# *Chapter Nine*

# After Fukushima: The Future of Nuclear Energy in the United States and Europe[1]

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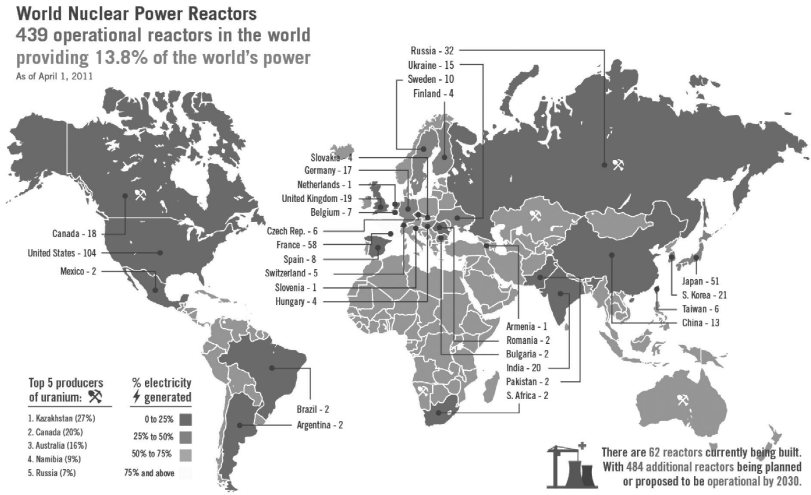
Before the Fukushima nuclear crisis, the energy world was abuzz with talk of a nuclear renaissance. Since the Fukushima accident, nuclear energy policy is being rethought across the world. The outlook of nuclear energy looks gloomy. The International Energy Agency's World Energy Outlook 2011 introduces a 'Low Nuclear Case', where the total amount of nuclear power capacity falls from 393 GW at the start of 2011 to 339 GW in 2035, compared with an increase to 638 GW in the New Policies Scenario, that is a drop of around 15 percent[2].

The various approaches that countries are taking towards nuclear energy in the wake of Fukushima can be put into five categories. The first category includes those countries with existing nuclear capacity, remaining to be scheduled for rapid expansion, such as China, India, South Korea and Russia. The second category includes emerging countries with new nuclear programs, such as the United Arab Emirates, Saudi Arabia or Vietnam, that are likely to go forward with the projects. The third group includes nuclear energy users that had

[1] The study draws heavily on the report of the transatlantic nuclear energy conference co-organized by the Center for Transatlantic Relations (CTR) at the Paul H. Nitze School of Advanced International Studies Johns Hopkins University, EU Center of Excellence Washington, DC and the Atlantic Council of the United States on May 31, 2011. The conference report was authored by David Koranyi and edited by Blythe Lyons, Mihaela Carstei, Wilfrid Kohl and John Lyman. The report is available at http://transatlantic.sais-jhu.edu/.

[2] Reuters: Post-Fukushima nuclear generation could fall 15 percent. http://uk.reuters.com/article/2011/11/04/uk-energy-iea-nuclear-idUKTRE7A 32AV20111104.

**Figure 1. World Nuclear Power Reactors**



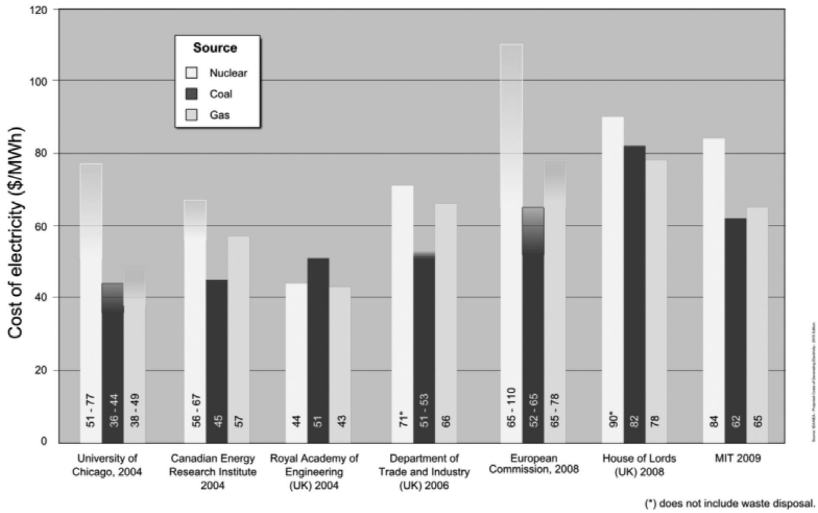

Source: Disaster Preparedness and Visualization, available at http://www.emergency-response-planning.com/news/?Tag=Radiation.

