Energy Funding Programme 2013–2020
FINAL REPORT

Extract

Recommendations based on the SCCERs and Joint Activities research findings

Read the full report

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FEEB&D

Future Energy Efficient Buildings & Districts

Action Area
Efficiency

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sccer | future energy efficient buildings & districts

The SCCER FEEB&D targeted a substantial reduction in energy consumption and CO_2 emissions of existing and future building stock. The focus was on measures to be realised in single buildings, at district, regional and national level.

Recommendations

based on the SCCER FEEB&D's research findings

- **Adopt regulations**
  Establish the legal basis and regulations for the public, cross-sectoral use of individual energy data and for energy sharing/trading on a local scale.

- **Enable renewable decentralised energy systems**
  Develop masterplans at district and municipal level that consider the local renewable energy sources and the public energy infrastructure for supply, storage and distribution.

- **Re-engineer the energy business**
  Promote innovative business models for sharing energy and data, the pricing of flexibility and the economically attractive integration of distributed privately owned renewable energy (electricity and heat).

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EIP

Efficiency of Industrial Processes

Action Area
Efficiency

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SCCER
EFFICIENCY OF
INDUSTRIAL PROCESSES

The SCCER EIP linked research institutions from all types of HEIs with a multitude of industry partners to push forward industrially relevant methodologies and technological innovations in the field of energy efficiency and to improve transparency over energy-efficiency potential within Swiss industry as a whole.

Recommendations

based on the SCCER EIP's research findings

- **Breakthrough for pinch analysis in industry**
  A streamlined user workflow for pinch analysis in combination with process simulation and lifecycle assessment allows energy-efficiency potential and measures to be identified and evaluated at a multitude of Swiss companies including small and medium-sized enterprises (SMEs). Efforts must be redoubled if a breakthrough in the application of this approach is to be achieved rapidly. This new workflow supports process engineers by making transparent the trade-offs between economics, energy and carbon savings. Mass and energy balances can be conducted quickly and accurately for a wide array of systems. It therefore acts as a natural complement to enabling process understanding. Conceptualised energy-efficiency measures based on pinch analysis of system changes can also be validated.

- **Market penetration of high-temperature heat pumps and vapour recompression systems**
  High-temperature heat pumps (HTHPs) and vapour recompression systems enable significant energy savings and reductions in CO_2 emissions in industry. Up to now, most of the practical applications of HTHPs in Switzerland have been in the food sector or for district heating, using industrial waste heat, wastewater and lake water as heat sources. There are still too many barriers hindering widespread implementation, such as relatively high investment cost, a small pool of manufacturers and inexperience. In order to overcome these hurdles, it is recommended that the applicability and long-term benefits of these new technologies be demonstrated in several industrial scenarios and in piloting facilities.

- **Towards climate-neutral concrete**
  Concrete has the potential to reabsorb all emissions relating to the decomposition of calcium carbonate in the clinker burning process. In order to industrialise this natural process, a pilot plant for the carbonisation of demolition concrete using CO_2 captured from the air was built and operated, showing very promising results: the plant operation was very stable, the CO_2 uptake was robust, and the carbonation process was managed successfully by the normal cement plant staff. The next step is to transform the concrete fines into calcium carbonate and sand. Both materials will subsequently be used in concrete, meaning that the concrete mixture embodies all CO_2 emitted along the cement and concrete manufacturing value chain. This will bring about climate-neutral concrete. Achieving this challenging goal, however, will still require tremendous efforts on the part of the construction industry to upscale these methods and implement the new construction material.

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SoE

Supply of Electricity

Action Area
Power supply (supply of electrical energy)

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SCCER SoE
SWISS COMPETENCE CENTER for ENERGY RESEARCH
SUPPLY of ELECTRICITY

The SCCER-SoE was dedicated to research related to two technologies – deep geothermal energy (DGE) and hydropower (HP) – to develop the technological and methodological foundations and to deliver solutions for their optimal contribution to the Energy Strategy 2050 in the years to come.

Recommendations

based on the SCCER-SoE's research findings

- In the short to medium term, the exploitation of geothermal energy should focus on the extraction or seasonal storage of heat, as this is the option most closely suited to the market. Stimulation techniques in tight rock for subsequent use as a high-temperature heat reservoir need further development, e.g. related to predictability and minimisation of unwanted seismic effects.

- The renewal, upgrade, extension and optimisation of hydropower facilities, including new schemes in periglacial areas, is fundamental to implementing the Energy Strategy 2050 while reducing environmental and climate change impacts. Thanks to its flexibility and storage options at multiple scales from minutes to seasons, hydropower is the backbone of the Swiss electricity system. Maintaining this central role will foster the integration of fluctuation electricity generation from solar radiation and wind power.

