

Energy efficiency in Switzerland

A mainstay of the energy transition!

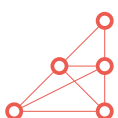


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CleantechAlps est une initiative des cantons de Berne, Fribourg, Vaud, Valais, Neuchâtel, Genève, et Jura et soutenue par le SECO au titre de la NPR.

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ABOUT THIS PUBLICATION

This special report was produced by CleantechAlps.

The author

CLEANTECHALPS

CleantechAlps is Western Switzerland's cleantech cluster. Its mission is to foster collaborative innovation, bringing together players who are contributing to ways of using our natural resources sustainably and developing new forms of renewable energy. As the pre-eminent exponent of the innovation ecosystem, CleantechAlps is Switzerland's cleantech enabler. Created by the cantons of Western Switzerland, this inter-industry platform facilitates interaction, stepping up and accelerating the capacity for innovation and the digital transition of Swiss enterprise. CleantechAlps increases the visibility of the region's cleantech businesses, positioning Western Switzerland as a centre of excellence at international level.

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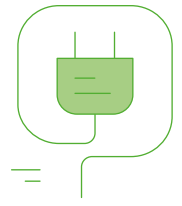
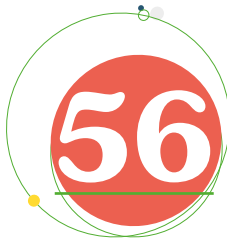
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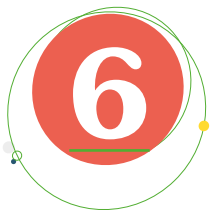
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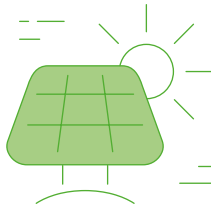
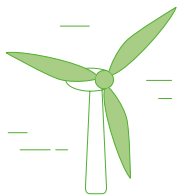
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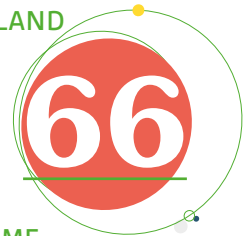


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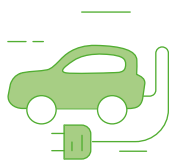
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The advent of a sustainable society is dependent on us achieving energy efficiency



ERIC PLAN

Secretary General of CleantechAlps

Melting glaciers, ocean acidification, increasingly frequent extreme climate events, rising sea levels... the effects of climate change are already here, all over the world. With these phenomena becoming increasingly severe, it is essential that the countries of the world work together to combat them.

When they adopted the Paris Agreement at COP 21, 196 parties committed to the shared objective of limiting global warming. For the first time, a binding agreement brought together every nation in an ambitious common cause.

For this to succeed, global greenhouse gas emissions must stop before the middle of this century. To achieve this, we are going to have to reduce our energy consumption drastically and use energy only from renewable sources. With the decarbonisation of the economy, energy efficiency is one of the main levers we need to use if we are to meet the 2050 objectives we have set ourselves.


In the last few decades the world has been somewhat resting on its laurels, but recent events have been a rather brutal wake-up call. With the series of crises we have suffered in the last few years, including the Covid-19 pandemic and the war in Ukraine, the fragility of the energy supply to certain regions has suddenly come into sharp focus. Switzerland and Europe are not immune to this. In view of our dependence on energy resources, there is no longer any doubt that we need to accelerate our use of a valuable local resource – energy efficiency – and take advantage of its full potential. If we are to benefit from this, we must make it the top energy priority, pulling out all the stops to bring it into people's consciousness and ensure it is comprehensible to all.

To the non energy specialist, the term energy efficiency might seem abstract, or even theoretical. But it actually plays a major role in the energy transition. It is often said that the best way to save energy is not to consume it in the first place. This applies to all forms of energy, not just electricity. There is enormous potential for this and it is therefore logically one of the fundamental pillars of the energy transition, in Switzerland as elsewhere.

This special report presents the main energy consumption sectors and the reduction potential that energy efficiency can bring to each of them. These aspects are complemented by our exposé of good practice and the practical, profitable solutions already available in Switzerland. Our aim is also to inspire others, encouraging them to join us in using energy efficiency to help achieve a more sustainable society.

This special report aims to make this concept comprehensible to all and demonstrate its importance to the energy future of society in its broadest sense. Numerous examples of energy efficiency do already exist in this country, but they remain little-known. This needs to change so that they can be replicated on a larger scale. The purpose of the business and project profiles appended to this report is to inspire the reader, demonstrate the economic benefit of their practical, concrete solutions, and encourage more users to adopt these practices so that they become part of all our lives.

Happy reading!



Alongside the concept of “energy efficiency”, the term “energy effectiveness” is often used. The difference between the two is a subtle one.

Energy effectiveness means the ability to obtain the desired or expected result, whereas energy efficiency describes the relationship between the results obtained and the resources used to achieve those results.

Improving the energy effectiveness of a system means improving its performance, but this does not necessarily mean that the energy consumed by this system is being used in the best possible way. Making technological changes to reduce consumption while maintaining the same effect (for example improving an industrial process) is referred to as energy effectiveness. If the reduction in consumption is achieved through a more general change (for example optimising a service, or implementing technological or behavioural measures), this is described as energy efficiency.

In this report, we therefore prefer to use the term energy efficiency, which is more all-encompassing.

Source: Cleantech lexicon, CleantechAlps

WHAT DO WE MEAN BY ENERGY EFFICIENCY?

A major strand of Switzerland's Energy Strategy 2050, energy efficiency is about using energy in a more rational way.

The objective is to reduce the amount of energy we use to produce goods and services, light and heat our homes and factories and get around, while maintaining the same quality of service. By "the same quality of service", we mean the same regularity of supply, safety of our infrastructures and reliability of the facilities and services provided for the population, the economy and government at all levels.

Rather than aiming to increase energy production capacity alone, improving energy efficiency remains the main lever for responding to demand. This approach is even more effective if it is combined with the objective of satisfying a substantial proportion of the country's energy requirements from renewable sources. While much of the overall solution relies on technological progress, understanding the habits and behaviours of each of us is the key to change – especially if we are to achieve a real paradigm shift in energy efficiency.

When technology – and big data and AI in particular – are applied to this information, it acquires a meaning and value that can be used to change behaviour and justify the requisite investment policy.

2020, a very different year

In Switzerland, compared to 2019, final energy consumption fell by 10.6% in 2020 (to 747,400 terajoules (TJ)). This reduction was essentially due to the coronavirus pandemic and more favourable weather conditions. However, in 2020, other factors driving an increase in energy consumption in the long term grew slightly: Switzerland's permanent resident population, the total number of motor vehicles and the country's housing stock. For their part, the increase in energy effectiveness and the effects of cleaner energy source substitution tend to lessen the increase in energy consumption¹.

2020 will remain an exceptional year due to the coronavirus crisis and the lockdown measures introduced, along with an almost complete shutdown of the economy for several months.

As far as reducing energy consumption is concerned, the incentive and innovation-boosting measures provided for in law are particularly relevant to three sectors: transport (36%), electrical devices (14%) and buildings (45%), in view of their significant shares of the nation's energy consumption.



Energy consumption versus electricity consumption²

Electricity is the form of energy that has the most diverse range of possible uses. It is used in every aspect of daily life and accounts for one quarter of Switzerland's total energy consumption.

Energy Strategy 2050: a benchmark for Switzerland

Following the Fukushima nuclear disaster in 2011, Switzerland's Federal Council and Parliament voted to begin phasing out nuclear energy. Nuclear power stations currently cover up to 40% of the country's energy requirements.

Like other fundamental changes occurring in the international energy market, this decision necessitates a transformation of the country's energy industry. Consequently, the Federal Council drew up its Energy Strategy 2050, which retains the priorities set in the Energy Strategy 2007 and complements them with new objectives.

SWITZERLAND'S ENERGY STRATEGY 2050 SETS THE FOLLOWING OBJECTIVES³

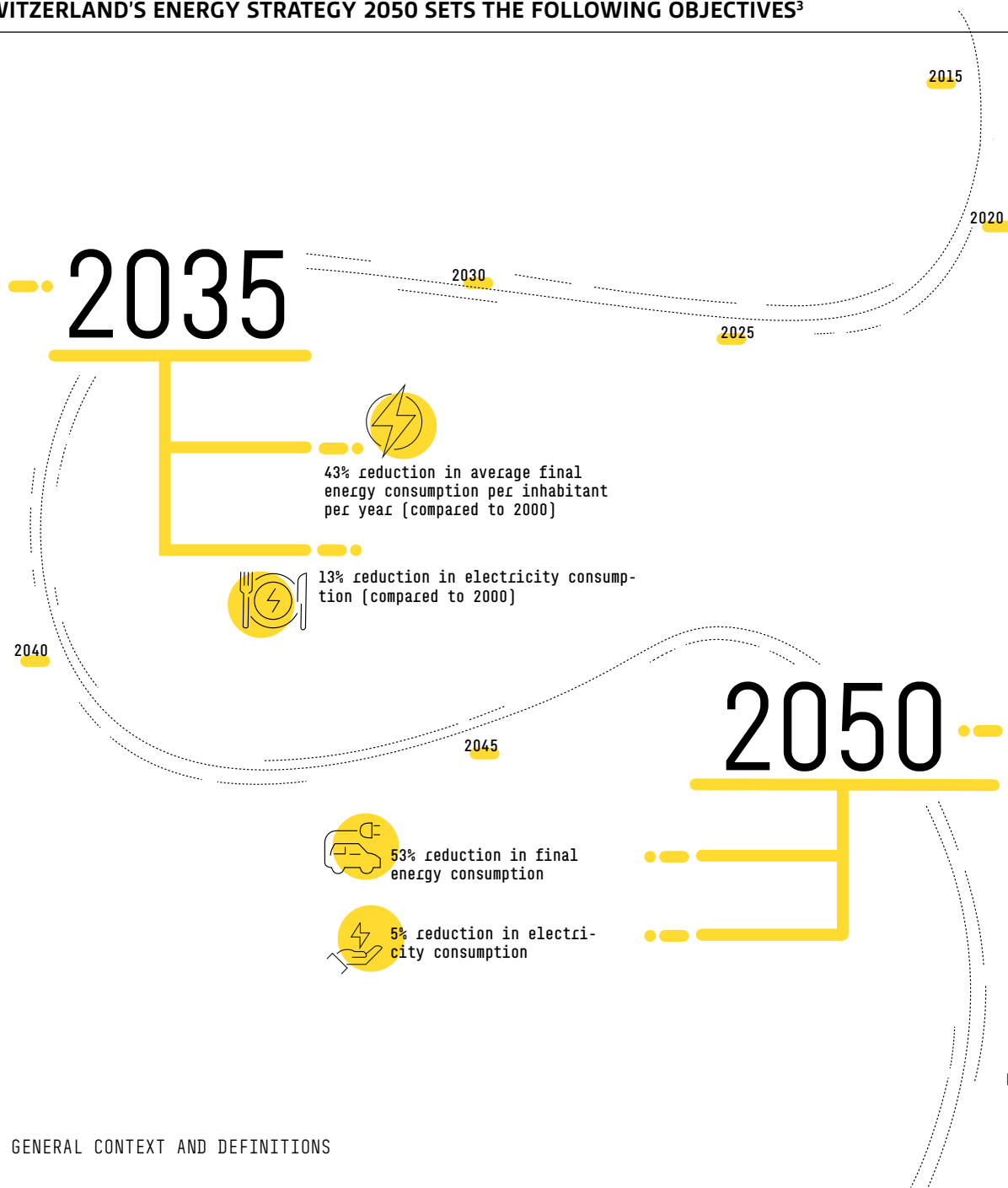


Figure 1

LOCAL OR GLOBAL OPTIMISATION

When a business runs into financial difficulties, it first has to optimise how it operates (improving production processes, reducing staff numbers, etc.). Once it has done all the optimising it can, the only other way it can survive and progress is through innovation. This means developing and marketing new ideas and products and coming up with fresh ways of creating new markets and customer bases. By analogy, innovating in behaviour is the key to “energy sobriety”.

Energy efficiency follows this optimisation logic and, unlike the new forms of renewable energy, it is available right now and can therefore produce tangible results very quickly.

This point is driven home by the fact that the energy that is cheapest to produce is the energy we don’t use. In our approach to energy efficiency, we therefore have to focus on “producing” negawatts, and above all on giving them sufficient value.

What is a negawatt? And what is energy sobriety?

The **negawatt** is an unofficial unit that measures an amount of energy saved because it is not used in the first place (effectively a negative watt), thanks to a technological innovation or a change in behaviour. This principle is based on the idea that it is costs less to save energy than to buy it (and therefore to produce it). The best megawatt hour is one we don’t use.

The Swiss Negawatt scenario proposed by the Négawatt Suisse association advocates a big decrease in consumption by 2050 by relying on three pillars: **energy sobriety** (choosing to do things in ways which use less energy, the importance of the human factor); energy effectiveness (reducing the amount of energy required to meet the same need); and renewables (meeting our energy needs from renewable sources).

Sources:

www.connaissancedesenergies.com

www.negawattsuisse.org



DANIEL BAILLIFARD
Managing Director of SATOM SA

Currently, we might question whether it is a good idea to use electricity to produce hydrogen, but we won’t once we have invested massively in solar power. So we must get on with that without delay.

ENERGY EFFICIENCY AND JOBS

In 2018, a number of laboratories at ETHL⁴ looked at three energy transition scenarios, comparing their different mixes of fossil fuels, renewable energy and energy effectiveness.

- ▶ The first scenario, called the “Status Quo” scenario, represents the energy situation in 2050 if the 2011 national energy policy had been maintained without the introduction of any new measures.
- ▶ The second one, “Political Measures”, is based on the impact by 2050 of the energy measures recently adopted, if they were carried through to the end.
- ▶ The third, “New Energy Policy”, represents the Confederation’s Energy Strategy 2050, the first package of measures of which was adopted on 21 May 2017.

The results of this analysis make use of energyscope.ch, the online calculator developed by EPFL’s Energy Center and IPESE (Industrial Process and Energy System Engineering) laboratory. They show that the number of jobs in Switzerland in the energy-related sectors would be around 35% higher in the third scenario than in the two others.

According to Professor Thalmann of EPFL’s Laboratory of Environmental and Urban Economics (LEURE), this result can be explained mostly by the jobs created in energy effectiveness, particularly in building renovation. In this sector, a significant proportion of the added value is contributed in Switzerland by local businesses. In contrast, in the scenarios that put more emphasis on importing fuels, a significant proportion of the cost relates to purchasing energy, which creates few local jobs.

Furthermore, in the third scenario, the transport sector benefits from an increase in employment brought about by a modal shift towards public transport. However, in this case a fall in employment in the motor industry is expected, stemming from the rollout of electric vehicles, which require significantly less maintenance than petrol cars.

When it comes to reducing energy consumption, one might think that in the long run this will have a negative impact on employment. This study demonstrates the opposite: combining energy effectiveness measures and renewable energy is likely to create more jobs in Switzerland and make the country more energy-independent, without any appreciable effect on costs.

In today’s context, that is welcome news! Indeed, there is currently a labour shortage in the building and energy industries, which are struggling to recruit at every level. Higher education establishments such as the University of Geneva lament the lack of interest in the energy sector at a time when demand for infrastructure and expertise (in areas such as heat networks and heat pump technology) is growing strongly. This observation applies to the whole value chain and is perhaps even more worrying when it comes to the lack of qualified installers, without whom none of these systems can get up and running. And that does not include the adjustment and maintenance of these installations, which are a key part of ensuring the long-term success of any energy efficiency approach.

Here we have put our finger on an element crucial to the future of energy efficiency: the future job market. This is because the job market is highly dependent on the scenario that plays out in society. The Nomads Foundation is well aware of this need and has joined forces with industry players to launch a number of research workshops supported by Innosuisse, on this and other topics. Their objective is to anticipate the building industry’s job requirements relevant to energy efficiency to prepare future training courses and deliver a workforce with the right training to plug the labour gap. We hope that this approach will catch on all over the country. The challenge is a big one: to find ways of overcoming this labour shortage and make the necessary changes to initial education and training and continuing professional development.

CHRISTIAN PETIT
CEO, Romande Energy SA



Romande Energie has positioned itself as a major player in the energy transition. Our goal is to help our clients with their own approach so that, together, we can contribute to the decarbonisation of western Switzerland.



ENERGY CONTRACTING AND THE ENERGY PERFORMANCE CONTRACT (EPC)

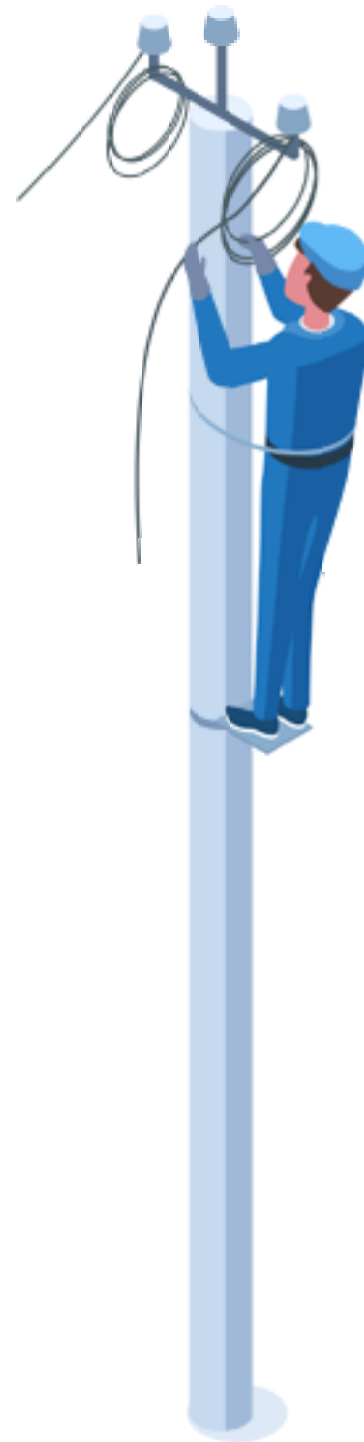
Energy contracting involves buying a comprehensive range of energy services and then contracting out the technical and financial aspects of these services to an energy specialist, the contractor. Of course, the contractor ensures that the installation operates efficiently, and consequently it will make energy savings over the previously existing situation. However, what the contractor sells to its customer is energy and not energy savings. In addition, energy contracting does not come with a guarantee of energy performance (even though it involves a performance incentive), whereas in an Energy Performance Contract (EPC) this is key.

The EPC is a market instrument that helps customers reduce their energy consumption and increase their energy effectiveness. In helping their customers prepare an EPC, energy services companies (ESCOs) provide the expertise and experience required to see through an energy effectiveness project to a successful conclusion. The ESCO incorporates all of the services required for the project in a single contract, and it can also organise the finance⁵. The association swissesco represents the main players in this field.

An EPC includes three essential provisions:

- › It applies to the entire building, not just the technical installations
- › An energy diagnosis of the building (envelope and facilities), carried out in advance
- › A guaranteed result in terms of energy consumption (rather than energy expenditure as previously), by means of a rigorous measurement and verification method.

EPCs are available either from large multi-industry groups that cover the whole gamut of expertise required or from consortiums such as BG Ingénieurs Conseils and Energo.



CÉDRIC JEANNERET

Member of the Energy Transition Board of SIG, Member of the Board of the European Council for an Energy Efficient Economy (eceee)

Even though energy effectiveness is the first pillar of the Energy Strategy 2050 and even though energy sobriety does feature in the cantons' energy master plans, there is still a great deal to do to realise the potential of these two approaches!



Specific examples of EPCs

The energy renovation of a rental apartment building in Geneva's Champel district is our first good example of an EPC. The general contractor **Losinger Marazzi** won the call for tenders issued in 2014 by the Hospice général of the Canton of Geneva.

The renovation, which met the Minergie renovation standard, included the façades and technical services of this imposing late-seventies building of 71 apartments. When the project was finalised in 2016, Losinger Marazzi committed to a 50% reduction in energy consumption over nine years. A tenant assistance programme was introduced to raise awareness of the eco-performance scheme in place, help tenants to stay in control of their energy consumption and encourage them to take part in the project. This was Losinger Marazzi's first project to be awarded under an energy performance contract.

The second example involves **Romande Energie Services**, the utilities company behind the first large-scale EPC for public lighting, in the Swiss village of Cugy. Introduced in response to ageing lighting installations, ever-increasing operating costs and disproportionate electricity consumption, this scheme resulted in a significant reduction in electricity consumption (72%). Involving the complete renovation and optimised management of the village's public lighting system, this EPC made use of new LED technology and smart lighting management solutions. In addition to achieving a major saving in electricity consumption, the new technology introduced has also improved the village's night-time ambiance and safety while preserving biodiversity and reducing light pollution. The system's remote management design allows for flexibility in the lighting management, enabling awareness campaigns and full-scale trials to be organised.

INNOVATION IN CONTRACTING IS IN ITS EARLY DAYS...

Industry players are also introducing innovative contracting methods to better meet their customers' evolving energy requirements. For example, **Romande Energie, Stignergy** and **Leclanché** have joined forces to provide the Vaud-based food production company **Sylvain & CO** with an innovative solution for optimising their energy production and consumption. Their pilot installation comprises a smart energy management system, a solar farm and an energy storage unit, the different elements complementing each other. This solution is also modular, which means it can be adapted to take into account changes in the electricity market – a Swiss first in energy efficiency.

Other models are also available for use by public authorities to fund heavy infrastructures such as heat networks, along with co-funding and tax burden optimisation options.

PHYSICAL OR VIRTUAL OPTIMISATION

The future is digitalisation, and this trend applies to energy efficiency too. The digital era has begun, and digital technologies are benefiting from the emergence of commercial applications that make use of AI. Their impact on the energy sector is only just beginning to make itself felt.

As in all other sectors, the way our electricity supply is structured is changing worldwide. Large fossil-fuel power stations are being replaced by small, decentralised units interconnected through a digital network, which offers greater flexibility of use and better network resilience.

Online accommodation booking platforms such as Booking.com do not own the hotels they take reservations for. Instead, they capitalise on optimising the existing network. The same applies to virtual power plants. The managers of these plants do not necessarily own the physical plants themselves. Their job is to optimise their use, aggregating the production capacity of a host of networked (small) power plants.

We are already at the stage where the largest virtual power plants easily outstrip major nuclear installations in terms of installed capacity. And by and large, they produce climate-neutral electricity that will meet the market's future challenges.

Eventually, private households may also become connected to a virtual power plant. This will be made possible by the widespread adoption of smart meters to replace the existing analogue meters, some of which date from the 1920s. Incidentally, electrical appliances can be used more efficiently through smart optimisation of the operation of a household's central heating, cooker, washing machine, freezer and boiler to take advantage of times when electricity is cheaper.

What is a virtual power plant?⁶

A virtual power plant is a collection of units decentralised from the electricity grid and instead connected via a shared regulation system. These units can be electricity generators (wind farms, solar farms, or hydroelectric, biogas or cogeneration plants), consumers, storage facilities and Power-to-X installations (such as Power-to-Gas and Power-to-Heat plants). The objectives of this kind of power plant are to pool commercial production of electricity and ensure flexibility of all of the global installations in terms of production and consumption.