decided to undertake new programs before Fukushima, such as the U.S., the UK or central European countries, but that will likely have a de facto moratorium in place for some time due to political, economic and technical uncertainties related to the accident. The fourth category includes countries that have decided to phase out their nuclear energy program, such as Germany, Spain, Belgium or Switzerland. Countries that have long opposed the use of nuclear energy (like Austria) and now feel vindicated belong to the final category.

First among the decisive factors determining the future of nuclear energy in a transatlantic context is the political dynamic fuelled by changing public perceptions of nuclear energy. An Ipsos-Mori poll taken in the wake of the Fukushima accident shows that public acceptance for nuclear power dipped considerably in most developed countries, although to a differing degree (more in the EU, less so in the U.S.[3]). As more and more details become known about the Fukushima accident, general support could slip further and the "not in my back-

[3] Available at http://www.ipsos-mori.com/researchpublications/researcharchive/2817/Strong-global-opposition-towards-nuclear-power.aspx.

**Figure 2. Levelised Costs of Electricity for Different Studies**




Source: *The Cost of Generating Electricity*, Royal Academy of Engineering, London, United Kingdom 2004; *The Economic Future of Nuclear Power*, University of Chicago, United States 2004; *Levelized Unit Electricity Cost Comparison of Alternate Technologies for Baseload Generation in Ontario*, Canadian Energy Research Institute, Calgary, 2004; *The Energy Challenge*, United Kingdom Department of Trade and Industry, London, 2006; *Energy Sources, Production Costs and Performance of Technologies for Power Generation, Heating and Transport*, European Commission, COM(2008)744, Brussels, 2008; House of the Lords, *The Economics of Renewable Energy, 4th Report of Session 2007-08*, Vol. I: Report, Select Committee on Economic Affairs, London, 2008; *Update on the Cost of Nuclear Power*, Massachusetts Institute of Technology, Cambridge, MA, 2009—graph available at http://en.wikipedia.org/wiki/File:Nuke,_coal,_gas_generating_costs.png.

yard" mentality would likely grow stronger both in the U.S. and Europe: a potentially very serious obstacle to any nuclear development in the future.

Equally important will be the financial implications of enhanced safety standards and other consequences of the Fukushima accident. Affordability matters most when it comes to electricity production. Even before March 2011, there were serious economic obstacles to nuclear development, especially in the U.S. A Massachusetts Institute of Technology (MIT) study[4] showed that nuclear cannot compete with

[4] *Update on the Cost of Nuclear Power* (Cambridge, MA: Massachusetts Institute of Technology, 2009).

coal and gas in competitive, deregulated markets,[5] because the cost of capital for nuclear is somewhat higher than for coal or gas due to the long investment lead time and greater associated risks. The current low costs of natural gas in the U.S. have greatly reduced the nearer term incentive to invest in new nuclear facilities and have reinforced the U.S. public's unawareness about key energy efficiency, sustainability, reliability and security challenges. Furthermore, increased capital costs coupled with the economic crisis and lackluster growth prospects could force governments and private companies to abandon at least some proposed projects.

Finally, uncertainties surrounding global efforts to fight climate change further increase unpredictability. Whereas Europe put a price on carbon, developed an internal carbon market and is at the vanguard of international climate change struggles, the U.S. until now has failed to act at the federal level. Therefore negative externalities such as greenhouse gas emissions are not accounted for in cost calculations, giving an arguably unfair advantage to coal and gas in the U.S. over nuclear (and renewables).

