Supplemental Information: A Monte Carlo Approach to Integrating Uncertainty into Levelized Cost of Electricity

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Appendix A: Data Sources Used to Calculate Input Distribution Parameters

Coal									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**
	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	3000-8400	20.40-31.60	3-5.90	8750-12000	93	1.99	40	211	2013
[2]	2934-6599	31.18-37.80	4.47	8800	-	-	-	-	2013
[3] [4]	-	-	-	10314	-	1.25	-	-	2002
[3] [4]	-	-	-	10297	-	1.28	-	-	2003
[3] [4]	-	-	-	10331	-	1.36	-	-	2004
[3] [4]	-	-	-	10373	-	1.54	-	-	2005
[3] [4]	-	-	-	10351	-	1.69	-	-	2006
[3] [4]	-	-	-	10375	-	1.77	-	-	2007
[3] [4]	-	-	-	10378	-	2.07	-	-	2008
[3] [4]	-	-	-	10414	-	2.21	-	-	2009
[3] [4]	-	-	-	10415	-	2.27	-	-	2010
[3] [4]	-	-	-	10444	-	2.39	-	-	2011
[3] [4]	-	-	-	10498	-	2.38	-	-	2012
[5]	8400-1920	31.6-20.40	2-5.90	-	-	-	-	-	2013
[6]	-	-	-	-	-	-	-	228.6	2014
[6]	-	-	-	-	-	-	-	205.7	2014
[6]	-	-	-	-	-	-	-	215.4	2014
[6]	-	-	-	-	-	-	-	214.3	2014

Natural Gas Combined Cycle									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**

	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	1006-1318	6.20-5.50	3.50-2.00	6700-6900	40-70	4.5	20	117	2013
[7]	-	-	-	-	87	-	-	-	2013
[2]	917-1023	13.17-15.37	3.27-3.60	6430-7050	-	-	-	-	2013
[4]	-	-	-	-	-	3.56	-	-	2002
[4]	-	-	-	-	-	5.39	-	-	2003
[4]	-	-	-	-	-	5.96	-	-	2004
[4]	-	-	-	-	-	8.21	-	-	2005
[4]	-	-	-	-	-	6.94	-	-	2006
[4]	-	-	-	-	-	7.11	-	-	2007
[4]	-	-	-	-	-	9.02	-	-	2008
[4]	-	-	-	-	-	4.74	-	-	2009
[4]	-	-	-	-	-	5.09	-	-	2010
[4]	-	-	-	-	-	4.72	-	-	2011
[4]	-	-	-	-	-	3.42	-	-	2012
[5]	510-1680	45.6-5.50	1.29-6.37	-	40-93	-	-	-	2013

Natural Gas Peaking									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**
	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	800-1000	5.00-25.00	4.70-7.50	10300-9000	10	4.5	20	117	2013
[2]	676-973	7.04-7.34	10.37-15.45	9750-10850	-	-	-	-	2013
[4]	-	-	-	-	-	3.56	-	-	2002
[4]	-	-	-	-	-	5.39	-	-	2003
[4]	-	-	-	-	-	5.96	-	-	2004
[4]	-	-	-	-	-	8.21	-	-	2005
[4]	-	-	-	-	-	6.94	-	-	2006
[4]	-	-	-	-	-	7.11	-	-	2007
[4]	-	-	-	-	-	9.02	-	-	2008
[4]	-	-	-	-	-	4.74	-	-	2009
[4]	-	-	-	-	-	5.09	-	-	2010
[4]	-	-	-	-	-	4.72	-	-	2011
[4]	-	-	-	-	-	3.42	-	-	2012

[5]	600-1200	5.26-14.52	3.17-29.90	-	5	-	-	-	2013

Carbon Pricing		
Source	**Carbon Price**	**Data Year**
	$/metric tonne	
[8]	$5.02	2014
[8]	$4.00	2014
[8]	$3.00	2013
[8]	$2.67	2013
[9]	$12	2015
[10]	$23	2012
[10]	$24.15	2013
[10]	$25.40	2014
[11]	$38.21 - $43.31	2010
[12]	$22.36 - $51.79	2013

