EXHIBIT J

Solar Ordinance	**Setbacks (feet)**				**Sound limit at perimeter (dBA)**
	From dwellings	From side/rear property lines	From road ROWs	Substation specifics	
Escanaba Township (original)	NA	50	50	NA	60
Cheboygan County	100	50	50	500' from dwellings and 250' from roads	60
Clinton County	NA	20	50	NA	60
Delta Township, Eaton County *	NA	5	5	NA	NA
Goodland Township, Lapeer County **	NA	130	130	NA	65
Imlay Township, Lapeer County	NA	50	50	NA	NA
AVERAGE		**60**	**66**		**61**

*** Standards for solar on residential lots; additional setbacks may be set by Township Board during application review; excluded from setback average.**

**** General sound limit for Industrial property; no solar limit referenced; wind sound limit is 45 dBA.**

EXHIBIT K

SECTION 16.10: ALTERNATIVE ENERGY

A. PURPOSE

It has become increasingly desirable in time of rising energy costs and shortages to look to alternative energy sources, solar and wind, for both residential and commercial uses. While utilization of these sources may reduce greenhouse gas emissions, implementation without realistic standards can cause problems visually and operationally both on and off site. These regulations are designed to balance rights of all parties and assist in benefitting the end user and the community as a whole in minimizing visual impacts and the potential for nuisance.

SECTION 16.10: ALTERNATIVE ENERGY

B. SOLAR ENERGY

Solar energy equipment consists of photovoltaic solar arrays and/ or a solar collection system. In addition to local ordinances and Marquette County Building Codes, they may also be subject to Restrictive Covenants or Owner's Association and/or Condominium Bylaws for specific sites. Common building code issues to address include exceeding roof load, unacceptable heat exchangers, improper wiring, inadequate separation from potable water supplies, etc. Potential zoning issues can include sideyard/bufferyard obstruction, exceeding height limits, visual degradation due to improper siting, off-premise vegetation growth affecting efficiency of ground mounted systems, etc. These items and other situation specific issues will be addressed upon application, site plan preparation and submittal, and a Public Hearing conducted by the Planning Commission.

C. WIND ENERGY

1. **DEFINITIONS**

Ambient Sound Level: The amount of background noise at a given location prior to the installation of a Wind Energy System (WES) which may include, but not be limited to, traffic, machinery, lawnmowers, human activity, and the interaction of wind with the landscape. The ambient sound level is measured on the dB(A) weighted scale as defined by the American National Standards Institute (ANSI) and is the sound pressure level exceeded 90% of the time (L90).

Commercial Freestanding Tower: Any tower except those used for Meteorological Tower (MET) measurement or Wind Energy Systems (WES).

Decibel (Db): The unit of power ratio equal to one tenth of a bell.

Noise: Any activity which creates or produces sound regardless of frequency exceeding the ambient noise levels at the property line of any property.

Noise Contour: The graphic depiction of the extent to which an average noise level affects the area surrounding a source of noise.

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

Noise, Decibel (dB): A unit for measuring the amplitude of sounds, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure of 20 micropascals.

Practically defined; the loudness of sound is measured in decibels. Whispering is approximately 30 decibels; conversational speech, 60; a garbage disposal, 80. Sound above 85 decibels may damage delicate hearing cells in the inner ear.

Meteorological Tower (MET): Includes the tower, base plate, anchors, guy cables and hardware, anemometers (wind speed indicators), wind direction vanes, booms to hold equipment anemometers and vanes, data logger, instrument wiring, and any telemetry devices that are used to monitor or transmit wind speed and wind flow characteristics for no more than a three (3) year period to record instantaneous wind information or to characterize the wind resource at a given location.

Non-Participating Parcel: A parcel of real estate that is neither a Project Parcel nor a Participating Parcel.

Participating Parcel: A parcel of real estate that is not a Project Parcel, but is subject to an agreement between the owner and developer allowing the construction of all or part of a LWES closer to a Participating Parcel property line or habitable structure than would be permitted in the absence of such an agreement.

Project Parcel: The parcel or parcels of real estate on which all or any part of a LWES will be constructed.

Tower Height: The height above average grade of the fixed portion (hub) of the tower.

Total Extended Height: For a *Horizontal Axis Wind Turbine* it is the distance from the average grade to highest point of the rotor blade and for a *Vertical Axis Wind Turbine* it is the distance from the average grade to the highest point of the wind turbine.

Wind Energy System (WES): A means of generating electrical power through the utilization of wind power which is further defined on the basis of capacity as:

Small Wind Energy System (SWES): A tower mounted system which includes the foundation, tower, generator, blades, wire or other components used in the system and which is primarily intended to reduce residential on-site consumption of utility power. The nameplate capacity rating shall not exceed sixty (60) kilowatts and the tower height shall not exceed one hundred (100) feet.

Medium Wind Energy System (MWES): A tower mounted system which includes the foundation, tower, generator, blades, wire or other components used in the system and which is primarily intended to reduce commercial, municipal, or industrial on-site consumption of utility power. The nameplate capacity is rated for more than sixty (60) kilowatts to up to a maximum of three hundred (300) kilowatts and the tower height shall not exceed one hundred sixty-four (164) feet.

Large Wind Energy System (LWES): A tower mounted system which includes the foundation, tower, generator, blades, wire or other components used in the system and which is primarily intended to supply electricity to a grid system for off-site customers. The nameplate capacity is rated to be more than three hundred (300) kilowatts and the tower height will exceed one hundred sixty-four (164) feet.

2. **METEOROLOGICAL TOWERS (MET) AND WIND ENERGY SYSTEMS (WES)**

a. **METEOROLOGICAL TOWERS (MET TOWER)**

Meteorological Towers (Met Towers) are permitted as a Temporary Conditional Use in the same districts as any Wind Energy System (WES).
Met Towers shall be permitted for not more than twelve (12) months for a Small Wind Energy System (SWES), twenty-four (24) months for a Medium Wind Energy System (MWES) and thirty-six (36) months for a Large Wind Energy System (LWES), and are subject to all applicable requirements and application procedures for Small Wind Energy Systems (SWES) regulated under Section b below.

b. **SMALL WIND ENERGY SYSTEMS (SWES)**

The primary use for this Small Wind Energy System, is for residential, on-site consumption of utility power produced by a generator of sixty (60) kilowatts or less and located on a tower not to exceed one hundred (100) feet in height above grade.

All applications shall be accompanied by the following informational requirements:

i. A completed Application Form, a Plot or Site Plan {Article 18- Site Plan Review, Section 18.03 (A) or Section 18.06} and a statement with supporting evidence, as specified in Article 17- Special Land Uses, Section 17.03 (C) APPLICATION PROCEDURE.

ii. Evidence of compliance with a setback of 110% of the total extended height of the Small Wind Energy System (SWES), from public road Right-of-Ways, overhead utility lines and all property lines. Guy wire anchors, if required, shall be placed a minimum of fifteen (15) feet from any property line and shall be clearly visible to a height of six (6) feet above grade.

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

iii. The Small Wind Energy System (SWES) specifications including the manufacturer, & model number, etc.; rotor diameter; tower height, type with drawings; tower foundation drawings.

iv. The method of restricting access to ground mounted electric/ control equipment and tower access to a height of ten (10) feet above grade.

v. Description of lightning protection and location of all underground wiring.

vi. Artificial lighting is prohibited unless required by the Federal Aviation Administration.

vii. Copies of written utility notification and permission to interconnect with the electric grid, unless the system is to be installed off-grid.

viii. Documentation that the rotor blade clearance will be a minimum of twenty (20) feet above grade.

ix. Evidence that turbine blade, shadow flicker will not fall on public roadways or off-site habitable structures.

x. A detailed description of the automatic braking, governing or feathering system to prevent uncontrolled blade rotation or over-speeding.

xi. Submission of a sound level analysis prepared by the turbine manufacturer or a Professional Engineer indicating that noise emissions from the Small Wind Energy System (SWES) will not exceed fifty (50) dB(A) measured at the property lines. This sound pressure level may be exceeded during short-term events such as utility outages and/or severe wind storms. In the event the ambient sound pressure level exceeds 50 dB(A), the standard shall be ambient plus 5 dB(A).

xii. A Small Wind Energy System (SWES) that is out-of-service for a continuous 12-month period will be deemed to have been abandoned. The Zoning Administrator may issue a Notice of Abandonment to the Owner of a SWES that is deemed to have been abandoned. The Owner shall have the right to respond to the Notice of Abandonment within thirty (30) days from receipt of the Notice of Abandonment. The Zoning Administrator shall withdraw the Notice of Abandonment and notify the Owner of such withdrawal if the Owner provides information that demonstrates the SWES has not been abandoned.

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

xiii. If the Small Wind Energy System (SWES) is determined to be abandoned, the Owner of the SWES shall remove the wind generator and the tower at the Owner's sole expense within ninety (90) days of receipt of the Notice of Abandonment. If the Owner fails to remove the wind generator and tower, the Zoning Administrator shall submit a recommendation to the Township Board to pursue legal action to have the wind generator and tower removed at the Owner's expense.

c. **MEDIUM WIND ENERGY SYSTEMS (MWES)**

The primary use of this system is for commercial, municipal, or industrial on-site consumption of utility power produced by a generator rated at more than sixty (60) kilowatts up to a maximum of three hundred (300) kilowatts and located on a tower not to exceed one hundred sixty-four (164) feet in height above grade.

All applications shall be accompanied by the informational requirements of Section b above except amended as follows:

i The Site Plan shall comply with the applicable requirements of Article 18- Site Plan Review, Section 18.06 REQUIRED INFORMATION.

ii Medium Wind Energy System (MWES) specifications including manufacturer & model numbers, etc.; rotor diameter; tower height, type & professionally certified drawings; professionally certified tower foundation drawings.

iii The method of restricting access to ground mounted electric/ control equipment and tower access to a height of twelve (12) feet above grade.

iv Demonstration that the rotor blade clearance is a minimum of thirty (30) feet above grade.

v Submission of a sound level analysis prepared by a Professional Engineer indicating that noise emissions from the Medium Wind Energy System (MWES) will not exceed forty-five (45) dB(A) measured at the property lines. This sound pressure level may be exceeded during short-term events such as utility outages and/or severe wind storms. In the event the ambient sound pressure level exceeds 45 dB (A), the standard shall be ambient plus 5 dB (A).

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

A Medium Wind Energy System (MWES) that is out-of-service for a continuous 12-month period will be deemed to have been abandoned. The Zoning Administrator may issue a Notice of Abandonment to the Owner of a MWES that is deemed to have been abandoned. The Owner shall have the right to respond to the Notice of Abandonment within thirty (30) days from receipt of the Notice of Abandonment. The Zoning Administrator shall withdraw the Notice of Abandonment and notify the Owner of such withdrawal if the Owner provides information that demonstrates the SWES has not been abandoned.

If the Medium Wind Energy System (MWES) is determined to be abandoned, the Owner of the MWES shall remove the wind generator and the tower at the Owner's sole expense within ninety (90) days of receipt of the Notice of Abandonment. If the Owner fails to remove the wind generator and tower, the Zoning Administrator shall submit a recommendation to the Township Board to pursue legal action to have the wind generator and tower removed at the Owner's expense.

d. **LARGE WIND ENERGY SYSTEMS (LWES)**

NOTE A: The construction of a Large Wind Energy System (LWES) is typically preceded by an investigation of on-site wind characteristics to assess suitability for power generation. This generally involves wind monitoring over several months with the installation of a Meteorological Tower (Met Tower), which due to its height, would necessitate an application for and approval of a Temporary Use Permit.

Prospective applicants are apprised that the Charter Township of Marquette has initially adopted basic regulations for Large Wind Energy System (LWES) to assist developers in site assessment and up-front planning to minimize potential problems.

Upon granting a Special Use for a Meteorological Tower in districts where LWES are conditionally permitted, the Charter Township of Marquette Planning Commission will commence work to complete this section of the ordinance within eleven (11) months. Topics to be addressed may include, but are not limited to, Road Use and Restoration Plan, Design Site Plan, Aircraft Protection, Blasting Plan, Avian & Wildlife Impact, Microwave and Electromagnetic Interference, Shadow Flicker Analysis, Noise & Testing Parameters, Lightning & Stray Voltage Assessment, Security & Emergency Response Plan, Emergency Shutdown Plan, Decommissioning & Site Restoration Plan and Bonding/Financial Guarantee Agreement, etc.

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

The primary use of this system is to supply electricity to a grid system for off-site customers produced by a generator rated at more than three hundred (300) kilowatts, and located on a tower exceeding one hundred sixty-four (164) feet in height above grade. Property may be owned or leased by the developer.

LARGE WIND ENERGY SYSTEMS (LWES) WILL BE INITIALLY SUBJECT TO THE FOLLOWING REQUIREMENTS:

(1) The Site Plan shall comply with the applicable requirements of Article 18- Site Plan Review, Section 18.06 REQUIRED INFORMATION.

(2) Turbine rotor blade clearance shall be a minimum of fifty (50) feet above grade.

NOTE B: Noise related to Large Wind Energy System (LWES) installations is a serious concern for impacted communities and the emergent wind industry. Available information about the negative effects of these systems upon individuals appears to be contradictory, although research completed and in progress appears to support the potential for public health risks for a segment of the population and other negative impacts upon property. Progress within the wind industry is continuous with increasingly higher generating capacity available in individual wind turbines. More study is required to assess the impact of these industrial-sized systems on the health, safety, and welfare of people residing, pursuing recreation and/or working in their general vicinity. Options presently available to reduce Large Wind Energy System (LWES) noise emissions involve reducing the sound power at the source or increasing the distance between source and receiver.

(3) **SETBACKS**

(a) Each Large Wind Energy System (LWES) shall be setback 150% of the total extended height of the LWES from any Participating Parcel or Project Parcel property boundary lines.

(b) Each Large Wind Energy System (LWES) shall be setback 200% of the total extended height of the LWES from any public road Right-of-Way and any overhead utility line.

(c) Each Large Wind Energy System (LWES) shall be located sixteen hundred (1600) feet from any single family or seasonal dwelling located on a Participating Parcel.

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

(d) Each Large Wind Energy System (LWES) shall be located thirty three hundred (3300) feet from any single family or seasonal dwelling located on a Non-Participating Parcel.

(4) **SOUND EMISSION TESTING**

All testing, modeling, and analysis of each Large Wind Energy System (LWES) shall conform to the measurement standards and protocols of The American Standards Institute (ANSI) S12.9, Parts 1-5: (ANSI) S12.17; (ANSI) S12.18 and International Electric Code (IEC) 61400 - 11 and be performed by a qualified Professional Consultant/Engineer selected by the Charter Township of Marquette and paid for by the applicant via an Escrow Account established by the Township.

(a) In order to establish long-term background noise, the pre-construction La90 and Lc90 ambient sound levels are to be measured at the property lines of Non-Participating Parcels during night time hours of 9:00 PM to 6:00 AM.

(b) Post-construction operating sound levels are to be measured within nine (9) months of a fully operational Large Wind Energy Systems (LWES) installation at the property lines of Non-Participating Parcels during night time hours of 9:00 PM to 6:00 AM. The maximum noise emission at any Non-Participating Parcels containing a single family or seasonal dwelling shall not exceed the following limits:

i Maximum Emission Level - 40dB(A)

ii Maximum Emission Level - 55 dB(C)

iii Maximum emission above preconstruction ambient level - La90 + 5dB

iv Maximum emission above preconstruction ambient level - Lc90 + 5dB

v Emission Spectra Imbalance - Lc90 + 5dB - (La90 + 5dB) ≤ 20dB

SECTION 16.10: ALTERNATIVE ENERGY – (Cont.)

Each limit (i) through (v) above is independent and exceeding any of the limits will be determined to be evidence of non-compliance. The Zoning Administrator shall immediately inform the operator of non-compliance with the Emission Limits. The Large Wind Energy System (LWES) shall be removed from operation until such time as compliance with noise levels can be demonstrated. (End Amend. 08-02-10)

Information in the Sounds Emission testing section is based in part upon "The How To Guide To Siting Wind Turbines To Prevent Health Risks From Sound" by G. W. Kamperman and R. R. James Version 2.1, dated October 28, 2008.

