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Fact sheet

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Energy Perspectives 2050

Federal Council's analysis of the options for provision of electricity

Purpose of the Energy Perspectives

The Energy Perspectives have served as the basis for all political decisions in the energy field and have been reviewed and updated regularly since the establishment of the general energy plan in the mid-1970s. In the 1990s, the Federal Council based the Decree on Energy Use, the Energy Act and the decision on the CO_2 tax on the findings in the perspectives. Most recently, on 21 February 2007, the Federal Council resolved to base its energy strategy on the four pillars of energy efficiency, renewable energies, large power stations and an active foreign policy in the energy field on the basis of the Energy Perspectives 2035.

The Energy Perspectives work with various scenarios and quantitative models that take account of how the various elements in the energy system influence each another. For example, supply and demand for energy are influenced by the price paid for it. The Energy Perspectives are not a prognosis but rather an if-then analysis. They depict a potential reality and indicate what effects energy prices, economic growth, population growth (framework developments), regulations, and pricing and promotional instruments (policy instruments) will have on the energy system.

Findings from the latest Energy Perspectives

On **23 March 2011**, the Federal Council asked DETEC to update the Energy Perspectives 2035 from 2007 on the basis of three options for provision of electricity. The findings from the analysis are presented below:

1. Development in demand

Continuing with the current energy policy leads to an increase in electricity consumption by 2050 even with more efficient appliances and applications (*cf. Figure 1*). The causes are population growth (by 2050 the population of Switzerland will reach the 9 million mark), multiple (e.g. second appliances or vehicles) or new appliances and applications. By 2050, significantly more electricity will be used in the transport sector. Measures introduced and implemented in the energy efficiency and renewable energies sectors (e.g. viable prices for delivery to the grid, construction programme, vehicle standards, etc.) are taken into account when calculating the development in demand. National energy consumption, including that for today's pump storage power plants, will increase to 86.3 billion kWh by 2050. Because of the construction of new pump storage power plants after 2015, national electricity consumption will increase to 91.9 billion kWh by 2050.