## Nuclear Power Policies in the United States and Europe After the Fukushima Accident

### *United States: Nuclear Remains Part of the Energy Mix*

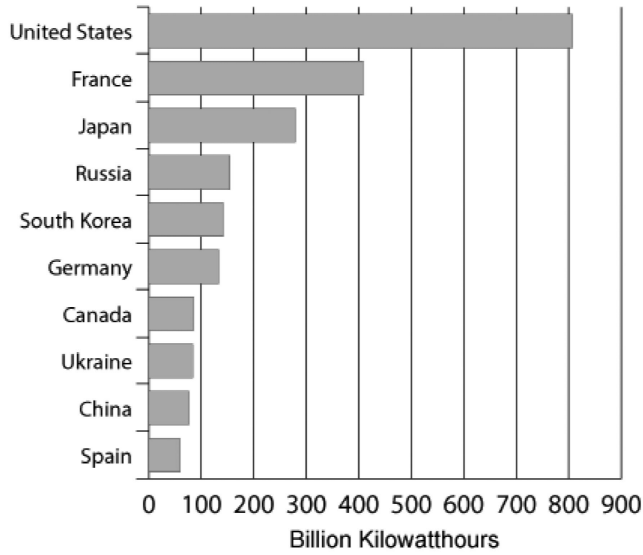
The United States is the world's number one nuclear energy producer. Its 104 operating nuclear power plants accounted for 20% of electricity produced, and for about 10% of the nation's electric generating capacity. Nuclear power accounts for almost 70% of the fuels that do not emit greenhouse gases in the U.S. generation portfolio.[6]

In the past, a number of factors have facilitated nuclear power plant construction in the United States. Consolidation of utilities and standardized plant design, in addition to tax incentives and loan guaran-

[5] The National Academy of Sciences recently found that nuclear is competitive with coal only if there is a requirement for CCS. "America's Energy Future: Technology and Transformation" (2009) available at http://www.nap.edu/catalog.php?record_id=12091.

[6] Energy Information Administration (EIA).

**Figure 3. Nuclear Generation 2010—Top 10 Countries: 2,229 Billion Kilowatthours**




Source: International Atomic Energy Agency, Power Reactor Information System File.

tees in the 2005 Energy Act, have assisted project development. In states that still have regulated electricity markets, nuclear has received support. The Energy Information Administration (EIA) forecasts a small increase in nuclear generation going forward, but by 2030 the share of nuclear in overall electricity generation may actually decrease, outstripped by growth of natural gas fired plants and renewable electricity generation capacity and the continuing dominant but slightly reduced share of coal.

There are seventeen reactor projects for which the Nuclear Regulatory Commission has received Combined Construction and Operating License (COL) applications, but five have been suspended. Currently, there remain twelve potential reactor projects in the United States with active plans for seven units for a total of 8460 MW gross. Active site work is being conducted on four AP 1000 units by the Southern Nuclear Operating Company and South Carolina Electric

and Gas. The Tennessee Valley Authority (TVA) has announced plans to complete the Bellefonte reactor project. TVA is completing the Watts Bar Unit 2—the only reactor under construction in the United States at present—and will finance the Bellefonte project with a lease-back sale of Watts Bar Unit 2 and a gas-fired power plant.

New construction is supported by an updated Nuclear Regulatory Commission (NRC) licensing framework, the Energy Policy Act of 2005, and state regulatory frameworks, which have eased the financing process in some states. NRC revamped its licensing process in 1989 for new nuclear reactors to avoid many of the challenges and delays encountered in the past. Although the public can intervene at various stages, the hurdle for intervention increases as the construction process moves forward.

The Energy Policy Act of 2005 provides a number of incentives for both regulated utilities and merchant generation companies that are building new nuclear reactors. The Loan Guarantee Program administered by the Department of Energy, production tax credits, and Federal Standby Support are all incentives that are geared towards helping finance new construction and mitigating investor concerns about investment recovery. Various states with regulated electric markets, mainly in the southeastern region of the U.S., have developed regulatory frameworks to support new nuclear construction. These frameworks include the pre-approval of budget costs and construction schedules, periodic progress review, the collection of financing costs during construction, final prudence determinations, and the ability to abandon investment. However, this only applies to regulated electric utilities, and not to merchant generation companies, which face difficult economic challenges in states with competitive markets.

While nuclear safety has always been a primary concern in the United States, the accident in Japan brought these issues to the center of public attention. Though safety measures continued to improve in the last two decades, in the wake of the Fukushima accident, President Obama asked the NRC to conduct a comprehensive review of the safety requirements of the 104 operating reactors in the U.S., and to strengthen those rules if necessary to safeguard health and safety in emergencies. The industry generally supports this evaluation but notes that there are major operational differences between the U.S.

and Japan, including differences in the preparations for severe accident management and operations, in independent regulation and oversight, in required training, drilling and exercises.

