The World Nuclear Industry Status Report 2015

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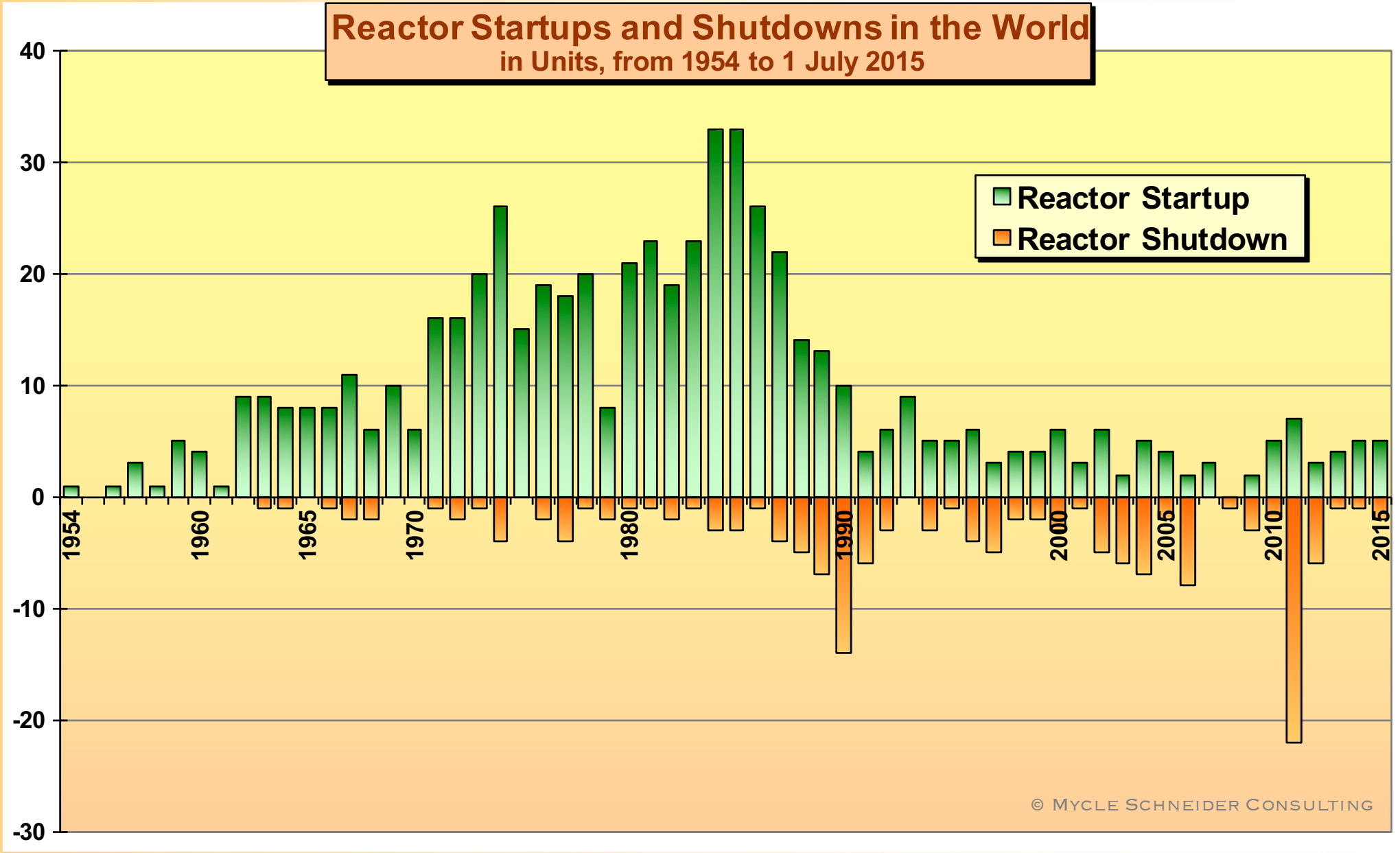
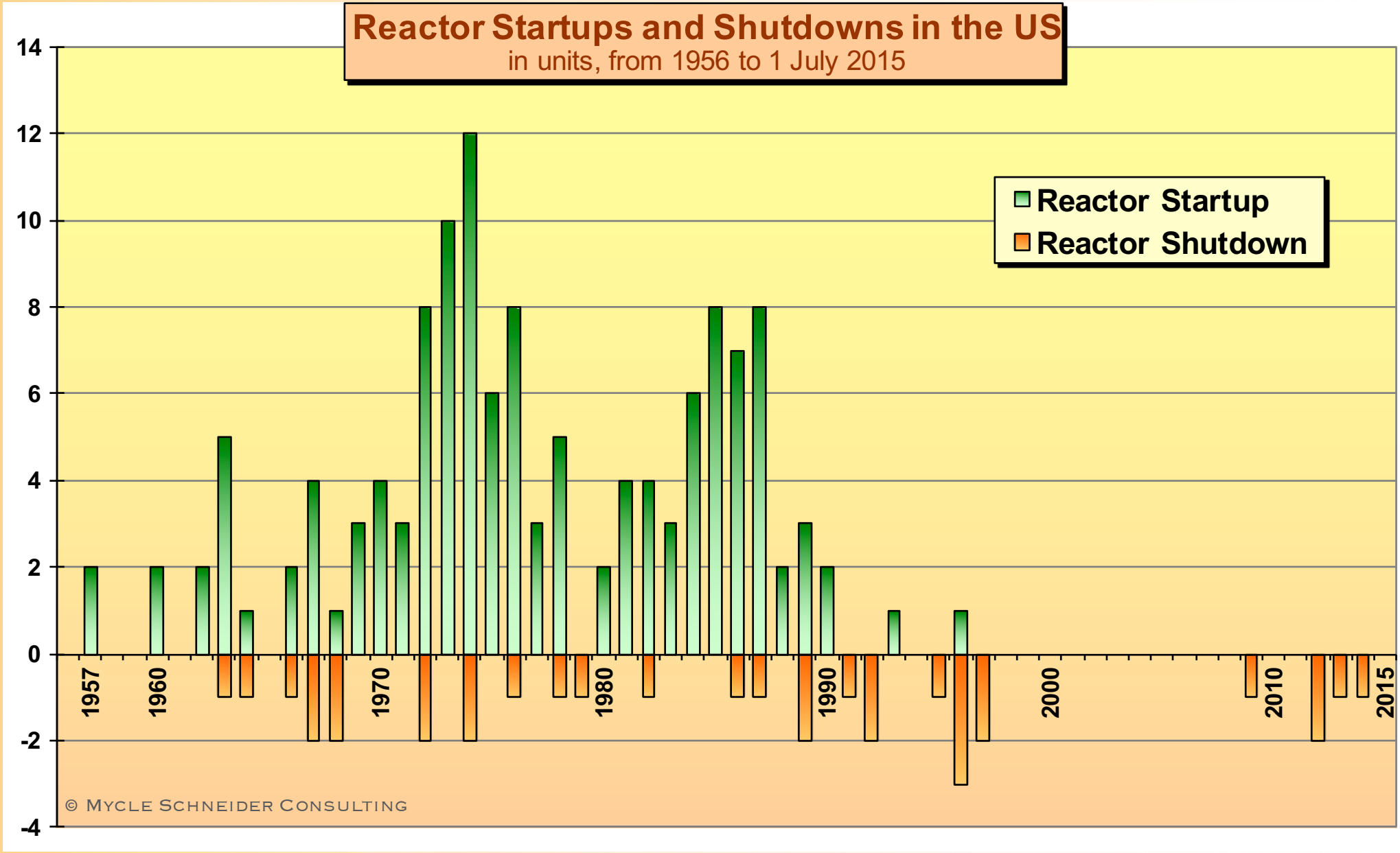
Convening Lead Author of the World Nuclear Industry Status Report (WNISR)

Atomkraft – Eine nachhaltige Technologie für den Klimaschutz?

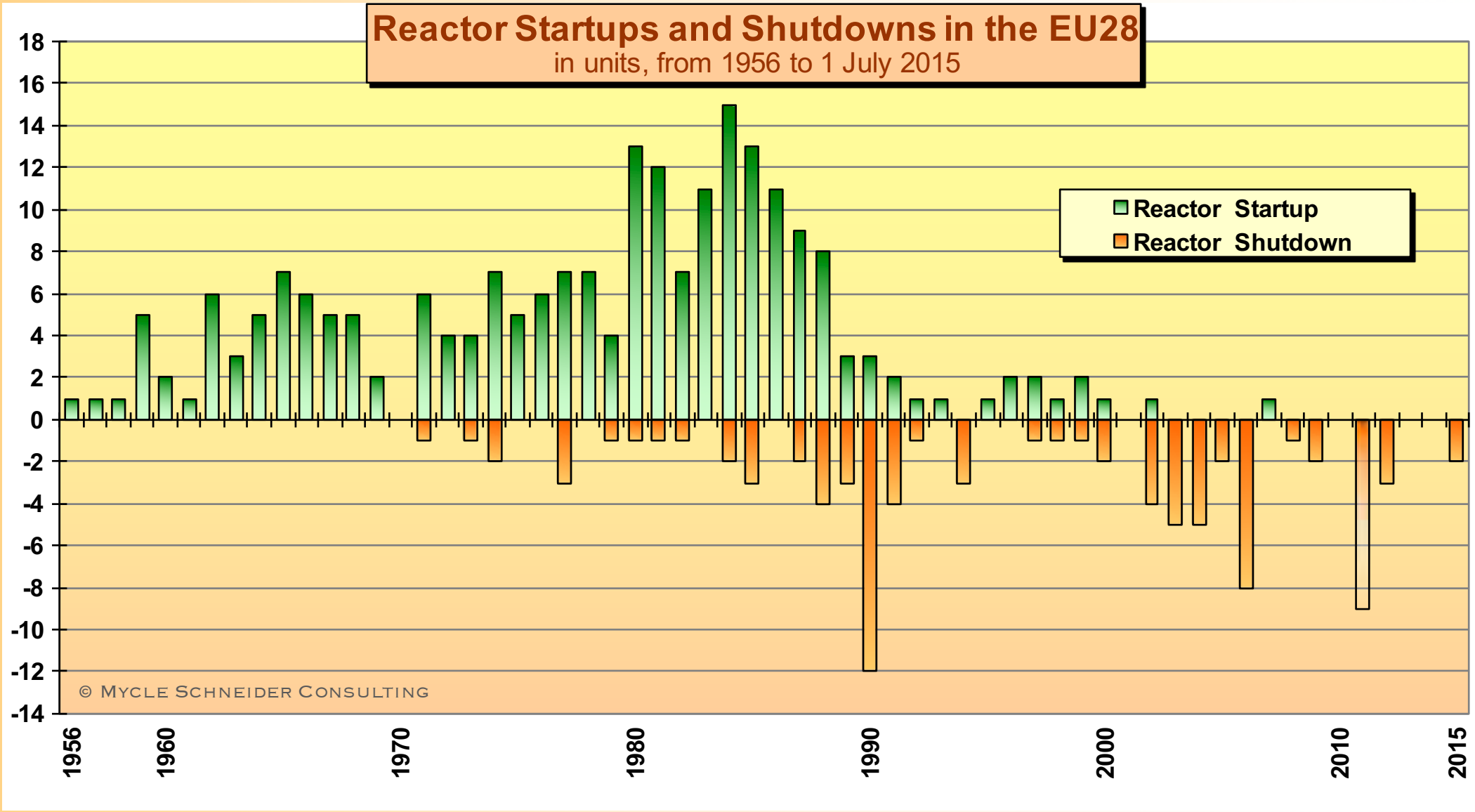
DIW, Berlin, 5 November 2015



Source: IAEA-PRIS, MSC, 2015



Source: IAEA-PRIS, MSC, 2015



Source: IAEA-PRIS, MSC, 2015

Misleading Official Information on World Reactor Fleet

IAEA | PRIS Power Reactor Information System

World Statistics | Country Statistics | Publications | Glossary | About PRIS

PRIS

The Database on Nuclear Power Reactors

The Power Reactor Information System (PRIS), developed and maintained by the IAEA for over four decades, is a comprehensive database focusing on nuclear power plants worldwide. PRIS contains information on power reactors in operation, under construction, or those being... READ MORE »

Registered User ENTRY | How to Register

SHORTCUTS

Select Country

Select Reactor

Nuclear Power Reactors in the World...

