FRIEDRICH EBERT STIFTUNG

PERSPECTIVE

The end of nuclear energy?

International perspectives after Fukushima

NINA NETZER AND JOCHEN STEINHILBER (EDS.)

July 2011

- The nuclear disaster in Fukushima turned into a long-term crisis shaking the very foundations of economies and institutional structures. This offers an opportunity to organise energy supply in a more sustainable manner throughout the world.

- While a shift in thinking can be seen in some countries, others unswervingly continue along the planned path of an expansion of nuclear energy. However, given the economic and environmental misgivings as well as various security and safety risks of nuclear and fossil energy sources on the one hand as well as the benefits of green growth on the other hand, countries worldwide do not want to miss the opportunity to expand the use of renewable energy sources.

- Against the background of an ongoing depletion of resources and volatile oil and gas prices, any future set up of energy policies throughout the world has to balance the goals of energy security, economic viability, ecological sustainability and social compatibility. At the same time, a restructuring in the energy sector has to be formulated in a democratic manner involving the national, state, and community levels as well as civil society and industry.

Dialogue on Globalization

Contents

Never waste a crisis … Green light for a sustainable energy supply

*Nina Netzer and Jochen Steinhilber**

The nuclear meltdown in Fukushima has once again underscored that energy policy is more than just the production, transformation, distribution and provision of energy. Energy policy can often lead to major encroachments upon the environment as well as the lives and work of human beings. One-time events such as the recent earthquake in Japan and the meltdowns in several nuclear reactor blocks in its wake have the potential to turn into long-term crises shaking the very foundations of economies and institutional structures. But crises also hold out opportunities. The crisis of Fukushima, for instance, offers an opportunity to organise energy supply in a more sustainable manner throughout the world. In weighing out the alternatives to nuclear energy, we need to learn from previous crises and take into account risks to human health and safety posed by future energy sources as well as their costs and impact on the environment.

1. The morning after Fukushima – Business as usual or learning from the crisis?

Within the space of only two decades, watershed changes have fundamentally changed global constellations and structures and have altered the constraints and factors conditioning political alternatives and their prospects for success: the »balance of terror«, the Cold War's repressive pattern with its clear-cut rules and routines has dissolved in the 1990s in a world in which the classic patterns and mechanisms of the old political order no longer functioned. »Uncertain«, »complex« and »in constant change« are the attributes most frequently used to describe world politics today. The terrorist attacks of September 11, 2001, which not only changed the USA but global security-policy structures as well, the economic and financial crisis of 2008, which shook the global economy to the core and finally the nuclear disaster of Fukushima have further heightened this complexity, once again underscoring the interrelationship between domestic societal processes and global developments and impact. If one adopts Susan Strange's definition of structural power, according to which the crucial structures are production, security, finance and knowledge, then each of these fundamental power structures, which only tend to change very slowly, has been shaken by a fundamental crisis in the last ten years. The ambivalences which have come about as a result have further fuelled this uncertainty, extending its grip to Western societies as well.

But crises are not only marked by growing uncertainty – they can also often offer latitude to reshape policy in the struggle between competing interpretations of events and through the crystallisation of new visions of the future. The precondition for this, however, is that we learn from crises and formulate alternatives. Only when collective alternatives to that which already exist become visible do times of crises also become »times of realisation« (Oskar Negt). Otherwise potential anxiety (terror, an uncertain energy supply) will predominate and familiar strategies will be preserved and carried on – even though they have failed. If the failure of old ways is too obvious to deny, two tried-and-proven justifications then come into play: in view of the complexity or the »general drama of politics«, stakeholders – not without interest of their own – decry the bankruptcy of policy, claiming that the possibility of an effective, change-inducing, and efficient collective action has come to an end. This is reinforced by the »creed of no alternatives«. Margaret Thatcher was fond of asserting that »there is no alternative« – thereby negating options, stripping criticism of legitimacy and suffocating political dialogue in its infancy. This reactionary mantra served its purpose for two decades, until it ultimately and rightfully became one of the main targets of the World Social Forum movement. All the more so because the supposed lack of alternatives always went hand in hand with the dismantling of social attainments, the auctioning off of public goods and the promotion of parochial economic interests.

A look at the period following the attacks on the World Trade Center and the financial and economic crisis shows that it cannot be taken for granted that people will learn from crises – even in the wake of watershed changes,

* The authors work for the Friedrich-Ebert-Stiftung in Berlin, Germany. Jochen Steinhilber is Head of the Department for Global Policy and Development, Nina Netzer is in charge of International Energy and Climate Policy.

some countries reacted to the legitimate desire of their societies for security by violently lashing out against perceived external threats with military means while drastically tightening internal security. 9/11 thus reinforced strategies which were already being practiced, weakened alternative political strategies and once again elevated warfare to a permanent state of affairs in which »the West« increasingly lost sight of its most important weapons – its civil, economic and social attractiveness. The dominant form of mature capitalism (financial) appears to have weathered this major crisis relatively unscathed in spite of obvious dysfunctions and calamitous social and economic effects. During the crisis itself hope for a fundamental reform of the international economic and financial markets flickered up for an instant, but after a brief moment of panic the old system was restored relatively smoothly. The flagrant failure of markets, the existing system's »near-death-experience« (Stiglitz) did not suffice to bring about any fundamental change in course, either, as there was neither any alternative capable of generating enough support in the political arena, nor were there any social forces capable of imposing one.

Similar to Chernobyl and other nuclear accidents of the past which have been forgotten, the disaster of Fukushima is an ongoing disaster whose further development and impact are unpredictable. Nevertheless there is much to suggest that, in contrast to other crises of the decade, it will lead to a watershed change which does indeed trigger societal learning processes. Nuclear energy does not have any future in democratic societies. The phase-out of nuclear power will not take place everywhere as quickly as in Germany, where the nuclear debate in society has been raging for decades, where proponents and opponents of nuclear power long constituted one of the last ideological separating lines and a strong anti-nuclear movement came about. Nuclear power will also lose ground in the political debate in other democratic countries as well, as it is a hermetic technology which is closely associated with non-transparent and authoritarian decision-making and administrative systems, promoting repression and societal control, and because it is too risky and ultimately too expensive as well. The crucial difference this time is to be found in the ever more refined development of more economical, sustainable, less risky and from a societal standpoint more acceptable alternatives which are fuelling opposition to nuclear energy, thus making it easier to compensate for the loss of nuclear power. The discussion over the future of nuclear energy thus does not merely involve the question of future energy supply – it also touches upon other fundamental socio-political questions involving the relationship between economy and state, democratic development, assessment of technology and management of risk as well as our understanding of progress.

»The bright side of the atom …«

As far back as at the beginning of the civil career of nuclear power, an attempt was made to play down the dangers of nuclear energy to a minimum in the public debate and indeed to paint a rosy picture of the future through the use of nuclear energy. This was no simple endeavour. After all, nuclear energy had been synonymous with death and destruction especially since the atomic bombs were dropped on Hiroshima and Nagasaki, but also as a result of large-scale testing of nuclear weapons. In his »Atoms for Peace« speech before the United Nations General Assembly in 1953, US president Eisenhower issued the order of the day: military use of nuclear energy was to be contained of all things through the massive expansion of civil and hence »peaceful« use of nuclear energy, in this manner preventing proliferation of equipment, technology and scientific knowhow. Even today compensation is still the core element of the Nuclear Non-Proliferation Treaty. Its advocates never doubted that atomic energy would be used for the good of humanity and progress. In almost euphoric terms they prophesied electrical power in abundance, a veritable electric Garden of Eden, which would form the foundations for development and prosperity. In addition to producing energy, the fields of transportation, agriculture and medicine were to profit from the new »spirit« of nuclear energy. The film »Our Friend the Atom«, animated by Walt Disney in 1957 and produced in collaboration with the Navy and General Dynamics, was also shown to German schoolchildren and served as the basis for a popular children's book. It describes a brave new peaceful world of atomic energy and ends with a plaintive wish for the atom to always remain the friend of humankind forever. In Europe the Brussels Atomium, built for Expo 1958, stands as a monument to technology and the triumph of the atomic age. With much hope being vested in the limitless possibilities of nuclear energy, the remaining risks – the residual risk – had to be accepted or ignored. It was particularly remarkable how Japanese society was won over to the charms of nuclear power:

memories of the nuclear holocaust of Hiroshima and Nagasaki were successfully banished and along with them collective fear of the destructive power of nuclear energy. The peaceful harnessing of nuclear power promised not only economic benefits and prosperity, but generally speaking also symbolised a new era in which the Japanese could bid farewell to the old system and through the application of new technologies on a massive scale forget the disastrous defeat ending a war which Japan helped bring about.

But just like everywhere else in the world, the use of nuclear energy in Japan was nothing more than the result of a weighing out of risks in which a country poor in raw materials (striving to enhance its status) purchased energy security at the cost of the dangers posed by nuclear energy. Security priorities are decided on a social and political battlefield, and the hierarchy of priorities is in constant flux. This especially goes for the use of technologies which are of an »unforgiving« nature, which can in the event of an accident have repercussions of a cataclysmic scale. When the Chairman of the Ethics Commission on the Future of Nuclear Energy, Klaus Töpfer, stated in the wake of the nuclear disaster in Fukushima that a »residual risk had materialized«, he meant that the risks of nuclear energy, which were no greater after Fukushima then they had been before, were no longer socially acceptable at least in Germany.

Even as far back as the 1950s, not everyone was »intoxicated by atomic power« (Rainer Hank) – it was then that the first warnings about the risks involved could be heard. The German philosopher Günter Anders called the expansion of the nuclear industry a »reckless overstepping of a frontier«. According to Anders, the technology would have unintended effects in the future, but humanity carried on as if it was not aware of the danger. Politicians advocating economic liberalism like to refer to a »pact between generations« when the order of the day is to roll back social benefits so that future generations will not be burdened. With respect to the impact of nuclear energy, even in the best-case scenario – without any accidents occurring – one would have to draw up a »pact between generations« of an entirely different nature. »Long-term« is a crass understatement for the periods of time which have to be taken into account as a result of the half-lives of fuel rods, which in some cases – like plutonium – span a period longer than the modern history of humankind. In the Ukraine vast stretches of land have been »blotted from history« (Alexander Kluge) and in Fukushima as well the evacuation zone will no longer be inhabitable. With technologies like these, it is not possible to quantify the problem in any realistic way and thus rationally »assess« the residual risk involved, as the potential lethalism of the technology and its spatial and temporal impact are beyond the grasp of human beings.

Following meltdowns in Harrisburg and Chernobyl, hushed-up accidents and numerous additional serious incidents over the last – few – decades, it would appear that cumulative statistical residual risks have produced full-scale disasters. After having made the leap from mere statistical probabilities to reality, in which only the weather and wind direction decide the scale of the disaster, it was no longer possible to deny the implications of nuclear energy. Accidents nevertheless continued to be treated as an abstract possibility in discussions among advocates of nuclear energy – especially in the Western industrialized countries. Harrisburg was shrugged off as a one-time event and the meltdown in Chernobyl isolated in its own special category as a »communist crisis«. Nevertheless, abstract trust and confidence in the ability to control the technology eroded in the ensuing period, with nuclear energy once again being strongly associated with anxiety over destruction and illness instead of hope and prosperity in the »risk society« (Ulrich Beck). With the rise of social movements, the discussion was finally removed from the technocratic realm and nuclear energy had to weather a societal debate in several countries – which it was unable to survive at least in Germany. Now meltdown in high-tech Japan has added a new chapter: the issue here is not the creation of a new security level to enhance controls and improve monitoring or to devise new models, but rather pure and simple the realization that this technology cannot be controlled and has to be terminated.

Under control? Nuclear energy caught in the crossfire between economic failure and threats to international security

The technical construction and operation of a nuclear power plant is already a complex task in and of itself. It is even more difficult, however, to create propitious underlying conditions for the establishment and expansion of nuclear energy. The strong concentration of nuclear energy in a few countries (more than 90 per cent of power plants are located in 22 countries, with roughly half of these being in the USA, France and Japan) shows that this is no simple task. And the massive decline in investment over the last two decades indicates that these structures can also change quickly as well. Economic, but above all political and social factors must all intermesh in a favourable constellation for nuclear energy to have any chance of surviving at all.

The global energy industry recognized early on that nuclear power plants are expensive and cannot compete with other types of power under normal market conditions – prompting it to have the state foot the bill. Nor did this change during the period of nuclear euphoria, when German energy companies were very sceptical about nuclear power with respect to financing, ultimately banking on soft coal, or in more recent years with the proclamation of a »renaissance« of nuclear energy: even under the most favourable conditions – strong capital markets (up until the 2008 crisis), massive political support and social acceptance – the American energy industry could not be enticed (or did not want) to spend one single dollar of private capital on the planned expansion of nuclear energy. Wall Street has not invested in nuclear facilities for 36 years. To cope with this reality, the nuclear industry insists that each loan be guaranteed by taxpayers, as otherwise prospects of attracting private capital are more or less nonexistent. Indeed, there is scarcely any power plant which is not projected and planned by government agencies, supported with massive public subsidies and operated by government, semi-government or semi-public enterprises. Nuclear energy is an »official technology« (Radkau) and whether a renaissance of nuclear energy comes about or not has never been up to a market economy or business decision. It has, rather, always been a political decision. 85 per cent of the biggest producer of nuclear power in the world, the French company EDF, is held by the state. The municipality of Tokyo holds a 40 per cent stake in the Tepco Group. The Enel Group, in which the Italian state is the majority shareholder, has controlled Spanish power plants since it took over the Spanish energy supplier Endesa and together with EDF is at present planning to build nuclear power plants in Italy, where there have been no nuclear power plants to date. The Swedish company Vattenfall, which is 100 per cent state-owned, operates six nuclear power plants in Sweden and until 2011 two in Germany. A process of strong concentration can be witnessed among builders of power plants, which is the domain of only a few enterprises, at the head of the pack the French company Areva, the two American-Japanese multinationals Westinghouse-Toshiba and General Electric-Hitachi and the Russian company Rosatom, while the German Siemens Group appears to be poised to phase out nuclear technology. The para-state nuclear economy is thus the very opposite of a smart economy: merely the rump of an outmoded industrial-policy strategy of »grand projects«, with the expensive mega-projects of the 1960s and 1970s riding a wave of economic prosperity, technological progress and nationalism. Countries where national renewal was linked to such mega-projects, like in France and Japan, tended to tolerate risky technologies more.

The *etatist* and hermetic nature of the technology is especially evident where military and civil use of nuclear power go hand in hand. »Peaceful« use of nuclear energy is a myth. The civil nuclear industry has always been a workshop for the bomb and spill-overs from »civil« to the military area are manifold, ranging from material and technologies, which often have dual-use capabilities, to the development of expertise which is also used for military purposes and the gathering of political support to build the bomb, which is easier in an environment which is already familiar with the technology, all the way to disguising secret plans to build nuclear weapons with civil programmes. Indeed, this type of proliferation is rampant. Numerous countries have used civil programmes to create the preconditions needed to build weapons, among them India, South Africa, Israel, Pakistan and North Korea. Libya and Iraq were well along this path, and many believe that Iran is as well, while other countries such as Brazil, Taiwan and South Korea, but also Switzerland and Sweden, have discontinued their military programmes. About one-third of those countries with a significant nuclear industry have conducted intensive research for military purposes. The structural contradictions of the Non-Proliferation Treaty (NPT) and the International Atomic Energy Agency are particularly stark here: the prohibition under the NPT for non-nuclear powers to institute nuclear weapons programmes is based on a pledge made by the five official nuclear powers upon the inception of the Treaty first of all to completely dismantle their nuclear arsenals (which they have not done) and secondly to provide all signatory states support in the civil use of nuclear power. In short: the proliferation of nuclear weapons was supposed to be stopped by spreading sensitive nuclear technology and weapons-grade material. A host of »countries possessing virtual nuclear weapons« (El-Baradei) have developed among signatory and non-signatory countries to the NPT (many of those countries with nuclear weapons capabilities at present did not sign the Treaty, suspended it in order to obtain the technologies they needed or did not sign the additional protocol to the NPT providing for stricter controls), and their number can be expected to grow in the coming years. In spite of the limited role played by civil nuclear energy in energy production throughout the world, its strategic military potential has grown steadily. The amount of »civil« plutonium, estimated at 230 tonnes, is double the amount of military plutonium contained in warheads. Without any disarmament taking place in these ostensibly civil structures of the nuclear industry, not only »global zero«, but also the containment of additional proliferation will be virtually impossible. This would then have to be based on a radically reformed non-proliferation treaty which creates new incentive systems for renunciation of military and civil use of nuclear energy.

From »nucleocracy« to energy democracy?

Advocacy of the nuclear economy requires not only a special relationship between the state and business – it also promotes a specific type of state. Or to put it the other way around: the nuclear industry enjoys propitious conditions wherever there are closed political systems, i.e. where the state is centralised, there is a hierarchical political system, technocratic ideas have a major influence on political decision-making processes and there is a tendency to exclude society from these processes. This applies not only to the establishment and support for a nuclear industry in normal operations, but also particularly in the case of accidents. This is when cover-ups, concealment and downplaying accidents and their causes and effects become the *modus operandi* across entire political systems. Because smaller accidents with high-risk technologies, whose social acceptance is based on trust and confidence, also put the technology as a whole in question, enterprises and public administrations tend to propagate half-truths and disinformation especially in a democratic environment.

While the preconditions for a nuclear industry are without a doubt most favourable in autocracies and dictatorships, there are also »special structures« within democracies as well which marginalise debate and insulate decisions favourable to the nuclear industry from public scrutiny. In France a »nucleocracy«, i.e. an especially tight-knit elite group of persons in the fields of science, politics and business whose members have usually been trained at the same schools, has along with other factors prevented a transparent political debate over nuclear energy. As a result of the impenetrable nature of government institutions, it is easier to insulate decision-making from the public there. This situation is reinforced by the general trust which the French population places in its cadres, the technocrats working in the public administration. In other democratic countries which have more open, decentralised and pluralist systems, are more oriented towards competition and which allow a public debate, on the other hand, nuclear energy came under pressure as an official technology earlier. It is not surprising, then, that both the USA and Britain's atomic energy programmes were most successful when they were tightly controlled by the military or the state and kept largely out of the public arena, and that these programmes have witnessed stagnation over the last few decades.

Where the political terrain is more difficult to negotiate, companies are forced to sway policy-makers and public opinion through lobbying. Especially the nuclear industry needs to come up with the right spin at the right time, a »pros-and-cons« type of rhetoric which downplays the risk of nuclear power, plays up other risks and then offers itself as an alternative. Against the backdrop of growing uncertainty in society, lobby groups have seen their chance to move nuclear energy back to the fore: fear of climate change, the oil-price shock, energy dependence, mounting electricity prices and the threat of black-outs have been the buzzwords in an aggressive campaign achieving erstwhile significant successes, including a lengthening of operating lifetimes for nuclear power plants and thus the negation of the nuclear accord achieved in Germany only a few years ago and a credit guarantee to the tune of almost 19 billion US dollars in the USA for the construction of new power plants shortly before Fukushima – while at the same time any guarantees for renewable energies were rejected. A striking example was a broad campaign at the end of 2010 in Germany, when the government and NPP operators agreed on a possible extension in the lifetime of nuclear reactors beyond the planned phase-out in 2020. Dubbed »Energiepolitischer Appell« (»Energy-Policy Appeal«), 40 celebrities such as Josef Ackermann, Chairman of the Management Board and the Group Executive Committee of the »Deutsche Bank«, a leading global investment bank, Rüdiger Grube, Chairman of the Management Board of »Deutsche Bahn AG«, the German national railway company, as well as people in the public limelight such as the popular football manager Oliver Bierhoff, called for an extension in the lifetimes of German nuclear reactors in a full-page newspaper ad – initiated by major electricity providers.

The nuclear industry has left its imprint on democratic systems. Even if Robert Jungk's thesis on the danger of a nuclear state in which nuclear reactors are used to justify increasing restriction of freedoms has not manifested itself entirely, it would nevertheless appear that the wall of political protection surrounding the nuclear energy, close ties between the industry and the political arena, repression and surveillance in connection with the annual clashes between demonstrators and security forces when atomic waste is transported in Germany have all helped create a »special zone« within democracies in which different rules of the game apply. The nuclear energy industry, in the words of Ulrich Beck, »has turned the world into a laboratory, an experiment with an uncertain outcome« without there being any transparency over the how and the consequences, let alone any democratic debate over the whether and possible alternatives. An absence of opportunities for participation like this has often enough led to civil society backlashes in the past.

In many countries civil opposition has been observed in situations in which policy decisions involving the energy infrastructure or energy sources has had an influence on the living or health situation of parts of society. Examples can be found in many countries, some of them more and some of them less democratic, in places where a nuclear power plant is supposed to be built next door or a search is going on for final storage facility for nuclear waste, but also when new wind power stations, power lines or electrical storage power stations are supposed to be constructed. Even in states where public discourse on contentious issues is suppressed, protest, mainly through internet campaigns, can be witnessed: In China there have been online anti-nuclear campaigns in provinces where nuclear power plants were to be built such as Shandong, Sichuan, Hunan, and Fujian, organised by local residents who fear health threats posed by radiation from the plants. In addition to situational protest in many countries, an established anti-nuclear-movement with NGOs and social movements at the vanguard has emerged. Examples include the French Réseau Sortir du Nucléaire (the French Nuclear Phase-Out Network), the Indian National Alliance of Anti-Nuclear Movements, consisting of more than 100 NGOs and popular movements or the Brazilian anti-nuclear movement, which is currently proposing a moratorium on the Brazilian nuclear programme. These movements function as facilitators for public concerns over nuclear energy, expressed in a range of activities ranging from peaceful demonstrations to violent conflicts between the police and protesters. The most current example is the huge public outcry in Jaitapur, India against the construction of a new nuclear facility in the aftermath of the Fukushima nuclear disaster. The protests turned violent and one anti-nuclear activist was shot to death by the police.

These examples show that democracies need to develop further at the nexus where technology and society meet, as the pace of technological development will scarcely diminish in the coming years – nor will ambivalence. Technologies of the future will become less visibly, more personally and more tightly interwoven with different aspects of political, social and private life. The phase-out of nuclear energy and the containment of climate change will also trigger new technological development. In contrast to information technology, however, which has been accepted by society without much opposition, the further advance of technologies in the 21st century will not have such an easy time of it. Societal acceptance of new technologies will increasingly become a prerequisite for fundamental innovations in pluralist societies. What is needed here is a new negotiating process between policy, science and society in which the rationality of science can be critically analysed, in which it can be discussed to what degree we are willing to accept a culture of uncertainty, what possible risk-minimising alternatives exist and what technologies need to be »un-invented« because they are obsolete or too risky. Especially here, where technologies have a significant influence on the lives of people, democracy has to be more than a mere power technique and instead become a lively public dialogue which thrives on informed, political-minded citizens.

The realisation that things cannot continue this way applies to many fields of politics, but usually no alternatives are presented. People can only be motivated to break out of old patterns in crises, however, when these alternatives become visible and when they realise that »learning from the crisis can have consequences which strengthen these alternatives« (Oskar Negt). No oil, no gas, no coal, no choice – that is how Claude Mandil, the former director of Gaz de France and the IEA, justified France's attitude to nuclear power. This has changed; the alternatives are obvious.

2. Renewable energies: a democratic and environmentally friendly alternative

The future of national energy policy has been a subject of discussion in many countries since the events in Fukushima. Independently of how the future of nuclear energy is judged – direct reactions range from phase-out plans to affirmations of the intention to expand nuclear energy – actors everywhere in the world are interested in alternatives. New technologies for producing energy offer the possibility for new growth trajectories, to diversify the national energy mix and to reduce national dependence on imports. If one leaves nuclear energy out of the equation for a moment, merely fossil fuels, which are only available to a finite degree and regenerative energy sources, remain. But just as in the case of nuclear energy, alternative energy sources and new technologies for supplying energy have to be reviewed in terms of their compatibility with democratic systems, conflicts in aims have to be resolved and residual risks have to be weighed out.

Energy policy and participation: bottom-up rather than top-down

The provision of energy and subsequent policies are frequently discussed in terms of aspects such as energy security, climate protection or competitiveness. But could a global energy transition towards renewable energies also offer an opportunity for societies to become more democratic worldwide?

National energy policies strongly impact nearly all aspects of human life such as economic activity, employment, health and consumption. In most countries, however, citizens scarcely have an opportunity to participate in shaping energy policy (apart from the possibility to elect representatives to parliament in democratic states). Instead, the public has to accept decisions taken by governments, often influenced by powerful industry associations and energy providers, which in many cases implicitly pose a threat to living and working conditions. These dangers are especially apparent in the case of nuclear energy or the use of fossil fuels. The expansion of energy infrastructure for renewable energies can impose severe encroachments as well, however, e.g. by expanding the present power-line system to integrate more renewable energy into the grid. The same holds true for the unforeseeable impact on nature and living environments by technologies such as Carbon Capture and Storage (CCS) or Hydraulic Fracturing (»Fracking«). Given these risks, it is absolutely essential for energy policies to be formulated in a democratic manner involving the national, state, and community levels as well as civil society and industry. Energy transition will only be successful in the long term if it is the result of a bottom-up approach – otherwise it will probably lead to widespread disenchantment among voters, who may well turn the government out of office at the next opportunity. In contrast to the exclusion of citizens from decision-making processes, influence by energy providers is much more prevalent, sometimes in a concealed and sometimes in an open manner.

In order to counteract the widespread and massive lobbying of energy providers and industrial associations, a stronger involvement of civil society and a democratic restructuring of energy policies is necessary. This requires both a greater inclusion of voters and civil society in decision-making as well as a change in the relationship between the national, state and community levels.

Participation and decentralisation

As described above, in many countries civil protest and opposition have been witnessed in situations when policy decisions on energy infrastructure or energy sources influence living conditions or the health situation of parts of society. Some counter-examples show, however, that such a process can be organised in a different, i.e. more democratic and peaceful manner by involving citizens and interest groups right from the outset. An impressive example of this was the decision on the construction of a final waste disposal in Östhammar, Sweden, which is slated to go into operation in 2020. If everything goes as planned, it would be the first final waste disposal facility in the world which is accepted or even welcomed by the local population. A democratic process ranged from the organisation of citizen forums to facilitate a dialogue between the public and the operating company Svens Kärnbränslehantering (SKB) to a public opinion poll in which 77 per cent of local citizens voted in favour of storing nuclear waste in their immediate vicinity. Having discussed the pros and cons, the factor new jobs and economic gains were held to outweigh the potential dangers of highly toxic radioactive waste. Another example of democratic energy policymaking are energy associations such as the German »Energiegenossenschaft Leutkirch eG«, which is made up of citizens, enterprises and civil society organisations. Its aim is to build regional renewable energy facilities and run them in a profitable manner. The members underwrite shares and are thus involved in decisions affecting the regional structuring of the energy infrastructure as well as in profit-sharing –several renewable energy facilities have been jointly constructed in this manner over the past years, while the numbers of members has doubled and the association's financial resources quadrupled.

These examples illustrate that the acceptance of decisions on energy policy and infrastructure can be increased by transparency and participation, thereby even accelerating planning processes by involving the population right from the beginning and avoiding protest at a later date.

Besides enhanced participation of civil society in energy policy-making, democratic restructuring of the energy sector is indispensable. In most countries the energy market is characterised by a centralist structure in which a few electricity suppliers produce a large percentage of electrical power. Competition is thus limited in most markets, creating a situation in which the few companies possess considerable power. As seen in the example of the newspaper campaign staged by German electricity providers, the powerful position these have as a result of centralized structures often facilitates their influence on energy policy-making. Widespread resistance against renewable energies linked with a decentralisation of grids and augmentation of energy providers are the logical consequence in a system in which energy monopolists generate maximum profits with large, centralized energy-production facilities in a structure in which they have only few or no competitors offering locally produced and cheaper electricity.

A transition away from fossil fuels and nuclear energy to renewable energies can thus be seen as a window of opportunity for energy democracy. An expansion of renewable energies goes hand in hand with more decentralised energy systems and will consequently affect countries' economies and societies as well as relations between national, state and community levels. Local communities and especially municipal energy suppliers and citizens' associations will have an opportunity to become self-sufficient in their energy supply and independent of large-scale enterprises, enabling them to develop their own concepts including block heating stations, combined heat and power stations and solar power plants. Besides a technical energy infrastructure, a process of decentralisation enables these actors to organise codes of procedure and building regulations in such a manner as to lower energy consumption and speed up planning processes. Increased independence is also without a doubt accompanied by a responsibility for investment decisions to be taken in the energy sector and a balancing out of their possible consequences as well as the challenge of involving citizens in a transparent and democratic process. Both at the national as well as at the state and community level this could involve procedures such as the establishment of a citizens' forum for energy policy or the appointment of an independent commissioner for energy policy who is not responsible to the government but rather to parliament. With the help of objective indicators and indexes, such a commissioner could be assigned by parliament to monitor the achievement of energy policy objectives, e. g. attainment of a certain share of renewable energies in the energy mix in a manner which is transparent to trade unions, consumer associations, NGOs and citizens in the energy policy-making process.

Nuclear phase-out and climate protection – not necessarily a trade-off

Against the background of increased awareness of climate change over the past years, supporters of nuclear energy have constantly underlined its alleged contribution to climate protection due to low CO_2-emissions. The debate on how climate protection can be realised without nuclear energy has intensified after the events in Fukushima, additionally fuelled by the fact that several countries are discussing a roll-back or even phase-out of nuclear energy. Since a departure from nuclear energy is unavoidably connected with the question what the future energy mix should be, a debate is now raging in many countries on whether renewable energies would be able to close the gap in the electricity supply which would arise. Doubt is often cast on this possibility in the current debate and it is even argued that it will be necessary to rely on coal-fired power plants to secure for a stable electricity supply without nuclear power. Opponents of nuclear energy now find themselves in the situation of having to explain what possible alternatives could look like, pressured by sceptics accusing them for not having any strategy or alternative solution for the time after (the nuclear era). On top of this, calls for coal or gas as bridging technologies could lead one to conclude that a phase-out of nuclear power and climate protection are mutually exclusive goals. A departure from nuclear energy and fossil energy sources will certainly not be attained overnight. In order to achieve an energy supply based on 100 per cent renewable energies, several structural changes need to be made to stake out the course towards a sustainable future – ranging from technical arrangements such as expansion of electricity grids to political regulations and introduction of new market mechanisms. At the same time, several aims in energy policy-making have to be brought in line: besides climate protection, security of the energy supply has to be guaranteed, the competitiveness of local and national markets has to be strengthened and it has to be ensured that the energy revolution is shaped in a social sustainable way, i. e. consumers' and households' access to affordable and safe energy has to be ensured.

