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## Which energy is best for Switzerland?

The future of energy supply is currently a hotly-debated issue in our country. The Federal Council and environmental groups have a vision of a "2000 watt society", while electricity utilities dream about a "renaissance of nuclear power".

Energy Minister Moritz Leuenberger created waves last year when he announced, "In the coming decades, the Federal Council will work towards realising the vision of a 2000 watt society. In this vision, per-capita consumption of energy would not exceed 2000 watts – that is, between a half and a third of the current level in this country. Such visions are not illusory." This target is to be met by making machines, motor vehicles and buildings more efficient and capitalising on the potentials offered by renewable energy.

Switzerland is currently witnessing a repeat of the policy debate that raged back in the 1970s and 80s. Once again, the talk is about energy scenarios for the coming years, fears of electricity deficits, and the possible construction of new nuclear or natural gas-driven power plants. And yet again, utility operators and their corporate interests are pitted against the brash and well-researched promoters of modern alternative energy sources.

### Energy prospects for Switzerland

This spring the Federal Office for Energy (SFOE) published its guidelines for a future energy policy for Switzerland. Its prognoses for the period 2035–2050 suggest that demand for electricity could increase by as much as 24 percent, and warns of "persistent electricity shortfalls" by about 2020 because the three smaller nuclear power stations in Beznau and Mühleberg will be taken off the grid and electricity supply contracts with France will begin to expire.

The SFOE has therefore announced a three-pronged strategy to secure power supplies: Firstly, broad technical improvements in energy efficiency; secondly, developing extra capacities for renewable energies such as geothermal power (heat from deep underground), photovoltaic energy (transforming light into direct current using photoelectric cells), biomass or wood as well as the expansion of hydroelectric power (technical upgrades, small-scale power plants); and thirdly constructing fossil thermal plants with optimised re-use of waste heat (combined gas power plants). Interestingly enough, the

SFOE is not planning to build new nuclear power plants for the time being because of the lengthy approval process and lack of a solution for disposing of nuclear waste.

### Call for "major action"

Environmental organisations are urging gutsier, more specific measures than the Swiss authorities. Yet they are pursuing the same aim of an environmentally friendly "2000 watt society" as the Federal Council. "We must reduce our energy consumption by two-thirds by 2050," they say. They are also calling for "major action", specifically employing the best technology for all investment and consumer decision-making; control taxes on all energy sources; stricter technical norms for electrical devices; the Minergie standard for insulation, windows and heat recovery in new and renovated houses; and cost-covering prices for electricity supplied from alternative sources.

Environmentalists say the following are essential in order to meet the ambitious target of creating a "2000 watt society": better technology (from heating systems to electric motors), better houses (insulation), better transport (cars that consume less than 3.5 litres of fuel per 100 kilometers, hybrid buses), less driving (for business and pleasure) and more renewable energy.

### A nuclear power renaissance?

The electricity industry has very different objectives. The "Preview of electricity supply in Switzerland in the period 2035–2050" by the industry's umbrella organisation points to a deficit in electricity supply from 2020 onwards. It says cuts in electricity consumption are "unrealistic in the long term." And it suggests that the proportion of domestic electricity production covered by renewable (wind, photovoltaic, biomass and geothermal) energy "would not exceed 10 percent for a long time." Three variations are proposed for bridging the gap between electricity supply and demand: new nuclear power plants, natural gas combined-cycle plants, and a combination of natural gas and atomic power.

"Nuclear power must play a major role in Swiss electricity supply in the long term," the nuclear lobby says. This has reignited the debate over nuclear power in Switzerland. Power companies are even talking about a "renaissance for nuclear power" and enthusing about the new European 1600-megawatt EPR pressurised water reactor.

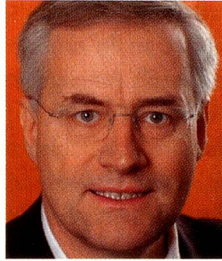
Energy expert Rudolf Rechsteiner says the high cost of investing in nuclear power makes it "uncompetitive in a free market". Given the political risks involved, it remains to be seen whether private investors like banks will invest in nuclear technology. Martin Bäuml, a scientist and Green National Councillor, says, "No-one can guarantee geological and social stability for the 10,000 years it takes to isolate highly radioactive waste."

