STATISTICS AUSTRIA
The Information Manager

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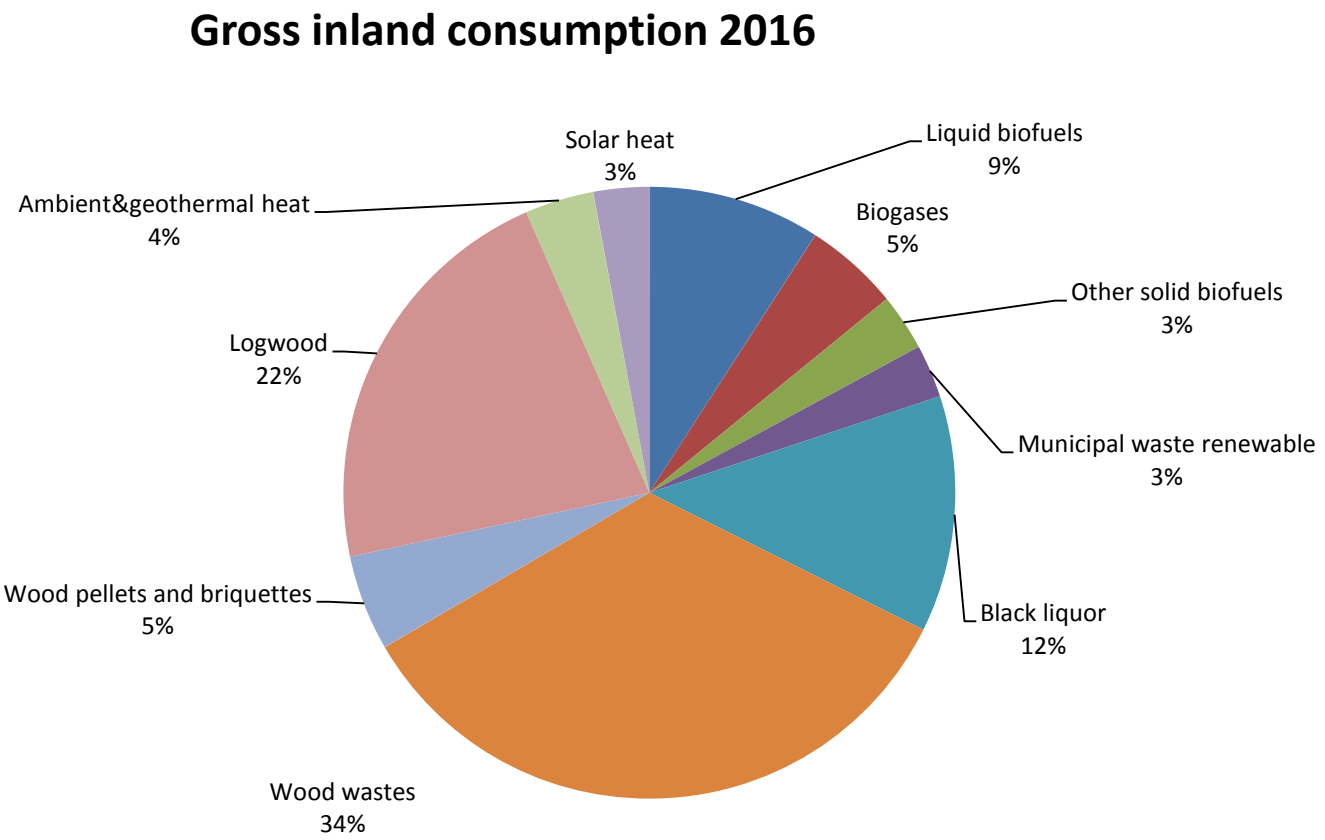
Collecting renewables non electricity data

Tricky tasks need a holistic approach

Content

- Renewables in Austria
- Data sources
  - Supply surveys
  - Consumption surveys
- Solar energy and ambient heat
  - Modeling and implementation example solar heat
- Biofuels
  - Classification from the data collection point of view
  - Data sources-surveys
    - Data alignment
  - Data sources-modelling
    - Modeling example biomass lighted heating plants
- Conclusions

Renewables in Austria – Shares 2016



Renewables in Austria -What they are used for

Final energy consumption 2016 by fuels and useful energy categories for Austria (in Terajoule)