In weighing out different aims and scenarios, it is considering that neither fossil fuels nor nuclear energy have ever been a low-emission or ecologically sustainable choice. While it is indeed true that a nuclear power plant does not produce any CO_2 in operation, if one takes into account the entire cycle of construction and operation all the way to decommissioning and in particular includes the mining of uranium and manufacture of fuel rods in the equation, greenhouse gases certainly are produced, as fossil energy fuels are used for many of these processes. On top of this, the potential for reduction of CO_2 emissions in this sector is not particularly high because of the low percentage of nuclear energy in global primary energy production. It will moreover scarcely be possible to build enough reactors in the near future in order to reduce the global emissions balance. To reach the target accepted by the international community of states at the World Climate Summit in Cancun of keeping global warming to below 2°, global greenhouse emissions would have to decline by at least 50 per cent by 2050. Because the average time required to put a reactor into operation from the planning to commissioning is approximately 10 years, nuclear energy cannot provide any speedier contribution to a reduction of emissions.

Furthermore, while in many countries nuclear energy has been subsidized in an open or hidden manner for decades, the chance was missed to use these investments for the promotion of renewable energies. In fact nuclear energy is the most expensive way of producing electricity, as it is only economically viable in many countries through various forms of open or hidden subsidization. In addition to government start-up financing for major nuclear projects, direct subsidization to preserve safety standards and tax exemptions, nuclear power is also promoted in a hidden manner by not passing on the enormous costs which accrue i. e. through the temporary and final storage of radioactive waste to consumers in the form of energy prices. These costs, rather, are borne by society as a whole and will be in the future as well. The companies operating nuclear power plants, for example, profit from the fact that they do not have to take out liability insurance commensurate with the risk involved. In the event of a nuclear accident, operators only have to pay a fraction of the damage. The majority of the costs have to be assumed by the state – and thus taxpayers. In sum total, one kWh of capacity at nuclear power plants requires approximately three times as much investment as gas and steam-powered power plants – even setting aside the costs of permanent storage and other subsequent costs (Umweltinstitut München 2011). Long-term support of nuclear energy therefore constitutes an expensive aberration from the path towards renewable energies. If a departure from nuclear energy and a subsequent move in the direction of renewable energies would have taken place much earlier, we would have already been much further along than we are now. But with this path being opposed by a huge sector of industry, which realised considerable profits from this form of energy production, and an active nuclear lobby making policy-makers and the public believe that there are no cheap and reliable alternatives, this chance was missed.

Besides the alleged trade-off between nuclear phase-out and climate protection mentioned above, there is another contentious issue in the current situation which could lead to another crisis of confidence between developed, emerging and developing economies. When industrialized countries decide on their future energy mix, they unavoidably influence the future of developing countries as well. The decision on whether to bear the risks of nuclear energy a couple of years longer or to instead opt for a nuclear phase-out and rely on coal to a larger extent until the initial investment costs for renewable energy production decrease will increase industrialized countries' carbon footprint, contributing to global warming and subsequent negative effects on developing and emerging countries as well. Industrialized countries would be sending out the wrong signal by substituting for nuclear energy with carbon-intensive energy sources such as coal, relocating their carbon emissions to developing countries with the help of instruments such as the CDM while at the same time asking poorer countries to reduce emissions and boost their economic growth in a sustainable way.

There is therefore widespread concern in developing countries that the nuclear roll-back or even phase-out in industrialized countries such as Germany or Japan could lead to an expansion in the use of fossil fuels, mainly coal and gas, which would lead to an increase in carbon emissions over the short term. Aside from its finiteness and negative impact on human health and environmental sustainability, coal in particular (a very carbon-intensive energy source) is one of the main drivers of ongoing climate change worldwide. Its use negatively affects the lives of hundreds of thousands of people at present, nor will this be any different in the future. Global warming is already having a severe impact in many countries in the form of droughts, flooding or hurricanes, consequently leading to losses of natural resources and thus people's means of existence, while jeopardising social and economic development. Even though many countries have already instituted a host of political, economic and informational measures seeking to promote the expansion of renewable energies or an increase in energy efficiency through laws and regulations or through massive public and private investment in green infrastructures or technological development, many developing and emerging countries still rely to a large extent on coal because it is a cheap source of energy. In addition, they argue (and justifiably so) that industrialized countries have attained their high standard of life in their present form of economy based on finite and carbon-intensive fossil energies. Developing and emerging countries, which in historical terms bear comparatively little responsibility for climate change, will be the countries most hard put to deal with the effects of global warming and scarce resources due to their geography, weak coping capacities, high concentrations of poverty and more vulnerable social, institutional and physical infrastructures. By using the internationally accepted goal of keeping global warming below the critical 2°C mark as a reference point, a pretty precise total global emissions budget can be calculated on the amount of emissions which can still be tolerated. The industrialized countries have already far exceeded their budget by producing at the expense of the entire global community for decades. This situation is frequently interpreted as a right to development, i.e. a right to generate economic growth on the basis of cheap, finite and carbon-intensive energy-sources and especially coal as well, by developing and emerging economies. At the same time, however, these countries do not want to miss the opportunity to participate in the benefits of green growth. Against the background of an ongoing depletion of resources and volatile oil and gas prices, the expansion of renewable energy sources and an increase in energy efficiency offer a way to satisfy growing energy demands, diversify national energy sources and reduce dependence on energy imports as well as boost local economic development with green technologies and products. There is widespread agreement that industrialized countries are obliged to take the lead in combating the impact of climate change in countries affected by it as well as in financing investments for the shift to lower-carbon and climate-resilient economies in developing countries while at the same time making the necessary adjustments in their own growth patterns.

To consider coal as an alternative option in the event of a nuclear roll-back or phase-out would be thinking in the wrong direction and could further undermine the already tattered trust between developed and developing countries. In a worst-case scenario, this could lead to a deadlock in ongoing negotiations for a new international agreement on climate change. Instead, industrialized countries need to set a good example, showing that neither nuclear energy nor fossil fuels are reliable options and that the promotion of a sustainable energy supply can help develop the economy and serve as an engine of job-creation. The cataclysmic accidents in Fukushima have once again emphatically underscored that the dangers of nuclear energy cannot be controlled by human beings despite all the technological progress which has been made and all the safety precautions instituted and many countries have subsequently begun to rethink their energy policies. A move away from nuclear energy does not necessarily mean a step backward for climate protection – the current situation, rather, offers a window of opportunity for a worldwide energy revolution.

The future of nuclear energy in the wake of Fukushima

*Lutz Mez**

The total meltdown in Fukushima has placed international energy policy at a crossroads. The global renaissance of nuclear energy hailed for decades has failed to materialise and following the nuclear disaster in Japan it has become even more unlikely that nuclear energy will play an important role in the global energy mix over the long term. On the contrary: since Fukushima there have been more or less clear signs of rethinking on the parts of governments in a number of countries, including Germany, Switzerland, China and now even Japan, indicating that they are considering picking up the pace in a fundamental change in energy policy. Especially the phase-out of nuclear power resolved upon by the influential EU member state Germany could have an impact on Europe as a whole, as EU Energy Commissioner Oettinger expects: the nuclear disaster in Japan faces us with the challenge of deciding »how Europe is to secure its energy needs in the foreseeable future without nuclear power«. Other countries like Russia, the Czech Republic or France, on the other hand, have announced that they intend to carry on with an expansion of nuclear power. This raises the question as to what impact the events in Japan will have on civil use of atomic power and the future energy matrix over the medium term. Because Japan and Germany – the third and fourth largest economies in the world – have decided to phase out nuclear energy and base future growth more on renewable energies, this inevitably poses a question to other states: If Japan and Germany don't need nuclear power, why does anyone? This article reassesses the purported international renaissance of nuclear energy against the backdrop of events in Japan.

1. Introduction

The massive accidents in Fukushima have once again made it painfully evident that the dangers posed to humanity by nuclear power cannot be contained. While critics of nuclear power want to put an end to the atomic age as quickly as possible, the pro-nuclear community continues to peddle nuclear power as a panacea for humankind. Writing in the biggest Danish daily, Berlingske, columnist Claes Kastholm for example posited only two weeks after the explosions in Fukushima that »nuclear energy is the most secure form of energy that we have« (Berlingske Magasin, 27 March 2011, p. 23). But has the oft-touted global renaissance of nuclear energy ever really materialised in the first place? In view of the looming climate crisis and dwindling fossil fuels – peak oil just to mention one – nuclear energy was propagated in the past decade as a CO_2-free, safe and secure, cheap solution to global energy problems. US President Barack Obama stated in February 2010: »Nuclear energy remains our largest source of fuel that produces no carbon emissions. To meet our growing energy needs and prevent the worst consequences of climate change, we'll need to increase our supply of nuclear power. It's that simple.« While the supposedly low costs of atomic energy were extolled in the early phase of civil use of nuclear power – »too cheap to meter« was the jingle – the claim has in the meantime been modified to »at least cheaper than the alternatives«.

The purported renaissance of nuclear energy has a long history: As far back as 9 October 1981 the New York Times featured an article entitled: »President offers plans for revival of nuclear power.« The US government under President Ronald Reagan, it stated, had taken concrete steps to revive commercial nuclear power. Since then the renaissance of nuclear energy has been heralded in the media at regular intervals. In the early days of nuclear energy there was actually more evidence to back this assertion than there is today: after all, there were 233 reactors under construction in the world in 1979, and in the USA alone there were almost 50 reactors in 1981 – today there are only 64 reactors under construction in the world. Nevertheless, generally speaking one can say that there has never been, nor is there now, any indication of a comeback for nuclear energy in the Western industrialised countries. No nuclear power plant whose construction was not subsequently cancelled has been commissioned for construction in the USA, the biggest market in the world for energy projects, since 1973. Even if the nuclear lobby untiringly attempts to talk up the resurrection of nuclear power, the facts speak a clear language: the number of reactors in the world only increased from 423 to 437 over the period 1989 to 2011, which is not even one

* Lutz Mez is Coordinator of the Berlin Centre for Caspian Region Studies at the Freie Universität Berlin, Germany.

reactor per year on average. In 2008 no new nuclear power went onto the grid at all – for the first time since the beginning of commercial use of nuclear power in 1956. Moreover, in 2011 there were seven nuclear power plants less in operation compared to 2002, when the historical zenith of 444 was attained. But what are the reasons why use of a purportedly safe and secure, cheap and environmentally friendly energy source in reality appears to have reached a dead-end? The status of nuclear programmes in the world is examined in the following, to be followed by a discussion of arguments which have stood in the way of a global renaissance of nuclear energy to date.

2. Status of nuclear energy programmes in the world

The International Atomic Energy Agency (IAEA) still counted 443 nuclear power plants with a total rating of 375,374 MW and an average of 26 years of »operability« on 20 April 2011, even though core meltdowns took place in three blocks of the Fukushima Daiichi nuclear power plant in the wake of the earthquake and tsunami which hit Japan in March 2011 and no more reactors can probably be operated at this site any longer (see table). For this reason, only 437 reactors are listed as being operable in the World Nuclear Industry Status Report 2010-2011.

Is the entire world really building nuclear power plants? By no means. According to the IAEA, 64 blocks with a rating of 62,562 MW are under construction. The building projects are spread out among fourteen countries: China (27), Russia (11), India (5), South Korea (5), the Ukraine (2), Canada (2), Japan (2), Slovakia (2) and Taiwan (2) and one block each in Argentina, Brazil, Finland, France, Iran and the USA. The World Nuclear Association (WNA) only lists 61 reactors under construction, but another 158 reactors in the category »under planning«. Actual development of nuclear technology teaches us, however, that reactors »under planning« by no means automatically move into the category »under construction«. In 1979, before the Three Mile Island accident in Harrisburg, there were 233 reactors under construction in the world, and over 100 cancellations followed (Schneider, Froggatt, Thomas 2011).

In view of these facts, the metaphor »renaissance of nuclear power« must therefore be viewed to be more of an ideological weapon. Examined more closely, it would appear that nuclear power has even taken a nose-dive in the Western industrialised countries. In the European Union there were 177 reactors in 1989, whereas the IAEA only lists 143 operable reactors in April 2011. This figure also includes the seven reactors in Germany which have been taken off the grid following Fukushima, with it being virtually certain that all or at least some of them will be shut down before originally planned. Of the 192 members of the United Nations, only 30 countries had nuclear power plants in operation in May 2011. Iran will become the 31st country if Bushehr1 starts commercial operation in 2012. Three countries (Italy, Kazakhstan and Lithuania) have in the meantime closed down their nuclear power plants, while in Austria a reactor has been built in Zwentendorf which was never connected to the grid.

The six biggest countries operating nuclear power plants (USA, France, Japan, Russia, Germany and South Korea) include several countries possessing nuclear weapons (USA, France and Russia) and produce three-fourths of total nuclear power. Nuclear power plants only produce somewhat over 13 per cent of electrical power worldwide. This corresponds to 5.5 per cent of primary energy needs and somewhat more than two per cent of global final energy consumption. In comparison to nuclear power, the potential contribution of renewable energies to easing the strain on the environment and tackling climate change is much higher because they account for almost 19 per cent of global power production and more than 12 per cent of primary energy production.In the European Union thirteen out of the twenty-seven member states do not produce any nuclear power themselves or have abolished this technology for technical or economic reasons following political decisions. Fourteen EU member states are currently using nuclear energy, while three countries have shut down their nuclear power plants, six additional countries are phasing it out and the remaining ten do not have any nuclear energy programme. Eight high-risk reactors were closed down in the new accession countries in the expansion of the EU to Eastern Europe, with the EU and other Western donor countries contributing more than one billion Euros to meet the costs of closure. Four reactors are labelled »under construction« in all of Eastern Europe at present, although a series of new nuclear power plants are being planned. In spite of liberalisation and partial privatisation of the electrical power sector, the completion or construction of new nuclear power plants constitutes a virtually insurmountable fancing problem, however. Looking at the historical development, there were still a total of 143 nuclear power blocks in operation in Europe in April 2011 – 125 of them

Table 1: IAEA Nuclear Power Plants Information

Operational & Long Term Shutdown Reactors by Country			Shutdown Reactors		Reactors under construction	
Operational						
Country	**No. of Units**	**Total MW(e)**	**No. of Units**	**Total MW(e)**	**No. of Units**	**Total MW(e)**
ARGENTINA	2	935			1	692
ARMENIA	1	375	1	376		
BELGIUM	7	5,927	1	10		
BRAZIL	2	1,884			1	1,245
BULGARIA	2	1,906	4	1,632	2	1,906
CANADA	18	12,569	3	478		
CHINA	13	10,058			27	27,230
CZECH REPUBLIC	6	3,678				
FINLAND	4	2,716			1	1,600
FRANCE	58	63,130	12	3,789	1	1,600
GERMANY	17	20,490	19	5,879		
HUNGARY	4	1,889				
INDIA	20	4,391			5	3,564
IRAN, IR OF					1	915
ITALY			4	1,423		
JAPAN	54	46,821	5	1,618	2	2,650
KAZAKHSTAN			1	52		
KOREA, REPUBLIC OF	21	18,698			5	5,560
LITHUANIA, REPUBLIC OF			2	2,370		
MEXICO	2	1,300				
NETHERLANDS	1	482	1	55		
PAKISTAN	3	725				
ROMANIA	2	1,300				
RUSSIAN FEDERATION	32	22,693	5	786	11	9,153
SLOVAK REPUBLIC	4	1,816	3	909	2	782
SLOVENIA	1	666				
SOUTH AFRICA	2	1,800				
SPAIN	8	7,514	2	621		
SWEDEN	10	9,298	3	1,210		
SWITZERLAND	5	3,263	1	6		
UKRAINE	15	13,107	4	3,515	2	1,900
UNITED KINGDOM	19	10,137	26	3,301		
UNITED STATES OF AMERICA	104	100,824	28	9,764	1	1,165
Total:	**443**	**375,374**	**125**	**37,794**	**64**	**62,562**
The following data is included in the totals:						
TAIWAN, CHINA	6	4,982			2	2,600
Long Term Shutdown						
CANADA	4	2,530				
JAPAN	1	246				
Total:	**5**	**2,776**				

Source: Above data from PRIS database. Last updated on 2011/04/20.

Table 2: Share of Nuclear Electricity of Total Final Energy Consumption of Six Largest Producers (2008)

	F	KOR	JAP	D	USA	RUS
TPES in Mtoe	266.50	226.95	495.84	335.28	2,283.72	686.76
Electricity gener. in TWh	570.3	443.9	1,075.0	631.2	4.343.8	1,038.4
Nuclear el. gen. in TWh	439.5	151.0	258.1	148.5	837.8	163.1
Share in %	77.1	34.0	24.0	23.5	19.3	15.7
TFEC in Mtoe	165.55	147.54	318.81	235.67	1,542.25	435.51
Share Electricity of TFEC in %	22.5	23.7	26.0	19.1	21.3	14.0
Share Nuclear electricity of TFEC in %	17.3	8.1	6.2	4.5	4.1	2.2

Source: IEA 2010

in Western Europe and, following the closure of Ignalina nuclear power plant in Lithuania, a total of 18 in Central and Eastern European countries.

According to the IAEA, there are another two reactor blocks under construction in Western Europe: one in Finland and since December 2007 one in France as well. Construction of the first so-called European Pressurised Reactor (EPR) with a rating of 1,600 megawatts began in Olkiluoto, Finland on 12 August 2005. Since then the project has been overshadowed by constantly exploding costs and delays: originally slated for 2009, commissioning will probably not take place until 2013 and instead of the originally planned 3.2 billion Euro the reactor will cost almost 6 billion Euro. An EPR is also being built in France. Construction officially commenced on 3 December 2007 and it was expected that it would take 54 months to complete the plant, i. e. by May 2012. According to inspection reports from the supervisory authority ASN, a host of problems have also cropped up here. As a result, the ambitious time schedule cannot be met and commissioning is not scheduled until 2014.

The three biggest emerging market countries of India, China and Brazil embarked on their nuclear energy programmes decades ago, but have only partially achieved their goals. Nuclear energy only accounts for a small percentage of electrical power production and the energy supply in these countries. China has the most ambitious plans for expanding nuclear power, operating thirteen nuclear power plants at present, which account for 1.9 per cent of power production. 27 additional nuclear power plants are under construction. How Chinese plans will change in the wake of the events in Fukushima, which prompted the Chinese government to review construction plans, remains to be seen. 20 smaller reactors are in operation in India, meeting 2.2 per cent of electricity needs, with five more under construction. In Brazil two reactors are in operation, producing 3 per cent of electrical power, with one additional reactor block under construction.

A closer look shows, however, that twelve out of the 64 reactors were already included in the statistics with the status of »under construction« more than 20 years ago. Construction of the reactor blocks Khmelnitski 3 and 4, for instance, began in the Ukraine as far back as 1986 and 1987. These blocks are listed under the category of »planned« in the WNA statistics, however. Three out of the eleven Russian nuclear power plant construction projects were also commenced in 1985 and 1986 and have yet to be completed. The Atucha-2 nuclear power plant in Argentina has been under construction since 1981 and still no date has been set for its commissioning. Construction of both of the blocks in Belene, Bulgaria, began in 1987 and no dates are scheduled when they will be connected to the grid. And construction at Mochovce 3 and 4 in the Slovak Republic was started in 1987, commercial operation is scheduled for 2013.

In first place for years as far as delays in construction are concerned, Bushehr nuclear power plant in Iran, for which the first cement was poured on 1 May 1975, was replaced in this dubious position in 2007 by the American construction site Watts Bar-2. The construction of Watts Bar-2 began what has now been almost 40 years ago, on 12 January 1972, with the project then being frozen in 1985. The company which owns the plant, the TVA, announced in October that it would complete the reactor by 2012 at a cost of 2.5 billion US dollars. This shows that the statistics contain a whole host of unfinished plants. In view of all these facts, it is erroneous to speak of any »global renaissance«, all the more so because such long building periods lead to exorbitant cost overruns which scarcely any bank would finance – unless the financial risk is assumed by a government. The complexity of the licensing procedure as well as the risks involved in a building project of this type should at any rate not be underestimated.

Age of and electrical power produced by nuclear power plants

At present nuclear power plants have a total rating of approximately 374,000 MW and an average operating lifetime of 26 years. The fact that installed power plant capacity has risen slightly on the whole in the last few years is not due to additional plants being constructed, but rather existing plants' ratings being increased through technical measures such as the replacement of steam generators.The closure of 130 reactors in the world to date following an average operating lifetime of 22 years does not exactly suggest a global renaissance is taking place. Eight reactors were closed down in 2006 alone, all of them in Europe, while only two reactors went into operation in the world and construction began on six blocks. In 2008 no nuclear power plant was built for the first time since 1956, two were connected to the grid in 2009 and five in 2010. A total of nine reactor blocks went into operation over the period from 2008 to April 2011 and eleven were shut down (Schneider, Froggatt, Thomas 2011). Assuming an operating lifetime of 40 years, a total of 95 reactors will be taken off the grid by 2015 and another 192 by 2025, i.e. a total of 287 reactors. These would have to be replaced by new reactors by 2025 in order to keep the installed rating of nuclear power plants in the world constant. If one assumes that all plants which are currently under construction are put into operation, an additional 18 plants would have to be added to those being under construction by 2015. »This corresponds to one new grid connection every three months, with an additional 191 units (175 GW) over the following decade – one every 19 days« (Schneider, Froggatt, Thomas 2011: 8). Because the lead time – the time between construction planning and commercial commissioning – for a nuclear power plant has now crept above 10 years, not even the current nuclear power rating can be maintained. If one looks at global power production by nuclear power plants, it is interesting that three-fourths of global nuclear power is produced in only six countries, three of which possess nuclear weapons – the USA, France and Russia. The others are Japan, South Korea and, for the time being anyway, Germany. Secondly it is clear that nuclear power only plays a very minor role from a global perspective: in these six countries, nuclear power as a percentage of total electrical power production in 2008 was between 16 per cent in Russia and 77 per cent in France. Because electricity only makes up between 14 and 26 per cent of total final energy consumption in these countries, nuclear power accordingly only accounts for a negligible percentage of total final energy consumption. This figure was between 17.3 per cent in France and 2.2 per cent in Russia in 2008 (see table). From a global perspective as well, nuclear power has been declining for years as a percentage of electrical power supply – in 2008 it was still 13.5 per cent. Because electricity only accounted for 17.2 per cent of global total final energy consumption in 2008, nuclear power only made a very modest contribution at 2.3 per cent – tendency declining.

Plans and forecasts

Current plans and declarations of intent by governments indicate that the United States, France, Japan, Russia, China and Korea will have the greatest installed nuclear power rating in 2020. The biggest expansion in capacity was being planned by China until recently. How China and Japan modify their plans for expansion, which in the initial reaction to the events in Fukushima were put on ice, remains to be seen. The Nuclear Energy Assembly (NEA) has estimated the development of global nuclear power plant rating until 2050 in an »optimistic« and a »pessimistic« scenario:

- Installed nuclear power plant output in the world will increase by a factor of 1.5 to 3.8 by 2050.
- In the »optimistic« scenario, nuclear energy as a percentage of total global electricity production will rise from barely 14 per cent at present to 22 per cent by 2050.
- In both scenarios nuclear electrical power production will continue to be strongly concentrated in the OECD area.

- The contribution of countries which have not built any nuclear reactors so far will only account for around 5 per cent of total global installed nuclear power plant output in 2020.

When US President Eisenhower proclaimed a program for peaceful use of nuclear energy in 1953, the doomsday images created by the atomic bombs dropped on Hiroshima and Nagasaki »were papered over with prophecies of the virtually infinite blessings of peaceful use« (Traube 2004). When construction of several large nuclear power plants commenced in the middle of the 1960s and commercial use of nuclear energy got under way, the euphoria had already in part subsided. Nevertheless especially in the USA and a few other Western industrialised countries there was a real construction boom for nuclear power plants lasting a decade. In the meantime, the optimistic forecasts from the 1970s on the expansion of nuclear power have proven to have been completely illusory. Thus, for example, the IAEA predicted in 1974 that the installed nuclear power plant output in the world would total 4,500 GW by the year 2000. This figure had only reached 375 GW in 2010, however, i.e. one-twelfth of the amount predicted for 2000. The market for nuclear power plants in the USA started to buckle as early as the middle of the 1970s. Of the 228 GW nuclear power plant output ordered, under construction and in operation in the USA back then, only 101 GW are operable at present.

3. Why nuclear energy is a thing of the past

We have seen that planned global expansion of nuclear energy has remained considerably behind its own targets and expectations. The reasons why a renaissance of nuclear power has not materialised include not only lack of industrial and production capacities and shortages of technical experts in the nuclear power industry, but above all constantly rising costs for the construction of nuclear power plants and financing problems associated with this. The assertion that nuclear power plants help combat climate change also turns out to be spurious upon examining the life cycle of nuclear power plants. In weighing out the pros and cons, it must always be kept in mind that military and civil use of nuclear power are intrinsically linked to one another like some sort of Siamese twins. This is why the danger of proliferation and vulnerability to terrorist attacks has taken on a greater importance as an argument against civil use of nuclear energy in democratic societies.

Problems faced by the nuclear industry

The nuclear industry has been battling a host of problems for three decades. A global construction boom can be ruled out at present if only due to the lack of production capacities and shortages of technicians; nor will this situation change much over the short and medium term. Only one single company in the world, Japan Steel Works Ltd., is able to forge the large pressure vessels in reactors the size of EPR. Not only the pressure vessel, but also the steam generators in the new Finnish plant come from Japan. In the USA, on the other hand, there is not a single manufacturing plant capable of producing such large components. The sole facility in Europe, the AREVA forge in the French city of Le Creusot, is only able to produce components of a limited size and in limited numbers. Beyond this, the nuclear industry in part is busy with retrofitting projects, as replacement of steam generators for power plants whose operating lifetimes are to be extended. Because such large production plants cannot be built overnight, this situation will not change quickly. New nuclear power plants moreover have to be operated by new personnel – but the nuclear industry and operators are scarcely even able to replace staff who retires. An entire generation of engineers, nuclear physicists and experts on protection against radiation are missing as the industry is challenged in a twofold respect: at the same time as new plants are being constructed, plants which have been closed must be torn down and solutions finally found for nuclear waste.

Costs and financing

In contrast to all other energy technologies, there are no economies of scale in the construction of nuclear power plants. Much to the contrary, specific investment costs have become ever more expensive. Moreover, plants have had considerable cost overruns – and not only in the USA. In the early phase in 1966/67, estimated overnight costs were 560 US dollars/kW, but actual overnight costs turned out to be 1,170 US dollars/kilowatt, i.e. 209 per cent more. In the years 1974-1975, estimated overnight costs of 1,156 US dollars/kilowatt were assumed, but actual overnight costs turned out to be 4,410 US dollars/kilowatt – i.e. 381 per cent more (Gielecki & Hewlett 1994). On top of this, current data on construction costs are only available in Western Europe and North America. The costs of construction projects in China, India and Russia are either not available or not comparable. Because construction costs for power plants have in general risen considerably over the last few years, especially due to the major expansion in conventional coal-fired power plants in China and India, specific construction costs for nuclear power plant projects have risen many times over. The nuclear power industry estimated construction costs at 1,000 US dollars/kilowatt for new generation III+ nuclear power plants by 2002. This cost level has turned out to be completely unrealistic, however. The contractual price for the European Pressurised Reactor ordered from AREVA NP in 2004 for the Finnish site in Olkiluoto was already 2,000 Euro/kW – at the time this was 3,000 US dollars/kW. »The project is four years behind schedule and at least 90 per cent over budget, reaching a total cost estimate of 5.7 billion Euro (8.3 billion US dollars) or close to 3,500 Euro (5,000 US dollars) per kilowatt« (Schneider, Froggatt, Thomas 2011: 8). As a result of this trend, estimates in the USA for 2007/2008 have soared to 5,000 US dollars/kW: Asked about challenges facing construction of new nuclear and coal power plants, the US Federal Energy Regulatory Commission (FERC) Chairman, Jon Wellinghoff, allowed that »we may not need any, ever. That's a ›theoretical question‹ because I don't see anybody building these things until costs get to a reasonable level« (Platts 22 April 2009). He characterized the projected costs of new nuclear plants as prohibitive, citing estimates of roughly 7,000 US dollars/kW. These estimates were confirmed in 2009 as well by the detailed offers tendered for the construction of a nuclear power plant in Ontario, the Ontario Nuclear Procurement Project: between 6,700 US dollars/kW and 10,000 US dollars/kW, which of course killed the project – especially as it did not even take into account the fact that cost estimates in the past were always below actual construction costs.

The leading rating agencies Standard & Poor's and Moody's also voiced misgivings over the last few years regarding the economic viability of new nuclear power plants: the leading credit-rating company, Standard & Poor's, warned as far back as 2007: »In the past, engineering, procurement, and construction contracts were easy to secure. However, with increasing raw material costs, a depleted nuclear-specialist workforce, and strong demand for capital projects worldwide, construction costs are increasing rapidly.« Moody's also revealed its scepticism in an analysis of possible new construction projects in the USA: »Moody's does not believe the sector will bring more than one or two new nuclear plants online by 2015.« It based its assessment on the year 2015 because this is the date which most companies trumpeting their nuclear ambitions at present use. Moody's affirmed that many of the current expectations for nuclear power were »overly ambitious«. It had more bad news for the industry when its June Global Credit Research paper concluded that »the cost and complexity of building a new nuclear power plant could weaken the credit metrics of an electric utility and potentially pressure its credit ratings several years into the project«. Even the Nuclear Energy Institute, the nuclear industry's trade organisation, stated in August 2008 that »there is considerable uncertainty about the capital cost of new nuclear generating capacity«. In conclusion, these would not appear to be very rosy prospects for a technology which was developed in the 1950s and 1960s and which could have scarcely survived down to the present without massive government subsidies in Western and democratic industrialised countries.

4. Climate protection through nuclear power plants?

The sector of electrical power production accounts for about 27 per cent of global anthropogenic CO_2 emissions and constitutes by far the biggest and fastest growing source of greenhouse gas emissions. That is why supposedly CO_2-free nuclear power plants have frequently been praised as a panacea against climate change. As an argument in favour of civil use of nuclear energy, advocates such as RWE manager Fritz Vahrenholt are fond of pointing out that the operation of nuclear power plant does not cause any CO_2 emissions (Vahrenholt in *Welt online*, 23 September 2010). And, underscoring the advantages of German nuclear power plants, he added: »if their output was replaced by power plants using fossil fuels, this would cause additional emissions of 120,000,000 tonnes of CO_2 per year.« Here Vahrenholt assumed that total nuclear power would be replaced by power generated by lignite coal plants. But a turnaround in energy policy would make greater use of decentralised gas-fired combined heat and power plants which do not cause any more CO_2 emissions than nuclear power plants.On top of this, viewed from a systemic perspective, nuclear power plants are by no means free of CO_2 emissions. Already today, they produce up to one third as much greenhouse gases as large modern gas power plants. CO_2 emissions of nuclear energy in connection with its production – depending on where the raw material uranium is mined and enriched – amounts to between 7 and 126 g CO_{2equ}[1] per kilowatt hour (GEMIS 4.7). Öko-Institut has estimated a specific emission of 28 g CO_{2equ} per kilowatt hour for a typical nuclear power plant in Germany – including emissions caused by the construction of the plant – with enriched uranium based on a mixture of supplier countries. An initial estimate of global CO_2 emissions through the production of nuclear power for 2009 has produced an amount of more than 114,000,000 t CO_{2equ} (see table) – this is roughly as much as the entire CO_2 emissions produced by Greece this year. And this data does not even include the emissions caused by storage of nuclear waste. In the coming decades, indirect CO_2 emissions from nuclear power plants will moreover increase considerably because much more fossil energy will have to be used to mine uranium (Storm van Leeuwen 2007). In view of this trend, nuclear power plants will no longer have any advantage over modern gas-fired power plants, let alone in comparison to the advantages offered by increased energy efficiency or greater use of renewable energies, especially when the latter are used in cogeneration plants.