Polls carried out this spring show that the Swiss remain split over the issue of nuclear power. Asked "Should the nuclear power plants in use today be replaced by a new generation of nuclear power plants?", 46 percent of respondents answered Yes, and 51 percent No. The future of atomic energy in Switzerland will eventually be decided by voters at home and abroad. The proposed Nuclear Power Act will be put to an obligatory referendum in a move to seek grass-roots approval for new nuclear power plants. ROLF RIBI

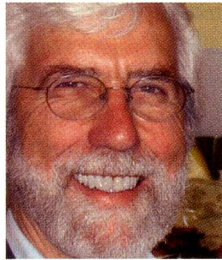
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“Swiss Review” put 9 questions on Swiss energy policy to three experts. The replies by Walter Steinmann (Director of the Federal Office for Energy), Daniel Spreng (a professor of energy policy at the Swiss Federal Institute of Technology in Zurich) and Rudolf Rechsteiner (a Social-Democrat National Councillor) can be found on the following pages.

**01** *Last year, for the first time ever, Switzerland consumed more electricity than it produced. Carbon dioxide emissions are higher than in 1990, and there are still no control taxes on energy producers. What sort of sustainable (and constitutionally enshrined) energy policy should Switzerland adopt?*



STEINMANN: Sustainable energy supply involves an efficient, environmentally-friendly, socially acceptable, just and economical approach towards energy on the part of producers and consumers alike. Energy policies must create the necessary underlying conditions for this and point us in a direction by which we can eventually reach our objectives. The Federal Office of Energy's strategy, based on the 2000-watt society, is a first sketch of future sustainable energy policies in Switzerland: one which, it should be remembered, contains many other elements apart from the aforementioned three pillars. However, our politicians will have to work intensively over the next few years to draw up the precise framework conditions and decide which instruments should be employed.



SPRENG: Energy policy is a difficult issue. Why? Because only a minority is interested in it: energy suppliers and environmentalists. That's why the two camps are constantly at loggerheads. In the past, energy policies have only functioned if they were part of a more comprehensive policy. In the 1970s, broad-based support for reductions in air pollution led to the introduction of strict regulations for oil burners. Amongst other things, being forced to comply with the regulations prompted the Swiss to develop oil burners that were unparalleled worldwide. Another example concerns the construction industry. When the Swiss Society of Engineers and Architects (SIA) introduced tougher norms on energy consumption by buildings, the government launched incentive programmes to promote continuing training for affected professional groups. These proved so successful that the SIA norms could be met and the construction industry increased its competitiveness. The fact that energy consumption in new houses more than halved in the space of 30 years was a welcome side-effect to the main aim of increasing the sector's competitiveness.



RECHSTEINER: Growing CO<sub>2</sub> emissions and dwindling oil reserves will favour sustainable energy supplies. Feed-in tariffs could also trigger a boom in “clean” technology in Switzerland. Buildings employing the Minergie and Minergie P standards will make a breakthrough. Freight will increasingly be transported by rail and ship. Within the single European electricity market, electricity will be produced where the resources are best: wind energy along coastlines, on plateaux and offshore, and solar power in areas with plenty of sunshine – in Switzerland that means the Valais and Engadine regions. We may also import electricity from Italy, Spain or Tunisia. Instead of investing in foreign atomic energy ventures, companies will become involved in wind and solar energy projects – like Axpo, which recently bought shares in Norwegian wind farms.

**02** *Global support for crude oil and natural gas will decline in the medium term, while demand grows and oil prices continue to rise. What are the implications for energy supply in Switzerland?*

STEINMANN: Just like any other country, Switzerland must expect the prices of fossil energy sources to remain high and supplies uncertain in the medium term. And we would be wise to expand the relevant measures – some of which are already in place today, for instance in the EnergieSchweiz programme – in a targeted manner and as soon as possible. For example, at least 50 percent of our heat requirements could be generated through the use of wood, biomass, solar thermal plants and heat pumps over the next 25 years (fossil fuels currently account for 80 percent of the total heating market). And in the long term, 10 to 15 percent of our engine fuels could come from renewable sources such as biogas, bio-ethanol and other renewable energies.