2016	Space heating and air condition	Vapor production	Industrial furnaces	Stationary engines	Traction	Lighting and computing	Electro-chemial Purposes	Total
Hard coal	228	3.472	605	0	5	0	0	4.310
Lignite	239	0	1.656	0	0	0	0	1.894
Coke oven coke	430	0	6.463	0	0	0	0	6.893
Petrol coke	0	141	1.565	0	0	0	0	1.706
Fuel oil	2.457	2.035	1.639	6	0	0	0	6.137
Gas oil	43.886	106	4.942	8	0	0	0	48.942
Diesel	0	5	3	14.796	251.791	0	0	266.595
Gasoline	0	0	1	233	64.599	0	0	64.833
Kerosene	0	0	0	26	33.126	0	0	33.152
LPG	1.516	36	1.053	601	484	0	0	3.691
Natural gas	77.331	43.309	58.445	2.469	10.752	9	0	192.315
Electricity	28.622	3.216	52.266	93.015	11.263	33.790	492	222.665
District heat	60.288	1.818	10.612	0	0	0	0	72.718
Log wood	50.567	97	6.258	0	0	0	0	56.922
Biofuels	27.902	36.666	16.603	360	22.949	0	0	104.479
Waste	1.620	3.302	7.679	0	0	0	0	12.601
Ambient and solar heat	11.306	0	5.352	0	0	0	0	16.659
Blast furnace gas	0	0	1.089	0	0	0	0	1.089
Coke oven gas	0	0	3.439	0	0	0	0	3.439
Peat	0	0	0	0	0	0	0	0
Total	**306.392**	**94.203**	**179.672**	**111.512**	**394.970**	**33.800**	**492**	**1.121.042**

S: STATISTICS AUSTRIA, Energy statistics: Energy balances for Austria 1970 to 2016. Compiled on 15 December 2017. – Breakdown with the structure of the useful energy consumption 2016.

Austrian Renewables Balances 1970 - 2016

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Renewables[1])

in Terajoule (10^{12} Joule)	1970	1980	1990	2000	2010	2011	2012	2013	2014	2015	2016
Indigenious production of primary fuels	123.458	161.271	209.197	278.911	364.855	346.189	396.538	405.555	394.741	398.602	417.313
Imports	501	1.217	4.438	4.945	35.318	39.982	38.889	40.737	41.072	39.561	36.414
Stock rotation	0	0	-545	0	515	-942	216	-112	46	431	-137
Exports	189	652	1.933	6.691	18.803	17.181	18.974	17.296	21.300	22.994	24.599
Gross inland consumption	**123.770**	**161.836**	**211.157**	**277.165**	**381.884**	**368.048**	**416.669**	**428.883**	**414.558**	**415.600**	**428.992**
Transformation input	77.417	107.999	122.061	174.200	235.328	222.042	269.237	262.919	262.179	255.378	261.156
Transformation output	0	0	0	32	9.767	9.250	11.581	10.701	11.189	11.636	10.225
Consumption of energy industries	0	0	0	0	0	0	1	1	13	0	0
Non energy use	0	0	0	0	0	0	0	0	0	0	0
Final energy consumption	**46.353**	**53.837**	**89.096**	**102.997**	**156.323**	**155.255**	**159.013**	**176.665**	**163.555**	**171.857**	**178.060**
of which:											
Burgenland	.	.	4.229	4.350	7.802	7.795	6.667	6.754	6.251	7.421	7.553
Carinthia	.	.	10.997	11.263	18.336	19.236	19.003	22.866	19.176	20.439	22.297
Lower Austria	.	.	19.272	21.386	31.019	31.058	33.265	33.440	32.446	35.420	36.406
Upper Austria	.	.	20.783	26.020	33.250	33.564	36.131	40.115	37.599	37.667	38.074
Salzburg	.	.	6.434	7.287	13.283	12.689	12.602	14.439	12.524	13.838	13.847
Styria	.	.	18.492	20.791	30.032	29.028	29.334	34.194	32.835	31.453	34.827
Tyrol	.	.	5.283	6.949	11.939	10.848	10.900	12.624	11.279	12.893	12.741
Vorarlberg	.	.	2.269	3.103	4.688	4.800	5.519	6.130	5.774	7.096	7.244
Vienna	.	.	1.337	1.849	5.975	6.236	5.591	6.102	5.670	5.629	5.072
of which:											
Agriculture	2.759	2.599	4.022	5.096	6.359	6.917	7.410	7.735	6.894	7.111	7.295
Industry	491	10.051	22.653	29.572	48.886	48.474	47.881	58.519	52.399	51.193	60.232
Traction	9	2	80	612	20.736	20.839	20.483	20.683	24.694	27.013	22.364
Services	3.620	374	2.904	5.045	6.855	7.469	7.566	6.830	8.565	9.789	9.190
Private households	39.474	40.811	59.436	62.671	73.487	71.556	75.672	82.898	71.004	76.751	78.979
of which:[2])											
Transport[3])	.	.	.	911	21.379	21.462	21.113	21.295	25.306	27.632	22.950
Space heating and cooling, water heating	.	.	.	65.251	83.236	82.989	87.582	95.710	82.641	86.027	89.775
Lightning & computing	.	.	.	0	0	0	0	0	0	0	0
Steam production	.	.	.	25.087	29.698	28.112	26.832	34.014	31.042	29.501	36.762
Industry ovens	.	.	.	11.715	20.741	21.289	22.181	24.021	22.991	28.334	28.213
Stationary engines	.	.	.	33	1.269	1.402	1.304	1.625	1.576	362	360
Elektrochemical purposes	.	.	.	0	0	0	0	0	0	0	0

