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IAEE Energy Forum

Fourth Quarter 2011 International Association for Energy Economics

President's Message

In my first president's message, I remarked that the worst was behind us. In the months that followed, we had the turmoil in the Middle East and North Africa, the disaster in Japan, a worsening debt crisis in Europe and a significant downward revision of GDP in the U.S. Globally, GDP growth estimates for 2011 have been reduced amid murmurs of a double dip. Research has shown that it takes much longer to come back from a recession that is coupled with a financial crisis—there is no bounce-back, but rather a protracted, slow recovery over several years. I continue to be an optimist and think there won't be a double dip, though the global economy will expand at painfully low levels for some time. Languid growth has damped energy prices and helped consumers. In the meantime, technological improvements are increasing availability of oil and gas from unconventional sources while boosting energy efficiency. Thus, energy prices may be subdued for some time, aiding the global recovery.

The IAEE has weathered the economic storm fairly well. We have added 92 members year to date, 70 of them students. Big membership increases came from Argentina, Columbia, France, Nigeria, Norway, Russia, Spain, the UK and the U.S. We now have affiliates in 32 countries, with the newest affiliates in Poland, Russia and Latin America.

Our flagship publication, The Energy Journal remains a source of notable articles in the field. A special issue, "Strategies for Mitigating Climate Change Through Energy Efficiency," will be out at the end of October, edited by guest editors Hill Huntington and Eric Smith. Richard Gordon, the EJ's Book Review editor for an astounding 27 years, retired in 2011. Richard made an invaluable contribution to the EJ, and he will be sorely missed. Providing a continuous supply of book reviews helps EJ meet its mission; we welcome suggestions regarding books to cover and reviewers to invite. Economics of Energy and Environmental Policy (EEEP) debuts in January 2012. We have received 45 submissions since we went live with the call for papers in March 2011. After a call for associate editors, our International Energy blog has six new associates working with editor Joe Marroquin. We are seeing quite a bit more activity on the blog and welcome your contributions.

We've had three great conferences this year, in Buenos Aires, Abuja and Stockholm. The international meeting in Stockholm had the largest number of delegates and abstracts of all IAEE conferences to date. As I write this, the USAEE conference in Washington, D.C., "The Changing Roles of Industry, Government and Research," is coming up. It will probably be over by the time this reaches you. The program includes many high-profile presenters discussing relevant energy issues, and the setting is the perfect place to explore U.S. and international energy policies and energy security.

We are looking forward to three conferences in 2012. The 3rd IAEE Asian Conference, "Growing Energy Demand, Energy Security and the Environment in Asia—Challenges Under Enormous Uncertainty," will be held in Kyoto, Japan, on Feb. 20-22 and has already attracted 120 abstracts. The 35th Annual IAEE International Conference is scheduled for Perth, Australia, June 24-27. The theme of the conference is "Energy Markets Evolution Under Global Carbon Constraints: Assessing Kyoto and Looking Forward." Finally, the 12th European IAEE Conference, "Energy Challenges and Environmental Sustainability," will be in Venice, Italy, in September 2012.

I would also like to note the passing of our colleague Lee Schipper with great sadness.

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Editor: David L. Williams

PRESIDENT'S MESSAGE *(continued from page 1)*

Lee was a long-standing member and supporter of the IAEE, always full of energy and ideas. He will be greatly missed.

This is my last President's Message. It has been a very rewarding year for me. I will treasure the good friends and experiences I gained this year. I'd like to thank the Council, EJ and EEEP editors, Executive Director Dave Williams and outgoing council members, Ken Medlock, Thomas Tangeras, Christian Von Hirschausen, Ben Schlesinger and Georg Erdmann for their dedication and hard work. It has been a pleasure working with such a great group of people. I wish the best to incoming president Lars Bergman and all our members.

Mine Yücel

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International Association for Energy Economics

IAEE Mission Statement

The International Association for Energy Economics is an independent, non-profit, global membership organisation for business, government, academic and other professionals concerned with energy and related issues in the international community. We advance the knowledge, understanding and application of economics across all aspects of energy and foster communication amongst energy concerned professionals.

We facilitate:

- Worldwide information flow and exchange of ideas on energy issues
- High quality research
- Development and education of students and energy professionals

We accomplish this through:

- Providing leading edge publications and electronic media
- Organizing international and regional conferences
- Building networks of energy concerned professionals

Editor's Notes

The primary focus of this issue is the impact of the Fukushima disaster.

Geoffrey Rothwell examines the Japanese "continuous-negotiation" mode of decision-making among stakeholders after the historic earthquake and tsunami disabled Fukushima-Daiichi nuclear power plant. Its owner, Tokyo Electric Power, has not provided timely information to any other stakeholders. This has destroyed the efficacy of Japanese decision making and lead to a cascade of crises.

Kenichi Matsui reports that the accident at the Fukushima Daiichi Nuclear Power Plant was caused by a natural disaster. But it was also caused by human error in risk management. To maintain energy security, development of new generation of nuclear power plants will be the only option for Japan.

Christian Growitsch and Felix Höffler examine the impact of Fukushima on German energy policy and conclude that the market rationally accounted for the fundamental consequences of the German nuclear moratorium. Long run, they expect the flexibility of the European energy systems to be sufficient to avoid large adjustment costs, but expect some rise in electricity prices.

Yishiki Iinuma analyzes the role of nuclear power generation in Japan as a means of CO_2 reduction and securing energy security before and after nuclear accidents at the Fukushima Daiichi.

Philip Andrews-Speed examines how China's domestic gas sector has dramatically changed over the last twenty years, noting that in 1990 domestic production accounted for about 2% of the country's total primary energy supply, whereas today it accounts for just under 4%. Gas imports have also grown markedly and he identifies the pipeline development that has enabled this to occur.

Joni Jupesta and Aki Suwa discuss the historical background to the Japanese nuclear and energy policy and provide a comment on its future direction.

Perry Sioshansi provides us two articles. In the first, he quantifies the change in Japan's nuclear plans from prior to post Fukushima. In the second, he comments on a report from the Worldwatch Institute, published on the 25th anniversary of the Chernobyl accident, arguing that nuclear's best years are behind it.

Rob Graber and Margaret Harding note that the Fukushima Daiichi nuclear accident could have escalated into a much more serious event which could have negatively impacted the motivation for countries to employ nuclear power. The response to the accident, however has been relatively tepid and is likely to have only a minimal impact on nuclear power. They detail why.

Aitor Ciarreta and Carlos Gutiérrez-Hita examine the impact of Fukushima from the Spanish standpoint and conclude that nuclear power is relatively safe, capable of ensuring the continuation of our industrial civilization and protecting the environment. It is a source of energy that can replace a significant part of the fossil fuels (coal, oil and gas) which contribute to the greenhouse gas effect.

Giacomo Grasso and Paride Meloni report on the Italian reaction to the Fukushima accident noting the difficulties encountered when uninformed public opinion is allowed to influence, even determine, national energy policy.

DLW

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Want to show you are a member of IAEE? IAEE has several merchandise items that carry our logo. You'll find polo shirts and button down no-iron shirts for both men and women featuring the IAEE logo. The logo is also available on a baseball style cap, bumper sticker, ties, computer mouse pad, window cling and key chain. Visit http://www.iaee.org/en/inside/merch.aspx and view our new online store!

Newsletter Disclaimer

The 35th Annual IAEE International Conference
24-27 June 2012
Perth, Western Australia
Perth Convention and Exhibition Centre

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
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Conference Theme
Energy markets evolution under global carbon constraints: Assessing Kyoto and looking forward

Objectives and Aims
The objective of the conference is to examine the dynamism of the world energy sectors in the context of what effect the Kyoto Process, which ends in 2012, had on the energy markets, technologies, and systems of the world. Also of interest is what technological and market developments occurred in spite of the Process? In other words, will the energy world of 2012 and beyond be purely the product of reactions to the Kyoto Protocols, or were there strong undercurrents of change that flowed throughout the period that would have occurred regardless? And from this examination, what may we reasonably expect for the near- to intermediate-future? Plenary sessions will examine these questions from industry, government, and academic perspectives.

Overview
The conference will address the full range of energy issues that may be expected to be commanding the attention of academics, analysts, policy-makers, and industry participants in 2012, looking both forward and back. In addition to all major fields of energy economics and policy typically covered, other possible topics include:

- Greenhouse gas policy after Kyoto
- Energy supply and demand security
- A growing role for nuclear
- The role of unconventional energy resources
- Price volatility
- Renewable and alternative sources of energy
- Carbon capture and sequestration
- Policy consideration in a carbon constrained world
- Distributed generation
- Energy efficiency in primary commodity production
- Resources sector taxation policy
- Developments in LNG markets
- Harmonization of cross-border energy regulations
- Evolving geopolitics of oil and gas
- Emissions modelling
- Emission trading schemes
- The econometrics of oil and gas markets
- The economics of climate change
- Risk mitigation methodologies
- Reserves, production, and peaks
- Energy development and the environment

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The Location: Perth, Western Australia

The conference will be hosted at the Perth Convention and Exhibition Centre. Visit the following website for a 3-minute online video of some of the wonders of Perth and the surrounding region: http://pcb.com.au/our-services/convention-tool-kit/destination-dvd.aspx. Come enjoy this beautiful part of the world, in one of the most dynamic energy development regions of the globe. We look forward to your company and active participation in the 35th IAEE International Conference in Perth, June 24-27, 2012.

Call for Papers

We are pleased to announce the Call for Papers for the 35th International Association for Energy Economics conference to be held 24-27 June 2012 at the Perth Convention and Exhibition Centre in Perth, Australia. **The deadline for abstract submission is 13 January 2012.**

We will be accepting proposals for two different structures of conference presentations. We will have the typical concurrent session paper presentations, and we will augment these with a limited number of extended presentations with formal discussants. The typical sessions include up to five papers and presentations are limited to 15 minutes, including Q&A. The extended presentation sessions will include not more than three papers, with each allocated 30 minutes, including discussant and Q&A.

Paper abstracts for the typical concurrent sessions shall follow the format of the Abstract Template, which may be downloaded at www.business.curtin.edu.au/creme/AbstractTemplate.doc, (ticking the appropriate choice). The abstract should be one to two pages in length, and it must include: a) keywords, b) overview, c) methods, d) results, e) conclusions, and f) references. NOTE: All abstracts must conform to the abstract format presented in the abstract template. Authors will be notified by 16 March 2012 of the status of their papers. **We strongly encourage industry and government submission with economics and policy focus.**

The extended presentation paper proposals **require a near-final draft of the completed paper** on the 13 January 2012 deadline submission date. In addition to a complete paper, one author of each paper must commit to being a discussant of another extended paper. Use the AbstractTemplate as your cover page (ticking the appropriate box); completing just the title, author(s), and keywords sections.

Concurrent session abstracts and extended presentation papers should be in either Microsoft Word or PDF format and sent to IAEE.Perth.Abstracts@curtin.edu.au.

Best Student Paper Award: the IAEE is pleased to announce the continuation of its Best Student Paper Award program in 2012. The top energy economics paper award will receive US$1000, and the three runners-up will each receive US$500. All four students will also receive waivers for their conference registration. Complete information for this competition, including submission details, may be requested from David Williams at iaee@iaee.org, or found at Conferences link on www.business.curtin.edu.au/creme.

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Centre for Research in Energy and Minerals Economics (CREME)

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Australia Association for Energy Economics

Conference registration fees (all fees are in Australian dollars, inclusive of 10% GST)		
	Early (before 1 May 2012)	**Normal** (1 May 2012 and later)
Speakers/Chairs/ Discussants	A$770	A$855
IAEE members	A$855	A$940
Non-Members	A$1,045	A$1,155
Students	A$440	A$440
Guests	A$440	A$440

NIGERIAN ASSOCIATION FOR ENERGY ECONOMICS

Affliate of International Association for Energy Economics

5TH ANNUAL NAEE/IAEE INTERNATIONAL CONFERENCE

ENERGY TECHNOLOGY AND INFRASTRUCTURE FOR SUSTAINABLE DEVELOPMENT

SHERATON HOTEL, ABUJA, NIGERIA

April 23-24, 2012

CALL FOR PAPERS

CONFERENCE OBJECTIVES:

After a decade of energy sector and economy-wide reforms, many developing countries, especially those in Africa, are confronted with the challenges of selecting and funding the appropriate technology and requisite infrastructure to deliver reliable and adequate energy services for sustainable human development. Appropriate choices of energy technology and infrastructure are arguably critical for these countries to realize the goal of sustainable development. The relative small size of these economies coupled with the more difficult conditions confronting availability of finance for energy infrastructure, in high cost environment that is so common in Africa, in the aftermath of the recent global financial crisis, present peculiar challenges to energy planners, managers and policy makers in these countries. The 5th NAEE/IAEE Conference will bring together energy sector specialists from the energy industry, academia, public institutions, regional and international organizations and non-governmental organizations to discuss the linkage between energy technology options, infrastructure development and sustainable human development. The central theme is sustainable energy development anchored on adequate supply of energy infrastructure that can deliver cost effective, adequate, reliable, and efficient energy services to meet the energy needs of consumers as well as eliminate the problems of low energy access. Further, discussions of international experiences and best practices in successful developing countries during the conference are expected to offer pragmatic examples of how to resolve inadequate energy infrastructure challenges to African countries.

CALL FOR PAPERS: We are pleased to announce the **Call for Papers** for the 5th International Conference of the NAEE to be held **23-24 April 2012** in the capital city of Nigeria, Abuja. You are cordially invited to submit proposals for presentations at the concurrent sessions on a range of topics including, but not limited to, those highlighted below. **Deadline for submission of abstracts is October 31, 2011.** All submitted abstracts should not exceed two pages, and must include the following sections: overview, methods, expected results and references. Those interested in organizing sessions should propose topic and possible speakers to: Engr. Dave Dogo, Program Chairman (p) +234-805-502-7475, (e) meanduk@gmail.com and Professor Adeola Adenikinju Conference Chairman (p) +234-802-344-0018, (e) adeolaadenikinju@yahoo.com.

Conference Themes and Topics: The following is a list of suggested topics that are of interest, but suggestions outside these topics are encouraged and will be considered.

Energy Infrastructure and Technology Options
Energy Conservative & Efficiency
Oil and Gas Infrastructure
Climate Change and the Energy Industry
Clean Energy Technologies
Energy, Poverty and Sustainable Development
Energy Planning and Policy
Energy and the Economy
Public Private Partnerships in Energy
Local Content and Technology
Energy Infrastructure and Regional Market Integration
Human Capital and Energy Infrastructure Development
Electricity Infrastructure
Energy Pricing, Investment and Financing
Renewable Energy Technologies and Infrastructure
Energy Infrastructure and Security of Supply
Energy Modeling
Energy Access
Legal and Regulatory Issues in Energy Infrastructure Development
Energy Infrastructure Development and Risk Sharing

Organizations under Volatile Uncertainty: An Analysis of the Fukushima Catastrophe

By Geoffrey Rothwell*

Economic theory and observation suggests organizations attempt to structure themselves to efficiently manage information flows to maximize their objectives. Aoki (2010) describes three information structure archetypes:

- "top-down-mode" with hierarchical control, also known as "H-mode;"
- "continuous-negotiation-mode" with horizontal coordination, previously known as the Japanese-mode, or "J-mode"; and
- "rule-based-mode" with self-organizing, independent modules ("M-mode") each with an assigned function, operating within open, established, interface rules.

When U.S. President Jimmy Carter visited the light-water-moderated-and-cooled Pressurized Water Reactor (PWR) at Three Mile Island on Sunday, April 1, 1979. He visited solemnly to raise hope for an anxious nation. He did this as its leader and healer, laying his hands on the plant, not because he was there to intervene, but because as an ex-naval submarine officer, he had slept beside PWRs in deep waters, and wanted to show that there was nothing to fear 100 hours after the accident happened: Jimmy Carter laid the disaster to rest. The interface rules between his function as the U.S. president and the plant manager had already been promulgated by the U.S. Nuclear Regulatory Commission (NRC) with and since its inception on January 19, 1975.

When Mikhail Gorbachev, the last General Secretary of the Communist Party of the Union of Soviet Socialist Republics (1985-1991), broke his 18-day silence after the April 26, 1986, steam explosion of Unit 4 of Chernobyl's Graphite-Moderated/Light-Water-Cooled Reactor (RBMK in Russian), he was the head of a chain of command that determined on the morning of the accident to cover up as much information as possible regarding the damages. This cover up continues today with no accounting of the health of the 500,000 Soviet Army Reservists, "bio-bots," who shoveled chunks of highly radioactive graphite (charred and contaminated charcoal) off the Chernobyl site (about two minutes per bio-bot in reused protective clothing and gas-masks without dosimeters), when instruments died in the robots originally tasked to do the job.

When Japanese Prime Minister (PM) Naoto Kan flew around the Fukushima site in a helicopter with the plant manager, Mr. Masao Yoshida, on March 12, 2011, the day after the tsunami hit, he was participating in the continuous-negotiation-mode among relevant players. Later, based on his bonding with Mr. Yoshida, PM Kan believed that he could participate in the Fukushima crisis management, one in which he had no previous personal experience.

These three approaches to managing a nuclear power plant accident can be described as "rule-based," "top-down," and "continuous-negotiation," respectively. Vertical control (hierarchical-mode) corresponds to a structure where each member has a specific task and has had job-specific training. The benefit of this structure is that managers know the technical possibilities of the firm and its employees. The disadvantages include information transmission delays and errors.

Second, an alternative approach is a continuous-negotiation-mode where teams are responsible for all functions. Personnel rotate through each task and eventually have a broad knowledge of the complete process. When a problem arises, the team addresses the problem with its own resources.

Third, Aoki (2010) proposes an "M-Mode" of interacting modules within a meta-structure of openness and rule-based decision making. The ideal type of the M-Mode structure is Silicon Valley. However, M-mode can be applied to organizing the manufacture of nuclear power plants (e.g., in sets of Small Modular Reactors, see Rothwell 2011). While the present paper focuses on the effectiveness of the continuous-negotiation-mode under volatile uncertainty, it assumes the lessons learned from rapid M-mode economic growth and the introduction of market discipline into the electric utility industry (see Rothwell and Gomez, 2003) since the publication of Aoki (1990).

Aoki (1990, p. 8) states that the relative advantage of continuous-negotiation "depends on such factors as the learning ability of personnel, the ease of communication between operating units, and the degree of economies of specialization with regard to the variety and volatility of market demand." Aoki then proposes the following hypothesis:

* Geoffrey Rothwell is with the Department of Economics, Stanford University. He thanks T. Amemiya, B. Carson, G. Coles, R. Graber, B. McDowell, B. Rasin, A. Seward, B. Smoter, K. Whattam, F. Wolak, and T. Wood for their comments and support. This work is being partially funded by the National Energy Policy Institute. Dr. Rothwell may be reached at geoffreyrothwell@yahoo.com
See footnote at end of text. A detailed Appendix is available from the authors.

> "When environments for planning (e.g., markets, engineering process, development opportunity) are *stable,* learning at the operational level may not add much information value to prior planning, and the sacrifice of economies of specialization in operational activities may not be worthwhile. On the other hand, if environments are *extremely volatile or uncertain,* decentralized adaptation to environmental changes may yield highly unstable results. In both these two contrasting cases, the H-mode may be superior in achieving the organizational goal. In the intermediate situation, however, where external environments are *continually changing but not too drastically,* the J-mode is superior. In this case, the information value created by learning and horizontal coordination at the operational level may more than compensate for the loss of efficiency due to the sacrifice of operational specialization." *(emphasis added*)

Aoki's hypothesis was tested empirically with information on nuclear power plants in Rothwell (1996). At these plants, operating periods can be characterized as environments that are "continually changing but not too drastically." Following Aoki, the horizontal information structure (J-mode) would be superior during operation. In contrast to operating periods, at nuclear power plants there are forced outages that can be "extremely volatile or uncertain" (many forced outages begin with the automatic insertion of control rods into the reactor core to stop the nuclear fission reaction; this is also known as a "scram," because in the early days of nuclear reactor operation, all personnel would scramble to the exit with an automatic shutdown). So, following Aoki, the Hierarchical-mode (H-mode) should be superior during outages.

