GlobalResearch
Center for Research on Globalization

One Year after Fukushima: Is Nuclear Power Phase-out a Feasible Alternative?

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Global Research, March 23, 2012
Current Concerns 19 March 2012

Region: Asia
Theme: Environment

Nuclear power phase-out

Discussions on the nuclear power phase-out took place in some countries following the events in Fukushima and partly led to a phase-out decision. Germany and Switzerland took that decision nearly at the same time. But if nuclear power plants are taken off the grid, the respective electricity production must be substituted. Germany has achieved a fast growth of its electricity production by a directed funding of renewable energies during many years. The complete replacement of nuclear power first and foremost by means of renewable energy seems predictable in the near future. A look to Austria may be helpful: The decision to do without nuclear power didn't create disadvantages or problems for Austria. The phase-out in Switzerland is politically intended. Is it actually being realized?

The nuclear energy, communicated to us as a safe source of energy, did not keep its promises. Five core melts and numerous further accidents since the introduction of this technology clearly point out that the probabilities of occurrence of catastrophic accidents as once computed are printers waste. Also newly developed reactor generations will not substantially improve security, as the assumed probabilities of accident occurrence were not corrected on the basis of the actual events up to now. The "myth of security"3 often prevented awareness of essentials. The crucial weak point is man as such, who is finally not able to control extremely complex systems in operation and in the planning of necessary safety precautions in the long run. The accidents of Three Mile Island, Chernobyl and Fukushima speak an all too plain language.

The decision of the Swiss Federal Council to phase-out from nuclear power should be welcomed. A reasonable energy policy should aim at avoiding the obvious risks of nuclear energy, at carefully dealing with fossil resources and at preventing possible effects on the environment like an inadmissible climate warming. All this points towards an energy policy which puts renewable energy sources for electricity production into the foreground.

The Kyoto-Protocol4 aims at the goal of limiting the rise in temperature of the earth by greenhouse gases. Apart from other measures the goal of the development and implementation of renewable forms of energy is mentioned in the article 2 for that same purpose. In 2009 a guideline in the same sense became effective on European Union level, in the introductory considerations of which the increased use of energy from renewable energy sources is affirmed as a worthwhile goal guarantying priority in supply to the grid. All member states have pronounced national goals for the share of renewable energy in electric power consumption.5

The following examples point the way to replace nuclear-power optimally and to achieve the necessary changes within assessable periods.

Development of electric power production from renewable energies

As early as 1991 Germany walked the path into a lasting power supply with the “Act of Feed-in Electricity”. The subsidy model specified in this law was later taken over by 18 states of the European Union and by other countries like China.6

Its revision, the “Renewable Energies Law” (EEG) stated in 2000 with amendments in 2004 and 2009 goes beyond the pure reduction of greenhouse gases. In its application it wants to protect environment and health and to avoid the risks posed by fossil sources of energy and nuclear power for electricity supply. The goals which this German energy policy set itself are ambitious: The EEG prescribes a share of renewable energies in electricity supply from 35% in the year 2020 to 50% in the year 2030 to finally 80% in 2050.7 The long-term subsidizing of innovative technology with an assured remuneration for feeding electricity to the grid over 20 years led to a very fast and accelerated introduction of electrical power from wind and solar into the market. The decision to take the seven oldest nuclear power plants in Germany off the grid is feasible on the basis of fast growing capacities in the renewable electricity production and large conventional reserve capacities of Germany’s power supply in. The country is equipped with an installed power of approx. 155 GW (2009) with an effective average output of 76.8 GW. Even at the highest peak load of the last 10 years of 80 GW sufficient power reserves would be available to compensate for planned maintenance and unplanned outages.8 Within the reserve capacities a surplus of at least 10 GW was specified, which had been available at the end of 2010 for taking the nuclear power plants off the grid.9 When turning off the 7 oldest nuclear power plants in Germany and the nuclear power plant Krümmel with a total output of 8.4 GW, supply security as well as grid stability are strained, but controllable according to estimates of the transmission network operators and the Federal Network Agency.

Starting from 2017, Germany could do completely without nuclear power according to this scenario. Beyond the power stations currently being built and additional biomass power stations, an additional capacity requirement of at the most 5 GW would exist until 2017, which would eventually be able to be covered by new highly-flexible and highly-efficient gas-fired power stations, by a faster development of renewable energies as well as by measures to increase energy efficiency.9

As an example for the fast development of renewable energies in Germany the following figures may characterize the electric power production there: During the storm front “Andrea” in the early morning of the 5.1.2012 wind power stations provided 23 GW of electric power, 50% of the total electric power produced at that point in time. On the hot summer day 2.8.2011, solar electric power achieved 19 GW, roughly 25% of the total power produced.10 When the wind blows and when the sun shines, the peak power values of this kind of energy production are impressive and characterize the rapidly progressing development. But it is to be emphasized that averaged during the year the share of renewable energies is still small. The average share of wind energy amounts to 6% over the year and the share of solar power is at 1.9% only. Remarkable is the share to electric power by biomass and waste with 5.4%. All renewable energies summed up, they supplied 16.4% in 2010, 17.1% in 2011 to the generation of electric power in Germany.11

The contributions of renewable energies in Germany are continually and quickly growing:

According to current investigations solar power stations with a nominal maximum power of 7.4 GW were built in the year 2010. This tendency will continue further. There exists a similar situation concerning wind energy, where new power stations are built. In 2009 1.9 GW and in 2010 1.5 GW have been installed.12 New impulses are expected by wind parks built offshore, where the average yearly production duration will rise from 2000 hours to 4000 hours. The first “offshore” wind parks are meanwhile commissioned and in operation. Numerous further parks are planned. One can probably assume that the ambitious goals for the introduction of renewable energies will be even exceeded.