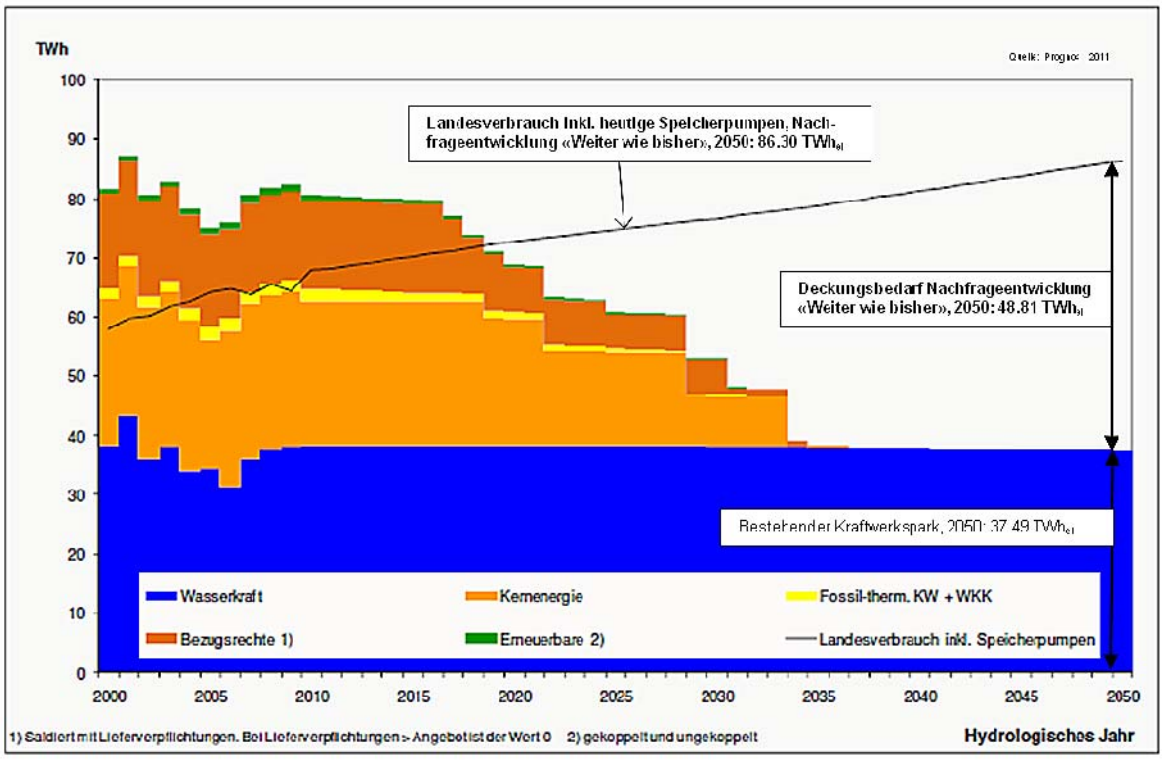

Figure 1: Existing power plants, demand for electricity and shortfall. More pump storage power plants will be built between 2015 and 2010. A further 6 billion kWh (6 terawatt-hours TWh) will be required to operate the plants; this is not included in the figure for national electricity consumption given above and increases the shortfall correspondingly.

Hydrological year, National electricity consumption including today's pump storage plants, development in demand in the "As before" scenario, 2050: 86.30 TWh_{el} / Shortfall caused by development in demand in the "As before" scenario, 2050: 48.81 TWh_{el} / Existing power plants, 2050 37.49 TWh_{el}
Hydropower / Exploitation rights 1) Balanced out with delivery contracts. In the case of delivery contracts > offer is valued at 0 /
Nuclear power / Renewable 2) coupled and non-coupled / Fossil thermal power plants + CG / National electricity consumption incl. pump storage plant

2. The Federal Councils' analysis of options for provision of electricity

Production costs for all three options for the provision of electricity will in all probability increase by 2050. The causes are increased demand requiring even more power plants which in turn are more expensive than older plants.

Option for provision of electricity 1

Continue with the current electricity production system with early replacement as necessary of the oldest three nuclear power plants to ensure the highest level of safety.

- **Content:** Today's energy policy resting on the four pillars of *energy efficiency, renewable energies, large power plants* and *energy foreign policy* is continued as before, electricity demand develops as before. Electricity is mainly produced in large power plants.
- **Options to cover shortfall:** Replacement of the oldest three nuclear power plants (Mühleberg, Beznau I + II) with two new nuclear power plants. Until 2017, when these are connected to the grid, the shortfall will be covered by electricity imports. Eventually the nuclear power plants at Gösgen and Leibstadt will be replaced with two new nuclear plants. If the nuclear power plants are not replaced, gas-fired combined cycle plants (GCC) will have to be utilised between 2017 and 2050 and these will also replace the electricity from long-term contracts for electricity supplies with France on expiry. Electricity from renewable sources and from cogeneration plants (CG) would complete the mix of options for provision of electricity.
- **Evaluation**: Large power plants continue to be the mainstay of electricity supplies, grids will have to be extended and rebuilt in stages. Optimal connection to the European grid

has to be guaranteed, but transformation of distribution grids to smart grids is not an absolute requirement. Apart from treatment of nuclear fuel assemblies, dependence on other countries remains negligible. If the GCC option is not used in the interim until replacement nuclear power plants become operational, CO_2 emissions from electricity production will only increase because of the additional cogeneration plants (CG).

Option for provision of electricity 2

Existing nuclear power plants will not be replaced at the end of their technically safe operating period.

- **Content:** Today's energy policy will be continued, electricity demand develops as before. Non-replacement of older nuclear power plants restricts the options for future electricity production.
- **Options to cover needs:** After the safe operating period expires (estimated at 50 years) nuclear power plants will not be replaced and will be decommissioned (Beznau I; 2019; Beznau II and Mühleberg: 2022; Gösgen: 2029; Leibstadt: 2034). The shortfall will be covered with an optimised mixture of hydropower, new renewable energies, CG facilities, GCC and electricity imports. Hydropower becomes very significant and will have to be expanded correspondingly.
- **Evaluation:** The gradual loss of production from nuclear power plants has to be compensated for by hydropower, new renewable energies, CG facilities and GCC. As thermal generation using fossil fuels will increase, additional emissions of 1.09 to 11.92 million tonnes of CO_2 are anticipated by 2050, depending on the proportion of CG and GCC. However, CO_2 emissions from the energy sector will be reduced by 14.4 million tonnes compared to 2009 by pursuing measures in today's energy policy until 2050, which means that overall emissions will not increase despite increased generation using fossil fuels. Electricity grids will have to be extended and rebuilt and transformation of distribution grids to smart grids becomes compulsory. Optimal connection to the European grid has to be guaranteed.

