



Harmony

The global nuclear industry's vision
for the future of electricity

The Harmony goal

To meet the growing demand for reliable, affordable and clean electricity, we will need all low-carbon energy sources to work together as part of a diverse mix. Achieving this means nuclear energy generation must triple globally by 2050. The nuclear community needs to meet this challenge. Harmony provides a framework for action, working with key stakeholders so that barriers to growth can be removed.

25%

of global electricity supplied by nuclear in 2050

1000 gigawatts

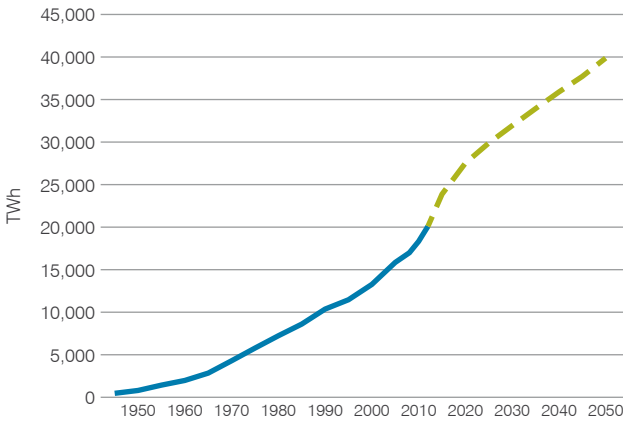
new nuclear capacity by 2050

Why we need Harmony

Access to electricity and the need for clean air are vital. Electricity consumption continues to rise but air pollution and greenhouse gas emissions must fall. The Harmony goal is developed from the International Energy Agency's 2°C scenario,

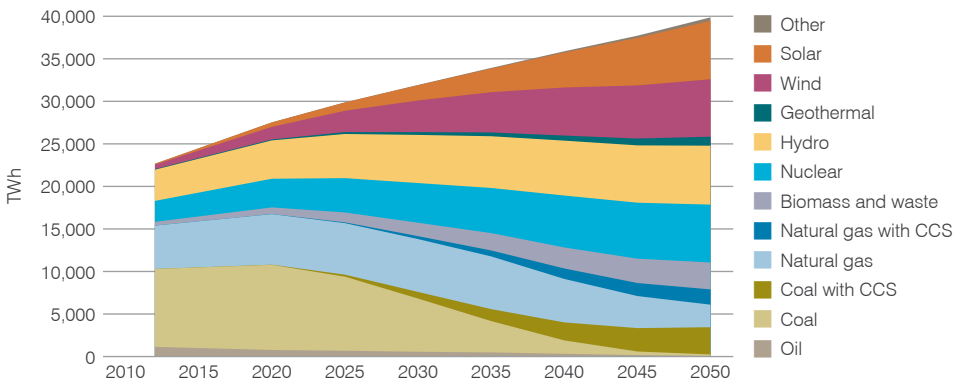
which sets out a pathway that avoids the most damaging consequences of climate change and requires a large increase of all low-carbon sources, of which nuclear is an important part.

Electricity consumption growth in a low carbon scenario



Source: 1945-1979, IEA databases and analysis
1980-2012, Energy Information Administration
2013-2050, IEA Energy Technology Perspectives 2016

IEA 2°C scenario



Source: IEA Energy Technology Perspectives 2016

An increased share of low-carbon sources, as well as a greatly reduced level of fossil fuels, work together in harmony to ensure a reliable, affordable and clean future energy supply.



Nuclear is an important part of the energy mix

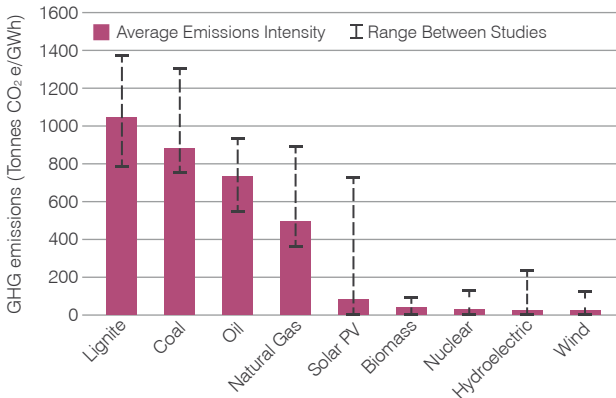
The international community recognizes the urgent need to decarbonize our electricity generation to protect people and the planet from the dangers of air pollution and climate change.



7 million premature deaths are linked to air pollution every year¹.

