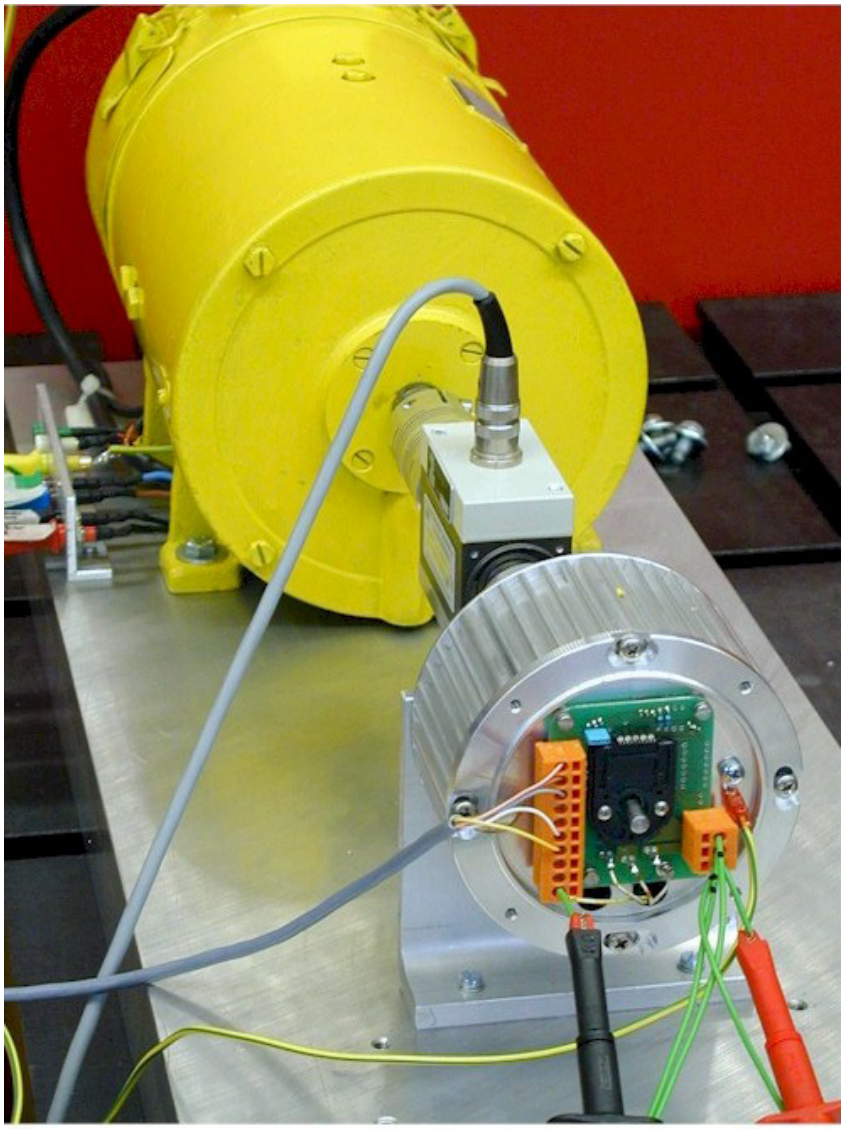
ELECTRICITY

Report on the 2002 research programme

Roland Brüniger

Roland.brueniger@r-brueniger-ag.ch



Energy-efficient motor (front) undergoing tests at the Lucerne College of Technology
(Source: Circle Motor AG)

If all asynchronous motors in Switzerland that have a capacity greater than 1 kW and are operated with a control device were to be replaced by the new energy-efficient model, it would be possible to save 75 GWh per annum.

Programme priorities and objectives

The Swiss Federal Office of Energy (SFOE) **Electricity** research programme promotes the optimum use of electricity in areas ranging from generation and distribution to efficient use. It sets out to find sustainable new ways of saving energy, and in particular to make a direct contribution towards the declared objective of SwissEnergy of limiting the increase in electricity consumption by 2010 to a maximum of 5% versus the 2000 level. One of the priorities of the Electricity programme is therefore to pass on the findings it obtains from its research activities for sustainable practical implementation with the least possible delay. The *Electricity* programme has **four priority areas:** *distribution, high-temperature superconductivity, energy and information technology, and electric drives/motors and similar devices*.

The uncertainties associated with the fact that a referendum was held in autumn 2002 on the proposed Electricity Market Act made it difficult for us to clearly define the practical objectives for the area of **electricity distribution**, since the electricity industry primarily focused its efforts on activities relating to campaigning and marketing. In view of this, it was decided to pursue the objective of formally establishing a joint education platform with the VSE (Swiss electricity industry association) in order to implement findings from research programmes within the electricity sector more efficiently and in line with defined goals. Priority was also attached to making technical preparations for forthcoming research activities.

The main objectives in the area of **high-temperature superconductivity in the energy sector** are twofold: the distribution of comprehensive information within Switzerland concerning national and international activities, and providing national projects with adequate support. Since an attempt to initiate a project in 2001 with the involvement of Switzerland's electricity industry proved unsuccessful, these objectives were adopted for 2002 without modification.

