EDITORIAL

Introduction to Energy Strategy Reviews theme issue “Nuclear energy today & strategies for tomorrow”

Finding the optimum energy supply system is one of the aims of energy strategy research and nuclear energy is a much debated real option. Proponents of nuclear energy argue that there are no technologies without risks and that nuclear power is needed for meeting growing energy demand in the emerging economies to fuel their industrialization and for mitigating climate change globally. For nuclear proponents, nuclear power is here to stay. Opponents of the technology view the Fukushima event as the ultimate proof that severe nuclear accidents can occur and are not just a remote risk. In their view, nuclear power represents socially unacceptably high risks and must be phased-out – the sooner the better. Governments must find a way to balance their power supply systems and select and decide on the trade-offs between environmental protection, energy security, economic development and the risks and benefits of nuclear power, while taking into account the various public perceptions. This issue of Energy Strategy Reviews assembles a series of articles that could help inform decision makers about relevant nuclear energy strategies – from phase-out to expansion.

1. Theme issue focus

The Fukushima Daiichi accident resulted from the devastating earthquake and subsequent tsunami on 11 March 2011 and was compounded by human error in risk management. The initial shock that reverberated around the world immediately after the Fukushima Daiichi accident prompted governments to assess the safety conditions of their national nuclear facilities. ‘Stress tests’ were conducted with respect to beyond design based events to strengthen the international nuclear safety regime (and apply it at home) and review their nuclear regulatory systems. As a result, the granting of new construction licences was temporarily suspended in many countries. By the end of 2012, suspensions were lifted in some countries while others pursue a wait-and-see strategy. Several countries have decided to phase out nuclear power in the foreseeable future.

This special issue of Energy Strategy Reviews (ESR) brings a collection of analyses, case studies and report reviews dedicated to critical questions related to the future of nuclear energy. Two years after the Fukushima Daiichi accident the future of nuclear power remains uncertain. Meanwhile electricity demand keeps on growing unabated, coal combustion is expanding at frightening rates and environmental pressures are mounting. Will nuclear energy, which today accounts for close to 13 percent of global electricity supply, continue to fill the gap

between fossil fuels and renewable energy supply systems?

2. Energy vision

A visionary statement was kindly contributed by Mr. LUIS ECHAVARRI, Director-General of the OECD Nuclear Energy Agency (NEA). In his ESR *Energy Vision* paper, nuclear power will continue to play a significant future role in meeting growing energy demand, enhancing energy security and alleviating the risk of global warming. He recognizes the necessity of strengthened co-operation on an international level, which must ensure that the highest standards of nuclear safety can be achieved and that the challenges of the 21st century will be met. The NEA will therefore continue to help pool knowledge in order to resolve emerging and outstanding issues, and contributes technical expertise and human infrastructure in support of nuclear energy activities.

3. Energy analyses

The ESR *Analysis* section features a MESSAGE study that models greenhouse gas scenarios and highlights the possible role for nuclear energy in such scenarios. MATHIS ROGNER and KEYWAN RIAHI of IIASA present two diverging global nuclear futures resulting from extensive MESSAGE modelling and scenario analyses. On the one hand, nuclear energy has the potential to be a vital component towards a clean energy strategy. On the other hand, their analyses indicate that stabilization of

greenhouse gas (GHG) concentrations at low levels (450 ppm CO₂) might be possible also with a phase-out of nuclear after 2050.

GASTON MEESKENS of the Centre for Ethics and Value Inquiry, University of Ghent (Belgium) argues for the need to develop a new rationale for the justification of nuclear power that aims to seek societal trust ‘by method instead of proof’, taking into account that the outcome of such a justification process might as well be an acceptance or a rejection of the technology.

4. Case studies

The ESR *Case Study* section comprises several studies with a country perspective (Japan, Finland, India, Nigeria) followed by assessments of various approaches to improve societal support for nuclear energy (papers by RICKWOOD, SCOTT, KIDD) and how knowledge management plays its own important role in that process (YANEV).

NOBUO TANAKA of the Institute of Energy Economics Japan (IEEJ) and former Executive Director of the OECD International Energy Agency (IEA), expresses concerns about Japan’s energy security and high electricity costs. In the light of shut-down nuclear power plants and the persistently looming risk of an oil crisis instigated by Iranian policy tensions, he expects an energy big bang may affect Japan in the not so distant future.

It has often been claimed that market liberalisation and competitive electricity pricing would be the final nails in the coffin of nuclear

power. Using the case of Finland, a research team from the School of Engineering, Aalto University, Finland lead by SANNA SYRI demonstrates that nuclear power, in the presence of policies directed at enhanced energy security and protection of the environment, can well be competitive in liberalized markets and conclude that this is not unique to Finland.