The Obama Administration has made a clean energy economy a top priority and underlined its continuous support for nuclear energy as a clean energy resource. Advancing energy innovation and diversifying the energy portfolio to include more low or zero carbon energy resources are key elements of the Administration's strategy. The Administration, with bipartisan support in Congress, wants to promote investment in next generation clean energy technology including nuclear. U.S. President Barack Obama, in his 2011 State of the Union address, outlined a vision of doubling the amount of electricity generated from clean sources from the current 40% to 80% by 2035. The President has made it clear on several occasions since Fukushima that nuclear energy remains an important part of the energy mix.

### *European Union: Stress Tests, while Member States Remain Free to Choose Nuclear*

Member states (MS) of the European Union freely decide on their energy mix, including the role of nuclear power; they are neither obliged nor prevented from using nuclear energy. At the same time, common rules govern the use of nuclear energy in the framework of the European Atomic Energy Community (Euratom).

The majority of the EU MS support the use of nuclear energy, with fourteen states currently operating one or more nuclear power plants. Nuclear energy accounts for one-third of electricity generation in the EU, and Europe's nuclear industry is a world leader in technology, safety, and security of installations.

Nuclear energy fulfills a key role in the EU's energy mix, and contributes to the security of supply, the competitiveness of the economy, and the fight against climate change. Thus it plays an important part in the EU's climate change and energy policy (the so called 20/20/20 Strategy). Though MS are free to determine their energy mix, according to the 1957 Euratom Treaty, certain aspects of nuclear power fall under collective responsibility. With one of the most advanced legal frameworks in the world, and by setting the highest standards of safety and non-proliferation, EU institutions play an important role in guar-

anteeing nuclear safety. The EU laid the foundation for these measures at the Union's inception before the disasters of Fukushima or even Chernobyl. Euratom was initially created to coordinate MS research programs for the peaceful use of nuclear energy. The Euratom Treaty today helps to pool knowledge, infrastructure, and funding of nuclear energy. It ensures the security of atomic energy supply within the framework of a centralized monitoring system.

Nuclear energy use in the EU before Fukushima was on an upward trend, but the events at Fukushima inevitably raised some concerns. Discussion within national governments and at the highest levels in Brussels began to focus on the role of nuclear energy in the MS. European leaders decided to launch a major safety review of the 143 reactors in Europe between June 1 and December 31, 2011. The so-called "stress tests" include everything from natural disasters and airplane crashes, to terrorist attacks, and are being conducted in cooperation with the European Commission, the operators and independent national regulators. The three-step process entails a pre-assessment by the operators themselves, with a detailed questionnaire on safety measures and plans (phase I), which will be analyzed and reviewed by the national regulator (phase II) and then peer-reviewed by multinational teams, largely composed of European Commission experts and representatives from other regulatory agencies, and concluding with on-site inspections (phase III). The European Commission will subsequently produce a report with recommendations that will be brought before the European Council.

### *France—Devoted to Nuclear Energy*

France has been at the spearhead of nuclear energy among EU MS, and continues to believe that nuclear is a crucial part of the energy mix. The promotion of nuclear power originates in the proactive response to the general scarcity of resources in the country, and the 1973 oil shock in particular. In response, the government launched an ambitious nuclear program. Today 58 reactors produce more than 75% of France's electricity needs. Political consensus among all governments prevailed on the nuclear program, and was supplemented by other policy initiatives promoting sustainable development, recycling nuclear materials, and nuclear waste management. The nuclear pro-

gram allowed France to significantly reduce greenhouse gas emissions and served as an environmental asset. In 2005 the National Assembly adopted a law on energy policy orientation, which confirmed nuclear energy's pivotal role in the country's energy mix. The law sets out three key objectives for nuclear energy: ensuring energy independence and security of supply, environmental protection, and economic competitiveness. It also contains the legal framework of the construction of Areva's first European Pressurized Reactor (EPR) in Flamanville.

In the wake of the Fukushima accident, the French government requested the Safety Authority to conduct an audit on the fifty-eight reactors within France, and to focus on the potential risks and operational management issues in emergency situations.[7] In the medium term, France is confident that nuclear energy will play an important role in the global energy mix and aims to promote the highest levels of nuclear security throughout the world. France has used its G-8 and G-20 presidencies this year to further that goal. The June 2011 IAEA conference attempted to draw initial lessons from Fukushima, and to consider steps to enhance the safety regime and collective ability to respond to a serious accident. Nonetheless, France strongly believes that each national authority must remain independent and no supranational authority shall undermine the responsibility of the national safety authorities' prerogatives.