No end is yet in sight to the rapid developments in **information and communication technology**. Since there is virtually no manufacturing industry in Switzerland in these areas, we have to primarily focus our efforts on the international arena. For this reason, our objectives here are to maintain and intensify international relations in order to more effectively co-ordinate efforts aimed at enhancing energy efficiency, and to analyse and define suitable measures. These include launching a new industry project in the area of server switching, which is to be accompanied by a study to determine the impacts switching may have on the service life of servers. In addition, criteria are to be defined in the area of industrial control devices.

Electric drives and motors currently account for around 45% of Switzerland's electricity consumption, so it is this area that holds the greatest potential for realising the objective set by SwissEnergy with respect to electricity consumption. The way to achieve this target is therefore to initiate clearly delimited pilot projects in a variety of industrial sectors with multiplication potential, and in addition to promote energy efficient technologies in the area of electric drives. It will also be necessary to join forces with manufacturers and distributors of electric motors to define the criteria for a target agreement aimed at promoting efficient devices. Here it will be important to take international findings into account and co-ordinate these with Switzerland's own activities.

Networking is no longer limited to voice and data transmission, but is now being used to an ever increasing extent in the area of **appliances** – in particular, household equipment – and this means that their electricity consumption is likely to increase as well. The objectives in this area mainly concern activities aimed at intensifying findings relating to networking in private households, and finding ways to improve the stand-by consumption of household appliances.

Tasks accomplished and results obtained

DISTRIBUTION

The referendum on the proposed Electricity Market Act was the predominant issue during 2002. The electricity industry primarily focused its attention on the referendum, and this left it with insufficient resources for dealing with issues relating to technology research. Although the agreement between the Swiss Federal Office of Energy and the VSE concerning **co-operation in the area of education** was in fact finalised and ready for signature, the electricity industry suddenly found itself faced with a reorientation process following the negative outcome of the referendum, and as a consequence the VSE felt that this was not the right time to sign such an agreement.

Universities are tending to find it increasingly difficult to motivate students to take courses in the areas of electricity transmission and distribution. In a project called ***Pilot model for a network with AC transmission line*** [1], the Yverdon College of Technology aims to draw up a model for an AC transmission line in order to verify the results obtained from numeric simulations. In this connection, the process of dimensioning the various components was completed in 2002.

The aim of a project called ***Increasing the number of independent energy production plants in distribution networks*** [2a] is to identify the technical prerequisites for the utilisation of decentralised energy production plants in the distribution network and to assess the associated economic impacts. A variety of scenarios concerning the current situation and future potential for independent energy production plants were mapped out in the course of 2002, along with the procurement of real network data with the aim of simulating the impacts of an increase in the number of such facilities as realistically as possible. The project team succeeded in defining relevant simulation models and carrying out initial simulations of real networks. The project has a variety of Swiss networks at its disposal thanks to co-operation on the part of a number of electricity companies.

A project entitled ***AC corrosion on pipelines*** [3] is studying the influences of electricity transmission lines on the formation of corrosive substances on gas pipelines. It has carried out on-site measurements at a variety of locations, and has simultaneously been able to further develop the existing measurement methods.

HIGH-TEMPERATURE SUPERCONDUCTIVITY (HTSC)

The aim of Switzerland's involvement in the ***Implementing Agreement for a Co-operative Programme for Assessing the Impact of High Temperature Superconductivity on the Electric Power Sector*** [4] – a programme managed by the International Energy Agency (IEA) – is to gain as much information as possible about international activities in this area. Two IEA information meetings were held in the course of 2002, the first of which was primarily devoted to the topic of cooling conductors in energy systems, while the second mainly focused on the measurement of the quality of electricity in networks, and methods of recording relevant statistical data. Although past studies in the USA have revealed that the quality of electricity in Switzerland's network is significantly higher than it is there, this topic is nonetheless gaining in importance in our own country too. One of the most promising solutions here concerns the use of superconductive flywheels. Boeing (USA) has successfully tested a 3 kilowatt flywheel (cf. Fig. 1), and the IEA is currently considering incorporating this test into a separate project of its own. All relevant information was distributed to the involved interest groups throughout Switzerland and was subsequently discussed in detail at the annual *HTSC Status Conference*.

Superconductive current limiters utilise the transition phase of a superconductor from superconductivity to normal conductivity status. The low impedance of superconductive current limiters in normal superconductivity mode makes it possible to meet what are in effect contradictory requirements for low network impedance and simultaneously low short-circuit currents. A project called ***Market potential of superconductive current limiters*** [5] is setting out to provide a practice-based overview of the potentials for superconductive current limiters, and to identify the

most promising uses in consideration of existing realisable technical potentials. It is also preparing a catalogue of the main technical requirements on the part of the market. The activities carried out during 2002 demonstrated that superconductive current limiters offer significant cost-saving potential in certain situations. While the technical properties of existing current limiters make it possible to meet the requirements of applications in coupled networks, they still need to be improved for use in input and output lines in terms of limiting characteristics and availability following a short circuit.