BERTRAND PICCARD

Initiator, President and pilot of Solar Impulse

Producing energy will never be as profitable as energy efficiency. That is where we should be investing, as much for our pockets as for the environment.



SPECIFIC EXAMPLES OF VIRTUAL POWER PLANTS

Switzerland boasts a great many virtual power plant initiatives. One example is the Zurich start-up **Adaptricity**, which markets electricity grid simulation and optimisation software that links in renewable energy sources. Geneva-based **Signa-Terre** specialises in the energy monitoring of buildings and assisting project owners with renovation and newbuild projects. **Siemens** also offers practical help in this field, as does **E-nno** with its predictive optimisation solution combined with an analysis service (see profile on page 79).

With its Smart Ski Resort project, the Valais-based SME **Simnet** has developed a generic management platform that optimises the energy efficiency of a ski resort lift system, controlling multiple energy sources and flows in real time. This also includes a decision-making tool that can be applied all over the wider area. This tool is designed to encourage more energy production from renewable sources, thereby playing an active part in the energy transition and reducing operating costs.

SWITZERLAND ON THE RIGHT TRACK

The Energy Strategy 2050 is a long-term project, and so the Swiss Federal Office of Energy (SFOE), in collaboration with the State Secretariat for Economic Affairs (SECO) and other federal government departments, has set up a monitoring system to keep track of decisive developments and progress. It is also measuring progress towards achievement of the strategy's goals and studying the economic costs and benefits of the measures in place. The idea behind this regular monitoring is to enable the federal government to intervene to redress the situation should any unwanted developments occur.

This monitoring shows that energy consumption per inhabitant has fallen since 2000. In 2020, it was 82.2 gigajoules (0.023 GWh), 23.7% lower than in 2000. When adjusted for the impact of the meteorological conditions, this figure is still 20.8%, better than the indicative value forecast for 2020⁷ (see the red curve in Figure 2 below).

In future, final energy consumption per inhabitant, adjusted for the impact of the meteorological conditions, will have to fall by an average of 2.2% per year to reach the indicative value set for 2035.

FINAL ENERGY CONSUMPTION PER PERSON PER YEAR

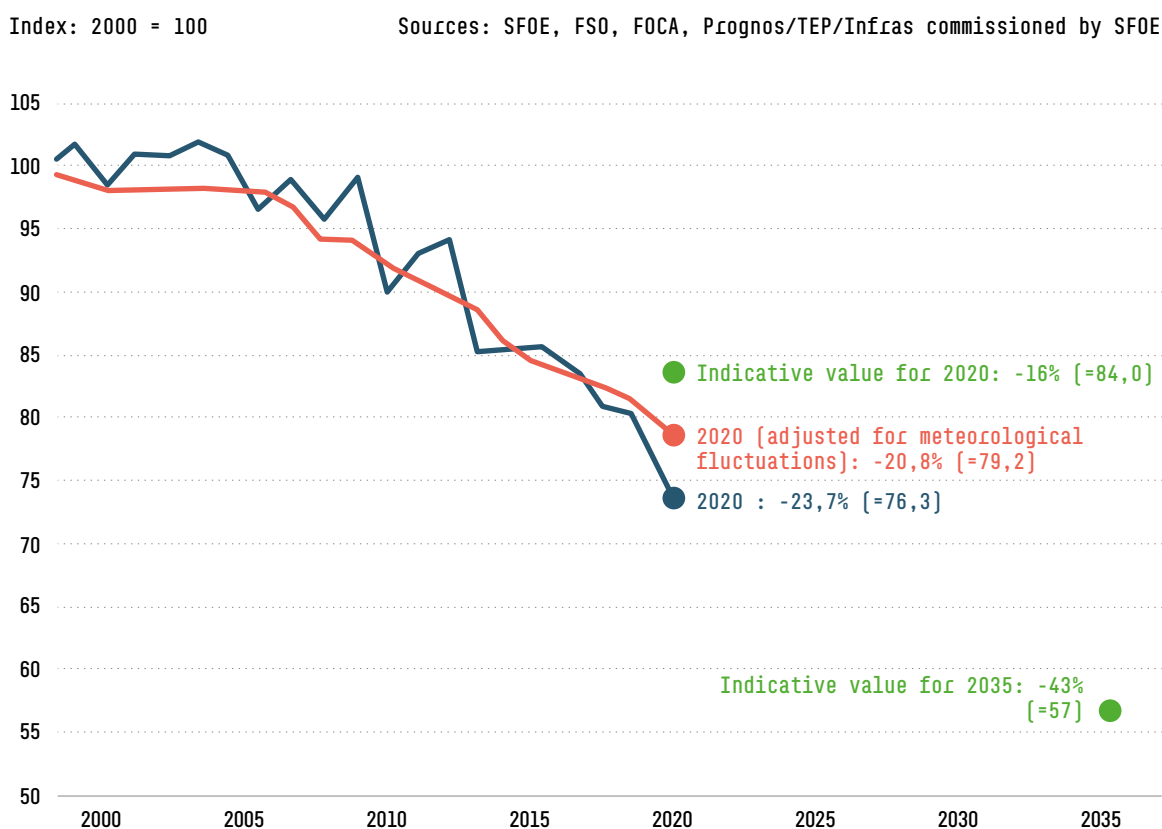


Figure 2 ▲
Change in final energy consumption per inhabitant since 2000 (indexed values)

Taken separately, electricity consumption per inhabitant increased between 2000 and 2006, but since 2006 this trend has been reversed. In 2020, the electricity consumption figure in absolute terms fell by 2.6% compared to the previous year, chiefly due to the Covid-19 pandemic and warmer temperatures than in 2019.

Since 2015, electricity consumption per inhabitant has been lower than the indicative value for 2020. However, even if electricity consumption continues to fall at this rate, the indicative value for 2035 (-13%) will not be reached unless an additional effort is made. According to Energy Perspectives 2050+ published in SFOE's monitoring report, if the climate goal of net-zero greenhouse gas emissions is to be met by 2050, a significant increase in demand for electricity is to be expected in the medium term. Efforts to meet the goal will be complicated by the future demands of electric mobility, heat pumps, new ways of consuming such as the electrolyzers used in hydrogen production, large-scale heat pumps, and in the long term negative emission technologies and carbon capture and storage systems. Consequently, significant new improvements to make electricity consumption more effective are necessary in the medium to long term to compensate for the additional consumption of electricity resulting from the electrification of the energy system.

A reason for optimism: the fall in CO2 emissions

If we are to protect the environment and climate, we need to apply a much broader analysis to energy saving measures. In this context, CO2 emissions must also be taken into account and examined in detail.

In Switzerland, CO2 emissions per inhabitant from energy production have fallen continuously since 2000. The overall volume has fallen slightly since 2000, while the country's population has increased over the same period. There is an increasing decoupling between population growth and CO2 emissions, and that is very gratifying. In 2019, domestic emissions per inhabitant totalled around four tonnes, 30% below the value for 2000 (5.8 tonnes).

By international standards, this figure is quite low. This is due to the fact that most of Switzerland's energy production does not generate CO2 emissions and that much of the services sector is involved in value creation. To reach the long-term global strategic goal, emissions per inhabitant will have to fall by an average of 0.08 tonnes per year.

IVAN KANTOR

Assistant Professor, Chemical and Materials Engineering, Gina Cody School of Engineering and Computer Science, Concordia University, Canada

The sustainable industry of the future requires re-thinking the design and objectives of industrial production and how to supply the materials and energy.



SWITZERLAND'S RESEARCH SECTOR: VERY ACTIVE AND VERY INVOLVED

In addition to Swiss businesses and start-ups, the country's research sector is also closely involved in the quest for energy sobriety. Various tools and organisations are working hard to further research and development in the field. Here is a brief rundown of the initiatives currently in place.



ARAMIS: the research project reference source

The ARAMIS database contains information on research projects and evaluations that the federal government carries out or funds on its own behalf. ARAMIS was developed not only to coordinate scientific data but also to ensure transparency, and comes under the overall responsibility of the State Secretariat for Education, Research and Innovation (SERI).

Details of the many energy efficiency projects are available at <https://www.aramis.admin.ch/Projektsuche/>

THE PROGRAMME OF THE SWISS COMPETENCE CENTERS FOR ENERGY RESEARCH (SCCER)

To step up energy research and facilitate the implementation of the Energy Strategy 2050, the federal government supported the establishment of the Swiss Competence Centers for Energy Research (SCCER) over the period 2013 to 2020.

Eight SCCER were launched to try to find solutions to technological, societal and political challenges posed by the Energy Strategy 2050. Two of them (FEEB&D, Future Energy Efficient Buildings & Districts, and EIP, Efficiency of Industrial Processes) came under the scope of energy efficiency, their remit covering both effectiveness in relation to energy supply and rational energy use.

SCCER CREST (Competence Center for Research in Energy, Society and Transition), on the other hand, focused on changes to the legal framework conditions and on incentive measures designed to act on supply and demand. This was the only SCCER to be fundamentally focused on user behaviour.

This programme is now at an end, and the resulting expert reports are available from the different research entities. We are not aware of any specific programme planned to take over on this purely academic front. The current trend is more for public-private consortium programmes such as Innosuisse's [Flagship Initiative](#) (which supports systemic innovation and is not focused exclusively on energy) and the SWEET programme from the Swiss Federal Office of Energy (SFOE).

SWISS ENERGY RESEARCH FOR THE ENERGY TRANSITION (SWEET)

Swiss Energy Research for the Energy Transition (SWEET) is a new incentive programme from the SFOE. Its purpose is to foster the innovations needed to implement the Energy Strategy 2050 and meet Switzerland's climate goals.

SWEET covers a large part of the innovation cycle, which progresses from basic research to applied research to implementation. It complements existing incentive programmes because it is designed specifically for partnerships that will work over several years on multi-disciplinary and inter-disciplinary projects and that all include energy efficiency. SWEET aims to foster in particular projects based on collaboration between research establishments, the private sector and public authorities.

This programme is at the cutting edge of measures to support innovation in Switzerland and Europe. With its pioneering cross-discipline scope and inclusive approach, it is highly valued around the sector and other sectors would do well to take inspiration from it!

For information, we provide below a brief description of SWEET's current consortium projects. (For more details, see the respective websites.)

› **PATHFNDR – Pathways to an efficient future energy system through flexibility and sector coupling (host institution: ETH Zurich)**

This project's goal is to develop and analyse transition pathways for renewable energy integration in Switzerland. It proposes feasible research opportunities, provides planning and operation tools, develops pilot and demonstration projects, identifies new business opportunities and innovation strategies, and analyses potential policies. <https://sweet-pathfndr.ch/>

› **EDGE – Enabling decentralized renewable generation in the Swiss cities, midlands, and the Alps (host institution: EPF Lausanne)**

The EDGE programme is designed to fast-track the growth of locally sourced, decentralised renewable energy in Switzerland. It aims to ensure that the Swiss energy system is suitably structured by 2035 and 2050. Once the ambitious targets for the use of renewable energy are reached, it must be able to operate optimally and securely, both from a technical and an economic point of view, and occupy a strong position on the European markets. <https://www.sweet-edge.ch/fr/home>

› **DeCarbCH – Decarbonisation of cooling and heating in Switzerland (host institution: University of Geneva)**

The overall objective of the project (with the ultimate target of net zero emissions) is to facilitate, speed up and de-risk the implementation of renewables for heating and cooling in the residential sector (for various scales and degrees of urbanisation) as well as for the services and the industry sector. <https://www.sweet-decarb.ch/>

› **SURE – Sustainable and resilient energy for Switzerland (host institution: Paul Scherrer Institute, PSI)**

This project aims to reconcile resilience and sustainability criteria with the main goals of the Swiss energy sector transformation. <https://sweet-sure.ch/>

› **LANTERN – Living labs interfaces for the energy transition (host institution: HES-SO Valais-Wallis)**

The objective of this project is to co-design energy solutions for a decarbonised Switzerland that ensures efficient management of resources and involves citizens through the use of open innovation tools. <https://www.hevs.ch/fr/hes-so-valais-wallis/actualites/sweet-lantern-un-projet-pour-decarboner-notre-quotidien-202344>

› **SWICE – Sustainable wellbeing for the individual and the collectivity in the energy transition (host institution: EPF Lausanne)**

This project aims to reduce Switzerland's energy use by adapting buildings and urban environments to new trends in consumer lifestyles, such as working from home. <https://actu.epfl.ch/news/a-sustainable-energy-transition-starts-with-indi-2/>

A large number of energy efficiency pilot projects and demonstrators are now springing up and many are now ready to be rolled out on a large scale. This is the case of **EnergyView**, a software package developed by a consortium of academic and economic players in the Canton of Valais, with the support of SFOE as a flagship project. This software has completed its pilot phase and is now on the market. It provides a fast, straightforward view of energy use by municipalities. The calculations are made on the basis of accounting data and electricity bills.

For other examples, we invite you to browse through the portfolio of businesses and projects appended to this report.

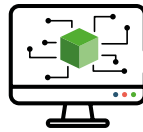
SWITZERLAND GLOBAL ENTERPRISE (S-GE), SUPPORTING SWISS SMES INTERNATIONALISE AND FOREIGN COMPANIES TO BECOME ESTABLISHED

Switzerland global enterprise (S-GE) the official export and investment promotion agency of Switzerland, present in all of Switzerland and in more than 27 countries, supporting Swiss SMEs, especially cleantech companies with international business development and helping innovative internationally active companies become established in Switzerland. Providing value to customers and creating prosperity for Switzerland through a unique national and global network of partners.



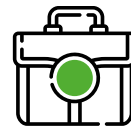
EXPORT PROMOTION

Working on behalf of the Swiss Confederation, represented by the State Secretariat for Economic Affairs (SECO), S-GE uses its expertise in internationalisation to help Swiss companies, especially SMEs, identify and develop new business potential on a worldwide basis. It provides regular information about relevant trends in the global markets, as well as professional advice and support in finding contacts and partners, and identifying new business opportunities.



SWISS CLEANTECH COMPANY DATABASE CUBE

This database of Swiss cleantech companies, known as the Cleantech CUBE, is a basis for communicating services and for promoting companies both in Switzerland and abroad. Re-gistration is free. www.s-ge.com/cube



INVESTMENT PROMOTION

As part of its remit from the Swiss Confederation and the cantons, S-GE provides potential foreign investors with information about Switzerland as a business location. Its services for foreign companies include assessing the potential of their projects before they are presented to the cantons. S-GE assists the cantons with the relocation of foreign companies, providing market and trend analyses and coordinating the activities of all the bodies involved.

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Sector-based approach

In Switzerland, the three following sectors of the economy are responsible for 74% of the country's final energy consumption⁸:

- › *the energy effectiveness of buildings and renewable energy sources for domestic consumption;*
- › *the mobility of private households and businesses;*
- › *installations and processes in the industrial and services sector.*

We have chosen to cover these three sectors in turn, presenting energy efficiency pathways for each of them. Following that, to round up our sector-by-sector approach, we look at efficiency in the broader context, for example at system, district, municipal and regional level.

Our discussion is structured in a similar way for each sector, with a presentation of the context, followed by the energy-saving potential and its structure, the choice of materials and their impact, and, to inspire the reader, examples of practical solutions.



BUILDINGS

CONTEXT AND ENERGY-SAVING POTENTIAL

Heating, hot water, air conditioning: the building sector alone accounts for 40% of the country's energy consumption. One of the reasons for this high proportion is the age of the building stock, with old buildings often using more energy than more recently built housing. Renovating old housing is therefore an essential starting point in combating energy waste.

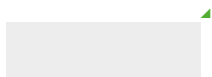
According to Swiss-Energyscope, if Switzerland's building stock was fully renovated to the Minergie basic standard (or an equivalent label), it would consume around half of the final energy that it currently uses. This would represent a reduction of 36 TWh per year, which is 18% of the country's total final energy consumption. However, energy efficiency renovations are currently carried out on only one in 100 houses⁹ each year. This is less than half of what is required to meet the Energy Strategy 2050 goals in the building industry.

Realistically, renovating the envelope of an existing building saves on average 50% of its energy usage. At the same time, practically any residential building (except in unusual cases) can be powered by renewable energy (solar energy, dissipated heat/heat pumps, wood energy/pellets, thermal solar, etc.). In addition, single-family dwellings and apartment buildings can also be used to produce renewable energy, sometimes in excess of their requirements.

It is therefore important to consider building effectiveness and the production of renewable energy as a whole (including the electricity required for electromobility)¹⁰. The Buildings Programme (see page 67) is designed precisely to support renovations of this kind.

Planning tools are now also available on the market. eValo is one such example. This analysis tool provides an overview of the energy efficiency potential of a sustainable real estate renovation project. Developed by the **Raiffeisen** banking group in collaboration with **Zurich University of Applied Sciences (ZHAW)** and the Schaffhausen-based company **a2-c AG**, it is available to customers of the Raiffeisen group banks.

Several Swiss businesses specialise in reducing the energy footprint of buildings. These include the recently founded Bern-based company **Cleveron**, which offers a plug-and-play solution for reducing the energy consumption of radiators in large residential blocks, and **Smart Energy Link**, also based in the Canton of Bern, which optimises daily solar energy consumption and turns buildings into profitable and environmentally friendly electrical 'power stations'.



We must use energy in a more efficient way – in the home, in transport and in business. That's why we launched the Energy Savers platform!

RONNY KAUFMANN
CEO Swisspower AG



DISTRIBUTION OF HEATING SYSTEMS IN THE SWISS BUILDING SECTOR

In the Swiss building sector, more than 70% of heating is today provided by boilers fuelled by oil, gas or wood. The remaining 30% comes from electric radiators, heat pumps powered by electricity and urban heating networks (district heating systems)¹¹.

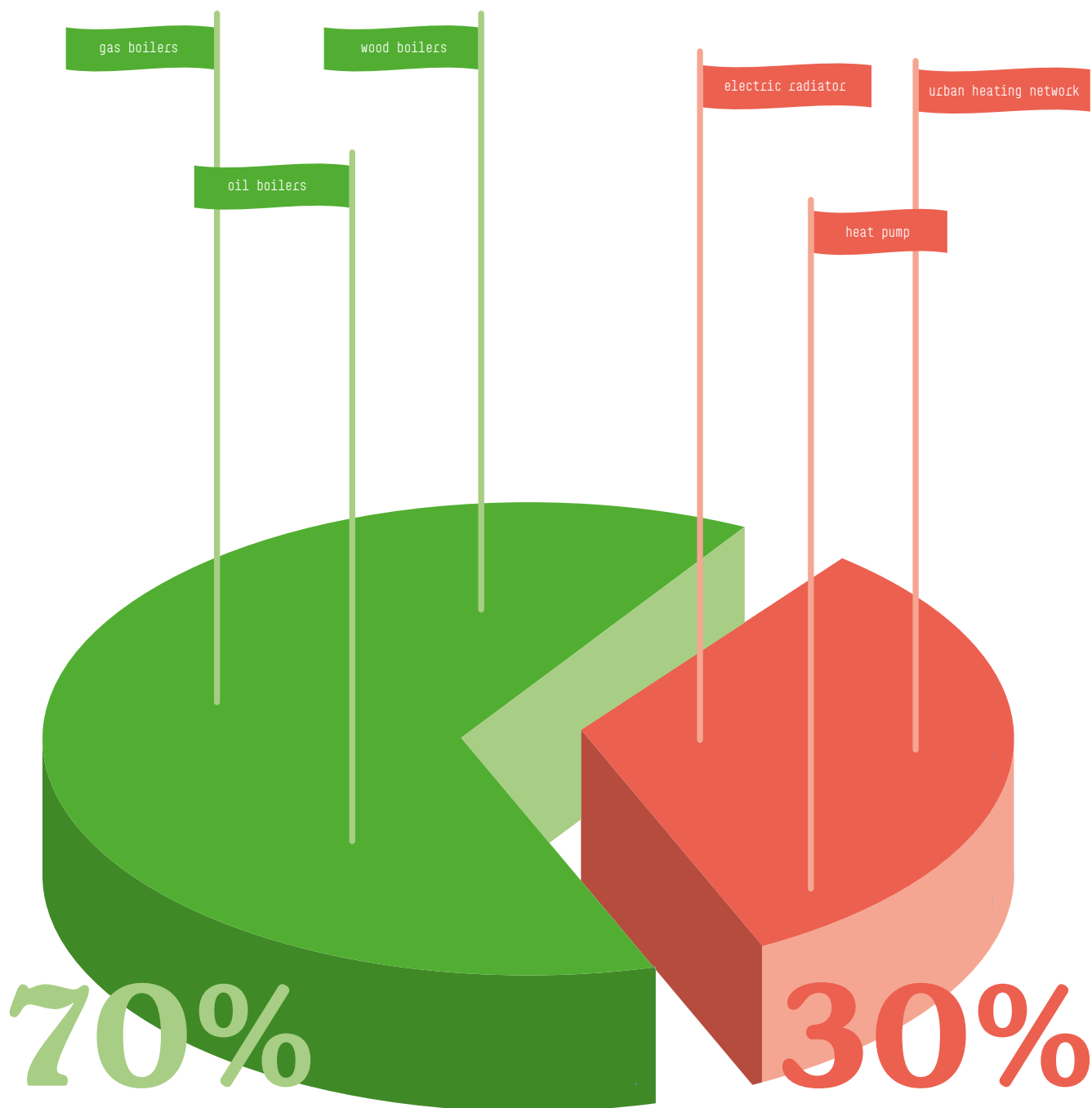


Figure 3 ^

The Vaud-based start-up **Droople** is developing a precise way to monitor a building's water consumption. The ability to track water usage is also important in relation to energy use, particularly when it comes to optimising hot water consumption. In a similar vein, the new Biel-based company **Gjosa** markets a shower that uses less water and energy, while **Joulia**, also based in Biel, has developed an energy-saving shower tray (see profile on page 76).

Architectural firm **Lutz** (see profile on page 84) and the Vaud-based company **eSMART** are also excellent examples of Swiss industry's capacity for innovation in the design and energy efficiency of buildings. Numerous consultants, engineering firms and architects (such as **Enoki**, **BG Ingénieurs Conseils**, **Amstein + Walthert AG**, **Planair**, **Atome & Cie**, **ab ingénieurs**, **Signa-Terre**, **CSD Ingénieurs** and **AtIB**) are contributing to the shift towards improved sustainability in the building sector.

Special programmes to promote building renovations

Through a special programme limited to the period 2021 to 2023, the federal government is offering incentives to encourage building owners to carry out major energy-saving renovations without this leading to significantly higher rents. These include interest-free loans from its working capital to support renovation projects that demonstrably improve the condition of the building envelope (through CECB level-B certification or in line with the Minergie standard). The loans are interest-free for the first 10 years and are granted for a total of 25 years. In addition, the sum of CHF 50,000 is paid per dwelling. In most cases, tenants do not have to move out of their home while the building work is carried out.

Alongside this, the Swiss foundation for the promotion of home ownership (FPPL) is due to offer a similar programme of loans from its fund. Here too, the objective is to improve the condition of the building envelope so that it qualifies for CECB level-B certification or complies with the Minergie standard.

These instruments are of note, because they provide innovative financial solutions that solve the situation in which tenants, and in the long run society as a whole, are otherwise forced to foot the bill for such improvements. Let us hope that these programmes will be renewed and copied by others!

OBSERVATION AND LABELS

How much energy do new buildings consume for heating and hot water in Switzerland? Does consumption as actually measured correspond to the heating requirements calculated when the building is planned, or is there a difference between these two figures? This concept is known as the performance gap.

