

# ***SOLARCAMPUS* – A Complementing Path for turning Universities to Renewables and Energy Efficiency**

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## **Abstract**

The interdisciplinary project-based student course “*solarcampus*” was brought up at Kassel University in winter term 2005/2006. Main objective of this course is to put students into realistic situations and processes, that are similar to those appearing in the graduates’ future work and which can’t be taught in the context of lectures and seminars.

In the first phase, photovoltaic systems with a total power of 67 kW<sub>p</sub> were installed on roofs of different buildings of the university without any costs for the university itself. In the second phase, which was started in winter term 2007/2008, students work out concepts for improving the energy performance of the university’s building stock.

Thus, *solarcampus* is contributing to reduce the university’s energy costs as well as its environmental impact. The course combines exemplarily high degree practical issues of the university itself with the education of students and uses the scientific expertise of the involved institutes. Transferability of the didactical concept should be given, so that gained experiences could lead other universities to launch similar courses.

This paper aims at scientific as well as administrative staff from universities who are willing to initiate similar projects at their own university.

## **1. Introduction**

On the one hand the budget of Kassel University suffers by increasing energy costs: Within the last years they nearly doubled up while the energy consumption of the university’s buildings kept quiet stable. On the other hand it can be assumed that energy saving potentials are in a range of 10% to 20% of today’s energy demand [1].

But a bunch of structural specific barriers is still constraining reaching these potentials: Insufficient energy management leads to imperfect information of energy use and energy saving potentials. The lack of access to capital constrains sustainable investments even if they are economically feasible. And up to now low, investment costs are predominantly still seen to be more important than life cycle costs including energy efficiency measures [2].

On a superior political level, the government of the German state of Hesse brought up a long-term sustainability strategy in 2008. One of the goals is to reach CO<sub>2</sub>-neutrality up to 2030 for the whole state administration. Thus, this programme includes the universities as well. Main steps to achieve CO<sub>2</sub>-neutrality are to minimize the energy demand by improving energy efficiency and substitute fossil by renewable energy sources.

So, how can the politically initiated and ecologically as well as economically necessary goals be reached? The interdisciplinary project-based student course *solarcampus* is carried out in this context. It has been launched in winter term 2005/2006. From the beginning, the basic idea was the implementation of a course which brings students of different programmes and disciplines together, that are somehow involved in renewable energies and energy efficiency projects. Contents arise of current issues in the direct surrounding of the university. It assumed that this concept can be transferred to other universities.

Meanwhile the objectives of the state government as well as the technical service of the university are mostly congruent to the objectives of the course, so that *solarcampus* is supporting the university by reaching its superior goals.

## 2. Course of action and participants

Simplified, *solarcampus* operates like a firm of consultant engineers. Client of this “company” is the university. Main objective is to give students of the subject renewable energies and energy efficiency the opportunity to practice their specific knowledge learned in lectures. So they can develop both, technical experience and soft skills for interdisciplinary teamwork, as both are mandatory in their future working life.

Most important in this context is to ensure continuity and knowledge transfer from one students’ generation to the next because usually projects take several years, but students are able to participate only for one or two terms. Therefore a special didactical concept has been developed, which is described in [3].

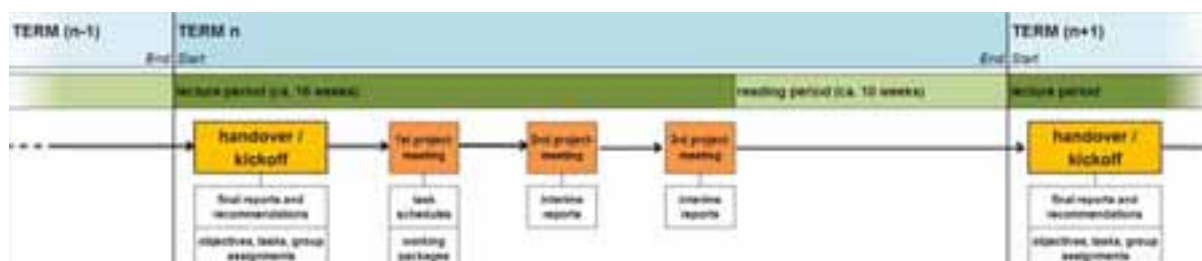


Fig. 1. General project schedule

Meanwhile the course has been integrated in the module scheme of several degree programmes. More than 100 Students have successfully graduated the course. Furthermore three master thesis have been written and actually two PhD-Thesis were started in this context.