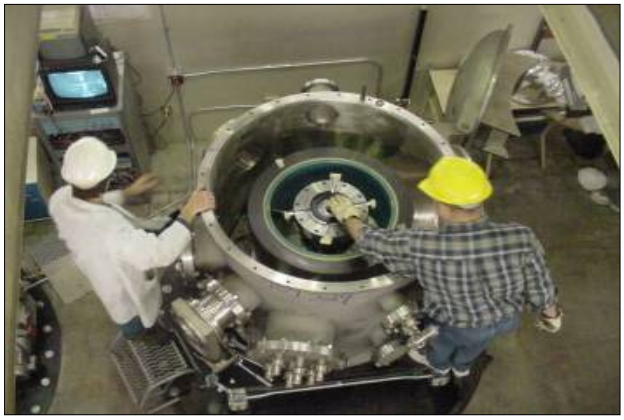


Figure 1: *Testing a prototype of an HTSC flywheel developed by Boeing (source: Boeing, USA)*

ENERGY AND INFORMATION TECHNOLOGY

Information technology is responsible for approximately 10% of Switzerland's overall electricity consumption, and the trend is clearly upwards. In the year under review, the focus of activities within the scope of the ***Energy and Information Technology Competence Centre*** [6a] was on promoting energy efficiency in the area of information and communication technology – and in particular with respect to new systems for networking appliances and methods of using the Internet – through the implementation of specific measures. The publicly accessible document database (www.biblioite.ethz.ch) was also updated in the course of the year.

In the ***Energy efficiency of computer networks*** project [6b] it was found that the degree of efficiency of power supply units for computers is between 60% and 80% when the load is greater than 20%, and that the degree of efficiency quickly decreases when the load is below this level. The required voltage at the processor level is now only 1.5 V and will be even lower in the future. In addition, the voltage produced in the power supply unit – which is typically 12 V and 5 V or 3.3 V - is transferred to the end device at an even lower level. The most effective technical measures for increasing the efficiency of the power supply concern optimisation with respect to actual power requirement, and providing a separate, optimised power supply for active and stand-by modes. For PCs, these two measures have the potential to reduce the present-day level of power consumption by up to a third. At the energy-policy level, priority is being attached to two measures in particular, namely the introduction of an energy declaration for power supply units, and a tightening of requirements placed on the maximum power consumption of IT devices in all modes (active, stand-by, on, off).

Servers are normally in operation 24 hours a day, even though they are often only used in exceptional circumstances at night and over the weekend, especially in small and medium-sized companies. In a study entitled ***Potential for reducing electricity consumption by switching off servers*** [7a] it was demonstrated that it would be possible to save around 90 gigawatt hours per annum in Switzerland if servers installed in small and medium-sized companies (current total, approximately 117,000 servers) were to be switched off when not in use, i.e. at night and at weekends. Since the equivalent figure within the EU would be 2,000 GWh, the findings of this report were also presented at international conferences, and in view of the international attention they received, they may well form a sound basis for future regulatory measures. In the project called ***Energy efficient server***

management [8], a solution is being developed on the basis of a low-cost embedded web server that automatically powers data processing servers up and down at prescribed times of day. The aim here is to achieve the greatest possible degree of system independence and the highest possible level of market conformity. A list of specifications has meanwhile been drawn up, and a variety of systems have been evaluated. Models were then created for two promising systems, and the development team set out to construct functional prototypes with the aim of determining the technical feasibility of the solution. Another project was initiated in this area (***Impacts of periodical switching on and off on the reliability of server hardware*** [9]) in order to determine whether switching servers on and off has any significant influence on their service life.

Efficient *power management functions* like those that are commonly used in laptops, PCs and monitors should also be installed in servers and network components, and optimised upon delivery to end-users. By citing such requirements in their requests for tenders, the federal government, cantonal authorities and municipal councils can place pressure on manufacturers to improve their products. In view of this, specimen texts are being formulated in a project called ***Documentation for requesting tenders for servers, PCs and network devices*** [7b]. 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.

The aim of the project called ***Energy efficiency of uninterruptible power supply systems*** [2b] is to extend the principles that were defined in a project that has since been concluded (*Identification of parameters and measurement procedures for UPS systems*) concerning the design, quality, energy efficiency and operation of UPS systems, to stand-by losses, and to prepare them for application within the member states of the EU. For this purpose, an existing industry support group was reactivated, the relevant documents were translated into English, and studies were initiated on ways in which the problem of stand-by losses can be added to the agendas of standards organisations.

In a project called ***Energy analysis FuturLife House*** [7c], the electricity consumption of a networked intelligent household was measured in detail for the first time. The result was that the overall consumption was more than 3 times higher than that of an average non-networked house. The central infrastructure for networking operations (i.e. the server) and other essential devices each consumed approximately the same amount of electricity as an average house. It would be possible to reduce these network-related consumption rates by 95% (servers) and 80% (other devices) respectively with the aid of relatively simple measures (e.g. operation without a UPS device, use of a power management system). However, the additional electricity consumption attributable to networking is still significant, and may give rise to an increase in demand for electricity in Switzerland in the next few years.

