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Research Programme *Electricity*

Annual Report 2003

Research Programme „Electricity“
of the
Swiss Federal Office of Energy

worked out by
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On behalf of
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ELECTRICITY

Report on the 2003 research programme

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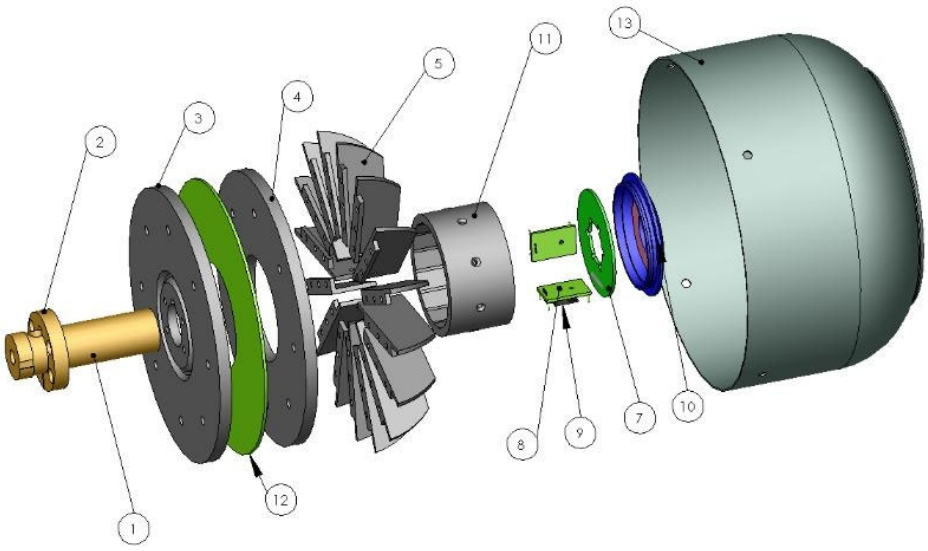

Ventilator section of an innovative integral drive (*source*: *IDS AG)*

With a compact integral drive it is possible to save around 220 GWh in Switzerland in comparison with non-regulated motors. This photo clearly shows the supplementary resistor (12) and rotating electronic components (8, 9) beneath the fan cowl.

Programme priorities and objectives

Representing around 20 percent of overall end energy demand and a financial value in terms of sales of about 8 billion Swiss francs, electricity is of central economic importance. Promoting the most efficient use possible of this valuable energy carrier is therefore a key goal. The *Electricity* programme focuses on *electricity use*, *electricity transport*, *electricity storage* and the broader area of *cross-section technologies*. In view of the declared objective of *SwissEnergy* [31] to limit the growth of electricity consumption to 5% for the period from 2000 to 2010, the programme has to concentrate its efforts on efficient and economical use of electricity.

Specific targets were set for each segment within the area of **electricity use**. In the area of *information and communications technology*, efforts were made to implement the findings obtained from a research project in IT training in the energy sector. Intensification of international co-operation was also declared a clear objective. The focus was on server switching and the power consumption of set-top boxes, and plans were drawn up to establish a support group in the area of uninterruptible power supply devices comprising representatives from the industry. Although modern *household appliances* already have a high level of efficiency, there is still a need for action in certain areas, and the main goal for 2003 was to carry out a background study in order to identify these areas.

Drives and electric motors are responsible for the consumption of approximately 45% of electrical energy, and with an estimated savings potential of up to 30% (which is equivalent to more than 7,000 GWh), this area possesses the greatest efficiency potential. Since compressed air systems are clearly definable and have an efficiency potential of around 100 GWh p.a., the main objective here was to initiate the long-since planned feasibility study concerning the establishment of a *competence centre for compressed air systems*. Furthermore, the question needs to be carefully examined of how the ongoing German programme aimed at increasing the efficiency of compressed-air technology can be implemented in Switzerland too. If the introduction of the *Motor Challenge Programme* into Europe should be delayed, it is important that continuity is secured in Switzerland by initiating our own project.

As before, in the area of **electricity transport and storage** the issue of decentralised production plants calls for solutions to highly demanding technical problems. Identifying these problems and addressing them through joint projects with industry were therefore among the main objectives for 2003. In the area of **high-temperature superconductivity** the main objective for 2003 was to secure continuity with respect to project activities and the distribution of information despite limited financial resources. This called for continued participation in the corresponding IEA implementing agreement on the one hand, and intensified interaction with the relevant industry on the other hand.

In the area of **cross-section technologies**, a variety of cross-over projects aimed at enhancing efficiency are under consideration, though the next steps will primarily be taken on the basis of reactive impulses arising from the industry.

Another major goal for 2003 was to take the ***concept*** of the *Federal Government Research Programme for the period from 2004 to 2007* [37] as the basis for integrating the priorities of the Electricity programme into a concept for the same period. It was also decided to update the existing Internet home page.

Tasks accomplished and results obtained in 2003

ELECTRICITY TRANSPORT AND STORAGE

Since the Swiss Federal Office of Energy quickly moved in the direction of preparing new legislation governing the electricity industry after the proposed Electricity Market Act was rejected by the electorate in autumn 2002, its originally planned activities relating to a specific research initiative were no longer an urgent priority. In view of this, it shifted its focus back to the topic of decentralised production. During the year under review, a formal agreement was concluded between the Swiss Association of Electricity Producers (VSE) and the Swiss Federal Office of Energy concerning the transfer of new findings from the *Electricity* programme. This was especially pleasing in that it represented an intensification of the close co-operation between the SFOE and the electricity industry.

