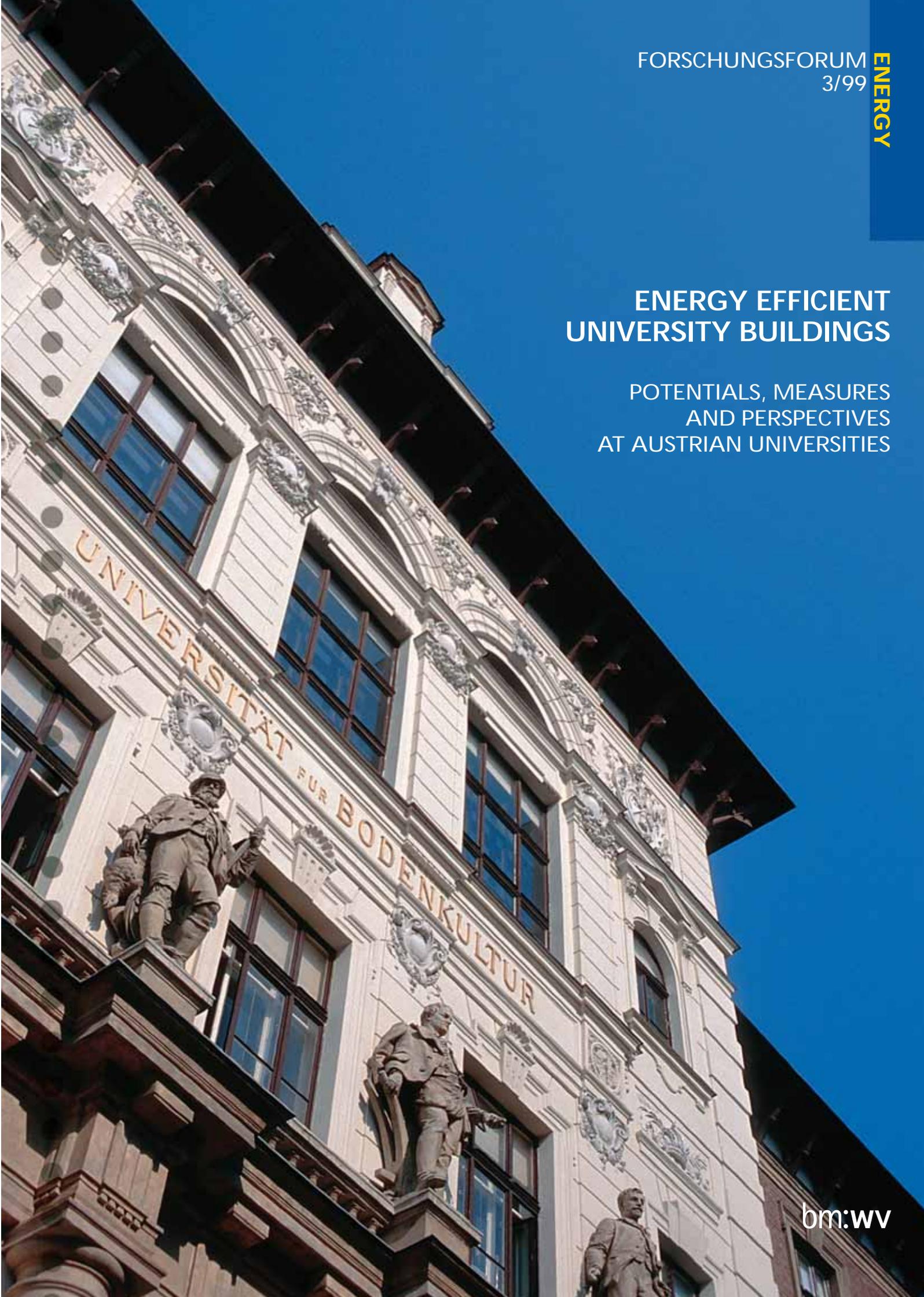


## ENERGY EFFICIENT UNIVERSITY BUILDINGS

POTENTIALS, MEASURES  
AND PERSPECTIVES  
AT AUSTRIAN UNIVERSITIES





## P R O J E C T

# ENERGY EFFICIENT UNIVERSITY BUILDINGS

*Energy efficiency at universities must not be reduced to a matter of costs and consumption - this would clearly be not enough. Energy efficiency at universities has to become tangible for all those involved and has to be conceived as a social task.*

Final Report April 1999

■ In 1996, the Austrian Federal Ministry of Science and Transport started the initiative "Energy Efficient Universities" and commissioned the *Energieverwertungsagentur* (E.V.A.) with the realization of the project. The objective of the initiative was to streamline, reinforce and coordinate already existing activities and to give new impetus to the overall objective of improving energy efficiency at Austria's universities. All universities agreed to cooperate and to support this initiative.