SECTION 16.11: PARK & RIDE

1. Park & Ride land use may only be located in the zoned, General Business (GB) Zoning District and Development District (DD).

2. Park & Ride land use shall be subject to the review and approval requirements set forth in Article 14 – ACCESS MANAGEMENT REGULATIONS, ARTICLE 17 SPECIAL LAND USES, ARTICLE 18 – SITE PLAN REVIEW, ARTICLE 20 – MISCELLANEOUS PROVISIONS, and ARTICLE 21 – OFF-STREET PARKING REQUIREMENTS.

3. A Park & Ride Lot shall not have more than 150 parking stalls in a single development.

SECTION 16.12: TINY HOMES

1. In addition to complying with of other relevant Sections of this Ordinance, except for minimum square footage requirements, petitioners desiring to site and/or construct a Tiny Home (*as defined in Section 2.02*) shall also provide the following information to be considered for a special land use permit:

   a. Marquette County Building Permit(s)
   b. Marquette County Health Department Permit(s)
   c. Off-street parking conforming to residential single-family dwelling units under Article 21.
   d. Connection to a public sewer and water supply in compliance with the Marquette Township requirements, or to such private facilities as approved by the Marquette County Health Department.

SECTION 16.13: SHORT-TERM RENTALS

1. In addition to complying with other relevant sections of this Ordinance, petitioners desiring to conduct a short-term rental unit (as defined in Article 2), the petitioner shall also provide the following information in order to be considered for a special use permit:

EXHIBIT L

DRAFT **1/10/2020**

Orion Renewable Energy Group, LLC

Property Tax Contribution

125MW Chandler Solar Project in Escanaba Township, Delta County, MI

DRAFT capital cost estimates and projection figures provided for methodology validation.

Educational tax rate exemption applied to personal industrial property.

Year	Total Tax & Fees:	Township Fee	State Education (Real & Personal Utility Property Only)	County Operating	Gladstone School Operating (Real & Personal Utility Property Only)	Gladstone School Debt	911 Authority	Intermediate School	Community College	Road Patrol	COMM ACTION	Township Operating	Com College Debt	Delta Area Transit Auth (DATA)	Recycling	Jail Bond Debt
Millage Rate			6.00000	5.03170	18.00000	6.20000	0.75000	2.38510	2.30760	1.30000	0.60000	0.80410	1.00000	0.50000	0.30000	0.83500
	%	1%	0.6000%	0.5032%	1.8000%	0.6200%	0.0750%	0.2385%	0.2308%	0.1300%	0.0600%	0.0804%	0.1000%	0.0500%	0.0300%	0.0835%
1	$ 1,230,008	$ 12,178	$ 16,926	$ 278,062	$ 50,778	$ 276,239	$ 41,447	$ 131,805	$ 127,523	$ 71,841	$ 33,157	$ 44,436	$ 55,262	$ 27,631	$ 16,579	$ 46,144
2	$ 1,061,737	$ 10,512	$ 15,054	$ 237,950	$ 45,162	$ 243,187	$ 35,468	$ 112,792	$ 109,127	$ 61,477	$ 28,374	$ 38,026	$ 47,290	$ 23,645	$ 14,187	$ 39,487
3	$ 943,872	$ 9,345	$ 13,728	$ 210,154	$ 41,184	$ 219,147	$ 31,325	$ 99,616	$ 96,379	$ 54,296	$ 25,060	$ 33,584	$ 41,766	$ 20,883	$ 12,530	$ 34,875
4	$ 851,343	$ 8,429	$ 12,675	$ 188,518	$ 38,025	$ 199,745	$ 28,100	$ 89,360	$ 86,457	$ 48,706	$ 22,480	$ 30,126	$ 37,466	$ 18,733	$ 11,240	$ 31,284
5	$ 771,419	$ 7,638	$ 11,759	$ 169,960	$ 35,276	$ 182,601	$ 25,333	$ 80,564	$ 77,946	$ 43,911	$ 20,267	$ 27,161	$ 33,778	$ 16,889	$ 10,133	$ 28,205
6	$ 704,320	$ 6,973	$ 10,979	$ 154,482	$ 32,936	$ 167,930	$ 23,026	$ 73,227	$ 70,847	$ 39,912	$ 18,421	$ 24,687	$ 30,702	$ 15,351	$ 9,211	$ 25,636
7	$ 650,240	$ 6,438	$ 10,335	$ 142,083	$ 31,005	$ 155,926	$ 21,178	$ 67,350	$ 65,161	$ 36,709	$ 16,943	$ 22,706	$ 28,238	$ 14,119	$ 8,471	$ 23,578
8	$ 609,343	$ 6,033	$ 9,828	$ 132,764	$ 29,484	$ 146,751	$ 19,789	$ 62,932	$ 60,887	$ 34,301	$ 15,831	$ 21,217	$ 26,385	$ 13,193	$ 7,916	$ 22,032
9	$ 554,848	$ 5,494	$ 9,185	$ 120,365	$ 27,554	$ 134,337	$ 17,941	$ 57,055	$ 55,201	$ 31,098	$ 14,353	$ 19,235	$ 23,921	$ 11,961	$ 7,176	$ 19,974
10	$ 527,141	$ 5,219	$ 8,814	$ 114,124	$ 26,442	$ 127,998	$ 17,011	$ 54,097	$ 52,339	$ 29,485	$ 13,609	$ 18,238	$ 22,681	$ 11,341	$ 6,804	$ 18,939
11	$ 485,830	$ 4,810	$ 8,307	$ 104,805	$ 24,921	$ 118,414	$ 15,622	$ 49,679	$ 48,065	$ 27,078	$ 12,497	$ 16,749	$ 20,829	$ 10,414	$ 6,249	$ 17,392
12	$ 457,963	$ 4,534	$ 7,937	$ 98,565	$ 23,810	$ 111,916	$ 14,692	$ 46,721	$ 45,203	$ 25,465	$ 11,753	$ 15,751	$ 19,589	$ 9,794	$ 5,877	$ 16,357
13	$ 430,031	$ 4,258	$ 7,566	$ 92,324	$ 22,698	$ 105,354	$ 13,761	$ 43,763	$ 42,341	$ 23,853	$ 11,009	$ 14,754	$ 18,349	$ 9,174	$ 5,505	$ 15,321
14	$ 415,669	$ 4,116	$ 7,332	$ 89,163	$ 21,996	$ 102,005	$ 13,290	$ 42,265	$ 40,891	$ 23,036	$ 10,632	$ 14,249	$ 17,720	$ 8,860	$ 5,316	$ 14,796
15	$ 346,573	$ 3,431	$ 6,552	$ 73,685	$ 19,656	$ 85,358	$ 10,983	$ 34,928	$ 33,793	$ 19,037	$ 8,787	$ 11,775	$ 14,644	$ 7,322	$ 4,393	$ 12,228
16	$ 345,830	$ 3,424	$ 6,455	$ 73,603	$ 19,364	$ 85,269	$ 10,971	$ 34,889	$ 33,755	$ 19,016	$ 8,777	$ 11,762	$ 14,628	$ 7,314	$ 4,388	$ 12,214
17	$ 345,086	$ 3,417	$ 6,357	$ 73,522	$ 19,071	$ 85,180	$ 10,959	$ 34,850	$ 33,718	$ 18,995	$ 8,767	$ 11,749	$ 14,612	$ 7,306	$ 4,384	$ 12,201
18	$ 344,343	$ 3,409	$ 6,260	$ 73,440	$ 18,779	$ 85,091	$ 10,947	$ 34,812	$ 33,680	$ 18,974	$ 8,757	$ 11,736	$ 14,595	$ 7,298	$ 4,379	$ 12,187
19	$ 343,599	$ 3,402	$ 6,162	$ 73,358	$ 18,486	$ 85,002	$ 10,934	$ 34,773	$ 33,643	$ 18,953	$ 8,748	$ 11,723	$ 14,579	$ 7,290	$ 4,374	$ 12,174
20	$ 342,856	$ 3,395	$ 6,065	$ 73,276	$ 18,194	$ 84,913	$ 10,922	$ 34,734	$ 33,605	$ 18,932	$ 8,738	$ 11,710	$ 14,563	$ 7,281	$ 4,369	$ 12,160
21	$ 342,113	$ 3,387	$ 5,967	$ 73,195	$ 17,901	$ 84,824	$ 10,910	$ 34,695	$ 33,568	$ 18,911	$ 8,728	$ 11,697	$ 14,547	$ 7,273	$ 4,364	$ 12,146
22	$ 341,369	$ 3,380	$ 5,870	$ 73,113	$ 17,609	$ 84,734	$ 10,898	$ 34,657	$ 33,530	$ 18,890	$ 8,718	$ 11,684	$ 14,530	$ 7,265	$ 4,359	$ 12,133
23	$ 340,626	$ 3,373	$ 5,772	$ 73,031	$ 17,316	$ 84,645	$ 10,886	$ 34,618	$ 33,493	$ 18,868	$ 8,709	$ 11,671	$ 14,514	$ 7,257	$ 4,354	$ 12,119
24	$ 339,882	$ 3,365	$ 5,675	$ 72,949	$ 17,024	$ 84,556	$ 10,873	$ 34,579	$ 33,455	$ 18,847	$ 8,699	$ 11,658	$ 14,498	$ 7,249	$ 4,349	$ 12,106
25	$ 339,139	$ 3,358	$ 5,577	$ 72,867	$ 16,731	$ 84,467	$ 10,861	$ 34,540	$ 33,418	$ 18,826	$ 8,689	$ 11,645	$ 14,482	$ 7,241	$ 4,345	$ 12,092
Yrs 1-5	$ 4,858,379	$ 48,103	$ 70,142	$1,084,644	$ 210,425	$1,120,919	$ 161,672	$ 514,137	$ 497,431	$ 280,231	$ 129,337	$173,333	$ 215,562	$ 107,781	$ 64,669	$ 179,994
Yrs 6-10	$ 3,045,892	$ 30,157	$ 49,140	$ 663,818	$ 147,420	$ 732,943	$ 98,945	$ 314,660	$ 304,435	$ 171,505	$ 79,156	$106,083	$ 131,927	$ 65,964	$ 39,578	$ 110,159
Yrs 11-15	$ 2,136,065	$ 21,149	$ 37,694	$ 458,542	$ 113,081	$ 523,048	$ 68,348	$ 217,356	$ 210,293	$ 118,470	$ 54,678	$ 73,278	$ 91,131	$ 45,565	$ 27,339	$ 76,094
Yrs 16-20	$ 1,721,715	$ 17,047	$ 31,298	$ 367,199	$ 93,893	$ 425,454	$ 54,733	$ 174,058	$ 168,402	$ 94,870	$ 43,786	$ 58,681	$ 72,977	$ 36,489	$ 21,893	$ 60,936
Yrs 21-25	$ 1,703,128	$ 16,863	$ 28,860	$ 365,155	$ 86,580	$ 423,226	$ 54,428	$ 173,089	$ 167,465	$ 94,342	$ 43,543	$ 58,354	$ 72,571	$ 36,285	$ 21,771	$ 60,597
Total	$13,465,179	$133,319	$ 217,133	$2,939,358	$ 651,398	$3,225,590	$ 438,126	$1,393,299	$1,348,026	$ 759,418	$ 350,501	$469,729	$ 584,168	$ 292,084	$ 175,250	$ 487,780

EXHIBIT M

5lakes energy
Clean Energy & Sustainability Consultants

Solar Farms and Property Values

Solar farms do not decrease property values

Recent studies of the effect solar farms have on property values show that there is no discernable impact to property values when solar farms are located near residential, agricultural or industrial properties.[1,2] Detailed property valuation studies in North Carolina,[3] Illinois, and Indiana,[4] including interviews and surveys of real estate agents and county assessors, have all found no effect on property values from utility-scale solar farms.

These findings are similar to those of property values and wind farms. Lawrence Berkley National Laboratory conducted a study of more than 50,000 home sales proximate to 67 wind facilities in 27 counties across nine U.S. states.[5] The researchers found no measurable impact of proximity to wind turbines on home sales.

Moreover, studies have found that there are substantial benefits flowing to the communities where solar farms locate. A report by the University of North Carolina examined the economic impact of more than 100 solar projects in over 50 counties, finding that solar farms have increased the tax revenue from agricultural property by between 1,000 and 10,000 percent.[6]

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[1] CohnReznick, LLP. May 2018. "Property Value Impact Study." http://www.co.kendall.il.us/wp-content/uploads/Attachment-29-Property-Value-Study.pdf.

[2] Kirkland Appraisals, LLC. April 2018, "Flatwood Solar Impact Study." http://www.chathamnc.org/home/showdocument?id=39355.

[3] *Ibid.*

[4] CohnReznick, LLP. May 2018. "Property Value Impact Study." http://www.co.kendall.il.us/wp-content/uploads/Attachment-29-Property-Value-Study.pdf.

[5] Hoen, B. et al. 2013. "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States." Lawrence Berkeley National Laboratory, LBNL-6362E. http://emp.lbl.gov/sites/all/files/lbnl-6362e.pdf.

[6] Davidson, A. et al. 2015. "Analyzing the Impact of Utility-scale Solar Installations on Local Government Revenue in Counties Across North Carolina." University of North Carolina, ENEC 698 Capstone Project. https://ie.unc.edu/files/2015/12/capstone_ENEC698Fall15FinalPaper.pdf.

EXHIBIT N

5lakes energy
Clean Energy & Sustainability Consultants

Economics of Solar Energy

Solar farms bring new tax revenue

Solar farms provide much needed long-term tax revenue to local communities. A 20 megawatt solar farm in Michigan can provide as much as $7 million dollars in additional tax revenue to a host community over 30 years. The revenue can support schools and a wide array of community services, including police and fire, senior services, libraries and road improvements.

Solar farms bring reliable income to landowners

Farmers whose lease their land for solar farms often receive $800 – 1500 per acre annually. This amounts to several times more dollars per acre than farmers would receive either by farming the land themselves or leasing the land to tenant farmers.

Solar farms lower wholesale electricity costs

Recent studies show that solar and wind energy reduce the wholesale price of electricity in electricity markets.[1] Reducing these prices benefits all ratepayers by reducing the energy costs of producing goods and services.

Solar energy is quickly becoming the lowest way to produce electricity

Deployment of large-scale solar farms is accelerating around the country with solar energy predicted to become the dominate new energy source in the future.[2] Utility-scale solar energy is expected to fall to $0.03 per kwh across all U.S. markets by 2030 without any federal or state subsidies.[3] At that cost, solar energy will become the dominant energy choice for broad applications. In fact, Midwest utilities like Consumers Energy in Michigan are planning significant investments in solar energy over the next 30 years because it will be the cheapest option.

