AUSTRIAN ENERGY AGENCY

The cost competitiveness of wood

against other fuels

Dietmar Hagauer

General information

- shortage of resources
- rising prices
- rising energyconsumtion

thus we know we need

- mobilisation of timber in the forests
- improving energy efficiency for the timber sector
- Short Rotation Forestry

Political goals for Austria

2020: **34 %** Renewables in final energyconsumption (about **500 PJ**) → ac. RES-directive-proposal 2007/19/EG	2016: **9 %** Energysavingsbenchmark or 80,4 PJ energysavings → ac. Energyefficiency- and Energyservices directive 2006/32/EG
2020: 20 % Improvement of energyintensity → ac. Program of government	2020: Decrease of energyconsumption for 20 % (as measured by forecasts) → ac. EU Council in March 2007

Austrian Initiatives to promote Energy Efficiency (1)

Ambitious targets concerning energy efficiency:

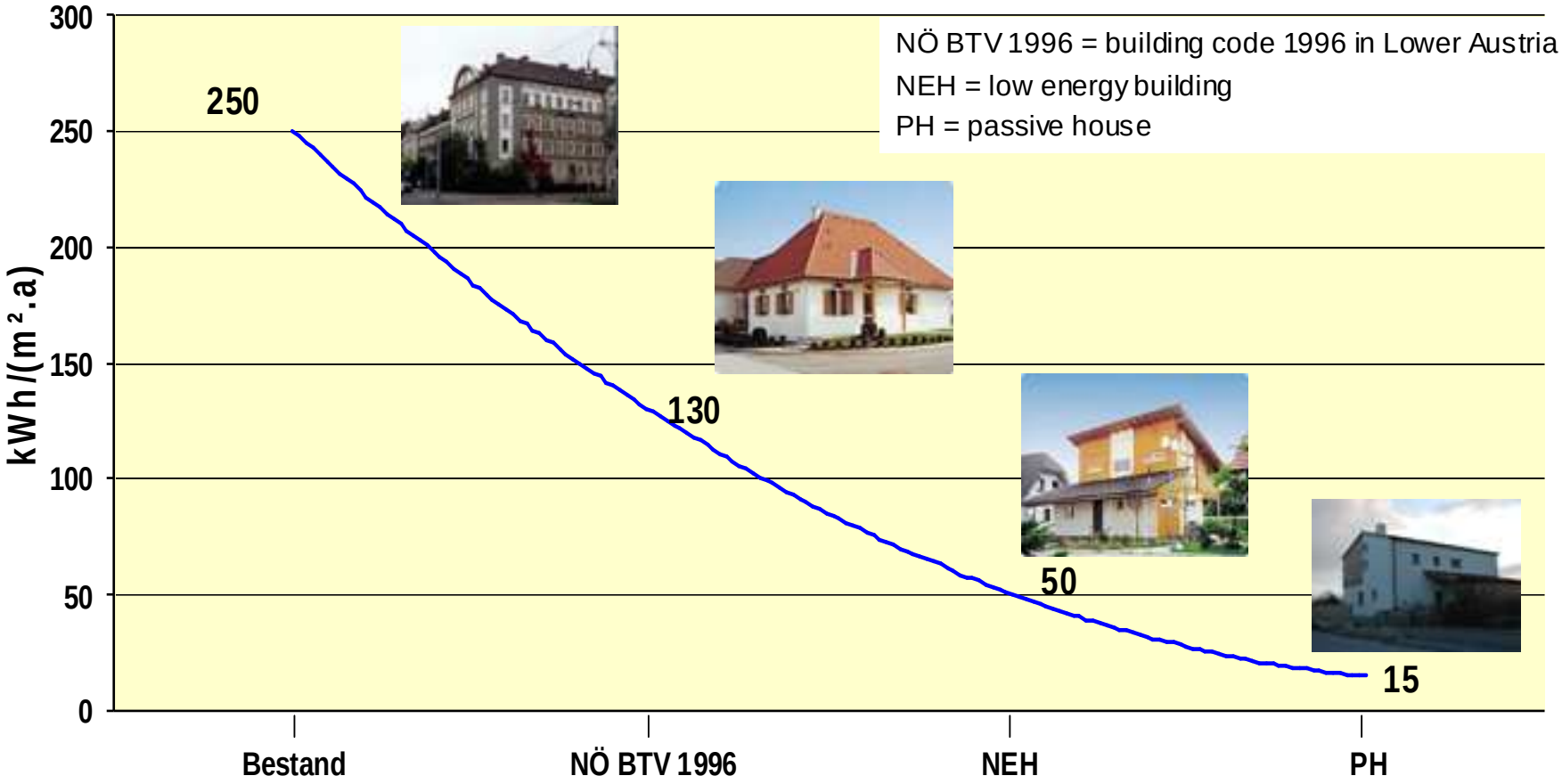
- A National Energy Efficiency Action Plan, coordinated by the Austrian Energy Agency
- Reduction of energy intensity by a minimum of 5 % until 2010 and a minimum of 20 % until 2020
- Energy-Check of all Austrian households until 2010
- Increasing the renovation rate in all buildings, which should enable the thermal renovation of all postwar buildings (1950-1980) until 2010
- For 50 % of new buildings a klima:aktiv standard is the aim
- From 2015 housing subsidies will only be granted for buildings which meet the “klima:aktiv-Passive house standard”
- Development and utilisation of energy efficient equipment and solutions (stand-by)
- expanding of combined heat and power as an efficient method for the production of electricity and heat

Austrian Initiatives to promote Energy Efficiency (2)

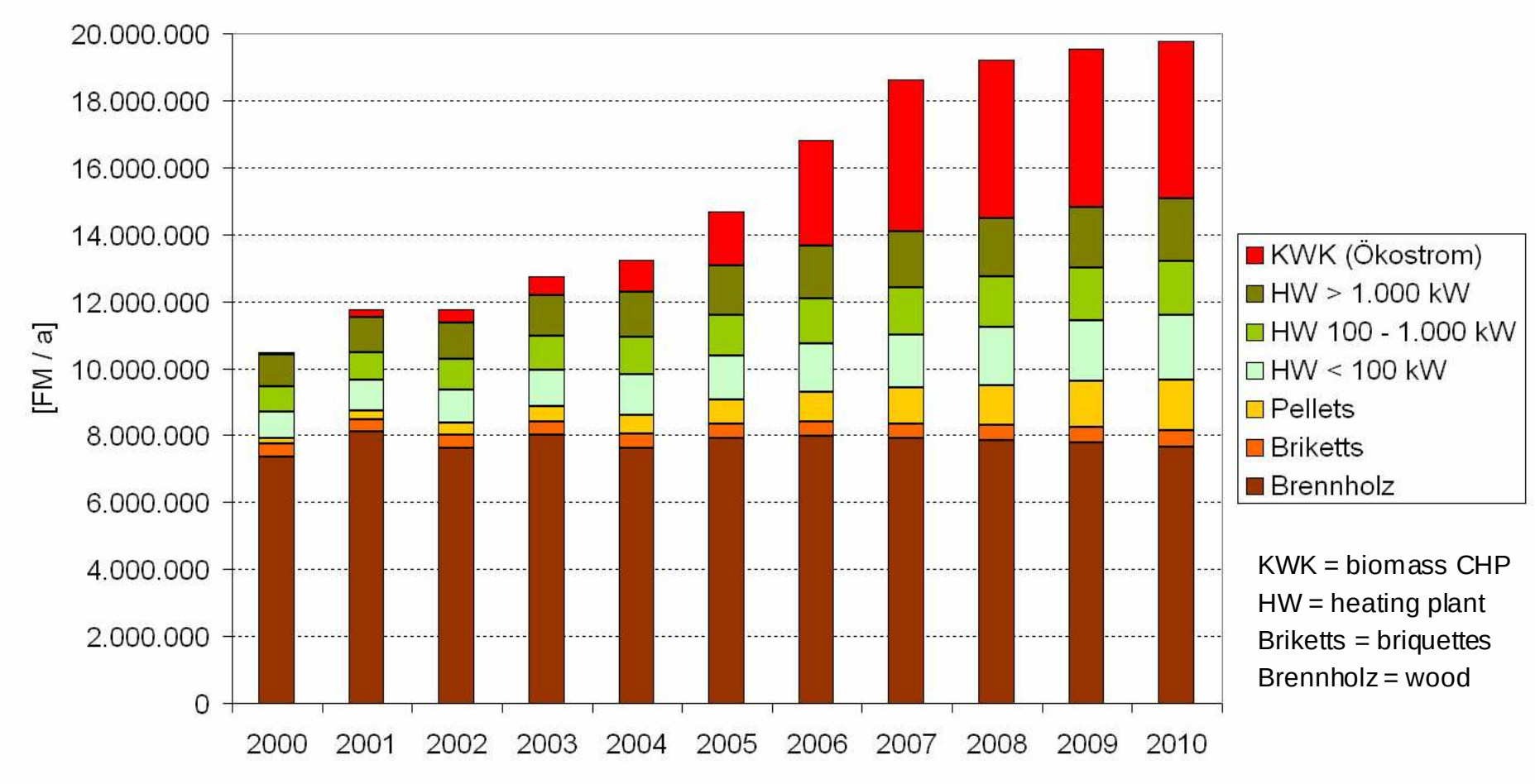
- **New National Climate Strategy**
  - Austria has committed to reduce its GHG-emissions by 13% (compared to 1990) until the period 2008/2012.
  - The Climate Strategy 2007 focuses on a broad mixture of measures and is substantially based on the following pillars: Industry, Housing, Development of urban public transport and the purchase of CO2-emission certificates.

