Dr. Sven Teske

THE MARKET HAS ALREADY DECIDED:
WHY WE ARE HEADING TOWARDS 100% RENEWABLES

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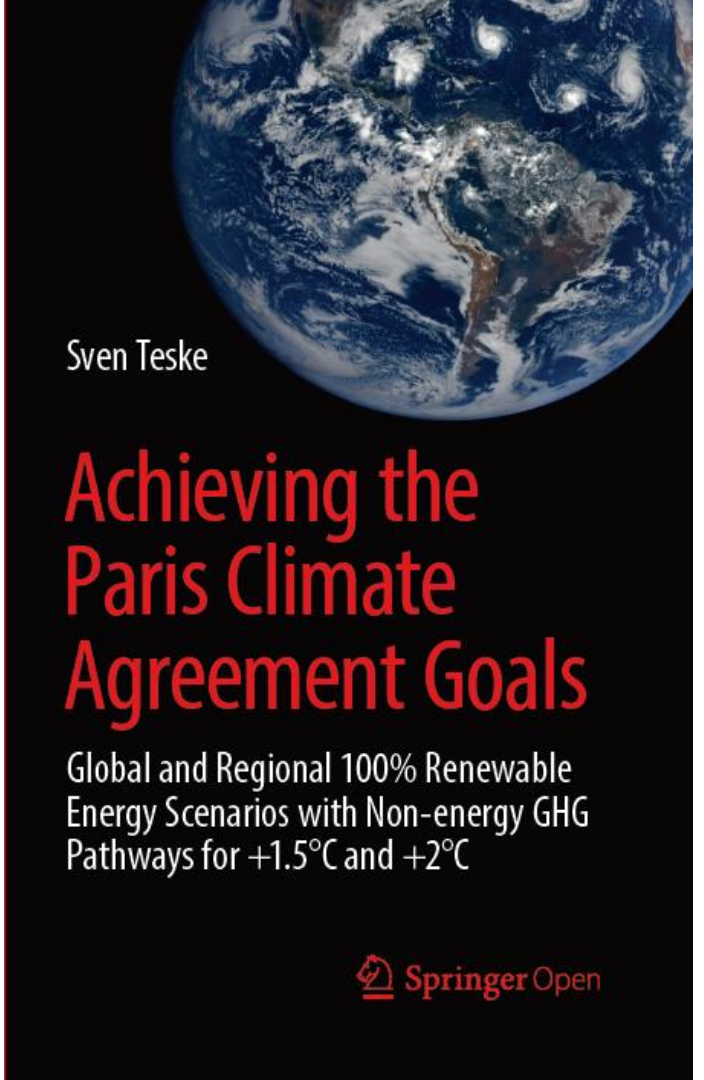


