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Global Nuclear Policy Development and Trends

Agneta Rising
Director General

Nuclear Energy Seminar
Energiforsk
25 January 2017, Stockholm

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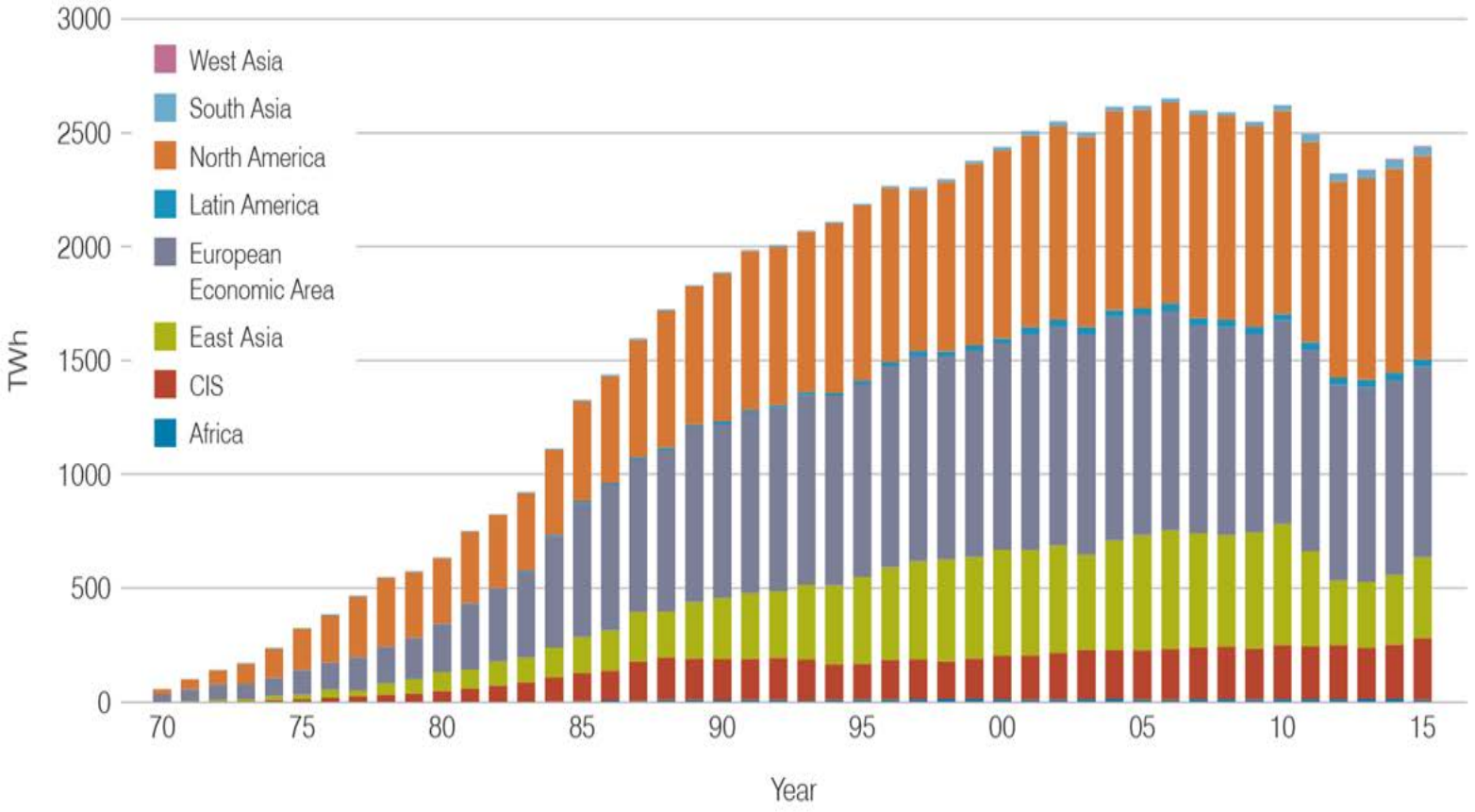
Global nuclear generation



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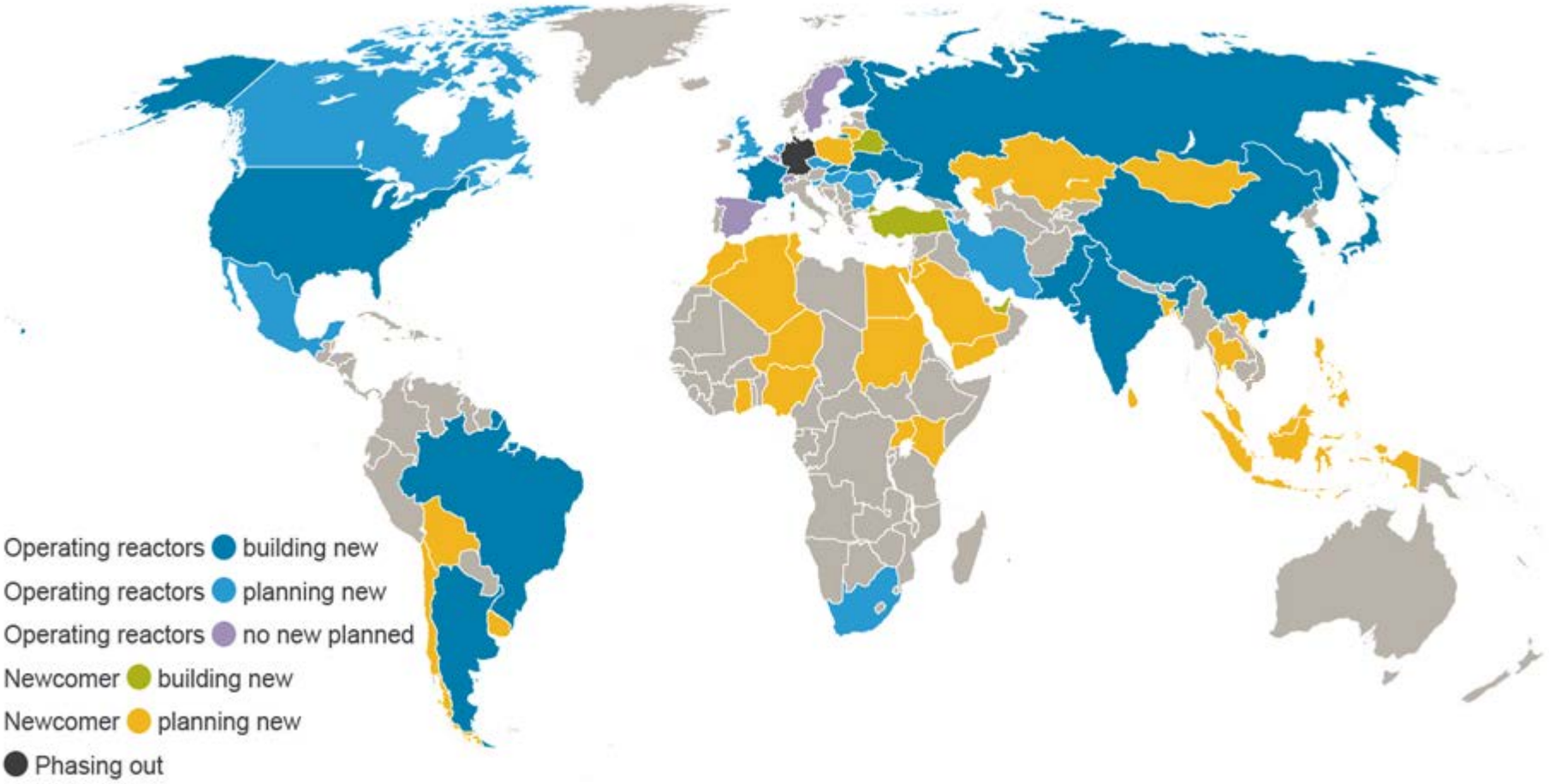
Global nuclear status



