use an additional heating system? (only one choice possible)

1 ☐ No

2 ☐ Central heating ratio from E1: ____

3 ☐ Gas convector heater

4 ☐ Electric heater with fixed radiator

5 ☐ Stove ratio from E1: ____

6 ☐ Supplenetary electric heating system

7 ☐ Solar plant

8 ☐ Heating pump

E8 Do you use an air conditioner in your dwelling (fix installed or mobile)?

1 ☐ yes 2 ☐ no

E9 Which thermal renovations were realised during the last 10 years in yor dwelling? (multiple choice possible)

1 ☐ None

2 ☐ Boiler change

3 ☐ Heat insulation of external walls

4 ☐ Heat insulation of the topmost ceiling

5 ☐ Changes of windows

→

E10 Car-Use

First car

E 10-1-1: Year of construction ____ Year

E 10-1-2: Air conditioner incorporated?

1 ☐ yes 2 ☐ no

E 10-1-3: Fuel used?

1 ☐ Gasoline 2 ☐ Diesel 3 ☐ other

E 10-1-4: Km driven at the last year? ____

E 10-1-5: Fuel consumption in liter/100 km ____

Second Car

E 10-2-1: Year of construction ____ Year

E 10-2-2: Air conditioner incorporated?

1 ☐ yes 2 ☐ no

E 10-2-3: Fuel used?

1 ☐ Gasoline 2 ☐ Diesel 3 ☐ other

E 10-2-4: Km driven at the last year? ____

E 10-2-5: Fuel consumption in liter/100 km ____

Energieeinsatz der Haushalte – MZ 3. Quartal 2004 Seite 2

Preparation

- Interviewer training
  - Interviewers should have a good knowledge on the different fuels.
  - Interviewers should be well trained on consumption pattern of different stove types as well as on typical consumption pattern of different purposes (e.g. for space heating, water heating and cooking).
  - Practical leaflets with region-specific bills (electricity, natural gas and heat from district heating) could help the interviewers to assist the respondents
- Respondents information (notification letter)
  - the purpose and the content of the survey
  - the data they will be asked for and
  - the question to prepare bills

Data validation

STATISTICS AUSTRIA
The Information Manager

Two separate validation procedures:

- Computer aided checks during the interview (Software: BLAISE)

  But: All checks can be suppressed during the interview, so they have to be implemented in the second plausibility check again!

- Checks on the overall dataset using VBA-routines

Validation procedure 1

The checks during the interview are as follows:

- Electricity has to be reported
- One fuel for space heating has to be reported
- One fuel for water heating has to be reported
- At least one fuel for cooking has to be reported
- The type of heating system (LFS) must be compatible to the main fuel used for space heating
- The age of the building (LFS) must not conflict the heating systems age
- Unrealistic prices (+/-25% divergence from avg. prices)

Validation procedure 2 - the modelling exercise

1. Data validation and correction of the *recorded overall energy consumption* of **each reporting household** taking into account all fuels used for the given purposes in comparison to an *assumed final energy consumption* (range of tolerance: -50% / +50%)

2. Grossing-up and aggregation of energy consumption and expenditures by end-use category on fuel level for **Austria and the provinces** taking into account additional information

Modelling consumption by purpose 1

Average Values of Annual Energy Consumption for Water Heating and Cooking (Parameters for the Surveys 2003/2004 - 2015/2016)

End-Use Category	Nr. of Persons in the Household	Energy Demand	
		[kWh]	[GJ]
Water Heating [1]	pro Person	1199	4,3164
Cooking [2]	1	375	1,35
Cooking [2]	2	475	1,71
Cooking [2]	3	544,444	1,96
Cooking [2]	4	713,889	2,57
Cooking [2]	5 and more	883,333	3,18

[1] assumed as linear function [2] assumed as a non-linear function;

Modelling consumption by purpose 2

Average Annual Energy Demand for Space Heating in kWh per m² in Dependence of the Buildings' Size and Age

Detached & semidetached houses				Apartment houses			
Construction period				Construction period			
A	B	C	D	A	B	C	D
232	166	97	44.2	182	132	96	44.2

Construction period A: up to 1960; B: 1961 to 1990; C: 1991 to 2005; D: after 2005.

The calculation of the average annual heating demand (HD) is basing on normed climate conditions. Therefore it is divided by the longstanding average heating degree days (HDD)for Austria and multiplied with the population weighted HDD for the respective survey periods and Laender.