Rothwell (1996) organizes data on operation and outages from 49 nuclear power plants (with most of the nuclear power units in the U.S.) between January 1976 and December 1985; constructs an index of hierarchy based on nuclear power plant organization charts in Olsen et al. (1984) from the Final Safety Analysis Reports; and estimates parameters that support the proposition that less hierarchy is associated with higher productivity through longer periods of operation: The J-mode is associated with longer periods of operation, but the H-mode is associated with shorter periods of outage. Because plants are running a higher percentage of the total time, the hierarchical-mode is superior most of the time.

On March 11, 2011, in Fukushima, Japan, following a magnitude 9.0 earthquake, the six unit Fukushima-Dai-ichi nuclear power plant began its shutdown, when Units 4, 5, and 6 were down for refueling. Table 1 is a partial list possible earthquake damages at Fukushima. All units are based on the General Electric (GE) Boiling Water Reactor (BWR). Unit 6 was a collaboration between GE and Toshiba, and served as a model for Toshiba's construction of Units 1 and 3, and Hitachi's construction of Units 2 and 4, at the Fukushima-Dai-ni site, 10 km from Fukushima-Dai-ichi in the same seaside village.

- Water seal leaks in reactor core cooling systems
- Water leaks in reactor buildings
- Oil leaks in reactor core cooling system pumps
- Oil leaks in the transformer facility
- Fire in the transformer facility
- Loss of power to and from the transformer facility
- Water leaks in the backup diesel generator facility
- Loss of power to the liquid waste disposal system
- Cracks in the cooling water intake system
- Radioactive contaminated water leaks
- Uneven liquefaction under the reactor site

Table 1: Possible Earthquake Damages at the Fukushima Nuclear Power Plants

See http://www.nirs.org/international/asia/reportonearthquakedamage71907.pdf .

Although the complete story has not yet been told, the continuous-negotiation-mode seems to have functioned smoothly immediately after the earthquake. However, the absence of electric power after the tsunami resulted in extreme volatility and uncertainty, and the continuous-negotiation-mode led to highly unstable results.

The "Seawater Decision"

The failure of the continuous-negotiation-mode during the Fukushima crisis can be seen in the decision to cool reactors with seawater. See chronology in Appendix A, available from the authors. The New York Times (6-13-2011), p. A1, discusses seawater:

> "On the evening of March 12, the Fukushima Dai-ichi nuclear plant's oldest reactor had suffered a hydrogen explosion and risked a complete meltdown. Prime Minister Naoto Kan asked aides to weigh the risks of injecting seawater into the reactor to cool it down. At this crucial moment, it became clear that a prime minister who had built his career on suspicion of the collusive ties between Japan's industry and bureaucracy was acting nearly in the dark. . . . Based on a guess of the mood at the prime minister's office, the company ordered the plant manager to stop. But the manager [Masao Yoshida] did something unthinkable in corporate Japan: he disobeyed the order and secretly continued using seawater; a decision that experts say almost

> certainly prevented a more serious meltdown and has made him an unlikely hero. . . . Last week, TEPCO gave Mr. Yoshida its lightest punishment of a verbal reprimand for defying the order."

On the other hand, Prime Minister Kan suffered a heavy punishment when he agreed to resign in exchange for votes against the motion of no-confidence in his government on June 2, 2011 (see BBC, 2011):

> "Japanese Prime Minister Naoto Kan has survived a no-confidence motion brought by [Members of Parliament] critical of his handling of the earthquake and tsunami disaster. Before the motion was debated, Mr. Kan told his party he would step down when the crises were under control. He was trying to head off a rebellion by senior members of his party which could have forced him from power. . . [S]enior figures in his Democratic Party of Japan (DPJ) had indicated they would support the no-confidence motion, increasing his chances of being forced out. In a last-minute attempt to rally support, he urged a meeting of DPJ politicians to reject the no-confidence motion . . . The no-confidence motion was submitted by the main opposition Liberal Democratic Party (LDP) . . . The LDP has accused Mr. Kan of mishandling the reconstruction and relief efforts following the tsunami, as well as the Fukushima nuclear crisis. In parliament on Wednesday, LDP leader Sadakazu Tanigaki told Mr. Kan: 'You have no personal virtues.' . . . [T]he result of an opinion poll published on Wednesday suggests the public has a dim view of Mr. Kan's handling of the Fukushima crisis. In a survey of 700 adults, 79% rated his management of the crisis as poor, according to the Pew Research Center. . . . The Fukushima Dai-ichi power plant, which was badly damaged by the tsunami, is still leaking radiation."

In the March 11th Fukushima catastrophe, TEPCO's and government officials' behaviors revealed that the typical continuous-negotiation-mode of decision making was not at all appropriate to addressing the volatile uncertainty following the tsunami at Fukushima. At times it converted itself to a typical hierarchical-mode organization with the station manager making decisions, as encouraged by the IAEA and the U.S.

But at no time since has the situation converted to an open-rule-based modular system where each "module" (e.g., plant manager, TEPCO management, Japanese Atomic Energy Agency, Nuclear and Industrial Safety Agency, Prime Minister and aides, DPJ, defense forces, etc.) of the decision-making structure is linked through simple, open, and transparent interface rules. Indeed, PM Kan exploded in anger because he suspected TEPCO was withholding information from him (after TEPCO requested an evacuation of the site on March 14th) at a meeting (March 15, 5:30am) in Tokyo less than one hour before the dual hydrogen explosions damaged the containment and roof of Unit 2 (March 15, 6:10am) and in the reactor building and the spent fuel pool of Unit 4 (March 15, 6:14am), following hydrogen explosions on television on March 12th at 3:36pm and March 14th at 11:00am. Were TEPCO officials withholding information at the March 15th meeting? What did they know and when did they know it?

There remain unsettling issues, such as, when will Unit 1 come under TEPCO control? (It was not under control on June 15th, when this paper was submitted.) Apparently, the radiation level has been rising linearly from April 18th to April 27th to May 15th to June 4th. When will it start falling?

There remain unanswered questions, such as, how much damage is there to the reactor pressure vessels of Units 1, 2, and 3? When Representative Edward Markey (D-MA) told the public what the NRC had suspected, i.e., that molten fuel might melt through the reactor pressure vessels, the NRC retracted its suspicion. However, on May 17th, TEPCO confirmed that molten fuel (at 2,800° C) had probably caused stress fractures in the lower head of the reactor pressure vessel in Unit 1, and on June 7th, the Japanese government began an inquiry to determine if there had been any "melting through" the reactor pressure vessels. Did any of the vessels "melt through"? What will this mean for decontamination and decommissioning, D&D? (On D&D economics, see Pasqualetti and Rothwell, 1991.)

Another puzzling question concerns "recriticality." Criticality would occur if the molten fuel could have generated a self-sustaining nuclear fission reaction. This would be classified as a "criticality accident," such as the one at the Tokai-mura fast reactor fuel fabrication facility on September 30, 1999, where a self-sustaining chain reaction with a sufficiently high level of reactivity in a specific geometry lasted about 20 hours (http://www.world-nuclear.org/info/inf37.html). On March 12th, PM Kan asked Prof. Madarame whether injecting seawater could cause a criticality accident, and the professor's response was that the chances of such a thing happening were "non-zero." (NYT, June 13, 2011)

Had there been criticality accidents in Units 1, 2, or 3, the Prime Minister could have been the hero, and the plant manager could have been accused of being the disobedient employee without "personal virtues." On May 2nd, Prof. Matsui in "Deciphering the Measured Ratios of Iodine-131 to Cesium-137

at the Fukushima Reactors," http://arxiv.org/abs/1105.0242, using seawater samples, concluded that a criticality accident might have occurred 10-15 days after March 11th, i.e., between 3-21st and 3-26th. Have there ever been any criticality accidents at Fukushima?

Finally, there is the worrisome issue of finding plutonium in samples outside the plant on March 21st and 22nd, which was not reported until March 28th (CNN, "TEPCO says plutonium found on quake-damaged plant grounds"). On March 28th, TEPCO concluded that the levels of plutonium were not greater than background levels of plutonium, from, for example, Hiroshima, Nagasaki, and the atmospheric testing of atomic and hydrogen weapons during the 1950s in the Pacific. However, TEPCO has not issued a statement on the molten MOX in Unit 3. Compare their silence on molten MOX to their earlier announcement of loading MOX into Fukushima Dai-ichi Unit 3 on August 2010:[1]

"In plutonium-thermal ("plu-thermal") power generation, plutonium is removed from spent fuel and mixed with uranium to produce MOX (Mixed oxide composed of uranium and plutonium) fuels for use in existing nuclear power plants. This effective utilization of limited uranium resources is expected to contribute significantly to securing stable energy supply in the future. To promote the introduction of plutonium-thermal power generation, electric power companies in Japan are making various efforts to obtain broad public acceptance of this new power generation method. At TEPCO, we have loaded MOX fuel into Unit 3 at the Fukushima Daiichi Nuclear Power Station in August 2010, and are steadily working our way toward the implementation of plutonium-thermal power generation." (emphasis added) http://www.tepco.co.jp/en/challenge/csr/nuclear/cycle-e.html

TEPCO is a rate-of-return-regulated monopoly electricity generator, transmitter, and distributor in one of the largest metropolitan areas in the world with one third of Japan's electric power assets. Its political power rivals that of the Japanese government. To encourage a more open-rule-based structure in the Japanese "nuclear village," TEPCO and the Japanese (nuclear) electric utilities should be "modularized" into competing generating companies by selling their transmission and distribution assets to the Japanese government in exchange for payments to Fukushima victims, Fukushima's decontamination and decommissioning, and nuclear power plant upgrades, for example, to TEPCO's Kashiwazaki-Kariwa, the world's largest nuclear power plant, where 5 units remain disabled almost four years after a magnitude 6.8 earthquake on July 16, 2007, with warnings 45 months before March 11, 2011.

Footnotes

[1] To experience the silence, google <<"molten MOX" & TEPCO>>; on June 15, 2011, there were only 8 hits, none at www.tepco.co. Compare this with the noise resulting from a search for <<MOX>> on the TEPCO web site: http://www.tepco.co.jp/en/index-e.html.

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Development of Science and the Human Being: Implications for Japan after Fukushima

By Kenichi Matsui*

The accident at the Fukushima Daiichi Nuclear Power Plant of the Tokyo Electric Power Company (TEPCO) can be divided into two phases. The first phase is what happened before the occurrence of the power station blackout; the second phase is what happened thereafter.

At the first stage, the plant was immediately shut down and the automated power system worked as expected when the earthquake hit. It proved safe against an earthquake of magnitude 9. However, after the blackout at the power station, as primary water inventory was lost, core degradation occurred through some combination of zirconium oxidation and clad failure. Hydrogen produced from zirconium oxidation was vented from the containment chamber into the reactor building. Hydrogen in the reactor building exploded causing the building to collapse around the containment chamber. A decision was made to inject seawater into the reactor pressure vessel. However it could not stabilize the reactor at a low temperature. In this process, delayed decision making was repeated by TEPCO. Lack of Government leadership and miscommunication with TEPCO made the situation worse which resulted in the worst nuclear power plant accident in the world with the same INES level 7 as the Chernobyl accident.

This accident was induced by a serious natural disaster but what made the situation worse was the human factor: mismanagement by TEPCO and the Government. It was really unlucky for the Japanese people that both TEPCO and the Government were led by people lacking proper leadership at the time of this misfortune.

Judging from what happened in this accident, I will say, it was a unique Japanese accident, which will not happen in other countries.

To understand the background of this accident, we need to look back at the unique historical relation of the electric power companies and the Government. For more than 100 years, many small private electric power companies had operated, but they were nationalized before the Second World War into one State Electric Power Company. This was an unforgettable and bitter experience for them. It created the so called “Allergy to Government Control” for the electric power companies.

After the Second World War, there was much contention as to the structure of the postwar electricity industry. Government wished to keep a single integrated State Electric Power Company and the private electric power companies wanted a regional, monopolized, integrated private system. Finally, the latter idea was chosen with the support of the General Headquarters of the U.S. Army, and the current electricity supply system was introduced. This system worked. However, the Government tried to erode the system and strengthen State control whenever there was a chance. Private power companies tried to keep their independence, avoiding intervention by the Government as much as possible. The weak point of the private electric power companies has been the need for Government approval of the electricity tariff, which assures them of 6% rate of return on investment.

So, private electric power companies follow a policy or cooperating with the Government but still trying to keep as independent as possible.

This policy affected the development of nuclear power plant construction. Both the companies and Government wished to expand construction as much and as quickly as possible. Companies choose a policy of relying on foreign established reactors, especially those of General Electric (GE) and Westinghouse (WH). They trusted these reactors. The Government wanted to develop Japan’s own nuclear power plant technology and asked (1) for a financial contribution from the private companies and (2) for them to use the developed technology even if it were more expensive. The electric companies cooperated but they didn’t wish success for this effort because they trusted the technology of GE and WH and didn’t trust the technology developed in Japan. Also, the success of these efforts, they feared, would strengthen the control and power of the Government over the private electric power companies. When nuclear power plant engineers advised the electric power companies to strengthen the safety of their power plants by changing some parts, companies requested GE or WH’s concurrence for the changes and often rejected the advice. And when Japan’s own technology showed signs of succeeding, the companies tried to prevent the success.

This policy of the companies resulted in disdain for the engineers and created obstacles to the development of Japan's own technology and ignorance of safety arrangements.

Through the Fukushima accident, we learned the importance of our own

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technology to operate nuclear power plants safely. One can not manage or will have difficulty managing borrowed technology during emergencies.

As mentioned, I think the accident of the Fukushima Nuclear Power Plant is a uniquely Japanese situation and the world will understand it when the investigation reveals precisely what happened. In this sense, this accident is a Japan-specific one and nuclear power plants in the world need not worry about the possible occurence of this type of accident especially where there is no earthquake or tsunami.

What are the implications of the Fukushima accident for the future of energy in Japan? It is obvious that the anti-nuclear movement is now strengthened and the operation and construction of nuclear power plants face a very severe situation. Renewable energy, specifically solar and wind, is booming in the media. But that is an illusion for Japan.

I believe in the power of science. The 20th century was the era of mechanics based on Newtonian physics and the 21st century will be the era of technology based on the relativity theory and the quantum theory. That is, nuclear energy, photovoltaic technology and information technology.

We should continue to develop nuclear power plant technology. We know there already exists very safe, pro non-proliferation nuclear power plant technology, like small reactors and thorium reactors, which can be applied to most developed countries where the future growth of electricity demand will be small and also to many developing countries with small electricity demand.

The future of nuclear power plants will not be as simple as in the past, overwhelmed by large scale light water reactors, but will be more diverse in terms of reactor type, size and familiarity. Japan should develop a new dimension of nuclear power plant technology, different from an extrapolation of the past. There will be no other way for a country like Japan to survive, with almost no fossil energy resources and having around 100 million people.

Civilization has been led by science. Those who reject the nature of science will not survive. The nature of science is not a thing to be decided by majority vote. Those who reject nuclear power by majority vote will have to pay some time in some way.

Science and technology have two sides; a very large benefit and a very large destructive power. Human beings have coexisted with the development of science and technology whatever the dangers they pose. Humans made many mistakes. But humans are not stupid. They know where stupidity should be stopped. I don't make any ethical judgment on the development of science. But the difficulty caused by technology has been overcome with more advanced technology in the past and it will be repeated in the future. I believe there is no other way to live.

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Impact of Fukushima on the German Energy Policy Debate

By Christian Growitsch and Felix Höffler*

A Brief Review of Events

Nuclear power always faced considerable opposition in the German public debate. However, nuclear constituted a core component of electricity generation for decades. By 2000, total installed capacity amounted to 23 GW (out of a total of 125 GW), with a total production of 170 TWh (out of 577 TWh).

In 2000, a leftist government (social democrats, SPD, and the Green Party) engaged in an agreement with the four companies running nuclear power plants in Germany (EnBW, E.ON, RWE Vattenfall) to phase out nuclear power. The phase out was based on plant specific total (plant lifetime) production budgets, and essentially implied a reduction from 23 GW to about 8 GW by 2020, and full decommissioning by the year 2021/2022.

This "phase out consensus" was never supported by the conservatives (CDU/CSU) and the liberals (FDP). In the 2009 election campaign, both parties announced that they would revise the phase out plan, and after winning the 2009 election, indeed, implemented a new energy law, extending the average nuclear power plant lifetime by 12 years. This implied about 13 GW installed capacity by 2020, and a full decommissioning by about 2035.

As a reaction to the events of Fukushima on March 11th 2011, the very same government, anticipating strong revival of anti-nuclear sentiments, was quick to revise its position. By March 14, the conservative-liberal government entered into a "Moratorium on nuclear power" to reconcile the risks of this technology. This implied the immediate shutdown of 5 GW generation capacity of older nuclear plants (another 3.5 GW of relevant capacity was in revision, anyhow).

On June 6, even before the end of the Moratorium (planned for 3 months, i.e., up to June 14), the very same government which overruled the phase out plans of its leftist predecessors, now committed to an accelerated phase out. It implies total decommissioning by 2022. Given that nuclear power has lost support in all political parties, it is most likely that this will indeed happen.

The Institute of Energy Economics at the University of Cologne (EWI) provided expertise to the federal government throughout this process, i.e., concerning evaluation of the effects of extensions of the run-times, as well as for the effects of the now decided accelerated phase-out.

The Short Term Effects of the Moratorium

The shut down of 5 GW nuclear capacity by March 14, which was fully unexpected and constitutes a text book example of a negative supply shock, had considerable short term effects on prices and power flows. For the short term (day ahead) prices, a price reaction is hardly discernable. Figure 1 depicts the base and peak price at the German electricity exchange before and after announcement of the memorandum.

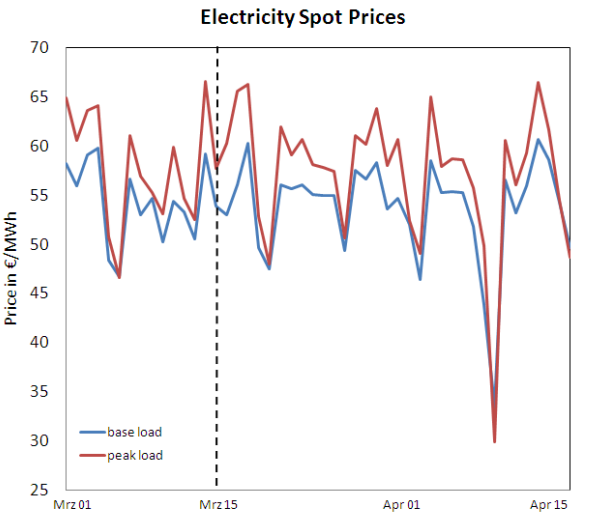

Figure 1: Electricity Spot Price Development.
Source: EEX.

That no clear spot price effect can be identified is not surprising, given the high volatility of day ahead prices. However, future prices clearly reacted. Figure 2 shows that at the German electricity exchange, future prices increased sharply and – after some "overshooting" – stayed on a significantly higher level than before the memorandum.

At the EWI, we conducted an analysis to elicit from the market prices the quantity effects which the market expected (Thoenes, 2011). Figure 3 illustrates which changes in the merit order (i.e., reduction of nuclear capacity) would support the price changes of Figure 2, i.e., the "capacity effect" (in MW). It shows that the market immediately accounted for the reduction of the 5 GW capacity but quickly adjusted to a level of about 3 GW. This reflects that the market (correctly) anticipated that part of the withdrawn nuclear capacity would be replaced by fossil power plants and imports. Looking at longer term expectations beyond the end of the moratorium in June 2011, Figure 4 (which depicts the futures for the fourth quarter of 2011) shows that the market anticipated that the nuclear capacity would not come back, but that the capacity effect remained stable at about 3 GW.

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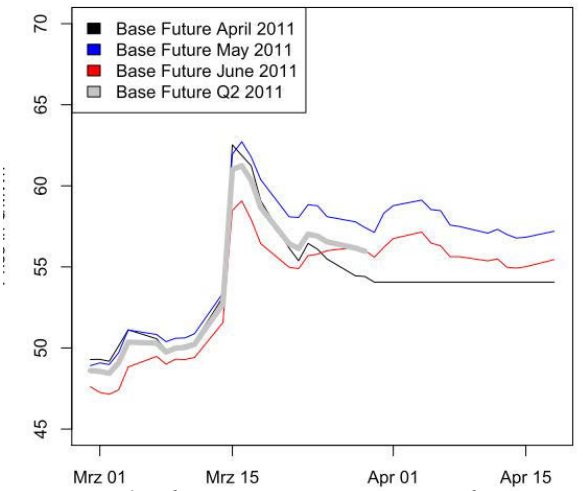

Figure 2: Electricity Future Price Development.
Source: EEX.