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BIOSWEET

Biomass for Swiss Energy Future

Action Area
Biomass

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biosweet
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Roughly half of the renewable energy used worldwide comes from biomass. This makes biomass an important option for the provision of green energy. Nevertheless, research activities like the SCCER BIOSWEET are urgently needed to contribute to more efficient biomass utilisation and deliver improved solutions to cover the markets for heat, electricity and fuel.

Recommendations

based on the SCCER BIOSWEET's research findings

- Biogas production from anaerobic digestion processes is technologically mature, and innovative concepts were further developed, promising sound implementation under the local frame conditions in Switzerland. This technology option is therefore basically mature enough to be implemented, especially in using organic side and waste streams to contribute to GHG mitigation.

- The thermochemical methanation process was further developed, and substantial progress was made on understanding this challenging conversion pathway from solid biomass into a natural gas substitute. Nevertheless, this process is technologically demanding and so this expensive possibility seems to be an option for the remote future.

- The use of solid biofuels for heat provision can be increased by using less-promising types of solid biomass in an environmentally sound way (i.e. very low particulate matter emissions). The extended use of such low-cost solid organic material therefore can and should be more strongly supported in Switzerland.

- Although chemicals are largely outside the Energy Strategy 2050's remit, it is recommended that the successful work on biomass depolymerisation and on an improved combination of biological and chemical upgrading processes be continued. If these conversion processes move closer to the market – and due to the given cost/price ratio this is most likely to be for feeding markets for raw materials (i.e. chemicals) – they should help to defossilise the chemical industry. If this proves successful, the provision of transport fuels will be the next step. This promising conversion pathway should therefore be further developed.

- Biomass is an important option to help achieve the challenging goals defined within the Energy Strategy 2050. The assessment of the pros and cons of the various biomass-for-energy options in the context of tensions with other consumers of biomass (e.g. food) is therefore an ongoing process to be continued in the future. Depending on the market penetration of other renewable sources of energy in the years to come, there might be a need to adjust and/or redefine the role of biomass in Switzerland.

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FURIES

Future Swiss Electrical Infrastructure

Action Area
Grids and their components, energy systems

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The SCCER-FURIES is the scientific arm of the Energy Strategy 2050 for the "power grids" research area. Its vision is to develop technologies enabling the seamless and sustainable powering of Swiss homes, businesses and communities, based on traditional and new renewable energy resources.

Recommendations

based on the SCCER FURIES's research findings

- The SCCER-FURIES built up a large, coherent, interdisciplinary pool of researchers who can create solutions and strategies for adapting the power grid as the central infrastructure for the energy transition. It is important to maintain this research network with established contacts with network operators, the regulatory authority and industry as well as with the European and international expert community throughout the whole period of the energy transition.

- The regulator should enable market mechanisms that leverage local dispatch in distribution grids. Together with distributed sensing technologies for grid awareness and the integration of synthetic inertia from power electronic components, this is essential for the implementation of distributed renewables. End-users should be included in the development of these market mechanisms, as their acceptance of grid-friendly energy management and renewable generation is key.

- Swiss policymakers should revise the renewable energy targets toward a higher share of PV, given the price evolution and research findings on PV systems. Only system management that includes rising consumers such as electric vehicles and heat pumps will enable a higher share of PV to be achieved within the Swiss energy system; planning and implementation need support from financial incentives.

- Switzerland needs more integrated network coupling with its neighbouring electricity markets to improve the capability for cross-border trading and more granular levels of market clearing to reduce network congestion limitations. Measures to strengthen the Swiss transmission system against the loss of a few transmission elements should be considered in this context.

- Power electronic solutions are key to future storage, conversion and power quality solutions, such as novel active network management with storage and soft open points, circuit breakers with shorter interruption times, and high frequency magnetic elements with reduced losses and increased power density. Distribution system operators (DSOs) and own equipment manufacturers (OEMs) should actively pursue these technologies.

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HaE

Heat and Electricity Storage

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Storage

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Storage
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In order to meet the climate protection goals, the future energy system must be based on renewable rather than fossil energy sources. Most renewables draw their energy from intermittent sources such as the sun and wind, which are dependent on the weather and the season. Such an energy system therefore requires a large amount of long-term and short-term HaE storage.

Recommendations

based on the SCCER HaE's research findings

- Policymakers should create incentives to invest in renewable energy and storage by adopting duties and taxes for unsustainable technologies, applying a full-cost approach. Alternatively, they should subsidise sustainable technology to equalise the costs for comparable use cases – or do both – to avoid adverse conditions. This would lead to new business models and facilitate investment decisions for storage technologies.

