Nuclear Power: Reliable Global Energy

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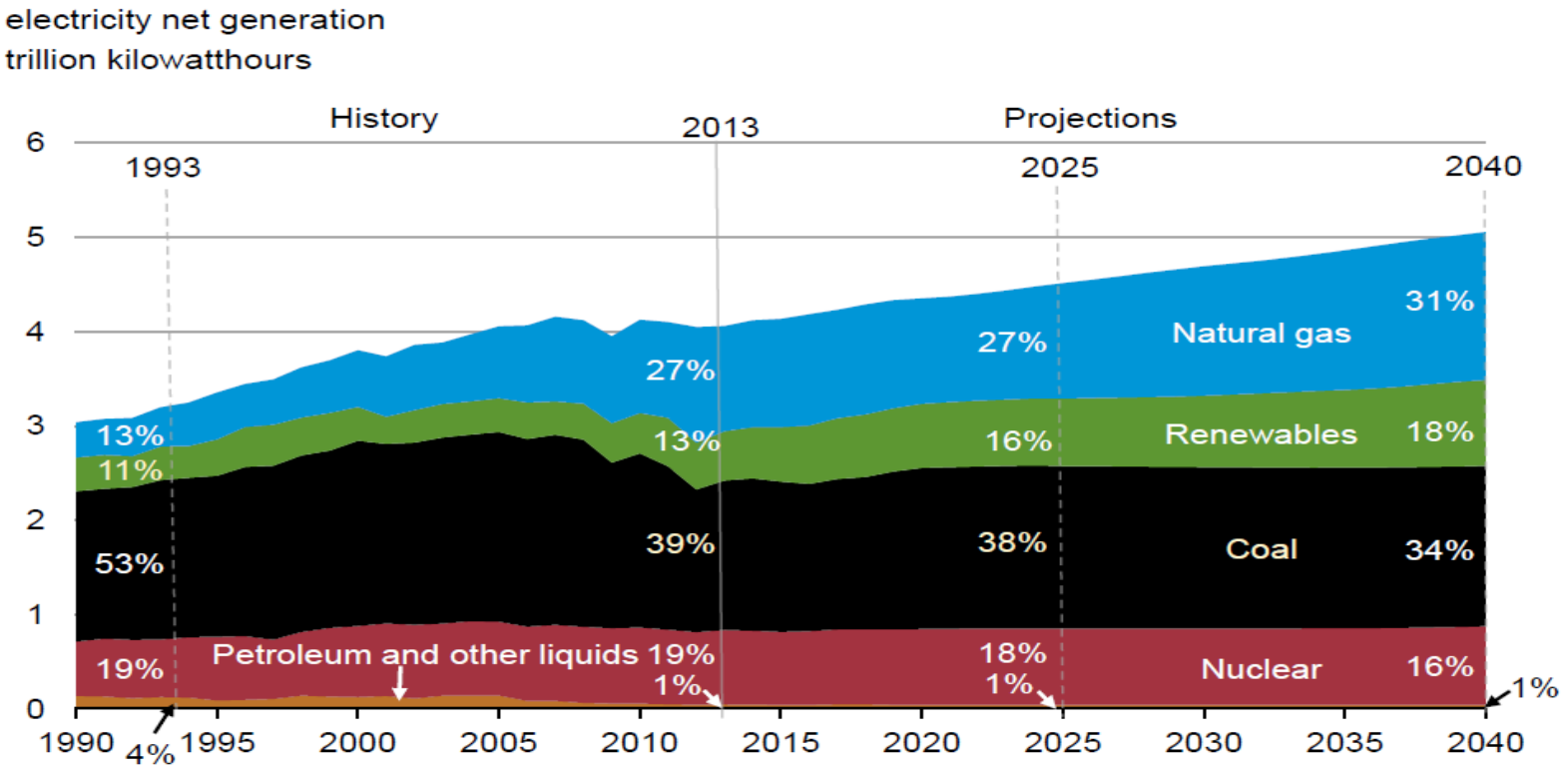
Energy Trends and Projections

Over time the electricity mix gradually shifts to lower-carbon options, led by growth in nuclear energy, renewables and gas-fired generation.



Source: EIA, Annual Energy Outlook 2015 Reference case

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Why Nuclear Energy?

- Meets policy goals to reduce greenhouse gas emissions
- Highly reliable and safe baseload power source
- Stable fuel price
- Competitive costs
- Supply security
- Fuel diversity
- Large number of well-paying jobs and an anchor of the local economy

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Nuclear Energy Today: A Snapshot