While there are numerous individual activities in this field, there is still a great potential for energy saving, which could be realized by organizational, legal, and technical measures and without major financial investments. In this context, the objective of "increasing energy efficiency" is considered part of a more comprehensive goal aiming at a more efficient use of resources in a broader sense and including, for instance, a reduction of water consumption. The efficient use of energy and other resources would contribute to a reduction of operating expenses and thus, increase the financial scope of the universities. The implementation of appropriate measures should be initiated by the universities

themselves; the *Energieverwertungsagentur* as project manager takes the role of a catalyst, so to speak.

In addition to economic and ecological aspects the project also involved social-political factors: The project offers the opportunity to combine theory and practice. Scientific know-how might be put into practice by the efficient use of energy at one's own workplace. The use of renewable forms of energy (such as solar energy) would acquaint students with these new technologies in their every-day lives. On the other hand, universities as institutions of research and training also play an important part as social multipliers. Universities may serve as an example for society as a whole, and energy saving programs put into practice at universities might act as a signal to other sectors. For these reasons dealing with the topic of energy efficiency in this context seems to be particularly promising. The first phase of the project "Energy Efficient Universities" has been completed in the meantime and a final report has been presented. Dr. Einem, Federal Minister of Science and Transport has already decided to continue the project.

The project also presented a detailed and systematic analysis of the total energy costs at Austria's universities. In 1997, the total energy consumption at Austria's universities amounted to almost 250 GWh for heating and to nearly 170 GWh for electricity. The resulting costs were ATS 175 million for heating and ATS 278 million for electricity. While university buildings constitute only 14.7% of federally owned buildings the costs for energy (ATS 453 million) amounted to 23.6%. The potential for saving has been estimated to be ATS 80 to 100 million per year, which would cover the costs of approx. 150 assistant professors.

During the first phase of the project (1996 - 1999) a number of **energy saving programs** have been realized at Austrian universities.

In addition to a detailed analysis of energy consumption at Austrian universities and an estimate of saving potentials the project also yielded a comprehensive catalog of measures to be taken. 25 individual measures, which are to improve energy efficiency have been described and discussed.

The project also initiated a "stock exchange" for diploma theses and organized a contest, which yielded a number of very interesting works. The diploma stock exchange will be continued during the second phase of the project.

### Realized savings

*implemented during the project phase (examples):*

- ATS 700,000 by a readjustment of the air conditioning system in a building of the Technical University Vienna
- ATS 1,3 million by negotiating new energy supply tariffs for the University of Economics, Vienna
- ATS 800,000 by an analysis of energy consumption and appropriate measures in a building of the University of Vienna
- ATS 100,000 by an evaluation of the need for technical equipment at the University of Veterinary Medicine, Vienna

## ENERGY CONSUMPTION, MEASURES, AND POTENTIALS

At the beginning of the project some of the persons involved showed a rather skeptical attitude. On account of the present organizational structure of universities the efficient use of energy and the reduction of energy costs meet with user-investor conflict in more than one aspect. There is a conflict of interest between the owner of the buildings and the university, on the one hand, and between university and the individual institutes, on the other. Persons and institutions involved in the project often feared that money saved by a more efficient use of energy would not flow back and be credited to their own budgets. At present, the budgets for university expenditures are "frozen"; however, rearrangements between given budget items are possible, thus, the allocated funds remain with the respective university.

Therefore, one of the most important tasks of the *Energieverwertungsagentur* was to promote and to support the exchange of information between the actors involved in the project. An advisory body including representatives of all groups involved (universities, Austrian Union of Students, energy advisors of the Federal Government, etc.) has been founded by the Ministry of Science and Transport. Numerous discussions were held to improve communication between the individual actors.

### ■ SURVEY OF ENERGY CONSUMPTION

In order to analyze the total energy consumption at Austria's universities comprehensive questionnaires have been sent to all 18 universities in Austria in two phases of the project. A precise analysis of energy consumption and ensuing costs is sometimes very difficult as these data are not centrally compiled and analyzed, in general.