Global Energy Status

FIGURE 1. Estimated Renewable Share of Total Final Energy Consumption, 2018

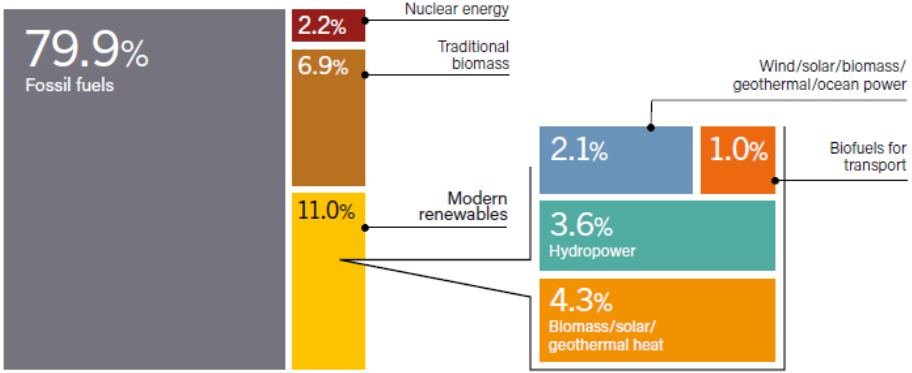
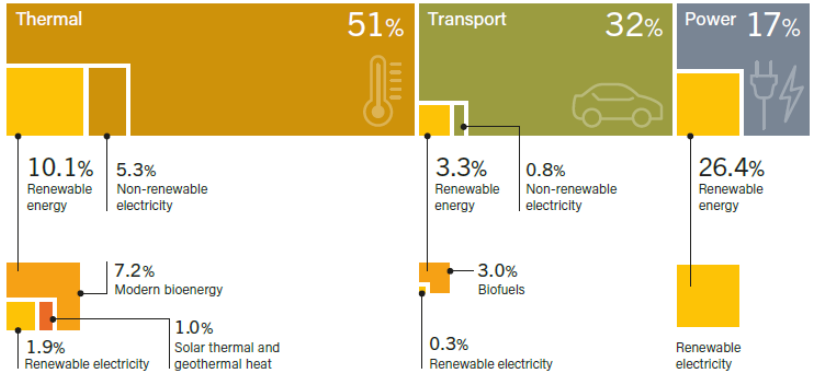


FIGURE 3. Renewable Share of Total Final Energy Consumption, by Final Energy Use, 2017



Global Trends in the Power Sector

- New Power Generation Capacity mainly solar PV and Wind as most economic
- High shares of variable power generation = the end of base load power plants
- Digitalisation of electricity:
  - Decentralised generation and Storage
  - Consumer turn into Prosumer
- Sector-Coupling:
  - Increased electrification in transport and heating sector

Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital

A key consideration in determining the LCOE values for utility-scale generation technologies is the cost, and availability, of capital(1); this dynamic is particularly significant for renewable energy generation technologies

Source: Lazard estimates.

Note: Analysis assumes 60% debt and 40% equity. Unless otherwise noted, the assumptions used in this sensitivity correspond to those used in the global, unsubsidized analysis as presented on the page titled "Levelized Cost of Energy Comparison—Unsubsidized Analysis".

(1) Cost of capital as used herein indicates the cost of capital applicable to the asset/plant and not the cost of capital of a particular investor/owner.

(2) Reflects the average of the high and low LCOE for each respective cost of capital assumption.

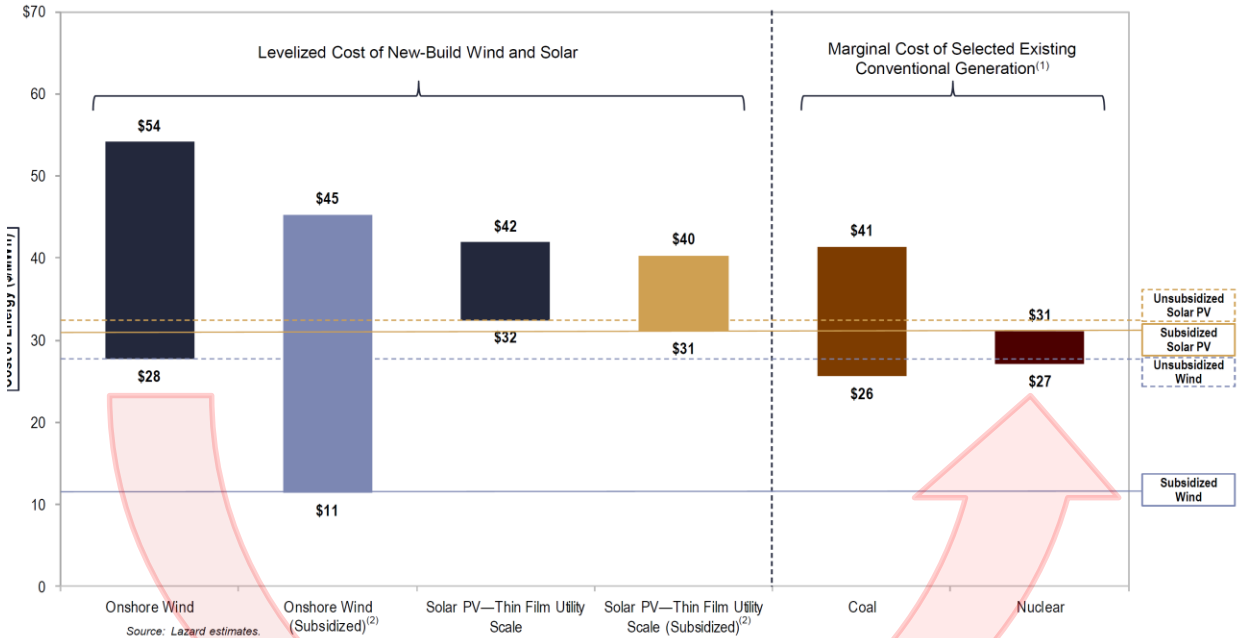
LCOE difference
Nuclear
versus
Solar / Wind

