Energy
National Research Programmes 70 and 71

Synthesis

Market Conditions and Regulation

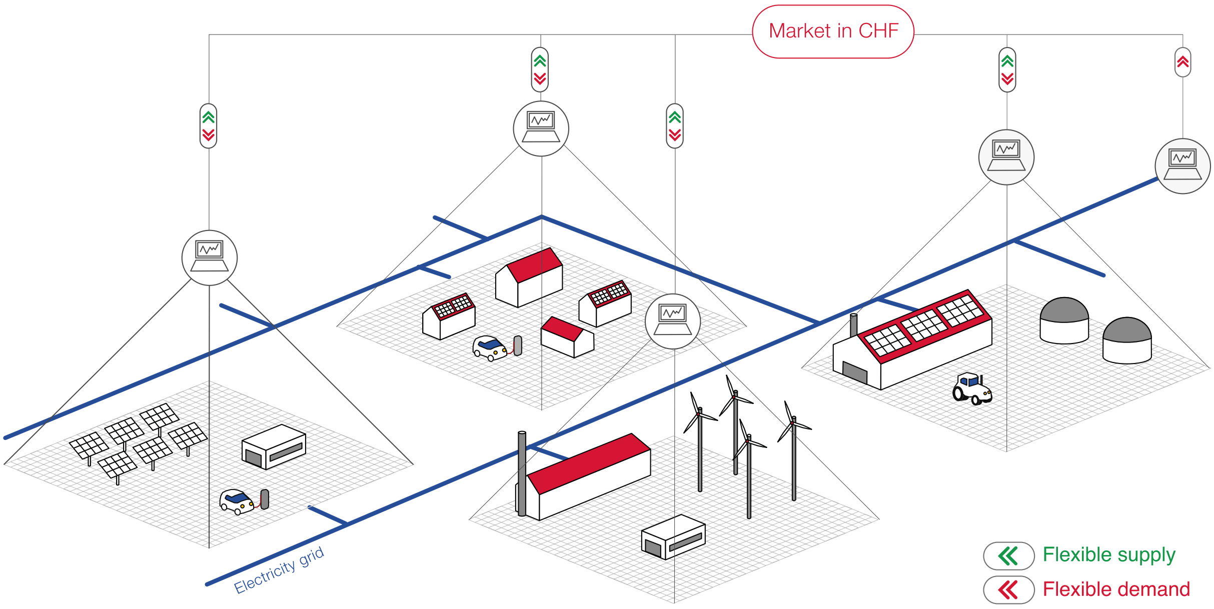
Market Conditions and Regulation

This thematic synthesis integrates the findings from projects which have an economic orientation. It presents in particular the anticipated impact of promotion-based and steering-based energy policies, as well as an ecological tax reform concerning innovation, energy efficiency and distribution. It will also describe how the energy market could be regulated in an optimal way to take account of energy efficiency and distribution.

1. Key elements for the transformation of the electricity system

It will not be possible to transform the Swiss electricity system with technological solutions alone. The shaping of market conditions and regulations will be at least as important. These market conditions and regulations need to guide economic resources in the right direction through the provision of incentives and possible solutions. And it is here that action needs to be taken.

1.1. Core messages

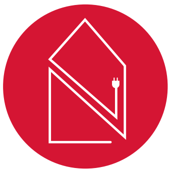


The Swiss electricity system is complex in itself and is also closely linked to the other energy sectors as well as the European market. As such, individual isolated activities will not be able to ensure a transformation in line with Energy Strategy 2050. Instead, a mix of various measures that are coordinated with one another to the greatest possible extent and which are compliant with EU legislation is required.

- On the basis of the results of the “Energy” National Research Programme, this synthesis has identified need for action in three main areas: the market alone cannot trigger the investments required under Energy Strategy 2050 for the expansion of so-called new renewable energies, namely solar and wind power. They therefore still require financial support. Over the longer term, compensation is also likely to be necessary for certain reserve capacities and special infrastructure. Wherever possible, however, preference should be given to steering measures rather than promotion.
- With the growing share of new renewable and intermittent energy sources, massively higher requirements are emerging on both the supply and demand side for flexibly manageable capacities. The introduction of flexible prices for electricity and grid use could be one means of adjusting consumption in line with supply fluctuations. Digitalisation technologies and new intelligent smart grid infrastructures provide the basis for such measures.
- The expansion of renewable energy capacities will see decentralised units across the entire electricity system gain in importance. Energy cooperatives, self-consumer communities, regional distribution grids, electricity storage operators and “prosumers”, who act both as small-scale producers and consumers, are emerging as new stakeholders. The cooperation between these different players and their optimal integration within the electricity system will be vital to the success of further developments. Inevitable

decentralisation means that the system, which to date has been dominated by a top-down structure, is now increasingly characterised by the interplay between both top-down and bottom-up approaches. This will have a major impact on the future market model.

1.2. Key recommendations



Develop the electricity system towards 'more market'!

Steering is more effective and efficient than promotion. The new requirements placed on the electricity system must therefore be translated into market incentives and the various areas must be organised and regulated accordingly in line with developments in the EU. Examples include putting a price on the provision of flexibility, making use of CO_2 taxes and rewarding grid-assistive behaviour.

Integrate decentralised units and utilise their potential for flexibility!

Decentralised units are becoming more important. They offer several advantages: they can be used more flexibly to break peaks or eliminate bottlenecks. Due to their high number, they allow for greater variety, meaning that ever-better possible courses of action can emerge.

Provide flexible support for new renewables!

The new renewable energies are not yet fully competitive. They therefore require further support in the form of flexible instruments that will help the individual technologies reach market maturity before subsequently being transferred to the free market on a step-by-step basis, for example through the use of an auction model. Here, it will be essential that the relevant stakeholders can rely on stable and simple rules.

Over the coming years, the Swiss electricity market will have to undergo fundamental change both for the transformation of the energy system and against the backdrop of any decision on an electricity agreement with the EU. This synthesis has aggregated the results from more than 20 projects on the main topic of market conditions and regulation conducted as part of the NRP "Energy" and identified 14 recommendations for action for Switzerland's key stakeholders. An echo group comprising ten specialists has assessed and commented on these recommendations with a view to their impact and feasibility. Three key recommendations emerged during this process:

1. **Develop the electricity system towards 'more market'!** Steering is more effective and efficient than promotion. The new requirements placed on the electricity system must therefore be translated into market incentives and the various areas must be organised and regulated accordingly in line with developments in the EU. Examples include putting a price on the provision of flexibility, making use of CO_2 taxes and rewarding grid-assistive behaviour.
2. **Provide flexible support for new renewables and gradually expose them to the market!** The new renewables, such as solar and wind energy, are not yet fully competitive. They therefore require further support in the form of flexible instruments that will help the individual technologies reach market maturity before subsequently being transferred to the free market on a step-by-step basis, for example through the use of an auction model. Here, it will be essential that the relevant stakeholders can rely on stable and simple rules.
3. **Integrate decentralised units and utilise their potential for flexibility!** Decentralised units are becoming more important. They offer several advantages: they can be used more flexibly to break peaks or eliminate bottlenecks. Due to their

high number, they allow for greater variety, meaning that ever-better possible courses of action can emerge. And thanks to their regional roots, these ensure that projects enjoy a higher level of acceptance. Legislation and regulations must therefore create the best-possible conditions for their development and integration within the electricity system.

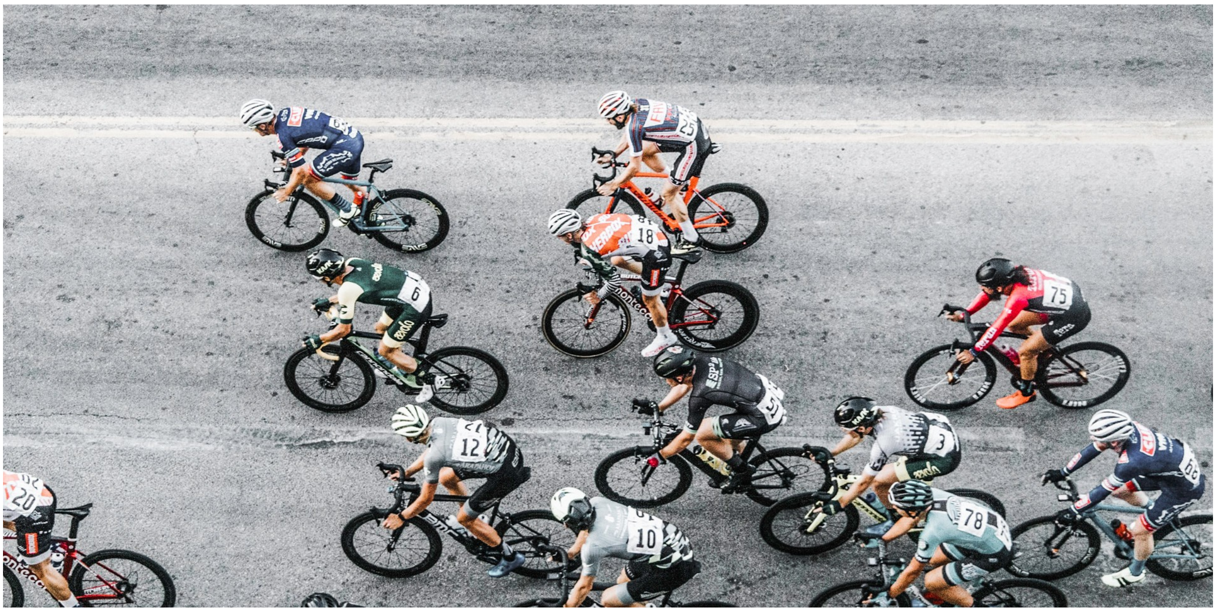
A more detailed explanation of all recommendations for action can be found in the section "Recommendations for action for a functioning electricity market".

2. In search of effective rules and instruments

The structure of the electricity market is key for the transformation of the Swiss energy system. The institutional rules and all economic and socio-political instruments must interact with one another as optimally as possible both within Switzerland and with the EU markets.

Supply security # Energy efficiency # Sustainability # Energy provision # Politics (federal government, canton, municipality)

2.1. Energy Strategy 2050 specifies the objectives



Under Energy Strategy 2050, Switzerland is pursuing three primary objectives in the electricity market[1]: a reduction in consumption, environmentally compatible production and supply security. In addition to technical measures, market mechanisms, in particular, should serve to achieve these goals. The structuring of the required regulatory framework and the targeted use of market instruments will thus play a central role in the transformation of the energy system.

The more rational use of electricity can be promoted by, among other things, targeted efficiency measures. Here, the impact of the measures on economic development as well as the fair distribution of costs and benefits should always also be taken into account.

To improve the environmental compatibility of production, the share of renewable energy must be increased. To this end, in addition to the expansion of hydropower, new renewables such as solar, wind and geothermal power, in particular, should be utilised. Instruments and measures that are both market-compatible and socially acceptable are thus required to promote these energy sources.

A fundamental requirement for ensuring supply security will be the clarification of what exactly is meant by this in a transformed energy system and how it can be measured. A further factor will be clearing up Switzerland's relationship with the EU electricity market. Depending on the political decision, alternative courses of action must be available, as the exchanging of electricity with foreign countries is essential for secure supply and the temporary balancing of loads. A rapid expansion of the transmission grids and a conversion to smart grids[2] will be required for future production infrastructure and the domestic exchanging of electricity.

Notes and References

1 See Federal Council, Botschaft zum ersten Massnahmenpaket der Energiestrategie 2050 (Revision des Energierechts) from 4 September 2013, 13.074, p. 7609ff.
2 “A smart grid is a system that intelligently ensures the exchanging of electrical energy from various sources with consumers who exhibit different consumption profiles, i.e. through the incorporation of measurement technologies as well and information and communication technologies (ICT)”, definition of a smart grid as per the SFOE Smart Grid Roadmap Fact Sheet, March 2015

Regulation # Digitalisation # Europe / EU # Decentralisation

2.2. Regional market design in an international setting

With the expansion of new renewable energy such as solar and wind power, the burden placed on electricity grids is changing just as fundamentally as the market structure on the production side. Greatly fluctuating input will see decentralised components grow in significance with respect to electricity provision as well as storage and consumption. To allow for the changed requirements to be met, the grids need to be converted with a view to establishing a smart grid and monitoring system.[1]

This fundamental restructuring of infrastructure and market development will also have consequences at a regulatory level. Here, the main challenge will lie in establishing how an optimal balance between self-organisation and state regulation can be found right down to the level of Switzerland's cities and municipalities. In particular, regulation is required for the areas of data protection and data management. Smart grids are posing new challenges here, with the medium- and long-term consequences being difficult to foresee. A forward-looking and flexible framework is therefore needed that can also respond to future product innovation and business models of energy suppliers and integrate them within a reasonable period of time.

Developments in neighbouring countries represent a further factor, with Switzerland being reliant on the international exchange of electricity for its own supply security. Switzerland's electricity market design must therefore be compatible with the markets of these countries and is thus significantly influenced by developments in the EU.[2]

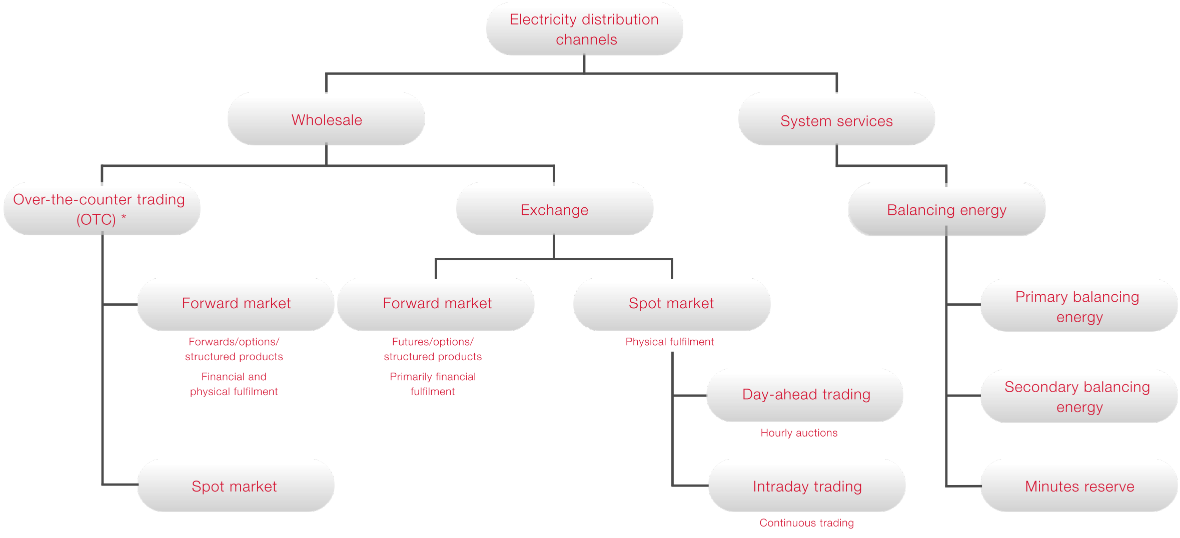
Notes and References

1 See in this regard SFOE, 2015, Smart Grid Roadmap Schweiz, Wege in die Zukunft der

Schweizer Elektrizitätsnetze, Arbeitsgruppe Technologie.
2 For a conceptual analysis, see the special report of the German Council of Environmental Advisors (SRU) 2013, Den Strommarkt der Zukunft gestalten, Berlin

Supply security # Energy grids # Investment # Energy provision

2.3. Four core elements of a functioning electricity market



Electricity distribution channels. *Source: German Council of Environmental Affairs (2013): Den Strommarkt der Zukunft gestalten, Abbildung 2.1 Stromvertriebswege, p. 24*

The Swiss electricity market must fulfil several different tasks for the economy, population and state. Energy Strategy 2050 places four key requirements under the spotlight: the synchronisation of supply and demand, guaranteed supply security, assured grid stability and the expansion of production with renewable energy. These four tasks can be viewed conceptually as core elements of the overall market each of which functions according to its own criteria and mechanisms.