In order to encourage more students to consider enrolling for courses on electricity transmission and distribution, and as a means of obtaining new findings in the area of DC transmission, a model of a DC transmission line was constructed

within the scope of a project called ***Démonstrateur pour réseau avec transport d`énergie en courant continue*** (*Demonstration network for DC transmission*) [1] at the Yverdon Institute of Technology.

The pronounced increase in the number of decentralized production plants in the transmission network is giving rise to additional technical challenges for network operators. In the low-voltage network in particular, attention has to be paid to the maintenance of voltage, and suitable measures have to be taken to counter the related growing proportion of harmonics. These and other findings have been obtained from the ***Increase in the number of decentralized energy production plants in distribution networks*** [2a] research project, since it was possible to carry out realistic comprehensive simulations thanks to the network data provided by the participating electricity companies.

A project called ***Use of compressed air storage systems*** [3] was initiated in close collaboration and co-operation with the SFOE *solar chemistry / hydrogen* programme. The aims of this project are not only to identify suitable uses for compressed air storage, but also to analyse the technical and economic hurdles that a new, innovative, feasible isothermal compressed air concept would have to overcome in order for it to be brought onto the market, especially in comparison with alternative storage technologies. In the year under review, tests were conducted on pressure tanks, transformation, electronics and drive mechanisms, including efficiency assessments.

A project entitled ***AC corrosion on pipelines*** [4] is studying the influences of electricity transmission lines on the formation of corrosive substances on gas pipelines. Field tests were carried out, and a specific electrochemical testing method was identified for estimating the risk of corrosion.

Results of other research projects implemented by the relevant departments of the two Federal Institutes of Technology and the Biel School of Engineering and Architecture that are being financed by the PSEL (Project and Study Fund of the Electricity Industry) are available on the Internet [35].

HIGH-TEMPERATURE SUPERCONDUCTIVITY (HTSC)

It is essential that Switzerland maintains contact with leading global research in the area of high-temperature superconductivity. New discoveries in this area are always on the cards, as the discovery of the new superconductive material, MgB_2, in 2001 clearly underscores. Switzerland's participation in the ***Implementing Agreement for a Co-operative Programme for Assessing the Impact of High-Temperature Superconductivity on the Electric Power Sector*** [5]***,*** a programme initiated by the International Energy Agency (IEA), gives the opportunity to stay in touch with developments in this area. Two IEA information meetings in the course of 2003 took place, both of which were dedicated to the topic of superconductive cables (see Figure 1). The documentation relating to these meetings was passed on to all research institutions and industries in Switzerland active in the area of superconductivity on the occasion of the annual status seminar. It was also agreed to prolong the IEA agreement for a further 2 years.

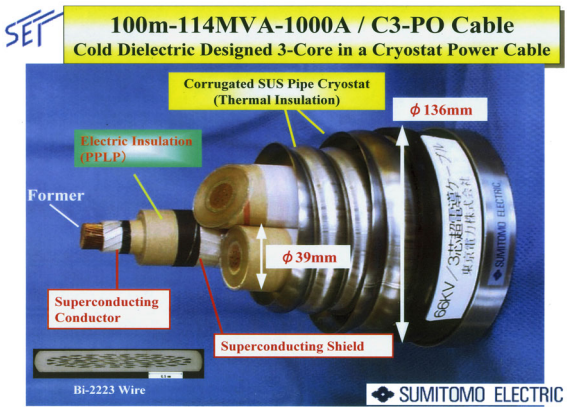

Figure 1: *Prototype HTSC cable from Sumitomo (source: Sumitomo Electric, Japan)*

A practice-based overview of the potentials of superconductive current limiters was provided through the ***Market potential of superconductive current limiters*** project [6]. Here, with the aid of simulations and following comprehensive discussions with a variety of interested parties it was found that the most attractive potential lies in the coupling of medium-voltage networks. While the technical properties of already realisable superconductive current

limiters meet the requirements for use in the area of network coupling, certain improvements are still necessary before they can be put to practical use. This study forms the main basis for the decision whether a suitable prototype is to be developed and installed in the Swiss network.

Within the scope of the ***National Centre of Competence in Research project on materials with novel electronic properties*** [36], under the auspices of the Swiss National Research Fund, a total of 8 institutions and industries are involved in theoretical or practical research in the area of high-temperature superconductors.

ENERGY AND INFORMATION TECHNOLOGY

The ***Energy and Information Technology Competence Centre*** [7] at the Federal Institute of Technology, Zurich, supports the promotion of more efficient energy use in information technology and electronic entertainment equipment. For this purpose it collects, processes and distributes relevant information. Since information and communications technology is an international market segment, special attention is given to events and activities abroad – not simply in order to eliminate redundancies, but also to utilise synergies between activities at home and abroad.

Although servers are often only used to a very limited extent at night and over the weekend, especially in small and medium-sized companies, they are normally in operation 24 hours a day. Recent studies have revealed that if servers were to be switched off when they are not required, it would be possible to save approximately 90 GWh p.a. in Switzerland, and as much as 2,000 GWh p.a. within the EU. As a result of these findings a number of projects are now focusing on this topic. In the ***Energy-efficient server management*** project [8a], a functional model of an externally installable, intelligent switching panel was developed on the basis of an inexpensive embedded web server, and in principle the solution was found to be feasible. In this way it is possible to switch data processing servers on and off according to pre-set schedules. A follow-up project ***Energy-efficient server management in practice*** [8b] is now focusing on thoroughly testing the functionality of the new switching panel (see Figure 2) in different IT environments, and optimising it from the point of view of user-friendliness. In another project ***Impacts of periodical switching on and off on the reliability of server hardware*** [9] it was scientifically established that switching servers on and off does not have any significant influence on their lifecycle.

