

The World Nuclear Industry Status Report 2018 (WNISR2018)

www.WorldNuclearReport.org

Mycle Schneider

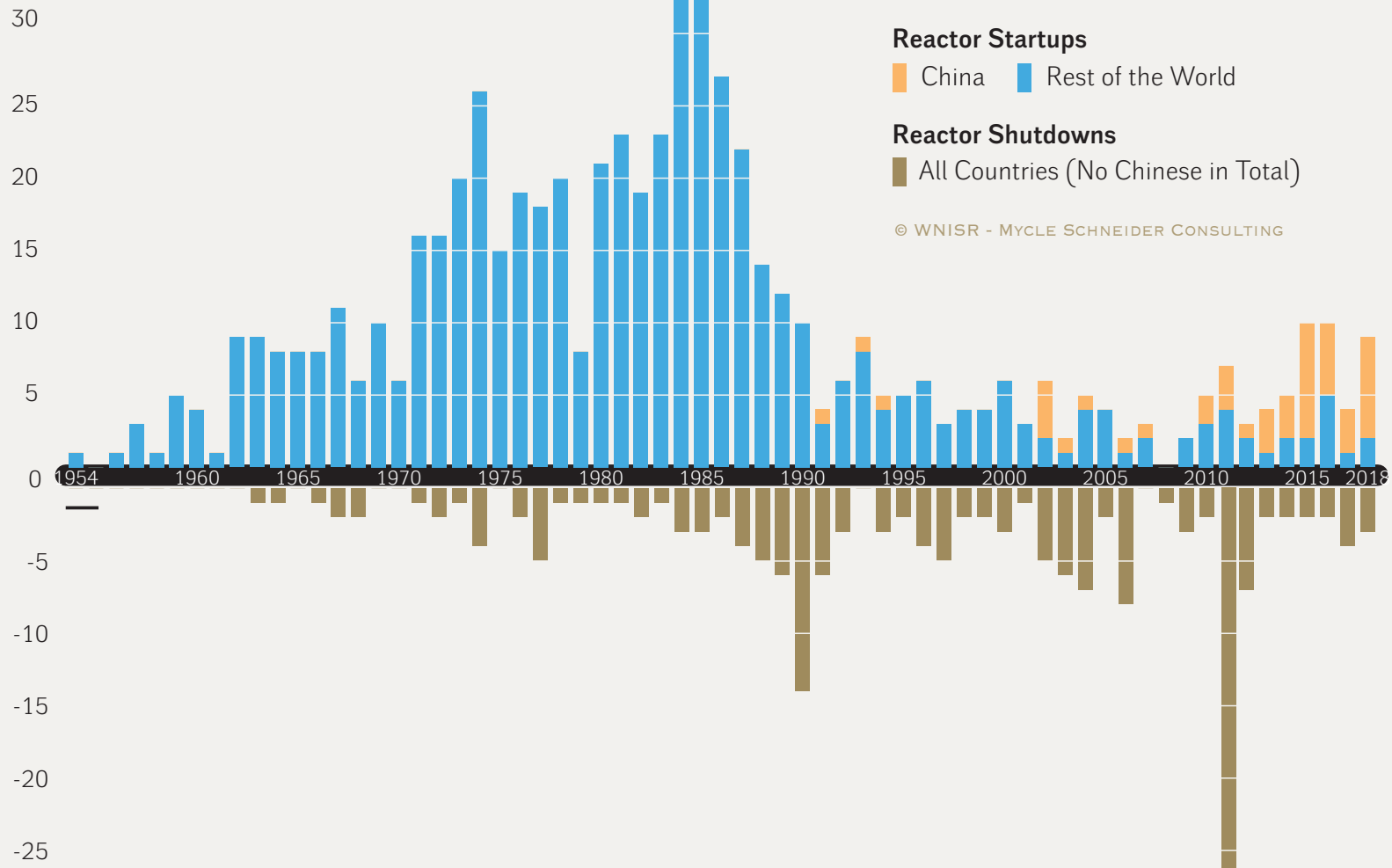
*Independent International Consultant on Energy and Nuclear Policy, Paris
WNISR Convening Lead Author and Publisher*

“Nuclear Power: Asset or Barrier for the Energy Transition?”

*Heinrich Böll Stiftung EU – Greens-EFA in the European Parliament
Representation of the State of Baden-Württemberg to the EU, 5 February 2019*

Reactor Startups and Shutdowns in the World

in Units, from 1954 to 2018



Reactor Startups

China Rest of the World

Reactor Shutdowns

All Countries (No Chinese in Total)

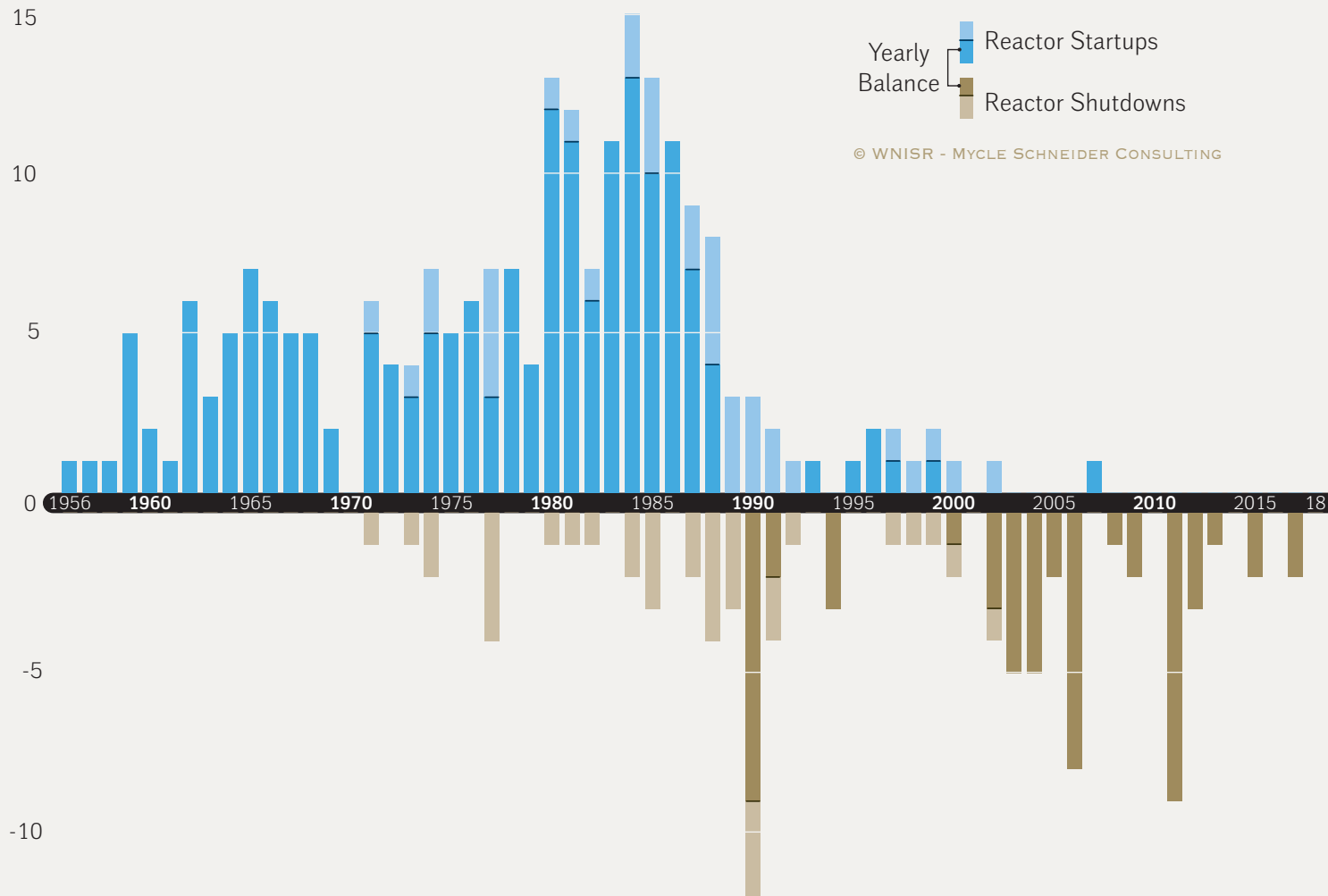
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Sources: WNISR, with IAEA-PRIS, 2019

WNISR2018 EU28 – STARTUPS AND SHUTDOWNS

Reactor Startups and Shutdowns in the EU28

in Units, from 1956 to 2018

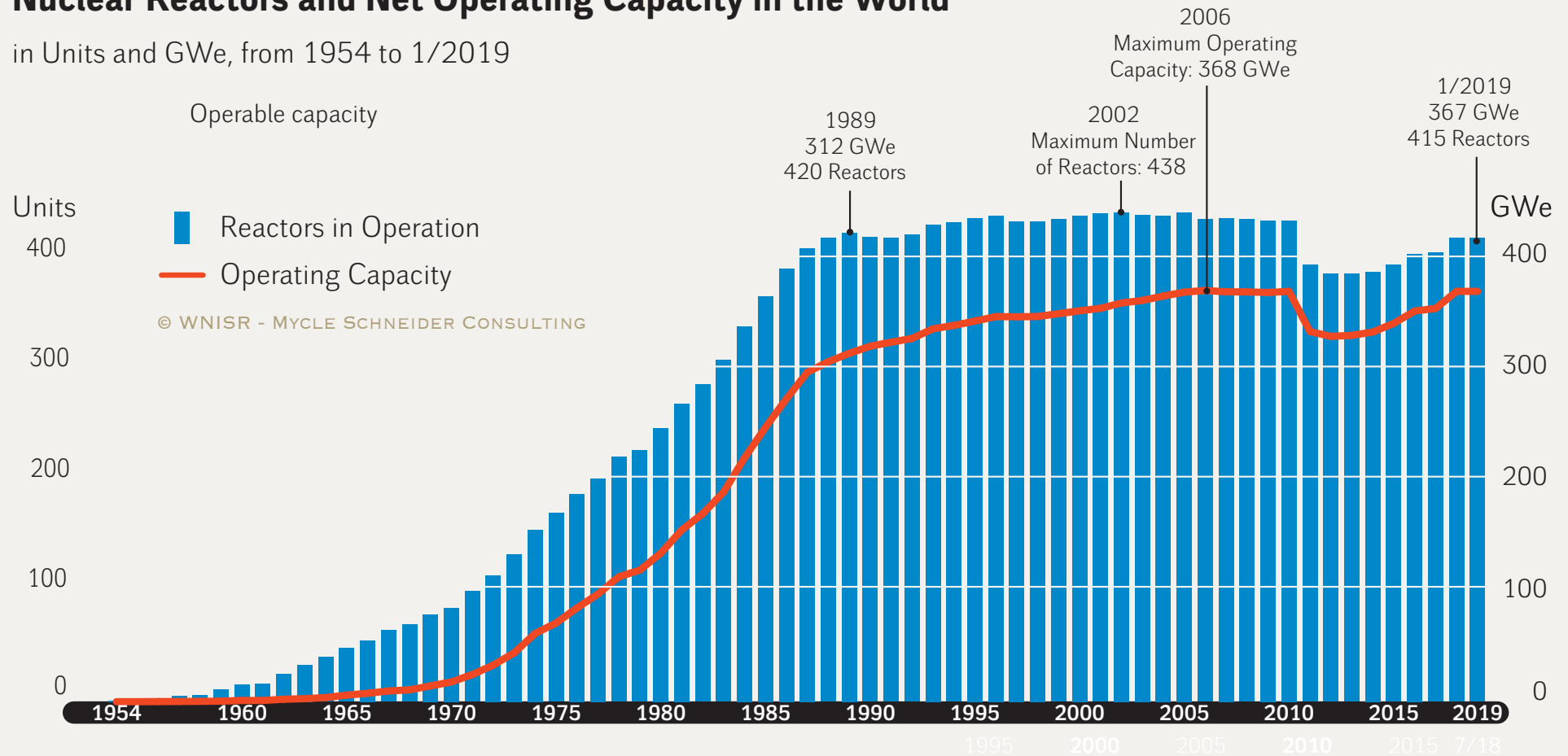


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Sources: WNISR, with IAEA-PRIS, 2019