- **Climate- and Energy Fond**.
  - This Fond is operative since July 2007. The Fond is endowed with € 500 Million, and € 50 Million of the overall budget are supposed to be spent until the end of 2007. For the following three years, a spending budget of € 150 Million is planned.

Massive reduction of specific heat demand of new buildings since the 90ies



Biomass: High demand for fuel



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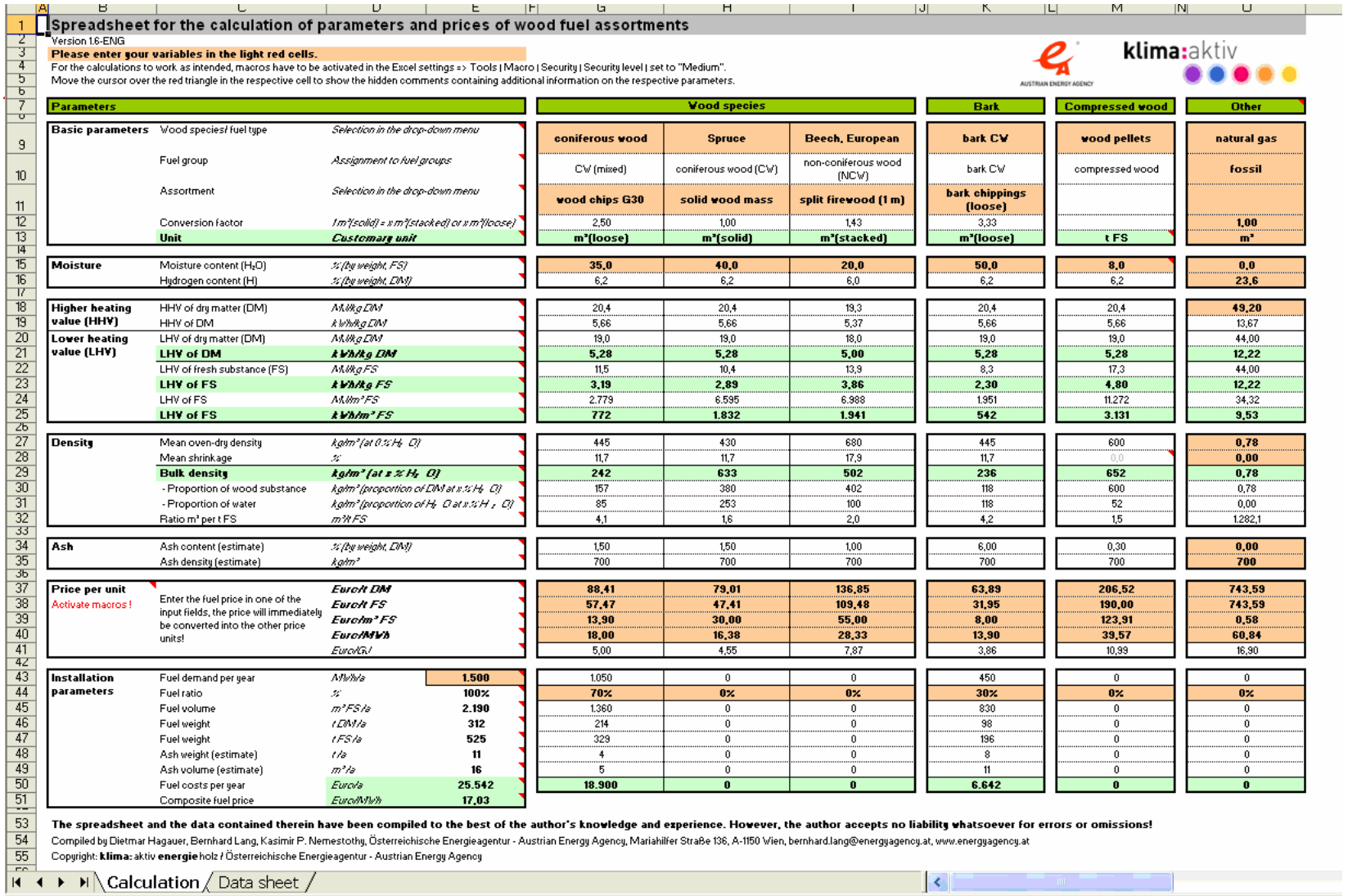
calculation of wood fuel parameters



Spreadsheet for the calculation of parameters and prices of wood fuel assortments

Version 1.6-ENG

Please enter your variables in the light red cells.

For the calculations to work as intended, macros have to be activated in the Excel settings => Tools | Macro | Security | Security level | set to "Medium".
Move the cursor over the red triangle in the respective cell to show the hidden comments containing additional information on the respective parameters.

klima:aktiv

Parameters				Wood species			Bark	Compressed wood	Other
Basic parameters	Wood species/ fuel type	*Selection in the drop-down menu*		**coniferous wood**	**Spruce**	**Beech, European**	**bark CW**	**wood pellets**	**natural gas**
	Fuel group	*Assignment to fuel groups*		CW (mixed)	coniferous wood (CW)	non-coniferous wood (NCW)	bark CW	compressed wood	**fossil**
	Assortment	*Selection in the drop-down menu*		**wood chips G30**	**solid wood mass**	**split firewood (1 m)**	**bark chippings (loose)**		
	Conversion factor	*1 m³(solid) = x m³(stacked) or x m³(loose)*		2,50	1,00	1,43	3,33		**1,00**
	Unit	***Customary unit***		**m³(loose)**	**m³(solid)**	**m³(stacked)**	**m³(loose)**	**t FS**	**m³**
Moisture	Moisture content (H_2O)	*% (by weight, FS)*		**35,0**	**40,0**	**20,0**	**50,0**	**8,0**	**0,0**
	Hydrogen content (H)	*% (by weight, DM)*		6,2	6,2	6,0	6,2	6,2	**23,6**
Higher heating value (HHV)	HHV of dry matter (DM)	*MWh/t DM*		20,4	20,4	19,3	20,4	20,4	**49,20**
	HHV of DM	*kWh/kg DM*		5,66	5,66	5,37	5,66	5,66	13,67
Lower heating value (LHV)	LHV of dry matter (DM)	*MWh/t DM*		19,0	19,0	18,0	19,0	19,0	44,00
	LHV of DM	***kWh/kg DM***		**5,28**	**5,28**	**5,00**	**5,28**	**5,28**	**12,22**
	LHV of fresh substance (FS)	*MWh/t FS*		11,5	10,4	13,9	8,3	17,3	44,00
	LHV of FS	***kWh/kg FS***		**3,19**	**2,89**	**3,86**	**2,30**	**4,80**	**12,22**
	LHV of FS	*MWh/m³ FS*		2,779	6,595	6,988	1,951	11,272	34,32
	LHV of FS	***kWh/m³ FS***		**772**	**1.832**	**1.941**	**542**	**3.131**	**9,53**
Density	Mean oven-dry density	*kg/m³ (at 0 % H_2O)*		445	430	680	445	600	**0,78**
	Mean shrinkage	*%*		11,7	11,7	17,9	11,7	0,0	**0,00**
	Bulk density	***kg/m³ (at x % H_2O)***		**242**	**633**	**502**	**236**	**652**	**0,78**
	- Proportion of wood substance	*kg/m³ (proportion of DM at x % H_2O)*		157	380	402	118	600	0,78
	- Proportion of water	*kg/m³ (proportion of H_2O at x % H_2O)*		85	253	100	118	52	0,00
	Ratio m³ per t FS	*m³/t FS*		4,1	1,6	2,0	4,2	1,5	1.282,1
Ash	Ash content (estimate)	*% (by weight, DM)*		1,50	1,50	1,00	6,00	0,30	**0,00**
	Ash density (estimate)	*kg/m³*		700	700	700	700	700	**700**
Price per unit	Enter the fuel price in one of the input fields, the price will immediately be converted into the other price units!	***Euro/t DM***		**88,41**	**79,01**	**136,85**	**63,89**	**206,52**	**743,59**
Activate macros !		***Euro/t FS***		**57,47**	**47,41**	**109,48**	**31,95**	**190,00**	**743,59**
		Euro/m³ FS		**13,90**	**30,00**	**55,00**	**8,00**	**123,91**	**0,58**
		Euro/MWh		**18,00**	**16,38**	**28,33**	**13,90**	**39,57**	**60,84**
		Euro/GJ		5,00	4,55	7,87	3,86	10,99	16,90
Installation parameters	Fuel demand per year	*MWh/a*	**1.500**	1.050	0	0	450	0	0
	Fuel ratio	*%*	**100%**	**70%**	**0%**	**0%**	**30%**	**0%**	**0%**
	Fuel volume	*m³ FS/a*	**2.190**	1.360	0	0	830	0	0
	Fuel weight	*t DM/a*	**312**	214	0	0	98	0	0
	Fuel weight	*t FS/a*	**525**	329	0	0	196	0	0
	Ash weight (estimate)	*t/a*	**11**	4	0	0	8	0	0
	Ash volume (estimate)	*m³/a*	**16**	5	0	0	11	0	0
	Fuel costs per year	*Euro/a*	**25.542**	**18.900**	**0**	**0**	**6.642**	**0**	**0**
	Composite fuel price	*Euro/MWh*	**17,03**						