  According to initial calculations, the cost to the economy for modernising and constructing power plants and measures to reduce electricity demand amount to about 0.4 to 0.7 per cent of the gross domestic product (GDP).

Option for provision of electricity 3

Premature phasing out of nuclear power, existing power plants will be shut down at the end of their safe operating life.

- **Content:** Today's energy policy will be continued, electricity demand develops as before. Existing nuclear power plants will be decommissioned without replacement after the 40-year operating period ends (Beznau I + II and Mühleberg: 2012; Gösgen: 2019 and Leibstadt: 2024).
- **Options to cover shortfall:** Hydropower, new renewable energies and GCC plant have to be greatly expanded. In the medium to long term, use of GCC plant will also have to increase and substantial amounts of electricity will need be imported. Use of fossil fuels will lead to a further increase in CO_2 emissions in the short to medium term. However, CO_2 emissions from the energy sector will be reduced by 14.4 million tonnes by pursuing the measures in today's energy policy until 2050. Dependence on electricity supplies from abroad increases because either higher gas imports or larger volumes of electricity will be required.
- **Evaluation:** If nuclear power is phased out prematurely, the existing energy policy cannot be further implemented because massive use of thermal plants powered with

fossil fuels (CG and GCC) would be necessary to cover the demand for electricity and high dependence on foreign supplies of electricity would have to be taken into consideration (imports of gas and electricity). Because of the massive increase in electricity imports from 2012 on, the national grid would be stretched to capacity. The required transformation of the generating infrastructure (modernisation and construction of power plants and grids and measures to reduce demand) cause very high costs in the short to medium term. This would lead to a major burden on Switzerland's economy due to rising national energy prices. Further, new arrangements would have to be made for the funds for decommissioning and disposal.

3. Gradual phasing out - option for provision of electricity 2

Based on the current Energy Perspectives, the Federal Council has opted to phase out nuclear power gradually and is therefore pursuing the course outlined in option 2 for the provision of electricity. This requires a new energy policy whose aim is to substantially reduce the overall final demand for energy by 2050 (*cf. Figure 2*):