SwissEnergy has summarised the results of several performance gap studies published in recent years. One finding is that the heating requirements of multi-family dwellings are on average higher than the calculated requirements. Another is that the actual heating requirements of rental apartment blocks are on average higher than the requirements calculated for the purposes of the energy certificate drawn up as part of the building permit application. It is, however, not always easy to compare the results of different studies because they sometimes use different methods and reference values. For heating requirements in particular, the occupant behaviour assumptions made in different studies can vary.

According to the experts, user behaviour is responsible for the 10 to 20% gap between the calculated requirements and actual consumption. Studies do show that residents in new multi-family dwellings set their heating thermostat higher, leave windows open more often and use sunshades more frequently than is allowed for in the relevant Swiss building standard (SIA). This observation again underlines the challenge arising from the human factor, a decisive element in almost all energy efficiency initiatives.



Consumer barometer of renewable energy

Every year for the last 11 years, Raiffeisen, Switzerland's third-largest banking group, has published its 'barometer of renewable energy', in collaboration with the University of St. Gallen.

Some of the results of the 2021 survey are very interesting in the context of energy efficiency:

- ▶ 94% of the Swiss population think that energy suppliers should invest more in renewable energy in Switzerland.
- ▶ 62% see banks' investments in coal, oil and gas abroad as a risk to Switzerland as a financial centre.
- ▶ 71% see banks' investments in coal, oil and gas abroad as a risk to Switzerland as a financial centre.

Additional information: www.iwoe.unisg.ch/kundenbarometer

Labels: simplifying planning and construction

Planning, building, operating and renovating energy-effective and climate-friendly buildings and sites in Switzerland require the use of the appropriate instruments. Building labels simplify planning by laying down specific requirements for the building or site to be renovated and providing instructions for the construction or energy efficiency renovation.

The different labels¹² presented below are transparent about their purpose and clearly differentiated from each other. The main differences between them are the range of criteria included and their scope of application (for example an individual building or an entire site).

› GEAK/CECB

The cantonal energy certificate for buildings (GEAK/CECB) is an assessment of the quality of the building envelope and the overall energy effectiveness of a piece of real estate. The GEAK/CECB Plus label comes with a consultancy report that proposes and evaluates the options for energy efficiency renovation.

www.geak.ch | www.cecb.ch

› MINERGIE

MINERGIE is a building standard for existing construction projects and those at the planning stage. It is synonymous with exacting requirements for the quality and comfort of housing. There are three standards in the MINERGIE family:

- › **MINERGIE**: above-average quality, comfort and energy requirements
- › **MINERGIE-P**: constructions with minimal energy consumption; also meets the maximum quality, comfort and energy requirements
- › **MINERGIE-A**: buildings with a PV solar power system of which the annual electricity production covers at least the building's energy requirements.

These three basic standards can be combined with the complementary ECO label, which takes into account the health and environmental aspects of the construction, including the use of grey energy.

www.minergie.ch

› SNBS Building Construction

The SNBS Building Construction standard is a comprehensive sustainable construction concept in Switzerland. It covers the building itself along with the site in its environmental context. It is a way of taking into account, equitably and in the most comprehensive way possible, the needs of society, the economy and the environment in the planning, construction and operation of a building. To achieve this, the project must provide an overall vision of the life cycle of a piece of real estate. This standard was developed by economists and the public authorities and is a result of the Federal Council's sustainable development strategy.

www.snbs.ch

› 2000-Watt Site

The 2000-Watt Site label extends beyond consideration of an individual building. A 2000-Watt Site recognises energy effectiveness, use of renewable energy and climate protection on the scale of an entire district. The label's quantitative requirements guarantee that the Energy Strategy 2050 goals are met, along with the CO₂ emissions requirements laid down in the 2015 Paris Agreement. To achieve this, the primary energy needs and CO₂ emissions arising from the construction life cycle, operation and mobility relating to the site are taken into account.

A 2000-Watt Site certificate can be implemented during the planning stage, for existing districts where rehabilitation work is being carried out, or for sites that are already up and running.

www.2000watt.swiss

› SEED, next generation living

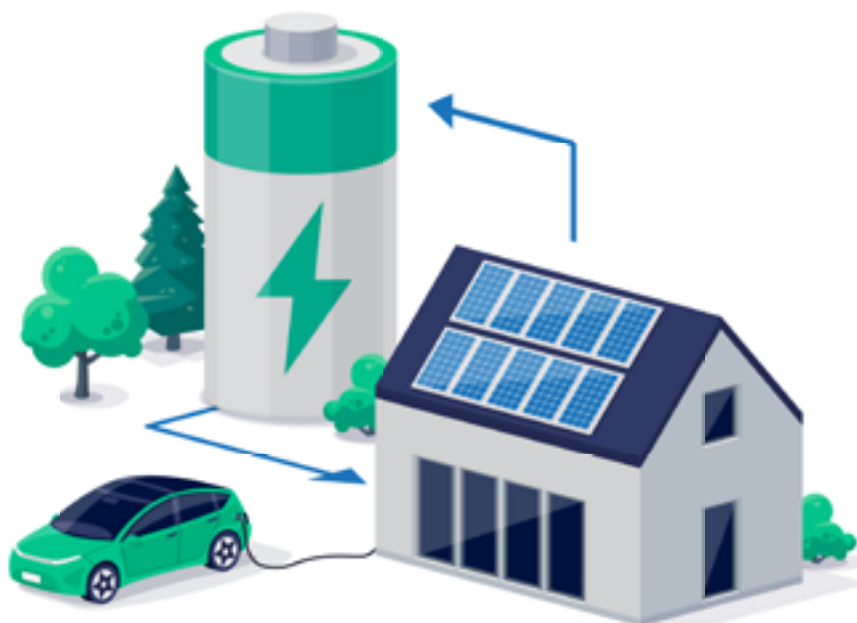
SEED, next generation living' certification was developed by the Swiss association for sustainable districts, which was created in 2018 by WWF Switzerland and Implenia Suisse SA). Following on from the One Planet Living initiative, SEED is a unique, independent certification scheme based on six founding principles. It is granted to districts that respect these principles on the basis of 30 performance objectives and 60 measured indicators. Its mission is to reinvent housing, designing sustainable, welfare-oriented districts that focus on respect for the environment and the well-being of its residents. Its aim is to reduce the ecological footprint of the urban environment.

<https://seed-certification.ch/>

Other labels also exist, such as Gutes Innenraumklima, which evaluates the quality of the ambient air in indoor settings based on the measurement of every harmful substance present. Another label, Swiss DGNB certification, takes into account the environmental and economic aspects of the entire life cycle of a building, and even sometimes goes as far as to analyse its socio-cultural parameters. LEED v4 incorporates environmentally friendly practices and technology that exceed building standards. Buildings are awarded points based on a number of strict criteria. The more points a building accumulates, the higher the certification level it achieves: Silver, Gold or Platinum. Other labels are also available around the world.

SwissEnergy publishes various brochures written to help designers and architects gauge their technical installations correctly with a view to the appropriate and effective use of energy. These brochures cover both new constructions and replacing an existing installation.

Energytools, a website of the **Swiss Society of Engineers and Architects (SIA)**, also offers other planning tools designed to help gauge technical installations correctly (www.energytools.ch).



LAURENT BALSIGER
Director SEFA



For our society, used to an abundant supply of cheap energy, achieving 100% renewable will not be possible unless we embrace energy saving and energy sobriety.

MATERIALS AND HEATING

Reducing the energy consumption of a building is not just about reducing its energy use for heating and hot water. With the materials now available and the latest state of the art in construction, numerous energy requirements can be met.

A building's envelope and thermal insulation are the starting point when it comes to making it energy-efficient. These days, most houses can also be insulated after they are built, with insulating materials available for every possible application.

Once fitted, external thermal insulation works reliably and maintenance-free for decades while saving a maximum of useful heat compared to other parts of the building such as the windows, roof and cellar ceiling. This makes it a key measure in the energy-saving process. In an old building, on average around 30% of the useful heat is lost through the external walls. In certain cases, adding a second insulating layer to existing insulation can be a good idea.

In this field, the Swiss company **Fixit** has developed an Aerogel insulating plaster that consists mostly of air and is an environmentally friendly replacement for interior and exterior insulation made of polystyrene. Because it is applied in such a thin coat, the building's characteristics remain practically unchanged, making this an ideal product for renovating historical buildings. **Magripol** (Vaud) is developing a natural, environmentally friendly insulating material containing flax fibre, and **FenX** (Zurich) uses industrial waste to manufacture high-performance insulating panels.

In addition to uses in insulation, other materials can be very effective in improving the energy efficiency of a building or constructing in a more eco-friendly way with a lower environmental footprint. This is the case of the Ustinov Hoffmann Construction System from Valais-based newcomer **UHCS Ustinov Hoffmann Constructions SA**, a modular construction system that makes use of composite resin sourced from recycled plastics such as PET and HDPE. Similarly, **Fagus Suisse** (Jura) builds with beechwood instead of steel and concrete. This results in buildings with a lower carbon footprint and also enables the local economy to benefit from the added value created.

The Bern-based start-up **Neustark** is developing a way to make recycled concrete. Its first pilot unit recently began operating in Bern. In the same vein, the Fribourg-based company **Mobbot** has come up with a way to 3D print concrete. This technology, coupled with the use of locally sourced raw materials, reduces the quantity of concrete used without compromising on strength.

When it comes to heating, modern systems are also now in existence. These consist of heat pumps, small cogeneration units (which produce both heat and electricity, also known as combined heat and power) or a combination of the two. Furthermore, these systems are increasingly being combined with (thermal or photovoltaic) solar panels. The heat produced by these systems is distributed around the buildings by low-temperature heat distribution networks (containing water or air) operating at a temperature similar to that to which the rooms are heated. They also feature a heat-recovery air-renewal device.

The EPFL spin-off **Enerdrape** (see profile on page 90) has plugged a gap with its geothermal panel technology that exploits the heat available in underground buildings. This modular solution can be used to reduce the energy footprint of a building by making use of the excess geothermal energy in underground environments for a building's heating and cooling requirements.

DECARBONISING PROPERTY PORTFOLIOS

Clearly, sustainability is growing ever-more important to the real estate sector. This phenomenon is explained mainly by the good performance of investments of this type and by high demand from investors. But industry regulators have also played their part, because the legislation and regulations that they adopt on a global scale have a growing influence on the sector and the management of property portfolios.

As an example, the Raiffeisen Futura Immo fund invests all over Switzerland in existing property and sustainable construction and renovation projects in which the emphasis is squarely on energy effectiveness and/or the use of recyclable materials. Its property selection is based, among other things, on the recommendations of the Inrate rating agency, which evaluates the sustainability of buildings on the basis of certain quality criteria.

Investment funds that fulfil the sustainable development criteria defined by Raiffeisen are identified by the Raiffeisen Futura label. Raiffeisen offers its clients the options of entering into a sustainable asset management mandate and acquiring shares in a wide range of sustainable funds. In 2020, the amount of capital managed as sustainable investments in Switzerland was CHF 1.520 billion¹³. This pro-sustainability investor behaviour is bound to have tangible effects on the way businesses produce – and build – in the future.



CÉDRIC PETITJEAN

Director General, cantonal office for energy (OCEN), Canton of Geneva

We must change the paradigm if we are to have any hope of meeting the goals that Geneva has set itself and of responding to the climate emergency. It's up to every one of us to grab every opportunity to commit to the energy transition with both hands: optimising technical installations, insulating buildings and replacing fossil fuels with renewable energy.

EXEMPLARY INNOVATIONS AND PROJECTS

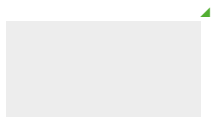
Switzerland already boasts several successful examples of decentralised energy systems supplying everything from single-family homes to industrial sites, as illustrated below.

Two examples from Romande Energie show how momentum in this sector is growing: :

- › The Les Cèdres housing development is one of the major urban housing projects in the Lausanne region. The roofs of the first six buildings in the district will be fitted with photovoltaic panels that will produce enough local, sustainable and green energy to supply the residents living in the development's 350 apartments. The buildings will be interconnected by a vast private internal network (microgrid) enabling all residents in the district to benefit from the local solar energy generated on the rooftops. This network will also be connected to the public grid to ensure a constant supply and that any surplus production can be injected into the grid. The microgrid concept is an environmentally and economically sound solution for residents that does not compromise their comfort or quality of life. By distributing the energy generated from the solar panels to several buildings, it maximises energy autonomy and local consumption of renewable energy. This development concept also features a high-rise building covered in vegetation.
- › The second example is the OASSIS project, developed by Patrimonium. The objective was to create an innovative, sustainable, modern and environmentally friendly mixed district perfectly adapted to the urban environment. Around half of the building roofs feature vegetable gardens, while the other half are fitted with solar panels. As a result, the nearly 600 dwellings and 50 commercial premises and offices are supplied with clean, sustainable energy, most of which is locally generated solar power. The district is connected to the public grid via a vast private internal microgrid and transformer station.

What is a decentralised energy system?

Decentralised energy systems are systems or groupings of several buildings equipped to produce renewable energy that combine different energy carriers such as electricity, heat and hydrogen and also feature both storage technology (e.g. batteries or thermal energy storage) and energy conversion technology (e.g. heat pumps, electrolyzers). The objective of these systems is to cover a major part of the site's energy consumption with locally produced energy, making use of the flexibility of its own storage and energy-carrier conversion facilities (power-to-heat/gas).



DANIEL BÜCHEL
Vice Director of the Swiss Federal Office of Energy (SFOE),
Head of the Energy Efficiency and Renewable Energy Division
Energy efficiency must come first – to protect our climate
and provide a secure energy supply.



ELECTRICAL DEVICES AND LIGHTING

In addition to the construction industry and building stock, electrical devices and lighting also have a high energy-saving potential. In 2020, there were 49.5 million domestic appliances, computers, items of office equipment and consumer electronics devices in Switzerland with a combined electricity consumption of more than 6.55 billion kWh (11.8% of the country's total electricity consumption). The number of devices has increased, by 41.8% compared to 2002 (34.9 million devices), but their electricity consumption has actually fallen, by 1.216 billion kWh (-15.6%) compared to 2002 (7.794 billion kWh).

Going by the most efficient devices, the energy-saving potential of all of the devices currently in use is estimated to be 25%. In addition to domestic appliances, consumer electronics is not only a feature of every household or apartment building but is also present in the industrial sector, particularly in stores and shopping centres. Thanks to major advances in technology, the energy effectiveness of computer equipment, office equipment and consumer electronics has improved by more than 50% since the year 2000 and by 30% since 2002 in the case of large domestic appliances¹⁴.

This area has interesting potential in view of the average lifespan of this class of devices, which is estimated by S.A.F.E. (the Swiss agency for energy effectiveness) to be 10 to 15 years. It is possible to make an impact on energy consumption in the relatively short term, especially if this is combined with measures encouraging energy sobriety. This contrasts with the building sector, where building envelopes are built to last for 50 years on average.

Some Swiss businesses are developing solutions designed to facilitate energy saving at home and in the workplace. One example is **Moost**, based in the Canton of St. Gallen. This company markets an automation system that can, for example, be used to switch off the power supply to certain devices or turn down the heating at night, simply with the press of a button. **MyStrom** (Canton of Bern) sells smart plugs that eliminate standby-mode power consumption by household devices.



FRANÇOIS MARÉCHAL
Professor EPFL

Energy effectiveness is actually our biggest source of renewable energy. It requires us to understand the energy services and how we provide them.

Energy standards and labelling

In March 2021, new energy labelling was introduced in the EU and Switzerland. The new energy labels for refrigerators, washing machines, tumble dryers and screens (TVs and monitors) indicate a rating from A to G only. The previous + ratings are no longer used and the ratings applied in the previous energy labelling system have been revised downwards. For example, on the new scale, a device previously rated as A+++ might now come under a C rating. As yet, no devices have been rated as class A, leaving room for manufacturers to develop more energy-effective devices in future.

When it comes to lighting, savings of more than 50% can now be made through the use of LEDs and sensors. Swiss solutions for this are legion, from the solar-powered LED street lamp developed by **DTI-Energies** (Geneva) to the electronic regulator system for street lamps available from **DSPlus** (Valais) and the public lighting management software marketed by **Esave** in the Canton of Graubünden. In addition, **Schröder Swiss** has developed software for controlling the lights in a lighting network remotely. This software produces real-time data and offers energy savings of up to 85%. A similar product is available from **Novaccess**, a company based in the Canton of Vaud (see profile on page 73).

SwissEnergy considers that the development of LED technology still has a long way to go. With OLEDs (organic LEDs), in a few years' time it will be possible to produce light from large pieces of thin, flexible material that could be used to line whole walls and ceilings, effectively turning them into lights.

Switzerland is also coming up with innovative lighting technology. One example of this is the Vaud-based newcomer **L.E.S.S.**, which offers an alternative to LED, establishing a new lighting quality standard that is even more energy-efficient. **Combivap** (St. Gallen) develops low-consumption lighting solutions based on organic electroluminescent diode technology.

A lighting management system (LMS) can also make a major contribution to a building's energy effectiveness. Depending on the site, the building and how it is used, an electricity saving of between 30 and 80% can be made compared to a lighting system not fitted with a management system. However, this kind of extensive lighting management system does feature a large number of components that themselves consume energy. Because this type of system is always on, depending on the components used, the amount of self-consumption can be considerable, thereby negating some of the energy savings made.

Neuchâtel-based **Novaday** produces lighting solutions for industry and logistics centres. These smart solutions adapt to their environment and external parameters, enabling them to offer appropriate low-energy lighting. The Vaud-based company **ActLight** has also made lighting its key business. It manufactures light sensors for mobile devices, offering considerable energy savings and thus lower costs.

In addition, because they can save energy, public lighting control systems are becoming increasingly important. **Topstreetlight** proposes a wide range of options for managing urban lighting.



TRANSPORT

CONTEXT AND ENERGY-SAVING POTENTIAL

In the transport sector, energy efficiency has an impact on both infrastructures/buildings and vehicles/operations. Improving energy recuperation in trains, trams and buses is one specific example. Improvements in technology and optimised control systems for infrastructures, the use of heating, ventilation and air conditioning tailored to the actual requirements of vehicles, and the acquisition of lighter vehicles are also areas of interest. Waterways transport is also concerned by this revolution, with the advent of foil technology in commercial boats.

Optimum operations management can also make a significant contribution to improving energy efficiency. These technological and operational measures are all very well, but we must not lose sight of the fact that the choice of means of transport has the biggest effect.

In future years, the trends towards digitalisation and transport sharing (a form of energy sobriety that is coming about through a change in practices) will become even more important to mobility. In addition, the electrification of engines will continue to progress, and this will have a major impact on the mobility system.

The Federal Council's Energy Strategy 2050 states that by 2050 the entire transport industry needs to reduce its energy consumption by half and that it will have to contribute to the production of renewable energy. We cover the federal government's Energy Strategy for Public Transport 2050 (ESPT 2050) in the chapter on major support programmes later in this publication (see page 67).

Transport accounted for 36% of Switzerland's energy consumption in 2017. The vast majority of this was passenger transport by road (70%). Fossil fuels are by far the main sources of energy used in the transport industry (accounting for more than 95%).

It is thought that introducing the following measures will lead to an improvement of around 20%¹⁵ in the energy efficiency of mobility by 2030:

- ▶ using energy-saving modes of transport;
- ▶ smarter control of mobility chains through the purchase of passenger cars that use less energy;
- ▶ more energy-efficient driving behaviour;
- ▶ greater use of innovative driver-assistance systems.

There are other potential ways of reducing the energy consumption of business mobility and freight logistics, and part of the answer here is to replace fossil fuels with electricity and renewable fuels. Automating the logistics of freight transportation is the speciality of the Vaud-based company **Aeler Technologies**. Also operating in the logistics industry, the start-up **Ponera** manufactures modular pallets made of recycled plastic that have a lower ecological footprint than the disposable timber pallets making up the majority of the market.



TRISTAN CHEVROULET

Programme Head of the Energy Strategy for Public Transport 2050, Federal Office of Transport (FOT)

Energy efficiency is not just for technophiles. Sharing transport can be a positive social experience while reducing our dependence on oil.

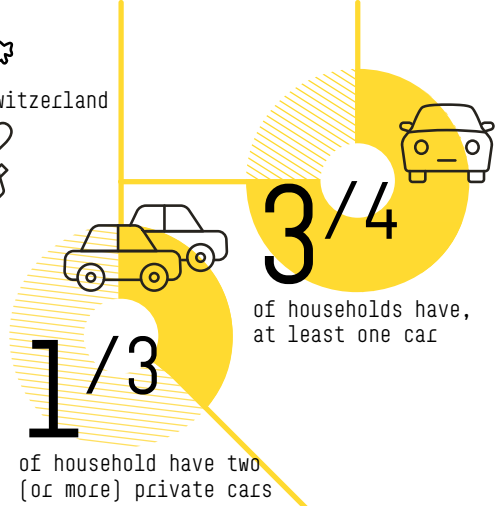
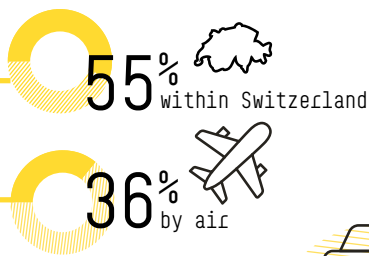
Figure 4 ►

Source: Swiss Federal Statistical Office (FSO), 2017

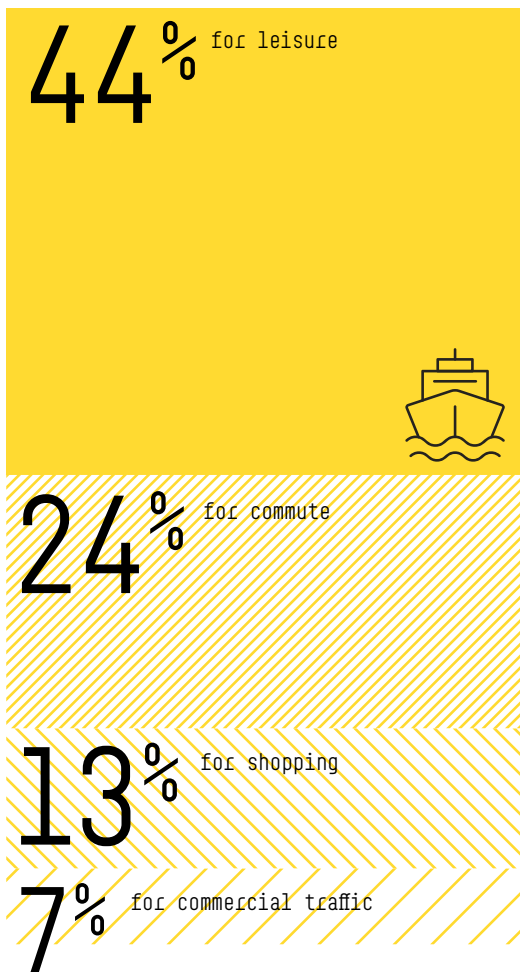
* This infographic does not take into account the figures for 2020/2021, which do not accurately represent the actual change in consumption, as a result of the healthcare situation arising from the Covid-19 pandemic

THE SWISS AND TRANSPORT

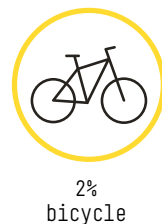
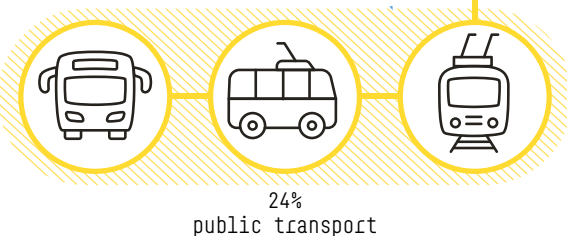
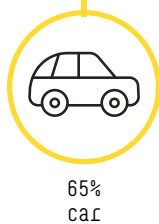
25'000
 KILOMETERS TRAVELLED
 Average distance travelled
 by every Swiss resident each year.



