2008 Annual Report of the Swiss Federal Office of Energy Programme Head

Research programme Electricity technologies and applications

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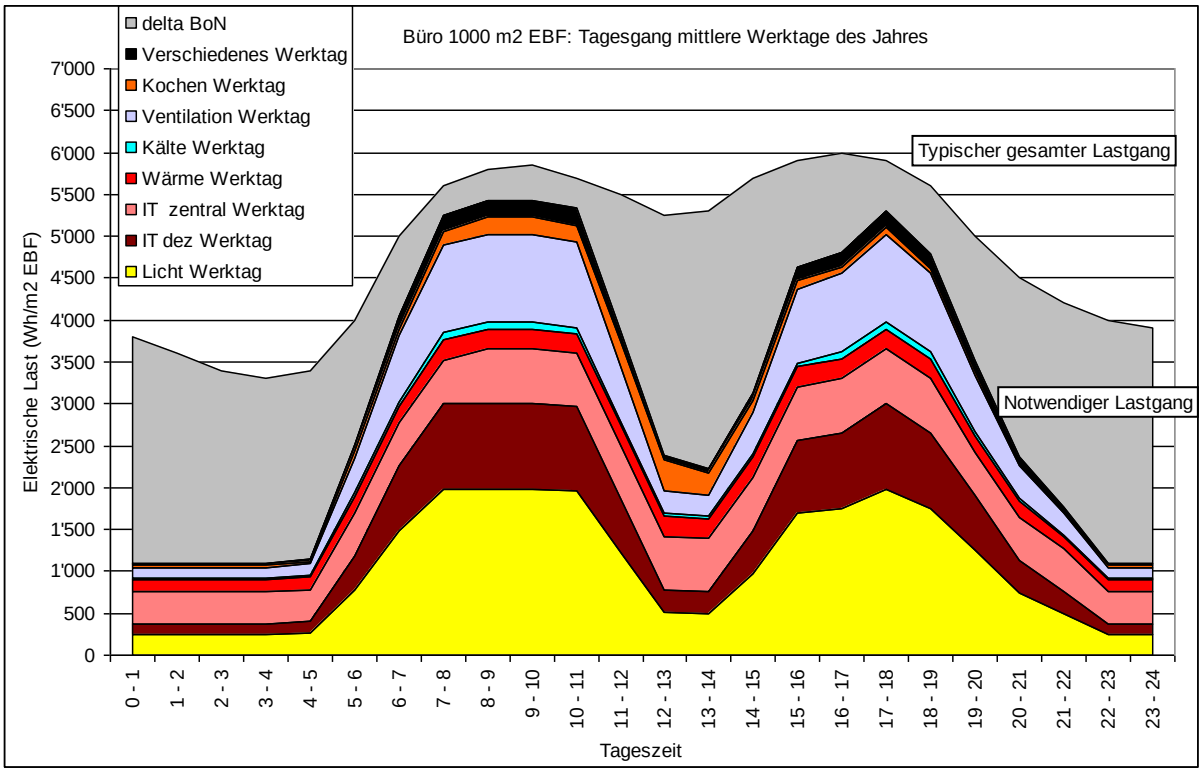

Diagram of load on a working day in a typical office building (source: Swiss Agency for Efficient Energy Use, SAFE)

The above diagram depicts the estimated electricity consumption (grey area) of appliances that are switched on but not in use. The topic of *electricity consumption of appliances that are switched on but not in use* was closely examined in a special project, and an efficiency potential of more than 2,000 GWh p.a. was estimated for the services sector.

Programme priorities and objectives

A considerable unexploited energy efficiency potential exists in many areas of application. The main objective of the "**Electricity technologies and applications**" research programme is to create the conditions and prerequisites for the efficient use of electricity. The programme is divided into two main sections: "**Technologies**" and "**Efficient applications**".

In 2008, the objectives in the "**Technologies**" section were to improve the efficiency of *thermoelectric materials* by increasing their *figure of merit*, and to examine potential applications for directly converting heat into electricity in both the high-temperature and low-temperature range. After a background study carried out in 2007 indicated a promising potential utilisation of the *magneto-calorific effect* in the area of central cooling systems, in 2008 the next step was to initiate follow-up activities. Progress relating to materials is constantly being made in the area of *high-temperature superconductivity*, but the Swiss industry is still reticent when it comes to initiating its own activities. In view of this it is all the more important to secure a minimum degree of continuity with respect to projects and the provision of information. This means participating in the corresponding IEA programme (Implementing Agreement on High-Temperature Superconductivity in the Electric Power Sector), and also interacting with the industry. Finally, in 2008 efforts were made to find suitable industry partners for continuing research in the area of compressed air storage technology.

The "**Efficient applications**" section is very complex. One of the most important areas of focus is *information and communication technology*. Here one of the main objectives in 2008 was to obtain more detailed findings concerning energy consumption in the area of *home automation*. Another goal was to identify criteria for the substantial reduction of losses from appliances in operation without use. As in the past, in the area of electric drives a great deal of attention was paid to the development of technical criteria for the planned know-how transfer via the SwissEnergy programme. Another important activity concerned the development of technical criteria for increasing the efficiency of drive systems. Here, the improvement of efficiency in the field of traction of railway locomotives (Swiss Federal Railways) was a specific objective. Other activities in the year under review included preparatory work for a new IEA Implementing Agreement on the establishment of an international research and know-how platform for *electrical appliances*. The aim here is to increase efficiency at the international level with the support of national projects.

Tasks accomplished and results obtained in 2008

Technologies

High-temperature supraconductivity (HTSC)

Participation in the *IEA programme for assessing the impact of high temperature superconductivity on the electric power sector* [1] permits a comprehensive overview of activities throughout the world in the area of high-temperature superconductivity. The materials industry achieved a great deal of progress in the course of 2008. For example, Y-123 tapes with lengths exceeding 1,300 metres were produced that have an electrical density of 150 A/cm (with a standardised width of 10 mm). These tapes are used in prototypes in the fields of current limiters, power cables and motors.

Energy conversion

In the *Application of magnetic refrigeration technology and its evaluation* feasibility study [2a] it was demonstrated that two applications in particular are promising in terms of energy-efficient use of magnetic refrigeration technology, namely household refrigerators without freezers and central refrigeration systems (see Fig. 1). Researchers at the Haute Ecole d'Ingénierie et Gestion du Canton de Vaud (HEIG College of Engineering) in Yverdon-les-Bains have meanwhile initiated an engineering project in collaboration with a renowned manufacturer of refrigerators with the aim of more intensively studying magnetic household refrigerator technology. In the follow-up project, *Central magnetic refrigeration and cooling*

systems and their evaluation [2b], the objective is to find out, in an in-depth study with the aid of numeric simulations, which conventional cooling systems are the most suitable for replacement by magnetic refrigeration systems.