- The synchronisation of supply and demand is currently organised as a pure energy market (energy only). Here, quarter-hourly contracts are negotiated in the so-called intra-day market and uniform prices are agreed on an hourly basis by means of day-ahead auctions.
- With respect to supply security, it is a matter of both maintaining the system's short-term stability (system security) and ensuring a sufficient supply to cover maximum demand and load (system adequacy).[1]
- Robust control mechanisms must ensure that grid stability is also preserved when feed-ins and withdrawals are not in balance. Grid operators are authorised and obligated by law to take measures aimed at maintaining the security and reliability of the electricity supply system.
- Investments in new plants for the production of electricity from renewable sources are stimulated through an incentive system that provides compensation and funding.

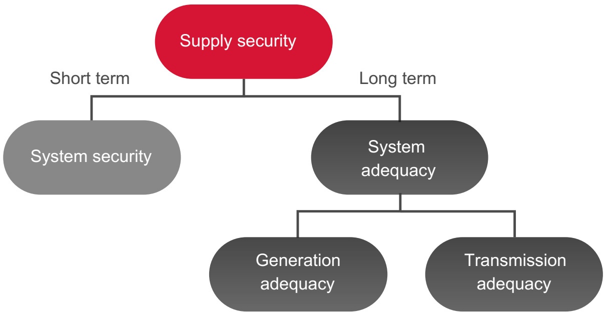
In order to achieve the objectives stated under Energy Strategy 2050, each of the four sub-elements must in future not just work for themselves. As they have a significant impact on one another in some cases, they must also interact as optimally as possible. For instance, the trade markets and the market for balancing reserves are strongly dependent on the production mix. An increase in production with solar and wind power, for example, will lead to a fundamental change in the distribution of production surpluses and deficits at particular times.

Notes and References

1 Supply security: several dimensions, unclear responsibilities

Market # Supply security # Energy grids # Energy provision

2.4. Supply security: several dimensions, unclear responsibilities



Dimensions of supply security.

Supply security can be depicted in two dimensions in line with the special features of the electricity market[1]:

System security – the short-term maintenance of system stability – requires a stable supply with the permanent physical balancing of supply and demand. Deviations may occur due to unforeseen power plant or line outages or as a result of the incorrect forecasting of load or production levels. In the main, responsibility for system security lies centrally with the transmission system operator Swissgrid. In this role, Swissgrid is not only responsible for grid operation, but also for the system services and the associated procurement and provision of reserve power.

System adequacy – long-term supply security in the sense of sufficient supplies to cover maximum demand and grid loads – has itself two dimensions, namely generation and transmission adequacy.

- Generation adequacy: the ability to bring electricity generation into line with electricity grid consumption requires the adequate availability of power plant capacities.
- Transmission adequacy: the ability of the transmission system to control the electricity flow arising from locations in which consumption and generation are taking place, including through the use of imports as an alternative to domestic production.

As grids and electricity provision are both complimentary and substituting, there can be no sharp division of responsibilities. Long-term supply security will require both grids and power plants. Just how the relationship between domestic production and imports will develop over the longer term will be dependent on numerous parameters such as relative production costs, cross-border grids, the regulatory framework and political strategies.

Notes and References

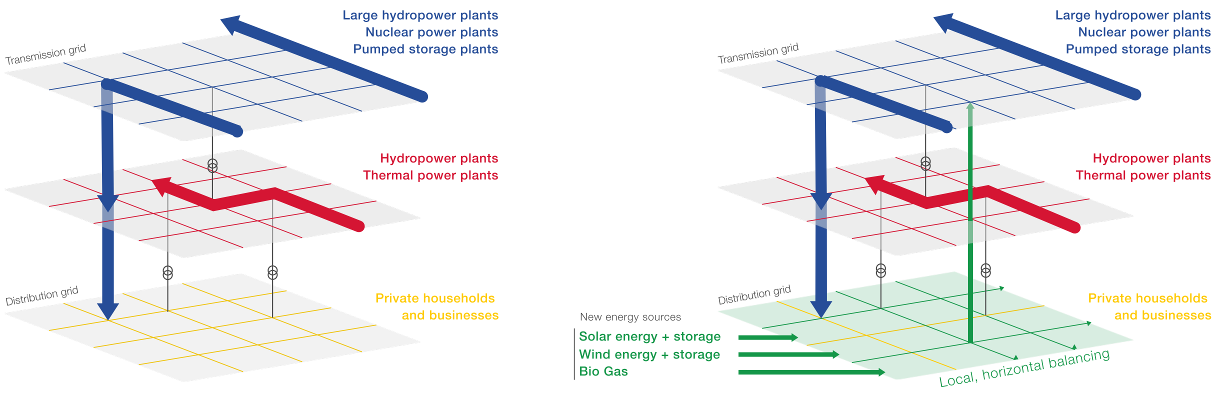
1 See Meister, U. (2016): Der Markt ist für die Versorgungssicherheit verantwortlich, BKW Blog Energie von Morgen, https://blog.bkw.ch/der-markt-ist-fuer-die-versorgungssicherheit-verantwortlich/ based on CIGRE (International Council on Large Electric Systems).

Smart meter # Digitalisation # Prosumers # Guidance # Decentralisation

2.5. Growing importance of decentralised units – change towards a more “bottom-up” approach

Today:
central, hierarchical network

Tomorrow:
decentral, intelligent network



Further development of the electricity grid – supplemented by high-performance decentralised units and new energy flows.

The Swiss electricity market is currently characterised by a largely “top-down” architecture which comprises a few large and many small electricity supply companies (ESCs). As producers with their own power plants, they ensure, among other things, the required level of flexibility and until now have generally enjoyed a local monopoly as suppliers. Alongside other factors such as non-internalised external effects and misplaced incentives provided under various regulations, these local monopolies give rise to distorted electricity prices.

However, a transformation is now being observed. On the one hand, electricity grids are becoming more intelligent. Smart grids based on digital technologies provide access to a variety of measurement data and thus open up new opportunities for market mechanisms. On the other hand, a gradual market opening is being seen in connection with the liberalisation of the electricity market. Electricity prices are thus assuming a better incentive and coordination function. Significant price fluctuations are permitted and also occur. In order to increase the share of new renewable energy, incentive-based and promotion instruments, such as compensatory feed-in remuneration, are also being used.

These parallel developments are changing the market architecture on a long-term basis. For example, the future electricity market will be determined by a mix of “bottom-up” and “top-down” elements. Many new and also smaller stakeholders will now emerge, including so-called prosumers, who as private individuals produce electricity in small power plants while also being customers of the ESCs. This will result in additional flexibility on both the generation and demand side, meaning that shortages can also be reflected via prices. In a functioning mixed interactive “bottom-up” and “top-down” architecture, the share of new renewable energy and thus also electricity provided on a decentralised basis will increase.

The coordination of the significantly greater number of stakeholders cannot only be assured via well-functioning market and price mechanisms. For this reason, the liberalisation of the electricity market is an essential prerequisite for the transformation of the energy system.

Acceptance # Energy efficiency # Steering / promotion # Incentives

2.6. The crucial question: steering or promotion?

	Regulatory steering (rules and bans)	Financial steering (subsidies, taxes, etc.)	Persuasive steering (information, advice, etc.)	Procedural steering (networks, voluntary agreements, etc.)
Buildings	Model provisions of the cantons in the energy sector	Building programme; tax incentives; CO_2 levy; cantonal funding programmes	SwissEnergy (Competence Center) Building energy certificate of cantons	
Renewable energy (Electricity and heat)	Regulations for systems and devices; electricity market regulation	Compensatory feed-in remuneration (KEV); Cantonal funding programmes	SwissEnergy (agency for renewable energy; networks; infrastructure facilities)	SwissEnergy (agency for renewable energy; networks; infrastructure facilities)
Industry and services Mobility		Competitive tenders; CO_2 levy (exemption)	SwissEnergy (energy-efficient devices and large devices)	SwissEnergy (Energy Agency of the Swiss Private Sector target agreement)
	CO_2 emission regulations	SwissEnergy (EcoCar)	SwissEnergy (Quality Alliance Eco-Drive); Energy label	SwissEnergy (auto-schweiz target agreement)

Red = primarily cantonal instruments. SwissEnergy is a platform for questions on energy efficiency and renewable energies. It is managed by the Swiss Federal Office of Energy and should also play a key role in the implementation of Energy Strategy 2050. SwissEnergy finances and supports projects of partners from the public and private sectors.

Table with overview of steering and promotion instruments. *Source: Balthasar / Walker 2015*

To reduce energy consumption and increase the share of renewable energy in the electricity mix, two fundamentally different approaches are available: steering mechanisms in the form of energy and CO_2 taxes or promotion through tax breaks and subsidies. In both cases, mandatory specifications can also be imposed. These include efficiency requirements for electrical appliances and exhaust emission limits for cars.

During a first phase up to 2020, focus is being placed on promotion measures for the achievement of the objectives. In order to promote the economic use of energy, efficiency measures are being supported. Investment contributions and compensatory feed-in remuneration (KEV) are ensuring the expansion of hydropower and new renewable energy, whose share in the electricity mix needs to increase massively.[1]

For the second phase from 2020, it was originally planned to transition from promotion measures to steering mechanisms with the Climate and Energy Incentive System (KELS). It stipulated taxes on combustibles and fuels as well as electricity. However, the steering of electricity demand is a highly controversial political topic and the KELS was unable to gain a majority backing in parliament. Politicians are to develop alternative solutions by 2020.

In order to assess the solution variants, it must be possible to compare their impact. As part of the “Energy” National Research Programme, several research projects addressed these issues. For example, simulations were performed on the basis of models that examined factors such as promotion versus steering, a CO_2 tax, vehicle taxation and different electricity tariff systems for consumers. [2]

Notes and References

1 See Federal Council, Botschaft zum ersten Massnahmenpaket der Energiestrategie 2050 (Revision des Energierechts) from 4 September 2013, 13.074, p. 7594

2 Project "Promotion or steering-based energy policy", Project "Environmental tax reform and endogenous growth", Project "Tax incentives to reduce energy consumption"; SFOE (ed.) 2013, Energy Strategy 2050, Konzeption des Übergangs von einem Förder- zu einem Lenkungssystem, Literaturanalyse und Varianten, final report, Berne.

2.7. Multi-stage synthesis process

This synthesis on the main topic of “Market Conditions and Regulation” was created as part of a multi-stage process. In October 2016, when the researchers were still in the middle of performing their project work, they exchanged information on their research questions, methods and solutions in order to identify interdependencies and potential synergies. Half a year later, the researchers met with representatives from associations, federal offices, cantons and relevant NGOs in order to find out more about the expectations placed on the research results and their dissemination.

On the basis of these findings, the Steering Committees of the NRP “Energy” developed a synthesis concept for each of the six main topics. In February 2018, an initial draft was available for each of these main topics, including for the area of “Market Conditions and Regulation”. On this basis, these texts were drawn up by Beat Hotz-Hart, scrutinised within the Steering Committees of the NRP “Energy” and edited by a science journalist.

In May and July 2019, an echo group comprising 11 specialists from the worlds of administration and business came together in order to reflect on and assess the draft synthesis (see “Publication details”). They also evaluated the recommendations with a view to their impact and feasibility. Following further revisions and additions, the synthesis was approved in September 2019 by the Steering Committees of the NRP “Energy”.

3. Economic, environmentally compatible and secure electricity supply

The challenges that need to be met by the market during the conversion of the Swiss energy system can best be classified on the basis of the three overriding objectives stipulated under Energy Strategy 2050, namely "economic viability", "environmental compatibility" and "supply security".

3.1. Economic viability: efficiency, growth and distribution

The transformation of the energy system has the potential to trigger a considerable economic impact. It is therefore all the more important to examine regulations as well as promotion and steering measures not only with a view to their direct costs and benefits, but also to take account of their indirect effects.

Market   # Just distribution   # Steering / promotion   # Costs / benefits

3.1.1. Shape steering measures effectively with considered redistribution

Swiss policy paradigms	Instrument classification in literature	Policy instrument	Policy target	
			Electricity	CO_2
Steering-based system	Market-based system	Taxes	Electricity tax	CO_2 tax
Promotion-based system		Subsidies	Open competitive bidding	Building programme
	Command-and-control instruments	Standards	Efficiency standards for electrical appliances	Building programme

Taxonomy of regulatory instruments, which are of key importance for Swiss climate and energy policy.

At a macroeconomic level, steering measures are considerably more efficient and effective than promotion measures and up to five times more cost-effective. This was the clear result reached by model calculations on the Swiss electricity market conducted as part of the project “Promotion or steering-based energy policy”[1]. However, there is a mutual dependency between efficiency and distribution effects, as the gains and burdens are not distributed equally across the different socio-economic groups. There are “winners” and “losers” in both strategies. The distribution effects of the respective strategies do differ, however, in three key points:

- Due to significant changes in energy prices, steering leads to a considerably broader distribution of the effects on freely disposable income between households.
- Most households are better off with steering measures than promotion mechanisms.
- With the promotion strategy, almost all households lose out, while with steering a third of households are better off.

Who benefits or loses out due to steering measures greatly depends on the tax’s redistribution mechanism as well as on a household’s income and energy expenditure. For example, a per capita redistribution protects low-income households against rising energy costs in most cases. On the other hand, homeowners are in a worse position than renters as are households in rural areas relative to households in cities or agglomerations.

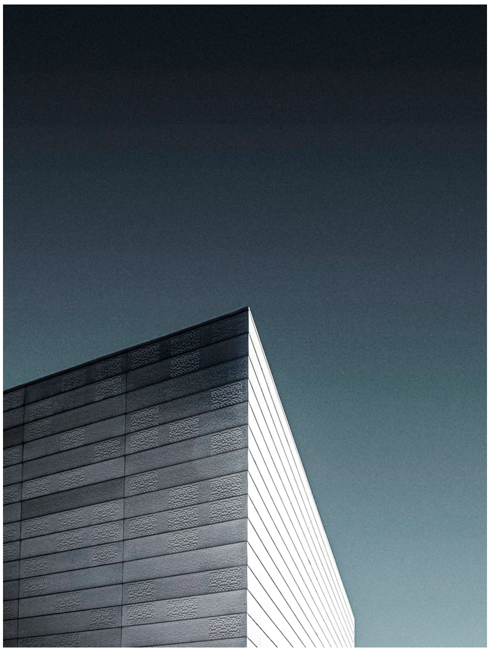
As the project “Tax incentives to reduce energy consumption”[2] showed using the example of motor vehicle taxation in Basel, the respective context is very important with respect to the level of impact achieved. It was not possible to demonstrate any influence on either buying or driving behaviour owing to the relatively small incentives from motor vehicle taxes spread over many years. In order to bring about a change in behaviour, incentives should be immediately perceptible and have a clearly visible and unambiguous impact on prices.

Notes and References

1 Project “Promotion or steering-based energy policy”
2 Project “Tax incentives to reduce energy consumption”

Regulation # Innovation # Costs / benefits # Incentives # Businesses

3.1.2. Measures have a different impact from the perspective of companies



From the perspective of individual companies, the current political framework in Switzerland, Germany and Austria is at least in part responsible for stimulating their decision to introduce environmentally friendly energy technologies. However, the absolute amount that they invest remains largely unaffected by this. In the case of Switzerland, it is unlikely that market incentives alone will lead to sufficient investments in green energy technologies. On the other hand, both voluntary agreements and standards as well as public subsidies and taxes increase levels of willingness. Subsidies also serve to boost investment intensity. These are the results of a survey undertaken as part of the project “Creation and assumption of energy related innovations”[1]. It was conducted simultaneously at companies in the three countries[2]. These assessments from those directly affected serve to partially qualify the results generated by macro-oriented model simulations.
For the development and commercialisation of new technologies in the area of green energy, in particular, positive effects from subsidies, zero impact from voluntary agreements and negative effects from taxes and regulations can be observed. The latter can primarily be attributed to a decline in the financial resources available for product innovations. Negative effects from taxes and regulations on product innovations are offset by the positive impact on demand for energy-efficient products.