To date, national and international research activities in the area of information and communication technology have focused on office equipment and consumer electronics. A project called ***Energy consumption of process control units*** [10] sets out to define initial criteria in an area that has been largely ignored to date, namely programmable control units. The tasks of this project team are to classify existing products, analyse and evaluate a variety of typical case studies, and project the energy consumption attributable to such devices on the basis of rough estimates. Furthermore, they are assessing the extent to which such systems are already subject to international declaration requirements, and studying ways in which it would be possible to introduce a new declaration requirement. The results of initial tests carried out at the Institute of Technology in Chur (cf. Fig. 2) show that the power consumption of process control units is largely unrelated to the configuration of the processes concerned. This means that it is possible to obtain findings concerning electricity consumption without having to configure and programme a large number of processes. It was also found that a high proportion of losses is attributable to power components. As with PCs, it is also the case with process control units that most power components are operated at a low partial load with correspondingly poor levels of efficiency.

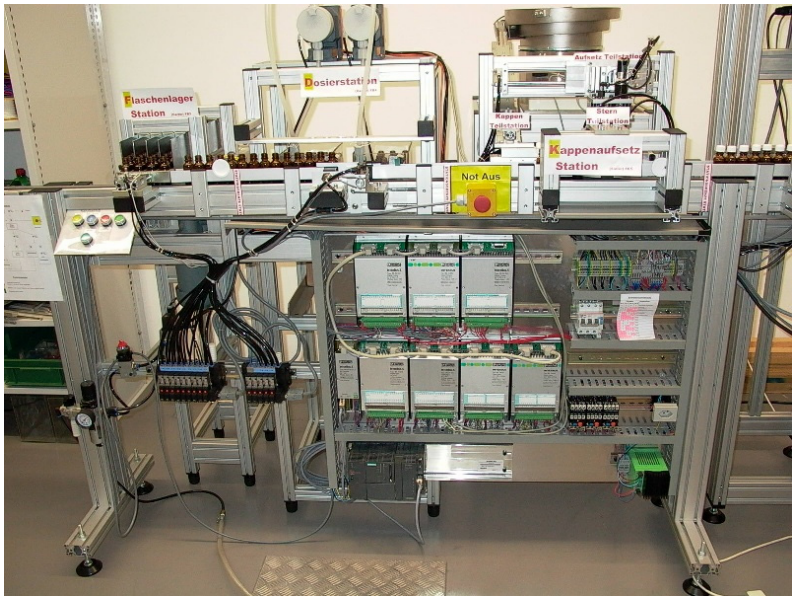


Figure 2: *Measurements of a process control unit being carried out on a process automation model (source: Institute of Technology, Chur)*

DRIVES / ELECTRIC MOTORS

A classification scheme is used within the EU for electric motors, comprising categories eff1, eff2 and eff3. The aim of the efforts on the part of the EU is that motors classified eff3 (low level of efficiency) should vanish from the market altogether, eff2 motors are to represent the standard, and the use of eff1 motors should be increased. In this connection, the EU Commission's European Committee of Manufacturers of Electrical Machines and Power Electronics (CEMEP) concluded an agreement in 1997 aimed at bringing about a 50% cumulative reduction of motors in the eff3 category by 2003 versus the 1998 sales level, while simultaneously promoting the use of motors in categories eff1 and eff2. The Swiss Federal Office of Energy intends to support and promote energy-efficient motors in Switzerland with the assistance of the industry, based on the above EU agreement. For this purpose, in a project called ***Industry agreement on the energy efficiency of motors (eff1, eff2 and eff3)*** [2] a workgroup was set up in collaboration with the relevant industry, that is to create the necessary prerequisites for successful implementation. Here the main goal is to conclude an agreement between the federal government and the Swiss electric motors/drives industry.

In the European project, ***Pilot Actions for the Motor Challenge Programme*** (MCP) [11], documentation was compiled concerning technical tools for increasing the efficiency of electric motors. The conditions for participating in MCP partnerships were formulated in separate modules per sector (drives in general, pumps, ventilators, compressors, management policy), and these were then supplemented with practical information. Switzerland is to be represented in the partnership by two companies specialising in electric motors, both of which have been audited by specialists from the Swiss *Motor Challenge* team, who carried out a broad analysis in order to identify the most appropriate areas in which to apply efficiency measures, and defined corresponding MCP modules. These two companies are now applying to the EU for membership of the partnership.

The existing tool for evaluating electric motors, *OPAL*, has also been used within the MCP, and its functions are to be expanded in a separate project, ***Expansion of OPAL with ventilation and pump systems*** [12]. In the year under review, measurements were carried out on pumps and ventilation systems as a prerequisite for evaluating potential energy-efficiency measures. The American software, *PSAT* (Pumping System Assessment Tool), was also evaluated and a basic version of the *OPAL* expansion was developed that enables the evaluation of these types of drive systems as well as the calculation of savings potentials.