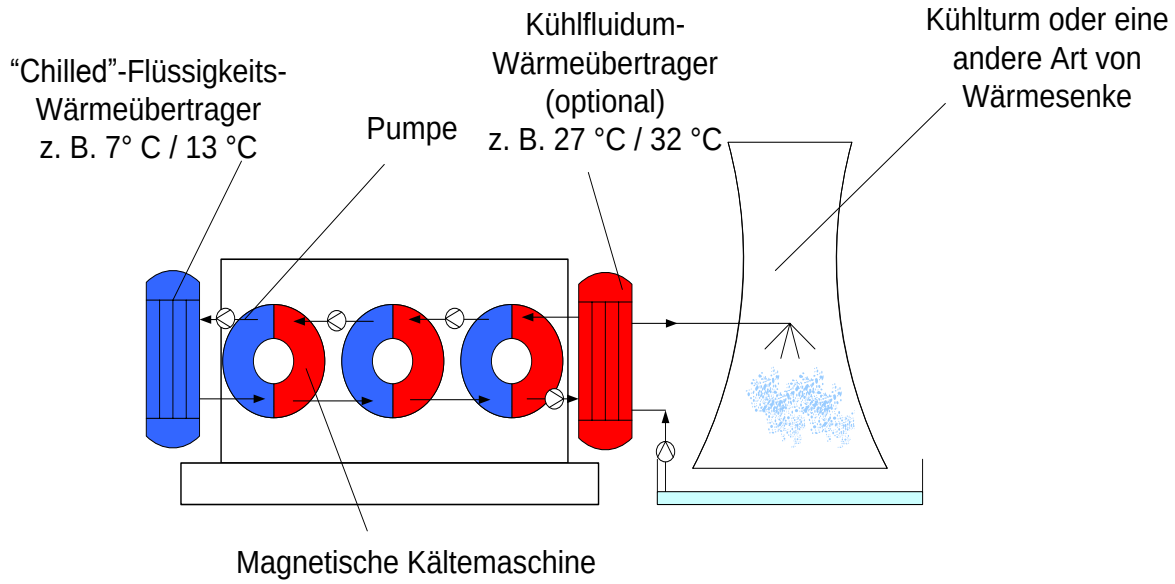

Fig. 1: Diagram depicting an example of a three-stage magnetic refrigeration system. The temperatures of the cooling water (flow/return) are 27° C and 32° C respectively, and the temperatures of the chilled water are 7° C and 13° C (source: HEIG).

The most important finding of the *Applications of magnetic power production and their evaluation* [2c] project were that magnetic energy conversion can be superior to conventional technologies in a variety of ways. This is especially the case with heat sources with low exergy. Here, conventional systems are not efficient enough to function economically, whereas magnetic energy conversion technology can lead to greater exergy efficiency. The disadvantage of a somewhat low Carnot efficiency is offset by the advantage that magnetic energy conversion can function with the temperature difference independently of the two temperature levels (source and cooled). A first suitable practical implementation would be a system with permanent magnets and a heat source with a temperature of around 120° C.

With the thermoelectric effect, heat can be converted directly into electricity. In two projects – *Thermoelectric power plant* [3a] and *Potential for the application of thermoelectric power production in the high temperature range* [3b] – studies were carried out to find out which applications are suitable for thermoelectric power production, and which requirements have to be placed on the conversion material. With the materials available today, thermoelectric energy production does not represent a competitive alternative to conventional technologies because of the low degree of efficiency. And in the area of waste heat utilisation, in which there are few or no technological alternatives, high-output thermoelectric energy production is not a feasible option due to the enormous specific investment costs. With intensified efforts in the area of materials research and the resulting more efficient and possibly at the same time cheaper materials with a ZT value of 2 to 3 (the ZT value refers to the energy-relevant thermoelectric figure of merit of a thermoelectric material), the application potential and market for thermoelectric generators would increase considerably. A ZT value > 5 could revolutionise the entire field of electricity production from thermal energy.

The available thermoelectric materials indicate a low level of efficiency, and this means that their uses have mainly been limited to niche applications to date. In the *Geo-thermopower (Geo-TEP) material* [4a] project, studies were carried out on environment-friendly, robust oxidic ceramics for applications in the low temperature range (see Fig. 2). Thanks to a better understanding of the relationships between the structural properties it was possible to raise the energy-relevant thermoelectric figure of merit (ZT) from the initial 0.021 to 0.3 over a broad temperature range. In the *Development of materials for solar-thermal electricity production (Solar-TEP)* [4b] project, polycrystalline cobaltates with a Perowskite-like or

layered structure were analysed, with the focus on high-temperature application. The efforts carried out to date to increase the efficiency of thermoelectric materials with layered structures are being continued in two ongoing projects: *Development and modelling of a thermoelectric oxidic module (TOM) as demonstrator* [4c], and *Layered thermoelectric converters* (LTEC) [4d].

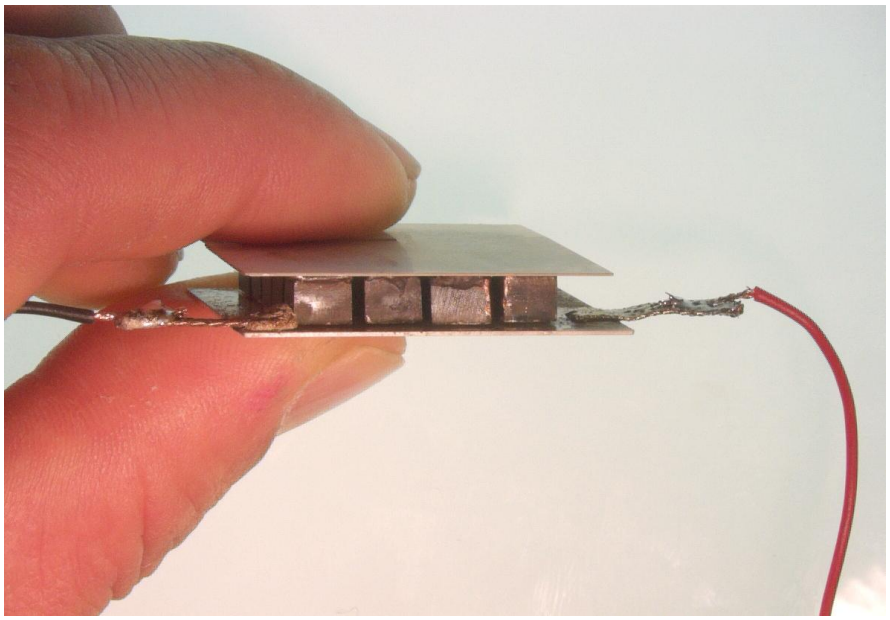

Fig. 2: Thermoelectric component with the latest materials (source: Swiss Federal Laboratories for Testing and Research, EMPA)

Storage

As a result of the promotion of renewable energy and the associated increase in stochastic feed-in of electricity into the grid, energy storage is becoming an important factor in electricity supply security. Following the completion of a variety of projects involving *compressed air*, efforts were made to find industry partners who would participate in, and support, further research. Despite talks with a number of renowned industry players, no firm arrangements were concluded in 2008. These efforts are therefore to be pursued further during 2009.