Operating Experience with NPP (OPEX)

PRIS STATISTICS – User's Manual

OVERVIEW

Current Status:

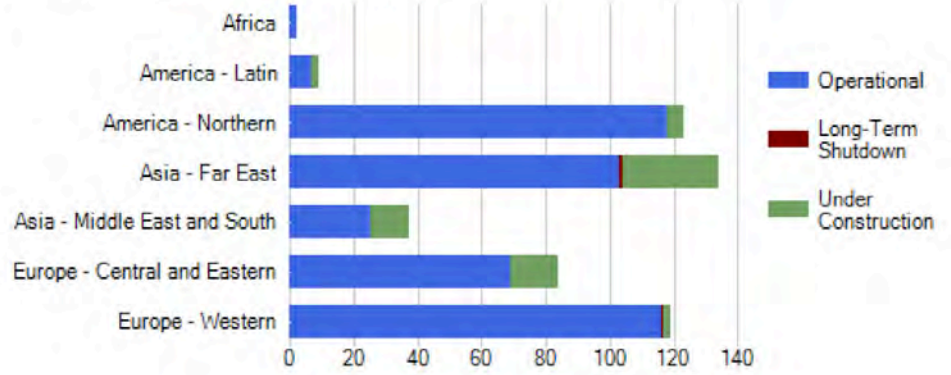
440 NUCLEAR POWER REACTORS IN OPERATION

381 055 MW_e TOTAL NET INSTALLED CAPACITY

2 NUCLEAR POWER REACTORS IN LONG-TERM SHUTDOWN

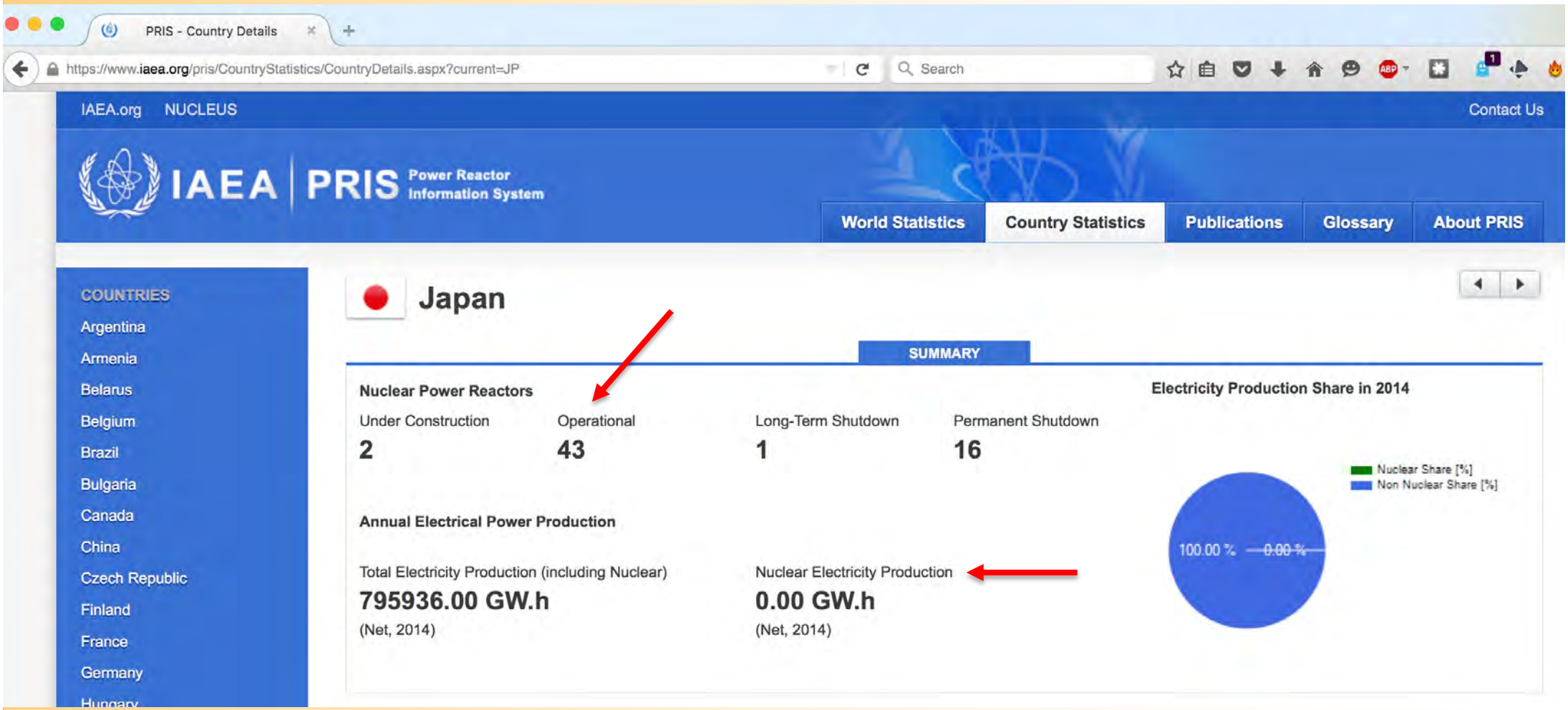
66 NUCLEAR POWER REACTORS UNDER CONSTRUCTION

Regional Distribution of Nuclear Power Plants (Click on the chart for more statistics)



Source: IAEA-PRIS, Screenshot, 5 November 2015

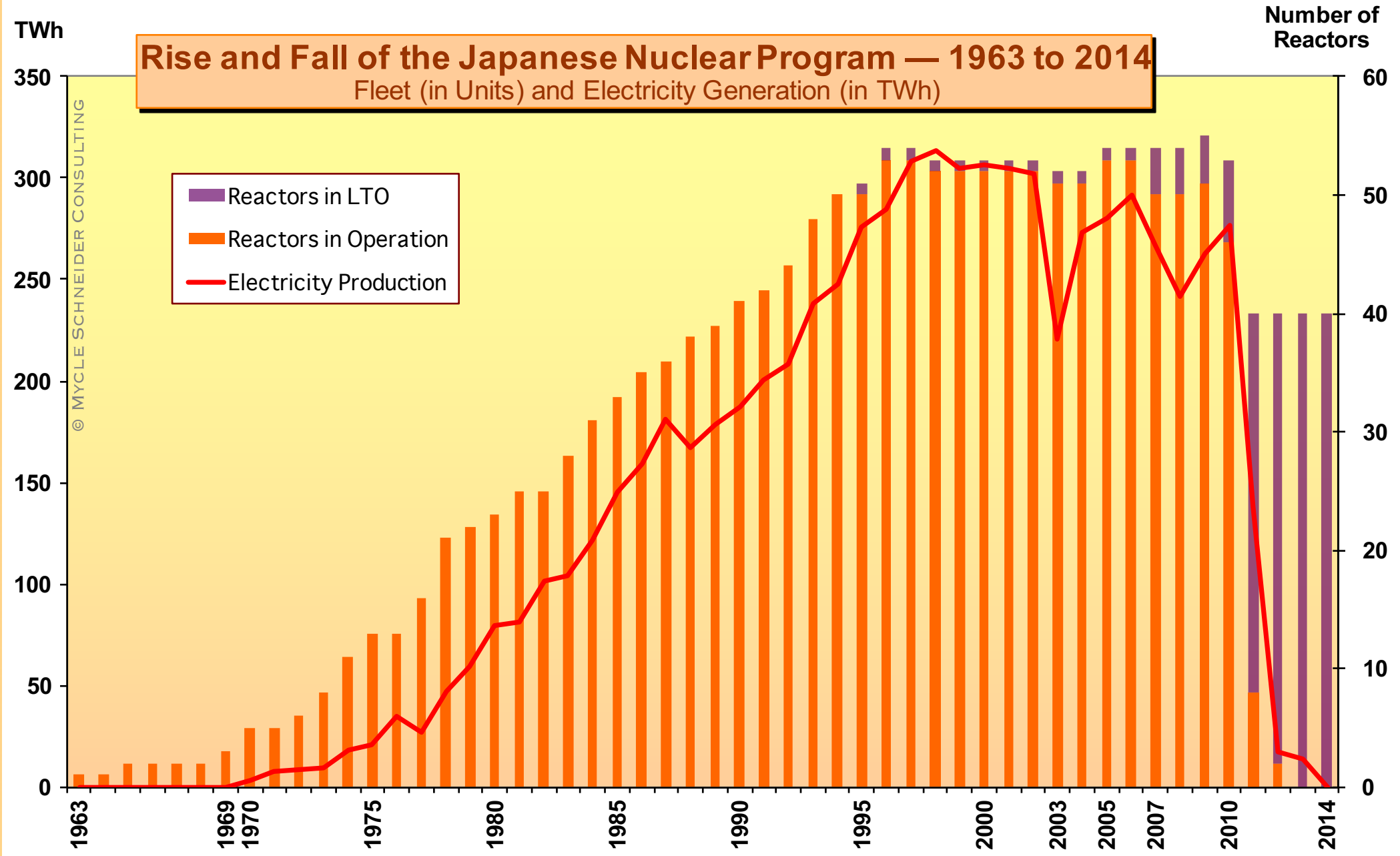
Misleading Official Information on Japan's Reactor Fleet



Source: IAEA-PRIS, Screenshot, 13 October 2015

Rise and Fall of the Japanese Nuclear Program — 1963 to 2014

Fleet (in Units) and Electricity Generation (in TWh)



Source: IAEA-PRIS, MSC, 2015

The WNISR2014 Establishes New Reactor Status Category: Long-Term Outage or LTO

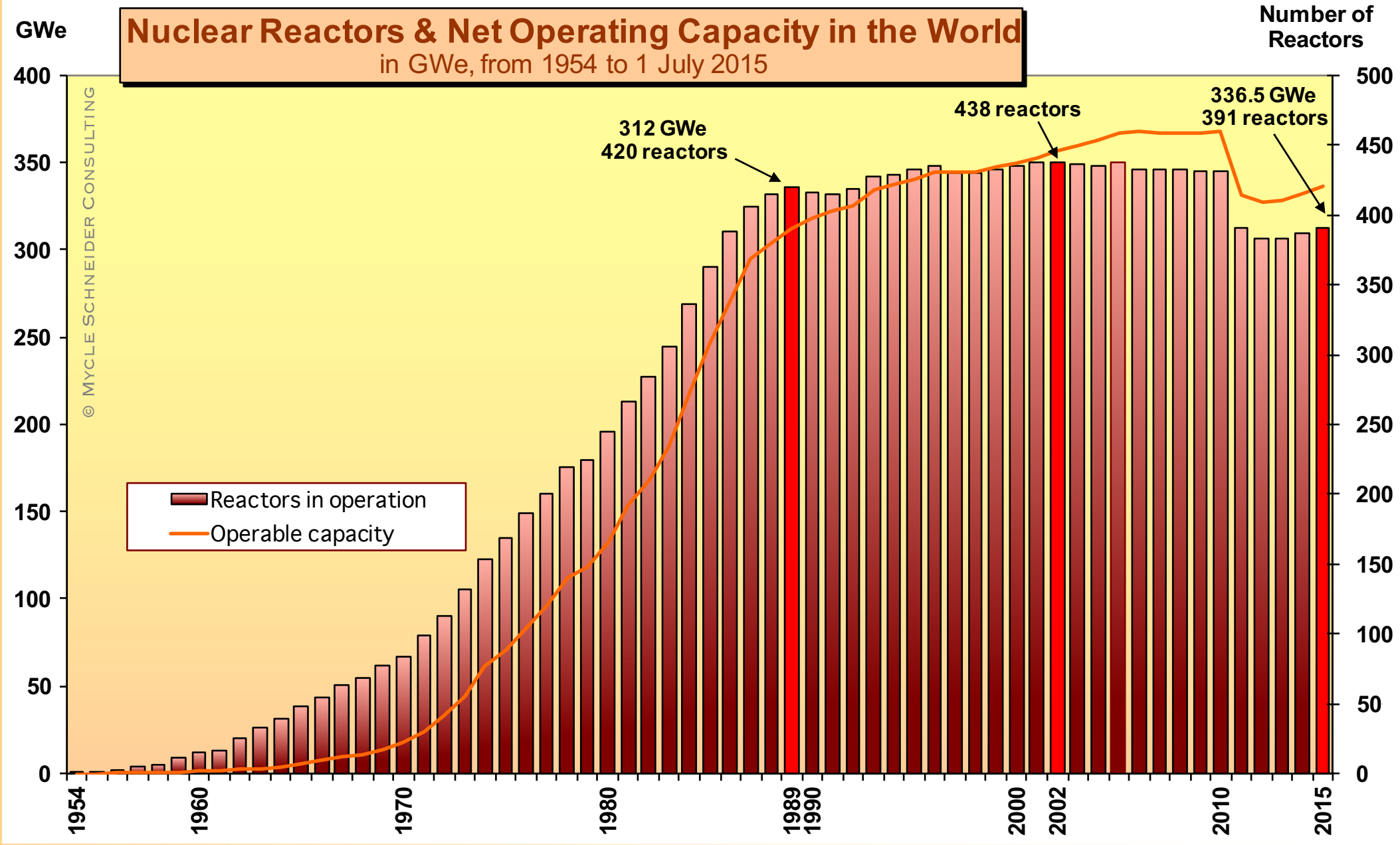
"A nuclear power reactor is considered in Long-Term Outage (LTO) if it has not generated any power in the entire previous calendar year and in the first semester of the current calendar year of the WNISR."