Most of the buildings in question are equipped with only a few electricity meters, thus, consumption cannot be exactly attributed to individual users. Therefore, the data presented in the final report are sometimes based on

estimates and have a certain margin of error. Austria's universities spend a total of ATS 450 million per year on energy costs, two thirds of this sum for electricity, and the rest for heating. Of the overall cost of energy electricity consumes about 40%. The following figures might serve as an illustration of the total costs: The energy costs per student and year amount to ATS 2000. This corresponds to ATS 42 per cubic meter and approx. ATS 220 per usable square meter. University buildings constitute only 14.7% of the total cubature of Federal buildings, the energy costs, however, amount to more than 23.8%.

### ■ MEASURES TO IMPROVE ENERGY EFFICIENCY

The list of measures has to be seen as a number of proposals and suggestions; some of the measures have already been implemented others will have to be modified to suit the individual requirements of the different universities. The list of measures may also be used by energy managers and other decision makers as a basis for the compilation of target group oriented information.

The measures focused predominantly on information, motivation, and organization as these seem to be the areas with the greatest deficits. In cases

where investments for technological improvements would be necessary "low-cost" solutions were put in the foreground.

#### ■ Information / Motivation

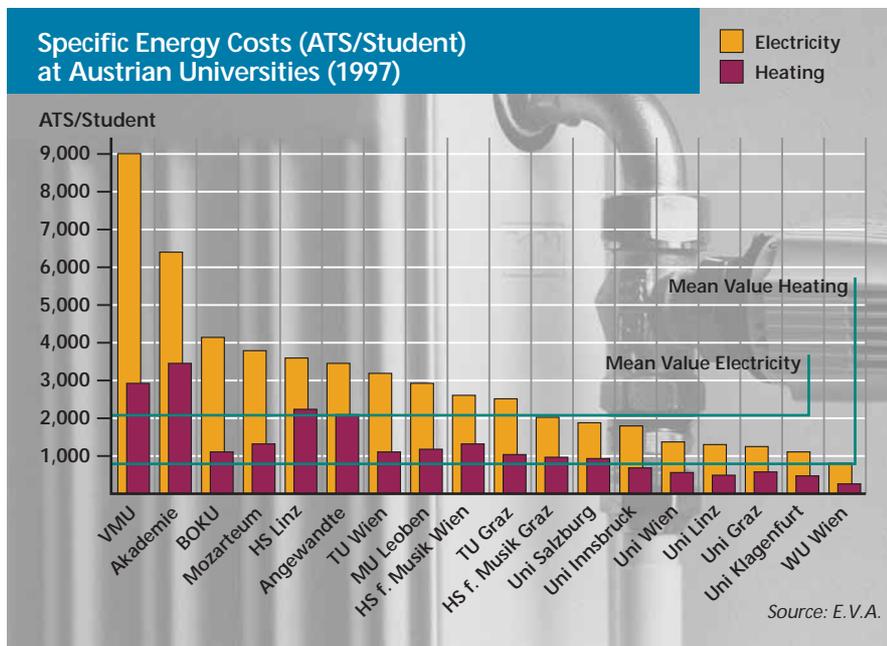
Activities in this area aim at improving the acceptance of energy saving measures in the general public. The activities include information, premiums, incentives, transparency of energy consumption and energy costs, as well as the presentation of positive examples.

#### ■ Organizational measures

These measures address individual universities and are to contribute to a more precise analysis of the real demand for energy. They comprise an energy report, a review of the energy demand and an optimization of the use of space available at universities during vacations, in particular in summer.

#### ■ Technical measures at universities

These measures comprise a re-examination of the adjustment of various installations, an analysis of the actual



need for lighting, the optimization of circulation pumps, peak load management, and an organized load management in general.

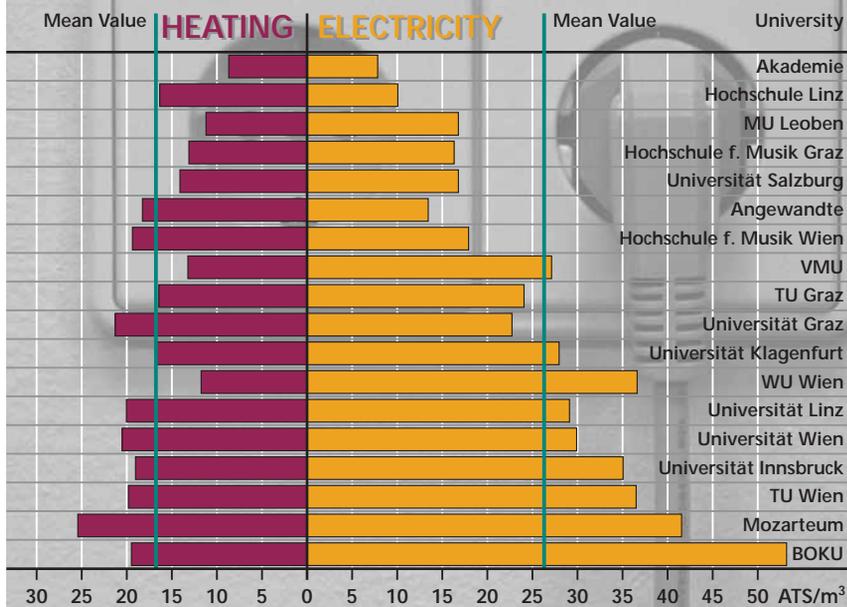
■ **Cooperation between individual universities**