Nuclear Reactors and Net Operating Capacity in the World

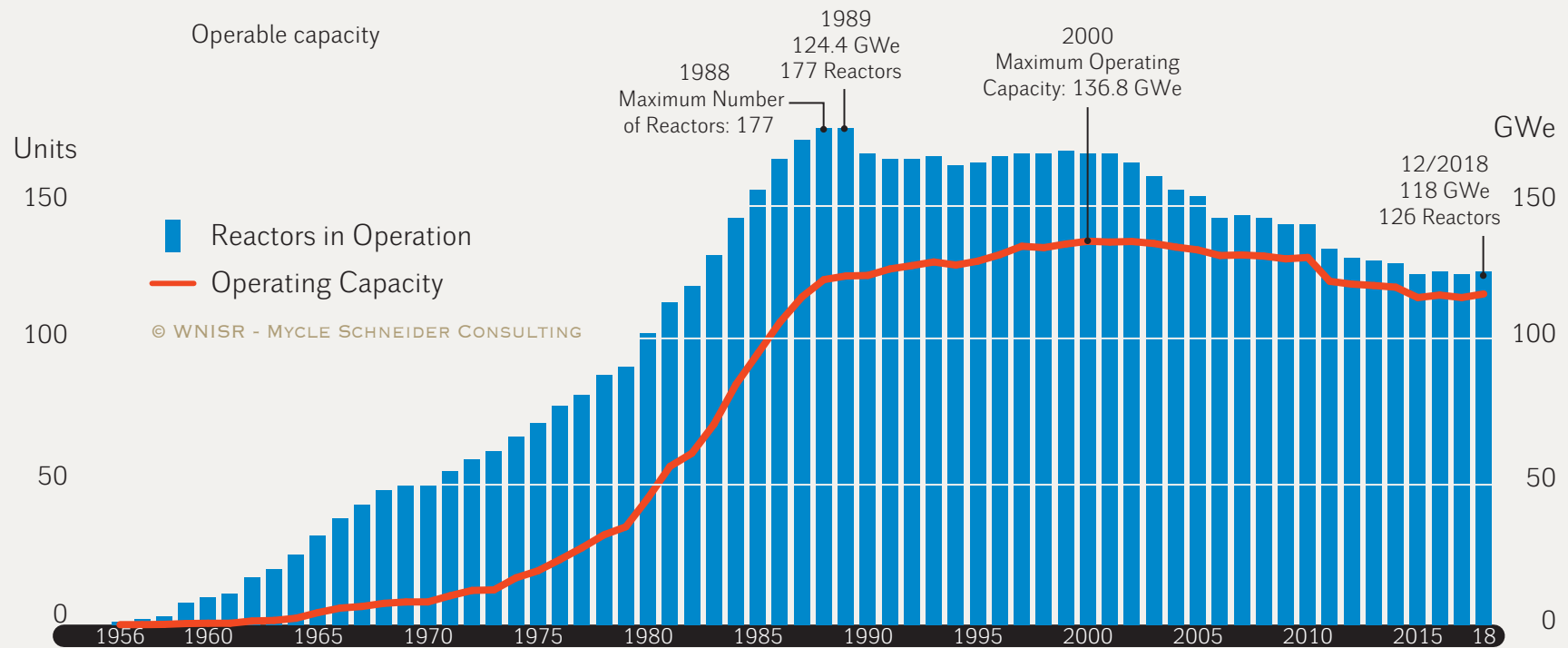
in Units and GWe, from 1954 to 1/2019



Sources: WNISR, with IAEA-PRIS, 2019

Nuclear Reactors and Net Operating Capacity in the EU 28

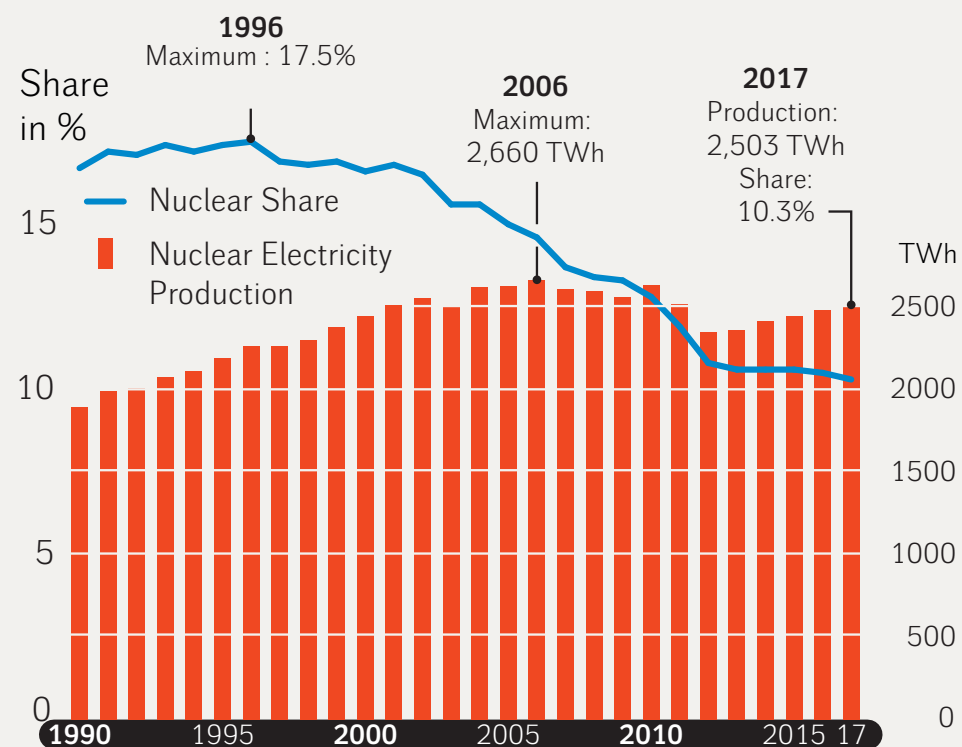
in Units and GWe, from 1956 to 2018



Sources: WNISR, with IAEA-PRIS, 2019

Nuclear Electricity Production 1990-2017 In the World...

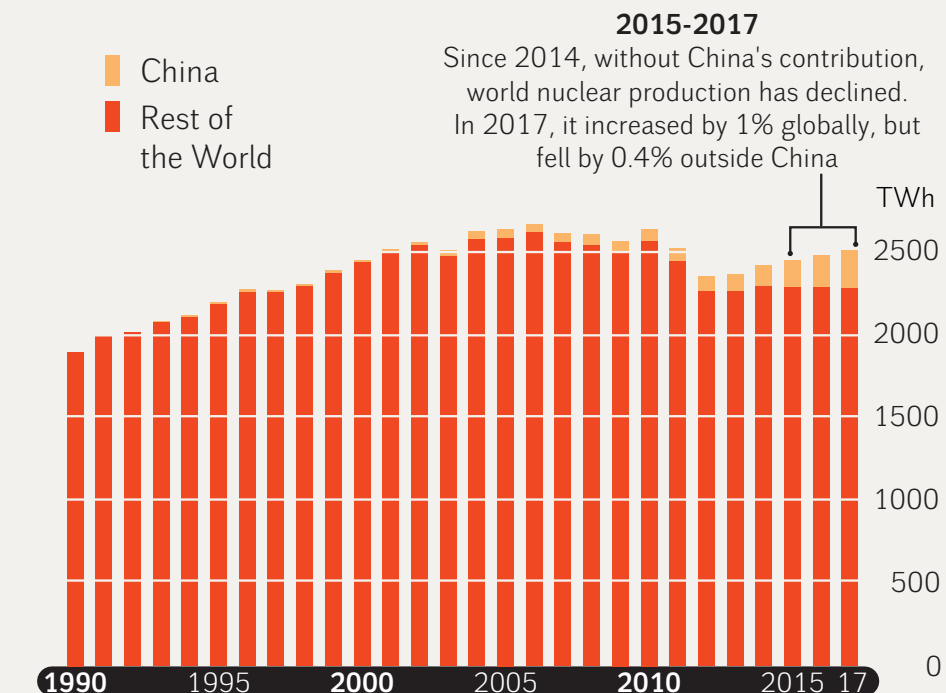
in TWh (net) and Share in Electricity Generation (gross)



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...and in China and the Rest of the World

in TWh (net)



