SUNPOWER

August 28, 2008

Electronic Delivery

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California Energy Commission
Dockets Office, MS-4
Re: Docket No. 08-IEP-1B
1516 Ninth Street
Sacramento, CA 95814-5512

Re: Docket No. 08-IEP-1B

Docket Office:

Please find attached SunPower Corporation's comments in response to Joint Committee Workshop on Achieving Higher Levels of Renewables in California's Electricity System, 2008 Integrated Energy Policy Report Update.

Please contact me should you have any questions. I can be reached at 408-240-5577.

Sincerely,

Julie Blunden
Vice President
Public Policy and Corporate Communications
SunPower Corporation

Attachments

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SunPower's Comments in response to the August 21, 2008 Joint Committee Workshop on Achieving Higher Levels of Renewables in California's Electricity System

Docket number 08-IEP-1B:

2008 Integrated Energy Policy Report Update

Submitted by SunPower Corporation

August 28, 2008

SunPower Corp. appreciates the opportunity to comment to the California Energy Commission (CEC) on the key issues that must be addressed to support the 2020 goal of 33% renewables to meet electricity demand in California. We focus our comments on how solar photovoltaic (PV) power in both distributed and utility-scale central station applications are woefully underrepresented in all IEPR analyses regarding meeting the 33% goal: the resource approach, the transmission requirements and the grid operations.

PV is Not Represented in the Renewable Resource Inventory as a Central Station or DG Resource

Slides 10 and 11 of the staff presentation to the August 21, 2008 workshop provide the inventory of resources and costs expected to contribute to RPS compliance in California. Solar PV is not included in any form on the inventory.[1] Given the advent of utility distributed PV plans as well as utility-scale PV with the PG&E 800 MW contract announcement with SunPower and OptiSolar on August 14th, we respectfully request that the CEC include solar PV in all future analyses of the resources for RPS compliance.

PV is Expressly Included in the Utilities' RPS Compliance Plans

Distributed solar has now been expressly proposed at the CPUC by both SCE and SDG&E as a mechanism for meeting the RPS outside of the CSI. Therefore, we request that the CEC include and analyze both distributed rooftop and distributed ground-mounted PV in all IEPR RPS analyses.

On August 14, 2008, PG&E announced 800 MW of PV power plants to be delivered from two plants in San Luis Obispo County. SunPower's PV power plant will begin delivery in 2010, assuming all permitting, transmission and financing conditions are met, and complete delivery of 250 MW in 2012. The OptiSolar project, subject to the same conditions, will begin delivery in 2011 and complete delivery in 2013 of 550 MW of power.[2]

We request that the CEC collect and include data on utility-scale PV bids into the RPS RFOs in IEPR analyses. For example, on Slide 3 from June 30th presentation by Anne Gillette from CPUC on the status of the California RPS procurement process shows that solar bids in 2007 represented more that 30 GW of bids, comparable to the total wind bids in that year and greater than any prior year's total pan-renewables bids.[3] In order to

[1] http://www.energy.ca.gov/2008_energypolicy/documents/2008-08-21_workshop/presentations/Suzanne_Korosec_2008-08-21.pdf

[2] http://investors.sunpowercorp.com/releasedetail.cfm?ReleaseID=328221

[3] http://www.energy.ca.gov/portfolio/documents/2008-06-30_workshop/Status_of_California_RPS_CPUC.pdf

accurately understand the advent of PV as a utility-scale resource, we request that the CEC obtain information from the utilities separating the bids of all solar thermal electric technologies from all PV technologies.

PV is Active in Securing CalISO Queue Positions

Clearly there is a tremendous amount of activity in the RPS RFO bidding processes as evidenced by the California ISO queue.[4] Over 12 GW of PV are reported as active in the California ISO queue as of July 25, 2008. The first PV queue listing for PV was submitted on November 6, 2006. In 2007 the queue reflects the advent of utility-scale PV bids with over 6 GW in the queue. By mid-year 2008 a comparable number of additional PV MW were represented by active queue positions.

The Solar Resource is the Single Largest Solar Resource in the California and all Viable Solar Technologies Must be Planned to Participate in the Power Market

California is blessed with an outstanding portfolio of renewable resources. However, the CEC IEPR process has shown that the total solar resource in California dwarfs the other renewable resources on an aggregate basis. The CEC IEPR forecasts of the opportunity to access renewables for the state must reflect all of the practical technologies available to do so. Ignoring the PV technology applications results in a very distorted view of the immediate future in RPS compliance plans as well as the long-term opportunity for solar in both its CSP and PV forms to support RPS compliance.

Why is PV Suddenly a Major Contributor to RPS Compliance?

Solar PV has rapidly emerged as a major contributor to RPS compliance for two key reasons. First, global demand, including that from the California Solar Initiative, has spurred investment in capacity around the world that is lowering costs for PV solar systems and providing much larger delivery volumes that can serve utility-scale demand. Second, solar PV has a set of attributes which are very attractive to utilities:

- Ubiquitous Resource
- Modular Deployment
- Fast-to-Market[5]
- Peaking Energy Delivery: especially with trackers[6]
- Proven Technology: especially for wafered silicon

With regard to global scaling, the PV industry has been on a growth spurt for the last four years. The Prometheus Institute has provided a global solar PV supply-demand overview illustrating how the solar

[4] http://www.caiso.com/docs/2002/06/11/2002061110300427214.html

[5] SunPower has demonstrated the ability to install 1 MW / day of PV power plants in Spain in the second quarter of 2008 and has contracted to deliver a 25 MW solar power plant to FP&L in 2009.