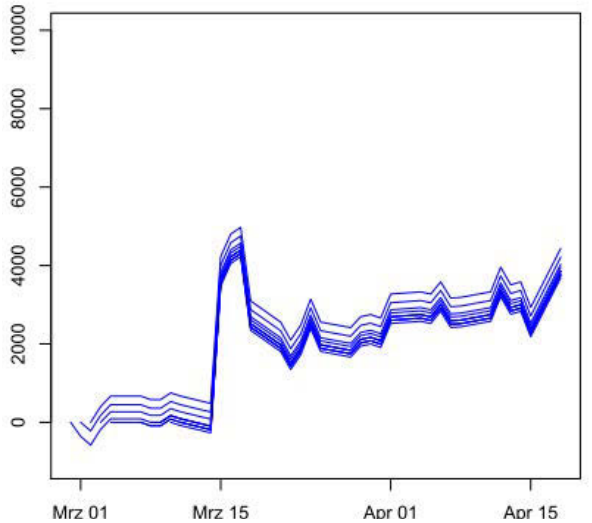

Figure 3: Electricity Future Price Development Capacity Effects for June 2011.
Source: Thoenes (2011).

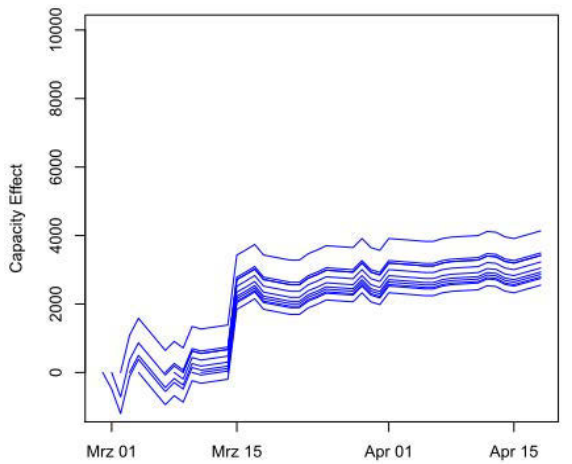

Figure 4: Electricity Future Price Development Capacity Effects for Q4 2011
Source: Thoenes (2011).

When analyzing quantity effects, it is also interesting to see that indeed imports quickly increased as a reaction to the Moratorium. With its beginning, Germany became a net importer of electricity, reaching a local net import maximum by May 2011 (which is the end of our observation period). As indicated in Figure 5, the developments between March and May 2011 cannot be explained by a seasonal pattern only. Rather, it seems that exports have dropped much below average volumes. A closer look into the data shows that France and the Czech Republic have increased their exports to Germany, while German exports to Austria, Poland, Swiss and The Netherlands declined.

Long Term Effects of the Accelerated Phase Out

In the long run, i.e., within the next 10 to 15 years, we expect that the reduction of nuclear capacity will be compensated by fossil fuel power plants, especially hard coal and natural gas. Although the German government has ambitious renewable energy targets with a percentage of 35 % in 2020 and 50% in 2030, we expect a rationale for new fossil capacity in the long run. First, a political aim today does not necessarily transform into future reality. Second, since the majority of renewables will be of stochastic nature (e.g., wind, solar), there will be a need for conventional back-up capacity.

The substitution on nuclear power plants by fossil fuel fired power plants will have an effect on CO_2 emissions in Germany. We expect them to increase in the years 2015 to 2030 compared to previous EWI scenarios (see Nagl et al., 2011). Under the European emission trading system this will not lead to an increase in European CO_2 emissions (but to an increase in permit prices). Also, the accelerated phase out should lead to a slight increase in imports not only in the short, but also in the long run. One reason for that is expected investment into additional capacity in continental Europe, both in renewables and – to a lesser extent – nuclear. Both technologies would crowd out German fossil fuels of the merit order.

Furthermore, at least in principle, Germany could fill the capacity gap to a large extent by becoming a heavy importer of electricity. Interconnector capacity will not be an obstacle. In the past, Germany exported electricity on average. This implies that (on average) the total amount of about 14 GW interconnector capacity could be used to substitute for a large part of the shut down 23 GW nuclear. However, this would have significant effects on other European markets. For Germany, we expect the wholesale price to rise, although (due to the substitution opportunities) we expect price increases to be modest.

Conclusions

On June 6, 2011, less than 3 months after the event in Fukushima, Germany's conservative-liberal government decided upon a quick nuclear phase out in Germany. This is especially interesting, since the same government skipped a similar phase out plan of the previous government in September 2010.

Albeit a radical policy change, the economic effects of the new energy policy seem less drastic. In the short term, reactions show a well functioning electricity market. The market rationally accounted for the fundamental consequences of the moratorium, and the market anticipated that the nuclear power plants would not come back but that parts of the missing capacity would be replaced otherwise, e.g., by imports.

Long run effects are obviously hard to predict. However, the flex-

ibility of the overall European energy systems seems to be sufficiently large to avoid large adjustment costs. Nevertheless, we expect slightly increasing electricity prices. For Germany, this will adversely affect the competitiveness of electricity intensive industries. On the European scale increases in CO_2 prices and long term changes in electricity import-export structures will be the most likely consequences of the post-Fukushima nuclear policy in Germany.

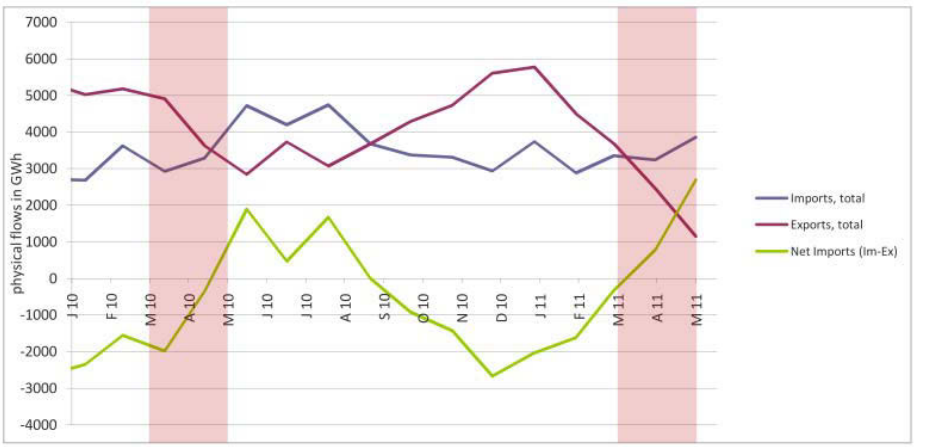

Figure 5: Electricity Imports and Exports in Germany.
Source: own calculations based on monthly data provided by ENTSO-E.

Literature

S. Nagl, M. Fürsch, M. Paulus, J. Richter, J. Trüby, D. Lindenberger (2011), Energy policy scenarios to reach challenging climate protection targets in the German electricity sector until 2050, EWI Working Paper # 10/6, forthcoming *Utilities Policy*.

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The Role of Nuclear Power Generation for a Low Carbon Society: Impact of the Fukushima Accidents on Japan

By Yoshiki Iinuma*

Status of Japan's CO_2 Emissions

Japan is the fifth largest emitter of CO_2 in the world. She emitted a total of 1.145 billion tons of CO_2 emissions in 2009. In Japan, CO_2 accounts for about 95% of GHG. As Figure 1 shows, total CO_2 emissions has decreased significantly in 2008 and 2009 due to the economic recession resulting from the financial crisis.

Over the years 1990-2009, the industrial sector aggressively pursued improvement of energy efficiency in order to compete in international markets. As a result, the industry succeeded in reducing their CO_2 emissions by around one quarter. In the meantime, growth in CO_2 emissions has been notable in the household and commercial sectors. These two sectors accounted for 33% of total CO_2 emissions in 2009.

During 1990-2009, CO_2 emissions from the household sector rose by 27% while the commercial sector increased its CO_2 emissions by 31%. It is highly likely that these sectors will continue to record positive growth in CO_2 emissions. Therefore, these two sectors are now major target sectors to reduce CO_2 emissions in Japan.

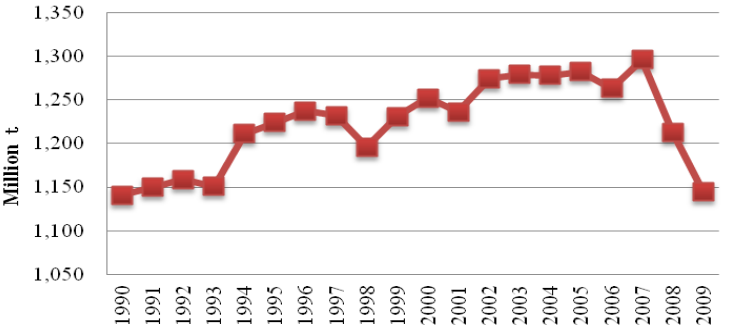

Figure 1
CO_2 Emissions in Japan (1990-2009)
Source: Institute of Energy Economics (2011)

Analysis of CO_2 Emissions

Applying the following Kaya Identity (Kaya, 1989), CO_2 emissions can be divided into three factors. Table 1 below shows the composition of changes in CO_2 emissions in the period of 1990-2009.

$$\Delta CO_2 = \Delta \frac{CO_2}{E} + \Delta \frac{E}{GDP} + \Delta GDP$$

Where ΔCO_2 = annual rate of change in CO_2 emissions

$\Delta \frac{CO_2}{E}$ = annual rate of change in CO_2 intensity in energy

$\Delta \frac{E}{GDP}$ = annual rate of change in energy intensity in GDP

ΔGDP = annual rate of change in GDP

For the period of 2005-2009, all three factors comprising a change in CO_2 emissions recorded negative growth. Among contributing factors, the weak Japanese economy is conspicuous. It can be said that the sluggish economy has been a major factor bringing about the reduction in CO_2 emissions. The last column in Table 1 shows the ambitious target for 2005-2020 that former Prime Minister Hatoyama pledged. Given the 30% reduction target, Japan needs to reduce carbon intensity and energy intensity significantly assuming positive GDP growth.

Energy Policy before Fukushima

The Strategic Energy Plan is national energy policy. It was formulated first in 2003 and revised in 2007 and 2010. The Strategic Energy Plan of 2010 (the Plan) aims at achieving three *E*s that are *E*nergy Security, *E*nvironmental Protection and *E*fficient Supply. The Plan set various targets. Table 2 summarizes major goals involving nuclear power generation and renewable energies in the Plan.

Targets for nuclear power generation were thought to be quite ambitious in light of circumstances surrounding nuclear power such as a lack of public acceptance by local communities even when the Plan was crafted. The goal set for renewable

* Yoshiki Iinuma is Director, Research Department, Japan Electric Power Information Center, Inc. The views expressed are his own and do not necessarily reflect the views of JEPIC.

	1990-2000	2000-2005	2005-2009	30% Reduction Target (2005-2020)
Δ GDP	1.1	1.3	-0.6	1.1
$\Delta \frac{CO_2}{E}$	-0.5	0.3	-0.6	-3.5
$\Delta \frac{E}{GDP}$	0.3	-1.1	-1.7	
ΔCO_2	0.9	0.5	-2.9	-2.4

Table 1. Composition of CO_2 Emissions (1990~2009)

Source: Data are from the Institute of Energy Economics (2011)

	2020	2030
Nuclear Power Generation	•Build 9 new nuclear power plants •Attain 85% capacity factor	•Build 14 new nuclear power plants •Attain 90% capacity factor
Renewable Energies	-	•20% of total electric generation by expanded feed-in tariff and other measures to promote use of renewables

Table 2. Nuclear and Renewable Energies in the Strategic Energy Plan

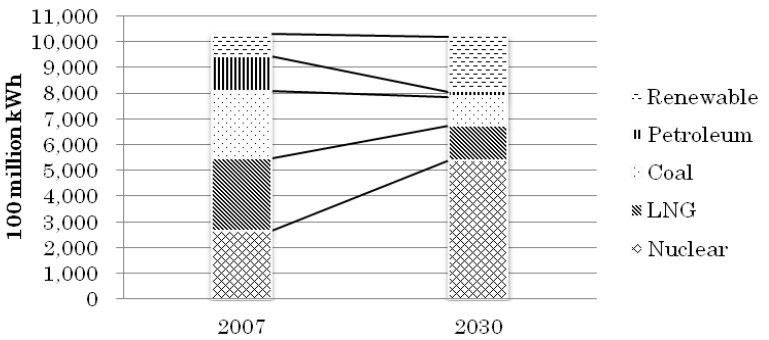

Figure 2 Generation Mix in 2007 and 2030

Source: Data are from Ministry of Economy, Trade and Industry (2010)

Measures	CO_2 Reduction (million ton)	Investment (trillion yen)	yen/ton
Energy conservation of houses and buildings	59	50.3	852,542
High efficiency hot water supply devices for household	19	4.6	242,105
Highly efficient illumination	28	4.2	150,000
Energy conservation in IT equipment	30	6.0	200,000
Renewable energies	60	26.1	435,000
Nuclear power plants	160	5.6	35,000
Improvement in thermal efficiency	25	2.5	100,000
Others	123	31.6	256,910
Total	504	130.9	259,722

Table 3. CO_2 Reduction and the Amount of Investment by 2030

Source: Ministry of Economy, Trade and Industry (2010)

energies is also very challenging due to the intermittent nature of renewable generation technology and the current cost level.

The government estimated the costs and amount of CO_2 reduction associated with diverse measures including nuclear and renewables. As Table 3 shows, it would cost 131 trillion yen to reduce about 500 million ton from CO_2 emissions in 2007.

Specifically, the amount of investment for new nuclear power plants is estimated to be 5.6 trillion yen which results in the reduction of CO_2 by 160 million tons while renewable energies cost 26.1 trillion yen to cut 60 million tons. The last column in the table 3 is cost of reducing one ton of CO_2. It clearly indicates that nuclear power generation is the most cost effective source of CO_2 reduction. The reduction cost by renewables is about 12 times higher than by nuclear power generation. Generally, generation costs by renewables are still higher than conventional power sources. To make use of a large bulk of on-grid renewable energies, power system operators need to also have extra measures to stabilize and balance the system. Installing batteries or re-dispatching thermal power plants are typical measures to make up for the intermittency of wind and PV. These measures are not inexpensive. Therefore, it is quite understandable that nuclear power generation is recommended as the most effective power source in order to achieve zero carbon generation. Either way, these estimates tell us that the marginal cost of achieving the CO_2 reduction target is quite high.

The Role of Nuclear Power after the Fukushima Accident

The government has begun to review the Plan because of the accidents at the Fukushima Daiichi Nuclear Power Plant. The direction of revision is clear. As the Prime Minister stated at the Commemoration Ceremony of the 50th Anniversary of the OECD, renewable energies will be elevated to one of the core energy sources. His plan is that the share of renewable energy in total electric power generation is increased to at least 20% by the earliest possible in the 2020s. His plan appears to move up the Plan to earlier than 2030. To realize this target, the administration is expecting to lower the cost of PV as one of the key renewable energies to one third of the current level by 2020 and to one sixth by 2030. Yet the base of his plan has not been clarified. His ambitious plan is simply doubtful.

The biggest question is the role of nuclear power generation. It goes without saying that nuclear power is the most important power source to tackle climate change. For Japan, which lacks natural resources, nuclear power is also a quasi-indigenous energy source for energy security. According to the Plan formulated before Fukushima,

14 new nuclear power plants were supposed to be built by 2030 as Table 2 shows. In order to achieve the CO_2 target in 2020 and 2030, nuclear power was expected to play a central role.

However, it has become extremely difficult to attain public acceptance of nuclear power from local communities as a result of the accidents. Realizing the Plan is, therefore, highly improbable, particularly in light of public sentiment against nuclear power. There are also uncertainties for existing nuclear power plants in Japan.

As of May 15th, only 17 units are in operation. The remaining 37 units are not in operation. Fourteen units out of 37 units suspended operation due to the earthquake. Among these, four units of Fukushima Daiichi will be decommissioned. It is uncertain when ten units can resume operation. In addition, 21 units are under regular inspection and maintenance. For these units, utilities are facing opposition from local communities to resuming operation. In addition, two units at Hamaoka owned by Chubu Electric Power Company also halted operation in early May in response to the request by Prime Minister Kan. It will take several years to implement measures to withstand a tsunami as demanded by the administration. Consequently, about 70% of Japan's nuclear power generation has not been in operation since March 11.

To make up for the expected shortage of supply capability to meet peak demand in the short term, alternative sources will be thermal power generation using LNG and energy saving. Tokyo Electric Power Company is going to be installing gas turbines and opening mothballed thermal power plants. However, it is likely that not only Tokyo EPCO but other EPCOs will face a shortage of power depending on the availability of existing nuclear power plants. As for energy saving, the government imposed a 15% restriction on power uses of large customers in the summer, invoking Article 27 of the Electricity Business Act governing the electric power industry. Other users, including households, are asked to save as much electricity as possible as well.

The future of nuclear power generation in the mid-term and long-term is quite uncertain. One thing is clear, however. We will not be able to build new nuclear power plants as included in the Plan before the Fukushima accidents. Siting new nuclear power plants is now impossible at least until credibility of nuclear power is restored. In case of the U.S., it took almost thirty years to revive nuclear power after the Three Mile Island accident.

There are four options for the future of nuclear in Japan. The first option is expansion of the share in generation mix, which was the energy vision for the government and electric utilities before Fukushima. Nuclear power generation was supposed to account for about 50% of total electric power generation in 2030. This target was the base of reducing CO_2 by 30% by 2030 compared with 1990. The second option is maintaining the current share of nuclear power generation for the foreseeable future. Nuclear power generation accounted for about 30% of total electric power generation in 2009. To retain this share, all existing nuclear power plants will at least have to take additional costly measures to enhance safety. The third option is the phase-out of nuclear power plants. Several countries including Germany have decided to phase out nuclear power after the nuclear accidents at Fukushima. The fourth option is to abandon nuclear power immediately.

The first option is not available as we mentioned earlier. The fourth option is simply not realistic. Therefore, the remaining options are either the second or the third. That is, maintaining status quo of nuclear energy or eventual phase-out. In the case of the status quo, however, utilities are required to replace old units at some point of time after 40 years of commercial operation. As figure 3 and table 4 show, 70% of nuclear units were built in 1970's and 1980's. Even if we do not expand the role of nuclear power, we will need to replace aging units with new advanced units which will be safer and more costly. Needless to say, the consent of local communities is a necessary condition for replacement to maintain the status quo.

The critical question is whether we should or should not phase out nuclear power. This question is very contentious. We have learned from the Fukushima accidents that the ramifications of nuclear accidents are immense. An unexpected event such as a huge tsunami may happen again even if we can build much safer nuclear plants. The probability of a similar accident occurrence at the Fukushima Daiichi can never be zero. We must be humble before Mother Nature. From such a perspective, we would abandon nuclear power as soon as possible.