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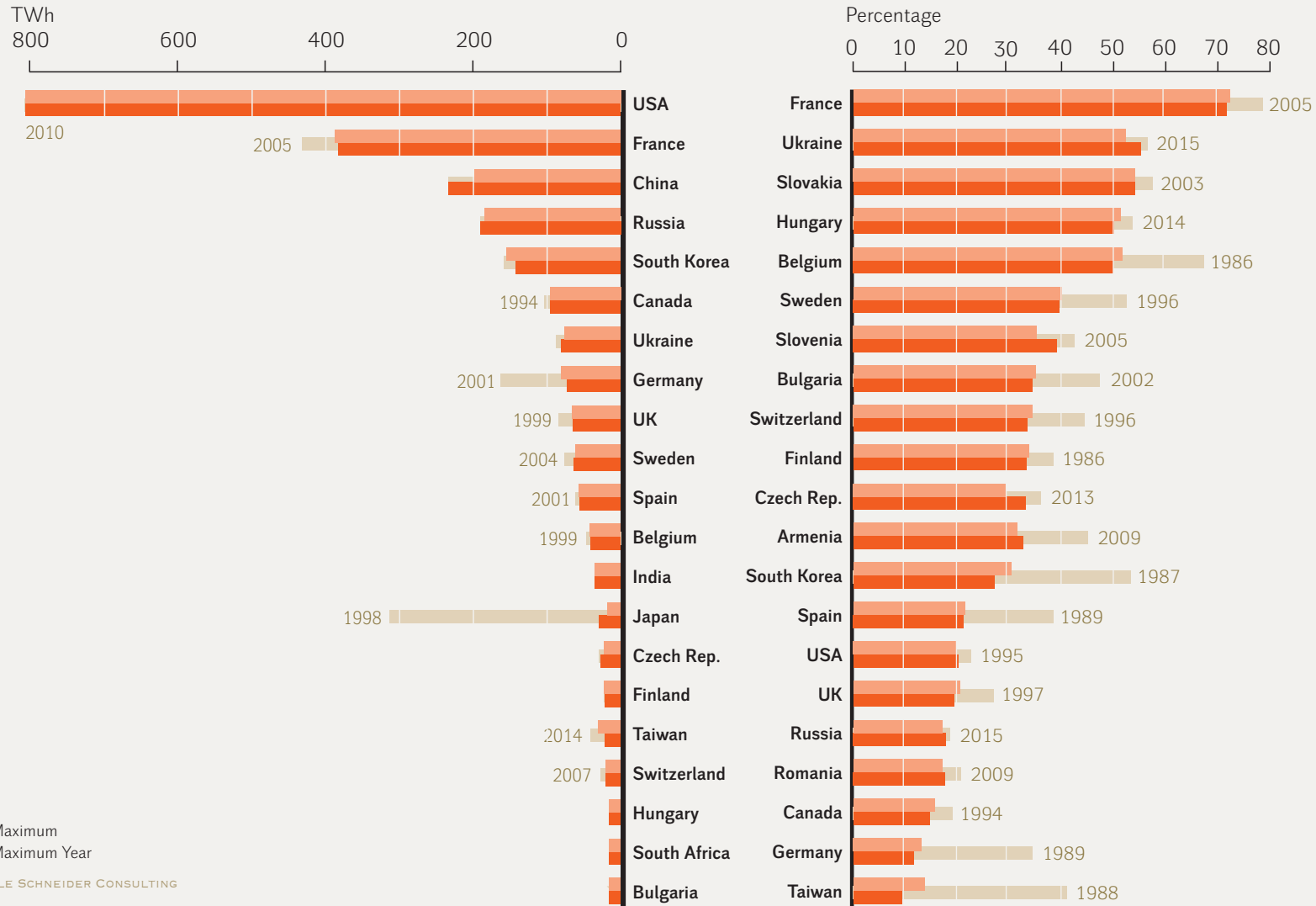
Sources: IAEA-PRIS, BP, 2018

WNISR2018 GLOBAL OVERVIEW – NUCLEAR ELECTRICITY GENERATION

(Top 21)

Nuclear Production in 2016/2017 and Historic Maximum

in TWh and Share In Electricity Production



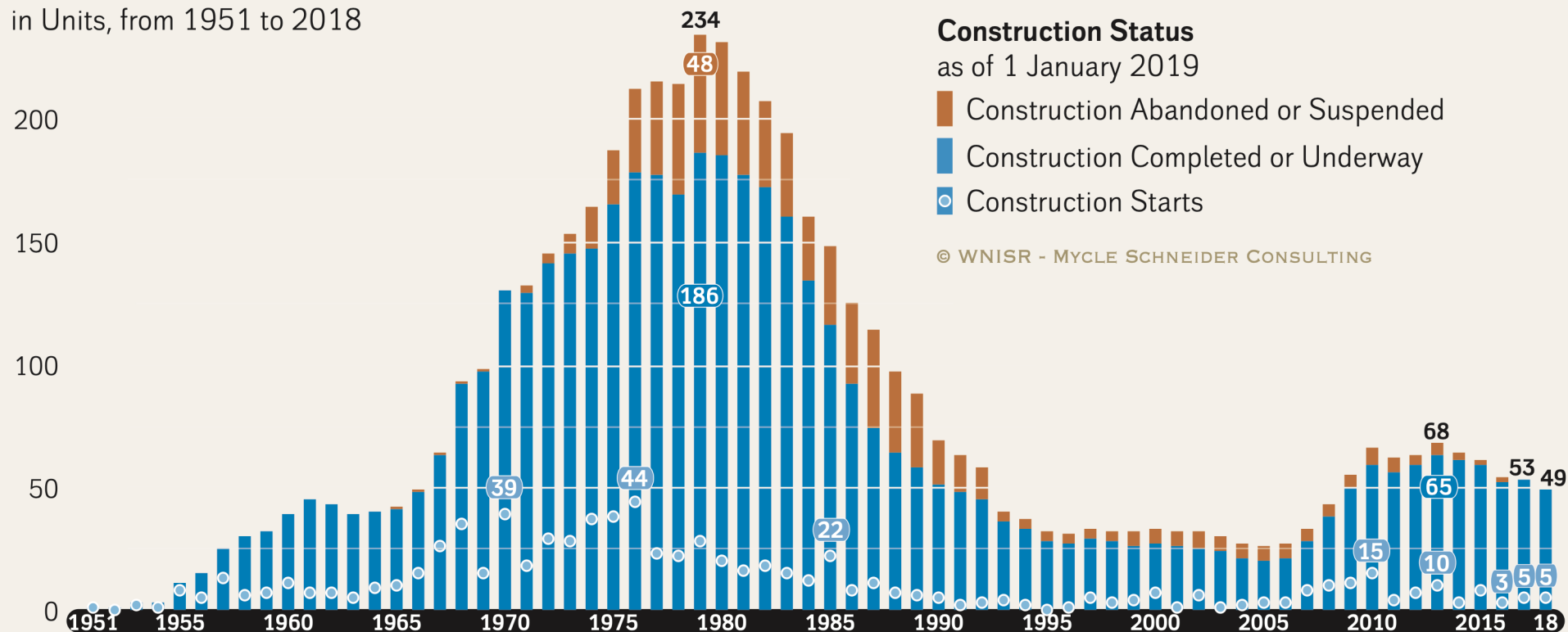
■ 2016
■ 2017
■ Historic Maximum
 1998 Historic Maximum Year

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Sources: IAEA-PRIS, BP, 2018

Reactors Under Construction in the World

in Units, from 1951 to 2018



Sources: WNISR, with IAEA-PRIS, 2019

WNISR2018 GLOBAL OVERVIEW — CONSTRUCTIONS

Nuclear Reactors “Under Construction” (as of 1 July 2018)

Country	Units	Capacity MW net	Construction Starts	Grid Connection	Behind Schedule
China	16	15 450	2009 - 2017	2018 - 2023	8-9?
India	7	4 824	2004 - 2017	2018 - 2023	5
Russia	5	3 378	2007 - 2018	2019- 2022	4
South Korea	4	5 360	2009 - 2017	2018 - 2022	4
UAE	4	5 380	2012 - 2015	2020 – 2021?	3-4?
Belarus	2	2 218	2013 - 2014	2019 – 2020	1-2?
Pakistan	2	2 028	2015 - 2016	2020 - 2021	-
Slovakia	2	880	1985 - 1985	2018 - 2019	2
USA	2	2 234	2013 - 2013	2021 - 2022	2
Argentina	1	25	2014 - 2014	2020	1
Bangladesh	1	1 080	2017 - 2017	2023	-
Finland	1	1 600	2005 - 2005	2019	1
France	1	1 600	2007 - 2007	2020	1
Japan	1	1 325	2007 - 2007	?	1
Turkey	1	1 114	2018 - 2018	2023	-
World	50	48 496	1985- 2018	2018 - 2023	33-36

Sources: Compiled by WNISR, 2018

WNISR2018 GLOBAL OVERVIEW – CONSTRUCTION TIMES

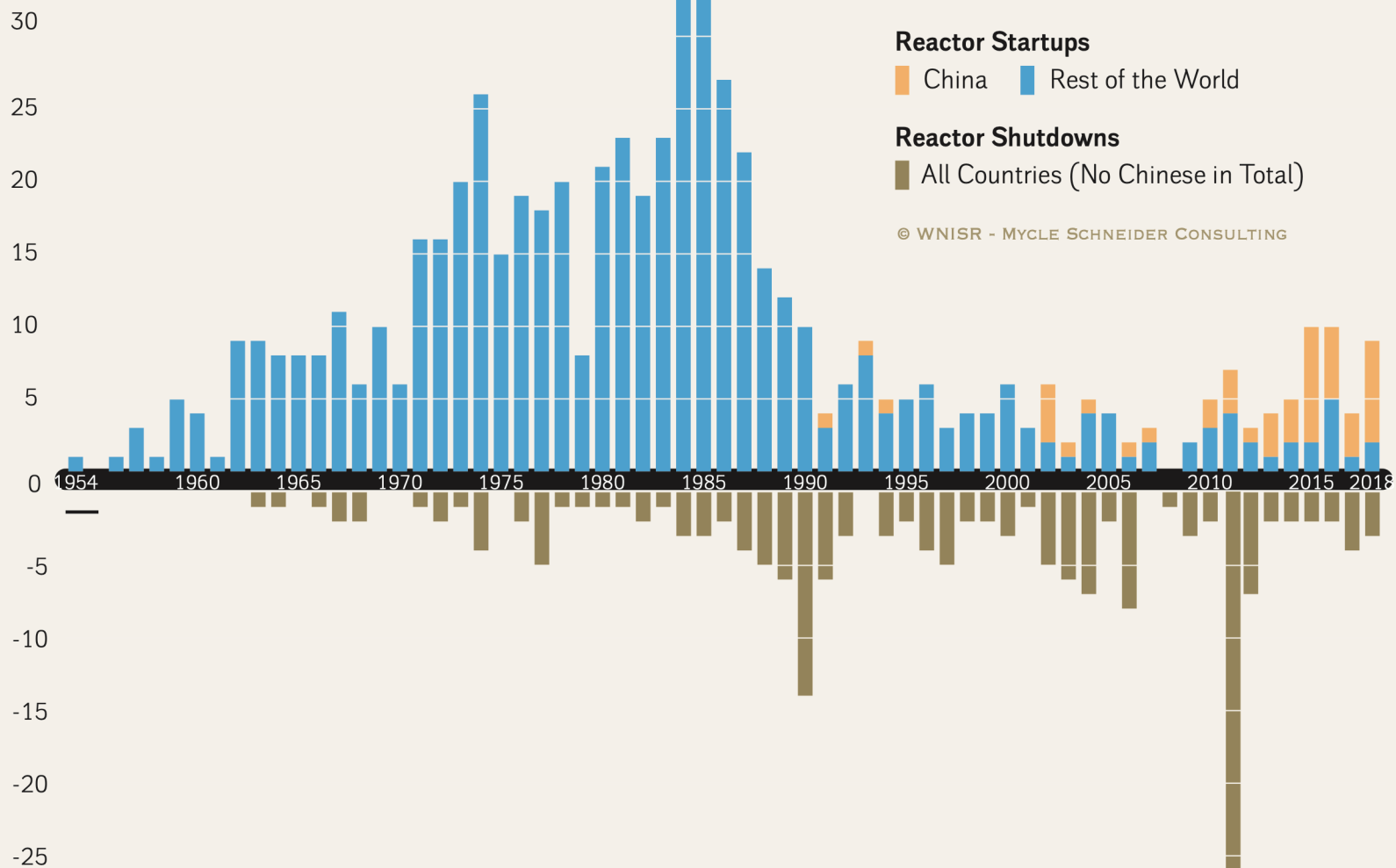
Reactor Construction Times of 55 Units Started-up 2008–7/2018

