

## Lazard's Levelized Cost of Energy Analysis—Version 11.0

The central findings of our LCOE analysis include: 1) certain Alternative Energy technologies (e.g., wind and utility-scale solar), which became cost-competitive with conventional generation several years ago, are, in some scenarios, approaching a LCOE that is at or below the marginal cost of certain conventional generation technologies; 2) despite the sustained and growing cost-competitiveness of certain Alternative Energy technologies, advanced economies will require diverse generation fleets to meet baseload generation needs for the foreseeable future; and 3) a rational and cost-based analysis is necessary to enable a modern grid, cost-effective energy development and an increasingly clean energy economy.

### **1) Certain Alternative Energy technologies (e.g., wind and utility-scale solar), which became cost-competitive with conventional generation several years ago, are, in some scenarios, approaching a LCOE that is at or below the marginal cost of certain conventional generation technologies<sup>1</sup>**

- Global LCOE values for Alternative Energy technologies continue to decline, reflecting, among other things: (a) downward pressure on financing costs as a result of continuously evolving, and growing pools of capital being allocated to Alternative Energy; (b) declining capital expenditures per project resulting from decreased equipment costs; (c) increased competition among Industry participants as markets evolve policies towards auctions and tenders for the procurement of Alternative Energy capacity (and away from standard offer programs, Feed-in-Tariffs, etc.); and (d) improving competencies in asset management and operation and maintenance execution
- As LCOE values for Alternative Energy technologies continue to decline, they are, in some scenarios, at or below the marginal cost of certain conventional generation technologies (e.g., coal and nuclear, which can have variable and fuel costs that are significant on a \$/MWh basis). We believe this trend will lead to ongoing and significant deployment of Alternative Energy capacity. However, such displacement will be moderated by the intermittent nature of Alternative Energy generation (discussed further herein) and the current reluctance of capital providers to underwrite merchant exposure, as well as an understanding of the need for resource diversity in a modern electric grid
- Costs continue to decline for Alternative Energy technologies, albeit at a modestly slowing rate. The gap between the costs of certain Alternative Energy technologies (e.g., utility-scale solar photovoltaic and utility-scale onshore wind) and conventional

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<sup>1</sup> This analysis does not take into account potential social and environmental externalities (e.g., the social costs of distributed generation, environmental consequences of conventional generation, etc.) or reliability- or intermittency-related considerations (e.g., grid investment required to manage intermittency).

generation technologies continues to widen as the cost profiles of such conventional generation technologies remain flat (e.g., coal) and, in certain instances, increase (e.g., nuclear)

- A number of leading Industry participants are beginning to develop utility-scale wind and solar “plus storage” offerings, thereby increasing capacity factors and serving grid needs not currently met by existing intermittent generation resources. We have included a preliminary analysis of the levelized cost of one such illustrative future offering, which compares favorably to its nearest competition, solar thermal with storage
- Certain large-scale conventional and renewable generation projects (e.g., IGCC, nuclear, solar thermal, etc.) continue to face a number of challenges, including significant cost contingencies, high absolute costs, competition from relatively cheap natural gas in selected geographies, operating difficulties and policy uncertainty

## **2) Despite the sustained and growing cost-competitiveness of certain Alternative Energy technologies, advanced economies will require diverse generation fleets to meet baseload generation needs for the foreseeable future**

- As electricity generation from intermittent renewables increases, the timing imbalance between peak customer demand and Alternative Energy production is accentuated; the optimal solution for many regions is to use Alternative Energy technologies as a complement to existing conventional generation technologies
- While some Alternative Energy technologies have achieved notional “grid parity” under certain scenarios (e.g., best-in-class wind/solar resources), such observation does not take into account potential social and environmental externalities (e.g., social costs of distributed generation, environmental consequences of conventional generation, etc.) or integration- and reliability-related considerations

## **3) A rational and cost-based analysis is necessary to enable a modern grid, cost-effective energy development and an increasingly clean energy economy**

- Alternative Energy costs have decreased dramatically over the past eight years, driven by advances in technology, maturation of the supply chain and the resulting economies of scale in manufacturing and installation and, in the U.S., by federal subsidies and related financing tools. A key question for Industry participants will be whether these technologies can continue their cost declines and/or meet growth expectations as the Industry continues to mature, and after the near-term step down and forthcoming permanent expiration of such subsidies

- Our rational, cost-based analysis and Industry perspective indicates that robust, modern and sustainable electricity systems must combine low-cost renewables with baseload conventional technologies in order to achieve sustainable energy independence, a cleaner environment and a stronger economic base

### **Conclusion**

Both the LCOE and LCOS studies will continue to evolve over time by necessity, and we appreciate that there are various views regarding the merits of some of the data inputs utilized. Accordingly, we would be happy to discuss this work in detail with you.