In the meantime, we need nuclear power from a different perspective. It appears that an energy mix without nuclear power is an implausible option for Japan from the standpoint of the international commitment to CO_2 reduction and in order to secure energy security. Renewable energy alone cannot replace conventional power sources including nuclear power in the foreseeable future. The intermittent nature of wind and PV requires thermal power plants to back them up. The batteries which are needed to maintain the reliability and stability of the power system are still very costly. Operating the power system with renewable energies also needs new technologies such as the Smart Grid. There are, therefore, a number

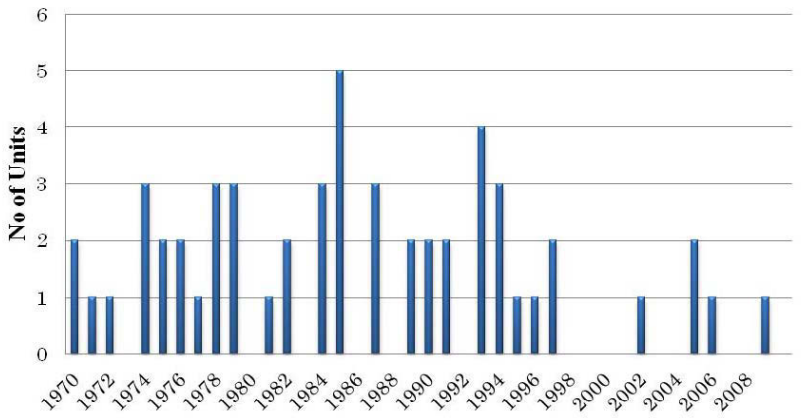

Figure 3. Commissioning Year
Source: Data are from Japan Atomic Industrial Forum (2011)

Vintage	Units (%)
30-40	19 (35%)
20-29	19 (35%)
10-19	11 (20%)
1-9	5 (10%)
Total	54 (100%)

Table 4. Distribution of Nuclear Units by Vintage
Source: Data are from Japan Atomic Industrial Forum (2011)

of challenges ahead to harness renewable energies in the centralized power system.

In either the case of the status quo or phase-out of nuclear energy, we will not be able to achieve CO_2 reduction targets. Reportedly, the Ministry of Environment estimated that CO_2 emissions would increase by 26 million tons per year as a result of suspension of six units at the Fukushima Daiichi (Yomiuri Shinbun, April 20, 2011). If nine new nuclear power plants as planned by the Plan are not built and fourteen existing nuclear power plants cannot resume operation, then emissions will increase by 120 million tons in 2020, which is a 10% increase in total CO_2 emissions compared with the 1990 level, according to another estimate conducted by the research institute (Tatsuo Kobayashi and Tetsuya Hattori, June 2011),

CO_2 will increase by 75 million tons next year which accounts for about 6% in total CO_2 emissions if all nuclear power plants were suspended and their capacity replaced by thermal power generation next year. In this case, Japan would face a serious shortage of power since the capability of thermal power is not sufficient to replace nuclear power.

Concluding Remarks

The ramifications of nuclear accidents are enormous. According to a study, the cost of the Fukushima accidents could be between 5.7 trillion and 20 trillion yen (Japan Center for Economic Research, April 2011). A major part of this cost is the cost of decommissioning. It would take at least ten years to decommission the damaged nuclear units, technically. However, since Tokyo EPCO has not succeeded in containing a meltdown yet, these estimates of decommissioning costs are indeterminate.

Nuclear power plants in Japan have been owned and operated by investor-owned electric utilities with the support of the national and local governments. The accident is forcing reconsideration of various issues involving the electric power industry. Whether we should nationalize nuclear power operation is one such issue. In light of nuclear power which contributes greatly to reducing CO_2 emissions and national security as public goods, there is an argument that the public sector rather than the private sector should be responsible for nuclear power operation. We have learned that the risks involving nuclear power operation transcend the capacity of a private company.

Discussion of such issues is beyond the scope of this paper. All that can be said is that it is time to review the electricity supply system fundamentally. The current electricity supply system was established 60 years ago immediately after the end of the World War II. Since then, the system has remained intact although there were some minor reforms in the Post-World War II era. The Fukushima disaster seems to be a wake-up call for us to create a better energy system for Japan.

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China's Booming Gas Sector: Threat or Promise?

By Philip Andrews-Speed*

China's domestic natural gas sector has changed beyond recognition over the last twenty years. Back in the early 1990's, annual domestic production was about 16 billion cubic meters and natural gas accounted for about 2% of total primary energy supply. Most of the gas was produced and used in just two regions, Sichuan in the south-west and Daqing in the north-east. Any company seeking to explore for and develop new gas fields would be told by the government that the preferred use for the gas was for manufacturing fertiliser – not an attractive commercial prospect, even for a Chinese national oil company.

The discovery, in the early 1990s, of new gas accumulations in the Ordos Basin in north-central China changed that outlook. The country's economy was growing rapidly, driving up energy demand, and the government realised that natural gas could provide not just additional supplies of energy but also that this energy was clean. Thus the first use for these new gas supplies in the late 1990s was to provide gas for heating, cooking and industrial uses in the cities of northern China, including Beijing. The progressive enlargement of these gas reserves in northern China and the discovery of new gas fields in north-west China encouraged the construction of a network of gas pipelines spanning the breadth of the country and triggered a new pricing regime that seeks to promote the exploitation of natural gas.

By 2010, annual domestic production of natural gas had risen to 95 billion cubic meters, six times that of twenty years earlier, and annual consumption had reached 107 billion cubic meters. These figures are at the very top end of the projections and targets set ten years ago. The one target which has not been met was the goal set in the late 1990s, that natural gas should account for 8% of primary energy supply in the year 2010. Instead it accounts for just under 4%. But this is not a failure of the gas industry, rather it represents a failure to constrain total energy demand. Also, ten years ago, many observers expected that much of the new gas supply would be directed at power generation, but this was not the case. Instead, industry accounts for 60% of demand and the residential sector (city gas) 20% , whilst only 20% goes to power generation.

The gap between consumption and domestic production has been filled, first, by liquefied natural gas (LNG) and, since last year, by gas from Turkmenistan supplied by pipeline. Total gas imports in 2010 amounted to about 16 billion cubic meters. Imports will continue to grow rapidly. CNOOC has recently started construction on its fourth LNG terminal. CNPC's first LNG terminal, in Jiangsu, will receive its first shipment of gas this year. Its terminal in Dalian is near completion and construction on its third LNG terminal will start in Tangshan this year. The total annual quantity of LNG contracted for the year 2014 already exceeds 30 billion cubic meters, mainly from Australia, Southeast Asia and the Middle East.

Flows of gas through the pipeline from Turkmenistan will progressively build up, reaching an expected 15 billion cubic metres in 2011 and rising to 30 billion cubic meters or more by 2015. In December 2010, construction started on a pipeline to bring gas from Kazakhstan to China. A new pipeline from Myanmar could supply a further 12 billion cubic meters by 2012.

These LNG and pipeline projects together could provide China with at least 60 billion cubic meters per year of gas imports by 2015. This amount may be further supplemented in due course by natural gas supplied by Russia along two pipelines, with a total capacity of nearly 70 billion cubic meters. Discussion between the two countries over gas supplies have continued on and off for almost twenty years. It is too early to say whether the current round of talks will indeed yield a deal, though the completion of the oil pipeline from Skovorodino may be a favourable sign.

Such plans and statistics will have formed the basis of the government's recent announcement that gas imports are expected to rise to 90 billion cubic meters by 2015, and that domestic production may grow to 170 billion cubic meters, with contributions from unconventional gas. This implies a total annual consumption in 2015 of 260 billion cubic meters, 2.4 times that in 2010, and an annual rate of growth of 20%. This is faster than the average of 18% over the previous five years. If these goals were to be achieved, the share of natural gas in China's primary energy supply might indeed reach 8% by 2015, which was the target originally set for the year 2010.

Such a growth in China's gas sector would place it behind the USA and Russia as the third largest gas user in the world and among the largest importers of gas, alongside Japan and Germany, and possibly the USA. Over the last decade or so, China has become progressively more dependent on international energy markets for imports, first for oil, then for coal and now for gas. Whilst this trend yields many benefits in terms of integrating China into the world economy, the scale of the country's energy sector means that small changes in the annual import requirement can

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have major impacts on international energy markets, driving prices sharply up or down in the short-term. We have seen this happen for oil and coal, we should now expect the same in natural gas markets.

However, the wider benefit of greater gas use is that China's energy sector will become progressively cleaner and more efficient, assisting the country's move to a low-carbon economy. The real question at this stage is whether the country's gas industry can successfully manage such rapid growth over the next five years. This will require coordination of construction and operation from well-head to burner-tip over a vast area and involving thousands of businesses and millions of households. Past performance in the domestic coal and natural gas industries during periods of rapid growth suggests that disruptions and discontinuities are likely to occur on account of the scale and complexity of the task, and through the ambiguity of policy instruments and economic incentives.

IAEE/Affiliate Master Calendar of Events

(Note: All conferences are presented in English unless otherwise noted)

Date	Event, Event Title and Language	Location	Supporting Organizations(s)	Contact
2011				
October 9-12	30th USAEE/IAEE North American Conference *Redefining the Energy Economy: Changing Roles of Industry, Government and Research* http:/www.usaee.org/USAEE2011/	Washington, DC	USAEE/NCAC/IAEE	USAEE Headquarters usaee@usaee.org
2012				
January 6-8	Annual ASSA Meetings *Energy Commodity Prices, Capital Flows & Balance of Payments // Topics in Energy Modeling*	Chicago, IL	IAEE/USAEE	Ken Medlock medlock@rice.edu
January 26-27	7th Spanish AEE Conference *Call for Papers Open until November 13* www.aeee.es/en/activities.php	Pamplona, Spain	SAEE	Enrique Loredo Fernandez eloredo@uniovi.es
February 20-22	3rd IAEE Asian Conference *Growing Energy Demand, Energy Security and the Environment in Asia*	Kyoto, Japan	IEEJ	Kenichi Matsui *kmatsuijr@aol.com*
April 23-24	5th NAEE/IAEE Conference Energy Technology and Infrastructure for Sustainable Development	Abuja, Nigeria	NAEE	Adeola Adenikinju adeolaadenikinju@yahoo.com
June 24-27,	35th IAEE International Conference *Energy Markets Evolution under Global Carbon Constraints: Assessing Kyoto and Looking Forward*	Perth, Australia	AAEE/IAEE	Ron Ripple r.ripple@curtin.edu.au
September 9-12	12th IAEE European Conference *Energy Challenge and Environmental Sustainability*	Venice, Italy	AIEE/IAEE	Edgardo Curcio e.curcio@aiee.it
November 4-7	31st USAEE/IAEE North American Conference *Transition to a Sustainable Energy Era/ Opportunities and Challenges*	Austin, Texas	USAEE/CTAEE/IAEE	USAEE Headquarters usaee@usaee.org
2013				
April 8-9	4th ELAEE Conference Theme TBA	Montevideo, Uruguay	LAAEE	Marisa Leon melon@adme.com.uy
June 23-27	36th IAEE International Conference *Energy Transition and Policy Challenges*	Daegu, Korea	KRAEE/IAEE	HoesungLee

Sustainable Energy Policy in Japan, Post Fukushima

By Joni Jupesta and Aki Suwa*

Background

Japan has limited fossil fuel reserves. It imported 83% of its total energy supply (coal 20%, oil 41% and gas 19%) in 2009. In terms of electricity, in 2009 Japan generated 1113 TWh of which 25% came from nuclear, 67% from combined oil, gas and coal, and the rest, 8%, from hydropower

This energy structure of Japan has to be understood within the context of the U.S./Japan relationship, which determined the level and the pattern of Japanese economic development. The current industrial energy structure, especially electricity company formation, was the brainchild of U.S. strategy: the privatized electricity companies originally functioned to reduce the Japanese central government's power over the energy industry, as well as to open the Japanese market to the international oil companies. In exchange, the U.S. supplied Japan with the technical assistance and a market for its final products. The oil crisis of 1973 marked the turning point for Japan, making it consider the issue of national energy security. An energy source diversification policy was adopted, including various energy efficiency measures. Subsequently, Japan's oil imports have decreased, while coal and natural gas imports have increased. Within the diversification context, nuclear energy also gained a position, replacing imported oil. Despite the fact that energy security policy was much discussed in reference to national energy independence, U.S./Japan co-operation continued for nuclear development. Many argue that nuclear development was only to increase Japan's reliance on U.S. companies, as they control nuclear fuels (Kihara, 1980). Japan's current proven fossil fuel reserves are regarded as immaterial, and the development of its indigenous energy sources is limited. However, the possibility of their future development should not be denied. For example, 821 million tonnes of coal are available for mining in Japan, while some natural gas reserves are also obtainable. With technical development, those reserves might be utilized. Technologies to develop renewable energies are comparatively well advanced in Japan. However, their practical application is unsatisfactory, with a rather modest target for their further utilization.

The government-industry relationship, whose foundation dates back to post WWII U.S. policy, has been kept under tight control until recently, and the relationship between the government and the electricity companies contributed to allowing the current nuclear accidents and government reactions to it. The energy industries were enjoying a virtual monopoly over their supply areas for decades, with competition among and within the supply area being restricted. Market liberalization was brought into the policy contexts, as a means to bring economic efficiency. So far, however, the effect of market liberalization has been marginal, and the movement was halted after 1990s.

Economics

The cost of energy production shows that nuclear energy provided the lowest cost (at 0.20 US$) per kWh in 2008. In comparison, the production cost with coal, gas and oil are 0.40, 0.80 and 1.80 US$ per kWh, respectively (World Nuclear Association, 2011). The production costs using renewable energy sources, such as biofuel, solar photovoltaic and others, are even higher per kWh. The availability of coal is huge in East-Asia (China, Australia, Indonesia), but using coal is less desirable as greenhouse gas (GHG) emissions from coal are higher than for gas and oil with the same energy content. Thus coal must utilized with clean coal technology, making it still more expensive. Renewable energy sources such as solar, wind and biomass can play a role in reducing oil dependency in the future, but economic production and technology development will be the major determinants in their development. To promote renewable energy as a main energy source, requires introduction of a carbon tax and allocation of the proceeds to renewable energy R&D. National legislation on a feed in tariff for renewables is close to submission to the Parliament. Through these, it is expected that renewable energy costs could be more competitive and the gap in production costs with nuclear energy diminished.

Environment

Whilst coal, oil and gas emit 484, 350 and 270 kg CO_2 /MWh, renewable energy sources as biofuel are also not entirely CO_2 free during combustion, and could be even higher than with fossil fuel with the same energy content, in some situations (Jupesta, 2011). From this point of view, nuclear was considered by the Japanese government as a climate mitigation technology. However, safety issues became the major hurdles for further implementation of this technology,

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as is obvious from the huge environmental and economic impact of the Fukushima disaster (The Economist, 2011a). It is estimated that the cost for the Fukushima nuclear leakage may grow to US$600 billion. Radiation from explosions on the site was deposited on land, and highly contaminated water has been pumped from the nuclear reactor into the Pacific Ocean. These will directly and indirectly affect humans and the ecosystems at various geographical scales. Even before the earthquake, there was recognition that the nuclear energy expansion would not save Japan from oil dependency since some of the energy demand sector, such as transportation, still needs a huge amount of gasoline.(Barret, 2011).

Politics

Japanese politics are known to be less potent than its administrative bureaucracy, which practically determines government policy in most fields. This is largely a result of the single party dominance by the Liberal Democratic Party (LDP) which lasted nearly 40 years beginning in 1955. Under the LDP regime, bureaucrats could predict and produce necessary policy proposals, including those related energy issues. The LDP had a deep connection with U.S. nuclear interests, and it formed schemes to introduce and maintain nuclear technology in Japan. After the LDP regime lost power in 1993, Japanese politics became highly fluid. The Democrat Party took power in 2009. The current Prime Minister Kan has a personal record of backing renewable energy, and in May 2011, he announced that renewables would be the main pillar of Japan's energy policy. His plan, the Sun Rise Project, is to install photovoltaic (PV) devices on all available roof tops in Japan by 2030, and to promote large scale off-shore wind turbines, biomass and geothermal energy by 2020.

There are thus some signs that the politicians will take public demand on environmental and safety issues into account. The "ancient regime", however, remains and resists change. For example, many LDP Members of Parliament are representing the vested interests of particular industrial sectors, notably the power generating industry, and act to protect the industry's business interests. The Japanese Democrats, on the other hand, seem not yet able to co-ordinate sufficient policy integration to counter these interests. Further political leadership is seen necessary if there were to be a firm political commitment for the energy and environmental security in Japan.

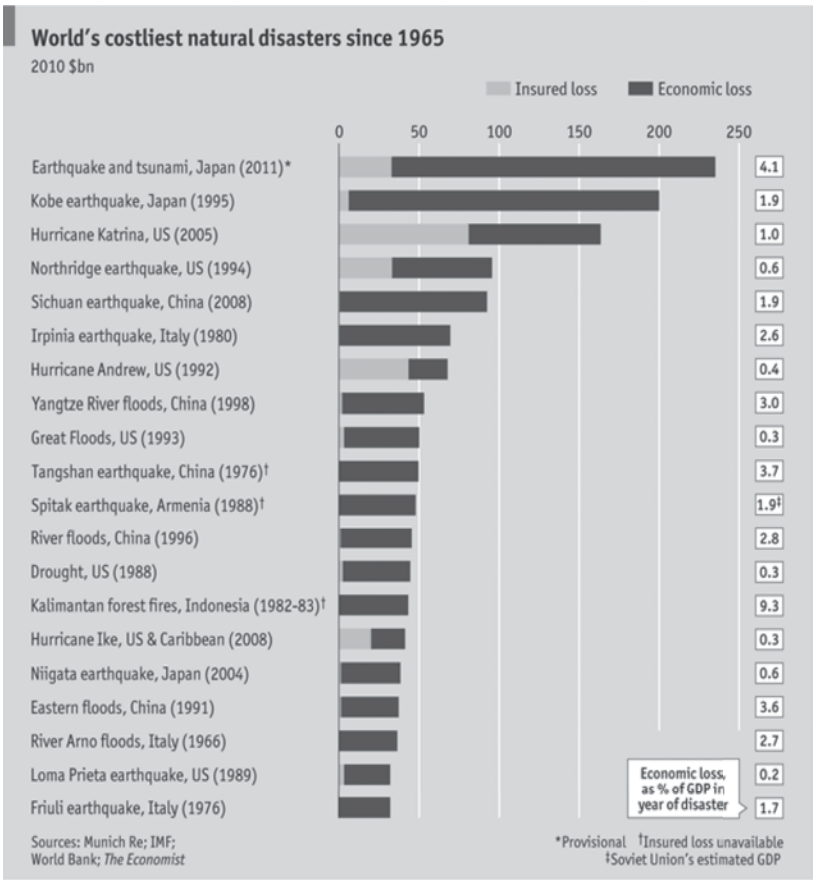

Figure 1: The Cost of Natural Disasters
Source: *The Economist*

The Economic Impact of Fukushima

Soon after the earthquake, 11 reactors in Miyagi, Fukushima and Ibaraki prefectures were automatically shut down. The other 3 reactors in Fukushima prefecture are still under inspection at this writing. Altogether 12 GW of power supply was disrupted which accounts for 25% of Japan's electricity supply (Japan's Ministry of Economy Trading and Industry, 2011). Japan is expected to have a large amount of property loss and (relative to the size of the earthquake and tsunamis) small human casualties. It is reported that this earthquake will cost Japan between 5-7% of its GDP or US$300-600 billion (Kashyap and Hoshi, 2011). In comparison, the Kobe Earthquake in 1995 cost Japan 2% of its GDP. The Great Kanto Earthquake in 1923, which devastated the Tokyo area, cost 30% of GDP for its property damage. The cost of the world's recent natural disaster is shown in Figure 1.

Electricity supply in the Metropolitan Tokyo area was thrown into chaos after the Fukushima Dai-ichi nuclear plant and other generators were shut down by the quake and tsunami. Through compulsory power cuts executed by TEPCO and energy saving measures, mainly in the Kanto region, in addition to power generation from local utilities and industries, electric-

ity supply became marginally sufficient to meet demand. The study from the Institute of Energy Economics shows several measures to save energy: lighting reduction can save 1.72-2.95 GW; increasing 1-2 degrees Celsius in air conditioning settings can save 0.45- 0.94 GW; office automation machines using energy saving modes can save 0.36 GW and reducing elevators and escalators can save 0.17-0.28 GW (The Institute of Energy Economics, 2011c). To cope with the anticipated electricity shortage, companies and households have shown a willingness to curb demand during peak hours, which the government hopes will ward off blackouts.

The operator of the Fukushima power plant, TEPCO, has lost four-fifths of its value because of the disaster. TEPCO posted the largest loss in Japanese corporate history outside of the financial sector on 20th May which amounted to ¥1.2 trillion (The Economist, 2011b). That does not include compensation payments (which are estimated over ¥2 trillion), which will be too much of a financial burden for a single utility like TEPCO. Therefore, the government is currently developing a scheme to support TEPCO to complete compensations. TEPCO, in the middle of public anger, has been trying to ease the situation by selling assets unrelated to supplying energy (such as property and cross-shareholdings) and halting its business expansion. This company has cut 40% and 25% of executives and workers' salaries, respectively, and its president, Masataka Shimizu, has stepped down.