Michigan utilities are transitioning to solar energy

DTE Energy and Consumers Energy, Michigan's two largest utilities, have announced plans to build 11,550 megawatts of renewable energy, most of which will be solar energy, to provide long-term clean and economical energy sources for Michigan consumers.[4,5]

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1 http://eta-publications.lbl.gov/sites/default/files/report_pdf_0.pdf
2 https://e360.yale.edu/features/northern-lights-utility-scale-solar-power-spreading-across-the-us
3 https://www.energy.gov/eere/solar/sunshot-2030
4 https://pv-magazine-usa.com/2018/06/21/michigan-utility-lay-out-plan-for-6-35gw-of-solar-and-no-coal-by-2040/
5 http://newsroom.dteenergy.com/2017-05-16-DTE-Energy-announces-plan-to-reduce-carbon-emissions-by-80-percent#sthash.S9f3dJi3.dpbs

EXHIBIT O

NOVEMBER 2019

LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS—VERSION 13.0

LAZARD

Introduction

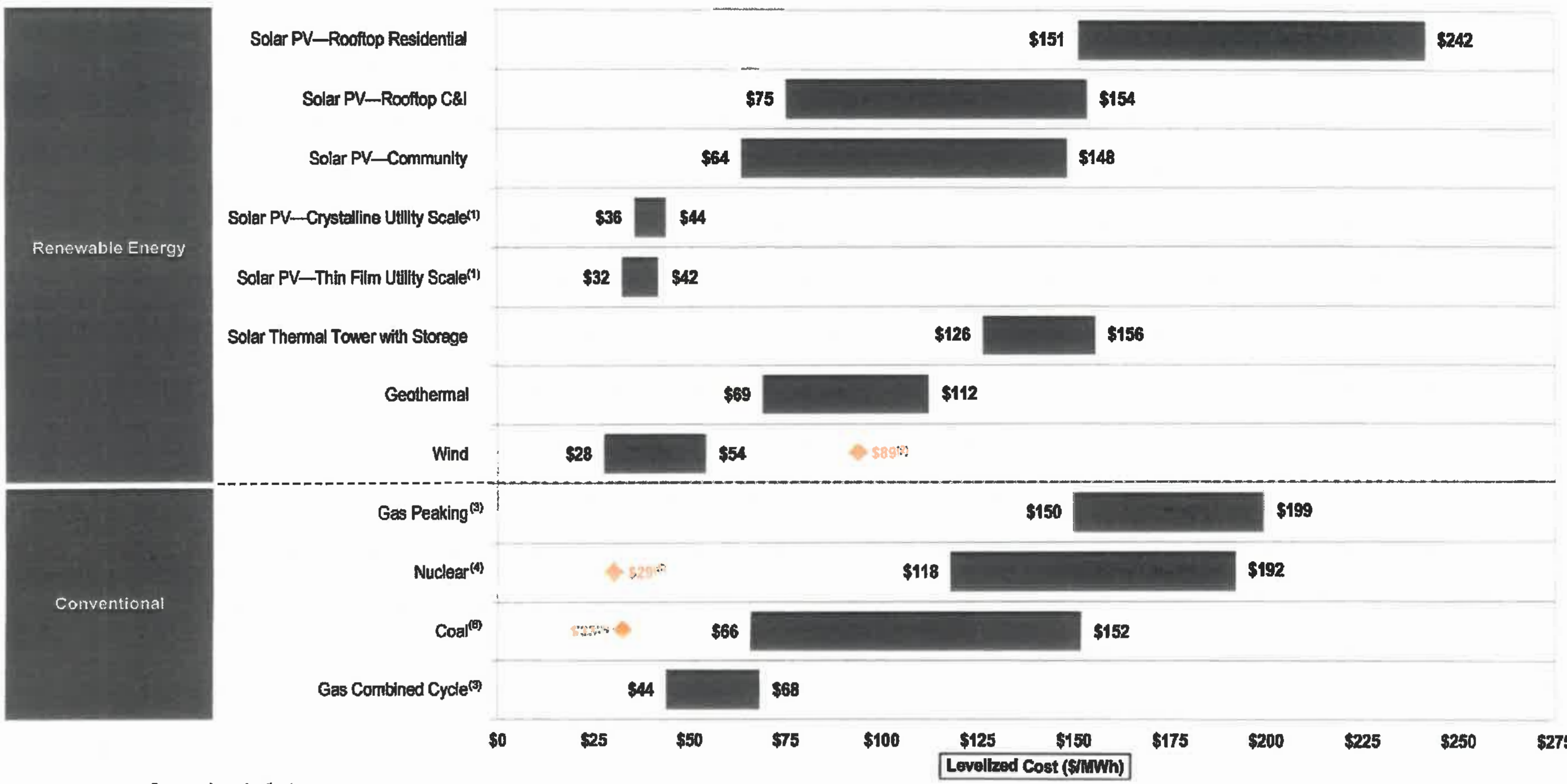
Lazard's Levelized Cost of Energy ("LCOE") analysis addresses the following topics:

- **Comparative LCOE analysis for various generation technologies on a $/MWh basis, including sensitivities for U.S. federal tax subsidies, fuel prices and costs of capital**
- **Illustration of how the LCOE of onshore wind and utility-scale solar compare to the marginal cost of selected conventional generation technologies**
- **Historical LCOE comparison of various utility-scale generation technologies**
- **Illustration of the historical LCOE declines for wind and utility-scale solar technologies**
- **Illustration of how the LCOEs of utility-scale solar and wind compare to those of gas peaking and combined cycle**
- **Comparison of capital costs on a $/kW basis for various generation technologies**
- **Deconstruction of the LCOE for various generation technologies by capital cost, fixed operations and maintenance expense, variable operations and maintenance expense and fuel cost**
- **Overview of the methodology utilized to prepare Lazard's LCOE analysis**
- **Considerations regarding the operating characteristics and applications of various generation technologies**
- **An illustrative comparison of the value of carbon abatement of various renewable energy technologies**
- **Summary of assumptions utilized in Lazard's LCOE analysis**
- **Summary considerations in respect of Lazard's approach to evaluating the LCOE of various conventional and renewable energy technologies**

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: capacity value vs. energy value; network upgrades, transmission, congestion or other integration-related costs; significant permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distributed generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., nuclear waste disposal, airborne pollutants, greenhouse gases, etc.)

Levelized Cost of Energy Comparison—Unsubsidized Analysis

Selected renewable energy generation technologies are cost-competitive with conventional generation technologies under certain circumstances



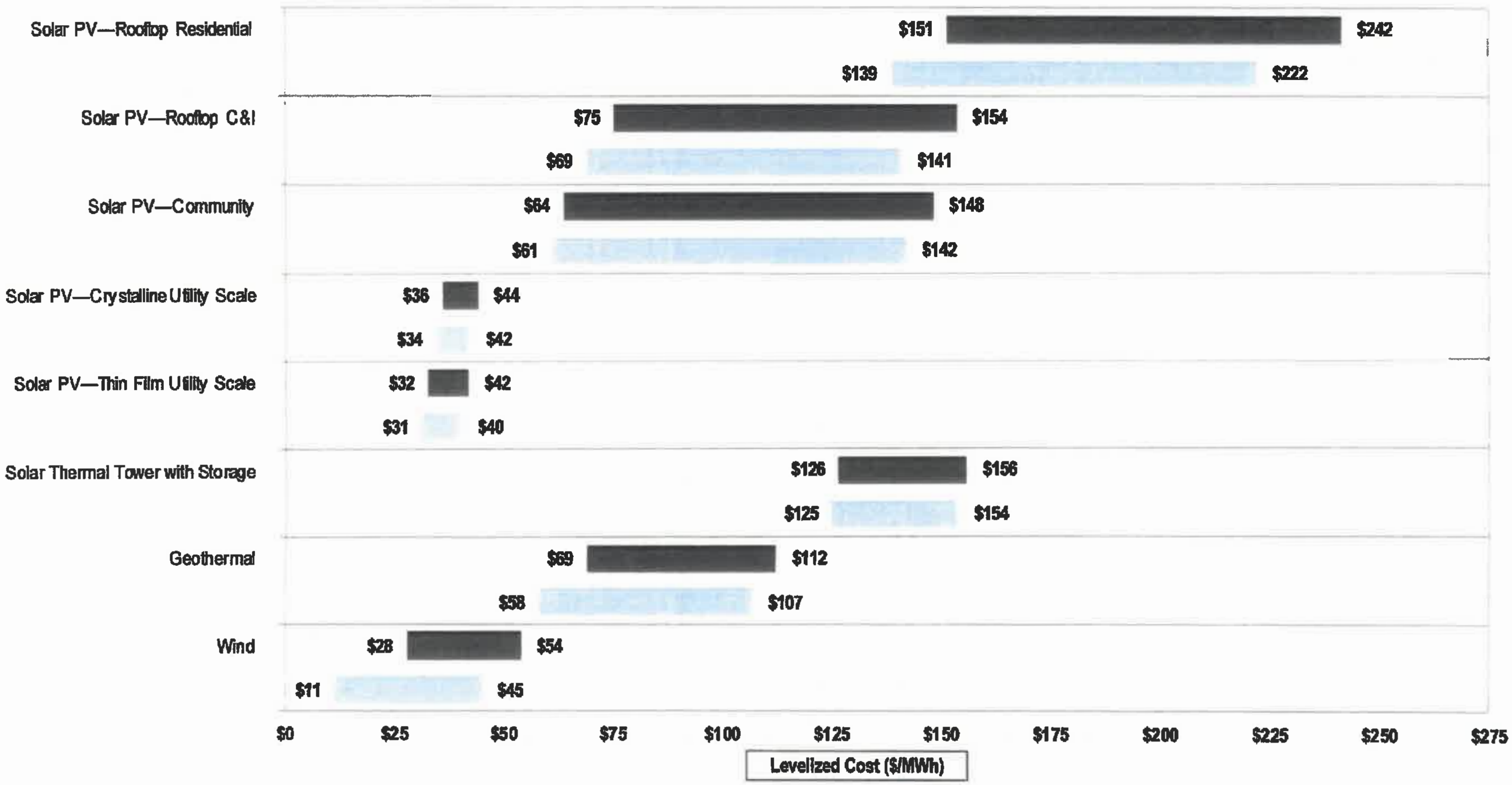
Source: *Lazard estimates.*

Note: Here and throughout this presentation, unless otherwise indicated, the analysis assumes 60% debt at 8% interest rate and 40% equity at 12% cost. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital" for cost of capital sensitivities. These results are not intended to represent any particular geography. Please see page titled "Solar PV versus Gas Peaking and Wind versus CCGT—Global Markets" for regional sensitives to selected technologies.

(1) Unless otherwise indicated herein, the low end represents a single-axis tracking system and the high end represents a fixed-tilt system.
(2) Represents the estimated implied midpoint of the LCOE of offshore wind, assuming a capital cost range of approximately \$2.33 – \$3.53 per watt.
(3) The fuel cost assumption for Lazard's global, unsubsidized analysis for gas-fired generation resources is \$3.45/MMBTU.
(4) Unless otherwise indicated, the analysis herein does not reflect decommissioning costs, ongoing maintenance-related capital expenditures or the potential economic impacts of federal loan guarantees or other subsidies.
(5) Represents the midpoint of 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. Please see page titled "Levelized Cost of Energy Comparison—Renewable Energy versus Marginal Cost of Selected Existing Conventional Generation" for additional details.
(6) High end incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies(1)

The Investment Tax Credit ("ITC") and Production Tax Credit ("PTC"), extended in December 2015, remain an important component of the levelized cost of renewable energy generation technologies



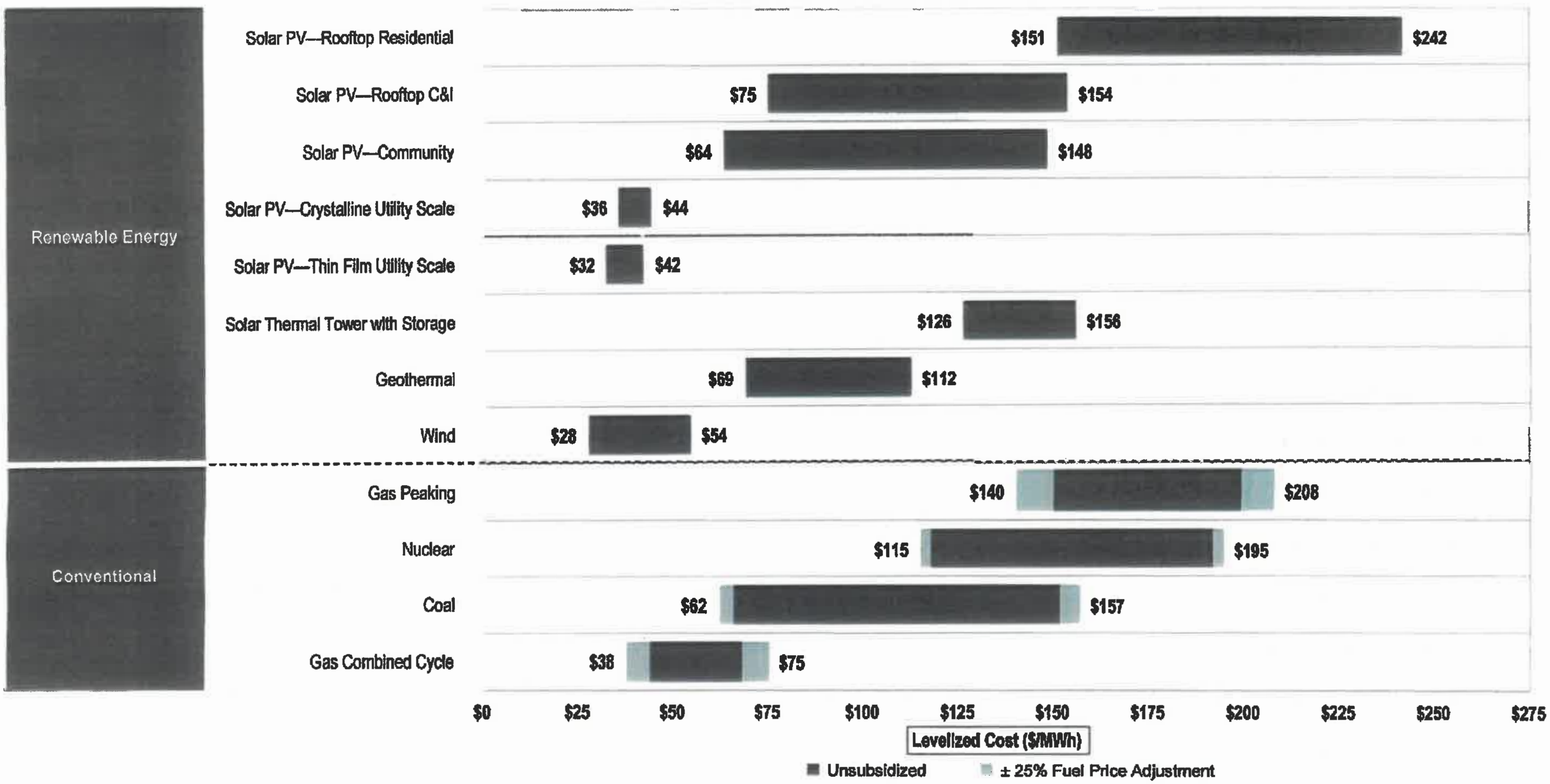
Source: Lazard estimates.

Note: The sensitivity analysis presented on this page also includes sensitivities related to the U.S. Tax Cuts and Jobs Act ("TCJA") of 2017. The TCJA contains several provisions that impact the LCOE of various generation technologies (e.g., a reduced federal corporate income tax rate, an ability to elect immediate bonus depreciation, limitations on the deductibility of interest expense and restrictions on the utilization of past net operating losses). On balance, the TCJA reduced the LCOE of conventional generation technologies and marginally increased the LCOE for renewable energy technologies.

(1) The sensitivity analysis presented on this page assumes that projects qualify for the full ITC/PTC and have a capital structure that includes sponsor equity, tax equity and debt.