The spreadsheet and the data contained therein have been compiled to the best of the author's knowledge and experience. However, the author accepts no liability whatsoever for errors or omissions!

Compiled by Dietmar Hagauer, Bernhard Lang, Kasimir P. Nemestothy, Österreichische Energieagentur - Austrian Energy Agency, Mariahilfer Straße 136, A-1150 Wien, bernhard.lang@energyagency.at, www.energyagency.at

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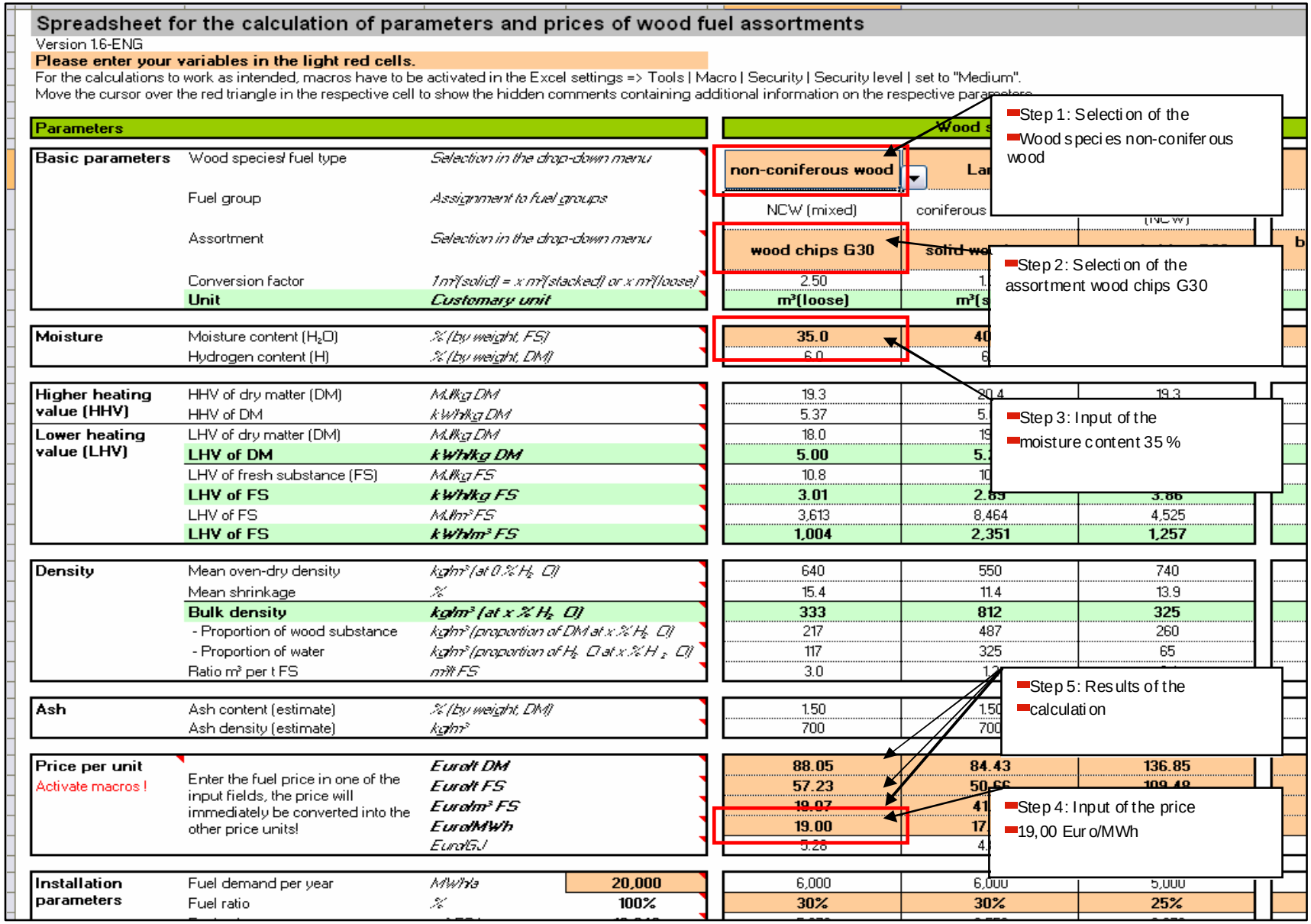
Calculation / Data sheet

Bereit



Spreadsheet for the calculation of parameters and prices of wood fuel assortments

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Move the cursor over the red triangle in the respective cell to show the hidden comments containing additional information on the respective parameters.

Parameters						
Basic parameters	Wood species/ fuel type	*Selection in the drop-down menu*	non-coniferous wood	La		
	Fuel group	*Assignment to fuel groups*	NCW (mixed)	coniferous		
	Assortment	*Selection in the drop-down menu*	wood chips G30	solid wo		b
	Conversion factor	*1 m³(solid) = x m³(stacked) or x m³(loose)*	2.50	1.		
	Unit	***Customary unit***	**m³(loose)**	**m³(s**		
Moisture	Moisture content (H_2O)	*% (by weight, FS)*	**35.0**	**40**		
	Hydrogen content (H)	*% (by weight, DM)*	6.0	6		
Higher heating value (HHV)	HHV of dry matter (DM)	*MJ/kg DM*	19.3	20.4	19.3	
	HHV of DM	*kWh/kg DM*	5.37	5.		
Lower heating value (LHV)	LHV of dry matter (DM)	*MJ/kg DM*	18.0	19		
	LHV of DM	***kWh/kg DM***	**5.00**	**5.**		
	LHV of fresh substance (FS)	*MJ/kg FS*	10.8	10		
	LHV of FS	***kWh/kg FS***	**3.01**	**2.69**	**3.86**	
	LHV of FS	*MJ/m³ FS*	3,613	8,464	4,525	
	LHV of FS	***kWh/m³ FS***	**1,004**	**2,351**	**1,257**	
Density	Mean oven-dry density	*kg/m³ (at 0 % H_2O)*	640	550	740	
	Mean shrinkage	*%*	15.4	11.4	13.9	
	Bulk density	***kg/m³ (at x % H_2O)***	**333**	**812**	**325**	
	- Proportion of wood substance	*kg/m³ (proportion of DM at x % H_2O)*	217	487	260	
	- Proportion of water	*kg/m³ (proportion of H_2O at x % H_2O)*	117	325	65	
	Ratio m³ per t FS	*m³/t FS*	3.0	1.		
Ash	Ash content (estimate)	*% (by weight, DM)*	1.50	1.50		
	Ash density (estimate)	*kg/m³*	700	700		
Price per unit	Activate macros !		**88.05**	**84.43**	**136.85**	
	Enter the fuel price in one of the input fields, the price will immediately be converted into the other price units!	***Euro/t DM***	**57.23**	**50.66**	**109.48**	
		Euro/t FS	**19.07**	**41**		
		Euro/m³ FS	**19.00**	**17**		
		Euro/MWh	5.28	4.		
		Euro/GJ				
Installation parameters	Fuel demand per year	*MWh/a*	**20,000**	6,000	6,000	5,000
	Fuel ratio	*%*	**100%**	**30%**	**30%**	**25%**