After the Fukushima nuclear leakage, Chubu Electric agreed to the request from Prime Minister Kan to stop all its nuclear reactors at the Hamaoka Nuclear power plant in Shizuoka prefecture. Many other governors have been seriously concerned that they may face a similar situation as Fukushima, in case of earthquake and tsunamis. Currently only 19 of the country's 54 nuclear reactors are in service. The tsunami impact worsened the situation in three prefectures (Miyagi, Fukushima and Iwate). Toyota, the automobile giant, delayed its production as one of its suppliers located in Fukushima was severely affected. The microcontroller chip supplier is expecting to be back to normal production by the autumn. Many other small and medium enterprises (SME) were also devastated. The Government has tried to support the economic recovery by several financial schemes which totaled 10 trillion yen for SMEs (Japan's Ministry of Economy Trading and Industry, 2011). These funds also support early restoration of infrastructures for oil and gas terminals, facilitating projects to save electricity, and subsidizing radiation level inspection of export product.

The question of how much of these government reactions could be substantiated for the Fukushima reconstruction is a matter of argument. Japan is thus facing a cross roads where long term sustainability challenges energy security and economic viability. At the moment of writing, Prime Minister Kan is in the midst of criticism for handling the crisis. However, looking back at the history of energy interests which formed the background to the current nuclear disaster, there is no guarantee that any politician of the opposition party, as well as those in the ruling party, could handle the situation better. After the disaster, politicians, regardless of party, generally feel it would be difficult to return to nuclear development in Japan, but they consider that it would be an economic loss to abandon all the nuclear related technologies. Therefore, they may choose to maintain nuclear as a "technology", though further increases of nuclear as "power" may not materialize. Development of alternative energy, on the other hand, requires further political commitment in order to be firmly rooted in the Japanese energy systems.

A recent survey conducted by Asahi Shimbun shows that 74% of voters support abolishing nuclear power after a phase out period, compared with 14% opposed. Sixty five percent said that renewable energy for electricity production should be increased and electricity fees raised (Asahi Shimbun, 2011). Despite the concern for nuclear safety, shown by the nuclear phase out in Germany, Italy and Switzerland, some other countries did not change their nuclear development policies due to tight energy supply-demand balance and underdeveloped social infrastructure which is crucial for their high economic and industrial growth. China, India, Pakistan, Russia and Bulgaria are moving forward to increase nuclear power with French support. Even concern about the safety issues of nuclear power, cannot stop their use of nuclear power because phase out would lead to an economic recession (The Institute of Energy Economics, 2011b).

Summary

There are several conclusions which could be drawn from this study:

* From an energy security perspective, and international nuclear market development, Japan may still maintain nuclear technology as one of the energy sources for the time being, but its future capacity increase, as previously planned, became highly uncertain after the Fukushima accidents.
* From the economic point of view, the cost of production of nuclear energy in Japan is the lowest compared to all other sources, but most of the existing cost calculations have not taken account of

all the externalities and government subsidies.

* To promote renewable energy, policy options such as a carbon tax and feed in tariffs could be introduced to produce lower production costs of renewable energy and diminish the wide cost gap with nuclear energy.
* From an environmental point of view, nuclear energy was considered as a climate mitigation technology. Considering the huge risk of nuclear leakage, the safety issue became the top issue in considering any further nuclear development.

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The Institute of Energy Economics, 2011b. New Nuclear Plant Inauguration in Developing Countries-"Only Rich Countries Have the Option of Phasing out Nuclear"- Is This True? The Institute of Energy Economics, Tokyo.

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Member Get A Member Campaign Continues Success

Wally Tyner Wins Complimentary Registration to the Wasington USAEE/IAEE North American Conference

IAEE's Member Get a Member campaign was a grand success in the second quarter with 48 new members added in that period as a direct result of this program.

Members had their membership expiration date advanced three months for each new member referred. Wally Tyner, with Purdue University, referred the most new members – 4. He won a complimentary registration to the Washington North American Meeting.

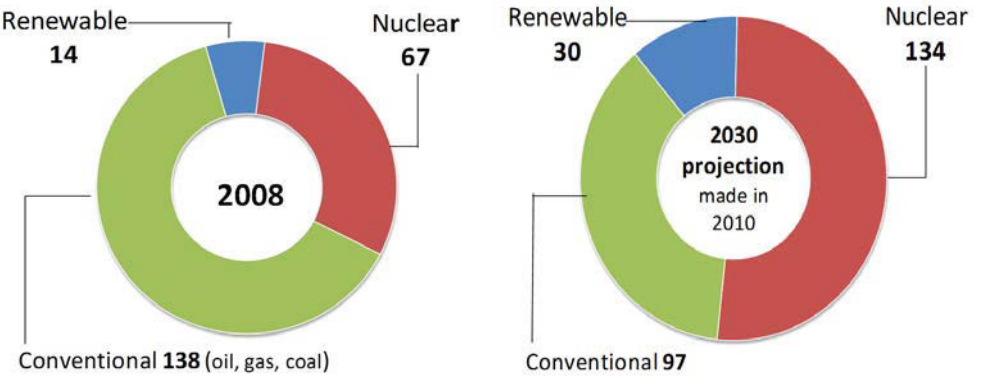
Plan B: Japan Rethinks Its Nuclear Future

The beginning of the end, or the end of the beginning, or mere readjustment?

By Perry Sioshansi*

Before the Fukushima Nuclear Plant went out of control following the magnitude 9 earthquake and the ensuing tsunami on 11 March 2011, Japan was on record to increase its dependence on atom for electricity generation from the current 30% to roughly 42% by 2020 and 49% by 2030. That would have required the building of at least 14 new reactors. That was the government's Plan A, strongly endorsed by the 10 private electric utilities, Tokyo Electric Power Company (TEPCO) being the largest by a big margin.

In mid May 2011, however, Prime Minister Naoto Kan announced that time had arrived for Plan B – a future less heavily reliant on nuclear power. At an official briefing, a sober looking Mr. Kan in uncharacteristically undiplomatic language said, "The existing energy policy outline needs to be scrapped, and discussions should be started from scratch."



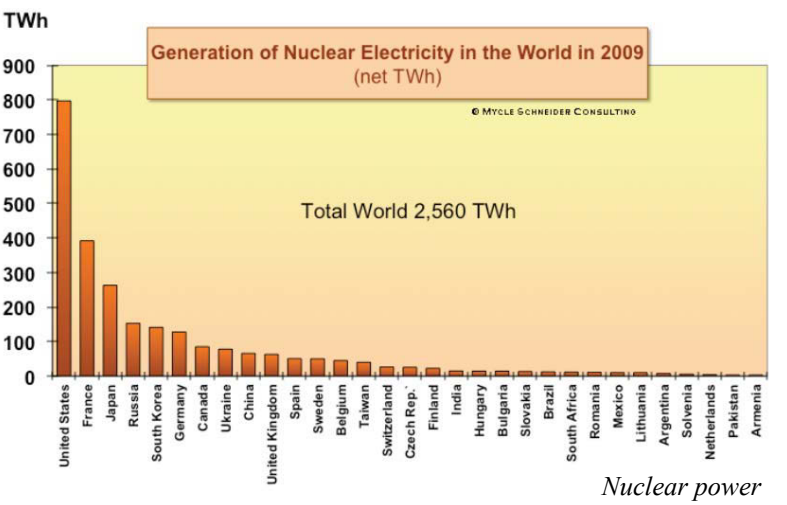
Now to Plan B
Japan's power generation mix, 2008 and as previously planned for 2030, in million metric tons of oil equivalent

Source: *The Wall Street Journal* (11 May 2011) based on IEA data

He added that the country's overwhelming historical dependence on imported oil and nuclear power must be augmented by increased reliance on domestic renewable energy resources and on energy conservation. Japan, like South Korea, has virtually no indigenous energy resources other than hydro – which have already been largely tapped.

The envisioned about face, assuming that the Minister's views prevail and are pursued, will mark the beginning of the end for Japan's important nuclear industry. Before the Fukushima accident, the country's 55 operating reactors had a rated capacity of 47 GW – only France and U.S. have more installed nuclear capacity.

But the writing is already on the wall. Fukushima's 6 reactors are unlikely to ever see the light of day, while several other TEPCO nuclear facilities may also come under pressure to shut down, some permanently. The government has already ordered Chubu Electric Power Co to shut down the Hamaoka nuclear plant due to safety concerns.



Nuclear power
Nuclear generation by country, 2009 data in TWh

Source: Nuclear power in a post-Fukushima world, WWI, 2011

The nuclear's crisis of confidence in Japan is being felt in countries close and far. South Korea, the other regional nuclear powerhouse with 21 operating reactors and nearly 19 GW of installed capacity, is also re-examining its nuclear future in face of safety concerns. Korea, which currently depends on nuclear generation for 31% of its electricity needs, was planning to increase this share to 48% by 2022 and 59% by 2030. These ambitious plans are now under review.

In Germany, the decision to shut down 7 existing reactors has resulted in increased greenhouse gas emissions due to more heavy reliance on coal-fired plants – not a desirable outcome (see next page). Ironically, some of the gap created by the absence of the 7 nuclear plants has been filled by nuclear imports from France and the Czech Republic.

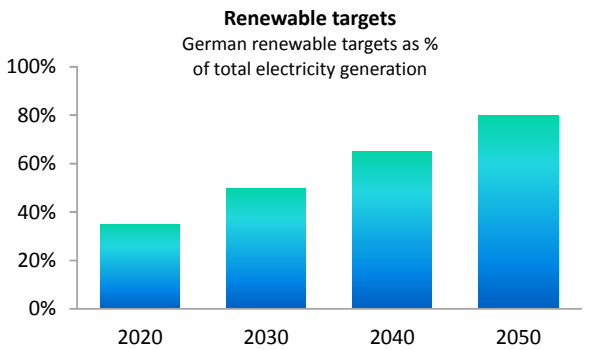
* Perry Sioshansi is President of Menlo Energy Economics and Editor of the *EEnergy Informer*. These articles are reprinted from the latter.

Germany's Knee Jerk Reaction to Fukushima

German Chancellor Angela Merkel, like all politicians, has a habit of changing her mind on the country's energy direction based on what is politically expedient. A few months ago, after much debate, she granted the German nuclear operators a breather. The decision was to allow the life of the 17 existing reactors to be extended by an average of 12 years in return for extracting roughly $43 billion from the country's 4 nuclear operators, Eon, RWE, EnBW and Vattenfall.

Following the Fukushima accident, Ms. Merkel has made an abrupt about face. First, she ordered 7 of the oldest units to be shut down for a 3-month evaluation period – many observers assume that these, plus 1 unit already out of service for repairs, would never come on line again.

Now, an appointed commission looking into the country's future energy options is expected to propose that all 17 reactors be phased out within a decade, replaced with wind, natural gas-fired generation and coal. If approved, it would require the share of renewable energy to increase to 35% 2020, 50% by 2030, 65% by 2040, eventually approaching 80% by 2050, an astonishing target for Europe's industrial powerhouse.

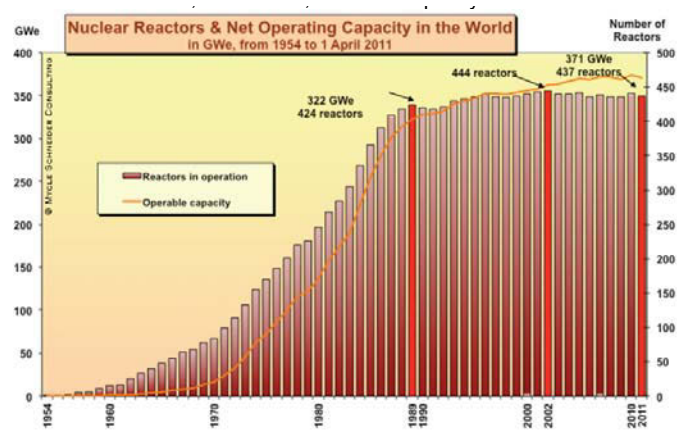


Source: German Govt. proposals

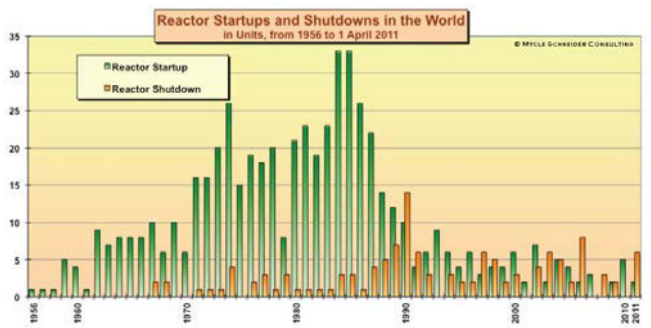
There are a number of guesstimates on how much this would cost – predictions are that average retail electricity rates may have to rise by 25-30%, saddling consumers with an additional $47 billion, disproportionately affecting businesses. One estimate puts the cost of additional investments required to fill the nuclear gap at €20 billion per year for a decade. One can only surmise that the big 4 German generators are not particularly happy about the recent turn of events.

Nuclear's Best Years Are Behind Us

And that was before Fukushima



Peak nuclear?
World nuclear fleet, 1954-2011, installed capacity in GW
Source: Nuclear power in a post-Fukushima world, WWI, 2011



Not so rosy
Nuclear reactor connections and shutdowns, 1956-2011
Source: Nuclear power in a post-Fukushima world, WWI, 2011

When it rains, it pours. The nuclear power sector, never universally loved, appears to be getting more than its share of bad news these days. To top it off, a report prepared for the Worldwatch Institute (WWI) on the occasion of the 25th anniversary of the Chernobyl accident – the worst civilian nuclear accident ever experienced to date – concludes that nuclear energy's best years are already behind us.

"The (nuclear) industry was arguably on life support before Fukushima. When the history of the nuclear industry is written, Fukushima is likely to begin its final chapter," according to Mycle Schneider, lead author of *The World Nuclear Industry Status Report 2010-2011: Nuclear Power in a Post-Fukushima World*. Perhaps slightly overstated, but only time will tell.

The global nuclear generation peak has already occurred, most likely in 2005-6. In 2009, nuclear power plants generated 2,558 TWhs of electricity, about 2% less than 2008. This, according to the Nuclear Energy Institute, industry's lobby organization, was the fourth year in a row of declining generation.

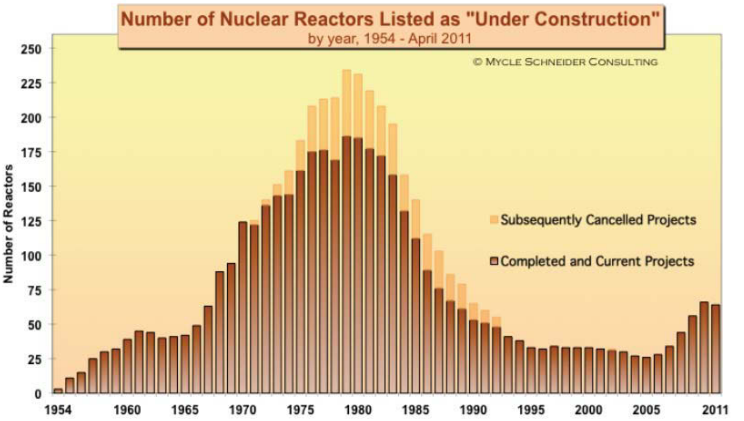
As of 2011, before the Japanese disaster struck, there were 437 nuclear reactors operating in the world, seven fewer than in 2002. At least 14 reactors have been shut down since the accident occurred in Japan and Germany alone – most are not likely to resume operations. More may follow in other countries as further stress testing is carried out.

Moreover, the WWI reports that in 2008, for the first time since the beginning of the nuclear age, no new unit was started up. In 2009-10, 7 new reactors were added while 11 were shut down.

The proponents of the industry often dreamed of a nuclear renaissance – but even the die-hard supporters are now faced with a re-assessment given the negative public perception generated by the recent Japanese accident.

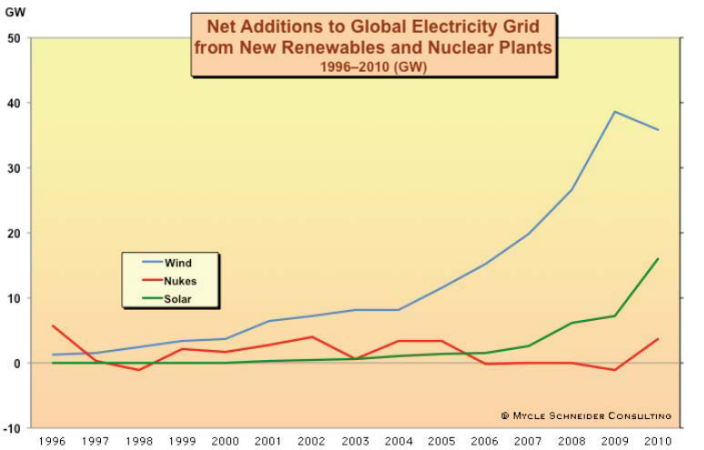
The figure on right shows a slight pickup in new construction of new reactors in the past few years, mostly attributed to a massive planned build in China and India. But even in these countries, the wisdom of the planned rapid nuclear expansion may come into question. China is apparently reviewing its earlier plans, India may follow.

The overwhelming problem facing the industry, however, is the rapid aging of the existing fleet. Even assuming successful re-licensing, life-extension, and uprating – technical alterations at existing plants to increase their output – the existing fleet will eventually have to be phased out of service, sooner or later. Without a massive investment into new reactors, there is no future for nukes.



Time for reassessment
Number of nuclear reactors under construction
Source: Nuclear power in a post-Fukushima world, WWI, 2011

In the mean time, other developments are eclipsing the nuclear's role as an important component of electricity generation. According to WWI, in 2010, worldwide cumulative installed capacity from wind turbines, biomass, waste-to-energy, and solar power surpassed installed nuclear capacity. Far more money is pouring into renewable energy than nuclear power – total investment in renewable energy technologies was estimated at $243 billion in 2010. Very little money is currently flowing to new nuclear projects in Europe or America. Such trends are becoming hard to ignore.



Follow the money
Net additions to global electricity grid from new nuclear and renewables, 1990-2010, in GW

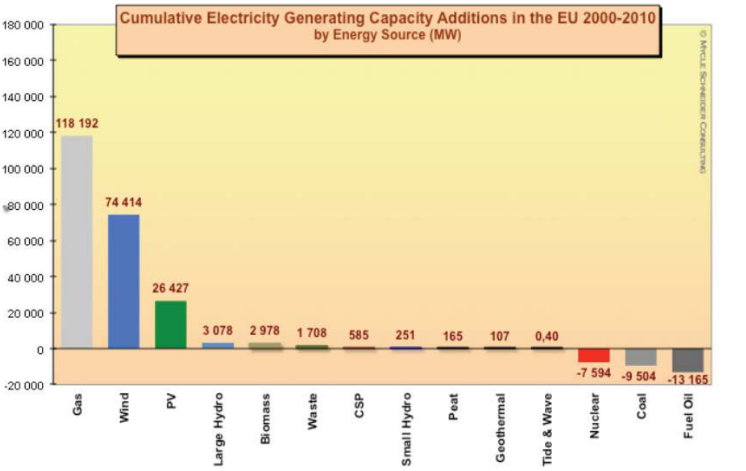
WWI points out that annual renewable capacity additions have been outpacing nuclear start-ups for 15 years. In the U.S., for example, the share of renewables in new capacity additions has increased from 2% in 2004 to 55% in 2009 and growing, with no new nuclear capacity added.

The story is pretty much the same in Europe, where natural gas and renewables will continue to dwarf nuclear's contribution in the electricity generation sector going forward as they have during the past decade. All the talk about the nuclear renaissance – well – appears to be mostly talk.

"U.S. news headlines often suggest that a nuclear renaissance is under way," said WWI President Christopher Flavin. "This was a big overstatement even before March 11, and the disaster in Japan will inevitably cause governments and companies that were considering new nuclear units to reassess their plans."