Nuclear power plants also contribute to climate change by emitting radioactive isotopes such as tritium or carbon 14. And the radioactive noble gas krypton 85, a product of nuclear fission, ionises the air more than any other radioactive substance. Krypton 85 is produced in nuclear power plants and is released on a massive scale in reprocessing. The concentration of krypton 85 in the earth's atmosphere has soared over the last few years as a result of nuclear fission, reaching a new record at present. Even though krypton 85 may have an impact on the climate (Kollert & Donderer 1994), these emissions have not received any attention in international climate-protection negotiations down to the present. As for the assertion that nuclear power is needed to promote climate protection, exactly the opposite would appear to be the case: nuclear power plants must be closed down quickly in order to exert pressure on operators and the power plant industry to redouble efforts at innovation in the development of sustainable and socially compatible energy technologies and especially the use of smart energy services.

1. The greenhouse effect produced by a combination of the six most important greenhouse gases is expressed in CO_2 equivalents (CO_{2equ}).

5. Civil and military use of nuclear power – proliferation

Viewed in historical terms, military use of nuclear energy has gone hand in hand with the development of civil nuclear technology, the reason being that most countries attached first priority to the development of nuclear weapons and other military uses, with production of energy in nuclear power plants at first only being a waste product. This by-product developed its own momentum, however: nuclear power became an icon for clean, highly modern technology and technological progress. Moreover, it was a risk-free, highly profitable business for operators of plants because governments paid considerable sums in subsidies and producers could pass on costs to electrical power customers. Branches of the economy which are the most intensive users of electrical power profited from »cheap nuclear power« – as did the military in countries with nuclear weapons – because civil nuclear facilities offer many possibilities for military use. The borderlines between military and civil nuclear technology and thus between war and peace are often hazy. In order to minimise the risks of military use, possibilities for civil use of nuclear energy have been contemplated within a multilateral framework for some time. The idea of establishing an international atomic energy agency (IAEA), to which states are to transfer uranium stocks and other fissionable material, was proposed by former US President Dwight D. Eisenhower in his »Atoms for Peace« speech[2] as far back as 1953 and during the first Geneva atomic conference in 1955. The purpose and aim of the IAEA was to develop methods to ensure that fissionable nuclear material can be used by humankind in a »peaceful« manner – in agriculture, medicine and energy production for countries and regions of the world with limited energy resources. The nuclear weapons limitations agreement which went into effect in 1970 constituted an attempt to prevent nuclear »beggars« from becoming nuclear powers through civil nuclear technology transfer. In reality, however, a series of countries such as Israel, India, Pakistan and North Korea have obtained nuclear weapons under the pretext of civil use of nuclear power, while other countries such as Iran are accused of having this intention.

2. »I therefore make the following proposals. The governments principally involved, to the extent permitted by elementary prudence, should begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency. We would expect that such an agency would be set up under the aegis of the United Nations.«

Table 3: Indirect CO_2 emissions from NPP 2009

Electricity from NPP in	g CO_2-eq / kWhel	g CO_2 / kWhel	TWh	Mio. t CO_2-eq	Mio. t CO_2
Argentina	8	8	7.6	0.1	0.1
Armenia	65	62	2.3	0.1	0.1
Belgium	7	7	45.0	0.3	0.3
Brazil	108	100	12.2	1.3	1.2
Bulgaria	70	66	14.2	1.0	0.9
Canada	8	8	85.3	0.7	0.7
China	82	72	65.7	5.4	4.7
Czech Republic	70	66	25.7	1.8	1.7
Finland	62	58	22.6	1.4	1.3
France	8	8	391.7	3.1	3.1
Germany	28	27	127.7	3.6	3.4
Hungary	70	66	14.3	1.0	0.9
India	32	30	14.8	0.5	0.4
Japan	47	45	263.1	12.4	11.8
Lithuania	65	62	10.0	0.7	0.6
Korea	47	45	141.1	6.6	6.3
Mexico	59	57	10.1	0.6	0.6
Netherlands	28	27	4.0	0.1	0.1
Pakistan	32	30	2.6	0.1	0.1
Romania	70	66	10.8	0.8	0.7
Russian Federation	65	62	152.8	9.9	9.5
Slovak Republic	70	66	13.1	0.9	0.9
Slovenia	66	62	5.5	0.4	0.3
South Africa	126	114	11.6	1.5	1.3
Spain	32	30	50.6	1.6	1.5
Sweden	32	30	50.0	1.6	1.5
Switzerland	32	30	26.3	0.8	0.8
Taiwan	47	45	39.9	1.9	1.8
Ukraine	65	62	77.9	5.1	4.8
UK	32	30	62.9	2.0	1.9
USA	59	57	798.7	47.1	45.5
Total			**2,560.1**	**114.3**	**109.2**

Source: GEMIS 4.7; World Nuclear Association, April 1, 2011; For Bulgaria, Hungary, Romania and Slovak Republic merely russian upstream processes and transport included; Please note: all data do not include final waste disposal.

This development shows that it is difficult to prevent nuclear weapons from being built and that there is a great likelihood that more and more countries will obtain nuclear weapons capabilities in the future. When a nuclear infrastructure is in place and the basic material for weapons is being produced in facilities for enrichment or reprocessing, in military reactors, dual-purpose reactors or fast breeder-reactors, then it is merely a question of political will and willingness to invest in nuclear technology which decides whether a country is able to develop nuclear weapons or not.

6. Conclusion

We have seen that the much-discussed global renaissance of nuclear energy would appear in actual practice to have failed to materialise as a result of economic and environmental misgivings as well as various security risks. Have nuclear power plants reached a dead-end or are they necessary as a result of the finiteness of fossil energy and climate change – 25 years after Chernobyl and following the events in Fukushima? And instead of this is it foreseeable that there will be a shift from Western to Eastern Europe over the long term, with the long-heralded renaissance of nuclear power ultimately taking place there?

The history of nuclear energy has shown that a rethinking has usually taken place in many countries following major nuclear accidents. 26 April 2011 was the 25th anniversary of the meltdown in Chernobyl. This disaster, which took place in the Ukraine in early 1986, accelerated the phase-out of nuclear energy in a host of Western industrialised countries, beginning in the USA in the 1970s. Following the meltdown in the Three Mile Island 2 reactor in Harrisburg, Pennsylvania in 1979, almost two thirds of American nuclear power plant projects were cancelled. Nuclear programs in Austria and Denmark were put on ice in Europe even before the disaster in Chernobyl. After 1986, Italy, the Netherlands, Belgium, Sweden and Germany resolved to phase-out nuclear energy and have in part already done so. There is a nuclear moratorium in Spain and Switzerland.

This contrasts with developments in Eastern Europe: In the wake of Chernobyl the anti-nuclear power movement in the Soviet Union attained a freeze on nuclear projects and a nuclear moratorium during Glasnost and Perestroika, but following the end of the Cold War technocrats in the energy sector were able to resume old programmes and projects. Central and Eastern European states assiduously continued along the path of nuclear technology following national independence and the disintegration of the Soviet Union. Only in Poland was the construction of a nuclear power plant in Żarnowiec, west of Gdansk, stopped by a local referendum.While it was assumed in the 1970s that nuclear power plants would have a life expectancy of 25 years, the operating times of nuclear power plants were extended to more than 40 years towards the end of the 20th century, initially in the USA and then in other countries. On top of this, the term »bridging technology« was coined: nuclear power plants were to run longer, in this way easing the transition to renewable technologies. The extension of lifetimes for German nuclear power plants adopted in a nuclear act amendment by the German Bundestag in the autumn of 2010 would have extended the predominance of big power plants and prevented the expansion of small, decentralised, environmentally compatible power plants, which are much easier to operate with renewable energies. As first European country Switzerland announced plans to phase out nuclear power, in the wake of the Fukushima nuclear accident in Japan. The Swiss government decided on 26 May 2011 that the country's five nuclear power stations would close gradually over the next 20 years. And Germany decided to phase-out stepwise all remaining 17 nuclear power plants until 2022, starting with eight reactors in 2011.

References

Fritsche, U.R.; Rausch, L.; Schmidt, K. (2007): Treibhausgasemissionen und Vermeidungskosten der nuklearen, fossilen und erneuerbaren Strombereitstellung. Arbeitspapier des Öko-Instituts, März 2007. (http://www.oeko.de/oekodoc/318/2007-008-de.pdf).

Gielecki, M. & Hewlett, J. (1994): *Commercial Nuclear Power in the United States: Problems and Prospects*, US Energy Information Administration, August 1994.

Kollert, R. & Donderer, R. (1994), *Klimarisiken durch radioaktives Krypton 85 aus der Kernspaltung*, Bremen.

Mez, L., Schneider, M., Thomas, S. (eds.) (2009): *International Perspectives on Energy Policy and the Role of Nuclear Power*, Brentwood: Multi-Science Publishing.

Mez, L., de Haan, G., Gerhold, L. (Hrsg.) (2010): *Atomkraft als Risiko. Analysen und Konsequenzen nach Tschernobyl*, Frankfurt/M.: Peter Lang.

NuclearEnergy Institute (2008): White Paper. The Cost of New Generating Capacity in Perspective, Washington DC, August 2008.

Schneider, M., Froggatt, A., Thomas, S. (2011): The World Nuclear Industry Status Report 2010-2011. Nuclear Power in a Post-Fukushima World, Paris, Berlin, Washington, April 2011.

Storm van Leeuwen, J.W. (2007): CO_2 emissions from nuclear power, in: Barnaby, F. and Kemp, J. (Eds.): *Secure Energy? Civil Nuclear Power, Security and Global Warming*. Foreword by Jürgen Trittin. Oxford Research Group, Briefing Paper March 2007, 40-44 (http://www.oxfordresearchgroup.org.uk/publications/briefing_papers/secureenergy.php) .

Traube, K. (2004): Renaissance der Atomenergie?, in: *Solarzeitalter 4/2004*, Dezember.

Country Perspective: Brazil

*Célio Bermann**

1. Status Quo of Nuclear Energy in Brazil

Nuclear energy accounts for 1.8 per cent of the energy produced in Brazil's electrical energy grid, with an installed capacity of 2,007 MW. There are currently two nuclear plants in operation: Angra 1 and Angra 2. A third plant, Angra 3, is under construction and is expected to begin operating in 2015.

Table 1: Electrical energy grid production in Brazil

Source	%
Hydro power plants	72.3
Conventional Thermo power plants*	18.6
Nuclear power plants	1.8
Biomass power plants	6.6
Wind power plants	0.7

* Includes mineral coal, natural gas, petroleum-based derivatives;
Source: ANEEL – Power Generation Database, 2011.

The Angra dos Reis region, in the south of the state of Rio de Janeiro, was chosen for the installation of Brazil's nuclear complex because it has certain facilitating features. Chief among these is its proximity to large consumer centres, because this allows the plant to provide energy through relatively short power lines. Angra is 220 km from São Paulo, 130 km from the city of Rio de Janeiro, and 350 km from Belo Horizonte, all of which are large centres of electrical energy consumption in Brazil. Its proximity to the sea is another fundamental aspect, since PWR (pressurized water reactor) type plants use a large amount of circulating water to cool the steam that is produced to drive the turbine and to turn on the electrical generator. The construction of the first nuclear plant in Brazil (Angra 1) began in 1971. This plant was part of a turn-key[1] type contract developed by Westinghouse – a US-based company and General Electric subsidiary. With its installed capacity of 657 MW, it was connected to the grid in 1982 and began commercial operations in January of 1985. Its early years were characterised by frequent technical interruptions, resulting in an extremely low capacity factor of around 20 per cent. In 1975, while still under a military regime, Brazil signed a nuclear cooperation agreement with Germany. Based on the agreement, eight more reactors were to be set up in Brazil: two in Angra dos Reis, next to Angra 1, and another six along the southern coastline of the state of São Paulo. The people of São Paulo blocked construction of the plants by creating an environmental protection area precisely in the location where the nuclear plants were to be built. Thus, of the eight plants that had been planned, only Angra 2 was finalised, with an installed capacity of 1,350 MW. The project was developed by Germany's Siemens KWU-Kraftwerk Union AG company. Construction began in June 1976 and was marked by technical problems and constant schedule delays. It only began operating commercially in February 2001, at a final cost of close to 10 billion US dollars.

Another result of the Brazil-Germany nuclear agreement was the third nuclear plant, Angra 3, which applied the same technological standards as Angra 2. Angra 3 is a PWR-type plant developed by Siemens-KWU, with a 1,435 MW capacity. Work began in June 1984, but in April 1986 construction stopped. During this time, 750 million US dollars were invested in the purchase of equipment. Construction resumed in June 2010. During these 24 years, 20 million US dollars were spent per month to maintain equipment. Work on the Angra 3 plant is set to finish in December 2015 and requires a total of 6.5 billion US dollars for its completion. The BNDES (Brazilian Development Bank) will finance 60 per cent of the project (3.8 billion US dollars). A group of banks led by French bank Société Générale and including BNP Paribas, Crédit Agricole, Santander, and CNC will provide 1.6 million US dollars in financing to purchase equipment from ARENA, a company created by the merger of Germany's Siemens-KWU and France's Framatome. To facilitate the purchase of equipment, approval was given on 30 December 2010 for the creation of the Renuclear-Special Incentive Regime for the Development of Nuclear Plants with IPI (Incise Tax) and Import Tariff exemption. The final price tag for

* Célio Bermann is Professor of the Institute of Electrotechnics and Energy at the University of São Paulo and researcher for the CNPq (Brazilian National Council for Scientific and Technological Development).

1. This is a type of operation employed in bidding processes where the company that is awarded the contract is required to deliver the project in full functioning condition. Both the price of the service as well as the deadline for delivery is defined within the process itself.

Angra 3 is 7.25 billion US dollars. Investment costs are 5,300 US dollars/kW installed, which is very high when compared to the average international cost of around 3,000 US dollars/kW. The operating licence for the Angra 3 plant depends on the proposal for a place for final disposal of high-intensity radioactive waste. It is worth mentioning that, in the cases of Angra 1 and 2, this waste has remained in the pools at these two plants. The electrical energy produced by the Angra 1 and 2 plants is acquired by the government-run Furnas company for 84 US dollars/MWh; the company then resells it to distribution companies for 53 US dollars/MWh. This difference represents annual losses of 315 million US dollars for this state-owned company.[2] The National Energy Plan projects additional installation of 4,500 MW (three to four new plants) for 2030, which could reach 33,000 MW (25 to 33 new plants). This would account for 4.9 per cent of the total electrical energy production forecast for the country in 2030.

In the short term, construction of two nuclear power plants is currently being planned in Brazil's northeast region. The location chosen is the city of Itacuruba, in the state of Pernambuco, where two plants (of approximately 1,000 MW each) are to be built on the banks of the São Francisco River with the chance for future expansion to hold up to six plants with the same capacity. According to the Brazilian Decennial Energy Plan (2011-2020), the first north-eastern plant will start operating only after 2020. Five days after the nuclear accident in Fukushima, the Minister of Science and Technology, Aloizio Mercadante, called it an »incident« that should provide an opportunity for a review of the safety policy at Brazilian plants. Yet nothing is being done for now.[3] During the weeks following the accident, Brazil's media was overpowered by the nuclear lobby. Several technicians from Brazil's nuclear industry and university academics were interviewed. They characterised Brazil's nuclear plants as being safer than Japanese plants, moreover indicating that Brazil is subject neither to earthquakes of the same magnitude as Japan nor to tsunamis with 10-metre-high waves that hit the nuclear installations at Fukushima. Little attention was given to critics of the nuclear programme, who warned of the problem that the Fukushima accident highlighted: the dependence on pumping water in order to cool the reactor so as to prevent the fuel rods from melting.

2. *Folha de São Paulo*, 30 September 2010.

3. Ibid., 16 March 2011.

Only in late March 2011, did the Eletronuclear company[4] present a plan for construction of small hydroelectric plants that would supply the nuclear plants of Angra dos Reis, in Rio, in cases of emergency, thus increasing the security of their operations. Another measure for increasing the security of the installations would be construction of a dedicated power transmission line for the plants. The energy produced by the hydroelectric power plants would be directed to the nuclear power plant in cases of supply system failure. The Angra 1 and 2 plants currently rely on twelve diesel generators that are able to feed the reactor cooling pumps, which are similar to those being used at the Fukushima plants in Japan. The power from the hydroelectric plants would be yet another security item in addition to the generators. The company also announced that it has a contract with an outside consultant to review monitoring of the shoreline near the three plants located in Angra dos Reis. Built near the shore, the plants also run the risk of landslides damaging auxiliary facilities, such as waste deposits.[5] Brazil has no contingency plan for evacuation of the city of Angra dos Reis if a problem similar to what happened at Japan's Fukushima nuclear power plant were to occur. The Angra emergency plan establishes removal of the population – a total of 12 thousand people – in a 5 km radius from the plants, which is the minimum required by the International Atomic Energy Agency. According to the President of the National Nuclear Energy Commission (CNEN), removal of the population within a 20 km radius, as in Japan, »starts to include the city of Angra and is more complicated«. The Brazilian government is »going to think« about revising the emergency plan.[6] However, it is worth noting that the Fukushima accident was played down by Brazil's nuclear authorities. Government initiatives were evasive and plans for construction of new nuclear plants did not undergo any changes.

2. Socio-Political Discourse on Nuclear Energy

The experience gleaned from the design, construction, and operation of Angra 1, 2, and 3 – as well as having one of the largest uranium reserves in the world, estimated

4. Eletronuclear is a subsidiary of Eletrobras, and was established in 1997 for the purpose of operating and building thermal nuclear power plants in Brazil.

5. Ibid., 29 March 2011.

6. Ibid., 15 March 2011.

at around 309 thousand tonnes (fifth largest reserve worldwide), which adds to the technological mastery of the fuel cycle – are the reasons given by the Brazilian government for presenting nuclear energy in Brazil as a highly competitive energy alternative that allows the country to guarantee energy self-sufficiency. The anti-nuclear movement in Brazil operates through actions by NGO's as Greenpeace in Brazil and through local movements such as SAPE (Environmental Protection Society of Angra), which is headquartered in Angra dos Reis. It also operates through social movements such as the Movement of the Victims of the Nuclear Accident of Goiania (1987) and GAMBA (Environmentalist Group of Bahia), which operates in the city of Caetité, where uranium is currently being mined.

A study was conducted by the IBOPE intelligence agency in Brazil in cooperation with the WIN-Worldwide Independent Network of Market Research agency from 21 March to 10 April 2011 in 47 countries to assess the repercussions of the nuclear accident at Fukushima on international public opinion. It found that 54 per cent of Brazilians are »against« the use of nuclear energy as a means of generating electricity for the world, compared to a global average of 43 per cent. It is important to note that prior to the Fukushima accident, the proportion of Brazilians against nuclear energy was 49 per cent.The study also showed that 57 per cent of Brazilians are concerned about the possibility of a nuclear incident in the country, compared to a global average of 49 per cent. The anti-nuclear movement in Brazil is currently proposing a moratorium on the Brazilian nuclear programme and the debate is heating up in the media. Yet, it has not been able to achieve a change in current plans to expand the use of nuclear energy in the country. It is worth noting that although there is an anti-nuclear movement in Brazil, it does not have the same importance as in European countries.

3. Alternative Energy Paths

A breakdown of the electrical energy grid in Brazil shows hydro power accounting for 72.3 per cent, conventional thermoelectric plants (coal, natural gas, and petroleum derivatives) for 20.4 per cent, biomass (mostly sugarcane bagasse) for 6.6 per cent, wind power for 0.72 per cent, and photovoltaic solar panels for 15 MW. Although hydroelectricity is considered to be a renewable energy, the massive hydroelectric plants already built in Brazil have resulted in the compulsory relocation of around 200 thousand families in order to form reservoirs and have also irreversibly altered ecosystems. Around 65 per cent of the hydroelectric potential to be explored in coming years is located in the Amazon Region, a biome that is characterised by significant fragility. The small hydroelectric plants could increase their share, which is today around just 2.9 per cent, provided that their construction does not bring about social and environmental problems.On the other hand, a mere 794 MW of wind energy has been installed, compared to an estimated potential of around 143 GW. In turn, the potential for co-generation using sugarcane bagasse is estimated at around 8 GW, in addition to the possibility for using biogas for electrical energy generation. Furthermore, the potential for using solar energy, both thermal and photovoltaic, is extraordinary.

Plans to increase the share of renewable energies, with the exception of hydroelectric power, are still quite insignificant. Insertion of solar energy into the grid has yet to be regulated and the cost of acquiring photovoltaic panels is still an obstacle to greater use of this source. Wind power has shown better conditions for growth, in pace with international trends. The latest auctions[7] held by the government have reduced costs, increasing the competitiveness of wind power in Brazil's electrical energy supply.

Technical losses in the Brazilian power grid reached 15 per cent. It would be possible to reduce this rate to 10 per cent, although as of yet there is no knowledge on where these losses occur (in the transmission and/or distribution grid). The ANEEL (National Electrical Energy Agency) does not set loss-reduction targets for companies. This 5 per cent drop in losses could add around 46 thousand GWh per year to Brazil's electrical grid. Another alternative is in repowering/modernising hydroelectric plants that have been operating for more than 20 years. Although Brazil's government has presented data that overestimate the capacity for the country's current hydroelectric system to produce energy, studies point to a theoretical potential to gain around

7. The regulatory model for electrical energy in Brazil defines the type of auction in the bids in order to increase the energy supply. The criteria are based on price of generation, and the companies (public and private) compete among themselves or in consortiums to win the auction.

3,400 MW of power, which could reach 8,000 MW with repowering.[8] For this to happen and provide incentives for power companies, a change is necessary to the standards that define remuneration of energy gains produced using repowering, which is currently considered to be a surplus energy whose value is much lower than the energy it would provide.

Thus, nuclear energy would become absolutely unnecessary as an alternative for satisfying Brazil's energy demands. Regarding its medical and industrial uses, it shows relative usefulness, which may be ensured by low-power nuclear research reactors.

8. WWF Brazil, Repowering Hydroelectric Utility Plants As an Environmentally Sustainable Alternative to Increasing Energy Supply in Brazil, 2004.

Country Perspective: China

*Daniel Krahl and Su Junxia**

China is a comparatively new player regarding civilian nuclear power. Only in 1991 did its first nuclear power plant go online. Since then, however, it has become one of the most enthusiastic supporters of the technology – by 2011 it already had four nuclear power plants with 13 nuclear reactors in operation, 28 reactors under construction, and has around 50 more being planned. So far, all of these plants have been in the eastern and southern coastal provinces, where most of the rapid economic growth of the last three decades has taken place, far from the vast coal deposits of northern China. Because of this late start, the percentage of nuclear energy in China's overall energy mix is still relatively small. By the end of 2010, China's total installed electricity capacity was 962 GW, of which nuclear capacity contributes a mere 10.8 GW, making up only 1.12 per cent of overall capacity. However, during the course of the 11th Five-Year Plan (FYP 2006-2010), installed nuclear capacity has grown annually by 9.59 per cent.Moreover, extra generation capacity of around 30 GW is expected from the 28 reactors that are currently under construction, leading to a total of over 40 GW by 2015. However, China's overall energy generation capacity is supposed to be over 1,400 GW by that time, leaving the nuclear share still a mere 3 per cent compared to 20.4 per cent in Germany. Coal will remain the dominant source of energy in China, due to its local abundance and the government's concerns about energy security. The US Energy Information Agency (EIA) estimates that coal will comprise 62 per cent of the overall energy mix by 2035. But as China has pledged to fight CO_2 emissions and reduce air pollution, this will be down from the 71 per cent share coal had in 2008. In this strategy, nuclear plays a minor but important part, and therefore China is talking about expanding, not phasing out, nuclear energy.[1] In 2007 the government aimed to reach 40 GW installed nuclear capacity by 2020, out of a total planned generation capacity of roughly 1,000 GW. But already by the end of 2010, the total installed capacity from both operational reactors and those under construction amounted to the same number. The newest unofficial plans developed pre-Fukushima were reported to aim as high as 90 GW capacity by 2020.

In the wake of the Fukushima accident, China announced that it will suspend approval for all new nuclear power plants, including those in the pre-development phase, until a nuclear safety plan is passed. In the meantime, safety checks will be conducted at both operational nuclear facilities and those under construction. To improve regulation, the government also announced that it will start drafting an Atomic Energy Law by the end of 2011, and will quadruple the number of safety staff for nuclear reactors, from 300 to 1,000 by 2012. However, there is no official information on how long the suspension will last, with some indication that the end date is 2012, after the nuclear safety plan is completed. By announcing it will move from »rapid and proactive expansion« to »safety-based steady promotion«, China signalled a strategy adjustment, but it is unlikely to dismiss nuclear energy from its general energy strategy due to its growing energy needs and ambitious CO_2 policies. This was emphasised by Vice Premier Zhang Dejiang at a summit on the legacy of Chernobyl on 19 April 2011 in Kiev, who claimed that »nuclear energy must be developed on the basis of safety«, while also emphasising that »peaceful use of nuclear energy to increase the share of clean energy is an indispensable part of China's energy development strategy«. China has promised to cut its carbon intensity by 40 to 45 per cent by 2020, compared to 2005 levels, and it wants to meet the goal of generating 15 per cent of its electricity from non-fossil fuels by 2020. Therefore, the 12th FYP has set the goal to cut carbon intensity by 17 per cent and to increase the share of non-fossil fuel in its primary energy consumption to 11.4 per cent by 2015. Also, China feels uneasy about being too reliant on imported coal and crude oil to meet its growing energy demand, due to fears over energy security in case of an international conflict involving China. Therefore, the Chinese government sees nuclear as an

* Su Junxia works as a consultant for the Natural Resources Defense Council, Beijing. Daniel Krahl is a lecturer of International Relations at the China Foreign Affairs University, Beijing.

1. For the 10th FYP, China planned to *moderately* develop nuclear power; for the 11th FYP, it aimed to *aggressively* promote nuclear power plants. Development of MW-scale nuclear power plants was set as a priority. In the 12th FYP (2011-2015), which was officially adopted three days after the Fukushima accident, China aims *to effectively develop nuclear power on the basis of safety*.

indispensable addition to renewable energies, considering issues concerning cost and development of these technologies.

1. Socio-Political Discourse on Nuclear Energy

In general, the political system of China limits the public discourse on contentious issues such as environmental hazards, but different positions on nuclear can be seen. The central government is generally supportive of nuclear energy for the reasons stated above, and the provinces see it as boosting investment. The nuclear industry is state-owned and therefore enjoys influential support from the government, especially as many family members of state leaders like former Premier Li Peng are involved in the energy industry. Unsurprisingly, China's nuclear industry remains confident about nuclear safety, citing that China is using more advanced technologies than Japan, and therefore argues that China should stick to its nuclear strategy. In an interview after the Fukushima accident, Pan Ziqiang, Director of the Committee of Science and Technology at the China National Nuclear Corporation, stated that the nuclear danger has been exaggerated. He claims that China has kept a good record of nuclear safety and should keep its nuclear development plan. Similarly, the China Nuclear Energy Association claims that nuclear energy will play an even bigger role in meeting clean energy demands in the future.

Still, not all government agencies are fully supportive. The China Electricity Council, a research group for China's power industry, has called for a lower nuclear capacity target for 2020, a slowdown in reactor construction in interior regions, and has suggested that nuclear power should account for no more than three per cent of total power generation due to safety concerns, admitting the original target it proposed was too ambitious. Already in January 2011, two months before the Fukushima accident, the State Council Research Office (SCRO) also called for »a moderate pace and scale of nuclear energy«, citing limited capacity regarding nuclear staff, fuel, and regulation. Therefore, the SCRO suggested China should avoid going too far too fast, and also suggested the National Nuclear Safety Administration, which is now under the Ministry of Environment Protection, should be under the direct control of the State Council, serving as an independent regulatory body with direct authority.

Among academics, the opinion on nuclear power is divided after Fukushima: Lin Boqiang, Director of the Center for Energy Economics Research at Xiamen University, and Zhou Dadi, from the planning commission's Energy Research Institute, have advocated nuclear energy as being important for meeting China's carbon-intensity reduction targets by 2020, and suggested that the scaling up of nuclear and hydro power development should be part of China's long-term energy strategy. On the other side, prominent scholars like He Zuoxiu, researcher at the Chinese Academy of Science, have been advocating renewable instead of nuclear energy. Considering the constraint on technology, cost, and resources, they see nuclear power only as an emergency source of electricity.

While the importance of public opinion has grown in the political process in China in recent years, awareness of the debate on nuclear power is still relatively limited, and public concerns so far have not been seen as a constraint to governmental expansion plans. However, in the wake of the Fukushima accident, the attitude has changed as fears about nuclear safety have grown in China. In mid-March, a rumour about the imminent contamination of Chinese coastal waters by the disaster in neighbouring Japan led to widespread panic-buying of salt for fear that seawater-salt would be unusable in the future, and consumers across China believed that iodised salt would ward off nuclear radiation. Within hours, many shops were left with empty shelves, even as salt was sold at prices five times higher than normal and the government had to open up the national salt reserves.Anti-nuclear protests in mainland China were rare before the Fukushima accident. In recent years, there were online anti-nuclear campaigns in provinces where nuclear power plants were to be built, such as Shandong, Sichuan, Hunan, and Fujian. But these protests were organised by local residents who fear the plants pose physical harm by radiation. Only in Hong Kong has there been an organised anti-nuclear movement, especially because of the proximity of the Shenzhen Daya Bay Plant. China's media have to follow government guidelines and are advised to keep the focus off environmental safety issues inside China. Although many media members try to push the boundaries to expand their freedom, there has so far been only one incident of a nuclear accident in China being reported; however, leaks at the Daya Bay nuclear power plant in May and October 2010 were reported only one month after they happened, and were mixed with official denials. After the Fukushima accident, which was widely reported in the Chinese media, the debate about the pros and cons of nuclear energy has been reported in the media while the government has been eagerly trying to keep the discussion under control through a proactive policy and censuring of certain Internet discussions.