Step 1: Selection of the Wood species non-coniferous wood

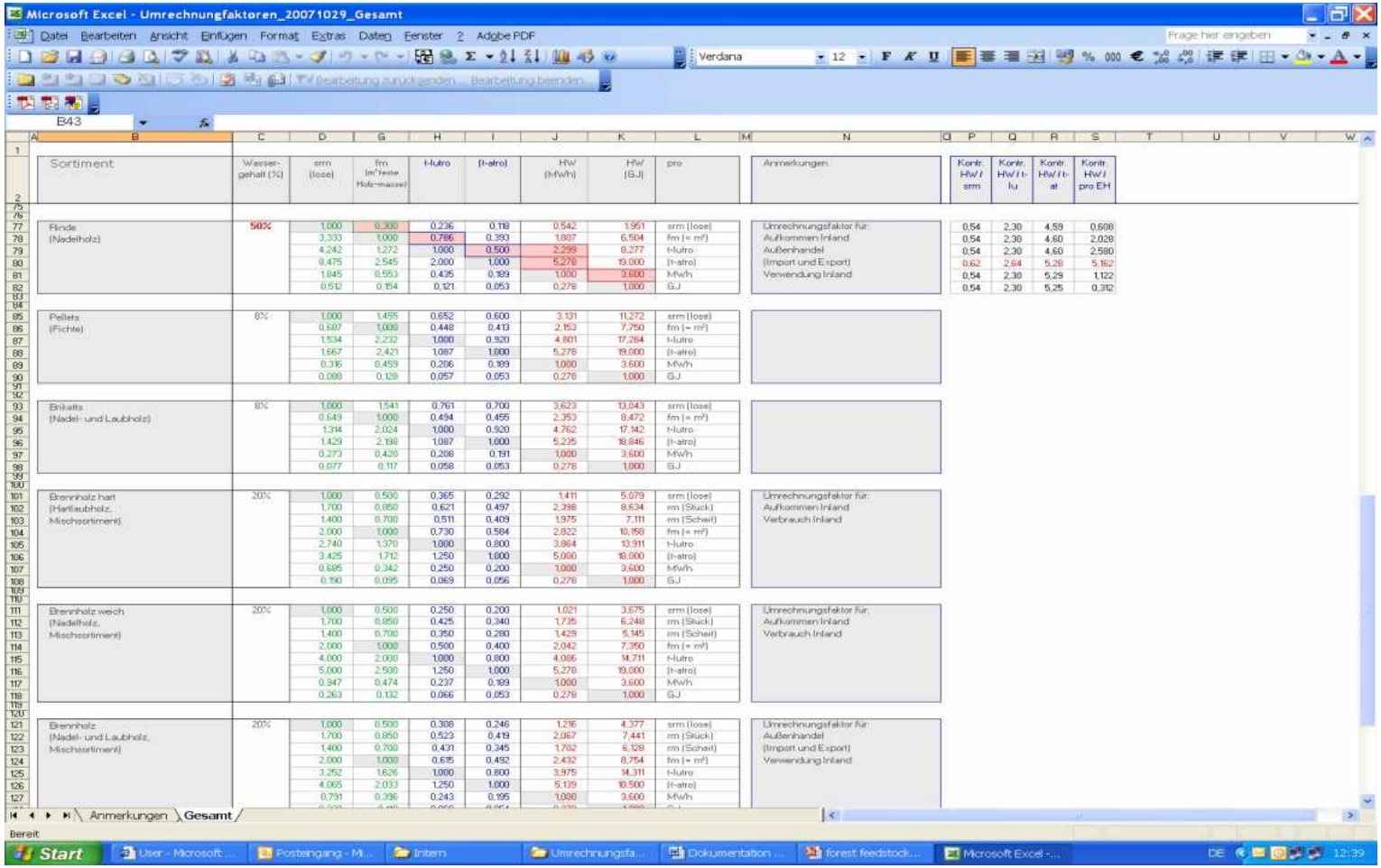
Step 2: Selection of the assortment wood chips G30

Step 3: Input of the moisture content 35 %

Step 4: Input of the price 19,00 Euro/MWh

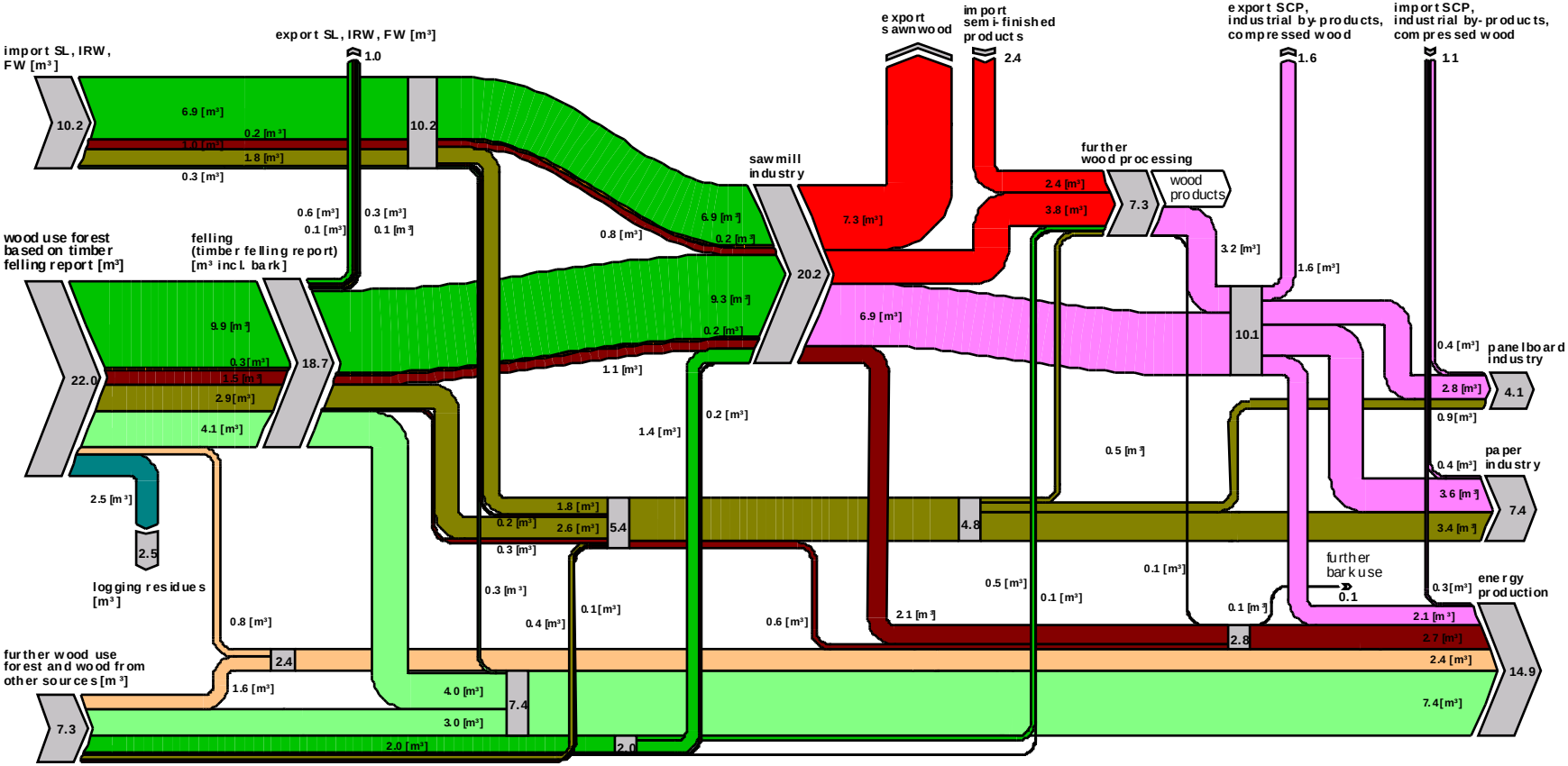
Step 5: Results of the calculation

Conversion factors for wood fuels (volume – weight – energy content)