REASON FOR TRAVEL ▼



▼ **90**
 MINUTES
 In Switzerland, people are on the move
 for an average of 90 minutes per day,
 during which they travel almost 37 km
 within the country.



In the air... and on the water

When discussing the subject of energy efficiency in transport, it is hard to avoid mentioning the **Solar Impulse** project led by Bertrand Piccard and André Borschberg. This full-scale demonstrator completed the first circumnavigation of the globe by a solar-powered aircraft, proving that such a feat was possible. It also highlighted the pioneering role that Switzerland has played in this field. Solar Impulse's heritage continues through the 1000 Efficient Solutions label, awarded to the most promising energy-saving technologies being developed. It is also felt through **H55**, the **Solar Impulse** spin-off based in Sion (Canton of Valais) that develops certified electric propulsion systems and batteries for clean, quiet aviation. The aeroplanes of tomorrow are on the horizon...

Even though it is landlocked, Switzerland also excels on water, thanks to the industrial SME **Leclanché**, based in Yverdon (Canton of Vaud). This is the company behind Ellen, the power supply and storage system of the largest electric ferry in the world, the maiden voyage of which took place in August 2019 in southern Denmark, with around 30 cars and 200 passengers on board. Many other nautical applications have seen the light of day, such as the MS Jungfrau on Lake Brienz, the Yara Birkeland, the first fully autonomous electric container ship, and the battery system for the zero-emission freight ferry PR24 operated by Scandlines.

As we mentioned in the introduction to this chapter, the shipping industry is working towards zero-emission ships that are highly energy-effective. This is the heritage of foil technology, which refers to the hydrofoils that enable a boat to rise above the water surface in order to reach higher speeds while reducing energy consumption, with the added bonus of improved passenger comfort. This technology has come into its own with the famous **Alinghi** racing boats, which themselves capitalised on the experience of the Hydroptère project. You may remember this yacht developed by EPFL, which set a new world absolute speed record for a sailing boat on 4 September 2009 (over 51 knots, the equivalent of 95 km/h).

The new generation is now here, the likes of the all-female 2022 Sailing Squad, four young international women sailors and a double-Olympic-medallist coach who showcased 'flying boat' technology at the Bol d'Or, the longest closed-water regatta in the world!

When it comes to Switzerland's record-setting tradition, the **SP80** project, also developed by EPFL, plans to smash the current record, aiming for an incredible 80 knots (150 km/h)! It is on the right track, and no one doubts that the project will succeed. The only uncertainty is the date when this new record will be achieved. **SP80** and **Alinghi** may be the nautical equivalent of Formula 1 racing cars, but we citizens are always interested in benefiting from the fruits of these high-tech developments.

This day will soon come, once foil technology is incorporated into boats used for public transport. The race is on around the world, and Switzerland's Lake Geneva region is lucky to have two contenders among its ranks. Valais-based **MobyFly** and **Almatech** in Lausanne are currently developing this kind of watercraft, designed for use on water-borne public transport routes such as those operating in Osaka Bay in Japan.

This whistle-stop tour would be incomplete without a mention of the new-generation boat in the pipeline: the **Swiss Solar Boat** project. This collaborative project is the work of some 50 students at EPFL working on designing and building the Dahu, a proa-inspired hydrofoil boat powered by solar energy and piloted by one person. This boat came about as a result of the Hydrocontest, taking part for the first time in 2014, winning its first prize in 2015 and since going on to earn multiple distinctions!

ARNAUD ZUFFEREY
Olika Director



The Negawatt strategy has been going for 20 years, and the three levers behind it are as relevant and pressing as ever: energy sobriety, energy effectiveness, renewable energy.



Photo credit : Guillaume Fischer SP80



Photo credit : ZEEST/Almatech — www.zest.ch



Photo credit : MobyFly

Back on terra firma...

The technology developed by **E-Force One** has succeeded in electrifying goods trucks. This company, based on the shore of Lake Lucerne in central Switzerland, manufactures the traction batteries it has itself developed. These particularly high-performance batteries are available in different sizes. The Zurich-based company **Designwerk**, which is part of the Volvo group, also offers an entire range of products, chargers and batteries for electric trucks.

Batteries, and energy storage devices in general, play a key role in the electrification of different modes of transport. The Vaud-based company **Aurora's Grid** has used machine learning to develop an algorithm that increases battery life. This type of innovation will speed up the energy transition, giving used batteries from the motor industry a second life for use in stationary applications in buildings and for network stability. This example shows how technologies can be used in new applications across different industries. It also demonstrates the potential of energy efficiency, which by definition is not industry-specific and is also agnostic when it comes to possible uses and technologies.

Mobility: more ambitious objectives at national level

When it comes to Switzerland's energy strategy, the first stage of the roadmap for electric mobility, covering the period 2018 to 2022, set the objective of increasing the proportion of plug-in vehicles among new passenger car registrations to 15% by 2022. A strong commitment from the industry and the desire, largely shared by the population, to turn increasingly towards more climate-friendly mobility, has made it possible to reach this objective early. Federal Councillor Simonetta Sommaruga, head of the Federal Department of the Environment, Transport, Energy and Communications (DETEC), therefore suggested extending the roadmap to 2025 and setting more ambitious goals. A number of workshops, a summit meeting and a written consultation involving the parties involved in the roadmap have resulted in a joint formulation of the new objectives for 2025. The roadmap players and other interested parties were invited to adapt the current measures to meet the new goals and to submit new measures.

Three new goals have been set for 2025. The proportion of plug-in vehicles (100% electric and plug-in hybrids) among new car registrations is now required to reach 50% by 2025. By the first quarter of 2022, this figure had already reached 25.5%. By the end of 2025, 20,000 public charging points must be available. In early 2022, Switzerland boasted around 7,150 public charging points, according to the website rechargemycar.ch. Lastly, a qualitative goal has also been set. This is to provide user-friendly charging facilities available to the network, at home, at the workplace and on the road. To achieve these three goals, the roadmap players have committed to introducing voluntary measures appropriate to their own sectors¹⁶.

Towards a change in behaviour with electric cars

That said, we should expect that our mobility habits will change once we own an electric car. This is when the 'rebound effect' will occur. Consequently, it is unlikely that a technological advancement that improves energy effectiveness will lead to an exactly proportional reduction in petrol consumption, since some of the potential energy savings will be cancelled out by user behaviour. In this context, the concept of energy sobriety and the resulting change in behaviour can also play a decisive role, reducing the rebound effect.

In private transport in Switzerland, the rebound effect is thought to account for an increase in use of between 30% and 70%, which is consistent with the results observed in other European countries such as Germany. This implies that up to 70% of the energy saving technically achievable is ultimately not made, due to changes in driver behaviour¹⁷. Who said that man is a responsible being?

What is a rebound effect?

This is the phenomenon caused by the behaviour of the consumer, who, following an energy-efficiency improvement of a device, can react by increasing their use of that device. Applied to mobility, the rebound effect suggests that a person who replaces an old car with a more efficient new one in terms of energy consumption will be tempted to use it more than they did previously.

MATERIALS

The use of new materials has a considerable impact on energy consumption in the transport sector. Improving fuel consumption and the aerodynamics of vehicle bodywork reduces CO2 emissions and improves the energy efficiency of vehicles. Other factors, such as the vehicle's weight, have the same effect.

The Swiss have a long-standing preference for large, heavy cars – the larger and heavier the better. This is compounded by the fact that car weights are continually increasing due to the addition of ever-more comfort and safety features. This weight gain cancels out some of the technological improvements made to improve energy efficiency.

Now, means of transport made from new, biodegradable materials are being made in Switzerland. One such example is the **Softcar**, developed in the Canton of Fribourg and designed to be fully recyclable. This urban vehicle was conceived for all-round efficiency, designed to be used in a way that does not cause the rebound effect, tying in perfectly with the notion of energy sobriety.

Bcomp (Canton of Fribourg) also offers solutions for the transport industry with its natural fibres used in vehicle bodies for both motor racing and mass-production cars. Having proved the technology is viable through its partnership with the UK-based McLaren brand, famous for its Formula 1 team, the company has raised more than CHF 30 million through investors in mobility (BMW, Volvo and Porsche). The materials marketed by Bcomp are just as strong as composite materials and are often lighter – and above all easier to recycle.



GRÉGOIRE BLANC

Director of the ProKilowatt programme of SFOE, CimArk SA

With funding from ProKilowatt, you can lower your consumption and reduce your electricity bill.

INDUSTRY

CONTEXT AND ENERGY-SAVING POTENTIAL

Swiss industry consumes nearly 18% of the country's final energy, essentially in the form of electricity and fossil fuels for heat production. This proportion is lower than the European average, which is explained by the fact that the Swiss economy has gradually become de-industrialised and increasingly services-based, which consumes less energy.

Businesses in this sector have already successfully stepped up their energy effectiveness, and have in particular reduced their CO₂ intensity. They have managed to reduce their CO₂ emissions by replacing oil with gas, wood energy, district heating, and ambient electricity and heat.

Industrial activity consumes a large proportion of the energy it requires in the form of heat, in installations such as kilns, chemical reactors, boiler plants and driers. But the production and use of this heat remain poorly optimised, with a few (rare) exceptions. This results in significant energy losses. Optimising industrial processes would substantially reduce these losses. Part of the answer is to produce heat more effectively and at the right temperature. In addition, more effort must be made to re-use waste heat. For example, the waste heat from a boiler plant can be used in driers in the place of a dedicated energy source. These kinds of improvements can be made within a business and also through exchanges between neighbouring businesses. It is even possible to use waste heat to generate electricity. The higher the temperature of the waste heat, the more potential it has for re-use¹⁸.

In general terms, industry thus has a lot of potential when it comes to energy effectiveness. This applies chiefly to electric propulsion systems, heat recovery and the re-use of waste heat. In the services sector, the potential lies more in the information and communication technologies (ICT) and infrastructures such as ventilation, air conditioning and lighting.

When it comes to industrial heat, savings of between 30 and 35% are achievable. And the potential savings in drives and electromechanical processes are estimated to be 20-25%. In ICT (mainly data centres), savings of more than 35% would appear to be realistic. Often referred to as efficiency in ICT, this technology can also be used to save energy in other applications (efficiency through ICT).

Staying on the subject of the use of heat, the Eguzki project demonstrates just how dynamic this sector is. This project is supported by the Swiss Federal Office of Energy (SFOE) and run by a consortium of companies and institutes (RWB, Satom, Oiken, ALTIS and Idiap). Its goal is to use AI to develop a program that simulates the operation of district heating networks to offer fast, predictive resolution of complex ring networks¹⁹.

A predominant role for heat networks

Heat networks have a predominant role to play in energy efficiency by making use of heat that is usually lost to the environment. However, for this to be profitable in comparison to heat generated from fossil fuels such as gas and oil, the operators of these networks must be able to reduce the losses from the network pipes and ensure that the supply is stable all year round. They must also allow for future network extension so that they can make use of the power that will become available once the required energy efficiency measures for buildings are fulfilled. It is also important that they optimise the control parameters of their networks dynamically and simulate the extensions as a function of the buildings' demand and local production. The use of AI (which lies at the heart of this approach) should make it possible to carry out an instant simulation instead of the explicit physical simulation of the networks.

It is important to develop decision-making software for contractors before they make any significant investments. In reality, projects like Eguzki will make it possible not only to optimise the overall architecture of these networks while reducing investment costs but also to optimise their operation while reducing the energy losses from the network.

Numerous examples in Switzerland

Swiss examples in this area, too, are legion. For example, **Fireforce Technology**, based in the Canton of Vaud, has developed a very efficient biomass combustion system. Its installations are not only very efficient (operating at an installed capacity of up to 500 kW), they also limit atmospheric pollution. The **DynaBlue** project run by EPFL Valais Wallis and HES-SO Valais-Wallis is working on developing high-temperature heat flux sensors. An array of these low-energy devices can be used to identify potential improvements in industrial processes, thereby improving the energy effectiveness of installations. Although promising, this technology has yet to find a place on a relatively conservative market.

In the same vein, the Vaud-based company **Ewattch** is developing sensors and applications for use in Industry 4.0 and smart buildings. In addition, **Smart-Conversion**, based in Lucerne, has produced a cooling unit that works without using refrigerant, which has a harmful effect on the climate. **Zero-C Climat Gestion** (Canton of Valais) has developed a refrigeration and air-conditioning system tailored specifically to industrial and retail environments. This company has for example installed a cooling system that operates on CO₂ rather than ammonia for the new ice rink in the town of Visp.

As a general rule, industry is aware of the potential for improving the energy effectiveness of its installations. Organisations such as the Energy Agency of the Swiss Private Sector (EnAW) offer useful support to in-house technical staff who are keen to turn to specialists for help. In an industrial world where the expected ROI is of the order of two or three to one, the issue lies more in the ability of companies to find arguments that will convince their senior management to introduce changes. In this sense, public programmes such as the ProKilowatt programme (see page 67) can make all the difference.

Lastly, social and political pressure in favour of climate protection, energy effectiveness and renewable energy is mounting. Businesses are getting more involved because they are required to do so by international and national climate and energy policies and also because that is what consumers are demanding. By ensuring their own contributions exceed the minimum requirements laid down by policy, businesses can make a favourable impression on their customers.

EFFICIENCY AT MUNICIPAL OR REGIONAL LEVEL

An energy-efficient town can be defined as one that aims to make optimum use of new technology to improve how it functions and to serve its population better. The participation of society in the choice and/or use of this technology is a key element of this approach.

This section is derived from observations we have made of how energy efficiency works in real-life situations. This is an unconventional approach which simply draws on the inherent characteristics of energy efficiency, which is a complex, interconnected issue that becomes overly simplistic if analysed in terms of discrete units.

As in a thermodynamic evaluation, where the result depends on the limits or boundaries applied to the system being analysed, we propose to add the notion of a geographical limit to our analysis of energy efficiency. What this means in practice is considering energy efficiency at the level of a system, facility, installation, house, district, municipality or region.

This change of dimension in the analysis – or of altitude, as ballooning cleantech pioneer Bertrand Piccard would have it – has a greater impact, since it is the result of optimisation at the highest possible level (ideally at regional level) and not the sum of separate efficiencies in a single system or facility. Distributors and utilities are the perfect candidates for playing this role of aggregator or coordinator, harmonising actions and aligning them with different priorities or strategies in a bid to give them maximum impact.

The result? The initiatives are all in step with the strategic direction set, which encompasses all sectors of application (construction, industry, transport, electrical devices, etc.) and all of the activities carried out in the region (production and distribution of energy, maintenance, raising awareness, mobility plan, etc.). This approach puts working examples centre stage and brings citizens or users on board, making use of the synergies between the different activities.

In this context, it is easier to see why certain regions appear to be ahead of the game when it comes to energy efficiency. **Services industriels de Genève (SIG)**, the utilities company operating in the Geneva area, has developed considerable expertise through its éco21 programme, which greatly benefits users in Switzerland and abroad.

Energy Savers

Now is more than ever the time to maximise our energy saving performance.

In 2022, Swisspower, Services industriels de Genève (SIG) and the Swiss Federal Office of Energy's SwissEnergy programme launched the Energy Savers platform. Its aim is to encourage energy effectiveness by creating links between energy industry stakeholders and public authorities and by supporting practical projects.

The Energy Savers share common values and are working towards the same goals:

- ▶ Giving greater importance to energy saving measures
- ▶ Investing more in energy effectiveness and exploiting its potential more effectively
- ▶ Sharing success stories.

The main target group of the Energy Savers platform is energy suppliers and local and regional authorities. This is because municipalities and cantons play an important role in launching and funding energy effectiveness programmes. Utilities also play their part by implementing the programmes and through their close relationship with their customers.

The platform's ambition is to grow into a strong and meaningful community capable of coming up with practical ways of reducing our dependence on non-renewable energy sources and cutting greenhouse gas emissions.

Utilities, federal government departments, associations, universities, research centres and businesses can join the community at www.energysavers.ch and commit to using energy more effectively.

SEFA, an exemplary vision

This development at regional level is often connected with visionary personalities who have shown the way and launched their organisations with this goal in mind. By way of example, we could mention **Romande Energie**, **Energie 360** and **Altis**, but there are many others too.

An impetus of this kind also arises from the local context, which inspires others to achieve their own goals. The public utility company **Société Electrique des Forces de l'Aubonne (SEFA)** is a prime example of this. In 2020, SEFA celebrated 125 years in business, and it remains a source of inspiration today. Below are excerpts from the book *La SEFA au fil du temps – 125 ans au service de la région (SEFA through the years – 125 years at the service of the region)*:

An innovative company at the service of the region: in 1895, SEFA took on two missions: to build a tram line connecting Allaman, Aubonne and Gimel and to provide the region with electric public lighting. In this period of industrial revolution, the north shore of Lake Geneva was growing fast and had a pressing need for more energy and better transport provision. Now, 125 years later, SEFA has hugely diversified its business, always keeping in step with the emerging needs of local residents. This small company based in Aubonne has become a giant in everything directly or indirectly connected with clean energy, mobility and telecommunications...

A transition, or rather a new revolution: in 2020, it is apparent that only half of the electricity sold on the network is generated in the region. Similarly, the area's mobility and heat production requirements are mostly met by burning fossil fuels. To change the game, SEFA is working in two areas: energy effectiveness (audits, energy renovation)

and new renewable energy sources. SEFA's goal, in the medium to long term, is to return to a situation where the energy supplied and used for mobility is 100% local and renewable. As it was when the company was founded 125 years ago. This will make the area self-sufficient in energy. This is how we can be in control of our energy and guarantee an always-on supply. As a locally based, responsible and committed company, we are thus contributing to a local economy that is sustainable, dependable and that creates jobs. Sometimes, looking back can be a great leap forward. This new direction is a unique opportunity for our region to regain its pioneering role and inspire others to do the same.²⁰

These extracts say a lot about the vision of society. It is a perfect illustration of the impact that a responsible local player can have when it decides to apply its vision across the different sectors in which it operates.

To sum up, efficiency on the scale of a town or region aims quite simply to achieve as much as possible with local resources, whereas efficiency in a sector is concerned only with that sector (industry, transport, etc.) and does not try to exploit potential synergies.

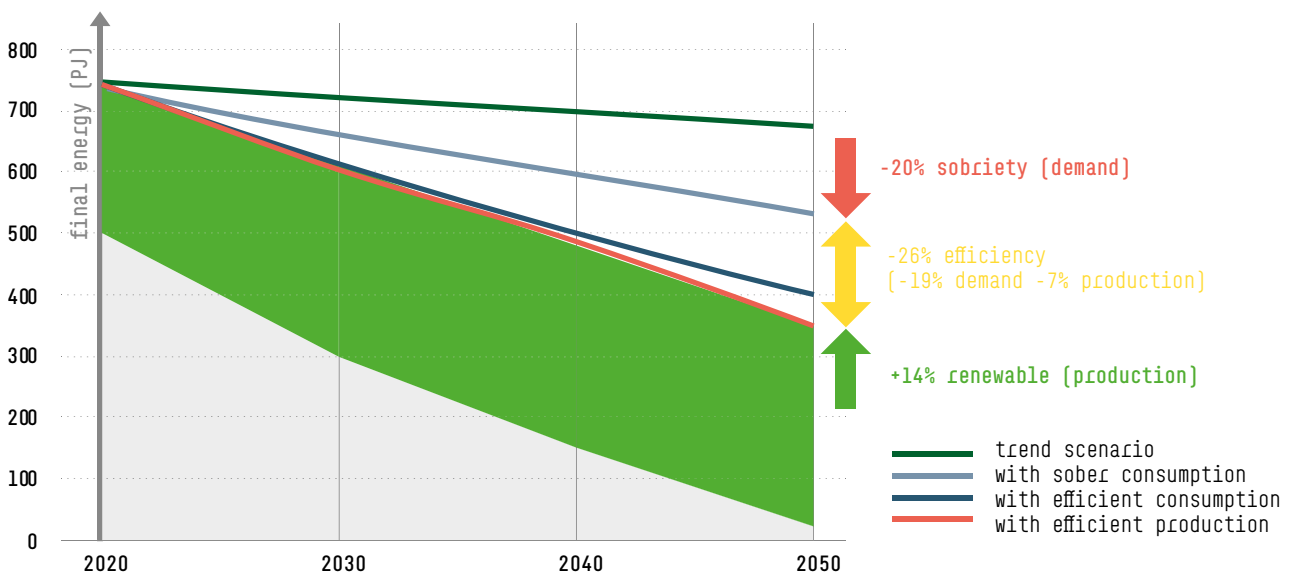
When it comes to planning, companies such as **Sympheny** (Zurich), **Urbio** (Valais) and **Energis** (Bern) use AI-based approaches to fast track their optimised energy planning and supply solutions for buildings, districts and urban areas.

As we have seen, to make a significant impact we need to use a combination of energy efficiency and energy sobriety, as shown by the potential for this estimated by the Négawatt Suisse association in the figure below.

Figure 5 ▼

Source: <https://www.negawattsuisse.org/scenario/>

SCÉNARIO NEGAWATT





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As the official investment promotion agency for Western Switzerland, **GGBa** advises and assists **innovative international companies** in setting up business operations in the region. Our support is tailor-made, free of charge and confidential.

Switzerland is among the global leaders in sustainability and the issue is of clear importance to us as we strive to attract new investors. Our region actively contributes to solving the world's sustainability challenges: the **Oeschger Center for Climate Research** at the University of Bern is one of the most important hubs for international climate research; **CLIMACT**, a joint initiative between EPFL and the University of Lausanne, promotes integrated economic, social and environmental resilience; in Valais, **ALPOLE** studies high-altitude and high-latitude environments, which are sentinels of climate change.



Thomas Bohn

Executive Director, Greater Geneva Bern area (GGBa)
www.ggba-switzerland.ch

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The impact of digital tech on each sector

*We are now well into the digital era, and as Xavier Comtesse so aptly put it in his book *Résilience & innovation – Agir²¹*, the power of data continues to grow. In particular the third and fourth levels of data that he identifies in his approach, namely IoT data (data generated by connected objects) and AI data (the use of AI to analyse both structured and unstructured data).*

We consider the role of digital technology in energy efficiency sufficiently important to dedicate a separate chapter to this topic so that we can discuss the issues involved in more depth.



CONSTRUCTION

Digitalisation is a fundamental trend underlying our society. Buildings and the construction industry are no exception to this. Increasing numbers of digital applications are appearing, improving energy efficiency and providing project owners with a growing amount of data.