41 reactors worldwide in LTO

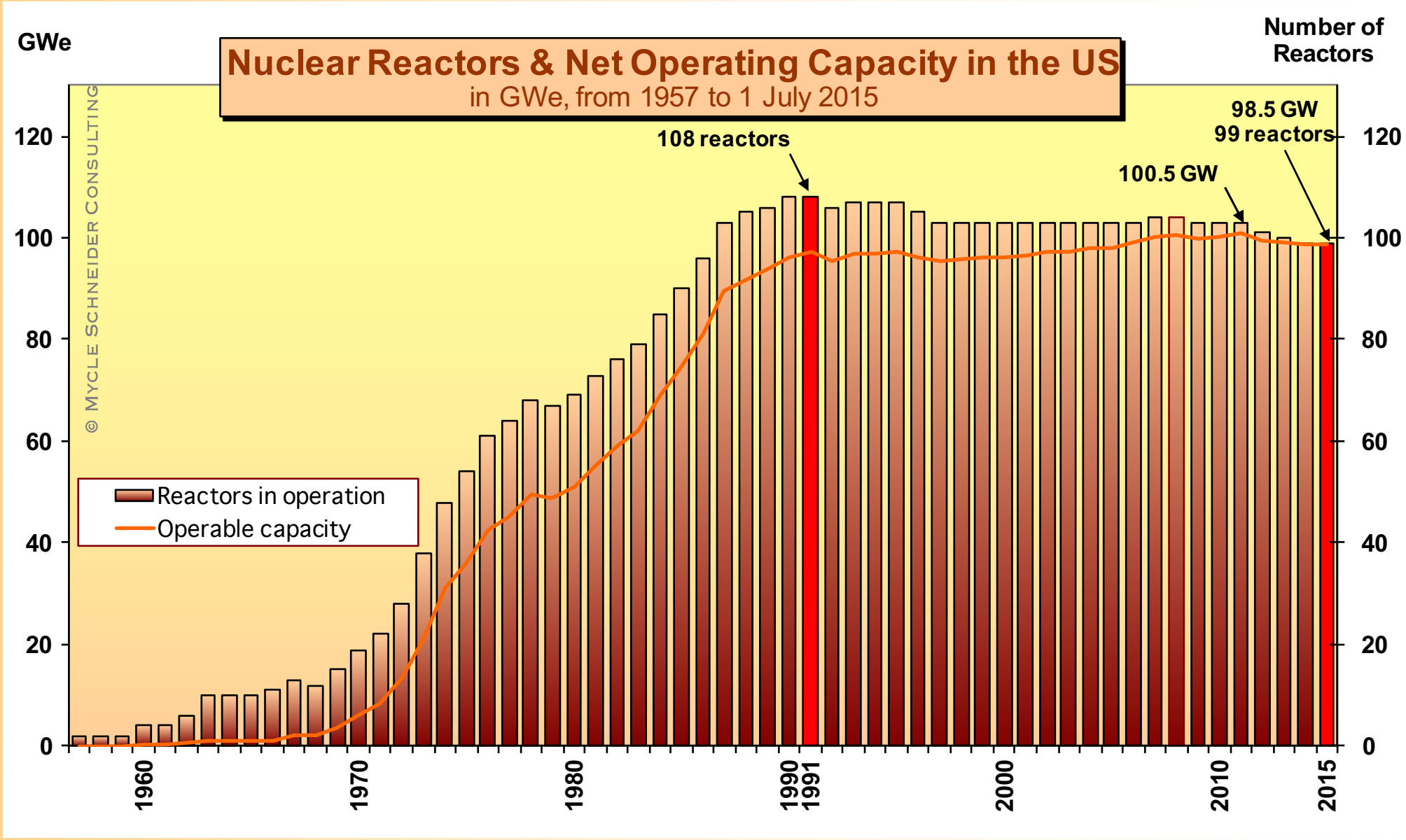
- 40 in Japan, shut down between 1995 and 2012
- 1 in Sweden (Oskarshamn-2), shut down in June 2013