Figure 2: *Prototype of an intelligent switching panel for server management (source: EMT AG, Ermatingen)*

On the manufacturer side there are various solutions for the energy management of servers. The ACPI (Advanced Configuration and Power Interface) standard, which is widely known from PCs, has been adopted in the area of Windows® servers. Although various manufacturers guarantee the system compatibility of certain low-end servers with this standard, it is still not known how ACPI sleep modes function in practice in a server environment, nor what their limits are. The aim of a project called ***Optimised energy use with ACPI functionalities*** [10a] is to gain practical experience with ACPI functionalities on low-end servers and obtain findings regarding their limits. For these purposes a low-end server has been equipped with *Windows 2003*.

Digital television is going to have an increasing impact on electricity consumption. The EU has estimated that the electricity consumption of digital TVs will reach 23,000 GWh in 2006, while the savings potential as the result of

improved energy efficiency is estimated at 15,000 GWh. It will be possible for a central gateway (otherwise known as set-top box) to operate a number of end devices. Here it is important to include providers of information services such as film distributors, broadcasting corporations and network operators, as well as manufacturers of end devices (TVs, DVD players, hi-fi systems, etc.) in the future energy management of end devices, since consumers eventually will have access to bi-directional, interactive, timed services. Basic principles are to be defined and coordinated at the international level in a project called ***Principles for improving the energy efficiency of set-top boxes*** [10b], and a study is to be carried out concerning the future trend in Switzerland.

The aim of the ***Energy efficiency of uninterruptible power supply devices*** [2b] project is to add standby losses to the criteria formulated to date regarding the design, quality and energy efficiency of UPS devices, and to pave the way for European implementation. International contacts have been established at the EU level (research organisations) and through Switzerland's active involvement in the relevant IEC (International Electrotechnical Commission) working group. Now that the necessary contacts with the Swiss industry have been established and incorporated into a trend-watching group, the next step is to push ahead with implementation efforts and simultaneously promote international discussion of this topic.

The ***Energy consumption of process control units*** [11] project is studying an area that has been largely ignored to date. Since there are practically no reports, guidelines, labels, etc., to refer to with respect to the energy consumption of process control units, it was necessary to carry out a variety of measurements. Some of these were carried out within the industry on running systems, and at the *Institute of Technology in Chur*, and they were supplemented by evaluations of company catalogues and discussions with specialists in the field. It was found that the power consumption of the various units is fairly low and that, at around 14 GWh, the overall share of consumption in Switzerland is barely of significance. Furthermore, the majority of recent models have already been optimised.

DRIVES / ELECTRIC MOTORS

The EU aims to eliminate motors with low efficiency levels from the market through a variety of measures. For example, it concluded a voluntary agreement with the *European Committee of Manufacturers of Electrical Machines and Power Electronics* (CEMEP), in which it was agreed to apply an efficiency classification system and stipulate an increase in sales figures of energy-efficient motors (types eff1 and eff2) and a reduction in the sales volume of inefficient motors (type eff3). The federal government in its turn intends to promote the sale of energy-efficient motors in Switzerland by taking similar measures involving Swiss manufacturers and retailers. The relevant principles are to be defined within the scope of the ***Industry agreement on the energy efficiency of motors*** [2c] project. In order to pave the way for implementation, a special workgroup has been set up in co-operation with the industry that is to examine the prerequisites for concluding a voluntary agreement and prepare the definitive version. A first draft has already been drawn up.

The pilot project concerning the European ***Motor Challenge Programme (MCP)*** [12a] organised by the EU Commission is intended to create both the technical prerequisites for later implementation of the programme and contacts with industrial companies, as well as carry out initial energy analyses. The main aims of this programme are to heighten the awareness of top industry managers to energy issues in the area of drives, and to promote their commitment to energy-efficiency activities within their own company. With the aid of the *Energy Agency for Industry*, a number of companies were found in Switzerland that expressed an interest in the programme, two of which decided to become involved – a foodstuffs producer and a major chemical company. These two companies are applying to the European Commission for membership of the partnership. Within the scope of this project, a total savings potential of more than 18 GWh p.a. was identified, with an average payback time of 13 months, 3 GWh p.a. of which were attributable to the two Swiss companies.

In the ***Expansion of OPAL with ventilation and pump systems*** [13a] project, the existing design software (OPAL) was expanded in order to enable a fast and simple assessment of the energy efficiency of such systems while taking account of viability aspects. These modules were tested in the above-mentioned *Motor Challenge Programme*. A comprehensive tool for realising the savings potentials of electric motors is being developed in a new international SAVE project (***Promot: a decision-making tool for motor operators*** [13b]), utilising existing synergies. This means that the findings and developments of OPAL will be optimally distributed at the international level.

The ***Efficient gearless drives*** project [14] is setting out to develop efficient drives for applications with low speeds. These comprise an IGBT converter and a high-pole permanently activated synchronous machine, and can be used as both a motor and a generator system. They are being tested for applications in the 1.2-megawatt and 3.0-kilowatt

categories. In the year under review, converters and machines were completed and tested for a 1.2-megawatt system. The measurements confirmed the pre-calculated efficiency levels of around 95.8% for the machine and approx. 98% for the converter – equivalent to a more than 50% reduction in losses. The high level of efficiency is achieved since it is possible to eliminate the need for a mechanical drive mechanism, but also because the machine and converter have been accurately attuned to one another and optimised in a variety of ways. Since the design of the 3-kilowatt machine is considerably more time-consuming, testing will only take place during 2004.

The ***Prototype of an energy-efficient motor*** [15] project is based on a newly developed technology with a permanent magnet rotor. In view of the fact that a feasibility study yielded promising results, alternative ways of enhancing energy efficiency are now being studied, primarily in the areas of winding technology and stator construction. For this purpose, a series of magnetic flux simulations were carried out during the year under review.