Home automation applications enable buildings to provide innovative solutions to their occupants' comfort, safety and communication needs. They can also be used to anticipate how buildings will be operated and estimate energy consumption in different weather conditions and temperatures. However, excessive use of sensors and control modules can also result in more energy being required. There are a great many Swiss businesses active in this field. Here are just a few examples: [digitalSTROMAG](#) (Zurich), [eSMART Technologies](#) (Vaud), [myStrom](#) (Bern), [Paul Vaucher](#) (Vaud), [SDAutomation](#) (Valais), [3ids](#) (Vaud), [CS Domotic](#) (Fribourg), [Atelier R2D2](#) (Valais).

ADJUSTING FACILITY OPERATION LOCALLY TO STABILISE NETWORKS

In office and apartment buildings, it is possible to group together connected large electrical appliances such as heat pumps, water heaters, batteries and even household appliances into balancing zones. This is a way of stabilising the electrical network so that it doesn't have to be extended. Also, electric vehicles can be used as energy storage devices when needed. Companies such as [Hive Power](#) (Ticino) and [Adaptricity](#) (Zurich) have developed offers in this field.

The global challenge, however, lies in data aggregation and the ability to give data a value in the way that companies such as [E-NNQ](#) in Geneva typically do for property management organisations. The other challenge is to manage the micro-grid and energy use of a single building, group of buildings or whole district. This is part of the Valais-based company [Smartsuna](#)'s core business and its concept of the autarkic house or district.

More generally, energy management systems are set to optimise user consumption and storage of locally produced renewable energy, enabling the infrastructure to become integrated into the smart electricity system. By conducting peer-to-peer transactions, prosumers can then sell their excess energy on specialised platforms.

What is a prosumer?

A prosumer is a user of the low-voltage electricity distribution grid with a decentralised electricity production installation that can both inject electricity into and take it from the network at the same connection point.

GUARANTEEING NETWORK STABILITY

According to the Energy Strategy 2050, smart grids guarantee a balance between injected electricity obtained from both conventional and decentralised and renewable energy sources on the one hand, and decentralised consumption on the other hand. Electricity generated in significantly fluctuating quantities dependent on the weather conditions is a new element which, in the medium term, will test these networks' voltage and frequency stability. In this context, a company such as **depsys** (Vaud) provides a way of continually monitoring the real-time status of the network to detect and predict any instability. **Aurora's Grid** (Vaud) offers buffer storage solutions that support the grid when these instabilities appear. The key to guaranteeing the future stability of the grid lies in the installation of smart meters. In practice, when excess electricity is detected, the smart grid activates additional consumption units such as boiler plants to absorb this excess. If there is insufficient electricity, the grid draws more from conventional sources.

In Switzerland, plans are afoot to replace conventional meters with smart meters. According to the Swiss Academy of Engineering Sciences (SATW), smart meter coverage in the country is set to reach 80% by 2028.

On this basis, companies like **Pronoo** (Fribourg) have developed applications that save energy by automating energy data management. **Neolec** (Vaud) provides a solution for energy communication and management between a PV solar power system (photovoltaic panels and batteries) and a building's technical equipment such as its heat pump or water heating system. This enables smart redistribution of the excess PV solar production of buildings or groups of buildings. **Smart-me** (Zug) delivers technology for monitoring, controlling, billing and optimising energy for one or more buildings. Similarly, **BEM** (Monthey) has developed a platform for monitoring, managing and billing self-consumption energy in buildings supplied by solar installations.

Lastly, the Valais-based start-up **ExerGo** facilitates exchanges of waste heat between buildings, developing an efficient urban heating and cooling network that uses CO₂ (see page 80).

BUILDING INFORMATION MODELLING (BIM) – DIGITAL TWINNING

Building information modelling (BIM) is starting to make its presence keenly felt on the construction market in Switzerland. This method has already been used in a large number of major projects. BIM is shaking up habits in the Swiss building industry and many building clients are now keen to apply this method, which has many advantages. BIM is a collaborative way of working based on a 3D digital model. Its many advantages include keeping construction costs down, but it is also used to optimise building operation.

The **Swiss Society of Engineers and Architects (SIA)** describes the BIM method as much more than a way of digitally creating two- or three-dimensional representations of a building, acclaiming it as a useful digital twin that can be used for every possible optimisation simulation. It is based mainly on the idea of preparing the data to suit the project's objectives, using it and making it available to the other project partners. Used correctly, data models can be tailored to different building phases and users. The building model should include as much data as necessary but as little as possible. This kind of modelling is an advantage of the use of digital technology in the construction industry.

ELECTRICAL DEVICES AND DATA CENTRES

Equipment such as PCs, tablets and smartphones are the obvious, visible side of digital technology. But digital tech also includes network infrastructures (land and undersea cables, mobile phone masts, fibre optic cable, etc.) and the data centres that house the thousands of servers on which the data is stored and processed.

In terms of figures for Switzerland, in 2019, the country's data processing centres and server rooms consumed a total of 2.1 TWh of electricity, 3.6% of the nation's total electricity consumption²². This figure is today thought to be around 7 to 8%, equal to the electricity consumption for the whole of the Canton of Vaud. And it could even reach 50% in Switzerland by 2035 if measures are not quickly adopted, according to Monica Gille, managing director of Hewlett Packard Enterprise Suisse Romande²³. The number of planned data centres currently under consideration in Switzerland is set to take consumption even higher than the figure quoted above. It is imperative that Switzerland's cantons start working together with a view to prioritising the use of electricity around the country.

Currently, even though **ProKilowatt** (SFOE's energy efficiency programme) is supporting promotional programmes aimed at replacing data centre facilities with more energy-efficient devices (which have a better PUE, or power usage effectiveness), it is clear that this is not yet the norm on the ground for new installations. The good news is that a few pioneers are leading the way when it comes to energy efficiency in this sector.

HighDC operates an energy-efficient data centre with hosting services with a very low ecological footprint, which will hopefully inspire others to follow suit. In 2019, the Zennaro twins, co-founders of **VNV** in Neuchâtel, opened an environmentally friendly data centre in La Chaux-de-Fonds that boasts server racks with a very low CO2 emission rate. This data centre is located at over 1,000 metres and uses free cooling, benefiting greatly from the cooler air found at this altitude, which has a direct impact on its energy consumption. The company's deliberate choice to concentrate on data storage for companies located in the vicinity also reduces transmission times and therefore also the resulting energy consumption.



SAMUEL PFAFFEN

Head of Business Development, Eniwa AG

The period of cheap energy is over.
Energy is now rated at its true value.

TRANSPORT

Digitalisation and automation mean that the transport sector is in for some fundamental changes. The integrated solutions that will come about with the mobility-as-a-service concept – a way of simplifying the urban experience by offering multiple modes of transport – are set to shape the transport industry of the future. Combining several means of transport (self-service, shared mobility, mobility on demand and conventional modes) will perhaps not be a headache for long.

The ticketing system is already showing the way, thanks to the **Fairtix** app, which automatically calculates the best fare for the user. Similarly, **RouteRank** is a route-finding solution that calculates the optimum routes from A to B with a view to reducing CO2 emissions as much as possible.

Swiss Federal Railways (SBB), Switzerland's leading mobility company, is also developing digital concepts to bring on the mobility of the future. SBB's Swiss Smart Mobility project brings together all of the different mobility offers in a single app, also trying out completely new ways of simplifying journeys and making them more efficient. When it comes to energy efficiency, SBB has developed a software solution that optimises energy consumption by sending information such as when to accelerate and at what rate directly to train drivers, thereby optimising the instantaneous load on the network and route sections concerned.

Working towards a national mobility data infrastructure

In July 2020, the Federal Council gave the go-ahead for a federal mobility data infrastructure (MODI). To make it easier to combine different modes of transport and to tailor mobility offers more effectively, businesses need to obtain data from service providers and the mobility sector.

This national mobility data infrastructure, a public service offered by the federal government, will simplify this exchange of data. It will be introduced gradually as a voluntary scheme.



INDUSTRY

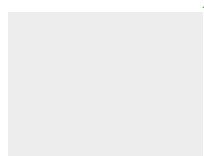
With Industry 4.0, the sector is entering its fourth revolution, characterised by the merging of the Internet and production plants. At each link of the production and supply chains, tools and workstations are constantly communicating via the Internet and virtual networks. Machines, systems and products exchange information, both between each other and externally. By optimising their production tool, manufacturers hope to produce their goods in a quicker, cheaper and more environmentally friendly way.

The main tools required for Industry 4.0 to happen are already here: sensors, automated machines, big data, the Internet of Things, cloud computing... Industry 4.0 is not so much a technological revolution, it is more akin to a complete reorganisation of the method of production, making use of the existing tools and giving greater importance to the network. The aim of this new generation of factories is to give industry a renewed impetus through several means: modernising production, increasing competitiveness and improving positioning to face the challenges of globalisation²⁴.

Through the vast amount of data and sensors it will use, Industry 4.0 is also likely to promote energy efficiency within the industrial fabric. Several businesses have already started down this road, developing specific digital solutions. One of them is **SP Solutions** (Valais), which specialises in managing energy efficiency and automating industrial processes.

Similarly, **Pmax**, also based in Valais, automates the processes of industrial companies, not only making remote access possible but also improving energy efficiency. **Ypsys**, in the Canton of Vaud, offers smart digital solutions for optimising industrial operations, while Geneva-based **Swiss Electricity** advises businesses on their energy market purchases and **Stemys** (Jura) helps companies implement new connected services to optimise the operation of machinery and equipment in the precision-manufacturing industry (see profile on page 78).

In addition to these specialist companies, a whole series of industries have devised efficiency projects, many with the support of the federal **ProKilowatt** programme. Businesses such as Swiss Krono, Hydro Aare, Spühl, Feldschlösschen and MES have introduced measures to improve the energy effectiveness of their production tools. The Zurich-based start-up **SIGMATools** offers a solution designed to optimise the energy effectiveness of production systems, in particular machine tools.



Energy efficiency is the easiest and fastest measure to put into practice in the transition that we simply have to bring about.

OLIVIER ANDRES

BFE Unit Assistant Director, BG Ingénieurs Conseils SA





THE
FUTURE
LIES IN
CLEAN
ENERGY



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sia

schweizerischer ingenieur- und architektenverein
société suisse des ingénieurs et des architectes
società svizzera degli ingegneri e degli architetti
swiss society of engineers and architects

SIA – ensemble pour créer un cadre de vie durable

La Suisse constitue une fine mosaïque culturelle et paysagère densément peuplée. Qualité du territoire et qualité de vie sont étroitement liées. En vertu de quoi l'aménagement de notre cadre de vie doit se faire de manière réfléchie et compétente, avec pour finalité d'en assurer la durabilité. C'est animée de cette conviction que la SIA s'engage sur divers fronts pour défendre les intérêts de ses membres, mettant en lumière – tant auprès du grand public que des milieux professionnels – leur contribution essentielle à une culture du bâti et un patrimoine construit exigeants.

Promouvoir qualité et compétence

Depuis la création de la SIA il y a 180 ans, qualité et compétence imprègnent son action associative et en sont les valeurs cardinales. La SIA est l'association faitière des spécialistes de la construction, des techniques du bâtiment et de l'environnement. Réseau interdisciplinaire fort de plus de 16 000 membres, la SIA œuvre – par le biais de ses groupes professionnels, sections, sociétés spécialisées et de plus de 200 commissions normatives – à préserver et développer le patrimoine construit suisse de manière durable, innovante et porteuse d'avenir.

Outiller les professionnels

Largement appliquées, les règles établies par la SIA en matière de conception et de construction constituent un cadre normatif qui fait référence dans toute la Suisse. La Société en vérifie, révisé et actualise continuellement les contenus, et informe les professionnels quant à leur application concrète. Les normes, cahiers techniques et documentations afférents sont élaborés paritairement par des professionnels SIA, des maîtres de l'ouvrage, des entrepreneurs, des fournisseurs, ainsi que des représentants des autorités et des milieux académiques.

Véhiculer des valeurs fondamentales

Les ingénieurs, architectes, et plus largement les professionnels de la construction façonnent notre espace de vie, endossant une lourde responsabilité. Si le défi est de taille, ils peuvent toutefois compter sur la SIA pour les épauler activement. Dans le même temps, elle pose un cadre éthique à leur activité : respect des principes d'une saine concurrence, exemplarité déontologique, maximisation de la durabilité. Consciente de la diversité géographique, culturelle et linguistique de la Suisse, la Société tient compte de ces spécificités dans la conduite de ses actions. La SIA promeut la formation continue auprès de ses membres et défend un niveau de qualification élevé, reconnu à l'international.

Représenter, conseiller

La SIA se met résolument au service de ses membres. Elle les soutient et défend leurs intérêts. Les juristes de la Société prodiguent des conseils notamment en matière de droit de la construction, passation des marchés, droit d'auteur, droit du travail, droit des assurances sociales et concurrence. Les bureaux membres peuvent s'adresser à la SIA pour bénéficier d'informations et de prestations sur-mesure touchant aux ressources humaines, aux finances, à l'organisation, au marketing à l'acquisition clients et aux contrats. Le service de formation continue SIA inForm propose un large choix de cours dans les domaines de l'ingénierie et de l'architecture. Qui plus

est, les sociétés spécialisées, sections et commissions de la SIA organisent régulièrement des séances d'information et des cours de perfectionnement afin d'éclairer des sujets spécifiques. Le Réseau femme et SIA met en relation des femmes architectes et des ingénieures, représente leurs intérêts et promeut les métiers techniques auprès des jeunes filles.

Favoriser l'interdisciplinarité

La rapidité des transformations technologiques, couplée à des défis écologiques, sociétaux et économiques majeurs oblige le secteur de la construction à s'adapter à un contexte en constante évolution. Face aux problématiques qui se dessinent, la SIA table sur des partenariats performants, compétents et fondés sur l'interdisciplinarité. Que ce soit au travers de ses quatre groupes professionnels – Architecture, Génie civil, Technique et Environnement –, de ses sociétés spécialisées, de ses commissions ou encore de ses sections, la SIA décroïsonne les spécialités, cultures et générations pour favoriser une collaboration transversale.

Agir sur différents fronts

Les membres de la SIA se regroupent au sein de 18 sections régionales et d'une section internationale. Les sections régionales entretiennent le dialogue avec les autorités locales, les milieux politiques et académiques et travaillent sur des problématiques à l'échelle de leur région, veillant à promouvoir les valeurs de la SIA en adéquation avec les particularités culturelles cantonales. La section SIA International épaulé les membres dans le cadre de leurs activités transfrontalières et contribue à leur visibilité.

Les quatre groupes professionnels de la SIA s'engagent pour défendre les intérêts des corps de métier qu'ils représentent ainsi que pour préserver et améliorer leur reconnaissance sociale. À l'écoute de leurs membres, ils traitent de leurs préoccupations, s'engageant notamment dans le domaine politique et celui de la formation professionnelle.

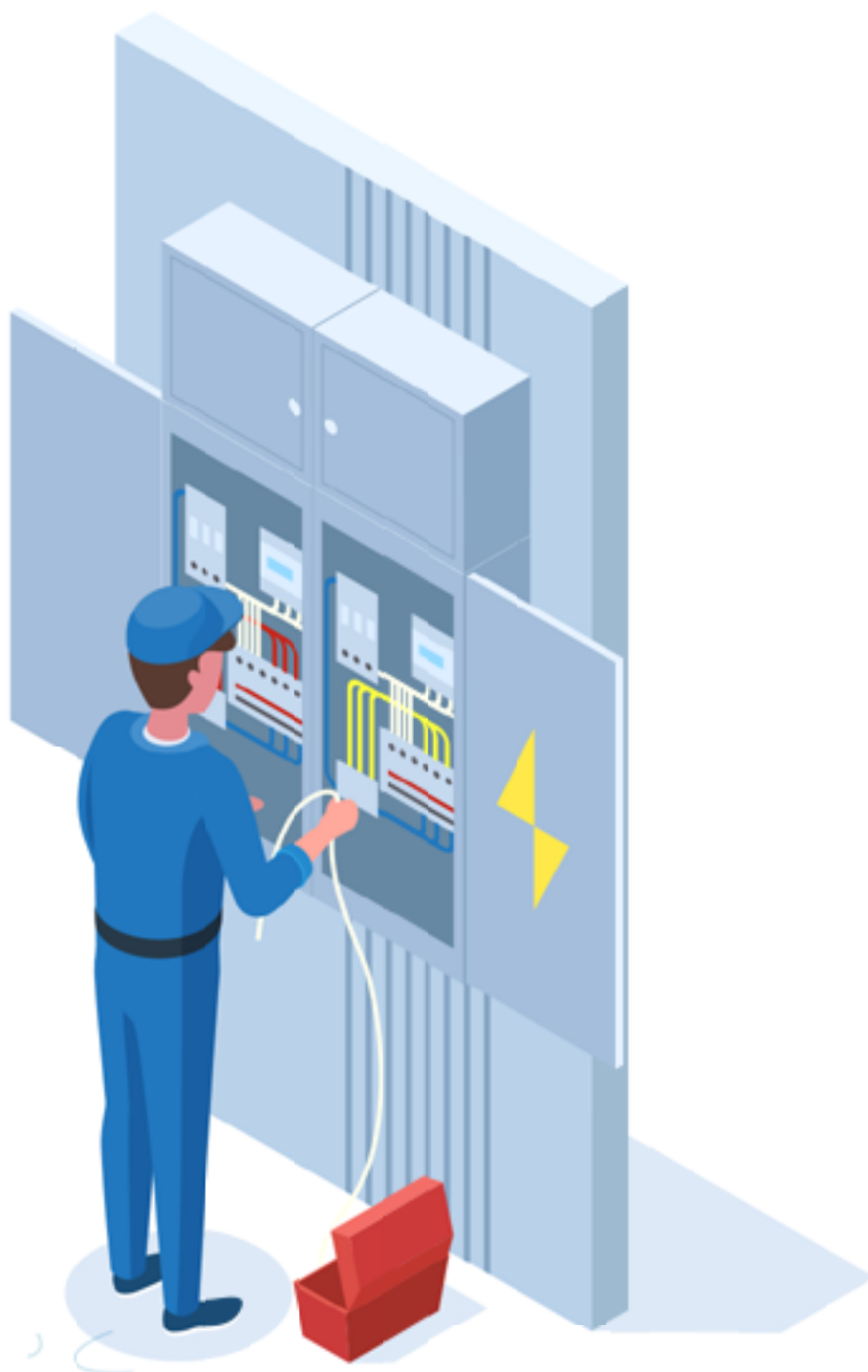
Les 24 sociétés spécialisées de la SIA couvrent des domaines d'expertise spécifiques, et constituent des plateformes d'échange autour des avancées techniques et des nouvelles connaissances acquises dans leurs spécialités. La SIA encourage les activités menées par ces associations indépendantes ; elle leur assure son appui en matière de relations publiques et d'administration et prend part à leurs projets.

Mettre les savoirs en réseau

Si la SIA est la représentante de ses membres, ceux-ci en sont le corps constituant. Ses groupes professionnels, commissions, sociétés spécialisées et autres organes vivent en effet de l'implication – généralement bénévole – de professionnels SIA. Cet engagement mutuel a non seulement permis de grandes avancées dans le secteur de la conception et de la construction, mais aussi l'émergence d'un important bassin de savoirs. Ce réseau de connaissances interdisciplinaires constitue la base solide sur laquelle la SIA s'appuie dans l'accomplissement de sa mission : contribuer aujourd'hui comme demain à un cadre de vie de qualité, durable et porteur d'avenir.

www.sia.ch

The energy efficiency value chain and players in Switzerland



GENERIC VALUE CHAIN

Because energy efficiency applies across all sectors of the economy, we thought it would be helpful to present a generic value chain, identifying the links relating to the different sectors or applications involved (transport/mobility, the building industry, etc.).

The value chain is outlined in Figure 6. It ranges from the materials used through to complete installations and includes the various subsystems (structural components, burners, sensors, etc.) required to make the finished product or build the complete facility (such as a boiler plant, heat pump, machine tool and EV charging points).

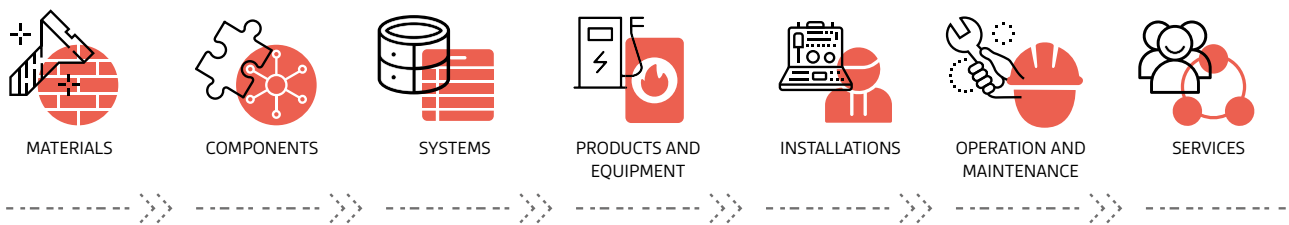


Figure 6 ▲
Energy efficiency generic value chain (source: CleantechAlps 2022)

The two last links in the value chain cover, respectively: management and maintenance operations for installations and services platforms (AI, diagnostics, etc.), and services. The services link includes all service providers such as consultants, architects and/or engineering firms with specialist knowledge or expertise in energy efficiency. The financial organisations and banks involved also come under this last link in the chain.

By showing the way the different players are spread along this value chain, we can measure the density of the economic fabric and identify the areas of expertise available in the ecosystem. We present the results of this analysis in the following pages.