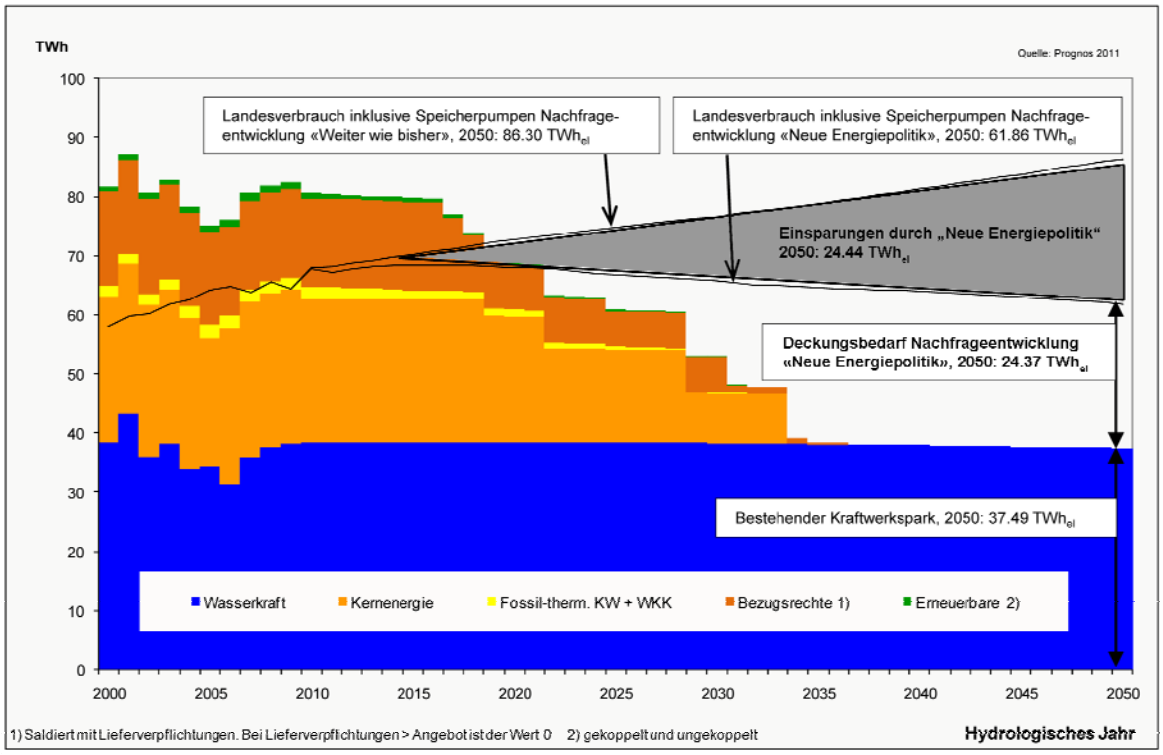

Figure 2: Shortfall to be covered under the new energy policy. Plans have been made to expand pump storage power plant capacity between 2015 and 2020. A further 6 billion kWh (6 terawatt-hours TWh) will be required to operate the plants; this is not included in the figure for national electricity consumption given above and increases the shortfall correspondingly.
Hydrological year / National electricity consumption including today's pump storage plants, development in demand in the "As before" scenario, 2050: 86.30 TWh_{el} / National electricity consumption including today's pump storage plants, development in demand in the "As before" scenario, 2050: 61.86 TWh_{el} / Economies achieved with the "New energy policy" scenario 2050: 24.37 TWh_{el} / Shortfall caused by development in demand in the "As before" scenario, 2050: 37.49 TWh_{el}
Hydropower / Nuclear power / Fossil thermal power plants + CG / Exploitation rights 1) Balanced out with delivery contracts. In the case of delivery contracts > offer is valued at 0 / Renewable 2) coupled and non-coupled

The new energy policy underpins current policy which is based on the concept of the 2,000 watt society or 1 tonne of CO_2 per capita society. Energy efficiency and promotion of renewable energy sources are central to this policy. A paradigm change is required not just in energy policy but also in society as a whole. Under the new energy policy demand for electricity will rise slightly for a few years and fall to 56.4 billion kWh (56.4 terawatt-hours TWh) by 2050, and to 61.86 billion kWh when the expanded pump storage facilities are included.

- Implementing the new energy policy will make it possible to reduce energy sector CO_2 emissions by 26 million tonnes compared to the 2009 figure. As a result of the use of fossil fuels for electricity generation, in 2050 between 1.09 and 5.9 million tonnes of CO_2 will accrue depending on the proportion of CG and GCC plant.

- Phasing out nuclear power over a longer term guarantees that funds for decommissioning and disposal can accumulate. This also provides time to exploit potential for greater efficiency and the potential inherent in renewable sources of energy will also be available. The overall cost (discounted) for electricity production is somewhere between 197 and 211 billion francs compared to option for provision of electricity 1 (197 billion francs). Rough initial estimates have led to the following conclusions: the cost to the economy for modernisation and construction of power plants and measures to reduce electricity demand amount to about 0.4 to 0.7 per cent of the gross domestic product (GDP).

- Imported electricity will continue to be necessary to balance supply and demand. Transmission lines and distribution grids have to be modernised and built rapidly and distribution grids have to be converted to smart grids. An optimal connection to the European grid has to be guaranteed.

- The change from central to increasingly decentralised and irregular electricity generation means a fundamental change in the available types of power plant. Neither the sun nor the wind are constant, so the necessary reserve and storage capacities will have to be made available in the future and the tried and tested use of base load supply and peak supply will have to be adjusted.

- The Swiss energy system will have to be transformed while taking account of potential conflicts of interest and targets already set in various sectors, such as climate protection, conservation of lakes, rivers and the countryside, and spatial planning, and the established division of tasks between the Federal Government and the Cantons will have to be maintained.