Efficient applications

Information and communication technologies

Information technology accounts for approximately 10 percent of Switzerland's overall electricity consumption, and rapid growth rates are anticipated. Numerous activities are being carried out at the national and international levels with the aim of promoting efficient electricity use in the areas of office equipment and consumer electronics, and measures are also being taken to exploit this efficiency potential. The *Energy and Information Technology Competence Centre* [5] is making a valuable contribution here as Switzerland's information hub. It collects relevant information in Switzerland and abroad, then processes and distributes it. In 2008, it also focused on continuing the activities relating to efficient computer centres and analysing energy demand in the mobile telecommunications segment.

In the *Energy consumption in the mobile communications segment* [6] project, a detailed analysis was carried out of the energy requirements of the infrastructure of a mobile communication network. One of the findings obtained from this study was that there is only a very minor correlation between power requirement and network load of GSM and UMTS base stations. In addition, data were measured relating to the energy consumption of mobile communication network components and air-conditioning systems. With respect to the cited points, optimisation proposals and alternatives were formulated for operators of mobile communication networks. Finally, future scenarios regarding UMTS900, the use of femtocells

and open wireless were theoretically evaluated from the point of view of energy-related impacts.

The integration densities of IT servers are constantly increasing, and this is resulting in higher energy requirements. Users of IT services (mainly IT departments) are often not aware of the fact that the acquisition of IT components results in increased electricity consumption and higher electricity costs. In the *Promotion of energy-efficient computer centres through sensitisation via transparent cost accounting* [7a] project, an Excel-based cost accounting model was developed that clearly depicts the influences of electricity consumption and energy efficiency in the operation of a computer centre. The model also shows how the situation would look in the future based on assumptions of increasing integration densities, higher specific electricity consumption and increased supply security in computer centres. The model was successfully verified through its application in two selected computer centres.

The objectives of the *Development of the market for energy efficient servers* [7b] project that is embedded in the EU *Intelligent Energy Europe* programme are to demonstrate the significant potentials on the part of servers for reducing energy consumption and cutting costs, and to prepare the market for energy efficient servers. In the year under review, a variety of demonstration projects were carried out in the EU, in which energy savings of between 60 and 90 percent were demonstrated through the virtualisation and consolidation of servers. Unfortunately, small and medium-sized companies were barely represented in these projects, and in view of this, Switzerland introduced aspects associated with this category of companies into the above project: in a typical company, the number of servers was reduced through virtualisation from 4 to 2, and this resulted in a reduction in electricity consumption by 24 percent.

Networking in private households (home automation) is expected to increase significantly in the future, and it is therefore important to identify and stem the resulting increase in electricity consumption as early as possible. With the *Recent developments in home automation and the associated electricity consumption* [7c] project, it was theoretically demonstrated that with a simple control system with components that are available today the overall consumption grows only around 1 to 3 percent. Measurements in two new single-family dwellings have shown the reality that electricity consumption increases by between 37 and 54 percent as the result of networking (see Table 1), since it is often the case that control units with touch screen and audio/video systems are installed for the sake of comfort. This level is considerably lower than that obtained from the first complete measurement of a “FutureLife” house, but significant efficiency potentials nonetheless exist, and these need to be exploited. Above all, components are not equipped with a standby function, and this means that various systems are constantly in operation even though they are not directly in use (see Fig. 3).

Objekt	jährlicher Strombezug ohne Vernetzung	jährlicher Strombezug durch Vernetzung	Mehrverbrauch durch Vernetzung	Jahr	Bemerkung
FutureLife-Haus	6'140	6'830	111%	2002	komfortable Haussteuerung, IT- und Multimedia-Vernetzung
Smarthome	6'370	2'381	37%	2005	
EFH Meier	6'500	3'516	54%	2007	
EFH Savia	5'000	1'864	37%	2007	
Musterwohnung mit Feller Zeptrion	4'500	83	2%	2007	nur einfache Haussteuerung, keine komplexen Steuerungs-funktionen, keine Touchpanel
Musterwohnung mit Legrand Powerline	4'500	137	3%	2007	
Musterwohnung mit KNX	4'500	63	1%	2007	
Musterwohnung mit Theben Luxor	4'500	137	3%	2007	

Table 1: Additional electricity consumption for “intelligent” households – studied buildings and laboratory measurements (source: Encontrol GmbH).

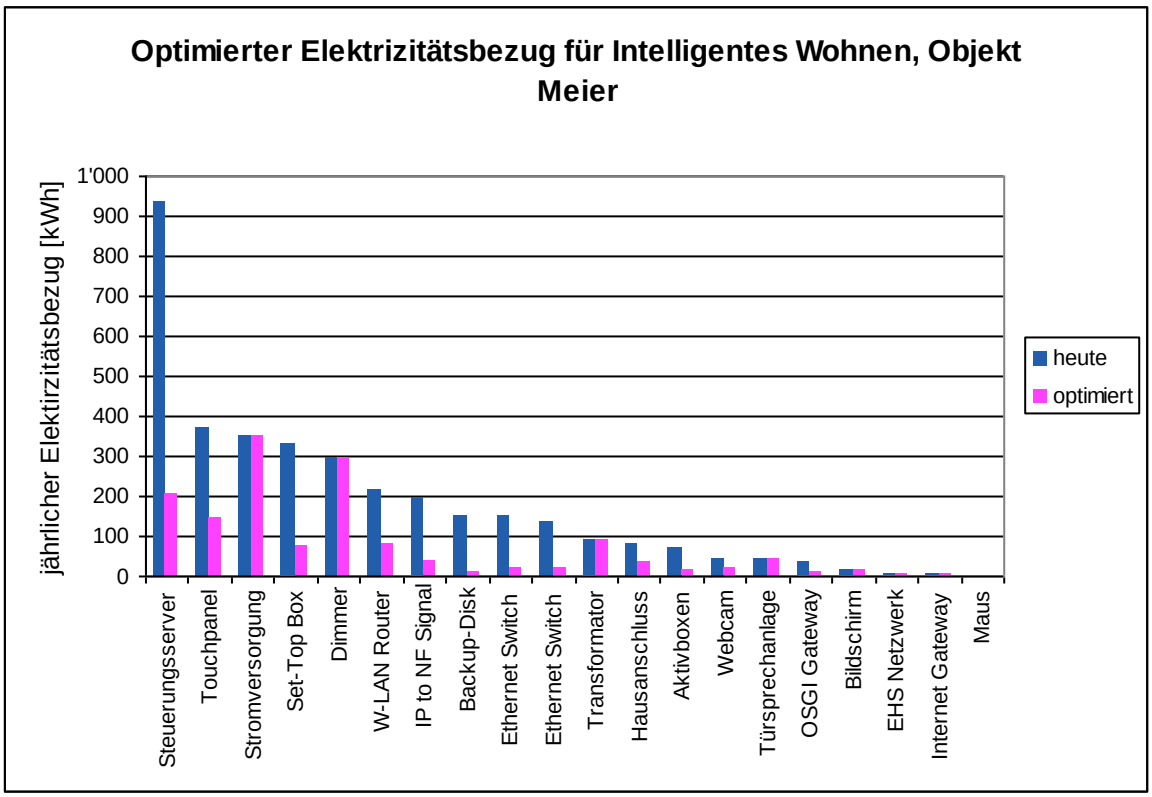

Fig. 3: Electricity consumption for "intelligent" households: "Meier" dwelling – comparison between present-day measurements and optimised situation (source: Encontrol GmbH).