Construction Times of 55 Units Started-up 2008-7/2018				
Country	Units	Construction Time (in Years)		
		Mean Time	Minimum	Maximum
China	31	6.0	4.1	11.2
Russia	7	24.0	8.1	35.1
India	5	9.8	7.2	14.2
South Korea	5	5.3	4.1	7.2
Pakistan	3	5.4	5.2	5.6
Argentina	1	33.0	33.0	
Iran	1	36.3	36.3	
Japan	1	5.1	5.1	
USA	1	43.5	43.5	
World	55	10.1	4.1	43.5

Sources: WNISR, with IAEA-PRIS, WNA, 2018

Reactor Startups and Shutdowns in the World

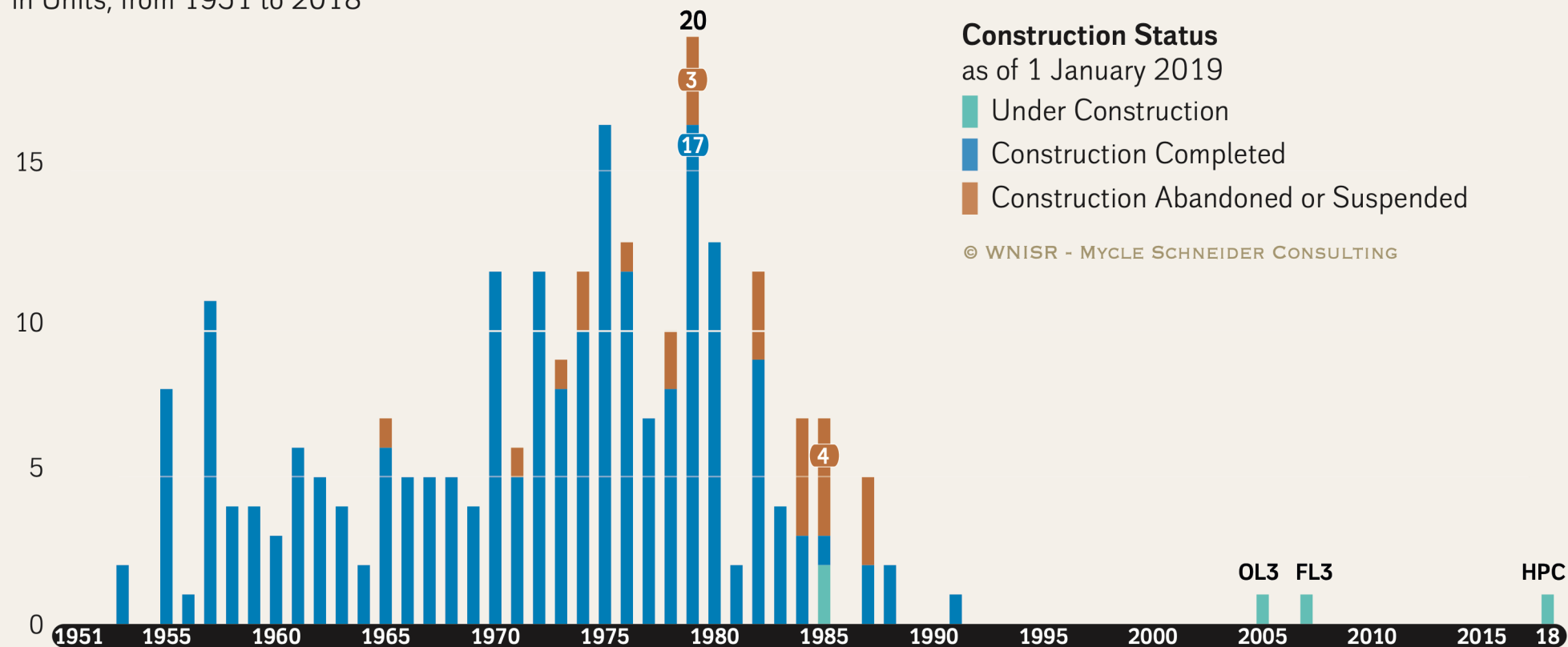
in Units, from 1954 to 2018



Sources: WNISR, with IAEA-PRIS, 2019

Construction Starts of Nuclear Reactors in the EU28

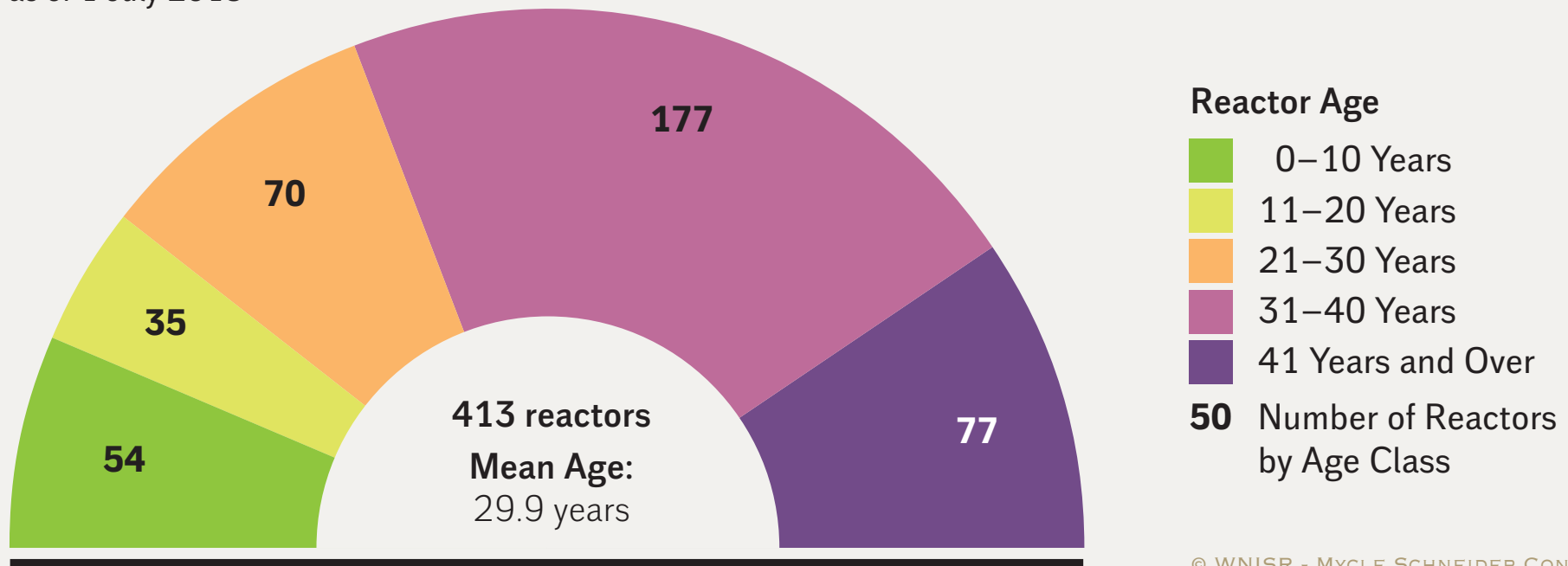
in Units, from 1951 to 2018



Sources: WNISR, with IAEA-PRIS, 2019

Age of World Nuclear Fleet

as of 1 July 2018

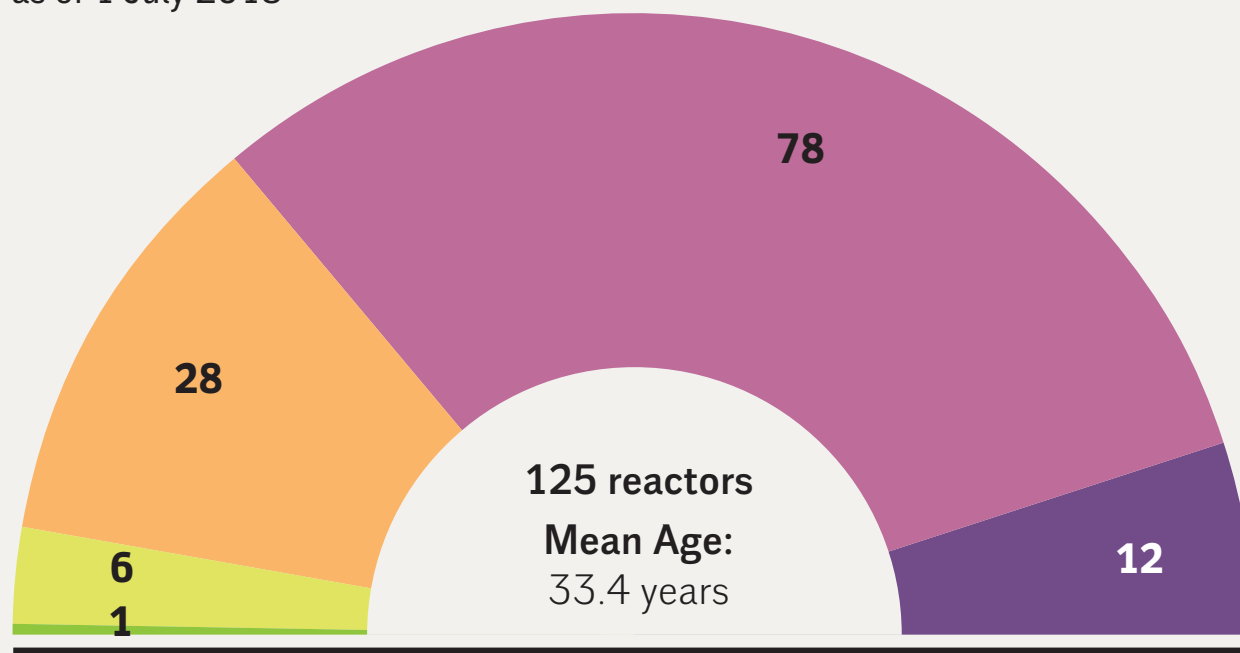


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Sources: WNISR, with IAEA-PRIS, 2018

Age of EU Nuclear Fleet

as of 1 July 2018



Reactor Age

- 0–10 Years
 - 11–20 Years
 - 21–30 Years
 - 31–40 Years
 - 41 Years and Over
- 50** Number of Reactors by Age Class

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Sources: WNISR, with IAEA-PRIS, 2018