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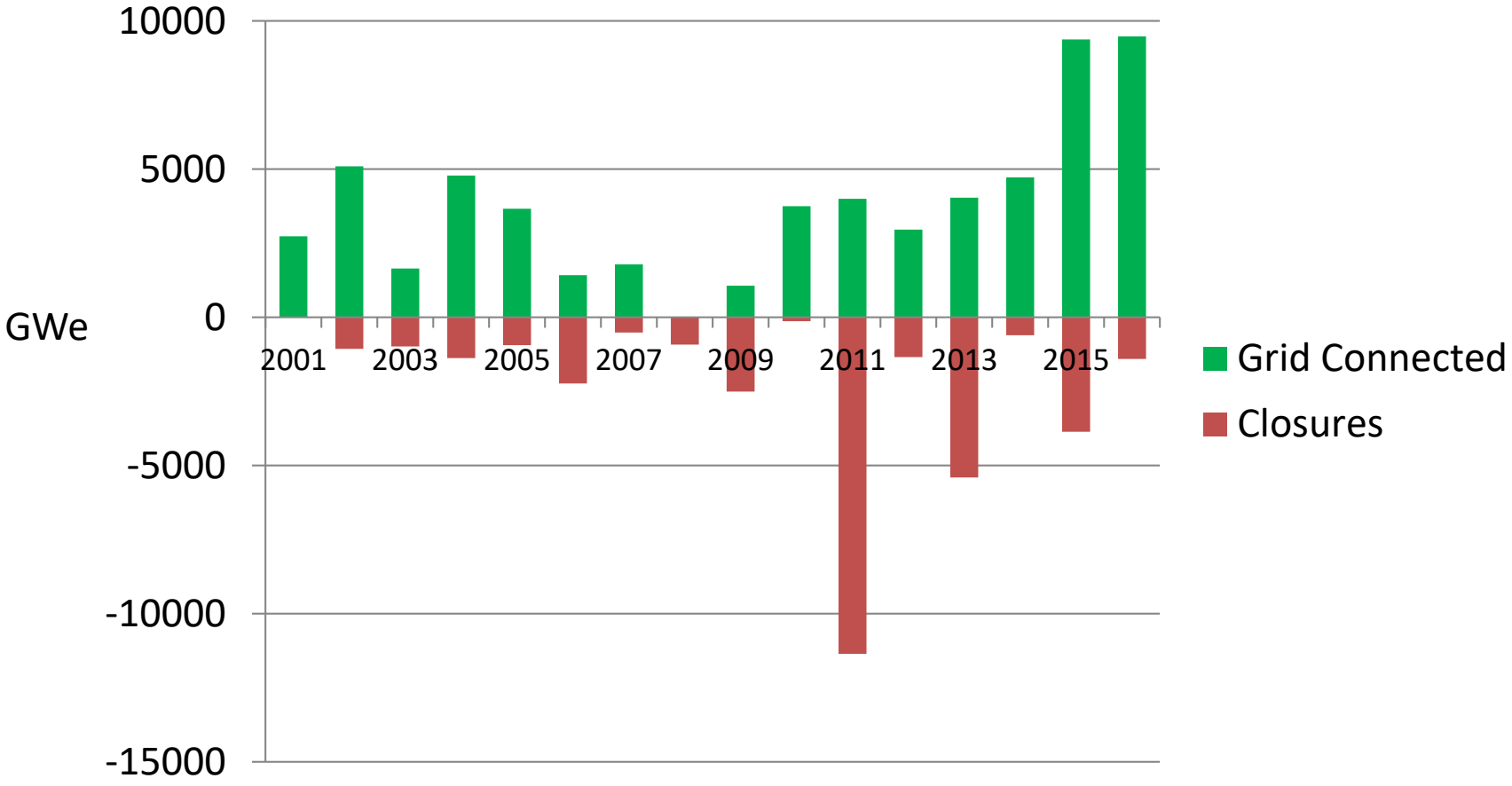
Global Reactor Grid Connection and Closures



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New reactor start-ups in 2016

India

Kudankulam-2

USA

Watts Bar-2

South Korea

Shin-Kori-3

Russia

Novovoronezh 2-1

Pakistan

Chasnupp-3

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New reactor start-ups in 2016