Nuclear Reactors & Net Operating Capacity in the World

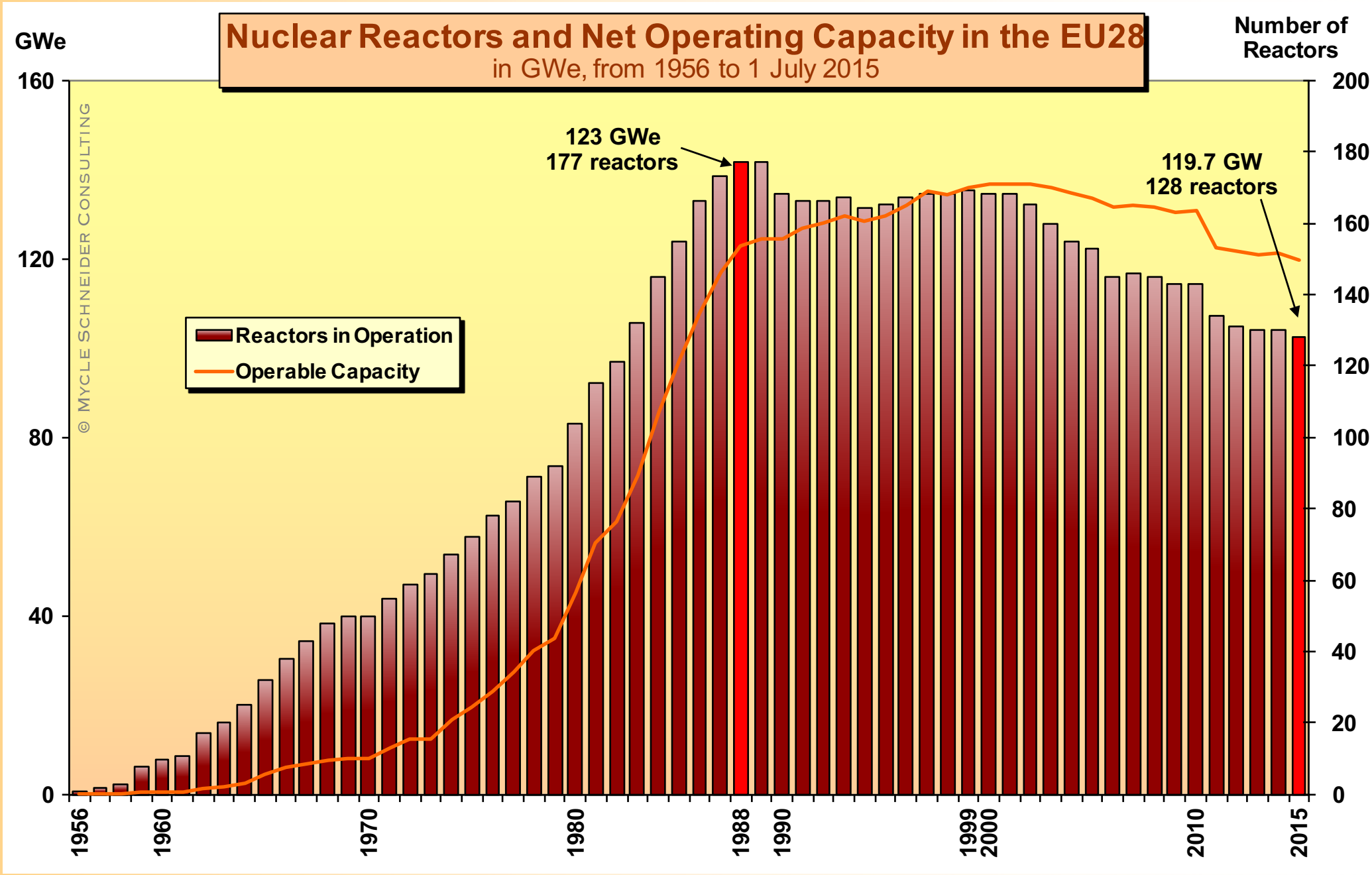
in GWe, from 1954 to 1 July 2015



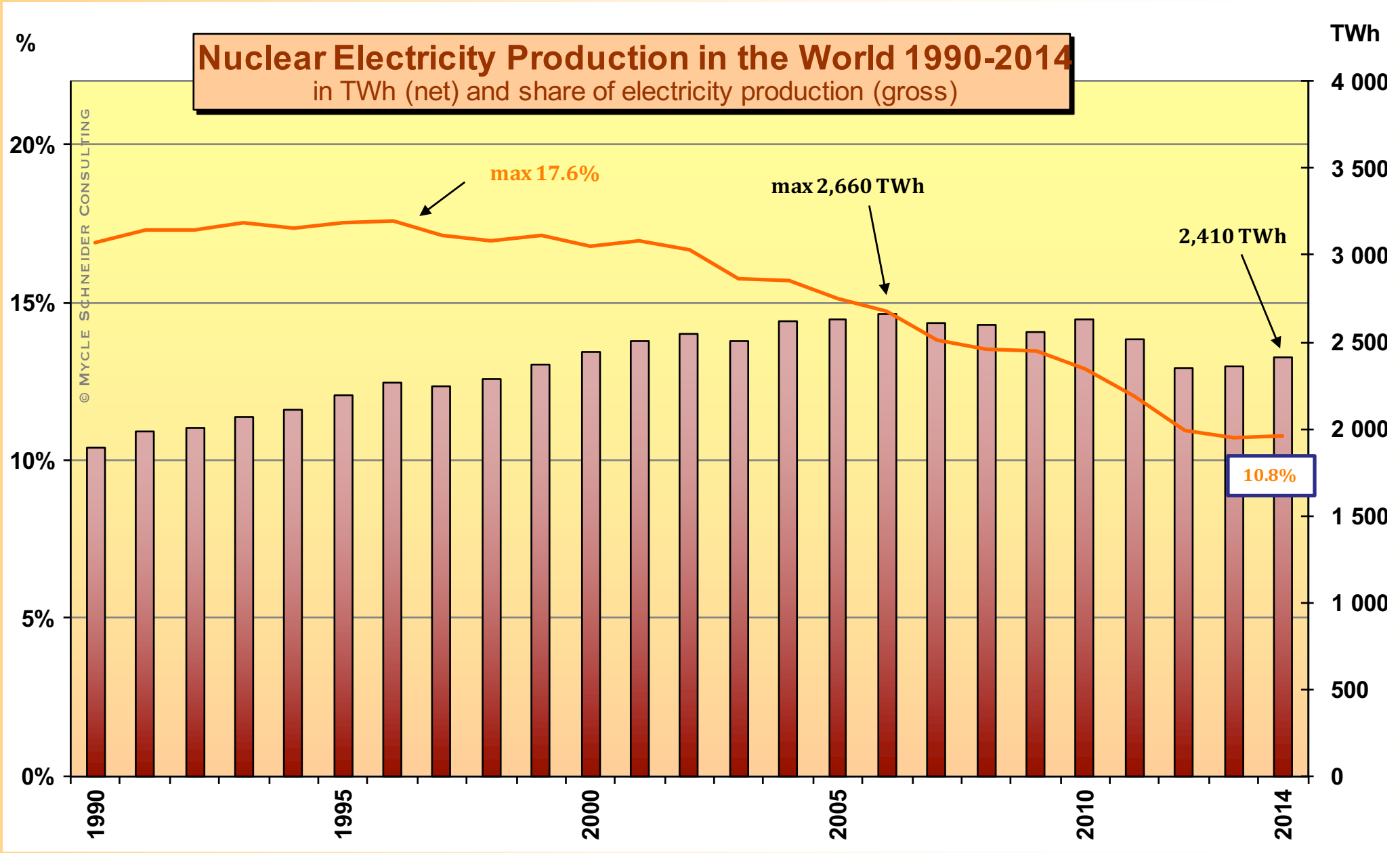
Source: IAEA-PRIS, MSC, 2015



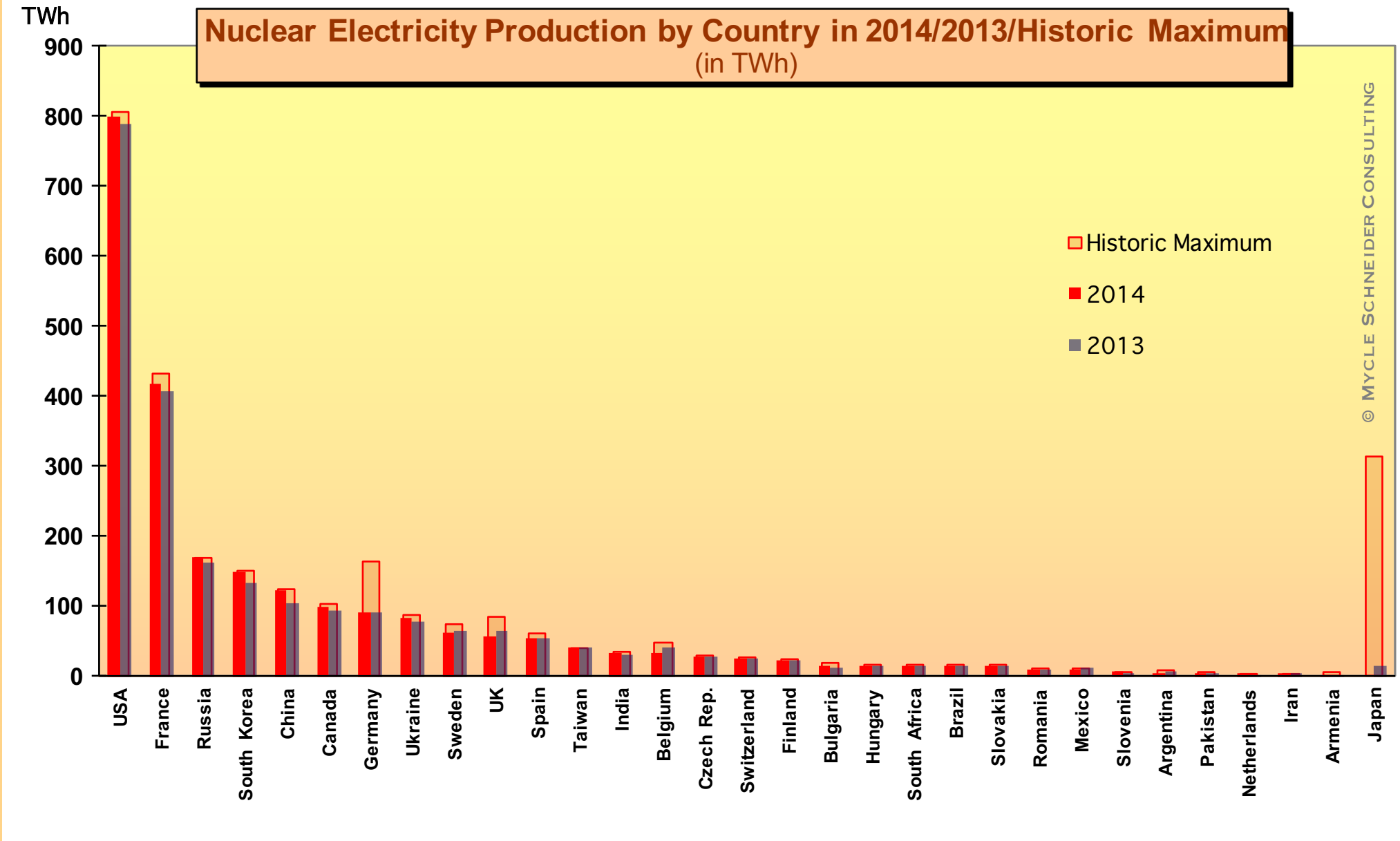
Source: IAEA-PRIS, MSC, 2015



Source: IAEA-PRIS, MSC, 2015



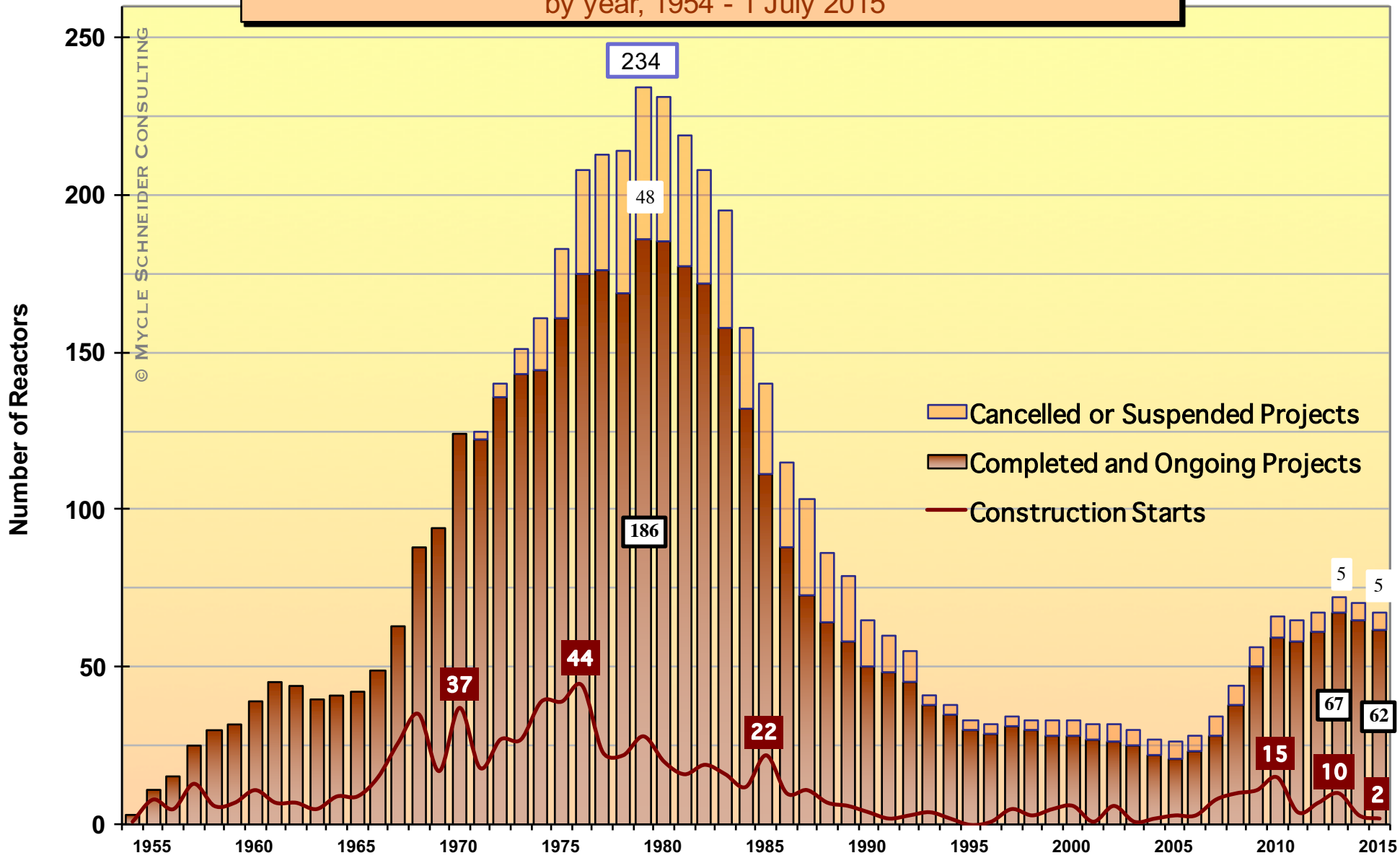
Source: IAEA-PRIS, MSC, 2015



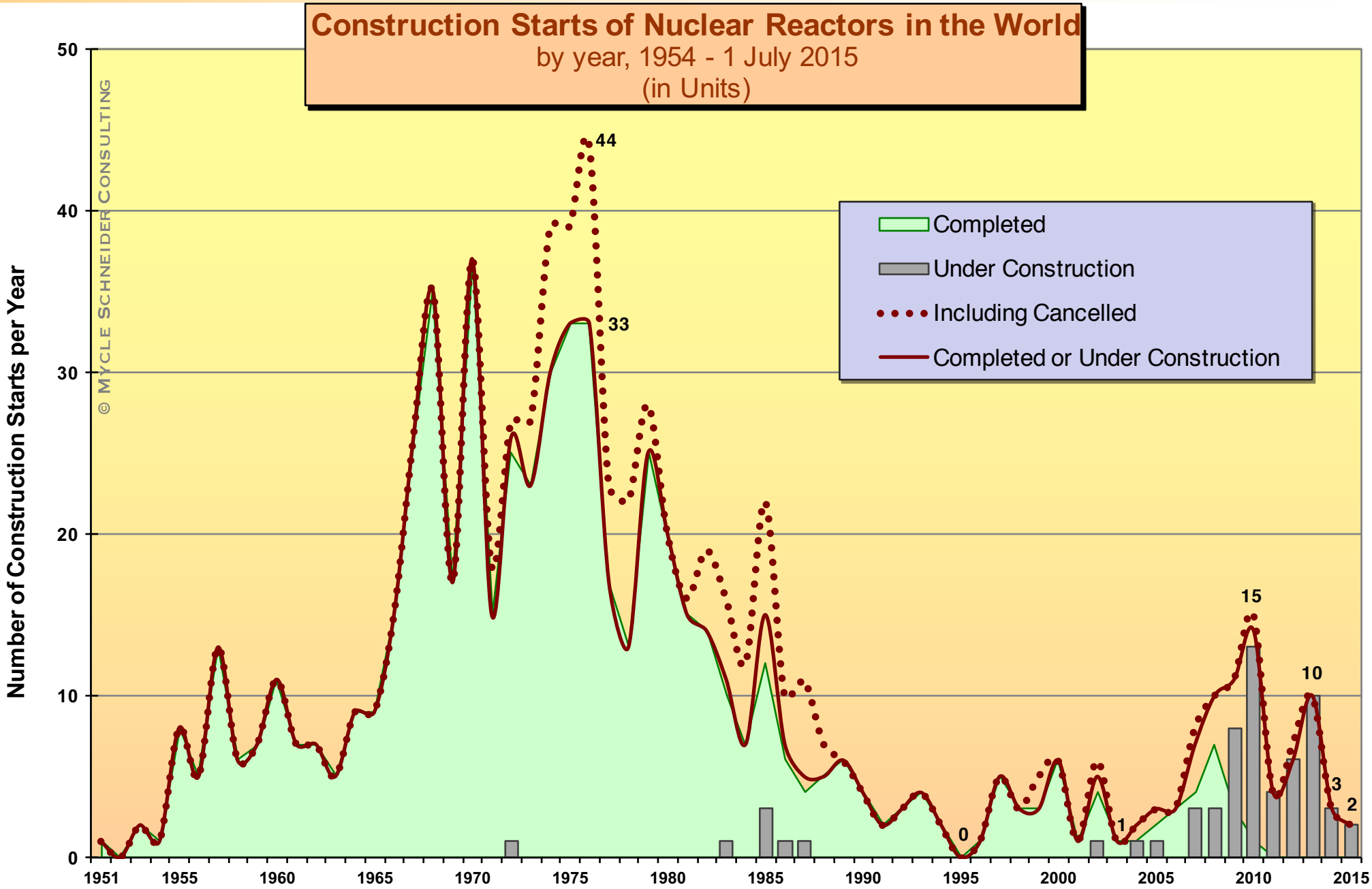
Source: IAEA-PRIS, MSC 2015

Number of Nuclear Reactors Listed as "Under Construction"

by year, 1954 - 1 July 2015

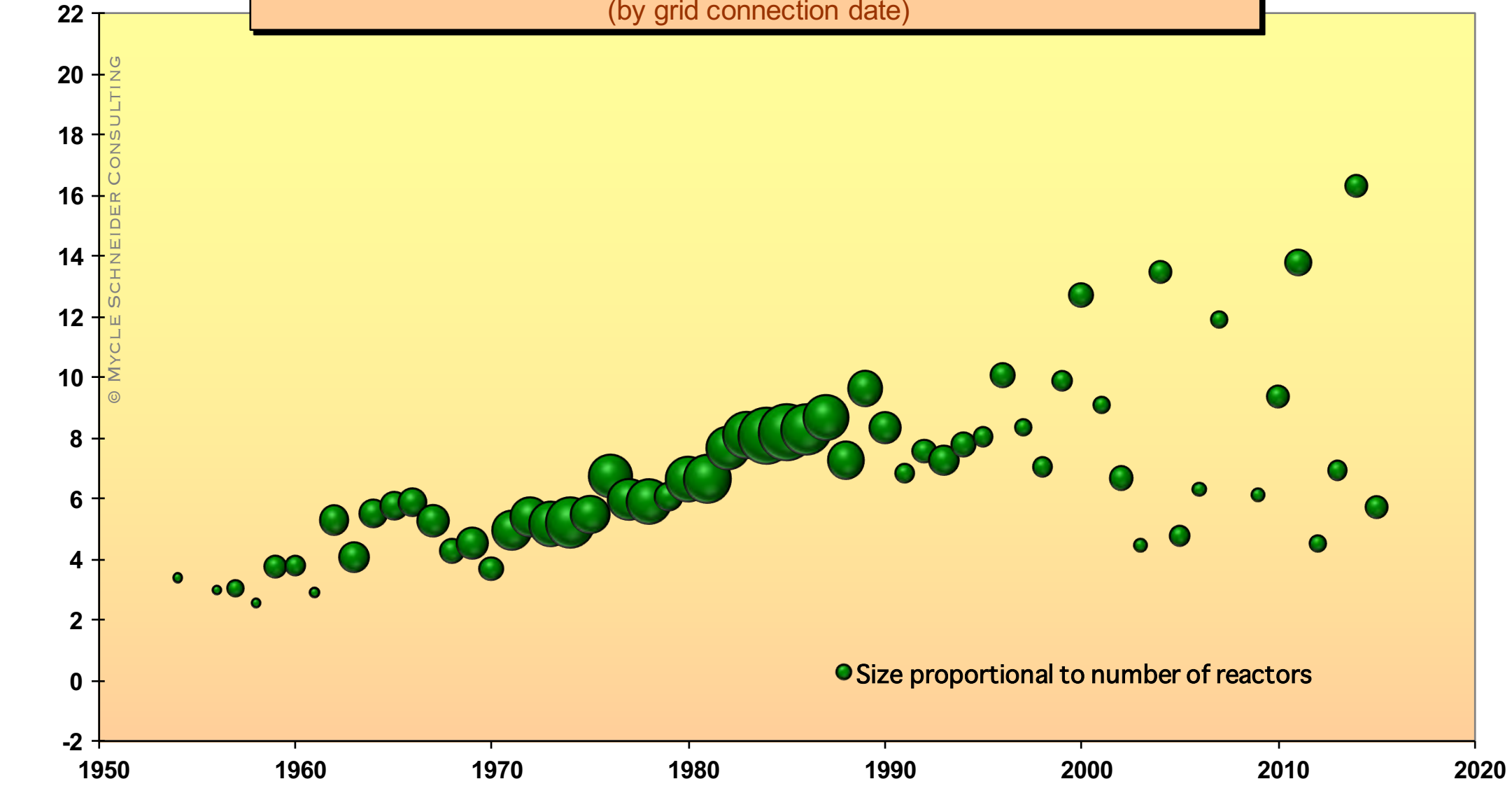


Source: IAEA-PRIS, MSC, 2014


Construction Starts of Nuclear Reactors in the World
by year, 1954 - 1 July 2015
(in Units)
© Mycle Schneider Consulting
Number of Construction Starts per Year
Completed
Under Construction
Including Cancelled
Completed or Under Construction
44
33
15
10
3
2
1
0
50
40
30
20
10
0
1951
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

Average Annual Construction Times in the World 1954-2015

(by grid connection date)



Source: IAEA-PRIS, MSC, 2015

Construction Times (in years)

