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October 18, 2021

SENT VIA EMAIL to jschmitt@duanesburg.net, MDeffer@duanesburg.net, tbakner@woh.com, and Dale@duanesburg.net.

Planning Board Town
of Duanesburg
5853 Western Turnpike
Duanesburg, NY 12056

RE: Public Comment Responses
Oak Hill 1 and Oak Hill 2 Solar and Energy Storage Projects (the "Oak Hill Projects")

Dear Chairman Schmitt,

Thank you for providing AMP Solar Development Inc. ("Amp") the opportunity to present at the September 16, 2021 Town of Duanesburg Planning Board Meeting. As you are aware, Amp agreed at that meeting to provide responses to public comments submitted since the closure of the public hearing on August 19, 2021. The Planning Board has allowed public comments to be submitted throughout the process, and at the September 16, 2021 meeting, the public was advised that the Planning Board would allow the submission of additional comments through October 12, 2021, notwithstanding that the public hearing already occurred. Please allow this letter to provide written responses to questions and comments raised before, during, and after the workshop, including public comments that have been available to Amp up to the comment deadline of October 12, 2021.

Received questions and comments have been consolidated and paraphrased for clarity in some instances. The comments and questions are numbered and displayed with **bold** text. Amp's responses are displayed under the questions and comments with standard text.

September 16, 2021 – Questions received during the Planning Board Meeting

1) Can the battery system be relocated elsewhere?

The Oak Hill Solar 1 LLC and Oak Hill Solar 2 LLC project proposals are reflected on the Issued for Construction drawings that are currently under Planning Board review.

During the project development process, an application for interconnection of a solar project with energy storage (batteries) was submitted for the current Point of Interconnection (POI), or physical point of grid connection. As is the case for any energy system seeking to connect to the existing utility grid, this system and location was studied by National Grid and found to be feasible and safe to connect to the grid. Subsequent to this, the significant cost of the upgrades was paid by the applicant and an interconnection service agreement was signed with National Grid. The location of the energy storage system has been shown to be safe and beneficial to the local distribution grid. Once this approval from National Grid is received, and the upgrade costs paid, moving the battery is not a viable option.

There are additional technical reasons why Amp cannot pursue a remote battery solution. Amp's proposed battery storage design is a direct current ("DC")-coupled system, meaning that the solar and energy storage equipment are both located on the DC side of the project inverter(s). The battery is charged with electricity that would have been clipped. Clipped energy is electricity that is lost due to differences in a project's DC capacity, which is dictated by its solar modules, and its alternating current ("AC") capacity, which is determined by its inverter(s). Without a battery, the clipped electricity is lost and is never sent to the electric power grid.

The electricity captured by the DC-coupled batteries can be sent to the grid during periods of peak energy usage to reduce system stress, which increases the efficiency and productivity of the energy generated by the solar energy system. A remote battery would not allow for the capture and utilization of clipped energy as a grid asset, which would result in a loss of this generated energy. Additionally, and contrary to New York's climate change goals, there could be no way to ensure the grid powered battery would only be charged with renewable electricity.

September 16, 2021 - Brunings and Biggs Letter to Planning Board

2) Who owns the Oak Hill Projects (and related questions regarding project ownership)?

As a preliminary matter, the ownership of the Oak Hill Projects are not a relevant concern for a zoning application. It is well established that zoning relates to regulating the land use itself, and not the operator of that project.

However, to provide transparency in response to public comments on this issue, we respond as follows. The Oak Hill 1 and Oak Hill 2 solar projects (the "Projects") are owned and being developed and constructed by Oak Hill Solar 1, LLC and Oak Hill Solar 2, LLC (the "Project Companies"), respectively. The Project Companies were formed in New York by Eden Devco LP, which subsequently assigned ownership in the companies to its affiliates ER Project II LLC and Eden Devco Borrower II LLC (together "Eden").

On May 7, 2018, on behalf of the Project Companies, an affiliate of Eden, Eden Renewables ("Renewables"), applied to the Duanesburg Planning Board (the "Board") for issuance of Special Use Permits for the Projects, which the Board issued to the Projects on September 19, 2019. Thereafter, Eden continued to develop the Oak Hill Projects.

On December 31, 2019, ASA Holdings NY I LLC (the "Amp Purchaser") purchased the Project Companies from Eden and appointed AMP Solar Development Inc. as "Manager" to manage their operation. The Manager requested that Renewables, again on behalf of the Project Companies, obtain an extension of the Special Use Permits for the Oak Hill Projects, which it did, and which the Board approved on July 21, 2020.

On March 4, 2021, in preparation for the financing of the Projects, the Amp Purchaser assigned ownership of the Project Companies to its affiliate ASA Seller NY II LLC, which continues to own the Project Companies as of the date hereof. At no time has ownership of the Oak Hill Projects themselves changed; they remain owned by the Project Companies.

Amp, through its various legal entities, will be the long-term project owner and operator.

3) Is Eden a solar development company?

As stated above, the business operations of a particular company are not relevant to consideration of a zoning application, regulating the proposed use is the purpose of zoning. Notwithstanding, Eden Renewables is a solar development company. The experience that Eden presented to the board is accurate.

4) Did the Planning Board approve the Subdivision?

The Town of Duanesburg Planning Board approved the subdivision plan as part of the September 19, 2019 "*Resolution Approving Special Use Permit, Subdivision and Site Plan for the Eden Renewables Oak Hill Solar Energy Projects*." As discussed during the September 16, 2021 Planning Board Meeting, the subdivision is recorded in the Schenectady County Clerk's Office on October 8, 2019 in Misc. Book 57 at Page 825 and in Cabinet P as Map No 39. Recording the subdivision map completes the subdivision process. Further, the subdivision runs with the land and does not require an extension.

5) Amp response to comments about significant changes

The proposed amendments to the Oak Hill Projects do not change the proposed use, i.e. a tracker-based solar energy project including battery storage. Nor do the amendments deviate significantly from the design previously reviewed and approved in September 2019. The potential environmental impacts have in many cases been reduced by the proposed changes. The physical size of the project has decreased due to the utilization of higher wattage modules and an alternative racking design. The proposed battery storage design is both safer and smaller (11.78 MWh per project in 2019, and now it is proposed to be 9.0 MWh per project in 2021) than the system that was approved in 2019.

At the September 9, 2021 Special Meeting & Workshop, the NYSERDA representative stated that he believes that modern centralized energy storage systems are safer than historic decentralized designs and that "it would raise red flags" if the project attempted to proceed with the previously approved design (meeting recording-2:01:24).

6) Amp response to comments about the NYSERDA review

With respect to inquiries related to NYSERDA's review of this project, it is noted that NYSERDA is a separate governmental entity operating under separate jurisdiction, and the projects' status with that agency is not germane to reviewing a proposed site plan amendment application.

Nevertheless, for the public's information, the applications to NYSERDA were completed in accordance with NYSERDA's guidance documents, procedures and protocols. The application and supporting documentation were reviewed and approved by NYSERDA. The process for receiving and paying of the incentive money allows for minor changes to projects which routinely occur when a project advances from conceptional design through the engineering, procurement and construction phases. Before any payments are received from NYSERDA, the projects must be operational and final documentation submitted. Incentives are paid based on the final, as built, project size and as such the total incentive paid may decrease, but not increase.

October 15, 2021 - Bruning Property Value Submission

7) Comments and questions pertaining to the projects' impact on property values and community character

There are several studies that examine the connection between solar projects and property values. Cohn Reznick. Cohn Reznick, a well-respected tax and property value advisor firm, studied the impact of property values adjacent to existing solar facilities in March 2021. The Cohn Reznick study concluded that no consistent negative impact has occurred to adjacent property that can be attributed to proximity to the adjacent solar farm. A screenshot from the study is included below[1]. The entire paper is included as Exhibit A.

> Based upon our examination, research, and analyses of the existing solar farm uses, the surrounding areas, and an extensive market database, we have concluded that ***no consistent negative impact has occurred to adjacent property that could be attributed to proximity to the adjacent solar farm***, with regard to unit sale prices or other influential market indicators. Additionally, in our workfile we have retained analyses of additional test subjects, each with their own set of matched control sales, which had consistent results, indicating no consistent and measurable impact on adjacent property values. This conclusion has been confirmed by numerous county assessors who have also investigated this use's potential impact on property values.

The University of Texas at Austin released *An Exploration of Property-Value Impacts Near Utility-Scale Solar Installations* in 2018. The study examines whether installations affect nearby residential property values. Among other activities, the study's authors "distributed an online survey to public sector property assessors in 430 unique counties identified" based on EIA Form 860 data. The University of Texas study states that the "results from our survey of residential home assessors show that the majority of respondents believe that proximity to a solar installation has either no impact or a positive impact on home values… the median and mode of all estimates of impact was zero, suggesting negative estimates from a few respondents were pulling down the mean." The complete study is included as Exhibit B.

Furthermore, the September 2019 Special Use Permit states that "The Project will also not change the community character as it has been sited to not be visible to the maximum extent possible to surrounding homes and roadways, and an evergreen landscaped buffer will be created on the property containing the project as set forth above" (Section 2J)

October 12, 2021 - Bruning to PB FEAF Submission

8) Has the Duanesburg Town Assessor provided the Project an emergency address?

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[1] https://montoursolar.com/wp-content/uploads/2021/03/CR-Solar-Impact-Study-Montour-Solar-One-Exec-Summary-3.8.21.pdf

The land has an existing emergency address and the projects rely on single existing point of access. This has not changed since the original application and is not a subject of the amendment.

9) Has the Applicant provided a DOT permit?

The project has not provided the DOT permit because it was not requested. However, the State of New York Department of Transportation granted a Highway Work permit on August 10, 2021.

10) Is the Quaker Street Fire Department the correct jurisdiction?

The correct Fire Department is the Esperance Volunteer Fire Department. A clarification letter will be submitted to the board.

11) Why did the 2019 FEAF not include non-residential construction heating or cooling?