In the *Efficiency increase in households through the use of "Digitalstrom" chips* [7d] project, studies are being carried out to identify the potential resulting from the use of "Digitalstrom" components in terms of reduction of electricity consumption, in particular taking account of their own consumption. Initial measurement concepts and the buildings to be equipped with these components were largely defined in 2008, and the next step will be to install the chips (see Fig. 4) in a number of buildings and launch a one-year measurement campaign in 2009.

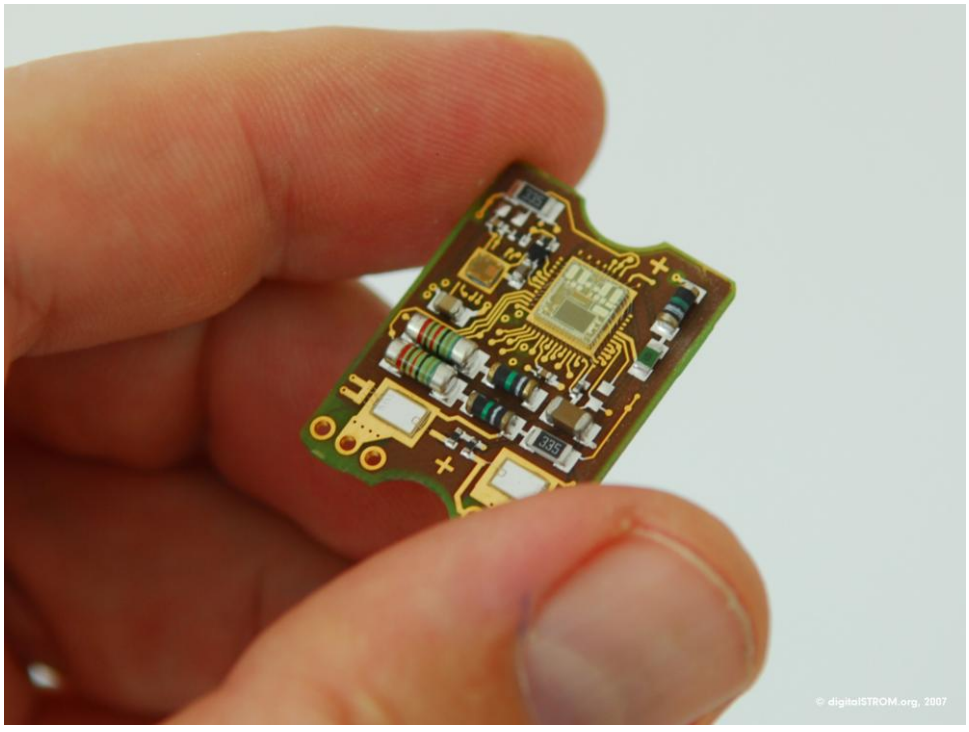

Fig.4: Chip manufactured by Digitalstrom (source: Digitalstrom).

The aim behind the recently initiated *Increased energy efficiency through specific user information (MEGA)* [8] project is to increase energy efficiency in private households by motivating the occupants to save electricity by making them more aware of their energy requirements. Earlier studies indicated that, in international projects, it is possible to reduce electricity consumption by 5 to 12 percent on average (and by as much as 25 percent in certain cases) by providing the occupants with feedback. The aim of this project is to develop a concept, including prototypes with the most commonly used means of communication, for providing occupants with information about their electricity consumption (see Fig. 5). For this purpose, concepts are to be developed in the course of 2009. The project is to be supplemented with a study on the subject of smart metering, and preparatory work has already been initiated in this connection.

Fig. 5: Technical concepts and alternatives for the visualisation of energy consumption (source: iHomeLab).

Within the scope of the *Support for the development of an efficient DSL modem* [9] project, the aim was to examine where potentials exist for reducing electricity consumption by such an extent that it would be possible to meet the ambitious target levels of the “Code of Conduct on Energy Consumption of Broadband Equipment”. Here, activities focused on the current market development for external power supply units, the forthcoming EU directive on energy using products, the current status of efficiency of DC/DC converters, and possibilities concerning electricity consumption attributable to TCP/IP ports. The objective was not fully met, mainly because of TCP/IP technology, but comprehensive findings were obtained, which will flow into the future product development of DLS modems thanks to the participation by the industry in this project.

Motors / electric drives

Electric motors and drives account for around 45 percent (approximately 26,000 GWh p.a.) of Switzerland’s total electricity consumption. In view of the estimated savings potential of more than 20 percent (or approximately 5,000 GWh p.a.), the “Electricity technologies and applications” research programme is making major efforts to exploit this potential.

In the E*fficient linear Generators/linear motors for piston engines* [10a] project, an efficient linear generator was constructed for a Stirling free-piston generator, and theoretical studies were carried out concerning the efficiency of linear motors for driving compressors. A prototype of the linear generator was produced and the measurements that were carried out were so promising that development work is now being continued by the industry. The

calculations also showed that a linear motor can attain a high degree of efficiency, but it cannot compete with a high-efficiency rotating permanent magnet motor.

In the *Efficient permanent magnet motor in the 3 kilowatt range* [10b] project, an efficient PMM was installed in a standard IEC casing as a prototype and subsequently measured in laboratory tests. At the same time, an efficient drive was developed. The measurements indicated a high efficiency of around 90 percent, which is superior to that of efficiency category eff-1 asynchronous motors in this output range. The aim of the *Efficiency increase of a high-efficiency IEC 3-kW permanent magnet motor including energy measurement as pump application* [10c] project is to demonstrate a level of efficiency above 90 percent with a prototype, and measure it as a pump application. The components were designed in 2008 (see Figs. 6 and 7), and the construction and measurements are to be carried out during 2009.

