Levelized Cost of Energy 2017

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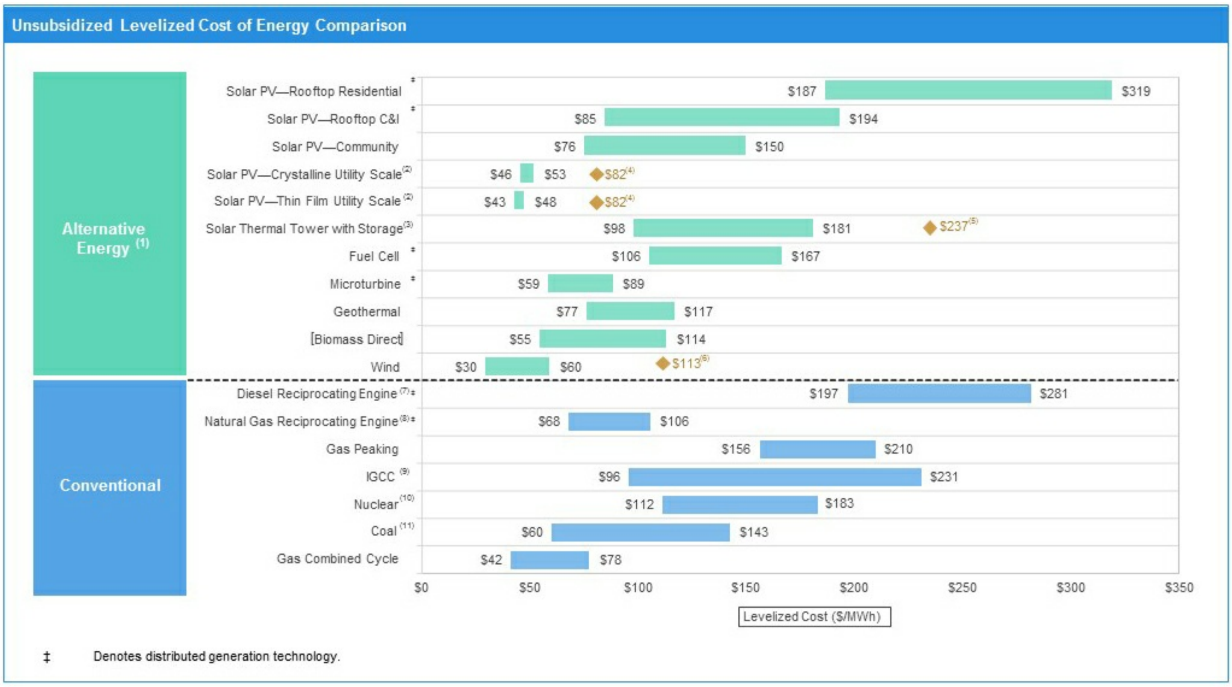
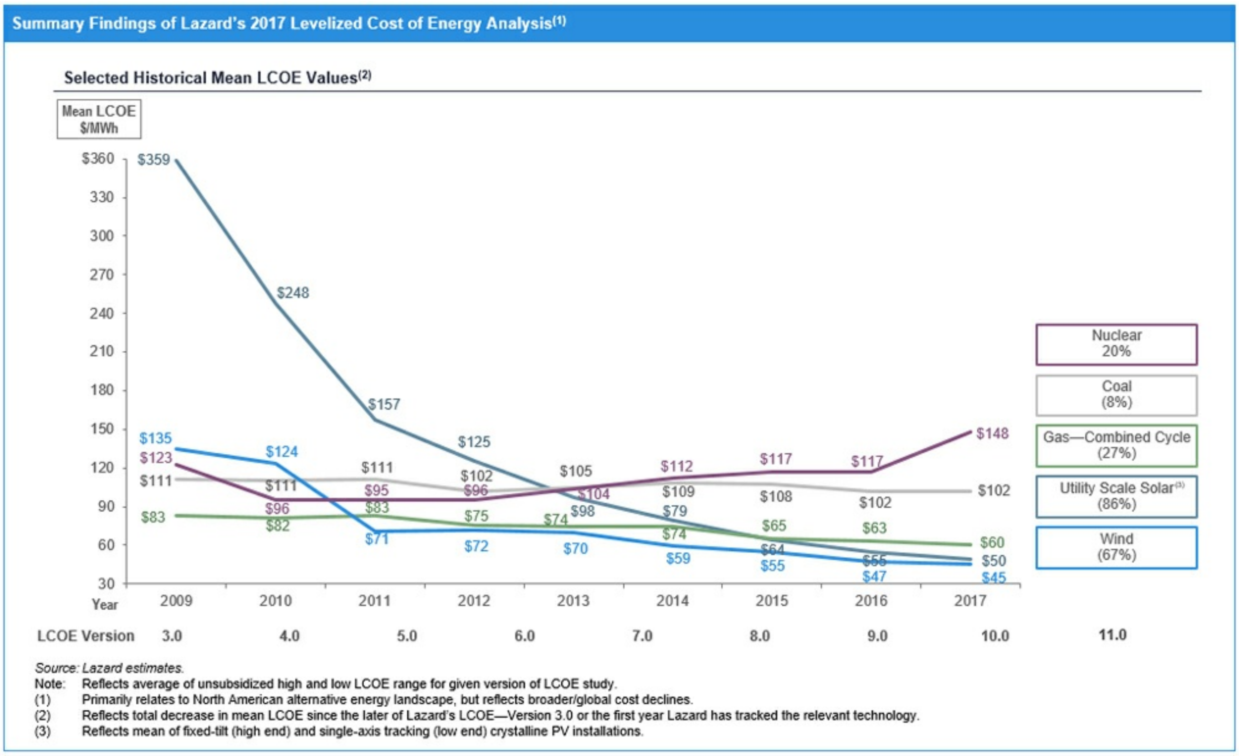
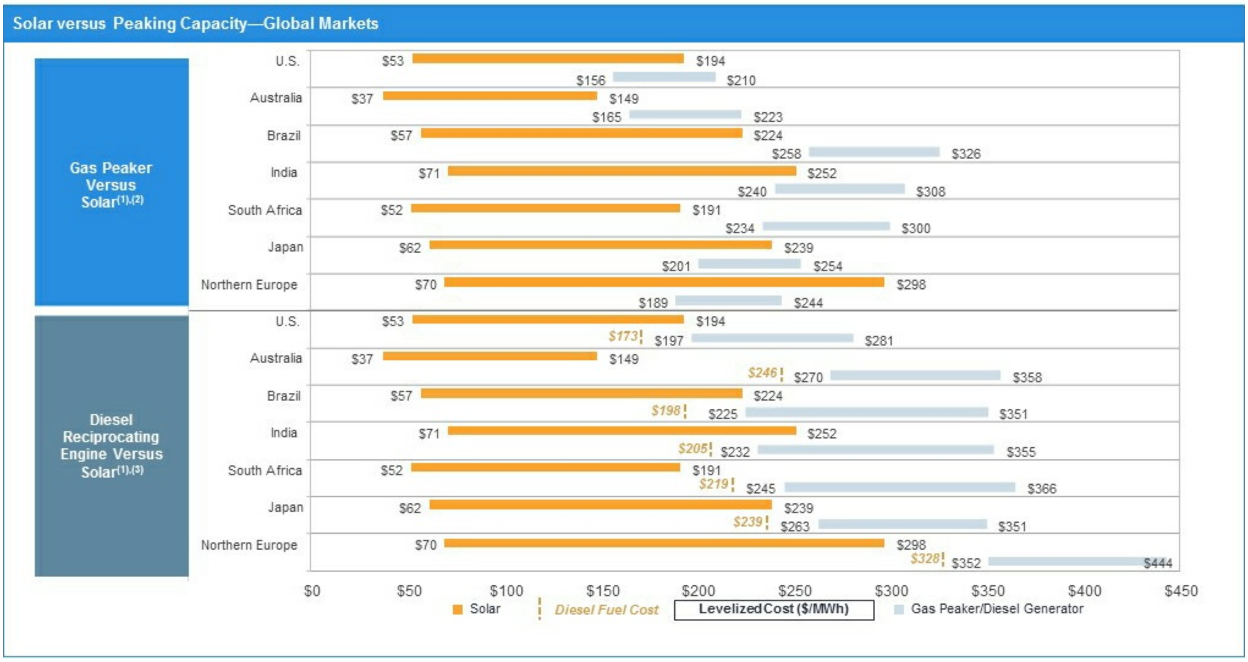
Lazard's latest annual Levelized Cost of Energy Analysis (LCOE 11.0) shows a continued decline in the cost of generating electricity from alternative energy technologies, especially utility-scale solar and wind.