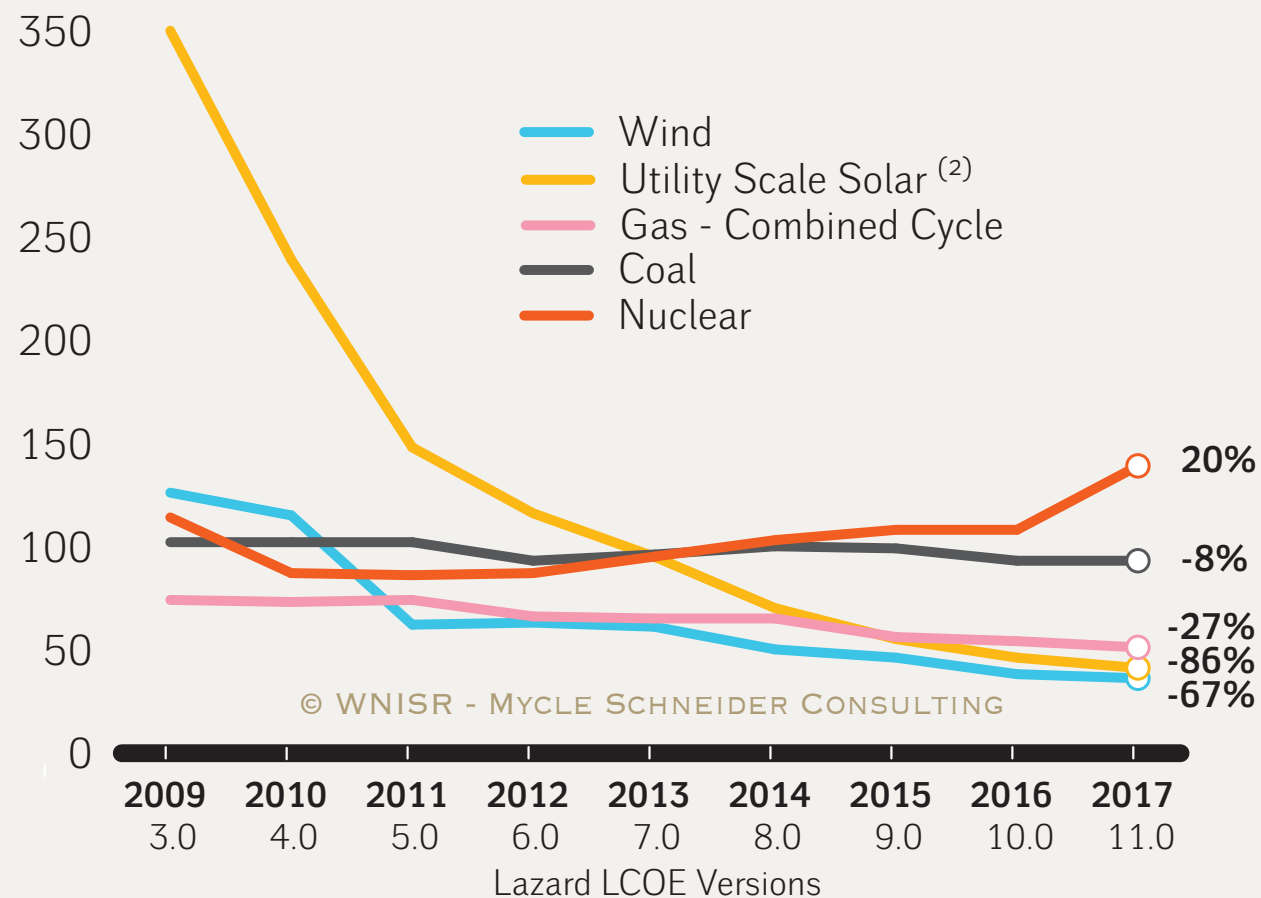
WNISR2018 US FOCUS – 18 EARLY CLOSURES ANNOUNCED 2009-2025

Reactor	Owner	Decision Date	Shutdown Date (last electricity generation)	Age at Shutdown (in years)	NRC 60-Year License Approval
Oyster Creek	Exelon	8 December 2010	December 2019 brought forward to 17 September 2018	49	Yes
Crystal River-3	Duke Energy	5 February 2013	26 September 2009	32	Application withdrawn
San Onofre 2&3	SCE/SDG&E	7 June 2013	January 2012	29 / 28	No application
Kewaunee	Dominion Energy	22 October 2012	7 May 2013	39	Yes
Vermont Yankee	Entergy	28 August 2013	29 December 2014	42	Yes
Pilgrim	Entergy	13 October 2015	31 May 2019	47	Yes
Diablo Canyon 1&2	PG&E	21 June 2016	November 2024 & August 2025	40	Suspended
Fort Calhoun	OPPD	26 August 2016	24 October 2016	43	Yes
Palisades	Entergy	8 December 2016/ 28 September 2017	2021 ^a	51	Yes
Indian Point 2&3	Entergy	9 January 2017	No later than 30 April 2020 / 30 April 2021	47 / 44	Under review
Three Mile Island-1	Exelon	30 May 2017	September 2019	45	Yes
Beaver Valley 1&2	First Energy	March 2018	2022	45/34	Yes
Davis Besse-1	First Energy	March 2018	2020	43	Yes
Perry	First Energy	March 2018	2021	35.5	To be submitted October – December 2020

Sources: Various sources compiled by WNISR

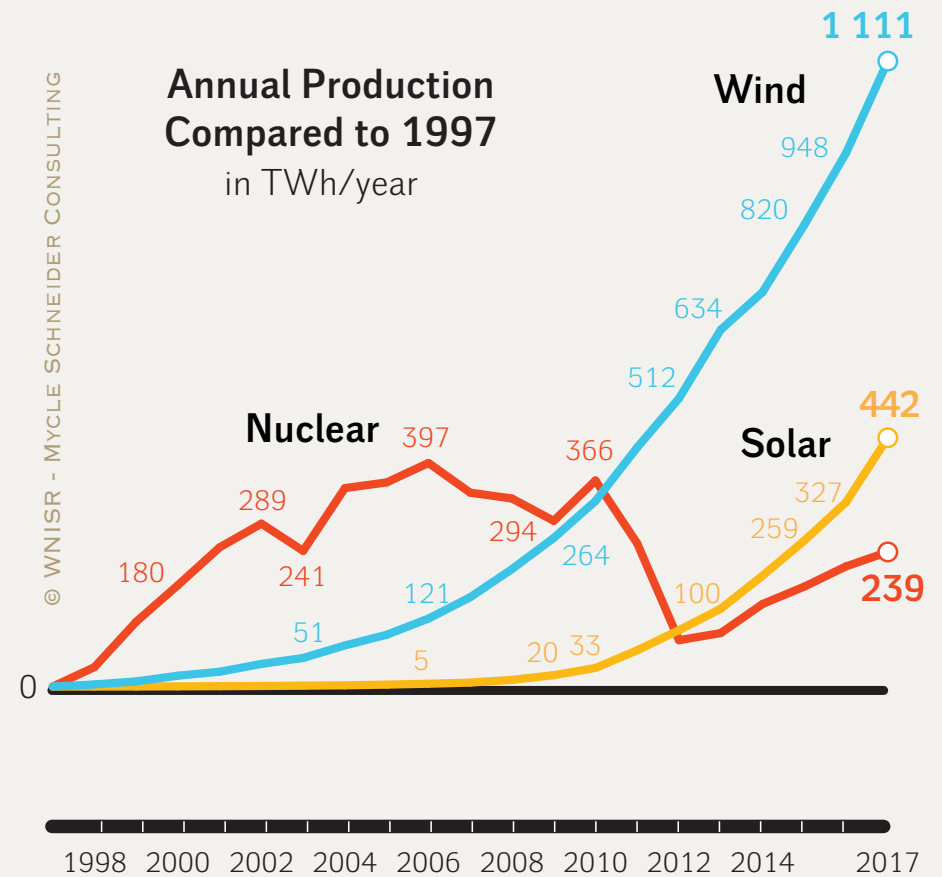
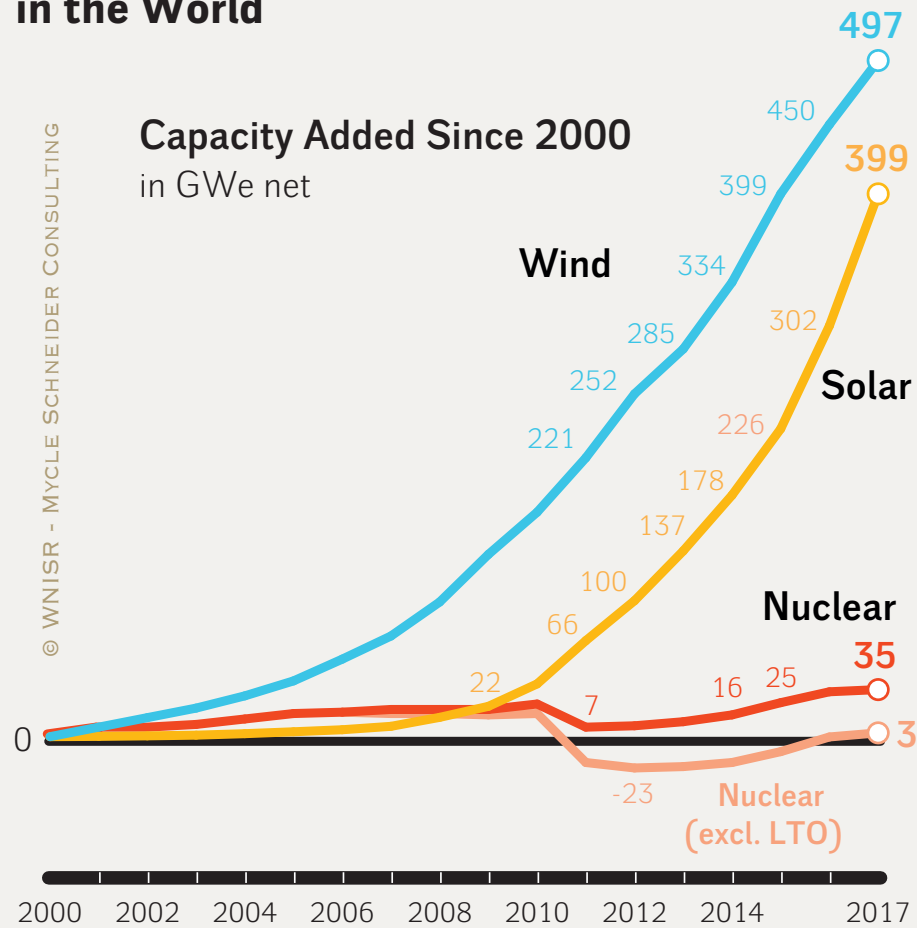
Selected Historical Mean Costs by Technology