S: STATISTICS AUSTRIA, Energy statistics: Energy Balances Austria 1970 to 2016. Compiled on 15 December 2017. – Rounding differences caused by calculation. – 1) includes fuelwood, biomass, ambient energy, hydropower, wind and PV. – 2) Broken down by the structure of useful energy survey. – 3) Transport is the sum of traction and agricultural off road traction. "." data not available.

The sources – Supply surveys I

- Statistics Austria
  - Intrastat & Extrastat (m): Pellets, Woodchips, Logwood, Wood briquettes, Charcoal
  - Short Term Statistics (m): Pellets, Wood briquettes
- Fed. Ministry of Sustainability and Tourism
  - MOS Oil (m): Bioethanol, Biodiesel blended
- E-Control
  - CHP & Electricity Survey (a): Electricity and sold CHP Heat from RES
  - MOS-Gas (m): Bio-methane injected

The sources – Supply surveys II

- UBA (Environment Agency)
  - Biofuels for transport (a): Bioethanol, Biodiesel, Veg. Oil
- Technical University of Vienna (model based)
  - Ambient heat (a)
  - Solar heat (a)
  - PV (a)

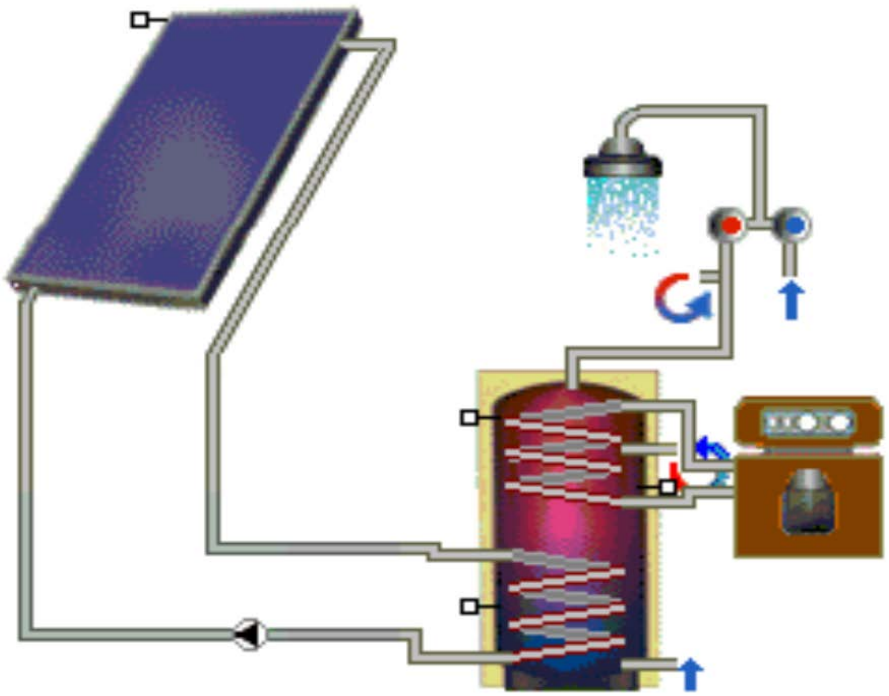
The sources – Consumption surveys I

- Statistics Austria
  - Household Energy Consumption Survey (2y): Logwood, Pellets, Woodbriquettes, Chips, Ambient & Solar Heat
  - **M**aterial **I**nput **S**urvey (MIS, large industry) (a)– Biofuels (heat), Ambient & Solar Heat
  - Energy Consumption Survey Services (a): Biofuels (heat), Ambient & Solar Heat
  - Energy Consumption Survey Industries (2y): Biofuels (heat), Ambient & Solar Heat
  - Until 2012: Survey on Biomass lighted District Heating Plants (5y)– Biofuels (heat)