According to the results of the survey, the respective energy policy in the three countries has no negative influence on the international market position of the companies. Even relatively high energy taxes and stringent regulations such as those seen in Germany appear not to hamper levels of competitiveness. Companies that have introduced new energy technologies or developed corresponding services and products themselves achieved a higher export performance. The introduction of energy-related technologies has had a positive impact on work productivity. This development has been facilitated by energy taxes as a market-based political instrument.

The project "Energy management as a central driver of energy efficiency'[3] identifies positive effects from voluntary agreements, for example in connection with CO_2 tax exemption and the cantons' legislation governing large-scale consumers. As the companies want to meet their legal obligations to the greatest possible extent in light of compliance considerations, they attach relatively high significance to the implementation of corresponding measures.

Notes and References

1 Project "Energy-related innovations"
2 Stucki, T, Wörter, M (2017): Die Effekte von energiepolitischen Massnahmen aus Sicht der Unternehmen, KOF ETH Zurich, https://doi.org/10.3929/ethz-b-000226767
3 Project "Determinants of energy-efficiency Investments"

Tariff # Bonus / penalty # Behaviour # Households

3.1.3. Combine innovative tariffs with consumption-specific information

On the tariff side, consumption behaviour can either be influenced via progressive prices, which impose additional charges on greater consumption, or via an incentive system, which rewards energy-saving efforts. The project “Energy efficiency in households”[1] concludes that progressive electricity tariffs are more effective than incentive-based systems from a macroeconomic perspective when measured according to their electricity-saving effect. The situation is completely reversed, however, when it comes to the acceptance of the two variants. While fines for excessive consumption are largely rejected, rewards for compliance with the desired behaviour are met with approval. This is consistent with experiences in other countries. No country has progressive tariffs that have been introduced on a voluntary basis. There thus appears to be agreement among experts at utility companies that the appropriate implementation of progressive tariffs requires either political or legislative support.

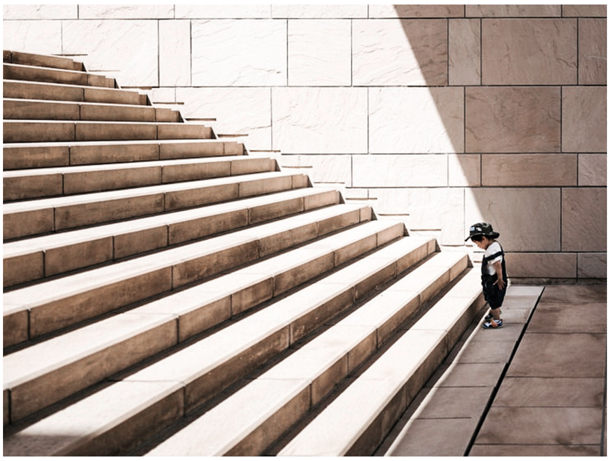
There is a marked increase in acceptance, however, if tariff systems that stipulate punishments in the form of higher prices should an objective not be met (penalty) are combined with the prospect of rewards if an energy-saving objective is achieved (bonus). As shown by the project “Behavioural mechanisms of household electricity consumption”[2], it is not only pricing that can be used as an incentive, but also information. The following applies: the more differentiated the information on electricity consumption is, the greater its electricity-saving effect. While highly aggregated, general consumption information only has an electricity-saving effect of 2 % to 3 %, consumption-specific feedback reduces consumption by 6 % to 10 %. Furthermore, the effect is greatest in those hours during which people are mostly at home. At peak times, reductions of 10 % to 20 % are achieved. In contrast, the impact at other times falls to almost zero. It is therefore worthwhile to break down the consumption components for individual customers in as much detail as possible. Additional temporary material incentives, on the other hand, make virtually no difference.

Notes and References

1 Project "Energy efficiency in households"
2 Project "Behavioural mechanisms of household electricity consumption"

Acceptance # Behaviour # Steering / promotion # Households # Businesses

3.1.4. The best solution from a macroeconomic perspective contradicts the interests of individuals



The most appropriate solution from a macroeconomic standpoint often contradicts the rationality of individual stakeholders. This contradiction is currently standing in the way of a steering-/promotion-based energy policy. For example, model calculations conducted as part of the project "Promotion or steering-based energy policy"[1] clearly show that a steering-based system is significantly more effective, cost-efficient and fairer than a system characterised by promotion measures when viewed from the perspective of the population as a whole. However, as revealed by the project "Energy efficiency in households"[2], the preferences of individual households and commercial enterprises lie on the other side. Households clearly favour subsidies that directly benefit them over progressive taxes. And according to a survey carried out as part of the project "Energy-related innovations"[3], companies also favour subsidies when it comes to the promotion of innovations.

The reason for this contradiction between individual and macroeconomic rationality comes down to how people feel such measures affect them. Figuratively speaking, the pain of losing CHF 1 far outweighs the joy of gaining the corresponding amount of money. As part of "prospect theory", Kahneman and Tversky[4] talk about loss aversion. This is the tendency observed in the fields of psychology and economics for people generally to attach greater significance to individual losses than gains. It seems almost natural that the individuals affected find themselves against a tax or progressive tariffs. Such measures would make them "losers" and thus give them a great incentive to come together and fight against the steering-based system.

Notes and References

1 Project "Promotion or steering-based energy policy"
2 Project "Energy efficiency in households"
3 Project "Energy-related innovations"

4 Daniel Kahneman, Amos Tversky: Prospect Theory (1979): An Analysis of Decision under Risk. In: Econometrica. Volume 47, p. 263–292.

Water fee # Market # Just distribution # Energy suppliers # Politics (federal government, canton, municipality)

3.1.5. Changes in water fees are offset by regional mechanisms

Are water fees primarily a cost factor for hydropower companies or rather a means of legitimately allowing the owners of the natural resource of water to participate in the revenues from the utilisation of hydropower? This question is the subject of controversial debate. The project "Swiss water fee system"[1] focussed on the revenues from hydropower and their distribution in the form of retained and distributed profits, taxes and water fees. Here, it was taken into account that the distribution of revenues is overlapped by various financial equalisation measures both within the cantons and at a national level.

The project concludes that the regulation of revenue distribution is a question of fairness and political economy and cannot be based exclusively on cost considerations. Over time, an adequate capital return should be ensured for the owners of hydropower companies and, at the same time, the holders of water rights must also be compensated appropriately.

According to the project "The future of Swiss hydropower"[2], the biggest recipients of water fees in 2016 were the mountain cantons of Valais and Graubünden with well in excess of CHF 100 million. Ticino, Aargau, Berne and Glarus receive between CHF 26 million and CHF 55 million a year. The gross financial streams relating to water fees represent an important pillar for some cantons (Valais and Graubünden around 50 %; Aargau, Ticino, Berne and Uri around 30 %) relative to the flows from national financial equalisation.

The impact of various water tariff rates at a cantonal level was investigated by the project "Swiss water fee system" on the basis of the canton of Graubünden. With a variation in the tariff rate of between CHF 80 and CHF 110 per kW, the current model comprising municipalities with a high and low level of resources proves to be stable. In contrast, significant changes with rates of CHF 50 or CHF 230 per kW impact the relative financial strength of some municipalities. In the canton of Graubünden, however, this would also be cushioned by the resource equalisation system among the municipalities.

Notes and References

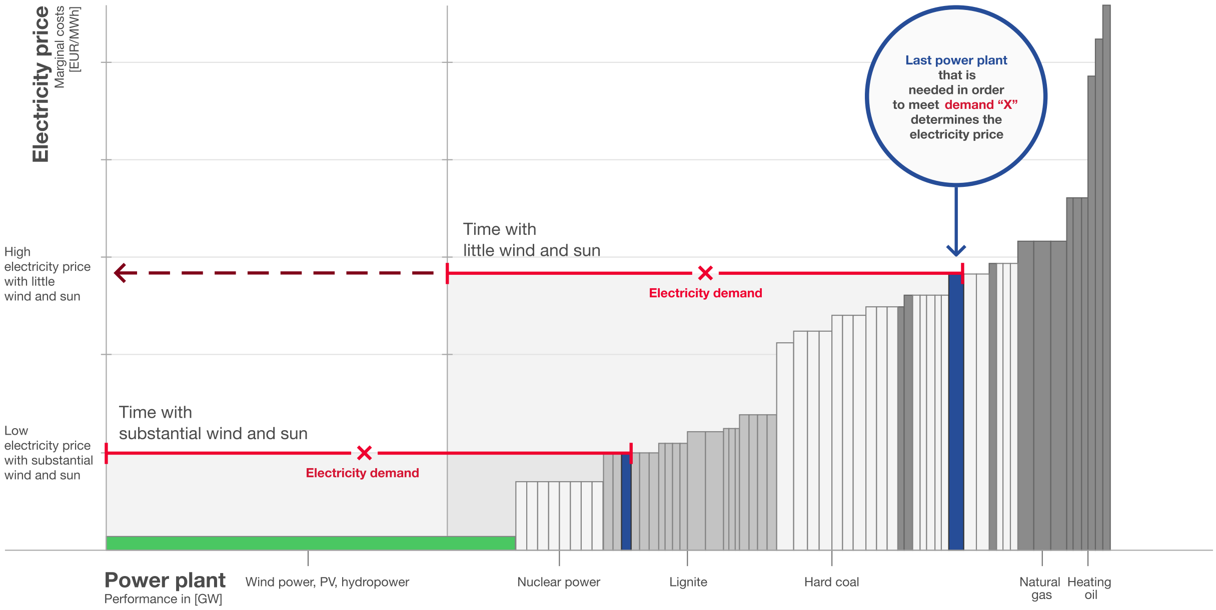
1 Hediger, W., Herter, M., Schuler, CH., 2019, The Future of Swiss Hydropower: Water Fee-induced Financial Flows in Switzerland, Final Report. For the energy-policy background, see SFOE 2018, Eckwerte für ein mögliches flexibles Wasserzinsmaximum – report for ESPEC-N, Berne. Barry M., et al. (2019): The Future of Swiss Hydropower Realities, Options and Open Questions, WWZ Working Paper 2019/08
2 Project “The future of Swiss hydropower”

3.2. Environmental compatibility: expansion of renewable energy

The various measures with which an expansion of renewable energy can be achieved differ in terms of their effectiveness, costs and indirect consequences. The NRP “Energy” investigated the opportunities offered by the market, promotion models and a CO_2 tax.

Market # Wind energy # Steering / promotion # Incentives # Photovoltaics

3.2.1. New renewables need support – and in return provide greater independence



Logic of electricity pricing – "merit order" curve: utilisation of plants in the order of their marginal costs. *Source: own illustration based on Agora, Energiewende 2012, p. 2*

A significant increase in the share of domestic energy production accounted for by new renewables such as solar, wind, biomass and geothermal energy is fundamental for the transformation of the Swiss energy system. This objective can only be achieved with targeted support, as revealed by model simulations conducted as part of the joint project "Assessing future electricity markets"[1]. According to the project's results, the investments initiated by the market alone are too low.

One of the consequences of an exclusively market-based and thus slow expansion would be a marked increase in electricity imports. Viewed over the year as a whole, Switzerland would become a net importer. Through the provision of support for new renewables as part of the planned objectives, imports would be much lower. In this case too, however, Switzerland would also become a net importer of electricity. Wholesale prices will therefore in future be determined by neighbouring countries one way or another.

If Switzerland values its independence in the area of energy provision, this thus represents a further reason to support renewable energy. The model simulations conducted as part of the joint project "Assessing future electricity markets" also show that the price for this would be negligible. For the refinancing of a promotion measure with which the objectives of Energy Strategy 2050 can be achieved, a maximum demand surcharge of CHF 0.008 per kWh is required. This would finance a grant that renewable energy producers receive in addition to the market price.

Notes and References

1 Project "Assessing future electricity markets"

Standard of living # CO2 / greenhouse gases # Innovation # Steering / promotion # Costs / benefits

3.2.2. A CO_2 tax barely slows the economy but triggers innovation

	CO_2 price [EUR/tonne of CO_2e]	Year
United Kingdom	20.6	2013
Republic of Ireland	20	2010
France	44.6	2014
Spain	15	2014
Portugal	13	2015
Netherlands	12.3	2020
Switzerland	84.2	2008
Denmark	20.1-23.5	1992
Sweden	113.8	1991
Norway	3-53.1	1991
Finland	53-62	1990
Estonia	2	2000
Latvia	4.5	2004
Poland	0.1	1990
Slovenia	17	1997

EU ETS only
CO_2 minimum price in EU ETS
CO_2 tax
Noteworthy political plans

CO_2 pricing in the EU, Norway and Switzerland. *Source: https://www.klimareporter.de/international/deutschland-allein-ohne-co2-steuer*

One of the objectives of Energy Strategy 2050 is to bring about a change in the electricity mix through an increase in the share of new renewable energy. One instrument for achieving this goal is a CO_2 tax which sees additional charges for non-renewable energies. However, in light of the fundamental role currently played by carbon-based energy sources, such a strategy has the potential to result in serious side effects. The fear of negative growth momentum is one of the most important reasons behind the resistance to the taxation of CO_2 emissions.

The project “Environmental tax reform and endogenous growth”[1] investigated the effects of a CO_2 tax on economic growth in Switzerland. According to the study, a corresponding tax reform would lead to a reallocation of resources due to new price signals. One outcome would be innovations aimed at reducing the tax burden, a development that would promote growth over the longer term. The negative effects of the tax on production would be offset and the economy could perform at roughly the same level over an extended period.

These model calculations are supported by a survey of companies in Germany, Switzerland and Austria. According to this survey, cost-driving effects from taxes and regulations on product innovations are offset at businesses by the positive impact on demand for energy-efficient products. Technologically very advanced companies especially benefit here. On the other hand, the study shows that promotion measures can only trigger innovations in new energy-efficient technologies if they stimulate demand for such technologies. In this context, the project “Environmental tax reform and endogenous growth” suggests that research and development will play an important role in transforming the economy with a view to achieving the objectives of Energy Strategy 2050.

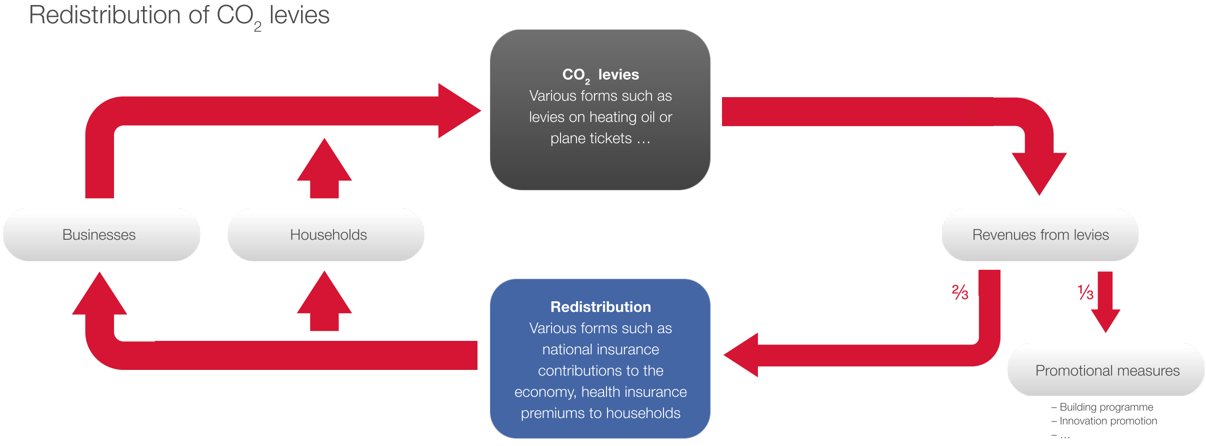
Notes and References

1 Project "Environmental tax reform and endogenous growth"

Standard of living # Just distribution # CO2 / greenhouse gases # Steering / promotion # Costs / benefits

3.2.3. CO_2 levies are best returned as a lump sum

Redistribution of CO_2 levies



The objective of a CO_2 tax is to transform the energy system and not to increase state revenue. The amounts received must therefore be returned to the population and the economy. Two fundamentally different approaches are up for discussion in this regard: a reduction in capital tax or the redistribution of these amounts to the population via lump sums. Significant aspects of the latter correspond to current practice, which sees two-thirds of revenues returned on a lump-sum basis. For the population, this takes place via health insurance premiums, while for the economy this is taken into account in social security contributions. One-third currently flows into federal and cantonal programmes for the energy renovation of buildings.