Some of the universities are already experienced in the field of improved energy efficiency. An improved exchange of information and a closer cooperation between universities in negotiating supply tariffs and the coordinated purchase of energy efficient office equipment would be an important contribution in this area.

■ **Framework conditions**

These are general measures aiming at an improvement of energy efficiency, and they are equally important for the universities as well as for their partners. Questions involved concern personnel, improved measuring equipment for the buildings, the "stock exchange" for diploma theses, the coordination of construction and buildings management as well as the development of new planning strategies for new constructions and renovations taking into account future energy and operational costs.

Numerous measures have already been successfully implemented by the universities in the course of the project. It turned out that very simple organizational changes often yield considerable savings. One example would be a campaign entitled "unplugged": Plugged in, many appliances consume electricity even when the power switch is turned off. For a PC electricity consumption in this case corresponds to approx. 10 Watts. Thus, by simply unplugging computers before holidays, for instance, considerable amounts of electricity could be saved.



Source: E.V.A.

■ **POTENTIAL FOR SAVING ON ENERGY COSTS**

According to rather conservative estimates the potential for energy saving at Austrian universities amounts to some ATS 80 million per year. This sum corresponds to more than 17% of the energy costs of all universities in this country. The figure is based on the following considerations:

- The energy analysis of a university building has shown a saving potential of approx. 10%, which could be realized without any need for investment, just by improved information on the scope and structure of energy demand. This finding also holds for high-technology buildings, which usually are very energy intensive.
- In addition, there is still the opportunity to negotiate cheaper tariffs, for some universities this margin would correspond to approx. 10% of present electricity costs.
- Studies on the use of block heating and generating plants (combined heat and electricity generation) have shown possible savings of some 15% assuming an amortization period of three to four years. Even if such a plant will not be realized these studies would form a serious basis to negotiate cheaper tariffs for electricity and heating.

■ Savings of approx. 10 – 15% could be realized by measures in the field of building management. Real awareness of costs has not been widespread among users at the universities, thus, better information and more transparency could change user behavior and quickly be successful.

On account of rather tight budgets, universities are usually not able to finance energy saving measures themselves. In this context, contracting schemes seem to be a promising alternative. "Contracting" is the outsourcing of measures ensuring the supply of energy or aiming at a more efficient use of energy. In "saving contracting" (as opposed to plant contracting) an external company plans and implements measures aiming at a reduction of the customer's energy demand. The contractor's fee will correlate with the amount of energy saved. Many Austrian universities have already received such offers from contracting companies. A workshop on this subject was held as part of the project.

## STOCK EXCHANGE FOR DIPLOMA THESES AND FUTURE INITIATIVES

■ An important initiative forming part of the project "Energy Efficient Universities" consisted in the organization of a "stock exchange" for diploma theses. It was meant as an incentive for students to deal with energy related topics and to benefit from already existing knowledge and the potential universities can offer in this field. While participation in the first phase was rather low (six theses submitted) the quality of the individual contributions was very high, thus, the initiative will be continued. The Minister of Science and Transport awarded the authors of the best three works with a prize.

■ **Energiemanagement an Universitäten - Ablaufschritte mit Beispielen europäischer Universitäten**  
*Karin Baumgardinger, WU Wien, Institut für Wirtschaft und Umwelt, Supervisor: Univ.Prof. Schubert*

This diploma thesis develops the theoretical background for energy management at universities and illustrates the individual steps involved in energy management by means of practical examples taken from other European countries. New ideas and proposals for activities in Austria resulted from this work, which has shown that, in addition to information and motivation, the overcoming of organizational impediments is a very important factor.



■ **Wirtschaftlichkeitsanalyse und Emissionsbilanz eines Blockheizwerks in einem fernwärmeversorgten Gebiet am Beispiel der Wirtschaftsuniversität Wien**  
*Ing. Stefan Thürrnbeck, TU Wien, Institut für Finanzwissenschaften, Supervisor: Univ.Prof. Schönböck*

This work analyses the economic efficiency of a combined heating and power plant in a public building using the University of Economics, Vienna as an example. The study also compares the emissions of such a plant with other forms of energy supply such as electricity from a regional power company or district heating, respectively.