[6] SunPower's T20 Tracker delivers up to 30 percent more energy per rated watt than a fixed tilt system.

industry will move rapidly from a cumulative 10 GW installed globally in 2008 to a global annual addition on the order of 10 GW in 2010, just 2 years later.[7]

The consequence of this scaling is an impressive cost reduction in manufacturing and system integration. These manufacturing and installation cost improvements have been masked over the last several years by an inadequate supply of polysilicon which has kept installed system costs artificially high. Dr. Richard Swanson, founder and CTO of SunPower, has written and lectured extensively about the cost reduction dynamics of PV industry due to scale economies and cycles of learning.[8] With the imminent improvements in silicon supply to the solar industry, we expect to see substantial improvements in end-use system pricing over the next several years.

The impact of scale on the levelized cost of energy (LCOE) for PV can be illustrated by investment bank analyses of the relative cost of PV. Lazard has submitted testimony in New Jersey for the Energy Master Plan proceeding on the relative costs of renewable and conventional technologies on an LCOE basis which we have appended to these comments. SunPower has prepared a whitepaper on the drivers of the LCOE for utility-scale PV which details the technological aspects of PV today that allow for the cost of PV to compete with other wholesale power options by 2010.[9]

On the second point, PV is attractive to utilities because it has a set of characteristics that allow PV to be built virtually anywhere, at any scale, fast, with delivery of the plant matching the need of the customer and delivery of energy aligned with peak energy requirements. This means that PV has the unique ability to serve as a central-station resource where transmission exists or will be built, a distributed power plant resource to relieve congestion and fit into the systems at load centers, and as a customer-sited resource to directly lower demand without any land impact. These flexibility features are valued by utilities. Based on the empirical evidence within California and across the country, we expect utilities, generation companies and customers to rapidly adopt solar PV.

Again, thank you for the opportunity to comment in this proceeding. We request that the CEC remedy the omission of PV as an RPS compliance resource in its IEPR analyses. We welcome the opportunity to work with the CEC to support its inclusion of PV in its forthcoming analyses.

[7] http://www.deq.state.va.us/export/sites/default/info/documents/climate/BradfordSolarMarketOutlookVirginia.pdf

[8] http://www.sunpowercorp.com/Smarter-Solar/The-SunPower-Advantage/~/media/Downloads/smarter_solar/swanson.ashx

[9] http://www.sunpowercorp.com/Smarter-Solar/The-SunPower-Advantage/Technical-Papers.aspx

JUNE 2008

LEVELIZED COST OF ENERGY ANALYSIS – VERSION 2.0

LAZARD

Introduction

This analysis will address the following topics:

- Comparative "levelized cost of energy" for various technologies on a $/MWh basis, including sensitivities, as relevant, for:
  - Fuel costs
  - Illustrative carbon emission costs
  - U.S. federal tax subsidies
  - Anticipated capital costs, over time
- Comparison of assumed capital costs on a $/kW basis for various generation technologies
- Decomposition of the levelized costs of energy for various generation technologies by capital costs, fixed operations & maintenance expense, variable operations & maintenance expense, and fuel costs, as relevant
- Considerations regarding the applicability of various generation resources, taking into account factors such as location requirements/constraints, dispatch characteristics, land and water requirements and contingencies such as carbon pricing
- Summary assumptions for the various generation technologies examined
- Summary of Lazard's approach to comparing the levelized cost of energy for various conventional and Alternative Energy generation technologies, including identification of key potential sensitivities not addressed in the scope of this presentation

Levelized Cost of Energy Comparison

Certain Alternative Energy generation technologies are already cost-competitive with conventional generation technologies under some scenarios, even before factoring in environmental and other externalities (e.g., RECs, potential carbon emission costs, transmission costs) as well as the fast-increasing construction and fuel costs affecting conventional generation technologies

Source: Lazard estimates.

Note: Reflects production tax credit, investment tax credit, and accelerated asset depreciation as applicable. Assumes 2008 dollars, 60% debt at 7% interest rate, 40% equity at 12% cost, 20-year economic life, 40% tax rate, and 5-20 year tax life. Assumes coal price of $2.50 per MMBtu and natural gas price of $8.00 per MMBtu.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.

(b) Represents a leading solar crystalline company's targeted implied levelized cost of energy in 2010, assuming a total system cost of $5.00 per watt. Company guidance for 2012 total system cost of $4.00 per watt would imply a levelized cost of energy of $90 per MWh.

(c) Represents the leading thin-film company's targeted implied levelized cost of energy in 2010, assuming a total system cost of $2.75 per watt. Company guidance for 2012 total system cost of $2.00 per watt would imply a levelized cost of energy of $62 per MWh.

(d) Low end represents solar tower. High end represents solar trough.

(e) Represents retrofit cost of coal plant.

(f) Estimates per National Action Plan for Energy Efficiency; actual cost for various initiatives varies widely.

(g) High end incorporates 90% carbon capture and compression.

(h) Does not reflect potential economic impact of federal loan guarantees or other subsidies.

(i) Based on advanced supercritical pulverized coal. High end incorporates 90% carbon capture and compression.

Levelized Cost of Energy Comparison – Sensitivity to Fuel Prices

Variations in fuel prices can materially affect the levelized cost of energy for conventional generation technologies, but direct comparisons against "competing" Alternative Energy generation technologies must take into account issues such as dispatch characteristics (e.g., baseload and/or dispatchable intermediate load vs. peaking or intermittent technologies)

Source: Lazard estimates.