In his contribution to this issue, RAVI GROVER, Director of the Homi Bhabha National Institute, Mumbai, presents the rationale for India viewing nuclear power as part of green growth. Considering growth in demand for modern energy services, renewable energy sources alone cannot meet future energy demand in India. The Government of India has, after examination of various options for green growth, reiterated the importance of accelerated development of nuclear energy along with other clean energy technologies with the aim to increase nuclear electricity generation to about 25% of total electricity generation by the middle of the century.

AMANZE RAJESH EJIUGU of the Aberdeen Business School, Aberdeen evaluates the rationale for Nigeria's plans to add nuclear energy to the country's energy mix. Several years of underinvestment in and neglect of its power sector have rekindled Nigeria's nuclear power ambitions to avert the long-lasting electricity shortage in the country. Although the country holds the largest oil and gas reserves of the African continent, this study concludes that due to the socio-economic and political limitations, substantial energy sector reforms are inevitable prerequisites for an introduction of nuclear power.

The dialogue with the public on its concerns about nuclear technology has not been a show case in favor of the nuclear industry. PHIL RICHARDSON, KATRIN and PETER RICKWOOD examine several cases of engaging the public as a response to these concerns and provide evidence of public involvement not only raising the overall tolerance for nuclear power but also making a significant contribution to improved safety. Lack of accountability within the nuclear community and neglect for fostering a positive dialogue with the public resulted in dismal failures.

DAVID SCOTT, Vice-President for North America at the International Hydrogen Energy Association, argues that the fear of deploying nuclear power is largely founded on low-dose

radiophobia and explains the hormesis response to low-dose radiation. He views nuclear energy as indispensable for the manufacture of the twin energy currencies hydrogen and electricity (hydricity) for expanding into non-electricity markets, especially transportation, and for greatly reducing anthropogenic CO₂ emissions.

STEVE KIDD of the World Nuclear Association (WNA) argues that rising capital costs rather than current public acceptance constrain nuclear new build in the United Kingdom and the United States. He notes a wide gap compared with the much lower capital costs observed in Asia and acknowledges that public acceptance issues are at least partly responsible for the cost gap. Resolving these is important to the industry and future nuclear costs.

YANKO YANEV, CEO of the Nuclear Knowledge Management Institute, Vienna, sees a diminishing knowledgeable nuclear work force as a serious threat to nuclear safety and presents his ideas on nuclear knowledge preservation. The traditional nuclear power countries of the OECD experience a rapid ageing of their nuclear workforce. With little policy support for the technology and limited job opportunities in many countries, young people no longer consider the nuclear industry as a career option. Still nuclear knowledge will be required for decades to come even under the unlikely event of a complete phase-out scenario.

JOEL KRUPA (University of Toronto) and CAMERON JONES (University of Sussex) consider nuclear energy as one of many Black Swans that have eluded energy system model predictions. They provide some policy recommendations of how to hedge against Black Swans and conclude that while Black Swans are inherently unpredictable we must remain consciously aware of their existence.

5. Report reviews

In the ESR Report Review section HANS-HOLGER-ROGNER highlights major conclusions from agency reports and literature on the world outlook for nuclear power. BOB VAN DER ZWAAN reviews the contribution to GHG mitigation by nuclear power. LUCILLE LANGLOIS highlights the new IAEA action plan on nuclear safety.

First, the 2012 projections of global nuclear power development prepared

annually by the International Atomic Energy Agency (IAEA) are highlighted by HANS-HOLGER ROGNER (IIASA; formerly at IAEA). While several countries turned their backs on nuclear power, the majority of countries continue with their pre-Fukushima nuclear strategies albeit at a somewhat slower pace. The projections indicate a delay in the expansion of nuclear power by about one decade but no significant retraction of national nuclear power programmes have occurred globally.

The role of nuclear power in mitigating greenhouse gas (GHG) and particulate matter (PM) emissions from electricity generation is the focus of the report review contribution of BOB VAN DER ZWAAN of the Energy research Center of the Netherlands (ECN). He assesses the life-cycle emissions of nuclear power and shows that technological progress in uranium enrichment has significantly lowered nuclear's life cycle GHG and particulate emissions and concludes that nuclear power can indeed play an important role in protecting the environment.

The "Action Plan on Nuclear Safety" developed by the IAEA jointly with its Member States in response to the Fukushima Daiichi accident is summarized by LUCILLE LANGLOIS (Independent consultant, Vienna). The twelve main action items for enhanced nuclear safety based on the lessons learnt from the accident are reviewed. While the plan calls for comprehensive action by both the IAEA Secretariat and by countries, she notes the missed opportunities for a more rigorous global nuclear safety regime under international oversight.

We think this fourth issue of Energy Strategy Reviews puts forward some highly relevant research contributions to the further development of nuclear energy in future energy systems. We hope you will enjoy the reading.

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Available online 20 March 2013