SPRENG: Unfortunately, it's by no means certain that oil prices will continue to rise. After all, they are the result of production bottlenecks, not a shortage of resources. High oil prices are a double-edged sword: On the one hand, the huge profits they bring to producing countries create enormous economic turmoil as well as political tensions that Switzerland, like other countries, cannot ignore. On the other hand, higher prices are healthy for purchasers too. It would be good if oil prices remained at the present high level for a long time to come. This would give alternatives a fair chance and encourage energy saving.

**03** *The Federal Office for Energy plans to use natural gas power plants to bridge the shortfall in electricity from the year 2020. What are the advantages and disadvantages of gas-fired power plants?*

RECHSTEINER: Demand should never outstrip supply. As prices increase, efficient and renewable technologies will (finally!) come to the fore. Those that aren't efficient will be swept off the market.

STEINMANN: If electricity consumption continues to grow by 1 to 2 percent a year, we will already start having deficits from 2015 during the winter months. At the same time as massively increasing our energy efficiency, we must try to plug the remaining gap on the production side. In so doing, the proportion of renewable energies should be expanded as far as possible. However, the remaining requirements must be met by conventional production technologies. Basically, we really have only two alternatives: new nuclear power stations or gas-fired plants. No new nuclear power stations are on the cards in the short to medium term, since the waste disposal issue first needs to be solved once and for all. Among the economically acceptable alternatives, we assume that combined gas-fired power plants are the lesser evil. Their relative advantages are that they can be planned, approved and built quickly, and they are acceptable from an energy point of view if coupled with credible CO<sub>2</sub> compensation measures. What's more, if we use combined gas-fired power stations, we are not tying ourselves to a technology for 60 years, as would be the case with new nuclear power plants.

SPRENG: One advantage is that gas-fired power plants do not tie up much capital and could therefore be suitable as a bridging solution. The disadvantage is that Switzerland would relinquish its trump card of CO<sub>2</sub>-free electricity production if it built new gas-fired power stations.

RECHSTEINER: Gas-fired power plants can handle peak loads. They are relatively cheap and quick to build. Combined with heat pumps and good waste heat reutilisation, they can even cut CO<sub>2</sub> emissions if part of the electricity is used to replace oil-powered heating systems (via heat pumps). The disadvantages are the CO<sub>2</sub> emissions and the lack of cost security, because gas prices follow the price of oil.

**04** *Is there still a sufficient potential for expanding and modernising hydroelectric power plants in our country? Can the capacities of hydroelectric plants be increased further?*

STEINMANN: Hydroelectric power remains the most important domestic pillar of our energy supplies. However, there is relatively little scope for economically viable expansion of hydroelectric power in Switzerland, and what there is, is based mainly on measures to optimise and expand existing plants. Hydroelectric power could therefore grow by 5 to 10 percent.

SPRENG: Hydroelectric power plants play a key role in securing the country's energy supplies. If the electricity market were opened up to competition, the state would have to ensure that the modernisation of hydroelectric power plants was not neglected. Looked at purely in terms of financial investment, many of these expansion and upgrading projects are not particularly cost-efficient. Luckily, nearly all hydroelectric power stations are still in public hands. So let's hope that the powers that be won't only be looking at short-term cash flows.

RECHSTEINER: Much can still be gained by modernising existing hydroelectric plants. In particular, Switzerland could earn even more money than it does now through an international reservoir management network. Wind energy and hydroelectric power complement each other ideally. When the wind blows, electricity prices fall and water reserves are preserved or topped up. When there's no wind, you can use the hydroelectric plants. The important thing is that water conservation is not neglected. If cleverly and carefully designed, protection and utilisation needn't be mutually exclusive.

**05** *Will Switzerland need new nuclear power plants when the existing ones close? Do atomic technologies even have a future? And how do you assess the attitudes towards nuclear power among the general public?*

STEINMANN: By 2020 at the latest, when the oldest nuclear power stations in Switzerland are taken out of operation, there will be a shortfall in our electricity supplies. This could theoretically be plugged in the medium to long term by a new nuclear power station, since this option still remains open in Switzerland following several referendums on the matter. In the meantime, however, construction of a new Swiss nuclear power plant is rather unrealistic. Instead of engaging in trench warfare over the issue for the next 20 years, we should work on improving energy efficiency and on renewable energy technologies. The Federal Office for Energy is presently drawing up its energy predictions for the year 2035. These results, which will be presented at the end of this year, can form the basis of the political debate about how many and what types of conventional power plants we really need in 20 to 30 years, be they nuclear or combined gas-fired.