The 2019 approval included battery storage as illustrated on the approved site plans, demonstrated by the applicant and stated by the Planning Board. The previously approved battery did not include an HVAC system which was why "N/A" was selected.

The original battery also did not have built in fire suppression, digital monitoring, ground fault detection, hydrogen monitoring capabilities, and the other safety features included in the 2021 applicant. The amendment application is a request to approve a smaller and safer battery than what was previously approved.

12) What is the height of the battery enclosure?

The battery enclosure is approximately nine feet and six inches tall.

13) Please clarify how any BESS and how many spare part containers per project?

There are two battery enclosures per project. There are four total battery enclosures. Each battery enclosure contains 20 battery stacks which is equal to 4.5MWh of batteries. There are two total spare parts containers across both projects.

14) Please confirm the "extent of building space to be heated or cooled?

The battery enclosures will be conditioned. The spare parts containers will not be conditioned.

15) How Many Square Feet of Impervious Surface will the project create?

The project will create 0.092 acres of impervious surface, as specified in the EAF. This translates to approximately 4,007.52 sq ft.

Despite the small amount of impervious surface being created (particularly compared to the size of the project), a SWPPP has been prepared to manage stormwater on the site, and with respect to this impervious surface. The SWPPP is being updated as part of the amendment process.

16) Questions related to equipment and project noise, including: what is the distance in feet from each equipment station to the nearest property line?

The requested information is included in the previously submitted Solar Farm Noise Analysis Report, dated August 25, 2021. The report was prepared by an engineering firm experienced in evaluating technical issues such as potential noise impact. The report identifies the noise levels for the transformer, inverter, and air conditioner associated with the projects. The report includes an attenuation graph that shows how sound attenuates over distance. It is noted that no noise study or analysis has been prepared by any commenter.

The distance between the equipment pads and the nearest property lines are approximately 950' (Ganster) and 750' (Briggs). The noise levels at those locations are expected to be approximately 40 dB and 42 dB respectively, which noise level is similar to that of a library or residential neighborhood. As such, no discernable difference of existing noise levels at the property line would be experienced.

17) Questions pertaining to whether generators are used as a secondary energy power source?

A thorough review of the energy storage system by Powin has determined that generators are not required for the safe operation of the energy storage system and therefore will not be used as a secondary energy power source.

18) Questions pertaining to ground vegetation

Limited site preparation and vegetative management will proceed construction, using industry best practices. Herbicides will not be used during construction. Once the construction is complete, seed mix will be applied to the disturbed areas within the solar array to promote suitable ground cover and to assist with the management of stormwater in accordance with the Stormwater Pollution Prevention Plan. Below is an image from another site that Amp and Greencells are currently constructing in the Albany region.

19) Will Applicant follow US and DEC regulations for recycling disposal?

The solar and energy storage projects, and its owners, are responsible for battery disposal. Lithium-ion batteries will be disposed of according to industry best practices and the applicable US and DEC regulations of the day for recycling.

20) Questions and comments pertaining to tree clearing

The area shown to be cleared within the southwestern portion of the facility is approximately 0.27 acres (less than the 20,000 sf of clear cutting allowed in one location per Local Law 1 of 2016). See IFC plan sheet C1.01.

In regards to comments about historic tree clearing, the September 19, 2019 Town of Duanesburg Planning Board Resolution Approving Special Use Permit, Subdivision, and Site Plan for the Eden Renewables Oak Hill Solar Energy Projects—1206 Oak Hill Road states that "the Planning Board Specifically finds that the property owner brush hogging the property and taking down some limited trees for agriculture and silviculture purposes was consistent with the past use of the property and did not directly relate to the development of the solar farm." (Section 3g)

21) Comment related to the omission of wildlife

The Full EAF includes all of the information recommended by the Full EAF instructions. The project team listed the "predominant wildlife species" per the EAF form instructions and did not list all species.

October 12, 2021 - Pamela H. Rowling Submission

22) **Who is the owner of this project and who is legally responsible for operations and liabilities connected with Oak Hill Solar 1, LLC, Oak Hill Solar, 2, LLC?**

Please reference question 2).

23) If the Project is sold when will the town be notified? How is the town notified of transfer? Is there a deadline of notification of transfer? are the responsibilities, liabilities and agreements to be fully transferred to the new owner?

As previously stated, zoning regulates the use of land, and not the operator. Court decisions have consistently struck zoning requirements that regulate the ownership of the property or project and not the land use. The Oak Hill Projects are not required to notify the town of a transfer. The project's obligations, responsibilities, liabilities, permits and agreements reside with the project companies.

24) If/when the project is abandoned, who specifically will manage the decommissioning plan outlined in contract documents?

As with any other type of development, the Project Companies are responsible for proper shut down and removal of the projects. The Decommissioning Agreements between the Town of Duanesburg and Oak Hill Solar 1 LLC and Oak Hill Solar 2 LLC, dated March 11, 2021, outline the responsibilities for decommissioning, and provide for a surety in the extremely unlikely event that the Project Companies were not able to fulfil their contractual obligations and the Town has to take responsibility for decommissioning. In such an event, the Town could draw on the posted decommissioning bond to fund the decommissioning.

25) With regards to decommissioning, why was there only one estimate provided or were multiple bids solicited with the intent of protecting the town's financial liability?

Decommissioning agreements rely on a single estimate that must be agreed to by all the parties after review by one or more engineers as to the decommissioning costs.

26) Does the applicant intend to increase the Project size?

No. Amp's plans are reflected on the Issued for Construction Drawings that are currently under Planning Board review. There is no plan to increase the project size. The project footprint has actually decreased in the proposed site plan amendment.

27) Why is topsoil being stripped from large areas of the project? Where will this be stored? What provisions are being made for the additional water runoff from disturbed lands

The site's limited grading plan is included in the Issued for Construction Drawings, which have been reviewed by the town's third-party engineer. Additionally, environmental and stormwater protections are included in the Stormwater Pollution Prevention Plan and the Issued for Construction Drawings that have been reviewed by the town's third-party engineer, and drafted consistent with state and Town erosion control measures, guidance and practices.

28) Comments, questions, and requests related to module height and a visual representation

The maximum array height when the modules are positioned at the maximum tilt of 60 degrees is approximately14.5', which complies with the Local Law 1-2016 requirement that "ground mounted arrays shall not exceed 20 feet in height when oriented at maximum tilt." The modules will be approximately 9' when positioned horizontally. The battery enclosure height is approximately 9'6". Please reference question 7).

Below is an image of a single axis tracker with a two portrait design that includes humans for scale as well as an image of the actual racking design by Schletter.

Below is an image of the Powin battery from an Amp project in Massachusetts.

29) Comments and questions regarding the character of the neighborhood, the values of surrounding property, and appropriate screening.

The September 19, 2019 Town of Duanesburg Planning Board Resolution Approving Special Use Permit, Subdivision, and Site Plan for the Eden Renewables Oak Hill Solar

Energy Projects—1206 Oak Hill Road states that "The Project will also not change the community character as it has been sited to not be visible to the maximum extent possible to surrounding homes and roadways, and an evergreen landscaped buffer will be created on the property containing the project as set forth above" (Section 2J) Please reference question 7)regarding property values.

The Town of Duanesburg and Oak Hill Solar 1, LLC and Oak Hill Solar 2, LLC executed a Visual Screening Maintenance Agreement on July 22, 2021. The agreement binds the Operator (Oak Hill Solar 1, LLC and Oak Hill Solar 2, LLC) to vegetative management standards and requires the Operator to maintain and replace the Visual Screening as required by the Town. The proposed visual screen will be planted on the project side of the property. The Landscaping Plan is displayed on sheet C7.00 of the Issued for Construction Drawings.

30) How if surface runoff to be managed?

The projects' many environmental controls are included in the Stormwater Pollution Prevention Plans, Issued for Construction drawings, and other project documents that have gone through a third-party review process.

October 12, 2021 - Lee and Leila Otis Submission

***31)* Comments on the historic battery submission, including comments on the omission of heating and air conditioning from the 2019 application**

As stated by the Planning Board, illustrated in the approved site plans, and thoroughly demonstrated by the applicant, battery energy storage was included in the 2019 application and Planning Board approval.

Eden presented battery information to the town as part of its 2019 application. The battery locations are included in the 2019 Site Plans. Amp's July 19, 2021 Oak Hill Solar 1 LLC & Oak Hill Solar 2 LLC's Energy Storage Projects Clarification letter details battery energy storage's inclusion in the 2019 application. The letter details a) formal submissions made to the town, b) email correspondence with the town, and c) executed land use authorization forms signed by the town, related to energy storage.

Eden's 2019 site plan did not provide any information for additional structures for heating and air-conditioning systems. That is because the approved 2019 battery did not include the safety features that the currently proposed batteries contain, such as thermal controls, built in fire suppression systems, digital monitoring capabilities or the other features included in the 2021 application. The amendment application is a request to utilize a safer and smaller (~9.0 MWh per project in 2021, as opposed to ~11.78 MWh per project in 2019) battery system than the model that was approved in 2019.

32) Comments on Perceived bylaw violations -14.6.1.4.7, 14.6.2.4.c.4, and 14.6.1.5.c

The commenter identifies provisions of the zoning code that identify features to be included in a site plan (14.6.1.4.7) and special use permit application (14.6.2.4.c.4), and for the planning board to consider in reviewing a site plan application (14.6.1.5.c). There is no special use permit application pending, therefore, Section 14.6.2.4.c.4 is not relevant. Further the proposed amended site plan shows the points of entry and exit, as well as areas that could be used for parking on the infrequent occasion when site maintenance is required. Should additional information need to be added to the site plan, the Planning Board or its engineers will request it.

33) Comments on Construction Traffic Management Plan

There are no significant changes to the proposed construction traffic as part of the proposed site plan amendment relative to the 2019 plan. There will likely be slightly less traffic relative to the original plan because of the decrease in the number of solar modules, racking post, decentralized inverters, and decentralized batteries. While actual deliveries and construction progress will depend on site progress and weather conditions, the project team anticipates that there will be approximately four truck deliveries per project (eight truck deliveries in total) a day. These deliveries are anticipated to cover all project components. The deliveries are anticipated to last for slightly over two-months during the construction period. Most of the equipment is already secured and housed in local rigging yards.