Startups between 2005 and July 2015

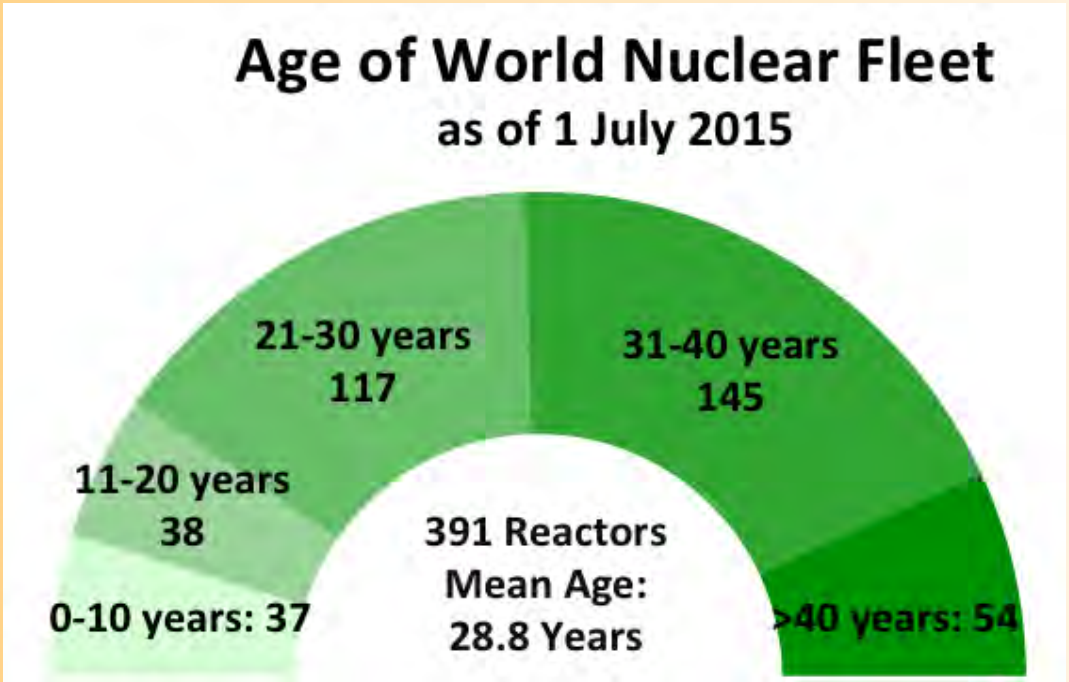
Country	*Units*	*Mean Time*	*Min*	*Max*
China	18	5.7	4.4	11.2
India	7	7.3	5.1	11.6
South Korea	5	4.9	4	6.4
Japan	3	4.6	3.9	5.1
Russia	3	28.0	25.3	31.9
Argentina	1	32.9	32.9	32.9
Iran	1	36.3	36.3	36.3
Pakistan	1	5.3	5.3	5.3
Romania	1	24.1	24.1	24.1
Total	**40**	**9.4**	**3.9**	**36.3**

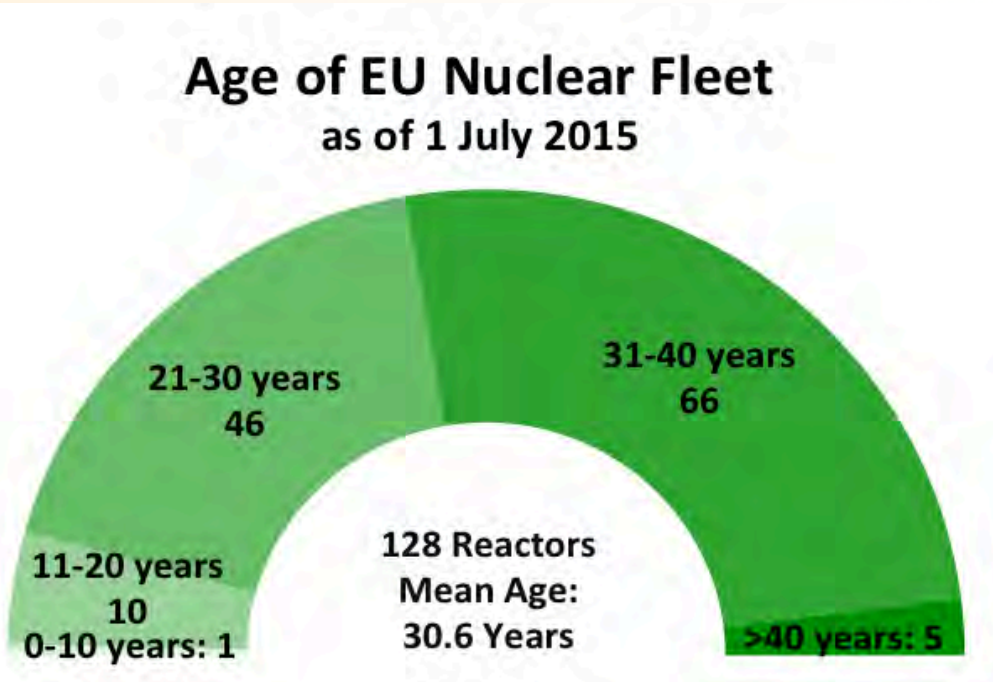
Sources: IAEA-PRIS, MSC, 2015

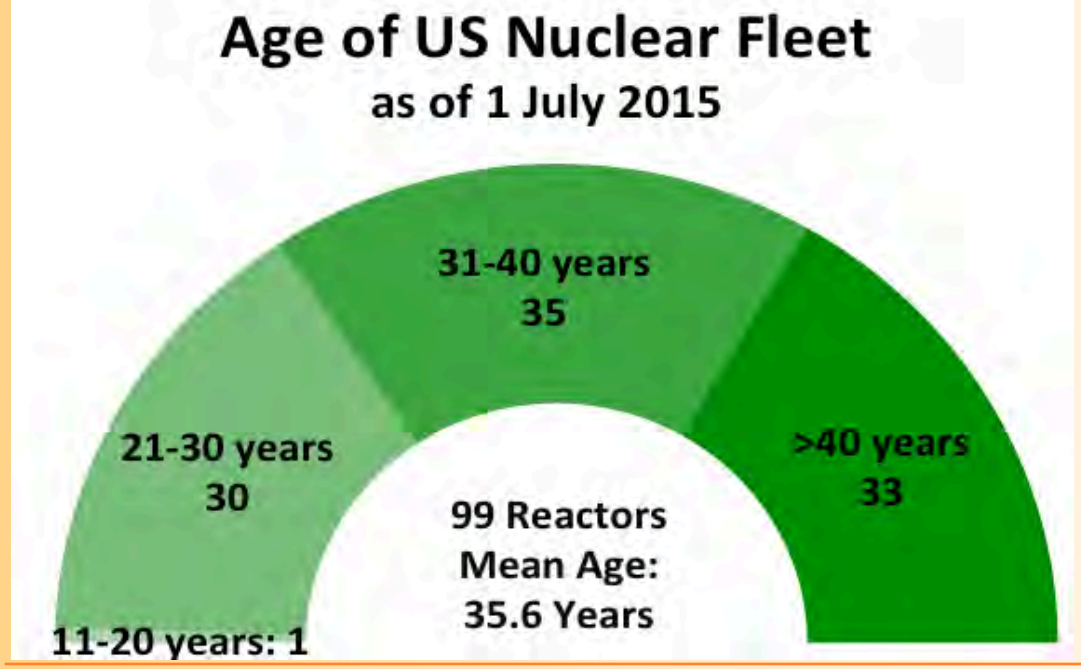
Reactors "Under Construction" in the World (1 July 2015)

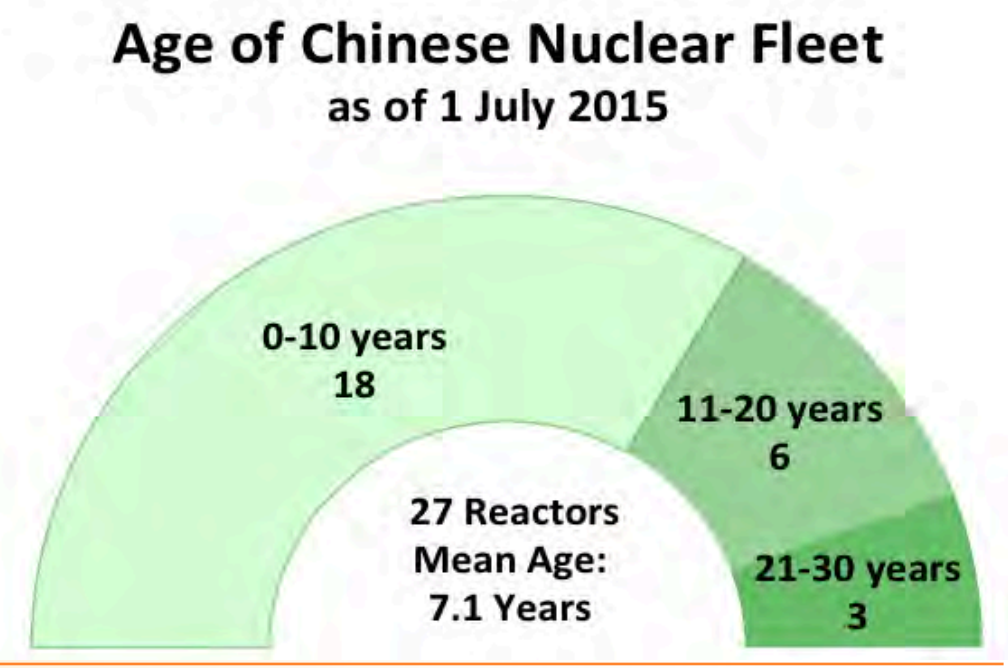
Country	Units	MWe (net)	Construction Start	Planned Grid Connection	Delayed Startup (Units)
China	24	23,738	2009-2015	2015-2021	15
Russia	8	6,262	1983-2010	2015-2019	8
India	6	3,907	2002-2011	2015-2019	6
USA	5	5,633	1972-2013	2016-2020	5
South Korea	4	5,360	2008-2013	2016-2018	4
UAE	3	4,035	2012-2014	2017-2019	?
Belarus	2	2,218	2013-2014	2019-2020	?
Pakistan	2	630	2011	2016-2017	2
Slovakia	2	880	1985	2016-2017	2
Ukraine	2	1,900	1986-1987	2019	2
Argentina	1	25	2014	2018	?
Brazil	1	1,245	2010	2018	1
Finland	1	1,600	2005	2018	1
France	1	1,600	2007	2017	1
Total	**62**	**59,033**	**1972-2015**	**2015-2021**	**47**

Source: IAEA-PRIS, MSC, 2015


Age of World Nuclear Fleet
as of 1 July 2015
21-30 years
117
31-40 years
145
11-20 years
38
391 Reactors
Mean Age:
28.8 Years
0-10 years: 37
>40 years: 54


Age of EU Nuclear Fleet
as of 1 July 2015
21-30 years
46
31-40 years
66
11-20 years
10
0-10 years: 1
128 Reactors
Mean Age:
30.6 Years
>40 years: 5


Age of US Nuclear Fleet
as of 1 July 2015
31-40 years
35
21-30 years
30
>40 years
33
99 Reactors
Mean Age:
35.6 Years
11-20 years: 1


Age of Chinese Nuclear Fleet
as of 1 July 2015
0-10 years
18
11-20 years
6
27 Reactors
Mean Age:
7.1 Years
21-30 years
3

"Is dismantling reactors the future of Westinghouse?"*

Early Closures Accelerate – Recent Cases from the US and Sweden

	Shutdown	Relicensed	Reason	Age
U.S.				
Crystal River-3:	2009	Underway	Containment damage	22
San Onofre-2 and -3:	2012	Yes	Steam gen. damage	28/29
Kewaunee	2013	Yes	Economics	39
Vermont Yankee	2014	Yes	Economics	42
Pilgrim	2017?	Yes	Economics	(45)
Fitzpatrick	2016/17	Yes	Economics	(41/42)
Sweden				
Oskarshamn-1	2015?	Upgraded	Economics	(44)
Oskarshamn-2	2013	Upgrade halted	Economics	39
Ringhals-1	2020	Upgraded	Economics	(46)
Ringhals-2	2019	Upgraded	Economics	(45)

*Sources: Various, compiled by MSC; *bizjournals.com, 2 Nov. 2015*

Gen III+ Reactor Construction Times

- "Passive safety", "modularisation", "standardisation" to reduce delays/costs…
- No Gen III+ design in operation
- 3 designs with 18 reactors under construction:
  - 4 EPRs (AREVA)
  - 8 AP1000s (Toshiba/Westinghouse)
  - 6 AES-2006s (Rosatom)—Little reliable information.
- **EPR** — Cost estimates now 3 x over budget for EPR
  - site quality (welding, concrete) major causes of delay
  - Instrumentation & Control serious regulatory concern
  - Flamanville and Taishan (China) may be scrapped if manufacturing errors for pressure vessel lid & bottom are too serious.
- **AP1000**
  - Construction experience from 2009 in China and 2013 in USA: Longer delays in China than for EPRs and US units as European EPRs
  - Module production facilities: Coolant pumps caused serious problems in China.

Gen III+ Reactor Construction — Key Findings

- No evidence new designs cheaper than predecessors. Fukushima lessons mean costs likely to continue to increase.
- Claim that design could be simplified were an illusion. EPR based on old design with *added* safety so could hardly be simpler. AP1000 more modern but high cost and delays suggest no reduction in complexity.
- Modularisation moved quality problems from site to factory.
- Standardisation for 40 years with no success. Technology still not mature, ordering rates too low, national regulators' requirements differ. Generic design approval impossible without standardisation.

Hinkley Point C: EDF's Waterloo in the Making?

Investment bank Investec has advised clients to sell shares in French energy group EDF amid fears that its connection with the nuclear plant at Hinkley Point C could put payouts to shareholders under threat. The nuclear development was trumpeted last week as the Chinese government confirmed plans to invest £6billion in EDF's scheme to build the power station in Somerset.