LCOE values in US\$/MWh ⁽¹⁾



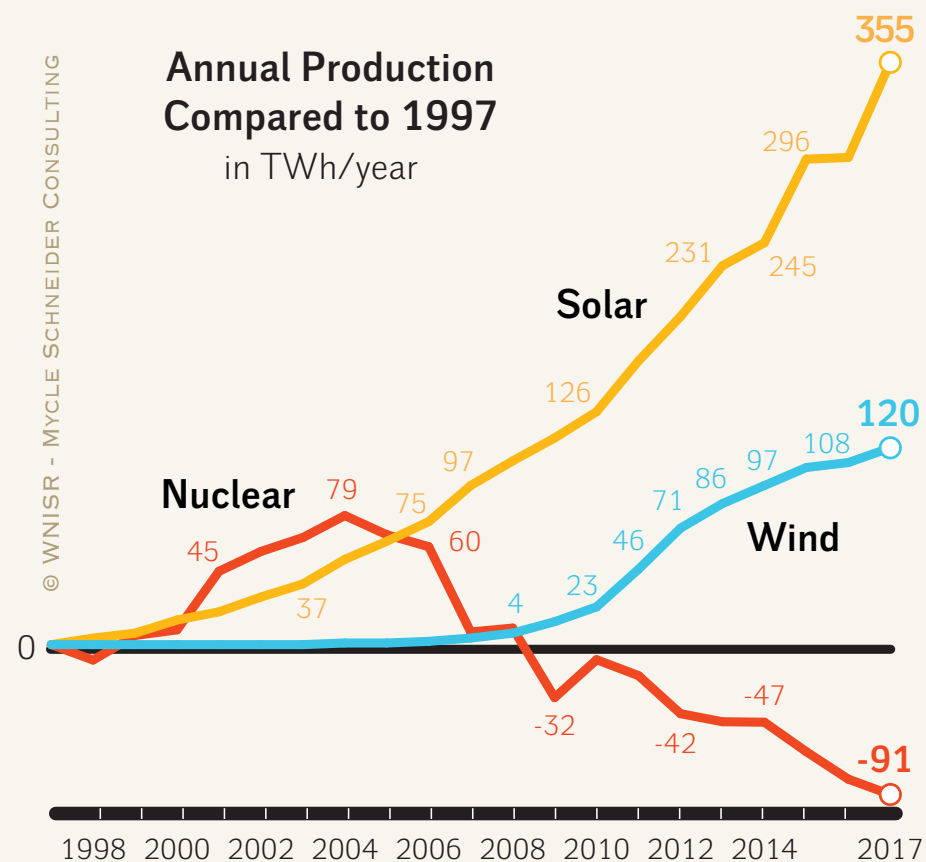
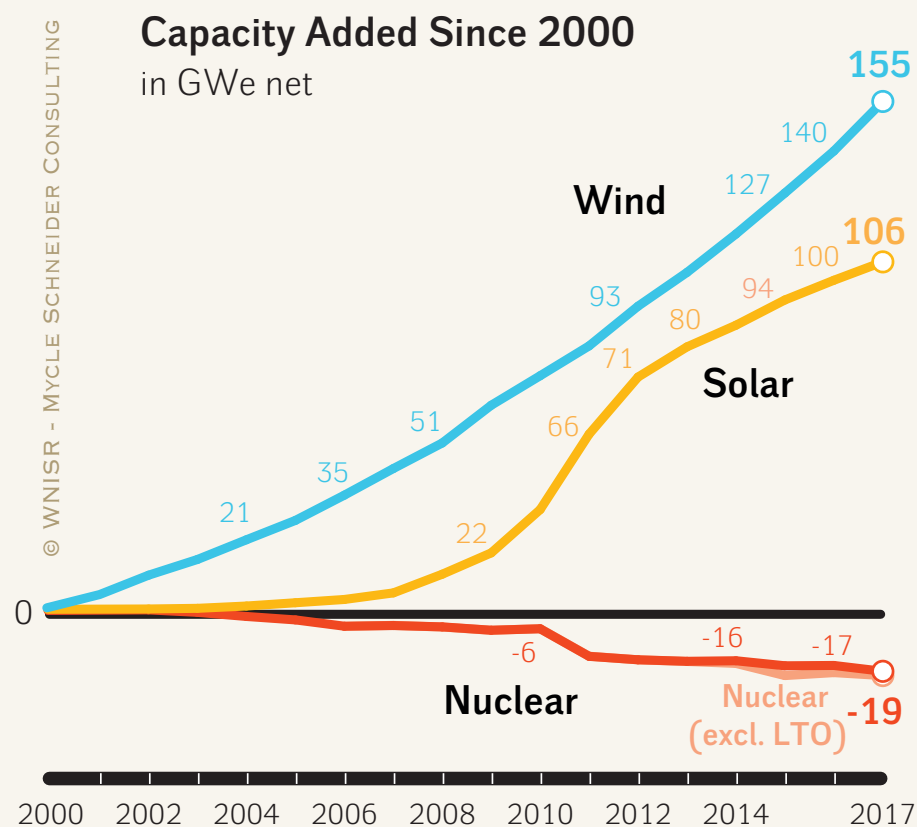
Sources: Lazard Estimates, 2017

Wind, Solar and Nuclear Developments: Installed Capacity and Electricity Production in the World



Sources: WNISR, IAEA-PRIS, BP Statistical Review 2018

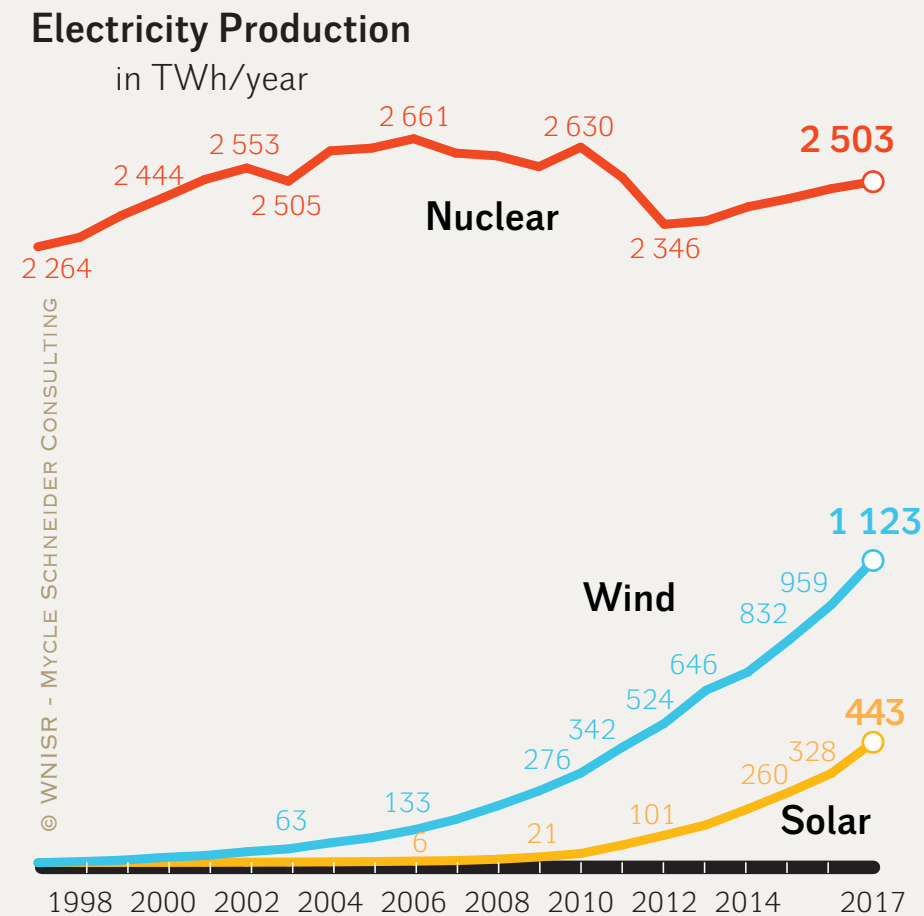
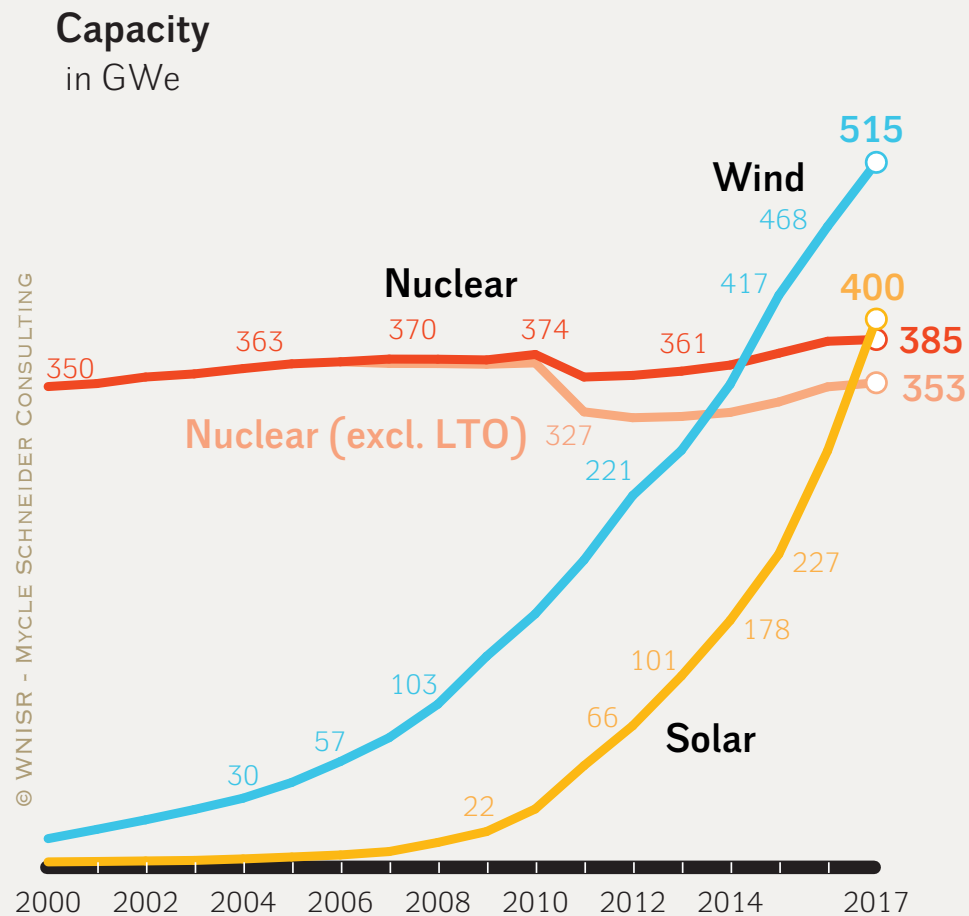
Wind, Solar and Nuclear Developments: Installed Capacity and Electricity Production in the EU