Note: Darkened areas in horizontal bars represent low end and high end levelized cost of energy corresponding with ±25% fuel price fluctuations.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.

(b) Represents a leading solar crystalline company's targeted implied levelized cost of energy in 2010, assuming a total system cost of $5.00 per watt. Company guidance for 2012 total system cost of $4.00 per watt would imply a levelized cost of energy of $90 per MWh.

(c) Represents the leading thin-film company's targeted implied levelized cost of energy in 2010, assuming a total system cost of $2.75 per watt. Company guidance for 2012 total system cost of $2.00 per watt would imply a levelized cost of energy of $62 per MWh.

(d) Low end represents solar tower. High end represents solar trough.

(e) Represents retrofit cost of coal plant.

(f) Estimates per National Action Plan for Energy Efficiency; actual cost for various initiatives varies widely.

(g) High end incorporates 90% carbon capture and compression.

(h) Does not reflect potential economic impact of federal loan guarantees or other subsidies.

(i) Based on advanced supercritical pulverized coal. High end incorporates 90% carbon capture and compression.

Levelized Cost of Energy – Sensitivity to Carbon Emission Costs

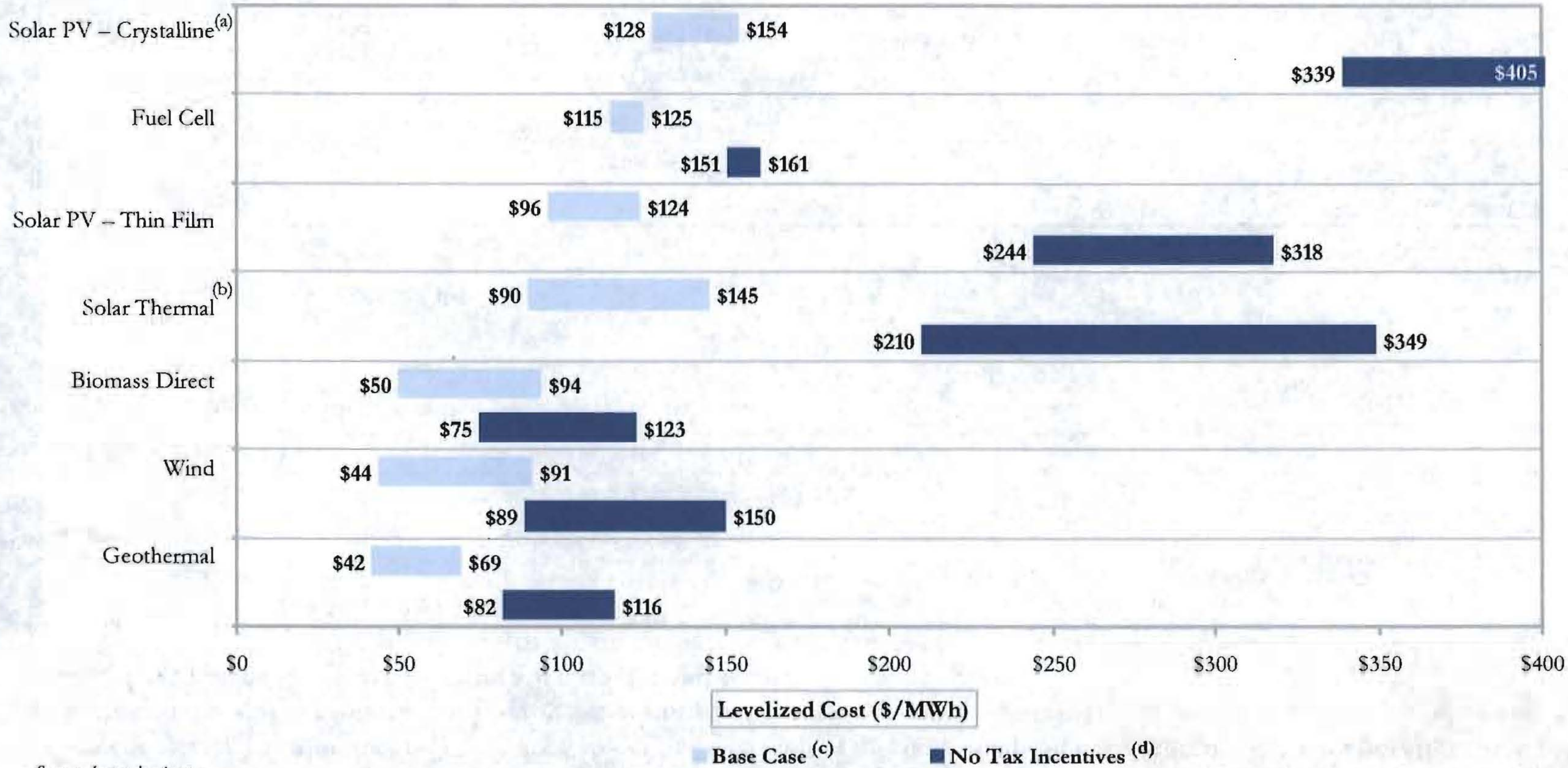
Conventional generation technologies are subject to uncertainty regarding the potential for future carbon emission costs, which would not affect Alternative Energy generation technologies except positively through credit positions or otherwise (n.b., these potential positive benefits are not reflected below)

Source: Lazard estimates.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.
(b) Represents a leading solar crystalline company's targeted implied levelized cost of energy in 2010, assuming a total system cost of $5.00 per watt. Company guidance for 2012 total system cost of $4.00 per watt would imply a levelized cost of energy of $90 per MWh.
(c) Represents the leading thin-film company's targeted implied levelized cost of energy in 2010, assuming a total system cost of $2.75 per watt. Company guidance for 2012 total system cost of $2.00 per watt would imply a levelized cost of energy of $62 per MWh.
(d) Low end represents solar tower. High end represents solar trough.
(e) Represents retrofit cost of coal plant.
(f) Estimates per National Action Plan for Energy Efficiency; actual cost for various initiatives varies widely.
(g) High end of light horizontal bar incorporates 90% carbon capture and compression and no carbon emission cost. Diamond represents no carbon capture and compression, and a carbon emission cost of $30 per ton.
(h) Does not reflect potential economic impact of federal loan guarantees or other subsidies.
(i) Based on advanced supercritical pulverized coal. Diamond represents no carbon capture and compression, and a carbon emission cost of $30 per ton.