- The legal framework should be adapted to allow for new concepts for storage systems, power-to-gas and power-to-liquid. The same applies to spatial planning and building legislation, which needs to take large underground storage installations into account. These are important for seasonal heat storage and adiabatic compressed-air storage.

- Research into materials has the great potential to make conversion more efficient and thus reduce energy storage costs. Corresponding funding opportunities should be ensured.

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Mobility

Efficient Technologies and Systems for Mobility

Action Area
Efficient concepts, processes and components in mobility

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sccer mobility

The SCCER Mobility aimed at developing the knowledge and technologies essential for the transition from the current fossil fuel based transportation system to a sustainable one, featuring minimal CO_2 output, primary energy demand as well as virtually zero-pollutant emissions.

Recommendations

based on the SCCER Mobility's research findings

- **Incentives and attractive offers are a must**
  A combination of soft and financial incentives, new policies and a wider range of mobility-as-a-service (MaaS) solutions and associated infrastructure are needed to reduce transport demand in general and drive the shift from fossil fuel-based powertrain technologies to renewable and environmentally friendly modes of transport.

- **Flexibility through sector coupling**
  To cover future demand for power storage and hence increase the flexibility of the energy system, the transport sector must be comprehensively coupled with other electricity-consuming sectors, in particular the building sector.

- **Individual mobility and more**
  While car manufacturers appear to have embraced the systematic electrification of individual mobility, other key transport domains such as local freight distribution, air transport and long-distance shipping still need to step up their decarbonisation efforts.

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CREST

Competence Center for Research in Energy, Society and Transition

Action Area
Economy, environment, law, behaviour

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Understanding what people in Switzerland use energy for and how they use it is a prerequisite for planning and steering the energy transition. This transition also requires a level of investment that tends to exceed what the market alone will provide under current framework conditions, which necessitates improvement on both the demand and the supply side.

Recommendations

based on the SCCER CRESTS's research findings

- Transition policies need to work both on innovation, by pushing low-carbon alternatives, and on reduction, by putting pressure on existing but unwanted technologies and business models. Different policies are required for different phases of the transition and for different sectors. These need to be sequenced and ratcheted up in accordance with the development of technology in order to build broad acceptance.

- Initiatives, instruments and campaigns aimed at reducing energy consumption should be based on continued research into the nature and scale of demand from different activities and sub-groups. Indeed, they need to be geared to the wide variety of consumers and pay more attention to "outliers", especially those people and practices that are likely to provide the greatest assistance to the energy transition. They should combine monetary incentives with non-monetary measures including salience, increasing energy literacy or equality and gender considerations.

- There is also a diverse set of actors on the supply side of the energy system, who must be induced through a variety of measures to implement technical and nontechnical innovations with stronger links between heat, mobility and electricity. Energy policy and governance structures at all levels should enable these actors to test ideas, business models and new patterns of collaboration, and should support the diffusion of successful new concepts and products across Switzerland.

- Energy sector startups have different needs to startups in other sectors and require specific support. Established companies outside the traditional energy sector could make a more significant contribution.

- Market designs need to be found that make investments in renewables profitable at market prices, that also make investments in backup capacities and grid extensions profitable, and that provide sufficient incentives to produce electricity when it has the highest value. Flexible electrification technologies can be supported through carbon pricing and measures to reduce curtailment; the latter can be achieved through incentives for flexibility services and new business models, saving on grid expansion costs.

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Joint Activity

Scenarios and Modelling (JASM)

Participating SCCERs
FEEB&D / EIP / SoE / BIOSWEET / FURIES / HaE Storage / Mobility / CREST

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There is strong demand from industry, science and public administration for robust and authoritative scenarios regarding the development of the Swiss energy system over the next few decades. To meet this demand, JASM combined the modelling capabilities of all eight SCCERs to develop such scenarios.

Recommendations

- **Need for carbon capture and negative emissions**
  To achieve net-zero emissions in 2050, at least 9 Mt/a of CO_2 needs to be captured and stored. These emissions include unavoidable emissions from waste incineration and cement plants. Switzerland's CO_2 storage potential is likely to be insufficient, however, meaning that it will need to link up with foreign storage sites.

- **Hydrogen needs to be promoted**
  To achieve net-zero emissions in 2050, an annual net contribution of 10–20 TWh/a of hydrogen is needed, mainly for the indirect electrification of mobility, especially for freight transport, CHP and industrial heat. This hydrogen will be produced through a mix of electrolysis, gas reforming and biomass gasification.

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Joint Activity

Integrated development processes for hydropower and deep geothermal projects: regulatory, political and participatory perspectives (IDEA-HDG)

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Hydropower (HP) and DGE have a crucial role to play in the Swiss energy transition due to their controllable productions levels and large potential. However, these projects often encounter difficulties during the planning and authorisation phases due to complex authorisation procedures and objections from local communities, NGOs or the general public.