The aim of the ***Integral drive II: integrated motor converter with controlled energy consumption*** [16] project is to develop an energy-efficient, low-cost asynchronous motor in the 0.1 to 12.0 kW range with an integrated choke mechanism for the pump and ventilation units, which betters all existing solutions for variable speed drives on the market in terms of both cost and volume. The load component (rotating electronics) was designed during the year under review, while a low-cost and reliable solution was developed for the power supply and signal transmission to the load component. A compact and sturdy solution already exists for the mechanical configuration and the installation of the complete converter assembly, and a test bench has meanwhile been set up (see Figure 3).

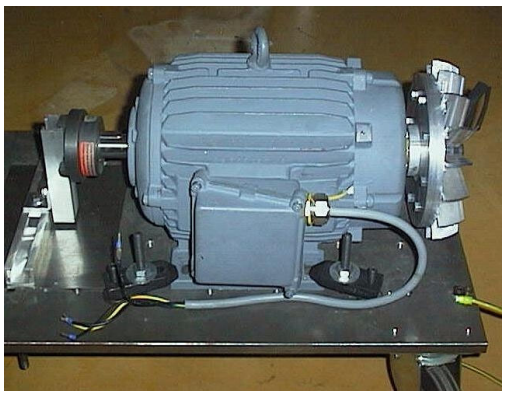

Figure 3: *Test bench for integral motor with open ventilation (source: IDS AG, Zurich)*

In Switzerland, approximately 150,000 compressed air systems consume around 750 GWh of electricity per annum, which accounts for 1.5% of the country's overall electricity consumption. However, using energy efficient compressed air systems it would be possible to save 300 GWh in theory – and around 100 GWh in practice – of electricity per annum. In a project called ***Compressed air competence centre*** [17], a feasibility study was carried out at the Institute of Technology, Horw, which basically confirmed that the market would in fact accept an independent competence centre of this sort, and that it would be possible to build up the corresponding competencies and infrastructures at this institute of technology. At the same time, the ***Feasibility study on the transfer of the German "Efficient compressed air" campaign to Switzerland*** [18] showed how it would be possible to transfer this campaign to Switzerland, and to what extend.

APPLIANCES / MISCELLANEOUS DEVICES

Since minibars are installed directly in hotel rooms, they need to be silent. This means that absorber refrigerators have to be used, which for technical reasons have a very high electricity consumption. However, the efficiency potential is considerable here: in Switzerland, it is estimated that the approximately 50,000 absorber minibars in use in hotels consume around 22 GWh p.a., and this figure does not include the additional electricity consumption in air-conditioned rooms. From the technical point of view, it would be possible to provide minibar services with a quarter of present-day electricity consumption. In a project called ***Efficient hotel minibars*** [12b], in a first step a variety of alternatives were outlined that could significantly reduce the electricity consumption of these appliances. The next step will be to establish direct contact with suppliers in order to find a partner for developing an alternative minibar system.

More and more banks, offices and department stores are now installing water dispensers. These appliances normally comprise a casing with a built-in refrigeration unit and a removable water container. Water can be cooled (and in some cases, heated) just before it comes out of the tap. The ***Energy-efficiency potential in the area of water dispensers*** [10c] project yielded initial findings concerning the increasing use of this type of appliance. The associated national electricity consumption is around 4.5 GWh. The growth rate here is very high, and it is estimated that consumption could rise to 42 GWh by 2010. Studies have revealed that the technical savings potential is in the region of 50% and involves the following efficiency measures: improving the efficiency of water dispensers, excluding the option of hot water, and switching off appliances at night and over the weekend.

At the end of the 1990s, approximately 16,000 refrigerated dispensing machines for beverages and foodstuffs were in use in Switzerland, and these accounted for an estimated annual energy consumption of 50 GWh. In order to utilise the existing substantial efficiency potential, the ***Fact sheet on optimal energy use in refrigerated beverage and food dispensers*** project [10d] compiled a checklist concerning the maintenance of these machines and the choice of the most suitable location. Here the main target group is operators of these machines and lessors of the sites on which they are located. The resulting fact sheet was finalised during the year under review, following a period of consultation with the relevant industry.

The project called ***Energy-efficiency potential of hot beverage dispensers used in the area of staff catering*** [19] estimated the nation-wide energy consumption of these appliances at around 43 GWh p.a. This figure does not include household coffee machines, which were studied in a separate project. Although there are various obstacles that prevent full implementation of efficiency measures, it was nonetheless possible to implement some of them thanks to activities on the part of the federal government and the relevant industry. Options here include automatically switching appliances on and off in buildings used by the federal administration, plus voluntary agreements.

The electricity consumption of household appliances is well documented for conventional operating cycles, but there were still significant gaps in knowledge regarding consumption in standby mode. In this area, new findings were obtained with the aid of market surveys, measurement programmes and analyses carried out within the scope of the ***Standby consumption of household appliances*** [12c] project. **Standby losses for household appliances in Switzerland amount to approximately 400 GWh**, the greatest proportion of which – approximately 80% – is attributable to heating requirements for coffee machines. In some categories the proportion of standby consumption to overall electricity consumption of the appliances is extremely high. The main technical criteria for enhancing the energy efficiency of coffee machines are an automatic switch-off function and improved insulation of boilers. With respect to induction cooker, it is possible to significantly reduce the surprisingly high losses associated with control devices. Here, for all measures aimed at enhancing efficiency it is essential to formulate practical **guidelines** and define **testing standards** for declaring standby losses.