2. Alternative Energy Paths

Besides nuclear energy, China has been keen to promote renewable energy to reach its CO_2 and air pollution goals. Of the 962 GW total installed generation capacity in 2010, hydro power contributed 213 GW (22.18 per cent), wind power 31 GW (3.23 per cent), and solar energy 240 MW (0.02 per cent). In the 12th FYP, renewable energy is set to take up to 11.4 per cent of the total energy mix by 2015, up from 9.6 per cent at the end of 2010, and China aims to increase the share to 15 per cent by 2020. By then, the installed capacity from hydro power, wind power, biomass, and solar energy is planned to reach 380, 150, 30, and 20 GW, respectively. However, like in other countries, the very nature of renewable energies puts some limits on an even more rapid growth. Hydro power development has been facing doubts about ecological destruction and popular protests due to large-scale relocation of whole communities. Also, China faces a growing water shortage due to climate change, water pollution, and inefficient use. While China plans to build at least an additional 120 GW capacity from hydro power within the next five years, the expansion of hydro power seems to have reached its natural limit. Wind and solar power deployment are still constrained by a lack of grid and storage infrastructures that would be capable of making up for the irregular availability of both sources. Although China is the leading solar photovoltaic producer and exporter worldwide, solar energy is still mostly used for water heating rather than electricity generation, explaining its rather small share in total power generation.To promote renewable energy development, China has introduced a feed-in tariff policy and subsidies, including electricity surcharges. On the technical side, to enlarge power transmission from wind farms in northern China to the power-hungry east, China needs to develop a smart-grid system. However, the main focus is on improving energy efficiency. Between 2006 and 2010 China managed to cut its energy intensity by 19.1 per cent through mandatory measures. To achieve this number, some local provinces even implemented power blackouts. In the new FYP, China aims to further reduce its energy intensity by 16 per cent by 2015. This target has been criticised by some environmental NGOs as being set too low to push local governments and enterprises to fundamentally change their intensive energy consumption models.

Country Perspective: France

*Sezin Topcu**

1. Nuclear Energy as »National Identity« in France

France is the most nuclearised country in the world – 78 per cent of its electricity is produced from nuclear power (~450 TWh). The political decision for the construction of a massive nuclear park that today holds 58 reactors was taken in 1974 in response to the international oil crisis. Indeed, the nuclearisation of France had been planned as early as the 1950s. The development of both civil and military nuclear technologies was considered a unique guarantee for the »independence« of France. France thus sought to master the whole nuclear »cycle« via the construction of a wide range of facilities for converting, enriching, fabricating, processing, and reprocessing nuclear materials. The historian Gabrielle Hecht convincingly showed how the first French nuclear projects – with the »radiance« of France as their aim – were implemented by the Commissariat à l'Energie Atomique, the French Atomic Energy Commission, and the Electricité de France (EDF) – the national electricity utility – as »technopolitical« artefacts laden with symbols of national pride and grandeur that have become a major component of France's »national identity«.[1]

After the Chernobyl disaster, France was the only European country to continue the construction of new nuclear reactors. Since 2006, a »third generation« nuclear reactor – the European Pressurized Reactor (EPR)[2] – has been under construction in Flamanville (Manche), and a second EPR is planned in Penly (Seine Maritime). The EPR of Flamanville is supposed to serve as the »tête de série« for the entire renewal of the current nuclear park for the next two decades.

The Fukushima nuclear accident has had almost no impact on the government's nuclear projects. No moratorium is envisaged or has been announced for the EPR projects in Flamanville and in Penly. In the latter case, however, the company Total – one of the entrepreneurs of the project – declared recently that the EPR in Penly was on »stand-by«, declaring that the initial timetable for the construction of the reactor was no longer valid. The government has stated the opposite and announced its determination to construct the EPRs, assuring the public that they are the safest reactors ever. Concerning the conventional reactors, despite critical voices demanding the immediate shutdown of the oldest ones – in particular the 34-year-old Fessenheim nuclear plant (Alsace) constructed in a seismic zone and which has been contested by the Swiss local councils (among others) – no such decision is expected in the near future.

2. From Nuclear-based National Independence to »Ecological«, »Transparent«, and »Safe« Atomic Energy: Political Discourse on Nuclear Energy before and after Fukushima

In the 1970s, the pro-nuclear political advocates claimed that it was the only way for France, which has poor fossil energy resources, to assure its »energy independence«, thus allowing for growth of its industries. In the 1980s, the cost-effectiveness of nuclear energy became part of the EDF's promotional discourse. After the Chernobyl disaster, the official line insisted on the »irreproachable safety« of the French nuclear reactors, »designed in a totally different manner than the ones in USSR«. Following the public mistrust generated by the »state lie« concerning the Chernobyl fallout in France, nuclear energy was also to become »transparent« – the political strategy was to, above all, show that nuclear secrecy was over. In the 1990s, with environmental concerns rising to an international level, and as a result of the Rio Protocol and climate change becoming a social and a political problem, nuclear energy was given a new image and became an »ecological« – even »green« – energy source. The industrialists advertised this widely, claiming that nuclear energy was indispensable in the struggle against global warming, given its »very low« – even »zero« – CO_2 emissions.[3]

* Sezin Topçu is researcher at the National Scientific Research Center (CNRS) in Paris, France.

1. Gabrielle Hecht (1998): The Radiance of France. Nuclear Power and National Identity after World War II, Cambridge, MIT Press.

2. With an augmented capacity of 1,600 MWe, EPR is considered an »evolutionary« reactor vis-à-vis the »second generation« reactors (i.e., the light-water reactors constructed in the 1970s and 1980s), in particular in safety terms.

3. Such a claim is controversial, even erroneous, when the whole nuclear »chain« (and not only the electricity-generation process) is taken into consideration. Cf. B.K. Sovacool, Valuing the Greenhouse Gas Emissions from Nuclear Power. A Critical Survey, *Energy Policy* 36 (2008): p. 2950-2963.

Since the Fukushima disaster, these claims have not been abandoned but reinforced. During the disaster-in-progress phase (which still has not been completed, unfortunately), the government of President Nicolas Sarkozy has affirmed the »relevance of France's nuclear choice« and has rejected all demands for a referendum on nuclear energy (as formulated by the Greens-Europe Ecologie), stressing that the public will have a chance to say yes or no to nuclear energy during the presidential elections of 2012. President Sarkozy even affirmed that a nuclear phase-out would mean »cutting an arm« off France, given not only the energy independence issues but also the Kyoto commitments. Among the political parties, the Greens and the Left Party are the only ones that have clearly demanded a nuclear phase-out through an immediate shutdown of the oldest reactors and a progressive replacement of what remains in the nuclear park with alternative energy sources. The Socialist Party (PS), which is the major opposition party and traditionally pro-nuclear, has merely declared its will to re-evaluate the country's »all nuclear policy«. It has demanded the strengthening of nuclear safety measures via a complete audit of the power stations currently operating. Hoping for an alliance with the Greens for the presidential campaign, the PS First Secretary, Martine Aubry, said herself recently that she was in favour of a gradual nuclear phase-out. MoDem, the centrist party, insists on the necessity of a broad debate but is in favour of nuclear energy. The Communist Party, which has always favoured nuclear energy, has proposed maintaining the nuclear option, under the condition that the entire sector becomes public. Finally, the extreme right-wing party, the National Front, says it is wholeheartedly in favour of nuclear energy, and it accuses those who are demanding a nuclear phase-out of trying to take France back to the Middle Ages.

Beyond the political parties, several civil society organisations are campaigning for a nuclear phase-out but have not managed to mobilise massive support in the post-Fukushima period. Two days after the first explosion in Fukushima, an antinuclear protest march organised in Paris by Réseau Sortir du Nucléaire (the French Nuclear Phase-Out Network) – an antinuclear federation created in 1997 with around 800 antinuclear groups – was only attended by 300 people, whereas 60,000 people marched in Germany during the same weekend. One week later, not more than a thousand people took part in a protest meeting organised in front of the National Assembly, with several ecological and political figures participating. Indeed, the issue of shale gas (*gaz de schist*) generated much bigger reactions in France, with several thousand people protesting in different regions (Lot, Drôme, Saint-et-Marne) during the same period. Protest marches should not, however, be considered as a unique action form for antinuclear protest. More radical actions have been undertaken – especially in light of the 25th anniversary of the Chernobyl disaster – with several activists occupying EDF offices (Bordeaux) and even launching hunger strikes (Alsace).

Some of the mass media have been of no help to antinuclear groups during this period. They are seen to have created a polemic on whether the ecologists have been »irresponsible«, even »indecent«, for having »profited« from the Japanese disaster and the suffering of the victims, with the unique aim of promoting their antinuclear thesis. This was an offensive launched by the ministers of industry and of ecology just after the first explosions. The media, uncritically, mobilised it. Moreover, TV channels such as France 2 broadcast the assuring messages and viewpoints of the nuclear industry, whereas the antinuclear activists were rarely invited on television.

Concerning public opinion polls, they reveal contradicting »realities«. Those conducted by nuclear authorities or by certain media organs argue that the public has confidence in nuclear energy, while those conducted by antinuclear groups mention an antinuclear tendency in public opinion. Hence, an opinion poll recently ordered by EDF just after 11 March revealed that »55 per cent of French people were against the proposition of ecologists for a nuclear phase-out«.[4] Another opinion poll conducted for the Greens during the same period – a poll that did not pose the question of a nuclear phase-out as being an »urgency dictated by the ecologists« – revealed that »70 per cent of French are in favour of stopping the French nuclear programme and the functioning of the power stations, be it immediately or in 25 30 years«.[5] Still another poll conducted by a TV channel, this time in 47 countries, showed that »the French public is among the most favourable to nuclear energy, with a 58 per cent pro-nuclear majority«.[6]

4. TNS-Sofres-EDF, Les Français et le nucléaire, 15-16 March 2011.

5. IFOP-Europe Ecologie-Les Verts, Les Français et le nucléaire, 17 March 2011.

6. BVA-France 2, L'opinion internationale face au nucléaire, 23-24 March 2011.

Whatever the public opinion polls reveal about public reactions to nuclear energy, a central issue concerns the way government and the nuclear authorities have rapidly reframed the »debate«, thus directly influencing the relations between nuclear industry and society. Indeed, in the aftermath of the Fukushima accidents, the political discourse has focussed on two technical issues: transparency of public information and nuclear safety. After the first explosion in Fukushima Daiichi, government officials and the industrialists first minimised the fallout of the events. The Minister of Industry, Eric Besson, declared that there was no »disaster … nothing comparable to Chernobyl«. However, the inevitable need for »transparent« politics rapidly became a leitmotiv. On 16 May 2011, the Chairman and CEO of EDF, Henri Proglio, affirmed that the nuclear industry was the most transparent of all industries. The French Nuclear Safety Authority (L'Autorité de sûreté nucléaire, ASN) and its expert body, the French Institute for Radioprotection and Nuclear Safety (the Institut de Radioprotection et de Sûreté Nucléaire, IRSN), promised the public complete transparency.

The contents of many press releases, technical information notes, and other reports were thus diffused. Through the end of March 2011, when the initial Fukushima fallout in Europe was expected, Criirad – an expert NGO created just after the Chernobyl accident as an independent watchdog of the nuclear industry – adopted an official stance close to that of IRSN. They assured that the Fukushima cloud, according to predictions, would have almost no impact on public health. However, Criirad quickly distanced itself from other official bodies afterwards. It denounced the non-communication of the fallout data by the US government (where the fallout seems to have been more severe), it criticised the »underestimation« of the events by IRSN, and it judged as »inacceptable« the very unsatisfactory information provided on the »real« situation in Fukushima.

Concerning safety issues, EDF in particular argued that the French nuclear industry was characterised by an »obsession for security«, and that this was a guarantee for the »perfect safety« of the French nuclear park. The EDF authorities thus publicly criticised Germany's reaction to the Fukushima accidents (immediate shutdown of the oldest reactors) as »purely political« (and not »technically rational«). Industry and public authorities also insisted, just after the first explosions, that the Japanese accident was really an exception and that such extreme circumstances (earthquake + tsunami) were not possible in France. Only the risk of water-flooding (as already experienced in 1999 in the Blayais power plant) was mentioned as a possible threat. More recently, though, the official stance has changed. Once again, ASN, but also EDF, has declared its willingness to learn lessons from Fukushima so as to improve the safety of the national nuclear park. The ASN experts affirm that they will prepare for the most improbable scenarios and take seriously the domino effect (i.e., the cases whereby several disasters happen simultaneously) while imagining the »unimaginable«. Indeed, the Director of ASN, which is an official body often criticised by pressure groups for not being independent enough vis-à-vis the »lobby«, has recently made several declarations critical of EDF. He even contradicted the government by affirming that a moratorium on the EPR under construction in Flamanville could not be completely ruled out. In particular, he declared that »a grave accident could not be excluded in France«. He even admitted, during a public speech, that »the cumulated disaster scenarios were not taken into account in the conception of the French nuclear power stations«.

3. Prospects for a Nuclear Phase-Out in France: Dream or Reality?

If the development of alternative energy sources is a precondition for a nuclear phase-out in France, this will be difficult as renewable energies have always held a very marginal position in French energy policy. The antinuclear movement of the 1970s did manage to put renewable energies and energy control onto the political agenda (see below the creation of *Commissariat à l'Energie Solaire* and of the French Agency for Energy Control). However, the oil counter-shock of 1986 put an end to such developments. The crucial role attributed to nuclear energy by the state (which resulted in the allocation of most of the research budget being spent on nuclear technologies), the difficulty in modifying the centralised network of electricity production and distribution in France (which does not favour the development of renewable energies), and the administrative drawbacks confronted by industrial actors willing to invest in the renewable energy sector have presented obstacles to the development of alternative energy sources.[7] Even

7. Aurélien Evrard, La résistible intégration des énergies renouvelables. Changement et stabilité des politiques énergétiques en Allemagne et en France, Note de recherche Cevipof, n°21, May 2007.

when a legal framework (2000) obliged EDF to (re)buy renewable electricity, the repurchase rate that was fixed for EDF was quite low and thus discouraged private investors.[8] Currently, hydro power is the major renewable energy source in France. It provides 90 per cent of renewable electricity production and covers 12 per cent of the country's total electricity consumption, whereas electricity production from wind power is only 1.5 per cent, and close to zero for solar, biomass, and geothermal. Only recently has the government developed a concrete action plan with the aim of putting European Directive 28/CE/2009 (related to the promotion of renewable energies) into force. It envisages raising the share of renewable energy in energy production to 23 per cent by 2020, which would mean more than doubling its capacity (i.e., a shift from 17 to 37 Mtep).[9] Nevertheless, no official nuclear phase-out scenarios are being considered.

Indeed, nuclear phase-out scenarios in France have mostly been developed by NGOs or independent counselling bodies. According to a scenario proposed in 2006 by NegaWatt – an expert NGO specialised in energy economies and renewable energies – France can abandon nuclear energy by 2035 if it decides to stabilise, or even reduce, its energy consumption (at a level of ~420 TWh) by 2050 (via the prevention of energy loss, renewal of the current energy equipment, replacement of electric radiators by other energy sources, etc.) and if it heavily invests in alternative energies.[10] The NegaWatt scenario estimates that, thanks to new and more efficient wind power technologies, offshore implementation possibilities, and progress achieved with insertion of wind turbines in the electricity network, wind energy can provide 137 TWh of electricity produced in France by 2050 (64 onshore, 73 offshore). Hydro power would be the second largest energy source, according to this scenario, as it already has an installed capacity of 70 TWh, which can be raised up to 80 TWh through efficiency measures and without necessarily constructing new big dams. Thirdly, the NegaWatt scenario relies on solar photovoltaic, which it also considers very promising for France. With good utilisation of available spaces (roofs, building fronts, etc.) and stations constructed on abandoned/idle terrains (wastelands, route edges), the NegaWatt experts estimate a production of 65 TWh from photovoltaics by 2050. Finally, the NegaWatt scenario foresees the development of other renewable sources, namely biomass, sea energies (current and wave technology), and geothermal energy, which offer a potential production of 50 TWh, 10 TWh, and 25 TWh of electricity, respectively, by 2050.

Other nuclear phase-out scenarios exist as well,[11] with slight differences in their objectives and the means utilised. Thus, some of them estimate that a nuclear phase-out is urgent and should be planned for soon by replacing nuclear power stations not only with renewable sources but also fossil energies (especially coal), at least temporarily. Others consider such a vision unrealistic and risky in terms of its social and political acceptability (considering the importance now given to climate change problems, which has resulted in a systematic rejection of fossil energy sources as a substitute for nuclear energy). They estimate that the only alternative to nuclear is renewable energies. Nevertheless, the main problem for France is not the absence of alternative energy scenarios. The problem is that the alternatives to nuclear have been rejected by politicians and removed from media debates for the last four decades. Indeed, French public opinion first needs to rediscover its faith in alternatives, which have been de-legitimised in this country as an unrealistic »dream« or »utopia«. Only afterwards will it be possible for French society to envisage the most appropriate non-nuclear energy choices – which are, above all, social and political choices.

8. Ibid.

9. Mtep = million tonnes of equivalent petrol. French Ministry of Ecology, Energy, Sustainable Development and Seas, Plan d'action national en faveur des énergiesrenouvelables, période 2009-2010.

10. Negawatt, Scenario Negawatt 2006. Pour un avenir énergétique sobre, efficace et renouvelable, December 2005.

11. Réseau Sortir du Nucléaire, Nucléaire: comment en sortir? Document d'information; IEER, Low-Carbon Diet without Nukes in France, May 2006.

Country Perspective: Germany

*Regine Günther**

1. Wind of change: Fukushima and its impact on the very foundation of conservative-liberal energy policy in Germany

On Friday 11 March 2011, an earthquake shook Japan. It was followed by a huge tsunami. Both events caused severe malfunctioning in several nuclear power plants, which led to the shutdown of most Japanese nuclear power plants and meltdowns in at least three reactor blocks. In the Fukushima reactor complex the absolute worst case scenario occurred, the precise scope of which cannot yet be determined. Even now, weeks after the disaster, the situation is still not under control.

The huge destruction wrought in north-eastern Japan was the result of three catastrophes, two of which were natural disasters which could not have been averted. The third – the nuclear disaster in Fukushima – is, in the final analysis, a man-made catastrophe. It was the result of a policy that did not integrate in practical governance the »residual risk« category of accidents which wreak monumental damage – an error with grave consequences, as we now know.

In Germany there was an earthquake of a political nature following the events in Japan on 11 March 2011, which marked a turning point in the energy policy of the German conservative-liberal (CDU-FDP) government. On Monday 14 March 2011, three days after the disaster in Japan, Chancellor Angela Merkel announced far-reaching changes to Germany's energy policy at a press conference:

> »… the events in Japan teach us … that the risks which were regarded as totally unlikely were not completely so. And if a highly developed country like Japan, with high safety standards and norms, cannot prevent such consequences for nuclear power after an earthquake and a tsunami, then this has consequences for the whole world, it also has consequences for Europe, and it has consequences for us in Germany.«

A »three-month moratorium« was announced as an immediate measure, during which the seven oldest German nuclear power plants and the Krümmel reactor in Schleswig-Holstein, which was prone to malfunction, would be taken off the grid. Within a few days, therefore, 8,400 megawatts (MW) of nuclear capacity – approx. 41 per cent of the total German nuclear power capacity (20,500 MW) – was no longer available.

Shortly afterwards an Ethics Commission on Safe Energy Supply was established in Germany, made up of public figures such as former politicians, researchers and church representatives. Chancellor Merkel assigned them the task of submitting proposals by the end of May 2011 for how a »rigorous turnaround in energy policy leading up to the era of renewable energies« could be realised.[1] The stated objective was a »well-tailored turnaround in energy policy« while taking into account a lifetime for nuclear power plants that is »finite and as short as possible«. In parallel the German Reactor Safety Commission was given the task of reviewing the safety of German nuclear power plants in the light of findings in Fukushima.[2]

This turnaround by the German conservative-liberal coalition is particularly remarkable, given that only six months prior to Fukushima, during the »autumn of decisions« as Chancellor Merkel called it, the phase-out of nuclear power in Germany (decided upon by the SPD-Green coalition in 2000) was reversed with much fanfare and the lifetime of nuclear reactors extended by twelve years on average. Let's not forget: In 2000 the SPD-Green government negotiated an agreement with the nuclear power plant operators, according to

* Regine Günther is Head of International Energy and Climate Policy at the World Wildlife Fund (WWF) in Berlin, Germany.

1. Ethics Commission on a Safe Energy Supply, »Germany's Energy Transition: A Collective Endeavour for the Future«, 2011, available for download [in German] at: http://www.bundesregierung.de/Content/DE/__Anlagen/2011/05/2011-05-30-abschlussbericht-ethikkommission,property=publicationFile.pdf.

2. Reactor Safety Commission, »Plant-specific safety review (RSK-SÜ) of German nuclear power plants in the light of the events in Fukushima-1 (Japan)«, 2011, available for download [in the form of an English summary] at: http://www.rskonline.de/English/downloads/summary_rsk_safetyreview_20110520.pdf.

which all German nuclear power plants have to be taken off the grid after an average operating lifetime of 32 years. The remaining lifetime of the nuclear power plants was calculated as an outstanding electricity budget which could be transferred from old to new nuclear power plants. In the autumn of 2010, government circles were unanimously letting it be known that the revision of SPD-Green nuclear policy was a key element of CDU-FDP coalition policy. From the perspective of energy policy, there was no need to reverse the SPD-Green decision to phase out nuclear power in Germany. The share of nuclear energy in the German power mix had already fallen from 29.4 per cent in 2000 to 22.5 per cent in 2010. Within the same period the use of renewable energies grew from only 6.6 per cent in 2000 (mainly traditional hydroelectric power plants) to 16.5 per cent in 2010 (mainly wind power plants). The success story of renewable energies – in which the German Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG) introduced by the SPD-Green government played an instrumental role – demonstrated to people that it is possible and feasible to move away from highly dangerous and climate-damaging means of power production without jeopardising security of supply, climate protection and the competitiveness of German industry. The experience that there are viable alternatives to nuclear power and coal had a crucial impact on the debate in Germany.

In accordance with the German conservative-liberal government's decision to extend the lifetime of nuclear power plants, the last nuclear plant in Germany would probably have been decommissioned around 2040. On the basis of this lifetime extension the four largest utility companies in Germany were set to reap additional profits amounting to 100 billion Euros. A nuclear fuel tax was introduced in Germany, along with an energy and climate fund, into which the four nuclear power companies were supposed to transfer a minor portion of their additional profits. The safety standards at existing nuclear power plants in Germany were not tightened.

There was huge public outcry in Germany in September 2010 when it emerged that the government and utility companies were drawing up the agreement at night and the documents were initially kept under wraps. This gave the public the impression that the primacy of politics had been abandoned and the four large utilities in Germany had free reign to write their own policy and could shape it to their advantage. If the individuals are to be believed who participated in thisround of decision-making at the Chancellery on the legendary night of 5th to 6th of September 2010 when the lifetime extension was decided, Merkel herself was not so much the driving force in the exorbitant concessions made to the energy giants. Rather, it is claimed, she was »driven« by the so-called »steel helmet« faction from within her own party ranks and the liberal coalition partner. In addition, the German energy giants were putting – with the support of the Federation of German Industries (Bundesverband der Deutschen Industrie, BDI) - the government under huge pressure in the run-up to negotiations by means of large-scale advertising campaigns.

Another factor which played a not insignificant role was the fact that the lifetime extension decided upon in autumn 2010 in Germany was embedded in a far-reaching energy plan – or rather, it had to be embedded in such a plan in order to create acceptance for the lifetime extension of nuclear power plants. It should be highlighted that long-term climate goals (a 40 per cent reduction of German GHG emissions by 2010 and an 80-95 per cent reduction by 2050 compared to 1990 levels) and ambitious goals for increasing the use of renewable energies (e.g. with renewables having an 80 per cent share of total electricity production in Germany by 2050) were set. Thus, as a framework for the lifetime extension of nuclear power plants a time horizon was determined for energy and climate policy which should still apply for the period after the abandonment of these lifetime extensions.

As expected, the anti-nuclear movement in Germany gained fresh momentum in the autumn of 2010, resulting in large demonstrations being held by tens of thousands of people from all walks of life. German society reacted vehemently to the concessions granted to the four large utility companies in Germany: RWE, E.ON, Vattenfall and EnBW. However, this case of social opposition had something new: it was not brought about by people of the »left« only, but rather it swept up people from all social ranks very quickly. Objection to the German nuclear policy made deep inroads into the German middle classes. Moreover, many small and medium-sized enterprises expressed their antipathy towards the policy in large advertisements. In particular small and medium sized energy suppliers like municipal utilities saw themselves as being put at a huge disadvantage by the four big German utilities amassing additional profits. Investments made by municipal utilities which ran into billions of Euros were suspended following the lifetime extension of German nuclear power plants. They placed full-page adverts in major German newspapers under the caption »Four Win, Millions Lose«.

The decisions taken in Germany on and after 14 March 2011, in which major elements of the old conservative energy policy were reversed in one fell swoop, can only be understood against the background of the social climate in Germany. The substance of the policy is not new – but the actors practising it are. For the first time a conservative-liberal government of a major industrial country has decided to phase out nuclear energy very quickly while at the same time continuing to pursue ambitious climate goals. According to the current time frame for the nuclear phase-out, the eight nuclear power plants (of the 17 in Germany) that had already been taken off the grid are decommissioned; an additional nuclear power plant will be decommissioned in 2015, 2017 and 2019, respectively. Three further nuclear plants will be decommissioned in 2021 and the last three in 2022. The total outstanding electricity budget for these plants is limited, analogous to the SPD-Green coalition's decision on the phase-out. During this nuclear phase-out, the fixed targets for reducing German greenhouse gas emissions by 40 per cent up to 2020 and by 80-95 per cent up to 2050 compared to 1990 still apply and are to be met. This will inevitably entail a huge increase in the use of renewable energies and rapid improvements in energy efficiency, if the current coalition does not want to jeopardise its credibility again. What we are witnessing in Germany at the moment, then, is the systematic repositioning of the conservative/liberal spectrum in the field of energy policy.

But it was not only the government, which established the above-mentioned Ethics Commission, as well as non-governmental organisations (NGOs) which reacted quickly to the events in Japan. Since the announcement that the lifetime of nuclear power plants would be extended, an intense conflict had been brewing within the German Association of Energy and Water Industries (Bundesverband für Energie- und Wasserwirtschaft) between the four major utilities in Germany who pursued the lifetime extension and the hundreds of municipal utilities who opposed them, primarily for competitive reasons. The municipal utilities then pushed with all their power for the association to change its stance. In a spectacular and widely publicized reversal of policy announced at a special board meeting on 8 April 2011, the association's board of directors in Germany called for the quick and complete phase-out of nuclear power by 2020 if possible and by 2022/2023 at the latest, without jeopardising security of supply, climate protection or financial feasibility. It announced this in the face of opposition from its largest contributors: RWE, E.ON. Vattenfall and EnBW. The German Association of Local Utilities (Verband kommunaler Unternehmen) adopted the same position at an earlier stage. In effect, then, the entire German power sector – aside from the remaining four large utilities RWE, E.ON, Vattenfall and EnBW – was endorsing the new government policy.

For German society a window of opportunity opened up once again, for which it was ultimately strategically and conceptually very well prepared. In recent years a whole host of different commissions[3], research institutes[4]

3. Enquete Commission, »Sustainable Energy Supply« of the German Bundestag, 2002, available for download [in German] at: http://webarchiv.bundestag.de/archive/2005/0919/parlament/kommissionen/archiv/ener/index.html; Enquete Commission, »Protection of the Earth's Atmosphere« of the German Bundestag, 1987.

4. EWI/GWS/Prognos, Energy Scenarios for the German government's Energy Programme, 2011, available for download [in German] at: http://www.bmu.de/files/pdfs/allgemein/application/pdf/energieszenarien_2010.pdf.

Öko-Institut/Prognos/Ziesing, »Blueprint Germany: A strategy for a climate-safe 2050«, conducted on behalf of WWF Germany, 2009, available for download at: http://www.wwf.de/fileadmin/fm-wwf/pdf_neu/WWF_Blueprint_Germany.pdf.

Renewable Energy Research Association, »Energy Concept 2050 for Germany with a European and Global Perspective: A vision for a sustainable Energy Concept based on energy efficiency and 100 % renewable energy«, 2010, prepared by Fraunhofer IBP, Fraunhofer ISE, Fraunhofer IWES, ISFH, IZES gGmbH, ZAE Bayern und ZSW, available for download at: http://www.fvee.de/fileadmin/publikationen/Forschungspolitische_Papiere/Energy_Concept_2050/EK2010_EN.pdf.

EUtech, »Climate Protection: Plan B 2050: An Energy Concept for Germany«, conducted on behalf of Greenpeace, 2009, available for download at: http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/klima/Plan_B_2050_lang.pdf.

Öko-Institut, »Analysis and classification of the model for an accelerated phase-out of German nuclear power plants«, conducted on behalf of WWF Germany, 2011, available for download [in German] at: http://www.wwf.de/downloads/publikationsdatenbank/ddd/36918/.

Öko-Institut, »Nuclear power imports from France? Quick shutdown of German nuclear power plants and the development of electricity imports and exports in Germany«, conducted on behalf of WWF Germany, 2011, available for download [in German] at: http://www.wwf.de/fileadmin/fm-wwf/pdf_neu/KKW-Ausstieg%20und%20Stromimporte%20v5final.pdf.

Öko-Institut/Arrhenius, »Climate Protection and the Power Industry in Germany«, conducted on behalf of WWF Germany and German Environmental Aid (Deutsche Umwelthilfe), 2007, available for download [in German] at: http://www.wwf.de/downloads/publikationsdatenbank/ddd/27352/.

Hohmeyer/Menges/Schweiger, »Nuclear Phase-out as Opportunity: Perspectives for new jobs at nuclear power sites«, conducted on behalf of Greenpeace, 2000, available for download [in German] at:http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/atomkraft/chance_atomausstieg_langfassung.pdf.

and government advisory bodies[5] had conducted well-founded and diverse energy-economic analyses in Germany and elaborated energy and climate policy options for developing the German power system while at the same time abandoning coal-fired and nuclear electricity production. What is new about the current development in Germany is the fact that the decision to take this path was made by a conservative-liberal government. The widespread notion – expressed particularly abroad – that this was a chaotic, abrupt and impulsively decided change of policy does not hold water in the final analysis.