In 1978 Austria negated the use of nuclear energy for electric power generation in a plebiscite. In the same year this decision was recorded in the “Federal Constitutional Law for a Non-nuclear Austria” and also anchored in the Federal Constitution in 1999. As a consequence of this renouncement of nuclear energy the average share of renewable energies in the electric power production in Austria is quite high and amounted to 68.2% in 2009. A large part of the power is produced by river-run power plants, in artificial lakes and by storage power stations similarly to Switzerland. Likewise, fossil power stations cover a significant portion. In addition, Austria is actively using “new” renewable sources. Austria converted EU-legislation into its Öko-Stromgesetz13 and specified a series of goals for its electricity production. Between 2010 and 2015 power stations with a capacity of 2.35 GW shall be installed using renewable energies. Up to the year 2020 another 4.4 GW of electrical power shall be installed. This corresponds to an increase of the existing power generation capacity of roughly 50%.

In the mid 90s the use of wind force began in Austria and got a massive enhancement by attractive framework conditions in the 2003 energy policy, which lasted until 2006. In the years 2003 to 2006 100 wind-power plants were built on average with a cumulated installed power of approx. 0.2 GW per year. In 2009 however, when political and technical boundary conditions changed not one new wind-power plant was installed in Austria. The Austrian wind-power plants generated a total power of 1 GW in 2009, clearly more than the wind power installations in Switzerland.10 The generation of electric power from renewable energies in Austria is very high with a share of approx. 69%. Beside the power from hydro-electric power plants the wind force contributes 2.9%, the generation of power from biomass is at remarkable 6.4%. The shares of solar power and geothermal power are still negligible.

In Switzerland the statutory cost-covering feed-in compensation for electricity produced by renewable energy exists since 2009. The Swiss energy bill as of 1 January 2011 prescribes to increase average production of electric power from renewable energies by at least 0.62 GW equivalent capacity (approx. 8% of the entire capacity).up to the year 2030 in relation to conditions in the year 2000. The average annual production of electricity from hydro-electric power plants shall be increased by at least 0.23 GW equivalent capacity (+ 2.7%) up to the year 2030 compared to 2000.17 These goals are rather marginally set and reflect in no way the scenario and the necessary action to replace the electric power production in a phase-out from nuclear power in Switzerland.

Switzerland has a considerable capacity of electric power production by renewable energies using its storage power stations and the river-run hydroelectric powerplants; the situation however is very different from the German one. The hydro-electric power plants installed in Switzerland have a power peak of 12.8 GW in summer (17.9.2007) and 10.5 GW in winter (17.12.2008),18 Besides these maximum values the production scatters quite strongly as a function of the weather-dependent available amount of water. The safe minimum

hydropower production is assumed at approximately 9.6 GW in the summer and at approximately 5.25 GW in winter. Conventional thermal power stations with cogeneration of heat and power contribute 0.5 GW or 4.8%.19 The wind power production in Switzerland contributes negligible 0.046 GW or 0.06%.20 The production capacity of photovoltaic power in Switzerland with 0.07 GW21 is within a similar range as the wind force. In addition the Swiss nuclear power plants contribute 3.24 GW. If one adds all available electric power production capacities, a shortage of electric power to cover all requirements results in wintertime. In the last years it was necessary to import electric power. Even if one can export excess power in the summer, the power reserve is much too low.22 Potential losses due to maintenance work or unplanned outages caused by technical problems can be balanced by imported power only.

After the plebiscite from 23. September 1990 (nuclear power plant moratorium) no further nuclear power stations were built in Switzerland. But neither were there any active efforts at enlarging electricity production from renewable energies. Building up the necessary reserve capacity for a nuclear phase-out was not done or not done early enough to,.

An encouraging concept which might make the nuclear phase-out feasible in the foreseeable future is not in sight. The usage of gas-fired power stations would therefore perhaps be a necessary, but only the second-best solution.

In her speeches backing up the decision on nuclear power phase-out Mrs Leuthard touched on the economical impulse of such a decision apart from the avoidance of the nuclear risk. This effect is actually well visible. More than 185,000 people23 are working in green jobs in Austria, that’s every twentieth job in Austria. The occupation in the area of renewable energies in Germany doubled from 2004 onwards to now 367,400 workplaces (2010).24 The number of persons employed in the area of electricity supply decreased slightly to approximately 220,000, particularly through the declining hard coal mining industry and downstream processes.25 A similar development could be expected in Switzerland. The positive economic influence of an active policy for the promotion of renewable energies is obvious particularly with respect to the middle-size companies.