## 3. 1<sup>st</sup> project-phase: Photovoltaic

Starting point of the project were the results of a diploma thesis: One main result was, that approximately 3,000 m<sup>2</sup> on different roofs of the university are in principal suitable for the mounting of photovoltaic modules [4]. The main objective of the project was to exploit these potential, at least partly.

In the two-year project time, overall about 50 students from the master programme Renewable Energies and Energy Efficiency, Ecological Agriculture, Economics, Law, Architecture and Graphical Design took part in the realization process. One part of the work was the determination of technical and economical feasibility. On the other hand a financing model for the PV-modules had to be developed, because there was no possibility to get any support from the budget of the university. Thus, it was necessary to attract a lot of publicity to the project especially in the first two terms.

Finally, a financing model with public participation was chosen, which was – so far – unique in the higher education sector in Germany. More than 100 private investors, members of university's staff as well as citizen of Kassel and the surrounding region, granted loans of at least 500 Euro. *solarcampus* acted as intermediary. The students also worked out the necessary contracts and raised funds of more than 350,000 Euro, which was 70% more than anticipated, and coordinated the contacts between investors, university and operating company. This company administrates the loans, erected and operates the PV system.

Due to the oversubscription, it was possible to put up three solar power systems instead of one with an overall peak power of 67 kW<sub>p</sub>. Loans are paid back during the next 20 years within the feed in tariffs of the German "Renewable Energy Sources Act" and investors get a pretty good rate of 4-6%, depending on the produced solar electricity.



Fig. 2. By *solarcampus* initiated installation of three photovoltaic systems on university's roofs.

Meanwhile this kind of project has got a lot of successors at other German universities. *solarcampus* is one of the foundation members of the student network "UniSolar", which wants to bring up and support such initiatives at German universities. *solarcampus* was awarded 2007 with a prize by EUROSOLAR for its initiative and activities.

#### **4. 2<sup>nd</sup> project-phase: Energy Efficiency**

The second phase of the project started in 2007. The main topic is to improve the energy efficiency of the university's buildings. Technical potentials of energy saving measures are determined by both, theoretical methods and measurements. Based on the results, energy saving measures in the building services and other technical equipment are developed. It is planned to implement again a fund solution for investments in energy saving.

Therefore, the following objectives for the next five years were agreed on with the technical department:

- Identification and quantification of existing energy-saving potentials at Kassel University's buildings
- Development of appropriate measures for reaching these savings
- Development of financing models beyond the university's budget (e.g. fund model, similar to the one applied in the photovoltaic project)
- Development of an energy monitoring and controlling system in the university administration
- Development of a technical and organizational solution for encouraging energy-saving behavior of users

At the moment, the activities are focused on the systematic analysis of single buildings with high absolute and specific energy consumption, like two buildings of the Institute of Mechanical Engineering or the main canteen. Based on these investigations, specific measures are under development.

The focus of investigations in the main canteen lies on the hot water system. Students convinced the technical department to implement a solar thermal system with about  $100 \text{ kW}_{\text{th}}$ . Furthermore, they analysed the existing cooling systems and optimize its heat recovery. Most important for the two buildings of the engineering departments will be to realize a control of the central ventilation system which shall be adjusted to the actual needs. Besides that, students work out Energy Performance Certificates for several buildings, which are required by European law since July 2009.

Meanwhile students touch current state of research. So far there is no standard methodology, neither for the systematic determination of energy efficiency potentials of universities, nor for the implementation of an energy-controlling. Models for public investments for energy savings are generally new and part of the current state of research. So far, three master theses have been completed in the context of *solarcampus*. Based on that, two thematically closely connected PhD-theses have been started.