The project will abide by all local and state transportation regulations. Temporary turning truck warning signs will be utilized to inform vehicles that they are approaching a construction zone where trucks may be entering or exiting. Construction vehicles, including delivery trucks, will utilize the access roads shown on the Issued for Construction Drawings.

34) Comments related to on-site management of vehicles and deliveries

There are no significant changes to material staging as part of the proposed site plan amendment as compared to the previously approved project. All material staging will occur within the project's limit of disturbance/fence line. Before any work can occur, the project must install the appropriate environmental protections specified in the projects' Stormwater Pollution Prevention Plan, Issued for Construction Drawings, and various project documents to protect the environment and the wetlands. The project documents have been reviewed by the town's third-party engineer.

35) Comments regarding Passerby Safety and Route 7

As stated previously, there are no significant changes to the proposed construction traffic as a part of the proposed site plan amendment. There is no expectation that route 7 will be shut down during the construction process. The site's proposed access driveway has been reviewed by the New York State Department of Transportation ("DOT") as part of the issuance of a highway access drive permit. Among other aspects of DOT's review is confirming that the line of sight from the proposed access road is safe and will not create a potential for accidents. In addition, the appropriate safety signage will be posted to alert vehicles they are approaching a temporary construction entrance. The project will comply with its DOT highway access permit and all local and state regulations.

October 12, 2021 - Bruning Comments Oak Hill Solar 1 Drawings

36) How many total motors?

There are 116 tracker motors at Oak Hill 1 and 113 tracker motors at Oak Hill 2. Each racking table has a dedicated motor, and the number of racking posts has decreased from 1,975 per project in 2019 to 1512 and 1501 solar panel posts at Oak Hill 2 and 1. The approved 2019 design also utilized a single axis tracker design.

37) Comment regarding the Map

The map key shows the approximate location of the project. The projects will not be built in the mature forested area. The location of the project is displayed on the Issued for Construction drawings.

38) How many acres of land are clear cut for the installation of the array?

The area shown to be cleared within the southwestern portion of the facility is approximately 0.27 acres (less than the 20,000 sf of clear cutting allowed in one location per the local regulations). See IFC plan sheet C1.01.

39) What is the maximum height? And What is the maximum height that an array may be?

The maximum array height when the modules are positioned at the maximum tilt of 60 degrees is approximately 14.5', which complies with the Local Law 1-2016 requirement that "ground mounted arrays shall not exceed 20 feet in height when oriented at maximum tilt." The modules will be approximately 9' when positioned horizontally.

40) Comments on the different ramming depth?

Different piles have different embedment depths based on site and geotechnical considerations. As is standard practice for a development of this nature, geotechnical studies have been completed for the projects to ensure that the site is properly engineered and designed.

41) What is the clearance of the bottom edge of the panel to the ground 1.2 feet or 3 feet?

When positioned at a maximum tilt of 60 degrees the clearance at the bottom edge will be approximately 3'. When positioned horizontally, modules will have a clearance of approximately 9'.

42) How will the array operate with these clearances in the winter?

Solar trackers are designed to withstand snow loads and have proven operational histories in snowy locations. The selected tracker stows at 9 degrees off horizontal during high wind events. The tracker sheds snow by rotating to full tilt during accumulation events. Solar modules are black, causing them to heat up with sunlight. The lubrication caused by melting snow helps snow to slip off the modules.

43) Please clarify will the array always be 14.5 feet in height or will the array vary in height?

The maximum array height when the modules are positioned at the maximum tilt of 60 degrees is approximately 14.5'. The modules will rotate over the course of the day with the tracker. Typically, modules will be at lower heights than 14.5' because the tracker tilt will not be at its maximum. For example, the modules will be at approximately 9' when positioned horizontally.

October 12, 2021 - Bruning to PB Decom Estimate Appendix 2

***44)* What is Verdanterra's relationship?**

Verdanterra is an engineering firm that was hired by Amp to provide a decommissioning estimate for the BESS systems.

45) Who is legally responsible for the BESS and Who owns Oak Hill Solar 1, LLC and who owns Oak Hill Solar 2, LLC?

Oak Hill Solar 1, LLC and Oak Hill Solar 2, LLC own the batteries and are responsible for them. Please reference question 2) for project ownership information.

46) Various comments on the decommissioning cost estimate

The cost of removing the DC-DC converters and BESS enclosures was prepared by an engineering firm with experience in preparing such estimates. The proposed decommissioning costs are included in Storage Decommissioning Costs. These costs are broken out as line items in the Verdanterra Storage Decommissioning Costs estimate. The utility poles will be owned by National Grid and cannot be removed by the Project Companies. National Grid is responsible for the removal of its equipment.

The solar modules will be recycled and/or disposed of according to industry best practices and the standards at that time, at the end of their operational lives.

The salvage value is NOT factored into the decommissioning costs. However, the salvage value is provided to illustrate that the salvage value will likely be higher than the decommissioning costs.

47) Comments regarding the changes in modules.

The 2021 project design utilizes higher wattage modules to generate the same amount of clean electricity with fewer modules. The increase in module capacity and the alteration to the tracking system design have enabled a slight decrease in the project's footprint. The new and old modules have similar physical characteristics, as shown on their spec sheets.

48) Why has the height of the entire array increased from 8.5 feet in 2019 to 14.5 feet in 2021?

As described in the July 28, 2021, Summary of Changes Cover Letter, the amendment proposes to move the single-axis tracker from a single module in portrait to two modules in portrait. The maximum array height when the modules are positioned at the maximum tilt of 60 degrees is approximately 14.5', which complies with the Local Law 1-2016 requirement that "ground mounted arrays shall not exceed 20 feet in height when oriented at maximum tilt."

The change occurred to increase production and to reduce the number of piles/foundations that would be required. In collaboration with the higher wattage modules, the revised tracking design has enabled a reduction to the array footprint and environmental impact.

October 12, 2021 - - Joshua Barnes Submission

49) Will there be a containment system for any hazardous materials that could leak from the 53' containers of BESS and pollute the local environment?

The BESS is designed to maximize safety and minimize any risks to the environment. The Lithium Ion batteries to be used at the Oak Hill projects do not have a liquid component that can leak.

50) Will there be a site soil test done pre construction?

A phase 1 Environmental Site Assessment has been conducted and identified no Recognized Site Conditions (sources of contamination) from the previous land uses. Soil testing for geotechnical purposes have been conducted

51) Will there be a site soil test done yearly?

No. Soil testing is not required as Silicon based solar panels are inert and have been shown not to leach harmful levels of metals or other compounds into the surrounding environment. The project does not contain or utilize hazardous materials that could leak.

52) Will it be a third party doing the testing?

Please see question 51.

53) What is the impact to the town and neighbors of this project?

The September 19, 2019 Town of Duanesburg Planning Board Resolution Approving Special Use Permit, Subdivision, and Site Plan for the Eden Renewables Oak Hill Solar Energy Projects—1206 Oak Hill Road states that "The Project will also not change the community character as it has been sited to not be visible to the maximum extent possible to surrounding homes and roadways, and an evergreen landscaped buffer will be created on the property containing the project as set forth above" (Section 2J)

The proposed site plan amendment, if approved, will contain any conditions that the Planning Board finds necessary to ensure that there is no significant adverse impact to the Town or neighboring properties.

54) Will assessments go down?

Please see question 7).

55) During an emergency event, does the BESS system release any toxic fumes/gasses into the environment?

There are no fumes under normal operations. In an extremely unlikely thermal runaway event, the primary gases to be released are hydrocarbons. The results of this worst-case scenario are presented in the 9450A test results that have been shared with the town's third-party battery storage expert for evaluation. Below is a screenshot.

Gas type	Gas components		Total volume of gas (L)	
			Before cell venting	Throughout the test
Hydrocarbon species	Methane	CH_4	25	61
	Propylene	C_3H_6	0	66
	Propane	C_4H_8	0	8
	Cyclopentane	C_5H_{10}	5.7	12.7
Nitrogen containing species	Nitrogen Monoxide	NO	2.5	10
Others	Carbon Monoxide	CO	9	25
		CO_2	33	89.9
	Hydrogen	H_2	0	0.02
Total Hydrocarbons (equivalent to C_3H_8, measured by FID)			64	225

56) Is there an evacuation plan for neighboring houses?

An evacuation (including an evacuation plan and perimeter) would not be needed. If there were a thermal runaway event, the third-party testing suggests that it would not propagate within the battery. In the unlikely event that the testing is incorrect and it does propagate (and the built-in fire suppression system failed), the battery would burn down in place on the concrete foundation. The primary gases released would be hydrocarbons, and there would not be the need for an evacuation.

However, the project company can discuss the need for an evacuation plan with the fire department if the town believes that it is warranted.

57) Where is the water coming from to cool these 53' containers in the event of a failure? (No hydrants or public water)

The third-party battery testing (9450A) states that in an extremely unlikely thermal runaway event, the fire will not propagate within the battery. Additionally, fire suppression systems are placed over every group of stacks. In the extremely unlikely event that the battery catches fire and the fire is not contained by the built-in fire suppression system, the battery would be left to burn down in place.

The only water requirement would be ensuring that the fire does not spread off the equipment pad. This water could be provided by the local fire department(s). Even without additional water, the chances of the fire spreading out of the steel enclosure with the built-in fire suppression system off the equipment pad are extremely low. There are intentional design setbacks built into the equipment pad and between the equipment pad and the modules/any fuel sources.

58) What are the water/environmental impacts in the event of a total failure?

The results of a total failure event are included in the 9450A test results that have been provided to the town's third-party battery reviewer (and are included in the project materials on box.com).