Levelized Cost of Energy Comparison—Sensitivity to Fuel Prices

Variations in fuel prices can materially affect the LCOE of conventional generation technologies, but direct comparisons to "competing" renewable energy generation technologies must take into account issues such as dispatch characteristics (e.g., baseload and/or dispatchable intermediate capacity vs. those of peaking or intermittent technologies)

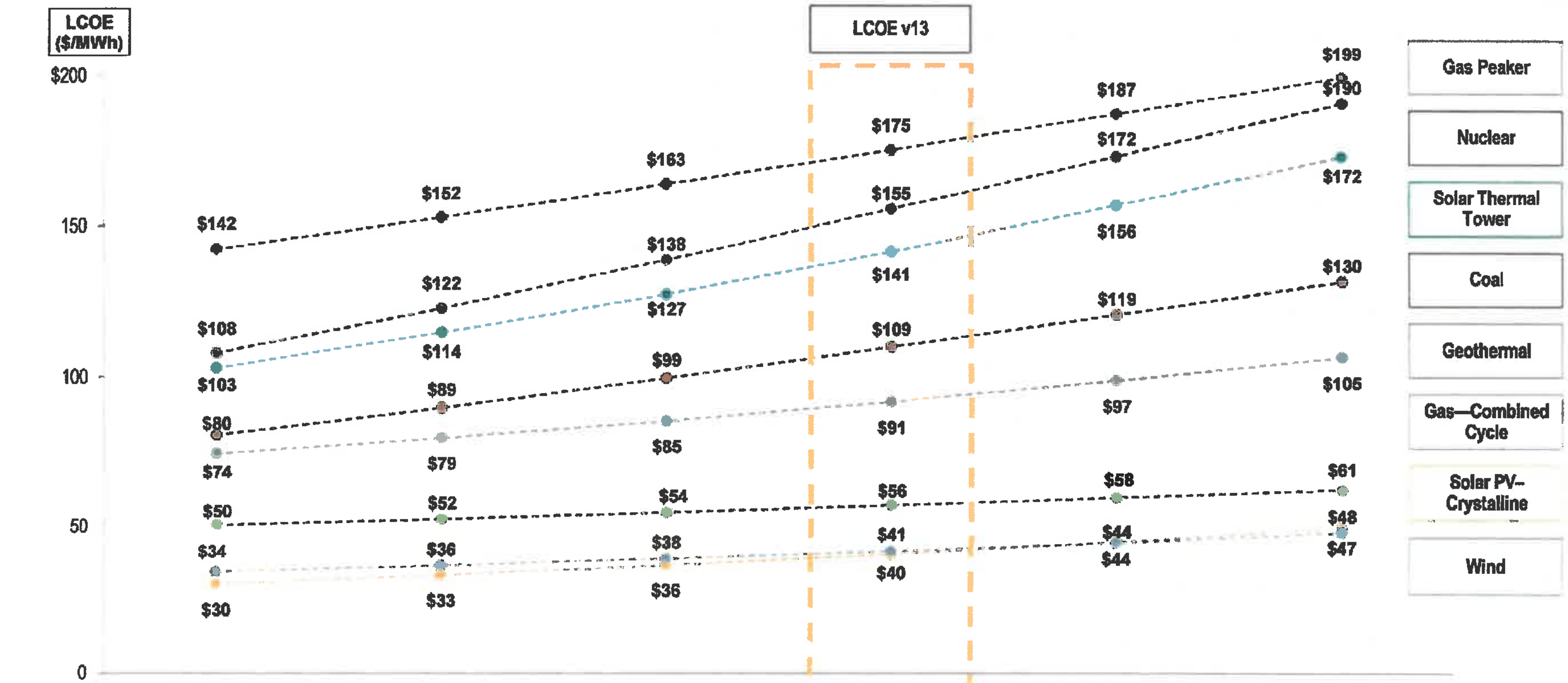


Source: Lazard estimates.
Note: Unless otherwise noted, the assumptions used in this sensitivity correspond to those used in the global, unsubsidized analysis as presented on the page titled "Levelized Cost of Energy Comparison—Unsubsidized Analysis".

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

Midpoint of Unsubsidized LCOE[2]

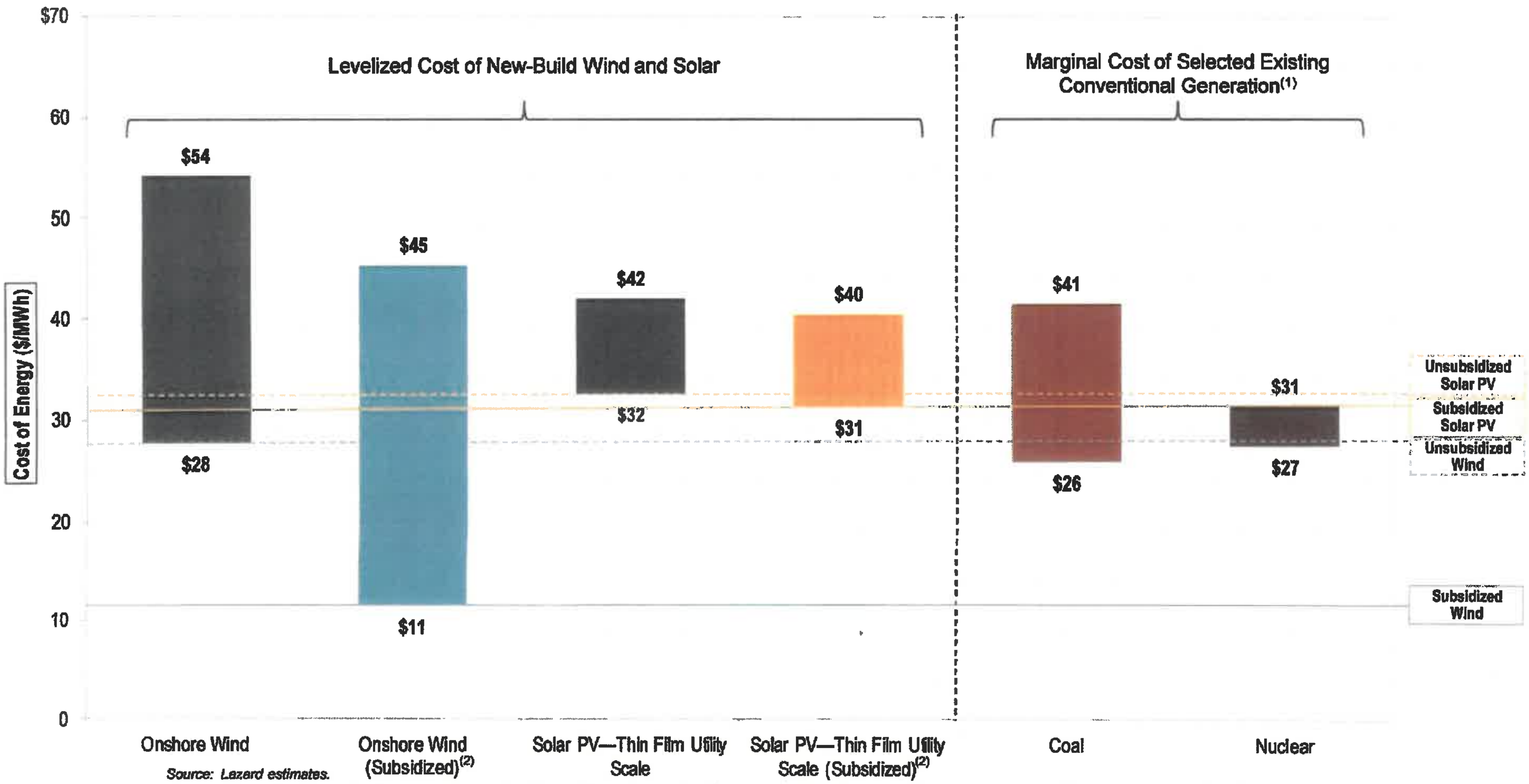


After-Tax IRR/WACC	5.4%	6.2%	6.9%	7.7%	8.4%	9.2%
Cost of Equity	9.0%	10.0%	11.0%	12.0%	13.0%	14.0%
Cost of Debt	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%

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.

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".

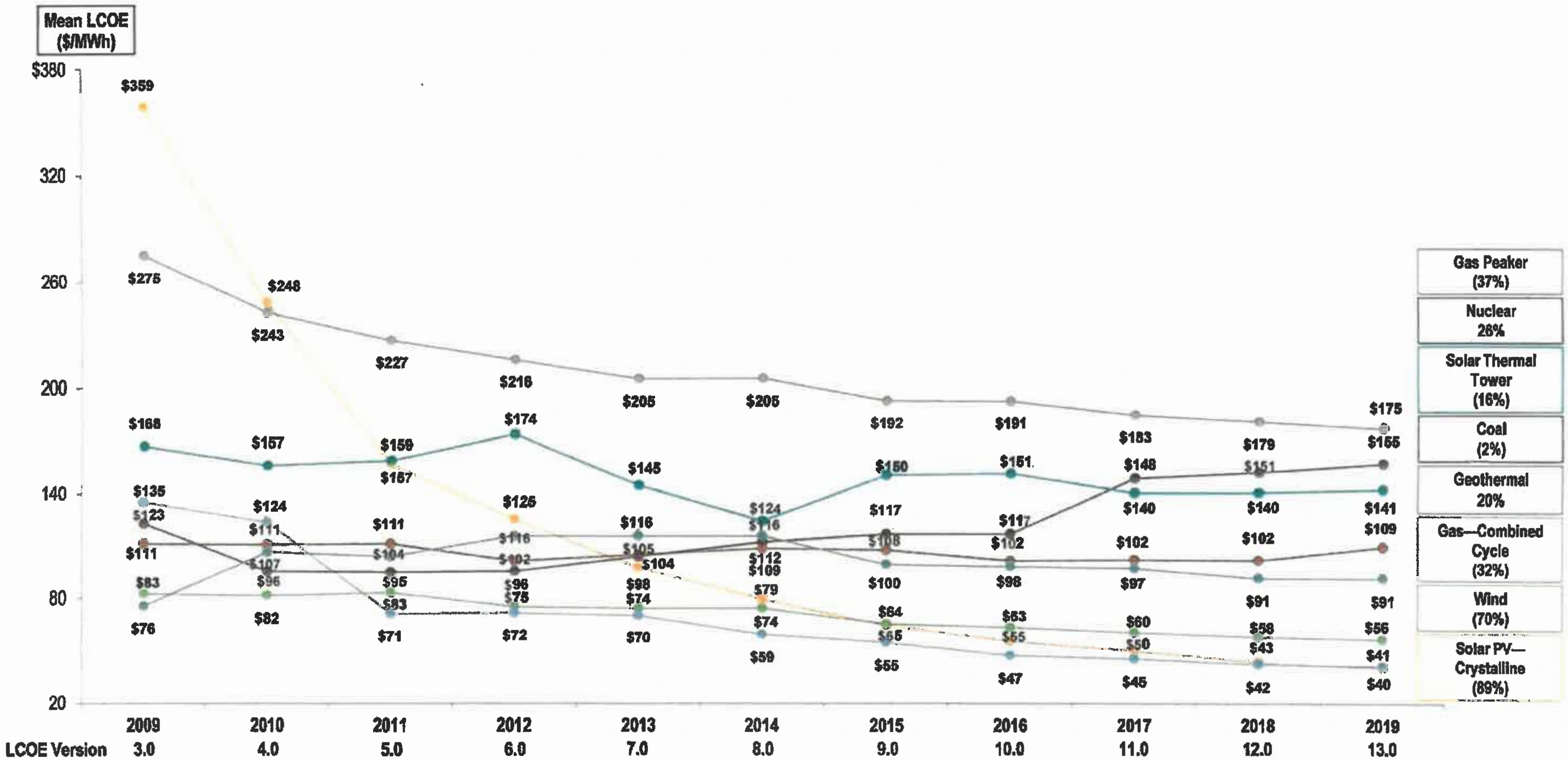
(1) Represents the marginal cost of operating coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to its decommissioning and site restoration costs. Inputs are derived from a benchmark 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.

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)



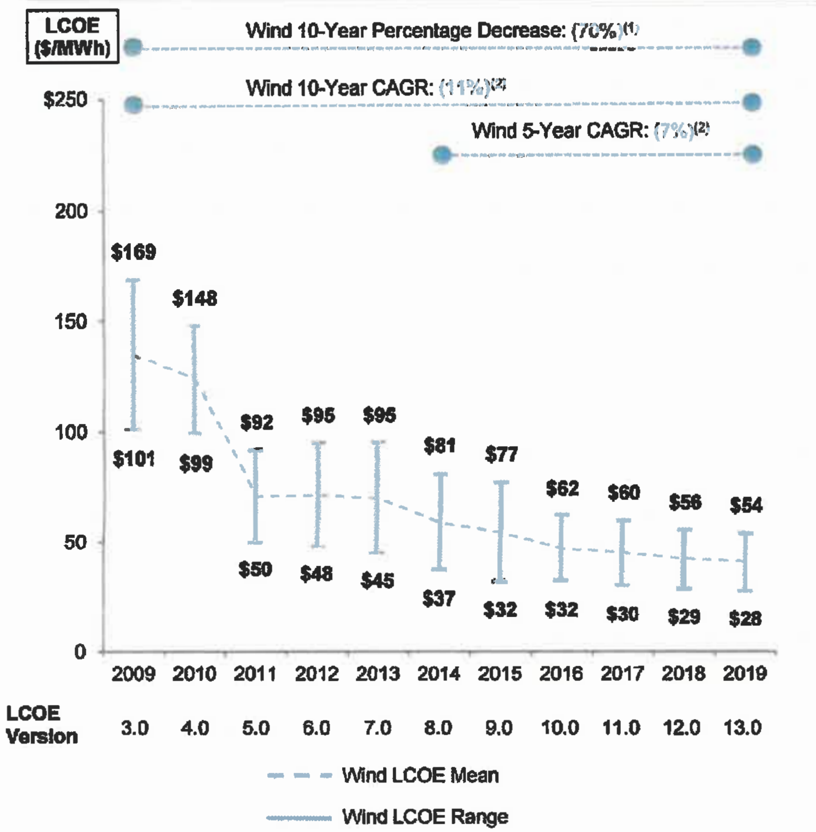
Source: Lazard estimates.

(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.

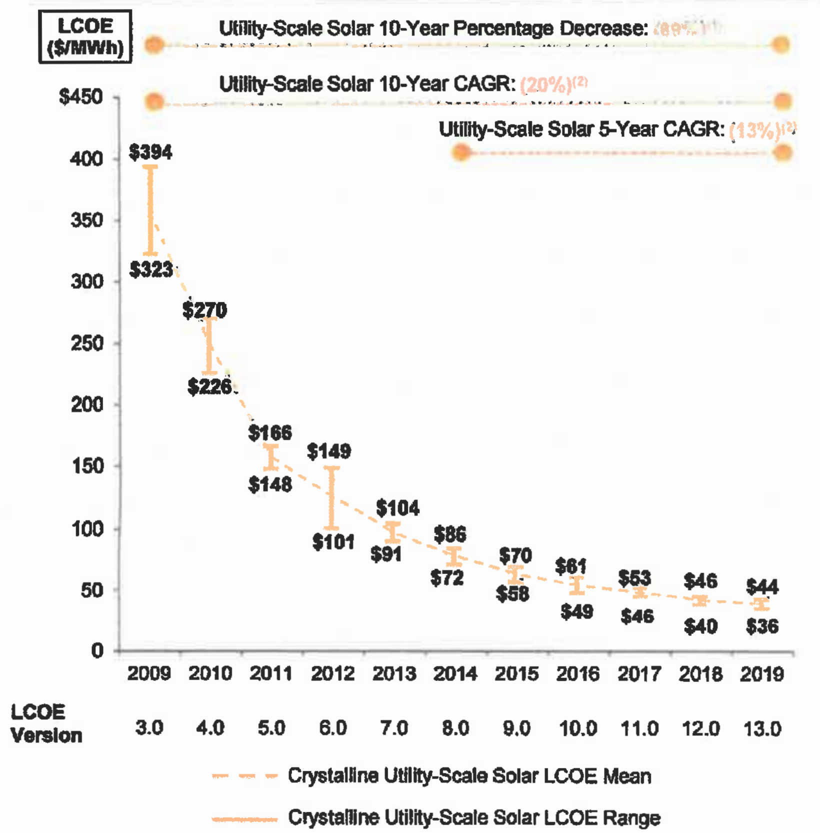
Levelized Cost of Energy Comparison—Historical Renewable Energy LCOE Declines

In light of material declines in the pricing of system components and improvements in efficiency, among other factors, wind and utility-scale solar PV have exhibited dramatic LCOE declines; however, as these industries mature, the rates of decline have diminished

