

Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development

Objective

To enhance the capacity of Member States to perform their own analyses of electricity and energy system development, energy investment planning and energy–environment policy formulation and their economic implications; to sustain and effectively manage nuclear knowledge and information resources for the peaceful uses of nuclear science and technology; to support Member States interested in including nuclear energy in their national energy mixes by providing nuclear information.

Energy Modelling, Databanks and Capacity Building

The Agency updates annually its estimates of future nuclear electricity generating capacity in the world. In 2011, the exercise took into account changing perceptions about the future of nuclear power resulting from the accident at TEPCO's

“Demand continued to increase for Agency assistance in capacity building for energy system analysis and planning, and for conducting national and regional studies on future energy strategies and the role of nuclear power.”

Fukushima Daiichi nuclear power plant (hereinafter the Fukushima Daiichi accident) after the earthquake and tsunami that hit Japan on 11 March 2011. The 2011 high estimate projected that global nuclear power capacity would increase from 369 GW(e) at the end of 2011 to 746 GW(e) in 2030 and 1228 GW(e) by 2050. The low estimate projected growth to 501 GW(e) in 2030 and 560 GW(e) in 2050.

The number of operating nuclear reactors is projected to increase by about 90 by 2030 in the low estimate and by about 350 in the high estimate from the total of 435 reactors at the end of 2011. Most of the growth will occur in countries that already have operating nuclear power plants. Projected growth is

greatest in the Far East. The nuclear capacity in this region is projected to grow from 79.6 GW(e) at the end of 2011 to 180 GW(e) in 2030 in the low estimate and to 255 GW(e) in the high estimate.

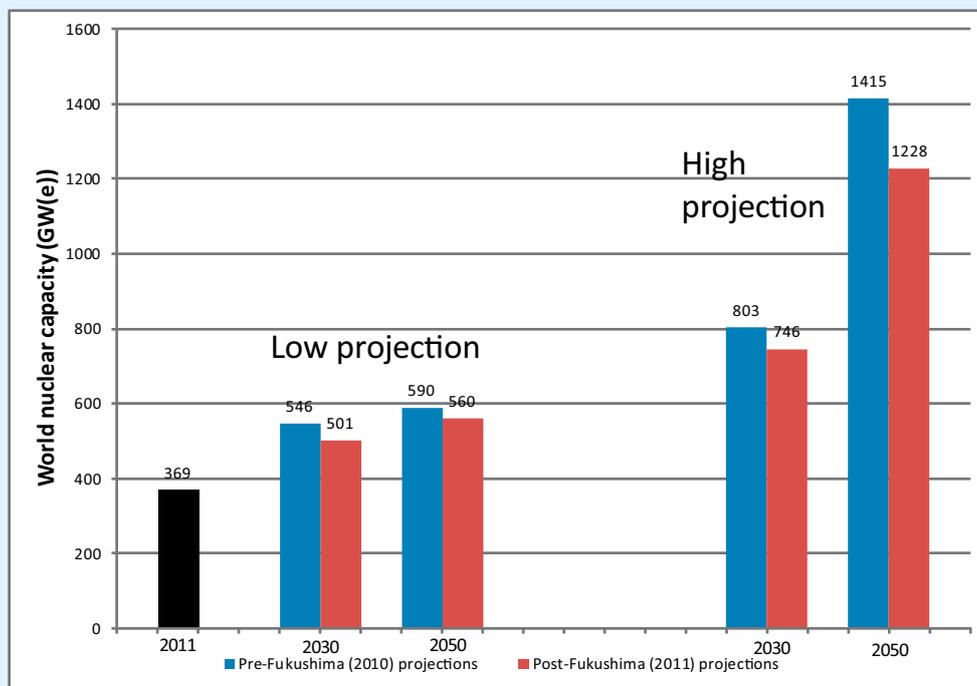
The low and high estimates do not represent extreme situations but cover a plausible range. They are prepared by an international group of experts assembled by the Agency, and are based on a country by country, bottom-up approach, reflecting plans by governments and electric utilities, and the judgement of experts.