■ **Energieanalyse der Grazer TU Institute in der Inffeldgasse**  
*Theodor Alexandru, TU Graz, Institut für Wärmetechnik, Supervisor: Univ.Prof. Halozan*

This work presents a detailed analysis of the heat consumption (district heating) of the university institutes at Inffeldgasse, Graz, with the goal to optimize the relation between offer and demand and to prepare the necessary data for facility management. An interesting aspect of the paper lies in the fact that – in accordance with the Austrian standard ÖNORM B8135 – it compiles all relevant data needed for the calculation of heating costs in a database. This method makes it possible to simulate planned renovations (new windows, insulation) and to calculate the effect these measures will have on the energy balance of the building.

The first phase of the project "Energy Efficient Universities" was very successful. It showed the great potential for energy efficient measures at universities, some of which have already been implemented. The initiative with its direct effect on teaching and business management of universities is an important example for the cooperation between science, research, and eco-

nomy. Therefore, the project will be continued in a second phase entitled "From idea to implementation".

The following activities are to enlarge experiences made in the first phase and put them into practice:

- Improving and expanding network activities between individual universities and different branches of federal authorities
- Improvement of user motivation
- Increased integration of students
- Implementation of successful pilot projects

The *Energieverwertungsagentur* works in different fields with the goal to support the universities in their effort to use and to put into practice the potential for increased efficiency, which presents itself on account of the growing administrative autonomy of the universities.

The different fields of work comprise the following areas:

- Elaboration and management of an information network (exchange of information, newsletter, internet, events...)
- Activities in the field of user motivation (focusing on the participation of individual university institutes)
- Compilation of a shopping list for energy efficient office equipment
- Project management at an "energy efficient university"
- Cataloging of university buildings
- Continuation of the "stock exchange" for diploma theses

Information on the stock exchange for diploma theses:

<http://www.eva.wsr.ac.at/service/diplom.htm>

Report on the continuation of the project:

<http://www.eva.wsr.ac.at/projekte/uni.htm>



## C O M M U N I C A T I O N

# STRATEGIES FOR INTERNATIONAL NETWORKING

■ An important aspect lies in the fact that the Austrian project "Energy Efficient Universities" is embedded in international activities. International activities are characterized by a rather broad approach to this subject, which might be subsumed under the term "sustainability". In this context it would be important that universities play a more active part in the promotion of sustainability within the scope of all their activities (management, research, teaching).

The study also presented the two most important international declarations on the environment addressing universities. The Geneva "Copernicus Declaration" of 1994 was drawn up by the Association of European Universities and till now has been signed by six Austrian universities. This declaration comprises ten points, the first of them requiring universities to show more

engagement for the protection of the environment and sustainable developments in their theoretical and practical work.

The "Tailloires Declaration" (1990) important above all on the American continent formulates these goals more precisely (thus, universities are invited to develop programs for the conserva-

tion of resources, recycling, and waste reduction), and, at the same time underlines the important socio-political role universities could play in this field.

In addition, the study presents an energy management model for Austrian universities, which is based on a similar model developed by the ETH Zurich.

## F I G U R E S / D A T A / F A C T S

### PROJECT SPONSORS

The initiative "Energy Efficient Universities" has been started by the Austrian Federal Ministry of Science and Transport, the *Energieverwertungsagentur* (E.V.A.) has been commissioned with the support and the coordination of the initiative.

**Project Director and author of the final report:** DI Dr. Georg Benke

trian Ministry of Science and Transport (BMWV). This report and information on the initiative have also been published on the E.V.A. homepage : [http://www.eva.wsr.ac.at/projekte/uni\\_bilanz.htm](http://www.eva.wsr.ac.at/projekte/uni_bilanz.htm)

The intermediate report on the project as well as a conference report have also been published in the series mentioned above.

The reports are available from:  
*PROJEKTFABRIK,*  
*Nedergasse 23, A-1190 Vienna.*

### PUBLICATIONS

The final report on phase I of the project "Energy Efficient Universities", Vienna, April 1999 has been published in the series "Berichte aus Energie- und Umweltforschung" (Reports on energy and environment research) by the Aus-

You will find a complete list of all publications of the series "Reports on Energy and Environment Research" on the FORSCHUNGSFORUM HOMEPAGE: <http://www.forschungsforum.at>

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