SPRENG: In spite of the danger of proliferation and the durability of radioactive waste, I get the impression that mankind will not be able to resist the temptation to use this compact energy source. I would be happy if Switzerland didn't build any more reactors that were not inherently safe, i.e. that the chosen reactor types couldn't possibly release unhealthy amounts of radioactivity in the event of an accident.

**06** *What should be done with the radioactive waste produced by Switzerland's five nuclear power plants? And what is the ethical justification for storing nuclear waste for tens of thousands of years?*

RECHSTEINER: Nuclear power plants represent an unacceptable safety risk and must be prevented with all the political and legal means at our disposal. On closer inspection, the so-called "nuclear renaissance" is pure propaganda. Few nuclear power plants are being built anywhere in the world, and even these are mostly at the state's expense. In view of the trend towards renewable energies, especially wind and solar power, it is becoming increasingly difficult to justify new nuclear risks even for propaganda purposes. Atomic energy is not only beset by unsolved safety and waste problems. Its competitiveness on the free market is also restricted by a lack of cost-effectiveness and long construction times. Wind farms the size of the Gösgen plant can be planned and built within a year. Nuclear power plants, by contrast, take ten times as long.

STEINMANN: From an ethical point of view, it's clear that we must solve the problem of radioactive waste disposal, because as the beneficiaries of atomic energy we owe it to future generations to clean up our mess. Extreme care must be taken in selecting possible locations for storage. This we are doing by putting together a "deep geological depository plan" which starts by laying down the criteria by which we should select suitable locations. Aside from safety criteria – the safety of people and the environment are always foremost – there are also pressing social and economic criteria and needs to take into account. Only when all the criteria are in place can the actual search for a storage location begin, with cantons, responsible foreign bodies, organisations and the general public being informed early on and involved in the process as appropriate. Assuming the Swiss authorities give us carte blanche, possible locations can then be assessed on the basis of these criteria. Further geological analyses may also need to be carried out. The procedure for selecting a location could be completed by the end of the decade. The aim is to be able to start using the deep depository by around 2040.

SPRENG: The problem should not be played down, and when it comes to storage, corners should not be cut. In Switzerland we are well on the way towards developing a concept that both offers reliable passive protection in stable geological strata and – for future generations – provides for checks with the possibility of improving storage. Other sectors could take a leaf out of this book.

RECHSTEINER: There is no technical solution to the waste problem. All we have is damage limitation. Even burial deep underground entails risks that merit a worldwide ban on nuclear technology. It's just a question of time.

**07** *Could wind farms in the North Sea one day replace our nuclear power plants for generating electricity? How do you evaluate wind energy from a technical point of view i.e. in terms of power fluctuations, line loss, landscape conservation and wind availability?*

STEINMANN: First we have to ask ourselves what exactly we mean by "securing supply for our country". Can nuclear power stations in France, gas-fired plants operated by Swiss companies in Italy, or wind parks run by majority Swiss-owned Nordic firms make a real contribution towards securing our energy supplies in the sense of being self-sufficient? It's also debatable whether there's really any sense in transporting energy. Firstly, transporting electricity over such large distances involves not insubstantial losses. Secondly, present-day transport capacities would hardly suffice, which means that we'd need massive investment in new lines. For landscape conservation reasons and because of the relatively low wind factor, only a few locations in Switzerland are suitable for wind energy generation. In the EU, by contrast, wind energy is witnessing a huge expansion, partly also in the face of stiff opposition from environmental groups. If the proportion of wind energy in the European electricity network increases, this can lead to fluctuations in production and prices. And this in turn could benefit Swiss storage power stations, which could provide back-up power at very short notice when the wind drops.

SPRENG: Wind farms are a good thing. And, in principle, wind and water complement each other nicely in terms of electricity production. But we Swiss are not alone in Europe. The countries that build these wind farms will want to use this electricity themselves and build the necessary back-up power plants and network support facilities. As regards landscape conservation, there is no way of generating energy without a downside.

RECHSTEINER: Wind energy is increasingly being harvested in all the world's oceans. Its potential has even been recognised in China and the United States. When DC lines are used, transport losses remain below 5 percent, even over very long distances (1000–2000 km). Fluctuations in wind availability can always be managed if wind farms are properly networked. After all, it's always windy somewhere. Added to this, we have electricity storers and demand-side management. Landscape conservation regulations restrict planning and ensure that large wind farms are built in sparsely populated areas or out at sea. However, just like hydroelectric plants in the Alps, wind farms are very lucrative for local residents. That's why wind power exploitation is growing exponentially.