Nuclear									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**
	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	5385-8199	60	-	10450	90	0.65	40	-	2013
[2]	5530	93.28	2.14	-	-	-	-	-	2013
[3]	-	-	-	10442	-	-	-	-	2002
[3]	-	-	-	10422	-	-	-	-	2003
[3]	-	-	-	10428	-	-	-	-	2004
[3]	-	-	-	10436	-	-	-	-	2005
[3]	-	-	-	10435	-	-	-	-	2006
[3]	-	-	-	10489	-	-	-	-	2007
[3]	-	-	-	10452	-	-	-	-	2008
[3]	-	-	-	10459	-	-	-	-	2009
[3]	-	-	-	10452	-	-	-	-	2010
[3]	-	-	-	10464	-	-	-	-	2011
[3]	-	-	-	10479	-	-	-	-	2012

[5]	2870-8200	12.80-127	.42-6	-	85-90	-	-	-	2013

Wind									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**
	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	1500-2000	30	6.00-10.00	-	30-52	-	20	-	2013
[2]	2213	39.55	-	-	-	-	-	-	2013
[13]	-	-	-	-	15-51	-		-	2012
[14]	-	-	-	-	-	-	20	-	2013
[5]	1200-2600	12.24-60	7.45-23	-	24-44.50	-	-	-	2013

Solar Photovoltaic									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**
	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	1750-2000	13-20	-	-	20-27	-	20	-	2013
[2]	3873-4183	24.69-27.75	-	-	-	-	-	-	2013
[5]	2500-7600	7.56-110	-	-	15.48-28	-	-	-	2013

Solar Thermal									
Source	**Capital Cost**	**Fixed O&M**	**Variable O&M**	**Heat Rate**	**Capacity Factor**	**Fuel**	**Facility Life**	**CO_2 Emissions**	**Data Year**
	$/kWh	$/kW-yr	$/MWh	Btu/kWh	%	$/MMBtu	yrs	lbs/MMBtu	
[1]	5600-9000	50-80	3	-	43-52	-	40	-	2013
[7]	-	-	-	-	20	-	-	-	2019
[2]	5067	67.26	-	-	-	-	-	-	2013

[5]	4250-8090	49.50-82	.71-25	-	25-43	-	-	-	2013

Appendix B: Comparison between Lazard's Results and our Results.

The ranges obtained from Lazard represent their LCOE ranges for 2013 on an unsubsidized basis. The table below compares these ranges with the Monte Carlo ranges obtained from our analysis. Lazard does not provide best estimate point values, and so ranges are the only comparison point available. For our Monte Carlo results, we provide our best estimate along with the 50% and 90% confidence intervals from the analysis.

Our 90% confidence interval results are similar to Lazard's for most technologies. Our estimates for coal and natural gas generation are somewhat lower for both high and low estimates, due mostly to a lower range for expected capital costs. While we agree with Lazard on the low end of solar costs, our high end estimates are much higher, due to a higher "high end" for capital costs and a lower "low end" for expected capacity factor. Other differences can be understood through differences in assumptions and modeling approach. Lazard neglects variation, by using fixed values, in several variables that find to be important, including all fuel prices, interest rates, and some capacity factors.

Table A1: A comparison between our Monte Carlo results and the Lazard Capital LCOE study [1].

Generation Technology	LCOE ($/MWh) Lazard Range	Monte Carlo Best Estimate	Monte Carlo (25th percentile - 75th percentile)	Monte Carlo (5th percentile - 95th percentile)
Coal	$65-$145	$71	$55-$82	$43-$115
NGCC	$61-$87	$59	$51-$66	$42-$79
Peak	$179-$230	$202	$171-$228	$138-$284
Nuclear	$86-$122	$88	$77-$97	$66-$115
Wind	$45-$95	$76	$63-$86	$51-$110
Solar PV	$91-$104	$156	$119-$184	$87-$256
Solar Thermal	$125-$164	$232	$186-$267	$146-$353

Works Cited

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