As the project “Environmental tax reform and endogenous growth”[1] shows, the two variants have very different effects. Measured by its impact on growth, a reduction in capital tax is clearly the better option. It triggers entrepreneurial activities and can also lead to a reduction in overall costs. The impact on prosperity is low in the case of both variants. An environmental reform can, however, only bring about a higher level of prosperity if the benefits associated with an improvement in environmental quality are also monetised in the form of an environmental dividend.

Issues relating to just distribution are at least as important as any impact on economic growth and prosperity. The results here are unclear. If the objective is merely to achieve a minor reduction in CO_2 emissions by means of a low-set tax, a reduction in capital tax fares better. However, if we work on the assumption of high reduction goals and correspondingly high taxes, redistribution via capital taxation comes off worse. The reasons for this are its progressive character and the uneven distribution of capital in the population.

This “unjust” redistribution is reinforced by the fact that the innovations that are triggered by a tax cut primarily increase the returns of capital holders. According to the model simulation, the differences are not very marked one way or the other.

Notes and References

1 Project “Environmental tax reform and endogenous growth”

Price # Guidance # Steering / promotion # Energy provision

3.2.4. Flexible support is superior to pure price or quantity control

With the end of compensatory feed-in remuneration, new models will be required to support renewable energy. As the project group SCCER CREST[1] shows, flexible instruments to this end are superior to pure price or quantity control. However, they necessitate a differentiated structure. Here, issues such as the ability to plan and control costs, including regulatory expenses, as well as the scope of deadweight effects and the handling of any green electricity certificates need to be clarified.

In the case of flexible quantity control, technology-neutral final or expansion volumes are defined for renewable energy. For these volumes to be met, auctions are held, with the most cost-effective offers winning out. The level of promotion is therefore not defined by the state in this model, but rather determined in accordance with competitive principles in the form of auctions. Nevertheless, a price cap should be introduced. Among several factors, it is decisive that there is sufficient competition between the plant operators and that effective sanctions are enforced if the stipulated amount of electricity is not provided despite the awarding of a contract. One disadvantage is that there is a likelihood of deadweight effects, with producers being supported who would have invested in any case even without the promotion measures.

Experience shows that an auction model such as this generates lower expansion rates than is the case with a quota model under which ESCs are required to achieve specific quotas for the expansion of renewable energy. In the case of a quota model, a certificate market is created alongside the electricity market. The certificates can be traded and have a market price. Auctions are more flexible and from a financial perspective are more cost-effective than quota models.[2]

In the case of flexible price control, market premiums are offered for the provision of renewable energy and a maximum quantity is defined. This concept is already in force for the electricity generated by hydropower producers that work below their production costs. However, this instrument is not compliant with EU regulations. This means that it will no longer be permitted if an electricity agreement is reached with the EU.

Notes and References

1 SCCER CREST, 2017, Was kommt nach der kostendeckenden Einspeisevergütung (KEV): Fördern, Lenken, Abwarten? White Paper 3.

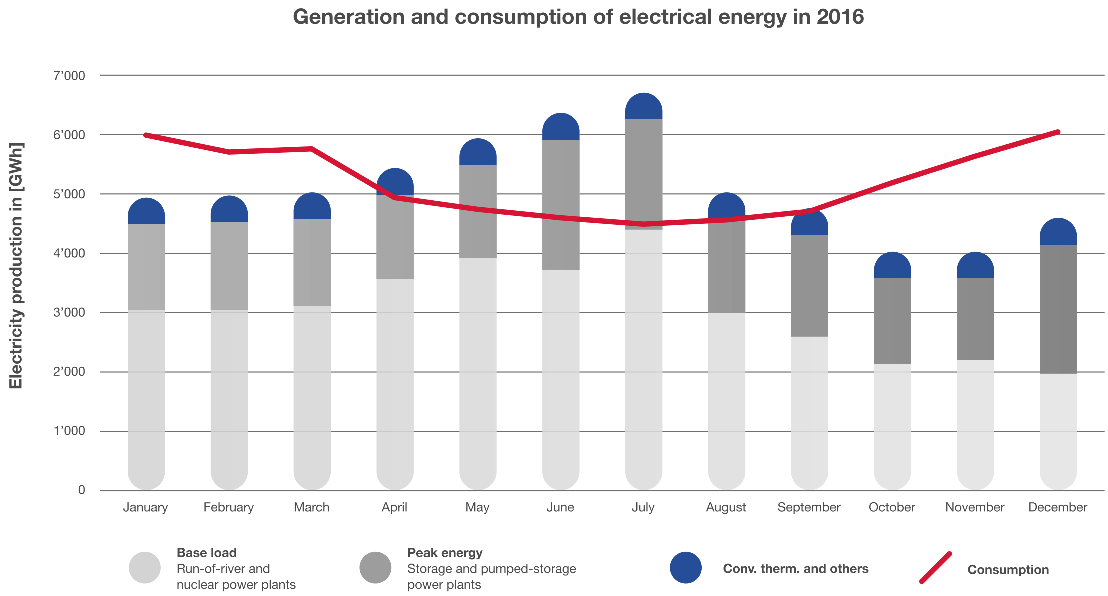
2 See in this regard Hettich, Peter, Walther, Simone, Wohlgemuth, David, Camenisch, Livia & Drittenbass, Joel, 2017, Strommarkt 2023: Quotenmodelle im Zieldreieck vom Umweltverträglichkeit, Wirtschaftlichkeit und Versorgungssicherheit, Schriften zum Energierecht. Volume 6. Zurich. An overview and appraisal of various market regulation instruments can also be found here.

3.3. Supply security: dependent on Europe – but the extent can be shaped

To ensure a sufficient supply of electricity throughout the year is available at the required quality and appropriate rates in a transformed energy system, two key challenges must be overcome: the seasonal and the short-term volatility of solar and wind energy.

Risk # Supply security # Import # Europe / EU # Politics (federal government, canton, municipality)

3.3.1. Additional safeguards against seasonal import risks can be established



Source: Bundesamt für Energie BFE 2017

Supply security in Switzerland primarily depends on water availability and import options. Storage and pumped-storage power plants ensure short-term flexibility. Differences in seasonal provision during summer and winter represent a particular risk for stable electricity supplies over the entire year.

As the joint project "Assessing future electricity markets"[1] shows, the currently applicable EOM (energy-only market) design will still be suitable for ensuring supply security in a transformed environment. This is on the premise that Switzerland is integrated in the European electricity market and remains able to import electricity from a technical perspective. The EOM design primarily focusses on the provisions of the market players themselves. If they fall short, experience shows that they can be supported with control energy via Swissgrid in the event of outages that do not exceed the usual magnitude. But they pay a high price for this. Extremely large outages cannot be fully covered by the control energy market.

In an expanded concept, policy measures could further reduce import risks, which especially exist in winter. This would be the case, for example, if the risk that a neighbouring country could limit its exports to Switzerland is deemed significant.

Two solutions are available here[2]: a strategic reserve or decentralised performance obligations. A strategic reserve[3], for which a relatively low generation capacity is required, is typically acquired domestically. As the central authority, responsibility here is usually assumed by the transmission system operators. It is refinanced by consumers.

Via a decentralised performance obligation, electricity suppliers or large consumers undertake to keep available a certain quantity of generated electricity. This would have to be demonstrated in the form of certificates.

Notes and References

1 Project "Assessing future electricity markets"
2 See the report on behalf of the SFOE, Frontier Economics Ltd (2017): Eckpfeiler des Schweizerischen Strommarktdesigns nach 2020, Berne
3 In the consultation draft on the revision of the Federal Electricity Supply Act of 17 October 2018, the Federal Council proposes that a storage reserve be established in the sense of providing "energy insurance" in order to ensure that Switzerland also has a secure electricity supply in the event of unforeseen extreme situations. This should be put out to tender each year by the national grid company Swissgrid and financed via grid usage tariffs.

\# Price # Supply security # Energy storage # Energy provision

3.3.2. Capacity market or strategic reserve hardly has an impact on wholesale prices

The introduction of a capacity market or a strategic storage reserve would not have any impact on the electricity wholesale market or the investment decisions taken within the Swiss electricity system. This is shown by simulations performed as part of the joint project “Assessing future electricity markets”[1].

In order to assess the impact of the phasing out of nuclear energy and the simultaneous increase in the share of renewable energy on the stability of the energy system, a simulation model that also included Switzerland was developed for Europe at a country level. This was linked to a detailed model for electricity supply and the cross-border infrastructure for electricity transmission.

According to these simulation calculations, the reliability of the system, including electricity transmission itself, does not appear to be an issue even after the phasing out of nuclear energy and an increase in the share of irregularly produced renewable energy.

Two forms of capacity mechanisms were also investigated in order to ensure adequate electricity generation in Switzerland over the long term: a capacity market that ensures a maximum peak load can be handled and a strategic storage reserve.

As the existing generation capacity of pump storage facilities and reservoir plants already exceeds the capacity goal, the introduction of a capacity market has no impact on investment behaviour in Switzerland.

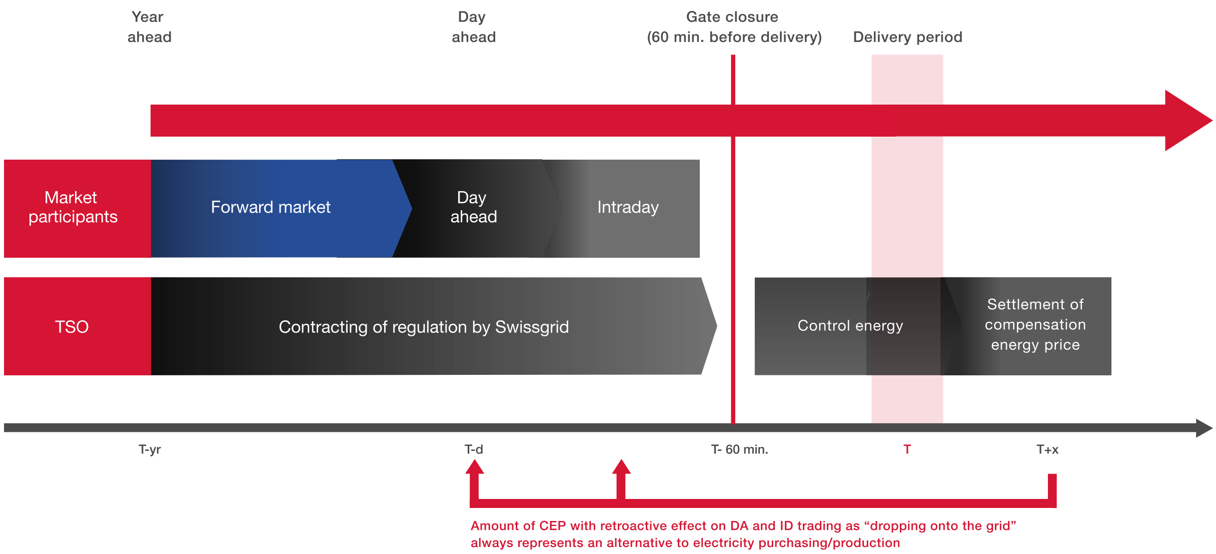
In contrast, a strategic storage reserve requires a minimum amount of energy that remains stored at pump storage and reservoir energy plants at all times. In the simulations, this scenario nevertheless only has a minor impact on the electricity market and has no significant effects on the wholesale price. Investment decisions thus also remain unaffected by a strategic storage reserve.

Notes and References

1 Project "Assessing future electricity markets"

Supply security # Import # Energy grids # Europe / EU

3.3.3. Stable operations are also assured following the transformation



Control energy price with retroactive effect on willingness to pay and prices in upstream markets. *Source: Frontier Economics, in: BFE 2016: Eckpfeiler eines Schweizerischen Strommarktdesigns nach 2020, p. 53.*

The question of whether the Swiss electricity system will even be able to handle the production mix and expected import and export volumes envisaged in Energy Strategy 2050 is fundamental for the supply security of our country. Simulations from the project "Assessing future electricity markets"[1] arrive at the conclusion that no serious threats are to be expected for Swiss electricity grid operations irrespective of the specific development path.

Here, it was assumed that Switzerland will continue to participate in the European internal electricity market and there will be no further restrictions with respect to international electricity exchanges. Furthermore, no stress tests were conducted with extreme assumptions (weather conditions or an increased decline in existing capacities in Germany and France) – this is the task of so-called system adequacy tests[2], which were not part of this project. The lower grid levels were also not incorporated. On the basis of the results, it can be assumed with respect to Switzerland's supply security that, from an operational perspective, no further mechanisms or measures are required that go beyond the already planned grid expansion projects.

The current market design with a spot and balancing market is suitable for absorbing fluctuations against the backdrop of market operations as expected with the implementation of Energy Strategy 2050. The existing hydropower plants together with the available import and export capacities and planned measures, including the expansion of the Swiss transmission grid and load-flow-based bottleneck management, will also be able to ensure stable short-term operations in a transformed energy system with a growing share of solar and wind power[3].

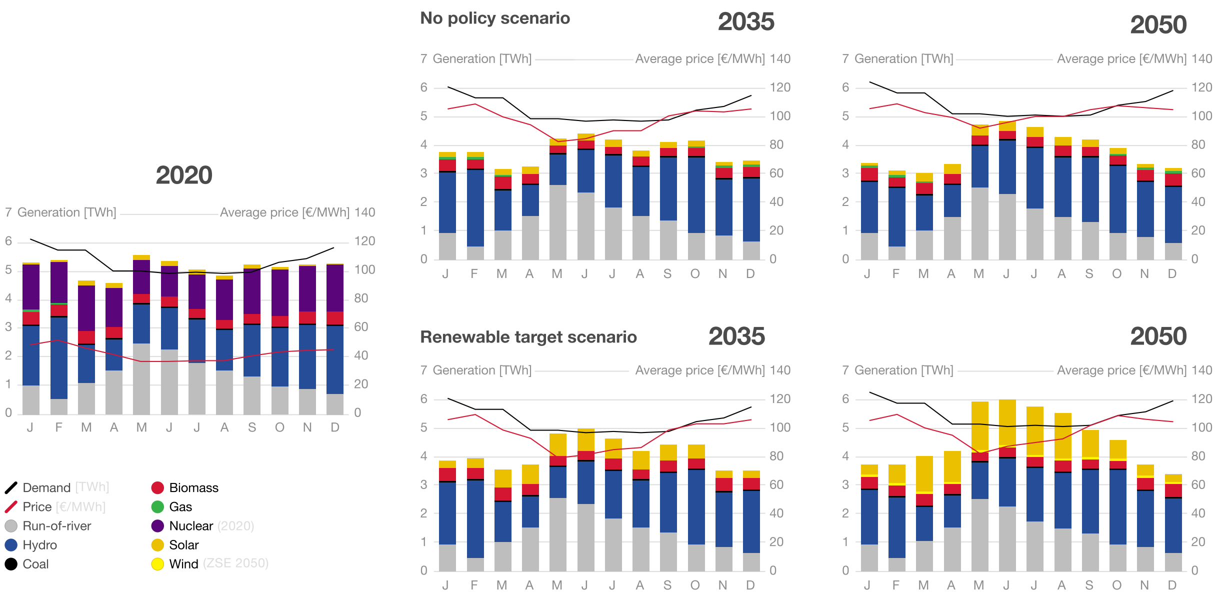
However, it is also important to note that a purely market-based expansion of capacities in Switzerland will only occur to a very limited extent without further financial support. The results underline the key importance of the grid expansion and market access to Europe as well as European market developments for the Swiss electricity market.

