

Innovation in nuclear is key for a sustainable energy future

By William D. Magwood, IV



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For most countries, a successful energy policy is one that fulfils the three pillars of sustainability — security of supply, environmental protection and affordability. In the rapidly evolving electricity market, the value of nuclear power to the energy mix will depend on its capacity to meet current and future energy needs — as reflected by these three pillars. It is evident that meeting these expectations will require innovation in nuclear technology.

Nuclear power plants provide reliable dispatchable power generation that is transmitted as needed by electricity grid operators day and night, all year around, and in all weather conditions. Moreover, nuclear power plants are deployable on a large scale to meet the expected increase in demand for carbon-neutral electricity. It is likely that with the share of variable renewable energy increasing substantially, nuclear generation will need to be flexible beyond its traditional baseload operation mode. Increased flexibility will imply a need for optimization and innovation in areas such as: reactor and fuel designs; enhanced load-following capacity of nuclear reactors; the deployment of small modular reactors (SMRs); and the development of co-generation strategies that can provide additional demand and revenue streams to plant operators.

While there is general consensus that nuclear is a clean, low-carbon technology that can address environmental concerns, its ability to adapt to today's very challenging market conditions is in question. Such market conditions include a decrease in the costs of renewable energy coupled with very favourable government policies and subsidies towards renewables, as well as a growing share of non-conventional sources of fossil fuels such as shale gas without carbon pricing in the market. Because electricity markets are not structured to reflect these changes in technology and policy, these factors reduce the profitability of many existing baseload electricity plants, particularly nuclear power plants. To be sustainable, the electricity markets must be modernized to ensure long-term reliability; but whatever path the future

takes, nuclear power's future will require innovation to decrease the overall cost of generation while maintaining high levels of nuclear safety.

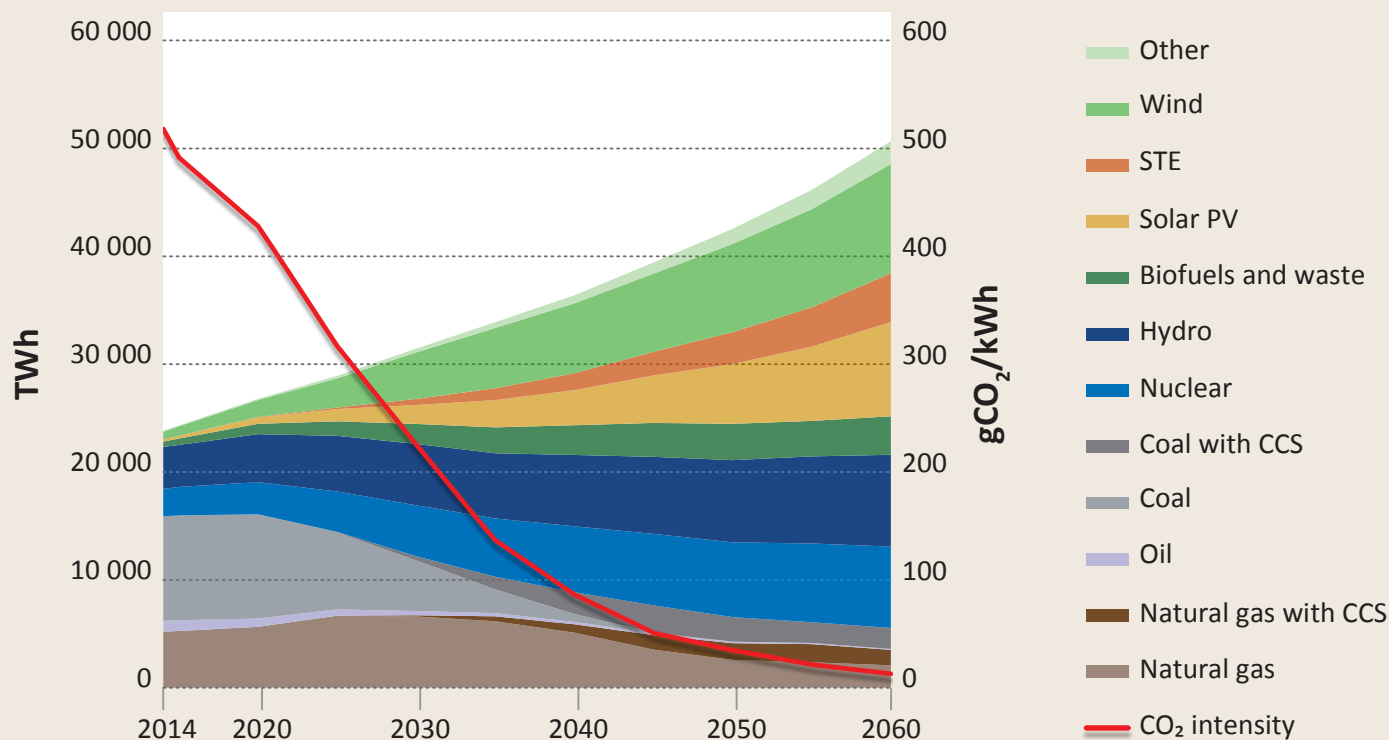
The importance of international cooperation

The Nuclear Energy Agency (NEA) launched the “Nuclear Innovation 2050” (NI2050) initiative to encourage new cooperative approaches among countries for the purpose of furthering research and the deployment of innovative nuclear technologies that contribute to a sustainable energy mix. This goal is also supported by other NEA initiatives, such as an ongoing study on advanced reactor systems as well as work jointly carried out with the International Energy Agency (IEA) on the electricity market.

The core of NI2050's approach is to apply multilateral strategies to support more effective deployment of innovative nuclear technologies. Multilateral approaches can create the confidence needed for the worldwide deployment of innovative technologies through the identification of priorities, the establishment of solid common foundations based on scientific validation of technologies and the definition of shared qualification methods to support robust licensing processes.

Because safety is a priority to be “built in” at the early design stages of any technological evolution, some level of interaction with authorities and regulators is necessary. International collaboration among safety bodies is probably one of the most effective ways to get early insight into the safety aspects of any innovation without compromising regulatory independence. The NEA already offers such a framework by providing a broad platform for discussion through its various specialized committees. NI2050 has now selected a set of topical areas to develop “10-year programmes of action” on accident-tolerant fuels, severe accident knowledge management, passive safety systems, the management of ageing

Global electricity generation by source



(Data from Energy Technology Perspectives 2017, International Energy Agency)

Today one third of generated electricity comes from low-carbon sources. If global targets for CO₂ emissions are met, this share would increase to nearly 85 % by mid-century.

Source: NEA

structures, advanced fuels and materials, advanced components, fuel cycle chemistry/recycling, heat production and cogeneration, modelling and simulation, digitalization and measurements, infrastructures and demonstrations. By gathering stakeholders around shared priorities, NI2050 could trigger innovation in nuclear technology, which is the most important condition for nuclear energy to play a role in the sustainable energy mix of the future.

Many countries are faced with the challenge of simultaneously dealing with an electricity market growing in complexity, increasing demand for electricity and the need to establish national policies to reduce carbon

emissions. Without sufficient innovation capacities, countries using nuclear technology may be forced to rely on more technologically innovative countries, with implications regarding their sovereignty in the energy field. For this reason, governments need to pay close attention to the overall strategic dimension of nuclear power beyond the economic and environmental dimensions.

Innovation in nuclear technology today requires increased involvement and cooperation among countries and actors in the nuclear sector to harness collective skills and means, to create sound and robust confidence in new technologies, to open the international market and to attract investment.