Computation of the Final Energy Consumption (**FEC**) for each surveyed household 1

1. Computation of the **reported FEC** based on the corrected and completed amounts as sum of the energy consumption of all fuels in one household in kWh

2. Computation of the **assumed FEC** of one household in kWh as sum of all shares for space and water heating and cooking

3. Step-wise **correction** of the *reported* FEC using the range of tolerance of the assumed FEC (-50% / +50%)

The reasons to calculate and use tTED

STATISTICS AUSTRIA
The Information Manager

1. To loose no information – and already the fuel mix used in a household is a valuable information –tTED is used to estimate the consumed quantities.
2. In case of grid independent fuels that are able to be stored, normally purchased and not used quantities and respective expenditures are reported. This regularly causes under- (in case of destocking) or overestimations (in case of stock build) of energy consumption. Such distortions can be reduced by the comparison of the reported quantities with tTED.
3. In case of estimations of grid connected energy carriers (natural gas and heat from district heating) unrealistic quantities can be cleared.
4. In case of unmetered or not measurable energy consumption like. solar- and ambient heat consumption is estimated according tTED.
5. Electricity consumption for thermal purposes is always calculated (using the defaults of tTED)
6. If a fuel is used for more than one purpose the breakdown to all purposes can be done with tTED.

Calculation of the tTED

Calculation of annual tTED with the default values dependant on floor space and number of household members:

$$tTED = a*m^2 + b*n + c_n$$

„a“: Default value for annual use for heating (GJ/m²) dependant on fuel type

„b“: Default value for annual use for heating water (GJ/person)

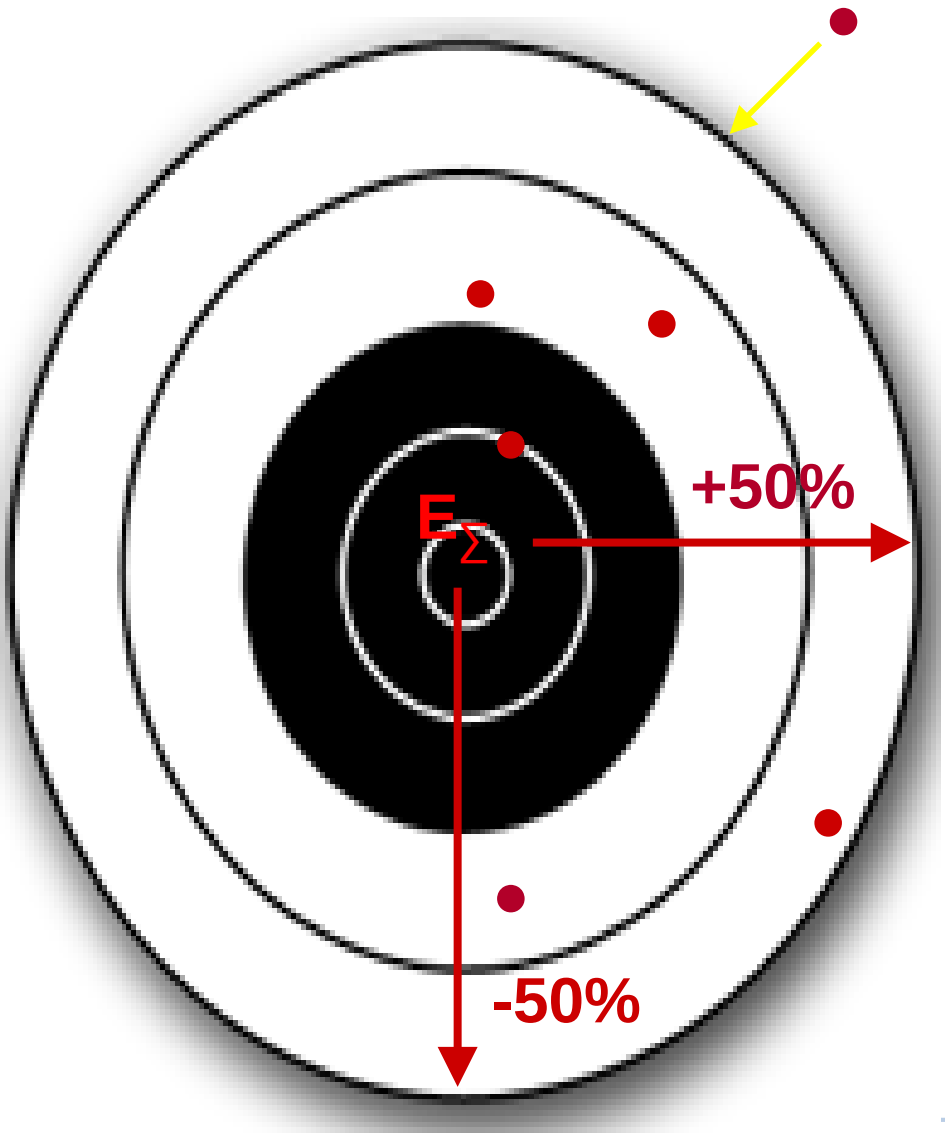
„c“: Default value for annual use for cooking depending on persons