Notes and References

1 Project “Assessing future electricity markets”
2 See in this regard by the same authors, SFOE (ed.) (2018): Modellierung der System Adequacy in der Schweiz im Bereich Strom, Berne. “The results show that supply security in Switzerland will in future continue to be classified as uncritical for the most part. (…) Only in the event of considerably reduced generation capacities in the observed countries will there be an increase in supply-critical situations. The biggest influences on the Swiss supply situation are therefore also European system developments”, ibid., p. 73.
3 Project “Future energy infrastructure”

Wind energy   # Supply security   # Import   # Europe / EU   # Photovoltaics

3.3.4. The export-import pattern will become even more pronounced



In both scenarios, the nuclear phase-out leads to a general reduction in electricity production in Switzerland, which is distributed fairly evenly over the months. Thus, in the "no policy scenario", the current pattern of "summer export and winter import" develops into a "year-round import". In the case of the "Renewable Target Scenario", the increased production of electricity by PV will lead to a long-term revival of the pattern of "summer export and winter import". However, total imports still exceed exports. *Source: Figure 4: Monthly Dispatch Results, in: Schaffner, CH. (2019): Assessing Future Electricity Markets (AFEM), Final Scientific Report (umbrella project), p. 7.*

Imports from and exports to neighbouring European countries are essential for Switzerland’s supply security. Simulations from the project “Assessing future electricity markets”[1] show that the exchanging of electricity will increase in light of the transformation of the Swiss energy system and thus become more important.

Here, both the scenarios without special promotion measures for renewable energy as well as those which provide renewables with targeted support lead to a decline in domestic electricity provision and thus primarily to a growth in imports. The reason for this is that in both cases renewable energy cannot make up for the decline in production that will result from the phasing out of nuclear power.

The pattern observed today, i.e. with summer exports and winter imports, will thus become even more pronounced and in both scenarios Switzerland will become an import country across the whole year. Nevertheless, this negative balance will be much lower with the support of renewable energy than would be the case without it.

Over the long term, the provision of active support for the expansion of renewable energy will allow for a supply pattern to be re-established that corresponds to the current situation. Over the entire year, however, total imports will still exceed exports.

Notes and References

1 Project "Assessing future electricity markets"

Regulation # Liberalisation / market opening # Supply security # Import # Europe / EU

3.3.5. The EU sets regulations that shape Switzerland's electricity market design

Due to its central location and close links to the European system, Switzerland is an electricity transit country and Europe's electricity trading hub. Here, prices are largely determined by the pan-European market. Decisions on the market design in neighbouring countries and pan-European developments are therefore key in shaping the Swiss electricity market[1].

The objective of the EU is to link extensively the national electricity markets with the markets of neighbouring countries and to break down existing trade barriers between the member states. Pan-European planning with respect to the expansion and use of the grid infrastructure together with common integrated load and grid management and joint trading systems should create a Europe-wide internal energy market for more than 500 million consumers. Amongst other things, this integrated electricity market will allow member states to acquire from abroad flexibility reserves which have become necessary due to the change to variable energy generation from renewable energy. This is assured as it is invariably the case that the wind is blowing, the sun is shining or a reserve power station is available somewhere in Europe.

The economic benefits of obtaining this flexibility through market mechanisms and cross-border trade are substantial. Viewed over the long term, it is therefore unlikely that Switzerland will be able to continue to afford its own more expensive and less efficient supply security system.

The EU's third energy package from 2009 continues to define the applicable cornerstones. Here, the following provisions are key for Switzerland[2]:

- Completely discrimination-free grid access for producers and free supplier selection for consumers.

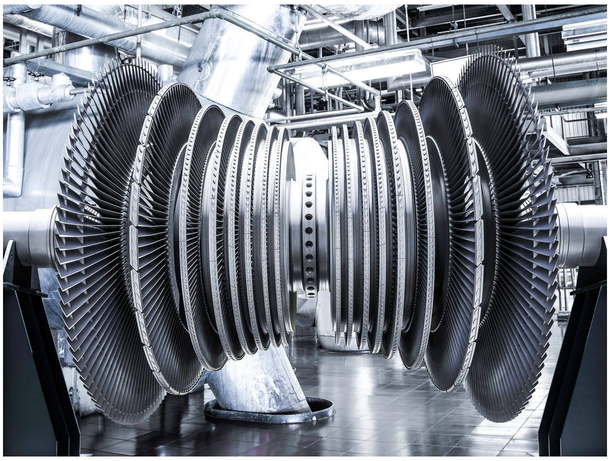
- Monitoring of market participants by independent regulatory authorities that are not permitted to accept government directives.
- Legal unbundling for existing grid operators and so-called ownership unbundling for new grid operators.
- Greater consumer rights such as facilitated supplier changes.
- Creation of the Agency for the Cooperation of Energy Regulators (ACER) which should better coordinate the work of the 28 national energy regulators.

Notes and References

1 It will become more expensive without an electricity agreement with the EU
2 For the future, see the eight legislative proposals of the European Commission from 30 November 2016 under the title “Clean energy for all Europeans” (“clean energy package”) for the revision of other parts of the energy and electricity sector; https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

Regulation # Liberalisation / market opening # Supply security # Costs / benefits # Europe / EU

3.3.6. It will become more expensive without an electricity agreement with the EU



Should an electricity agreement with the EU fail to be reached, Switzerland would be confronted with various disadvantages. These include, in particular, greater investments for supply security, higher wholesale prices and fewer hydropower exports. The extent of these disadvantages will depend on the EU's specific behaviour vis-à-vis Switzerland. This was the finding of the projects "Europeanisation of the Swiss energy system"[1] and "Switzerland and EU energy policy"[2].

In the scenario in which Switzerland does not reach an electricity agreement, both projects show how limited the Swiss electricity industry's room for manoeuvre will be. Swiss companies would no longer be guaranteed equal access to the internal electricity market and even permanent exclusion from European trading platforms would be a possibility.

Cross-border trading would also be made more difficult for larger ESCs due to the lack of a link between electricity trading and the required line capacity: exclusion of Switzerland from "market coupling".[3] The liberalisation of the markets and the harmonisation of market regulations by the EU, which Switzerland has only replicated in part, have already worsened the trading conditions for Switzerland's electricity companies.

The ability to import electricity is likely to decline. This would result in the need for greater investments in domestic equalisation reserves and the storage of seasonal hydropower and solar electricity. However, this would thus also open up regulatory leeway, for example with respect to the promotion of storage solutions and sector coupling between the various energy sources and grids. In terms of technical requirements, however, it will remain important to ensure harmonisation with European legislation.

All of this is leading to uncertainty and risks for electricity trading companies. Cross-border trading is likely to decline with negative consequences for the efficient assurance of supply security and the exportability of flexible Swiss hydropower. This would result in considerable extra costs such as excessive wholesale prices and significantly higher system costs.

Notes and References

1 Project "The European electricity market: staying away will be expensive but will also open up room for manoeuvre"
2 Project "Switzerland and EU energy policy"
3 Market coupling within the European Union's internal electricity market refers to the integration of two or more electricity markets from different areas via an implied cross-border allocation mechanism and has been viewed from the outset as the key instrument for the integration of the EU wholesale markets by the European energy regulators. Instead of explicitly auctioning off the cross-border transmission capacities among market participants, market coupling implicitly makes available the capacities on the electricity exchanges of the different areas.

Regulation # Liberalisation / market opening # Import # Europe / EU

3.3.7. An electricity agreement will be decisive for the Swiss electricity market one way or another

The conclusion of an electricity agreement with the EU will have consequences for the framework conditions of the Swiss electricity market, as shown by the project "Europeanisation of the Swiss energy system"[1]. Even in the absence of an agreement, alignment with European rules on renewable energy in the form of autonomous adoption not only makes sense, but is also essential in order to avoid regulatory conflicts and technical inconsistencies. From a technical perspective, Switzerland is fully integrated in the European grid and is dependent upon it. Grid security can only be ensured in a European context.

At the same time, the regulatory framework conditions must also be compatible with those in Europe. Under the applicable EU regulations, various regulatory aspects would either have to be adjusted or adopted by Switzerland in the event of an agreement[2]:

- The EU's objective of liberalising the electricity markets requires that Switzerland's electricity market is fully opened up (liberalisation phase II).
- The EU guidelines adopt a critical stance with respect to cantonal involvement in utility companies. The transfer of profits to municipalities is viewed sceptically.
- EU regulations on transparency, for instance as regards state aid, must be adhered to. In return, Switzerland would gain a right to aid from EU institutions.
- Certain Swiss promotion measures that benefit hydropower plants conflict with EU state aid legislation. The EU wishes to expose such major facilities increasingly to market price

signals and ensure that any promotion measures are competitive in nature (quota models or auctions) and technology-neutral.

- The new European regulations call for a possibility to exchange renewable energy, for example through self-consumption communities, peer-to-peer energy trading and electricity purchase contracts, even without ESCs. This is only possible to a limited extent under the current Swiss legal framework.
- Agreement on the settlement of disputes with respect to the interpretation and handling of the electricity agreement's contents via an international electricity arbitration court is required. However, this would also provide Switzerland with the right to take action against distortions by other countries.

Notes and References

1 Project "The European electricity market: staying away will be expensive but will also open up room for manoeuvre"
2 For the future, see the eight legislative proposals of the European Commission from 30 November 2016 under the title "Clean energy for all Europeans" (clean energy package) for the revision of other parts of the energy and electricity sector, especially the proposal for an EU directive on common rules for the EU internal electricity market (revised version of the directive on the internal electricity market 2009/72/EU); https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

3.4. Electricity grids: interplay of regional market design and grid infrastructure

The expansion of renewable energy requires more flexible transmission and distribution grids that can deal with decentralisation and greater production volatility. At the same time, the grids need to be made intelligent to allow for transparent monitoring and dynamic tariffs.

Prosumers # Guidance # Decentralisation # Households # Energy suppliers

3.4.1. Make the market more flexible by involving consumers

The growing importance of wind turbines and photovoltaic plants represents a challenge for market design. As the project group SCCER CREST 2018 shows[1], due to the decentralisation involved, both investment and usage decisions have to be coordinated by a markedly increased number of stakeholders who are significantly more heterogeneous. The future electricity system will likely not only see a few hundred major power plants interact with one another, but rather also several hundred thousand smaller units. And new stakeholders will also emerge. These include so-called prosumers who act as both consumers and small-scale producers.

Until now, electricity has been provided on the basis of consumer demand ("generation follows demand"). With the increase in the share of renewable energy and the associated volatility, a need is also emerging to adjust demand in line with current and weather-dependent electricity provision ("load follows generation"). Ensuring adequate system flexibility exclusively via the generation side would not be cost-efficient.

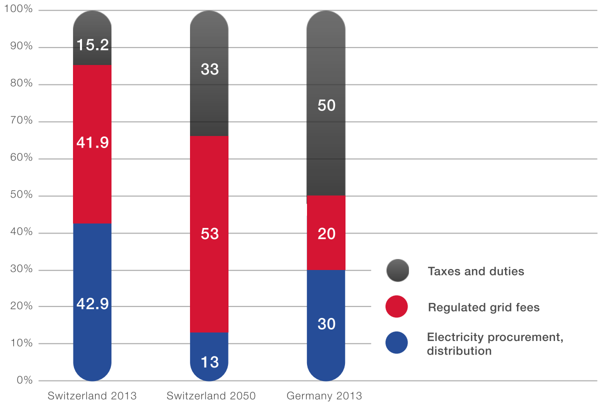
The energy-policy decision as to whether the current pattern of "generation follows demand" is to be maintained, or whether a switch to a "load follows generation" approach should be accepted and pursued, is fundamental for the further development of the market. In the latter case, the design of the existing "energy-only market" can be preserved with slight adjustments. However, the greater involvement of consumers will be necessary to this end, for example through the use of flexible tariffs based on time or an interruptible supply. This will allow for demand flexibility to be used to an economically viable extent and desired investments in decentralised generation and storage plants to be stimulated at a macroeconomic level. Such a system would lead to a significantly different supply architecture. Instead of expensive overcapacities and backups, flexible demand and decentralised storage would offset the majority of fluctuations.

Notes and References

1 See SCCER CREST 2018, Strommarktdesign: In welche Richtung soll es gehen? White Paper 5 - June/2018; Weigt, H, Strommarktdesign: Die Politik bestimmt die Richtung, in: Die Volkswirtschaft, Heft 12, 2018.

Smart meter # Digitalisation # Energy grids # Guidance # Costs / benefits

3.4.2. Intelligent grids are more cost-efficient than a conventional grid expansion



Components of electricity price for end consumers: an expression of energy strategy.
Source: Association of Swiss Electricity Companies (VSE)

Due to the growing share of renewable energy, the energy landscape is becoming considerably more fragmented with smaller units. This development is leading to occasionally significant feed-ins from volatile, decentralised generating plants via the distribution grid as well as far more diverse electricity consumption patterns.

In the decentralised distribution grids, an increasing prevalence of bottlenecks and surpluses is to be expected. To avoid this, grid operators can opt for a conventional grid expansion in the form of grid optimisations, grid reinforcements and the construction of new lines. Alternatively, however, they can also utilise flexibility in terms of the grid users' behaviour in order to rectify bottlenecks within a shorter period and in a more cost-efficient manner.

On the producer side, the variable feed-in power of plants provides economically viable flexibility. For consumers, the controlling of industrial consumption processes as well as the consumption patterns of households, the battery charge cycles of electric vehicles and the use of decentralised storage systems provide opportunities for flexibility in the area of load management.[1]

The project "Integration of sustainable multi-energy hub systems from the perspective of system control" shows the benefits of decentralised, intelligent systems. Multi-energy hub (MEH) approaches allow for the operation of systems that incorporate entire urban districts or villages. The procedures allow for operating costs to be minimised and also take account of data protection considerations as only a minimum of data is exchanged. They support system security and provide opportunities for avoiding costly grid expansions. To this end, the project developed an intelligent network and specific control algorithms on the basis of two case studies in Zernez and Zurich Altstetten. A control solution comprising centralised systems proved not to be feasible for such cases.

Notes and References

1 SFOE (ed.) 2016, Smart Grids in der Cost+ Regulierung, E-Bridge Consulting GmbH, Bonn; Frey, H., Lastmanagement mit intelligenten Tarifen, in: e & i Elektrotechnik und Informationstechnik, October 2009, Volume 126, Issue 10, p. 358–364.

Feed-in renumeration   # Tariff   # Energy grids   # Guidance   # Energy storage   # Incentives

3.4.3. Smooth out loads with grid-assistive consumption and feed-in behaviour

The policy objective is to expand electricity supply through new renewable energy. This means an increase in fluctuating production and thus a changed load pattern in the decentralised distribution grids. Situations will emerge in which the load can no longer be covered by the grid and the need for flexibility in system operations increases.[1]

Flexibility potential for grid-assistive behaviour can be created and utilised in various ways[2]:

- With respect to self-consumers ("prosumers"), make flexible use of loads that can be switched on and off depending on the available options (heat pumps, decentralised storage, battery capacities or charging of electric cars).
- Reduce and curtail peaks via feed-in management and relativise the purchase obligation of ESCs.
- Make use of energy conversion in seasonal storage.

A clever combination of flexible, grid-assistive self-consumption and feed-in behaviour can lead to relevant cost savings in the distribution grids over the medium to long term.

The mobilisation of this flexibility potential and the choice between the different options should be implemented via the market and associated incentives. For example, ESCs could reward grid-assistive behaviour by offering local units batteries against payment or compensating PV operators for curtailing output. For grid-assistive use, the available and required capacity would have to be determined and managed as part of a forward-looking bottleneck forecast. There is currently no market for grid availability, while grid shortages do not yet have a price.