Based on current analyses that have been widely discussed, German civil society swiftly drew up a six-point paper which outlined demands for the new energy policy which, it argued, should be geared to eliminating the possibility of disasters that cannot be restricted geographically or in terms of duration. The key issue was thus to minimise risk in the context of power supply. It should not be possible to pass this risk on to future generations, which is why it is essential for the phase-out of nuclear power to be accompanied by ambitious climate measures. Climate protection and nuclear phase-out – that's the key demand – must not be played off against each other. The construction of new coal-fired power plants, for example, must not become part of a strategy for substituting capacity lost through the nuclear phase-out. NGOs have called for a consistent strategy for developing a power supply system by 2050 that is virtually zero-carbon and does without nuclear power. In 2009 WWF Germany commissioned two well-respected research institutes to calculate how such a goal could be realised.

Not only did the Ethics Commission on a Safe Energy Supply and the German Reactor Safety Commission begin working on the regulations for the phase-out of nuclear power and the launching of a new energy era in the ensuing weeks – entire units at key ministries also took up the task.

In Germany discussion has chiefly focused on issues relating to the feasibility of such a nuclear phase-out. Opponents of the new energy policy have attempted to discredit the phase-out by claiming that great, uncontrollable risks are supposedly involved, including accelerated climate change due to growth in CO_2 emissions and the supposedly unavoidable building of new coal-fired power plants harmful to the climate, soaring electricity prices, a so-called »electricity gap« and increased imports of nuclear power from France.

In two studies published in mid-April 2011[6] WWF Germany was able to demonstrate convincingly that a nuclear phase-out by 2017 is possible without these risks arising. It was even possible to expose the imports of nuclear power as not real. CO_2 emissions will not rise in the EU as a result of Germany's nuclear phase-out as they are capped by emissions trading. Instead of building new coal-fired power plants harmful to the climate – which would keep Germany's emissions at a very high level for decades – sophisticated gas-fired power plants can be built which have the advantage of flexible production and which, with their significantly lower CO_2 emissions on the supply side, would ideally complement the growing share of renewable energies. According to estimates by WWF Germany, electricity prices will rise only slightly, by 0.5 ct/kwH. On multiple occasions it has been demonstrated that there are sufficient power reserves available so that the »lights don't go out« and that imports from French nuclear power plants did not increase after the moratorium was imposed.

The phase-out of nuclear power in Germany is an important requirement for the quick transformation of the power supply so that it becomes sustainable. At the same time, however, it is also crucial that the right policy roadmap is found for a rapid increase in the use of renewable energies, the improvement of energy efficiency, and the development of infrastructures and storage capacities. That will be the big challenge in the years ahead.

With the German government's approval of the Energy and Climate package on 6 June 2011, the country has taken an important step towards a sustainable energy supply. WWF Germany supports these efforts. But we are still a long way from reaching our goal.

5. German Council of Environmental Advisors, special report, »Ways towards a 100 % renewable power supply«, 2011, available for download [in German] at: http://www.umweltrat.de/SharedDocs/Downloads/DE/02_Sondergutachten/2011_Sondergutachten_100Prozent_Erneuerbare.pdf?__blob=publicationFile.

German Federal Environment Agency, »Policy Scenarios for Climate Protection V – on the way to structural change – Greenhouse gas emission scenarios up to 2030«, 2009, available for download [in German] at: http://www.umweltbundesamt.de/uba-info-medien/3764.html.

6. Öko-Institut, »Analysis and classification of the model for an accelerated phase-out of German nuclear power plants« conducted on behalf of WWF Germany, 2011, available for download [in German] at: http://www.wwf.de/downloads/publikationsdatenbank/ddd/36918/.

The political landscape in Germany has dramatically changed as a result of the events in Fukushima. About two weeks after the earthquake in Japan, a »Green Minister-President« was elected for the first time – and this in Baden-Württemberg, which is politically one of the most important and economically one of the strongest federal states in Germany. After approx. 60 years of conservative government there, the Green politician Winfried Kretschmann took office. In a widely publicized interview, Kretschmann made it very clear that the profound differences on nuclear policy which emerged in autumn 2010 had been resolved through the new energy policy. New coalition partnerships thereby could become possible, on the basis of which new dynamics can evolve in important fields like energy and climate policy.

Current developments in Germany show very clearly how significant the long-term development of a societal foundation for new approaches in energy and climate policy is. If it is socially possible to hold well-founded and long-running debates about risks, possible alternatives and above all practical experiences gathered in successful development of these alternatives, it creates a resilient basis for a fundamental change in energy policy. The real success story of German energy policy will be, however, the transition to a low-risk and climate-fair power supply. This will be the biggest project of Merkel's government in her second term in office. There are very good prospects that it will succeed. Germany has after all been prepared for this for years.

Country Perspective: India

Suresh Prabhu[*]

1. Status Quo of Nuclear Energy as Energy Source

India has been active in securing its energy supply ever since gaining independence in 1947. Political freedom and independence could only be secured by ensuring an adequate and affordable supply of energy to all its citizens. All of India's energy policies since 1947 have been based on the overriding preoccupation of securing the nation's energy supply.

India has been mainly producing energy from coal, which currently comprises 63 per cent of India's energy mix. The reason coal has been the mainstay of India's ever expanding energy basket is that coal has been plentiful within its territories. The second-largest source of energy is hydro power, which comprises close to 23 per cent of the energy mix. Energy from hydro is possible due to geography and the abundance of water, which has allowed India to produce more hydro-electricity. Nuclear energy is less than three per cent of India's 170,000 MW of installed capacity. Nuclear power is thought to have been generated in India ever since the time of the first Prime Minister of independent India, Pandit Jawaharlal Nehru. All subsequent Prime Ministers up to the current one have supported nuclear energy as one of the core elements of India's energy security. Nuclear power was always a priority of the heads of the government, evident from the fact that all the Prime Ministers kept nuclear energy matters under their direct administrative control.

India suffered a huge setback with its nuclear energy development programme after 1974 and 1998, when India conducted nuclear weapons tests to investigate its nuclear capabilities. Embargos were placed on technology transfers – primarily concerning sophisticated technology areas – and also on access to uranium, which was critical for the development of peaceful nuclear energy in India. India thus could not expand its peaceful nuclear energy programme for electricity for a very long time. Two years ago, India signed a civilian nuclear energy agreement with the United States, an agreement that was subsequently taken on board by the International Atomic Energy Agency, which lifted the embargo on transfer of technology. Subsequently, India was able to convince the nuclear suppliers group (energy) to reinstate the supply of uranium, which was crucial in the quest for more nuclear energy. As a result, India has now planned more than 20,000 MW of capacity from nuclear power by 2020. It is sought to be expanded to eight per cent of India's energy mix by 2035, when India's total installed capacity would be in excess of 900,000 MW.

Table 1: Nuclear Power Generation (2006-2007 to 2010-2011)

Year	Gross Generation (MUs)	Capacity Factor (%)	Availability Factor (%)
2010-2011 (Up to March 2011)	26,473	71	89
2009-2010	18,831	61	92
2008-2009	14,927	50	82
2007-2008	16,956	53	83
2006-2007	18,880	64	85

India's nuclear thrust also coincided with the so-called nuclear renaissance that emerged on the world scene. The United States, which has not constructed any nuclear plants for the last 30 years, began talking about movement in this direction, followed by Japan and China. Europe, where nuclear activity has almost come to a standstill, also began planning new plants. Japan, where more than 30 per cent of electricity is generated from nuclear energy, has suffered a severe shock since the events at Fukushima. The shock has not been due to the earthquake or the tsunami that followed, but due to the faulty response system in the aftermath of the accident that took place in a nuclear plant there. Even after almost a month, matters have further deteriorated and Japan has had to raise the nuclear alarm to the level of Chernobyl (level 7), which is the highest for any nuclear accident. Japan, which had hitherto claimed to have the capability to deal with any catastrophe, is currently reeling due to various uncertainties, thereby raising serious doubts about issues surrounding nuclear safety, even in India.

* Suresh Prabhu is Former Union Cabinet Minister for Power in India.

Table 2: Nuclear Power Plant Capacity

Plant	Unit	Type	Capacity (MWe)	Date of Commercial Operation
Tarapur Atomic Power Station (TAPS), Maharashtra	1	BWR	160	October 28, 1969
Tarapur Atomic Power Station (TAPS), Maharashtra	2	BWR	160	October 28, 1969
Tarapur Atomic Power Station (TAPS), Maharashtra	3	PHWR	540	August 18, 2006
Tarapur Atomic Power Station (TAPS), Maharashtra	4	PHWR	540	September 12, 2005
Rajasthan Atomic Power Station (RAPS), Rajasthan	1	PHWR	100	December 16, 1973
Rajasthan Atomic Power Station (RAPS), Rajasthan	2	PHWR	200	April 1, 1981
Rajasthan Atomic Power Station (RAPS), Rajasthan	3	PHWR	220	June 1, 2000
Rajasthan Atomic Power Station (RAPS), Rajasthan	4	PHWR	220	December 23, 2000
Rajasthan Atomic Power Station (RAPS), Rajasthan	5	PHWR	220	February 4, 2010
Rajasthan Atomic Power Station (RAPS), Rajasthan	6	PHWR	220	March 31, 2010
Madras Atomic Power station (MAPS), Tamil Nadu	1	PHWR	220	January 27, 1984
Madras Atomic Power station (MAPS), Tamil Nadu	2	PHWR	220	March 21, 1986
Kaiga Generating Station, Karnataka	1	PHWR	220	November 16, 2000
Kaiga Generating Station, Karnataka	2	PHWR	220	March 16, 2000
Kaiga Generating Station, Karnataka	3	PHWR	220	May 6, 2007
Kaiga Generating Station, Karnataka	4	PHWR	220	January 20, 2011
Narora Atomic Power Station (NAPS), Uttar Pradesh	1	PHWR	220	January 1, 1991
Narora Atomic Power Station (NAPS), Uttar Pradesh	2	PHWR	220	July 1, 1992
Kakrapar Atomic Power Station (KAPS), Gujarat	1	PHWR	220	May 6, 1993
Kakrapar Atomic Power Station (KAPS), Gujarat	2	PHWR	220	September 1, 1995
Total Nuclear Power Plant Capacity			**4,780**	

A large French facility due to be built on the west coast of India in a place called Jaitapur in the Ratnagiri district of Maharashtra was already the target of huge public protests. Its construction is now facing uncertainty in the wake of the nuclear crisis in Japan. The proposed plant location has raised concerns among the people in Jaitapur about such a project coming there. The government of India has already announced to review all the nuclear energy establishments in India to ensure that they do not contain any safety issues. The political opposition has already asked the government to put on hold further expansion plans till safety fears are allayed. Though there is no proposal to change laws or suspend the government's plans for generating up to 40-50 MW nuclear power, events in Japan have certainly raised concern about India's nuclear programme.

Nuclear power has been given priority, as it is clean energy that does not generate greenhouse gases, and thus does not contribute to climate change. Nuclear power could be used in India through the use of uranium, and the recycled uranium could then be used for thorium reserves, which are plentiful in India and which, in turn, could provide energy security to India by using the locally available raw materials. India has developed the technology that can utilise the thorium, which can allow India to produce electricity from domestic resources. Thus, the argument for nuclear power comes from an energy security angle as well as a climate change angle. India's nuclear scientists have developed indigenous technology to work on nuclear power. Through this, a flagship government programme for a long-term energy strategy has been outlined. Critics, however, have always been apprehensive about nuclear safety issue. The world has not found any solutions concerning the disposability of nuclear waste. Critics also protest about importing reactors, which thus led to the loss of the indigenous technology that had been developed during the time of the technology embargo.

2. Socio-Political Discourse on Nuclear Energy

In India the political discourse on energy could be described as having self-reliance as the primary aim. It is also important to be at the helm of technology advancement in order to use technology in all spheres of activities. India has always claimed to be a technology-competent country and has always aspired to be one of the most advanced nations of the world. Use of nuclear energy is, in a way, a sign of proactive nationalism on the energy front.

There was a strong civil society movement against the use of nuclear power even before the Japanese event, but now it has intensified post-Fukushima. More and more segments of the public are joining mainstream civil society that opposes nuclear advancement. Two of the prominent anti-nuclear activists include the following:

(i) Coalition for Nuclear Disarmament and Peace (CNDP), India, has been working on the issues of disarmament and peace since November 2000. Post-Fukushima, CNDP has intensified its campaign against nuclear energy.

(ii) National Alliance of Anti-Nuclear Movements was launched in June 2009 and claims to be an association of over 100 NGOs, people's movements, and concerned citizens.

The left and the right wings of civil society are joining to create a formidable opposition to this nuclear plant in Jaitapur. The main two political parties in India – the Congress and the BJP – have not opposed nuclear power *per se*. The opposition to this is coming primarily from the Communist Party and the Shiv Sena, which is a regional party in Maharashtra and may be described as the right wing of the political spectrum in India. The opposition of the Communist Party to the proposed nuclear plant at Jaitapur stems mainly from the United States being the main partner in India's nuclear programme. The debate continues and probably can only conclude by learning lessons from Fukushima.

The nuclear industry in India is controlled by the government, as no private sector actors were allowed to partake in the nuclear energy sector. The Nuclear Power Corporation of India, which is under the direct control of the Prime Minister, is the only body that can represent the nuclear power industry in India. The body has not come out with any new evidence since the Fukushima accident, except for the statements made by the nuclear power establishment saying that India's nuclear power establishment has not suffered and that there is no cause for concern. Even if the nuclear establishment had evidence of problems, it would not be available for public scrutiny. The Environment Minister, who has the mandate by law to give clearance in environmental matters, had already given a go-ahead to the plant in Jaitapur. But post-Fukushima, the minister has stressed on record that tsunami-type risks would have to be considered while making the risk-assessment measures for the nuclear plant. Civil society opposition to the plant is already pressurising the government to cancel the clearance. The media have been divided on the nuclear power issue, and there have been mixed responses to issues related to nuclear power. Post-Fukushima, the media have been raising all the concerns regarding the nuclear disaster and covering the events, but they have not joined in the debate about the lessons to be learnt from this unfortunate episode. As of now, it is very difficult to categorise media outlets as being pro- or anti-nuclear.

3. Alternative Energy Paths

India needs 20 to 25 MW of electricity every year for at least the next 50 years. Half of India's population is without electricity. India is the lowest consumer of electricity in the world per capita, but it has a growing population and aspires to become a dominant economy of the world. To eradicate its poverty, India will need more electricity in the years to come. But quantity alone cannot be the only answer to the problem. The quality of the power to be generated is important, too, as is the energy mix. In the wake of mounting concerns regarding climate change, clean and green energy is something India needs to generate. This is only possible if India moves away from fossil fuel energy and adopts the renewable energy path. Energy security and clean energy can be achieved only if India pursues renewable energy as an alternative source of energy. Solar energy is plentiful in India due to the fact that almost all parts of India get 300 days of sunshine. The potential for solar energy is in excess of 500,000 GW, as estimated by one agency. India has already decided to generate 20,000 MW solar energy by 2021. Wind energy, which is now estimated to be more than thrice its earlier assumption by the government, is another alternative. The latest evidence shows that India could produce huge amounts of wind power. India's potential for hydro is 150,000 MW. Biomass could also provide a substantial portion of India's proposed energy mix.

Currently, renewable energy is about 10 per cent of the current »energy basket«. The Electricity Act of 2003 mandates that state regulators prescribe a minimum level of renewable energy sources in the energy mix. This would mean that India's share of renewable energy will rise rapidly in the years to come. By 2050 India's share of renewable energy could easily be at least a quarter, if not more, of its extensive installed capacity.

There are no serious objections to the advancement of renewable energy in India. In fact, there is almost uniformity in public and political opinions on the subject. The impediments come in the form of finance and technology and lack of scalability. Low-scale use is a root cause of high costs of such energy. With more and more diffusion of this technology, large-scale use of renewable energy will definitely happen. India has already begun to look at all possible options to promote clean energy, not as an alternate to nuclear energy but a parallel to it. Nuclear power in all likelihood will be put on the back burner and renewable energy will receive validation as a consequence of the accident in Japan.

Country Perspective: Indonesia

*Made Pande Udiyani and Bobby Rizaldi**

1. Background

Energy demand continues to increase worldwide and has started to deplete there serves of conventional energy sources such as petroleum and coal. Therefore, it is necessary for the world to find suitable alternative energy sources as a substitute. In some countries, especially those with minimal natural energy resources, nuclear energy was chosen as the alternative. However, the Fukushima nuclear power plant accident in March 2011 revived the debate of whether it is still a viable option to continue with or to increase the use of nuclear energy to overcome energy shortages. Many countries have now started to re-evaluate their nuclear energy policies, including applying more stringent safety inspections, supervising that nuclear power plants do not extend their operating licences, and delaying the development of nuclear power plants that are in use.

Nuclear power in Indonesia has been, in fact, one of the promoted means to utilise alternative energy sources in anticipation of the decreasing supply of fossil fuels, especially oil. The country is very dependent on oil, despite the fact that since 2004 Indonesia has been a net-importing country. In addition to that, domestic production capacity has also been decreasing. Yet, the country's energy needs are rising in line with its economic growth. Therefore, renewable energy sources will play a more prominent role in meeting Indonesia's energy needs. However, renewable energy sources from wind, solar, and hydro, which are considered safer than nuclear energy, are only sufficient in meeting the energy needs for lighting but are far from adequate to accommodate industrial needs. Indonesia has the world's biggest geothermal power source, and this option must be further explored. But even with geothermal power, the energy created will still not be enough. In 2020, it is predicted that the national energy needs will reach 55 GW and will increase in the coming years.

Currently, many actors consider nuclear energy as one of the most rational options to meet Indonesia's energy needs. Sceptics of nuclear energy frequently express concerns about the quality of human resources and the level of technology. Supporters counter that these concerns are not scientifically grounded because a Commission for the Preparation of the Establishment of Nuclear Power Plant was founded in 1972. Furthermore, a nuclear reactor for research purposes was established in Serpong in 1978. Moreover, the International Atomic Energy Agency (IAEA) has made it known through its Deputy Director, Kwako Aning, that Indonesia is ready to benefit from nuclear power.

2. The Status Quo of Nuclear Energy as an Energy Source in Indonesia

According to Presidential Regulation no. 5/2006, the government has established the use of various energy sources by 2025: less than 20 per cent for petroleum, more than 30 per cent for natural gas, and more than 33 per cent for coal. Whereas the use of geothermal sources and biofuels each have to reach levels of at least five per cent, as do other new renewable energy sources (micro-hydro, biomass, wind, solar) as well as nuclear energy; the level for liquefied coal is two per cent. Therefore, the total for alternative energy, renewables, and nuclear energy is planned to contribute a share of about 17 per cent of the country's energy needs (ESDM 2011). Indonesia has decided to use nuclear power in efforts to realise a just and prosperous society, as explained by law no. 10/1997 on nuclear power. Law no. 17/2007 on the Long-Term Development Plan 2005-2025 stipulates in its Mid-Term Development Plan 2015-2019 that by 2016, the first nuclear power plant must be able to operate with a 2,000-MW capacity.

In Indonesia, the construction of new nuclear plants are in the planning. They should be operational by 2025 with a target of around 5 GWe (equivalent to five nuclear power plants, each with a capacity of 1,000 MWe; or seven Fukushima nuclear power plants with the capacity of 700 MWe each). The research for prospective

* Pande Made Udiyani is a Senior Researcher of Power Reactor Safety Analysis and a Reviewer for Safety Analysis Report for Research Reactor at the National Atomic Energy Agency (BATAN). Bobby Rizaldi is a Member of Parliament from the Golkar Party who works for the Commission of Energy in Indonesia.

nuclear power plants was initiated in 2011 (BATAN 2010). However, lessons learned from Fukushima show that there is a need to consider carefully the location of the nuclear power plants (NPPs), taking into account the possibility of natural disasters.

After the accident in Fukushima, the Indonesian government issued a statement saying that nuclear power plants will still be built but that the process would be carried out more carefully and that the number of new NPPs might be lower than originally planned. Currently, Indonesia has three reactors, but only for research purposes. They are located in Serpong (30 MW), Yogyakarta (100 KW), and Bandung (2 MW). Indonesia still does not have a reactor for power generation. The government also stated that it wants to intensify the search for alternative non-nuclear energy sources. Utilisation of nuclear energy should be the last option to meet national energy needs. »However, this last option does not mean that nuclear power is not prepared. Construction of nuclear power plants (NPPs) will be done with the principle of harmony, readiness, and safety« (DEN-ESDM 2011).

On 18 May 2011, there was a hearing between the Parliament (Commission VII of the DPR) with the National Atomic Agency (BATAN), the Nuclear Energy Regulatory Agency (BAPETEN), and the Directorate General of Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Minerals. They concluded that between 2015 and 2019, Indonesia will have its first nuclear reactor for power generation. Most likely it will be located in Bangka-Belitung. Assessments are ongoing.

3. Socio-Political Discourse on Nuclear Energy

Before the Fukushima incident, the public of Indonesia was sceptical with regards to the safety of NPPs and there was a lot of media coverage reporting on the security risks of NPPs. After the Fukushima accident, with a variety of information from national and foreign media (including the Internet), the public became more informed about other aspects of nuclear energy such as effects on the economy, the environment, as well as climate change. To date, the government has not been able to alleviate the widespread fears in Indonesian society concerning nuclear accidents and the lack of safety. The protests have been organised by the anti-nuclear campaigns led by civil society organisations such as Walhi, Greenpeace, and Manusia. If the government is unable to cope with these criticisms, it is of utmost importance to identify a renewable energy source that is able to replace nuclear power.

The authors conducted research by sampling 100 Indonesian Internet articles in March 2011. The conclusion was that 20 per cent of the articles are against nuclear power, 40 per cent are neutral, and 40 per cent are supportive of nuclear power. The articles against nuclear power use the classic arguments such as safety issues, environmental issues, energy abundance in Indonesia, and the readiness of human resources in the mastery of nuclear technology. The points made by the articles that offered neutral positions suggest the following: finding alternative energy sources that have no risk; assessing the readiness of human resources for operational management; exploring the continued fear about corruption in Indonesia (meaning that supervision can be manipulated, resulting into inadequate safety measures); and raising the question about the most ideal location that is able to cope with natural disasters. The reasons for favouring nuclear power can be summarised as follows: a number of people (especially young, educated people) think of nuclear power plants as a source of national pride (as they assume that economically and technologically advanced countries always use NPP); then there are also issues related to economic and energy independence, mastery of technology, respect from other nations, and nationalism.

In what ways are political camps divided into supporters and opponents of nuclear energy? Currently, political parties have not openly stated their opinions on nuclear power. Nuclear energy is not part of the campaign platform of any party. So far, only the personal opinions of politicians about nuclear power plants have been given. For example, former Chairman of the People's Consultative Assembly Amien Rais declared that he did not reject nuclear power plants (Rais 2011). Former Minister of Environment Sonny Keraf rejects the idea of building nuclear power plants now (once traditional fossil fuel sources run out, the implementation of nuclear power plants can be reconsidered) (Keraf 2011). Support for nuclear power has been stated by former President B.J. Habibie: »I am not rejecting (the construction of nuclear power plants), but we should be cautious in making our decisions. We should not be against, but should remain critical, and observe the research findings« (Habibie 2011). Ratu Hemas, member of the Upper House (DPD), advised that the aspirations of the community concerning the development of nuclear power plants should not be ignored (Hemas 2011).

To summarise, nuclear power has not become one of the prominent issues presented by political parties to voters, and the individual responses from politicians have been rather mixed. However, in the last hearing between the Parliament and related government agencies on 18 May 2011, all parties in the Commission agreed to speed up the process in the provisioning of nuclear power. The National Awakening Party (PKB) was originally against it because they have started to potray themselves as a green party. But in the end, they gave in and agreed with the positions of other parties.

4. Alternative Energy Paths

National studies have shown that electrical energy demand will increase from 29 GWe in 2000 to 100 GWe in 2025 (Kompasiana 2011). Indonesia's coal and gas reserves still provide enough power, but Indonesia will have to become an importer of petroleum. In 2050, it is predicted that the overall energy demand will double in 2025, reaching 200 GWe. Although, if the sources for geothermal energy, solar, and wind are fully developed, the total capacity of these three energy sources – plus the energy from hydro – can still only reach about 80 GWe. Moreover, the most optimistic estimates concerning coal and gas supplies totals only about 80 GWe, meaning that the total capacity could rise to 160 GWe in 2050. This means that nuclear energy would need to provide 40 GWe to supplement the other energy sources.

After the Fukushima accident, the government (Ministry of Energy and Mineral Resources 2011) rethought its national energy policy. The government is revising the rules for the use of nuclear and renewable energies in the energy mix – renewables were previously targeted to increase their share from 17 per cent to 25 per cent by 2025. The main political motives for the civilian use of nuclear energy were driven by factors such as economic growth, meeting energy needs, and achieving energy independency. The projected mix of energy without the use of nuclear power by 2025 consists of: 6.7 per cent biofuels, 2.4 per cent waste biomass, 3.9 per cent geothermal, 5.3 per cent hydro energy, 0.3 per cent marine energy, 2 per cent solar energy, 0.8 per cent wind energy, 3.7 per cent coalbed methane. The increase in the use of geothermal energy and coal bed methane is due to the replacement of nuclear energy. Meanwhile, the projected consumption of fossil energy without nuclear energy in 2025 is 23.7 per cent of oil, 19.7 per cent of gas and 31.6 per cent of coal (ESDM 2011).

Indonesia's vision for its 2025 energy demand – for lighting as well as industrial development – is 100,000 MW. If Indonesia relies on non-nuclear sources of energy, fulfilling these energy needs may prove difficult to achieve. The government lacks concrete proposals regarding alternative resources, but it is time that the government decides on a comprehensive energy programme instead of half-heartedly exploring nuclear options.

References

BATAN – National Nuclear Energy Agency (2010): Renstra BATAN 2010-2014. Jakarta, Indonesia articles (from websites).

DEN-ESDM (2011): Opsi Terakhir bagi Nuklir untuk Memenuhi Kebutuhan Nasional; available at: http://www.esdm.go.id/news-archives/323-energi-baru-dan-terbarukan/4313-energi-nuklir-opsi-terakhir-untuk-indonesia.html.

Detikpertama (2011): Pengaruh Radiasi Nuklir di Jepang terhadap rencana Pembangunan PLTN di Indonesia; available at http://web.detikpertama.com/view/pengaruh-radiasi-nuklir-di-jepang-terhadap-rencana-pembangunan-pltn-di-indonesia.

ESDM – Ministry of Energy and Mineral Resources (2011): Pogram Nuklir harus Lebih Pro Publik; available at: http://www.esdm.go.id/berita/artikel/56-artikel/4324-program-nuklir-harus-lebih-pro-publik.html.

ESDM (2011): Belajardari Kecelakaan PLTN Fukushima-Daichi, Jepang. Seminar, Energy Mining Press Club, April, Jakarta-Indonesia; available at: http://www.esdm.go.id/news-archives/323-energi-baru-dan-terbarukan/4333-belajar-dari-pltn-fukushima-daiichi-desain-pltn-harus-menjamin-keselamatan-reaktor-dalam-segala-kondisi.html.

Greenpeace (2011): Energi Terbarukan ada di sini; available at: http://www.greenpeace.org/seasia/id/news/Energi-Terbarukan-Ada-di-sini.

Habibie, B.J. (2011): Jangan Buru-buru Tolak PLTN; available at: http://www.antaranews.com/berita/250536/habibie-jangan-buru-buru-tolak-pltn.

Hemas R. (2011): Ratu Hemas Minta Aspirasi Masyara kat soal PLTN diperhatikan; available at: http://www.mediaindonesia.com/read/2011/03/27/213417/89/14/Ratu-Hemas-Minta-Aspirasi-Masyarakat-soal-PLTN-Diperhatikan.

Insani E.K. (2010): Krisis energi Indonesia di depan mata; available at: http://www.id-jurnal.blogspot.com/2010/08/melirik-k...i-terbarukan-di.html; http://www.kamusilmiah.com/lingkungan/meneropon...-dunia-bagian-kedua/; http://gamil-opinion.blogspot.com/2008/11/elast...tensitas-energi.html; http://www.esdm.go.id/news-archives/56-artikel/...rnatif-di-india.html.

KEN – National Energy Board (2011): Pogram Nuklir harus Lebih Pro Publik; available at: http://www.esdm.go.id/berita/artikel/56-artikel/4324-program-nuklir-harus-lebih-pro-publik.html.

Keraf. S. (2011): PLTN Sudah Tutup Buku; available at: http://www.antaranews.com/berita/250179/sonny-keraf-pltn-sudah-tutup-buku.

Kompasiana (2011): Pentingnya Energi Nuklir di Indonesia; available at: http://regional.kompasiana.com/2011/03/27/pentingnya-energi-nuklir-di-indonesia/.

Rais A. (2011): Indonesia Butuh Energi Nuklir; available at: http://m.inilah.com/read/detail/1357712/amien-rais-indonesia-butuh-energi-nuklir/

Country Perspective: Japan

Iida Tetsunari *

1. The Strategic Energy Shift and the Position of Nuclear Power in the Wake of March 11

On March 11, 2011, Japan's northeast region (Tohoku) was hit by a massive magnitude 9 earthquake and a nearly 40-metre tsunami, which led to a nuclear accident in the Fukushima reactor complex. The cataclysm has also delivered an historic and still expanding socio-political shock that is almost equivalent to the two main historic events in Japan: the first being the Meiji[1] Restoration of 1868, which restored imperial rule in Japan and led to enormous changes in Japan's political and social structure; the second being the surrender of Japan, which ended the Asia-Pacific War in 1945. The current situation can be considered as the third great upheaval in Japan's modern history.

2. The Shock of the Nuclear Disaster

Tohoku and parts of northern Kanto (the region around Tokyo) experienced a huge blow from the earthquake and tsunami, which flattened many of the communities. Furthermore, the nuclear disaster in the Fukushima reactor complex continues to impede any possible prospects for recovery. It was claimed at the outset that three (out of the six) nuclear reactors of the Fukushima Daiichi nuclear power plant went into emergency shutdown mode. However, the earthquake and the subsequent tsunami in fact knocked out external power as well as the absolutely essential emergency power supply. As a result, it was impossible to cool the reactor cores in the wake of the shutdown. The fuel in the reactor cores, as well as spent-fuel pools, melted down and massive amounts of radiation were released. Enormous volumes of water were used to cool the reactors, but this strategy brought further releases of radiation as the cooling water flash evaporated. As we all know from the dismaying daily news, the crisis has continued and is far from over. Future prospects are sobering. It will take many years before the reactors' pressure and containment vessels can be repaired to a condition wherein they cease releasing radiation. During that time radiation will continue to spread. For the next several decades, it is feared that there will be significant damage to human health, pollution of foodstuffs and water, economic losses through rumour and misinformation, and other adversities.

The direct cause of this nuclear catastrophe was a natural disaster – the earthquake and the tsunami. But this risk was pointed out long before the catastrophe eventuated. That means it was neither »unforeseen« – as the operating company, Tokyo Electric Power Co. (TEPCO) claims, nor was it in fact a »natural disaster«. The executive management of TEPCO had long ignored warnings from outside their ranks regarding the safety of the Fukushima Daiichi nuclear power plant. So too did the national authorities in charge of safety and nuclear power policy. Both the operating company and the bureaucratic overseers need to be subject to an intense scrutiny regarding their responsibilities in what is quite clearly a »human disaster«.