**08** *The price of solar power and the cost of solar cells have dropped. What future does solar power have in this country? What are its chances?*

STEINMANN: Photovoltaic energy has an enormous potential, but we will only be able to capitalise fully on it in the long term – i.e. in a few decades. At present there are still too many technical hurdles to overcome and the costs are too high. Photovoltaics can be considered one of the key technologies of the future. Technical advances are already bringing prices down by about 5 percent a year, which means that production costs per kilowatt-hour should be competitive in 20 to 30 years' time. Switzerland is very well-positioned in this technical field. It has excellent researchers and lots of experience with practical applications. Even so, our research and development needs further support and applications need to be promoted so that Switzerland can maintain its strong position (also as an exporter of energy).

SPRENG: It's true that Switzerland was once a leader in Europe in this field, at a very basic level. However, I don't think it would be tragic if only modest amounts of solar power were generated in Switzerland. The important thing is our role as a world-class provider of high-end technology. The direct use of solar energy is a perfect example of an area that encompasses many promising technologies. It helps our planet survive and it's "good business" if our industry gears itself to long-term viability. With this in mind, a sustainable energy policy must form an integral part of a forward-looking policy on technology.

RECHSTEINER: Solar power can meet about a third of our electricity needs. Here, too, a tie-in with hydroelectric power is important. By about 2020 cell prices will have fallen to such an extent that solar power plants will be competitive around the world.

**09** *Do you think there is a need or a possibility to reduce energy consumption? And if so, how and by what means?*

STEINMANN: Energy efficiency policies have been a key pillar of Swiss energy policies since the 1990s. In addition to regulations for factories, cars and machines, the government together with the cantons and the private sector are primarily focussing on voluntary mechanisms (e.g. information, advice, education and further training) within the framework of the EnergieSchweiz programme. The cantons in particular are responsible for regulations for buildings and the implementation of their own promotion programmes.

To date such energy efficiency measures have scored several successes, but it is clear that they don't go far enough. Energy policy as a whole is facing major long-term challenges that cannot be addressed without a massive increase in energy efficiency. This means that, alongside the voluntary schemes, we must also introduce obligations and, for example, take certain energy-wasting devices off the market altogether.

SPRENG: The most important thing is to save energy. If we in Switzerland needed less energy overall, higher energy prices would be easy to digest from an economic standpoint. It takes technical advances and the right energy price to promote energy saving. Without economic incentives, technical progress is wasted on unnecessary supplementary applications. Years ago, while working for Alusuisse, I calculated where energy could be saved by using light vehicle parts made of aluminium. Alusuisse (now a part of ALCAN) had great success developing light vehicle parts. Unfortunately, cars have not got lighter. Instead, bigger vehicles have been built and fitted with air conditioning and electric motors for windows, seat adjustment and other "creature comforts".

For the past 30 years, I and other scientists have been calling for an energy tax. Yet in all those years, all attempts to introduce such a tax have come to nothing. It seems that too few people are interested in an energy tax for it to be introduced on its own in a direct democracy. Given that there is even a danger that the planned CO<sub>2</sub> emission caps will not be introduced, it is clear that short-sighted special interests exert too much influence on energy policy. Taxes of this kind must be seen as a part of financial policy. Our country's competitiveness depends to a large extent on the level of taxation and income-related contributions. Opponents of an energy tax implicitly support higher labour taxation. Revenues from energy or other resource-based taxes could take the burden off welfare contributions and income tax.

RECHSTEINER: We are currently witnessing an "autonomous efficiency gain" of about 1-2 percent a year based on economic output. Global per-capita oil consumption has decreased since 1979. However, the increased efficiency is partly counteracted by increased consumerism (more electrical devices, more living space and increased traffic).

Higher prices for oil, gas and coal will not only promote energy efficiency but also make new renewable energy sources affordable. This can lead to a very strong reduction in energy consumption, assuming that technologies that generate no waste heat (e.g. wind turbines, solar cells and biomass combined heat-and-power generators) replace thermal power plants and car engines, which at present gobble up between 60 and 80 percent of our primary energy.