Factor 3

Global Trends in the Power Sector

Levelized Cost of Energy Comparison—Renewable Energy versus Marginal Cost of Selected Existing Conventional Generation

Certain renewable energy generation technologies are approaching an LCOE that is competitive with the marginal cost of existing conventional generation



Source: Lazard estimates.

Note: Unless otherwise noted, the assumptions used in this sensitivity correspond to those used in the global, unsubsidized analysis as presented on the page titled "Levelized Cost of Energy Comparison—Unsubsidized Analysis".

(1) Represents the marginal cost of operating coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to its decommissioning and site restoration costs. Inputs are derived from a benchmark of operating coal and nuclear assets across the U.S. Capacity factors, fuel and variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research.

(2) The subsidized analysis includes sensitivities related to the TCJA and U.S. federal tax subsidies. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies" for additional details.

LAZARD

NEW BUILD
Unsubsidized
Utility scale
Onshore wind & PV

Reach marginal cost of

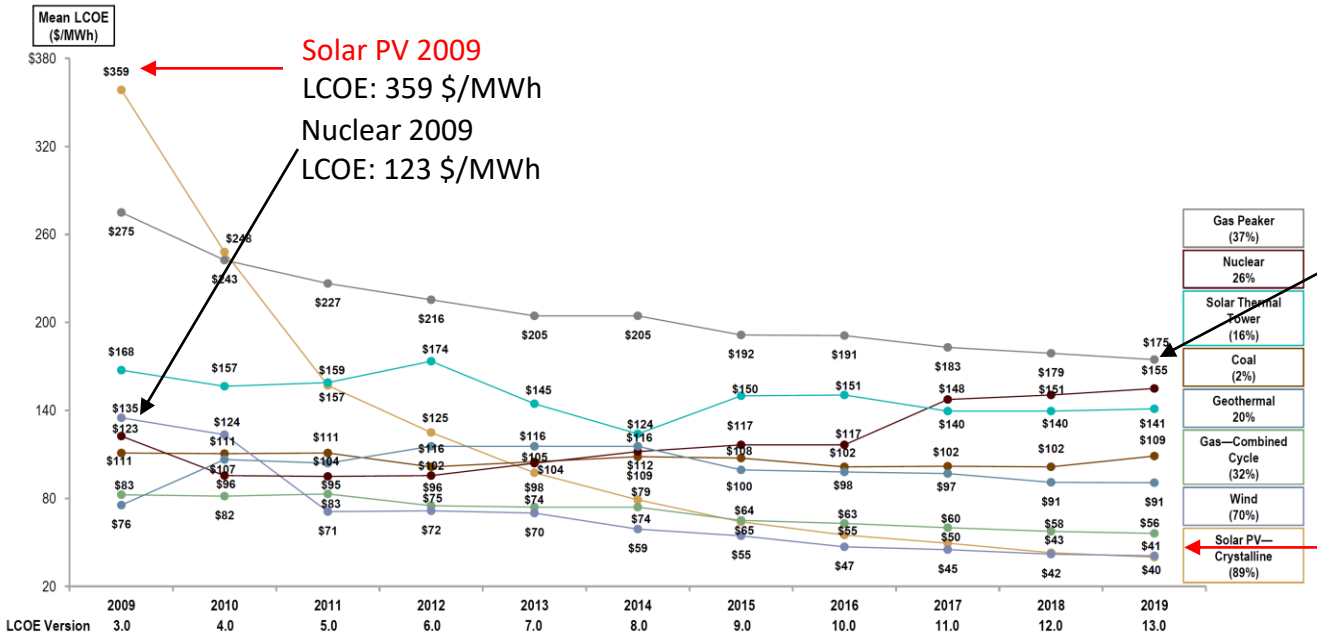
EXISTING

Coal + Nuclear Power Plants in the USA

Levelized Cost of Energy Comparison—Historical Utility-Scale Generation Comparison

Lazard's unsubsidized LCOE analysis indicates significant historical cost declines for utility-scale renewable energy generation technologies driven by, among other factors, decreasing capital costs, improving technologies and increased competition

Selected Historical Mean Unsubsidized LCOE Values(1)



Solar PV 2009
LCOE: 359 $/MWh

Nuclear 2009
LCOE: 123 $/MWh

Nuclear 2019
LCOE: 155 $/MWh

Solar PV 2019
LCOE: 40 $/MWh

LAZARD
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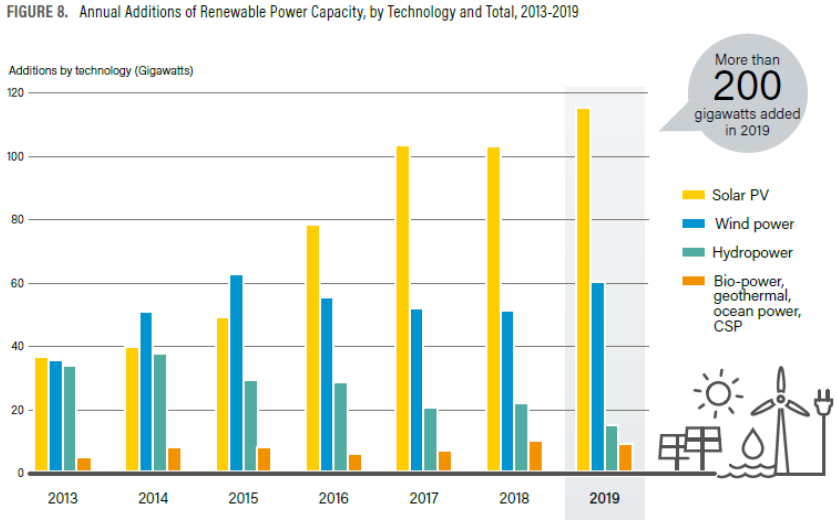
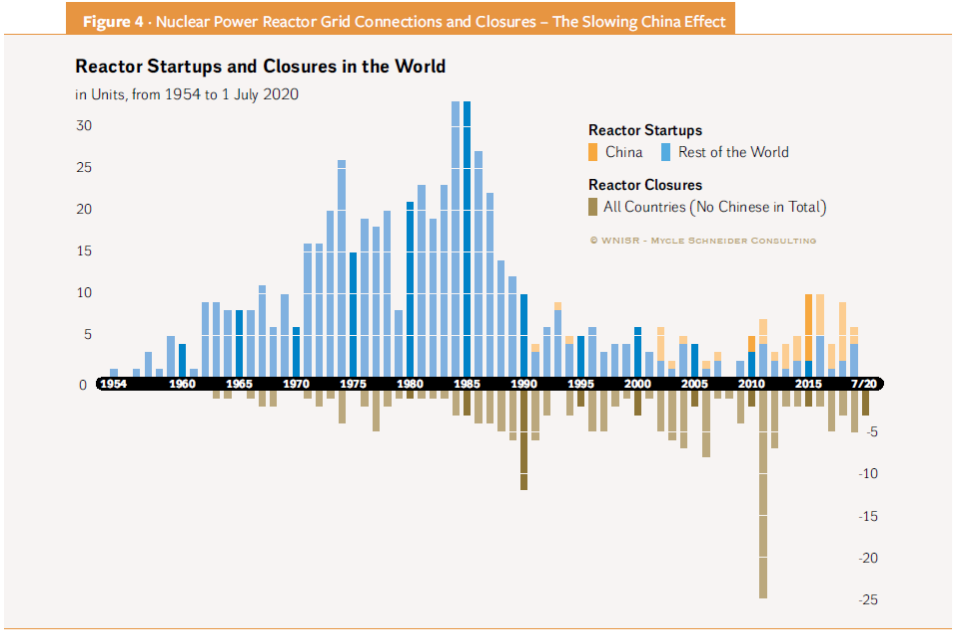
Source: Lazard estimates.
(1) Reflects the average of the high and low LCOE for each respective technology in each respective year. Percentages represent the total decrease in the average LCOE since Lazard's LCOE—Version 3.0.