Nuclear energy is proven, available today and can be expanded quickly - making it an important part of the solution to air pollution and climate change.

Nuclear energy is low-carbon. It ranks among the best when considering whole life-cycle emissions.



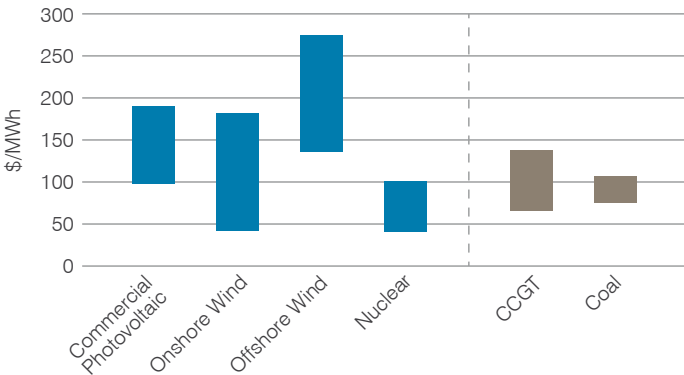
Source: World Nuclear Association meta study, incl. IPCC 2014

¹ Data published by the World Health Organisation, Department of Public Health, Environmental and Social Determinants of Health, 2014



Nuclear power remains one of the most cost-effective low-carbon options for generating electricity.

Levelized cost of electricity ranges (at 7% discount rate)



Source: *Projected Costs of Generating Electricity - 2015 Edition*, International Energy Agency and OECD Nuclear Energy Agency

Nuclear generation is a cost-competitive low-carbon generation option according to the IEA World Energy Outlook 2016. The cost per unit of electricity produced from wind or solar PV is stated to be 22-40%

higher than that from nuclear generation, even without counting the additional costs of adapting the grid and providing the back-up generation required to compensate for their intermittent supply.

The challenges



There are currently several barriers standing in the way of achieving the Harmony goal.



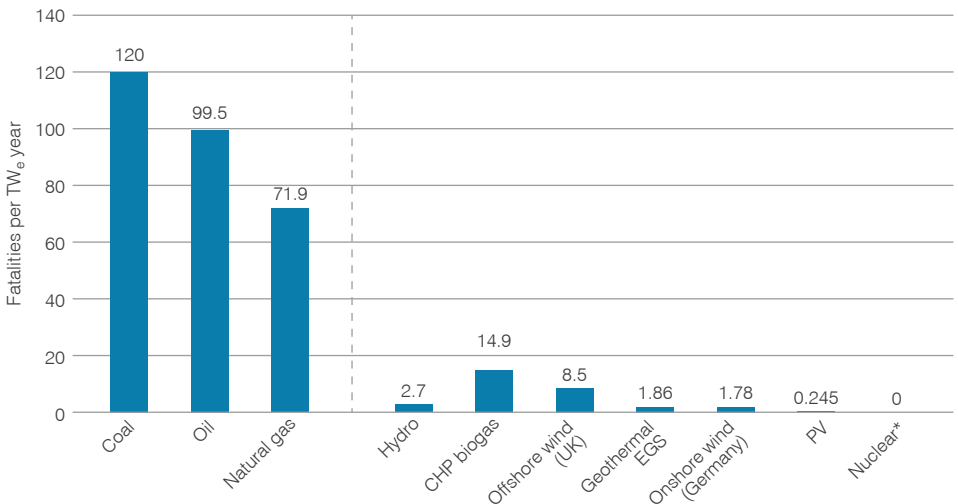
- 1 Most electricity markets are distorted and do not recognize the full costs of different forms of electricity generation. Even when carbon pricing is included, it does not represent the true long-term costs of climate change. There are also significant system effects and costs associated with unpredictable and intermittent renewable generation that are not reflected in the market price. Also, reliable and dispatchable energy, such as nuclear, is not valued by many liberalized markets.
- 2 The current nuclear regulatory regime has provided a high level of safety. However development of nuclear regulations and standards remains fragmented, and has not kept pace with the growth of recent international new build projects, limiting global civil nuclear trade and investment.



3 The current energy system fails to consider safety from a holistic society perspective. The health and environmental benefits of nuclear energy are not valued on an equitable basis with alternative energy sources.

The current preoccupation with the safety first message is driving the nuclear debate to focus on nuclear safety issues alone, ignoring other factors such as economics, industrial, social, public health and environment.