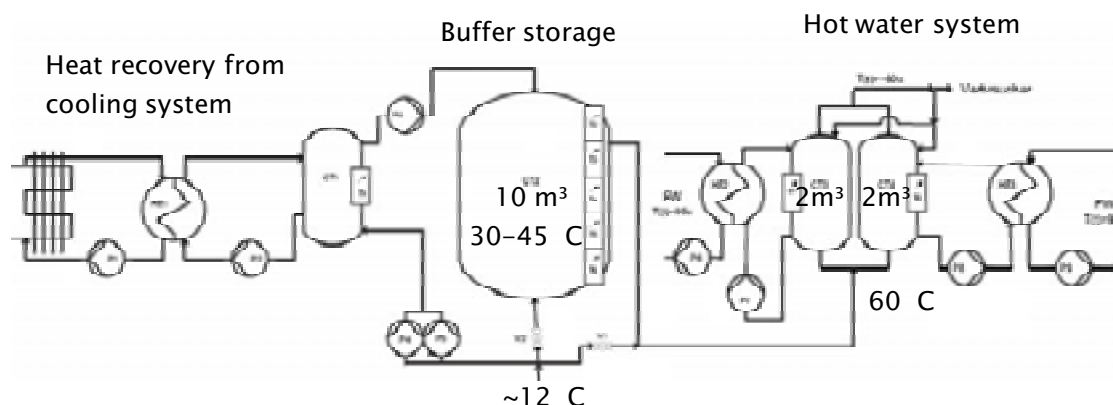


Fig. 3. Hot water system of the main canteen - actual situation

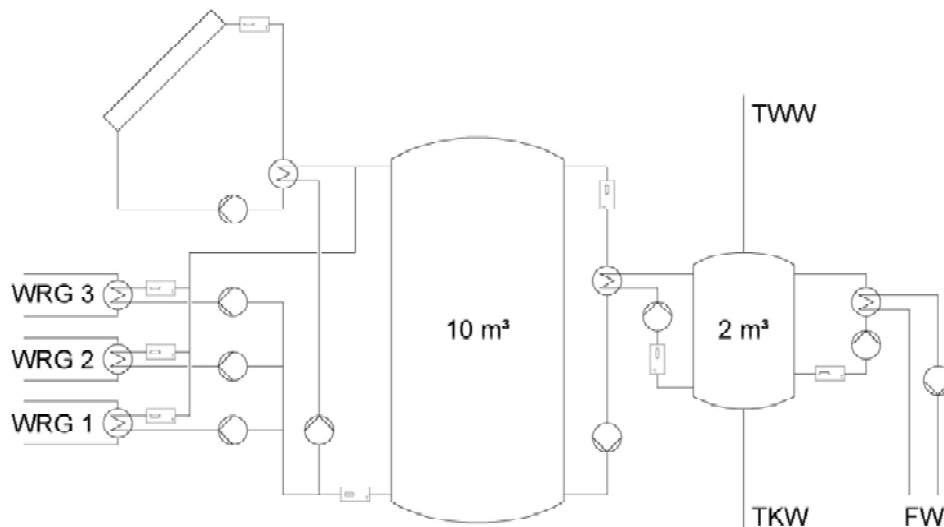


Fig. 4. Hot water system of the main canteen - proposal for modifications

## 5. Conclusion

*solarcampus* combines practical issues with teaching and training of the students as well as the existing scientific expertise at Kassel University. All involved parties benefit: Students can apply their knowledge learned in lectures on concrete issues. The university gets support for its “environmental profile” and counteracts the increasing energy costs. The saved means can be used for its core functions: science and education. Last but not least: The reduced energy consumption contributes to decrease the ecological impact of the university.

Success of the first phase is directly visible by the photovoltaic systems on the roofs of the university. In the ongoing second phase of *solarcampus* the results of the students’ investigations delivered essential knowledge of partly very high specific energy consumptions. In next steps, the origin of the highest energy consumptions shall be identified, the saving potentials shall be determined and the necessarily counteractive measures are to be taken.

The chosen form of practically orientated learning inside the “safe” surrounding of the university has been very successful. On one hand this is shown by the continuously increasing number of participants – so far about 100 students have graduated the course. On the other hand some students keep on working in the project although it is not possible for them to get more marked credits.

*solarcampus* was successfully implemented in the master degree “Renewable Energies and Energy Efficiency” as a regular course. Furthermore, it is open for students from other thematically appropriate programmes, too. This kind of project-based student courses does not require special resources and should also be transferable to other universities. The gained experience could lead other universities to launch similar courses. Cooperations with other universities are anticipated.

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