Levelized Cost of Energy – Sensitivity to U.S. Federal Tax Incentives

U.S. federal tax subsidies remain an important component of the economics of Alternative Energy generation technologies (and government incentives are important in all regions), notwithstanding high prevailing fossil fuel prices; future cost reductions in technologies such as fuel cells, solar PV and solar thermal have the potential to enable these technologies to approach "grid parity" without tax subsidies (albeit such observation does not take into account issues such as dispatch characteristics or other factors)



Source: Lazard estimates.

Note: Assumes 2008 dollars, 60% debt at 7% interest rate, 40% equity at 12% cost, 20-year economic life and 40% tax rate. Assumes coal price of $2.50 per MMBtu and natural gas price of $8.00 per MMBtu.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.

(b) Low end represents solar tower. High end represents solar trough.

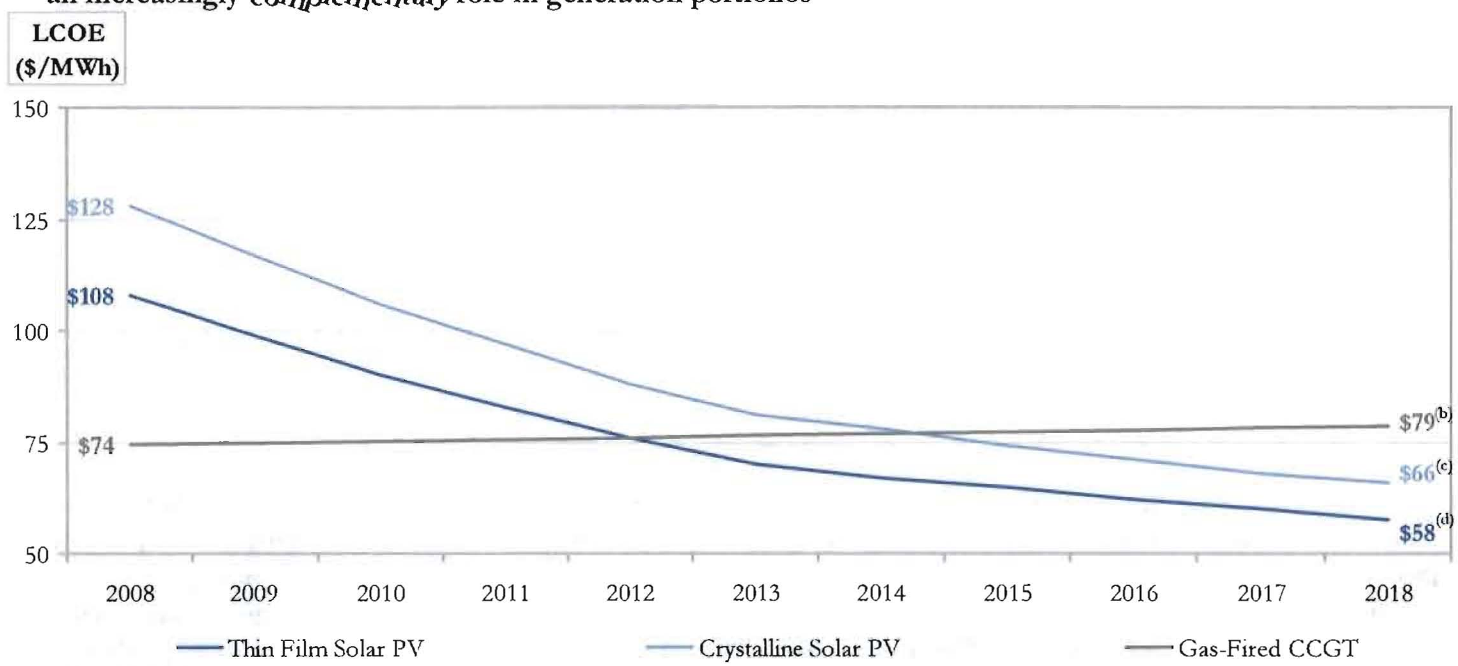
(c) Reflects production tax credit, investment tax credit, and accelerated asset depreciation as applicable.

(d) Illustrates levelized cost of energy in the absence of U.S. federal tax incentives such as investment tax credits, production tax credits and assuming 20-year tax life.

Levelized Cost of Energy – Sensitivity to Capital Costs[a]

An important finding in respect of Solar PV technologies is the potential for significant cost reductions over time as manufacturing scale along the entire production value chain increases; by contrast, conventional generation technologies are experiencing capital cost inflation (as well as fuel cost inflation), driven by high levels of global demand for conventional generation equipment, where potentially cost-reducing manufacturing improvements for these mature technologies are largely incremental in nature

- **This assessment, however, does not take into account the intermittent nature of Solar PV as compared with the dispatchable nature of conventional generation; the key finding in this regard is that Solar PV technologies will play an increasingly *complementary* role in generation portfolios**



Source: *Lazard estimates.*

Note: Reflects production tax credit, investment tax credit, and accelerated asset depreciation as applicable. Assumes 2008 dollars, 60% debt at 7% interest rate, 40% equity at 12% cost, 20-year economic life, 40% tax rate, and 5-20 year tax life. Assumes coal price of $2.50 per MMBtu and natural gas price of $8.00 per MMBtu.