Energy accident fatalities for OECD countries



* Gen II PWR, Swiss

Source: Paul-Scherrer Institut. Data for nuclear accidents modified to reflect UNSCEAR findings/recommendations 2012 and NRC SOARCA study 2015

Actions for success

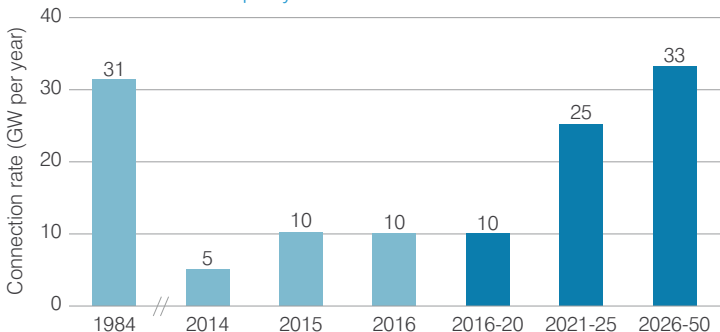
The global nuclear industry needs to work on removing the barriers to the growth of nuclear energy. Three objectives are key to achieving the Harmony goal:

- 1 Establish a **level playing field** for all low-carbon energy technologies, valuing not only health and environmental qualities, but also reliability and grid system costs.
- 2 Ensure **harmonized regulatory processes** to provide a more internationally consistent, efficient and predictable nuclear licensing regime, to facilitate significant growth of nuclear capacity, without compromising safety and security.
- 3 Create an **effective safety paradigm** where the health, environmental and safety benefits of nuclear are valued when compared with other energy sources, by focusing on increasing genuine public wellbeing whilst ensuring high safety standards are met.

Today, with the experience and knowledge it has gained, the nuclear energy industry is in a strong position to deliver on the Harmony goal. This is an ambitious programme, but the rate at which new reactors will have to be built is no higher than what has been historically achieved.

The build rate required to meet the Harmony goal of 1000 GWe of new nuclear capacity by 2050 is:

- 10 GWe per year between 2016 and 2020
- 25 GWe per year between 2021 and 2025
- 33 GWe per year between 2026 and 2050



“Nuclear sector aims to build 1000 GW of new reactors by 2050.”

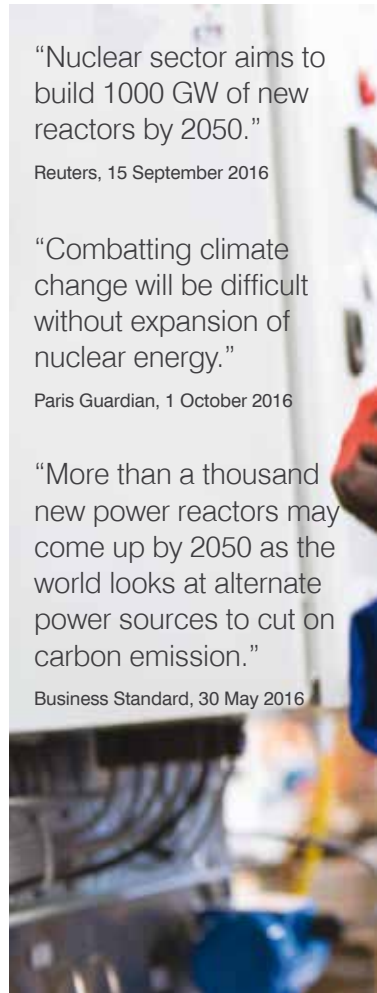
Reuters, 15 September 2016

“Combatting climate change will be difficult without expansion of nuclear energy.”

Paris Guardian, 1 October 2016

“More than a thousand new power reactors may come up by 2050 as the world looks at alternate power sources to cut on carbon emission.”

Business Standard, 30 May 2016





The International Energy Agency (IEA) has called for nuclear energy to receive “clear and consistent policy support for existing and new capacity, including clean energy incentive schemes for development of nuclear alongside other clean forms of energy.”

IEA Energy Technology Perspectives 2017

Roadmap

The Harmony goal is ambitious but crucial for the world to meet the energy challenge. It has been established in 2016 by the World Nuclear Association and is gaining traction in the global energy arena.

Achieving 1000 GWe of new nuclear build by 2050 will require a cooperative effort by the whole nuclear community - from industry to research, governments, and regulators - to focus on demolishing the real barriers to growth.

Harmony provides the framework for action for the nuclear industry to deliver its potential. The World Nuclear Association is leading the way in identifying the solution-oriented measures that need to be put in place, and getting support from key stakeholders to ultimately deliver the Harmony goal.

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