What’s next?

The examples grant clues towards a solution. Austria can very well live without nuclear energy on the basis of a high portion of renewable energies, which do not come from hydropower only. Germany is well prepared for the nuclear power phase-out and can take this step in foreseeable time. Switzerland must create a basis for the nuclear phase-out as was now decided on with a clear political framework of conditions. But it will benefit from the available advanced technologies.

Naturally one can only touch on the topic, here. Naturally the problems of the power grid will become larger with the fluctuating energy feed-in at an increasing share of new forms of power production. It is a welcome opportunity to use the engineering spirit and to work out new solutions, which will also pay off economically, as the development of renewable technologies in different countries during the last decades, also in Switzerland, already shows.

A high and very high share of renewable energies becomes feasible if electricity can be transmitted over far distances. To be mentioned is the increasing build of wind-power plants offshore, of solar power production in southern countries. In both cases the efficiency can be

increased. New direct current high-voltage transmission technology transports power over large distances with relatively small losses of approx. 3% per 1000 km. Storage techniques must be further developed and organized. In an enlarged and structured electric grid the influence of the weather can be better balanced between distant areas were different weather conditions prevail. Finally, those renewable forms of energy should be promoted, which provide constant power like the terrestrial heat, tidal energy or wave-energy. Thereby we can become independent of the available energy's fluctuations from wind, sun and water and develop supply security on this basis.

However, the above-mentioned examples point to the fact that reliable messages and frame conditions must come from politics. The strong funding of renewable power production has contributed to economic success in Germany and should also lead to success in Switzerland this way. Nuclear power phase-out can be achieved and is an alternative when seriously effectuated. •

Notes

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3 Fukushima: The myth of safety, the reality of geoscience, J. Nöggerath, R.J.Geller, V.K.Gusiakov Bulletin of the Atomic Scientists 2011
4 Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto 11.12.1997
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7 Gesetz für den Vorrang Erneuerbarer Energien (Erneuerbare-Energien-Gesetz – EEG) Ausfertigungsdatum: 25.10.2008 geändert am 22. Dezember 2011 (BGBl. I S. 3044)
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9 Umweltbundesamt Berlin, Hintergrundpapier zur Umstrukturierung der Stromversorgung in Deutschland, Stand Mai 2011
10 EEX-transparency platform, exercises statutory disclosure requirement on grind operation, http://www.transparency.eex.com/de/,
11 Bundesministerium für Wirtschaft und Technologie, Berlin, Energiedaten für Deutschland
Stand: 15.08.2011
12 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), Berlin, Stand Juli 2011
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13 75. Bundesgesetz über die Förderung der Elektrizitätserzeugung aus erneuerbaren Energieträgern (Ökostromgesetz 2012 ÖSG 2012), Bundesgesetz-blatt für die Republik Österreich 29.7.2011
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15 Bundesamt für Energie, Sektion Analysen und Perspektiven, Schweizerische Statistik der erneuerbaren Energien, Ausgabe 2010
16 Bundesministerium für Wirtschaft und Technologie, Energiedaten, ausgewählte

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17 Schweizerisches Energiegesetz vom 26. Juni 1998, Stand am 1. Januar 2011
18 Diplomarbeit, Universität Wien, Die Strommärkte der Schweiz und Österreichs im Vergleich, Clemens Jedlicka, betreut von Univ.-Prof. Dr Franz Wirl
19 Elektrizitätsstatistik 2009, Bundesamt für Energie, Schweiz
20 Stand 19.1.2012, www.wind-data.ch
21 Elektrosuisse Bulletin 5/2010, Das Wachstum bei der Fotovoltaik fällt stärker aus als erwartet
22 Grafiken der Elektrizitaets-Statistik BFE 2009
23 Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien Die Entwicklung erneuerbarer Energie in Österreich im Jahr 2009, Dezember 2010
24 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Entwicklung der erneuerbaren Energien in Deutschland in 2010, Stand Dez 2011
25 Umweltbundesamt Berlin, Hintergrundpapier zu Auswirkungen des EEG, Stand April 2011

(Translation Current Concerns)

Situation in Japan

Although the financially strong lobby of the nuclear industry in Japan advertises to go on with nuclear energy after Fukushima1, a change in public opinion is taking place. The lack of electric power in the summer of 2011 was mastered by activation of reserve power plants and in addition by voluntary subjection to restrictions in electricity consumption. In January there were only 3 out of 54 Japanese nuclear reactors hooked to the grid. In March probably all nuclear power plants will be switched off. Apart from the stress tests that are taking place and the necessary ongoing of retrofits and repair work on the damages of the last earthquake, the responsible authorities refuse to grant operation permits2. It comes as a surprise that the company TEPCO as power station operator in the region of Tokyo affirmed that there will be no shortage of electrical power in the coming summer even at demand peaks.