(a) Assumes capital costs for thin film and crystalline Solar PV decline by 10% annually through 2012 and 5% annually thereafter; assumes capital costs for gas-fired CCGT increase by 2.5% annually and gas prices constant at $8.00 per MMBtu.

(b) Assumes 85% capacity factor.

(c) Assumes 26% capacity factor based on single-axis tracking.

(d) Assumes 23% capacity factor.

Capital Cost Comparison

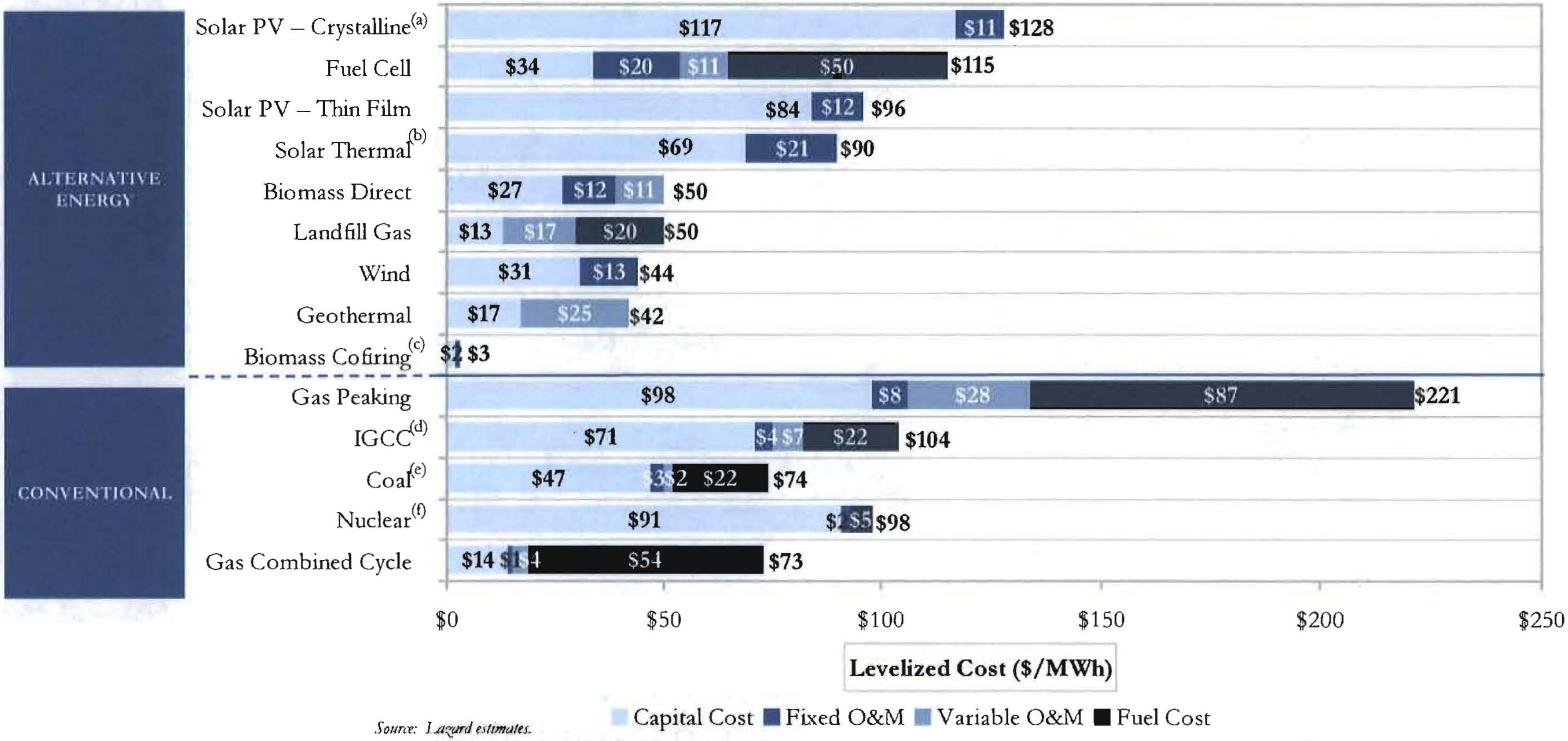
While capital costs for a number of Alternative Energy generation technologies (e.g., solar PV, solar thermal) are currently in excess of conventional generation technologies (e.g., gas, coal, nuclear), declining costs for many Alternative Energy generation technologies, coupled with rising construction and fuel costs for conventional generation technologies, are working to close formerly wide gaps in electricity costs. This assessment, however, does not take into account issues such as dispatch characteristics, capacity factors, fuel and other costs needed to compare generation technologies

Source: Lazard estimates.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.
(b) Based on a leading solar crystalline company's guidance of 2010 total system cost of $5.00 per watt. Company guidance for 2012 total system cost is $4.00 per watt.
(c) Based on the leading thin-film company's guidance of 2010 total system cost of $2.75 per watt; company guidance for 2012 total system cost is $2.00 per watt.
(d) Low end represents solar trough. High end represents solar tower.
(e) Represents retrofit cost of coal plant.
(f) High end incorporates 90% carbon capture and compression.
(g) Based on advanced supercritical pulverized coal. High end incorporates 90% carbon capture and compression.