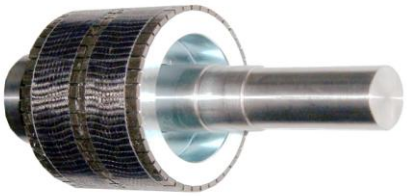

Fig. 6: Rotor of the IEC 3-kW permanent magnet motor (source: Circle Motor AG)

Fig. 7: 3-kW IEC permanent magnet motor (source: Circle Motor AG)

In the *Improvement of the energy efficiency of lifts and conveyor systems through the development of a new type of frequency converter* [11] project, a new type of I-converter was developed instead of using a standard U-converter. Thanks to this innovation, it was possible not only to ensure energy recovery when braking, but also to benefit from the fact that the I-converter can be disconnected from the mains when the lift is not in use, thus eliminating standby losses. This is very significant, since earlier studies showed that, for lifts – especially in residential buildings – the proportion of overall electricity consumption attributable to standby is often higher than 70 percent.

Correct dimensioning and the early identification of savings potentials are significant factors for the efficient use of electric drives. For this purpose a number of projects are in progress that aim to provide the SwissEnergy programme with corresponding tools. In the *Expansion of OPAL for permanent magnet motors* [12] project, the existing tool for the design of pumps and ventilators for maximum energy efficiency has been supplemented by a module for permanent magnet motors. In addition, a web-capable interface has been programmed in German, French and English, and a comprehensive motors database has been integrated that contains around 10,000 entries. The aim of the *Sotea – a software tool for calculating efficiency potential for electric drives* [13a] project is to develop a tool permitting the calculation of the efficiency potential of a machine park by means of a quick analysis. Finally, in the *Analysis and procedure for the optimisation of energy efficiency of pumps used in water supply systems* [14] project, the objective is to work together with the industry to develop know-how for rapidly calculating efficiency potential in existing water supply companies. The methodology to be developed will be subsequently tested and optimised on the basis of a number of case studies.

Appliances

In order to ensure that the necessary importance is attached to energy efficiency already in the procurement process, in the *Product declaration for small refrigerators* [15a] project a declaration form was developed in collaboration with an international industry representative so that buyers can be made aware of the efficiency of the appliance and the associated costs

(awareness of life-cycle costs). Since in the course of the project it became apparent that not all suppliers provide comparable data on the self-declaration form, in a second project – *Measurements of small refrigerators* [15b] – a variety of products were measured on the basis of uniform criteria and compared with one another. The results should be available in 2009, and are to be subsequently implemented via the SwissEnergy programme.

Although efficiency category A++ refrigerators are already available on the market, considerable efficiency potential nonetheless still exists. With the support of a renowned Swiss manufacturer, in the *Minimisation of energy consumption of refrigerators through thermal optimisation* [16] project efforts are being made to substantially reduce thermal losses by using new types of heat insulation. When the initial analyses have been completed, the studied optimisation options are to be developed and tested in the course of 2009.

Numerous systems and appliances are left on 24 hours a day, even though this would not be necessary. In the *Operation without use* [13b] project, efforts were made to improve the situation in the services sector. The analyses of the various daily processes yielded a wealth of useful information. Although only a rough estimate has been made to date, it can nonetheless be stated that systems and appliances in the services sector that are left on without being used account for more than 2,000 GWh p.a. Follow-up studies will be required in order to obtain more accurate figures and identify corresponding efficiency measures.

As an alternative to static uninterruptible power supply (UPS) devices, rotating UPS devices can be used from output levels of around 500 kVa and higher. The areas of application and technologies differ from those for static UPS devices, and this has consequences, particularly in terms of their efficiency and electricity consumption. In the re-initiated *Rotating UPS devices and dynamic energy storage* [17] project, a comparison is being made between rotating and static UPS devices, including dynamic storage with battery systems.

In the area of electric heating systems, the estimated efficiency potential is considerable. Corresponding measures range from optimisation of control devices, auxiliary heating systems and highly efficient heat insulation (e.g. Minergie-P standard) through to replacement of heat generation (e.g. using heat pumps) by installing central heating systems. For operators of properties with electric heating systems, the high financing requirement normally poses the main problem. With the *Electric heating systems – measures and practical options for reducing electricity consumption* [18] project, all technical options are being analysed, and criteria are being defined for comprehensive packages of measures while at the same time gaps in technical know-how are being identified.

Lighting and lamps

As a consequence of the new regulations, energy-efficient lamps with electronic starters are being used to an ever-increasing extent. In view of various concerns that have been expressed, studies are being carried out in the *Impacts of energy-efficiency lamps on the power supply* [19] project to examine to what extent the increased use of these lamps will impact on the mains supply. Here, various lamps have been measured in terms of harmonics, and in 2009 the overall effects are to be estimated on this basis in the form of projections and theoretical deliberations.

With the development of the white LED (light-emitting diode), a new technology is available for efficient room lighting. However, the situation with respect to development and the market is still far from clear, and binding standards that conclusively and comparably define LEDs are still largely lacking. Consumers often find themselves out of their depth when making purchases, and the risk of choosing the wrong product is very high, especially in view of the rapid developments in this sector. In the recently initiated *Quality characteristics of LED lighting* [20] project, the pending questions relating to LED applications for room lighting are being systematically examined. The aim here is to produce a comprehensive description of the quality characteristics of LED lighting.

Miscellaneous developments

An initial study carried out by Swiss Federal Railways (SBB) indicated substantial potential savings in the region of 100 GWh p.a., and it is pleasing to note that the SBB is pushing ahead with the implementation of this programme by introducing specific measures. Engine drivers are being trained to operate locomotives more energy efficiently, and measures to optimise rolling stock are being successively implemented (see Figs. 8 and 9). With the new *Verification of reduced electricity consumption through energy-efficient train management* [21] project, the energy efficiency effects of the SBB's intelligent train management programme that is currently being developed are being verified. Reductions in consumption can be obtained by avoiding unnecessary stops at signals and through carefully planned operation based on optimised scheduling. To quantify the current situation, in 2008 various concepts and methods were developed for identifying the number of "conflicts" (stops at signals) and monitor driving behaviour on the basis of operational data (time stamp of trains passing the main signals). In addition, initial evaluations and projections were carried out throughout the entire railway network. The analysis is to be extended to the Bözberg line and the Zurich to Chur stretch in order to take account of the influences of freight and long-distance transport. Finally, for the long-term monitoring of the SBB's traction-related energy consumption, a concept was developed to record major influencing factors directly from locomotives during operation. The concept will be implemented in 2009 and recordings will be made using a number of vehicles.