The events in Fukushima have clearly demonstrated once more that Japan's nuclear energy policy has failed miserably in terms of energy security and climate policy. In spite of this, the iron triangle of interests in politics, the bureaucracy, and the industry remain largely unbowed. There are three primary reasons that Japan's environmental and energy policies remain deeply mired in a 20th century paradigm.

The first reason is that the intellectual moorings of Japan's policies are quite distant from those in the mainstream of international common sense. Indeed, it is no exaggeration to say that Japan's policy rationales are divorced from experience, resistant to learning from the past, and nearly impervious to information from other areas and regions. One can call this situation the »Galapagos-isation« of knowledge. In every policy realm, the international policy community diffuses a common sense to one degree or another. This is called the policy discourse, and it embraces the whole of socially-oriented intellectual action rather than simply offering a means of transcribing events. Our understandings of the world and the experiences we share as well as the social world we inhabit are construc-

* Iida Tetsunari is Director of the Institute for Sustainable Energy Policies.

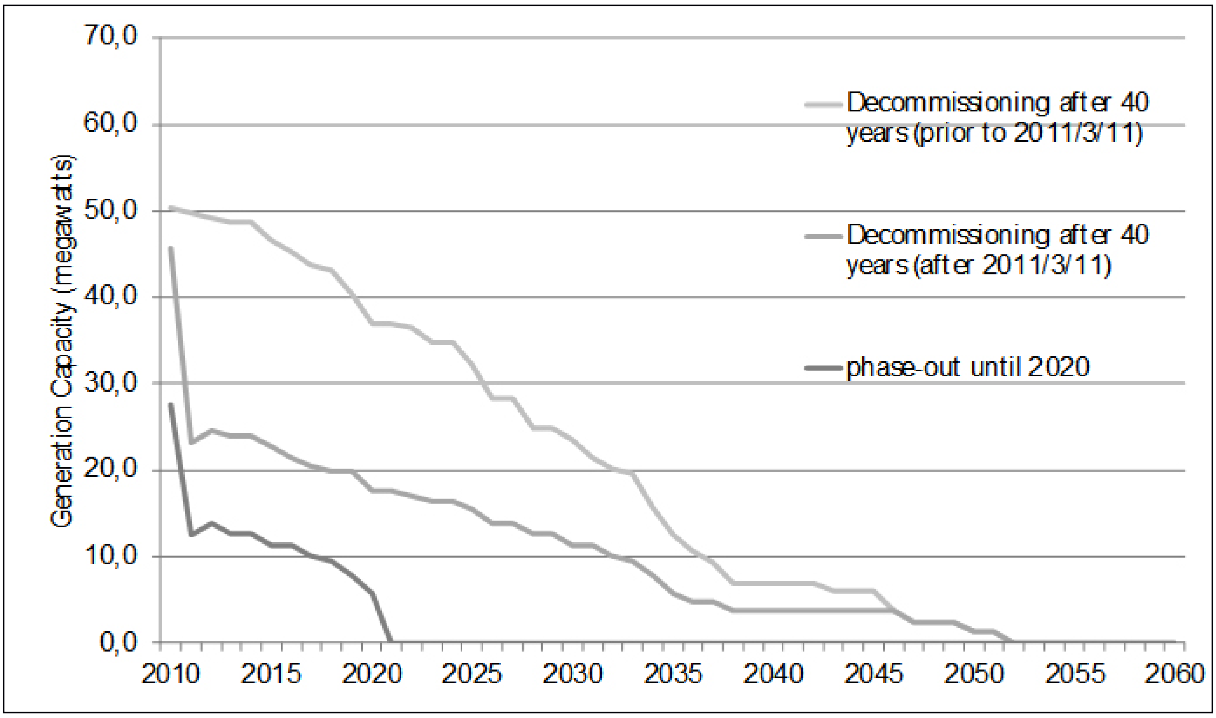
1. The term Meiji refers to the ruling class of the Meiji period that reigned during the first half of the Empire of Japan from 1886 to 1912.

ted through such discourses. This is especially true at the intellectual level in international society. Environmental policymaking is animated by a discourse whose common principles and frameworks are largely composed of the environmental laws, environmental politics, environmental research, and other aspects of environmental policy developed by the Europeans. But in Japan there is little engagement or awareness of this international environmental discourse. We see this in Japanese politics with respects to feed-in tariffs (FIT) for renewable energies. The policy periodically arises in the policy agenda of a »village society« whose politics are sharply polarised between pro and con positions. The struggle between advocates of these two positions leads to minimal area for compromise, and the cycle is repeated. Very little learning takes place.

The second problem is one of »policy silos«. These silos divide policy sectors from one another, and this tendency appears to be worsening. Each bureaucratic department is in charge of policymaking within its own fief. The role of politicians in this milieu is to become, as ministers, temporary ornaments for their respective bureaucratic organisations.The third problem is structural. Japan's ten regional electrical utilities were constructed in the wake of the Asia-Pacific War (1931-1945). The decision on whether to set up the electrical network as local public companies or private firms was hotly debated. Eventually, the country was divided into ten regions, with each having its own monopolised electrical utility. This is regional monopolisation, and it is still in place today. Moreover, power generation, transmission, distribution, as well as sales are all performed within a monopolised, vertically-integrated electrical firm. This is the monopolisation of functions.

The latter part of the 1990s saw a movement towards regulatory liberalisation. And although there was some liberalisation, the dual regional and functional monopolisation has not changed. The continuation of dual monopolisation is highly unusual from a global perspective, even among the developing countries. The shock of the earthquake and tsunami offers an opportunity to restructure this environmental and energy policy context within Japan. What is required is a thorough restructuring of safety policy, energy policy, the monopolised utilities, and the rest of the organisational and operational content of the power economy.

Graph 1: Japan's nuclear plants before and after the earthquake



Source: ISEP (Figures calculated under the assumption that Fukushima 1 and 2 as well as the Onagawa, Totsuu, Tôkai, and Hamaoka reactors are offline. The Kashiwazaki-Kariwa and Shimane plants are also projected for gradual shutdowns.

3. The New Reality of Nuclear Power

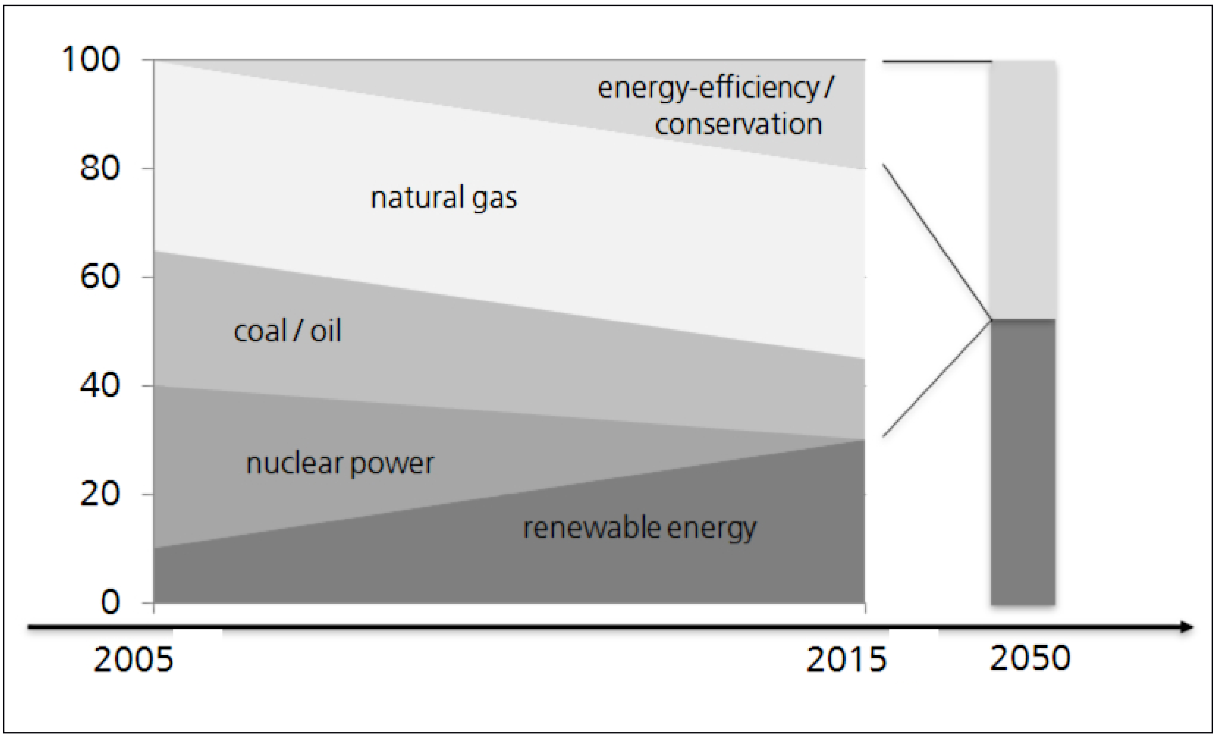
There is a general idea that »30 per cent of Japan's electricity is generated by nuclear power.« This claim has become outdated since the nuclear catastrophe – the country is experiencing a sharp decrease in nuclear power capacity and the onset of a »new reality«. Right after the March 11 incident, Japanese electricity generation dropped precipitously by more than 20 per cent. After the accident in Fukushima, further reactors were shut down, such as the dangerous Hamaoka reactor of Chubu Electric Power Co. Hamaoka is located 200 km southwest of Tokyo and is near the junction of two tectonic plates, where a strong earthquake is expected in the not too distant future. Moreover, much of Japan's nuclear power generation capacity is from old power plants, with the Fukushima reactors themselves being about 40 years old. Over the coming years, a significant share of Japan's remaining nuclear plants will have to be retired, and building new plants appears to be out of the question. As a result, the share of nuclear power production will steadily decline as a matter of course – by roughly 10 per cent over the next decade. It is entirely possible to prepare a more rapid schedule for shutdowns than that.

4. Structuring of a Future without Radioactivity and Climate Change

Aside from nuclear power, there are two major items that need to be considered in energy policymaking. One is the impact of rising costs of fossil fuels, such as coal and oil. These rising costs are going to severely disrupt our lifestyles. Another is climate change – the most dire threat that the human race has ever confronted.

Regarding both of these crises, conservation through energy efficiency – the »efficiency power plant« – is the most immediately effective response. Within a 10-year time span, it is also possible to rapidly expand the use of renewable energies. The German example shows that it is possible: over the past decade, Germany has increased its reliance on renewable energy by 10 points – from 6 per cent to 17 per cent of their power generation. Over the next decade, they have determined that they will increase this share from 17 per cent to 35 per cent, or by about a further 20 per centage points. This performance underscores the merit of renewable energies as small-scale distributed technologies that can scale up and innovate fast.

Graph 2: Aiming for a post-fossil fuel and post-climate change future while eliminating nuclear power



We have seen a similar phenomenon with personal computers, liquid crystal display televisions, mobile phones, and other small-scale distributed technologies. The more you diffuse the product, the more the technology advances and costs decline. Regarding wind power, the countries that have diffused the technology have already seen it become a competitor to thermal-fired power generation. Solar power is already experiencing annual cost declines of 10 per cent. This performance has allowed solar power to achieve grid parity already in countries such as Italy.

So what is the vision for a future without anxieties about radioactivity and climate change? We can project a power economy that, over the next decade, eliminates nuclear power and further reduces demand by 20 per cent through energy efficiency. Renewable energy can realistically be relied upon to provide 30 per cent of power capacity. Further out, by 2050 we can eliminate fossil fuel usage entirely, increase energy efficiency by 50 per cent and rely on renewables for 100 per cent of our energy needs.

5. The 21st Century Environmental-Energy Revolution Has Begun

We need to devise a new policy framework for renewable energy-centred regional self-reliance to replace the 20th century fantasy of nuclear power. Renewable energy is the fourth revolution of the human race, following on the spread of agriculture, the industrial revolution, and the IT revolution. It is also a rapidly expanding revolution, which last year exceeded 20 trillion Japanese yen globally in total worth. Renewables can ramp up capacity in a short space of time. They can scale up quickly and bring energy production as well as good jobs and a robust economic base to regions. Energy efficiency and renewable energies not only bring employment and economic opportunities to regional areas, they also keep income within the region rather than allowing it to be spent on the purchase of energy resources from elsewhere.

This new green economy has been projected to grow by 10 times and to exceed 200 trillion Japanese yen over the next decade. In spite of this enormous opportunity, Japan was determined to turn its back on renewables and had centred its attention on nuclear power. The tragedy of the nuclear catastrophe now offers an unmatched opportunity to ignite a 21st century environmental and energy revolution. This revolution could leave the next generation a splendid legacy of abundance rather than crushing debt and other miseries. The Meiji Restoration of 1868 opened the road to the »rich country, strong army« approach advocated by the leaders of late 19th century Japan. However, eventually it led to war, defeat, and then surrender in 1945. The post-war period brought its own awful legacy with a fixation on economic growth that has led to the unfolding nuclear catastrophe. Now there is a real chance to build a strong country knitted together through renewables across the regions. The realisation of this sustainable dream is the responsibility of contemporary politics.

Country Perspective: Korea

Lee Pil Ryul *

1. Status Quo of Nuclear Energy in Korea

In 2009, Korea had 20 reactors in operation, providing the country 34.1 per cent and 13.1 per cent of its electricity and primary energy, respectively. Four of the 20 reactors are Canadian heavy-water reactors and 16 are pressurised light-water reactors. By comparison, nine nuclear reactors provided about 50 per cent of the country's electricity and 14.2 per cent of its primary energy in 1990. During this period, electricity consumption in Korea grew more rapidly than the expansion of nuclear power. In 2010 a new reactor was connected to the grid and started to produce electricity, increasing the generation capacity of nuclear power to 18,716 MWe and the share of nuclear total capacity to 23.9 per cent. Seven pressurised light-water reactors with generation capacity from 1,000 to 1,400 MWe are under construction and a further four are being planned. The current government announced the 5th Electricity Supply Plan in December 2010 and declared that it would enhance the share of nuclear electricity to 48.5 per cent of the energy mix by 2024. To reach this target, two more nuclear reactors have to be constructed by 2024. If this plan goes well without disruption, Korea will have 35,916 MWe of installed nuclear generation capacity in 2024, which is almost two times more than the 18,716 MWe in 2010. According to the Energy 2030 Plan announced in 2008, nuclear reactors would supply 59 per cent of the country's electricity consumption and 27 per cent of its primary energy. The nuclear policy in Korea is exclusively set by the central government, because the Korean nuclear power company is owned by the state.

2. The Influence of the Fukushima Accident

The Fukushima reactor catastrophe on 11 March 2011 influenced the government's nuclear policy very little. Government officials emphasised after the nuclear catastrophe in Japan that Korean nuclear reactors were absolutely safeguarded against any earthquakes that might occur in Korea. The officials additionally claimed that Korean reactors were much safer than the nuclear power plants in Fukushima for the following reasons: they are different reactor types; they have double-cooling cycles compared to the Fukushima reactors; unlike Fukushima reactors, they are equipped with »passive« hydrogen removal facilities, which could work without an electricity supply and consequently prevent the type of hydrogen explosion that occurred in Fukushima. As for radioactivity from Fukushima, officials declared that because of the prevailing westerly winds, the Korean peninsula was absolutely safe from contamination by radioactive materials from Japan. The officials added that Korea has to expand its nuclear capacity to satisfy the ever-increasing electricity consumption, despite the accident in Fukushima.

Almost 97 per cent of the energy consumed in Korea has to be imported from abroad. Due to such a heavy dependency on foreign energy suppliers, nuclear energy is considered as the one and only promising energy for the future, although uranium must be imported from abroad, too. However, because uranium is much easier to store than oil and natural gas – and because the share of the fuel cost in the total nuclear electricity generation cost is lower than five per cent – the government and nuclear power supporters like to portray nuclear energy as being domestically produced and claim that Korea should rapidly expand nuclear energy to be free from foreign energy sources. Nuclear technology is also considered an important export industry item and the Korean government is investing large amounts of money in researching and developing nuclear technology. When the government-backed Korean consortium succeeded in exporting nuclear power plants to the United Arab Emirates in 2009, the majority of the Korean people enthusiastically welcomed it.

For the government and most politicians, nuclear energy is a secure and safe form of energy supply and a faithful guard of economic growth. On the contrary, opponents of nuclear energy – mainly from environmental organisations like the Korean Federation of Environmental Movement, the Energy Alternative Center, Green Korea, and Eco-Center – claim that nuclear energy is too danger-

* Lee Pil Ryul is Professor at the Korea National Open University in Seoul, Korea.

ous to keep as an electricity generation option because of its potential to cause nuclear catastrophes and the unsolvable nuclear waste disposal problem. Still, only a few politicians, experts, and citizens agree with the opponents of nuclear energy. The Fukushima catastrophe influenced, to some extent, the politicians of opposition parties. Due to the impact of that incident, 14 MPs of opposition parties like the Democratic Party and the Democratic Labour Party urged the government to revise its current aggressive nuclear expansion policy. But their announcement did not get much public attention. On the contrary, MPs of the ruling government did not raise their voices to ask for a rethink of nuclear policy. Some of them, especially the majority floor leader, sharply attacked the nuclear power opponents and claimed that they were making people panic by spreading groundless rumours. Even the current President openly said after the accident that Korean reactors were safe but that the rumours were dangerous.

As with the politicians, the Fukushima accident has had little influence on the general public. According to a Gallup International survey published on 19 April 2011, the proportion of supporters of nuclear energy fell only from 65 per cent before the accident to 64 per cent after accident. Yet on the local level, some remarkable changes can be observed. In Samchok, a city on the east coast, the majority of people wanted to have nuclear power plants in their area before the accident, but after the accident they changed their minds and are now opposing the construction of nuclear power plants in their region. In Busan, the second largest city with about 3.5 million inhabitants and where six nuclear reactors are being operated in the outskirts, several district parliaments passed a resolution requiring the immediate shutdown of the first Korean nuclear reactor built in 1978.

There are a number of environmental organisations that generally oppose nuclear energy, even though they hardly get support from the people. Among them is the largest organisation, the Korean Federation of Environmental Movement, founded in 1993 and has about 70,000 members. The second largest organisation is Green Korea, founded in 1996 and has more than 10,000 members. On the contrary, the government succeeded in getting the support of the people. This is because after the failure to construct a spent-fuel storage facility – thanks to fierce resistance from the locals – it founded the Nuclear Culture Foundation in 1993 to »enlighten« the »lay innocent« people. Through this organisation, it vigorously propagated the advantages of using nuclear energy. Big conservative newspapers are by and large pro nuclear energy. Their tone has not changed regarding nuclear issues even after the accident in Fukushima. Only two or three relatively small progressive newspapers like *Hangyoreh* and *Kyunghyang* and Internet media like *Pressian* are raising critical voices against using nuclear energy after the catastrophe in Fukushima.Traditionally, most of the politicians and political parties are pro nuclear energy. Only the small leftist Democratic Labour Party is against using nuclear chain reaction for producing electricity, but it has little influence and its core interest lies in issues other than nuclear, like labour or reunification. Some politicians of the biggest opposition party, the Democratic Party, required the government to change its nuclear energy policy after the Fukushima catastrophe. However, their announcement can be interpreted as opportunistic because they would certainly change their mind if they could retake political power in 2013. During their administration, they continued the nuclear expansion policy and oppressed the protest movements of the local people against government plans for construction of an interim spent-fuel storage facility in 2003 and 2004.

3. Energy Consumption and the Possibility of an Energy Shift

Energy and electricity consumption in Korea is rapidly growing. Per capita, the primary energy consumption in 2007 (4,586 kg oil equivalent) and per capita electricity consumption in 2008 (8,944 kWh) were higher than in most OECD countries. According to the statistics of the Korea Electric Power Corporation, industry comprised 51.4 per cent of total electricity consumption in 2010, the public and service sectors 34.5 per cent, and the residential sector 14.1 per cent. The share of industry, the public/service sector, and the residential sector accounted for 50.09 per cent, 34.9 per cent, and 15.1 per cent, respectively, in 2006. The electricity consumption of industry has increased the most rapidly. The troubling reality for establishing a sustainable energy supply system is that primary energy and electricity consumption for all three sectors will steadily increase until 2030 or even beyond. According to the Energy 2030 Plan, per capita electricity consumption in 2030 will reach 13,510 kWh – comparable to the amount used in 2007 by the United

States, one of the highest electricity-consuming countries in the world. Considering this situation, it is hard to expect Korea to establish a sustainable energy system. If Korea really wants to achieve a sustainable energy supply, the first thing Korea should do is to reduce its primary energy and electricity consumption by increasing energy efficiency, energy savings, and intelligent energy consumption, like Germany or Denmark. Developing and exploiting renewable energy sources is important too, but it is not the most important task for the establishment of a sustainable energy system.

According to a study carried out by the Korean Energy Research Institute, abundant amounts of renewable energy sources – mainly solar power (0.59 Gtoe[1]), solar thermal (0.87 Gtoe), and geothermal (0.23 Gtoe) – exist in the southern part of the Korean peninsula. The total technically exploitable amount of renewable energy is 1.7 Gtoe, which is about seven times more than the total primary energy consumption in 2007. However, according to the forecast of the Energy 2030 Plan, this amount would be reduced to 4.5 times of the total primary energy consumption in 2030. As for electricity, the potential of photovoltaic energy amounts to 585 Mtoe, which is about 10 times more than the total electricity consumption in 2008.

Considering the huge amount of exploitable renewable energy, one can come to a conclusion that if the people really want it, it would be possible in the long term to shut down all the nuclear and fossil fuel power plants and to supplant most of the primary and end-energy with renewable energy sources. However, most people in Korea do not (or do not want to) believe in this possibility. They think that it is very difficult to develop and use renewable energy sources and that nuclear energy is cheap and not as dangerous as the environmentalists claim. The renewable energy sources are only considered as supplementary to nuclear and fossil energy. According to the Energy 2030 Plan, the »new and renewable energy« share of primary energy consumption would increase from 2.6 per cent in 2008 to 11.5 per cent in 2030 and contain not only solar, wind, and bio-energy, but also non-organic waste, waste-gas from the petrochemical industry, and even energy produced by fuel cells and liquefied coal. If only real renewable energy sources like solar, wind, hydro, bio, and geothermal energy were considered, this share would be reduced from 2.6 per cent to 0.75 per cent in 2008 and from 11 per cent to 7 per cent in 2030. According to the Energy 2030 Plan, the »new and renewable energy« share of electricity consumption would increase from 1.2 per cent in 2008 to 7.7 per cent in 2030. Compared with the 59 per cent share of nuclear energy for electricity and the 27 per cent share of primary energy in 2030, the share of pure renewable energy is almost negligible.

The reasons presented by supporters of nuclear energy – as to why basing the energy system on renewable energy sources is impossible – are trivial. They claim that renewable energy sources are expensive, do not contain enough energy per unit weight or area compared to nuclear and fossil energy, and need large amounts of space, etc. They claim that especially wind turbines destroy landscapes, kill birds, and disturb the inhabitants who live nearby because of the noise. To the contrary, they claim nuclear energy is very compact, cheap, clean, carbon-dioxide free, and almost not exhaustible. Therefore, the government is planning to close the nuclear fuel cycle by introducing reprocessing of spent nuclear fuel and fast breeder reactor technology. As for spent fuel and low-level waste, Korea has no disposal facilities. Only a plan to dispose of low-level waste in a site on the south-west coast has been announced, but no disposal plan for spent fuel is being prepared. More than 10,000 tonnes of spent nuclear fuel are being stored in the temporary cooling pools in the reactor sites. Annually, about 700 tonnes of spent fuel are added to the storage pools, where there is little free space. This huge amount of spent fuel simply being stored in reactor sites is a big potential danger. However, it is hard to find proper sites for spent-fuel disposal or interim storage facilities. Several attempts to construct an interim storage site have failed because of fierce protests by local inhabitants. For that reason, the government is eager to introduce reprocessing and fast breeder reactors and to reuse fission materials from spent nuclear fuel.

However, Korea cannot start its own reprocessing programme because of the 1991 Joint Declaration of the Denuclearization of the Korean Peninsula as well as a civil nuclear cooperation agreement with the United States. To bypass this barrier, the Korean government is intensively researching the pyroprocessing method. Because pyroprocessing cannot supposedly produce

1. toe = tonnes of oil equivalent; Mtoe = million tonnes of oil equivalent; Gtoe = billion tonnes of oil equivalent.

weapon-grade plutonium, this method is considered by the government to be totally different from the wet reprocessing process. Therefore, the government claims that pyroprocessing is not reprocessing, poses no danger of proliferation, and does not violate the 1991 joint declaration. Pyroprocessing continues to be carried out in the laboratory, but the Korean government considers it to be very promising because it could solve the spent nuclear fuel disposal problem and secure the nuclear fuel supply for a long period.

Country Perspective: Portugal

Carlos Laia[*]

1. Status Quo of Nuclear Energy in Portugal

Nuclear energy is not (and never was) part of Portugal's energy mix. There are no plans to build nuclear power plants in the future. The path followed by Portugal in the last decades was to improve the energy efficiency of electricity generation, while reducing its environmental impact, by installing combined-cycle natural gas power plants and setting up an ambitious renewable energy programme. Existing coal-fired power plants (1985-1993) were kept as part of the national electricity system for base-load supply, due to their low production costs and as a means to diversify fossil fuel-imported sources, thereby improving security of energy supply. As a consequence, fuel oil-based power plants were phased out and a natural gas pipeline network was built.

From a historical perspective, nuclear energy was close to being adopted in the 1980s as a result of the proposed national energy plan. That plan endorsed the construction of four nuclear power plants in Portugal. The Minister of Industry and Energy at the time, Veiga Simão, Socialist Party (PS), argued that the supply side of the electric system of Portugal would not cope with the growing demand for electricity (an estimated 5 per cent increase each year) if the nuclear option was not followed, which was considered by him the »unique« viable economic option for electricity generation after two oil crises. That government was comprised of the grand coalition between the PS and PSD (Social Democratic Party, one of the two largest political parties). However, strong opposition to the nuclear option came from other government members (ministers and secretaries of state, no matter whether they were party-affiliated or independents), environmentalist groups, and other popular movements, which led to the failure of the plan. The plan was rejected twice in formal voting in two meetings held by the Ministers Council in 1984. The introduction of natural gas in the country and the increased use of renewable energy sources were adopted as the main drivers of the energy plan. After that, the nuclear debate was silent for 20 years. Thus, no other government or political party has proposed the adoption of nuclear energy in Portugal. Currently, the official position of the Portuguese government is that the nuclear option is not part of its agenda. Nevertheless, since 2004 the nuclear debate has returned to the public discussion as a result of a move from a pressure group led by the business man Patrick Monteiro de Barros. Industry association leaders, some political actors, and other players immediately supported the adoption of nuclear energy.

Since the Fukushima nuclear accidents, there have been no visible changes in the government's or opposition's attitudes towards the nuclear option. Yet, the debate has again received attention from the media, concentrating mainly on safety issues, as one might expect.It is likely that some political actors may change or reinforce their positions regarding the nuclear option if they perceive a change in public opinion. In fact, many politicians and scientists have avoided showing a clear pro or con position; some of them may now be inclined to take one side of the discussion, most probably against the nuclear option, as a result of safety concerns regarding operation of nuclear reactors (one fact to take into account at this point is that Portugal falls under the classification of having a moderate seismic risk). Pedro Passos Coelho for example, the leader of the PSD, showed a willingness to debate the nuclear energy option in a statement produced about one year ago. However, after the Fukushima accident, he has been silent on the issue. This eventually will »kill« the nuclear debate for the medium or long term, as happened in the 1980s. Such an evolution would not need to be backed by other political initiatives (e.g., plans or laws).

Supporters of nuclear energy in Portugal – basically industry leaders and the pressure group led by Patrick Monteiro de Barros – claim that cheaper electricity costs provided by nuclear power plants will improve the manufacturing industries' competitiveness and will help to reduce private households' expenses. The argument of (weak) competition factors of Portuguese manufacturing is always highlighted through comparison with Spain – Portugal's only neighbour – which usually shows lower energy prices at the end-user level, namely lower electricity and auto fuel prices. Although there are many facts to explain the gap between the electricity prices for Portuguese and Spanish

* Carlos Laia is a senior mechanical engineer and works as partner and manager for CEEETA-ECO, a private think tank in the energy, transport and environment sector.

consumers, that argument leads to the inclusion of nuclear energy in the Spanish energy mix as being the main reason for the difference. Thus, lower electricity cost is the main pro-nuclear argument. Other arguments used by nuclear energy supporters include the fact that there are some natural reserves of uranium in Portugal, which – once exploited and used – would reduce the country's dependence on energy imports. They also claim that nuclear plants would not increase the safety and environmental contamination risks of Portugal due to nuclear accidents because Spain already has nuclear reactors in operation not far from the Portuguese border (the nuclear power plant Almaraz is 100 km distance from the border).

Critics say that the costs of nuclear electricity may not be cheaper. They point out that the recent case of a new Finnish nuclear power plant shows a huge cost increase in relation to the initial budget. They also argue that without subsidies, hidden or not, or other forms of governmental support, nuclear energy is not viable. Another critique is that Portugal lacks know-how and staff structures to licence, commission, and control the security and safety operation of nuclear power plants. Supporters counterargue that Portugal could try to make an agreement with Spain in order to use the same staff structures.

Another important point raised by the critics is, like elsewhere, the safety concerns for the population and environmental ecosystems and the lack of a sound solution for the ultimate disposal and storage of nuclear waste. Other points worth mentioning, which are more technical-based, are: i) the relatively small size of the Portuguese electric load to »accommodate« the electric power of the proposed power plant (EPR with 1,600 MWe), which could lead to difficulties in the management of the Portuguese electric system; ii) the large water quantities needed to cool the nuclear reactor in operation, as water is a scarce resource in Portugal. Finally, the renewable energy programme endorsed by the last few governments has led to the successful creation of national manufacturers and approximately 2,400 direct jobs and about 33,700 indirect jobs in the sector. A nuclear programme would jeopardise these efforts.

2. Socio-Political Discourse on Nuclear Energy in Portugal

The political discourse in Portugal is based on one word: precaution. Government says that the nuclear option is not in its agenda, but it does not dismiss it explicitly, probably because a more assertive attitude might provoke open disagreement from some industry leaders. Only two political parties have a clear position against nuclear energy use: The radical left Bloco de Esquerda (BE) and the Partido Ecologista »Os Verdes« (»The Greens«, PEV, is a very small party with only two members in parliament thanks to its coalition with the Portuguese Communist Party, PCP). PEV is more assertive in its attitude against the nuclear option, having proposed in October 2010 a constitutional amendment to refuse nuclear energy in the fundamental law.