Sources: WNISR, IAEA-PRIS, BP Statistical Review 2018

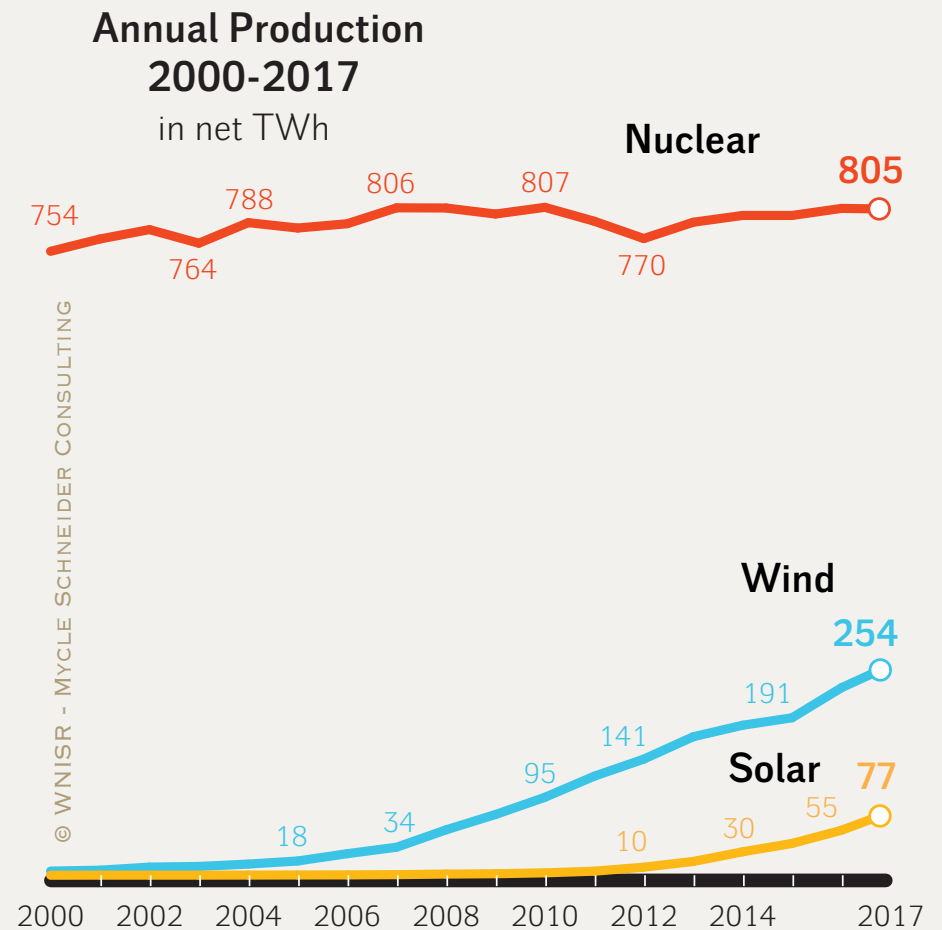
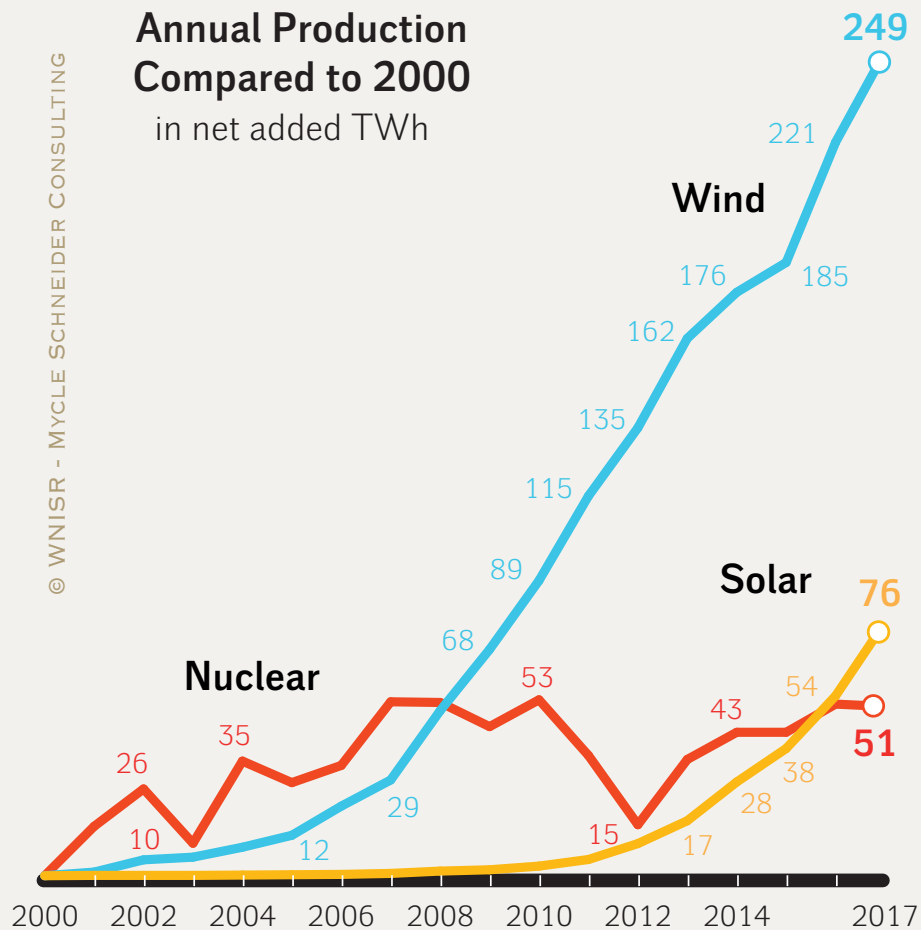
WNISR2018 NUCLEAR POWER VS. RENEWABLES DEPLOYMENT

Wind, Solar and Nuclear Installed Capacity and Electricity Production in the World



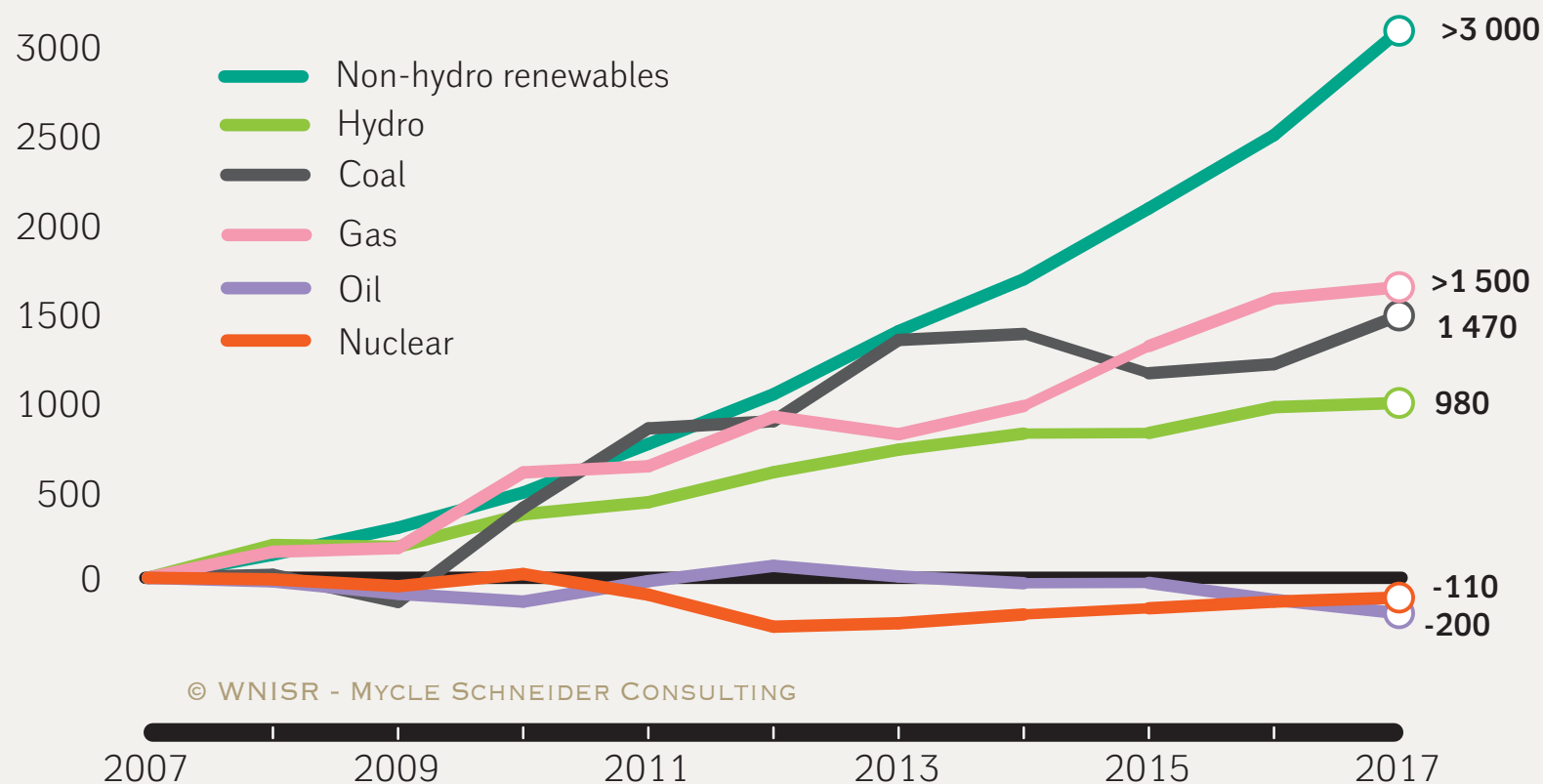
Sources: WNISR, IAEA-PRIS, BP Statistical Review 2018