This is Money, 25 October 2015

French Nuclear Companies in Trouble

EDF — World's Largest Nuclear Power Operator

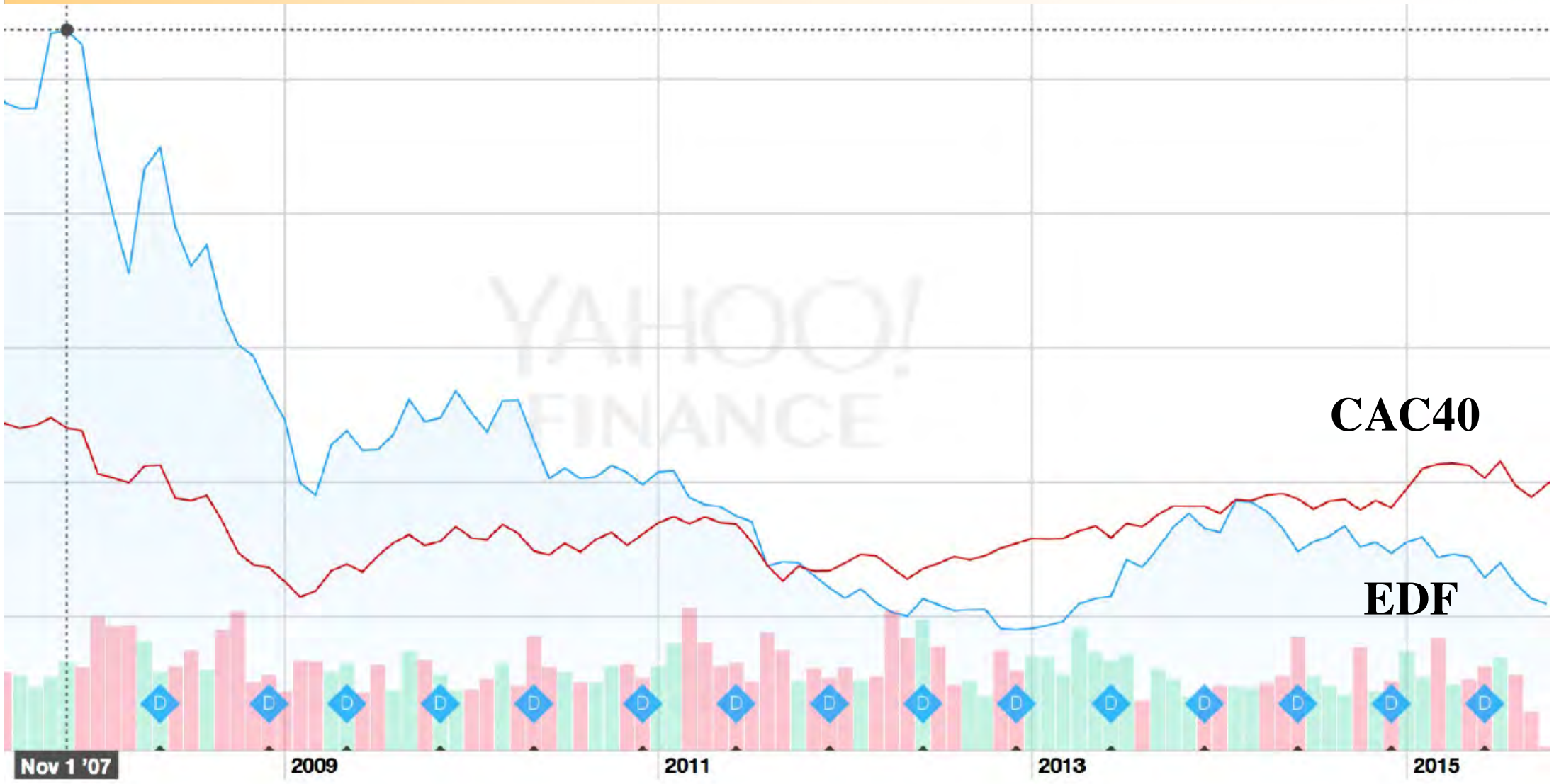
- 4.5%/a operating cost increase 2007-2012
  - → Loss of €1.5 billion in 2012
  - → Need for significant tariff increases
- Stock value plunged ≈80% (up to 85%) since 2007
- High debt €34.2bn (€37.5bn 1st half year 2015) for turnover of €73bn

AREVA — "Global Leader in Nuclear Energy"

- Technically bankrupt
- Loss of €4.8bn (almost €8bn in 4 years = annual turnover)
- High debt €5.8bn (€6bn 1st half year 2015) for turnover of €8.3bn
- Stock value plunged by >90% since 2007
- Standard & Poor's downgraded AREVA shares to BB+ ("junk") in November 2014 and again to BB- in March 2015

Sources: Company websites; Standard & Poor's

Stock Price Development EDF vs. CAC40

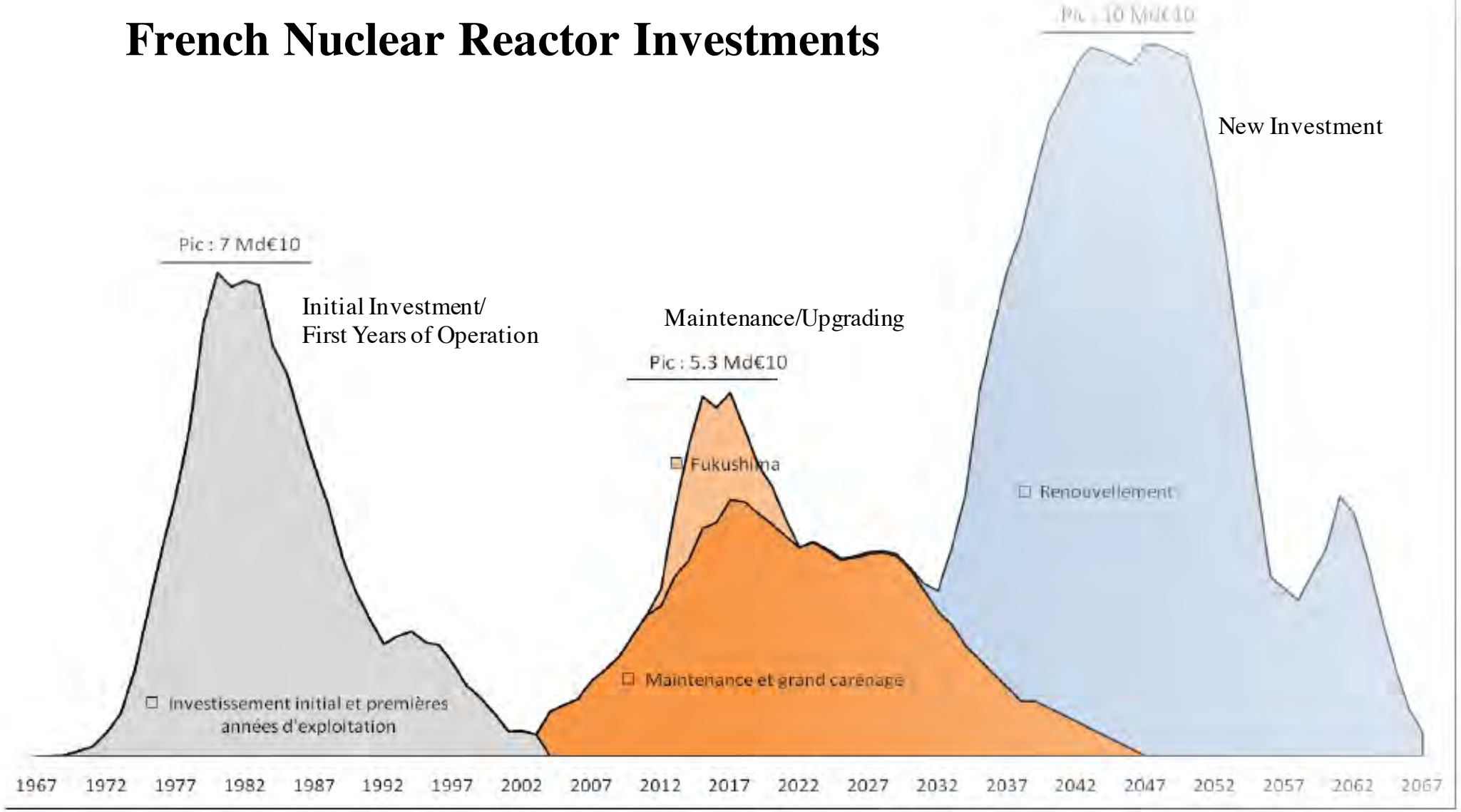


Source: http://finance.yahoo.com, 4 November 2015

Stock Price Development AREVA vs. CAC40

Source: Le Figaro – Bourse, 4 November 2015

French Nuclear Reactor Investments



Traditional Utilities Under Pressure

The 20 largest European energy utilities lost over half of the €1 trillion stock market value since 2008, some a lot more.

Europe's electricity providers face an existential threat.

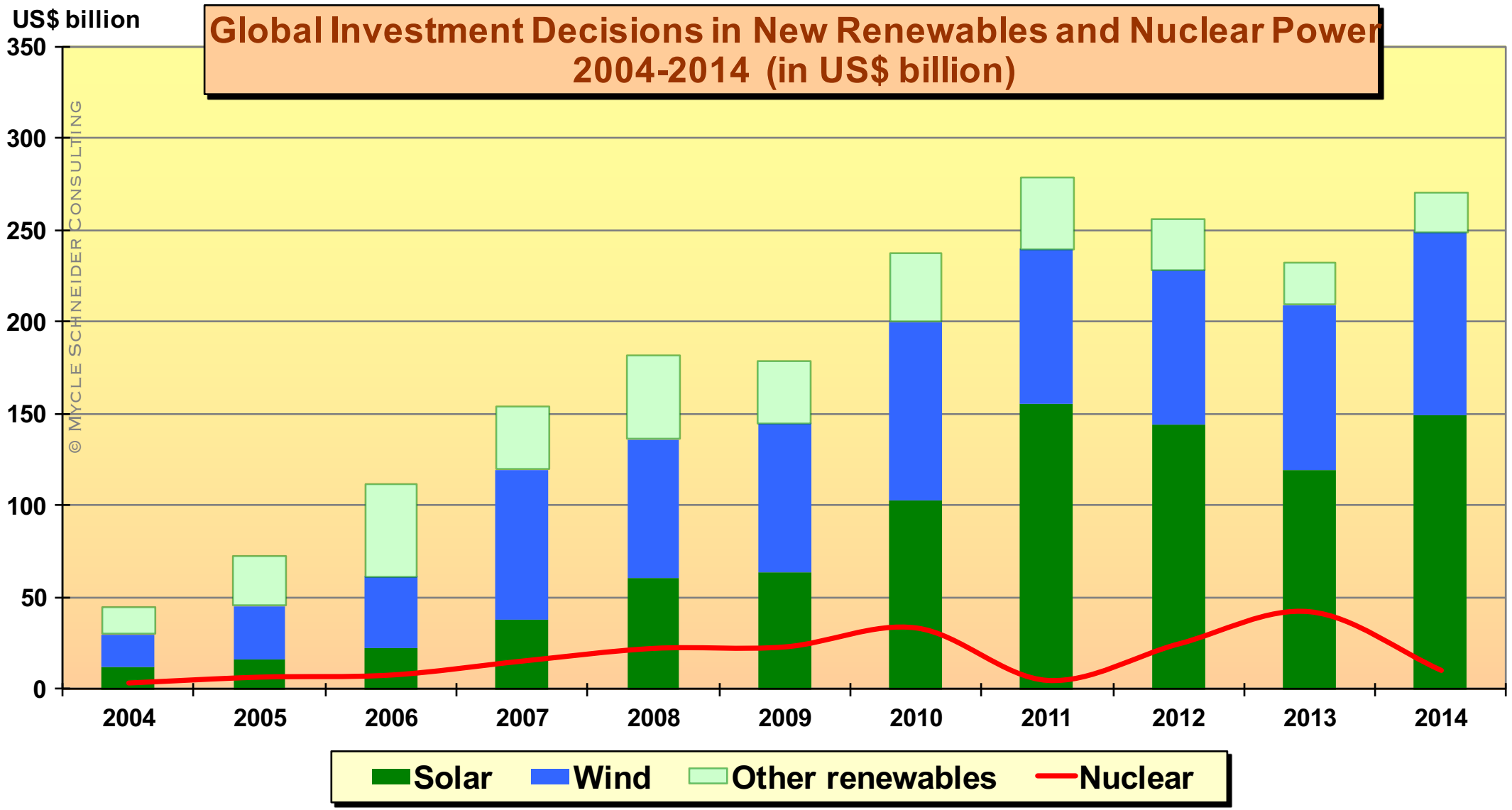
The Economist, London, October 2013

Utility business models are threatened by the dramatic growth in the deployment of technologies that generate electricity onsite or at the distribution grid level.