Notes and References

1 SCCER CREST 2016, Netznutzungstarife im Zielkonflikt: Anreize für den Ausbau

erneuerbarer Energien versus Verursachergerechtigkeit, White Paper 2.
2 Federal Network Agency 2017, Flexibilität im Stromversorgungssystem - Bestandsaufnahme, Hemmnisse und Ansätze zur verbesserten Erschließung von Flexibilität, Bonn, especially p. 28ff. New organisational forms for bottleneck management in the distribution grid.

Prosumers # Just distribution # Tariff # Energy provision # Photovoltaics

3.4.4. Avoid unfair cross-subsidisation during the expansion of private PV plants

An expansion of local PV plants to the planned extent will not only cause additional costs for the distribution grid, but also hinder their financing. In particular, if less electricity is consumed via the distribution grids, due to self-consumers drawing high levels from private facilities, the consumption-dependent grid usage tariff currently in effect means that the financing base for distribution grids will be diminished. Furthermore, the costs are not attributed to their source. Instead, there is cross-subsidisation of self-consumption and thus redistribution. Electricity users who are not self-consumers are forced to bear the share of grid usage costs that are lost by the distribution grid operators due to the self-consumption of prosumers.[1] This tends to place a strain on lower-income and less wealthy groups while easing the burden on the wealthier.

This system does not allocate the costs to their source. Grid usage tariffs should provide incentives for an efficient local energy supply infrastructure comprising the grid, storage mechanisms and generators. At the same time, they should also assign the relevant costs to their source. Both of these requirements must be coordinated with the incentives for the expansion of renewable energies. A basic grid contribution would be a possible solution.

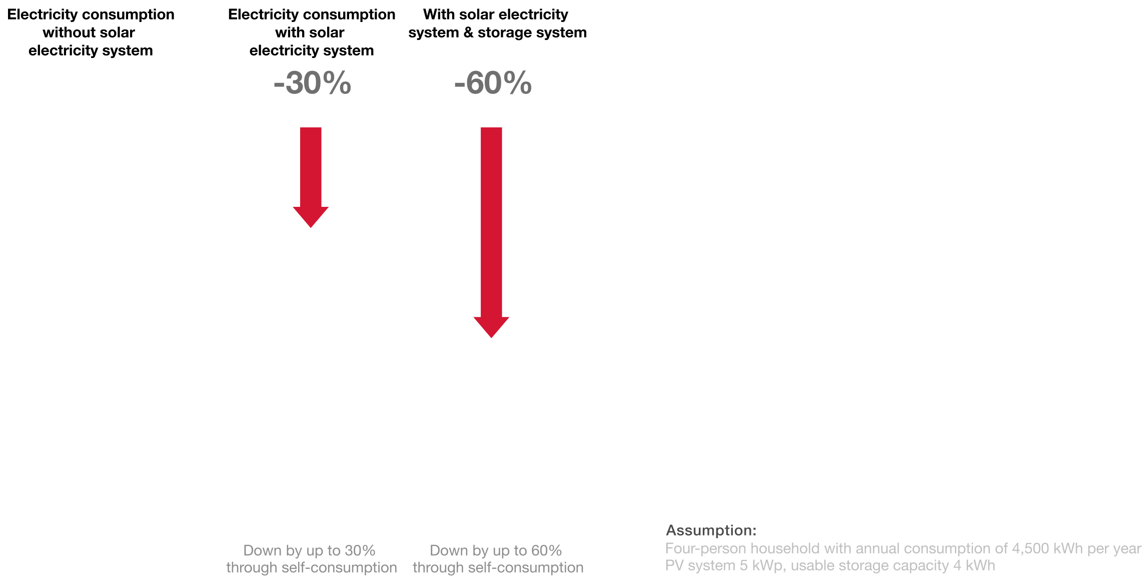
The specific implementation of these coordination measures depends on the regional distribution grid operators. To this end, they must first develop new business models in the area of regional flexibility provision. There are still only a few innovative grid-assistive business models. This is primarily related to the current framework conditions which hardly provide end customers and “prosumers” with any incentives to behave in a grid-assistive manner or to make investments in storage solutions and smart grid technologies.

Notes and References

1 Ulli-Beer S., Hettich P., Kratz B., Krause T., Kubli M., Walther S., Kobe C. (2016): Netznutzungstarife im Zielkonflikt: Anreize für den Ausbau erneuerbarer Energien versus Verursachergerechtigkeit, SCCER CREST (ed.) White Paper 2.

Tariff # Energy grids # Energy storage # Decentralisation # Incentives

3.4.5. Make regulations for local storage solutions attractive



Small solar power storage units: up to 60 % less electricity from the grid.*Source: Frauenhofer ISE, Quaschning HTW Berlin, BSW-Solar*

Within a certain area, the performance peaks of PV plants are usually synchronous. On a long and very sunny day, for example, this can quickly lead to the overloading of grids. Instead of the expensive expansion of grid capacity, these loads could be intercepted using storage systems that are charged during production peaks and discharged at a later time. Decentralised storage solutions at a district level, for example, could thus make a considerable contribution to a secure and efficient renewable electricity supply.[1]

At present, however, they are no incentives for the relevant stakeholders to utilise storage solutions of this kind in a system- and gird-assistive manner. If the process for charging and discharging electricity to a battery is deemed to be final consumption, a grid charge is incurred for both the storage and delivery of the electricity. Even though it can be passed on in part, this double charge makes system-assistive storage solutions economically unattractive.

A corresponding regulation in the Electricity Supply Act is pending. The costs of the grid are largely due to its dimensioning in accordance with the performance limits of the components. The decisive factor for the grid usage fee should therefore not be the amount of electricity effectively transported via the grid, rather the maximum power required by a grid user at a certain time. The current static grid usage fees, which are largely quantity-based, do not replicate network bottlenecks.

Notes and References

1 With respect to the mentioned issue, see SCCER CREST 2016, Netznutzungstarife im

Zielkonflikt: Anreize für den Ausbau erneuerbarer Energien versus Verursachergerechtigkeit, White Paper 2; Forum Energiespeicher Schweiz, Jahresbericht 2018, especially p. 13ff. Stellungnahme zur Revision des Stromversorgungsgesetzes (volle Strommarktöffnung, Speicherreserve und Modernisierung der Netzregulierung), https://speicher.aeesuisse.ch/files/user/pages/de/speicher/PDF/FESS_Jahresbericht_2018.pdf as well as Walther, S 2018, Gutachten zum regulierungsrechtlichen Umgang mit Energiespeichern in der Schweiz, https://www.dike.ch/Schriften_zum_Energierecht/Walther-Regulierung-von-Energiespeichern

Energy cooperative # Participation # Acceptance # Decentralisation # Energy suppliers

3.4.6. Support the transformation of the energy system with self-consumer energy communities

Source: SCCER FEEB&D, Portia Murray

At a local and regional level, energy cooperatives or self-consumer energy communities such as "communal solar" can make an important contribution to the transformation of the energy system. Energy cooperatives are pioneers which utilise new technologies and organisational procedures such as local consumption and the exchanging of energy between members. They work intensively with municipalities and in doing so advance local energy policy and its implementation. For the municipalities, they are welcome partners who support them in the development and implementation of their energy policy. See also in this regard the project "Regulations for the building stock"[1].

The project "Collective financing of renewable energies"[2] concludes that the organisation of the electricity market does not play a major role during the establishment of energy cooperatives. A territorial monopoly enjoyed by a utility company can even be a benefit here as, due to less pronounced competitive pressure, the energy provider is more inclined to support the cooperative or procure the generated electricity at cost-covering prices. However, the cooperatives are thus dependent on the goodwill of the energy supplier or on the political will that determines the energy supplier's focus. In the case of reluctant energy suppliers who only pay a small amount for the feeding in of electricity, the greater liberalisation of the electricity market could open up new sales opportunities for energy cooperatives. Furthermore, such market liberalisation would also provide greater potential for the networking of energy cooperatives, for example in the form of joint business activities.

Until now, however, the quantity of renewable energy produced by energy cooperatives has been very modest. Swiss energy cooperatives are also hesitating to extend their activities as the communal energy suppliers or consumers do not cover their costs and their access to feed-in remuneration is limited. The project "Collective financing of renewable energies" emphasises that they require greater support in order to be able to expand.[3]

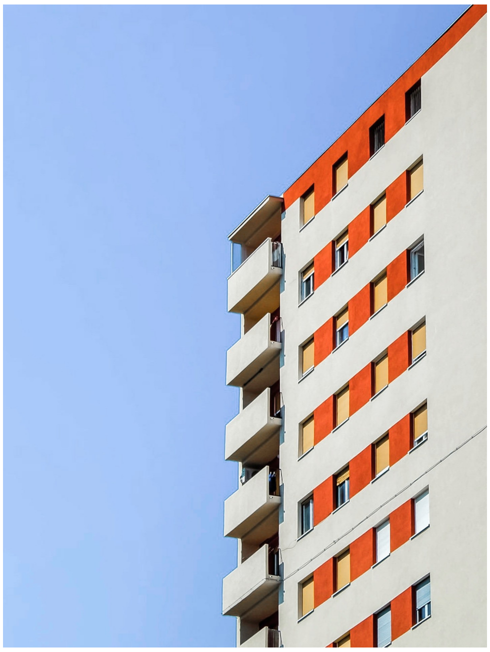
Energy hub, a multi-energy system that comprises various conversion and storage components as well as networks, has comprehensive local control mechanisms and can be brought into effect on different scales spacially.

Notes and References

1
2 Project "Collective financing of renewable energy"
3 Local community solutions promote the use of solar energy

Participation # Wind energy # Acceptance # Decentralisation # Photovoltaics

3.4.7. Local community solutions promote the use of solar energy



Alongside energy cooperatives, consumer associations, so-called “community solar” groups, can contribute to the distribution of building-integrated photovoltaics (PV). This was demonstrated by the project “Overcoming opposition to PV”[1].

“Community solar” is a concept for local solar installations that are used on a shared basis by several community participants, households and traders. These procure electricity from the installations in accordance with their purchased share. Such projects can relate to both community-owned projects as well as to plants of third-party providers such as local ESCs, whose electricity is shared by a community. Members of the community get the opportunity to utilise the benefits of solar energy even if they are unable to or do not wish to install solar panels on their property as they are tenants, for example. Ideally, the participants obtain electricity from the community solar park at a lower price than they would normally have to pay with their electricity supplier[2].

The project’s survey results show that more than 60 % of electricity consumers are willing to be part of such a solar network, irrespective of whether the offer comprises an integrated PV system or a PV system added to the facade. It was also shown that the likelihood of building owners installing a PV system is greater if their neighbours, family members of friends already use corresponding solutions. Direct contact with PV users makes consumers more energy-savvy and means they increasingly look for solutions themselves.

This finding corresponds to the general findings of the NRP Energy synthesis on “Acceptance”, according to which the people of Switzerland prefer the production of energy to be as local as possible[3]. The acceptance of projects also increases markedly if they are based on people’s existing social networks[4].

Notes and References

1 Project “Overcoming opposition to PV”
2 Project “Economics of multi-energy hub systems”
3 Use local links as an effective argument!
4 Use the powers of persuasion of social networks and role models!

Regulation # Digitalisation # Cooperation # Decentralisation # Energy suppliers

3.4.8. Data recording and exchange in an operable electricity system requires rules

The ongoing transformation of the energy system is being shaped by digitalisation. This process is posing the stakeholders with new challenges. The volume of data in the energy system is growing rapidly. Information increasingly has to be exchanged and processed in real time. The heightened requirements with respect to the forecasting prowess of all market players are also increasingly influencing the shape their market roles take. Examples include the integration of decentralised units in the electricity system, the use of flexibility via the involvement of consumers by means of intelligent grids and differentiated tariff models, the pricing of flexibility for optimal infrastructure utilisation and finally the optimisation of the entire system. The vertical coordination between transmission and distribution grid operators as well as the horizontal coordination of grid operators at the same level must be strengthened to this end.[1] This will require the availability and exchange of data between different stakeholders and grid levels.

Due to the necessity for data exchange, a variety of challenges emerging. In order to deal with them intelligent regulation must make a considerable contribution. The creation of data hubs, which provide all parties with equal access to information and facilitate quicker processes, represents one model to this end. Here, it must be determined who receives which data from whom and who should use and assess this data. It is just as important to ensure the temporal availability and quality of data as it is to guarantee data protection and security. How this is to be organised and financed is still completely open. In the case of some of the envisaged concepts, however, it is questionable whether the costs and benefits are appropriately balanced.

Models that require an information flow across several stages of the value chain also entail the risk of information misuse. Or they may lead to vertical integration and thus collide with the objective of “unbundling”. Unbundled companies, for their part, have incentives to withhold information. The rules for “unbundling” should therefore be formulated in a clearer and more succinct manner.

Notes and References

1 Project “Software-based real-time grid control”, Project “Sustainable decentralised power generation”, Project “Control of multi-energy hub systems”, Project “Energy efficiency in households”, Project “Future energy infrastructure”.

4. Recommendations for action for a well-functioning electricity market

The Swiss electricity system is complex and is closely interwoven with other energy sectors as well as with the European market. Transformation in the sense of Energy Strategy 2050 requires a combination of various measures that must be well co-ordinated and EU-compatible. An echo group of experts from business and administration (see 'publication details') discussed and evaluated the recommendations with a view to their impact and feasibility.

4.1. Supply: further develop the electricity mix

To considerably increase the share of new renewable energy, first and foremost it is politicians who need to take action. They need to ensure the provision of efficient support in the form of flexible instruments tailored to the market maturity of the individual technologies. This also includes the broad use of CO_2 levies and better framework conditions for local organisational models such as self-consumer energy communities. New renewable energy needs to be integrated in the electricity system and gradually transferred to the free market.

Public administration # Associations and NGOs # Energy suppliers # Politics (federal government, canton, municipality)

4.1.1. Support the expansion of new renewable energy!

The investments required for the expansion of new renewable energy as per Energy Strategy 2050 cannot be triggered by the market alone. Reliable framework conditions are required for the provision of efficient support here.

Simulations conducted in the project "Future electricity market models"[1] and the survey results of the project "Energy-related innovations"[2] show that it will not be possible to achieve the energy strategy's objective by 2050 without support measures for new renewable energy. Investment for the required expansion of capacity that comes from the market alone is inadequate. The new renewables must therefore be provided with targeted and effective support until further notice. The model calculations also show, however, that effective support can be provided at a relatively low cost.[3] Existing regulatory (approval processes) and fiscal (various taxes on PV investments) obstacles offer additional scope for reform.

The provision of support for new renewables can also ensure that Switzerland returns to its current export-import pattern over the long term even if total imports will still exceed exports in this case due to the phasing out of nuclear power[4]. The negative balance will be much lower with the support of new renewable energy than would be the case without it.

The prerequisite for the required long-term investment is a forward-looking and consistent energy policy that guarantees a high level of planning security and efficient approval processes.

Notes and References

1 Project "Future electricity market models"
2 Project "Energy-related innovations"
3 Project "Future electricity market models". According to the model simulation, the objectives for new renewable energy should be achievable with a premium of no more than EUR 0.038 per kWh, which means a demand surcharge of EUR 0.008 per kWh. Here, various assumptions are made such as a defined level of supply security, the development of electricity demand and the phasing out of nuclear energy by 2035. The investment costs for new renewable energy are based on the results of the project "Future energy infrastructures", with exogenous technological progress as per the EU Reference Scenario also being taken into account. Investment costs for new renewable energy thus fall over time.
4 Import-export pattern will become even more pronounced

Public administration # Associations and NGOs # Politics (federal government, canton, municipality)

4.1.2. In principle, steering should be given preference over promotion, but this depends on the objective!

From the perspective of a well-functioning market economy, steering measures in the area of electricity are to be given preference over promotion measures. At a macroeconomic level, they are considerably more effective than promotion measures and significantly more cost-effective.[1]

Politicians have two fundamental strategies for pursuing the consumption objectives laid down under Energy Strategy 2050 and CO_2 legislation: promotion measures with subsidies and price guarantees or the steering of consumption through the taxation of energy and CO_2. Mandatory specifications can also be imposed such as efficiency requirements for appliances and exhaust emission limits for vehicles.