China

Changjiang-2

Fangchenggang-2

Fuqing-3

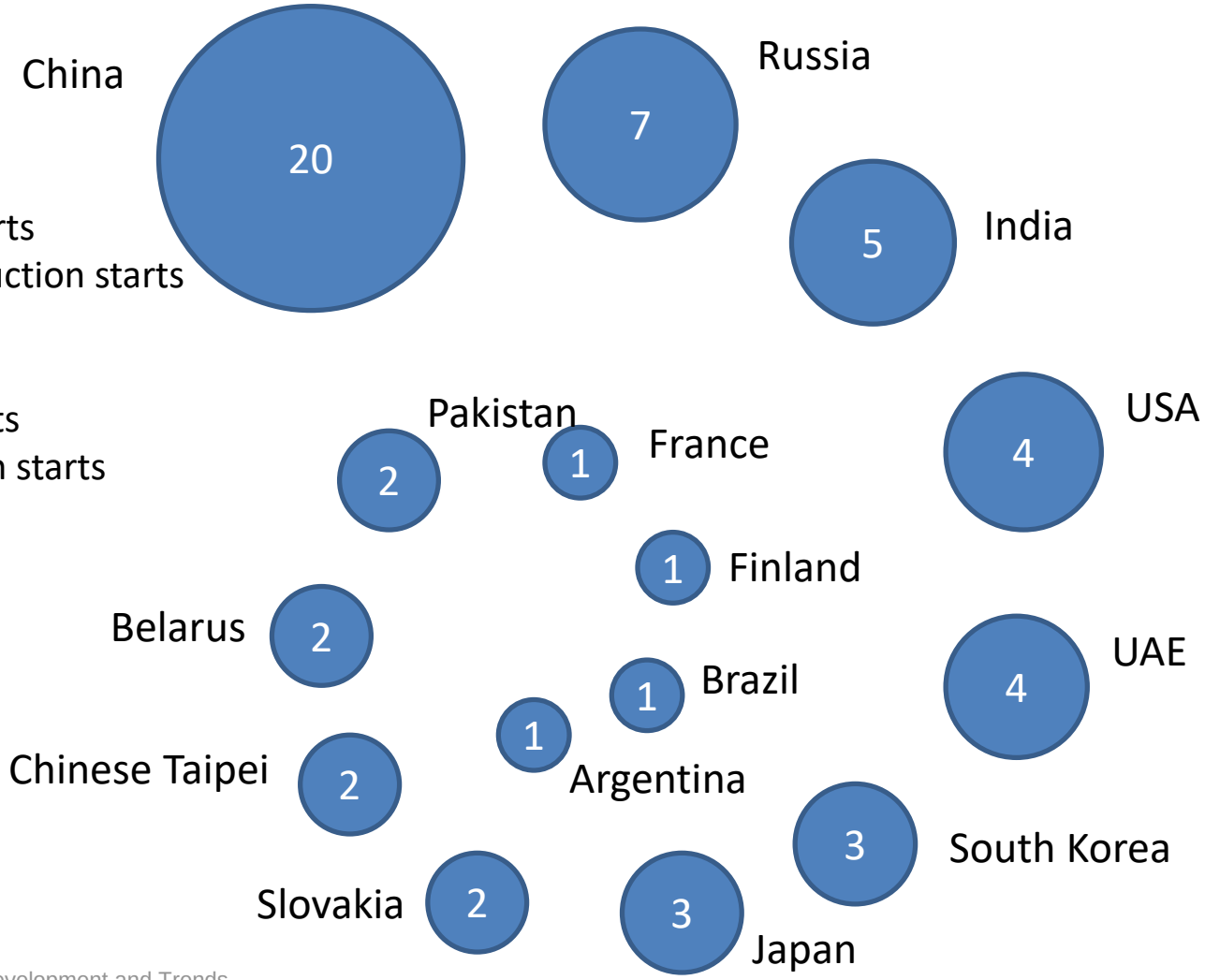
Hongyanhe-4

Ningde-4

58 reactors under construction worldwide

China 2016:
5 reactors starts
2 new construction starts

China 2015:
8 reactor starts
6 construction starts



Source World Nuclear Association

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Future expansion of nuclear build.

Status of New Build Plans	
Power reactors under construction	UAE, Belarus
Contracts signed, legal and regulatory infrastructure well-developed or developing	Lithuania, Turkey, Bangladesh, Vietnam(but deferred)
Committed plans, legal and regulatory infrastructure developing	Jordan, Poland, Egypt
Well-developed plans but commitment pending	Thailand, Indonesia, Kazakhstan, Saudi Arabia, Chile