France remains strongly committed to nuclear for the time being and French companies are hopeful that their state-of-the-art nuclear reactor designs could actually benefit from increased safety standards after Fukushima. However, there is an increasing shift in French public opinion over nuclear energy that could be problematic over the medium term.

### *UK: Replacement of Nuclear Plants and Possible Expansion*

The final report on the implications of the Fukushima accident for the UK nuclear industry was published in September 2011.[8] The findings conclude that there is no reason to curtail the operation of UK

[7] The Safety Authority will publish its final report by the end of November 2011—after the publication of this book.

[8] Available at http://www.hse.gov.uk/nuclear/fukushima/final-report.pdf.

operating sites, although operators should continue to follow the founding principle of continuous improvement. There are no fundamental weaknesses in the UK nuclear licensing regime or the safety assessment principles that underpin it, and the intention to create the Office for Nuclear Regulation (ONR) in statute will further enhance confidence in the UK's regulatory regime. The final report also confirms that there is no reason to revise the strategic advice given by the regulators on which the Nuclear National Policy Statement was based, or any need to change present siting strategies for new nuclear power stations in the UK. Nevertheless the findings of the report contain a list of recommendations for improvements in emergency response, contingency planning, communications, reviewing flooding studies, reviewing electricity and cooling supplies and new standards on spent fuel strategies.

Nuclear facilities in the UK receive no public subsidies, so any that are pursued are done so by private companies. The government does not know exactly how many plants and reactors will be built, but the intention is that all of the 19 reactors due to be retired by 2023 will be replaced.

### *Germany: Phasing Out Nuclear Power by 2022*

Germany is at the other end of the spectrum. Although German scientists were leaders in nuclear research in the 1930s and contributed to the discovery of nuclear fission, and in the early postwar period the German government gave strong support to research on civilian nuclear power, the accident at Chernobyl had a large negative impact as the fallout reached Germany. This was the beginning of a strong grass roots anti-nuclear movement.

In the 1990s, 23 nuclear reactors generated 40% of electricity in Germany. However, Germany began a change of course with the 1998 SPD-Green coalition government, which agreed to a gradual nuclear phase-out. This was followed by a law passed in 2001, taking effect in 2002, prohibiting construction of new reactors and limiting production of nuclear electricity to 2.6 GWh (a target that would have been reached around 2025).

A new and ambitious energy concept emerged, aimed at replacing nuclear power with renewables over time. In 2001, only 6% of electric-

ity came from renewables (mostly hydropower). With the new concept, increased renewable subsidies, and the so-called "feed-in tariff" for green electricity, the proportion of electricity from renewable sources was slated to increase to 17% by 2010. According to this plan, the ratio will further increase to 35% in 2020 and to 80% in 2050. This would also result in a drastic cut in emissions, of approximately 35% by 2020 and 80% by 2050. Germany is successfully fulfilling its obligations under the Kyoto Treaty, as emissions are already down by 23%.

Based on a new risk assessment after Fukushima, the German government led by Chancellor Angela Merkel decided to speed up the nuclear phase-out process. After Chernobyl, the government believed what happened with the Soviet reactor was highly unlikely to happen in the U.S., Japan or Germany, where reactor designs were more advanced. That risk assessment is different now after Fukushima; it supports the view that no complex, cutting-edge technology is completely immune from complication, and even the remote risks with nuclear installations are just unacceptably high.

Chancellor Merkel's government initially viewed the role of nuclear energy as a bridge technology to a future dominated by renewables. The CDU-FDP government had even decided in 2010 to support an extension of the life of some German reactors, but Fukushima provoked a repeal of that decision and a return to the previous timetable whereby all reactors will be shut down at the end of their life by 2022. In light of Fukushima the seven oldest reactors have been shut down since March 2011, and as of this writing one more is scheduled to shut down promptly. Out of the remaining seventeen, some will close gradually while nine will operate until 2021-22.