Unsubsidized Wind LCOE



Unsubsidized Solar PV LCOE



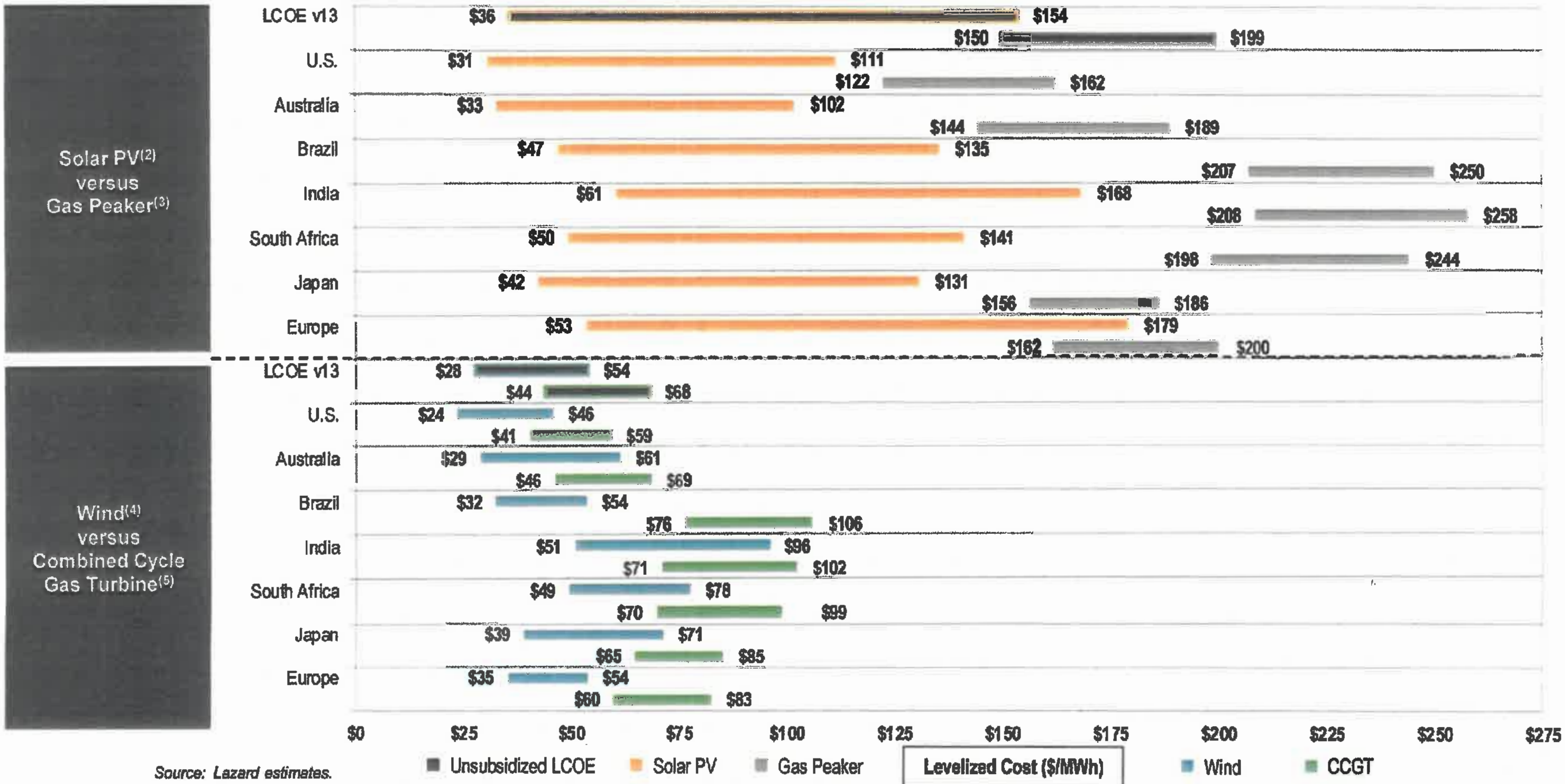
Source: Lazard estimates.

(1) Represents the average percentage decrease of the high end and low end of the LCOE range.

(2) Represents the average compounded annual rate of decline of the high end and low end of the LCOE range.

Solar PV versus Gas Peaking and Wind versus CCGT—Global Markets[1]

Solar PV and wind have become increasingly competitive with conventional technologies with similar generation profiles; without storage, however, these resources lack the dispatch characteristics, and associated benefits, of such conventional technologies



Source: Lazard estimates.

Note: The analysis presented on this page assumes country-specific or regionally-applicable tax rates.

(1) Equity IRRs are assumed to be 10.0% – 12.0% for Australia, 15.0% for Brazil and South Africa, 13.0% – 15.0% for India, 8.0% – 10.0% for Japan, 7.5% – 12.0% for Europe and 7.5% – 9.0% for the U.S. Cost of debt is assumed to be 5.0% – 5.5% for Australia, 10.0% – 12.0% for Brazil, 12.0% – 13.0% for India, 3.0% for Japan, 4.5% – 5.5% for Europe, 12.0% for South Africa and 4.0% – 4.5% for the U.S.

(2) Low end assumes crystalline utility-scale solar with a single-axis tracker. High end assumes rooftop C&I solar. Solar projects assume illustrative capacity factors of 21% – 28% for the U.S., 26% – 30% for Australia, 26% – 28% for Brazil, 22% – 23% for India, 27% – 29% for South Africa, 16% – 18% for Japan and 13% – 16% for Europe.

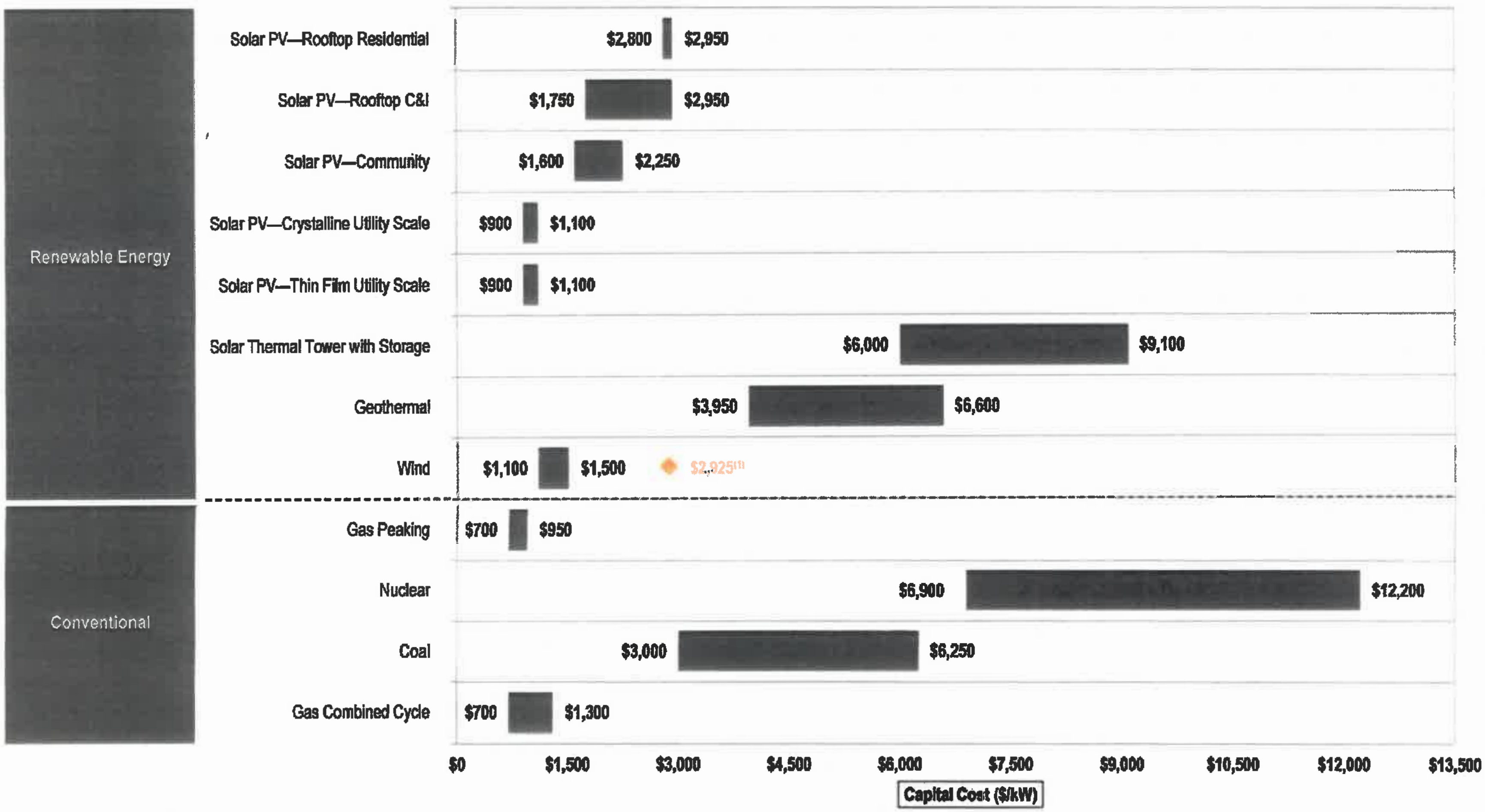
(3) Assumes natural gas prices of $3.45 for the U.S., $4.00 for Australia, $8.00 for Brazil, $7.00 for India, South Africa and Japan and $6.00 for Europe (all in U.S.$ per MMBtu). Assumes a capacity factor of 10% for all geographies.

(4) Wind projects assume illustrative capacity factors of 38% – 55% for the U.S., 29% – 46% for Australia, 45% – 55% for Brazil, 25% – 35% for India, 31% – 36% for South Africa, 22% – 30% for Japan and 33% – 38% for Europe.

(5) Assumes natural gas prices of $3.45 for the U.S., $4.00 for Australia, $8.00 for Brazil, $7.00 for India, South Africa and Japan and $6.00 for Europe (all in U.S.$ per MMBtu). Assumes capacity factors of 55% – 70% on the high and low ends, respectively, for all geographies.

Capital Cost Comparison

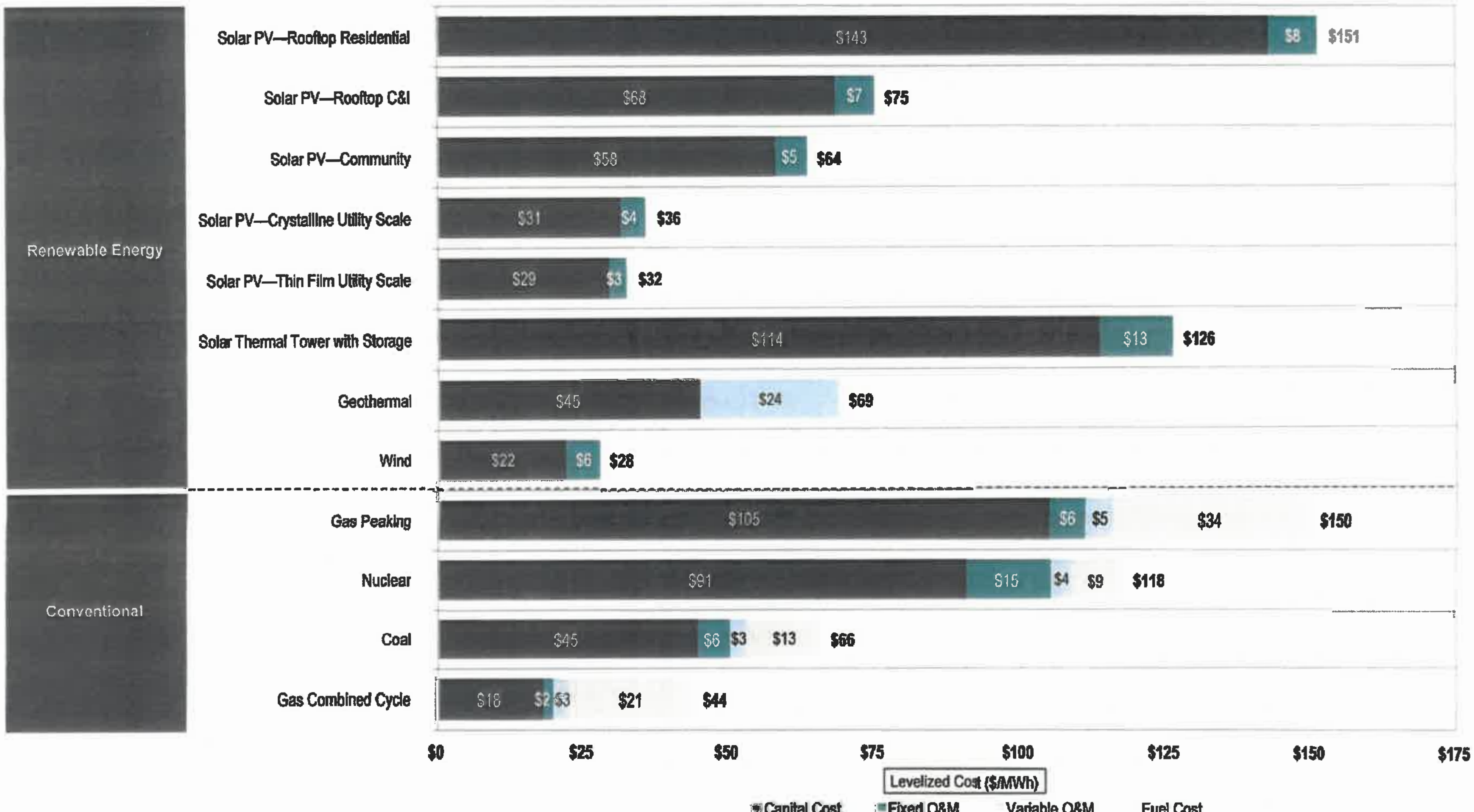
In some instances, the capital costs of renewable energy generation technologies have converged with those of certain conventional generation technologies, which coupled with improvements in operational efficiency for renewable energy technologies, have led to a convergence in LCOE between the respective technologies



Source: Lazard estimates.
(1) Represents the estimated midpoint of the total capital cost for offshore wind.

Levelized Cost of Energy Components—Low End

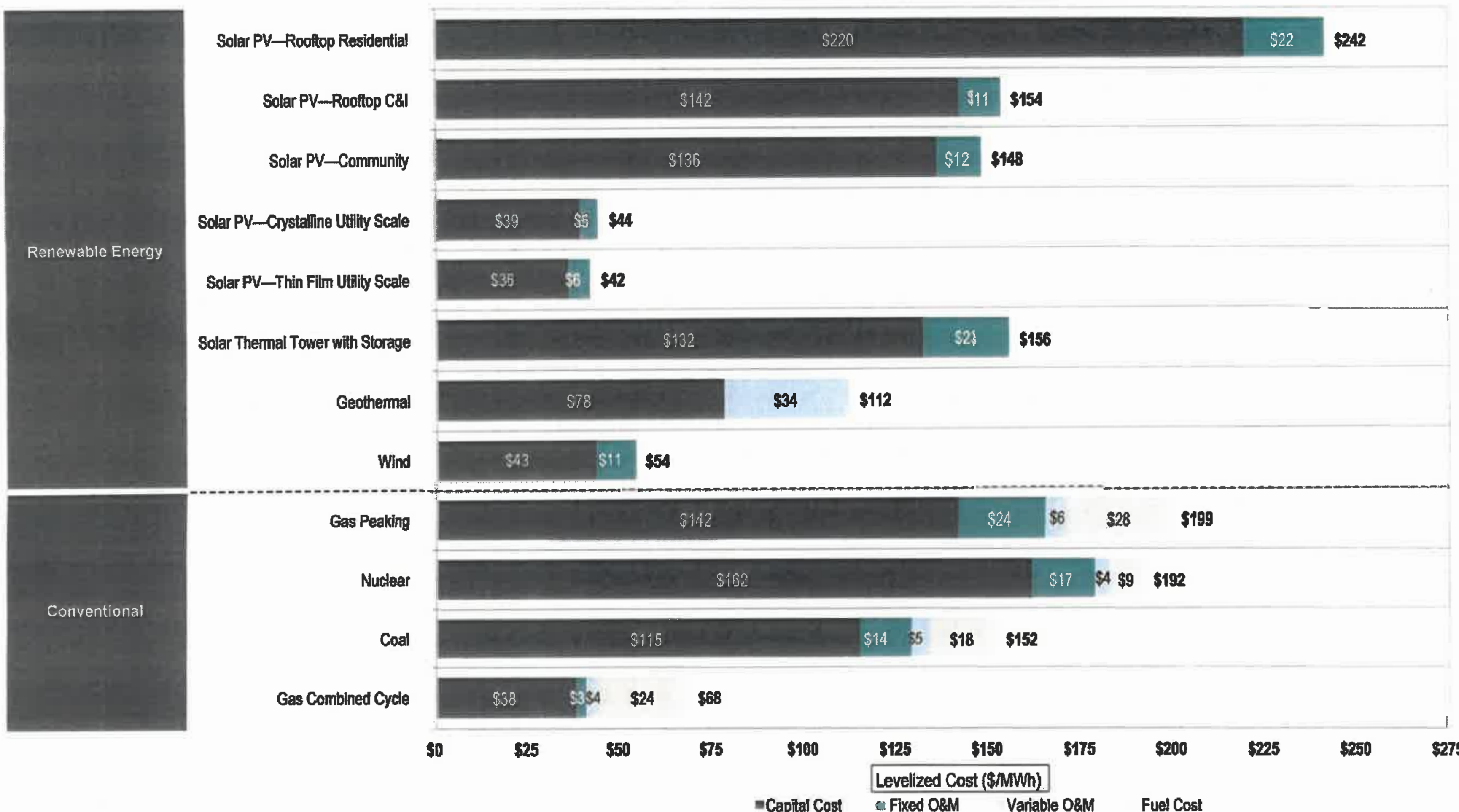
Certain renewable energy generation technologies are already cost-competitive with conventional generation technologies; a key factor regarding the continued cost decline of renewable energy generation technologies is the ability of technological development and industry scale to continue lowering operating expenses and capital costs for renewable energy generation technologies



Source: Lazard estimates.