„n“: number of persons

Renovation measures & temperature settings

- The specific heating need by m² is additionally influenced by renovation measures and thermostat settings.
- **Renovation measures**
  - In case of renovation measures (insulation, change of windows) the TED is adapted to a lower energy need for heating as follows:
    - 1 renovation measure: next construction period
    - 2 renovation measures: next but one construction period
- **Temperature settings**
  - For each °C >20°C the energy need for space heating (SHN) is increased by 2% (upper limit 25°C) and for each °C <20°C by 1% decreased (lower limit 17°C).
    - Example: In case of the setting on 25°C (+10%) during daytime and a setting on 17°C (-3%) during night-time SHN-Adaptation results in +7%.

Computation of the **FEC** for each surveyed household 2



Using the "Target" to correct the FEC

- range of tolerance of the assumed FEC:

-50%; +50%

- All reported final energy consumptions **within** the range are seen to be realistic and are **NOT corrected**

- Reported Values **OUTSIDE** the target range **are corrected step-wise**

Procedure

1. **Unrealistic prices** (+/-25% divergence from avg. prices) New calculation of the amounts with the expenditures and average prices
2. **Realistic prices but the FEC is too high**: iterative reduction (1% steps) of all fuels till the +50% tolerance limit is achieved
3. **Realistic prices but the FEC is too low** : iterative increase (1% steps) of all fuels till the -50% tolerance limit is achieved
4. **Recalculation** of all quantities used for thermal purposes

Grossing up - Weight 1: households

Households, because energy consumption for cooking, water heating and electricity use for “other purposes” is dependent on number of persons living in the household. Therefore following parameters are applied:

- household size (5) by Laender (9),
- number of households connected to the natural gas grid by Laender (9)
- heating systems available for pellets by Laender (9) since 2008, see heating systems available for wood chips by Laender (9) since 2008

Grossing up - Weight 2: dwellings

- Dwelling, because fuel consumption for space heating depends on area. Therefore following parameters (and number of the respective categories) are applied:
  - dwelling area by Laender (9), construction period (4) and building size (2)
  - number of households connected to the natural gas grid by Laender (9)
  - heating systems available for pellets by Laender (9) since 2008
  - heating systems available for wood chips by Laender (9) since 2008

Electricity and Natural Gas Journal

- Survey to collect representative data on
  - the equipment of households with electrical appliances
  - age and power-rating of the appliances
  - electricity and gas consumption by 24h periods
  - electricity and gas consumption behaviour
  - device-specific electricity consumption
  - electricity and natural gas use for
    - space heating
    - hot water heating and cooking
    - electrical appliances
    - illumination





Project Outline

- Project duration: October 2015 until December 2016
- Frequency: every 4 years
- Voluntary survey
  - questionnaires were dispatched to 607 households → response rate 52,4%
- Incentives for Households
  - allowance of € 100
  - energy cost meter

- Clients
  - Federal Ministry of Sustainability and Tourism
  - E-Control

E-CONTROL

lebensministerium.at

Survey Procedure

1) Questionnaire on electricity and natural gas devices
(October 2015 – February 2016)
Space and Water heating.
Annual electricity/natural gas consumption
Equipment with electric appliances
Illumination

2) Questionnaire on consumption behaviour in winter
(December 2015 – February 2016)
(one week with 24h periods)
Electricity and natural gas meters
Heating behaviour. hot water consumption
activities like dish washing
IT and entertainment electronics
Illumination

3) Questionnaire on specific consumption of relevant appliances
(March/April 2016)

Measurement with a portable electricity measurement system

4) Questionnaire on consumption behaviour in summer
(May/June 2016)
(one week with 24h periods)
Electricity and natural gas meters
Heating behaviour. hot water consumption
Activities like dish washing
IT and entertainment electronics
Illumination

Example – Questionnaire on consumption behaviour in winter I

V1 **Please list every evening at the same time (e.g. 8.00 pm) your meter reading for electricity and gas**

		Meter-reading 0*	Meter-reading 1	Meter-reading 2	Meter-reading 3	Meter-reading 4	Meter-reading 5	Meter-reading 6	Meter-reading 7
					Date				
Date	DD.MM								
					Time				
Time	00:00								
					Electricity meter				
Electricity-meter 1	[kWh]								
Electricity-meter 2	[kWh]								
					Natural Gas meter				
Gas meter	[Bm³]								