Fig. 8: Efficient operation can save up to 100 GWh p.a. (source: SBB)

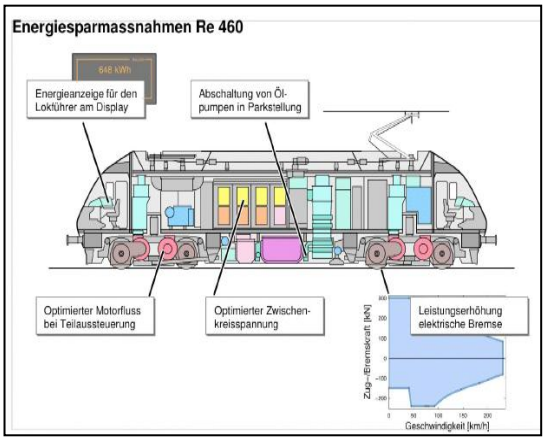

Fig. 9: Technical optimisation of RE 460 locomotive (source: SBB)

Co-operation at the national level

Representatives from industry, universities and research organisations who are members of the *SFOE trend-watching groups* that have been established in the areas of *information and communications technology, electric drives, uninterruptible power supply* and *high-temperature supraconductivity* meet on a periodical basis. This means that a tried-and-tested national information and discussion platform is at the disposal of interested specialists.

Increased networking in households (home automation) is expected to result in a substantial increase in electricity demand. The establishment of a competence centre at the University of Lucerne (iHomeLab) means that a new organisation is now available that possesses corresponding expertise.

19 national institutions and 6 industry partners are involved in the *Materials with Novel Electronic Properties (Manep)* project initiated by the Swiss National Fund. 8 institutions are focusing on theoretical or experimental aspects of high-temperature superconductors.

Co-operation with the respective industry has been pursued or extended in a variety of areas (e.g. railways, motors/drives industry, telecommunications sector, lighting and household appliances industry). With new projects, efforts are being made to ensure that at least one

industry partner is involved. The aim here is to ensure that the findings of successful projects can subsequently flow into the respective industry.

Generally speaking, close contacts are maintained with the SwissEnergy programme [27], and this considerably facilitates the implementation of research findings. For the national motors programme (*Topmotors*), for example, a variety of missing technical criteria were identified and updated.

The two Federal Institutes of Technology (in Zurich and Lausanne) are incorporated into research activities where deemed appropriate, and a great deal of importance is also attached to the integration of colleges of technology. For example, in the area of motors/high performance electronics, institutions in western Switzerland (Sion), north-west Switzerland (Brugg-Windisch), eastern Switzerland (Chur) and central Switzerland (Horw/Lucerne) have been involved in project activities, while the West Switzerland College of Technology in Yverdon has contributed towards research on magnetocalorific energy conversion. Contacts are also maintained with the college of technology in Zurich-Winterthur. The *Energy and Information Technology Competence Centre* at the Federal Institute of Technology in Zurich is continuing to make a valuable contribution towards national and international co-operation.

Thanks to the joint financing of research projects, it has been possible to maintain existing contacts with other sponsors such as the *EWZ Electricity Savings Fund*, the *Basel Electricity Savings Fund* and the *Commission for Technology and Innovation*.

Close contacts with Swiss agencies, e.g. *Energy Agency for Industry*, *Energy Agency for Electrical Appliances*, *Swiss Agency for Energy Efficiency* [28] are maintained via various projects and through the respective trendwatching groups. Industry representatives such as *swissT.net*, *Swissmem* and *Swico* are also included in various projects. For example, work on the *code of conduct in the area of set-top boxes* was carried out in co-operation with industry association *Swico* and the *Energy Agency for Electrical Appliances*.

Co-operation at the international level

Contacts are maintained worldwide and international research findings are exchanged through participation at international conferences and workshops, and involvement in international projects.

International co-operation within the scope of the 6th EU Framework Programme (STRP-505724-1 Hipermag project) was brought to completion in the course of 2008. Here, supraconducting magnesium-diboride (MGB_2) tapes and wires were developed for applications at temperatures of 20° K. 13 groups were involved in this programme.

Thanks to participation in the *IEA Programme for Assessing the Impact of High Temperature Superconductivity on the Electric Power Sector*, the activities throughout the world in this area are being closely observed. Finally it should be noted here that thanks to its possession of unique testing equipment, the University of Geneva is able to implement a high-temperature supraconductivity measurement programme for determining the characteristics of electric conductors from the USA, Japan and Germany.

New international contacts have been established thanks to an intensive involvement in the preparatory work for the new IEA *4E* (Efficient Electrical End-use Equipment) programme, which focuses on set-top boxes, lighting and electric drives/motors. The topic of standby operation is also being dealt with, and in a separate project (*Mapping and Benchmarking*), international findings relating to the introduction of efficient appliances onto the market are being evaluated. Switzerland assumed responsibility for the “motors” segment of this programme, and has meanwhile successfully concluded the preparatory work.

The “Electricity technologies and applications” research programme is also actively involved in the EU’s *Intelligent Energy Europe (IEE)* programme. Here, Switzerland has been involved in the *Development of the Market for Energy Efficient Servers*” [29] project since its initiation, is contributing its own expertise and is able to make use of the resulting know-how.

In view of the rapidly developing world of communication and information technology, in the framework of the “European Standby Initiative” the EU has drawn up *codes of conduct* [30] in the areas of set-top boxes, broadband devices and external power supply units. Switzerland is able to participate in both the development and ongoing improvement of these codes of conduct, and can thus contribute its own expertise. The activities within the scope of the EU directive on energy using products are also being closely observed.

Personal contacts with various energy agencies (especially in Denmark, Germany, Austria and France), as well as with key figures in international programmes such as the UK Market Transformation Programme, repeatedly result in useful ideas and proposals. Contacts are also being intensified with the European Commission, the International Energy Agency (IEA), the US Environmental Protection Agency (EPA) and the Lawrence Berkeley National Laboratory in the USA.

Pilot and demonstration projects / implementation activities

The results of research activities need to be implemented as efficiently as possible with the aid of suitable measures, and this often calls for prior market research. The following activities pursue this objective.

Information and communication technologies

With its *code of conduct*, the EU has created an instrument by means of which committed industry players can voluntarily undertake to produce or procure appliances with minimal consumption ratings. Switzerland, and in particular representatives of Swisscom, made a significant contribution towards the fact that the code of conduct that entered into effect for *broadband devices* contains ambitious target levels. Switzerland also made a similar contribution towards the formulation of an ambitious code of conduct for *set-top boxes*, but unfortunately the industry successfully opposed this move. It now has to be assumed that this code of conduct will only be pursued by a much smaller group of players from the industry, and furthermore that the industry will now draw up its own internal agreement that will cover around 90 percent of the market. The aim is to avoid regulatory measures that may be imposed by the EU within the scope of its directive on energy using products.

Motors / electric drives

The implementation of research findings is of the utmost importance, and in view of this the “Electricity technologies and applications” research programme supports the various preparatory activities where necessary. The aim of the *Certificate of Advanced Studies: efficiency and energy in technology and industry* [22] project is to create the necessary basis for professionals to obtain detailed information concerning efficient motors and drives by attending a further education course. The planned pilot course had to be abandoned since too few persons signed up for it, but another attempt is to be made in 2009. The content of the course will be modified to suit the main requirements of the participants.