The ***Efficient gearless drives*** project [13] is setting out to develop drives for applications with low speeds. These systems comprise an IGBT converter and a high-pole permanently activated synchronous machine. They can be operated in both directions in terms of rotation and energy, and can therefore be also be used as power generating systems. The high level of efficiency in terms of both output and material wear and tear is achieved since it possible to eliminate the need for a mechanical drive mechanism, but also because the machine and converter can be accurately attuned to one another and optimised in a variety of ways. This drive system is being developed and tested for applications in the 1.2 and 3.0 kilowatt categories. All conceptual tasks were carried out in the course of the year under review. Converters and machines were evaluated, simulated and constructed, and the production of some prototypes (cf. Fig. 3) was completed, so that it will be possible to commence testing early in 2003. The detailed calculations indicate that it will probably be possible to reduce losses by more than 40% in comparison with conventional drive systems that use gears. And it should also be possible to reduce material wear and tear by around 30% compared with conventional machines and converters.

Figure 3: *Prototype of a 1,200 kilowatt converter shortly before completion (source: Technocon AG)*

The level of efficiency of asynchronous motors that have a capacity of less than 1 kilowatt and are operated on a control device, is very low. In a project called ***Energy-efficient motors*** [14], studies were carried out on a newly developed technology based on a permanent magnet rotor in order to determine whether it would be suitable for use at the level of 230 V, how much energy it would thus be possible to save, and whether this would be economically viable. In all three cases the findings were positive, and the next step will be to develop a specific application. The energy measurements are being carried out at the Lucerne Institute of Technology (cf. cover page of this report).

In a project called ***Energy-efficient stepping motor drives*** [15] it was demonstrated that it is possible to more or less halve energy consumption by powering these motors in such a manner that they only consume the electricity they actually need for any given position. An estimated payback time of 1 year also assures economic viability. The associated measurements were carried out at Zurich/Winterthur Institute of Technology (cf. Fig. 4).

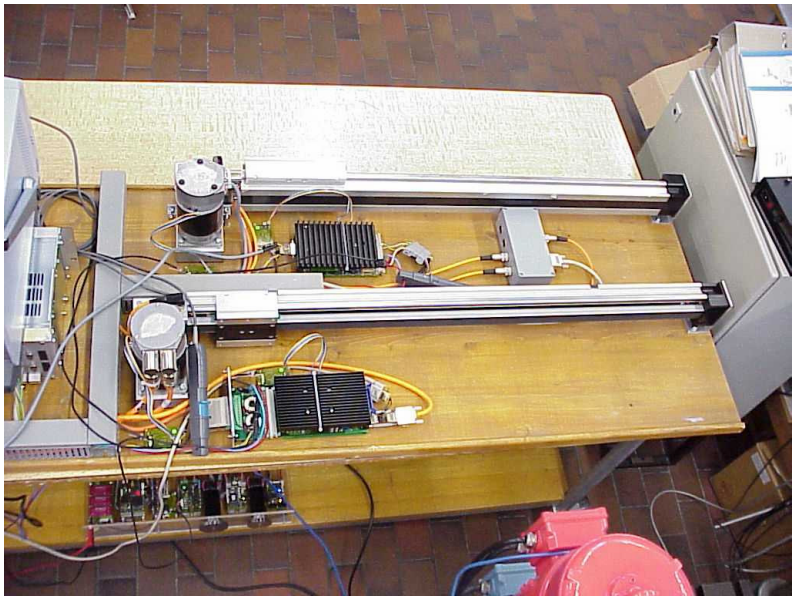


Figure 4: *Testing a prototype of a stepping motor (source: LEAG AG)*

APPLIANCES / MISCELLANEOUS DEVICES

A project called ***Heat pump tumble dryers for multiple family dwellings*** [16] is to help bring a technology onto the market that only requires half the energy of conventional tumble-dryers yet produces the same drying capacity. For this purpose, a series of 10 prototypes was produced. The fact that manufacturer *Miele* is interested in developing this technology is extremely pleasing, and it is to be assumed that this company will be instrumental in efforts to bring a finished product onto the market.

The goal of a European programme called *GreenLight* is to enhance the energy efficiency of lighting systems in business premises and public buildings. *GreenLight* was jointly launched by twelve member states of the EU, and now intends to set up *National Contact Points* in a variety of other countries. Since Switzerland is interested in participating in this programme, it has initiated its own project called **Establishment of GreenLight National Contact Points in Switzerland** [17], which is to carry out the associated preparatory tasks. Here the initial step was to inform all potential interest groups about the project.

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 ***Electric band heaters*** project [11b] it was found that action would be required at a variety of levels in order to implement measures aimed at promoting the more efficient use of these devices. In addition to publishing detailed reports for the attention of plumbing, heating and electrical engineers, a basic fact sheet needed to be prepared for more widespread distribution. This task is being carried out in a sub-project called ***Fact sheet on the efficient use of electric band heaters*** [11c].

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 [7d] is compiling a checklist concerning the maintenance of these machines and the choice of the most suitable location so that it will be possible to attain the highest possible level of energy efficiency. The fact sheet is addressed to operators of these machines and lessors of the sites on which they are located, since they are usually responsible for paying the associated electricity bills and receive lump-sum remuneration.