Global Trends in the Energy Sector





Sources: WNISR, with IAEA-PRIS, 2020

2019: Solar + 115 GW
Wind + 60 GW

= + 175 GW

Nuclear : New capacities cannot replace closures

Global Trends in the Power Sector

Additional capacity

Table 1. Renewable Energy Indicators 2019

		2018	2019
INVESTMENT			
New investment (annual) in renewable power and fuels[1]	billion USD	296.0	**301.7**
POWER			
Renewable power capacity (including hydropower)	GW	2,387	**2,588**
Renewable power capacity (not including hydropower)	GW	1,252	**1,437**
Hydropower capacity[2]	GW	1,135	**1,150**
Wind power capacity	GW	591	**651**
Solar PV capacity[3]	GW	512	**627**
Bio-power capacity	GW	131	**139**
Geothermal power capacity	GW	13.2	**13.9**
Concentrating solar thermal power (CSP) capacity	GW	5.6	**6.2**
Ocean power capacity	GW	0.5	**0.5**

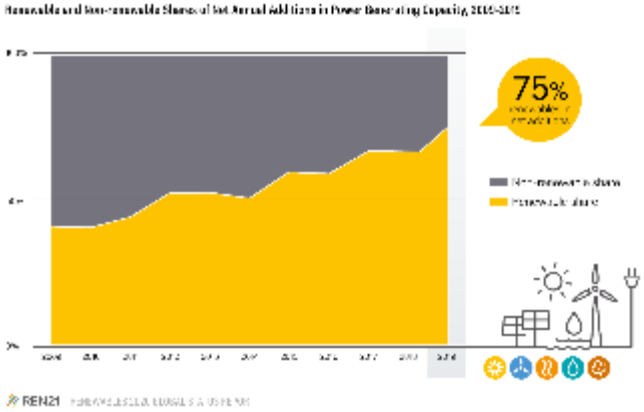
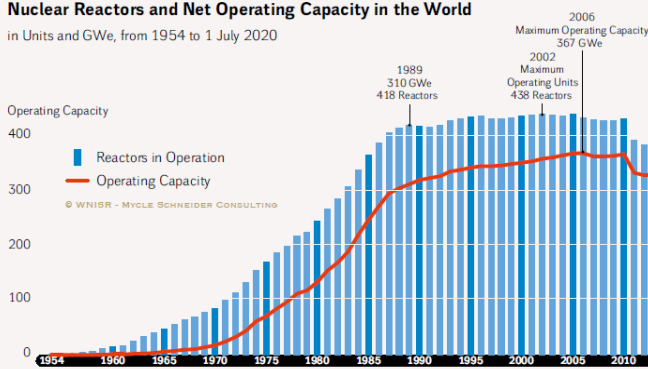