AUSTRIAN ENERGY AGENCY

Woodflow Austria 2005



LEGEND (all values in millions [m³]; streams < 0.1 million m³ are not shown)

- sawlogs (SL)
- industrial roundwood (IRW)
- firewood (FW) incl. bark
- logging residues
- sawmill co-products (SCP), industrial by-products, compressed wood
- off-cuts
- bark
- forest chips
- sawnwood and semi-finished products

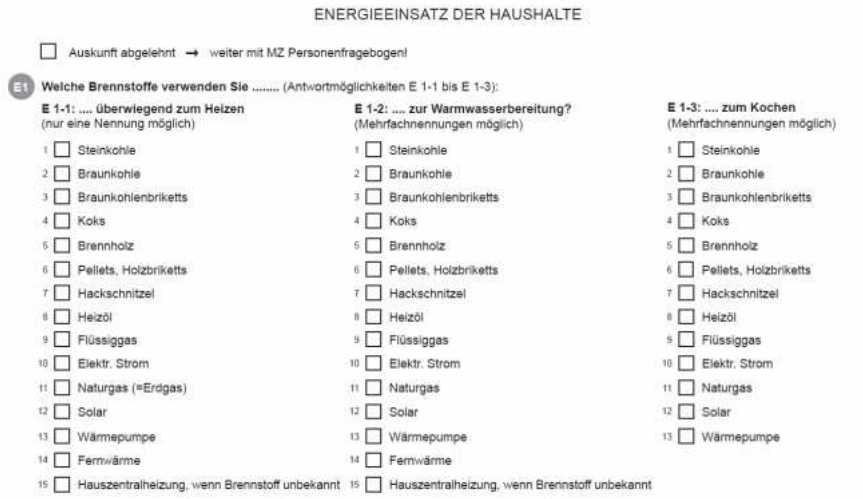
date: november 2007

Problems in drawing the wood flow - example firewood (1)

- Investigation of data by Statistics Austria in „Microzensus Energy“ every 2 years
- 1% of Austria`s households = approx. 23.000 HH
- Model taking into account the heating days
- Longterm average approx. 65 PJ
- Suggestions

  for conversion

  in PJ:
  - Coniferous wood/non
  - 20 % water content
  - 660 kg lutro/m³
  - approx. 9,4 PJ/million m³



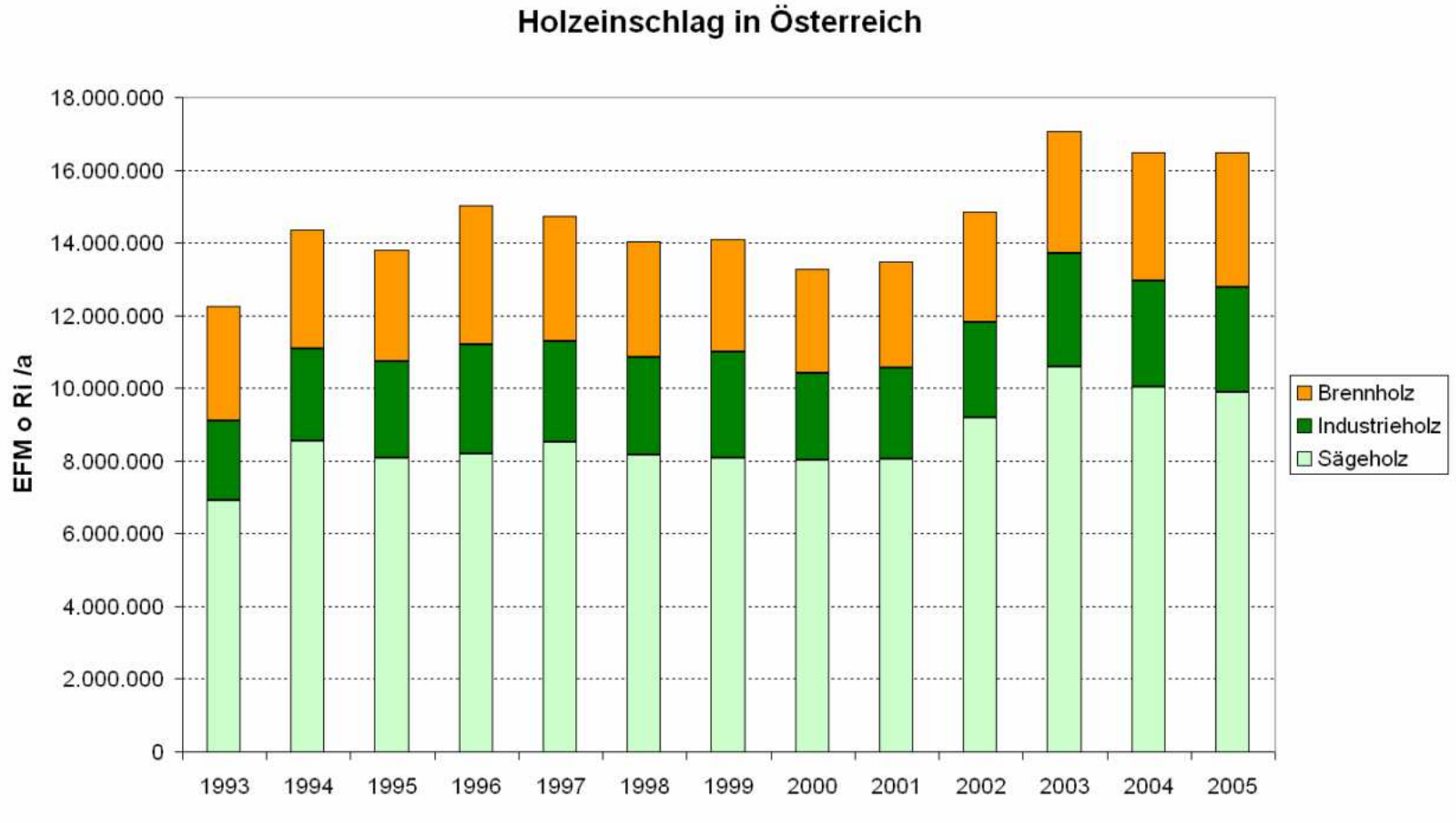
ENERGIEEINSATZ DER HAUSHALTE

☐ Auskunft abgelehnt → weiter mit MZ Personenfragebogen!

E1 **Welche Brennstoffe verwenden Sie .....** (Antwortmöglichkeiten E 1-1 bis E 1-3):

E 1-1: .... überwiegend zum Heizen (nur eine Nennung möglich)	**E 1-2: .... zur Warmwasserbereitung?** (Mehrfachnennungen möglich)	**E 1-3: .... zum Kochen** (Mehrfachnennungen möglich)
1 ☐ Steinkohle	1 ☐ Steinkohle	1 ☐ Steinkohle
2 ☐ Braunkohle	2 ☐ Braunkohle	2 ☐ Braunkohle
3 ☐ Braunkohlenbriketts	3 ☐ Braunkohlenbriketts	3 ☐ Braunkohlenbriketts
4 ☐ Koks	4 ☐ Koks	4 ☐ Koks
5 ☐ Brennholz	5 ☐ Brennholz	5 ☐ Brennholz
6 ☐ Pellets, Holzbriketts	6 ☐ Pellets, Holzbriketts	6 ☐ Pellets, Holzbriketts
7 ☐ Hackschnitzel	7 ☐ Hackschnitzel	7 ☐ Hackschnitzel
8 ☐ Heizöl	8 ☐ Heizöl	8 ☐ Heizöl
9 ☐ Flüssiggas	9 ☐ Flüssiggas	9 ☐ Flüssiggas
10 ☐ Elektr. Strom	10 ☐ Elektr. Strom	10 ☐ Elektr. Strom
11 ☐ Naturgas (=Erdgas)	11 ☐ Naturgas	11 ☐ Naturgas
12 ☐ Solar	12 ☐ Solar	12 ☐ Solar
13 ☐ Wärmepumpe	13 ☐ Wärmepumpe	13 ☐ Wärmepumpe
14 ☐ Fernwärme	14 ☐ Fernwärme	
15 ☐ Hauszentralheizung, wenn Brennstoff unbekannt	15 ☐ Hauszentralheizung, wenn Brennstoff unbekannt	