Supporters of nuclear energy are asking for a »national debate« on the nuclear option. They argue that this issue is treated as a »taboo« that poses obstacles to a free debate. However, since 2004 the issue has been widely discussed in the media and civil society. Several conferences, seminars, and roundtables have been held.

The recent events at Fukushima have refocussed the public's attention on the nuclear energy issue. Safety concerns about nuclear energy reactors have now jumped to the top of the agenda. However, the price of electricity is still a point supporters can use to find some sympathy within public opinion, especially in the context of the present Portuguese financial crisis. Since the Fukushima accidents, one important change in the political discourse has taken place: the Socialist Party has just presented its electoral manifesto for the next legislative elections (June 5) and it rejects the nuclear energy option, although in ambiguous terms,[1] and has confirmed its support for the renewable energy programme.

The public attitude towards nuclear energy is not a consensual issue within the national debate. Supporters argue that the majority of the population is in favour of nuclear power, as was shown in: i) an online survey carried out by the daily newspaper *Diário de Notícias* (18 June 2006), with 70 per cent of 16,000 respondents supporting nuclear energy; ii) two polls organised by the weekly *Expresso* indicated 62 per cent (July 2005) and 52 per cent (March 2006) were in favour of nuclear energy. However, the critics say that those polls did not meet scientific criteria, having being criticised by the National

1. The only phrase in the electoral manifesto about nuclear energy reads as follows (translation): »To the nuclear temptation of some, the PS responds with the utilisation of renewable natural resources that are plentiful in the country: sun, wind, ocean, and water.«

Authority for Media and Press. Furthermore, critics argue that those results are not consistent with European data from the Special *Eurobarometer 247: Attitudes towards Energy* from the European Commission, January 2006, which shows only five per cent in Portugal in favour of nuclear energy as opposed to an average of 12 per cent in Europe-25. Finally, a study from May 2011 referring to a poll conducted by May-June 2010 by survey experts for *Accenture* shows that 70 per cent of householders are against the construction of a nuclear power plant in Portugal, due to health and safety risks. The Fukushima nuclear accidents have certainly had a negative impact on public opinion in Portugal regarding nuclear energy. However, there is no available data to quantify this shift in perception.

Another factor not favourable to nuclear energy is the current financial and economic crisis. Since large energy-generation investments in competitive energy markets are developed through project-finance schemes – and taking into account the current difficulties in the banking system (there is simply no money) – raising such huge sums of money to pay for the capital costs of the construction of a nuclear plant would be a major burden. Nuclear energy projects stress this source, since they require very large capital investments.

Environmentalist groups are important players in Western civil societies. In Portugal, environmental NGOs such as QUERCUS, LPN, GEOTA, GAIA, etc., just to mention the well-known ones, have established a platform (*Plataforma Nãoao Nuclear*, http://www.naoaonuclear.org) with the aim to demonstrate that nuclear energy is not an option for Portugal. There has been no support from any Portuguese environmental group for the nuclear option. Obviously, some renewable energy lobby groups, supported by energy experts, are actively campaigning against the nuclear energy option. Still, no further opposition can be found nowadays from other civil organisations or movements – when compared to the 1980s – as there is no realistic probability of any nuclear power plants being constructed. In fact, back in the 1980s, the most vigorous opposition came from local associations in the regions where the construction of the plants was planned.

Patrick Monteiro de Barros is a Portuguese entrepreneur with some level of association in the nuclear energy industry. He was the figure that introduced the nuclear energy debate in Portugal in 2004 with his proposal to lead the construction of a nuclear power plant in Portugal. He managed to form a lobby group that included Mira Amaral, former Ministry of Energy and Industry and member of the PSD; Pedro SampaioNunes, former Secretary of State for Scientific Research and senior officer at the European Commission at the Directorate General for Energy, member of CDS-PP (the right-wing Social Democratic Center-Popular Party); and Francisco Van Zeller, President (until mid-2010) of Confederação da Indústria Portuguesa (CIP), the confederation of Portuguese industry associations.

One of the most well-known opponents of nuclear power is Carlos Pimenta, who is also affiliated with the PSD and now involved in the development of renewable energy groups. Pimenta was a Member of the European Parliament and Secretary of State for Environment (1983-1985). He was the most active political leader acting against the 1983 Energy Plan at that time. Eduardo de Oliveira Fernandes – professor at Porto University, former Secretary of State for Energy and Secretary of State for Energy and Environment – also plays an important role in the design of and advising on national energy plans and strategies, putting the emphasis on energy efficiency and renewable energy sources. J. J. Delgado Domingos – professor at the Technical University of Lisbon, and now also chairman of the Local Energy Agency of Lisbon – is very active in the press and media and has written two books explaining that nuclear energy was not an option for Portugal.

Both pro and con nuclear energy pressure groups can be easily identified in the media landscape. They are transversal within the political parties, with the exception of the BE and PEV parties. However, it is on the right end of the political spectrum – namely within the PSD and CDS-PP – where the strongest political tensions regarding the nuclear energy debate emerge. At the moment, it is not clear that one side is managing to gain a decisive advantage over the other.

3. Alternative Energy Paths

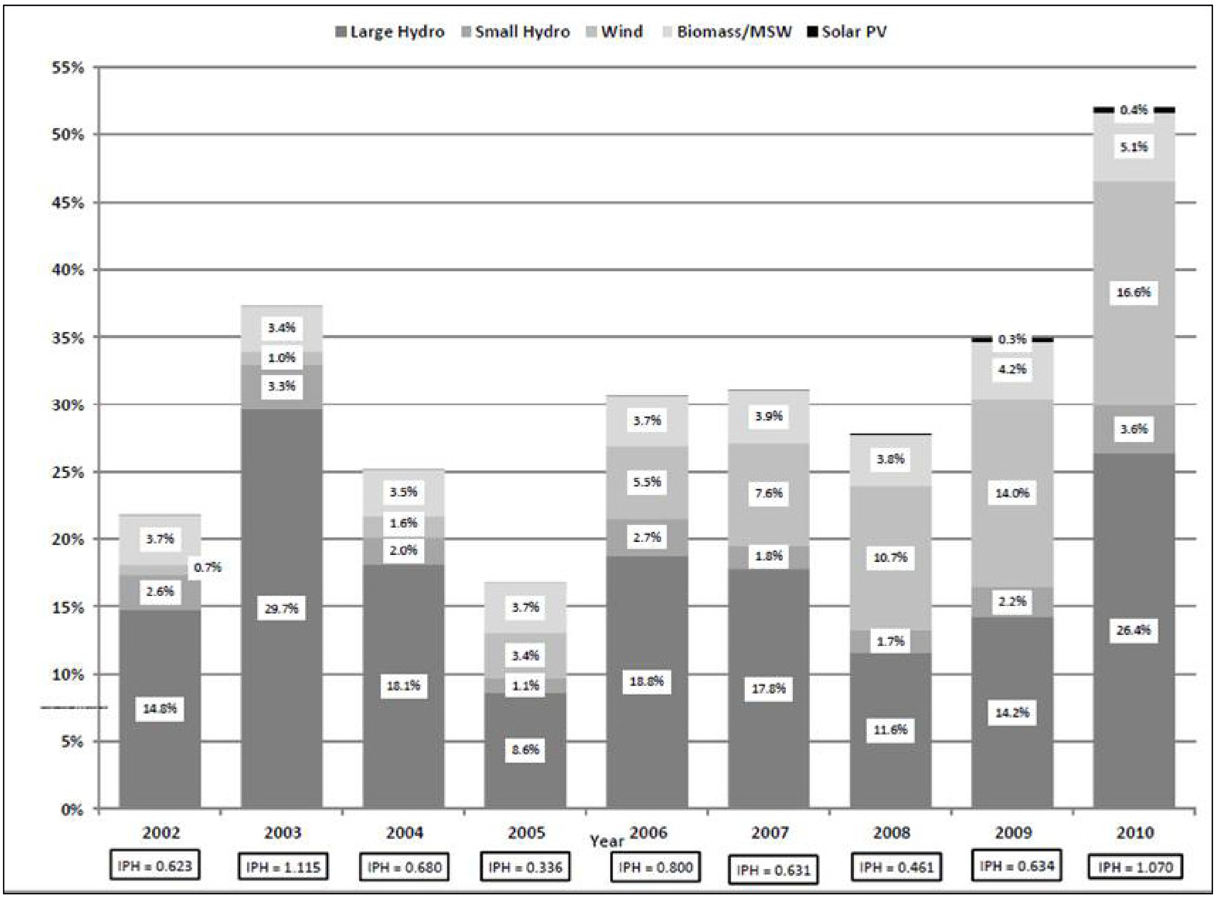
Portugal's energy outlook can be illustrated with the use of two indicators: first, a high level of energy dependency[2] (between 80 to 90 per cent, depending on the yearly fig-

2. Energy dependency shows the extent to which a country relies upon imports in order to meet its energy needs.

ures, whereas the EU average is slightly above 50 per cent); secondly, a poor performance in terms of energy intensity,[3] a measure of the energy performance of one country's economy. Portugal's energy intensity is around 200 toe/M€$_{2000}$, while EU average is around 170 toe/M€$_{2000}$.[4]

Portugal has no fossil fuel resources. Coal and natural gas are imported and used for electricity generation, although natural gas is also used as heat for other energy end-uses (space heating, water heating, cooking, process heat, etc.). Renewable energy sources (RES) are mainly derived from hydro power and wind. Biomasses and residues, coming from industry processes and municipal solid waste (MSW), are also used in the electricity production directly or in co-generation (CHP – combined heat and power) systems. Solar photovoltaic (PV) energy is also exploited and has a lower percentage in the mix.

The graph below shows the evolution of the RES share in the Portuguese electricity mix (i. e., energy produced by RES divided by gross electricity production plus net electricity imports) from 2002 till 2010. It is important to stress the relevant relative weight of hydro power in the total share of RES, as Portugal is very dependent on the each year's level of rainfall. Thus, the graph also shows the IPH (index of hydro power production), which is the rate of the hydro power produced in one specific year compared to the hydro power produced in the reference year. The reference year used is 1997, which was the base year for the former European Directive on the promotion of Renewable Energy Sources. Thus the hydro energy produced by hydro power unity in the year 1997 is the reference value. An IPH above the reference value indicates that that specific year experienced greater rainfall levels than in 1997.



3. Energy intensity gives an indication of the effectiveness with which energy is being used to produce added value. It is defined as the ratio of Gross Inland Consumption of energy to Gross Domestic Product.

4. toe = tonne of equivalent oil, an energy measure to account for primary energy figures.

During the last years, as can be observed in the graph above, the share of RES in electricity generation has been consistently increasing. Thus, the share of RES in electricity generation has increased from 30 per cent in 2006 to more than 50 per cent in 2010. As the Portuguese renewable energy programme advances, an even higher penetration of RES in the electricity mix can be expected in the coming years.

Another important aspect of Portugal's energy policy is the emphasis on energy efficiency. As mentioned above, Portugal's energy intensity is higher than the EU average, revealing a feeble energy-efficiency performance. Although many instruments and regulations have been put in place in the last two decades, the lack of effectiveness of those policies is now perceptible. Thus, the most important challenge for the near future is to achieve real gains in efficiency.

Portugal has recently approved the National Renewable Energy Action Plan (PNAER), as set out by European Directive 2009/28/EC on the promotion of the use of energy from renewable sources. According to this directive, each member state shall define a target for the share of energy from renewable sources in gross final consumption of energy in 2020 and ensure the application of measures to fulfill it. The mandatory target for Portugal is to reach 31 per cent of RES share in gross final energy consumption, an increase of more than 10 per cent as compared to 2005 energy figures. PNAER set targets for the evolution of different RES, as indicated in the tables below, according to the three different »sectors«: electricity generation, heating and cooling, and transports.

In the electricity-generation sector, hydro power will continue to grow, but wind will be the most important RES in 2020 as a result of a huge increase in electricity production. Solar, coming from photovoltaic or from solar-concentrating technologies, will also assume an important share.

In the heating and cooling sector (i. e., RES for buildings), the traditional use of biomass will decline. By contrast, solar will show an important increase. RES for the transport sector will come mainly from biofuels.

Barriers to the proliferation of renewable energy sources are still related to their higher capital costs. Therefore, measures addressing this issue continue to be very important. From this perspective, all kinds of support mechanisms should be judiciously studied and scrutinised, such as subsidies or grants for investment, feed-in tariffs, tax incentives, etc.

Another important aspect to promote the use of RES is to provide a stable legislative framework, in particular as related to feed-in tariffs and the sustainability of the emerging market for its products and services.

Table 1: Electricity generation from RES (PNAER)

Energy Source	2005 (GWh)	2020 (GWh)
Hydro	5,118	14,074
Geothermal	55	488
Solar	3	2,475
Marine (waves, tidal …)	0	437
Wind	1,773	14,596
Biomass	1,976	3,516
Total	8,925	35,584

Table 2: Heating and cooling from RES (PNAER); total energy intensity (ktep)

Energy Source	2005 (ktep)	2020 (ktep)
Geothermal	1	25
Solar	22	160
Biomass	2,507	2,322
RES with Heat Pumps	0	*
Total	2,530	2,507

(*) Estimate to be made after definition of methodology by European Commission

Table 3: RES for transports (PNAER)

Energy Source	2005 (ktep)	2020 (ktep)
Biofuels replacing gasoline	0	257
Biofuels replacing gas oil	0	450
Electricity with RES	12	58
Total	**12**	**535**

Country Perspective: Russia

*Anton Khlopkov**

Russia has ambitious plans to develop its nuclear power industry. It currently operates 32 power reactors and intends to build 26 more inside the country and about as many abroad over the next 20 years. Whereas the tragedy at the Fukushima nuclear plant should make these plans more realistic and the nuclear power plants safer, one can hardly expect any major changes in plans to build new power reactors in Russia. At the same time, some projects may be considered for review, and those include the plan to complete the construction of a »Chernobyl-type« reactor at Unit 5 of the Kursk nuclear plant, the building of floating nuclear reactors, as well as a new reactor in Armenia.

1. The Current State of Russia's Nuclear Industry

Russia has large-scale and ambitious plans in the field of nuclear energy. It is not an accident that the programme for the industry's development has been dubbed Atomic Project No. 2 – analogous with the Soviet Atomic Project that created the country's »nuclear shield«. President Dmitry Medvedev of Russia has included nuclear technology development among the five innovative development priorities for Russia. In 2010 the Russian government adopted the federal targeted programme New-Generation Nuclear Energy Technologies, which – together with the Energy Strategy until 2030 adopted in 2009 – has been assigned the key role of developing nuclear energy for peaceful use. The nuclear industry is expected to be the driver of the whole economy. The state corporation on atomic energy, Rosatom, has been tasked with not only developing national projects in the nuclear energy field, but also expanding international cooperation in the nuclear field. Accordingly, Russia's export potential in the nuclear field has, in recent years, been an important item on the agendas of the country's top leaders, President Dmitry Medvedev and Prime Minister Vladimir Putin, during foreign visits. From January to August 2010 alone, Rosatom signed agreements on nuclear cooperation with counterparts from Argentina, Armenia, Kazakhstan, and Turkey during the official visits to those countries by President Medvedev, and with Venezuela and India during the visits by Prime Minister Putin.

Russia is interested in seeing an early end to the crisis of the nuclear industry caused by the Fukushima accident and in deriving lessons from the Japanese tragedy. Russia has the fourth largest number of operating power reactors in the world (after the United States, France, and Japan). Nuclear energy is generated in the country by 32 power units with an installed capacity of 24.2 GW located at 10 nuclear plants. In 2010 nuclear energy accounted for 16 per cent of all the energy generated in the country; in the European part of Russia, the ratio is 30 per cent; in the North-West 37 per cent. Ten power units are in various stages of construction (only China has more – 27) as well as two floating nuclear plants. Russia has developed a new commercial reactor, VVER-1200, and it is planning to organise serial production of equipment for it and its commercial assembly. The total amount of orders for equipment for nuclear plants in 2011 is 220 billion roubles (about 7.5 billion US dollars). The plans for nuclear power development in Russia envisage an increase in the share of nuclear power in the total energy balance in the country to 20 per cent, and 25-30 per cent by 2030. Russia intends to build 26 new power units in the foreseeable future.

Rosatom believes that it has the potential to build abroad in the coming years 23 to 25 reactors with an output of 1-1.2 GW, with a prospect for increasing the number to 30. Twelve units are expected to be built in India, four in Turkey, between two and four in Vietnam, two in China, and two in Belarus and Ukraine. In 2009 Rosatom's export earnings (without taking into account the HEU-LEU contract) amounted to 3.6 billion US dollars, and the total earnings of Rosatom, its organisations, and enterprises were 528.5 billion roubles (about 17.5 billion US dollars). The company OAO Tekhsnabeksport (JSC Tenex), which delivers uranium enrichment services to the world market, has an order book of 20 billion US dollars. If one adds the orders placed with other subsidiaries of Rosatom (both contracted and expected) – above all with

* Anton Khlopkov is Director at the Center for Energy and Security Studies (CENESS) in Moscow, Russia and Editor-and-Chief of the *Yaderny Klub (The Nuclear Club)* journal.

the fuel companies TVEL and ZAO Atomstroyexport, the general contractor of the building of Russia-designed nuclear power plants abroad – the portfolio of orders for the Russian nuclear industry abroad may exceed 100 billion US dollars by 2030. According to Rosatom's report for 2009, it has a workforce of 275,000, which is almost four times less than at nuclear power enterprises on the eve of the collapse of the USSR (1.1 million), but is still large enough to deter the government from making hasty decisions regarding the nuclear industry (even if there are prerequisites for such decisions).

2. Russia's Reaction to the Fukushima Tragedy

Shortly after the Fukushima crisis began, the Russian President and Prime Minister spoke in support of nuclear energy on condition that the safety of the operation and planning of nuclear reactors is reviewed. On March 14, three days after the start of the drama at the Fukushima nuclear plant, Prime Minister Putin said, during his working visit to Tomsk in Siberia, that Russia did not intend to renounce the use of nuclear energy in the wake of the incident at Fukushima. The following day, he ordered a review of the state of the nuclear industry and its development plans, with the results of the study to be submitted to the government within a month.

On March 24, two weeks after the start of the Fukushima nuclear plant crisis, President Medvedev made a statement on that issue in his blog, announcing that stress tests were to be conducted at Russian nuclear power plants, including resistance to earthquakes. He stressed the need to improve the standards for choosing the sites as well as the designing, building, and operation of nuclear plants. The President also emphasised the priority of building new reactors over extending the lifespans of existing ones, and the need to give broader powers to international organisations in the field of nuclear safety in crisis situations. Addressing the BRICS summit in Sanya, China, on April 15, the Russian President underscored the need to draw conclusions from the Japanese nuclear plant disaster, but noted that catastrophes need not stop human progress. On March 24 Sergey Kiriyenko, the Director-General of Rosatom, announced during a visit to the United States that Russia and the United States had agreed to coordinate their work in conducting stress tests of nuclear power reactors.

3. Impact on the Future of Nuclear Energy in Russia

Considering the scale of the nuclear industry in Russia and the lack of an alternative that could replace nuclear energy, one can hardly expect Fukushima to exert a significant influence on Russia's strategic plans in the field of nuclear energy over the short and medium term. At the same time, it is obvious that the safety requirements for existing reactors and those under construction must be toughened, and therefore the deadlines for their construction may be postponed. In addition, some of the projects that are in the works or on the drawing boards may be revised.

First, such projects include Unit 5 at the Kursk nuclear power plant, which is based on the RBMK reactor, that is, a Chernobyl-type reactor. The building of the reactor began in 1986, was suspended several times, and was stopped altogether after 70 per cent had been completed. No work on the project has been conducted in recent years and its future hangs in the balance. Under current conditions, the decision to abandon construction seems to be reasonable. The problem is not primarily that of safety because lessons have been drawn from the tragedy that occurred 25 years ago and the reactor's safety systems have been greatly improved; the main problem is the public perception of the project. Public debate on the need for building a Chernobyl-type reactor may cost the Russian nuclear industry more than the likely economic benefits from its operation.

Secondly, the plans to build and export so-called floating nuclear reactors should be revised. The idea of a »nuclear battery«, or a compact source of electricity based on nuclear technologies, is attractive and innovative. However, the technologies being used to implement it were developed more than 40 years ago for icebreakers, and they should be replaced with new technologies that take into account the advances made in the field of enhancing the safety of nuclear power plants. It is necessary to form a positive attitude to the project on the part of public opinion in Russia and the expert community abroad, without which the project cannot be realised on the declared scale. The plan envisages the construction of tens of floating nuclear reactors. The two floating nuclear reactors that are currently being constructed should be considered experimental or as research nuclear power units for trying out the technologies for operating and ensuring the safety of such units in the future.

The modern sites being used to build nuclear plants in Russia are not in earthquake-prone zones, so requirements in that respect must apply above all to future projects. Under the Energy Strategy until 2030 approved by the government in November 2009, the share of renewable energy in Russia will rise from the current 1 per cent to 4.5 per cent by as early as 2020. Obviously, the Fukushima tragedy should make the Russian government more willing to support research into alternative sources of power and the possibilities for expanding their use in Russia, where they can compete with the types of energy currently being used, including nuclear energy.

4. Projects Abroad

There is, however, a site where a Russian project is underway and where the risk of earthquakes is high. This is the Metsamor nuclear plant in Armenia. At present it operates a VVER-440 reactor, which meets more than 30 per cent of Armenia's electricity needs. In 2016, when the reactor will reach the end of its lifespan, it is expected to be decommissioned. In August 2010 Russia and Armenia signed an intergovernmental agreement on the construction of a replacement 1,200-MW unit on the same site. However, the earth tremors in the area of the nuclear plant during the Spitak earthquake in 1988 reached a force of 6.5-7 on the Richter scale (at the time, the station operated steadily and continued to supply electricity, including meeting power needs during the aftermath of the earthquake). With requirements to seismic resistance increased as a result of the Fukushima nuclear plant tragedy, it would be practicable to take another close look at the safety of the planned project.

Among other foreign projects, some changes may be made to the project to build a nuclear plant in Turkey, but the reason would not be earthquake risk. Turkey has repeatedly organised tenders for the construction of nuclear plants (this is the fifth attempt in the country's history to get nuclear plant construction underway) and each time the projects were scrapped regardless of who won the tender. Therefore, insufficient internal support for the nuclear plant project may be the main cause for rejection of the project. The high risk of earthquakes in certain parts of Turkey may then be used as a pretext for such a decision. The approaching general elections in Turkey lend particular relevance to the issue of the development of nuclear energy.

It is worth noting that in the late 1980s, Iran evinced an interest in building a nuclear reactor on the Caspian coast in the country's north. Russian (more precisely, Soviet) geologists, after exploring the site, said work in the region was not practicable because of the seismic threat. As a result, in spite of the pressure on the part of Iran, it was decided to build the reactor in Bushehr in the south of the country.

5. Conclusion

Nuclear energy is among the priorities of Russia's modernisation. Russia plans to build as many as 50 new nuclear reactors in the next 20 years, of which about half will be built inside the country and half under Russian projects overseas. Russia is interested, therefore, in seeing an early end to the crisis at the Fukushima nuclear plant and relief from its consequences, as well as the development of mechanisms that would prevent similar accidents in the future. Considering the experience gained in relief from the aftermath of the Chernobyl nuclear plant accident, Russia could lead the way in developing new safety standards. President Medvedev has already formulated proposals on the need to toughen safety requirements for nuclear plants – specifically to revise the approach on extending the service life of old reactors and to formulate restrictions on the building of nuclear plants in earthquake-prone areas. Russia also favours the creation of an international mechanism to prevent and contain human-induced and natural disasters that would be open for accession by all countries.

Country Perspective: Tunisia

*Mustapha El Haddad**

1. Nuclear technology as an energy source – a review of the situation

In 2009, total consumption of primary energy in Tunisia amounted to 8.9 million tonnes of oil equivalent (toe), with the energy mix comprising 43 per cent petroleum products, 46 per cent natural gas, and 11 per cent renewable energies, primarily from traditional biomass (wood and charcoal). At present, Tunisia's energy mix does not include any power from nuclear energy.

Tunisia does not have a nuclear power station for electricity generation. No nuclear power plants are under construction and, to date, no decision has been taken to construct a nuclear power station for electricity generation in Tunisia. The Tunisian Electricity and Gas Company, which is a state-owned company, has been mandated by the Tunisian government to conduct technical and economic feasibility studies for a nuclear power station for electricity generation with a capacity of 900 MW. The results of these studies are to be announced in 2013/2014. In the wake of the catastrophe at Fukushima in Japan, the Tunisian government felt the need to clarify its position in a press release published by *La Presse de Tunisie* on 2 April 2011:

> »The Minister of Energy notes that in November 2006 the Tunisian Electricity and Gas Company was given the task of conducting a technical and economic study of possible energy sources for Tunisia from 2030. The study to be produced by the Tunisian Electricity and Gas Company will be completed in 2013/2014. The study in question will provide all the technical, economic, and environmental information required for decision-making to the government authorities. In the meantime, Tunisia has not opted to adopt nuclear power.«

After the dramatic accidents affecting the Fukushima reactors, the Tunisian government has continued with its study programme initiated in 2006 and has not, for the time being, adopted any decisions on civilian use of nuclear power. However, it is important to note that the provisional government – which has been in power since the »revolution« on 14 January 2011 and will remain in power until the election of the new constitutive assembly on 24 July 2011 – has no authority to take decisions that would signify long-term commitments for the country.

2. What Would Be the Tunisian Government's Interest in Civilian Uses of Nuclear Power?

In Tunisia electricity is generated primarily (circa 90 per cent) from natural gas. Half of this natural gas is imported from Algeria. In order to reduce this dependency on a single energy source (natural gas) and on a very limited number of suppliers, the government is exploring ways to improve the energy mix and, in particular, the electricity mix in Tunisia. Using nuclear energy is part of this approach.

The interest of other countries in the region in nuclear power also appears to be boosting Tunisia's interest in this technology. Developing skills in the technologies involved in the process of civilian nuclear power has strategic regional significance.

3. Civil Society Is Kept on the Sidelines in the Debate on Nuclear Power in Tunisia

To date, there has not been a public debate on the issues at stake regarding the use of nuclear energy in Tunisia. The government has not organised any consultations with Tunisian energy-sector experts. Recently some articles presenting conflicting viewpoints have been published in the press. The »anti« camp draws attention to the limited capacity of the electricity grid in Tunisia, the risks involved in depending entirely on imported technologies and fuel, and to security issues. The »pro« camp emphasises the country's right to develop skills in nuclear technology and the opportunities associated with diversifying Tunisia's energy mix. More recently, after the accident at Fukushima, on Sunday 27 March 2011, the Parti des Verts pour le Progrès (Green Party for Progress) – founded only recently – has begun to agitate in the Kélibia region against the possible construction of a nuclear power plant in Tunisia.

* Mustapha El Haddad is Energy Consultant in Tunisia.

4. A Dearth of Communication from the Government on Nuclear Power

Official discourse is neutral, although there are two semi-official sub-components with opposing positions. One component, which could be dubbed »political«, takes a pro-nuclear stance and is of the opinion that access to nuclear technology is a right and that Tunisia must not lag behind other countries in the region. The second component, which could be dubbed »economic«, considers for its part that civilian use of nuclear power is not the right response from Tunisia regarding energy demand over the next two or three decades. Before the »revolution« of 14 January, the question of nuclear power was addressed by local media as an administrative issue and dealt with succinctly. Finally, civil society has not had an opportunity to express an opinion on the nuclear question. This is due, on the one hand, to a lack of information about the issues at stake and the risks associated with nuclear power, and on the other hand to restrictions on freedom of expression that have only been eased very recently. As mentioned above, the official discourse of the transition government has not changed since the serious accident at the Fukushima power station in Japan, and to date the general public has not had an opportunity to be involved in debates on the nuclear option in Tunisia. For example, Tunisia's few energy-sector professional associations have never held a public debate on the nuclear question. Opinion polls worthy of the name have not been conducted either. When it comes to the official media, they communicate succinctly and in a rather technical mode on the various measures undertaken by the government (study, bilateral and international agreements, etc.).

5. Rejection of Nuclear Power by Public Opinion Since the Recent »Revolution«

Since the accident at Fukushima, the general public has been more concerned with the »revolution« unfolding in Tunisia since the start of this year. However, to judge by certain media reports,[1] Tunisian citizens are not indifferent to the risks that may arise from the Fukushima catastrophe. In the weeks since the Fukushima catastrophe, the media have produced several reports on nuclear power, most of which have been critical. Recently, symbolic surveys have been conducted on the Internet. Opinions expressed here are on the whole opposed to nuclear power. Recent opinions expressed on the Internet reveal an interest in renewable energy sources, which are held to be cleaner in environmental terms and offer a safer option than nuclear energy. Visible steps taken to lobby in favour of civilian use of nuclear power stem in essence from the French government. The first Franco-Tunisian agreement on civilian use of nuclear power dates from 2006. Since then, there have been regular meetings between representatives of the two countries and these have become more frequent over the last three years. The top decision-makers in the Tunisian electricity sector are imbued with a »culture« close to that of EDF (Electricité de France) and reflect an approach analogous to that of EDF concerning development prospects in the electricity sector. This stance overestimates future demand for electricity, minimises the contribution of renewable energy sources, and ignores potential for energy efficiency.

»Supporters« of nuclear power are to be found mainly among the ranks of top managers in the electricity sector (however, management of the Tunisian Electricity and Gas Company has changed hands over the last few weeks). When it comes to »opponents« of nuclear power, the recently founded Parti des Verts pour le Progrès (Green Party for Progress) has organised a demonstration in Kélibia against the »project« to construct a nuclear power station in the region. In addition, Tunisie Verte (the Green Tunisia Party) recently called on the provisional government to terminate the project underway to study the options for a nuclear power station. A number of anti-nuclear initiatives on Facebook deserve a mention: these have been organised by the Jeunes-Démocrates (Young Democrats), along with two petitions, one under the heading »No to nuclear power in Tunisia«, the other entitled »Speak out again the nuclear agreements between Tunisia and France«.