In the extremely unlikely event of a fire (and that the fire unexpectedly propagated and overcame the BESS's built-in safety features), the battery would burn down in place on the concrete foundation, and the impacts would be limited. The primary chemicals that would be released during a total failure event would be hydrocarbons. The volume of gases limited would not provide a threat to neighbors.

59) Does this added BESS create any permanent local jobs?

As previously stated, batteries were previously approved. The battery will be serviced by New York-based crews.

60) What is the actual revenue generated for the town? (With and without BESS)

The revenue generated to the Town is not germane to site plan review. Nevertheless, the Oak Hill Projects executed a Payment in Lieu of Tax Agreement ("PILOT Agreement") on January 9, 2020, in an amount approved by the Town. It is also noted that the project will not create a demand for public services such as road maintenance, public water or sewer, or other Town-provided services.

61) What is the actual revenue generated for the school? (With and without BESS)

See the response to question 60), above. The School District similarly has entered into a PILOT Agreement with respect to the projects. Further, the projects will not result in the addition of school-aged children, and as such, will not create an economic burden on the school, notwithstanding that the school is receiving PILOT payments from each project.

62) Has there been a new glare study done at the increased solar array height with tracking?

Yes, EDP Engineers prepared an analysis that was provided to the town and reviewed by the Town's third-party engineer (dated July 23, 2021). The analysis was revised and re-released (August 25, 2021) following PrimeAE comments. This analysis found that no glare is predicted. No comments upon, or competing glare analysis has been submitted by an engineering professional by any member of the public.

63) Why is the increased height needed?

The revised tracking design, in collaboration with higher wattage modules, has allowed for increased clean energy production and a reduction to the project footprint and the number of piles/foundations that are required. This reduces environmental impact while increasing the energy produced by the project. The increased height remains compliant with the height limitations in the Town Code.

64) Can you generate the same amount while keeping the height the same as previous?

Amp's proposal is reflected on the Issued for Construction drawings currently under Planning Board review. This proposal complies with all applicable zoning requirements for a solar energy facility, including the height limitations. As noted above, the increased height allows for a smaller project footprint and reduced environmental impacts.

65) Will herbicides/pesticides be sprayed on the site at any point? This will effect water and soil

The proposed site plan amendment application does not include any changes to the proposed vegetation management strategies for the project.

66) Is their any studies on ground water contamination?

The project does not include the discharge of any liquids or materials that could contaminate groundwater. As such, no groundwater studies are warranted.

67) Are PFAs used in any part of this project?

According to the United States Environmental Protection Agency, "PFAS are found in a wide range of consumer products that people use daily such as cookware, pizza boxes and stain repellants. Most people have been exposed to PFAS." The EPA continues that PFAS can be found in food, commercial household products, workplaces, drinking water, and living organisms.

To Amp's knowledge, the project will not include PFAS materials in amounts above recommended exposure limits.

68) **Questions regarding the proposed Energy Storage Systems**

The proposed energy storage systems are a DC-coupled lithium iron phosphate battery energy storage solution. Lithium iron phosphate is the safest available lithium chemistry. The batteries will be placed in conditioned steel enclosures with a built-in fire detection, suppression, and alarm system, redundant thermal controls, humidity detection, hydrogen detection capabilities, ground fault detection abilities, an uninterruptible power supply backup, and other safety features. The system offers real-time temperature and voltage monitoring down to the cell level (the building block for the system architecture). These measurements are taken multiple times a second and automatically shut down the system if abnormalities are detected.

The enclosure will be placed on an engineered concrete foundation with a grounding grid. A crane is typically used to lift the enclosure onto the foundation. After being positioned on the foundation, the proper electrical terminations/connections are completed, and the fire suppression and HVAC systems are commissioned. Once the fire suppression and HVAC systems are functioning correctly, the battery stacks are installed and connected inside the enclosure. Crews with appropriate safety training and experience will perform all work.

Each project (Oak Hill 1 LLC and Oak Hill 2 LLC) will have two energy storage enclosures and be approximately 3.84 MWs and 9.00MWh. There will be 18.0 MWh in aggregate across the two projects. For clarity, each of the four energy storage enclosures between the two projects will have a capacity of approximately 4.5 MWh. This is a reduction from the 11.78 MWh per project (or approximately 23.56 MWh in aggregate for both projects) that was originally approved in 2019. As a DC-coupled system, the batteries will be charged by the solar system. However, they will receive auxiliary power from the electric power system (grid). Please reference question 1) for a more detailed description regarding how the battery is charged and why it cannot be relocated to another location.

The batteries will be connected/powered by the solar modules. Electricity will then flow from the battery through the DC-Converters to the inverters and eventually to the grid. The battery enclosure height is approximately 9'6". Each battery enclosure weighs approximately 26,415 lbs.

There are infiltration trenches surrounding the proposed equipment pads (including pads that contain the BESS) to manage stormwater. The fire suppression system is installed inside the enclosure. Unlike the lead-acid batteries that individuals may be familiar with, the proposed batteries are solid state and do not have a liquid component that can leak. Photos of the BESS system are included in the publicly available Oak Hill 1&2 amendment package documents. The batteries (and equipment pads) will be located towards the center of the solar arrays and be approximately 950' (Ganster) and 750' (Biggs) from the nearest property lines.

The cut sheet for the DC Converters has been added to the public project application documents. DC-DC Converters are an integral component of a DC-coupled solar system. The technology is a type of power converter that converts a source of direct current from one voltage to another. There is one DC-converter per energy storage enclosure. The DC-

Converters will be placed on concrete foundations next to the batteries. The locations of the DC-Converters are displayed on the Issued for Construction drawings.

Amp is a leader in DC-coupled energy storage. Amp built some of the first DC-coupled solar and storage projects in the United States and currently operates three DC-coupled solar and energy storage projects that actively utilize the same Powin BESS technology. Amp is currently in the process of building another DC-coupled Powin BESS project in the greater Albany region.

Amp has experience building solar and energy storage projects in remote locations. For example, Amp partnered with the Xeni Gwet'in band of the Tsilhqot'in people of British Columbia to build a microgrid to power a first nation community 100 Km from the nearest electrical grid.

In the extremely unlikely event of a battery fire, the third-party testing states that the event will be contained within the cell, and the fire will not propagate from one cell to the next within the battery. Additionally, there are internal steel barriers within the battery that provide a thermal barrier and provide additional protection against propagation. Fire suppression canisters are placed directly over every individual stack. In the even more unlikely event that there is a fire, and it propagates (against the third-party test results) and the built-in fire suppression system does not contain it, the battery would burn down in place on the concrete foundation. Due to physical separation between the steel enclosures (hundreds of feet) and intentional setbacks and buffers from native fuels and the solar modules, the risk of fire propagation from one enclosure to another or the surrounding area is extremely low.

The results of this worst-case scenario are presented in the 9450A test results that have been shared with the town's third-party battery storage expert. If a fire occurs, the primary gases that will be released are hydrocarbons. This will not have a significant impact on neighbors or the town. An evacuation (including an evacuation plan and perimeter) would not be required. In the extremely unlikely event of a fire that overcame the built-in safety systems, the fire department(s) would observe the fire and use water to ensure that it does not spread off the equipment foundation, which it should not due to intentional setbacks between the enclosure, edge of the pad, and native fuel sources.

A fire or safety event would need to be treated on a case-by-case basis. However, in the unlikely event of a serious failure, the individual BESS unit that malfunctioned would be serviced or removed from the project, depending on the severity of the failure. If there was a serious safety event, such as a fire, that necessitate the removal of a BESS enclosure, the piece of equipment would be removed as soon as its safely practical.

Please refer to questions 50) and 51) for questions regarding environmental testing. Please refer to 60) and 61). Please refer to Question 2) for regarding the community character and property values.

69) Questions regarding Operations and Maintenance

Powin Energy, the battery system provider, will be responsible for monitoring and maintaining the BESS. The batteries will be digitally monitored multiple times a second to proactively detect any system abnormalities that could develop into safety concerns.

Additionally, local crews will physically visit the site and inspect the battery quarterly (once every three months).

There is a separate Operation and Maintenance agreement with Greencells, the Engineering, Procurement, and Construction company for general site operations and maintenance. The access road, fence, solar modules, and other project components would be covered under the Greencells operations and maintenance agreement. Additionally, the module's equipment manufacturer has provided a module warranty. The site will be inspected regularly under the general Operations and Maintenance agreement.

Amp cannot allow neighbors to participate in onsite inspections and operations and maintenance activities. However, we can work with the neighbors to design and release an annual report that could answer their questions and provide images.

70) Questions Regarding the Emergency Plan?

An emergency plan was provided to the town's third-party energy storage expert for review. The plan has also been uploaded to the project documents on box.com. The applicant does not have a New York office. However, the project is contracting with local crews to service the project and respond in the case of an emergency event.

71) Economic Questions Regarding the Oak Hill Projects?

Questions regarding project economics are not pertinent to the Planning Board's review of the proposed amendment to the existing special permit.

72) Questions regarding local benefits

The BESS will be serviced by New York-based service crews. However, the vast majority of the jobs associated with the project will be temporary construction jobs. The project team will attempt to utilize local labor, wherever possible, during the construction process. Funds will be generate for the town and the school district through PILOT agreements.

Neither the BESS equipment nor solar panels are purchased from town, county, or state companies. This has not changed since the original approved 2019 application.

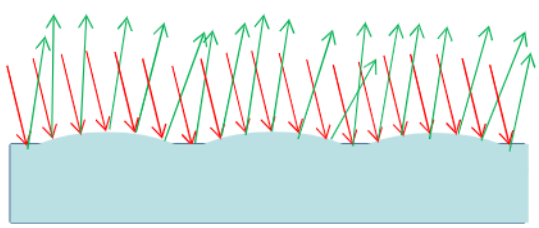
The projects are currently more than 98% subscribed, which is more than enough to start construction. All community solar subscribers are New York National Grid customers. If interested in being an offtaker, please visit https://community-solar.energy/nysignup.