The sources – Consumption surveys II

- E-Control
  - CHP & Electricity Survey (a): Biofuels (electricity and heat)
- UBA (Environment Agency)
  - Biofuels for transport (a): Bioethanol, Biodiesel, Veg. Oil pur
  - ETS (a): Biofuels (heat)
- Fed. Ministry of Sustainability and Tourism
  - Since 2013: Database on subsidized biomass lighted heat plants: Biofuels (heat)

Solar Heat



IEA/ESTIF (European Solar Thermal Industry Federation) method for calculating SH supply

- Simple to calculate
- Takes into account all systems relevant, for the time being
- Only sales data for solar panels needed
- Follows the IRES/IEA fuel definitions

Data Implementation Example: Solar heat 1

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1. **Solar heat supply (IEA/ESTIF methodology):**
    1. Annual survey on panels installed last year
    2. Calculation assumptions:
        1. A durability of 25 years
        2. National yield factors calculated with the IEA/ESTIF methodology and the global irradiation of Graz (1126 kWh/m²):

unglazed: 327 kWh/m²*year
glazed (DHW): 495 kWh/m²*year
glazed combi: 372 kWh/m²*year

Data Implementation Example: Solar heat 2

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2. Solar heat consumption of households:

1. Biannual survey on household energy consumption:
    1. Solar heat for hot water only
    2. Solar heat for hot water and space heating
2. Calculation assumptions:
    1. Energy demand for water heating is 1 199 kWh by person living in that household and year.
    2. If solar is used 70% of hot water used is coming from solar heat

Data Implementation Example: Solar heat 3

3. If solar is used as main heating system 70% of heat is coming from solar
4. If solar is used as auxiliary heating system 30%, 15% or 10%, depending on the number of auxiliary systems used, come from solar
5. Annual energy need for space heating in kWh by m² depending on dwelling type and construction period

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.

Data Implementation Example: Solar heat 4

Supply calculation:

1 716 GWh from glazed panels of which at least 93% of the installed panel area are attributed to households

That means 1 596 GWh are produced by households.

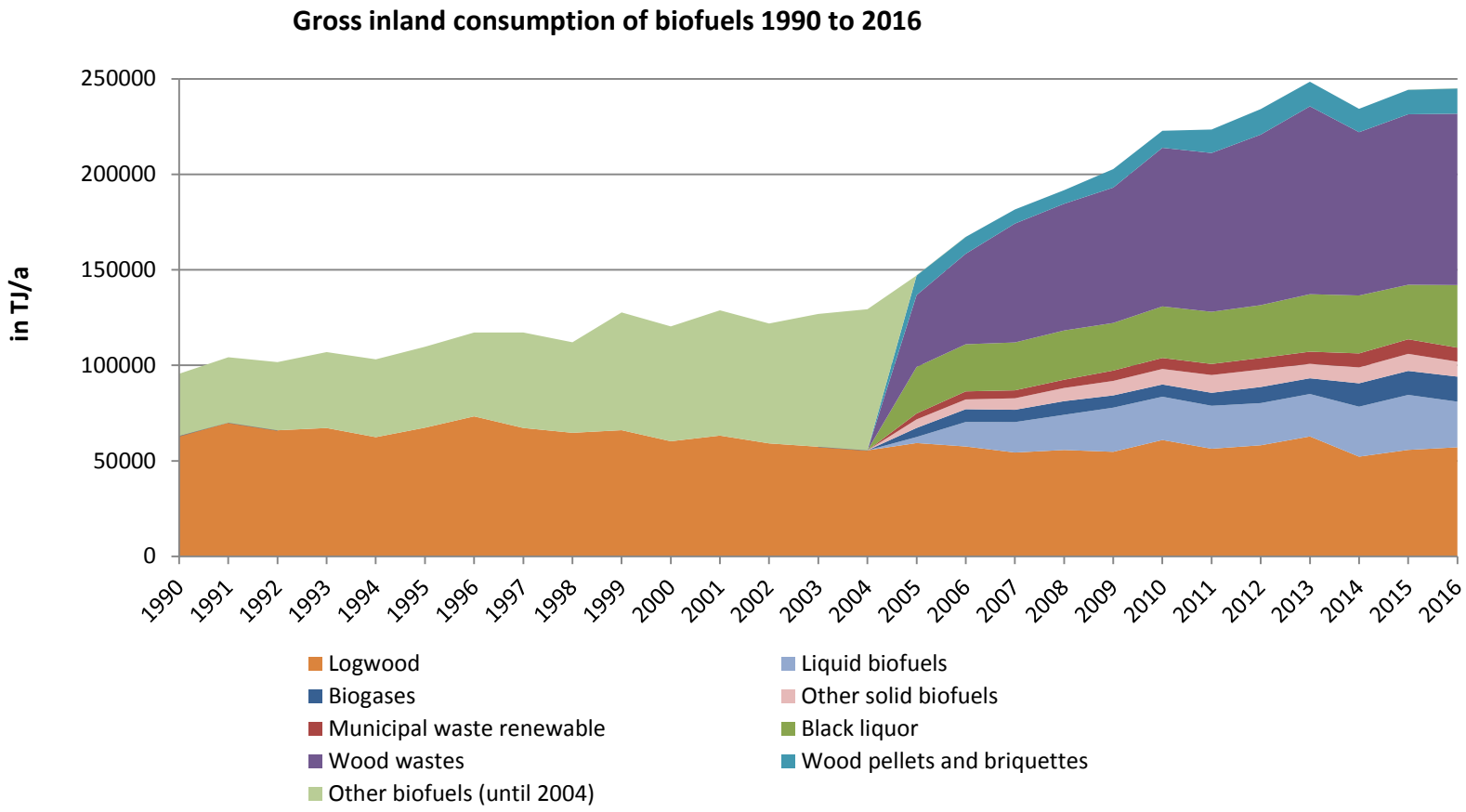
Consumption calculation:

Households consumed 1 287 GWh for water and space heating

Conlcusion:

Taking into account the production is measured at the panel exit and given transport losses of 10% (160 GWh) than 91% of the 1 436 GWh available from panels allocated to households are really consumed.

Biofuels in Austria 1990 to 2016



Biofuels standardised

- Standardised quality and constant calorific value
- Supply and consumption data available
- Standardised biofuels:
  - Biomethane injected
  - Bioethanol blended
  - Biodiesel blended
  - Wood-pellets
  - Wood-briquettes

Biofuels non standardised 1

General data problems….

- No specific surveys exist for non standardized biofuel supply like they normally do for fossil fuels.
- Production data as well as foreign trade data for such biofuels are fragmentarily, missing or are not differentiated into products for energy and non energy use.
- No satisfying stock information exists
- No exact information on non energy use of wood products e. g. for the manufacture of plywood, laminboard, particle board, fiber board and other boards and panels

Biofuels non standardised 2

..and a lot of biomass specific problems..

1. Diversity of the fuels
2. Inhomogeneous fuels
3. Diversity of units (m^3 [scu], m^3 [bv], sm^3, t)
4. Conversion factors
5. Wide range of water content – calorific values
6. Unclear boundaries between biofuels and (non renewable/hazardous) wastes

Data alignment between MIS – ETS – CHP

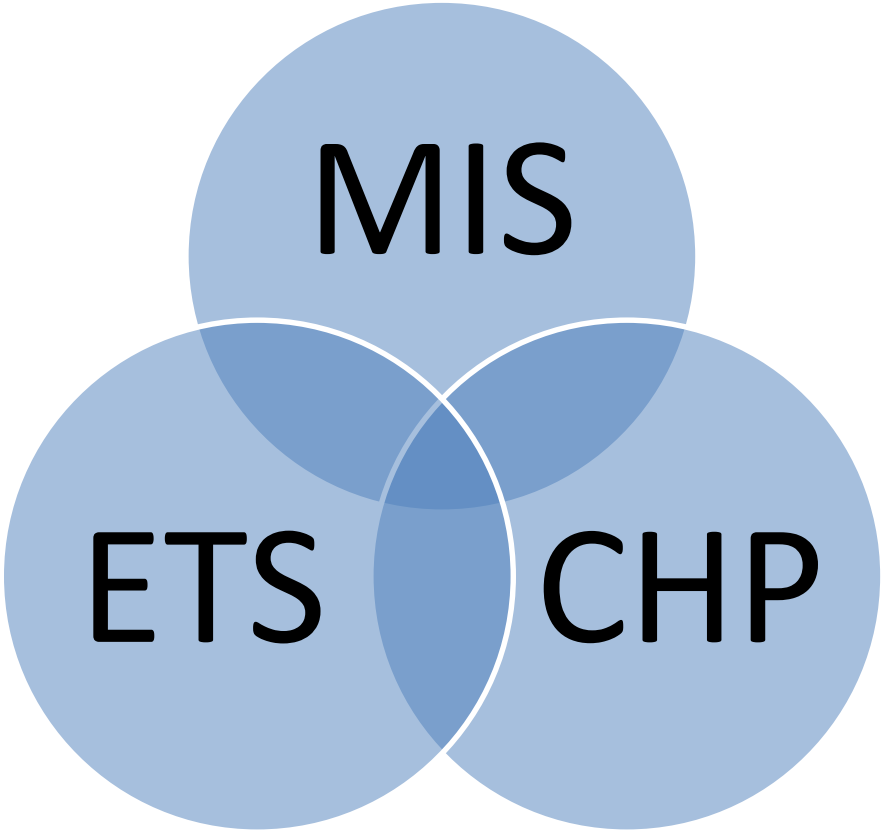
- This alignment starts with the reporting year 2009 and is done on enterprise and fuel level.
- This in depth comparison became necessary, because many respondents do not report in the same manner in the three surveys. To compare the survey results on sectoral level, as it was done before, caused double counting. So e.g. respondents report production residuals in one survey as industrial wastes and in the others as biomass.
- The prerequisites for this exercise are:
  - all **enterprises are clearly identified** in all three datasets
  - all **fuels** reported in the three surveys **are unambiguously allocated** to each other.

Data synchronisation between MIS – ETS – CHP

- MIS data
  - Include overall energy consumption (transformation input and final energy consumption) of each enterprise in physical and monetary units.
  - Therefore MIS (theoretically) gives **the highest quantities** of all surveys
- ETS data
  - Include all transformation inputs for electricity and heat and FEC of the participating plants on fuel level in physical and energy units.