Figure 5 · World Nuclear Reactor Fleet, 1954–2020

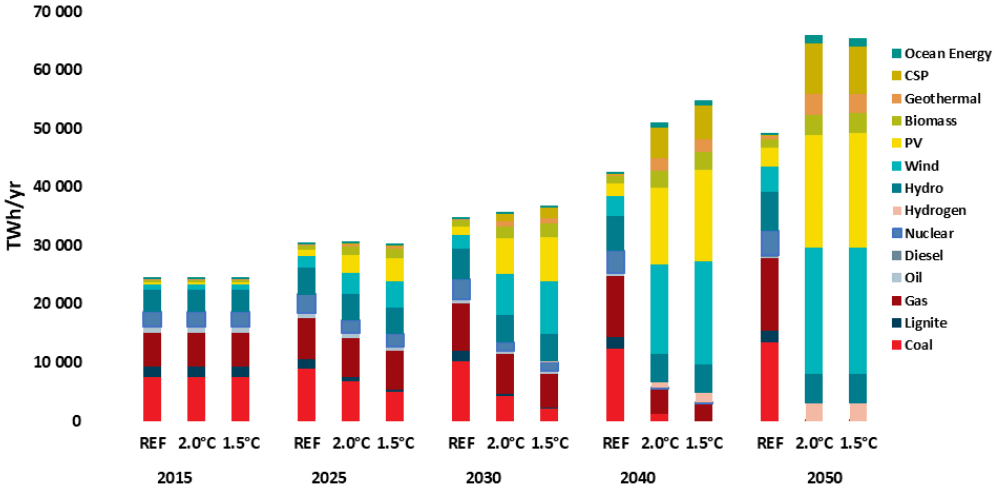


Sources: WNISR, with IAEA-PRIS, 2020

Note:
Changes in the database regarding closing dates of reactors or LTO status slightly change the shape of this graph from previouus editions. In particular the previous "maximum operating capacity" of 2006 (overtaken in July 2019) is now at 367 GW.

Key Results – Global and Regional Long-term Energy Pathways

Global: Electricity Generation and Capacity:



in GW		2015	2025	2030	2040	2050
Hydro	5.0°C	1 202	1 420	1 558	1 757	1 951
	2.0°C	1 202	1 386	1 416	1 473	1 525
	1.5°C	1 202	1 385	1 415	1 471	1 523
Biomass	5.0°C	112	165	195	235	290
	2.0°C	112	301	436	617	770
	1.5°C	112	350	498	656	798
Wind	5.0°C	413	880	1 069	1 395	1 790
	2.0°C	413	1 582	2 901	5 809	7 851
	1.5°C	413	1 912	3 673	6 645	7 753
Geothermal	5.0°C	14	20	26	41	62
	2.0°C	14	49	125	348	557
	1.5°C	14	53	147	356	525
PV	5.0°C	225	785	1 031	1 422	2 017
	2.0°C	225	2 194	4 158	8 343	12 306
	1.5°C	225	2 829	5 133	10 017	12 684
CSP	5.0°C	4	13	20	39	64
	2.0°C	4	69	361	1 346	2 062
	1.5°C	4	92	474	1 540	1 990
Ocean	5.0°C	0	1	3	9	22
	2.0°C	0	22	82	307	512
	1.5°C	0	22	80	295	450
Total	5.0°C	1 971	3 285	3 902	4 899	6 195
	2.0°C	1 971	5 604	9 478	18 243	25 583
	1.5°C	1 971	6 644	11 420	20 980	25 723

Thank you

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Achieving the Paris Climate Agreement Goals

Global and Regional 100% Renewable Energy Scenarios with Non-energy GHG Pathways for +1.5°C and +2°C

Editors: **Teske**, Sven (Ed.)

UTS Institute for Sustainable Futures

Presents robustly modeled scenarios to achieve 100% renewable energy by 2050