6. Improving Energy Efficiency and Removing Barriers to the Development of Renewable Energies

In order to provide a durable solution to national energy demand without deploying nuclear energy, there is a need on the one hand to improve energy efficiency, and

1. See the article »Le tunisien et le risque nucléaire au Japon« published at webmanagercenter.com on 17 March 2011.

on the other hand to increase the use of other forms of energy, in particular from renewable energy sources. Energy intensity in Tunisia, which is the principal indicator of efficient energy use, is 320 toe per million US dollars, compared with an average energy intensity of 170 toe per million US dollars for the European Union. Energy intensity in Tunisia could be reduced by an average two to three per centage points per annum. In addition, some assessments (by the GIZ, IEA, and by the author) indicate that renewable energy sources (wind, solar, hydraulic, and biogas) could account for 30 per cent of electricity generation in 2030. Solar energy could be used to advantage by all sectors to produce heat (solar water heaters could provide up to 15 per cent of demand for the residential sector) and electricity (solar-thermal and photovoltaic power plants could provide 13 per cent of domestic demand for electricity). Wind generators could supply 10 per cent to 17 per cent of national electricity production. The potential to deploy waterpower is very limited and the potential of geothermal energy has not yet been analysed (particularly for air conditioning using heat pumps). Scope to utilise biomass (with the exception of traditional biomass) to produce energy will be limited to the production of biogas from municipal or industrial waste. Domestic production of biofuels does not appear to be economically viable.With the exception of traditional biomass, the share of renewable energies in Tunisia's energy mix is currently very small, less than one per cent. It is confined to generation of a modest quantity of electrical power: 38 GWh using hydraulic power and 39 GWh using wind power (compared with overall domestic power generation of 15,300 GWh in 2009). Geothermal springs in the south of Tunisia are also utilised to heat greenhouses for agricultural purposes. In 2010 the Tunisian government launched a »Tunisian Solar Plan« for 2010 to 2016. Its stated objective is to increase the share of renewable energies in Tunisia's energy mix to five per cent in 2016 (not including traditional biomass). To date, the bulk of initiatives to make greater use of renewable energies have been adopted by the government.

Barriers to developing renewable energies exist in several spheres:

(1) Institutional: there is not yet a specific regulatory framework for utilisation of renewable energies. The Tunisian Electricity and Gas Company, which is the incumbent public-sector utility company, holds a monopoly on transmission and distribution of electricity. The feed-in price for energy produced by the private sector and supplied to the Tunisian Electricity and Gas Company is fixed below the cost of the energy thus replaced. In addition, non-targeted subsidies to the energy sector (natural gas, LPG, and electricity in particular) are problematic.

(2) Technical: the limited capacity of the electrical grid and the lack of functioning interconnections regionally also constitute an obstacle for the development of renewable energies in Tunisia.

(3) Cultural: the »French-style« training of some of the electrical experts from the Tunisian Electricity and Gas Company has probably not helped to promote the development of renewable energies in Tunisia.

7. What Are the Preconditions for Increasing the Share of Renewable Energy in Tunisia's Energy Mix?

Six groups of measures are proposed to foster development of renewable energy sources in Tunisia:

(1) A commitment by the government to reasonably ambitious objectives for broader use of renewable energies;

(2) The establishment of a specific legislative framework for each of the various forms of renewable energy (solar, wind, small-scale hydraulic, and geothermal);

(3) Restructuring of the Tunisian Electricity and Gas Company into two distinct companies – one dealing with power generation and the other assuming responsibility for transmission and distribution;

(4) The feed-in price for electricity produced by the private sector needs to be index-linked to the costs avoided in terms of thermo-electric generation;

(5) Interconnections need to be established with Europe via Italy, along with an increase in energy exchanges with Tunisia's neighbours, whilst the capacity of the domestic electricity grid must also be augmented;

(6) Gradual abolition of non-targeted subsidies for natural gas, electricity, and LPG.

Country Perspective: Turkey

*Umit Sahin**

Turkey has a long history concerning nuclear power, without actually having ever had any nuclear power plants. Turkey's involvement in the »Atom for Peace«[1] initiative had started with a US-Turkey agreement in 1955 – about the time Turkey acquired NATO membership – as well as Turkey's strategic cooperation with the United States during the Cold War. The first national agency for nuclear power, the Atomic Energy Commission (AEC), was established in 1956; Turkey became a member of the International Atomic Energy Agency (IAEA) in 1957; and the first legislation concerning »Implementation of Nuclear Power in Turkey« was adopted in 1959.

But this initial desire for nuclear power in Turkey was never to be satisfied. Several attempts to begin commercial nuclear energy production have failed over the last 40 years, although almost every government from all ends of the political spectrum have tried to get on the nuclear train. The government under the current right-wing Justice and Development Party (AKP) has attempted perhaps the most aggressive plan for nuclear energy. But Turkey's status within the world of nuclear power shows that it will have 4 of the 158 planned nuclear reactors in the world, though not one has been realised.

1. Failed Attempts

The first research reactor of Turkey in the Çekmece Nuclear Research and Training Center (ÇNAEM), Istanbul, started operation in 1962, and the second in 1981 (which was stopped after an incident in 1995). Istanbul Technical University's Nuclear Energy Institute (recently renamed the Energy Institute) established the third research reactor in 1979. The only nuclear energy engineering department with an undergraduate programme is the one in Hacettepe University, Ankara, established in 1982. The Turkish Atomic Energy Authority (TAEA), as the successor of the AEC, is the highest public institution concerning nuclear power in Turkey, and was also established in 1982.

All of these research reactors, nuclear energy authorities, institutes, and academic posts have focussed on the same strategic aim: acquiring several (or at least one) commercial nuclear power plants in Turkey. Hundreds of nuclear engineers have dreamed of it, pro-nuclear PR activities have promoted it, and cover-ups have cleared the way for the same goal, but nonetheless it has not been fulfilled.

Nuclear power plants were first mentioned in Turkey's Five-Year Development Plan in 1968. A prototype nuclear reactor was planned in 1973, and the site licence for Akkuyu was obtained in 1976. Akkuyu is a small bay in the vicinity of the Buyukeceli village (a small municipal town, with a population of ca. 2,000) on the eastern Mediterranean coast of Turkey, an administrative part of the Gulnar district in the Mersin province. The site is 950 km away from Istanbul, but only 65 km away from Cyprus. The first full-scale project for Akkuyu started in 1977 under the administration of the center-left Republican People's Party (CHP), led by Bulent Ecevit. The 600 MW reactor was going to be built by Swedish companies. But for several reasons it was unsuccessful, including the presence of a new, mostly local Turkish antinuclear movement, which consisted of the leader, Chairman of a local fishing cooperative, Arslan Eyice; two renowned journalists, Orsan Oymen and Omer Sami Cosar; as well as Swedish civil society groups. The Swedish government had withdrawn the credit guarantee in 1980 and the project was cancelled.

Although the military coup in 1980 created a two-year pause in the project, the military administration began a second attempt for Akkuyu in 1982. But this attempt failed too, in 1985. If one ignores another failed negotiation by the right-wing government of Turgut Ozal with Argentina between 1989 and 1991, a long-term attempt that was to be started in 1992 by a right-left coalition government under Suleyman Demirel and Erdal Inonu can be counted as the third attempt. The

* Umit Sahin is Spokesman of the Turkish Green Party.

1. The term refers to a speech by US President Eisenhower in 1953, which is widely considered a tipping point for the international focus on the peaceful use of atomic energy and led to the establishment of what is today the International Atomic Energy Agency.

project was for a 2,800-MW plant in Akkuyu, and a tender was opened in 1996.This project triggered the largest and most visible reaction in history of the anti-nuclear movement in Turkey. The first public demonstration in Silifke, Mersin, had been organised by the Turkish Green Party in 1990. But a nationwide movement was established in 1993 by more than a hundred different organisations and individuals, including professional organisations, unions, political parties, environmentalist NGOs, ecologist initiatives, left-wing movements, independent activists, and intellectuals. This coalition, which still exists, was called later the »Anti-Nuclear Platform«. The Anti-Nuclear Platform, regional platforms, and independent groups and individuals organised hundreds of different activities between 1992 and 2000. Examples include large protests and parades in Akkuyu every August, demonstrations, rallies, direct actions, legal cases, conferences, publications, film festivals, rock festivals, concerts, bicycle tours, sit-ins, etc. This lively movement kept awake the public's attention about nuclear energy – which had started after the Chernobyl accident – and created a strong public opposition against nuclear power.

Chernobyl was an unsettling experience for Turkey. The government and the TAEA attempted such a large cover-up about the radioactive fallout on Turkey – including the marketing of tea harvested on soil near the heavily polluted Black Sea – that people never trusted the authorities again. Most of the population still remembers the famous picture of the Minister of Industry, drinking a cup of tea in a press conference as a performance to mislead people. Even Prime Minister Ozal said that the small amount of radiation was good for the health. Heavy radioactive pollution of tea and hazelnuts was revealed later on, as well as the increased cancer cases, particularly in the Black Sea region. The Chernobyl record of Turkish authorities has not been forgotten. But public opposition and protests were not the only reasons for the failure of the Akkuyu project in the 1990s. AECL of Canada, Siemens-Framatom, and Westinghouse participated in the tender. Tender deadline was postponed six times in four years because of technical and economic reasons, and sometimes because of intense opposition. Then finally the Ecevit government declared the cancellation of the project before the seventh deadline. This landmark victory of the antinuclear movement, in July 2000, followed popular rumours about corruption in the tender process.

Several failures in those 25 years had also distinct economic reasons. The Turkish economy was relatively small, quite unstable with a high inflation rate, and shaken by frequent economic crises. The military coup in 1980 crushed the democratic powers and started the liberalisation of nation's economy. But stabilisation came after the last big recession in 2001. The inflation rate dropped to the single digits, average growth rate rose to five per cent, and a typical consumer society with large shopping malls, widespread airline system, mass tourism, growing motor transport, and fast urbanisation with a growing construction sector led to much higher projections about future energy needs.

The last and most aggressive nuclear power projects were planned under these circumstances, with the help of a nuclear renaissance atmosphere across the world.

2. Russian Akkuyu Nuclear Power Plant

The first AKP government came to power at the end of 2002. This conservative (or moderate Islamist) and neo-liberal one-party government started an economic development programme without heeding any environmental concerns, particularly in its second term after 2007. One of the most important components of this programme has been energy investment. Liberalisation of energy markets, fossil fuel plants, and hydro power are the leading businesses. The AKP government revived the nuclear project in 2004. Akkuyu was the first place, but then Sinop, a small Black Sea city, became a target for a second plant.

The first years saw some other failed attempts, including nuclear legislation that was cancelled in the higher court in 2009, and a failed tender: six companies intended to participate, but probably because the outcome did not seem profitable enough, only one company – Atomsroyexport of Russia, which is a part of Rosatom – made an offer. The tender eventually was cancelled by the higher court. After this failure, the government decided to realise the Akkuyu project directly with Russia, which was the only country to show enthusiasm during the tender. But this would be a direct agreement between the states, without another tender or legislative »chaos«. The governments of Turkey and Russia signed a bilateral nuclear cooperation agreement in 2010, ignoring the huge public reaction against it. The agreement was ratified in Turkish Parliament in July 2010. This current deal determined the following conditions about how the Akkuyu Nuclear Power Plant (NPP) will be realised:

- State-owned Russian atomic energy corporation Rosatom will construct and run the Akkuyu NPP. Turkey will provide the site free-of-charge and the necessary permits, but will have almost no authority on how it will be constructed and operated, including the design and radioactive waste disposal. The plant will be owned by Rosatom until the end of decommissioning, and Rosatom's share will never be lower than 51 per cent. This means that the Akkuyu NPP will be the first and only NPP on a state's sovereign land that is owned and operated by another state. Also, the fuel will be provided only by the Russian TVEL company, and all the qualified staff will be from Russia.

- The reactor type is VVER-1200 (AES-2006 design). This reactor has never been tried before, and Akkuyu could become the first one. Turkey will not have any authority for a design review. The Akkuyu NPP will consist of four reactors with a total installed capacity of 4,800 MW. The total installation cost was estimated at 20 billion US dollars. Electricity will be produced by a Russian company and sold to Turkey with a fixed price of 12.35 US cents/kWh during the first 15 years. This can be calculated as a guaranteed payment to the Russian company of 71 billion US dollars only for these first 15 years.

This extremely exceptional deal, which gives great privileges to Russia, received a prompt reaction from the antinuclear movement. Even a considerable number of pro-nuclear people, including some nuclear engineers and academics, opposed the agreement. But the government was determined.

3. After Fukushima

The Fukushima accident created a double-pronged reaction. The antinuclear movement raised its opposition. The government showed its persistence. The media gave more tsunami news in the beginning, and then largely ignored the nuclear crisis. But the coverage has been more about Fukushima lately. This can be considered an outcome of the continuous actions by the antinuclear movement.

The earliest reaction of the government was a quick cover-up attempt. Energy Minister Taner Yildiz declared that there were no important problems in Fukushima. This was before the Japanese authorities recognised the core meltdown. The second reaction came from Prime Minister Tayyip Erdogan. Erdogan visited Russia three days after the accident. He and Russian President Dmitri Medvedev jointly declared that there would not be any change or postponement of Akkuyu after Fukushima. Prime Minister Erdogan made his remarkable comment on the nuclear accident saying: »We cannot stop because of the risks. Everything has risks. Can you give up using an LPG stove in your house? LPG cylinders can explode like a nuclear plant.«

This comparison of nuclear energy to liquefied petroleum gas (LPG) created more public reaction. Experts, activists, and NGOs protested the Prime Minister's playing down of a tragic event and the crucial risks of nuclear power. Energy Minister Yildiz later made more careful comments and said that they would re-evaluate the risks. But there was no specific info about what and how. The government stated its persistence about nuclear power on several occasions after Fukushima. This persistence included urging Japanese companies to negotiate a planned Sinop NPP (four reactors for a total of 5,600 MW), and bringing forward a third NPP site: Igneada on the Black Sea coast, very close to the Bulgarian border. Sinop and Igneada have yet to be realised as projects, and can be considered merely as political strategies at this point.

The government also made some legislative changes to the Environmental Impact Assessment (EIA) regulation on 14 April 2011, just one month after Fukushima. Although these changes were only in one ad-hoc article and minor, the impacts on nuclear power investments were substantial. After this legislative change, nuclear power plants were excluded from the EIA. Many environmental lawyers and experts commented that this change was made in order to prevent Akkuyu projects from be subject to EIA processes.[2] This move shows how the government is trying to protect its Akkuyu project from the post-Fukushima circumstances by using different methods.

2. According to the change of ad hoc Art. 3, projects invested in before 1993 (which is the year the EIA regulation was adopted) were to be exempt from the EIA process. There are few projects that come under this article's exemption, and the Akkuyu nuclear power plant and Ilisu dam are among them.

However, antinuclear protests have increased since Fukushima. Together with the 25th anniversary of Chernobyl, several big demonstrations have taken place, such as a long human chain action along several points of the Mersin province; a lively demonstration just one week after the accident jointly organised by Green Party, Greenpeace, and Global Action Group in Istanbul with thousands of people; and a large Chernobyl rally in Istanbul organised by the Anti-Nuclear Platform. The antinuclear movement and several journalists have started a debate about a referendum on nuclear power in Turkey. The major opposition party, CHP, declared that they are also in favour of a referendum, although they are not exclusively against nuclear power (but openly against the Russian Akkuyu NPP project).

Greenpeace recently ordered a poll about public opinion on nuclear power in Turkey. The study was conducted by a well-known research company using a representative sample. The result is that 64 per cent of the population would say »no« to nuclear power in Turkey, if there were a referendum.

The main justifications for opposition, particularly after Fukushima, can be summarised as follows:

- Accident risks and waste problem are always the uppermost concerns. Akkuyu is in the middle of the most important tourist region of the country, and even rumours can have an economic cost. Akkuyu is also on an active earthquake zone, the Ecemiş fault line, but this is disregarded in the project. There are even new findings that the expected earthquake acceleration is higher than originally stated, but this crucial information is hidden by the Turkish Atomic Energy Authority (TAEK). The site licence for Akkuyu – given without any consideration of earthquake risks, since they were not known in 1976 – is out-of-date, and this fact is stated even by Prof Tolga Yarman, who is one of the scientists who signed the licence. The Turkey-Russia agreement gives exaggerated privileges and full control to Russia, without any monitoring mechanism by a national independent institution. This is sometimes compared to the circumstances of a military base.

- Turkey is very dependent on Russia's fossil fuel supply (66 per cent for oil, and 33 per cent for gas), and nuclear energy will make its energy dependency on Russia even higher. VVER-1200 is not a tested design, and Russia does not have any experience with earthquakes. Also, 12.35 US cent/kWh is a relatively high price.

- Turkey's current energy mix is highly fossil fuel-based. Almost 50 per cent of electricity production is from natural gas, and more than 30 per cent from coal. Wind barely reaches one per cent. However, Turkey has a very rich renewable energy potential, especially for wind, solar, and geothermal, as well as a great »negawatt« potential from energy efficiency – but all these are overshadowed by the obsession for nuclear energy.

- And last but not least, most of the population – and particularly people in Mersin and Sinop – are strictly against nuclear power. And this fact became more apparent after Fukushima.

Every concern counts. But now, Turkey's nuclear power adventure is much more about democracy.

References

Adalıoğlu, Dr. Ulvi (2009): Türkiye 'de Nükleer Enerjinin Tarihçesi, http://www.enerji2023.org/index.php?option=com_content&view=article&id=230:tuerkye-de-nuekleer-enerjnn-tarhces&catid=6:nuekleer&Itemid=156.

Hacettepe University Nuclear Energy Engineering Department: http://www.nuke.hun.edu.tr.

Künar, Arif (2002): Don Kişotlar Nükleer Enerjiye Karşı: Anti-nükleer hikayeler, Elektrik Mühendisleri Odası. Ankara.

Künar, Arif (2010): Nükleer Yanlışlıktan Vazgeçelim … Enerjive Tabii Kaynaklar Bakanı Sayın Taner Yıldız 'a Açık Mektup. Ankara. May 16, http://akunar.blogspot.com.

Republic of Turkey and Russian Federation (2010): »Agreement Between the Government of the Republic of Turkey and the Government of the Russian Federation on Cooperation in Relation to the Construction and Operation of a Nuclear Power Plant at the Akkuyu Site in the Republic of Turkey« – signed on May 12.

Turkish Atomic Energy Authority (TAEA): http://www.taek.gov.tr.

Yarman, Tolga (2006): Nükleer Enerjive Türkiye, Türkiye Enerji Kongresi, 27-30 Kasım, İstanbul.

Country Perspective: United States

*Sebastian Ehreiser**

As the crisis at the Fukushima Daiichi nuclear power plant continues to unfold, serious concerns regarding the use of nuclear power as a viable, sustainable energy source in the United States have arisen. Questions brought to the forefront have been about the future and safety of nuclear power, especially in regards to radiation leaks, spent fuel storage, meltdowns, and regulation of the industry. While the Obama administration has made it clear that it will attempt to learn important lessons from the tragic events in Japan, it has made it equally clear that the United States is committed to nuclear energy as a key part of its future energy mix. In order to facilitate a shift away from fossil fuels and nuclear energy production, the United States would stand to benefit from policy measures that will internalise the costs associated with fossil fuel and nuclear energy production and shift subsides from the nuclear and fossil fuel sectors towards R&D for the renewable energy sector.

1. Status Quo of Nuclear Energy as an Energy Source

The United States operates 104 nuclear reactors, which account for 20 per cent of its electricity mix. Recently, nuclear energy has been thought to be going through a renaissance – as it was termed in the press – in which there would be a ramp-up of nuclear energy production after a long period in which few reactors were built. In 2010 the Obama administration demonstrated its support for the nuclear renaissance, allocating 8.3 billion US dollars in loan guarantees to help with the construction of two nuclear reactors in Georgia. Obama's 2012 budget proposal, announced in February 2011, sets aside 36 billion US dollars in new loan guarantees to build more nuclear reactors, plus 853 million US dollars for nuclear energy research, which is in addition to the 18.5 billion US dollars that have already been budgeted but not spent, bringing the total to 54.5 billion US dollars.[1] President Obama reaffirmed his support for nuclear in his State of the Union Address in January of 2011, in which he called for »building a new generation of safe, clean, nuclear power plants« as a necessary component of the US clean energy standard, which has a goal of deriving 80 per cent of power from »clean energy« sources by 2035. The clean energy standard certainly has its flaws, in that it covers only the electricity sector and would include nuclear energy and clean coal as clean energy sources; however, at present this is the only option that is politically viable with cap-and-trade and a renewable energy standard effectively off the table.Currently, there is only one nuclear plant under construction (Watts Bar 2 in Tennessee[2]) in the United States, with an additional 9 planned and 24 proposed. There is no nuclear phase-out foreseen in the United States; however, the recent catastrophic events in Japan have called into question if, and how quickly, the so-called nuclear renaissance should move forward. The high costs of building nuclear plants as well as an increase in perceived risk – coupled with new supplies of comparatively cheap natural gas that can be tapped through hydraulic fracturing (the merits of which are currently being debated by the public as well as in Congress) – have led many to question whether continuing to invest in nuclear is the best path forward for the United States.

As the world's largest producer of nuclear power, the United States must confront the risks and costs associated with nuclear power generation. In order to effectively price nuclear power, all costs should be internalised so as to provide a true understanding of what producing nuclear power actually costs. As Ronald Brownstein notes in a recent *National Journal* article, »The Price Is Not Right«:

> »It's not unrealistic to demand better ways to understand and compare the relative dangers posed by the competing energy sources – oil, natural gas, coal, nuclear, and renewable options such as solar and wind. That's almost impossible to do now because so few of the risks associated with these sources are incorporated into the prices.«

* Sebastian Ehreiser is Program Officer on E3 (Energy, Environment and Economy) at the Friedrich-Ebert-Stiftung in Washington.

1. Loan guarantees are the primary method for supporting the nuclear industry; the administration claims that these loans come at neutral cost, assuming the projects finish on time and within budget.

2. Construction of the Watts Bar 2 reactor began in 1973, then was postponed in 1985 until construction recently resumed in 2007. It is expected to come online in late 2012 within the 2.5 billion US dollar budget.

The best-case scenario would be to internalise all the costs (including risk and environmental degradation) of each of the energy sources in order to allow for rational choices between them. In the case of nuclear energy in the United States, despite the manipulations of the free market through subsidies and loan guarantees to the nuclear industry, nuclear should not be an attractive long-term option because of the prohibitively high cost of building nuclear plants, the risk of nuclear disaster, and the lack of a viable plan to dispose of nuclear waste.

2. Government Response

In light of the events in Japan, there have been sevral hearings in the United States Congress addressing nuclear energy safety. The administration, represented by Secretary of Energy Steven Chu, made it clear during a House Energy and Commerce Committee Hearing on 15 March 2011 that it remains steadfastly committed to nuclear energy as an integral part of any US energy mix. While voicing support for nuclear energy production, Secretary Chu cautioned that the United States must learn from the lessons that can be learnt as a result of the events at the Fukushima reactors. It is unclear, however, whether the current concerns that have been raised in Congress will lead to substantial changes in nuclear energy production in the long run because the strength of the nuclear energy lobby and the Republican majority in the House of Representatives will make it difficult to apply stricter regulation to the industry. Despite the high costs and risks associated with nuclear energy production, there are still political motives for the civil use of nuclear energy. First, proponents of domestic energy production favour nuclear because it can be created at home, thereby reducing US dependence on foreign energy sources and keeping energy dollars in the United States. Second, some environmental groups see the low-carbon-intensive energy that nuclear provides as an important way to curb the effects of global warming. The fact remains that if the United States moves away from nuclear, there will be a 20 per cent gap in its electricity production that will need to be filled. The debate on how and whether this gap can be filled is a contentious one, with many arguing that a shift from nuclear will lead to an increase in fossil fuel consumption.

3. Socio-Political Discourse on Nuclear Energy

3.1 Political Discourse

Representative Edward Markey (Democrat-Massachusetts), who was also a proponent of comprehensive climate change legislation in the past Congress, has led the charge for greater oversight of the nuclear industry, introducing House Resolution 1242, The Nuclear Power Plant Safety Act of 2011, which calls for an overhaul of US nuclear safety policy and imposes a moratorium on all new nuclear reactor licences or licence extensions until new safety requirements are in place that reflect the lessons learnt from the nuclear disaster in Japan. Other members of Congress such as Representative Joe Barton (Republican-Texas) have staunchly defended the US nuclear power industry. Recently, after visiting a nuclear power plant in Texas, Representative Barton said, »Nuclear power is very safe … Our new safety systems are passive in the sense that if the worst case happens, they don't require human intervention.«Traditionally, nuclear energy production has been politically divisive along party lines, with Republicans favouring increased nuclear energy production and Democrats advising caution because of the high risks associated with the production and waste processing of nuclear power. Over the past few years, this line has blurred, with many Democrats coming to the side of the nuclear industry because of the perceived advantage of carbon-free production of energy as a way to combat climate change.

While the nuclear lobby in the United States is very powerful, civil society entities such as environmental groups and NGOs opposed to nuclear energy are extremely weak. For example, the most outspoken anti-nuclear group, Beyond Nuclear, has a staff of only four people. Judy Pasternak of the American University Investigative Reporting Workshop has found that over the past 10 years, nuclear energy companies, utilities, and unions related to the nuclear industry have spent more than 600 million US dollars on lobbying and nearly 63 million US dollars on campaign contributions. These campaign contributions are funnelled to the lawmakers who hold the key to the subsidies and loan guarantees that the industry relies on to survive. This lobbying activity is mainly organised and carried out by the Nuclear Energy Institute, an organisation comprised of 350 members in 19 countries. As for a counterweight, Robert Alvarez, a former Energy Department official, summarises the issue of influence in the industry: »You could squeeze the critics of the nuclear industry into a phone booth. The Nuclear Energy Institute is a big player here and are able to hand out large sums to members of Congress seeking to keep or get their jobs.«

3.2 Public Opinion

In the United States there has been a shift in public opinion against nuclear energy since the nuclear disaster took place in Japan. According to a 17-20 March 2011 Pew Research Poll survey, 39 per cent of respondents say they favour promoting the increased use of nuclear power, while 52 per cent opposed it, whereas in October 2010 the same poll found that 47 per cent favoured promoting increased use of nuclear power and 47 per cent opposed it.

According to a 15-16 March 2011 Civil Society Institute survey:

- Over half of Americans would support a moratorium on new nuclear reactor construction in the United States »if increased energy efficiency and off the shelf renewable technologies such as wind and solar could meet our energy demands for the near term.«
- Seventy-three per cent of Americans do not think »[t]axpayers should take on the risk for the construction of new nuclear power reactors in the United States through billions of dollars in new federal loan guarantees.«
- Seventy-six per cent of Americans say they are now »more supportive than…a month ago to using clean renewable energy resources – such as wind and solar – and increased energy efficiency as an alternative to more nuclear power in the US«.

4. Alternative Energy Paths

The main counterargument to shifting away from nuclear power is that each alternative to nuclear has its own sets of challenges and risks, and it is argued that these alternatives are not viable at present. Those who are concerned about climate change and pollution claim that coal is unsustainable because of the intensity of its carbon output, while proponents of fossil fuel and nuclear energy claim that renewables are prohibitively expensive and unreliable. If the United States does choose to shift away from nuclear energy, it will have to focus on energy efficiency and an increase in renewable energy production in order to make up for lost production. From an efficiency standpoint, the United States would benefit greatly from policies that would incentivise energy efficiency in manufacturing and production as well as in the commercial and residential building stock. In order to ramp up the share of renewable energy from the current eight per cent of the energy mix in the United States,[3] subsidies for incumbent, mature industries such as coal, nuclear, and oil should be redirected towards R&D for renewable energy and smart grid technology. For renewables to reach parity with other energy sources, the United States must implement policies that will allow private investment to spur competition among renewable energy sources, which will in turn lead to the innovation necessary to drive down costs. Unfortunately, the policy proposals that would have spurred such private investment, such as a cap-and-trade mechanism or a renewable energy standard, have stalled in the legislative process. The main objection to these proposals has been that they will disrupt an already fragile economic recovery in the United States by increasing energy prices.

5. Conclusion

Unfortunately, in the case of nuclear energy production, the risk of future disaster is inherently difficult to quantify because it is not known when or if a disaster will happen, and if one does happen, it is unclear what a worst-case scenario will look like. What is easier to quantify, is that more nuclear energy produced means more nuclear waste to be processed and stored, which places a strain on future generations, as they will have to deal with the costs associated with our current consumption. The fact remains that finding a place to store nuclear waste in a country with a decentralised governmental structure such as the United States remains extremely difficult, as was made evident by the political battle over

3. The approximate breakdown of renewable sources is: 1 per cent Solar; 35 per cent Hydroelectric; 5 per cent Geothermal; 50 per cent Biomass; 9 per cent Wind.

the Yucca Mountain Repository site in Nevada.[4] Many of the arguments for or against nuclear power centre around value-based judgments regarding the possible dangers associated with nuclear energy production. This is evidenced by the variety of opinions regarding nuclear power in the United States and the varying positions that different nations took in response to the nuclear disaster in Chernobyl and have taken in response to the more recent disaster in Japan. The situation regarding the future of nuclear energy production in the United States is complicated by political factors such as the perceived negative effect that a shift to renewables would have on the United States economy. Moving forward, the current debates over the budget, the deficit, and the fragile economic recovery will dominate the discussion and have profound impacts on the future of energy production in the United States. Whether this will lead to a shift to greater renewable energy production depends largely on the ability of the United States government to adopt forward-thinking policies that will wean its dependence from fossil fuels and nuclear power and towards a more sustainable energy future.

References

Almanac of Policy Issues (2003): Nuclear Energy in the United States.

Black & Veatch (2010): What Will Be the North American Energy Industry's »New Normal«.

Brownstein, Ronald (2011): The Price Is Not Right, *National Journal*, March 19.

Civil Society Institute (2011): Americans Want to Hit the Brakes on More Nuclear Power, March 22.

Investigative Reporting Workshop, American University School of Communication (2010): Nuclear Energy Lobby Working Hard to Win Support.

US Energy Information Administration (2011): What Is the Status of the U.S. Nuclear Industry?

4. There have been over 9 billion US dollars invested in the Yucca Mountain Repository site; however, the Obama administration has decided the site is not a viable choice for nuclear waste disposal and therefore will not continue to fund the site, effectively ending the possibility of Yucca Mountain as the final resting place for nuclear waste in the United States.

About the authors

The views expressed in this publication are not necessarily those of the Friedrich-Ebert-Stiftung or the organization for which the author works.

Imprint

Friedrich-Ebert-Stiftung | Global Policy and Development
Hiroshimastr. 28 | 10785 Berlin | Germany

Responsible:
Nina Netzer | Global Policy and Development

Phone: ++49-30-269-35-7476 | Fax: ++49-30-269-35-9246
http://www.fes.de/GPol

To order publications:
Sandra.Richter@fes.de

Global Policy and Development

The department Global Policy and Development of the Friedrich-Ebert-Stiftung fosters dialogue between North and South and promotes public and political debate on international issues in Germany and Europe. In providing a platform for discussions and consultation we aim at raising awareness of global interdependencies, developing scenarios for future trends and formulating policy recommendations. This publication is part of the working line »International Energy and Climate Policy«; in charge: Nina Netzer, Nina.Netzer@fes.de.

This publication is printed on paper from sustainable forestry.

EFQM Committed to excellence

ISBN 978-3-86872-810-1