  - Include (theoretically) the **most trustable data** (checked by independent experts)
  - Include additional information like composition of industrial wastes (shares of renewable and non-renewable components) and CV.
- Power plant- and CHP data
  - Include all transformation input and output quantities for all power- and CHP plants with an installed electrical capacity >= 1MW on plant and fuel level in physical and energy units.
  - Include (theoretically) the **most plausible data** because they are checked with the transformation efficiency.

Alignment of the main data sources for industrial energy use

MIS: overall consumption only physical



ETS: extremely detailed fuels physical& energy

CHP: physical&energy

The sources – Consumption modelling

- Extrapolation of RES use for space heating for years after the last survey with heating degree days and after the next survey recalculation of the years between the two surveys with heating degree days and progressive averages.
- Split of the CHP survey data into CHP transformation, electricity only transformation and final energy consumption by following the IEA/Eurostat CHP reporting guidelines.
- Calculation of fuel input into and heat output from biomass fired district heating plants.

Biomass lighted district heating plants 1

Model assumptions

1. Fuel mix used in these plants is rather constant
2. The efficiency of the transformation process remains rather constant, too.
3. Heat production is correlated with installed capacity and temperature.

Model input

1. Annual survey of installed capacity
2. Continuous calculation of heating degree days.
3. Fuel input by fuel type into biomass lighted district heating plants and corresponding heat production on plant level 1997, 2005 and 2010. Since 2013 use annual data from a database on subsidized plants

Biomass lighted district heating plants 2

➢ Modeling steps until 2012

1. Calculation fuel input in TJ by installed MW and heating degree day for the reporting years.
2. Calculation of the typical fuel mix for the reporting years
3. Calculation of actual heat production with the formula (for Austria 2005):
   Heat(kWh)= Installed MW * Actual Degree Days *0,4695 (=kWh heat output by MW_i and degree day)
4. Calculation of actual fuel input after the last survey with the fuel mix relations and efficiencies of the last reporting year.
5. The district heat produced and fuels used between two survey years are calculated with the currently installed capacity, the respective Heating Degree Days and the moving average between two survey years.