Example – Questionnaire on consumption behaviour in winter II

STATISTICS AUSTRIA
The Information Manager

Section 2: Stove, Oven, Washing machine and dryer, dishwasher

V6 **Please indicate the cooking time in your household (summarize cooking at several flames)**

	day 1	day 2	day 3	day 4	day 5	day 6	day 7
Cooking with Stove 1	min	min	min	min	min	min	min
Cooking with Stove 2	min	min	min	min	min	min	min

V7 **Please indicate the backing time**

	day 1	day 2	day 3	day 4	day 5	day 6	day 7
Backing with Oven 1	min	min	min	min	min	min	min
Backing with Oven 2	min	min	min	min	min	min	min

V8 **Please enter for each day, how many times you washed with your domestic washing machine**

	day 1	day 2	day 3	day 4	day 5	day 6	day 7
Washing machine 1	times	times	times	times	times	times	times
Washing machine 2	times	times	times	times	times	times	times

V9 **Please enter for each day, how many times you washed or dried with your domestic washer-dryer**

	day 1	day 2	day 3	day 4	day 5	day 6	day 7
Washing with washer-dryer	times	times	times	times	times	times	times
Drying with washer-dryer	times	times	times	times	times	times	times

V10 **Please enter for each day, how many times you dried with your domestic dryer**

	day 1	day 2	day 3	day 4	day 5	day 6	day 7
Drying with dryer	times	times	times	times	times	times	times

V11 **Please indicate for every day the use of the dishwasher**

	day 1	day 2	day 3	day 4	day 5	day 6	day 7
Rinse with dishwasher 1	times	times	times	times	times	times	times
Rinse with dishwasher 2	times	times	times	times	times	times	times

Bottom-up energy efficiency indicators for the domestic sector

- Advantage: data at a very detailed level
- Bottom-up indicators can provide information
  - for the need of consumption behavior programs
  - About the extent of stand-by energy use
  - about potential energy savings by the use of new, energy efficient domestic appliances
  - about possible energy savings in lighting

- Information about the development of energy efficiency
  - Illustration of energy savings
  - Illustration of structural changes (new devices, changes in use of devices, …)

Comparison with results of the previous surveys

Average household electricity consumption 2008, 2012 and 2016 by purposes

	Electricity consumption in kWh		
	2008	2012	2016
Average household consumption			
Overall consumption	4.057,6	3.964,3	3.559,9
Heating	666,4	774,6	816,3
Main heating system	405,5	444,5	570,8
Auxiliary heating systems	130,4	148,0	89,7
Supporting electricity	48,2	128,4	108,7
Circulation pump	82,4	53,7	47,1
Water heating system	549,2	393,5	343,5
Water heating	530,6	369,2	318,5
Circulation pump	18,6	24,3	24,9
Cooking	401,1	344,0	343,4
Stove, oven	310,5	264,7	257,2
Other cooking appliances[1)]	90,6	79,3	86,2
Cooling and freezing	558,9	610,4	470,7
Refrigerator, fridge-freezer-combination	331,6	357,6	319,8
Freezer	227,3	252,7	150,9
Dishwasher	192,6	221,5	206,1
Laundry washing	167,2	167,7	148,8
Washing machine	165,0	165,5	147,1
Tumble dryer	2,3	2,2	1,7
Kitchen[2)]and domestic appliances	233,7	209,0	150,3
Office, entertainment and communication devices	282,9	311,9	294,0
Lightning	404,1	351,2	305,3
Air condition	0,5	4,0	1,9
Other relevant appliances[3)]	180,6	168,3	153,7
Chargers	6,1	2,4	5,6
Stand-by consumption	125,8	158,6	111,5
Unspecified consumption	288,3	247,1	208,9

Statistical matching

- Household Energy Consumption survey:2008, 2012 and 2016 (recipient data records)
- Electricity and Gas Journal: 2008, 2012, 2016 (donor data records)
- The following variables to match the data sets:
  - V1: Number of persons in the household (5 categories)
  - V2: Number of dwellings in the property (5 categories)
  - V3: Age of property (8 categories)
  - V4: Use of solar heating (2 categories)
  - V5: Primary heating system (5 categories)
  - V6: Space heating with electricity (2 categories)
  - V7: Water heating with electricity (2 categories)
  - V8: Dwelling size (m^2)
  - V9: Overall power consumption (kWh/a)