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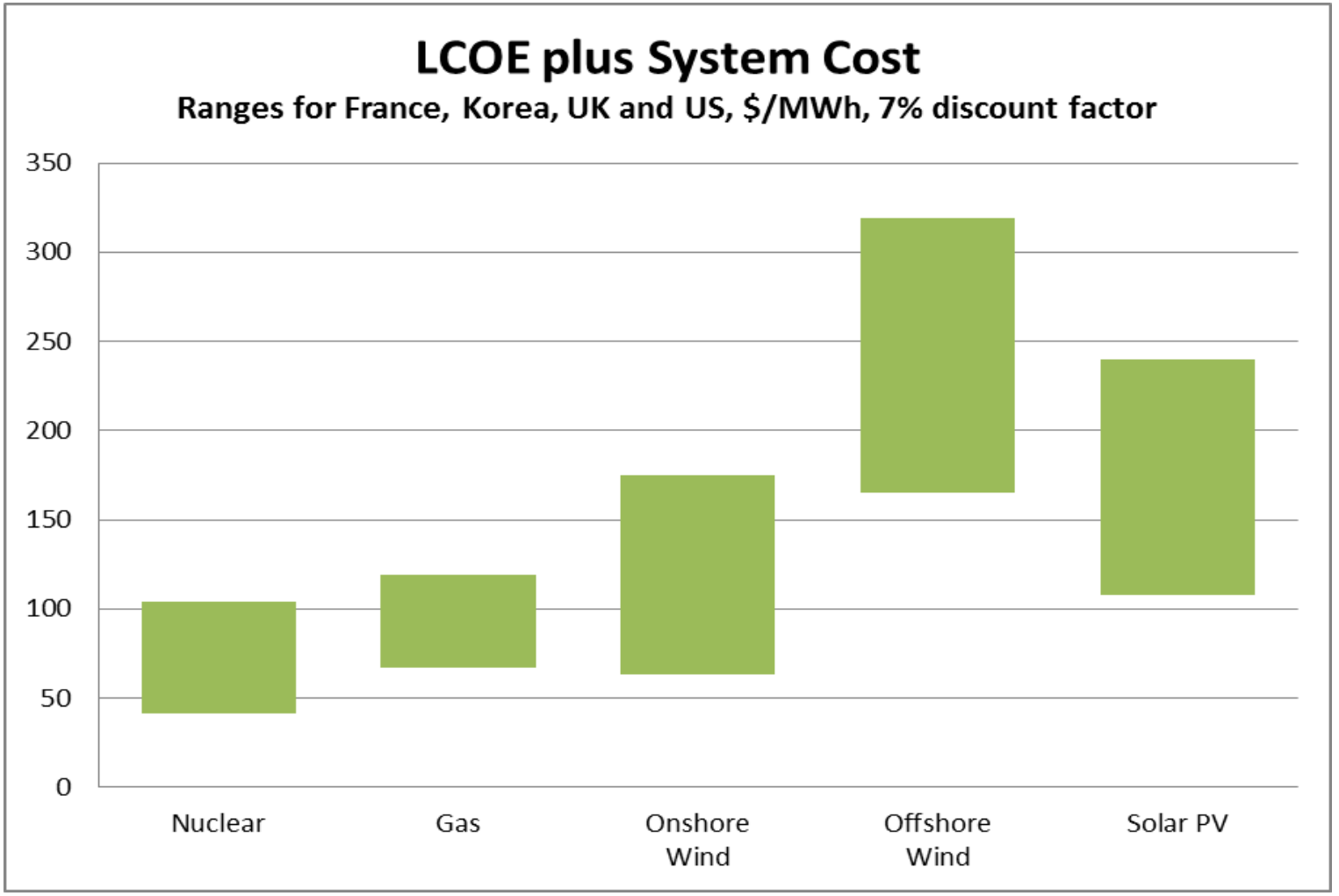
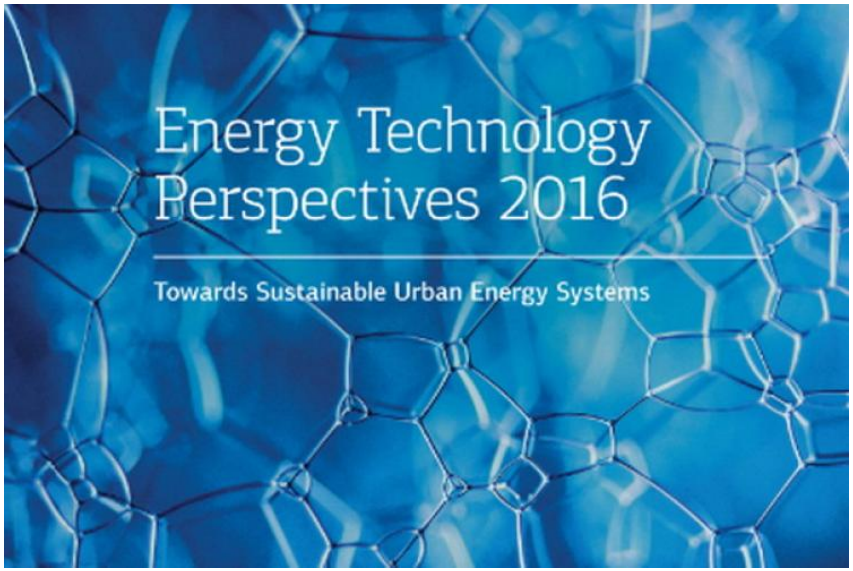
Levelised cost of electricity



IEA Energy Technology Perspectives 2016

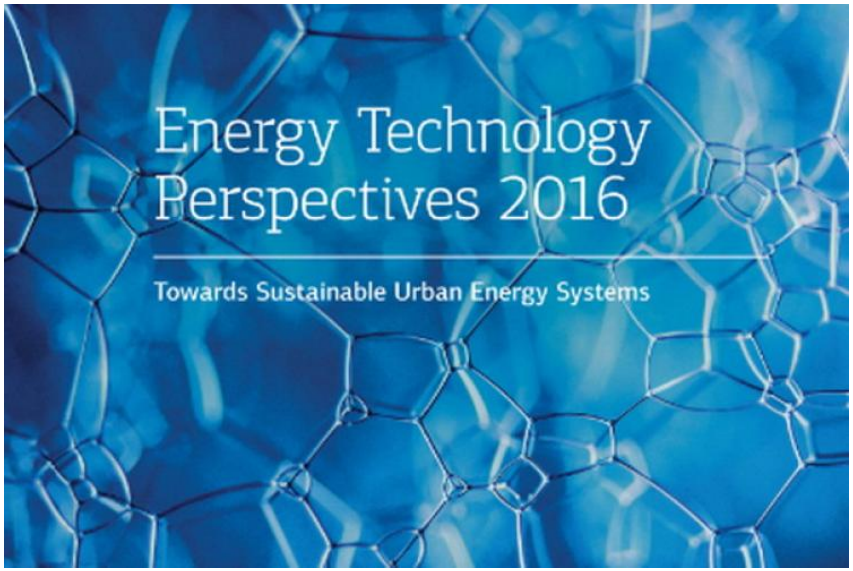
"Nuclear power plant grid connections doubled in 2015. Furthermore, progress and construction times in 2015 show the long-term 2 Degree Scenario targets to be more achievable than previously thought."



IEA Energy Technology Perspectives 2016

Final electricity prices need to reflect the environmental and other costs of fossil-based generation.

Recognition needs to be given to the emissions reductions that clean energy generation can provide and the energy security and flexibility made possible by these resources, whether variable and distributed renewables or large centralised clean energy solutions such as nuclear and CCS."



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IEA World Energy Outlook

IEA News Release and Forward

- Renewable energy plays an ever-increasing role in energy supply, both today and in the future.
- "We see clear winners for the next 25 years – natural gas but especially wind and solar – replacing the champion of the previous 25 years, coal"
- The growth in renewables and energy efficiency lessens the call on oil and gas imports
- "Renewables make very large strides in coming decades but their gains remain largely confined to electricity generation," said Dr Birol. "The next frontier for the renewable story is to expand their use in the industrial, building and transportation sectors where enormous potential for growth exists."
- *Nuclear not mentioned in news release or report Forward*.

Our Press Release

- The World Energy Outlook 2016 450 scenario… shows global nuclear generation output increasing by almost two and a half times by 2040
- In this scenario low carbon energy sources dominate the generation mix. Hydro generates 20%, nuclear 18%, wind 18% and solar PV 9%.
- Nuclear generation is a cost-competitive low-carbon generation option according to the IEA report. The cost per unit of electricity produced from wind or solar PV being 22-40% higher than that from nuclear generation.
- World Nuclear Association Director General, Agneta Rising said, "We will need all low carbon energy options to work together to achieve this, and nuclear will make a major contribution, because it is scalable, reliable and competitive."