Biomass lighted district heating plants 3

➢ Modeling steps since 2013

1. Calculation fuel input in TJ by installed MW and heating degree day for the reporting units.
2. Application of the results to the overall population
3. Calculation of the typical fuel mix for the overall population
4. Calculation of actual heat production

   Formula for Austria 2016:

   Heat(kWh)= Installed MW * Actual Degree Days

   *0,5721 (=kWh heat output by MW_i and degree day)

Coefficients calculated for 2005 and 2016

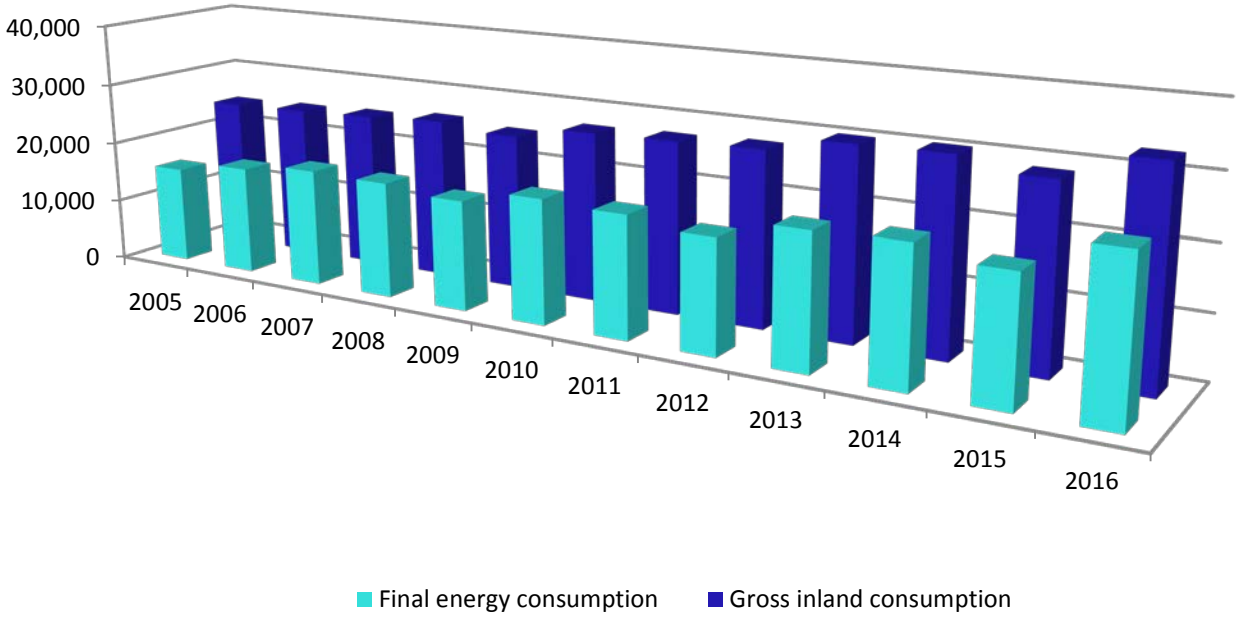
2005	heat MWh/ MW*HDD	bark (t / MW*HDD)	Wood chips (industry) (t/MW*HDD)	Saw dust (t/MW*HDD)	Wood chips (forestry) (t/MW*HDD)	Other biomass. (t/MW*HDD)	Straw (t/MW*HDD)	Natural gas (1 000 m³/ MW*HDD)	Fuel oil (t/MW*HDD)
B	0,4486	0,0106	0,0119	0,0018	0,1245	0,0000	0,0144	0,0002	0,0003
C	0,3593	0,0061	0,0188	0,0081	0,1009	0,0000	0,0032	0,0000	0,0008
LA	0,4521	0,0116	0,0199	0,0049	0,1308	0,0016	0,0035	0,0002	0,0014
UA	0,4259	0,0119	0,0314	0,0053	0,0998	0,0000	0,0046	0,0001	0,0002
S	0,4941	0,0240	0,0365	0,0040	0,1070	0,0000	0,0032	0,0002	0,0002
ST	0,4021	0,0192	0,0213	0,0103	0,1025	0,0009	0,0034	0,0003	0,0007
T	0,3655	0,0085	0,0334	0,0048	0,0927	0,0000	0,0006	0,0000	0,0004
V	0,4274	0,0007	0,0619	0,0006	0,0801	0,0000	0,0129	0,0002	0,0007
2016	heat MWh/MW*HDD	bark (t / MW*HDD)	Wood chips (industry) (t/MW*HDD)	Saw dust (t/ MW*HDD)	Wood chips (forestry) (t/MW*HDD)	Other biomass. (t/MW*HDD)	Straw (t/MW*HDD)	Natural gas (1 000 m³/ MW*HDD)	Fuel oil (t/MW*HDD)
B	0,5880	0,0008	0,2152	0,0116	0,0000	0,0062	0,0000	0,0032	0,0001
C	0,5283	0,0014	0,1797	0,0077	0,0009	0,0000	0,0000	0,0019	0,0018
LA	0,5951	0,0047	0,2280	0,0060	0,0026	0,0028	0,0000	0,0022	0,0003
UA	0,5814	0,0027	0,2049	0,0159	0,0000	0,0000	0,0000	0,0004	0,0001
S	0,5385	0,0068	0,1600	0,0164	0,0025	0,0000	0,0000	0,0007	0,0008
St	0,5922	0,0060	0,2206	0,0096	0,0000	0,0000	0,0000	0,0004	0,0002
T	0,5769	0,0155	0,1815	0,0234	0,0000	0,0000	0,0029	0,0012	0,0007
V	0,5321	0,0100	0,1325	0,0340	0,0024	0,0000	0,0000	0,0020	0,0009