Problems in drawing the wood flow - example firewood (2)



Source: BMLFUW

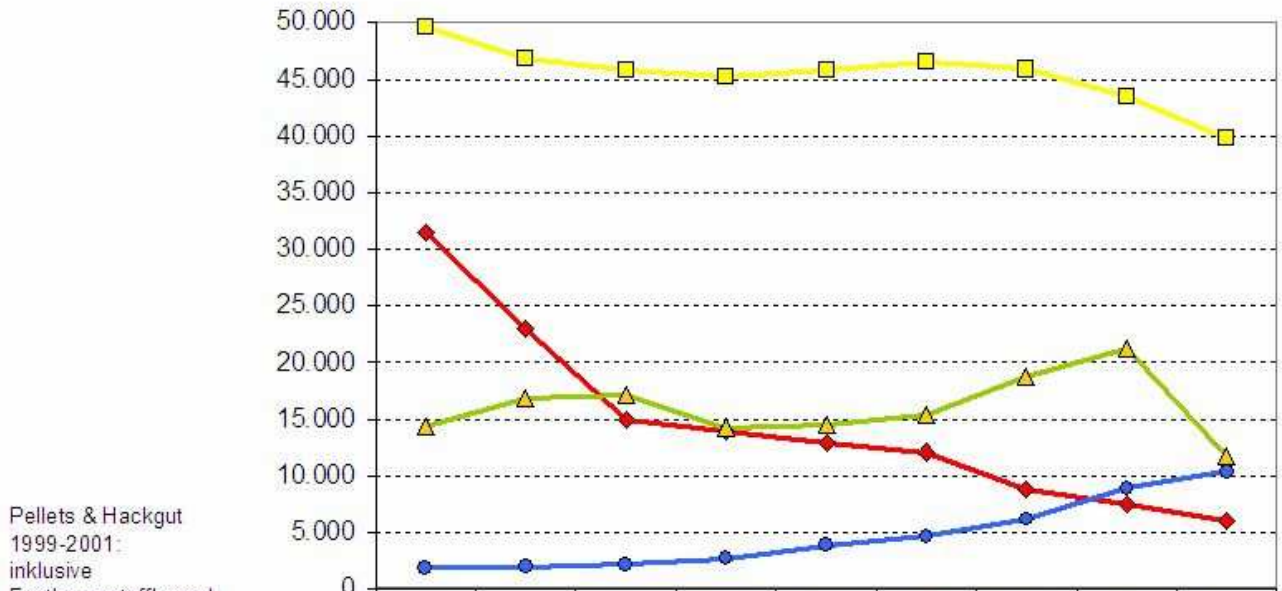
Big differences

Cutting of firewood by HEM:
3 - 4 million m³ without bark per year

Use of firewood by Statistics Austria:
7 – 8 million m³ / year

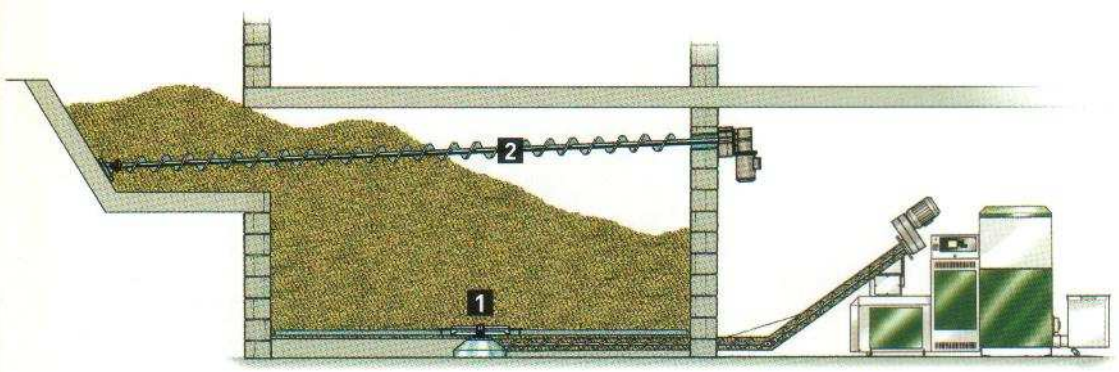
Explanations:
- **Too low estimation of cutting figures by HEM**
- **Use of firewood from non-forest-areas (parks, wine yards etc.)**
- **Use of recycling wood for firewood (especially in rural areas)**

New Installation of Boilers in Austria

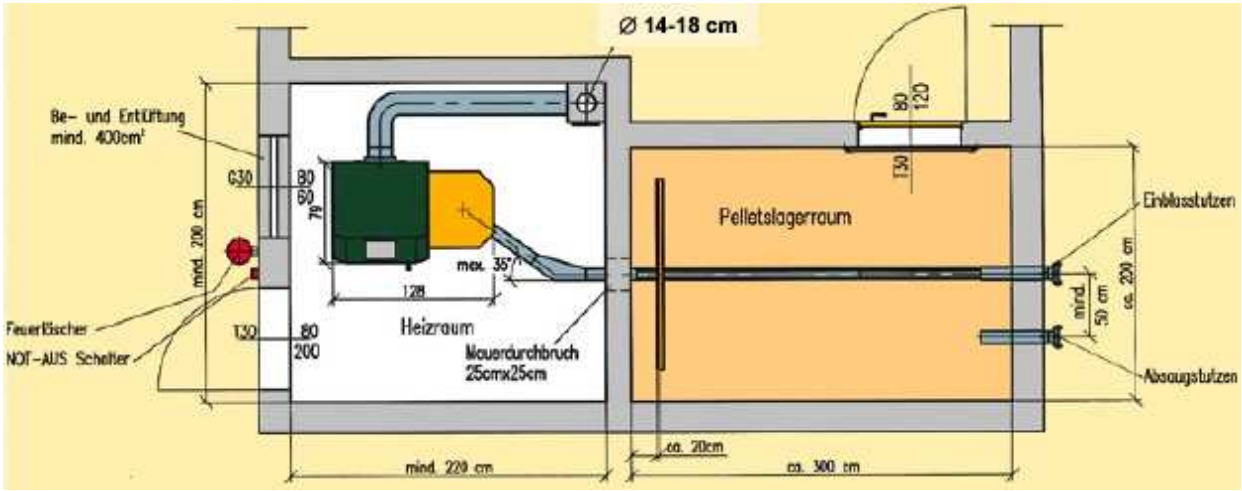


	1999	2000	2001	2002	2003	2004	2005	2006	2007
Öl	31.500	23.000	15.000	14.000	12.900	12.100	8.800	7.500	6.100
Erdgas	49.600	46.900	45.800	45.300	45.800	46.600	45.900	43.500	39.800
Pellets/Hackgut/Stückholz	14.400	16.800	17.100	14.300	14.500	15.400	18.800	21.300	11.800
Wärmepumpen	1.900	2.000	2.200	2.700	3.900	4.700	6.200	8.900	10.400