Demand continued to increase for Agency assistance in capacity building for energy system analysis and planning, and for conducting national and regional studies on future energy strategies and the role of nuclear power. The Agency's analytical tools developed for this purpose are now being used in more than 125 Member States. During 2011, over 600 energy analysts and planners from 67 countries were trained to use these tools. Traditional face to face training was regularly supplemented by web based e-training courses. For countries introducing nuclear power, the Agency held four regional and five national training workshops on assessing the economic and financial viability of nuclear power projects and establishing national positions on the introduction of nuclear power, which is the first of the 19 infrastructure issues identified in the publication *Milestones in the Development of a National Infrastructure for Nuclear Power* (IAEA Nuclear Energy Series No. NG-G-3.1).

Energy–Economy–Environment (3E) Analysis

For the 17th Conference of the Parties (CoP-17) to the United Nations Framework Convention on Climate Change, held in December 2011 in Durban, South Africa, the Agency published *Climate Change and Nuclear Power 2011*, which emphasizes the importance of nuclear energy in reducing carbon dioxide emissions in the electricity sector (see Fig. 1) and provides up to date information on a number of issues related to the subject. As in previous years, the Agency maintained an information centre at CoP-17 that provided an opportunity to present

The Fukushima Daiichi accident resulted in a slowing of the expansion of nuclear power, but did not reverse it. As shown in the figure below, the Agency's post-accident projections of global nuclear power capacity in 2030 were 7–8% lower than what was projected before the accident. This continued growth in both the low and high projections suggests that the factors that contributed to increasing interest in nuclear power before the Fukushima Daiichi accident have not changed: these include increasing global demand for energy as well as concerns about climate change, volatile fossil fuel prices and security of energy supply.



Comparison of projections for nuclear power before and after the Fukushima Daiichi accident.

its work on the linkages between nuclear power and climate change mitigation, to disseminate relevant publications, and to discuss broader issues pertaining to nuclear energy with government and non-government delegates. In addition to nuclear power's low greenhouse gas emissions, the Fukushima Daiichi accident and the overall safety of nuclear power plants were the most frequent subjects about which questions were asked. Nuclear power continued to be of major interest to delegations from developing countries as they assessed their climate change mitigation options.

Many Member States, especially those with both abundant and cheap coal resources and with the capacity to build and operate nuclear power reactors, must decide on their preferred mix for electricity generation using coal and nuclear power. Key issues include the relative advantages and disadvantages associated with managing the waste products, specifically carbon dioxide in the case of coal based power and radioactive waste in the case of nuclear power. An Agency book published by

Springer in 2011, *Geological Disposal of Carbon Dioxide and Radioactive Waste: A Comparative Assessment*, assesses carbon dioxide and radioactive waste disposal and reveals many similarities, including the transformation of the geological environment, safety

“Nuclear power continued to be of major interest to delegations from developing countries as they assessed their climate change mitigation options.”

and monitoring concerns, and regulatory, liability and public acceptance issues. The publication is intended to help policy makers consider, as part of developing national energy strategies, the broad range of issues involved in the disposal of waste from nuclear energy and from fossil based power generation with carbon dioxide capture. The Agency