73) Questions regarding the solar panels

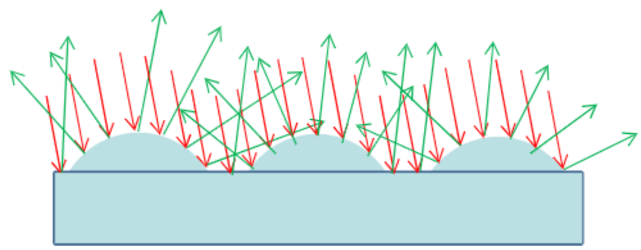
The cut sheets for the 310W-330W Stave modules that were proposed in 2019 are included in the project application materials saved to Box.com. The project now intends to utilize higher wattage (380-385W) Vikram modules to realize the technological advancements that have occurred since the September 2019 approval. The higher wattage modules, in addition to the updated solar tracking design, has allowed the project to decrease the number of modules and reduce the project footprint as well as the number of foundations that need to be installed. The cut sheets for the Vikram modules are saved to Box.com. The Vikram modules have already been secured, so there is no concern of needing substitutes or changes or changes to US policy. Vikram modules are manufactured in India.

The modules are backed by a 25 year performance warranty. It is not anticipated that many modules will fail within the first two years of operation. Modules that fail, either during construction or during the operational lifespan, will be recycled or disposed off-site based on the regulations at the time. Hypothetical speculation about the impacts of future technology advancements are not pertinent to Amp's application. Amp's plan is reflected on the Issued for Construction drawings under Planning Board review.

Information on the module's anti-glare protection is provided with the project material on box.com. The selected modules include both AR coated glass and a texturing pattern that combine to provide the highest level of glare resistance (typically utilized if in a sensitive location such as adjacent to an airport). The textured glass anti-glare glass reflects light in different directions causing a light diffusion with lighter glare reflective to conventional solar modules. An image is below.



a) Normal Solar Glass



b) Anti-glare solar glass

The AR coating supplements the anti-glare glass to reduce any glare from the project. The AR coating is primarily composed of SiO_2, which is relatively stable. The coating will have a similar life to the glass. It is not anticipated that the coating will be reapplied during the project lifetime. The AR coating does not contain any toxic components.

There is no plan to clean the solar panels beyond regular rainfall. While solar projects in dry environments such as southwestern deserts require cleaning to remove dust, solar projects in the wetter north east rarely if ever require cleaning due to regional weather patterns. There will be a degree of soiling from dust or debris. The soiling is factored into the solar project's production simulations.

Both the 2021 and 2019 project designs utilized solar trackers to maximize clean energy production. Solar trackers move over the course of the day to follow the sun's path to maximize energy production. The tracker movement is powered by electric motors. The motors rotate torque tubes, which rotate the modules. The array rotates daily to follow the sun's position in the sky. At the end of the day, the modules are rotated to face the sunrise. The Scheletter trackers that will be utilized rotate 40 times a day in 3 degree increments (they move 120 degrees in a day). If we are moving throughout 12 hours of sunlight, that is approximately one 3 degree movement every 18 minutes. However that will vary by length and time of day. Before dawn the trackers will tilt to 60 degrees facing East. Here is a link to a video showing how the system moves.

The motors are serviced as part of the ongoing operations and maintenance agreement. There is one motor per racking table. Additionally, the solar tracking system has the same bylaw compliant setbacks that were approved in 2019 and upheld by the State of New

York in the legal challenge to the existing, approved project.

The maximum array height when the modules are positioned at the maximum tilt of 60 degrees is approximately 14.5', which complies with the Local Law 1-2016 requirement that "ground mounted arrays shall not exceed 20 feet in height when oriented at maximum tilt." The modules will be approximately 9' when positioned horizontally. The module specifications are included in the project materials on box,com.

The September 19, 2019 Town of Duanesburg Planning Board Resolution Approving Special Use Permit, Subdivision, and Site Plan for the Eden Renewables Oak Hill Solar Energy Projects—1206 Oak Hill Road states that "The Project will also not change the community character as it has been sited to not be visible to the maximum extent possible to surrounding homes and roadways, and an evergreen landscaped buffer will be created on the property containing the project as set forth above" (Section 2J)

Damaged or nonfunctioning modules may be temporarily stored in the spare parts containers before being taken offsite for recycling or disposal. The spare parts containers will contain spare parts and equipment that may be utilized by the operations and maintenance team. The project is responsible for removing the spare part containers and the rest of the system, during decommissioning. The Decommissioning Agreement governs the process to be used for decommissioning, including the use of surety funds, in the unlikely event that the company cannot fulfill its contractual decommissioning obligations.

74) Questions regarding the visual analysis and glare analysis?

Amp provided an updated Supplemental Visual Impact Assessment, dated September 8, 2021, as part of its amendment package. No visual assessments or comments regarding Amp's visual assessment were provided by any engineers as part of this extended public comment period. The exact height of the photographer is unknown.

The project, including the modified components that are the subject of this site plan modification, is ~800'+/- from the Biggs residence and ~1500+/- from the Gangster residence at its closest point. Amp has not conducted site visits, nor are such visits required by the Town Code or commonplace, particularly for an application seeking to modify an approved project.

However, Eden held two public open houses in the summer of 2019 and 2020. The 2020 event was specifically held for the abutters who claimed that they did not know about the first event. After the meeting, Eden offered to meet and discuss project concerns. In 2021, Amp sent an unrequired courtesy notice to all residents within 1,000' feet of the project (whose family was not previously involved in project-related litigation) informing them of the amendment application and offering to participate in a one-on-one phone conversation.

The project will not be visible from Route 7 due to the existing vegetative screening. For questions regarding the module height, please reference question 39). Post depths will vary between 12' and 18' for both Oak Hill Solar 1 LLC and Oak Hill Solar 2 LLC. The individual post depths were selected to ensure stability and meet safety requirements. If bedrock is encountered, then a foundation acceptable to the Engineer of Record will be installed.

75) Questions regarding site screening

The Point of interconnection ("POI") will be on NYS Route 7. The utility poles along Route 7 will not be screened, similar to the existing utility poles on Route 7. The Applicant is required to replace the screening included in the Visual Screening Maintenance Agreement (this is not for the POI) if the screening dies. Please refer to question 26) with questions about the screening agreement.

The projects are designed so that sheep *may* be used for vegetative management. Sheep are often used for vegetative management on solar tracking systems. The terms and specifications of the project real estate documents are confidential.

76) Questions regarding the Environment?

The projects' many environmental controls are included in the Stormwater Pollution Prevention Plan, Issued for Construction drawings, and other project documents that have gone through a rigorous third-party review process.

77) Questions regarding the fence

The fence height was increased to eight feet to provide additional site security and ensure compliance with all codes. The fixed knot galvanized steel wire fence is a fairly standard design suitable for harsh weather and long winters. This type of fence is widely deployed in upstate New York and has been used on several New York solar projects.

In the unlikely event of a fence failure, the project companies would fix or replace the fence. Without knowing the nature of the hypothetical fence failure, it is difficult to state the exact replacement process. However, it would likely involve local crews removing the damaged sections of the fence and installing replacement material/equipment.

The standard line post spanning is 120". The fence location is displayed on the Issued for Construction Drawings. Additional fence details can be found on the Issued for Construction Drawings on Sheet C5.01. The anticipated project life is 25 to 40 years.

78) Questions regarding clear cutting

The area shown to be cleared within the southwestern portion of the facility is approximately 0.27 acres (less than the 20,000 sf of clear cutting allowed in one location per the local regulations). See IFC plan sheet C1.01. The property owners recall that previous tree clearing occurred in Summer/Fall 2019.

79) Final Questions

Project contracts are confidential. However, Amp does not plan to expand the solar and energy storage project beyond the plans currently being reviewed by the Planning Board. Amp will provide contact information so neighbors can contact the project to communicate any concerns or raise complaints. Please see 6) Property Values and community character for questions about property values and community character.

10/12/2021 - Bruning to Comments on Oak Hill Solar Decommissioning Plan

80) **Who is legally responsible in case of catastrophic failure?**

Oak Hill Solar 1, LLC and Oak Hill Solar 2, LLC own the batteries and are responsible for them.

In the extremely unlikely event of a catastrophic fire, the project companies and their owners would be responsible.

81) Is this for one BESS of two containers? And Is this for two BESS with a total of four containers?

The $36,099 is for one of the projects (including both enclosures). Each project has two BESS enclosures.

82) Comments regarding the Flint Mine Comparison

It is difficult to understand the Flint Mine comparison without more details on the project and the decommissioning methodology. However, the Flint Mine project is significant larger at 100 MW solar and 100 MWh storage that may face different challenges.

Amp's updated decommissioning estimate (to take into account the proposed changes) has been submitted as part of the project documents. It is noted that the Oak Hill Projects has an approved decommissioning estimate as part of the approved project, which would only be subject to change as to the modifications proposed in the application currently under review.

83) Will the Decommissioning Agreement Travel with the land?

The decommissioning plan would be integrated into a modification to the existing, binding Decommissioning Agreement. The Decommissioning Agreement would be an obligation for the Project Companies and is a condition to the Special Use Permit. So long as the permit remains in effect, then the Decommissioning Agreement would be required as well. However, it would not be recorded and run with the land.

84) What if the land owner ends up owning the BESS?

The landowner is the land lessor and does not own the batteries or the solar equipment. The project companies are responsible for the BESS. There is no credible scenario where the landowner would own the battery.

85) What is the distance from Biggs' house to the nearest BESS container?

The distance from the closest BESS to the Biggs residence is a little over 1,500'.

Bruning Comments on Tracking System

86) **Comments and requests for tracker images.**

Below is an image of a single axis racking system with a two-portrait design by Schletter, the racking manufacturer.

Below is an alterantive image with humans included for scale.

87) How often is the array moving?

The array rotates daily to follow the sun's position in the sky. At the end of the day, the modules are rotated to face the sunrise. The Scheletter trackers that will be utilized rotate 40 times a day in 3 degree increments (they move 120 degrees in a day). If we are moving throughout 12 hours of sunlight, that is approximately one 3 degree movement every 18 minutes, however that will vary by length and time of day. Before dawn the trackers will tilt to 60 degrees facing East. Here is a link to a video showing how the system moves.