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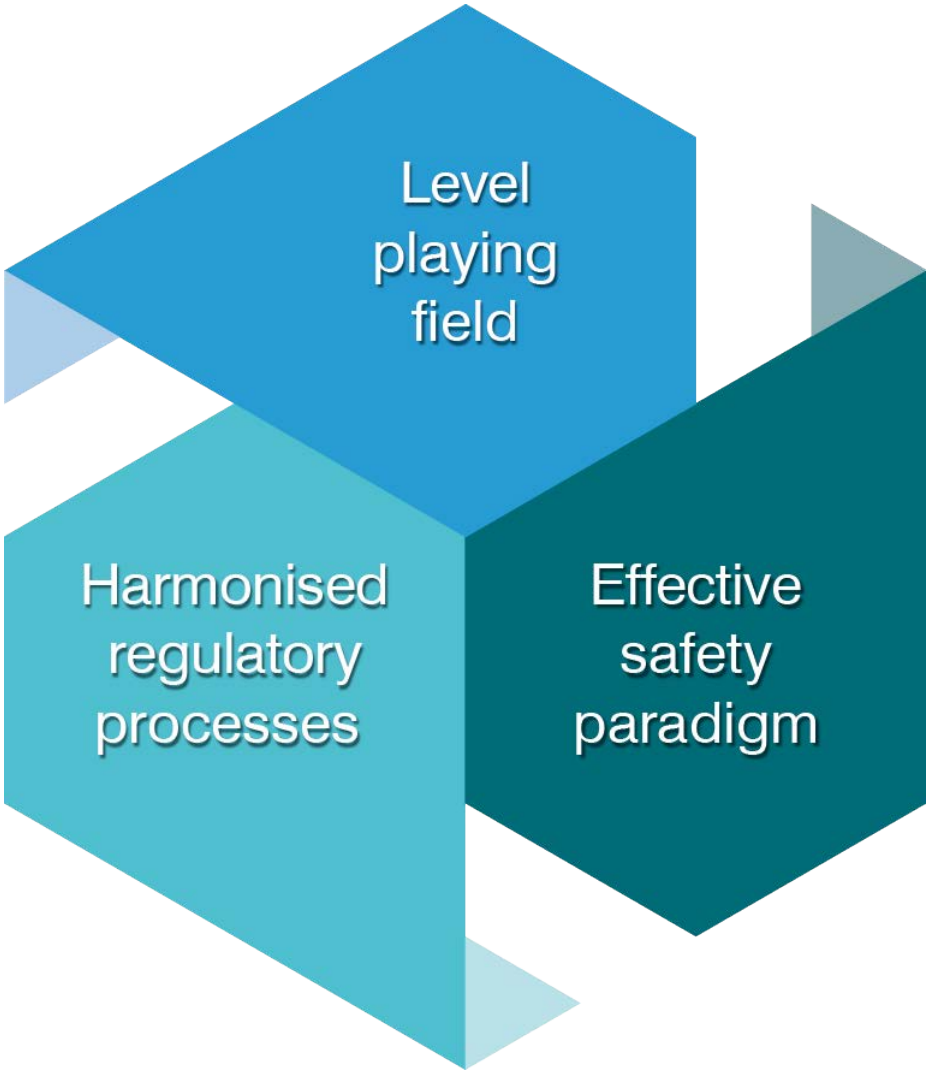
Harmony objectives



1000 gigawatt new nuclear capacity by 2050

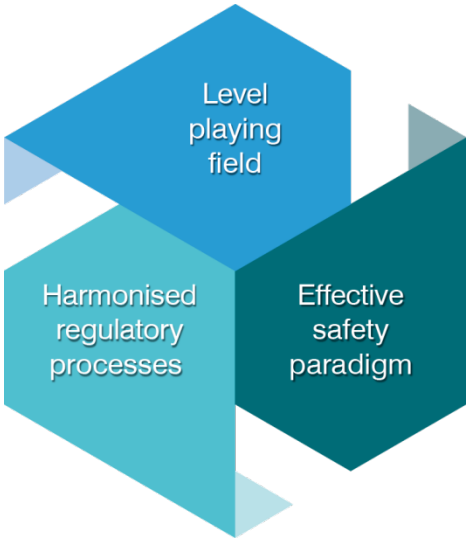
25% of electricity supply 2050

Nuclear energy to deliver reliable, affordable and clean electricity

Level playing field

Markets should be reformed to:

- support capital investments
- include grid system costs
- eliminate nuclear-only taxes
- reform subsidies
- give credit for low carbon emissions
- value 24/7 reliability
- support innovative finance solutions



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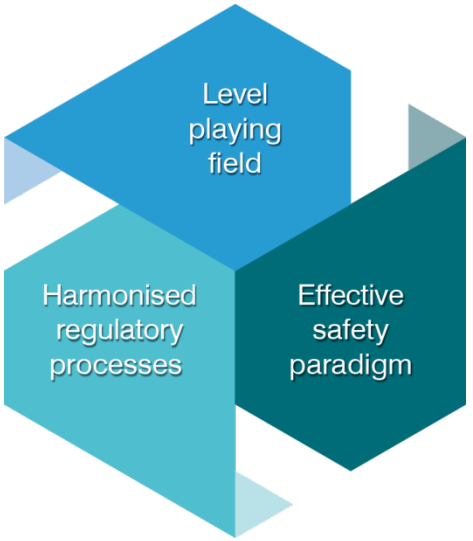
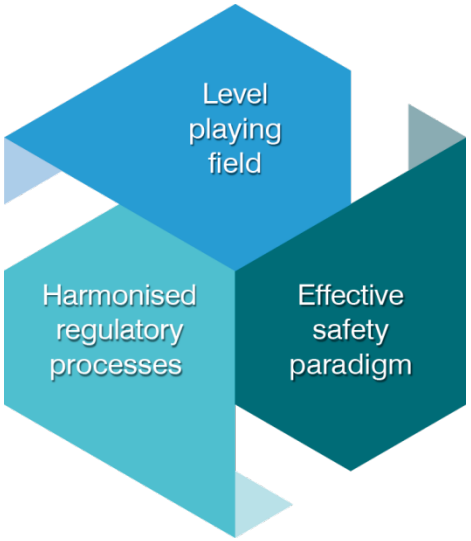
Harmonised regulatory processes