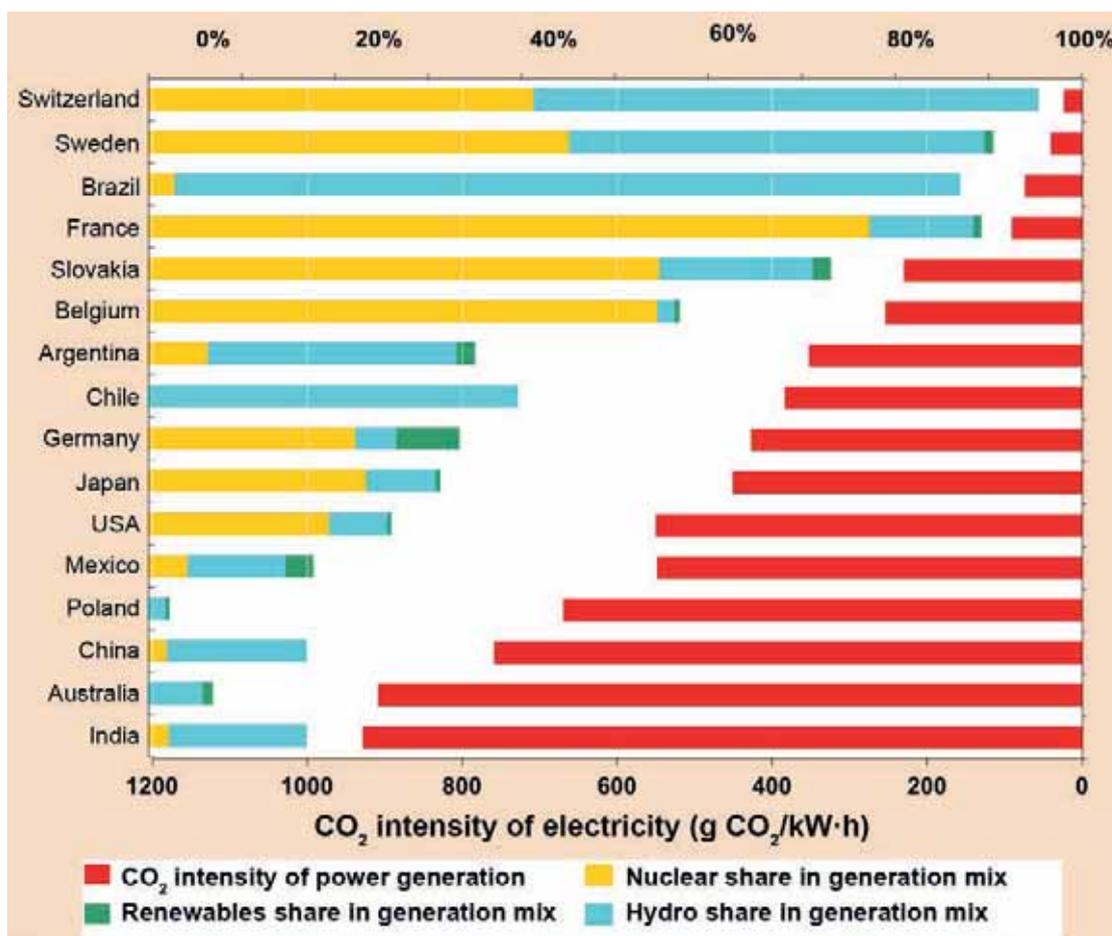


FIG. 1. Carbon dioxide intensity and the shares of non-fossil sources in the electricity sector of selected countries (Agency calculations based on IEA data).

also completed a CRP that supported Member States in the preparation of comparative assessments of the geological disposal of carbon dioxide and radioactive waste in the context of their own specific requirements.

In response to the diverse range of privatization and deregulation concepts and programmes across

“The Agency continued to participate in the international debate on the potential role of nuclear power in climate protection and mitigation.”

Member States, a series of technical meetings was held to explore the prospects for nuclear power under different electricity market regulatory arrangements. Their preliminary conclusion was that regulated markets generally offer better opportunities for nuclear power, through government support and

long term power purchase agreements, compared with pool based deregulated markets with less flexibility for long term power purchase agreements. However, the decisions of investors are influenced strongly by factors unrelated to power market reforms, such as climate change policy, the price of natural gas, feed-in tariffs (which provide a guaranteed revenue per kilowatt-hour to producers), resource abundance and security of supply.

The Agency continued to participate in the international debate on the potential role of nuclear power in climate protection and mitigation. In addition to publishing *Climate Change and Nuclear Power 2011*, it delivered invited presentations at a number of topical international conferences, prepared a paper on nuclear power and climate change for the Human Development Report of the UNDP Asia-Pacific Regional Centre and contributed to the Fifth Assessment Report of the IPCC. The Agency also expanded the scope of its climate related activities to explore the impacts of climate change and extreme weather events on nuclear energy installations and the energy sector at large; it also

organized a workshop at the Abdus Salam ICTP in Trieste, reported at major international conferences and prepared a special issue of the journal *Climatic Change* on extreme weather events.