Recommendations

- When developing DGE projects, companies should pay more attention to their framing. This development process should enable companies to become embedded in a local social context. This means connecting with existing discourses about the wishes of the community, its development plans and political orientation.
- Given that the political debate on DGE is still nascent, great caution is necessary when guiding people's (and parties') discourse in relation to this issue. The fact that subjective knowledge and effective objective knowledge are not always congruent has to be taken into account when designing communication and engagement strategies for DGE projects. Further instruments are needed to encourage people who are especially uninformed about the topic to engage with more information.
- Stronger coordination between federal offices (and other actors) would facilitate the work of the cantons. Administrative and economic actors are particularly relevant for HP projects.

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Joint Activity

Socio-economic and technical planning of multi-energy systems (RED)

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JA RED explored the coupling of the electrical grid with heat and gas systems and addressed the socio-economic aspects of the multi-energy systems and smart grid solutions developed by SCCER-FURIES in its Romande Energie and Arbon demonstrators.

Recommendations

- **Refine the role and responsibilities of local, cantonal and federal authorities in the implementation of the Energy Strategy 2050**
  Authorities can play a catalytic role in the implementation of the Energy Strategy 2050 by improving the conditions for the implementation of multi-energy grid solutions via energy plans, support measures and revisions of energy law.

- **Develop a decentralised production and flexibility market**
  Decentralised production and a flexibility market could make a significant contribution to the Energy Strategy 2050. Decentralised concepts require flexibility, but without a market for the latter investor uncertainty will remain an obstacle to implementation.

- **Create a database for energy planning purposes**
  A significant amount of data is available that could be used for precise energy planning and is not subject to privacy issues. However, a large portion of this data is only discoverable by experts. A central, publicly accessible database needs to be created in order to collect data for energy planning uses.

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Joint Activity

Coherent Energy Demonstrator Assessment (CEDA)

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In the course of their work, the SCCERs established a large number of demonstrator platforms and systems. JA CEDA was initiated to create a data exchange and communication platform with the aim of creating cross-links between the various projects.

Recommendations

JA CEDA showed the importance and necessity of an interdisciplinary exchange of ideas between the experimental and modelling community. Such an exercise calls for effort from both sides, and the resources required to overcome the gap between the different mindsets are not necessarily available.

The recommendations are that:

- modellers should use the CEDA archetype concept as a template for structuring and streamlining the debate, and extend the existing database;
- experimental researchers should feed their data into the CEDA database in order to continuously improve this valuable database;
- the CEDA database should continue to be developed and updated;
- companies and governmental organisations should use case studies based on the database as a feasible simulation tool for exploring new business cases that support the energy transition.

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Joint Activity

White Paper on the Perspectives of Power-to-Product (P2X) Technology in Switzerland

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Power-to-X (P2X) refers to technologies that convert (green) electricity into gases, liquids or heat that can be stored on a long-term basis and used as feedstock for many kinds of energy use or for the production of chemicals. "X" often stands for hydrogen, synthetic gases such as methane, or synthetic fuels such as diesel, gasoline or kerosene).

Recommendations

- **Strengthen the systemic view**
  The flexibility of the Swiss energy system needs to be adapted to the requirements of intermittent renewable sources, namely that long-term (seasonal) storage of electricity will play a more important role than it does today. Decisions about future transport and heating concepts also need to be prepared and made.

- **Further develop the technology**
  Several processes need to become more mature (higher efficiency, greater stability, lower costs) before they can be implemented in the energy system. This will require timely research and development.

- **Adapt the market and legal framework**
  The implementation of greater flexibility and the introduction of new technologies like P2X into the market require significant changes to the legal framework before these technologies can become competitive. A long-term perspective will stimulate development but requires immediate action.

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Joint Activity

The evolution of mobility: A socio-economic analysis (Mobility)

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At the core of JA Mobility was detailed scientific analysis and forecasting of individual and household behaviour in view of the development and introduction of new technologies and services relevant to energy consumption in the transport sector.

Recommendations

- **Consider behaviour as a relevant factor and focus on effective behaviour types in further studies and interventions.**
  The mobility behaviour of individuals and households is a relevant variable that should be considered as an active element in achieving the emissions and energy goals of the mobility sector. JA Mobility demonstrated how mobility behaviour is influenceable. Based on the results achieved so far, an in-depth analysis is now required to determine how the relevant types of behaviour can actually be brought about.

- **Use the full portfolio of governance options for the mobility sector.**
  Further work should investigate which mix of interventions has the most promising effects. This applies not least to the mix of national and local interventions.