The aim of a European programme called *GreenLight* is to increase the energy efficiency of lighting systems in buildings. Since Switzerland is interested in participating in this programme, the associated preparatory tasks were initiated within the scope of its own project called ***Establishment of GreenLight National Contact Points in Switzerland*** [20]. The programme has been widely publicised in the form of promotion campaigns, the creation of a dedicated web site, and presentations at special events. In the meantime a first endorser (IBAarau Elektro AG) and a first partner (City of Zurich) have been found, and the intention now is to pursue these activities through the *Swiss Agency for Energy Efficiency (S.A.F.E.)* once the preparation work is concluded successfully.

Co-operation at the national level

In all priority areas, one or more meetings were held within the scope of the various **trend-watching groups**, each of which comprises representatives from the relevant industries, academic institutions and other research centres. These periodical conferences attended by recognised experts represent an ideal information and discussion forum at the national level. In the year under review a new trend-watching group was established in the specific area of uninterruptible power supply units.

At the Biel School of Engineering and Architecture, the activities carried out within the scope of the *Increase in the number of decentralized energy production plants in distribution networks* project have given rise to the formation of a **competence centre in the area of distribution networks**. In addition, the prerequisites were created for the School of

Technology and Architecture, Lucerne, to set up a *compressed air competence centre*. In general, efforts were made to integrate **colleges of technology**, and a number of projects were also implemented. The ***Energy and Information Technology Competence Centre*** at the Federal Institute of Technology, Zurich, continues to make a valuable contribution towards co-operation at both the national and international levels, and has meanwhile become a widely recognised institution in this area.

Contacts were intensified with other **sponsors** as the result of joint financing of research projects, most notably with the *EWZ Electricity Savings Fund*, the *Basel City Electricity Savings Fund*, the *PSEL* (*Projects and Studies Fund of the Electricity Industry*), the *Commission recherche, développement, prospective de la Chambre romande d'énergie électrique* (RDP-CREE), and the *KTI*. Co-financing was arranged with the KTI in particular in two major projects.

Close contact is also maintained with Switzerland's **energy agencies** in a variety of projects [32]. For example, joint actions have already been initiated with the *Energy Agency for Industry* (EnaW), the *Energy Agency for Electrical Appliances* (eae) and the *Swiss Agency for Energy Efficiency* (S.A.F.E.). In virtually every project we also try to involve the major **business and industry associations**.

A variety of Swiss Federal Office of Energy research projects were presented to a wide-ranging public at a conference organised jointly by the *ETG (Electrotechnical Association)* and the *ITG (Information Technology Association)* in spring 2003 (**No energy – No IT**).

Co-operation at the international level

At the international level, close contacts are maintained in all priority areas, both within the scope of direct co-operation in projects as well as at international conferences and workshops.

In addition to Switzerland's participation in the IEA programme, ***Assessing the Impact of High-Temperature Superconductivity on the Electric Power Sector***, two Swiss groups are actively involved in the ***BIG POWA*** project (GRD1-1999-10461) within the scope of the *5th EU framework programme* (***Growth***), and are studying the problem of AC losses associated with a transformer and model coil. Furthermore, as a member of the steering committee and with two participating groups, Switzerland is also taking part in the European ***Superconducting European Network, SCENET II*** programme (GTC1-2001-43047), which encompasses more than 80 groups and was initiated in July 2002 for a period of 4 years. *SCENET II* wants to optimise information flow within Europe and thus improve the competitive capacity of European research. This international integration has given rise to numerous contacts with research institutions, with the result that various Swiss institutions were able to participate in the preparatory work for the 6th EU framework programme focusing on *high-temperature superconductivity*.

In the area of *decentralized energy production plants*, an exchange of information was set up with the ***University of Dortmund***. The ***Use of compressed air storage systems*** project was implemented in close co-operation with the European *INVESTIRE* project (ENK5-CT-2000-20336).

Switzerland's activities in the area of **information and communications technology** are internationally based and co-ordinated. Switzerland also maintains besides others relationships with the *European Commission*, the *Environmental Protection Agency (EPA)* and the *LPL (Lawrence Berkeley National Laboratory)*, both of which are based in the USA, and with the *Agence de l'environnement et de la maîtrise de l'énergie (ADEME)* in France.

A number of national projects were presented at the ***3rd International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL´03)*** [33] held in Turin in autumn 2003, which also provided a good opportunity to firm up existing contacts and establish new ones.

The co-support of the European and German Copper Institute was secured within the scope of **supplementary support activities for the *Motor Challenge* Programme (MCP) in Switzerland**. Furthermore, international co-operation in the area of enhancement of efficiency of motors was intensified in that the Fraunhofer Institute (Germany) was asked to examine the question of transferring the German programme aimed at increasing the efficiency of compressed air technology (*Druckluft efficient*) into Switzerland. Switzerland is also an active partner in the European ***SAVE project***, **Promot: a decision-making tool for motor operators**. In the year under review, the Swiss Federal Office of Energy

programme head was invited to speak at an international conference held by a renowned European motor manufacturer.

Finally, through its involvement in the ***GreenLight* programme** and the ***Cluster pilot project for the integration of RES into European energy sectors using hydrogen***, Switzerland is able to secure access to the international research community.

Pilot and demonstration projects

ELECTRICITY TRANSPORT AND STORAGE

The main aims of an international project called ***Cluster pilot project for the integration of RES into European energy sectors using hydrogen (RES = reversible energy storage system)*** [21] are to study the interaction between renewable energies in autonomous networks within the scope of an initial pilot project on Gran Canaria, and to test a hydrogen storage system based on an autonomous power plant. The design stage has been almost completed.

Based on the premise that an increasing number of decentralized producers will be generating electricity in the future, it is essential that findings are obtained concerning the interaction between a large number of small-scale plants. The principal objective of a feasibility study called ***decentralized production plants in low-voltage networks*** [22a] is to specify the general conditions for implementing a project to install an operational pilot and demonstration network within the 400 V network. From the contacts established to date with associations, energy supply companies and manufacturers/distributors of independent energy production plants it has become apparent that there is a great deal of interest in this project. In the course of 2004 it will be necessary to define pilot installations and clarify the financing of their operation and respective environment.