A main result: houshold energy consumption in TJ by purpose 2016

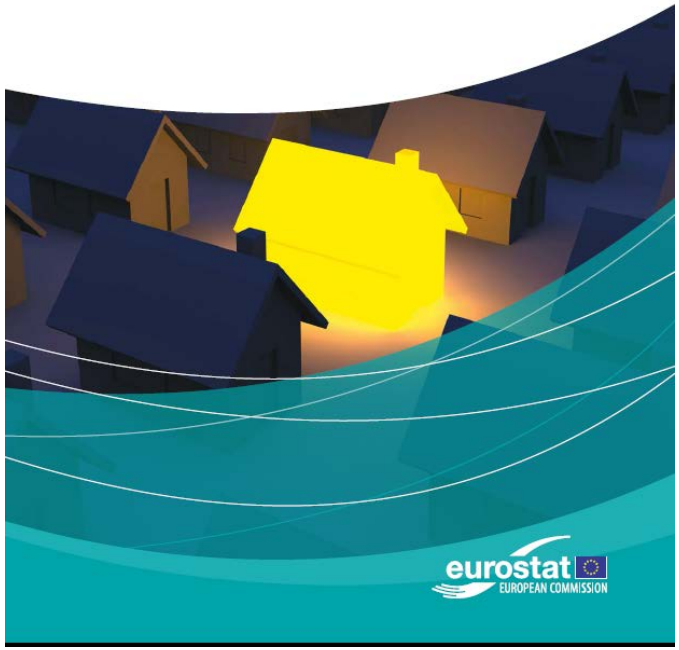
Residential sector	Space heating	Hot water	Cooking	Cooling & freezing	Large appliances	Small appliances	Consumer electronics	Lightning	Other	Traction	TOTAL
	Terajoule										
Hard coal	218	9	1	0	0	0	0	0	0	0	228
Lignite	180	10	1	0	0	0	0	0	0	0	191
Coke oven coke	384	25	0	0	0	0	0	0	0	0	409
Petrol coke	0	0	0	0	0	0	0	0	0	0	0
Fuel oil	0	0	0	0	0	0	0	0	0	0	0
Gas oil	37.632	4.705	0	0	0	0	0	0	0	0	42.337
Diesel	0	0	0	0	0	0	0	0	0	78.510	78.510
Gasoline	0	0	0	0	0	0	0	0	0	36.511	36.511
Kerosene	0	0	0	0	0	0	0	0	0	0	0
LPG	1.064	126	20	0	0	0	0	0	0	0	1.210
Natural gas	42.870	7.227	397	0	0	0	0	0	0	0	50.493
Electricity	12.915	10.767	6.616	7.420	6.412	2.219	6.302	5.158	6.311	0	64.120
District heat	28.400	5.237	0	0	0	0	0	0	0	0	33.636
Log wood	47.928	4.661	328	0	0	0	0	0	0	0	52.918
Biofuels	12.113	1.769	5	0	0	0	0	0	0	6.392	20.279
Waste	0	0	0	0	0	0	0	0	0	0	0
Other energy sources	6.822	5.352	0	0	0	0	0	0	0	0	12.174
Ambient and solar heat	6.822	5.352	0	0	0	0	0	0	0	0	12.174
Blast furnace gas	0	0	0	0	0	0	0	0	0	0	0
Coke oven gas	0	0	0	0	0	0	0	0	0	0	0
Peat	0	0	0	0	0	0	0	0	0	0	0
TOTAL	190.526	39.889	7.367	7.420	6.412	2.219	6.302	5.158	6.311	121.412	393.016

For more information…

ISSN 2315-0815

eurostat
Manuals and guidelines

Manual for statistics on energy consumption in households



Standard documentation
Meta information
(Definitions, comments, methods, quality)

on Random Sample Survey

Energy Consumption of Households

This documentation applies to the reference period:
2003 bis 2013

Status: **24.07.2014**

STATISTICS AUSTRIA
Federal Institute Statistics Austria
A-1110 Vienna, Guglgasse 13
Phone: +43-1-71128-0
www.statistik.at

Directorate Spatial Statistics
Organizational unit Energy

Dipl. Geogr. Eva Korus
Phone: +43-1-71128-8202
e-mail:
eva.korus@statistik.gv.at

Contact persons:
Walter Frech
Phone: +43-1-71128-7254
e-mail:
walter.frech@statistik.gv.at

Dr. Wolfgang Bittermann
Phone: +43-1-71128-7315
e-mail:
wolfgang.bittermann@statistik.gv.at

Please address queries to:
Wolfgang Bittermann

Contact information:
Guglgasse 13, 1110 Vienna
phone: +43 (1) 71128-7315
wolfgang.bittermann
@statistik.gv.at

Thank you for your attention