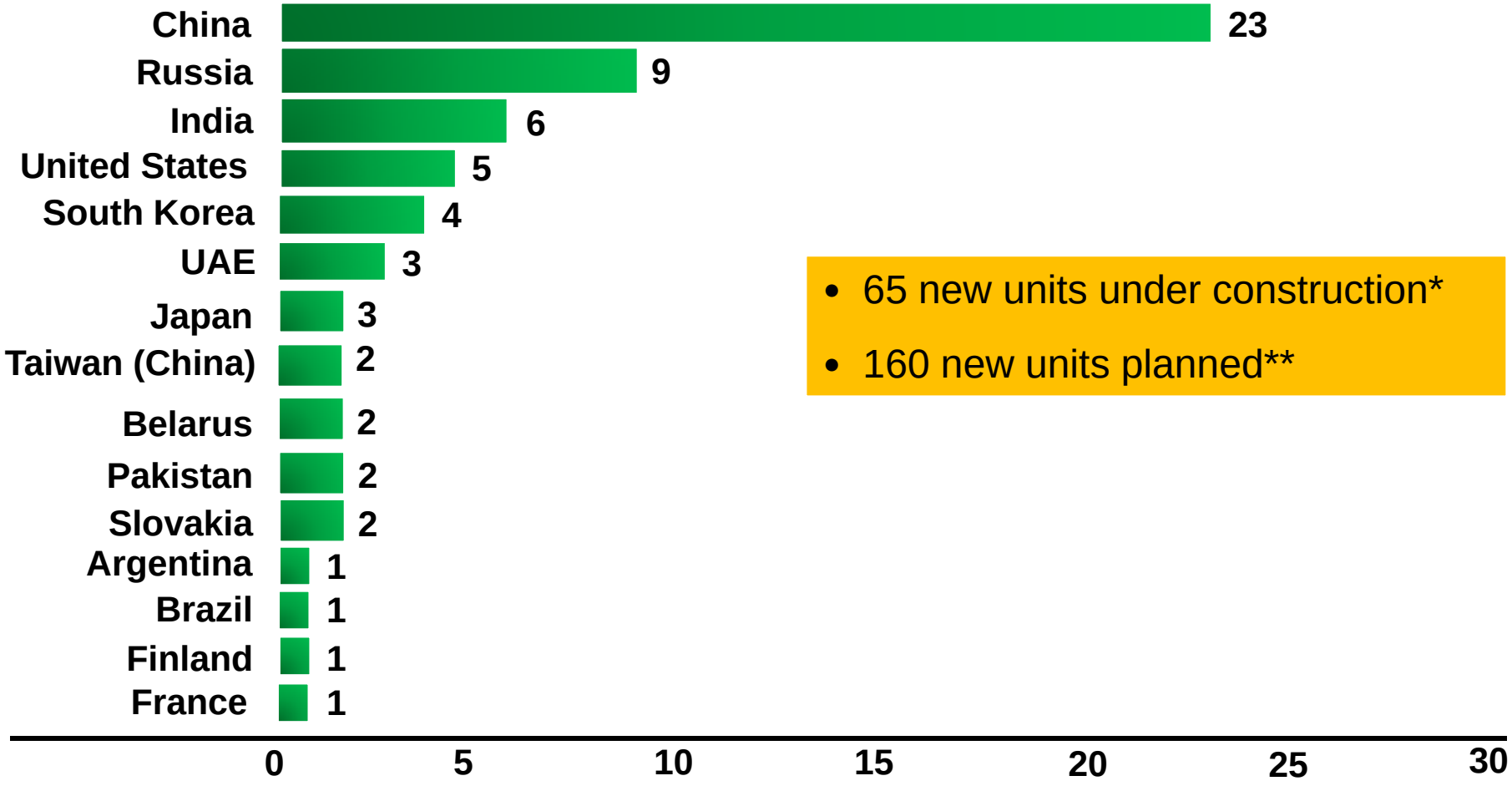
- Plants in Operation
  - Worldwide: 437 reactors, 11% of electrical output
  - United States: 99 reactors, 19% of electrical output
- Plants Under Construction
  - 65 units in 14 countries

Angra – Rio de Janeiro, Brazil

Diablo Canyon – Avila Beach, California

Source: WNO 4/15

Nuclear Power Units Under Construction



- 65 new units under construction*
- 160 new units planned**

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*Sources: IAEA + WNO 4/15
**Source: WNA 3/13

Westinghouse **AP1000®** Plant: Safe, Simple and Standardized

AP1000 *Plant Site at Sanmen, China*

- **Passive safety** replaces mechanical and electrical systems – harnesses natural forces like gravity, convection and condensation to achieve safe shutdown
- **Strong licensing pedigree** based on reviews in multiple countries; first Generation III+ reactor to receive design certification from the U.S. NRC
- **Simplified design and modular construction** provide a plant that is easier and less expensive to build, operate and maintain

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Sanmen Site Progress: Time Lapse View

Photos © Sanmen Nuclear Power Company Ltd.