88) What is the distance between the abutting residences and the nearest motor?

Motors are integrated into the racking system. There is at least a 100' buffer between the solar array and property lines, which complies with the Town's zoning code requirements. This has not changed since the 2019 approval and is not a subject of the amendment currently under review.

89) How many motors are in each array?

116 for Oak Hill 1 and 113 for Oak Hill 2. The previously approved site plan utilized single access trackers so the presence of motors has not changed and is not a subject of the amendment.

90) When do the panels rotate back to the most easterly position + does entire array rotate back to the easterly position at one time?

The use of tracking was previously approved and is not a subject of this amendment. The modules rotate back to the most easternly position at the end of the day. The entire array generally moved in unison. Here is a link to a video showing how the system moves.

91) Comment on slope and site appropriateness

The proposed system is appropriate for the site. Schletter (racking OEM) has been involved in the system design and has confirmed that the terrain of the site is within the slope tolerance of the racking system with some grading required as shown in the grading plans. While level ground is optimal for the installation of almost all equipment, projects are routinely engineered to be safely constructed and operated on sloped land.

92) Comments and questions onsite preparation and vegetative management

Vegetation and topsoil will not be removed from the entire site. Below is an image of a tracker installation at another project that Amp and Greencells are currently building in the Albany region.

The grading and limited tree clearing required for the Oak Hill 1 Solar LLC and Oak Hill 2

Solar LLC are displayed on the Issued for Construction Plans.

93) Does the Applicant anticipate using concrete footings?
The Oak Hill Projects will use driven post foundations and will not utilize concrete ballast footings.

October 12, 2021 - Biggs Questions

94) **Has the Applicant demonstrated that they will uphold NYS Department of Environmental Conservation Rechargeable Battery Law, Article 27, Title 18 of the Environmental Conservation Law?**
Article 27, Title 18, expressly excludes batteries used "for storage of electricity generated by an alternative power sources, such as solar…generators." As such, it is not applicable to the Projects.

95) Has the Applicant provided confirmation that both delivery and decommissioning transportation will conform with the US Department of Transportation regulations for transporting hazardous materials, specifically lithium-ion batteries?
The transportation and decommissioning of the batteries will comply with all applicable regulations and requirements of the day.

96) What is the projects infancy mortality rate for batteries? How will failed batteries be disposed of during installation and operation?
The battery integrator offers a 20-year performance guarantee. It is not anticipated that there will be any BESS infant mortality. Any failed batteries (during installation or operation) will be recycled or disposed of offsite according to the applicable regulations of the day.

97) Comments Regarding the Applicant's Track Record with BESS
Amp is a leader in DC-coupled energy storage. Amp built some of the first DC-coupled solar and storage projects in the United States, including the very first DC-coupled system under the Massachusetts SMART program, and currently operates three DC-coupled solar and energy storage projects that actively uses the same Powin BESS technology. Amp is currently in the process of building another DC-coupled Powin BESS project in New York state and will build many additional US BESS projects in 2022.

Amp has experience building solar and energy storage projects in remote locations. For example, Amp partnered with the Xeni Gwet'in band of the Tsilhqot'in people of British Columbia to build a microgrid to power a first nation community 100 Km from the nearest electrical grid. However, most of the project teams energy storage experience comes from Powin Energy, who is an energy storage leader that has delivered more than 600 MWh of battery energy storage projects.

As discussed during the August Planning Board meeting, the battery will be installed by electrical subcontractors. The subcontractors will possess the necessary knowledge, safely training, and industry experience to safety and successfully install the battery system. Further, the projects cannot be operated until both the Town, and the utility, sign off on the projects and their compliance with all applicable building, fire and electrical codes.

98) Comments regarding the solar array height

Please refence question 45).

99) Comment regarding the fence location
The location of the fence, the Biggs property line, and the setback are shown on the issued for construction drawings.

100) Comment regarding the Visual Screening
Please reference question 29).

101) Comments regarding Herbicides
The solar tracker motors will be approximately 4.9' above the ground. Vegetative management will be required and the system is designed so that sheep can be utilized. Sheep have a proven history of being used for vegetative management at solar projects with tracking.

102) Comments regarding property values and community character?
Please reference question 7).

.
Thank you for your time and consideration.

Oak Hill Solar 1 LLC and Oak Hill Solar 2 LLC By:
AMP Solar Development Inc., its Manager

Nicole LeBlanc
Authorized Signatory
Director, US Transactions

Exhibit A: Impact Study of Property Values Adjacent to Solar A Study of Nine Existing Facilities

The document is protected and cannot be attached, it will be emailed separately

Exhibit B: An Exploration of Property-Value Impacts Near Utility-Scale Solar Installations

An Exploration of Property-Value Impacts Near Utility-Scale Solar Installations

Leila Al-Hamoodah, Kavita Koppa, Eugenie Schieve, D. Cale Reeves, Ben Hoen, Joachim Seel and Varun Rai

Abstract

Nationwide, electric utilities increasingly rely on solar installations as part of their energy portfolio. This trend begs the question of how they affect nearby home values. Understanding whether these installations are amenities or disamenities and the scale thereof will help policymakers, solar developers, and local utilities to site and build solar installations with minimal disruption to nearby communities. This paper investigates where large solar installations are located, the housing and income characteristics of the surrounding areas, and if the installations affect nearby residential property values. We approach these questions using geospatial analysis and a survey of residential property assessors. Geospatial analysis examines both housing density and median income surrounding these facilities, while the survey gauges local assessors' opinions of the impacts of these installations on property values. Property values can be a useful proxy for various non-market goods like scenic value, tax benefits, and of particular interest here, both positive and negative perceptions of utility-scale solar facilities. Our results show that while a majority of survey respondents estimated a value impact of zero, some estimated a negative impact associated with close distances between the home and the facility, and larger facility size. Regardless of these perceptions, geospatial analysis shows that relatively few homes are likely to be impacted. Though only one component of a larger analysis, these property value impacts are likely to be of growing interest as more solar facilities are built. This exploration of impacts will help inform solar developers, public officials, home assessors, and homeowners about the effects and implications of solar energy infrastructure.

Introduction

The installation of utility-scale solar facilities continues at a rapid pace across the United States, with over ten gigawatts of new photovoltaic (PV) capacity installed in 2016 alone (Bollinger et al., 2017: p. 1; Perea et al., 2016). These utility-scale PV installations, often informally called solar farms (Fehrenbacher, 2016; New York State PV Trainers Network, 2017), are defined here to include installations one megawatt (MW_{AC}) and larger. Like other power plants, these utility-scale solar installations have the potential to impact nearby home values. The potential adverse impact on home prices due to the installation of solar utilities is relevant to solar developers, public officials, home appraisers, and homeowners, yet no peer-reviewed literature has directly addressed the subject to date.

The primary research question is: Do utility-scale solar PV installations impact the value of nearby homes? This study contributes to the existing literature on amenities and disamenities by extending the research to utility-scale solar PV installations. Amenities are considered to be features that increase the value of a home, while disamenities have the opposite effect. The information in this study tackles relevant issues for solar stakeholders and identifies questions for future research.

Background and Literature Review

Residential housing literature covers a broad range of amenities and disamenities, including open-space and water views (Anderson & West, 2006; Bond et al., 2002), as well as landfills, coal-fired power plants, shale gas production facilities, oil and sour gas facilities, and transmission lines (Anderson et al., 2007; Des Rosiers, 2002; Case et al., 2006; Muehlenbachs et al., 2014; Davis, 2008; Locke, 2012), respectively. Research on High Voltage Transmission Lines (HVTLs), for example, has found adverse effects on proximate home values to be present in some analyses, while not in others, and, in general to be sensitive to micro-siting differences (Anderson et al., 2007; Des Rosiers, 2002). Alternatively, research on power plants and natural gas facilities has found that increasing proximity to the disamenity correlates to a greater change in property values (Davis, 2008; Boxall, 2005).

In the case of utility-scale wind turbines, much of the available research in the U.S. has not found consistent or compelling evidence of sales price impacts on homes (Hoen et al., 2015; Hoen & Atkinson-Palombo, 2016; Lang & Opaluch, 2013). In fact some studies have documented wind turbines' connection to increased property tax revenues to local school districts (and local taxing entities), which might be connected to increased property values by extension (Loomis & Aldeman, 2011). Additional benefits of utility-scale wind can include job growth, supply industry growth, landowner profits, and road improvement, most of which are an effect of increased tax revenue from the large installations (Loomis et al., 2016). Recent survey results suggest that U.S. residents living near wind facilities prefer living next to a wind turbine over more conventional energy infrastructure, such as coal, nuclear and natural gas (Hoen et al., 2018). Respondents in the same survey who lived within a half a mile of a wind project expressed similar preferences between living next to a wind (37 percent) or a solar facility (24 percent), with roughly a third having no opinion, but these differences were not statistically significant. This, therefore, suggests that disamenity research on wind's effects on property values, a proxy for local preferences, might provide a reasonable basis for comparison to utility-scale solar facilities.

To the best of the authors' knowledge, no existing peer-reviewed research provides quantitative evidence of property value impacts associated with utility-scale solar facilities, but existing studies address related areas. Previous research on residential PV installations, for example, has indicated that buyers place a premium on homes with PV systems (Hoen et al., 2017). In addition, available literature has explored public opinions surrounding utility-scale solar installations and perceived property value impacts. A survey by Carlisle et al. found that around 80 percent of U.S. survey respondents support the development of large-scale solar facilities both in the U.S. generally, and within their own county (2015). However, this survey also indicated that 70 percent of respondents believe these installations will decrease property values. A public opinion survey on solar facilities by the Idaho National Laboratory found that 43 percent of respondents in the southwest United States believed that a view of a large-scale solar facility would decrease the value of their home, while 23 percent believed it would increase the value (Idaho National Laboratory, 2013). In the same survey, one fifth of respondents indicated that a buffer of less than a mile would be acceptable between utility-scale solar facilities and residential areas (21 percent), while the remainder believed the buffer should be between one and five miles (26 percent), six and ten miles (16 percent), more than ten miles (21 percent), or were unsure or had no preference (16 percent). Notably, respondents in the southwest sample were more open to proximity to solar installations within one mile of a residential area (26 percent) than was the national sample. Finally, select appraiser research conducted in North Carolina has found that utility-scale solar facilities have no impact on property values (Kirkland, 2006).