Different parameters

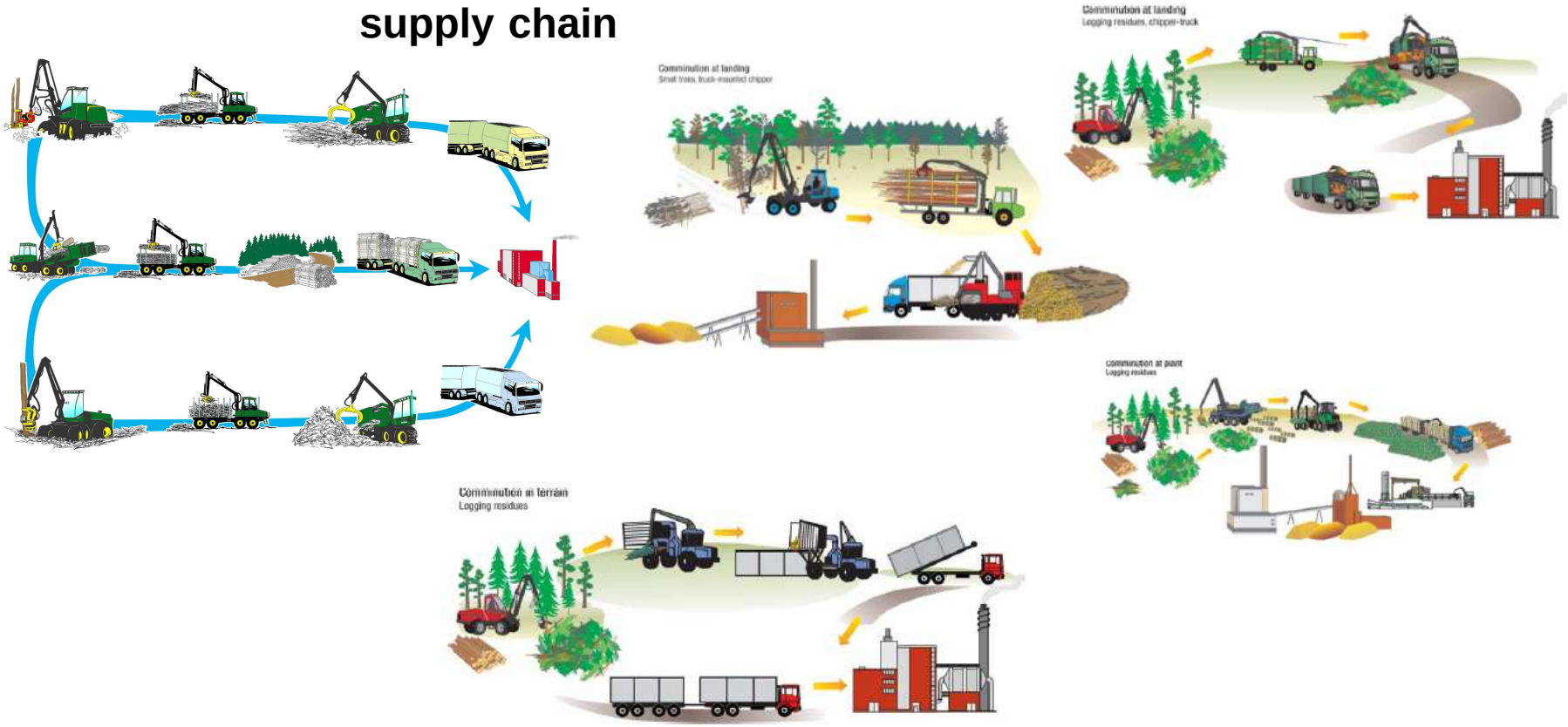


storage room



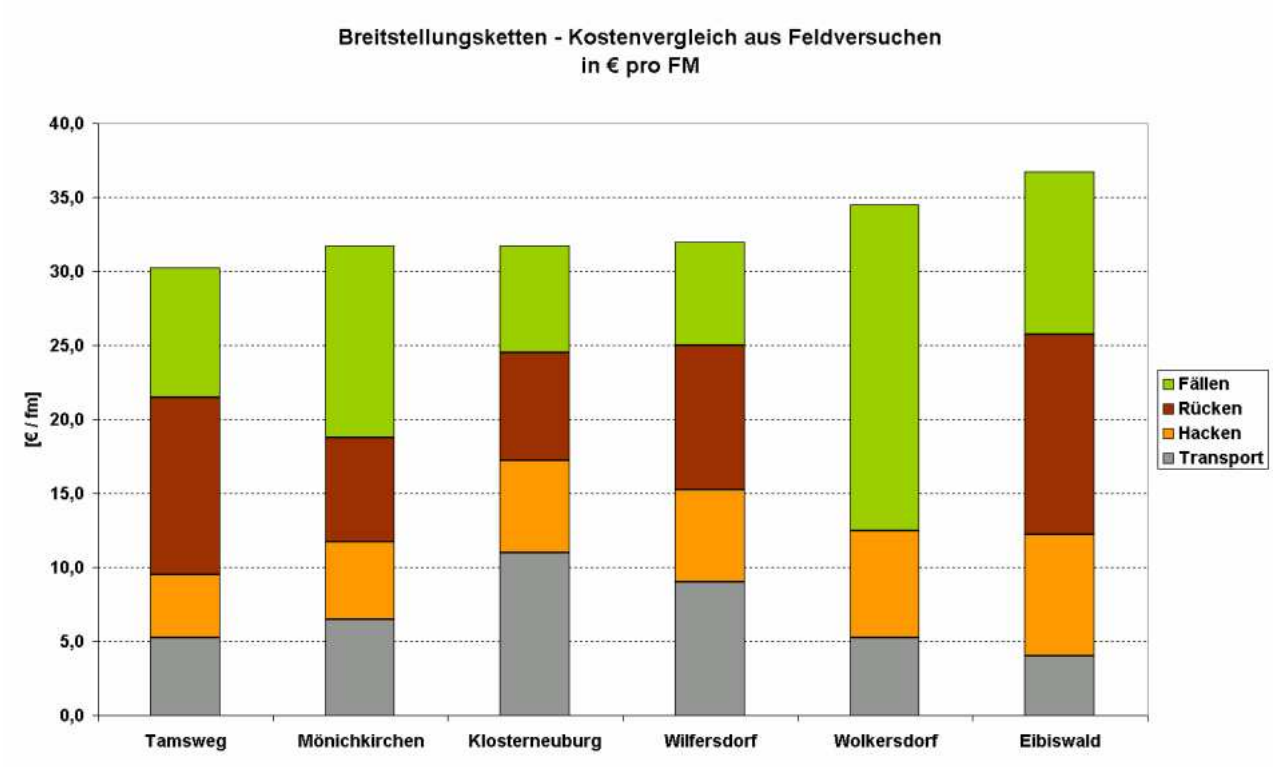
Different parameters

supply chain



Source: VTT / Alakangas

Production costs for wood chips (different supply chain analysis)