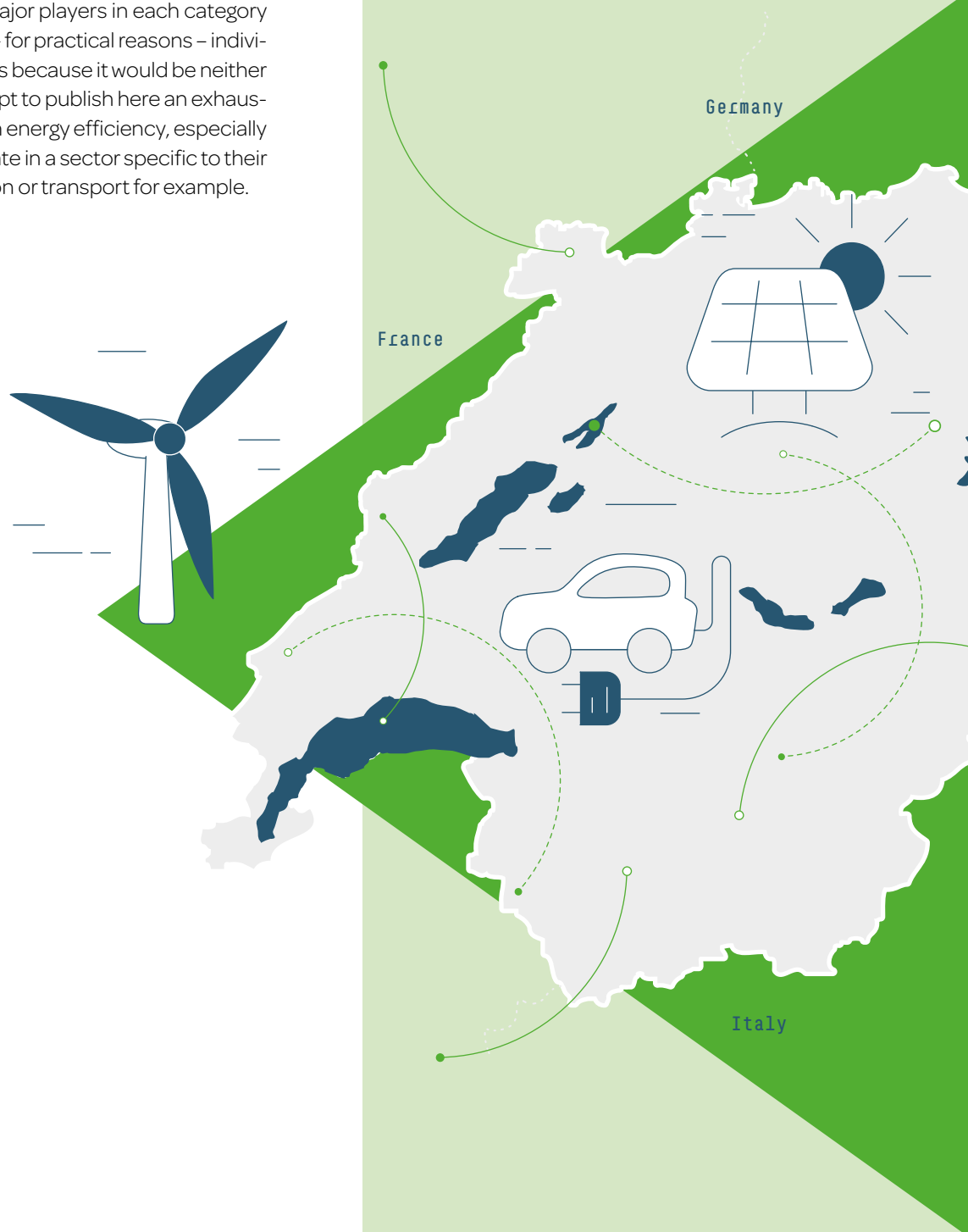
MARTIN PATEL
Professor, University of Geneva



Decarbonising more quickly inevitably calls for faster energy efficiency improvement in order to realize more economical, future-proof systems.

THE ENERGY EFFICIENCY PLAYERS IN SWITZERLAND

Here, we present a systemic overview of the Swiss energy efficiency ecosystem. This overview describes the categories of players making up this ecosystem in the different sectors of application. The major players in each category are explicitly mentioned, but – for practical reasons – individual businesses are not. This is because it would be neither relevant nor realistic to attempt to publish here an exhaustive list of companies active in energy efficiency, especially since these companies operate in a sector specific to their business, such as construction or transport for example.



INCUBATORS AND TECHNOLOGY PARKS

- › BlueFactory
- › Microcity
- › Energypolis
- › Impact Hubs (ZH, BE, GE, VD, NE, ...)
- › TechnoParks (ZH, LU, AG, ...)
- › BlueBox

ASSOCIATIONS & FOUNDATIONS

- › swissesco
- › négaWatt
- › nomads
- › AEnEC
- › Reffnet
- › swisscleantech
- › aee suisse
- › The Ark
- › energie-cluster
- › Swissmem
- › S.A.F.E.

SWISS CONFEDERATION

- › Swiss Federal Office of Energy (SFOE)
- › Federal Office for the Environment (FOEN)
- › State Secretariat for Economic Affairs (SECO)
- › Innosuisse – Swiss Innovation Agency
- › State Secretariat for Education, Research and Innovation (SERI)
- › Federal Office of Transport (FOT)

ACADEMIC INSTITUTIONS

- › EPFL/ETHZ
- › Universities
- › Universities of Applied Sciences (UAS)
- › EMPA
- › PSI
- › CSEM

MAJOR SUPPORT PROGRAMS

- › Eco21
- › SWEET
- › Building Programme
- › ProKilowatt
- › PEIK / AgriPeik

INDUSTRY

- › SMEs
- › Start-ups
- › Corporates
- › Engineering practices
- › Utilities

AMBASSADOR PROJECTS

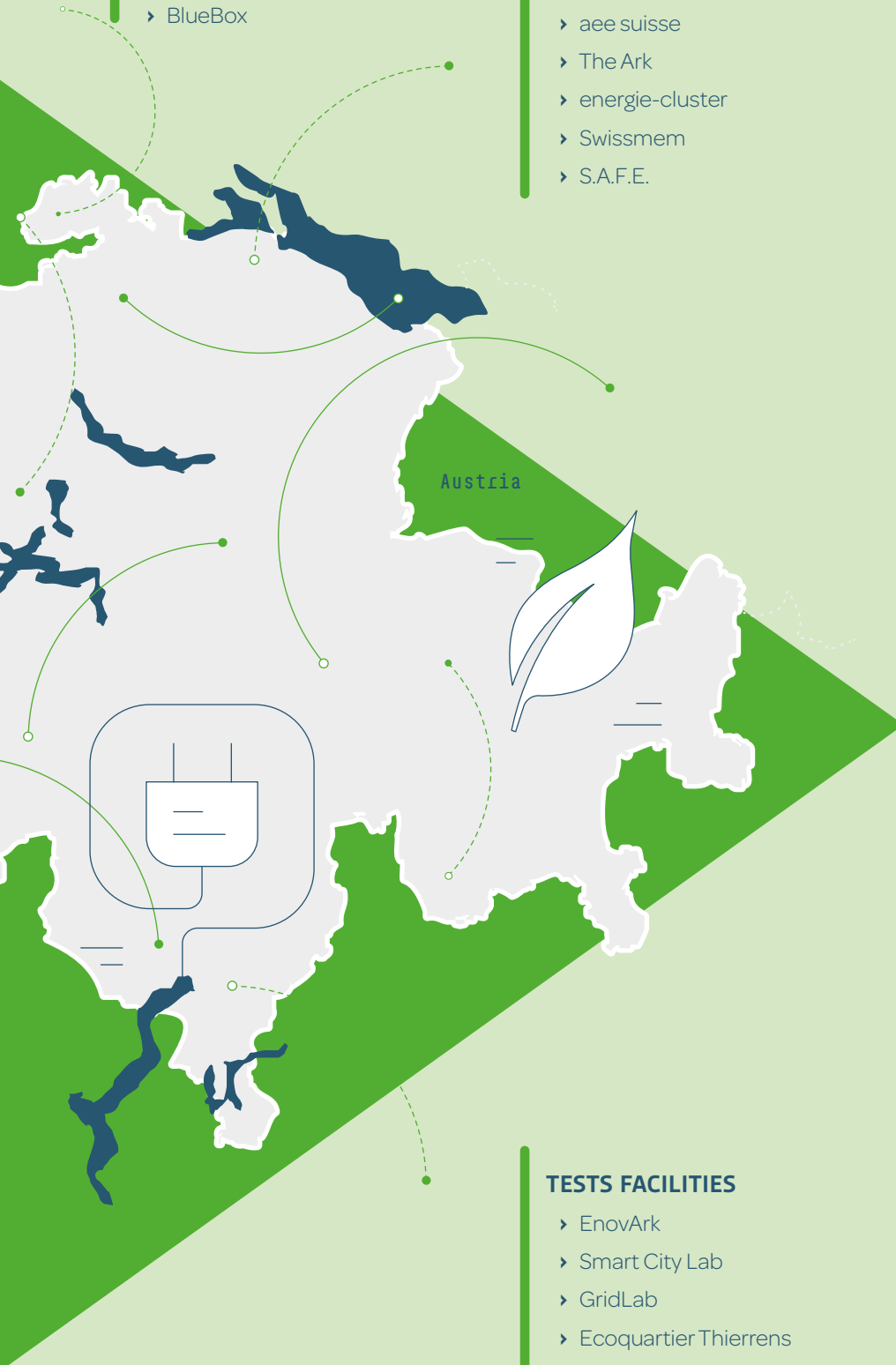
- › Energy Savers Platform
- › Softcar
- › H55
- › MobyFly
- › ZESST/Almatech

CONNECTORS

- › ÖBU
- › CleantechAlps

TESTS FACILITIES

- › EnovArk
- › Smart City Lab
- › GridLab
- › Ecoquartier Thierrens
- › Smartlab
- › iHomeLab
- › Mobility Lab
- › Smart Living Lab



A FEW FIGURES AND TRENDS

What makes up the economic fabric in relation to energy efficiency? This question comes up again and again, and the purpose of this section is to provide answers in terms of the sector of application (construction, transport, industry, etc.), the size of the businesses concerned and how they are distributed along the value chain. Please remember that this analysis applies mainly to the private sector.

The majority of the businesses concerned operate in the construction sector. This is the most attractive sector due to its volume and the scale effect it represents (Figure 7).

DISTRIBUTION OF PLAYERS BY SECTOR OF APPLICATION

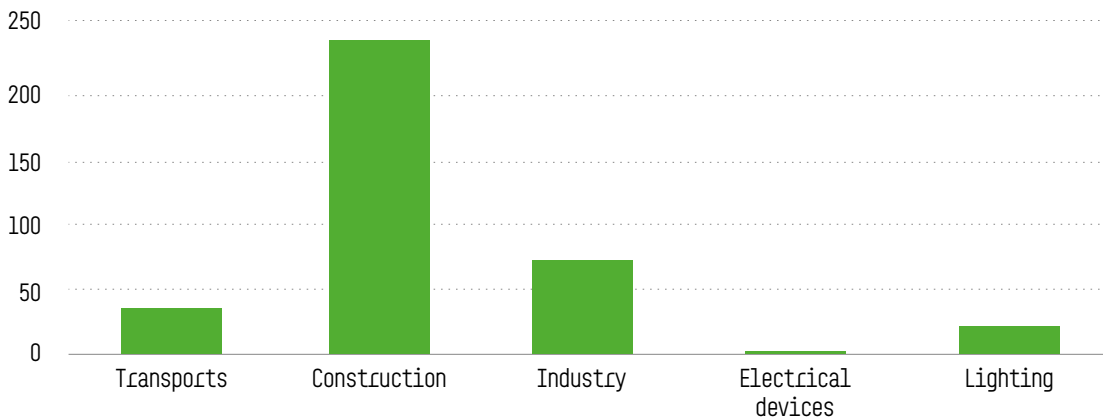


Figure 7 ▲
Distribution of players by sector of application



Figure 8 provides a more detailed analysis of the types of companies in each of these sectors and highlights the importance of the technology element, which is demonstrated by the dominance of start-ups. Note, however, the shared predominance of start-ups, SMEs and engineering firms in the construction sector. This underlines how these diverse business types work together to deliver an appropriate solution. It is also interesting to note that all business types without exception are more active in the construction sector.

DISTRIBUTION OF PLAYERS BY SECTOR AND BUSINESS TYPE

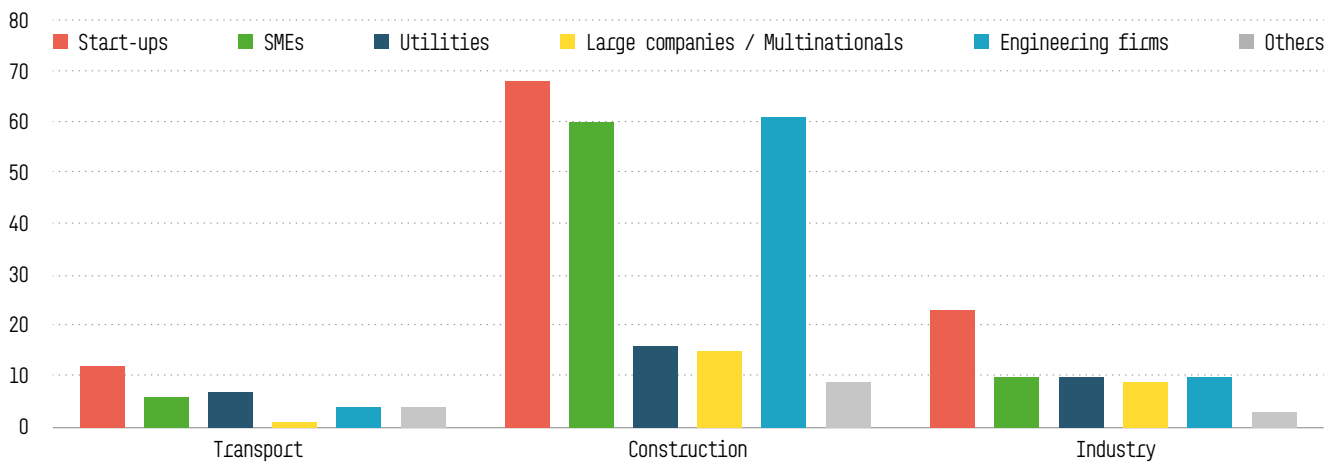


Figure 8 ▲
Distribution of players by sector and business type

Looking at the distribution of players along the energy efficiency generic value chain is highly instructive (Figure 9 on the following page). It is clear that the greatest number of players is in the services sector. This type of activity is provided mainly by consultants, engineering firms and architects. In addition, some SMEs also offer advice to individuals on choosing the appropriate equipment.

This figure also shows that the equipment installation link is the third-biggest. The link representing the second-highest number of companies is the one offering finished products or ready-to-use equipment such as electrical devices and digital platforms.

DISTRIBUTION OF PLAYERS ALONG THE VALUE CHAIN

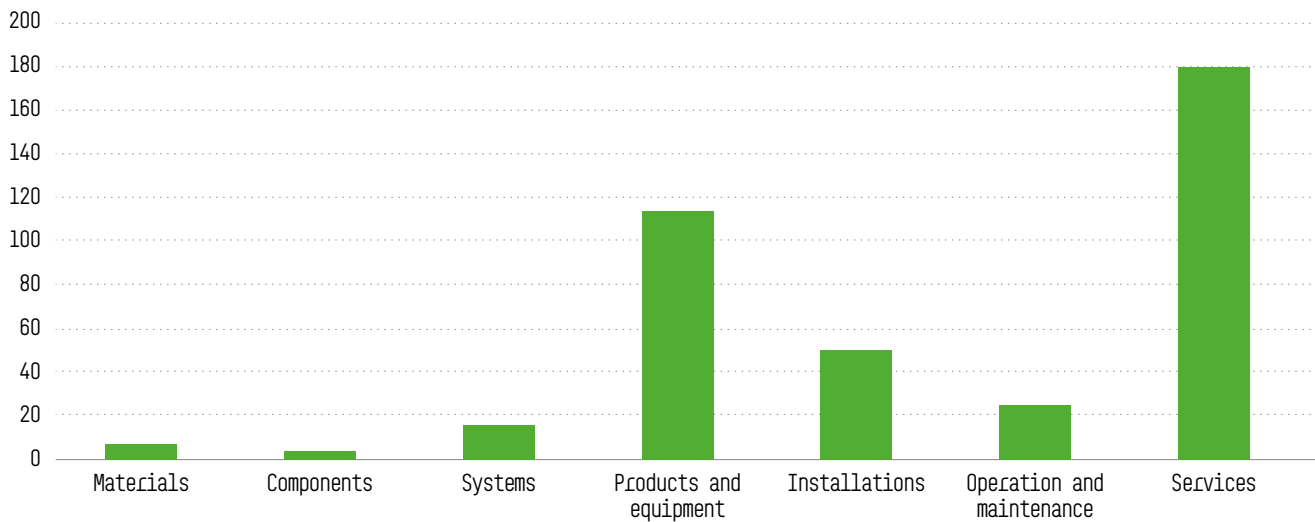


Figure 9 ▲
Distribution of players along the value chain

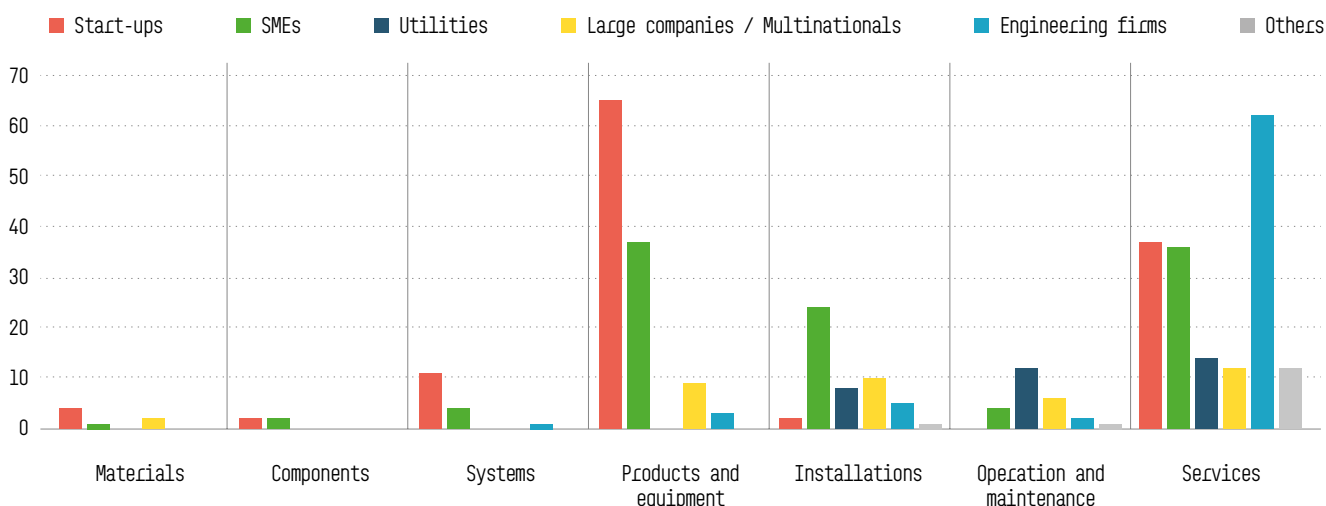
A more detailed analysis of the types of companies in each of the links, as shown in Figure 10, is very informative. As expected, we find confirmation of the predominance of engineering firms. This category includes all consultancy services, including those provided by architectural firms. Also apparent is the large number of SMEs offering advice on selecting the appropriate equipment, alongside the many start-ups. Many start-ups offer services based on operating digital platforms for activities such as monitoring, diagnostics and data aggregation.

In the second-largest link in terms of the number of players (finished products and ready-to-use equipment), it is start-ups that dominate, with SMEs coming second. This underlines the importance of applying technology to energy efficiency, in particular digital and data processing technologies. It is no surprise that SMEs are greatest in number when it comes to activities related to installing equipment – the third-biggest link in the value chain in terms of the number of players.

It is also worth noting the leading position of utilities in the link covering the operation and maintenance of installations.

Figure 10 ▼
Distribution by business type of the players along the value chain

DISTRIBUTION BY BUSINESS TYPE OF THE PLAYERS ALONG THE VALUE CHAIN



WHAT ABOUT DIGITAL TECHNOLOGY?

The importance of digital technology is apparent in the above figures, and this is clearly a component of energy efficiency applications. This observation led us to look at this aspect in more detail. Around 40% of the products or services offered by the energy efficiency players include a significant digital component.

By going into more detail in our analysis (Figure 11), we can see that more than 50% of start-ups have built their offer around digital technology, whereas only 10% of consultants have done so. The good news is that, for SMEs, this figure is 20%. There is much room for improvement, however. One slightly surprising finding is the digitalisation rate among utilities, with around 40% of them relying heavily on digital tech. This figure does, however, mainly apply to large utilities, since our analysis did not include small companies operating at municipal level.

PERCENTAGE OF PLAYERS OFFERING A SERVICE OR PRODUCT WITH A SIGNIFICANT DIGITAL TECHNOLOGY COMPONENT, BY BUSINESS TYPE

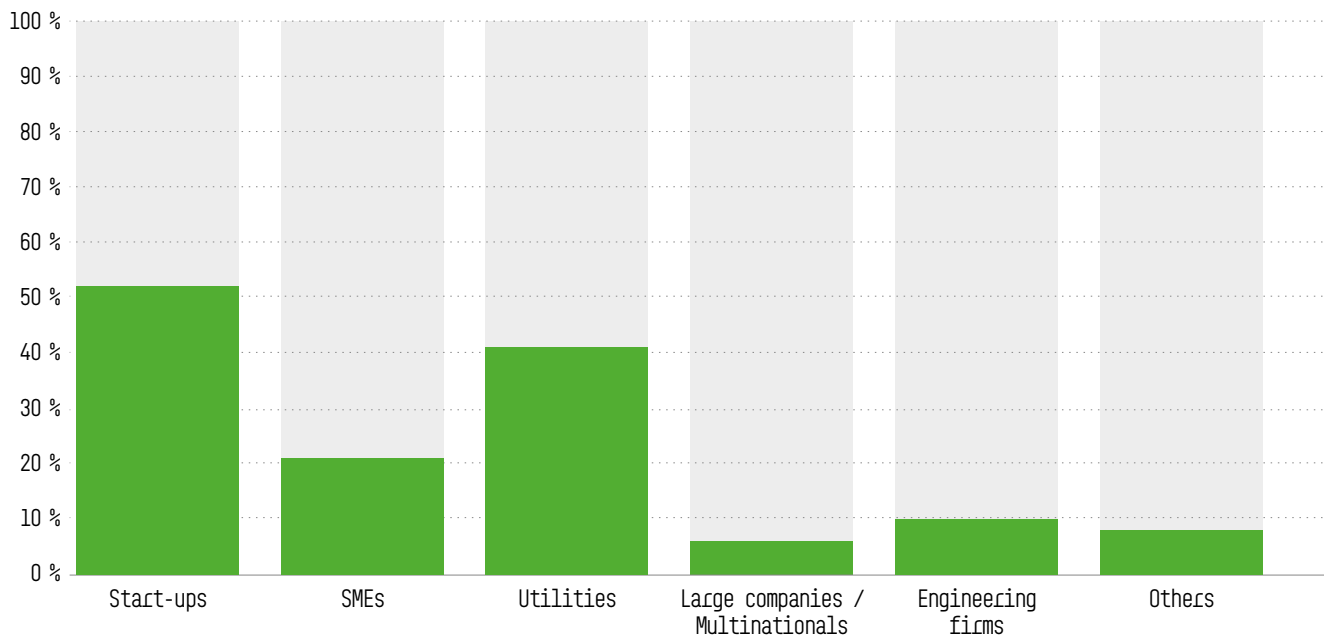


Figure 11 ▲
Percentage of players offering a service or product with a significant digital technology component, by business type

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Federal Office for the Environment FOEN



SPONSORS



Support programmes

There is a lot of support available in Switzerland to individuals and businesses keen to improve their energy efficiency. Here, we list the main programmes currently available.



BUILDINGS PROGRAMME

The Buildings Programme from the federal government and cantons provides a grant for property owners all over Switzerland to improve the thermal insulation of their home or building. In addition, most cantons also support those wishing to switch to a heating installation that makes use of a renewable energy source, such as a heat pump, solar installation or wood-fired system.

www.suisseenergie.ch/page/fr-ch/programme-batiments

PROKILOWATT

ProKilowatt is a programme run by the Swiss Federal Office of Energy to support electricity-effectiveness measures aimed at reducing electricity consumption. The grants available through this scheme, which can cover as much as 30% of the investment cost, are designed to encourage users to replace old installations and invest in more energy-efficient technology. ProKilowatt supports the replacement of old installations in a variety of fields including lighting, refrigeration, motors, pumps, ventilation, industrial processes, municipal facilities and others (including electrical cables in industry and hydroelectric plants).

www.prokw.ch

PEIK & AGRYPEIK

The PEIK programme supports SMEs in energy matters. PEIK advisers help SMEs decide on, plan and implement energy-saving projects.