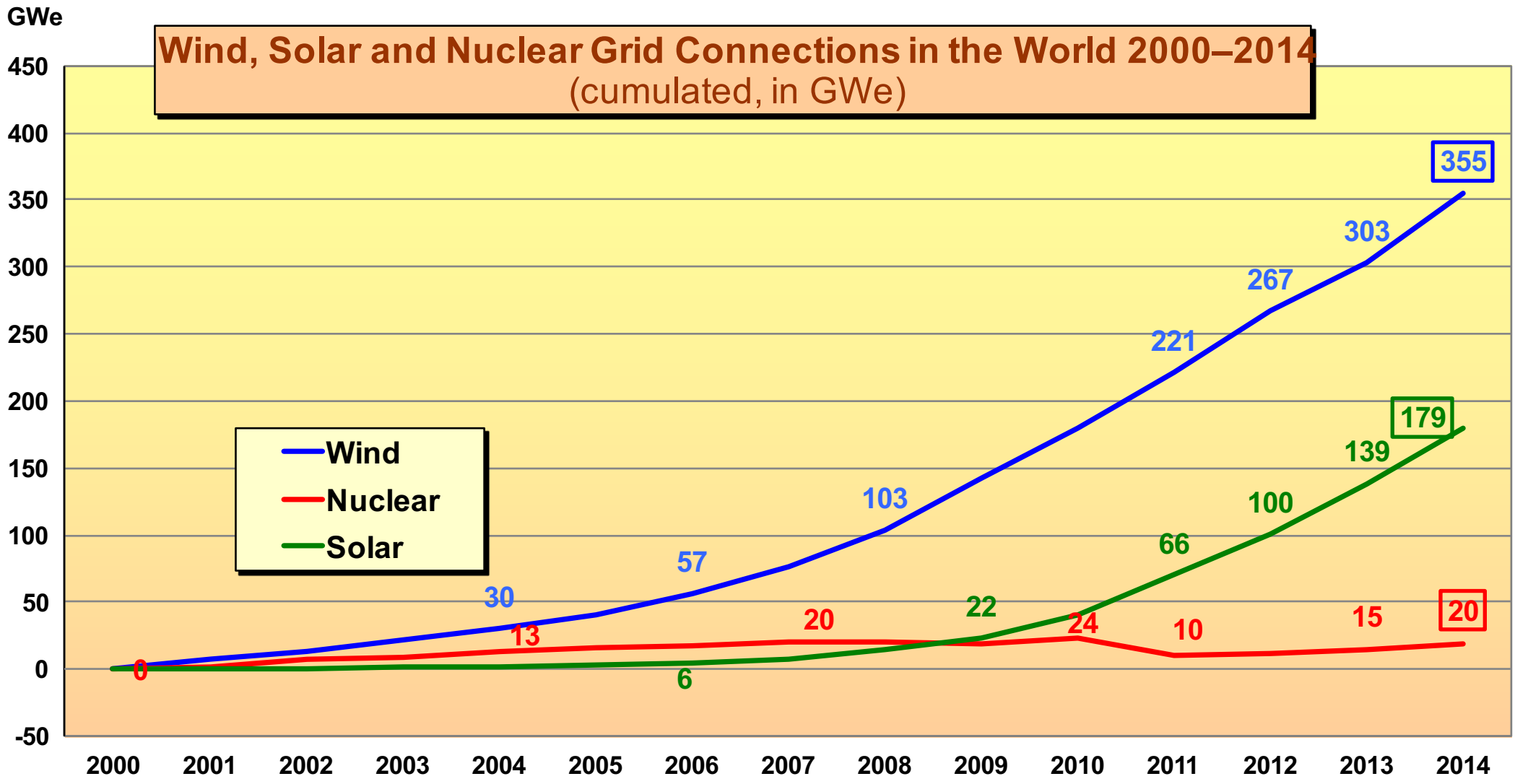
Navigant Research, Boulder, USA, August 2014

A new technological paradigm in electricity and the end of the reign of the large-scale utilities.

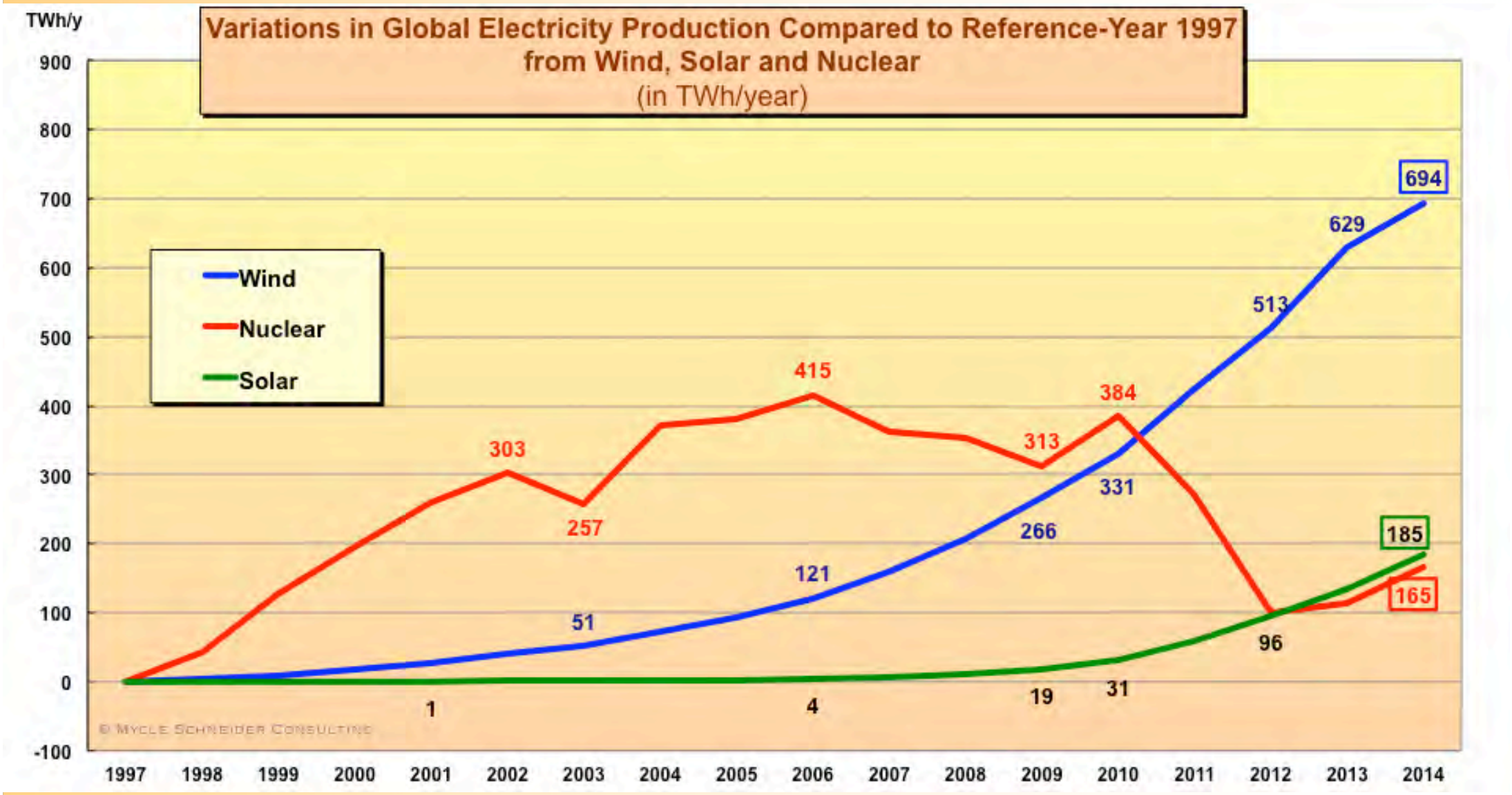
Institute for Public Policy Research, London, September 2014



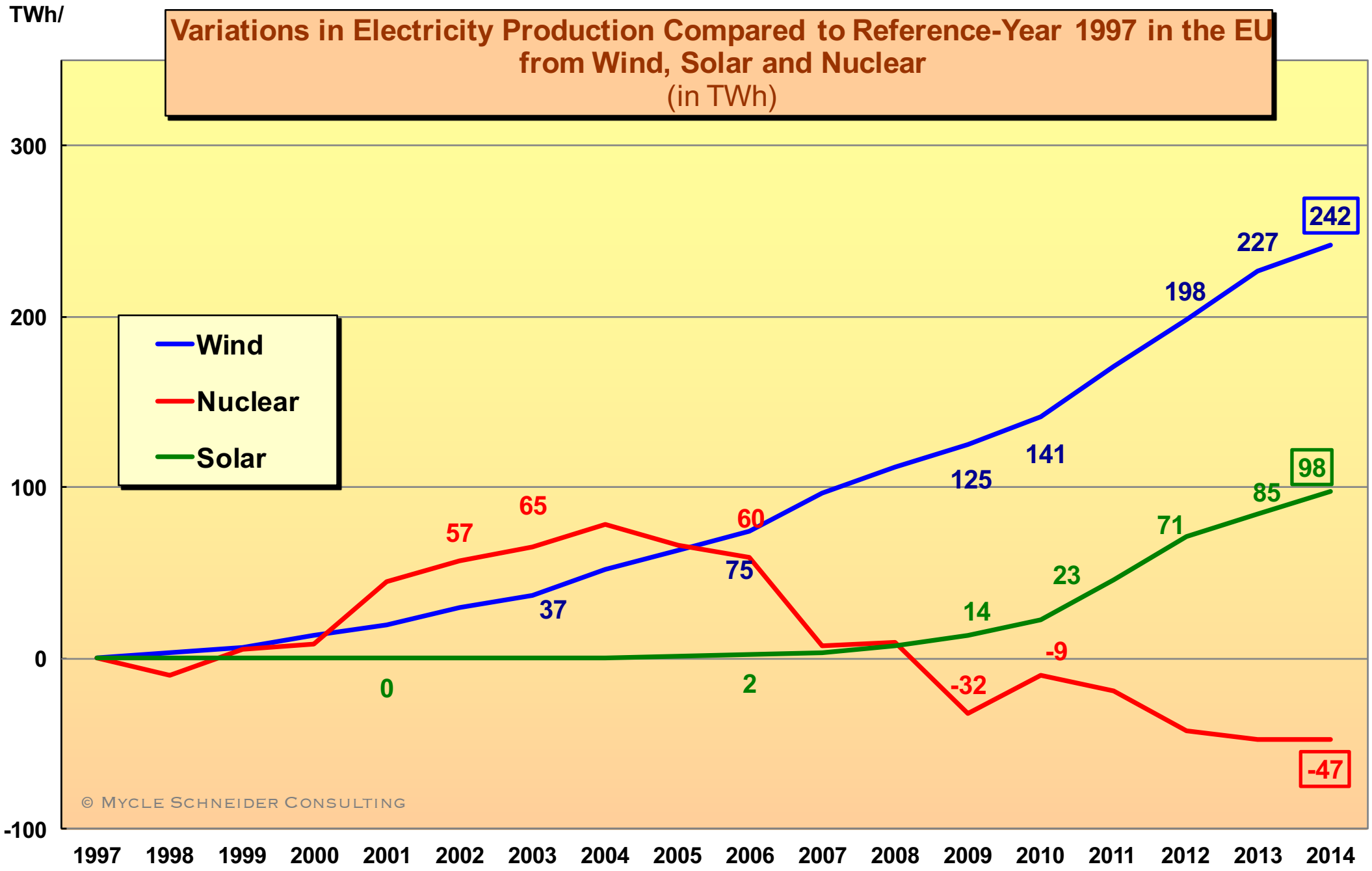
Source: FS-UNEP – BNEF 2015 and WNISR original research



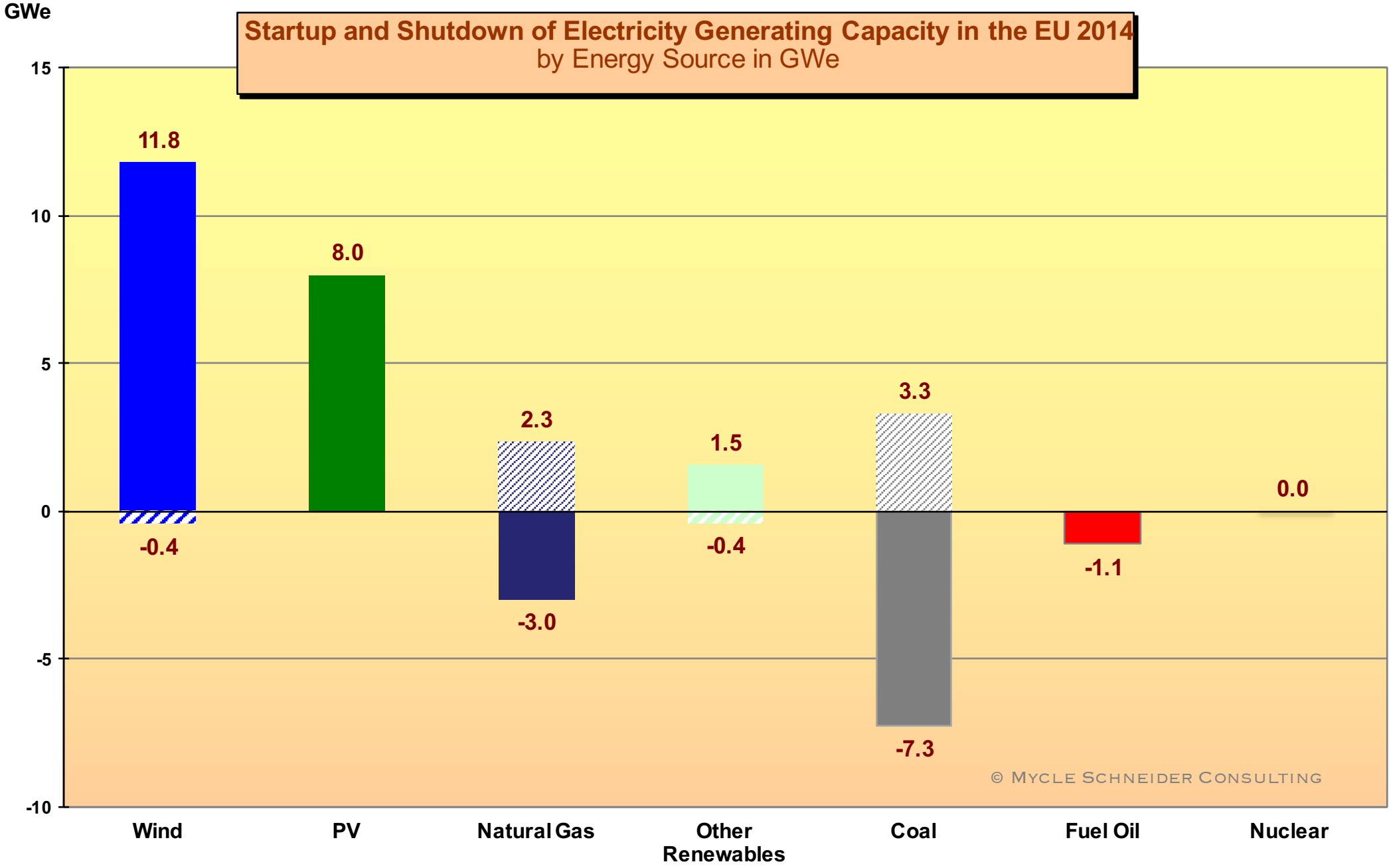
Source: WNISR, BP Statistical Review 2015