Mineral water is being provided in offices and department stores in Switzerland to an ever increasing extent, mostly in the form of self-service appliances (water coolers, water dispensers, etc. – cf. Fig. 5). The water is normally stored in 5-gallon (18.9-litre) containers, and cooled ready for consumption. Approximately 15,000 water dispensers were in use in 2001, and the market is growing rapidly. The aim of the ***Energy-efficiency potential in the area of water dispensers*** [7e] is to gain initial findings concerning the increasing use of this type of appliance. The energy consumption of the first water dispenser that was measured was 230% of the *Energy Star threshold* of 160 Wh/day.

Figure 5: *Water dispenser without casing (source: Encontrol GmbH)*

The main aim of a project called ***Energy-efficiency potential of hot beverage dispensers used in the area of staff catering*** [18] is to calculate the nation-wide energy consumption of these appliances. It is also setting out to evaluate measures to enhance their energy efficiency, as well as estimate their costs and potentials. A survey was carried out among providers of staff catering facilities in order to determine how many appliances are currently in use and the extent to which they are used, and a support group has been formed that comprises representatives from companies operating these appliances and a large-scale customer in the services sector.

Given the trend towards comfort functions such as status display, timer switching, networking, etc., the level of stand-by consumption in the area of household appliances looks set to increase. In order to assess the significance of this trend in terms of energy consumption, the main categories of household appliances are being measured on a random sample basis in a project called ***Stand-by consumption of household appliances*** [11d], taking account of factors such as distribution, market perspectives, usage, technological progress, etc. The data are then being evaluated with the aim of projecting the level of stand-by consumption in Switzerland. The results of the measurements carried out to date reveal that the consumption of power supply units installed in household appliances for control and display purposes is very low – the typical level here is around 2 watts, though some devices (most notably those found in cheaper models) indicate higher levels. However, it is often the case that the latter (e.g. washing machines and dishwashers with a door contact device) are equipped with a main switch that is usually turned off when the appliance is not in use. On the other hand, there are appliances such as coffee machines that are equipped with an energy-intensive comfort function (stand-by mode that enables instant production of coffee) similar to that found on photocopiers. A representative survey was carried out among households in the German-speaking and French-speaking areas of Switzerland in order to obtain information concerning ownership and use of coffee machines and steamers. The results of this survey, combined with a distribution of 64% among Swiss households and the high level of consumption associated with maintaining the necessary heat, indicate that coffee machines may well be the biggest culprits in the area of stand-by consumption in households.

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 research centres. As in the past, these periodical conferences attended by recognised experts represent an ideal information and discussion forum at the national level.

The ***Energy and Information Technology Competence Centre*** 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. Unfortunately, it has still not been possible to carry out the necessary clarifications and define the criteria for the planned ***Compressed Air* Competence Centre**, but this move has now been declared a priority for 2003.

Within the scope of a ***Swiss National Fund*** *National Competence Centre*, a total of 8 institutions and industries are involved in research in the area of high-temperature superconductivity in a project called *Materials with Novel Electronic Properties*.

As before, attempts are being made to involve various **institutes of technology** here, and a number of these (e.g. Chur, Lucerne, Zurich/Winterthur, Biel, Brugg, Valais, and Zurich University) are actively participating in projects organised by the Swiss Federal Office of Energy.

Contacts have been 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.

Close contact is also maintained with Switzerland's **energy agencies** in a variety of projects [25]. For example, joint projects 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 set out to involve the respective **business and industry associations**.

Co-operation at the international level

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

In addition to Switzerland's participation in the IEA programme, ***Implementing Agreement for a Cooperative Programme for 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 a model coil at 77 K. Thanks to the recent addition of countries of Eastern Europe, the ***Superconducting European Network, SCENET II*** (GTC1-2001-43047) programme now comprises more than 80 different European groups (or nodes) from universities and the industrial sector, all of which deal with aspects relating to superconductivity. *SCENET II* has set itself the goal of optimising information flow within Europe in order to improve the competitive capacity of European research. Switzerland is represented through 2 nodes, and is a member of the *SCENET* Steering Committee.

The fact that the head of the **Information and communication technology** programme was invited to attend the International Energy Agency workshop held on 21 and 22 February 2002 in Paris (*The Future Impact of Information and Communication Technologies on the Energy System*) is a clear indication of the recognition of Switzerland's activities in this area. Switzerland has been actively co-operating in the preliminary tasks associated with a European SAVE project entitled *Energy Efficiency Assessment for Entertainment, Information and Communication Appliances*, but unfortunately this project failed to gain formal approval at the European level. With respect to the issue of *stand-by losses* in **UPS systems**, contact was established with the IEC Committee in order to ensure that the

requirements placed on UPS systems in terms of energy consumption would be included on the agenda following the forthcoming revision of the relevant standard. Switzerland also maintains relationships with international institutions such as the European Commission, the Environmental Protection Agency (EPA) and the LPL (Lawrence Berkeley National Laboratory), both of which are based in the USA, and the Agence de l'environnement et de la maîtrise de l'énergie (ADEME) in France.