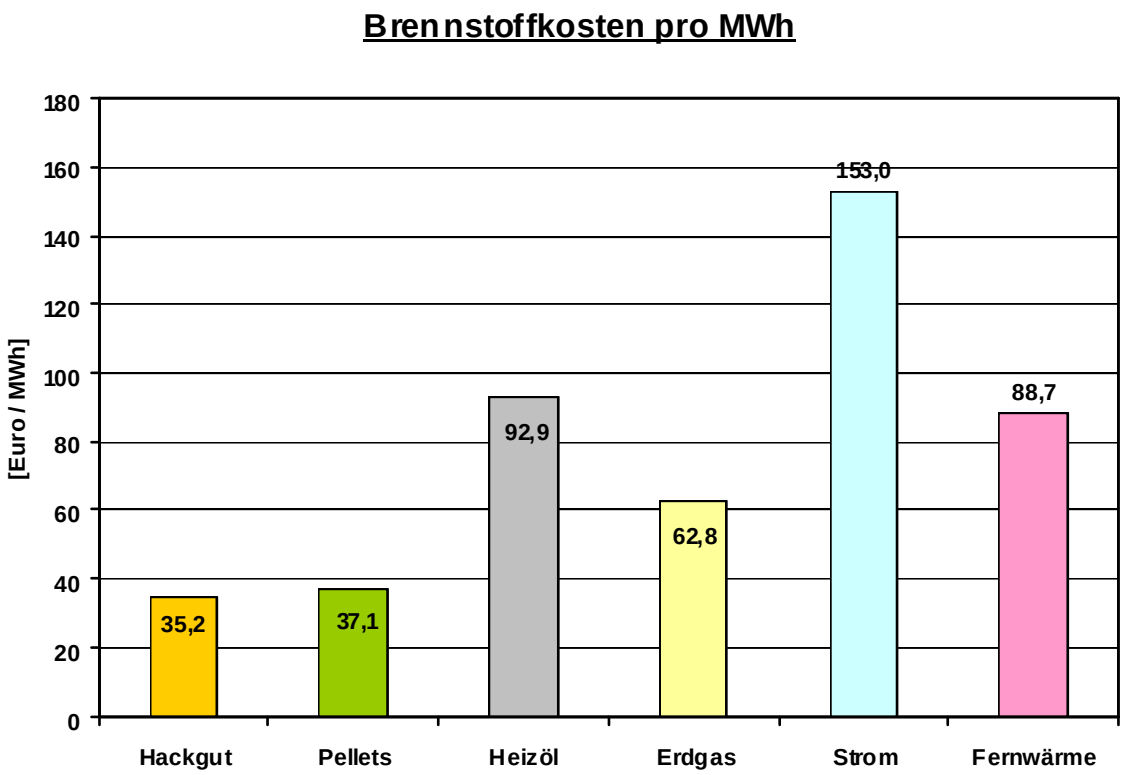


harvesting
transport
chipping
logistics

Comparison of fuels – an example of a typical Austrian house built in 1995

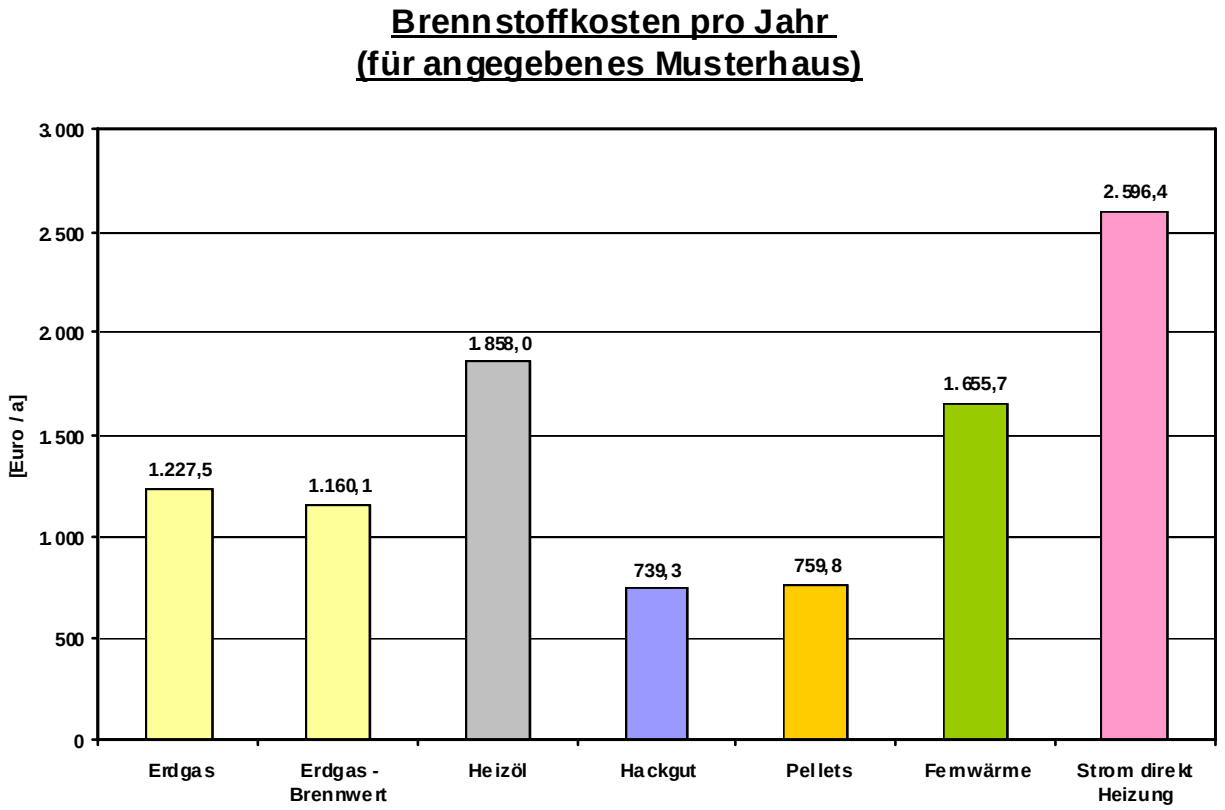
- Private house, two floors
- Both floors in total 176 m²
- Floors 2,75 m high
- Windowsurface 23 m²
- Heatload 12 kW
- Annual full load hours 1.400 h/a
- Heat demand 16.800 kWh/a or 95 kWh/m²a

Fuel costs per MWh

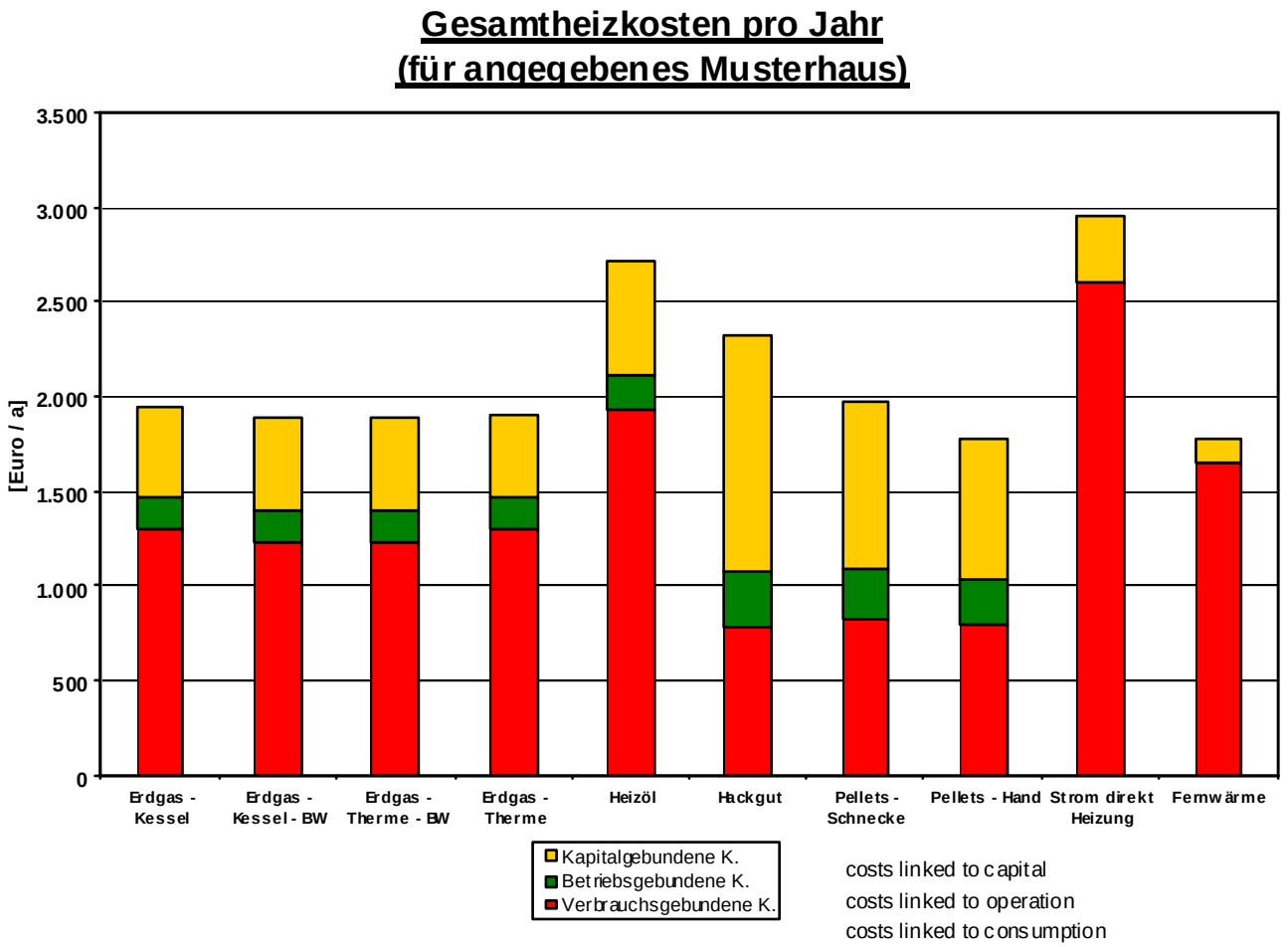


Source: IWO Austria

Fuel costs per year (for the mentioned example)



total costs per year
(differences of heating cost structure for the mentioned example)



Cost effectiveness of wood fuels

- Especially cost effective for companies with a heatdemand > 100kW
- In most of European countries wood fuels can be much more cost effective than oil
- Much more price stability
- Globalisation of the pellets market - pellets worldwide at moderate prices available

Cost structure of biomass heating systems

- Investment costs and costs linked to operation (service, insurance etc.) higher
- Considerable lower fuel costs
- The higher the heat demand of an object the more cost effective is the biomass heating system compared to oil or gas
- Due to high share of fixed costs less influence of fluctuations in prices of fuels

Thank you for your attention!

Dietmar Hagauer
Energy Economy & Policy

Österreichische Energieagentur - Austrian Energy Agency
Mariahilferstrasse 136
1150 Wien
Tel: + 43 1 5861524 - 126
Fax: + 43 1 5861524 - 340
Email: dietmar.hagauer@energyagency.at
URL: www.energyagency.at