Conclusions 1

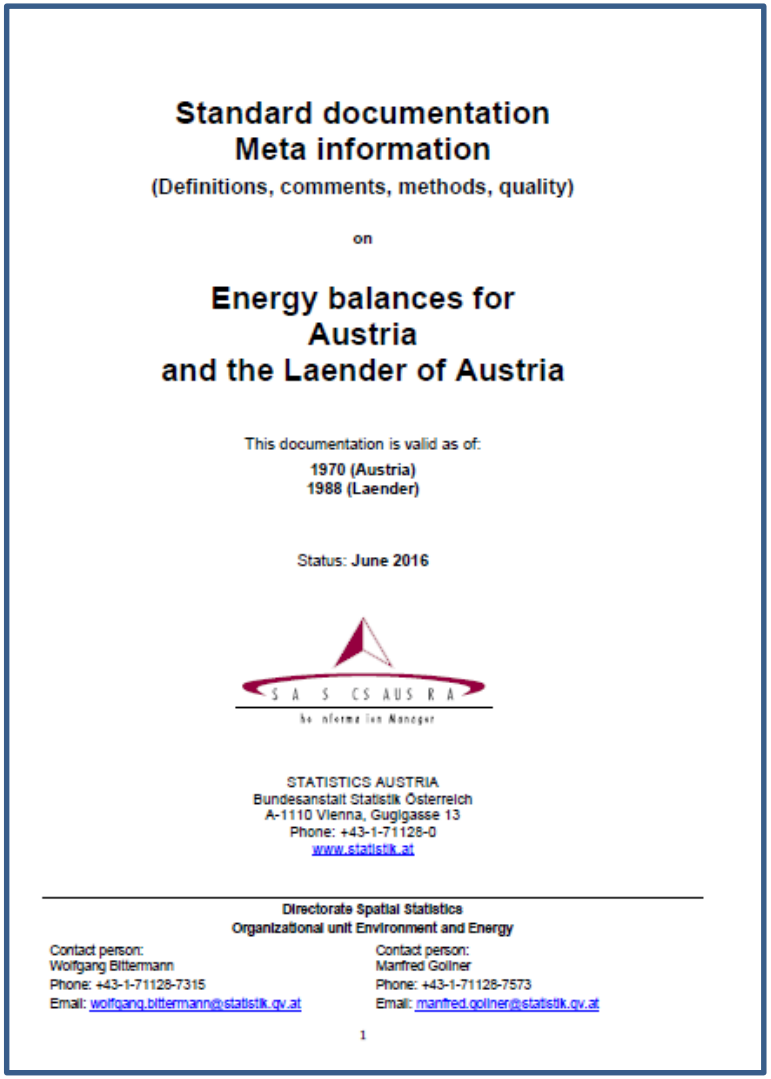
- Biofuel and wastes statistics base to a great extent on consumption data and model based calculations only.
- Wood waste, other wastes and black liquor normally are not purchased, and therefore data quality often is not the best and it is impossible to adjust the data with monetary information.
- For these reasons the data are of less quality than information about fossil fuels which base on supply and consumption data as well as on physical and monetary information.

Conclusions 2

- On the other hand the consistency of time series based on surveys tells us that these statistics give good information on the development although the absolute amount cannot be verified in all cases.



For more information.....



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

on

Energy balances for Austria and the Laender of Austria

This documentation is valid as of:
1970 (Austria)
1988 (Laender)

Status: **June 2016**

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Thank you for your attention