In the area of *motors/drives*, Switzerland is involved in the **SAVE pilot project for the Motor Challenge Programme** (contract 4.1031/Z/00-026). In this connection, the programme head was invited to join the *International Programme Committee of the 3rd International Conference on Energy Efficiency in Motor Driven Systems (EEMODS 02)* [26]. Unfortunately, no opportunity arose for carrying out negotiations with the European Commission concerning the motor design software *OPAL* and its planned integration into the European tool, *EURODEEM.* Switzerland actively co-operated in a proposed *SAVE* project entitled *Promotion of Energy Efficient Electric Motor Systems*, which was to pursue the goal of integrating these two software tools, but unfortunately this proposal was rejected by the EU.

Pilot and demonstration projects

DISTRIBUTION

The main aims of an international project called ***Cluster pilot project for the integration of RES into European energy sectors using hydrogen*** [19] – RES = reversible energy storage system – 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 using electricity generated from an autonomous power plant. This is an implementation-based project that largely involves commercially available components. It is innovative in that it involves the mutual integration of different components and studies their interactions.

ENERGY AND INFORMATION TECHNOLOGY

A pilot project called ***Energy aspects in IT education*** [20] studied ways in which energy-related know-how can be incorporated into training programmes for IT apprentices. This project was carried out with the support of SWICO (*Swiss Trade Association for Information, Communications and Organisation Technology*) and the *Energy Agency for Electrical Appliances* within the scope of a new training programme. For this purpose, a trial course was developed, which was subsequently taught in the two cantons involved in the pilot project (Berne and Zurich). The concept of combining a practical orientation and switching the focus from practice to theory proved to be very effective. Furthermore it was deemed preferable to append energy aspects to existing modules in the form of small packages rather than defining a separate module (*Energy aspects in IT education)*. Since it is the tutor who is the key figure for determining success, he or she has to be duly motivated and possess the necessary background knowledge. The proposal has been put forward to initiate another pilot project that is limited to the same two cantons as before (i.e. Berne and Zurich), but which is to incorporate a larger number of modules than its predecessor.

DRIVES / ELECTRIC MOTORS

With a share of around 1% of the national total, Lonza AG is one of the biggest consumers of electricity in Switzerland, and electric motors account for approximately 94% of its annual consumption. In a project called ***Savings potential for electricity used to power motors and drive systems at Lonza AG*** [21a], a variety of dissertations and in-depth studies identified a savings potential of between 5% and 20%. This prompted Lonza to create a new section (*Energy*

Challenging) that focuses exclusively on enhancing the efficiency of existing systems and optimising the design of future ones.

In the area of compressed air, two projects (***Optimising compressed-air processes in a joiner's workshop*** [22b] and und ***Optimising compressed-air processes in weaving operations*** [22a]) demonstrated that savings potentials can be realised through the implementation of relatively simple measures. The identified potentials were approximately 75% for weaving processes and around 30% for the joiner's workshop.

In a variety of sectors, specific pilot projects were initiated in collaboration with the companies concerned in order to pursue the defined objectives. Three projects were launched towards the end of 2002 (***Reduction of electricity consumption in a sawmill*** [23], ***Energy efficiency programme at Christoph Burckhardt AG*** [24], ***Efficient use of electricity in waste disposal plants*** [21b]), each of which set out to identify savings potentials by carrying out detailed analyses, and to subsequently implement the findings, thus establishing the basis for a multiplication effect.

Summary for 2002 and outlook for 2003

The most important development in the area of ***distribution*** was the outcome of the referendum on the proposed Electricity Market Act. As a result of the rejection of this bill, the electricity sector is now undergoing a process of reorientation. This also concerns the VSE, which therefore had to postpone its signature of the finalised agreement concerning a joint education programme. The Swiss Federal Office of Energy will also have to reorient itself in 2003 following the rejection of the EMA, and draw the corresponding conclusions as far as its own activities are concerned. The *Electricity* programme will of course be directly involved in this process. As before, the issue of decentralised production plants calls for solutions to highly demanding technical problems. Identifying these and implementing them through joint projects are therefore among the main priorities for 2003.

In the area of ***high-temperature superconductivity***, one of the objectives was met in that a project concerning current limiters was initiated in co-operation with the relevant industry, and the distribution of information in this area is also functioning smoothly. The main objective for 2003 is to secure continuity with respect to project activities and the distribution of information.

In the areas of **information and communication technology** and **networked household appliances**, it was possible to implement most of the planned activities, while preliminary work was commenced in the area of industrial control units. Furthermore, activities carried out in the areas of UPS systems, server switching and analysis of IT power supply units led to the definition of principles and criteria that have gained international recognition. International co-operation needs to be further intensified next year. On top of this, additional criteria need to be defined for energy-efficient standards and/or regulations, and it will be important to fill any identified gaps in know-how. Finally, efforts need to be made to more effectively implement energy-related findings arising from IT education.

Demonstration projects relating to **electric drives and motors** were initiated in a variety of sectors. Once again it was not possible to establish the planned *competence centre for compressed-air technology* in the year under review, but this project is to be followed up in 2003. Furthermore, the question of how the ongoing German programme aimed at increasing the efficiency of compressed-air technology (*Druckluft-effizient*) can be activated in Switzerland too, is currently being examined. If the introduction of the *Motor Challenge Programme* into Europe should be delayed, it is important that continuity is secured in Switzerland. Finally, additional sector-related demonstration projects should be initiated. Two projects (*Energy-efficient motors* and *Energy-efficient stepping motor drives*) led to the development and testing of **innovative solutions** that indicate substantial savings potentials (75 GWh and 64 GWh respectively). It is now up to the industry to put these findings into practice by developing products and bringing them onto the market.