The agriPEIK project, which came about through a collaboration between AgroCleanTech, the cantons of western Switzerland and SwissEnergy, was set up to help farmers reduce their direct energy consumption (electricity, fuel and heating), enabling them to carry out an energy audit of their farm.

www.peik.ch

ENERGY STRATEGY FOR PUBLIC TRANSPORT 2050 – ESPT 2050²⁵

The Federal Office of Transport (FOT) has been tasked with putting into practice the Federal Council's new energy strategy in its area of competence. To this end, the FOT has launched its Energy Strategy for Public Transport 2050 programme (ESPT 2050).

The FOT's strategy has set the following goals:

- ▶ Increasing energy efficiency: depending on the mode of transport and its associated constraints, energy efficiency is to be improved by between 10 and 50% by 2050.
- ▶ Opting out of nuclear energy: all electricity used for traction and infrastructures (lighting, electrical supply for signalling, points, buildings, etc.) will be from renewable sources.
- ▶ Reducing CO₂ emissions: consumption of fossil fuels by vehicles, buildings and infrastructures will be reduced.
- ▶ Increasing production of renewable energy: production of energy from renewable sources will be increased to replace nuclear power and cover peak load periods.

<https://www.bav.admin.ch/bav/fr/home/themes-a-z/environnement/setp2050/programme.html>

PROGRAMMES RUN BY THE CANTONS AND FEDERAL GOVERNMENT

Today, Switzerland offers a multitude of incentive programmes at different levels of government providing support that is important, or even decisive, in making the necessary energy investments. Because there are so many different incentive programmes, with in some cases significant variations locally, the situation is sometimes referred to as a 'jungle of subsidies' which can be confusing.

The portal www.energiefranken.ch provides an overview of the various financial support options available for different projects.

On its website <https://enaw.ch/fr/foerdermittel/>, the Energy Agency of the Swiss Private Sector (EnAW) also presents the different financial support packages on offer at cantonal and municipal level.

OTHER SUPPORT AVAILABLE

THE KLIK FOUNDATION

The KliK Foundation works on behalf of oil companies, fulfilling their legal obligation to offset part of their CO₂ emissions from fossil fuels (petrol, diesel and others) in Switzerland. To this end, the KliK Foundation provides financial support for projects and programmes designed to reduce greenhouse gas emissions. .

www.klik.ch

THE SWISS CLIMATE FOUNDATION

The Swiss Climate Foundation is a voluntary initiative by business for business. It works with financial backers in the form of corporate partners to award up to CHF 3 million in funding annually. The Foundation supports SMEs that either save energy themselves or develop climate-friendly products. The funds distributed by the Swiss Climate Foundation are sourced from more than 25 partner businesses, mainly banks and insurance companies.

www.climatefoundation.ch

THE SIG-ÉCO21 PROGRAMME

The SIG-éco21 programme is an initiative launched by the utilities company Services industriels de Genève (SIG) in 2007. It helps people and organisations in Geneva to reduce their energy consumption and CO₂ emissions. The programme offers different kinds of support, to individuals (for example when replacing a hot water or heating system, carrying out an energy and environmental audit, etc.), property management organisations and owners, businesses, local authorities and also the self-employed.

<https://ww2.sig-ge.ch/a-propos-de-sig/nous-connaître/le-programme-eco21>

TARGET AGREEMENTS

Target agreements are concluded between the federal government and businesses. They are designed to improve the business's energy effectiveness and reduce its CO₂ emissions at the same time. Target agreements are compulsory for major consumers (businesses that consume more than 5 GWh of heat energy per year or more than 0.5 GWh of electricity per year), but they can also be made by other businesses on a voluntary basis. The targets are drawn up and examined in close collaboration with the business concerned, the federal government, and the organisations Act (www.act-schweiz.ch) and EnAW (www.enaw.ch) acting on behalf of the federal government. These two organisations advise businesses on energy efficiency improvement measures and the procedure involved in drawing up a target agreement. They also provide standardised instruments to calculate the required measures, draw up the target agreement and monitor the results.

www.act-schweiz.ch

www.enaw.ch



IMPACT

IMPACT is the crowdfunding platform of the utilities company Services industriels de Genève (SIG), launched in 2018. Through IMPACT, anyone can support Geneva-based energy efficiency or new renewable energy projects in exchange for some attractive benefits. This platform is evidence of SIG's commitment to the energy transition, providing a way for anyone to contribute.

<https://www.sig-impact.ch>



Energy efficiency and sustainability: at the heart of what we do at Raiffeisen

What does sustainability mean to Raiffeisen?

« Sustainability is part of Raiffeisen's DNA. It is one of the bank's four values, along with proximity, credibility and entrepreneurship. For example, we offer our clients an energy audit of their properties, providing advice that includes an overview of their renewable energy options. In my opinion, this service offers our clients real added value. »

► **PAULO FONTES**

Private client advisor,
Raiffeisen Bank, Genève Ouest-Meyrin



What is our business model?

« Raiffeisen is keen to be in the vanguard of the companies that are working hard to improve sustainability and energy efficiency in our society. Our cooperative way of doing business, focused on Switzerland, is very much in step with the concepts of sustainability, proximity and entrepreneurship. »

► **KEVIN CALAME**

Corporate client advisor,
Raiffeisen Bank, Montagnes Neuchâtelaises

What help do we offer real-estate owners?

« We educate our clients about ways of improving the energy efficiency and reducing the CO2 emissions of their real estate. Simply by logging on to our online platform RaiffeisenCasa, a property owner can get an energy assessment of their property, apply for a CECB energy efficiency certificate, or calculate their energy consumption. »

► **RUBEN ARAUJO ESTEVES**

Corporate client advisor,
Raiffeisen Bank, Sierre et Région



Why do we promote sustainable investments?

« At Raiffeisen, we offer an extensive range of ecological, social and ethical investment products. This enables our clients not only to invest in company shares or corporate bonds that meet certain sustainability criteria, but also to acquire a share of a wide range of sustainable funds. With the Raiffeisen Futura fund, we directly and indirectly support the ecological transition and efforts to improve energy efficiency. »

► **KEVIN RAMOS ESTEVES**

Corporate client advisor,
Raiffeisen Bank, Moléson



Quelle croissance attendre pour les placements durables ?

« Sustainable investments are the future. Our figures demonstrate a growing appetite for this kind of investment. In 2019, sustainable investments totalled CHF 1,163.3 billion, and in 2021 they amounted to CHF 1,982.7 billion. This investor behaviour in favour of sustainability is bound to have a tangible effect on how businesses produce their goods and services in the future. »

► **PAULINE BORLAT**

Customer support agent,
Raiffeisen Bank, Gros-de-Vaud

What other practical steps have we taken?

« At Raiffeisen, we run campaigns offering our customers a thermal image of their premises for a special price, enabling them to identify weak points in their energy set-up. SwissEnergy's 'chauffez renouvelable' programme, which is supported by Raiffeisen, also gives owners the help they need when replacing their heating system with one that runs on renewable energy. »

► **NICOLAS LACHAT**

Client investment adviser,
Raiffeisen Bank, Ajoie



Summary

It is clear that energy efficiency is an essential part of the energy transition, and this special report demonstrates that fact. And it is increasingly gaining ground, in Switzerland as elsewhere. As we have seen in the pages of this study, a host of solutions already exist, and the challenge now is to ensure that users of all kinds buy into the process.

One very important aspect of this is applying energy efficiency at district, municipal, city or regional level. Regional energy efficiency is simply a question of doing as much as possible with local resources, whereas energy efficiency in one sector is about efficiency within that sector (such as industry or transport) without attempting to exploit potential synergies between sectors. This is common sense: using the available resources to create a greater impact. This approach has a promising potential for accelerating the energy transition.

We are clearly now in the digital age, and few would disagree that without the major developments achieved in recent years in the Internet of Things and AI in particular, energy efficiency measures would not have the impact they do today.

This special report also points out the links in the value chain where digital technology has the greatest impact and adds the most value. This tells us much about the types of professions and expertise we should be developing through training and education. Let us not forget that every sector relevant to the energy transition is woefully short of labour in every applicable profession.

If it is to meet the goals of the Energy Strategy 2050, the energy transition is in need of additional energy efficiency and sobriety measures. Understanding consumer behaviour and what drives this behaviour are key aspects of our ability to exploit the potential of energy sobriety. The human factor and consumer behaviour are clearly the common link that determines whether the federal government will achieve its energy and climate strategy goals.

The boundary between the federal government's Energy Strategy 2050 and its 2050 climate strategy (net zero emissions) is a tenuous one. Attempts to optimise energy use can result in initiatives that do not necessarily chime with ways of reducing CO2 emissions. The path to transition is thus far from clear, but cleantech at least provides solutions to the constraints inherent in these strategies.

Portfolio of business and project profiles

We thought it would be a good idea to shine a light on some of them, mostly innovative start-ups and SMEs. You can read about the expertise and pioneering developments they have introduced in the company profiles we present in the following pages.





Welcome to the Smart City

Novaccess develops applications for the Industrial Internet of Things. Its on-board systems have met with great success, particularly in smart public lighting.

A spin-off of the School of Management and Engineering Vaud (HEIG-VD) established in 2011, Novaccess has developed one of the most complete public lighting management applications in Europe – a hardware and software solution that came about through a partnership with the utilities company Services industriels de Lausanne and the Swiss innovation agency Innosuisse.

Novaccess's solution works by installing control systems inside street lights so that they can then be operated remotely from a central point, to carry out maintenance and change the lighting configuration for example. "Our system also incorporates a localised smart dimming feature that can alter the light level to take account of the time, vehicle flow and movement of pedestrians," explains CEO Hervé Dedieu. The result? A potential for spectacular energy savings. By adopting this system (and previously other similar systems) and by switching from sodium to LED technology, the town of Yverdon-les-Bains has reduced the electricity consumption of its public lighting by 85%.

20 EARLY ADOPTERS

Some 20 municipalities in western Switzerland have already adopted this solution, dubbed NovaLight, with Novaccess winning most of the calls for tender for public lighting issued in western Switzerland. "Our sector-spe-

cific approach enables us to respond in a highly targeted way to the municipalities' requirements," says Dedieu. The company made its name by working directly with local councils, but it now intends to step up a gear, offering its technology to players in the industrial services sector. Novaccess has set its sights on German-speaking Switzerland, along with Europe, Africa and the Middle East. With fewer than 10 serious competitors across Europe, for the future, the company has decided to focus mainly on markets with a high kilowatt cost – Germany and Italy, among others.

To fund this growth, Novaccess raised CHF 3 million from the Zurich-based Technology Fund in 2020, plus an additional CHF 1.8 million from its existing investors. It is also seeking capital investment from manufacturers. The company has also been working for several years with the infrastructure development company BMTC in Dubai to design and roll out the world's most advanced fire safety system. In addition, it has developed a road traffic management application and is working towards creating a global Smart City platform featuring other management applications for use by medium-sized municipalities and/or their utilities.



Software to improve the efficiency of Li-ion batteries

The software developed by Aurora's Grid is designed to optimise the management of lithium-ion batteries. This start-up uses electrochemical ageing modelling to achieve better battery sizing and promises, among other things, to extend battery life.

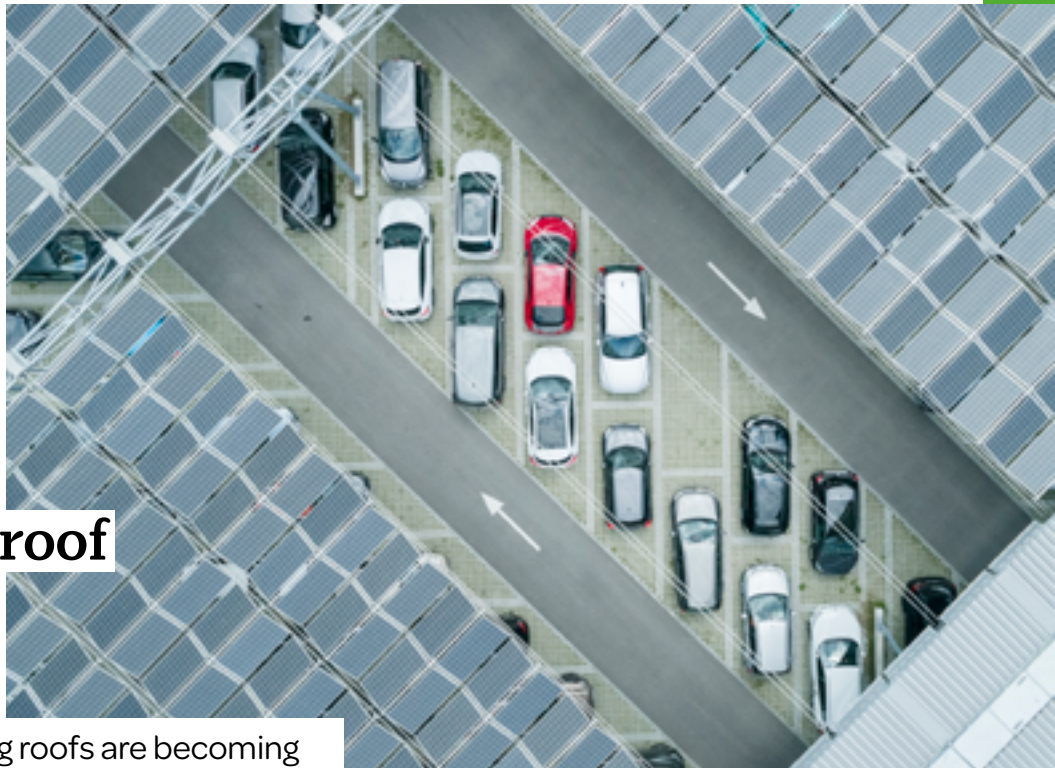
Forty percent. That is the increase in battery life that Aurora's Grid is promising users – both individuals and businesses – who install its Li-ion battery software. Their solution is to store energy produced from renewable sources and draw power from the battery at a slow rate when these renewable sources aren't producing enough energy. This approach extends the life of the batteries. "We guarantee smart charging and efficient discharging," explains Aurora's Grid CEO Dimitri Torregrossa. "Instead of using energy from the grid, the idea is to store green energy in batteries and then re-inject it in a controlled way at the most appropriate time."

This software also makes it possible to assign a Li-ion battery to several powering requirements at the same time – self-consumption, charging an electric vehicle and selling energy to the grid – in a management system that reduces the initial investment costs. Torregrossa explains another advantage of the management system: "Using our software, it is possible to check at any time the nature of the energy that is stored and then re-injected. It's a sort of guarantee of origin."

FROM START-UP TO SCALE-UP

The name of this start-up was not chosen at random. Aurora, or the dawn, when the sun's rays first appear, is very short. The company is deliberately drawing a parallel here, their way of saying that although the energy transition is going to take a long time to complete, we have to start making the necessary changes right now. And according to Torregrossa, their solution comes at just the right time for the market: neither too early nor too late.

After four years of development by five full-time employees, pilot projects carried out with the energy storage company Leclanché, the utilities company Services industriels de Lausanne and the motor manufacturer Groupe PSA, plus licence sales to energy companies such as Romande Energie, this start-up is now ready to grow and join the ranks of the scale-ups. Aurora's Grid has also enjoyed significant backing from western Switzerland's innovation support ecosystem, helped by bodies such as Innovaud and the experts in its network.



A folding solar roof

While solar panels on building roofs are becoming relatively commonplace, folding infrastructures that can be extended or retracted at will could seem rather futuristic. Not to dhp technology, however, which has already developed this innovative solution.

The infrastructures to which the photovoltaic panels are fixed are usually structurally and architecturally solid. However, this is not always the case, especially when it comes to covering industrial structures or parking areas with solar panels. Here, the solar installation needs to be both light and flexible. This is precisely what dhp technology from Graubünden offers with its innovative retractable photovoltaic roof. This ingenious approach enables the panels to be folded back at will, for instance when severe weather conditions could damage the system, or maintenance or repair work is required on site. The weather algorithm that comes with the infrastructure even retracts it automatically when bad weather is forecast.

SELF-SUFFICIENCY AND COMFORT

After completing seven projects in Switzerland with a generated power of between 200 and 800 kWp – mostly above wastewater treatment plants, but also one above a parking area – the company is planning further installations in Germany and Austria, where the system is in great demand. There is also interest from further afield, from the Netherlands, the United Kingdom, Spain, Italy and even Asia. But for now dhp technology is concentrating on expansion in its home market and its close neighbours.

The company is pleased to note that feedback from its projects indicates an increase in self-sufficiency of around 30%. "Our solar roofs also offer a comfort advantage because they provide shade for workers moving around the site," says Managing Partner Gian Andri Diem. The technology is also entirely of the moment: not only does it boost the image of the businesses that use it but it also helps them meet Swiss legal provisions encouraging energy self-sufficiency in industrial companies.

In the long term, the aim is to also equip more parking areas, so that owners of electric vehicles can recharge their cars with sustainably produced local energy.



Reducing the energy footprint of showering

Reusing waste heat is becoming a major concern in housing, and Joulia has concentrated its efforts on the heat losses generated when we shower. The company's innovative solution recycles more than 60% of the energy needed to produce hot water.

It is estimated that the energy required to produce hot water in a house is equivalent to that needed to heat the entire home. Over the course of a year, this adds up to a considerable amount of energy, and it is unfortunately lost in just a few minutes each time anyone takes a shower. However, this energy loss can be significantly reduced, by building a heat exchanger into the shower tray or drain channel to recycle the waste heat from the water pouring away.

The device developed by Joulia, based in Biel in the canton of Bern, has an output of 20 kW and is powered entirely by the waste heat from the hot water. In terms of performance, the system is capable of recycling more than 60% of the energy used to produce our hot water. This is equivalent to a saving of 1000 to 2000 kWh a year for an average family.

"Our technology is extremely easy to install and doesn't require any special electrical or technical connections, as everything is integrated into the shower elements sold by leading brands in the bathroom furniture sector," says the company's CEO, Reto Schmid.

THE SWISS MARKET IS FOLLOWING THE EXAMPLE OF THE DUTCH

Even though this is a mature technology, it has still to win over players in the Swiss construction industry, particularly the clients and building planners. The system developed by Joulia is relatively unknown in Switzerland and is often perceived as being too complex to install – a misconception that the company says is demonstrably unfounded. Although the Swiss market is obviously important to the company, it exports more than half its production to the Netherlands, where the process is well known and has been in use for many years now.

Having sold more than 3000 systems between Switzerland and the Netherlands, Joulia has accumulated some compelling arguments to encourage a greater take-up of its innovation in the Swiss market. MoPEC, the Swiss cantons' model energy regulations, also support its use, since builders are expected to recover and recycle waste heat wherever it is technically feasible to do so in a building. Ultimately, a system of this kind would be well worth recommending as a new construction standard.

Intelligent solar energy

With its sensor that plugs directly into solar panels and its powerful AI analytics, SmartHelio enables solar energy producers to predict faults in their infrastructures and extrapolate production volumes.



For energy producers and grid operators, solar energy is a sustainable solution that is promising but not without its difficulties. The main challenges include monitoring and maintaining the photovoltaic panels, and integrating a fluctuating energy volume into the grid. In answer to these problems, SmartHelio has developed a sensor linked to a digital platform that together enable users to understand and predict the behaviour of their energy production infrastructures.

MODELS TO IDENTIFY POTENTIAL HAZARDS

Plugged directly into the solar panel, the technology – awarded the Efficient Solutions Label by the Solar Impulse Foundation – measures fluctuations in current and voltage to identify and prevent potential problems (any shadows or dust obscuring the surface of the installations, for example) as well as possible damage or incorrect settings. The digital platform developed by SmartHelio then analyses the data provided by the sensor and integrates it into different predictive models based on a range of variables, including weather fluctuations.

“In the end, this gives energy producers the know-how to fix their problems even before they happen, while also helping grid operators to adapt their infrastructures to integrate a volume of energy that’s known in advance,”

says Govinda Upadhyay, the company’s CEO. During the pandemic, in-field interventions have become more complicated, making the technology from SmartHelio a smarter choice than ever. With it, the company’s clients can monitor infrastructures remotely, limiting unnecessary interventions – and saving the associated costs.

LARGE-SCALE PILOT TESTING

The company recently tested the pilot version of this technology in India, a country where renewable energy is developing on a large scale. These tests allowed the company to bring the technology to maturity with a large amount of data in a short period of time.

SmartHelio, based at the heart of the EPFL Innovation Park in Lausanne, has already marketed its system to a good thirty companies in Switzerland, the Netherlands, the United States, France and India. Its clients and partners include some major energy players such as Romande Energie and the Geneva utilities company (SIG).



Digital technology for the precision manufacturing industry

In the precision manufacturing industry, production machinery must be used as efficiently as possible, and this involves real-time operation monitoring. This expertise has been developed by stemys, which specialises in digitalisation and the Internet of Things.

The different sectors of the precision manufacturing industry – watchmaking, medtech, aeronautics and motor manufacturing – demand increasingly sophisticated machinery. With operating times pushed to the maximum and the ability to supervise production workshops in real time, these days everything depends on a business digitalising its machinery stock. This is where stemys comes in. In addition to developing digital solutions, stemys helps its customers implement new connected services to optimise the operation of their machinery and equipment.

Besides the precision manufacturing industry, stemys' customers also operate in the energy sector, mainly in the Fribourg region. For its energy customers, the company has for example developed an application that provides secure remote access to the energy infrastructures of different facilities. In the longer term, it may also move into the field of predictive maintenance, supplying energy producers and network operators with the digital tools they need to predict infrastructure faults, for example.

A SMALL COMPANY WITH AN INTERNATIONAL REACH

From its premises in Porrentruy in the Swiss Jura, a region whose industry is centred on high-precision manufacturing, stemys enjoys an international reputation. Some of its customers, such as industrial production machinery distributors, operate in Switzerland, Germany, France, Hungary and even Asia. "Because we develop certain functionalities tailored to the requirements of each customer, this sometimes results in us working closely with these international players," says Raphaël Müller, Managing Director of the company.

In pursuing its business development strategy, stemys surrounds itself with recognised industrial partners whose business is to supply their customers with the innovative, future-proof solutions that they develop.



The unexpected benefits of energy platforms

E-nno develops and provides energy optimisation and monitoring solutions for real estate and construction industry professionals. These are systems that use data to increase the energy efficiency of the building stock and reduce its environmental impact.

How can technology and data be used to optimise buildings undergoing energy renovation? The team at E-nno asked themselves this question and came up with EnnoBox, a solution that collects data from both existing and new installations. "Our system can connect any kind of boiler plant to our servers," explains CEO Maël Perret. "Our algorithms analyse the data and use the buildings' thermal behaviour to optimise the energy flows. We offer energy savings of up to 30% a year, after an installation period of just three months." The Geneva-based start-up took advantage of the slowdown in business caused by the Covid crisis to start working on a similar system for hot water. Now, EnnoBox can be used to optimise both heating and hot water.

E-NNO'S SELLING POINTS

Analysing the data every 15 minutes provides E-nno with a detailed picture of the energy consumption of a building – an invaluable aid when planning major renovation work. Analysing and cross-referencing the technical measurements and meteorological data provides information about when a building is consuming most energy and where the energy losses are taking place (from the building envelope, settings, etc.). The company's business model was inspired by the energy performance contract (EPC). By offering a service with performance-based invoicing, the start-up guarantees its customers added value: if no energy saving is made, the building owner is not charged.