The aim behind the *Promotion and co-ordination of the EU Motor Challenge Programme* [23] project was to provide operators of electric drives with information concerning the European Motor Challenge Programme and encourage them to carry out their own activities relating to the efficiency of motors. This project functioned as a national contact point for the European Motor Challenge Programme, and co-ordinated the flow of information between national actions in the area of efficient drives. The Motor Challenge project team participated in the preparation of an efficient drives implementation programme. This programme was initiated at the end of 2007 under the name “Topmotors”, and the previous promotional activities of the Motor Challenge programme were successively incorporated into “Topmotors” in the course of 2008 [31].

Switzerland was strongly involved in the development of the new IEA project, 4E (Efficient Electrical End-use Equipment), and following the conclusion of the IEA Executive Committee representation of the 4E Implementing Agreement [24] it is now participating in the activities

that are currently being initiated. The main focus is currently on the topics of *standby*, *set-top boxes*, *lighting*, *mapping and benchmarking*, and *drive systems*. On the basis of various preparatory activities in the present research programme and the *SEEMS (Standards for Energy Efficient Electric Motor Systems)* international co-ordination programme, following the preparatory work on the Motor Systems Annex for 4E [25], Switzerland has assumed the role of Operating Agent. The associated activities were initiated in autumn 2008 following the approval of the Executive Committee. The formal launch took place with the preparation and organisation of the international motors conference, the *Motor Summit.* The next step will be to finalise the content of the various fields of activity.

Appliances

The voluntary agreement on the *code of conduct for UPS systems* [26] was approved at the beginning of 2008, and a variety of international companies went on to sign it in the course of the year. But in the meantime, no activities of any note have taken place, other than the updating of certain fact sheets and documents.

Summary of 2008 activities and outlook for 2009

In 2008, the reorganisation of the Swiss Federal Office of Energy resulted in personnel changes within the “Electricity technologies and Applications” research programme, as well as in the management of the division. This position was filled again at the beginning of 2008, and following the required period of introduction, another change in personnel took place, and the position of division head was not filled again until October 2008. In addition to these changes in personnel, the programme’s web site was migrated to the IT environment of the SFOE. This move was completed in the autumn, and the current home page now matches the other SFOE pages in terms of structure and appearance.

In the area of **electrical technologies**, progress was achieved in research into materials for use in thermoelectric energy conversion. Here the all-important *figure of merit* was substantially increased. Since the involved academic at the Federal Institute of Technology in Zurich will shortly be completing his doctorate, it is important to make sure that the expertise that has been developed in the area of thermoelectric energy conversion is not lost to the programme. Following intensive efforts, a solution has been found that will secure this specialised know-how. It is also pleasing to note that one of the identified promising uses of the *magnetocalorific effect* is to be examined further in a follow-up project. In the area of *high-temperature supraconductivity*, international activities were continued within the framework of the corresponding IEA Implementing Agreement, but despite various discussions with industry representatives, the industry has not initiated any related projects to date. In the area of *compressed air storage technology*, too, the desired follow-up project has not been initiated despite talks with various industry players. The corresponding efforts are to be pursued further in 2009.

In the **efficient applications** segment of the programme, with respect to set-top boxes a variety of proposals and findings resulted in the framework of the EU directive on energy using products and the formulation of a more stringent voluntary agreement. These efforts are to be pursued during 2009. In the area of *information and communication technology*, the high level of additional electricity consumption associated with *home automation* was demonstrated, and this matter was subsequently tabled at a number of events. Thanks to the strong commitment on the part of Switzerland, IEA Implementing Agreement 4E was successfully initiated, and a first annex focusing on the topic of motors was approved following intensive preparatory work under Switzerland’s leadership. It is also pleasing to note that Swiss Federal Railways is implementing the obtained findings relating to energy efficiency, and is preparing a follow-up project aimed at filling a major gap in knowledge concerning efficient locomotive management. Finally it should be noted here that studies into *new LED lighting technology* are to be intensified in a specific research project.

List of R+D projects

[1] R. Flükiger (rene.flukiger@physics.unige.ch), Université de Genève, Genève: **Implementing Agreement for a Cooperative Programme for Assessing the Impact of High Temperature Superconductivity on the Electric Power Sector** (JB project 101533)

[2] P. Egolf, A. Kitanovski, O. Sari (peter.egolf@heig-vd.ch), HEIG-VD, Yverdon: a) **Anwendung der magnetischen Kältetechnik und ihre Bewertung** (Application of magnetic refrigeration technology and its evaluation) (SB project 101776) ● b) **Zentrale magnetische Kühl- und Kältemaschinen und ihre Bewertung** (Central magnetic refrigeration and cooling systems and their evaluation) (JB project 102873)● c) **Anwendungen der magnetischen "Power Production" und ihre Bewertung** (Applications of magnetic power production and their evaluation) (SB project 101776)

[3] K. Fröhlich, A. Bitsch, C. Eisenhut (froehlich@eeh.ee.ethz.ch), ETH Zürich: a) **Das thermoelektrische Kraftwerk** (Thermoelectric power plant) (SB project 101356) ● b) **Anwendungspotenzial der thermoelektrischen Stromerzeugung im Hochtemperaturbereich** (Application potential of thermoelectric power production in the high-temperature range) (SB project 101706)

[4] A. Weidenkaff (anke.weidenkaff@empa.ch), EMPA, Dübendorf: a) **Geo-Thermopower (Geo-TEP) Material** (SB project 101356) ● b) **Materialentwicklung für solarthermische Stromerzeugung (Solar-TEP)** (Development of materials for solar-thermal power production) (SB project 101706) ● c) **Erstellen und Modellierung eines thermoelektrischen oxidischen Moduls (TOM) als Demonstrator** (Development and modelling of a thermoelectric oxidity module as demonstrator) (JB project 101356) ● d) **Layered Thermoelectric Converters (LTEC)** (JB project 101356)

[5] B. Aebischer (baebischer@ethz.ch), CEPE, ETH, Zürich: **Kompetenzzentrum Energie und Informationstechnik** (Energy and IT competence centre) (JB project 30963) www.biblioite.ethz.ch

[6] M. Hufschmid, A. Corliano (markus.hufschmid@fhnw.ch), Fachhochschule Nordwestschweiz, Muttenz: **Energieverbrauch der mobilen Kommunikation** (Energy consumption in mobile communication) (SB project 102013)