At the beginning of 2011, 22.5% of electricity in Germany came from nuclear (about the same as in the U.S.); this will be reduced to zero in 2022. National consumption today oscillates between 40-80 MW a day. German electricity capacity including nuclear is 93 MW, and without nuclear, about 83 MW. Germany plans to increase its share of renewables by investing €1 billion/year in the grid in the coming decade. As of now 7.5% of overall electricity generation comes from wind, 4.5% from biomass, 3.2% hydro, and 1.2% solar.[9]

[9] Eurostat.

In the short and medium term, wind will be the most important source, coming mostly from offshore wind farms on the North Sea. If wind's success remains as it is today, its share of generation capacity could go up to 22%. On the other hand, in the long term, solar energy likely will be the main source, especially given its popularity and falling costs. The German government believes that even if electricity costs increase, German consumers are willing to pay a price to support renewable energy development.

Germany does not intend to increase the use of coal, and in the case that Carbon Capture and Storage (CCS) proves to be a unviable technology, Germany will aim to have coal completely disappear from the mix by 2050. However, this will not be easy, as coal currently accounts for 47% of total electricity generation.[10] Coal use may even increase in the near term, before increased gas supplies from Russia will be available, with the abrupt shut down of a major portion of nuclear generation. Natural gas currently comprises 11% of Germany's electricity generation[11] and is highly likely to increase at least in the medium term. Gas is certainly the best option of all fossil fuels from an emission standpoint but could hinder the development of renewables, just as current technology bottlenecks like energy storage: pumped-storage opportunities are limited in Germany, so they cooperate with Switzerland and Norway. Germany is supportive of fusion power as the ideal solution, but rather skeptical whether a breakthrough could happen anytime soon.

Germany considers the decision to do away with nuclear and increase renewables as a win-win, as it will lead to enhanced energy security, lessen imports on fossil fuels, save about $30 billion in imports of oil and gas by 2020, and create jobs in the domestic economy. Since 2001, 350,000 jobs[12] were created in the renewables sector, which is the fastest growing sector of the German economy.

It will be interesting to watch the German experiment unfold in the coming decade. Doubts linger over Germany's decision to completely phase out nuclear power by 2022 and over the country's ability to push

[10]Eurostat.

[11]Eurostat.

[12]Available at http://www.unendlich-viel-energie.de/de/politik/10-jahre-eeg.html.

renewables forward at such quick pace. Many question the wisdom of the decision since the surrounding states (France and the Czech Republic) might end up exporting more nuclear-generated electricity to Germany. There are worries about the potentially detrimental effects on German competitiveness, as the increased use of renewables could drive up energy prices. Nevertheless, removing nuclear power from the available options inevitably sends a strong signal to the private sector to invest in renewable energy technologies and their deployment.

### *Nuclear Development Plans Elsewhere Within the EU*

In Italy, nuclear power had been used until all the plants were closed down by 1990 in the wake of the Chernobyl disaster and the subsequent referendum on the use of nuclear power. The decision was reversed in 2008 and Italy planned to build 10 new reactors, with the goal of increasing the nuclear share of Italy's electricity supply from today's 10% to about 25% by 2030. After Fukushima, the Italian government put a one-year moratorium on plans to revive nuclear power and through a referendum on June 12, 2011 an overwhelming majority of voters (94%, with 55% of the eligible voters participating) voted in favor of the construction ban.[13]

Switzerland equally reversed course in May 2011 with the Swiss government deciding to abandon plans to build new nuclear reactors. The country's five existing reactors will be allowed to continue operating, but will not be replaced at the end of their life span. The last will go offline in 2034.[14]

Spain has eight reactors producing 20% of the country's electricity. The government decided on a gradual phasing out of all reactors shutting down all nuclear power plants at the end of their lifetime.[15]

Belgium also decided to phase out nuclear power from 2015 but without a final deadline.

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[13]OECD Nuclear Energy Agency—available at http://www.oecd-nea.org/general/profiles/.

[14]http://www.nytimes.com/2011/05/26/business/global/26nuclear.html?_r=2.

[15]OECD Nuclear Energy Agency—available at http://www.oecd-nea.org/general/profiles/.