In addition to the above research, various media outlets provide evidence of a perceived impact on home prices by homeowners. News articles from California, North Carolina, and Tennessee, for example, identify communities that expressed displeasure over solar installations proposed or constructed near their homes (Lunetta, 2017; McShane, 2014; West, 2015). Online forums also indicate concern by homeowners about the potential impact of a solar farm on home values (Zillow, 2017; Realtor.com, 2011; HackettstownLiFE, 2011). Some common concerns over proximity to solar farms include changes in property values due to the solar installation's appearance, safety or health concerns, or changes in the environment, such as water run-off or displaced wildlife (McShane, 2014; HackettstownLiFE, 2011; West, 2015; Appraisers Forum, 2015). Other homeowners expressed no concern about living near a solar facility, or even preferred solar farms to alternative uses like animal agriculture, wind farms, industrial uses, or housing development (Zillow, 2017; HackettstownLiFE, 2011). Online forums also indicate that appraisers have varying opinions about whether solar installations may constitute a disamenity (Appraisers Forum, 2015).

Building upon the available amenity, disamenity, and public opinion literature, this study explores the impact of utility-scale solar installations on home values using two complementary analytical approaches: a geospatial solar-siting analysis and a survey of property assessors. First, the solar-siting analysis examines both housing density and median income surrounding these solar facilities. This will provide context on the scope of potential impacts due to proximity to solar, by identifying the number of homes that may be affected and the characteristics of those residents. Next, a survey of residential property assessors was conducted to evaluate the scale and direction of those impacts, if any. This research seeks to understand both the characteristics of utility-scale solar installations as they relate to neighboring homes, and any potential impact on home prices due to proximity to a solar installation. The remainder of the paper outlines the data, methodology, and results of each analytical approach. It then identifies limitations and suggestions for further research, and concludes with recommendations for policymakers and other stakeholders.

Solar-Siting Analysis

The solar-siting analysis assesses the scope and equity distribution of utility-scale solar's potential impact on nearby property values. It does so by considering the number of homes that may be affected by proximity to solar. To do this, we mapped the locations for utility-scale solar facilities in ArcGIS 10.5, and combined it with housing census and median income data. The median income data was compared to the national average to determine if the siting of utility-scale solar raises any equity concerns.

Data

The primary data for this analysis is 956 unique solar sites completed in 2016 or earlier with confirmed latitude and longitude coordinates. This list was developed using data from the U.S. Energy Information Administration's (EIA) Form 860 and proprietary data from Lawrence Berkeley National Lab (LBNL), containing a total of 1,805 solar installations. Many utility-scale solar sites were included in both datasets, but sometimes differed in coordinates or total capacity due to aggregation. To ensure the accuracy of the latitude and longitude coordinates for these sites, the research team reviewed satellite images of each site. Installations were excluded if the provided coordinates were not directly on top of solar panels in satellite imagery. Where the EIA and LBNL sources reported different coordinates, the coordinates that more accurately aligned with the center of the array were used. Finally, entries in the EIA's database with a shared plant code ID were combined into a single facility with their summed nameplate capacity.

Ultimately we used 956 out of 1,805 installations that had been cleaned and compiled from the EIA and LBNL sources in this mapping analysis. In general, this sample of facilities used in the analysis has a similar distribution of nameplate capacity to the 1,805 installation sites. The average nameplate capacity of the full sample (1,805 installations) and the selection used in our analysis (956 installations) were not statistically significantly different (p-value = 0.5). For a complete comparison of the analyzed and total solar installation descriptive statistics, see **Appendix C.1.** The location of the facilities is also similarly distributed, with California hosting the most facilities, followed by North Carolina, in both sets. Thus, these 956 sites are representative of the total 1,805 installations from the EIA and LBNL sources. **Figures C.2 and C.3** in the appendix present histograms of total nameplate capacity for the two groups. The minimum, median, average, and maximum capacity of these 956 installations is $0.4MW_{AC}$, $4MW_{AC}$, $12MW_{AC}$, and $314MW_{AC}$, respectively.[1] These installations were then broken into categories based on capacity: 1-4.99MW, 5-9.99MW, 10-19.99MW, 20-49.99MW, 50-99.99MW, and 100+ MW.

[1] While we define utility-scale solar as facilities 1MW and higher, three sites under 1MW were included in the underlying EIA database. These were included in our dataset as well.

These GIS data are merged with data on housing density and median household income estimates throughout the United States. We used data on housing population density and median household income from the American Community Survey's 5-Year estimates of unweighted sample housing units and median household income by census block group. We joined estimated housing units and median household income per block group to TIGER/Line Shapefiles provided by the U.S. Census Bureau and displayed them as a density across the United States.

Methodology

To begin this analysis, the latitude and longitude coordinates for the verified operating solar facilities were plotted in ArcGIS. Starting from the coordinates of the solar facility, radii of 100 feet up to three miles were used to create select areas, or buffers, around the solar facilities. To account for the area of the solar facility itself, where no home could possibly exist, a circular area originating from the center of the facility was created, which we call here a "pseudo-polygon" (See **Figure A.1**). These pseudo-polygons were calculated by estimating the average area of utility-scale solar installations (the team assumed an average of 6 acres/MW), and then calculating the radius needed to equal the estimated area required. Pseudo-polygons were created for the following categories: 1MW = 1-4.99MW (6 acre circle); 5MW = 5-9.99MW (30 acres), 10MW = 10-19.99MW (60 acres); 20MW = 20-49.99MW (120 acres); 50MW = 50-99.99MW (300 acres); and 100MW = 100MW+ (600 acres) facilities. For the complete pseudo-polygon calculations, see **Appendix C.4**. Outside the pseudo-polygon, buffer zones of 100 feet, 500 feet, 1,000 feet, one half mile, one mile, and three miles were then used to estimate distances from the facilities. For a full extent of the buffer zones, see **Appendix C.5**. Estimates of the number of homes that exist within each zone were calculated, using the proportion of the block groups which overlapped with the distance radii. The number of homes within each distance radii were summed, by combining the buffer zones with aggregate housing data block group polygons. In some cases, those polygons did not fall completely within the buffer zones. In that case, housing units were estimated by comparing the area of the block group to the area intersecting the buffer zone, and proportioning the total housing units for the block group accordingly.

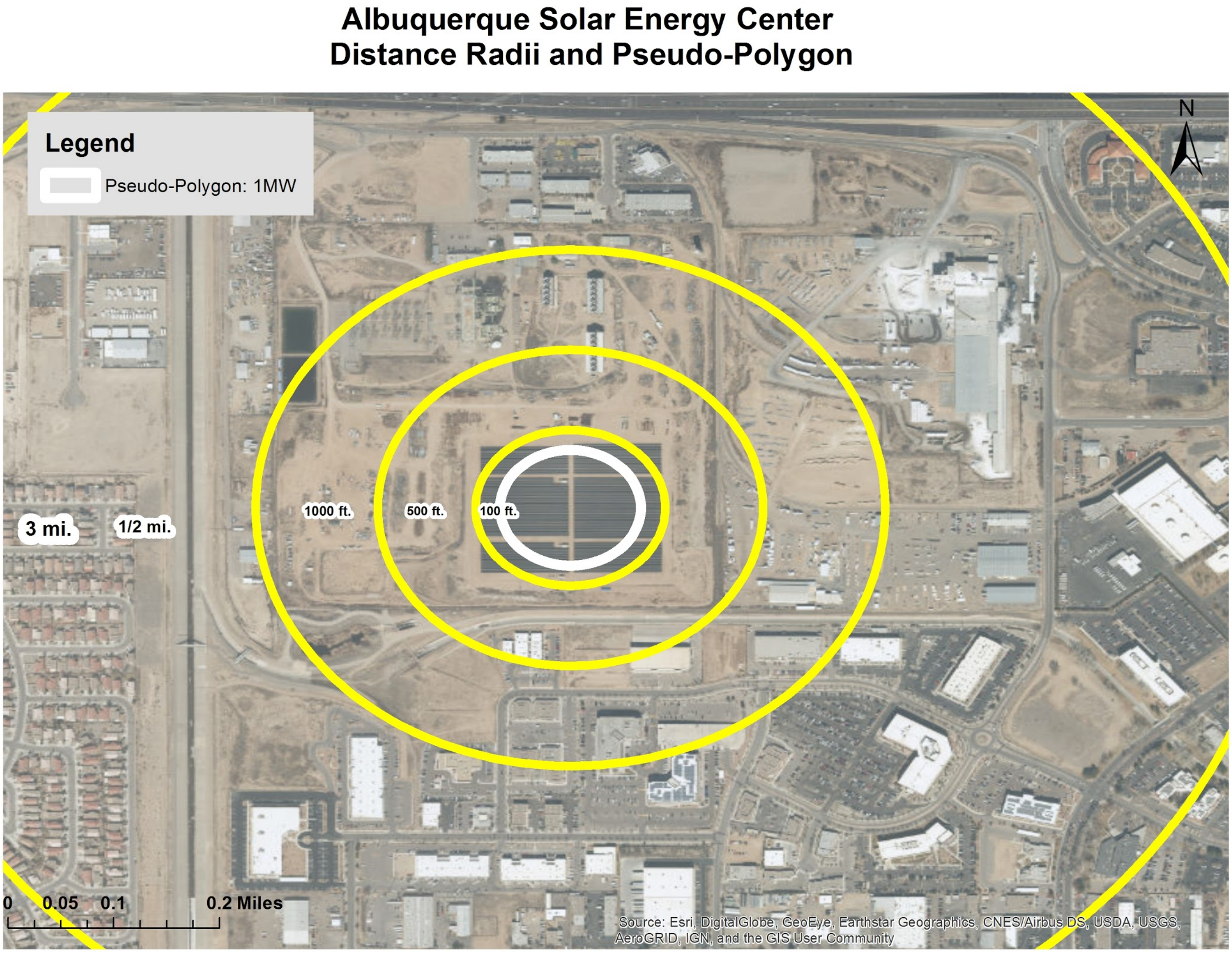


Figure A.1: *A satellite image of a pseudo-polygon (white) and the buffers (yellow) beginning at 100ft out to ½ mile are shown above. The pseudo-polygon buffers the area of the facility to account for the area where no homes can exist. As presented above, the pseudo-polygon does not encompass the entire facility, making the polygons a conservative estimate of the true facility size.*