Levelized Cost of Energy Components—High End

Certain renewable energy generation technologies are already cost-competitive with conventional generation technologies; a key factor regarding the continued cost decline of renewable energy generation technologies is the ability of technological development and industry scale to continue lowering operating expenses and capital costs for renewable energy generation technologies



Source: Lazard estimates.

Levelized Cost of Energy Comparison—Methodology

($ in millions, unless otherwise noted)

Lazard's LCOE analysis consists of creating a power plant model representing an illustrative project for each relevant technology and solving for the $/MWh value that results in a levered IRR equal to the assumed cost of equity (see subsequent "Key Assumptions" pages for detailed assumptions by technology)

Unsubsidized Wind — High Case Sample Illustrative Calculations

Year[1]		*0*	*1*	*2*	*3*	*4*	*5*	*20*
Capacity (MW)	(A)		150	150	150	150	150	150
Capacity Factor	(B)		38%	38%	38%	38%	38%	38%
Total Generation ('000 MWh)	(A) x (B) = (C)*		499	499	499	499	499	499
Levelized Energy Cost ($/MWh)	***(D)***		***$54.1***	***$54.1***	***$54.1***	***$54.1***	***$54.1***	***$54.1***
Total Revenues	**(C) x (D) = (E)***		**$27.0**	**$27.0**	**$27.0**	**$27.0**	**$27.0**	**$27.0**
Total Fuel Cost	(F)		--	--	--	--	--	--
Total O&M	(G)*		5.4	5.6	5.7	5.8	5.9	8.5
Total Operating Costs	**(F) + (G) = (H)**		**$5.4**	**$5.6**	**$5.7**	**$5.8**	**$5.9**	**$8.5**
EBITDA	**(E) - (H) = (I)**		**$21.6**	**$21.5**	**$21.3**	**$21.2**	**$21.1**	**$18.5**
Debt Outstanding - Beginning of Period	(J)		$135.0	$132.3	$129.4	$126.3	$122.9	$12.5
Debt - Interest Expense	(K)		(10.8)	(10.6)	(10.4)	(10.1)	(9.8)	(1.0)
Debt - Principal Payment	(L)		(2.7)	(2.9)	(3.1)	(3.4)	(3.6)	(12.5)
Levelized Debt Service	(K) + (L) = (M)		($13.5)	($13.5)	($13.5)	($13.5)	($13.5)	($13.5)
EBITDA	**(I)**		**$21.6**	**$21.5**	**$21.3**	**$21.2**	**$21.1**	**$18.5**
Depreciation (MACRS)	(N)		(45.0)	(72.0)	(43.2)	(25.9)	(25.9)	--
Interest Expense	(K)		(10.8)	(10.6)	(10.4)	(10.1)	(9.8)	(1.0)
Taxable Income	**(I) + (N) + (K) = (O)**		**($34.2)**	**($61.1)**	**($32.2)**	**($14.8)**	**($14.7)**	**$17.5**
Tax Benefit (Liability)[2]	**(O) x (tax rate) = (P)**		**$13.7**	**$24.5**	**$12.9**	**$5.9**	**$5.9**	**($7.0)**
After-Tax Net Equity Cash Flow	**(I) + (M) + (P) = (Q)**	**($90.0)**[3]	**$21.8**	**$32.4**	**$20.7**	**$13.7**	**$13.5**	**($2.0)**
IRR For Equity Investors		**12.0%**						

Key Assumptions[4]	
Capacity (MW)	150
Capacity Factor	38%
Fuel Cost ($/MMBtu)	$0.00
Heat Rate (Btu/kWh)	0
Fixed O&M ($/kW-year)	$36.5
Variable O&M ($/MWh)	$0.0
O&M Escalation Rate	2.25%
Capital Structure	
Debt	60.0%
Cost of Debt	8.0%
Equity	40.0%
Cost of Equity	12.0%
Taxes and Tax Incentives:	
Combined Tax Rate	40%
Economic Life (years)[5]	20
MACRS Depreciation (Year Schedule)	5
Capex	
EPC Costs ($/kW)	$1,500
Additional Owner's Costs ($/kW)	$0
Transmission Costs ($/kW)	$0
Total Capital Costs ($/kW)	$1,500
Total Capex ($mm)	$225

Technology-dependent

Levelized

Source: *Lazard estimates.*
Note: Wind—High LCOE case presented for illustrative purposes only.
* Denotes unit conversion.
(1) Assumes half-year convention for discounting purposes.
(2) Assumes full monetization of tax benefits or losses immediately.
(3) Reflects initial cash outflow from equity investors.
(4) Reflects a "key" subset of all assumptions for methodology illustration purposes only. Does not reflect all assumptions.
(5) Economic life sets debt amortization schedule. For comparison purposes, all technologies calculate LCOE on a 20-year IRR basis.

Energy Resources—Matrix of Applications

Despite convergence in the LCOE between certain renewable energy and conventional generation technologies, direct comparisons must take into account issues such as location (e.g., centralized vs. distributed) and dispatch characteristics (e.g., baseload and/or dispatchable intermediate capacity vs. those of peaking or intermittent technologies)

- **This analysis does not take into account potential social and environmental externalities or reliability-related considerations**

		Carbon Neutral/ REC Potential	Location			Dispatch			
			Distributed	Centralized	Geography	Intermittent	Peaking	Load-Following	Baseload
Renewable Energy	Solar PV[1]	✓	✓	✓	Universal[2]	✓	✓		
	Solar Thermal	✓		✓	Rural	✓	✓	✓	
	Geothermal	✓		✓	Varies				✓
	Onshore Wind	✓		✓	Rural	✓			
Conventional	Gas Peaking	✗	✓	✓	Universal		✓	✓	
	Nuclear	✓		✓	Rural				✓
	Coal	✗		✓	Co-located or rural				✓
	Gas Combined Cycle	✗		✓	Universal			✓	✓

Source: Lazard estimates.
(1) Represents the full range of solar PV technologies; low end represents thin film utility-scale solar single-axis tracking, high end represents the high end of rooftop residential solar.
(2) Qualification for RPS requirements varies by location.

Value of Carbon Abatement Comparison

As policymakers consider ways to limit carbon emissions, Lazard's LCOE analysis provides insight into the economic value associated with carbon abatement offered by renewable energy technologies. This analysis suggests that policies designed to shift power generation towards wind and utility-scale solar could be a particularly cost-effective means of reducing carbon emissions, providing an abatement value of $36 – $41/Ton vs. Coal and $23 – $32/Ton vs. Gas Combined Cycle

- **These observations do not take into account other environmental and social externalities, reliability or grid-related considerations**

	Units	Conventional Generation: Coal	Conventional Generation: Gas Combined Cycle	Nuclear	Renewable Energy Generation: Wind	Solar PV Rooftop	Solar PV Utility Scale	Solar Thermal with Storage
Capital Investment/KW of Capacity [1]	$/kW	$2,975	$700	$6,900	$1,100	$2,800	$900	$9,100
Total Capital Investment	$mm	1,993	560	4,209	1,111	8,232	1,476	7,462
Facility Output	MW	670	800	610	1,010	2,940	1,640	820
Capacity Factor	%	83%	70%	91%	55%	19%	34%	68%
MWh/Year Produced [2]	GWh/yr	4,888	4,888	4,888	4,888	4,888	4,888	4,888
Levelized Cost of Energy	$/MWh	$66	$44	$118	$28	$151	$32	$126
Total Cost of Energy Produced	$mm/yr	$322 (2)	$215	$576	$136 (1)	$740	$159	$618
CO_2 Equivalent Emissions	Tons/MWh	0.92	0.51	—	—	—	—	—
Carbon Emitted	mm Tons/yr	4.51	2.50	—	—	—	—	—
Difference in Carbon Emissions	mm Tons/yr							
vs. Coal		—	2.01	4.51	4.51 (3)	4.51	4.51	4.51
vs. Gas		—	—	2.50	2.50	2.50	2.50	2.50
Difference in Total Energy Cost	$mm/yr							
vs. Coal		—	($107)	$254	($187) (4)	$418	($163)	$296
vs. Gas		—	—	$361	($80)	$525	($56)	$403
Implied Abatement Value/(Cost)	$/Ton							
vs. Coal		—	$53	($56)	$41 (5)	($93)	$36	($66)
vs. Gas		—	—	($144)	$32	($210)	$23	($161)

: Favorable vs. Coal/Gas : Unfavorable vs. Coal/Gas

Implied Carbon Abatement Value Calculation (Wind vs. Coal)—Methodology

(4) Difference in Total Energy Cost (Wind vs. Coal) = (1) – (2) = $136 mm/yr (Wind) – $322 mm/yr (Coal) = ($187) mm/yr

(5) Implied Carbon Abatement Value (Wind vs. Coal) = (4) ÷ (3) = $187 mm/yr ÷ 4.51 mm Tons/yr = $41/Ton

Source: Lazard estimates.
(1) Assumptions utilized for the technologies presented in this analysis correspond to those associated with the Low LCOE cases.
(2) All facilities illustratively sized to produce 4,888 GWh/yr.

Levelized Cost of Energy—Key Assumptions

		Solar PV				
	Units	Rooftop—Residential	Rooftop—C&I	Community	Utility Scale—Crystalline [2]	Utility Scale—Thin Film [2]
Net Facility Output	MW	0.005	1	5	100	100
EPC Cost	$/kW	$2,800 – $2,950	$1,750 – $2,950	$1,600 – $2,250	$1,100 – $900	$1,100 – $900
Capital Cost During Construction	$/kW	—	—	—	—	—
Other Owner's Costs	$/kW	included	included	included	included	included
Total Capital Cost [1]	$/kW	$2,800 – $2,950	$1,750 – $2,950	$1,600 – $2,250	$1,100 – $900	$1,100 – $900
Fixed O&M	$/kW-yr	$14.00 – $25.00	$15.00 – $20.00	$12.00 – $16.00	$12.00 – $9.00	$12.00 – $9.00
Variable O&M	$/MWh	—	—	—	—	—
Heat Rate	Btu/kWh	—	—	—	—	—
Capacity Factor	%	19% – 13%	25% – 20%	25% – 15%	32% – 21%	34% – 23%
Fuel Price	$/MMBtu	—	—	—	—	—
Construction Time	Months	3	3	4 – 6	9	9
Facility Life	Years	25	25	30	30	30
Levelized Cost of Energy	$/MWh	$151 – $242	$75 – $154	$64 – $148	$36 – $44	$32 – $42

Source: Lazard estimates.

(1) Includes capitalized financing costs during construction for generation types with over 24 months construction time.

(2) Left column represents the assumptions used to calculate the low end LCOE for single-axis tracking. Right column represents the assumptions used to calculate the high end LCOE for fixed-tilt design.

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

	Units	Solar Thermal Tower with Storage[2]	Geothermal	Wind—Onshore	Wind—Offshore
Net Facility Output	MW	110 – 150	20 – 50	150	210 – 385
EPC Cost	$/kW	$7,950 – $5,250	$3,450 – $5,750	$1,100 – $1,500	$2,350 – $3,550
Capital Cost During Construction	$/kW	$1,150 – $750	$500 – $850	—	—
Other Owner's Costs	$/kW	included	included	included	included
Total Capital Cost [1]	$/kW	$9,100 – $6,000	$3,950 – $6,600	$1,100 – $1,500	$2,350 – $3,550
Fixed O&M	$/kW-yr	$75.00 – $80.00	$0.00 – $0.00	$28.00 – $36.50	$80.00 – $110.00
Variable O&M	$/MWh	—	$24.00 – $34.00	—	—
Heat Rate	Btu/kWh	—	—	—	—
Capacity Factor	%	68% – 39%	90% – 85%	55% – 38%	55% – 45%
Fuel Price	$/MMBtu	—	—	—	—
Construction Time	Months	36	36	12	12
Facility Life	Years	35	25	20	20
Levelized Cost of Energy	$/MWh	$126 – $156	$69 – $112	$28 – $54	$64 – $115

Source: Lazard estimates.
(1) Includes capitalized financing costs during construction for generation types with over 24 months construction time.
(2) Left column represents the assumptions used to calculate the low end LCOE, representing a project with 18 hours of storage capacity. Right column represents the assumptions used to calculate the high end LCOE, representing a project with eight hours of storage.

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

	Units	Gas Peaking	Nuclear	Coal	Gas Combined Cycle
Net Facility Output	MW	240 – 50	2,200	600	550
EPC Cost	$/kW	$650 – $900	$5,400 – $9,600	$2,400 – $4,900	$650 – $1,200
Capital Cost During Construction	$/kW	—	—	—	—
Other Owner's Costs	$/kW	included	$1,500 – $2,650	$600 – $1,300	$50 – $100
Total Capital Cost [1]	$/kW	$700 – $950	$6,900 – $12,200	$3,000 – $6,250	$700 – $1,300
Fixed O&M	$/kW-yr	$5.50 – $20.75	$108.50 – $133.00	$40.75 – $81.75	$11.00 – $13.50
Variable O&M	$/MWh	$4.75 – $6.25	$3.50 – $4.25	$2.75 – $5.00	$3.00 – $3.75
Heat Rate	Btu/kWh	9,804 – 8,000	10,450 – 10,450	8,750 – 12,000	6,133 – 6,900
Capacity Factor	%	10%	91% – 90%	83% – 66%	70% – 55%
Fuel Price	$/MMBtu	$3.45 – $3.45	$0.85 – $0.85	$1.45 – $1.45	$3.45 – $3.45
Construction Time	Months	12 – 18	69 – 69	60 – 66	24 – 24
Facility Life	Years	20	40	40	20
Levelized Cost of Energy	$/MWh	$150 – $199	$118 – $192	$66 – $152	$44 – $68

Source: *Lazard estimates.*

(1) Includes capitalized financing costs during construction for generation types with over 24 months construction time.

Summary Considerations

Lazard has conducted this analysis comparing the LCOE for various conventional and renewable energy generation technologies in order to understand which renewable energy generation technologies may be cost-competitive with conventional generation technologies, either now or in the future, and under various operating assumptions. We find that renewable energy technologies are complementary to conventional generation technologies, and believe that their use will be increasingly prevalent for a variety of reasons, including to mitigate the environmental and social consequences of various conventional generation technologies, RPS requirements, carbon regulations, continually improving economics as underlying technologies improve and production volumes increase, and supportive regulatory frameworks in certain regions.

In this analysis, Lazard's approach was to determine the LCOE, 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, etc.) 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 other important metrics. These inputs were originally developed with a leading consulting and engineering firm to the Power & Energy Industry, augmented with Lazard's commercial knowledge where relevant. This analysis (as well as previous versions) has benefited from additional input from a wide variety of Industry participants and is informed by Lazard's many client interactions on this topic.