Sweden is heavily dependent on nuclear power—nearly half of the electricity comes from ten nuclear power plants. The country formerly developed a phase-out policy regarding nuclear energy but allowed for the replacement of existing reactors in 2009. The Fukushima accident fundamentally altered prior support of nuclear power (now 64% of Swedes oppose new reactors and only 27% support them). The government so far resisted calls to reverse course again, but facing tough resistance they might be taking a somewhat more careful approach in the future.[16]

Finland approved plans in July 2010 to build a sixth and seventh nuclear facility as a way of reducing carbon intensity and limiting dependency on imported hydrocarbon resources. Finland's energy policy seeks to increase use of nuclear power due to Finland's lack of hydrocarbon resources, little potential for wind, and maximized hydropower potential. On the environmental side, for Finland to meet the EU's 20/20/20 energy and environment targets, the country must increase its renewables to 38% of total energy sources, and reduce its carbon emissions by 20%.

In central and eastern Europe, Poland recently decided to build two nuclear plants with four reactors in total by 2020, which will produce 10% of Poland's total electricity. Coal generates 90% of electricity in Poland, therefore the country is strongly incentivized to develop nuclear to honor binding commitments to the EU to reduce $CO_2$ emissions. How recent major shale gas findings in Poland could upset these plans remains to be seen. Lithuania had nuclear facilities between the 1980s and the present time, Lithuania's two nuclear reactors provided over 80% of the country's electricity. With the shutdown of the first plant in 2007 and the second in 2009, Lithuania today has no operating nuclear power capacity, and the country depends on Russia for 100% of its imports of gas for electricity generation. Hungary, Slovakia, the Czech Republic and Bulgaria are also at various stages of building replacing and expanding nuclear capacities. The central and eastern European countries are driven by the need to decrease dependency on Russian gas and some are also eyeing increasing export opportunities to the German market.

[16]OECD Nuclear Energy Agency—available at http://www.oecd-nea.org/general/profiles/.

## The Future of Nuclear Energy in the U.S. and Europe: Conclusions and Recommendations

We are still too close in time to the Fukushima accident to assess to its full impact on the future of nuclear energy. It is clear that the accident will have wide-ranging implication for the political debates surrounding the peaceful use of nuclear energy, the fight against climate change, business models in the nuclear industry, technology development and safety issues, other energy sectors from gas to renewables and energy prices.

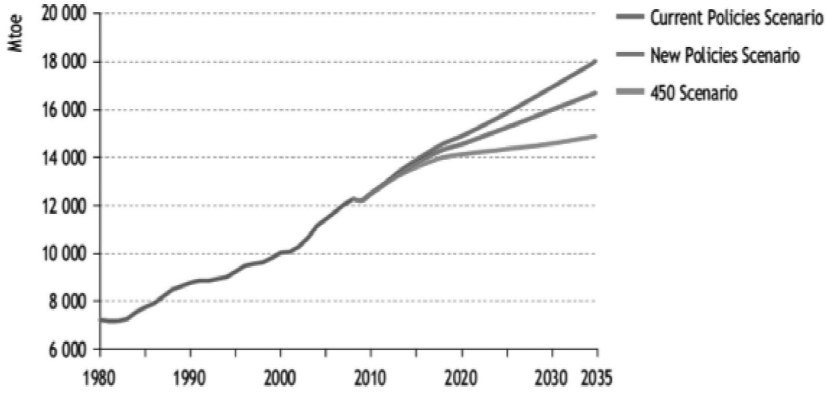
Nuclear power was growing before Fukushima as a source of electricity generation because of three key drivers: to meet rapidly expanding demand for base-load electric power at an affordable price; to increase the share of low and zero carbon energy resources in the energy mix to fight climate change; and to enhance energy security by reducing dependency on imported natural gas and oil and/or diversify energy sources. These drivers are still valid.

However, the constraints on governmental and private sector decisions in the U.S. and Europe triggered by the Fukushima accident may result in protracted political and regulatory processes that further raise costs for nuclear development to unbearable levels. That would effectively kill the development prospects of the nuclear industry in the U.S. and Europe for the foreseeable future, prolong the extended use of fossil fuels as base-load power and prevent the large-scale reduction of greenhouse gas emissions—a catastrophic scenario by all accounts.

To surmount obstacles and constraints of nuclear energy development, proactive policies are needed on both sides of the Atlantic. Nuclear energy needs to be promoted as provider of base-load electricity closely entwined with increasing renewable generation capacities. The United States and Europe can and should play a pivotal role in advancing the efficient and responsible use of nuclear energy in the U.S., Europe and worldwide by creating a level playing field, enhancing global safety standards and further developing the international regulatory and institutional regime.