Levelized Cost of Energy Components – Low End

Certain Alternative Energy generation technologies are already cost-competitive with conventional generation technologies; a key factor regarding the long-term competitiveness of currently more expensive Alternative Energy technologies is the ability of technological development and increased production volumes to materially lower the capital costs of certain Alternative Energy technologies, and their levelized cost of energy, over time (e.g., as is anticipated with solar PV technologies)



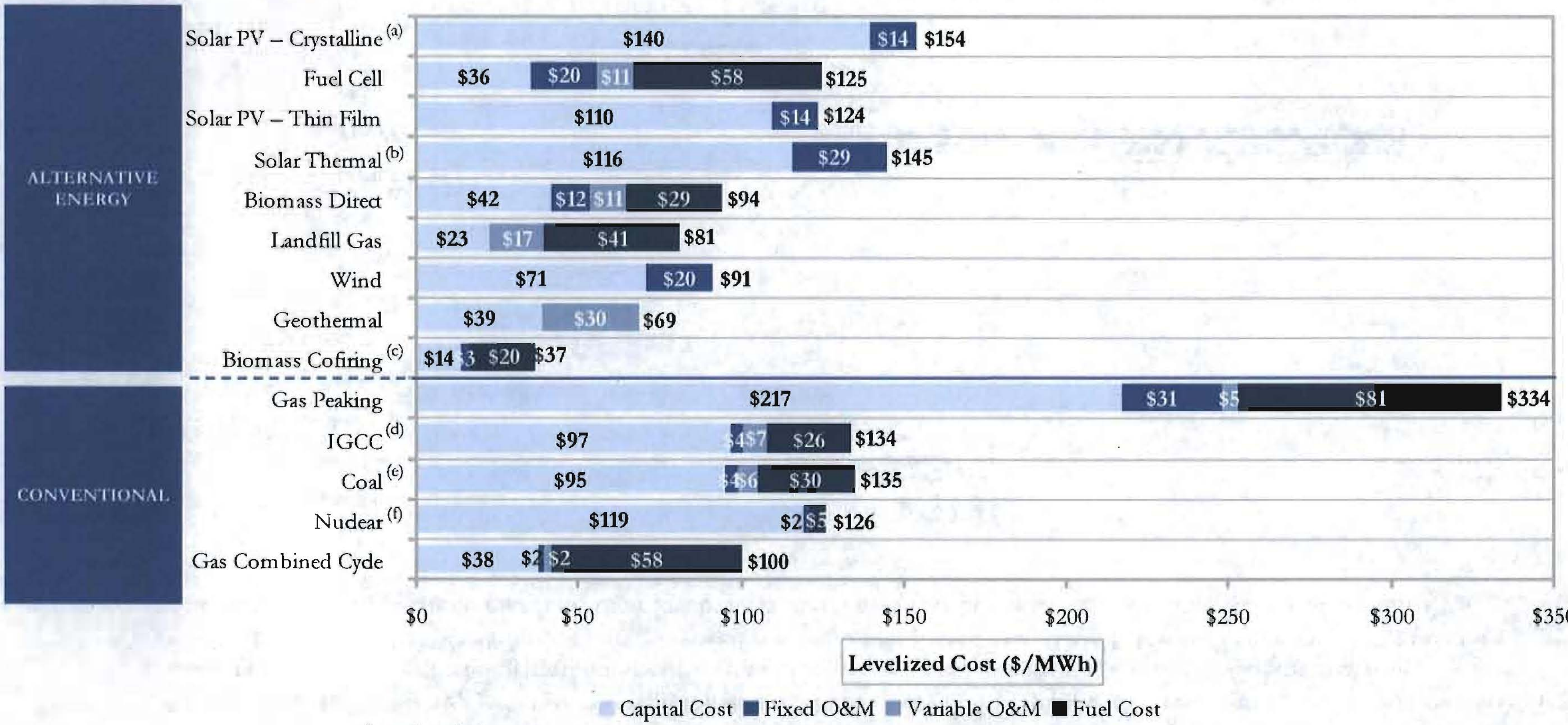
Source: Lazard estimates.

Note: Reflects production tax credit, investment tax credit, and accelerated asset depreciation as applicable. Assumes 2008 dollars, 60% debt at 7% interest rate, 40% equity at 12% cost, 20-year economic life, 40% tax rate, and 5-20 year tax life. Assumes coal price of $2.50 per MMBtu and natural gas price of $8.00 per MMBtu.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.
(b) Low end represents solar tower. High end represents solar trough.
(c) Represents retrofit cost of coal plant.
(d) Incorporates no carbon capture and compression.
(e) Based on advanced supercritical pulverized coal. Incorporates no carbon capture and compression.
(f) Does not reflect potential economic impact of federal loan guarantees or other subsidies.

Levelized Cost of Energy Components – High End

Certain Alternative Energy generation technologies are already cost-competitive with conventional generation technologies; a key factor regarding the long-term competitiveness of currently more expensive Alternative Energy technologies is the ability of technological development and increased production volumes to materially lower the capital costs of certain Alternative Energy technologies, and their levelized cost of energy, over time (e.g., as is anticipated with solar PV technologies)



Source: Lazard estimates.