- enhance standardisation
- streamline licensing processes
- harmonise and update global codes and standards
- enabling international trade
- ensure efficient and effective safety regulation
- nuclear innovation: enable development and timely licensing of new technologies



Effective safety paradigm

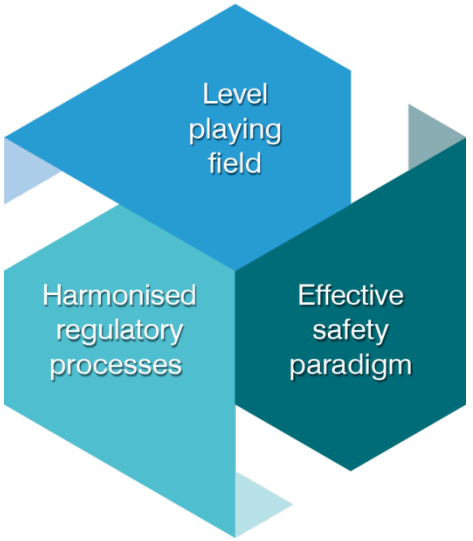


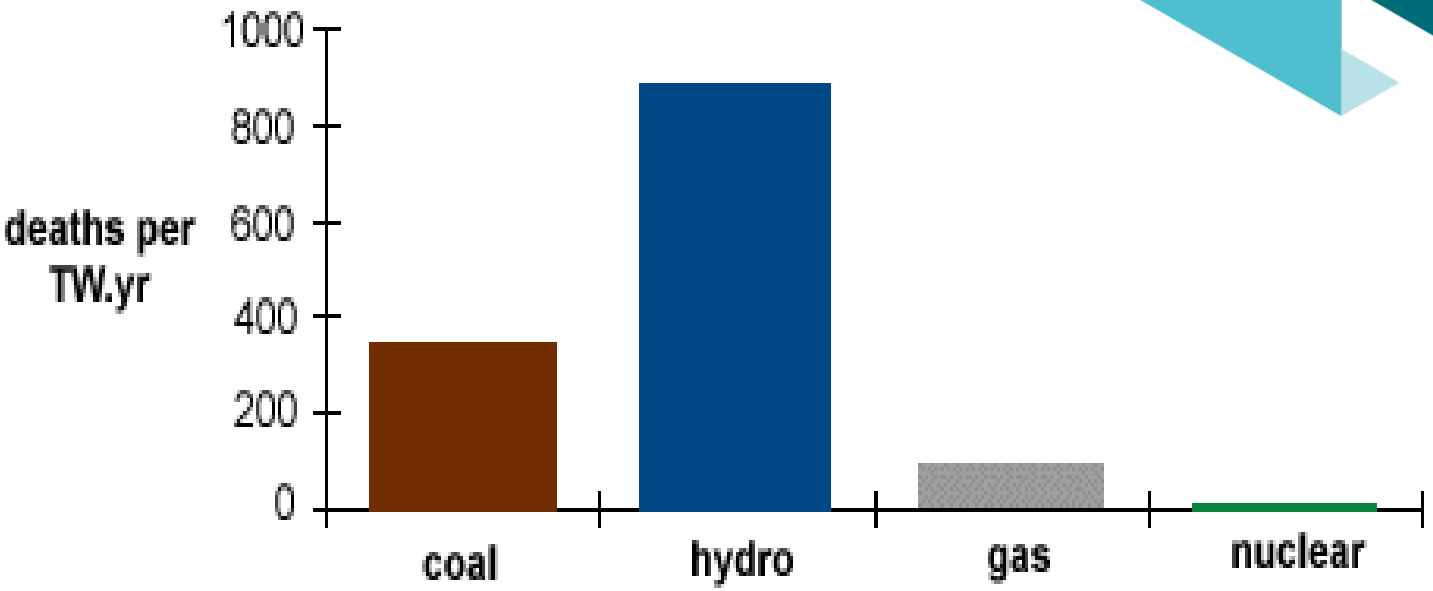
From the society perspective:

Increase genuine public wellbeing

Effective safety paradigm

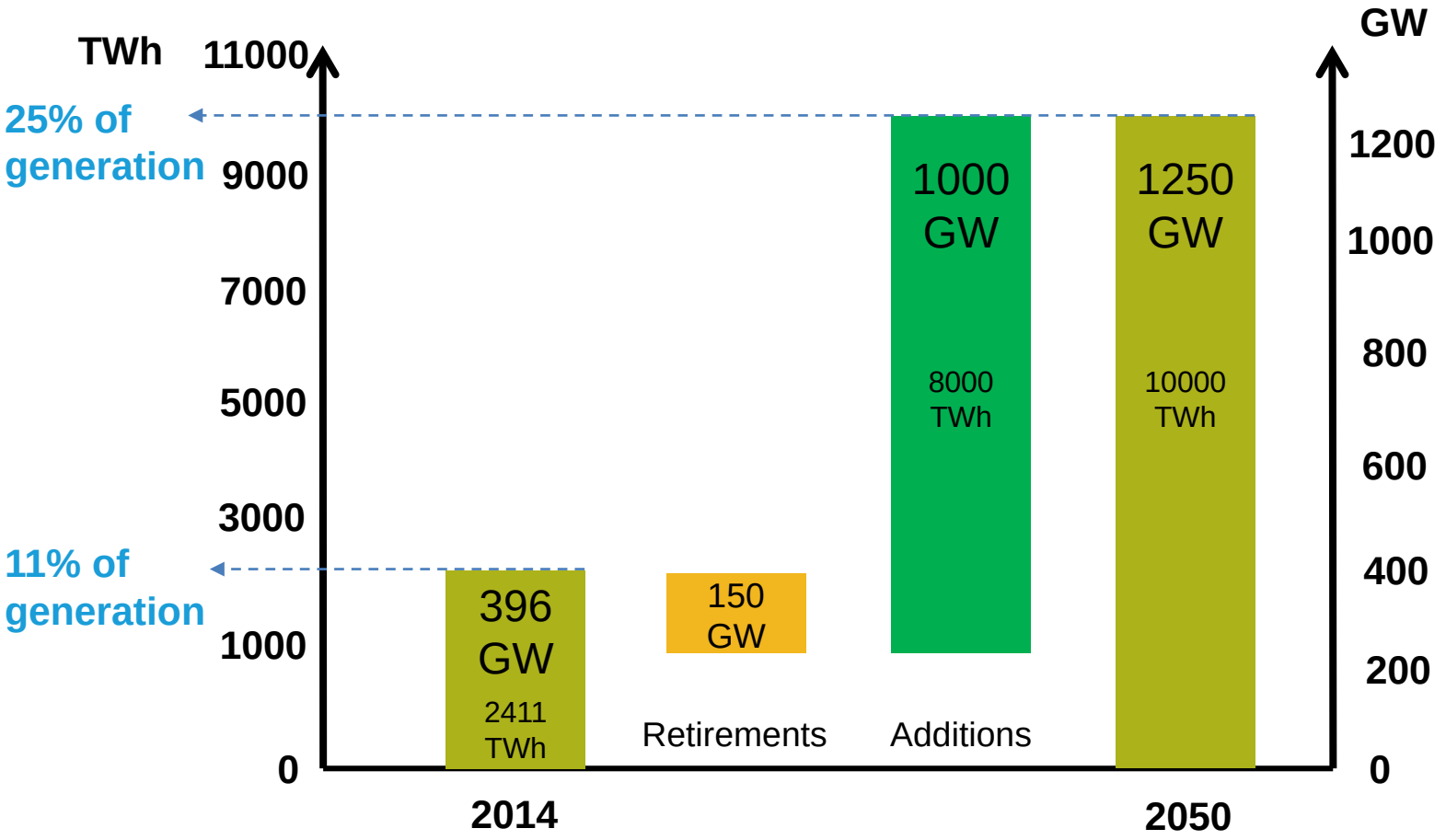
The alternatives to nuclear are far more dangerous – even including accidents