First, conscious of the climate challenge it is critically important to create a level playing field among all fuel types by internalizing environmental externalities, first and foremost greenhouse gas emissions.

**Figure 4. World Energy Demand by 2035**




Source: IEA World Energy Outlook, 2010.

The U.S. needs to join the EU in introducing a price on carbon preferably by a cap-and-trade scheme modeled on the EU Emissions Trading System (ETS) and by subscribing to global efforts by signing up to the extension of the Kyoto Protocol and ultimately to a comprehensive and compulsory global effort to fight climate change in the UNFCCC framework. In turn, a charge on carbon would likely provide a major economic incentive to nuclear energy (and renewable) developments.

The next generations of nuclear technologies (GEN III+) will bring fundamental improvements in safety. Nevertheless, as Fukushima proved, emergency preparedness is key and great attention needs to be paid to the eventual loss of onsite power at nuclear plants and the availability of backup power. Prevention is a goal, but rapid response capability must be part of the strategy. It is important to retain and develop the relationships and the depth and breadth of interaction and response that were made during the crisis between all the different stakeholders.

Thus, broader global cooperation in nuclear safety is imperative. The International Atomic Energy Agency (IAEA) must be supported and strengthened in its efforts. The U.S. and the EU should work to

strengthen international standards and rules in the framework of the IAEA. Each nation has to have a proper regime for regulation and enforcement of nuclear safety and security. Reviews shall be done at the level where the necessary expertise in the specific reactor designs lays, but it is crucially important to undertake systematic peer assessments.

In the wake of Fukushima, there is a need to rethink how spent fuel is stored at some reactor sites. A reliable emergency plan for coolant loss from spent fuel pools is necessary at every nuclear facility. It is also necessary to rethink the interim storage of spent fuel prior to final reprocessing or permanent storage. It is important to not just improve site-specific plans, but also to establish international and national response capability. Fukushima was an international event. Prevention is a goal, but rapid response capability must be part of the industry. Retaining and developing relationships and the depth and breadth of interaction and response that were made during the crisis between all the different stakeholders are important. Establishing a process and a structure to enable international consultation and collaboration in a time of crisis is crucial. Effective and uniform liability protection is essential: the Convention on Supplementary Compensation for Nuclear Damage (CSC) should enter into force as soon as possible. Such a uniform global legal regime would compensate victims in the event of a nuclear accident. A long-term waste management plan, including guidelines for disposal in a geologic repository should be in place from the beginning of a nuclear power program because reaching agreement on a suitable site for nuclear waste can take a long time.

Turning the tide as regards public opinion is crucial. Government and industry efforts based on independent, reliable and unbiased research and data shall be increased to improve public acceptance of nuclear energy usage. It is critically important to educate the public about externalities, lifecycle costs and overall impact of all energy resource.

Loan guarantees and other federal and state level incentives in the U.S. are critical in helping utilities to obtain financing for new construction and mitigating investor concerns about investment recovery, especially given the size of projects relative to utilities' equity base. Industry efforts to deliver plants on time and on budget are also crucial. A regional approach in central and eastern Europe is needed to

avoid costly public investment into nuclear overcapacities and to enhance collective energy security in the region.

The ongoing dialogue in the framework of the EU-U.S. Energy Council should be reinforced that supports the development and deployment of safe, low-cost nuclear technology; aims to develop and promote compatible taxation and incentives policies; and focuses on nuclear waste and site issues. Recommendations based on the findings of the stress tests in Europe and the NRC review in the U.S. will have to be implemented vigorously and without delay.

Participating countries, including the EU, need to continue to properly finance the International Thermonuclear Experimental Reactor (ITER) to prospectively bring fusion energy to the commercial markets.

Last but not least, combating nuclear weapons proliferation remains essential. Any proliferation accident anywhere in the world would have far-reaching consequences also on the peaceful use of nuclear energy. A renewed international framework for peaceful nuclear cooperation is needed to further minimize the risk of proliferation. The idea of an international fuel bank where nations can commercially access fuel needed for the peaceful use of nuclear energy should continue to be pursued vigorously. Discussions are already underway about the elements of such a regime under the International Framework for Nuclear Energy Cooperation (IFNEC). Instead of building new enrichment and reprocessing facilities, fuel leasing services could serve the needs of both the front and back end of the nuclear fuel cycle.