Sources: BP, IAEA-PRIS, MSC, 2015

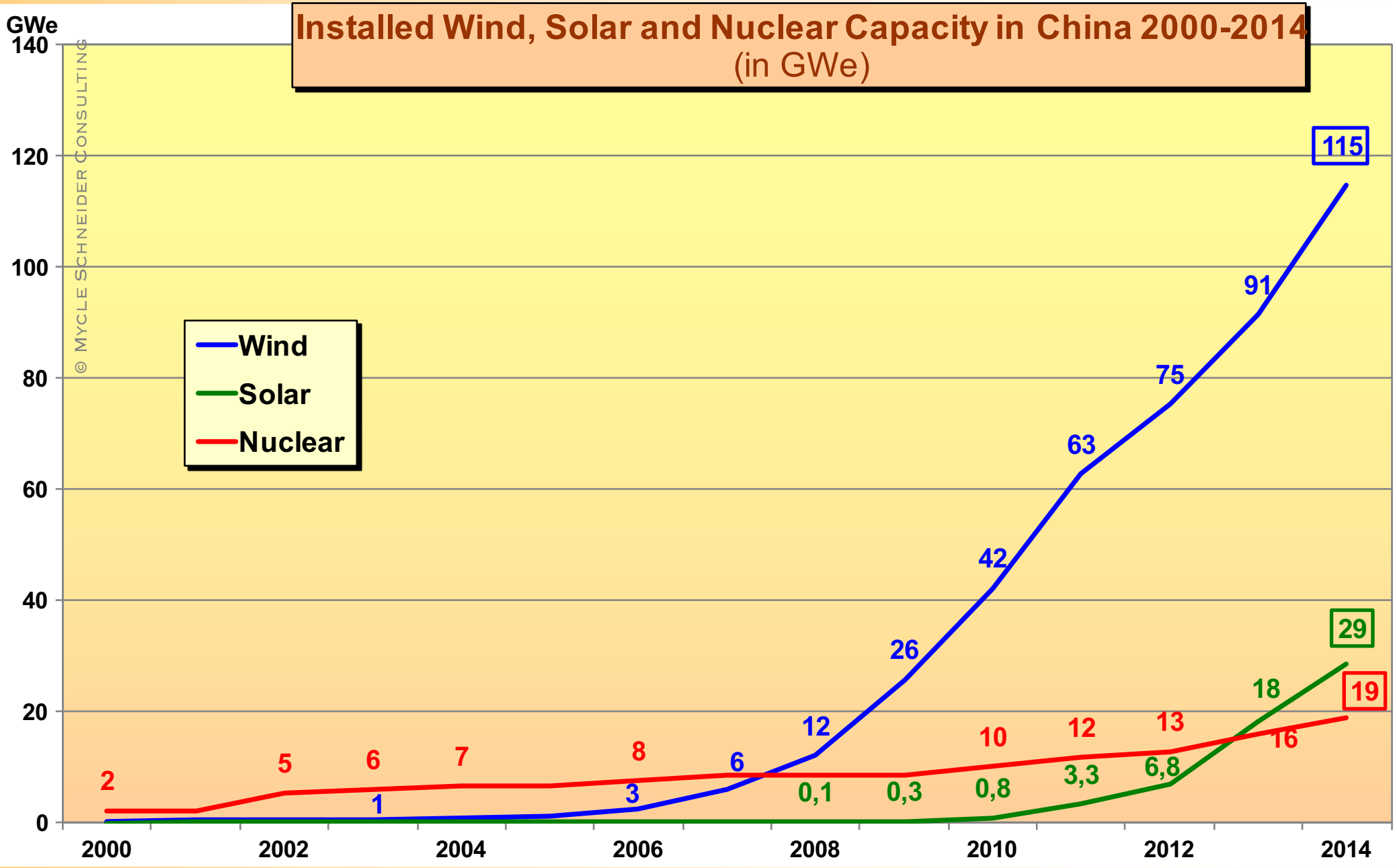


Source: IAEA-PRIS, BP, MSC 2015

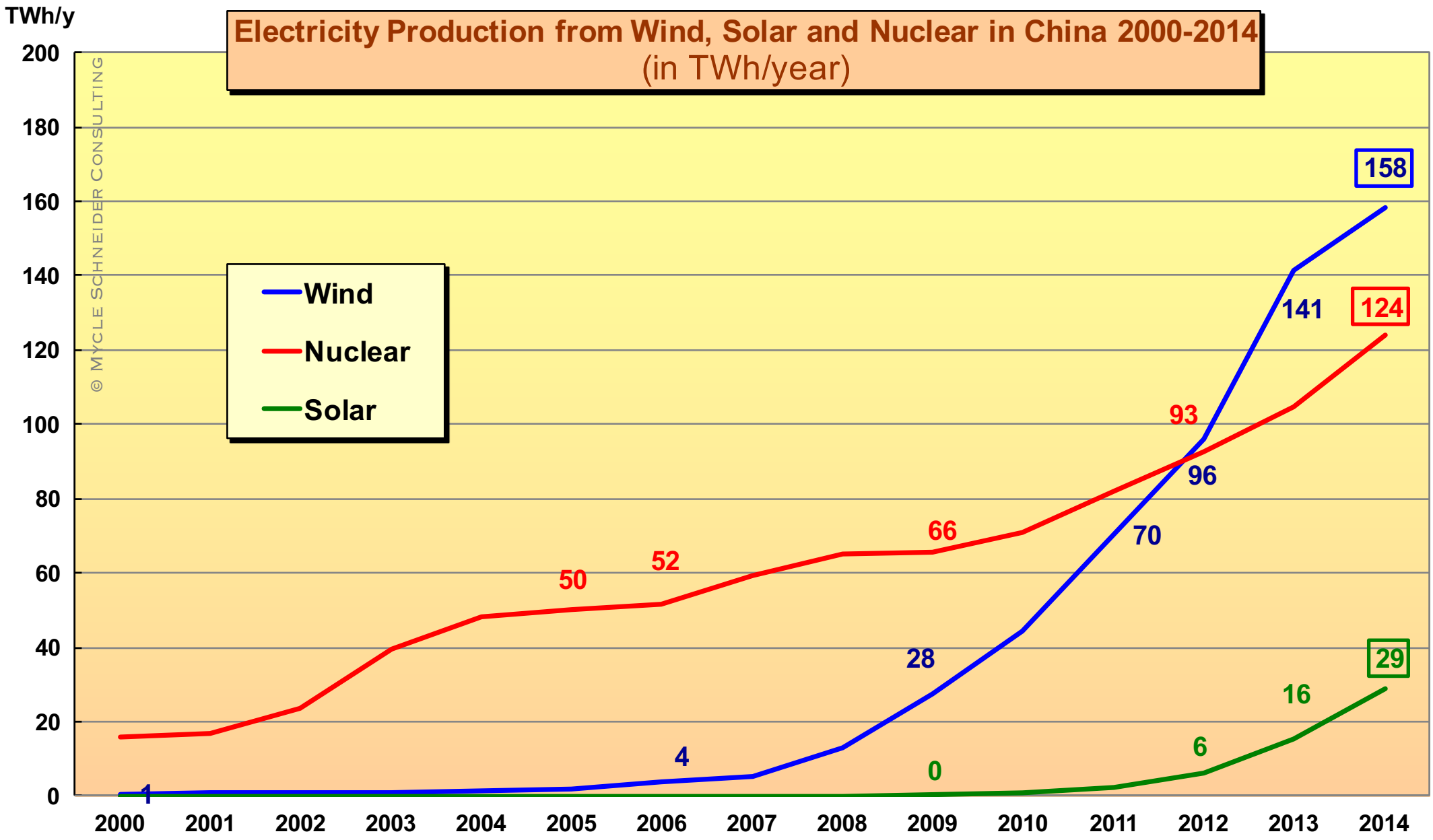


Source: EWEA 2015

Installed Wind, Solar and Nuclear Capacity in China 2000-2014
(in GWe)

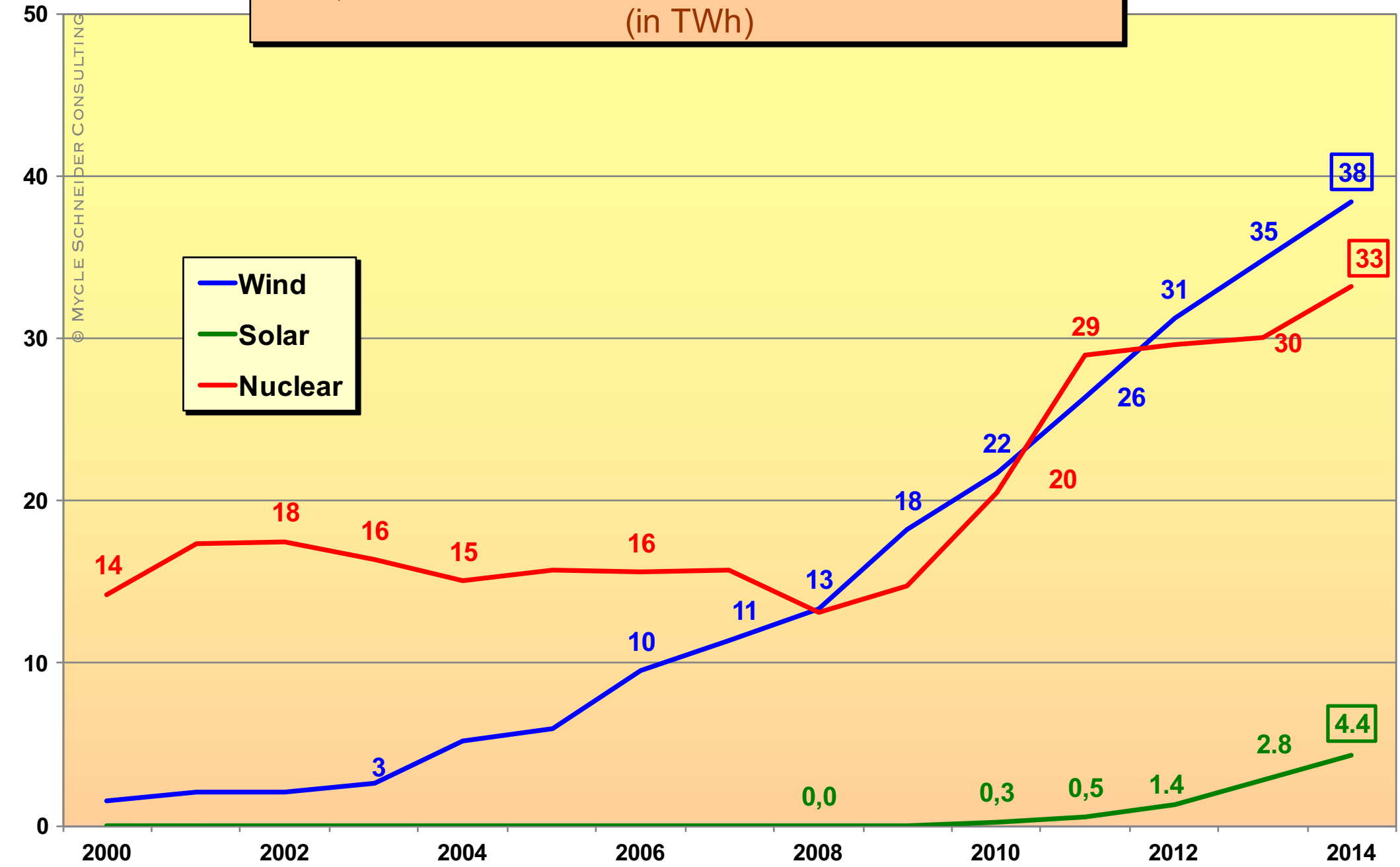


Source: EPIC, IAEA-PRIS, GWEC 2015



Source: BP 2015, IAEA-PRIS 2015

Wind, Solar and Nuclear Production in India 2000-2014
(in TWh)



Abschließende Bemerkungen

• Die meisten Indikatoren zeigen, dass die Rolle der Atomkraft auf den weltweiten Energiemärkten schrumpft. Alle Höchstwerte, ob bei Anzahl und Leistung der Reaktoren, Stromproduktion oder neue Baustellen, wurden bereits vor vielen Jahren erreicht.

• Die Position der Atomkraft auf dem Strommarkt gerät zunehmend unter Druck, bei steigendenden Produktionskosten und harter Konkurrenz durch die Erneuerbaren sinkt der Kundenstamm und sein Stromverbrauch,

• Atomunternehmen und Energieversorgungsunternehmen leiden unter hohen Schulten, schwindenden Gewinnmargen und sinkenden Großhandelspreisen.

Quotes on the WNISR

• Steve Kidd, former head of strategy of the World Nuclear Association (WNA): “Hence well-researched and articulate critiques against the concept of any nuclear growth (and notably of nuclear playing a substantial role in mitigating climate change) such as the annual World Nuclear Industry Status Report, are becoming increasingly difficult to ignore.” (NIW, 17 July 2015)

• In its latest update for Members the WNA reported that its Fuel Report Working Group "discussed the merits of producing an annual nuclear capacity scenario update. Such an update would be a useful communications tool and a counter to the industry-critical World Nuclear Industry Status Report".

Thank You!

Contact: mycle@orange.fr

www.WorldNuclearReport.org - online now!