ENERGY AND INFORMATION TECHNOLOGY

Specimen texts have been formulated in a project called ***Documentation for requesting tenders for servers, PCs and network devices*** [23a]. The aim here is that these forms should be used by large-scale buyers in both the public and private sectors in order to exert pressure on the industry to produce more energy-efficient servers, PCs and network devices. These are now being examined within the federal administration from the point of view of their suitability.

A variety of Swiss Federal Office of Energy projects have yielded new findings that can readily be implemented, and these are now being listed in a series of fact sheets within the scope of the ***Fact sheets in the area of IT*** [23b] project. There will be fact sheets on IT procurement, server switching and energy management in *Windows*®, two of which (*IT procurement* and *Energy management in Windows*®) have meanwhile been finalised, while the third (S*erver switching*) is currently in the consultation stage.

Studies have shown that it would be possible to reduce the proportion of electricity consumption for cooling IT rooms from the current level of approximately 50% to below 30% of overall consumption, and to below 20% for new IT rooms. The aim of the ***Energy efficient cooling of IT rooms*** [24a] project is to provide heating, ventilation and air-conditioning planners and IT operators with information concerning the relevant parameters and correlations for the energy-efficient cooling of IT rooms. A draft for the planning and information documentation has meanwhile been produced. In order to check the level of energy efficiency (balance between overall electricity consumption and power required for cooling), measurements are being carried out in an IT room and carefully compared with one another.

One of the measures for reducing electricity consumption in IT rooms concerns raising the mean ambient temperature from 22 to 26 degrees. A **fact sheet** produced by the **Swiss Federal Office of Energy** in the mid-1990s (*26 degrees as a safe temperature for computer rooms* [24b]) is being revised and updated.

DRIVES / ELECTRIC MOTORS

In order to ensure continuity once the EU pilot project relating to the *Motor Challenge Programme* has been concluded, a variety of ***supplementary support activities for the Motor Challenge Programme in Switzerland*** [25a] have been initiated. The objectives here are to continue to encourage the industry in Switzerland to participate in the motor

challenge programme, and to inform motor operators (as partners) as well as planners, suppliers and manufacturers (as endorsers) about efficiency potentials and measures to exploit them, so as to create motivation for taking action. An information and communication concept was drawn up in 2003, and preparations were made for carrying out measurements and analyses in the pilot project involving two buildings belonging to *Novartis Pharma AG* in Basel.

In the ***Efficient use of electricity in waste disposal plants*** [22b] project, all energy-related processes and process technologies in waste disposal plants were analysed from the point of view of optimisation potential (see Figure 4). A series of tests was carried out in order to analyse specific processes in greater depth. At the Turgi waste treatment plant it was found that the annual savings potential for electrical energy is between 1.8 and 2.3 GWh. Measured against its internal consumption of 17 GWh, this would be equivalent to annual savings of between 11 and 14 percent. A projection to all thermal waste treatment plants in Switzerland indicates an annual savings potential of around 40 GWh, which is equivalent to the electricity consumption of approximately 11,000 private households.

Figure 4: *Cooling system at Turgi waste treatment plant (source: Schnyder Ingenieure AG, Hünenberg)*

In the ***Energy efficiency in sewage treatment plants*** [26] project, measurements were carried out by a Swiss treatment plant using a new measurement method that does not interfere with existing processes. The measurements indicate that there is probably a certain amount of efficiency potential, and the findings obtained to date are to be reinforced by extending the measurements to other sewage treatment plants.

In a variety of sectors, specific pilot projects were initiated in collaboration with the companies concerned in order to pursue the defined objectives. The two projects, ***Reduction of electricity consumption in a sawmill*** [27] and ***Energy efficiency programme at Christoph Burkhardt AG*** [28] each revealed substantial potential for increasing the level of efficiency. Since much of this potential is economically viable, the various measures are to be implemented on a step-by-step basis.

APPLIANCES / MISCELLANEOUS DEVICES

Following the revision of the civil protection concept, there are now around 3,000 underground facilities throughout the country. In order to meet the relevant minimum requirements, these facilities have to be supplied with fresh air as well as dehumidified. In a project called ***Efficient dehumidification of sealed rooms*** [29], the aim is to demonstrate that the need for mechanical dehumidification can be reduced – or perhaps even eliminated altogether – through the optimal use of differences in temperature and humidity between the interior and the exterior. The energy requirement for dehumidification is around 10,000 kWh p.a. for each facility. If this were reduced by at least 20 to 30% through optimal ventilation, an overall efficiency potential would result of approximately 10 GWh p.a.

The objective of the ***Energy-optimised textile ventilation system*** [30] project is to separate humidification from air regeneration in textile ventilation systems. The target here is to reduce the necessary level of air regeneration by

approximately 50% in around 30% of all textile ventilation systems. For this purpose, in-depth analyses of the various humidification systems were carried out, but it soon became apparent that a comprehensive test model would need to be constructed in order to make a sound assessment of these systems. This is to be implemented in the course of next year.

Electric band heaters consume very large amounts of energy: it is estimated that these devices account for an annual consumption of around 300 GWh in Switzerland, which is roughly equivalent to the total consumption of all television sets. In the ***Fact sheet on the efficient use of electric band heaters*** [25b] project, the existing findings were presented in the form of a fact sheet to simplify practical implementation.

Summary for 2003 and outlook for 2004

With the assistance of the various support groups, one were able to achieve the declared objective of defining the orientation of the programme for the period from 2004 to 2007 in the form of a coherent **concept**. The planned update of the homepage was as well completed [34].

