7. Internationale Energiewirtschaftstagung an der TU Wien



## Energieversorgung 2011: Märkte um des Marktes Willen?

### 16. – 18. Februar 2011 Wien, Österreich

### Tagungsort:

Technische Universität Wien Karlsplatz 13 1040 Wien





### Veranstalter:

Institut für Energiesysteme und Elektrische Antriebe der TU Wien bm👽 🌔

Bundesministerium für Verkehr, Innovation und Technologie

AAEE (Austrian Association for Energy Economics)

# Using energy efficiency potential of selected household electricity appliances in Austria in a least cost way

Themenbereich: 4. Wie kann der Energieverbrauch nachfrageseitig reduziert werden.

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### Motivation and Core objective

Besides heating appliances the main electricity consumers in households are refrigerators, freezers, washing machines, tumble dryers and dishwashers. These appliances altogether consume approximately 25% of Austrian household electricity need in 2008. Consequently, the reduction of their consumption without disclaiming the comfort appears of core relevance to meet energy efficiency targets and represents an important contributor for climate change mitigation. Nevertheless, their potential for electricity saving and the corresponding costs differs among the selected types of appliances. This paper aims to show, on the one hand, their eventual electricity saving potential until 2025, comparatively by using best available (BAT) and business as usual (BAU) technology, and, on the other hand, estimates at which costs these potentials can be realised.

### Method of Approach

A common base for prospective analysis is to assess in detail historical consumption patterns, as e.g. provided by [1] [2] [3] with respect to the selected electric appliances (i.e. refrigerators, freezers, washing machines, tumble dryers and dishwashers). The historical data as well as the characteristics of reference appliances are considered in order to derive an aggregated picture of future electricity consumption in case of using BAU and BAT technologies at household level in Austria within a bottom-up approach. Thereby, the feasible future accoutrements rate of the appliances till 2025 is calculated in line with technology diffusion theory based on an S-curve approach which is generally used for technology substitution forecasting [4].

HH Sector-Reference year 2008	Refrigerator	Freezers	Washing machine	Tumble dryer	Dishwasher
Reference system	Volume: 300 I kombi with freezer	Volume: 230 l	Capacity: 5 kg	Capacity: 6 kg	Width: 60cm
day in function	365	365			
Annual number of cycle			220	220	280
lifetime (year)	14	17	12	12	12
Unit of consumption	kWh/d for 100 l	kWh/d for 100 l	kWh/cycle	kWh/cycle	kWh/cycle
BAU-consumption	0,78	0,76	1,28	4	1,04
BAT-consumption	0,43	0,41	0,85	1,6	0,83

Table 1: Assumptions and characteristics of selected HH appliances

The economic value of energy saving measures from the end user's viewpoint is based on the following formula:

$$\begin{split} C_{\textit{EndUser-eff}} &= \frac{(I_{\textit{EndUser}} * CRF) + C_{\textit{OM}} - R}{\Delta E_{\textit{tot}} / n} & \text{Where}; \\ C_{\textit{EndUser-eff}} & \text{cost effectiveness for the end user} \\ I_{\textit{EndUser}} & \text{Total investment of End users} \\ CRF & Capital Recovery Factor \\ C_{\textit{OM}} & \text{annual operation and maintenance costs (e.g. labour and non energy inputs)} \\ R & Revenue - i.e. annual benefits, mainly savings on energy costs} \\ \Delta E_{\textit{Tot}} & \text{Annual energy savings over the depreciation time (kWh)} \end{split}$$

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$$CRF = \frac{z^* (1+z)^n}{\left[\left(1+z\right)^n - 1\right]}$$
 Where;  
z Discount rate  
n Depreciation time (yr)

Taking into account policy measures it will also be discussed for which technology the largest and cheapest potential exist which should be supported with priority.

### **Results and Conclusions**

Some preliminary results of this analysis comprise:

- The analysis has shown that the largest future saving potential at the aggregated level exists for freezers as the consumption difference between a BAU technology and BAT is high.
- As the figure 1 indicates that in the case of tumble driers the specific saving potential of a BAT in comparison to the BAU technology is highest. On the other hand, as their accoutrement in Austrian households is still low, the aggregated saving potential due to the replacement of old appliances is low compared to refrigerators or washing machines where significant savings can be achieved with at low incremental investments needs.



Figure 1: Investment cost and over the lifetime electricity consumption of reference appliances based on reference year 2008

- Buying a BAT instead of BAU freezer or tumble drier is an economically valuable decision from the consumers' point of view. Policy instruments with informative character can help raising consumers' awareness in this respect.
- For dishwashers the comparison of BAT and BAU indicates that BAT represents a comparatively expensive option from the consumers' viewpoint, because the consumption difference is just 20% while investment costs double. Nevertheless, the contribution of BAT in total consumption would be high, as almost all households posses this appliance. In this respect BATs in such kind of appliances would require financial supports in order to raise attractiveness for consumers.

### Literatur

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