Mr. Flavin adds, "The Three Mile Island accident caused a wholesale reassessment of nuclear safety regulations, massively increased the cost of nuclear power, and put an end to nuclear construction in the United States. For the global nuclear industry, the Fukushima disaster is an historic—if not fatal—setback."

WWI may be over exaggerating slightly, but the overwhelming evidence is not pleasant news for the nuclear industry.



Do you see a nuclear renaissance here?
Cumulative electricity additions in EU, by energy source, 2000-10, in MW
Source: Nuclear power in a post-Fukushima world, WWI, 2011

The Impact of the Fukushima Nuclear Accident on the Future of Nuclear Power

By Rob Graber and Margaret Harding*

The Fukushima nuclear accident will likely have a limited impact on the future of nuclear power globally for one very simple reason: its role in the world's energy economy was already diminished prior to the accident on March 11th.

According to the U.S. Energy Information Administration's International Energy Outlook 2010[1] nuclear power is expected to comprise about 6% of the world's primary energy supply over the period 2010 to 2035 with little growth expected, particularly in the OECD countries. Natural gas and renewables will comprise most of the energy growth in the OECD countries. In the non-OECD countries, coal and renewables supply the growth; but with a higher nuclear growth rate than in the OECD countries. However, nuclear is growing from a smaller base than the other energy resources. Nuclear is simply not expected to be a factor in meeting the world's energy needs, nor abating atmospheric carbon dioxide (CO_2)[2].

The source of nuclear energy's diminished role is not hard to find. In spite of the fact that the new GEN III reactors were seen to herald in a new age of nuclear with safer, simpler and more efficient technologies, the capital costs were seen as a large barrier to implementation; and the time required to license, construct and commercialize nuclear reactors has not improved from the earlier new build era (1970-1990). These factors belied the initial claims of the industry that the new generation would be considerably cheaper than the GEN II technology, at least in the U.S. and Europe. Outside these regions, capital costs are, in fact, living up to billing, particularly in China, India and Russia.

The response to the accident varied by country; but where a country had aggressive build plans there was little immediate (and probably long term) impact of the accident on scheduling. This is shown in the accompanying table.

As can be seen from the table, except for Japan and Germany, there are no immediate plans to shut down reactors. Of countries with large nuclear fleets, or aggressive construction projects underway only the U.S. and China are holding up new reactor licensing for a period of time to absorb lessons learned. However, these stoppages are likely to be relatively short.

On the international front, the accident has revealed some shortcomings which will likely be reflected in new policies at the IAEA, and NRC in the U.S., and which were actively discussed at the G8-G20-NEA meeting in Paris on June 7th. First and foremost, and long overdue, there is a proposal for more IAEA monitoring and for stress testing of countries' nuclear plants, as well as obligatory peer reviews.

What can account for such a relatively tepid response to the accident—the third one in the last 32 years?

First of all, the disaster was initiated by a series of external events that border on the improbable and which exceeded the design basis of the reactor; not by any design or operational flaws (as was the case for both Three Mile Island and Chernobyl). In fact, the entire disaster could have been prevented with very basic measures, such as increasing the elevation of the emergency diesel generators that are designed to maintain power to the reactor pumps in the event of a station blackout. Further, most countries quickly concluded that the chances for such an event were relatively small, particularly countries not bordering the seismically active Pacific basin. For example, In the U.S. only 4 out of 104 units could be immediately affected by the same series of events.

Secondly, the reactors at Fukushima Daiichi are not in any way representative of the newer GEN III or GEN III+ nuclear reactors. The GEN III designs are the ones that initiated the so-called nuclear renaissance because they are simpler and safer to operate. These plants, especially the GEN III+ plants have incorporated the lessons learned from the GEN II era of plants. For instance, both the Westinghouse AP1000 and the GE Hitachi ESBWR have passive safety designs that can maintain cooling water for up to 72 hours under complete station blackout conditions and without any operator intervention. The core damage frequencies of these newer plants are at least an order of magnitude lower. These passive safety plants will make up a large proportion of new plants, perhaps more so following the accident.

And finally, most countries have climate change commitments for which only nuclear power, wind and solar technologies will be practically available in the near to medium term to stem the production of CO_2. While there are technologies in development that could use fossil fuels, such as coal gasification with carbon capture and sequestration, they are unproven at the required scale and will take a decade or more to enter commercialization, if they are proven economically viable. Of the three technologies mentioned, only nuclear is capable of continuous output; both wind and solar are intermittent resources that require backup, usually natural gas

* Rob Graber and Margaret Harding are with the EnergyPath Corporation.
See footnotes at end of text.

facilities, or advanced energy storage technologies that are not yet available.

There is little doubt, however, that the Fukushima accident will be a turning point in the history of civil nuclear power. The sheer scale of the accident (affecting directly 4 of the 6 nuclear units on the site), and the Japanese response (both TEPCO and the government) indicate that serious weaknesses were present in the Japanese regulatory system (and which are still being investigated) and may be present in other countries' regulatory regimes. In contrast, while Chernobyl demonstrated that an accident in one country can affect others, the unique design and non-standard operation contributed to a muted response in developing stronger international controls.

Fukushima, while an older design, is certainly not unique. Around the world there are dozens of reactors of similar vintage and design. While other countries, such as South Korea, Canada, the U.S. and most European countries operate a large number of reactors with few incidents—even when there are challenges such as earthquakes—there is concern that countries interested in implementing nuclear energy, but lacking a strong history in the technology may not be able to respond to similar disasters effectively. These concerns are driving increased international controls and oversight.

The Fukushima Daiichi nuclear accident will not materially influence the role of nuclear power in meeting the world's energy requirements. Countries with significant growth in energy needs and climate change commitments will continue to develop nuclear power, in spite of the accident, although international and national regulatory regimes are likely to change in the wake of the accident.

Country	Reactors Shut Down[3] (Immediate impact)	Halted/Delayed New Reactors (Impact 3-5 years)	Reduced Future Nuclear Role (Impact 5-20 years)	Affected PLE (Impact Immediate to 10 years)[4]
Argentina	No	No[5]	No	No
Armenia	No	No	No	
Belgium	No	None	None planned	
Brazil	No	No	No	
Bulgaria	No	Yes[6]	No	
Canada	No	No	No	
Chile	None	No[7]	No	
China	No	Yes	No	Yes[8]
Czech Republic	No	No	No	
Finland	No	No[9]	No	
France	No	No	No	Yes
Germany	Yes	None	Yes[10]	Yes[11]
Hungary	No	None	No Plan	No
India	No	No	No	No
Iran	No	No	No	None
Italy	None	Yes	Yes	None
Japan	Yes	Yes	Yes	Yes
Kingdom of Saudi Arabia	None	No	No	None
Mexico	No	None		
Netherlands	No	No	No	
Pakistan	No	Unknown	Unknown	Unknown
Romania	No	No	No	
Russia	No	No	No	No
Slovakia	No	No	No	
Slovenia	No	None	No	Not applicable
South Africa	No	No	No	Not applicable
South Korea	No	No	No	Unknown
Spain	No	None	Unknown	Unknown
Sweden	No	No[i]	No	Unknown
Switzerland	No	None	Yes	Yes
Taiwan	No	Yes[ii]	Under review	Yes
Turkey	No	Yes	No	
Ukraine	No	No	No	
United Arab Emirates	None	No	No	None
United Kingdom	No	Partial	No	
United States	No	Yes	Unknown	Unknown
Venezuela	None	Yes	Yes	None

Footnotes

[1] U.S. Energy Information Administration, "International Energy Outlook 2010 (Reference Case Projections)", http://www.eia.gov/oiaf/ieo/index.html

[2] See, for example, Rothwell, G., Graber, R., "The Role of Nuclear Power in Climate Change Mitigation", Generating Electricity in a Carbon-Constrained World, Sioshansi, F. (ed), Elsevier (2010)

[3] Platts Nucleonics Week, May 12, 2011

[4] "PLE" is Plant Life Extension

[5] http://www.cnechile.cl/?page_id=2756

[6] Platts Nucleonics Week, April 21, 2011

[7] http://www.bbc.co.uk/news/world-latin-america-12768148

[8] Platts Nucleonics Week, April 14, 2011

[9] Platts Nucleonics Week, May 5, 2011

[10] Platts Nucleonics Week, April 28, 2011

[11] Platts Nucleonics Week, March 24, 2011

[12] http://www.stralsakerhetsmyndigheten.se/In-English/About-the-Swedish-Radiation-Safety-Authority1/News/Press-release-Lessons-from-Fukushima-for-safety-work-in-Sweden/

[13] http://www.bloomberg.com/news/2011-04-12/taiwan-halts-plans-to-build-atomic-reactors-after-japan-crisis.html

Lee Schipper, Dedicated to Energy Efficiency and Environment, Dead at 64

Leon (Lee) J. Schipper, who devoted his career to transport, energy efficiency and the environment, passed away after a struggle with pancreatic cancer. Schipper, who died on August 16 at Alta Bates Summit Medical Center in Berkeley, was 64.

His passion for data led him to question the value of popular energy policies, like government subsidies for ethanol and for electric cars and the "cash for clunkers" program, The New York Times said.

Since 2008, Schipper was a senior research engineer at Stanford University's Precourt Energy Efficiency Center (PEEC), where developed research and policy studies on efficient energy use in transportation systems. He simultaneously worked as senior project scientist at the University of California-Berkeley's Global Metropolitan Studies. Schipper was a cofounder of EMBARQ, the World Resources Institute (WRI) Center for Sustainable Transport, in 2002 and remained with the center as senior associate emeritus.

Schipper was a member of IAEE since it launched in 1979. He was intensely involved in many IAEE conferences as chair, organizer and speaker. "Lee was always full of energy and ideas. Over the years, he brought together the leaders of industry and academia from around the globe to discuss and debate a variety of energy topics at our conferences. He will be greatly missed" said IAEE President Mine Yucel.

Born and raised in southern California, Schipper in 1968 earned his bachelor's degree in physics and music from the UC-Berkeley, where he also earned his doctorate in astrophysics. He was a Fulbright scholar at the Beijer Institute of Ecological Economics in Stockholm. He worked at Shell International Petroleum Co., and was a senior scientist at the Lawrence Berkeley National Laboratory for two decades. Schipper worked at the International Energy Agency in Paris as visiting scientist from 1995 to 2001. He has been a guest researcher at the World Bank, VVS Tekniska Foerening, the OECD Development Center, and the Stockholm Environment Institute.

"Lee developed and taught a great course in sustainable transportation, organized a transport research seminar, and mentored and inspired students," said James Sweeney, director of PEEC. "I miss him as a colleague, especially his crashing through my door to share some new insight or question."

Schipper has authored over 100 technical papers, and a number of books on energy economics and transportation around the world, including the book Energy Efficiency and Human Activity: Past Trends, Future Prospects (1992) with Stephen Meyers, Richard Howarth and Ruth Steiner. He served on the editorial boards of five major journals in the fields. Schipper was a member of the Swedish Board for Transportation and Communications Research for four years and a member of the U.S. Transportation Research Board's Committee on Sustainable Transport and Committee on Developing Countries.

Outside of work, Schipper had a passion for jazz and played the vibraphone as lead of the quintet Lee Schipper and the Mitigators. In 1973, he recorded an album titled The Phunky Physicist. With his wife, Agneta, he owned two enormous Maine coon cats, Ophelia and Two-Paws.

Schipper's daughter, Lisa, works on adaptation to climate change at the Stockholm Environment Institute. After living 13 years in Asia and Europe, Lisa recently moved back to Berkeley, where she lives with her husband, Markus Staas.

In addition to Agneta, Lisa and Staas, Lee Schipper is survived by his daughter Julia and son-in-law Ramon Munoz-Raskin of Washington, DC; and a sister, Amy Schipper-Howe, of Boise, Idaho.

Fukushima's Challenge: Is a Low Carbon Economy Without Nuclear Power a Realistic Goal? Insights from Spain

By Aitor Ciarreta and Carlos Gutiérrez-Hita*

Introduction: Energy for the Future Post-Fukushima

Our industrial civilization runs on energy and 85% of the world's energy is provided by fossil fuels; coal, oil and gas. However, at the present rate of consumption fossil fuels are estimated to be exhausted by about 2050 to 2100. Coal is the greatest contributor to global warming and renewable generation is currently incapable of supplying the energy required to sustain economic growth. Thus, despite the fact that renewable sources are important, they must be complemented by nuclear power in order to fulfill the energy needs of a growing low-carbon industrial civilization.

The recent disaster at the Fukushima nuclear plant has put new challenges for energy policy on the table. First, it may force governments to adopt a clear position in the ongoing nuclear energy debate. Second, environmental concerns make governments rethink the current energy mix, from a fossil-non renewable configuration to an alternative low carbon emissions scenario. Hence, Post-Fukushima energy policy design has to deal with the trade-off between environmental requirements and reinforced social pressures against nuclear power. The problem is not inconsequential: a substantial reduction in CO_2 emissions due to a significant decrease in the use of fossil sources must be covered by parallel increments in alternative sources of energy inputs. These alternatives are renewable energy sources and nuclear power.

There are at least two main reasons that advocate against a short term nuclear shutdown. First, there are a number of nuclear power plants at the beginning of their useful life cycle. Thus, a suppression of these would cause income losses due to non recovered investment projects. This fact may provoke higher prices in the short term in order to minimize the impact of closing nuclear plants. Moreover, firms involved in closing programs are in a better position to demand government compensation in the form of subsidies. In the medium and long term, by substituting nuclear power plants, firms must involve themselves in new research projects and investment in alternative technologies. This is costly and the availability of new GW is not immediate. Therefore, we think that a short-term scenario without nuclear generation is unrealistic because it would seriously harm the system's reliability and create a misallocation of financial resources to compensate for the capacity expansion of new sources.

Nuclear Energy, the Environment, and the Electricity Sector

The debate covers not just nuclear energy but also the alternatives to fossil fuels and renewable sources. An option arising from such a debate might be that governments should invest in safer nuclear energy power plants and continuously support the development of renewable technologies. Whilst there is no opposition to renewable investments, it is unfortunately the case that the nuclear industry has had a bad safety reputation. Not all of this reputation has been deserved.

The overwhelming majority of nuclear reactors have functioned safely and effectively for their entire lifetimes. Today over 400 nuclear reactors provide base-load electric power in 30 countries. There have been only three serious accidents in the commercial exploitation of nuclear power: Three Mile Island (TMI) in 1979 (in Pennsylvania, USA), Chernobyl in 1986 (in the Soviet Union, now the Ukraine), and more recently Fukushima in 2011 (in Japan, after an earthquake). However, the fact that these fatal disasters occurred in the civilian nuclear power industry within fifty years is less than those that have occurred in any year in the fossil fuel industries.

Despite these accidents, nuclear power is relatively clean, safe, reliable, compact, competitive and practically inexhaustible.[1] Nuclear reactors provide base-load power and are available over 90% of the time. The cost of nuclear power is competitive and stable. Moreover, uranium is found everywhere in the crust of the earth. A nuclear power station is very compact, typically occupying the area of a football stadium and its surrounding parking lots. Solar cells, wind turbine farms and growing biomass, all require large areas of land.

The global electricity supply sector accounts for the release into the atmosphere of over 8000 million tons of carbon dioxide annually, this being 37.5% of total CO_2 emissions. The electricity sector is likely to become a prime target in any future world where $C0_2$ emission controls are implemented and $C0_2$ mitigation is valued. In order to meet this challenge we must adopt the following mea-

* Aitor Ciarreta and Carlos Gutiérrez-Hita are with the Department of Economic Analysis II, University of the Basque Country, Bilbao, Spain and the Department of Economic and Financial Studies, Universitas Miguel Hernández, Elche, Spain, respectively. They would like to thank Ministero de Ciencia y Tecnología, MICINN (ECO2009-09120), and Gobierno Vasco (DEUI, IT-313-07) for their financial support. Carlos Gutiérrez also acknowledges financial support from the Ministerio de Ciencia y Tecnología, MTM2008-06778-C02-01/MTM, and Generalitat Valenciana ACOM2011/129.

See footnotes at end of text.

sures,

1. As suppression of fossil sources is almost impossible in the mid term, we may mitigate its effects on the environment by,
   a. Increasing efficiency conversion: the current world average efficiency is 30% but new technologies lay claim to 60% in under two decades.
   b. Moving to low carbon fossil sources emissions.
   c. Carbon dioxide sequestration and decarbonisation.
2. Increase of proven and alternative sources, mainly,
   a. To promote the use of nuclear power under safety standards,
   b. Entering renewable sources by using technological advances.

Nuclear Generation in the Spanish Electricity Sector

Spain, as an EU Member State is committed to the EU target of a sustainable energy system to avoid climate change. The *Europe 2020 Strategy* includes headline targets to be effective by 2020. Concerning energy and climate change it includes a reduction of greenhouse gas emissions of 20%, increasing the share of renewables in the energy mix to 20%, and achieving the 20% energy efficiency target by 2020. Two of these three targets have been met but energy efficiency will not be met unless further efforts are made.

Power Plant Name	Starting Year of Operation	Power (MW)
Sta.María de Garoña	1971	466
Almaraz I	1981	977
Ascó I	1983	1032
Almaraz II	1983	980
Cofrentes	1984	1092
Ascó II	1985	1027
Vandellós II	1987	1087
Trillo	1988	1066

Table 1. Nuclear Plants in Spain
Source: Ministry of Industry, and own construction.

Nuclear generation has traditionally played a key role in Spain to meet base load demand. There are six nuclear plants under operation. These eight light-water reactors have a total installed capacity of 7728 MW. Table 1 summarizes the power and starting year of operation of each plant.

Table 2 also shows the evolution of GWh produced by each type of resource from 2002 to 2010 to highlight the main power sources in electricity generation and to show to what extent it may determine the near future. In particular, the table shows the role that nuclear generation plays in the electricity mix and the eventual effect that its drastic reduction or even suppression would cause in the current Spanish electricity mix.

From Table 2, it is clear that Spain has a rather diversified technology mix that is made up of conventional thermal generation (nuclear, coal-burning, oil-fired, cogeneration and combined cycle plants) as well as renewable energy generation (mainly hydroelectric and windmills). However, there is a significant dependence on fossil fuel imports. The table shows an increase of wind and solar from less than 13000 GW/h to almost 50000 GW/h. Small hydro remains between 3000 and 4000 GW/h.

	----------Special Regime----------					----Ordinary Regime----			
Year	Wind	Solar	Small Hydro	Cogeneration	RSR	Large Hydro	Nuclear	Conventional	Total
2002	9,257	-	3,901	18,290	4,749	22,599	63,016	100,550	213,144
2003	11,720	-	5,091	18,995	6,336	38,874	61,875	95,267	229,265
2004	15,753	-	4,752	19,269	7,126	29,777	63,606	113,029	243,631
2005	20,520	-	3,820	18,808	8,623	19,169	57,539	136,291	253,884
2006	22,736	107	4,148	16,782	8,410	25,330	60,126	135,417	262,204
2007	27,221	495	4,126	17,715	8,697	26,352	55,102	142,369	271,636
2008	31,393	2,547	4,638	21,191	9,096	21,428	58,973	139,939	278,301
2009	35,424	5,429	4,188	17,548	1,120	23,236	52,765	116,461	251,305
2010	42,656	6,910				38,001	61,944	89,132	259,940

Table 2. Generation by Technology (GWh)

The investment path shows that most of it has been directed towards renewables generation and combined cycle plants.

In this context, nuclear power emerges as an alternative to cover the expected decrease in thermal generation, coal burning and oil-fired. Thus, it appears that the electricity mix might be dominated by nuclear power and renewable technologies. However, the share of each source largely depends on technology improvements and the regulatory framework. Eventually, transitory demand shocks should be covered by efficient cogeneration plants and large hydro.

Figure 1(a) plots the share of total capacity that comes from nuclear, renewable and thermal technologies, and part (1b) on the right represents the effective generation. Note that the nuclear share of total generation capacity has been declining over the past few years. There are two reasons; the lack of investment in new generation and the orientation of new investments towards renewable and combined cycle.[2]

The question is the impact on electricity prices. If the mix is based only on fossil fuels and renewables, avoiding nuclear, then there are potential price booms, as further increases in demand must be covered by fossils whose prices are more volatile. Alternatively, if the system is based on nuclear power and

renewable sources, prices are expected to be more stable in the medium and long term.