Another E-nno USP is the flexibility that its 'agile' strategy offers, as illustrated by its choice to work in a network with other start-ups that bring complementary skills to the mix. This approach enabled the company to install its first devices only six months after it began trading in 2018. To date, it has installed the system in more than 40 buildings. E-nno is on a mission to make the existing hard-to-understand platforms comprehensible to building owners. "We think it's important to make energy data more accessible, connecting up engineers, owners and data. Our role is to help developers and property management companies take control of their energy data and use it to their advantage."

Using CO2 to heat and cool urban areas



ExerGo has developed an efficient heating and cooling network solution. Using CO2 as the heat transfer fluid (to both heat and cool), the company boasts an 85% reduction in energy consumption compared to fossil-fuel-based solutions – with zero CO2 emissions.

"Projections show that by 2050, around two-thirds of the population of Europe will live in urban environments," explains Alberto Mian, CEO of this Energypolis spin-off. "This opens the door to numerous synergies in dealing with the increased concentration in energy demand and ever more ambitious climate goals." The CO2 network concept developed by ExerGo thus targets towns and cities, where it enables exchanges of waste heat between buildings and provides an efficient urban heating and cooling network. In this way, the residual heat from data centres, supermarkets and office buildings can be recovered and used to supply domestic hot water and heating to apartments for example.

USING DISCHARGES FROM INDUSTRY

Existing district heating and cooling networks use water in a closed circuit as the heat transfer fluid. ExerGo has replaced the water with R-744 CO2. This fluid, which is commonplace in commercial and industrial refrigeration, has an exceptional energy density. "We use R-744 not just as a coolant but also to transport low-temperature heat from the environment – such as lakes, rivers and underground – and recover it through decentralised heat pumps." This is a typical application for CO2 in industry (CCU), using a system that injects and stores it in the network rather than discharging it into the atmosphere.

ExerGo is targeting two customer profiles: utilities (through the installation of large-scale systems) and real estate developers planning on building ecodistricts. The company is initially focusing its strategy on deploying a heat and cooling services network, but in the longer term plans to extend the network to include the production and distribution of electricity with gas micro-CHP units using fuel cells, for CO2 capture. To publicise its technology far and wide, ExerGo is showcasing it in Switzerland and around Europe through collaborations with partners including – in Switzerland – the Geneva utilities company (SIG) and the energy company OIKEN. The system is currently installed in Sion, where it connects three buildings on the Energypolis Campus. ExerGo is being supported by the Swiss Federal Office of Energy and The Ark Foundation.



A floating solar farm below the Great St Bernard Pass

Crédit photo : Romande Energie

Since December 2019, Lac des Toules has been home to the Alps' first floating solar power plant, a demonstration installation commissioned by Romande Energie and co-funded by the SFOE.

The Lac des Toules reservoir, near Bourg-Saint-Pierre in Valais, reaches an altitude of 1810 metres and feeds the hydroelectric power station on the dam of the same name. Since December 2019, it has been home to the Alps' first floating solar farm. The installation consists of a carpet of 36 floats anchored to the bottom of the lake by chains connected to weights, and it rises and falls with the water level. The plant can produce more than 800,000 kilowatt-hours a year, equivalent to the annual consumption of almost 220 households, thanks to 2240 m² of bifacial photovoltaic panels. "We've been testing different panels at different inclinations since 2013, to get the best compromise between yield and snow removal," says co-director of Solutions Energie, Guillaume Fuchs.

A WORLD PREMIERE AWARDED WITH A WATT D'OR

According to the first results, the yield of the solar park is about 40% more than a similar park deployed on flat land. Romande Energie explains this difference by the strong reflection of light on the snow, the lower average temperatures and the thinner atmospheric layer. "The project was carried out in an extreme environment without causing any major concerns," adds Fuchs. "We are already working on optimising the technology, so we can create a product that is better suited to large power volumes."

With the initial results of the demonstrator living up to Romande Energie's expectations, the company is now looking at ways of optimising the technology and developing an "Alpine floating solar energy plant" business model, while extending the Lac de Toules installation. The objective is to cover nearly 35% of the lake's surface area with solar panels. The project involves various technical challenges, which the company is currently working to resolve. With this vast solar facility, the company aims to produce 22 million kilowatt-hours per year, enough to power more than 6,100 homes (around 90% of the homes in the region). Developed in collaboration with specialist companies such as ABB (which is making the inverters and transformers), Poralu Marine (designing and building the floating structure), and Drosera SA (carrying out the environmental impact studies), this project is a world first. It has been patented and was even awarded the Watt d'Or energy prize in 2021.

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A touchstone for sustainable architecture

For over forty years, the Lutz architectural practice has designed projects with a focus on sustainable approaches and the use of natural materials. The architects also specialise in energy-efficient construction.

"If you want a thing done well, do it yourself" – the maxim applies perfectly to Lutz Architectes. Thirteen years after its construction, the Green Offices building containing the practice's offices in the canton of Fribourg remains a shining example of energy efficiency and minimal environmental impact. It was the first office building in Switzerland to be awarded the Minergie-P-ECO label, and it has also won a Watt d'Or and the Prix Lignum.

The ambitious ecological goals of Green Offices are immediately apparent from its untreated wooden facades. And the interiors are no less green: milk paint, mud bricks, clay plaster, cellulose insulation, a wood frame sourced from the forests of Fribourg, offices and company vehicles powered by photovoltaic panels, pellet heating, composting toilets, rainwater recovery, and a passive design that produces a heating saving of around 90%. "Grey energy is very much front of mind for us," says Fabrice Macherel, Managing Partner of Lutz Architectes. "We assessed the carbon footprint of every material we used." The savings made are equivalent to the energy needed to heat the building for a hundred years!

TOWARDS A CIRCULAR ECONOMY

Lutz Architectes has also been involved in other outstanding projects, such as the design of the NEST SolAce unit at EMPA, the Swiss Federal Laboratories for Materials Science and Technology in Dübendorf, near Zurich. This research unit, developed in collaboration with EPFL in Lausanne, has active energy-producing facades.

Despite the availability of sustainable materials, the construction industry still doesn't seem ready to move on from concrete and synthetic materials. "Developers all build the same way, respecting just the minimum legal requirements – but the climate crisis and limited resources mean they need to go much further," says the architect. Lutz Architectes mainly works with private clients, who are more awake to ecological issues than developers, whose first interest is profitability. The approach established by the architectural practice, which meshes the comfort of the inhabitants, energy efficiency and a circular economy, is ripe for development in larger-scale projects.

Crédit photo : Lutz Architectes / Corinne Cuendet, Clarens



The innovative screen set to make greenhouses more eco-friendly

The Neuchâtel-based start-up Infrascreeen is developing a thin-layer plastic film incorporated inside a thermal screen. This technology should help heat greenhouses more efficiently while letting through the sunlight essential for photosynthesis.

Co-founded by Benoît de Combaud and Henri de Lalande, Infrascreeen is working on a solution for more sustainable greenhouse farming. Conventionally, greenhouses are heated using natural gas, a process that increases productivity 15-fold compared to field cultivation but which also emits three times as much CO₂.

The selective radiation filtration technology developed by Infrascreeen lets the sunlight through while retaining the heat. "It's a bit like putting up a survival blanket inside a greenhouse, but one that lets the sunlight through," says de Lalande. The screen is made up of various thin layers developed by the Swiss Centre for Electronics and Microtechnology (CSEM), combined with a thermal filter.

LOWER CO₂ EMISSIONS

The first trials were carried out in the Netherlands (which has one of the highest numbers of greenhouses in the world), where this technological breakthrough met with an enthusiastic reception. It was shown to be effective by an independent study carried out by a laboratory at Wageningen University. By retaining the infrared radiation, this process is not only more energy-efficient but also more profitable, with up to 200 tonnes lower CO₂ emissions per hectare per year and a 20% saving in the heating bill. This gives it considerable appeal to the market gardening industry in terms of sustainability, since

80% of the CO₂ emissions of a greenhouse are caused by heating. In addition, Infrascreeen's solution should offer a saving of around two euros per square metre. "Enough to offset the extra cost of switching to renewable energy sources for heating," claims de Lalande.

The next steps for Infrascreeen are to create an industrial production prototype and launch pilot trials in the Netherlands and Switzerland, starting in the autumn. For its future business development, the company has set its sights on northern Europe, Russia, Switzerland, Germany and Canada. And the potential is huge! It is estimated that there are five billion square metres of greenhouses worldwide.

In July 2020, Henri de Lalande and Benoît de Combaud were awarded the Banque cantonale neuchâteloise Innovation Prize for their solution. They are supported by the Foundation for Technological Innovation (FIT).

One of the most efficient Energy-from-Waste plants in Switzerland

Satom SA is a big player in the energy transition, with an ambitious vision encompassing five major projects. One of these is Ecotube, a project to supply steam to the neighbouring chemicals site, which is also set to help the company improve the overall energy efficiency of its plant.

The days when incineration plants were regarded as energy-inefficient polluters are well and truly over. A major regional player in energy and heat production, the Monthey Energy-from-Waste plant is a long-established energy provider. Built in the 1970s, the plant is constantly evolving in an effort to improve its energy and environmental performance, and it is currently running a large number of projects designed to meet the 2050 Energy Strategy. One of these is Ecotube, a steam supply pipeline running from Satom SA to the CIMO Compagnie industrielle de Monthey SA chemicals site. "The proximity of this chemicals site, which consumes a large amount of heat energy in the form of steam, is an opportunity for us to supply a large quantity of heat all year round," says managing director Daniel Baillifard. The project is also set to significantly increase the plant's overall energy efficiency with the replacement of its steam turbine.

UP TO 300,000 TONNES OF STEAM PER YEAR, WITHOUT BURNING FOSSIL FUELS

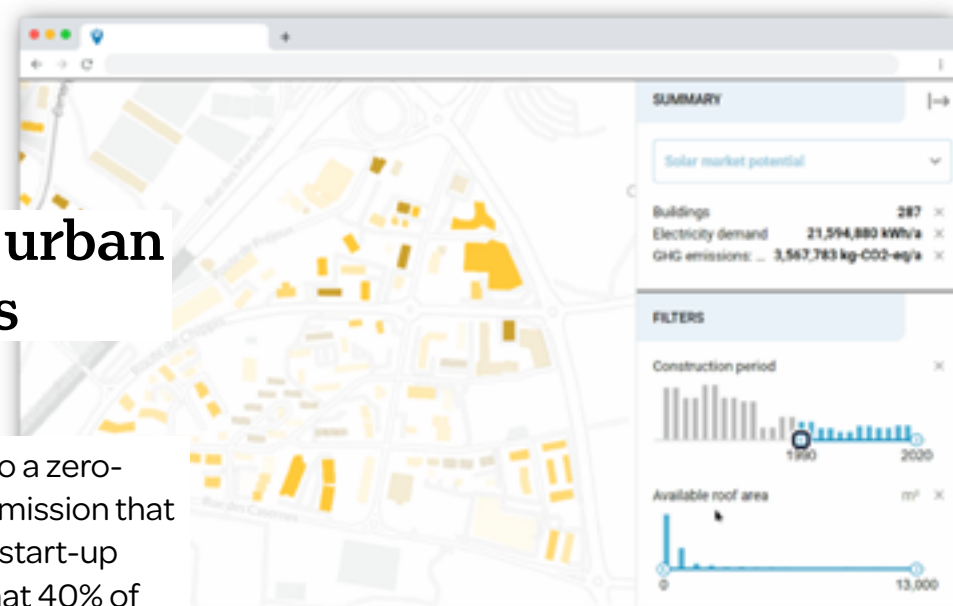
The Ecotube project began in autumn 2020 and is expected to cost CHF 42 million. It involves constructing an underground steam pipeline around 2.5 kilometres long, running from the Satom plant to the chemicals site. The steam – up to 300,000 tonnes per year, generated from waste incineration – will replace much of the heat currently being produced by CIMO using natural gas. A win-win situation in both environmental and economic terms, for CIMO, whose CO₂ emissions from burning fossil fuels will fall by 50% (saving nearly 45,000 tonnes a year), and for Satom. The plant will increase the energy efficiency of its Energy-from-Waste process with the installation of a new back-pressure steam turbine, enabling it to maximise its electricity production in summer and supply more heat in winter, and thereby to limit heat loss.

To help fund the project, Satom has secured recognition from the Federal Office for the Environment that Ecotube is a carbon offset project. It is also being supported by KliK, the Foundation for Climate Protection and Carbon Offset. The pipeline commissioned in the first half of 2022 make Satom one of the most efficient Energy-from-Waste plants in Switzerland.



Applying AI to urban energy systems

Accelerating the transition to a zero-carbon building stock is the mission that the recently founded Valais start-up Urbio has set itself. Aware that 40% of CO₂ emissions are generated by existing buildings and conscious of the great inertia dogging the sector, Urbio has developed software capable of reducing the time required for planning energy systems by a factor of 10.



Because although clean technology is already here, the problem is how quickly (or not) it is being introduced. To tackle this problem, Sébastien Cajot, Nils Schüller and Nicolas Sommer are now marketing an intuitive web-based platform that drastically speeds up and simplifies the current processes used to collect data and prospect and pre-design energy systems. Following a research and validation phase at EPFL Valais Wallis, Urbio was established in January 2020, ready to begin its entrepreneurial venture.

LIKE GOOGLE MAPS, BUT FOR ENERGY

Thanks to Urbio's artificial intelligence, our users can proactively prioritise high-impact projects while automating the design of the energy solutions used," says Sébastien Cajot, CEO and co-founder of the fledgling company. Targeting energy suppliers, engineering consultants and stakeholders in the real estate market, Urbio's solution offers its users three complementary functionalities. Firstly, it enables them to structure, combine and add to their geospatial data. Next, clients can easily visualise this data in map form and, for example, identify high-density heat zones for urban heating systems or buildings with solar energy promise. Lastly, Urbio's software can be used to design energy systems on a scale optimised to buildings or entire towns, generating different scenarios depending on their client's requirements.

There are plenty of ways in which this cutting-edge technology has been used. Sébastien Cajot quotes the example of solar contracting: "Our platform is similar to Google Maps, but instead of searching for a restaurant, our clients can use it to obtain all the energy data relating to specific buildings. Energy suppliers, for example, use it to establish which rooftops are most suitable for solar panels. They can then quantify the market potential using data relating to both a whole district and to an individual building." Urbio's technology is also useful for planning heat networks, municipal energy planning, and for drawing up decarbonisation strategies for building stock.

The platform became commercially available in September 2021, with Urbio also able to raise CHF 2 million in funding at that time. Two successes that have made it possible to expand the company, which today employs a team of around 15. The company currently has around 20 clients all over Switzerland, including Romande Energie, CKW and Intep, and is also doing business elsewhere in Europe, notably in Germany, where decarbonisation projects are very much in vogue.

PrimeEnergy Cleantech – investing in a sunny future

PrimeEnergy Cleantech was founded in 2011 in the canton of Geneva and specialises in financing and operating solar farms in Switzerland and the rest of Europe.

The main priority of this young company is to develop the renewable energy sector by offering bond issues, giving every investor, large or small, the opportunity to play a part in the transition to sustainable energy.

DAILY CONTRIBUTION TO THE ENERGY TRANSITION

To involve customers in the energy transition, PrimeEnergy Cleantech offers them the opportunity to participate in financing solar farms by subscribing to a socially responsible investment. And they have the satisfaction of knowing that, in doing so, they are contributing to a cleaner, greener future.

With the acquisition of PrimeEnergy Green Bonds, customers are buying a product that has been awarded the Efficient Solutions Label by the Solar Impulse Foundation. The bonds are among almost 1000 innovative and profitable solutions with a positive impact on the environment. They also offer the buyer the significant advantages of stable and sustainable interest rates, transparency, portfolio optimisation and attractive yields. Today, producing electricity from solar energy is no longer simply an ecological gesture but also an ethical, profitable and above all sustainable investment model.

The company has made it a priority to minimise its impact on the environment and to reduce its carbon footprint as much as possible by offsetting the CO₂ emissions produced in the manufacture of its solar panels.

WIN-WIN DEALS

Beside its 100 solar installations spread across Europe, which inject 45 GWh of energy into the grid each year, the company also has a property portfolio consisting of 40 buildings. Since 2018 and the entry into force of Switzerland's new legislation on renewable energy, the company has contracted with the buildings' occupants to sell the electricity generated by its photovoltaic power stations directly to them.

PrimeEnergy can thus conclude win-win deals with these customers, in which the electricity resale price is negotiated between the two parties. Without making any investment, the customers buy their electricity at a price below that of local distribution network operators. For its part, PrimeEnergy resells the electricity at a higher price than that offered on the distribution network. A mutually beneficial agreement!

Fire without smoke

The combustion process developed by Fireforce Technology is a very clean, efficient way of converting biomass into energy – an innovation that could revolutionise the heat production sector.

Deep in the Vaud countryside, a new type of wood burner has been developed on the back of the biochar research carried out by André Van der Veken, a self-taught combustion engineer convinced that it is better to prevent polluting emissions in the first place than to capture them after combustion. The results have exceeded his expectations. Analyses by an independent laboratory show that his process is an ultra-clean way of burning wood pellets and wood chips, paving the way to cleaner, more efficient, more compact and more economical boilers.

MORE EFFICIENT COMBUSTION PRODUCING NEAR-ZERO POLLUTION

Van der Veken's goal is not just to drastically reduce polluting emissions by equipping wood-fired boilers with Fireforce technology, but also to replace boilers that burn fossil fuels with his new device. "We are targeting industrial installations and district heating systems operating at 500 kW or more," says the entrepreneur. His company is working on several district heating pilot projects.

Because of its extremely low gas and fine-particulate emissions, the Fireforce process can do away with filtering the smoke through an electrostatic precipitator, ma-



king the resulting boilers smaller. Another advantage is its greater efficiency: around 8 to 30%. "Our prototype takes any kind of biomass of up to 65% humidity, making it possible to burn poorer-quality wood, which is cheaper," adds Van der Veken. And because his device is adjustable to a wide range of power outputs, heat production can be tailored precisely to users' requirements; this flexibility also means fewer maintenance call-outs if the boiler is pushed to its limit.

THE FIRST 100% RENEWABLE OLYMPIC FLAME

Fireforce is regularly consulted for its expertise in combustion engineering, developing the burner for the Olympic flame used at the most recent Youth Olympic Games in Lausanne. Fuelled by pellets made from locally sourced wood, it produced a flame that kept burning over a 24-hour cycle, with no electricity required. A shining example of energy efficiency with a major environmental impact. Fireforce has made its mark elsewhere too, helping to improve the technology used in Edelsun outdoor heaters.

Using modular panels to reduce the energy footprint of buildings

The technology developed by Enerdrape makes use of geothermal energy and excess energy from the underground surroundings of buildings for heating or cooling purposes. This patented solution has the advantage of increasing the proportion of renewable energy used by existing and new buildings, bringing down operating costs and considerably reducing greenhouse gas emissions.

Today in Europe, more than 75% of the existing building stock is still using non-renewable energy sources. Concerned by this high figure and keen to improve the carbon footprint of the building sector, since 2019, the team at Enerdrape have been working hard on developing an innovative product capable of making efficient use of geothermal heat sources.

When we asked Margaux Peltier, CEO of the fledgling company, to tell us a bit more about Enerdrape's solution, she was not short of convincing arguments. "Our panels are easy to install and relatively simple to maintain. They're tailored to the existing construction and remain consistently effective. They're also customisable, which means you can integrate them into any kind of architecture and you can also put advertising on them, or another kind of wording, depending on the customer's needs." This technology, in the form of a modular panel with a sandwich construction, incorporates a heat exchanger that captures both the geothermal energy and the heat present in the surroundings. The panels draw the heat from the concrete or air and use it to heat the water contained in a closed circuit of pipes which feeds a heat pump.



VERY POSITIVE INITIAL FEEDBACK ON THIS TECHNOLOGY

The young Vaud-based company carried out an initial test installation in a car park at the Realstone offices in Lausanne, enabling it to validate the first scaled-up application of the system and see how it performed. With very encouraging feedback received, it is likely that new contracts with private customers will be in the pipeline before long.

The market that Enerdrape is targeting is commercial buildings (offices, shopping centres, etc.) with an underground car park. This is because it is in underground environments that this technology is most effective at capturing geothermal energy and heat. This product is also aimed at businesses operating in the energy sector, such as utilities, and it may also be of interest to developers of energy solutions and engineering firms operating in the HVAC sector.

Bringing together solar and hydroelectric power

Covering a dam wall with photovoltaic panels? What a great idea! In the AlpinSolar project, Axpo, Switzerland's largest CO₂-emission-free energy producer, has teamed up with the Basel-based general utility company IWB to do just that. Located at Muttsee in the Glarus Alps, this project is a Swiss first that could give a new boost to solar energy production.



High up in the mountains at 2,500 metres altitude, the weather over the Muttsee dam is frequently sunny. This south-facing dam is also the widest in Europe: one kilometre of concrete spanning from one side of the valley to the other. These two factors are what gave Axpo the idea of setting up Switzerland's largest solar installation there.

The first part of the installation was finished in the summer of 2021. The pandemic and bad weather delayed further construction work, and installation will now be completed this summer. The result is already noticeable. "The cells produce 50% more than in the lowlands, putting them on a par with southern Europe," says a smiling Christoph Sutter, Head of Renewables at Axpo Group. A total of 3.3 GWh per year – enough to meet the needs of 740 average households over that time.

This impressive performance is not down to some kind of Alpine magic; rather, it can be explained by three factors. In addition to the absence of fog in winter, the snow cover there increases the indirect sunlight, reflecting the light like a mirror, and there is also the low temperature, which makes the cells more efficient. "This makes the installation particularly effective in winter. And that's handy, since it's in winter that we particularly need electricity in Switzerland," concludes Christoph Sutter.

There are also symbolic reasons why Axpo chose Muttsee for this pilot project: here, solar and hydroelectric power, the two energy sources that are our best hope for the future, work in concert. And AlpinSolar is likely to be the first of many mixed installations.

One thing preventing more installations is a lack of funding. This is because the public authorities only support installations that produce energy used directly on site, which is not the case at Muttsee. In that respect too, Axpo has innovated: Denner, Switzerland's third-largest retail business, has bought the electricity generated by AlpinSolar at a price fixed for 20 years. "This scheme, a power purchase agreement (PPA), is very common in Europe, but this is the first time it has been used in Switzerland to fund this kind of infrastructure," says Christoph Sutter proudly.

However, covering every dam and rooftop in Switzerland with solar panels would still not be enough to solve the problem of the country's electricity supply over the next 10 years. With nuclear power stations due to be shut down and the increase in the number of electric vehicles on the road, "we are going to have to break a taboo and lift the ban on installing solar panels in fields. At Muttsee, getting authorisation to install them on the dam wall was easy," says Christoph Sutter. When it comes to developing solar electricity in the Alps, one solution is to install panels on existing infrastructures such as ski lifts and dams. But if we are to achieve the energy transition, ground installations will also be needed.

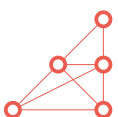
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Fribourg, Vaud, Valais, Neuchâtel, Genève, et Jura
et soutenue par le SECO au titre de la NPR.



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