[7] A. Huser, T. Grieder (alois.huser@encontrol.ch), ENCONTROL GMBH, Niederrohrdorf: ● a) **Stromeffiziente Rechenzentren durch Sensibilisierung über eine transparente Kostenrechnung** (More efficient computer centres through sensitisation via transparent cost accounting (SB project 102259) ● b) **Development of the market for energy efficient servers** (JB project 101967) www.efficient-server.eu ● c) **Neuste Entwicklung im Bereich Home Automation und des damit verbundenen Stromverbrauchs** (Recent developments in the field of home automation and associated electricity consumption) (SB Projekt 102344) ● d) **Effizienzsteigerung im Haushalt durch Digitalstrom** (Increased efficiency in households through the use of Digitalstrom chips (JB project 102468) www.digitalstrom.org

[8] R. Kistler, M. Fercu, A. Egli (alexander.klapproth@hslu.ch), Hochschule Luzern, Technik + Architektur, Horw: **MEGA, Mehr Energieeffizienz durch gezielte Anwenderinformation** (Increased energy efficiency through targeted user information) (JB project 102668)

[9] C. Jehle (cj@digitalstrom.org), Digitalstrom Association, Zurich: **Unterstützung bei der Entwicklung eines effizienten DSL-Modems** (Support with the development of an efficient DSL modem) (SB project 102543)

[10] J. Lindegger (info@circlemotor.ch), Circle Motor AG, Gümligen: a) **Effizienter Lineargenerator/Linearmotor für Kolbenmaschinen** (Efficient linear generators/linear motors for piston engines) (SB project 100915) ● b) **Effizienter Permanentmagnetmotor im Bereich 3kW** (Efficient permanent magnet motors in the 3-kW range) (SB project 100915) ● c) **Effizienzsteigerung eines hocheffizienten IEC 3kW Permanentmagnetmotor inklusiv energetischer Messung als Pumpenanwendung** (Increased efficiency of a high-efficiency IEC 3-kW permanent magnet motor) (JB project 100915)

[11] P. Kanyio, M. Bolla (mario.bolla@telma.ch), Econodrives GmbH, Seftigen: **Verbesserung der Energieeffizienz von Aufzügen und Förderanlagen durch Entwicklung eines neuartigen Frequenzumrichters** (Improving the energy efficiency of lifts and conveyor systems by developing a new type of frequency converter) (SB project 101691)

[12] R. Tanner (tanner@semafor.ch), Semafor Informatik & Energie AG, Basel: **OPAL-Erweiterung für Permanentmagnet-motoren** (OPAL expansion for permanent magnet motors) (SB project 102128)

[13] C. U. Brunner (cub@cub.ch), S.A.F.E., Zurich: a) **Software-Tool zur Ermittlung des Effizienzpotenzials bei elektrischen Antrieben** (Software tool for calculating the efficiency potential of electric drives) (JB project 102545) ● b) **Betrieb ohne Nutzen BoN** (Operation without use) (SB project 102345)

[14] B. Kobel, Y. Roth (yann.roth@rysering.ch), Ryser Ingenieure AG, Bern: **Analyse und Vorgehen zur energetischen Optimierung von Pumpen bei Wasserversorgungsanlagen** (Analysis and procedure for energy optimisation of pumps in water supply systems) (JB project 102686)

[15] A. Burri (adrian.burri@awtec.ch), AWTEC AG FÜR TECHNOLOGIE UND INNOVATION, Zurich: a) **Produktedeklaration Kleinkühlschränke** (Product declaration for refrigerators) (SB project 101953) ● b) **Messreihe Kleinkühlschränke** (Measurements of small refrigerators) (JB project 102672)

[16] M. Koebel (matthias.koebel@empa.ch), EMPA, Dübendorf: **Energieverbrauchsminimierung von Kühlschränken durch thermische Optimierung** (Minimisation of energy consumption of refrigerators through thermal optimisation) (JB project 102855)

[17] P. Mauchle, (peter.mauchle@sing.ch), Schnyder Ingenieure AG, Hünenberg: **Rotierende USV-Anlagen und dynamische Energiespeicherung** (Rotating UPS devices and dynamic energy storage) (JB project 102828)

[18] J. Nipkow (juerg.nipkow@arena-energie.ch), ARENA, Arbeitsgemeinschaft energie-alternativen, Zurich: **Elektroheizungen – Massnahmen und Vorgehensoptionen zur Reduktion des Stromverbrauchs** (Electric heating systems – measures and options for reducing electricity consumption) (JB project 102648)

[19] G. Dürrenberger (gregor@mobile-research.ethz.ch), Federal Institute of Technology, Zurich und G. Klaus (klaus@maxwave.ch), Maxwave, Zurich: **Netzrückwirkungen von Energiesparlampen** (Effects of energy-efficiency lamps on the mains supply) (JB project 102644)

[20] S. Gasser (stefan.gasser@eteam.ch) eTeam, Zurich: **Qualitätsmerkmale der LED-Beleuchtung** (Quality characteristics of LED lighting) (Project 102901)

[21] M. Meyer, S. Menth (markus.meyer@emkamatik.com), Emkamatic GmbH, Wettingen: **Verifizierung der Stromeinsparung durch energieeffizientes Zugsmanagement** (Verification of reduction of electricity consumption through energy-efficient locomotive management) (JB project 102645)

List of P+D projects

[22] V. Härri (vinzenz.haerri@hslu.ch), HOCHSCHULE LUZERN, Horw: **Certificate of Advanced Studies: Effizienz und Energie in Technik und Industrie** (Efficiency and energy in technology and industry) (JB project 101796)

[23] J. Nipkow (juerg.nipkow@arena-energie.ch), ARENA, Arbeitsgemeinschaft energie-alternativen, Zurich: **Promotion und Koordination EU Motor Challenge Programme** (Promotion and co-ordination of the EU Motor Challenge Programme) (SB programme 100403) www.motorchallenge.ch and www.topmotors.ch

[24] R. Brüniger (roland.brueniger@r-brueniger-ag.ch) R. Brüniger AG, Ottenbach: **IEA-EXCO-Vertretung des Implementing Agreements 4E** (IEA EXCO representation of Implementation Agreement 4E) (JB project 102435)

[25] C. U. Brunner (cub@cub.ch), A+B International, Zurich: **Motor Systems Annex for 4E** (JB projekct 102221)

[26] G. Schnyder (gilbert.schnyder@sing.ch), Schnyder Ingenieure AG, Hünenberg*;* **Code of Conduct für USV-Anlagen** (Code of conduct for UPS systems) (JB project 101109)

References

[27] **SwissEnergy web site** and SFOE: www.energie-schweiz.ch

[28] ***Homepages of energy agencies***: www.energieagentur.ch and www.energie-agentur.ch and www.eae-geraete.ch

[29] **Web site for IEE project**: www.efficient-server.eu

[30] **EU web site for information on activities relating to codes of conduct**: http://re.jrc.ec.europa.eu/energyefficiency/

[31] **Web site of Motor Challenge Programme**: www.topmotors.ch

[32] ***Research programme web site***: www.electricity-research.ch. Downloads of summaries, annual and final reports on research activities