Lazard has remained committed to the Alternative Energy sector because we believe that new technologies will continue to be developed and existing technologies will continue to be more widely deployed, particularly in light of increasing cost-competitiveness relative to conventional generation. Importantly, while energy storage could one day fundamentally change the way the U.S. and global power grids operate, Alternative Energy generation technologies, which remain intermittent despite significantly decreased costs, must for now be deployed as one element of a diversified generation fleet capable of meeting the needs of an advanced economy. In this regard, Lazard has been and remains a strong proponent of coordinated federal and state energy policy that is grounded in rational cost analysis and that will enable smarter energy development, sustainable energy independence, a cleaner environment and a strong economy.

More generally, from a client perspective, Lazard's commitment to the Global Power, Energy & Infrastructure sector is of the highest priority. In that regard, we believe that we have the greatest allocation of resources and effort among any investment bank. Further, we have an ongoing and intense focus on strategic issues that require long-term commitment and planning. Our objective remains to be a long-term thought leader and the most committed and independent advisor in the sector.

A selection of our recent assignments demonstrates Lazard's presence in every substantive sector of the Power, Energy & Infrastructure sector, globally:

- Advisor to The Carlyle Group on its sale of ITS ConGlobal to AMP Capital
- Advisor to Sempra on its pending acquisition of EFH's 80% ownership interest in Oncor
- Advisor to Calpine on its pending sale to Energy Capital Partners
- Advisor to Peabody Energy on facilitating an ownership change of the Navajo Generating Station (2,250 MW)
- Advisor to FirstEnergy Solutions on its ongoing strategic review
- Advisor to Great Plains on its pending merger with Westar

- Advisor to Areva on its restructuring and associated capital increases
- Advisor to WGL on its pending sale to AltaGas
- Advisor to Invenegy on the capital raise for Lackawanna Energy Center (Winner of North America Conventional Power Project Finance Deal of 2016)
- Advisor to Dynegy on its restructuring of Illinois Power Generating Company (Genco)
- Advisor to BlackRock on its take private of Gas Natural
- Advisor to the Special Committee of the Board of Directors of SolarCity on its sale to Tesla
- Advisor to The Carlyle Group on its sale of Connecticut Highway Service Plazas to John Laing Infrastructure Fund
- Publication of the 2016 Lazard-Sponsored Alternative Energy Poll
- Advisor to the Official Committee of Unsecured Creditors in the Chapter 11 cases of SunEdison
- Advisor to Clean Line Energy Partners on a range of strategic advisory matters, most recently culminating in the DOE's support of its Plains & Eastern long-haul transmission project, and its investment from Bluescape Resources at the holding company level
- Advisor to Columbia Pipeline Group on its sale to TransCanada
- Advisor to Royal Dutch Shell on its ongoing asset sale program
- Advisor to Dynegy on its acquisition of Engie's U.S. fossil portfolio
- Advisor to SDIC Power on its acquisition of Repsol's UK wind assets
- Advisor to the Board of ITC Holdings on its sale to Fortis
- Advisor to Enel Green Power on its integration into Enel
- Advisor to Williams on its proposed combination with Energy Transfer Equity (terminated)
- Advisor to the Corporate Governance Committee of TerraForm Power on its proposed acquisition of the operating assets of Vivint Solar (terminated)
- Advisor to Iberdrola S.A. on the merger of Iberdrola USA and UIL and the formation of AVANGRID
- Advisor to the Corporate Governance Committee of TerraForm Power on its acquisition of the operating assets of First Wind
- Advisor to NiSource on the spin-off of Columbia Pipeline Group and formation of an MLP
- Advisor to Dynegy on its acquisition of the Duke Ohio and EquiPower generation portfolios
- Advisor to Integrys on its sale of Integrys Energy Services to Exelon
- Advisor to Acciona on its sale of one-third of its renewable generation business to KKR
- Advisor to Integrys on its sale to Wisconsin Energy

- Advisor to the Unsecured Creditors' Committee of Energy Future Holdings
- Advisor to Pepco on its sale to Exelon
- Advisor on a wide variety of strategic and capital-raising assignments for other Alternative Energy clients
- Much more significantly, Lazard continues to advise a large number of Industry participants on ongoing strategic and ordinary course matters on a strictly confidential basis