The project “Promotion or steering-based energy policy”[2] concludes that steering is significantly more efficient from a macroeconomic standpoint and up to five times more cost-effective than promotion. In particular, promotion measures only reduce energy consumption where the relevant mechanisms are put in place and there are also invariably certain aspects that receive support that would have been achieved in any case. In contrast, steering measures have an impact everywhere and on every energy-relevant decision taken by households and companies.

In individual cases, however, the choice of the instruments to be used depends on the objectives to be achieved. Depending on the market maturity of a technology, for example, different support forms are optimal for increasing the share of new renewables.[3] New, less mature technologies for which the achievable market price is still well below manufacturing costs require secure investment conditions. They need to be promoted in a targeted manner through subsidisation measures such as compensatory feed-in remuneration or a one-off contribution. With the increasing marketability of the technology, the criteria of efficiency, the incentive to innovate and market proximity become more important for the selection of promotion instruments. Here, instruments such as quotas or auctions are more suitable. The promotion instruments must therefore be time-flexible and utilised in such a way that market participants can gradually be prepared for competition. Regulation needs to be adjusted. In the case of solar energy utilisation, the market must function in such a way that no further additional state investment incentives are required by 2035 at the latest.

Notes and References

1 Project "Promotion or steering-based energy policy", Project "Future electricity market models"; also SFOE (ed.) 2013, Energiestrategie 2050, Konzeption des Übergangs von einem Förder- zu einem Lenkungssystem, Literaturanalyse und Varianten, final report, Berne.
2 Project "Promotion or steering-based energy policy"
3 See Banfi, S., Minsch, J., 2012, Wie soll Strom aus erneuerbaren Energien gefördert werden? Swiss Academy of Engineering Sciences (SATW), Zurich, p. 16f.

Public administration # Energy suppliers # Politics (federal government, canton, municipality)

4.1.3. Use flexible instruments to support renewable energy!

The provision of support for new renewable energy is more efficient if, instead of fixed prices and quantities, adequate market mechanisms such as quantity control with price caps, tenders or market premiums are used.

As yet less mature technologies for new renewable energy have been promoted for a number of years with compensatory feed-in remuneration. As these technologies approach market maturity, this subsidisation should be replaced by instruments with greater market proximity that are both efficient and provide the required incentives for investment.

At an advanced phase of the transition to market maturity, flexible quantity control is appropriate.[1] Here, the targeted expansion during a specific period is defined by politicians, be this in the form of capacity or the amount of electricity produced. As part of a transparent tender procedure, the most efficient or cost-effective providers are then awarded the contract. The level of promotion is therefore not defined by the state, but rather according to competitive principles by means of auctions. Nevertheless, a price cap and rules for well-functioning competition among the providers should be observed.

Flexible quantity control via tenders also provides incentives for investment in technical progress and thus increases competitiveness among the electricity producers. In comparison to quota models, auctions generally achieve lower expansion rates. However, they are more flexible as well as more favourable from a financial perspective.[2] Flexible price control represents an alternative to flexible quantity control. Here, market premiums are offered for the provision of renewable energy, with a quantity cap being defined.

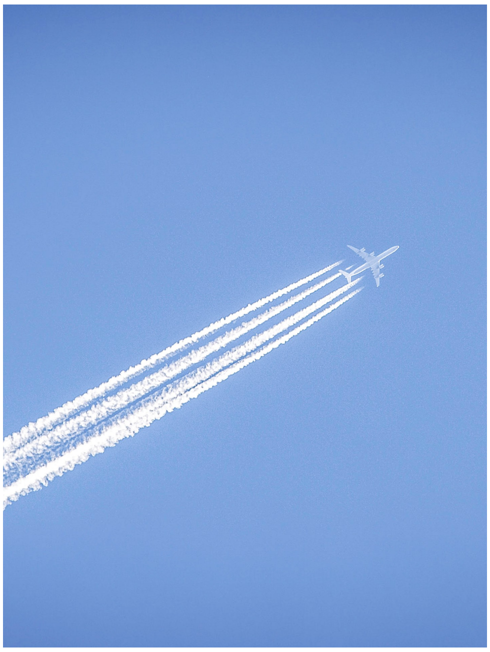
Notes and References

1 See SCCER CREST, 2017, Was kommt nach der kostendeckenden Einspeisevergütung (KEV): Fördern, Lenken, Abwarten? White Paper 3, January/2017, p. 7f. Hettich, Peter, Walther, Simone, Wohlgemuth, David, Camenisch, Livia & Drittenbass, Joel, 2017, Strommarkt 2023: Quotenmodelle im Zieldreieck vom Umweltverträglichkeit, Wirtschaftlichkeit und Versorgungssicherheit, Schriften zum Energierecht. Volume 6. Zurich.

2 Hettich, P., Walther, S., Wohlgemuth, D., Camenisch, L., Drittenbass, J. (2017): Strommarkt 2023: Quotenmodelle im Zieldreieck vom Umweltverträglichkeit, Wirtschaftlichkeit und Versorgungssicherheit, Schriften zum Energierecht. Volume 6. Zurich, p. 88f.

Public administration # Energy suppliers

4.1.4. Use CO_2 levies in all areas as a steering instrument!



Incentive levies on CO_2 emissions have almost no negative impact on economic development. They are effective and efficient and should therefore be applied in as many cases of fossil energy production and consumption as possible.

CO_2 taxes which price in the negative environmental impact of the use of fossil energy are a prominent steering measure. They are an important cornerstone of Swiss climate and energy policy and should be applied in all areas, including electricity imports. The passing on of such a tax in the form of rising wholesale prices for such energy sources is expressly desired here in order to change the energy consumption mix. Instead of a flat-rate consumption tax, electricity only becomes more expensive in the case of a CO_2 levy if it originates from fossil fuel production.

It is important that, as has been the case until now, the taxes are levied in a manner that is as technology-neutral as possible and that the associated revenues are likewise redistributed to the population and economy in a fashion that is neutral in terms of state quotas. In return for the CO_2 levies, other less efficient promotion measures within the electricity and heating sector also need to be replaced.

It can be seen that CO_2 levies of this kind have almost no negative economic impact. According to model simulations conducted as part of the project “Environmental tax reform and endogenous growth”[1], an environmental tax reform with stringent CO_2 emission goals can even have a positive impact on growth as there is an increase in investments in innovations aimed at increasing energy efficiency. These can compensate for the negative base effect of higher CO_2 taxes on production.

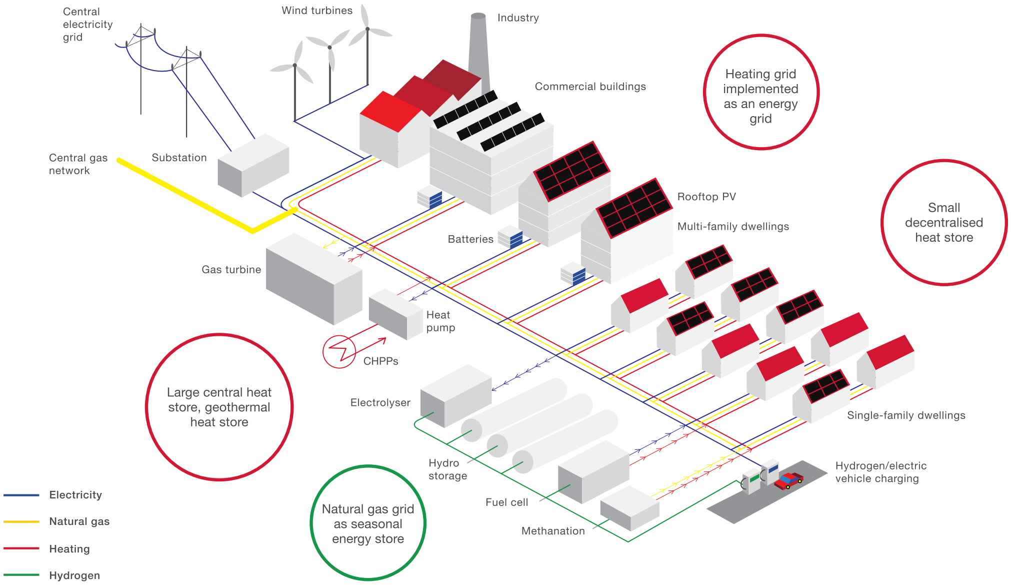
However, the effects are greatly dependent on the way in which tax proceeds are reimbursed. Redistribution through a reduction in capital taxation is the preferred option with a view to growth.[2] Here, it is assumed that the international competitiveness of companies will not be hit to the extent that they relocate their activities abroad. This risk can be minimised with a European minimum price for CO_2 emission certificates. Other less efficient (promotion) measures in the electricity and heating sector are to be replaced in return for a CO_2 levy.

Notes and References

1 Project “Environmental tax reform and endogenous growth”
2 See also in this regard SCCER CREST, 2019, Politische Maßnahmen zur Reduzierung der Energieeffizienzlücke, White Paper 8, January/2019.

Public administration (federal government, canton, municipality) # Associations and NGOs # Households # Energy suppliers # Politics

4.1.5. Establish optimal conditions for local organisational models!



Energy hub, a multi-energy system, that is comprised of various transformation, storage and network components. It has a local steering mechanism and can be put into operation to cover different spacial scales. *Source: SCCER FEEB&D, Portia Murray*

The breaking down of barriers to the formation of energy cooperatives and self-consumer energy communities pays off twice over. These not only help to increase the share of renewable energy, but also serve to promote local energy policy.

Energy cooperatives and self-consumer energy communities (SCCs) such as “community solar” can make an important contribution to the transformation of the energy system at a local and regional level. Energy cooperatives[1] apply new technologies and organisational approaches, work intensively with municipalities and in doing so advance local energy policy and its implementation. “Community solar”[2] refers to local solar plants from which community participants such as households and traders obtain electricity in accordance with their invested share. This can take place both via community-owned projects and via plants of third-party providers whose electricity is shared by a community. Decentralised multi-energy hub systems (DMES) that intelligently link electricity, gas and heating grids as well as storage solutions and energy consumers are a similar promising model[3].

SCCs and DMES solutions should have a certain amount of self-regulation behind their grid connection point – for example with respect to the use of storage solutions – without this being abused by local regional monopolies. Distribution grid operators are their partners with responsibility for grid financing and investments, grid stability and ancillary services. Initial pilot projects of this kind such as the Quartierstrom Walenstadt district electricity project headed up by the ETH Zurich[4] are already up and running.

SCCs are in future likely to control a large number of small-scale and micro plants. As aggregators, they will thus also be able to bundle the flexibility they provide and make it available accordingly. By means of scaling from single-family homes to regional associations, they have the potential to contribute to balancing energy and to act as players in the energy trading sector.

This could lead to competition in the areas of communal and cantonal energy concepts as well as spatial energy planning[5], which would serve to promote innovation. This would, however, give rise to a conflict of objectives for the SCCs and their regulation as they would not only be acting as self-consumers, but also as electricity producers and suppliers. As self-consumers, they would not be permitted to benefit from promotion measures that provide them with a competitive advantage as suppliers.

Notes and References

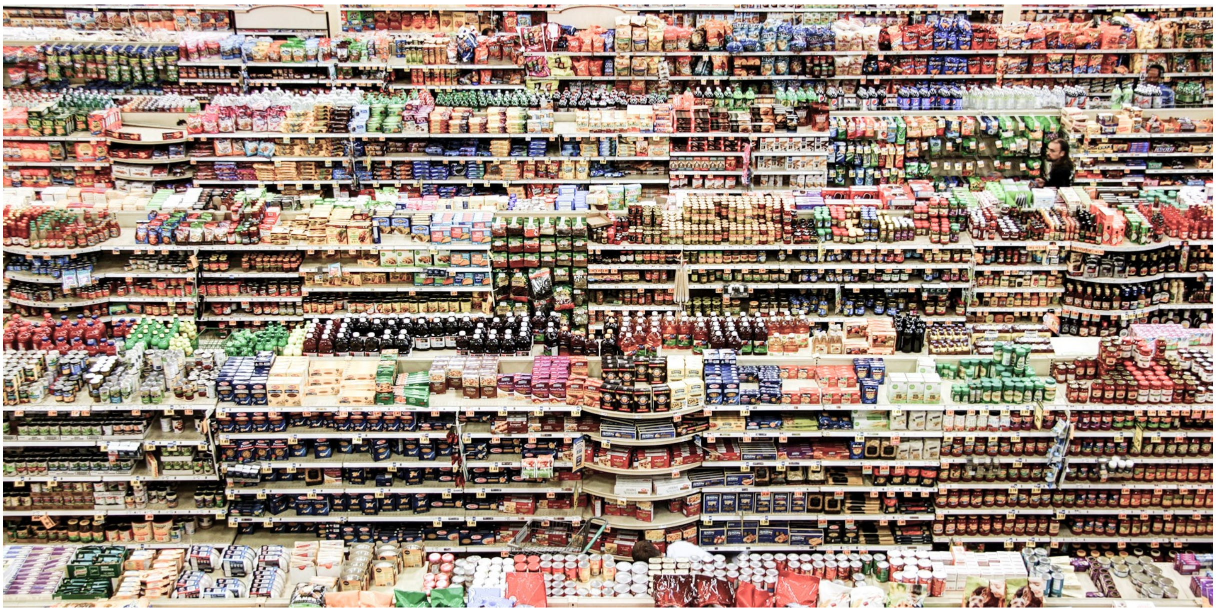
1 Project "Collective financing of renewable energy"
2 Project "Overcoming opposition to PV"
3 Main topic of "Buildings and settlements"
4 Switzerland's first local electricity market – a flagship project of the SFOE – provides a glimpse of the future of electricity supply, http://quartier-strom.ch/
5 See Walther, S. 2018, Gutachten zum regulierungsrechtlichen Umgang mit Energiespeichern in der Schweiz, https://www.dike.ch/Schriften_zum_Energierecht/Walther-Regulierung-von-Energiespeichern

4.2. Demand: make consumption more flexible

Alongside the grid expansion, the issue of demand must also be addressed if the long-term stability of the Swiss electricity system is to be assured in a cost-efficient manner. Electricity consumption should be coordinated flexibly in line with the growing volatility observed in the electricity supply. Decentralised storage solutions can foster the desired flexibility. ESCs need to develop instruments aimed at steering demand, while politicians are required to create the framework conditions required for this.

Households # Energy suppliers # Politics (federal government, canton, municipality)

4.2.1. Develop and utilise instruments aimed at steering demand!



Demand-side instruments such as dynamic tariffs, bonus-penalty systems and energy consulting services can break peaks in demand and make efficient use of surplus supplies.

Measures aimed at stabilising the electricity system should not only address electricity producers, but also consumers, and steer their demand appropriately in a more flexible and economic manner. Here, focus is placed on the possibilities provided by a largely automated system of “demand-side management”. Utility companies need to introduce or build on energy consulting services and changes in the pricing system in the form of dynamic tariffs and bonus-penalty systems.[1] To this end, they require the corresponding freedom with respect to the structuring of their tariffs.

Full market liberalisation, the implementation of which is being sought, will provide all customers with the option to select their provider freely. This will mean that current regulation, under which production costs are decisive for the price of basic power supply services, will no longer be necessary.

As studies reveal, those price systems that impose additional charges on greater consumption, for example in the form of progressive electricity tariffs, have the biggest impact. However, these have a problem with gaining acceptance among the population and in economic circles[2]. The level of rejection can be reduced if additional reward components for the achievement of energy-saving objectives are incorporated. The provision of differentiated specific information for individual consumers also demonstrably leads to a reduction in energy consumption.[3] ESCs should develop and offer corresponding new business models. Generally speaking, the cost awareness of consumers needs to be improved.