Note: Reflects production tax credit, investment tax credit, and accelerated asset depreciation as applicable. Assumes 2008 dollars, 60% debt at 7% interest rate, 40% equity at 12% cost, 20-year economic life, 40% tax rate, and 5-20 year tax life. Assumes coal price of $2.50 per MMBtu and natural gas price of $8.00 per MMBtu.

(a) Low end represents single-axis tracking crystalline. High end represents fixed installation.

(b) Low end represents solar tower. High end represents solar trough.

(c) Represents retrofit cost of coal plant.

(d) Incorporates 90% carbon capture and compression.

(e) Based on advanced supercritical pulverized coal. Incorporates 90% carbon capture and compression.

(f) Does not reflect potential economic impact of federal loan guarantees or other subsidies.

Energy Resources: Matrix of Applications

While the levelized cost of energy for Alternative Energy generation technologies is becoming increasingly competitive with conventional generation technologies, direct comparisons must take into account issues such as location (e.g., central station vs. customer-located), dispatch characteristics (e.g., baseload and/or dispatchable intermediate load vs. peaking or intermittent technologies), and contingencies such as carbon pricing

					LOCATION			DISPATCH			
		LEVELIZED COST OF ENERGY	CARBON NEUTRAL/ REC POTENTIAL	STATE OF TECHNOLOGY	CUSTOMER LOCATED	CENTRAL STATION	GEOGRAPHY	INTERMITTENT	PEAKING	LOAD-FOLLOWING	BASE-LOAD
ALTERNATIVE ENERGY	FUEL CELL	$115-125	? [a]	Emerging/ Commercial	✓		Universal				✓
	SOLAR PV	$96-154	✓	Newly Commercial	✓	✓	Universal	✓	✓		
	SOLAR THERMAL	$90-145	✓	Emerging		✓	Southwest	✓	✓	✓	
	BIOMASS DIRECT	$50-94	✓	Mature		✓	Universal			✓	✓
	WIND	$44-91	✓	Mature		✓	Varies	✓			
	GEOTHERMAL	$42-69	✓	Commercial/ Evolving		✓	Varies				✓
	LANDFILL GAS	$50-81	✓	Mature		✓	Varies				✓
CONVENTIONAL	GAS PEAKING	$221-334	✗	Mature	✓	✓	Universal		✓		
	IGCC	$104-134	✗ [b]	Emerging [c]		✓	Co-located or rural				✓
	GAS COMBINED CYCLE	$73-100	✗	Mature	✓	✓	Universal			✓	✓
	COAL	$74-135	✗ [b]	Mature [c]		✓	Co-located or rural				✓
	NUCLEAR	$98-126	✓	Mature/ Emerging		✓	Co-located or rural				✓

Source: Lazard estimates.

(a) Qualification for RPS requirements varies by location.

(b) Could be considered carbon neutral technology, assuming carbon capture and compression.

(c) Carbon capture and compression technologies are in emerging stage.

Levelized Cost of Energy – Key Assumptions

		Solar PV		Solar Thermal	
	Units	Thin Film Utility	Crystalline Utility[b]	Trough-No Storage[c]	Tower[d]
Net Facility Output	MW	10	10	200	100
EPC Cost	$/kW	$3,500 - $4,000	$6,000 - $5,500	$4,500 - $5,800	$5,000 - $6,300
Owner's Cost	$/kW	included	included	included	included
Total Capital Cost[a]	$/kW	$3,500 - $4,000	$6,000 - $5,500	$4,500 - $5,800	$5,000 - $6,300
Fixed O&M	$/kW-yr	$25.00	$25.00	$66.00	$70.00
Variable O&M	$/MWh	—	—	—	—
Heat Rate	Btu/kWh	—	—	—	—
Capacity Factor	%	23% - 20%	26% - 20%	29% - 26%	35% - 38%
Fuel Price	$/MMBtu	—	—	—	—
Construction Time	Months	12	12	24	24
Facility Life	Years	20	20	20	20
CO_2 Equivalent Emissions	Tons/MWh	—	—	—	—
Investment Tax Credit	%	30%	30%	30%	30%
Production Tax Credit	$/MWh	—	—	—	—
Levelized Cost of Energy	$/MWh	$\boxed{\$96}$ - $124	$128 - $\boxed{\$154}$	$108 - $\boxed{\$145}$	$\boxed{\$90}$ - $116

Source: Lazard estimates.

Note: Assumes 2.5% annual escalation for production tax credit, O&M costs and fuel prices, 40% tax rate, financing with 60% debt at 7% interest rate and 40% equity at 12% cost.

(a) Includes capitalized interest costs during construction.
(b) Left side represents single-axis tracking crystalline; right side represents fixed installation.
(c) Left side represents wet-cooled; right side represents dry-cooled.
(d) Represents a range of solar thermal tower estimates.

Levelized Cost of Energy – Key Assumptions (cont'd)