Nuclear Generation Growth - Market Concentration

Number of nuclear-power reactors in operation and forthcoming as per March 2014 and before the Japan earthquake and tsunami disaster (March 2011) (Nuclear News)

No	Reactor type (Some details on reactors)	No. of units		Installed capacity, GW_{el}		Forthcoming units	
		As of March 2014	Before March 2011	As of March 2014	Before March 2011	No. of units	GW_{el}
1	Pressurized Water Reactors (PWRs) (largest group of nuclear reactors in the world – 63%)	270 ↑	268	250 ↑	248	89	93
2	Boiling Water Reactors (BWRs) or Advanced BWRs (2^{nd} largest group of reactors in the world – 19%; ABWRs – the only ones Gen-III+ operating reactors)	81 ↓	92	76 ↓	84	6	8
3	Pressurized Heavy Water Reactors (PHWRs) (3^{rd} largest group of reactors in the world – 11%; mainly CANDU-reactor type)	48 ↓	50	24 ↓	25	9	5.8
4	Gas Cooled Reactors (GCRs) (UK, Magnox reactor) and Advanced Gas-cooled Reactors (AGRs) (UK, 14 reactors); (all these CO_2-cooled reactors will be shut down in the nearest future and will not be built again)	15 ↓	18	8 ↓	9	1	0.2
5	Light-water, Graphite-moderated Reactors (LGRs) (Russia, 11 RBMKs and 4 EGPs; these pressure-channel boiling-water-cooled reactors will be shut down in the nearest future and will not be built again)	15	15	10	10	0	0
6	Liquid-Metal Fast-Breeder Reactors (LMFBRs) (Russia, SFR – BN-600; only one Gen-IV operating reactor)	1	1	0.6	0.6	5	1.6
	In total	430 ↓	444	369 ↓	378	110	109

- Data in Table include 48 reactors from Japan, which are currently not in operation.
- Arrows mean decrease or increase in a number of reactors.
- Forthcoming GCR is a helium-cooled reactor.

Source: Westinghouse Technical Seminar. 3/15
Prof. Igor Pioro, Univ. of Ontario Inst. of Technology

Nuclear Generation Growth - Market Concentration

Number of nuclear-power reactors by nation (11 nations with the largest number of reactors ranked by installed capacity) as per March of 2014 and before the Japan earthquake and tsunami disaster (March of 2011) (Nuclear News)

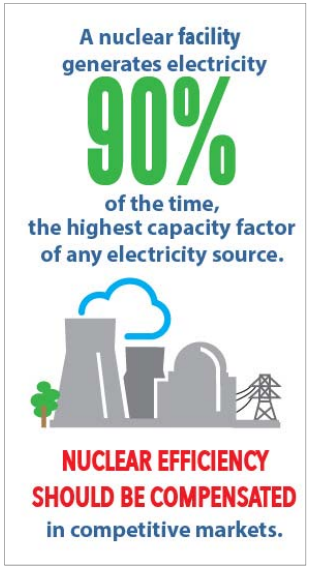
No	Nation	No. of units (PWRs/BWRs)		Installed capacity, GW_{el}		Changes in number of reactors from March 2011
		As of March 2014	Before March 2011	As of March 2014	Before March 2011	
1	USA	100 (65/35)	104	101	103	↓ Decreased by 4 reactors
2	France	58 (58/-)	58	63	63	No changes
3	Japan*	48 (24/24)	54	42	47	↓ Decreased by 6 reactors
4	Russia	33 (17/-/15[1]/1[2])	32	24	23	↑ Increased by 1 reactor
5	S. Korea	23 (19/-/4[3])	20	21	18	↑ Increased by 3 reactors
6	China	17 (15/-/2[3])	13	14	10	↑ Increased by 4 reactors
7	Canada	19 (-/-/19[3])	22	13	15	↓ Decreased by 3 reactors
8	Ukraine	15 (15/-)	15	13	13	No changes
9	Germany	9 (7/2)	17	12	20	↓ Decreased by 8 reactors
10	Sweden	10 (7/3)	10	9.3	9.3	No changes
11	UK	16 (1/-/14[4]/1[5])	19	9.2	10	↓ Decreased by 3 reactors

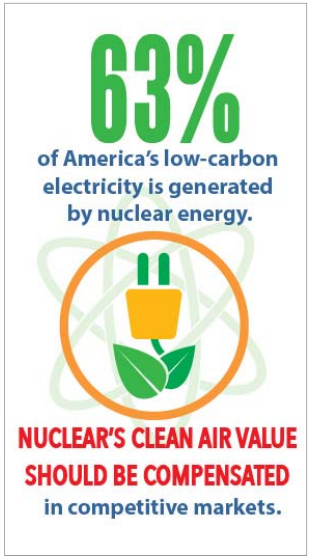
Arrows mean decrease or increase in a number of reactors.
[1] No of LGRs; [2] LMFBRs; [3] PHWRs; [4] AGRs; [5] GCR.
[1*]Currently, i.e., in October of 2014, no one reactor is in operation. However, some reactors are planned to be put into operation soon.

Source: Westinghouse Technical Seminar. 3/15
Prof. Igor Pioro, Univ. of Ontario Inst. of Technology

Critical Decisions to Be Made

- Energy needs must be addressed with environmentally responsible solutions
- Policies need to recognize the strategic role of nuclear globally
  - Carbon reduction
  - Electric system reliability
  - Economic growth
  - Technology leadership
  - Energy security





Nuclear Energy Matters

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What Does the Future Hold?

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Thank you!