In Spain, the electricity market is organized into two segments: the Day-ahead market and the futures and bilateral contracts market. The existence of a futures and bilateral contracts market aims to alleviate the potential for market power abuse in the Day-ahead market, provided the former and the latter markets are not highly concentrated.

In the Day-ahead market there is a diversified composition of generation mix, which varies over time in relation to weather conditions and the relative prices of natural gas and coal, thus affecting the order of dispatch. It can be observed that there has been a significant increase in wind production and a corresponding reduction in gas combined cycle and an almost constant level of coal generation. In this segment, the contribution of nuclear generation is low. Since concentration is low most of the renewable generation comes from smaller agents.

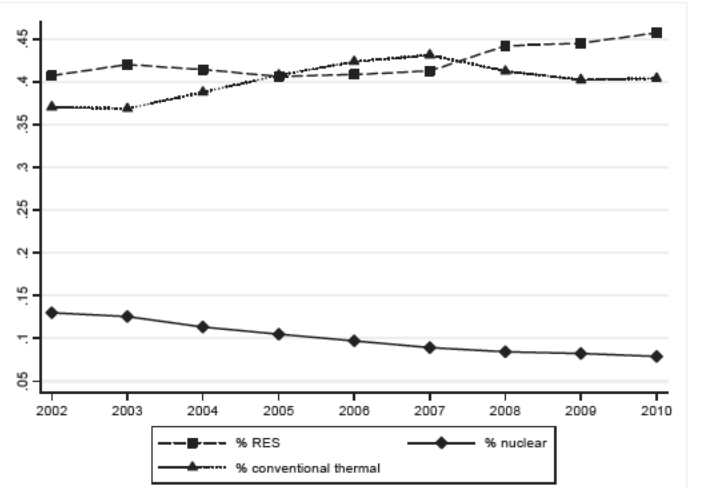


Figure 1(a)

In the futures and bilateral contracts market nuclear and coal technologies provide, on average, 80 percent of the total. Most of the nuclear and coal plants are under the ownership of the two largest generators, thus concentration is high.

The effect on competition of having a highly concentrated futures and bilateral contracts market and a low concentration in the Day-ahead market is not clear. As a result, the investment decisions on either type of technology determine the evolution of prices. It can be shown that there are diverging trends. On the one hand, fossil generation is declining in the technology mix. On the other hand, renewable sources are strongly increasing. The generation share of nuclear power and renewable sources is larger than the share of installed capacity. This is the result of a combination of technical advantages and a regulatory policy desire to enter first in the order of merit. The fact that nuclear power plants are used to meet base load demand is the main reason why, although the capacity share is currently below 10 percent, the share from total generation is clearly above 20 percent. Note from Figure 1b that conventional thermal is more volatile in terms of share of generation. A closer look at the daily pattern of production indicates that this is the case. The result is that prices are more stable. Thus, if the target is stable, competitive prices, the generation mix should be a system based on nuclear and renewable sources, together with combined cycle generation to meet unexpected shifts in demand.

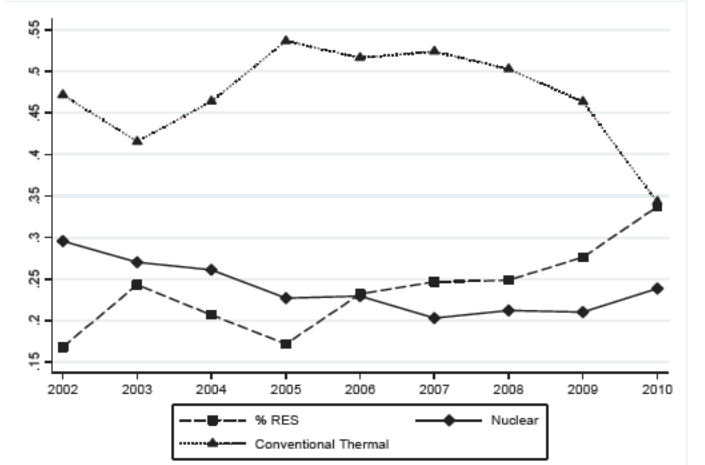


Figure 1(b)

An open issue is the subsidies to nuclear and renewables. These mean that price does not reflect real market conditions. Finally, the subsidy invoice must be covered by final consumers so electricity may be more expensive in the future unless technological improvements are offsetting. This applies to both subsidies to invest in nuclear and subsidies to enter renewable sources.

Conclusions

The needs of our industrial civilization and the growing needs of developing nations yield a rapid accumulation of atmospheric CO_2. Nuclear power is relatively safe, capable of ensuring the continuation of our industrial civilization and protecting the environment. It is a source of energy that can replace a significant part of the fossil fuels (coal, oil and gas) which massively contribute to the greenhouse gas effect. In addition, we must promote the more efficient use of renewable energies – wind and solar – wherever possible. Hence, nuclear power should be deployed together with renewable technologies to replace coal, oil and gas in industrial and developing countries. The Spanish electricity mix tends to be dominated by a mixture of a renewables and nuclear power to cover the bulk of primary electricity needs. However this system is insufficient to cover demand peaks. In these cases, it is necessary to increase generation with more efficient processes that use fossil sources in order to preserve price stability over time.

(See page 37 for footnotes and references)

Cherno-shima, i.e., Italy and Nuclear Energy: for Every Accident, a Referendum

By Giacomo Grasso and Paride Meloni*

As is widely known, the accident occurred at units 1, 2 and 3 of the Fukushima-Dai·ichi nuclear power plant. The accident, the largest for the nuclear industry since Chernobyl, reverberated around the World.

The differences between the two accidents are manifold, starting from the causes and up to the consequences. The Chernobyl reactor had been driven to a reactivity accident while carrying out an experiment; on the other hand, the reactors at Fukushima, all scrammed, suffered an incredibly-lasting-in-time complete lack of electrical power which prevented the actuation of emergency cooling functions beyond the grace period guaranteed by the passive systems. Concerning the consequences, the complete lack of a containment building for the Chernobyl reactor, let the destroyed core be poured out of the building, completely exposed to the environment, spreading fission products and actinides all around the globe through the stratosphere. On the other hand, the multiple barriers philosophy implemented at Fukushima allowed the core to be confined and separated from the environment, the main releases of radioactivity to the atmosphere were intentionally actuated by the plant operators according to accident management procedures. In this way the planned radioactive releases allowed the Japanese authorities to issue evacuation orders well in advance, minimizing the radiation exposure risks to the population.

Nevertheless, the two accidents have been associated, ignoring the differences in technology and context.

Actually the only and main similarity between the two cases lays in the great impact they had on public opinion, rather than in health or environmental issues, which for Fukushima are not expected to be on a global scale and are, anyway, far from being even comparable with those that followed the Chernobyl accident.

The first and more immediate consequence, mainly due to political rather than technical reasons, is a widespread reflection on the nuclear industry as a whole. In this sense, Italy is amongst the nations which will suffer the heaviest strokes of the Fukushima accident. As a matter of fact, the decision whether to go nuclear or not has been once more left to the people, with a popular referendum, and the Italian nuclear "renaissance", planned since 2008 with some preparatory laws, regulations and international agreements foreseeing the realization of plants for the production of nuclear energy, has been stopped by a moratorium. As in 1987, after the Chernobyl accident, the people were given the option of deciding on such a strategic matter as the electric power supply of a nation.

The urgency for an energy policy in Italy comes from the incompatibility between the present electricity source mix and the European requirements following the Kyoto Protocol: renewable sources already provide some 21% of the electricity demand, with a high penetration (15 and 1.5 out of 21%) of hydroelectric and geothermal, which are, however, almost saturated. Furthermore, the Italian electric energy portfolio (left frame of Figure 1) includes a 14% share representing the direct import from abroad, mainly produced by nuclear power plants in neighboring countries. The planned inclusion of nuclear energy for one fourth of the mix (right frame of Figure 1) would have reduced the fossil share by some 10 points (out of 65%) still guaranteeing the baseload supply, as well as replaced the imported share, thanks to homeland electricity generation.

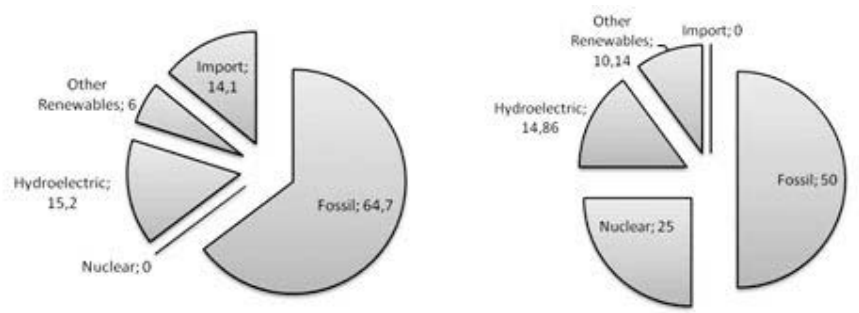


Figure 1
Present (left) and proposed (right) Italian electric energy mix

The Italian people, asked to vote on the nuclear policy of the Government, decided for the abrogation of the laws that would have paved the way to the nuclear renaissance. This decision, as already said, was heavily influenced by the Fukushima accident. After 15 years, this has been the first referendum ever to reach a quorum to get validity; also, public opinion, which immediately before the accident was not against the possibility of the nuclear option for the first time after Chernobyl, changed, and opposed the con-

* Giacomo Grasso and Paride Meloni are with ENEA.
See footnote at end of text.

struction of new nuclear power plants for the fear of a "Cherno-shima" at home.[1]

As a consequence of the duration of the moratorium of at least 5 years, nuclear policy in Italy risks being indefinitely *decommissioned*. Among other issues, the ability to preserve, in the long term, the technical and scientific nuclear knowledge will become a central point for the future of nuclear energy in Italy in the years to come. It will require a strong intervention on universities and research agencies in order to allow them to continue the ongoing activities on innovative reactors, components and fuel cycle strategies which at present still maintain Italy among the main actors of nuclear research.

Besides the stoppage of the nuclear program, two important decisions remain as the only heritage of this aborted renaissance: the setting up of a new Nuclear Safety Agency and the commitment for a national repository for nuclear wastes, envisaged by European policies. The decision to organize and centralize the management of the existing wastes coming from the past opration of the plants as well as from industrial and medical applications, was indeed a central and urgent point still unsolved, that now explicitly appears in the Government agenda. Concerning the Agency, it will be another important opportunity for preserving a strong competence in the nuclear field. Among the roles charged to the Agency, will be the siting and licensing of the national repository.

The Italian case should become a useful example for every country involved or interested in nuclear energy. Allowing public opinion to influence or even determine national energy policy is a risk to the rationality of the decisions to be taken, subjugating to the lack of information and scientific culture in general the ability to plan a balanced energy mix.

In this sense, an important lesson can be actually learned from the Fukushima accident: the urgent need for a wide dissemination of a sound scientific culture amongst the population. This would allow people to be aware of the energy and environmental issues, perceiving the need for energy availability and getting acquainted with all the aspects of the different energy sources. A strong and deep scientific (and energy in particular) culture is the only key to have public opinion set on a rational rather than emotional basis.

The dissemination of a scientific culture requires, as its foundation, the unconditioned support of education, research and development. The consolidation of a strong *intelligentia* will represent the reference for maintaining and further developing competences to support policy makers and to distribute knowledge to the people.

Footnote

[1] It is important to recall that ENEL, the main Italian electric utility, already owns and operates nuclear power plants abroad, and in particular, 7 reactors (6 PWR and 1 BWR) in Spain through the controlled ENDESA and 4 VVER in Slovakia through the controlled Slovenské Elektrárne. It is also engaged in the construction of two reactors at Mochovce, in Slovakia; owns a share of the 2 EPRs under construction at Flamanville and planned at Penly in France, and is involved in the construction of the second unit at the Cernavoda nuclear power plant, in Romania.

Fukushima's Challenge *(continued from page 35)*

Footnotes

[1] Nuclear energy produces almost no carbon dioxide, and no sulfur dioxide or nitrogen oxides whatsoever. One gram of uranium yields about as much energy as a ton of coal or oil. Nuclear waste is correspondingly about a million times smaller than fossil fuel waste (to the factor of a million). Moreover, nuclear waste is to be deposited in deep geological storage sites, so it does not enter the biosphere.

[2] A 150 MW nuclear power plant ended its useful life in 2006 (Jose Cabrera), and another 480 MW nuclear plant is in the latency phase after completion of its decommissioning (Vandellós I).

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Report from the 34th IAEE International Conference

The 34th IAEE International Conference was held in Stockholm, Sweden, June 19-23. The conference was hosted by the Swedish Association for Energy Economics and organized in close cooperation with the IAEE Headquarter. The venue was the newly renovated main building of the Stockholm School of Economics (SSE), located in the center of Stockholm. The almost 500 participants, among them around 120 students, could enjoy both a successful conference and the very light summer evenings and nights in Stockholm. Unfortunately they also had to experience lots of rain and temperatures well below what is normal in June.

At the opening of the conference welcoming remarks were made by Per Unckel, Governor of Stockholm and former Minister of Education and Research. With a background as the energy policy spokesman of the conservative party Mr. Unckel made a few reflections on the energy situation and energy policies in the Nordic region. Then IAEE President Mine Yücel delivered her Presidential Address, describing IAEE's recent progress in terms of membership and outreach activities. Building on her expertise in oil market issues she also commented the recent development of oil prices and offered an explanation based on market fundamentals. Lars Bergman, the General Conference Chair, in addition to welcoming the participants expressed his gratitude to the sponsors, the members of the Organizing and Program Committees, and to the SSE students in charge registration and a number of other services to the participants.

The overall theme of the conference was "*Institutions, Efficiency and Evolving Energy Technologies"*. This theme was elucidated in different ways and from many points of view in two Keynote Lectures. The opening day Keynote Lecture was given by Professor David Newbery, Cambridge University. Under the title "*Regulatory and market Design Challenges for Supporting New Technologies"* he elaborated the general theme of the conference. In particular he addressed the issue about how to efficiently support low-carbon electricity generation and energy R&D, pointing out both good and bad ways. Professor Newbery also gave his view on the role of energy economists. Among other things he pointed out the importance of differentiating between problems caused by market, institutional, behavioral and government failures and the role of economists in this process. Professor Newbery´s presentation can be found at the conference website www.hhs.se/iaee-2011.

While professor Newbery´s lecture was based on academic research the second keynote lecture, given on the second day of the conference by BP Chairman Mr. Carl-Henric Svanberg, had a corporate perspective. In his lecture Mr. Svanberg reflected on the insights gained in connection with the Gulf accident as well as BP's efforts to restore confidence among consumers and other stakeholders. He also elaborated his views on the role of oil companies in the transition to a sustainable global energy system.

The theme of first Plenary Session was *Institutions and the Development and Implementation of New Energy Technologies: Markets vs. Regulation*. The session was moderated by the Director General of the Swedish Energy Administration, Dr. Tomas Kåberger, and the speakers were professor William D. Nordhaus, who was later to receive IAEE´s Award for Outstanding Contributions to the Profession, Mr. Øysten Løseth, CEO of Vattenfall, and Dr. Jim Watson, Director of the Sussex Energy Group and Chairman of BIEE. The three speakers brought a very nice blend of academic and corporate perspective to the theme. Professor Nordhaus, who has carried out extensive research on the determinants of technological change, commented on "the perils of the learning model". In particular he pointed out the risk of biased estimates of key parameters of the learning model, leading to an upward bias in estimates of the value of new technologies. Professor Nordhaus' presentation can be found at www.hhs.se/iaee-2011.

Issues related to "smart grids", transportation, energy efficiency and the international oil market were elucidated in four Dual Plenary Sessions. As usual at IAEE conferences variety of energy and environmental economics issues were analyzed in depth in the concurrent sessions, this time 74 in number. Needless to say the papers presented in the concurrent sessions demonstrated the frontiers of energy economics research. Many of the speakers in the these sessions were PhD-students or Post Docs, illustrating the dynamism and global nature of energy economics as a field of research.

As an innovation two new types of concurrent sessions were organized. One of them was "Discussant Sessions", in which a discussant was given plenty of time to comment and scrutinize each of the papers presented in the session. The other was "Collaborative Conversation Sessions", in which current energy and energy policy issues were discussed in a round-table fashion. The initial impression was that both of these experiments were successful and worth repeating at future IAEE conferences.

The Gala Dinner was held at the Vasa Museum and was hosted by Vattenfall. During the dinner the prestigious IAEE Awards were handed over. As was mentioned above Professor William D Nordhaus received the 2011 IAEE Award for Outstanding Contributions to the Profession, while the 2011 IAEE

Award for Excellence in Written Journalism was given to the European Energy Review, represented by its Editor, Karel Beckman.

Ramteen Siohansi, Ohio State University, and Paul Denholm, National Renewable Energy Laboratory, received the 2010 Energy Journal Best Paper Award for their paper "The Value of Plug-In Hybrid Electric Vehicles and Grid Resources". The Student Best Paper Award went to Anant Sudarshan from Stanford University for the paper "Deconstructing the 'Rosenfeld Curve': Why is per capita residential energy consumption in California so low?" The Grande Finale of the evening was a much appreciated ABBA medley performed by a group of SSE students.

In the evening the second day of the conference the City of Stockholm hosted a reception in the Stockholm City Hall, where the Nobel Banquet is held on December 10 every year. After the reception the participants entered boats for a three hours trip in Lake Mälaren and the inner part of the Stockholm archipelago. Everybody on board seemed to like the light and sunny evening, in spite of the 15 minutes heavy rain that came exactly when the participants were to take the short walk from the City Hall to the Boats.

The theme of the closing Plenary Session was *Lessons from Power market Reforms and the Future of Liberalized Power Markets.* The speakers were Professor Richard Green, University of Birmingham, Professor Nils-Henrik von der Fehr, University of Oslo, Professor Jean-Michel Glachant, European University Institute, Florence, and Dr. Simon-Erik Ollus, Fortum (the major power company in Finland). One of the issues discussed was the impact of environmentally motivated regulations of the choice of technology in electricity generation on the continued liberalization of electricity generation and retail markets.

The final session was followed by a well-attended Closing Reception, after which many participants rushed to the airport. However, many stayed for the Technical Tours the day after. One group went to Södertälje south of Stockholm to visit the Igelsta combined heat and power plant, which is the largest bio-fuelled co-generation plant in Sweden. The other group went to Forsmark north of Stockholm to visit the Forsmark nuclear power plant and the 17th century Forsmark village. The weather? Rain, rain and rain!

Lars Bergman

Scenes from the 2010 IAEE International Conference (June 19 - 23, 2011)


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Report of the 4TH NAEE/IAEE International Conference

Introduction

The 4th NAEE/IAEE International Conference with the theme, "Green Energy and Energy Security: Options for Africa" was held at Sheraton Hotel and Towers, Abuja, Nigeria on 28th and 29th April 2011. The two-day Conference attracted over 170 delegates from within and outside Nigeria. Delegates cut across academics, energy industry, government, international organizations, finance, and the press. The student body of the Association was also heavily represented as postgraduate and undergraduate students came from different universities across the country. The Conference was preceded by a One-Day Practicum on Crystal Ball, @Risk, & Excel.

Conference attendees pose for an informal picture

Plenary Sessions

The first day started with an opening ceremony chaired by the Managing Director of Nigerian Liquefied Natural Gas (NLNG) Ltd, Engr. Chima Ibenechie. In her opening remarks, the 2011 IAEE President, Dr. Mine Yucel, who was ably represented by Professor Wumi Iledare, IAEE Vice President, Finance, expressed her regrets for not being able to attend the NAEE Conference, personally. She praised the remarkable progress that the NAEE has made in the short term of its existence and promised that the IAEE will continue to support the activities of the NAEE. The welcome address was delivered by the NAEE President, Professor Akin Iwayemi. He expressed his gratitude to all the invited dignitaries for their presence and support for the Association over the years. He assured the Conference participants two days of robust intellectual interactions and networking. The 2011 conference chairman, Engr. Ibinechie, thanked the Association for the invitation and observed that the theme for the conference is quite appropriate given the ongoing debate in academic and policy arena on sustainable development. He pointed to the recent nuclear crisis in Japan as illustration that even with technology, mankind cannot afford to be indifferent to the consequences of its energy choice. Goodwill messages to the Conference came from Dr. Emmanuel Egbogah, OON, FNAEE, Special Adviser to the President on Petroleum Matters and Professor Kassey Garba, the Chief Economic Adviser to the President, who was represented by Dr. Abiodun Adedipe, a Senior Special Assistant to the President.