	Units	IGCC[b]	Gas Combined Cycle	Gas Peaking[c]	Coal[d]	Nuclear[e]	Fuel Cell[f]
Net Facility Output	MW	580	550	150	600	1,100	2.3
EPC Cost	$/kW	$2,500 - $3,375	$700 - $875	$500 - $1,150	$1,825 - $3,825	$3,750 - $5,250	$3,000
Owner's Cost	$/kW	$1,250 - $1,700	$200 - $225	$150 - $350	$725 - $1,525	$2,000 - $2,300	$800
Total Capital Cost[a]	$/kW	$3,750 - $5,075	$900 - $1,100	$650 - $1,500	$2,550 - $5,350	$5,750 - $7,550	$3,800
Fixed O&M	$/kW-yr	$26.40 - $28.20	$5.50 - $6.20	$6.80 - $27.00	$20.40 - $31.60	$12.80	$169.00
Variable O&M	$/MWh	$6.80	$2.00 - $3.50	$28.00 - $4.70	$2.00 - $5.60	$11.00	$11.00
Heat Rate	Btu/kWh	8,800 - 10,520	6,800 - 7,220	10,880 - 10,200	8,870 - 11,900	10,450	6,240 - 7,260
Capacity Factor	%	80%	85% - 40%	10%	85%	90%	95%
Fuel Price	$/MMBtu	$2.50	$8.00	$8.00	$2.50	$0.50	$8.00
Construction Time	Months	57 - 63	36	25	60 - 66	69	3
Facility Life	Years	20	20	20	20	20	20
CO_2 Equivalent Emissions	Tons/MWh	0.93 - 0.11	0.40 - 0.42	0.40 - 0.42	0.94 - 0.13	—	0.36 - 0.42
Investment Tax Credit	%	—	—	—	—	—	30%
Production Tax Credit	$/MWh	—	—	—	—	—	—
Levelized Cost of Energy	$/MWh	$104 - $134	$73 - $100	$221 - $334	$74 - $135	$98 - $126	$115 - $125

Source: *Lazard estimates.*

Note: Assumes 2.5% annual escalation for production tax credit, O&M costs and fuel prices, 40% tax rate, financing with 60% debt at 7% interest rate and 40% equity at 12% cost.

(a) Includes capitalized interest costs during construction.

(b) High end incorporates 90% carbon capture and compression.

(c) Low end represents assumptions regarding GE 7FA. High end represents assumptions regarding GE LM6000PC.

(d) Based on advanced supercritical pulverized coal. High end incorporates 90% carbon capture and compression.

(e) Does not reflect potential economic impact of federal loan guarantees or other subsidies.

(f) Low end incorporates illustrative economic and efficiency benefits of combined heat and power ("CHP") applications.

Levelized Cost of Energy – Key Assumptions (cont'd)

	Units	Biomass Direct	Wind	Geothermal	Landfill Gas	Biomass Cofiring[b]
Net Facility Output	MW	35	100	30	5	2% - 20%[c]
EPC Cost	$/kW	$2,750 - $3,500	$1,900 - $2,500	$3,000 - $4,000	$1,500 - $2,000	$50 - $500
Owner's Cost	$/kW	included	included	included	included	included
Total Capital Cost[a]	$/kW	$2,750 - $3,500	$1,900 - $2,500	$3,000 - $4,000	$1,500 - $2,000	$50 - $500
Fixed O&M	$/kW-yr	$83.00	$40.00 - $50.00	—	—	$10.00 - $20.00
Variable O&M	$/MWh	$11.00	—	$25.00 - $30.00	$17.00	—
Heat Rate	Btu/kWh	14,500	—	—	13,500	10,000
Capacity Factor	%	80%	36% - 28%	80% - 70%	80%	80%
Fuel Price	$/MMBtu	$0.00 - $2.00	—	—	$1.50 - $3.00	$0.00 - $2.00
Construction Time	Months	36	12	36	12	12
Facility Life	Years	20	20	20	20	20
CO_2 Equivalent Emissions	Tons/MWh	—	—	—	—	—
Investment Tax Credit	%	—	—	—	—	—
Production Tax Credit	$/MWh	$10	$20	$20	$10	—
Levelized Cost of Energy	$/MWh	$50 - $94	$44 - $91	$42 - $69	$50 - $81	$3 - $37

Source: Lazard estimates.

Note: Assumes 2.5% annual escalation for production tax credit, O&M costs and fuel prices, 40% tax rate, financing with 60% debt at 7% interest rate and 40% equity at 12% cost.

(a) Includes capitalized interest costs during construction.

(b) Represents retrofit cost of host coal plant.

(c) Additional output to a coal facility.

Summary Considerations

Lazard has conducted this study comparing the levelized cost of energy for various conventional and Alternative Energy generation technologies in order to understand which Alternative Energy generation technologies may be cost-competitive with conventional generation technologies, either now or in the future, and under various operating assumptions, as well as to understand which technologies are best suited for various applications based on locational requirements, dispatch characteristics and other factors. We find that Alternative Energy technologies are complementary to conventional generation technologies, and believe that their use will be increasingly prevalent for a variety of reasons, including government subsidies, RPS requirements, and continuously improving economics as underlying technologies improve and production volumes increase.

In this study, Lazard's approach was to determine the levelized cost of energy, on a $/MWh basis, that would provide an after-tax IRR to equity holders equal to an assumed cost of equity capital. Certain assumptions (e.g., required debt and equity returns, capital structure, and economic life) were identical for all technologies, in order to isolate the effects of key differentiated inputs such as investment costs, capacity factors, operating costs, fuel costs (where relevant) and U.S. federal tax incentives on the levelized cost of energy. These inputs were developed with a leading consulting and engineering firm to the Power & Energy Industry, augmented with Lazard's commercial knowledge where relevant.

Lazard has not manipulated capital costs or capital structure for various technologies, as the goal of the study was to compare the current state of various generation technologies, rather than the benefits of financial engineering. The results contained in this study would be altered by different assumptions regarding capital structure (e.g., increased use of leverage) or capital costs (e.g., a willingness to accept lower returns than those assumed herein).

Key sensitivities examined included fuel costs and illustrative carbon emission costs. Other factors would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this current analysis. These additional factors, among others, could include scale benefits or detriments, the value of Renewable Energy Credits ("RECs") or carbon emissions offsets, the impact of transmission costs, and the economic life of the various assets examined.