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

Key sensitivities examined included fuel costs and tax subsidies. 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: capacity value vs. energy value; network upgrades, transmission, congestion or other integration-related costs; significant permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distributed generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., nuclear waste disposal, airborne pollutants, greenhouse gases, etc.).

EXHIBIT P

Peter Moritzburke

From:	Jody Norman <jody@deltacrc.org>
Sent:	Monday, February 17, 2020 4:43 AM
To:	Peter Moritzburke
Cc:	lhowlett@chartermi.net; Larry Klope; forester
Subject:	Re: Road Commission impacts from solar projects in Escanaba Township

Good morning Peter,

You are correct with all of your statements.

All of our funding is generated from the gas tax and vehicle registration fees, nothing comes from property taxes

We do not see any potential negative issues with having the solar system in the area, if anything, having a buffer around the fields will be a huge asset to help reduce drifting.

I do not know how this is all being set up, but I would assume the Twp's will most likely be getting some sort of revenue from the solar system if approving the proposal. If this is the case, I would think it will benefit the Twp's involved with matching the Road Commission for future road repairs.

Jody

From: "Peter Moritzburke" <peter@orionrenewables.com>
To: "Jody Norman" <jody@deltacrc.org>
Cc: lhowlett@chartermi.net, "Larry Klope" <lrk1952@yahoo.com>, "forester" <forester@chartermi.net>
Sent: Friday, February 14, 2020 1:21:19 PM
Subject: Road Commission impacts from solar projects in Escanaba Township

Hello Jody,

Thanks for your time on the phone. I just want to confirm some of our conversation, as below:

* The Road Commission does not receive funding through property taxes, and therefore would receive no direct positive financial impact from utility-scale solar projects in the County
* The Road Commission does not expect any negative financial impact from utility-scale solar projects in the County, as no additional services or road impacts are expected
* There could be positive financial impacts due to reduced snow drifting if solar panels and/or vegetative buffers (trees and shrubs) are placed adjacent to road rights of way
    * Panels and/or buffers placed 40 feet from road centerlines would provide maximum benefit
    * Reduction of drifting snow drops as panels and/or buffers are pulled back from roads further than 40 feet, but there is no additional drifting caused by panels and/or buffers placed further than 40 feet

Please offer any additional detail you see necessary. Thanks for your offer to speak with the ad hoc committee to clarify these points. I'm copying Larry Klope, Jack Penegor and Linda Howlett, committee members.

Best regards,
Peter

Peter F. Moritzburke
Development Consultant
Orion Renewable Energy Group
Cell: (415)306-1214
--
Thanks
Jody Norman, Manager
[mailto:jody@deltacrc.org | jody@deltacrc.org] Delta County Road Commission
(906)786-3200 Office
(906)280-3109 Cell

EXHIBIT Q

Solar Natural Resource Strategy
To Minimize Wildlife Impacts
Escanaba Township
Delta County, Michigan

Prepared for:

Orion Renewable Energy Group
155 Grand Avenue, #706
Oakland, CA 94612

By:

Western EcoSystems Technology, Inc.
7575 Golden Valley Road, Suite 300
Golden Valley, MN 55427

February 2020

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1 INTRODUCTION

The purpose of this Natural Resource Strategy (NRS) is to lay out the steps necessary to adequately describe the natural resource setting for a proposed photovoltaic (PV) ground-mounted solar energy project. The NRS also discusses the expected impacts associated with the solar facility and document Best Management Practices to avoid and/or minimize impacts on wildlife. The setting for this report is Escanaba Township in Delta County, Michigan.

From an energy policy perspective, utility scale ground-mounted solar PV installations present numerous societal and environmental benefits, including reduced greenhouse gases, an inexhaustible source of energy, and energy security (Hernandez et al, 2014). However, ground-mounted solar, similar to other energy and industrial land uses, can potentially introduce some adverse environmental impacts. Although the nature, magnitude, and extent of impacts varies based on land use intensity and other structural characteristics that are different from other forms of development, evaluation of potential effects is still good due diligence and provides an opportunity to minimize negative outcomes and further consider potential benefits. For example, ground-mounted solar projects present a unique opportunity for maintaining or even enhancing ecological integrity through appropriate project siting, design, construction, and ongoing operational management.

1.1 Corporate Commitment to Environmental Sustainability

Project proponents should state their current policies related to environmental sustainability. It is expected that, at a minimum, projects should be developed, constructed, and operated in a manner that balances the interests and rights of all landowners and the need for clean, renewable energy with consideration for local and on-site natural resource and wildlife protection.

1.2 Goals and Objectives for the Site

Project proponents should commit to developing and operating their projects in a way that complies with all laws and regulatory requirements, maintains the ecological integrity of the site, and considers key stakeholder feedback regarding natural resources.

1.2.1 Regulatory Compliance

Project proponents should commit to developing and operating their projects in compliance with all appropriate natural resource laws and regulations. Included below are key regulations that should be considered for solar facilities.

<u>Endangered Species Act</u>

Federal law protects endangered and threatened species listed under the Endangered Species Act of 1973 (ESA; 16 US Code [USC] 1531-1544 [1973]). The ESA is administered by the US Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries). Federally listed species and their designated critical habitats are protected under the ESA, which prohibits the take or trade of listed animals; however, there is a mechanism to grant permission for take that is incidental to an otherwise lawful activity.

State Endangered Species Law

State law protects endangered and threatened species under Michigan's Natural Resources and Environmental Protection Act, Act 451 of 1994, Part 365: Endangered Species Protection. This law prohibits the take, possess, transport, import, export, process, sell, offer for sale, buy, or offer to buy endangered or threatened plants and animals. Although the state of Michigan has a process by which take of endangered and threatened species can be authorized through a permit, it is designed to authorize take associated with scientific, zoological, or educational purposes and does not include take associated with otherwise lawful activity (typically referred to as incidental take).

Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA; 16 USC 703-712 [1918]) assigns legal authority to the USFWS to protect over 800 species of raptors (e.g. eagles, hawks), diurnal migrants (e.g. cranes), and passerine (e.g. sparrows, finches, warblers) migratory birds from take. Unlike the ESA, the MBTA only regulates direct take of migratory birds, it does not prohibit modification of habitat. On December 22, 2017, the Office of Solicitor of the US Department of the Interior (DOI) released a new legal opinion, M-37050, addressing the issue of incidental take under the MBTA (US DOI, 2017). According to M-37050, the policy of the DOI is that incidental take of migratory birds that results from the operation of a solar project is not regulated by the MBTA. Furthermore, the USFWS does not have a permit for incidental take of migratory birds under the MBTA associated with otherwise lawful activities, such as commercial or industrial operations.

Bald and Golden Eagle Protection Act

Bald (*Haliaeetus leucocephalus*) and golden (*Aquila chrysaetos*) eagles are afforded legal protection under authority of the Bald and Golden Eagle Protection Act of 1940 (BGEPA; 16 USC 668–668d [1940]). BGEPA prohibits the take, sale, purchase, barter, offer of sale, purchase, or barter, transport, export or import, at any time or in any manner of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. Take is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" (16 USC 668c [1940]). Disturb is defined as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior (16 USC 668c [1940]).

Clean Water Act and Waters of the US

Pursuant to Sections 404 and 401 of the Clean Water Act (CWA), the US Army Corp of Engineers (USACE) regulates the discharge of dredge and/or fill material into Waters of the U.S. (WUS). Section 404 requires that any entity proposing an activity that would discharge such materials into a WUS must obtain a permit from USACE. Section 401 requires states (in this case, Michigan) to review projects and federal permits to ensure they will not violate surface water quality standards. USACE has final and legal authority in determining the presence of jurisdictional WUS and the extent of their boundaries. The Michigan Department of Environmental Quality has the responsibility of reviewing and approving Section 401 Water Quality Certification for activities occurring outside of Indian Country within Michigan.

1.2.2 Maintain Ecological Integrity

Project proponents should commit to maintaining ecological integrity at their project sites to the degree practicable. Ecological functions of the land on which their projects is sited can be valuable for both human land use and other natural resource values. In addition to operating a renewable energy facility, their project lands can be managed with consideration for long-term soil health, water quality, vegetation structure and composition, and wildlife habitat. Even with the high density of solar facility structures, it is intended that the ecological value of the land should be maintained to the greatest extent practicable.

1.3 Early Stakeholder Communication

Early coordination with state and federal natural resource agencies and other stakeholders during the development process is critical to determine and address Project-specific environmental concerns. Project proponents should commit to coordinating with the USFWS and the Michigan Department of Natural Resources throughout the siting and development processes. NRS should reflect the comments and recommendations made during the coordination process with these agencies. As additional recommendations and comments are received from the agencies, NRS may be updated accordingly.

2 SITE ASSESSMENTS AND SURVEYS

2.1 Habitats in Project Area

2.1.1 Land Cover and Use

For each project, the Project proponent should provide a description of the current land cover within the Project area. Common data sources for this assessment include:

- U.S. Environmental Protection Agency Level III and IV Ecoregions (US Environmental Protection Agency, 2017).
- National Land Cover Data (Yang et al. 2018; Multi-Resolution Land Characteristics [MRLC], 2019).
- Site visit summaries and aerial photography (e.g. Google Earth)

2.1.2 Wetlands and Waterbodies

For each project, the Project proponent should provide a description of potential Waters of the United States within the Project area. Common data sources for this assessment include:

- National Wetland Inventory (NWI; USFWS, 2018).
- National Hydrography Dataset (NHD).
- FEMA Flood Insurance Rate floodplain mapping.
- Field delineations completed in accordance with USACE and state standards

2.1.3 Cultural Context and Public Lands

For each project, the Project proponent should provide a description of the cultural context for and the proximity to public lands to the Project area. Common data sources for this assessment include:

- National Register of Historic Places (NRHP).
- US Geological Survey Protected Areas Database

2.1.4 Vegetation

For each project, the Project proponent should provide a description of the vegetation within the Project Area. Characterizing the vegetation at a PV solar facility has two purposes: 1) assessing current and future potential wildlife habitat value, and 2) planning for restoration and ongoing land management. The combination of site-specific wildlife use data and vegetative cover and quality provides the complete picture for assessing wildlife habitat, and the opportunities for avoiding impacts and maintaining wildlife habitat. Site-specific mapping of vegetative cover and quality provides information for developing a vegetation management plan intended to maintain the type and integrity of the existing vegetation even with a change in land use to energy operations.

Common data sources for this assessment include:

- Michigan Natural Features Inventory (MNFI) Rare Species Review
- USFWS Information for Planning and Consultation (IPaC) report.
- U.S. Department of Agriculture (USDA) Major Land Resource Areas (MLRAs) of the United States (USDA 2006).
- Field surveys.
- Records of consultation with MNFI, Michigan Department of Natural Resources (MDNR) and USFWS.

The assessment should provide detail on available site-specific vegetation data collected, and recommendations for additional surveys, if needed, to fill any information gaps that might exist.

2.2 Wildlife in Project Area

For each project, the Project proponent should provide a description of the wildlife within the Project Area. Characterizing wildlife is important for assessing potential impacts and risk, and establishing site management goals. Common data sources for this assessment include:

- Michigan Natural Features Inventory (MNFI) Rare Species Review.
- USFWS Information for Planning and Consultation (IPaC) report.
- USGS North American Breeding Bird Survey (BBS).
- USFWS Listing of Birds of Conservation Concern.
- United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.
- Field surveys.
- Records of consultation with MNFI, Michigan Department of Natural Resources (MDNR) and USFWS.

The assessment should provide detail on available site-specific wildlife data collected, and recommendations for additional surveys, if needed, to fill any information gaps that might exist.

3 RISK ASSSESSMENT

A 2009 study assessed 32 impacts from PV solar facilities under the themes of land use intensity, human health and wellbeing, plant and animal life, geohydrological resources, and climate change and found that 22 of the considered 32 impacts were beneficial (Turney and Fthenakis, 2011). Of the remaining 10 impacts the study found four were neutral and six required further research before the impacts could be fully assessed, with none of the impacts being negative relative to traditional power generation (Turney and Fthenakis, 2011).

Although solar power has been identified as providing a positive effect on the environment when replacing or reducing certain other energy sources, research is on-going as to understanding the potential direct (e.g. mortality) and indirect (e.g. habitat modification) impacts of these facilities on nearby natural resources including wildlife (Moore-O'Leary et al., 2017). However, studies related to the interaction of wildlife species with human disturbance offers lessons for proper development of solar projects. The following sections examine the known and suspected impacts associated with the construction / decommissioning and the operation of these facilities, as well as planning and design measures to minimize these concerns throughout all phases of the project life cycle.

3.1 Impacts due to Construction and Decommissioning

The construction and later decommissioning of solar facilities requires significant ground disturbance. Similar to other construction projects, there are potential associated impacts to habitat and wildlife, including mortality from the installation and removal of equipment (e.g. arrays, substation), disturbance and modification of habitat, and other construction-related activities such as road installation, dust suppression, and transporting of equipment from off-site locations (Lovich and Ennen, 2011). Project proponents should enact best management practices that will reduce the potential for direct impacts during construction (see Section 4.2).

3.2 Impacts due to Operation

The literature generally suggests that, with proper planning, the ecological impacts of ground-mounted solar panels will be relatively limited and location-specific (Moore et al., 2017; Taylor et al., 2019). The severity of these impacts will be primarily dependent on the sensitivity of proximate species, the location and extent of disturbance, and the infrastructural design (Hernandez et al, 2014). Consultations with stakeholders in Escanaba Township have identified two primary issues of concern: a) impacts on avian species, including the common loon (*Gavia immer*); and b) impacts of fencing on large mammals, specifically white-tailed deer.

3.2.1 Impacts on Avian Species

Direct Impacts

The two main causes of direct mortality associated with solar facilities are collision and solar flux (Smith and Dwyer, 2016; Kagan et al, 2014), of which only the first is associated with PV solar. WEST (2014) synthesized public avian fatality data associated with the only publically available studies of PV utility-scale solar facilities. All three were located in California: California Valley Solar Ranch (CVSR), Desert Sunlight, and Topaz Solar Farm. Among fatalities found, passerines were the most represented bird type at the three facilities (49%). The majority of these passerine fatalities were horned lark, house finch, and western meadowlark. Doves and pigeons had the next highest percentage (22%) overall; however, at the Desert Sunlight facility loons and grebes ranked second (23%). Bird fatalities were reported within the PV array but also in areas away from array search plots, fences, and power lines, suggesting that a portion of the fatalities found during these studies were natural background mortality.

Walston et al. (2016) reviewed avian fatality data at three utility-grade solar projects in southern California in order to develop an estimated mortality rate based on annual energy production or birds deaths per MW per year. Two of these projects were concentrating solar power (CSP) facilities while the third was PV. For the PV facility, California Valley Solar Ranch[1] (CVSR), the study estimated that the mortality rate directly attributed to the utility solar facility was 0.5 bird fatalities/MW/year with an additional 10.20 bird fatalities/MW/year at the facility from unknown causes. It should be noted that the majority of fatalities were mourning dove feather spots that could not be attributed to a cause of mortality. A study conducted at the Jasper PV facility in South Africa for bird carcasses and other signs of collisions calculated the extrapolated mortality rate for the facility at 4.5 bird fatalities/MW/year (Visser et al., 2019).

Recent attention has been focused on potential for certain waterbirds to mistake solar panels for bodies of water, the "lake effect" hypothesis. This concern arose when water-associated (i.e., species that rely partly on water) such as herons and egrets, and water-obligate birds (i.e., species that cannot take flight from land) such as loons and grebes were detected stranded, injured or deceased at PV solar fields in the southwestern U.S. (Kagan et al., 2014, Smith and Dwyer, 2016). Given the few peer-reviewed papers available, it is unknown if this behavior of water-obligate species at PV solar facilities is widespread or represents a localized effect (e.g. water-obligates concentrate at water bodies near solar projects with documented fatalities). However, as noted earlier, a review by WEST (2014) found that the majority of fatalities were associated with passerines (49%). Doves and pigeons had the next highest percentage (22%) overall; however, at the Desert Sunlight facility loons and grebes ranked second (23%).