Additional highlights:



- As LCOE values for alternative energy technologies continue to decline, in some scenarios the full-lifecycle costs of building and operating renewables-based projects have dropped below the operating costs alone of conventional generation technologies such as coal or nuclear. This is expected to lead to ongoing and significant deployment of alternative energy capacity.
- Global costs of generating electricity from alternative energy technologies continue to decline. For example, the levelized cost of energy for both utility-scale solar photovoltaic (PV) and onshore wind technologies are down approximately 6% from last year.
- Despite the modestly slowing rate of cost declines for utility-scale alternative energy generation, the gap between the costs of certain alternative energy technologies (e.g., utility-scale solar and onshore wind) and conventional generation technologies continues to widen as the cost profiles of such conventional generation remain flat (e.g., coal) and, in certain instances, increase (e.g., nuclear). Specifically, the estimated levelized cost of energy for nuclear generation increased ~35% versus prior estimates, reflecting increased capital costs at various nuclear facilities currently in development.
- Although alternative energy is increasingly cost-competitive and storage technology holds great promise, alternative energy systems alone will not be capable of meeting the base-load generation needs of a developed economy for the foreseeable future. Therefore, the optimal solution for many regions of the world is to use complementary conventional and alternative energy resources in a diversified generation fleet.



The increasing economic advantage of renewables in the US has global implications, because in the US, conventional energy technologies are relatively cheaper to operate than in other developed economies. Given the higher costs of conventional energy sources in these other countries, the economics of alternative energy sources become even more attractive.

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LEVELIZED COST OF STORAGE

Source: Lazard estimates.
Note: Here and throughout this presentation, unless otherwise indicated, analysis assumes 60% debt at 8% interest rate and 40% equity at 12% cost for conventional and Alternative Energy generation technologies. Reflects global, illustrative costs of capital, which may be significantly higher than OECD country costs of capital. See "Unsubsidized Levelized Cost of Energy—Cost of Capital Comparison" page for additional details on cost of capital. Analysis does not reflect potential impact of recent draft rule to regulate carbon emissions under Section 111(d). See Appendix for fuel costs for each technology. See following page for footnotes

Source: World Bank, IHS Waterborne LNG and Lazard estimates.
(1) Low end assumes crystalline utility-scale solar with a fixed-tilt design. High end assumes rooftop C&I solar. Solar projects assume illustrative capacity factors of 26% – 30% for Australia, 26% – 30% for Brazil, 22% – 23% for India, 27% – 29% for South Africa, 16% – 18% for Japan and 13% – 16% for Northern Europe. Equity IRRs of 12% are assumed for Australia, Japan and Northern Europe and 18% for Brazil, India and South Africa; assumes cost of debt of 8% for Australia, Japan and Northern Europe, 14.5% for Brazil, 13% for India and 11.5% for South Africa.
(2) Assumes natural gas prices of $4.00 for Australia, $8.00 for Brazil, $7.00 for India, $7.00 for South Africa, $7.00 for Japan and $6.00 for Northern Europe (all in U.S.$ per MMBtu). Assumes a capacity factor of 10%.
(3) Diesel assumes high end capacity factor of 10% representing intermittent utilization and low end capacity factor of 95% representing baseload utilization, O&M cost of $30 per

kW/year, heat rate of 9,500 – 10,000 Btu/kWh and total capital costs of $500 to $800 per kW of capacity. Assumes diesel prices of $3.60 for Australia, $2.90 for Brazil, $3.00 for India, $3.20 for South Africa, $3.50 for Japan and $4.80 for Northern Europe (all in U.S.$ per gallon).