Paul Scherrer Institut 1998: considering 1943 accidents with more than 5 fatalities

Harmony goal for new nuclear build is 1000 GW



Source: World Nuclear Association. Growth required for nuclear energy to supply 25% of electricity in 2050 under demand forecast of two-degree scenario (see IEA, 2015, Energy Technology Perspectives 2015.
Assumption: 91% capacity factor

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Incoming low-carbon sources hoped to scale dramatically

Source	TWh generated in 2012	Additional TWh in 2050	Growth factor
Biomass and waste	439	+2651	**7.0x**
Geothermal	70	+985	**15.0x**
Wind (onshore)	505	+4880	**10.7x**
Wind (offshore)	15	+1352	**91.1x**
Solar PV	97	+3646	**38.6x**
Solar CSP	5	+3123	**625.6x**
Coal with CCS	13 (in 2020)	+3184	**245.8x**
Natural Gas with CCS	9 (in 2020)	+1786	**199.4x**
Biomass with CCS	7 (in 2025)	+67	**10.6x**

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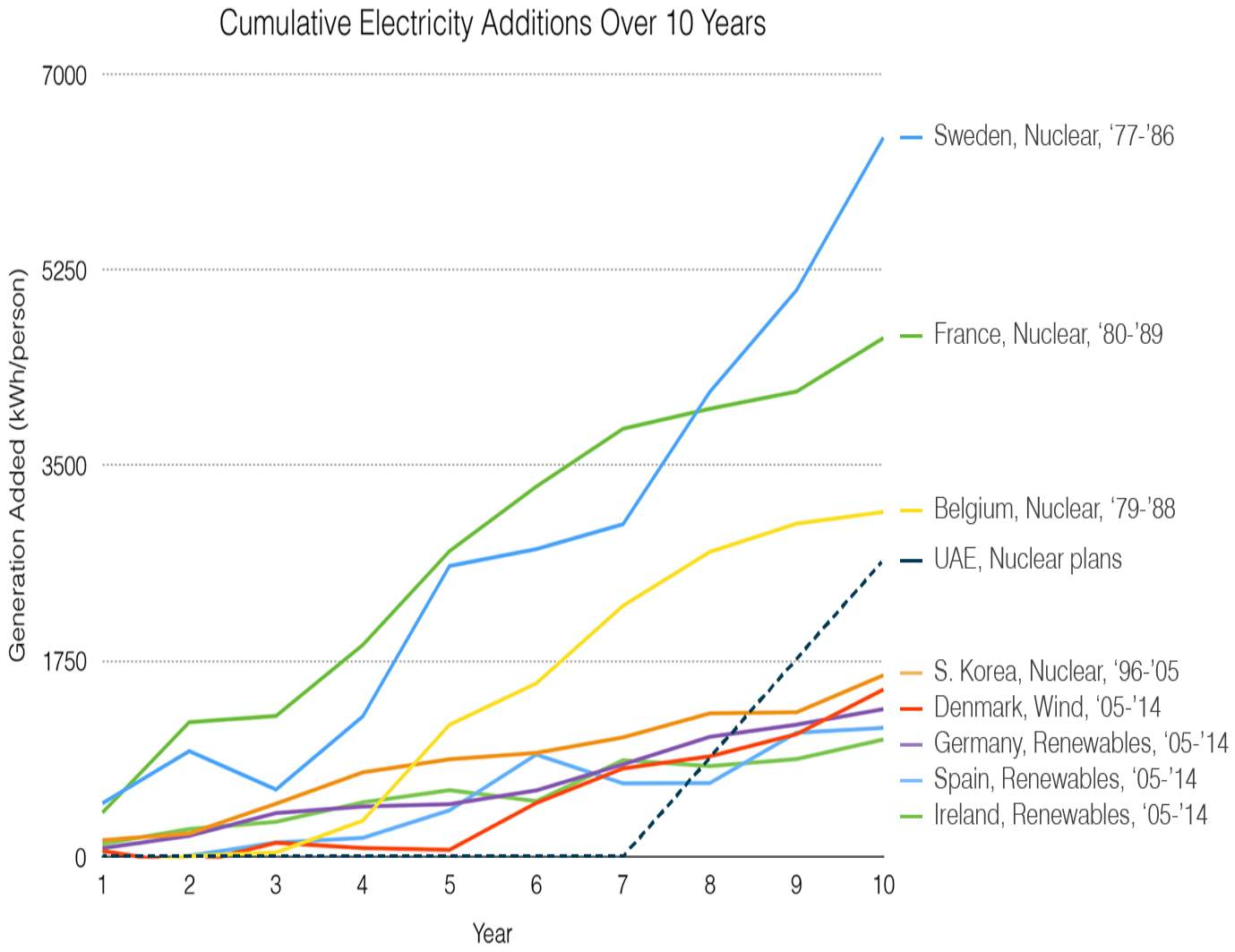
Established low carbon sources set for strong growth