The solar projects in grasslands habitats in central California (including CVSR) appear to experience higher levels of bird fatalities compared to other solar sites. However, causes of these bird deaths are generally unclear, are common to the surrounding area, and include such species as mourning dove, house finch, and horned lark. Background fatality levels at reference sites

[1] Both WEST (2014) and Walston et al. (2016) examined avian mortality data for the California Valley Solar Ranch but relied upon data reported in 2014 and 2015, respectively, by H.T. Harvey & Associates.

near these solar facilities suggest that natural mortality rates may be high (up to 7.2 birds/MW), suggesting that the solar facility may not contribute significantly to avian impacts. Water-associate/obligate birds have been found at these grassland sites, but in small numbers and loons have not been reported.

Overall, it appears that PV solar facilities pose a low risk for avian mortality relative to other sources of bird mortality. A recent review completed by WEST (2020 manuscript in prep.) concluded that the average annual fatality rate at PV solar facilities is 1.82 bird fatalities/MW/year. As a point of comparison, Sovacool (2009) estimated a fatality rate of 74.2 birds/MW/year from fossil fuel power plant operations. There is no reason to assume that most PV projects will experience a higher-than-average mortality, given the abundance of comparable habitat in close proximity.

Common loons, a water-obligate species, occur within the Upper Penninsula of Michigan. Some water-obligate species, including common loons, have been found within solar projects located within the desert portions of the southwest U.S. However, water-obligate birds such as loons and grebes that have been found at solar facilities appear to be limited to arid environments of the desert where suitable stop over sites are unavailable or limited. In total, 13 loon deaths have been identified across 10 solar facilities. The highest number of water-obligate birds found seem to be found near the Salton Sea, an important site in an arid region that provides stop-over and winter habitat for hundreds of thousands of water-associates and water-obligates.

Given the large amount of solar now installed across the country, including the Midwest, and the lack of reports or anecdotes of significant water-obligate bird discoveries suggests that solar facilities are not a widespread or significant cause of waterbird, including loon, mortality.

Avian Use

Several studies have documented altered avian use patterns at PV solar facilities, with mixed results. A study of eleven solar sites in the southern United Kingdom found a significantly higher diversity of birds within the solar plots compared to the adjoining land (Montag et al. 2016). A 2019 study published in Germany collected data from 75 solar facilities on "derelict" land and found that the installation of these PV solar facilities could improve biodiversity.[2] In contrast, the Jasper PV solar facility in South Africa reported that bird species richness and density within the PV facility tended to be lower than the boundary zones and adjacent undisturbed land, suggesting that birds may avoid solar facilities once they are operational (Visser et al., 2019). A study conducted at PV arrays and nearby airport grasslands in Arizona, Colorado, and Ohio observed lower species diversity at solar arrays, but there were twice as many birds per hectare in the solar arrays than in the airfield areas (DeVault et al., 2014).

[2] As reported in PV Magazine, November 21, 2019. Accessed on-line on December 31, 2019 at: https://www.pv-magazine.com/2019/11/21/solar-parks-help-biodiversity-by-recreating-pre-industrial-soil-conditions/

In terms of raptors, preliminary findings from avian point-count studies conducted at the California Valley Solar Ranch in south-central California documented no use of constructed solar arrays by raptors (Smith et al., 2013). A later study at the same facility documented higher raptor abundance pre-construction than post-construction, suggesting that raptors may avoid facilities once they are operational (Smith and Dwyer, 2016). These finding are consistent with the previously discussed study by DeVault et al. (2014), where large birds were also less common at PV arrays than nearby airfield sites. The results of these studies suggest that some avian species, such as large birds and raptors, likely avoid operational solar facilities while other species may actually prefer the artificial or restored habitat to the available natural habitat in the area.

Two additional studies have collected data to support this hypothesis. Avian point counts were conducted at the Topaz Solar Farms in San Luis Obispo County, California, both during construction and for three years post-construction (Griffiths et al., 2019). This study documented no negative impacts to avian use from construction or operation of the solar farm, and documented an increase in species richness (Griffiths et al., 2019). Overall wildlife and habitat studies conducted at the same facility documented higher vegetation productivity on site than in surrounding reference sites (Sinha et al., 2018). Additionally, numerous wildlife species, including 27 bird species, eight mammal species, and four reptile species, with six of the total species having special conservation status, were recorded using habitat at the solar facility (Sinha et al., 2018). These studies suggest that the development of the solar farm can create habitat that may benefit wildlife species through providing resources that would not normally be available within the surrounding habitat, and can potentially increase habitat quality through strategic restoration and land management.

3.2.2 Fencing

Utility-scale PV solar energy facilities must comply with the National Electrical Code and National Fire Protection Code, which include protective fencing that is at least seven feet high or six feet high with at least one foot of barbed wire at the top of the fence around generating stations and substations (Ode 2016). This fencing may act as a barrier to some non-avian wildlife from utilizing the habitat. Siting design should account for anticipated ground-based wildlife movement through and adjacent to their projects area while ensuring the safe and reliable operation of the infrastructure. In general, fencing that creates open travel areas between solar facilities allows the most effective big game movement (American Planning Association, 2019).

While research on best practices to improve access is still on-going (TNC, 2019), proper fencing design will need to consider multiple objectives. For example, ingress and egress by smaller mammals could be facilitated with shorter fencing, woven-wire type fencing with wide wire grid, and/or gaps at the bottom of the fence. However, to prevent deer from becoming entrapped in fencing enclosures, resource agencies recommend higher fencing and installing the fences tight to the ground with no gaps (Minnesota Department of Natural Resources, 2016; Oregon Department of Fish and Wildlife, 2019; Texas Parks and Wildlife, 2006; Wyoming Game & Fish Department, 2004).

In terms of large mammal movement, research is ongoing as to the impact of anthropogenic features such as fending on movement patterns including migration. Sawyer et al. (2017) examined how gas development influenced the migratory patterns of mule deer (*Odocoileus hemionus*). Their results indicated that mule deer avoided well pads, although the magnitude of this avoidance diminished in times of winter scarcity. However, ungulates could move through moderate levels of development (referred to as "semi-permeable barriers") with no effect on migratory behavior (Sawyer et al. 2017). Swihart et al (1995) found that white-tailed deer commonly habituate to human presence in suburban areas. Polfus (2011) concluded that white-tailed deer were sufficiently able to adapt to human activity that it was unlikely that residential development would severely disrupt migrations. Developers should coordinate with the Michigan DNR to determine if proposed projects occur within critical big game areas or habitats.

Project proponents should design their projects so that there are separately fenced areas, rather than a single large fence area. Arrays should be sited so as to allow for wildlife passage and these areas should be marked on the site plans. The sites will, in general, be managed to support diverse herbaceous native plants, which is consistent with summer habitat goals established by the Michigan Department of Natural Resources (2017), and requirements for appropriate landscaping for solar installations on land under Public Act 116 (PA 116) contracts.

4 AVOIDANCE, MINIMIZATION, AND MITIGATION

4.1 Pre-construction Siting and Design

Information gathered during the site assessments, field surveys and coordination with the USFWS and MIDNR should be used for PV array and infrastructure siting to minimize impacts to birds, bats, species of concern, and their habitats. Additionally, Project proponents should commit to siting their projects so as to consider the efficiency of selected PV array models and minimizing impacts to area residents. Prior to designing the facility layout, Project proponents should incorporate natural feature setback and constraint information from literature reviews, site-specific studies, and agency recommendations.

4.1.1 Project Siting Measures Used to Reduce Impacts

- Project sites should be developed to reduce impacts to sensitive areas to the extent possible (e.g., wetlands and streams, cultural resources).
- Pre-construction wildlife and habitat surveys should be conducted as necessary and project layouts should be designed to avoid impacts.
- Changes to the project boundary should be made as necessary to address setbacks for environmental and other factors.

4.1.2 Project Design Measures Used to Reduce Impacts

- Projects should be designed to minimize the infrastructure required in the planning of access roads, power lines, fences, and associated facilities.

- The Project design for electrical facilities should be based upon the Avian Power Line Interaction Committee's (APLIC) suggested practices for minimizing risk of electrocution of birds from power lines.
- The collector system should be buried underground to the extent feasible considering the presence of shallow soils in many areas of their projects, thereby reducing the risk of bird electrocution.
- On-site/substation lighting should be minimized and directed downward in order to not disorient nocturnal wildlife species, particularly birds and bats (e.g., down-shielded lighting).
- The Project layout should have multiple fenced areas, rather than a single large fenced area. Site designs should include natural openings between fenced areas to enable the free passage of wildlife near and around their projects.
- Based on pre-construction vegetation characterization, a detailed vegetation restoration and management plan should be developed. The objectives of this plan should be to restore and maintain a healthy habitat with a diverse herbaceous native plant community, which is resistant to non-native plant (i.e. noxious weed) invasions. The plan should further preserve the land's aesthetic value to the fullest extent possible while allowing for safe and effective management and operations of their projects. Further details are provided in Section 4.3.1, below.

4.2 Project Construction

4.2.1 Construction Best Management Practices

- Vegetation clearing, excessive site grading, and timelines for which soils are exposed should be minimized to the extent practicable.
- All trash and food-related waste should be placed in closed containers and removed daily from the site so as not to attract wildlife during construction.
- The Project's Storm Water Pollution Prevention Plan (SWPPP), to be approved by Delta County, should ensure control measures are taken to prevent erosion and runoff during construction of their projects. Of particular concern is runoff into wetlands as well as into streams and roadside ditches. The measures within the SWPPP should comply with the requirements of the National Pollutant Discharge Elimination System/State Disposal System Permit Program.
- To minimize the risk of wildfire that could destroy bird and bat habitat, or that could be injurious to construction personnel, construction crews should adhere to manufacturer specifications and governmental requirements while handling and storing flammable chemicals, petroleum, and other materials with the potential for combustion.

- Construction teams should be informed of invasive species and take measures to prevent their propagation via the movement of people, materials and equipment into and out of the site. Control measures include washing off any soil, dirt, and debris on vehicles, equipment, and personal clothing and footwear prior to construction activities should be implemented.
- The timelines between completion of construction and vegetation restoration should be shortened and minimized as much as possible, potentially through dormant native seeding in the winter months.
- Proponents should consider limiting tree clearing to the period when listed bat species are not expected to occur, which generally encompasses the period of October 1 – March 31. Consult with the USFWS for specific tree clearing dates. Tree clearing may occur during other periods of time depending on the results of habitat assessments, agency coordination, and on-site surveys.

4.2.2 Wildlife Best Management Practices

- Site personnel should receive training on wildlife awareness and response procedures. This training should include either the MDNR's "60-Second Snakes: The Eastern Massasauga Rattlesnake" video (available at https://www.youtube.com/watch?v=-PFnXe_e02w) or the Eastern Massasauga Rattlesnake factsheet at https://www.fws.gov/midwest/endangered/reptiles/eama/eama-fct-sht.html
- To minimize disturbance, all construction and operation vehicle traffic should be restricted to established roads, construction areas, and other designated areas. Construction and operation traffic should adhere to reasonable speed limits to minimize the risk of wildlife collisions.
- Dust suppression should occur during construction activities when necessary to meet air quality standards and protect biological resources.
- Wildlife-safe materials should be used for erosion control and site restoration.[3]
- Materials that could provide shelter/nesting habitat for birds during the nesting season may be capped (i.e., tubular steel pipes or culverts greater than 4 inches in diameters), covered with netting, or treated with other exclusion methods, where feasible and appropriate, to prevent birds from constructing nests. In addition, materials such as wooden pallets, wooden power poles, and metal tubing, providing nesting and shelter habitat for birds during the nesting season and artificial refugia for other special-status species should be thoroughly inspected before use.

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[3] For further information consult https://www.fws.gov/midwest/eastlansing/te/pdf/MichiganEMR_BMPsProjectReviewGuidelinesMarch2017.pdf

- During construction, personnel should visually inspect each open trench or pit daily to determine if any animal has become trapped in the trench or pit. If an animal has become trapped, the Site Manager should be notified and appropriate action taken to safely remove and release the animal and/or allow the animal to escape unimpeded.
- If any federally-listed threatened or endangered species is observed during Project construction-related activities, the USFWS should be notified within 24 hours.

4.3 Project Operations

4.3.1 Vegetation Management Plan

Solar project operations combine energy facility management with vegetation management due to the high density of solar facility structures on the landscape. This unique situation for solar projects requires an obligation on behalf of their projects operators to be good stewards of the land throughout the life of the facility thus allowing the leaseholder to return to "in-kind" land quality and cover after decommissioning.

Landscaping plans should support and conform with Michigan state requirements for use of lands under PA 116 contracts.

A qualified restoration professional should develop a vegetation management plan for each project site. This document should consider existing conditions (e.g. soil, climate), native species, anticipated operation and maintenance practices, and any restoration commitments made to key stakeholders.

4.3.2 Operational Best Management Practices

- An environmental training program should be developed and implemented throughout their projects operating life to ensure minimal impacts to wildlife during operations.
- Project access roads should be posted with a 25-mi per hour speed limit to avoid vehicle-wildlife collisions.
- Fire risk should be minimized by utilizing spark arrestors on all electrical equipment, and by restricting smoking to designated areas.
- During operations, tree trimming should be prioritized over tree removal and all tree trimming should occur in such a manner as to avoid impacting nesting or migrating birds and roosting bats.
- Operation and maintenance activities should be performed in conformance with the project's Vegetative Management Plan (Section 4.3.1).
- During the initial operation phrase, site checks should be performed to monitor ground cover conditions (including revegetation) and stormwater management facilities.
- Panels should be stowed tilted at night to minimize the potential for loons and other birds to attempt to land at the facility.

- Project collector and transmission lines should be maintained according to the recommendations of the Avian Power Line Interaction Committee as appropriate.
- Operations and Maintenance staff should monitor for unusual avian activities in and around their projects Area. Avian fatalities should be reported to the Operations Manager, who will in turn alert the designated representative of management.
- In the event that there is an unforeseen impact to wildlife associated with their project, the project owner should review the circumstances in a manner that is consistent with adaptive management principles (see Section 5).

5 ADAPTIVE MANAGEMENT

Natural resource agencies view adaptive management as a flexible decision-making framework to address uncertainties in ecological restoration as outcomes from prior management actions become better understood (Williams et al., 2009), with a particular focus on landscape-scale restorations that involve managing widespread invasive species. There is no universal approach to land management and restoration, and flexibility is key for selecting management actions that are appropriate for the state of the managed system at the time of the decision. Each management action will influence the managed system into the future, and therefore management strategies should, to the extent practicable, account for both the current and future impacts of management decisions. Oftentimes stakeholders can have differing views about the most appropriate management strategy, and the purpose of an adaptive management approach is to incorporate the various viewpoints into the decision making process. Through appropriate adaptive management, understanding of the resource can be enhanced over time, and management can be improved.

Adaptive management is a systematic approach for improving restoration and land management by learning from past experiences. Management actions should be selected based upon the response of the undesirable condition (e.g., erosion, weed, or noxious species) to the preceding action. Additionally, any unexpected findings pertaining to potential adverse impacts to wildlife could potentially trigger an adaptive management response from the project owner; any such adaptive management response would be evaluated in coordination with appropriate state and federal agencies.

Mortality of water-obligate species, including other loon species, has been documented at some solar projects located in the arid, desert southwest. To date, mortality of water-obligate species have not been reported to occur in the Midwest or Great Lakes. The reasons for mortality in the desert southwest are not fully understood and are the focus of ongoing research efforts. However, the lack of reported, widespread fatalities in other portions of the U.S. such as the Midwest or Great Lakes suggests that potential attraction associated with a "lake effect" could be limited to more arid portions of the U.S. where water sources are scarce. Projects should stow panels tilted at night to reduce potential attraction to water-obligate species that migrate or fly during the night. Operations and Management staff should be trained to record bird fatalities observed during maintenance activities to verify if fatalities of common loons or other water-obligate species are occurring, and further identify if further actions are needed.

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