Since the Swiss Federal Office of Energy quickly moved in the direction of preparing new legislation governing the electricity industry after the proposed Electricity Market Act was rejected by the electorate in autumn 2002, its originally planned activities relating to a specific research initiative were no longer an urgent priority, and were therefore placed on hold. However, the fact that the education agreement with the VSE was at last finalised and signed by both parties was a highly pleasing development. As before, activities in the area of decentralized energy production plants relating to ***electricity transport and storage*** will remain the centre of focus, and efforts are to be made to implement the planned field trial in a selected network in close co-operation with the industry.

The study of a current limiter with ***high-temperature superconductive material*** was brought to a successful conclusion, and it is now to be hoped that the industry will continue to pursue its activities. It is also wanted to encourage other industries to participate in projects relating to high-temperature superconductivity. Know-how transfer within Switzerland functions smoothly, and it is requested to ensure that this remains the case in the future too.

In the areas of **information and communication technology** and **networked household appliances**, it was possible to implement most of the planned activities, and it is pleasing to note that the findings relating to IT education in the energy sector that were obtained in an earlier project are now being implemented by third parties. Furthermore, the activities in the areas of UPS systems and server switching led to the definition of principles and criteria that have gained international recognition. International co-operation needs to be further intensified during 2004. Additional criteria need to be defined in the area of set-top boxes, and the energy-related findings concerning coffee machines need to be put into practice.

Demonstration projects relating to **electric drives and motors** were concluded in a variety of sectors, and at long last the criteria were defined for the creation of a *compressed air competence centre*. Furthermore, ways in which the ongoing German programme aimed at increasing the efficiency of compressed-air technology (*Druckluft-effizient*) can be put into action in Switzerland too, were formulated, and these findings need to be implemented in the course of 2004. Since the introduction of the *Motor Challenge Programme* in Europe was delayed, continuity was secured in Switzerland in the form of an own project. Finally, additional sector-related demonstration projects should be initiated during 2004.

List of R+D projects

(AR) 2003 annual report (available)
(FR) Final report (available)
ENET: ENET order no. of report
The reports can be downloaded from the Internet addresses indicated:

[1] C. Yechouroun, (cyrus.yechouroun@eivd.ch), HES-SO, *Yverdon:* ***Démonstrateur pour réseau avec transport d'énergie en courant continue*** (SB)

[2] G. Schnyder, (gilbert.schnyder@sing.ch), SCHNYDER INGENIEURE AG, *Hünenberg:* ***a) Zunahme der dezentralen Energieerzeugungsanlagen in Verteilnetzen*** (SB) ◆ ***b) Energieeffizienz von USV-Anlagen*** (JB) ◆ ***c) Industrievereinbarung Energieeffizienz von Motoren*** (JB)

[3] I. Cyphelly (cyphelly@ran.es), CYPHELLY & CO., *Les Brenets:* ***Einsatz von Druckluftspeichersystemen*** (JB)

[4] F. Stalder, M. Büchler, R. Bräunlich, (sgk@sgk.ch), SCHWEIZ. GESELLSCHAFT FÜR KORROSIONSSCHUTZ (SGK), *Zurich*: ***Wechselstromkorrosion an Pipelines***

[5] R. Flükiger, (rene.flukiger@physics.unige.ch), UNIVERSITÉ DE *GENÈVE:* ***Implementing Agreement for a Cooperative Programme for Assessing the Impact of High Temperature Superconductivity on the Electric Power Sector*** (JB)

[6] M. Lakner, D. Braun (martin.lakner@ch.abb.com), ABB FORSCHUNGSZENTRUM, *Baden-Dättwil*: ***Marktpotential von supraleitenden Strombegrenzern*** (SB)

[7] B. Aebischer, (bernard.aebischer@cepe.mavt.ethz.ch), CEPE, ETH *Zurich:* ***Betreuung des Kompetenzzentrums Energie und Informationstechnik*** (JB)

[8] B. Sauter, (beat.sauter@emt.ch), ENERGY MANAGEMENT TEAM AG, *Ermatingen:* ***a) Energieeffizientes Servermanagement*** (SB) ENET 230186 ◆ ***b) Energieeffizientes Servermanagement im praktischen Betrieb*** (JB)

[9] M. Held, (marcel.held@empa.ch), EMPA, *Dübendorf:* ***Auswirkungen von periodischem Ein- und Ausschalten auf die Server-Hardware-Zuverlässigkeit*** (SB)

[10] A. Huser, (alois.huser@encontrol.ch), ENCONTROL GMBH, *Niederrohrdorf:* ***a) Energieoptimaler Einsatz der ACPI-Funktionalität*** (JB) ◆ ***b) Grundlagen zur Energieeffizienz von Set-Top-Boxen*** (JB) ◆ ***c) Energieeffizienzpotential bei Wasserdispensern*** (SB) ENET 230060 ◆ ***d) Merkblatt zur optimalen Energienutzung bei Kaltgetränke- und gekühlten Warenautomaten*** (JB)

[11] E. Bush, (bush@spin.ch), BUSH ENERGIE GMBH, *Felsberg:* ***Energieverbrauch von Prozesssteuerungen*** (SB) ENET 230096

[12] J. Nipkow, (juergnipkow@swissonline.ch), ARENA ARBEITSGEMEINSCHAFT ENERGIE-ALTERNATIVEN, *Zurich:* ***a) Schweizer Vertretung im SAVE-Programm: Pilot Actions for the Motor Challenge Programme*** (SB) www.motorchallenge.ch ENET 230187 ◆ ***b) Effiziente Hotel-Minibar*** (JB) ◆ ***c) Standby-Verbrauch von Haushaltsgeräten*** (SB) ENET 230107