Mr. Osten Olorunsola, Vice President, Gas, Shell Africa delivered the keynote Address on the theme: *Green Energy and Energy Security: Options for Africa*. In his presentation he highlighted the importance of energy in socio-economic development and in achieving the millennium development goals. He defined green energy as energy that can be extracted, generated and/or consumed without any significant impact to the environment. He noted that population growth in Africa increases the need for energy use. However, over one-third of Africans have no access to energy. He noted that green energy is not the silver bullet that will solve all the continent's energy problems. He listed three hard-truths about energy: first, there will continually be an energy surge globally, second, hydrocarbons will continue to be used until 2050, and third, human activities change the planet earth disruptively and significantly. In his conclusion, he made the following key observations: green energy will progressively grow in the mix of energy sources available to Africa (the trick is to use all in a sensible mix); government policies and technology will play major roles in shaping the global energy outlook, and finally global energy demand will continue to grow.

Professor Iledare, IAEE VP for Finance made a presentation to delegates on *Getting to know IAEE and NAEE*. The presentation was designed to introduce the IAEE and NAEE formally to participants at the conference. He traced the historical development of the IAEE since 1977, highlighting the Mission of the IAEE, its publications outlet, membership structure and past Conferences. Delegates were especially pleased to know that NAEE is among the ten largest affiliates of the IAEE. There are 28 international affiliates of the IAEE and the NAEE is currently classified as one of the active emerging affiliates of the IAEE. He informed the conference that the membership mix of the IAEE is its strength and listed the several benefits of membership of the Association. With respect of the NAEE, he traced the impressive

growth of the NAEE since it was established in December 2006. The NAEE is the largest assemblage of energy professionals working or interested in the broad areas of energy economics in Nigeria. The NAEE has organized three high profile and successful past conferences and also awarded honors and recognitions to those who have made significant contributions to Nigeria's energy development.

The Conference was declared open by the Honorable Minister of State for Power, Arc. Nuhu Wyas who was represented by a Director in the Federal Ministry of Power, Engr. F.N. Olapade. The Minister called for greater collaboration between the Ministry and the NAEE. The Conference Programme Chairman, Professor Adeola Adeninkinju, gave the vote of thanks. He thanked the dignitaries and the sponsors of the Conference for their continuous support for the Association.

A new innovation in this year's conference is the Presidential Address. This was delivered by Professor Akin Iwayemi, the NAEE President. The session was chaired by Professor A.S. Sambo, FNAEE, Director General, Energy Commission of Nigeria (ECN), represented by Rev. J. Oladosu, a Director in the Commission. The title of the Presidential Address was *Solving Nigeria's Energy Puzzle: Why Economic Analysis Matters*. According to the NAEE President, the choice of the topic was motivated by two factors: first the persistence of the paradox of energy insecurity despite the enormous endowments of energy resources in the country, and second that the recurring energy paradoxes, with its attendant huge economic and environmental costs, deserve greater political will than ever. The paper focuses on those economic fundamentals that are essential to proper diagnosing of the dual energy puzzles and how to find efficient solutions to them. The paper argues that the energy paradoxes in Nigeria can be resolved if policy makers and government give dual recognition to the critical roles to appropriate incentives and institutional framework.

The third plenary session of the Conference was on the theme: Power Sector Outlook in Nigeria: Challenges, Constraints and Opportunities. It was chaired by the Executive Chairman of the Nigerian Electricity Regulatory Commission (NERC), Dr. Sam Amadi. The Lead Paper was presented by the Office of the Special Adviser to the President on Power. The paper was discussed by Professor Sesan Ayodele, Dean, College of Social and Management Sciences, Achievers University, Owo, Nigeria and Mr. Bede Opara, the President, Senior Staff Association of Electricity and Allied Companies.

In his presentation, the representative of the Special Adviser to the President, listed the various challenges facing the Power sector in Nigeria, including the problems of corruption and indiscipline, lack of adequate investment and poor funding of the sector by the government over the years. He proffered the following solutions: liberalization of the power sector to private participation, combination of pricing and institutional reform of the energy sector, review of the 2005 electricity Act, sustenance of government investment, good metering, addressing the gas to power challenges, human capital development. The presentation generated a number of interesting reactions from the discussants and from the floor.

The fourth plenary session, which took place, on the second day of the conference was chaired by Professor Tony Owen. It focused on "Emerging Issues in the Oil and Gas Sector in Nigeria". There were two presentations. The first was by Professor Wumi Iledare, Director/Professor, LSU Centre for Energy Studies, USA on *Managing Oil and Gas Wealth in Federal Systems: A Case study of Nigeria*. The second presentation was by Professor Akin Iwayemi, Department of Economics, University of Ibadan on the topic *Local Content and Economic Growth*. Both presentations identified options for deepening the benefits from the country's abundant oil and gas resources.

The second plenary session on the topic: Renewable Energy Technologies: Scenarios and Strategies for Energy System Planning was delivered by Professor Tony Owen, UCL School of Energy and Resources. He highlighted the lessons that Africa can learn from application of renewable energy technologies around the world.

The closing plenary Session of the Conference was on the theme: Competition Law in Nigeria: Providing Framework for Deregulated Energy Sector. The Chairperson for the session was Professor Yinka Omorogbe, Company Secretary/Legal Adviser, NNPC. The Lead paper was presented by Mr. Adeyemi Candide-Johnson (SAN) and discussed by Dr. Peter Obutte, Faculty of Law, University of Ibadan. The Presenter, an authority on competition law advocated for passage of the competition bill currently with the National Assembly to provide an enabling environment for successful energy sector reforms. He identified the cornerstone of competition policy to include statute, enforcement agency, and adjucating body. The competition law must also be made to reflect the Nigeria's socio-economic environment, rather than just copying from other countries.

Concurrent Sessions

There were 48 papers presented in 12 Concurrent sessions at the Conference. The concurrent ses-

sions were organized around the following sub-themes: Renewable energy: technology, accessibility and finance, energy issues: international perspectives; energy modeling; energy price shocks and macroeconomy; energy environment and the economy 1 & 2: energy planning and policy; energy sector reforms, market structure and institutions; energy use, conservation and efficiency; energy supply diversification and security: challenges and policy options; power sector deregulation: issues and options; and oil and gas industry reform: analysis of the impact of system performance measures. (All the concurrent papers can be downloaded on the website of the NAEE at www.naee.org.ng)

Annual General Meeting and Inauguration of the New NAEE Council 2011-2013

After the Closing Plenary session, the Annual General Meeting and the Inauguration of the new Council for the NAEE for 2011-2013 took place. The AGM was presided over by Professor Akin Iwayemi who thanked the members for their support and commitment to the Association over the years. Subsequently, he handed over to the new NAEE President, Professor Adeola Adenikinju, who introduced the new members of the council and addressed the members. The new Council of the NAEE for 2011-2013 are: Professor Adeola Adenikinju, Department of Economics, University of Ibadan, President; Mr. Babatunde Osho, Korea National Oil Company, Nigeria (Vice President, Membership & Liaison); Mr. Dave Dogo, Assistant General Manager, PHCN, (Vice President, Conferences and Publication); Dr. Tony Akah, Deputy General Manager, Nigerian Electricity Regulatory Commission, (Secretary); Mrs Grace Orife, Shell, (Treasurer); Mr. Olugbenga Adesanya, CEO, Jily Continentals Ltd, (Publicity Secretary); Dr. Mahmud Central Bank of Nigeria, (Auditor); Professor Akin Iwayemi (ex-Officio) and Mrs. Edith Olubanjo, General Manager, NNPC (ex-officio). The new President promised to move the association to the next level.

Dinner and Fellowship Award – Sponsored by the NNPC

The Conference ended with a well attended Dinner and Award Night sponsored by the Nigerian National Petroleum Corporation (NNPC). It was a night of entertainment and dancing. The highlight of the night was a presentation by Engr. Funso Kunplokun, former Group Managing Director of NNPC on the topic, "Fiscal Systems in Nigeria: A Comparison of New Fiscal Terms". The NAEE also used the occasion of the dinner to confer awards on some distinguished energy professionals and institutions. Engr. Funso Kupolokun was conferred with the award of Distinguished Public Service Award and honorary member of the NAEE; the Central Bank of Nigeria, for its support to the Power Sector was awarded the Distinguished Corporate Service Award; Professor Akin Iwayemi, and Professor Wumi Iledare were both conferred with the Fellowship Award of the NAEE. Engr. Kupolokun responded on behalf of the awardees and pledged their continuous support for the progress of the Association.

Adeola Adenikinju and Adetosin Adeniyi
University of Ibadan

12th IAEE European Energy Conference

Energy challenge and environmental sustainability

Fist Announcement and Call for Papers

Venice, September 9-12, 2012

The 12th IAEE European Energy Conference "**Energy challenge and environmental sustainability**" will be organized in Venice, on September 9-12, 2012, in the Ca' Foscari University campus, by the A.I.E.E - Italian Association of Energy Economists with the support of Fondazione Eni Enrico Mattei.

The Conference aims at providing a forum for an analysis of the new developments and a new vision of the future. No better stage can be imagined for this discussion than the magic and fragile environment of Venice, one of the most beautiful cities in the world.

The general programme of the Conference

Sunday 9/9
08.00 – 16.00 IAEE Council
16.00 - 18.00 Registration
18.00 Welcome Reception
20.30 – 22.00 IAEE Council Dinner

Monday 10/9
07.30 – 18.00 Registration
09.30 – 10.30 Opening Plenary Session
10.30 – 11.00 Coffee Break
11.00 – 12.30 Dual Plenary Sessions
12.30 – 14.00 Lunch
14.00 – 15.30 Concurrent Sessions (7–8 meeting rooms)
15.30 – 16.00 Coffee Break
16.00 – 17.30 Concurrent Sessions
19.00 – 22.30 Gala Dinner

Tuesday 11/9
07.30 – 18.00 Registration
09.00 – 10.30 Dual Plenary Sessions
10.30 – 11.00 Coffee Break
11.00 – 12.30 Concurrent Sessions
12.30 – 14.00 Lunch
14.00 – 15.30 Dual Plenary Sessions
15.30 – 16.00 Coffee Break
16.00 – 17.30 Concurrent Sessions
20.00 – 22.30 Conference Dinner

Wednesday 12/9
08.30 – 10.00 Concurrent Sessions
10.00 – 10.30 Coffee Break
10.30 – 12.00 Concurrent Sessions
12.00 – 13.00 Closing Session

The plenary sessions may cover the following topics:

Energy supply and security; Economic recovery and the evolution of energy demand; Climate change and the new GHG emission limitation regime; Toward Independent markets for energy commodities?; Environmental threats and opportunities for energy systems; Re-thinking nuclear power; The closing session will try to make sense of the results of the discussions throughout the Conference.

The "call for papers": the topics of the papers to be presented in the concurrent sessions

Among other include:
Extending the horizons of energy regulation in Europe - Learning by doing: cost reductions for RES - Technological development: the roadmap approach - Energy storage and its effects on the market - Changes in the geo-political situation after North Africa - Smart grids and smart meters - Unbundling in the gas sector - Market instruments for energy efficiency - Non-conventional hydrocarbon supplies - A sectorial approach to energy efficiency in industry - The European automotive industry and the challenge of energy for transportation - The NIMBY syndrome for RES - The formation of prices in gas and electricity markets - Energy from biomass and the EU agricultural policy - Energy poverty in developed countries - Access to energy in developing countries - Nuclear industry after Fukushima - The impact of PV on the merit order - Renewable energy policies - Sustainable communities and citizen-led activities - The "resource curse" - Energy innovation and patenting.

Abstract submission starts November 7, 2011 - deadline: April 9, 2012

Authors will be notified by **May 22, 2012** of their paper status. Authors whose abstracts are accepted will have to submit their full-length papers by **July 1st 2012** for publication on the conference website.

The conference website http://www.iaeeu2012.it will provide precise information regarding the format and modality for submitting the abstracts and information regarding the conference registration fees and student scholarship funds.

Arrangements will also be made for special rates with hotels of various categories near the conference venue.
In addition to a highly professional program, the conference will be an opportunity for delegates and accompanying persons to enjoy visiting Venice.

for any questions regarding the Conference you can contact:
AIEE Conference Secretariat:
Phone +39-06-3227367 - Fax 39-06-3234921,
e-mail: assaiee@aiee.it; info@iaeeu2012.it
http://www.iaeeu2012.it

Welcome New Members

The following individuals joined IAEE from 6/1/11 to 9/30/11

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Prince Ishaku Abner
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PORTUGAL

Italian Student Chapter Holds One-day Conference

AIEE - the Italian Chapter of IAEE - organized on September 28, 2011, in Rome, a one-day Conference on "Designing and Integrating Energy Efficiency in Buildings". In itself, this is just one of about 10 events of this type that AIEE promotes every year. However it is signaled here because it included one new feature: a session of the Conference was organized by the Student Section of AIEE in collaboration with the student sections of other European IAEE affiliates, as an international Session held in English. This first attempt was only partially successful, as it ended up with the participation of two graduate students from the Swiss association. Nina Bogen and Celine Ramseier, graduate students at Zurich Technical University (ETH), presented two contributions based on their thesis work, in line with the subject of the Conference, dealing with different aspects of non-technical barriers to the diffusion of energy efficiency in the building sector as experienced in Switzerland. They also offered a survey of the broad spectrum of subjects connected with sustainable energy, which are investigated at ETH and of the activities of SAEE, the Swiss chapter of IAEE.

The experience was considered positive and new initiatives along these lines, with the progressive inclusion of other European student sections will be considered in the future.

Publications

Climate Coup – Global Warming's Invasion of Our Government and our Lives. Patrick J. Michaels, Editor (2011). Price: $24.95. Contact: CATO Institute, 1000 Massachusetts Ave, NW, Washington, DC 20001, USA. Phone: 1-800-767-1241. URL: www.cato.org

The False Promise of Green Energy. Andrew Morriss, William Bogart, Roger Meiners and Andrew Dorchak (2011). Price: $24.95. Contact: CATO Institute, 1000 Massachusetts Ave, NW, Washington, DC 20001, USA. Phone: 1-800-767-1241. URL: www.cato.org

Arab Oil & Gas Directory 2011. Price: Euro 750. Contact: APRC, 7 avenue Ingres, 75016 Paris, France. Phone: 33-0-1-45-24-33-10. Fax: 33-0-1-45-20-16-85. Email: aprc@arab-oil-gas.com URL: www.arab-oil-gas.com

U.S. Gasoline – The End of an Era? James Longmore (2011). Price: £450.00. Contact: Marketing Department, Centre for Global Energy Studies, 17 Knightsbridge, London, SW1X 7LY, United Kingdom. Phone: 44-20-7309-3610. Fax: 44-20-7234-4338. Email: marketing@cges.co.uk URL: www.cges.co.uk

Calendar

October 31, 2011 - November 2, 2011, Australia Gas at Four Seasons Hotel, Sydney, Australia. Contact: Angela Hands, Business Development Manager, CWC Group Limited, Regent House, 16-18 Lombard Road, London, London, SW11 3RB, United Kingdom. Phone: +61 2 8003 5524. Fax: +44 207 978 0099 Email: ahands@thecwcgroup.com URL: www.cwcaustraliagas.com

2-3 November 2011, Carbon Forum Asia at Marina Bay Sands, Singapore. Contact: Ms. Su Ling Khoo, Regional Manager, Koelnmesse Pte Ltd, Singapore. Phone: 65-6500-6718 Email: slkhoo@koelnmesse.com.sg URL: www.carbonforumasia.com

6-8 November 2011, International Scientific Conference: Sustainable Consumption – Towards Action and Impact. at Hamburg (Germany). Contact: acompanying research project of the research programme "From Knowledge to Action – New Paths towards Sustainable Consumption", University of Bern, Switzerland Email: soefkonsum@ikaoe.unibe.ch URL: http://www.sustainableconsumption2011.org

7-11 November 2011, World Shale Gas Conference & Exhibition at Hilton Americas, Houston, Texas, USA. Contact: Gustavo Aranda, Senior Marketing Manager, CWC Group Limited, Regent House, 16-18 Lombard Road, London, London, SW11 3RB, United Kingdom. Phone: +44 207 978 0000. Fax: +44 207 978 0099 Email: garanda@thecwcgroup.com URL: www.worldshalegas.com

7-9 November 2011, Master Class Developments in LNG at to be determined. Contact: Janet Smid, Account Manager, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8308. Fax: +31 (0) 50 524 8301 Email: smid@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/master-class-developments-in-lng

13-14 November 2011, Conferencia de la Industria Solar - España 2011 at Madrid, Spain. Contact: Anika Sperling, Solarpraxis AG, Zinnowitzer Straße 1, Berlin, Berlin, Germany. Phone: 030-726296-310 Email: anika.sperling@solarpraxis.de URL: /www.solarpraxis.de/en/conferenze/cis-es-2011

14-16 November 2011, Master Class Gas Sales & Purchase Strategies in Liquid Markets at The Netherlands. Contact: Nynke Feenstra, Energy Delta Institute, Netherlands Email: feenstra@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/specific-programmes/master-class-gas-sales-purchase-strategies-in-liq

14-17 November 2011, World LNG Series at Rome Cavalieri Hotel, Rome, Italy. Contact: Tyler Forbes, Business Development Manager, CWC Group Limited, Regent House, 16-18 Lombard Road, London, London, SW11 3RB, United Kingdom. Phone: +44 207 978 0000. Fax: +44 207 978 0099 Email: LNG@thecwcgroup.com URL: http://world.cwclng.com

17-18 November 2011, Gas Transport and Shipping Course at Groningen. Contact: Janet Smid, Account Manager, Energy Delta Institute, Groningen, Netherlands. Phone: +31 (0) 50 524 83 08. Fax: +31 (0) 50 524 83 01 Email: smid@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/specific-programmes/gas-transport-shipping-course

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21-25 November 2011, Underground Gas Storage Course at Groningen, The Netherlands. Contact: Nynke Feenstra, Energy Delta Institute, Groningen, Netherlands. Phone: +31 (0) 50 524 83 19. Fax: +31 (0) 50 524 83 01 Email: feenstra@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/specific-programmes/underground-gas-storage-course

21-25 November 2011, Underground Gas Storage Course at Groningen. Contact: Janet Smid, Account Manager, Energy Delta Institute, Groningen, Netherlands. Phone: +31 (0) 50 524 83 08. Fax: +31 (0) 50 524 83 01 Email: smid@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/specific-programmes/underground-gas-storage-course

23-25 November 2011, Master Class Developments in LNG at The Netherlands. Contact: Jasper Hofman, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 83 08. Fax: +31 (0) 50 524 83 01 Email: hofman@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/specific-programmes/master-class-developments-in-lng

1-2 December 2011, PV Power Plants - USA 2011 at Phoenix, Arizona. Contact: David Gaden, Solarpraxis AG, Zinnowitzer Straße 1, Berlin, Berlin, 10115. Phone: 030-726296-373 Email: david.gaden@solarpraxis.de URL: http://www.solarpraxis.de/en/conferences/pv-power-plants-usa-2011/general-information/

8-9 December 2011, Oil & Gas Agreements at Utrecht. Contact: Janet Smid, Account Manager, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8308. Fax: +31 (0) 50 524 8301 Email: smid@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/oil-gas-agreements

12-16 December 2011, International Gas Value Chain Course at The Netherlands. Contact: Rik Cents, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 83 19. Fax: +31 (0) 50 524 83 01 Email: cents@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/introduction-programmes/international-gas-value-chain

12-16 December 2011, International Gas Value Chain Course at Groningen. Contact: Joel Darius, Account Manager, Energy Delta Institute, Groningen, Netherlands. Phone: +31 (0) 50 524 83 16. Fax: +31 (0) 50 524 83 01 Email: darius@energydelta.nl URL: http://www.energydelta.org/en/mainmenu/executive-education/introduction-programmes/international-gas-value-chain

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