Nuclear energy roadmap actions and milestones

**Key findings**

- Nuclear power is the largest source of low-carbon electricity in OECD countries and second at global level. Nuclear can play a key role in lowering emissions from the power sector, while improving security of energy supply, supporting fuel diversity and providing large-scale electricity at stable production costs.

- In the 2D scenario, global installed capacity would need to more than double from current levels of 396 GW to reach 930 GW in 2050, with nuclear power representing 17% of global electricity production.

- The near-term outlook for nuclear energy has been impacted in many countries by the Fukushima Daiichi nuclear power plant (NPP) accident. Although the accident caused no direct radiation-induced casualties, it raised concerns over the safety of NPPs and led to a drop in public acceptance, as well as changes in energy policies in some countries.

- However, in the medium to long term, prospects for nuclear energy remain positive. A total of 72 reactors were under construction at the beginning of 2014, the highest number in 25 years.

- Nuclear safety remains the highest priority for the nuclear sector. Regulators have a major role to play to ensure that all operations are carried out with the highest levels of safety. Safety culture must be promoted at all levels in the nuclear sector (operators and industry, including the supply chain, and regulators) and especially in newcomer countries.

- Governments have a role to play in ensuring a stable, long-term investment framework that allows capital-intensive projects to be developed and provides adequate electricity prices over the long term. Governments should also continue to support nuclear R&D, especially in the area of nuclear safety, advanced fuel cycles, waste management and increased safety levels and power output to benefit from economies of scale. This trajectory has come with an increased cost for Generation III reactors compared with previous generations.

- Small modular reactors (SMRs) could extend the market for nuclear energy by providing power to smaller grid systems or isolated markets where larger nuclear plants are not suitable. The modular nature of these designs may also help to address financing barriers.
Review arrangements in electricity market so as to ensure enhanced standardisation, harmonisation of codes, standards.

Governments that have not yet finalised their strategies and countries choosing to develop nuclear power for the first time will need to do so. Vendors must demonstrate the ability to build on time and to budget, and to reduce the costs of new designs.

Enhanced standardisation, harmonisation of codes, standards and regulatory requirements, and the streamlining of regulatory licensing processes, are needed to reduce costs and to improve new build planning and performance. Industry must continue to improve quality assurance and control for nuclear structures, systems and components.

Information exchange and experience sharing among regulators, and among operators of nuclear power plants, should be enhanced so as to improve overall safety and operational performance.

Countries choosing to develop nuclear power for the first time must be prepared to set up the required infrastructures prior to the start of a nuclear programme. Building capacities in terms of trained, educated and competent staff for future operation and regulatory oversight is an absolute necessity and requires long-term planning.

Actions to improve public acceptance must also be strengthened. These include implementing post-Fukushima safety upgrades in existing reactors and demonstrating that nuclear regulators are strong and independent.

Governments that have not yet finalised their strategies for managing nuclear waste, should do so without delay. For high-level waste, deep geological disposal (DGD) is the recommended solution. Long-term planning, political commitment and strong engagement with local communities are central to this strategy.

Key actions for the next 5 years

- Review arrangements in electricity market so as to ensure that they offer investment frameworks as favourable to new nuclear build as they are to other low-carbon technologies and allow nuclear power plants to operate effectively.
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**Nuclear investment requirements in the 2DS from 2012 to 2050**

*Source: International Energy Agency.*
Nuclear energy roadmap actions and milestones

**Nuclear fuel cycle**
- Develop targeted education and information programmes to improve the general public’s understanding of the benefits and risks of nuclear energy.
- Invest in environmentally sustainable uranium mining to address expected long-term demand.
- Ensure that policies are in place for long-term storage and disposal, including deep geological disposal of high level waste.
- Ensure that regulator are strong, independent and staffed with enough skilled, competent and adequately remunerated personnel to carry out their missions.
- Ensure that policies on low-carbon electricity sources through carbon trading schemes, carbon taxes or mandates for low-carbon electricity.
- Enhance and monitor safety culture across the nuclear sector and at all levels of staff.
- Develop targeted education and information programmes to improve the general public’s understanding of the benefits and risks of nuclear energy.

**Licensing and regulation, nuclear safety**
- Put in place public-private partnerships to develop demonstration projects for nuclear cooperation.
- Implement post-Fukushima safety upgrades in existing reactors in a timely manner.
- Continue to promote international co-operation through fora of regulators, industry and operators, and intergovernmental organisations and initiatives.
- Develop licensing frameworks for advanced reactors, including SMRs and Gen IV reactors.
- In nuclear countries, undertake national skills evaluations to quantify the need for a skilled nuclear workforce to maintain the operation of existing fleets, for future decommissioning activities as well as for nuclear new builds.
- In newcomer countries, develop local training programmes aimed at developing a nuclear-aware and nuclear-competent workforce.
- Accelerate harmonisation of codes and standards to improve the integration of a global supply chain.

**Financing nuclear development**
- Accelerate the development of SMR prototypes and launch construction projects.
- Optimise Gen III designs to improve constructability and reduce costs. The learning rate from FOAK construction needs to be accelerated to ensure that NOAK plants are built on time and to budget.
- Incorporate feed-back from operation of Gen IV prototypes to develop/FOAK Gen IV commercial plants.
- Optimize Gen IV designs to improve constructability and reduce costs. The learning rate from FOAK construction needs to be accelerated to ensure that NOAK plants are built on time and to budget.
- Put in place public-private partnerships to develop demonstration projects for nuclear cooperation.
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**Codes and standards**
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**Communication and public acceptance**
- Enhance and monitor safety culture across the nuclear sector and at all levels of staff.
- Develop targeted education and information programmes to improve the general public’s understanding of the benefits and risks of nuclear energy.

**NUCLEAR ENERGY**

**2015 edition**

**Nuclear generation capacity and share of electricity production 2012-50**

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- Governments have a role to play in ensuring a stable, long-term investment framework that allows capital-intensive projects to be developed and provides adequate electricity prices over the long term. Governments should also continue to support nuclear R&D, especially in the area of nuclear safety, advanced fuel cycles, waste management and innovative designs.
- Nuclear energy is a mature low-carbon technology, which has followed a trend towards increased safety levels and power output to benefit from economies of scale. This trajectory has come with an increased cost for Generation III reactors compared with previous generations.
- Small modular reactors (SMRs) could extend the market for nuclear energy by providing power to smaller grid systems or isolated markets where larger nuclear plants are not suitable. The modular nature of these designs may also help to address financing barriers.