[13] R. Tanner, (tanner@semafor.ch), SEMAFOR INFORMATIK & ENERGIE AG, *Basel:* ***a) OPAL-Erweiterung mit Lüfter- und Pumpensystemen*** (SB) ◆ ***b) Promot: Ein Werkzeug zur Entscheidungsfindung für Motorenbetreiber*** (JB)

[14] R. Niederer, (niederer@technocon.ch), KONSORTIUM TECHNOCON / BARTHOLDI, *Zurich:* ***Hocheffiziente getriebelose Antriebe*** (JB)

[15] J. Weingartner, (j.weingartner@baechli.com), BÄCHLI AG, *Kriens:* ***Prototyp Energie-Sparmotor*** (JB)

[16] A. Stoev, A. Dittrich (a.stoev@idsag.ch), IDS AG, *Zurich:* ***Integraldrive II: Integrierter Motor-Umformer mit bedarfsorientierter Energieaufnahme*** (JB)

[17] S. Eigen, (seigen@hta.fhz.ch), HTA LUZERN, INSTUITUT FÜR ELEKTRONIK, *Horw:* ***Druckluft Kompetenzcenter*** (SB)

[18] P. Radgen, (peter.radgen@isi.fhg.de), FRAUNHOFER INSTITUT, SYSTEMTECHNIK UND INNOVATIONSFORSCHUNG, *Karlsruhe:* ***Machbarkeitsstudie zur Übertragung der deutschen Energiesparkampagne „Druckluft effizient" in die Schweiz*** (SB) ENET 230188

[19] A. Huser, R. Schmitz (alois.huser@encontrol.ch / rolf.schmitz@electrosuisse.ch), KONSORTIUM ENCONTROL/ELECTROSUISSE, *Niederrohrdorf:* ***Energieeffizienzpotential bei Heissgetränkeautomaten in der Betriebsverpflegung*** (SB)

[20] P. Schneiter, (paul.schneiter@energieeffizienz.ch), SCHWEIZ. AGENTUR FÜR ENERGIEEFFIZIENZ, *Zurich:* ***GreenLight NCP – Aufbau eines National Contact Points in der Schweiz*** (SB)

List of P+D projects

[21] A. Stoev, (a.stoev@idsag.ch), IDS AG, *Zurich:* ***Cluster Pilot Project for the Integration of RES into European Energy Sectors using Hydrogen*** (JB)

[22] G. Schnyder, (gilbert.schnyder@sing.ch), SCHNYDER INGENIEURE AG, *Hünenberg:* ***a) Dezentrale Erzeugungsanlagen in Niederspannungsnetzen*** (JB) ◆ ***b) Elektrizitätseffizienz in Kehrichtverwertungsanlagen*** (JB)

[23] A. Huser, (alois.huser@encontrol.ch), ENCONTROL GMBH, *Niederrohrdorf:* ***a) Ausschreibungsunterlagen im Server-, PC- und Netzwerkbereich*** (SB) ENET 230105 ◆ ***b) Merkblätter im IT-Bereich*** (JB)

[24] A. Altenburger, (adrian.altenburger@amstein-walthert.ch), AMSTEIN + WALTHERT AG, *Zurich:* ***a) Energieeffizientes Kühlen von IT-Räumen*** (JB) ◆ ***b) Aktualisierung des BFE-Merkblatts „26 Grad in EDV-Räumen, eine Raumtemperatur ohne Risiko“***

[25] J. Nipkow, (juergnipkow@swissonline.ch), ARENA ARBEITSGEMEINSCHAFT ENERGIE-ALTERNATIVEN, *Zurich:* ***a) Ergänzende Unterstützungsaktivitäten zum Motor Challenge Programme in der Schweiz*** (JB) www.motorchallenge.ch ◆ ***b) Elektrische Heizbänder – Merkblatt für den effizienten Einsatz*** (SB) ENET 230082

[26] R. Bünger, (buenger1@bluewin.ch), BÜNGER CONSULTING, *Grenchen:* ***Energieeffizienz in Abwasserreinigungsanlagen (ARA)*** (JB)

[27] I. Wyrsch, (iso.wyrsch@wyrschtech.ch), WYRSCH TECHNOLOGIE, *Küssnacht a. Rigi:* ***Einsparung von elektrischer Energie in einem Sägereibetrieb*** (SB)

[28] R. Tanner, (tanner@semafor.ch), SEMAFOR INFORMATIK & ENERGIE AG, *Basel:* ***Energieeinsparung am Fallbeispiel Christoph Burckhardt AG*** (JB)

[29] A. Weitnauer, (adrian.weitnauer@weitnauer-messtechnik.ch), WEITNAUER MESSTECHNIK, *Näfels:* ***Effizientes Entfeuchten von abgeschlossenen Räumen*** (JB)

[30] U. Kupferschmid, (uku@luwa.ch), LUWA TEXTILLUFTTECHNIK, *Uster:* ***Energieoptimierte Textillufttechnikanlage*** (JB)

References

[31] Homepage of SwissEnergy and the Swiss Federal Office of Energy: www.energie-schweiz.ch

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

[33] Roland Brüniger: ***Travel report: 3rd International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL´03),*** www.electricity-research.ch

[34] ***Research programme web site:*** www.electricity-research.ch (downloads of summaries and final reports of research activities)

[35] ***Web site of the PSEL (Project and Study Fund of the Electricity Industry):*** also contains useful links to national research centres: www.psel.ch

[36] Web site of the National Center of Competence in Research (NCCR): ***Materials with Novel Electronic Properties MaNEP***: http://www.manep.ch/manep/manep.html

[37] ***Federal government energy research concept for 2004-2007***: www.energie-schweiz.ch/internet/03095/index.html?lang=de