In contrast, degressive electricity tariffs for which average energy procurement costs decline with increasing consumption give rise to greater energy usage. They should therefore be replaced by tariffs with uniform basic prices.

Notes and References

1 See SCCER CREST 2018, Strommarktdesign: In welche Richtung soll es gehen? White Paper 5 - June/2018; SCCER CREST, 2019, Politische Massnahmen zur Reduzierung der Energieeffizienzlücke, White Paper 8 – February/2019.

2 Steering is unpopular but efficient

3 Project "Energy efficiency in households", Project "Behavioural mechanisms of household electricity consumption"; SCCER CREST, 2018, Reduktion der Energienachfrage von Haushalten – erfolgversprechende Schritte auf einem langen Weg, White Paper 4 – January/2018.

Public administration # Associations and NGOs # Energy suppliers # Politics (federal government, canton, municipality)

4.2.2. Put a price on flexibility with respect to grid utilisation!

The currently widespread consumption-dependent grid tariffs must be replaced by dynamic capacity utilisation tariffs. This puts a value on flexibility and gives rise to greater true-cost pricing.

A key cost driver for the provision of electricity grids is their focus on peak load, i.e. the maximum power to be transported. The grid usage fees to be paid by end consumers, however, are usually based on the total amount of energy they use. From a system perspective, dynamic capacity utilisation tariffs would be much better. Demand-dependent dynamic grid fees based on the respective grid utilisation reflect local grid bottlenecks that occur. The demanded grid capacity is priced on the basis of the respective grid shortage, meaning use is guided by economic shortages. Flexibility thus gains a corresponding value and the costs are assigned to the source. This contributes to breaking peak loads.

Grid fees that are dynamic in terms of both time and location also create incentives for users to behave in a manner that eases the burden on the grid and to make investments in flexibility solutions such as power stores. PV systems, for example, are now adding ever more flexibility to the electricity grid. In connection with modern digitalisation and networking technologies, new opportunities are opening up to use intelligent price incentives that encourage such grid customers to behave flexibly. With dynamic demand tariffs, grid utilisation could be optimised on a targeted basis without the need for a direct intervention on the part of the grid operator with respect to customer’s consumption.

Business models that emerge like this provide benefits for all sides. Grid customers that provide grid-assistive flexibility are rewarded and can save on energy costs. One example here is cold storage warehouses, which cut back on cooling for a short period. However, the distribution grid operators at a local level also have benefits, especially if they can differentiate the fee according to location and time and thus significantly reduce the required grid expansion.

Public administration # Associations and NGOs # Energy suppliers # Politics (federal government, canton, municipality)

4.2.3. Create optimal framework conditions for decentralised storage solutions!

An optimisation of grid use should be supported by appropriate regulations. Decentralised storage solutions should not be disadvantaged, but made economically attractive.

It needs to be economically attractive for the entire system to make appropriate investments in storage solutions.[1] The regulations with respect to grid usage fees should therefore be defined in such a way that storage systems are not charged twice, but rather only for their net consumption. Here, it is important that the framework is set correctly.

For the distribution grid operators, legal certainty must be created as regards the extent to which they are permitted to operate their own storage solutions with a view to optimising their grids. For companies in the energy sector, it needs to be made attractive for them to incorporate the control potential they possess, thanks to storage, load management, power-to-heat and other flexible technologies, in a digital network and to offer this automatically on the open market.

The digital infrastructure required for such a grid optimisation that allows for the recording or real-time data and market signals as well as the optimal management of the electricity-heating system entails considerable investment costs and problems in the area of information procurement. The regulatory framework conditions are therefore important.[2] These include rules on grid use and access as well as the attribution of costs, data protection and data management. Clear ownership rights regarding the flexibility must also be defined.[3] Elements of this can be found in the consultation on the revision of the Electricity Supply Act. With a total of more than 600, Switzerland has an extremely large number of distribution grid operators relative to the country's size. It is therefore important that these rules can be enforced in a simple and transparent manner and at a reasonable cost.

Notes and References

1 Walther, S., Gutachten zum regulierungsrechtlichen Umgang mit Energiespeichern in der Schweiz, https://www.dike.ch/Schriften_zum_Energierecht/Walther-Regulierung-von-Energiespeichern; Brosche, T, Ulbig, A, Andersson, G (2016): Die Rolle von dezentralen Speichern für die Bewältigung der Energiewende, Power Systems Laboratory, ETH Zurich, SATW storage study.
2 See Walther, S. (2019): Regulatorische Behandlung von Energiespeichern, Chancen und Risiken für Speicherbetreiber,
https://www.energiezentralschweiz.ch/.../04_20190514_Chancen_und_Risiken_fuer_Speicherbetreiber
3 See in this regard SFOE (ed.) 2016, Praktische Aspekte bei der Ausgestaltung der Schnittstelle Markt-Netz im Verteilnetz, Frontier Economics Ltd, Cologne.

Associations and NGOs # Energy suppliers # Politics (federal government, canton, municipality)

4.2.4. Facilitate regional flexibility markets through incentive regulation!

Distribution grid operators should be able to access suitable flexibility capacities on nearby markets in the event of a forecast grid bottleneck.[1]

The increase in decentralised electricity generation is opening up new possible courses of action for distribution grid operators by giving flexibility a value not only in terms of time, but also from a spatial perspective. The following applies: the smaller the distance between a grid bottleneck and the response, the more efficient the measures. If distribution grid operators are able to rectify grid bottlenecks via nearby flexibility markets, they will also not be required to expand their distribution grid infrastructure to the same extent and thus save costs.

Decentralised storage solutions are important elements for achieving the required level of flexibility. They provide additional power reserves available at short notice and are to be viewed in synergy with large-scale power stores.[2]

For plant operators, regional markets of this kind also provide additional incentives to invest in flexibility options. Pure service providers or self-consumer communities can also bundle together flexible power loads from many small-scale producers and consumers to achieve a critical mass for marketing. Such a model could be realised in the short to medium term.

Dynamic grid payments can also have a comparable effect[3]. While their introduction is likely to take a long time and be more cost-intensive, they can also be integrated in local flexibility markets without difficulty at a later phase.

The fear that market forces alone will not lead to sufficient investments can be countered with tenders of distribution grid operators for grid-assistive storage. The costs that arise as a result can be passed on to end consumers via grid costs. Ideally, the structure of such decentralised flexibility markets would be harmonised across Switzerland and made compatible with the system service market.

Notes and References

1 Regionale Flexibilitätsmärkte, Marktbasierte Nutzung von regionalen Flexibilitätsoptionen als Baustein zur erfolgreichen Integration von erneuerbaren Energien in die Verteilnetze, study of Energietechnische Gesellschaft im VDE (ETG), Frankfurt am Main 2014, https://www.vde.com/de/etg/publikationen/studien/vde-studieregionaleflexibiltaetsmaerkte; Paulat, F, Hermann, J, Kotthaus, K, Pack, S, Mese, J, Zdrallek, M, Petermann, D 2018, Präventives Netzengpassmanagement durch die Nutzung regionaler Flexibilitätsmärkte auf Verteilnetzebene, 15th Energy Innovation Symposium, 14 to 16 February 2018, Technical University of Graz, www.EnInnov.TUGraz.at; Hettich P, Walther S & Wohlgemuth D 2015, Investitionen ins Verteilnetz: Rechtliche Grundlagen und Anreize bei zunehmender Eigenproduktion, EGI Working Papers Series, Working Paper No. 4.

2 See Brosche, T, Ulbig, A, Andersson, G (2016): Die Rolle von dezentralen Speichern für die Bewältigung der Energiewende, Power Systems Laboratory, ETH Zurich, SATW storage study.

3 Put a price on flexibility with respect to grid utilisation!

4.3. Supply security: secure access to the European market

Without access to the European electricity market, the costs for supply security will increase considerably. The electricity agreement with the EU is therefore key. In order to counter the supply risks from abroad that will increase one way or another, politicians must also develop the most economic solutions possible.

Energy suppliers   # Politics (federal government, canton, municipality)

4.3.1. Increase supply security as economically as possible!

Contractually secured strategic reserves, certificate-based performance obligations and a diversified power plant network offer addtional means for increasing supply security over the medium term. In the longer term, Switzerland's generation capacity needs to be expanded.

According to the joint project "Assessing future electricity markets"[1], the current market design of the Swiss electricity system with the "energy-only market" and backup in the form of control energy is suitable for ensuring the existing level of supply security in the medium term [2]. Switzerland has adequate generation capacity. However, if Switzerland wants a level of backup that goes beyond the current level of supply security – for example due to an expected decline in the availability of electricity or political risks relating to readiness for delivery in neighbouring countries – it will need to develop new production capacity domestically.

A means of covering risks of a limited magnitude can be provided by a strategic reserve and performance obligations. A strategic storage reserve is not tied to investment incentives and is therefore more cost-efficient than a capacity market. To bring this solution into effect, the clear structuring of the competences and responsibilities of individual stakeholders must be ensured, which is not the case at present.

According to Swissgrid, additional generation capacity will be required in Switzerland sooner or later irrespective of the utilised technologies.[3] The urgency for the provision of this capacity can be mitigated by various measures such as "demand-side" management. Either way, imports from and exports to our neighbouring European countries will also continue to play an important role in future market situations. They require an adequate and well-functioning link to the European market processes.

Notes and References

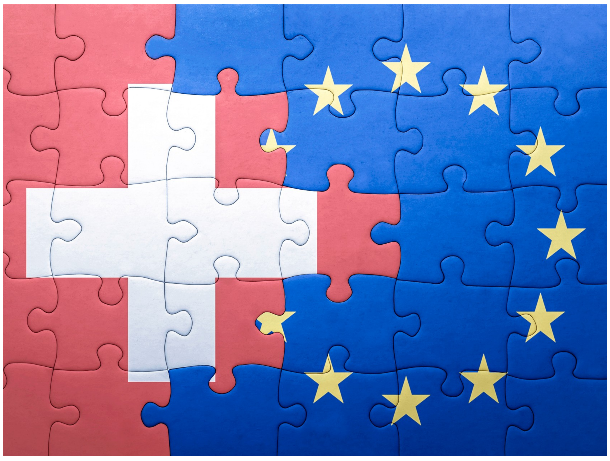
1 Project "Assessing future electricity markets"

2 Four core elements of a functioning electricity market

3 Revision of the Federal Electricity Supply Act: Swissgrid welcomes the political debate on security of supply, press release of 31 January 2019, and Swissgrid answer to the revision of the Federal Electricity Supply Act (in German) of 28 January 2019.

Energy suppliers   # Politics (federal government, canton, municipality)

4.3.2. Accelerate the conclusion of the electricity agreement with the EU!



In the absence of an electricity agreement, Switzerland would have to accept various disadvantages. In particular, the costs for supply security and wholesale prices will increase.

Supply security is significantly dependent on Switzerland’s access to the European electricity market. In the absence of an electricity agreement, markedly higher investments in Switzerland’s own production capacity and seasonal storage solutions would be required in order to maintain the current level. Switzerland’s ability to import electricity would likely decline, while wholesale prices would probably increase with both winners and losers. The exporting of electricity generated from hydropower, which until now has been economically attractive for Swiss ESCs, would also become much more difficult.

Switzerland also has a fundamental economic interest in ensuring smooth cross-border electricity trading and the use of investments in electricity facilities abroad. Due to Switzerland’s position in Europe and the physical and technical circumstances in the electricity system, it is forced to largely adapt to EU regulations with respect to technical matters in any case. Compatibility with Europe is essential for the functioning of Switzerland’s electricity system.[1]

Notes and References

1 Project “The European electricity market: staying away will be expensive but will also open up room for manoeuvre”

4.4. Strategy implementation: consistency in the electricity system and

pragmatic solutions

In order to prevent contradictions and redundancies during the targeted transformation of the electricity system, the worlds of politics and administration must develop a strategy that is consistent across all levels. This will require the willingness of the various interest groups to reach pragmatic compromises in the interest of the system as a whole. The overall strategy must, however, leave freedom for experimentation.

Public administration # Associations and NGOs # Politics (federal government, canton, municipality)

4.4.1. Define and follow a consistent strategy!

The current individual solutions for the implementation of Energy Strategy 2050 need to be consolidated into a consistent overall strategy. The many individual interests will otherwise inevitably lead to contradictions between the different measures.

The various partial solutions for sub-problems from the first set of measures of Energy Strategy 2050, which already exist, must be developed further to create an integral and consistent market and energy system design for phase II. The adoption of an overall perspective ("one-system approach") is required here. Due to the various individual interests at play, there is otherwise a risk that different solutions and measures for individual and sub-problems – such as promotion, steering, rules and bans that are also differentiated according to technology, energy type, consumer group and region or origin – will be strung together without any clear concept. This will inevitably lead to costly inconsistencies. The dependencies between electricity provision, transmission, storage and consumption must also be taken into account, with all components of the energy system being optimally coordinated with one another. For example, the various grid levels are increasingly converging, necessitating data exchanges as well as system- and grid-assistive behaviour.

Market-design decisions in neighbouring countries as well as the status and development of the electricity market design in the EU, including the current "Clean energy for all Europeans" package of measures, are important determinants for the functioning and performance of the Swiss electricity system. They must therefore be taken into account in Switzerland's own market-design decisions. Compatibility with pan-European rules needs to be established and preserved. This constraint – as is the case with the wholesale prices on the European electricity spot market – greatly restricts the room for manoeuvre and creative freedom of Swiss energy policy.

Associations and NGOs # Energy suppliers # Politics (federal government, canton, municipality)

4.4.2. Create and utilise freedom for regional experiments!

Many new approaches can only be developed via pilot projects. The legislative framework needs to provide the freedom required for this.

Not all innovations for the realisation of Energy Strategy 2050 can be definitively developed on the basis of computer simulations or in laboratories. Many new approaches can only be developed and realised via pilot projects and on the basis of specific tests and experiences. These include, for example, self-consumer communities, financing models and the complex interplay between alternative tariff structures, new business models and smart grid solutions. Such experiments also contribute to preparing market participants for further steps towards liberalisation.

On the one hand, the stakeholders need to make active use of the existing freedom for their innovations. On the other, additional freedom for training and learning processes in the energy sector should be made available through the flexible shaping of legislation, whereby legal certainty must be ensured in the operational area. The corresponding new regulations for their part should be structured taking account of the various interest groups and on the basis of collected experiences. They should also be developed further on an ongoing basis.

Public administration # Associations and NGOs # Energy suppliers # Politics (federal government, canton, municipality)

4.4.3. Overcome the constraints of individual interests with pragmatic solutions!

In order to create stable majorities for pragmatic solutions in the public interest and in the interest of the system as a whole, aggressive educational work and a willingness to compromise on behalf of the stakeholders will be required.

Solutions that are deemed optimal from a macroeconomic perspective often conflict with the interests of individual stakeholders. This has been shown by various projects.[1] In order to achieve stable majorities for system-oriented solutions, it is therefore essential to explain the benefits of an energy policy for the general public both to individual citizens and the relevant stakeholders and to make these advantages understandable. Politicians, administrative bodies and the affected economic stakeholders need to communicate aggressively and negotiate.

In order to achieve the targeted and necessary transformation of the entire energy system, which is characterised by numerous dependencies, it is essential that the various individual interests are balanced. This requires the willingness of the various interest groups to reach pragmatic compromises in the interest of the system as a whole. Politicians, in particular, are called upon here.

In parallel to this, the population must be motivated to contribute to the transformation of the energy system. As highlighted by the synthesis on “Acceptance”, the educational and mobilisation work must not only be credible, but also tailored to the individual addressees in as specific a manner as possible [2]. Furthermore, the more that campaigns also address benefits [3] for people's personal quality of life and highlight positive examples from areas in which they have personal experience [4], the more successful they will be.

Notes and References

1 Project "Energy efficiency in households", Project "Promotion or steering-based energy policy", Project "Energy-related innovations".
2 Provide information specifically and credibly!
3 Target co-benefits with respect to quality of life and health!
4 Create visibility for positive examples!