Source	TWh generated in 2012	Additional TWh in 2050	Growth factor
Nuclear	2461	+4341	**2.8x**
Hydro	3672	+3256	**1.9x**

Nuclear and hydro: 84% of low-carbon today

Credible, strong growth of 2-3x to 2050
(Electricity as a whole grows 2x)

Nuclear makes quick, lasting decarbonisation possible



Source: Breakthrough Institute

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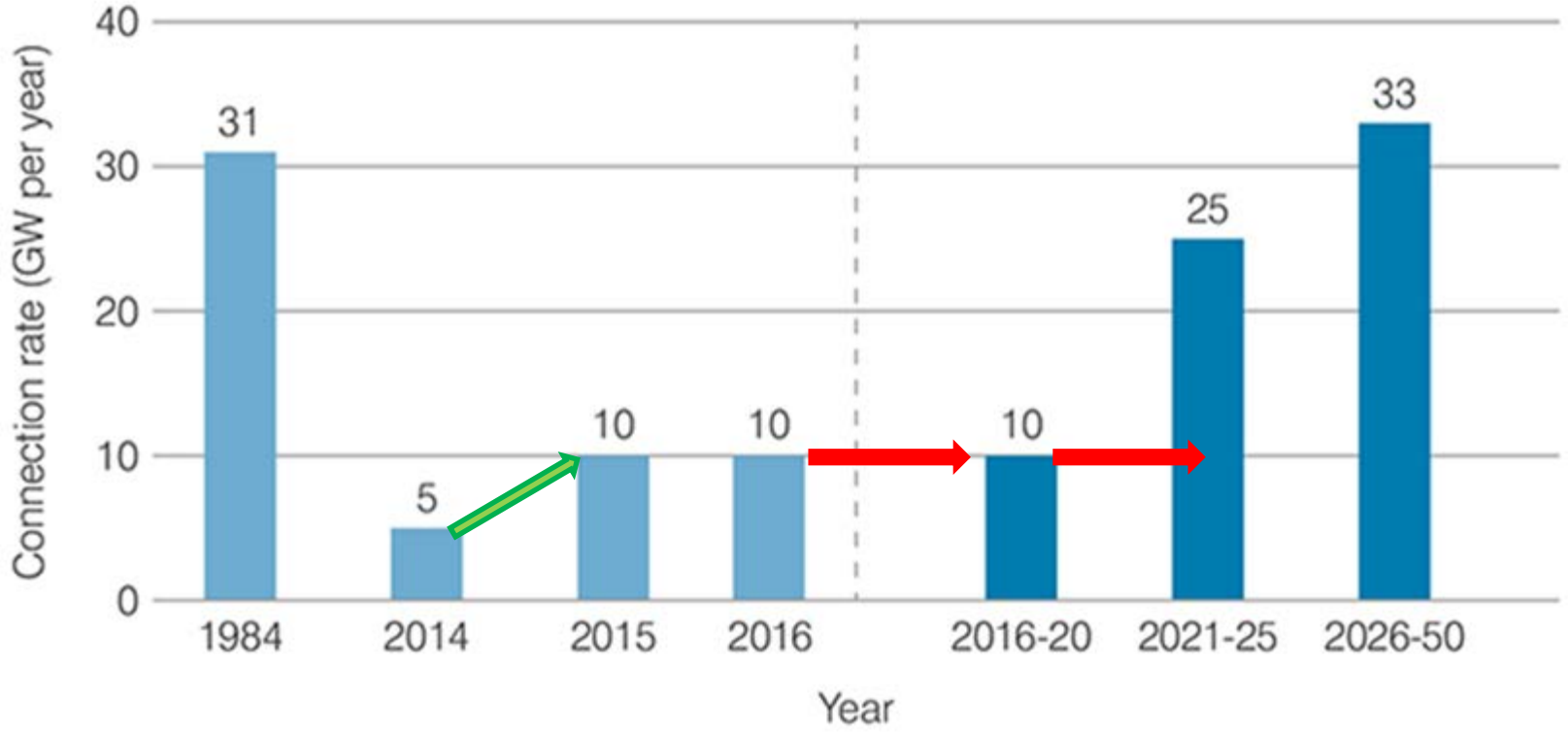
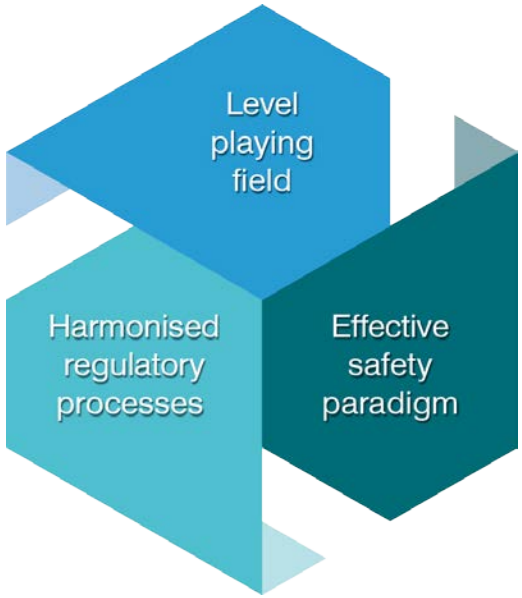
To deliver 1000 GW new nuclear capacity to 2050



Source: World Nuclear Association, Nuclear Fuel Report 2015

The global nuclear industry: identify barriers, engage in dialog, develop key actions

Level playing field:
Establish a level playing field for all low-carbon technologies, valuing not only environmental qualities, but also reliability and grid system costs.



Harmonised regulatory processes:
Enhance standardisation, harmonise and update global codes and standards.
Timely licensing of new technologies.

Effective safety paradigm:
Increase genuine public wellbeing from a society perspective. Ensure global nuclear safety. Confidence in management of nuclear technology and operations.

www.world-nuclear.org