In the course of 2002, a stronger emphasis was placed on how the findings obtained from research activities can be put into practice, and next year the focus should be on directly implementing pilot and demonstration projects, and on measures to bring new products onto the market within the scope of the SwissEnergy programme. Furthermore, the activities of the *Electricity* programme for the period from 2004 to 2007 are to be based on the criteria defined in the *Swiss Federal Energy Research Concept* for the same period.

List of R+D projects

(AR) 2002 annual report (available)
(FR) Final report (available)
ENET: report's ENET order number
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*** (JB)

[2] G. Schnyder, (gilbert.schnyder@sing.ch), SCHNYDER INGENIEURE AG, *Hünenberg:* ***a) Zunahme der dezentralen Energieerzeugungsanlagen in Verteilnetzen*** (JB) ⬩ ***b) Energieeffizienz von USV-Anlagen*** (JB) ⬩ ***c) Industrievereinbarung Energieeffizienz von Motoren (eff1, eff2, eff3)*** (JB)

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

[4] 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)

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

[6] B. Aebischer, (bernard.aebischer@cepe.mavt.ethz.ch), CEPE, ETH-*Zürich:* ***a) Betreuung des Kompetenzzentrums Energie und Informationstechnik*** (JB) ⬩ ***b) Energieeffizienz von Computer Netzgeräten*** (SB)

[7] A. Huser, (alois.huser@encontrol.ch), ENCONTROL GMBH, *Niederrohrdorf:* ***a) Stromeinsparpotential durch Schalten von Servern*** (SB) ENET 220109 ⬩ ***b) Ausschreibungsunterlagen im Server, PC- und Netzwerkbereich*** (JB) ⬩ ***c) Energieanalyse FuturLife-Haus*** (SB) ⬩ ***d) Merkblatt zur optimalen Energienutzung bei Kaltgetränke- und gekühlten Warenautomaten*** (JB) ⬩ ***e) Energieeffizienzpotential bei Wasserdispensern*** (JB)

[8] B. Sauter, (beat.sauter@emt.ch), ENERGY MANAGEMENT TEAM AG, *Ermatingen:* ***Energieeffizientes Servermanagement*** (JB)

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

[10] E. Bush, (bush@spin.ch), BUSH ENERGIE GMBH, *Felsberg:* ***Energieverbrauch von Prozesssteuerungen*** (JB)

[11] J. Nipkow, (juergnipkow@swissonline.ch), ARENA ARBEITSGEMEINSCHAFT ENERGIE-ALTERNATIVEN, *Zürich:* ***a) Schweizer Vertretung im SAVE-Programm: Pilot Actions for the Motor Challenge Programme*** (JB) www.motorchallenge.ch ⬩ ***b) Elektrische Heizbänder*** (SB) ENET 220124 ⬩ ***c) Elektrische Heizbänder – Merkblatt für den effizienten Einsatz*** (JB) ⬩ ***d) Standby-Verbrauch von Haushaltsgeräten*** (JB)

[12] R. Tanner, (tanner@semafor.ch), SEMAFOR INFORMATIK & ENERGIE AG, *Basel:* ***OPAL-Erweiterung mit Lüfter- und Pumpemsystemen*** (JB)

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

[14] M. Lindegger, (markus.lindegger@bluewin.ch), CIRCLE MOTOR AG, *Gümligen:* ***Energiesparmotor*** (SB)

[15] S. Berchten, (bn@leag.com), LEAG ANTRIEBSTECHNIK AG, *Schaffhausen:* ***Energiesparender Schrittmotorenantrieb*** (SB)

[16] E. Schwarzwald, THERMODUL CONSULTING, *Curio:* ***Wärmepumpentumbler für Mehrfamilienhäuser*** (SB)

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

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

List of P+D projects

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

[20] B. Aebischer, (bernard.aebischer@cepe.mavt.ethz.ch), CEPE, ETH-*Zürich:* ***Energieaspekte in der IT-Ausbildung*** (SB)

[21] G. Schnyder, (gilbert.schnyder@sing.ch), SCHNYDER INGENIEURE AG, *Hünenberg:* ***a) Einsparpotential an elektr. Energie bei Motoren und Antrieben in der Lonza*** (SB) • ***b) Elektrizitätseffizienz in Kehrichtverwertungsanlagen*** (JB)

[22] R. Gloor (gloor@energie.ch), GLOOR ENGINEERING, *Sufers:* ***a) Druckluftoptimierung in einer Weberei*** (SB) ENET 220175 • ***b) Druckluftoptimierung in einer Schreinerei*** (SB) ENET 220174

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

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

References

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

[26] Roland Brüniger: ***Reisebericht: EEMODS´02 26./28. September 2002 in Treviso,*** www.electricity-research.ch.

[27] ***Web site of*** **Electricity** ***research programme***: www.electricity-research.ch.