Nuclear Knowledge Management

The Agency continued to be an important source of methods and guidance for nuclear knowledge management activities in Member States. In 2011, it published *Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation* (IAEA Nuclear Energy Series No. NG-T-6.7), which presents the results of a CRP on the methods and tools used in various nuclear organizations. It concluded that knowledge preservation in nuclear organizations had not reached maturity, that many cost effective methods and tools were available and that knowledge preservation processes could improve operational procedures and overall performance. It recommended that organizations without formal knowledge preservation programmes conduct knowledge loss risk assessments and take knowledge preservation into account in their strategic planning. The Agency also published *Status and Trends in Nuclear Education* (IAEA Nuclear Energy Series No. NG-T-6.1), which provides a general overview of activities regarding nuclear knowledge management, nuclear education, and national and regional needs and expectations. It also presents detailed country reports on the status of nuclear education in Member States and recommendations about best practices in nuclear education.

Through its technical cooperation programme, the Agency conducted knowledge management assist visits to the Shanghai Nuclear Engineering Research and Design Institute in China, the Kozloduy nuclear power plant in Bulgaria, the Atomic Energy Committee of Kazakhstan, the State Atomic Energy Corporation 'Rosatom' and Typhoon Scientific Production Association in the Russian Federation, the South Ukraine and Khmelnytsky nuclear power plants in Ukraine, the Khalifa University of Science, Technology and Research (KUSTAR) in the United Arab Emirates, Texas A&M University in the USA, and several universities in Vietnam.

The Agency continued to facilitate three important regional networks, the Asian Network for Education in Nuclear Technology, the AFRA Network for Education in Nuclear Science and Technology, and the Latin American Network for Education in Nuclear Technology, which was created in December 2010 and held its second General Assembly in Chile in

October. A central element of the Agency's support is a 'Cyber Learning Platform for Nuclear Education and Training', which was installed in 2011 in Vienna, the Korea Atomic Energy Research Institute in the Republic of Korea, and KUSTAR in the United Arab Emirates.

In 2011, in cooperation with the Abdus Salam ICTP in Trieste, the Agency conducted its second School of Nuclear Energy Management and seventh School of Nuclear Knowledge Management. The former

"In 2011, in cooperation with the Abdus Salam ICTP in Trieste, the Agency conducted its second School of Nuclear Energy Management and seventh School of Nuclear Knowledge Management."

provided an opportunity for young managers from developing countries to be involved in a nuclear programme management course and to learn from world experts and the Agency's specialists about global nuclear energy development. The latter course targeted young professionals from developing countries and provided training on nuclear knowledge management and its implementation in nuclear organizations.

In cooperation with the Karlsruhe Institute of Technology in Germany, the Agency conducted a train the trainers course on nuclear knowledge management for university teachers to develop curriculums for Masters level courses in science and engineering.

Collecting and Disseminating Nuclear Information

In cooperation with 127 countries and 24 international organizations, the International Nuclear Information System (INIS) represents a global information system offering almost 3.4 million bibliographic records and more than 310 000 full-text non-conventional publications. This collection of documents on the peaceful uses of nuclear science and technology is now fully indexed and searchable on the Internet using the INIS Collection Search, a Google based web application developed by the Agency (<http://www.iaea.org/inis>). An average of over 50 000 searches were performed, as well as 3500 downloads, every

month in 2011. Through its technical cooperation programme, the Agency organized a regional training course for Africa in Morocco. In Vienna, it organized a training seminar with 40 participants from Member States. At the end of the year, the joint INIS/Energy Technology Data Exchange (ETDE) thesaurus contained 21 881 valid descriptors and 8675 'forbidden terms', i.e. terms that should no longer be used but should be replaced by a valid term included in the thesaurus.

The Agency has continued to complement its print collection at the IAEA Library with an increasing

number of electronic resources. The number of visitors per month increased from 1000 in 2010 to over 1200 in 2011. A total of over 15 000 research requests were processed, while the number of loans to users increased from 14 500 in 2010 to 20 000 in 2011. Membership in the International Nuclear Library Network (INLN), coordinated by the Agency, remained stable with 35 member libraries. The INLN has developed into a 'community of practice', i.e. a network of people with a common interest who work together over time to develop knowledge in a specific area.¹

¹ The main library web site is: <http://www.iaea.org/OurWork/ST/NE/Library/>
The library catalogue can be accessed at: <http://library.iaea.org/starweb/IAEA/servlet.starweb?path=IAEA/STARLibraries.web>
The INLN web site is: <http://www.iaea.org/OurWork/ST/NE/Library-INLN/>