Wind, Solar and Nuclear Developments in the United States 2000-2017



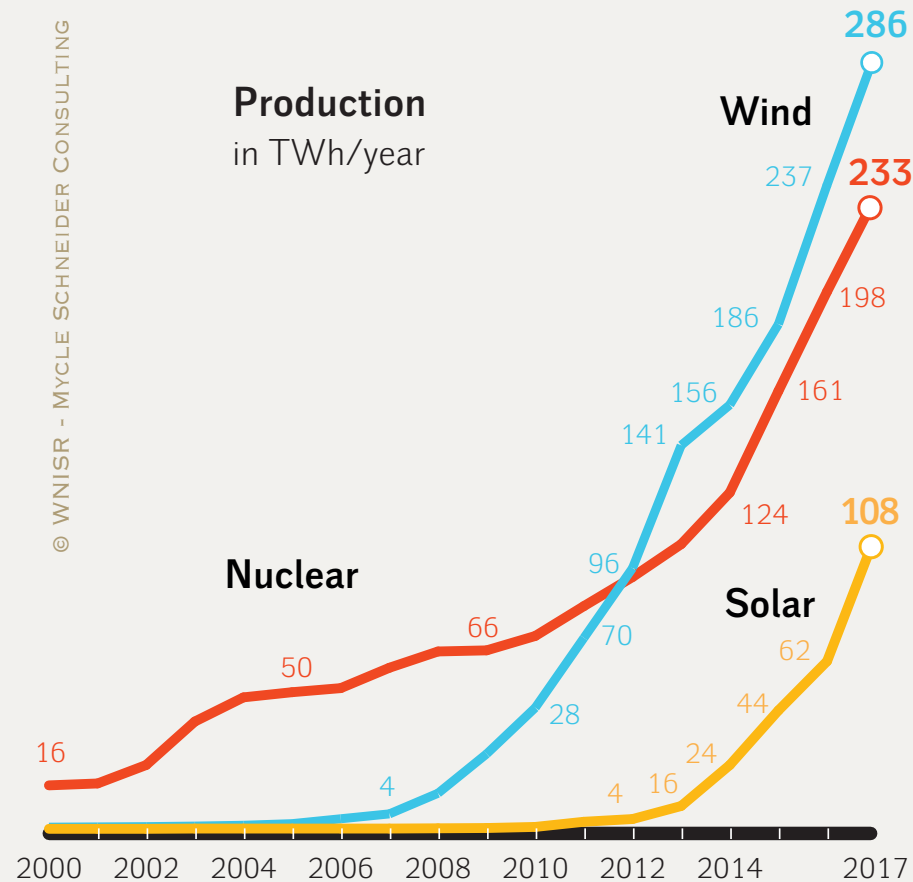
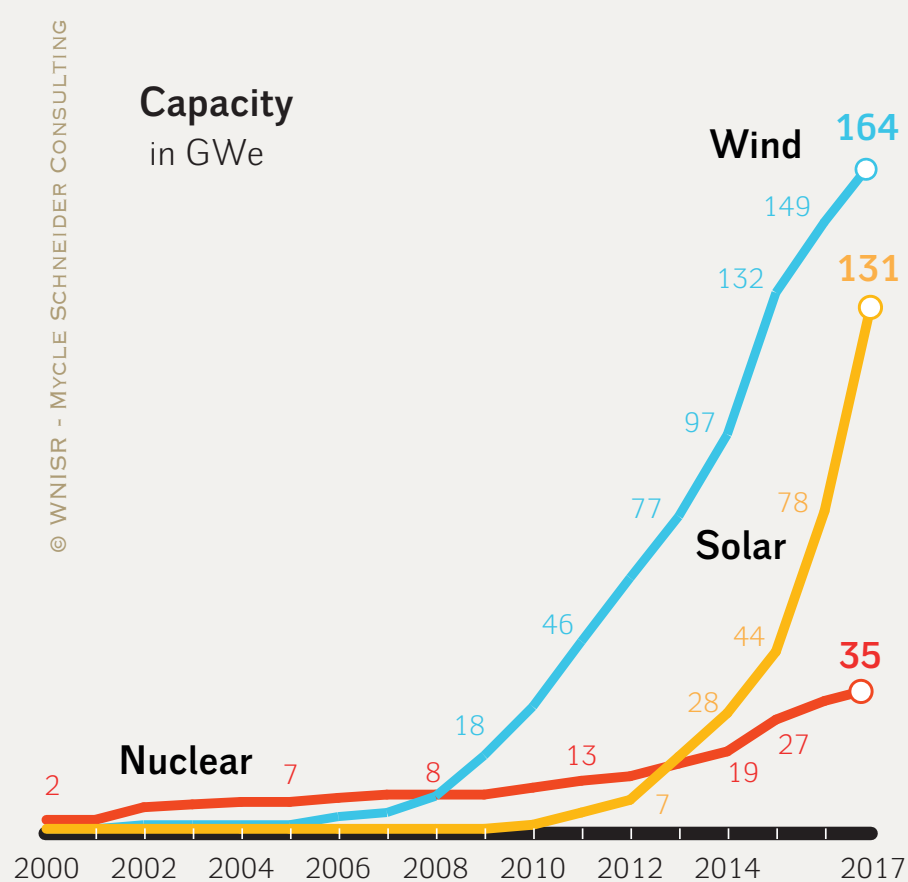
Power Generation in the World Annual Production Compared to 2007

in added TWh by Source



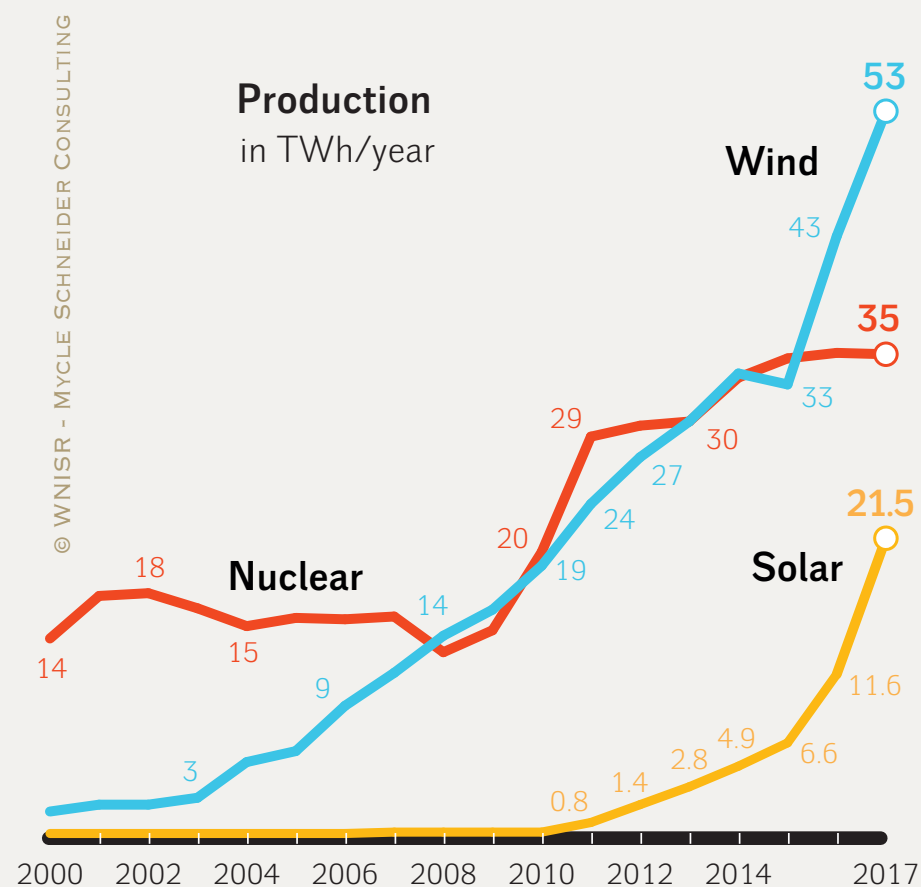
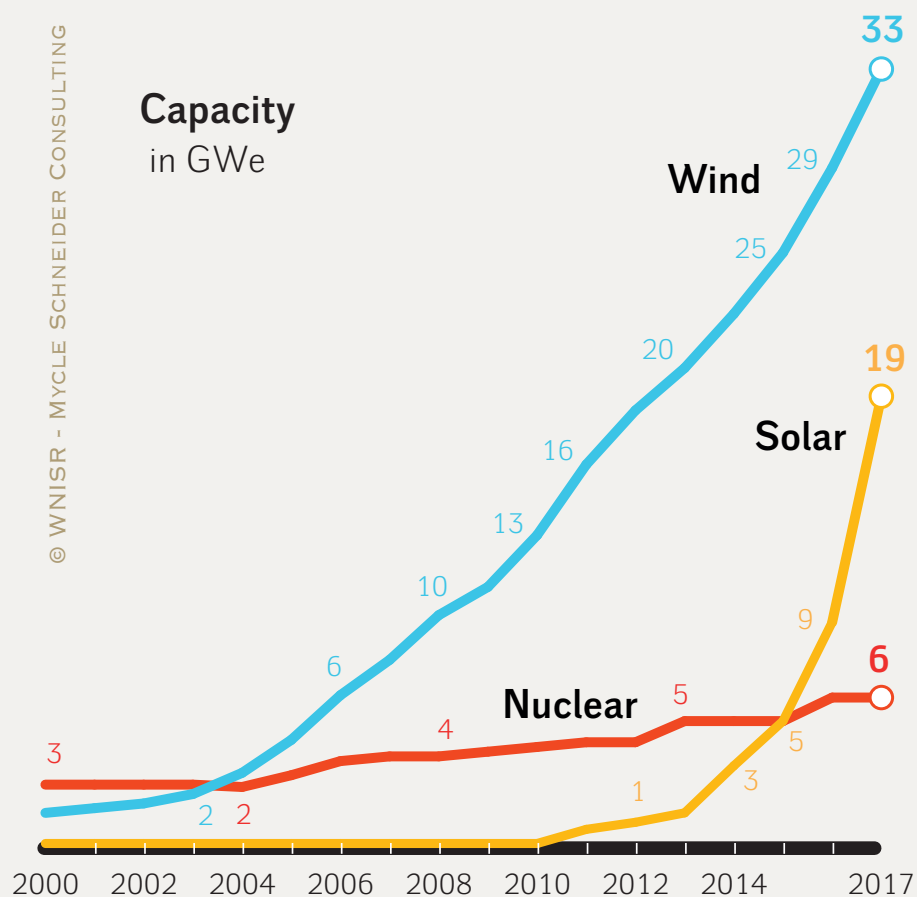
Sources: BP Statistical Review 2018

Installed Wind, Solar and Nuclear Capacity and Production in China 2000-2017



Sources: WNISR, IAEA-PRIS, BP Statistical Review 2018

Installed Wind, Solar and Nuclear Capacity and Production in India 2000-2017



Sources: WNISR, IAEA-PRIS, BP Statistical Review 2018

- Small increase of nuclear power generation essentially due to China.
- Long-term decline of nuclear power's role continues.
- Cost differential between nuclear and renewables still increases.
- Nine of 31 nuclear countries generate more power with renewables than nuclear.
- Nuclear power capacity additions are insignificant in global market (1 GW/257 GW net in 2017). Nuclear power becomes irrelevant.
- Reactor construction starts down from 15 in 2010 to 5 in 2018; no commercial reactor building started in China since 2016.
- Nuclear power is a species on way of extinction. Renewal rate too small for survival.
- Decommissioning in early stages, only 10 of 174 closed sites at greenfield status.
- New-build—and increasingly existing nuclear—is more expensive (€/MWh) than solar/wind and is therefore contributing to climate change.
- Existing nuclear is a very powerful innovation barrier see Germany vs. Japan.

Thank You!

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Mycle Schneider works as independent international consultant on energy and nuclear policy. He is the initiator and Convening Lead Author of the [World Nuclear Industry Status Reports](#). He is the Coordinator of the Seoul International Energy Advisory Council (SIEAC) and the Spokesperson for [IEAC](#). He is a member of the International Panel on Fissile Materials ([IPFM](#)), based at Princeton University, USA. In 2010-2011, he acted as Lead Consultant for the Asia Clean Energy Policy Exchange, implemented by [IRG](#), funded by [USAID](#), with the focus of developing a policy framework to boost energy efficiency and renewable energies. Between 2004 and 2009 he has been in charge of the Environment and Energy Strategies Lecture of the International Master of Science for Project Management for Environmental and Energy Engineering at the *Ecole des Mines* in Nantes, France.

From 2000 to 2010 he was an occasional advisor to the German Environment Ministry. 1998-2003 he was an advisor to the French Environment Minister's Office and to the Belgian Minister for Energy and Sustainable Development.

Mycle Schneider has given evidence or held briefings at national Parliaments in 15 countries and at the European Parliament. He has advised Members of the European Parliament from four different groups over the past 30+ years. He has given lectures or had teaching appointments at 20 universities and engineering schools in 10 countries.

Mycle Schneider has provided information and consulting services to a large variety of clients including international institutions and organizations, think tanks and NGOs.

In 1997, he was honoured with the [Right Livelihood Award](#) ("Alternative Nobel Prize").