The next analysis with ArcGIS sought to compare the median household income of residents living near utility-scale solar installations to that of the national average. Given the rapid growth of utility-scale solar within the past decade, the income of residents living nearby utility-scale solar utilities serves as an important indicator of equity in the siting of those facilities. This may be due, in part, to lower land prices. If solar were to be determined a disamenity, disproportionate build-out of utility-scale solar in lower-income communities could raise concerns about equity. In contrast, if proximity to solar is found to be an amenity, presence near lower income communities could increase home values. To determine whether or not utility-scale solar is located in communities which earn less than the national median income, we compared 2015 median income figures by block group within three miles of utility-scale solar installations to the national median income in the same year.

As above, 2015 U.S. median household income by block group data from the IPUMS NHGIS Database was joined with 2015 Block Group TIGER/Line shapefiles in ArcGIS. Of the median income data, approximately 6,484 of the 217,203 block groups (about 3 percent) did not report median incomes. As with housing density, most distance radii capture multiple block groups with differing reported median incomes. To estimate the median income at every distance, each distance radius was broken down by its percent of block groups. The median income of each weighted block group was then totaled to find a unique median income for every distance radius. In ArcGIS, this was accomplished using the same installation data and pseudo-polygons as above, and by intersecting these datasets with block group median income. A weighted sum of median income surrounding each facility at every buffer distance was calculated by determining the area of the block group intersected in proportion to the rest of the buffer area. The proportion of the block group area was then multiplied by its median income. Finally, the median income for the total area of the buffer was summed using the facility ID.

Results

Our analysis indicates that the greatest total number of estimated homes in proximity to solar installations is within three miles (cumulatively) of 1MW facilities (534,725 homes), while the smallest number of estimated homes is within 100 feet of 100MW facilities (ten homes). Heat maps of housing population with utility-scale solar installation locations both nationwide and California alone are presented in **Appendices C.6** and **C.7**. An estimate of the total number of homes within three miles of the 956 solar facilities used in our analysis is presented in **Table A.1** (for an extrapolation of the total number of homes within three miles of all 1,805 facilities, see **Appendix C.7**). These findings are consistent with the authors' expectations that more homes will be located near smaller facilities, where areas of higher population densities can only permit small facilities, and accordingly that the largest facilities will be located in rural regions. Not surprisingly, the total number of homes increases as distance from the facility, and therefore land area, increases. Further, an estimate of the average number of homes residing within the various distance radii of the capacity range of solar facilities is shown in **Table A.2**. These findings show similar trends: more homes will be found further from facilities and near smaller facilities. An average of 22 homes are located within three miles of a 1MW facility, while less than one home will be located within 100 feet of a 100MW facility, on average. Finally, a stacked bar of new utility-scale solar installations by year online and capacity size is presented in **Chart A.1**. This suggests that while the total number of all facilities is rapidly increasing, the largest facilities, 50MW and 100MW+ appear to be increasing the most rapidly.

***Table A.1**: The table below provides a count of the total number of homes in the U.S. located within certain distances of utility-scale solar. As indicated below, housing estimates increase as the utility-scale solar installations decreases in MW capacity and distance from the facility increases.*

Table A.1
Total Number of Homes Near Select Utility-Scale Solar Installations in the United States
by Proximity and Installation Size

	Facility Size					
Distance from Installation	**1 - 4.99MW**	**5 - 9.99MW**	**10 - 19.99MW**	**20 - 49.99MW**	**50 - 99.99MW**	**100MW**
	n = 521	n = 230	n = 83	n = 72	n = 23	n = 27
100 feet	184	129	42	41	14	10
500 feet	821	313	90	69	20	13
1000 feet	2,341	664	195	115	30	17
1/2 mile	14,146	2,747	942	438	77	34
1 mile	58,497	9,675	3,349	1,407	204	72
3 miles	534,725	87,597	27,983	10,970	1,890	419

Note: These housing counts are inlcusive of estimated homes near 956 utility-scale solar installations with verified coordinates. It does not represent a count housing near all known utility-scale solar installations in the United States.

Sources: U.S. Census Bureau 2012-2016 American Community Survey 5-Year Estimates, Unweighted Sample Housing Units. Solar installation coordinates based on EIA's Form 860 2016 Early Release and Lawrence Berkeley National Lab's proprietary Solar Installation data.

***Table A.2**: The table below provides a count of the average number of homes within a certain distances of individual utility-scale solar installations. The actual number of homes will vary by facility, but this table may serve as a useful tool for estimating the number of homes impacted by utility-scale solar*

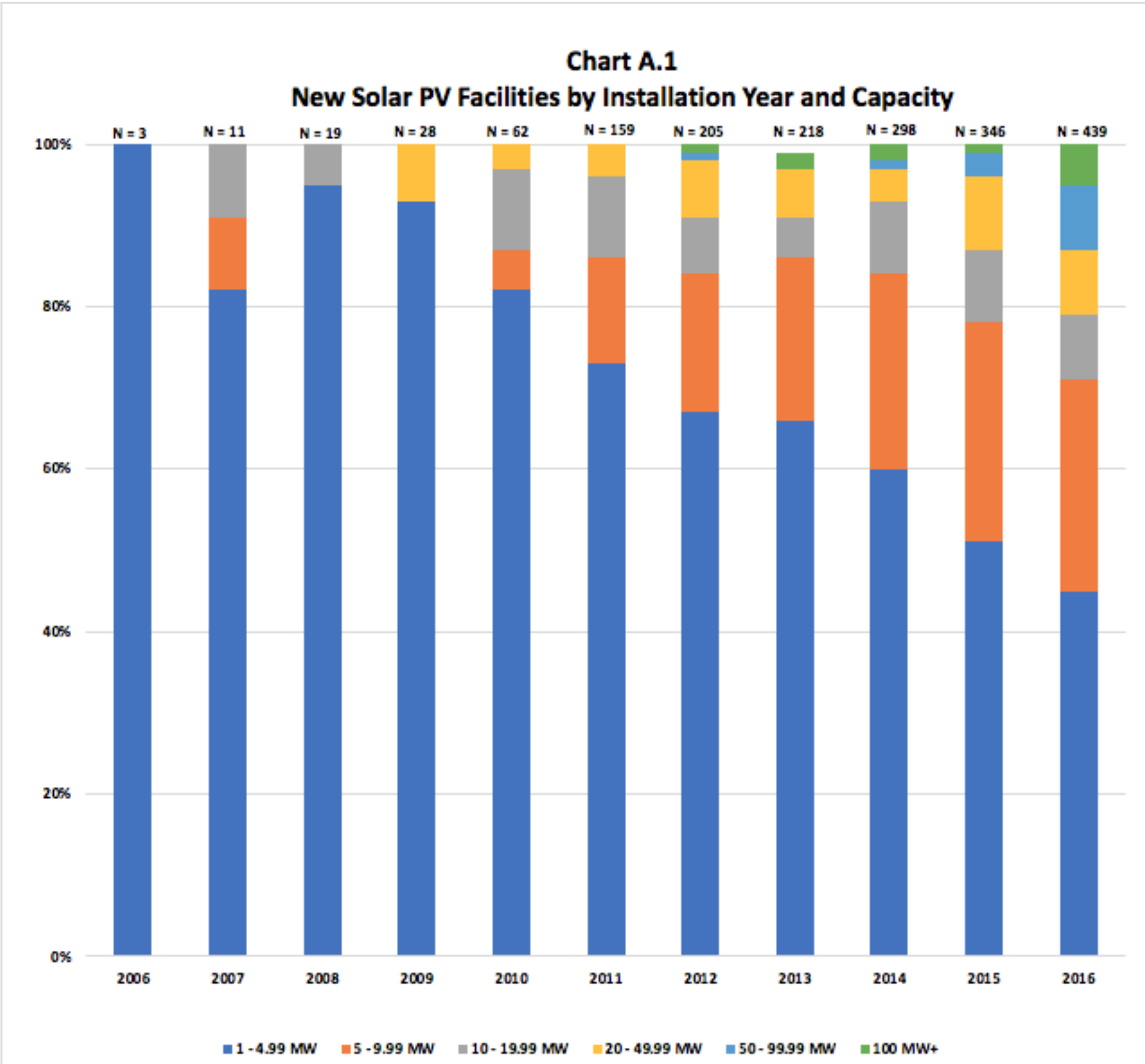
Table A.2
Average Number of Homes Near Select Utility-Scale Solar Installations in the United States
by Proximity and Installation Size

	Facility Size					
Distance from Installation	**1 - 4.99MW**	**5 - 9.99MW**	**10 - 19.99MW**	**20 - 49.99MW**	**50 - 99.99MW**	**100MW+**
	n = 521	n = 230	n = 83	n = 72	n = 23	n = 27
100 feet	0.30	0.48	0.41	0.46	0.53	0.26
500 feet	0.98	0.97	0.76	0.73	0.68	0.27
1000 feet	2.23	1.72	1.45	0.94	0.91	0.34
1/2 mile	6.86	4.89	4.88	2.05	1.96	0.57
1 mile	13.25	9.64	10.24	3.53	4.00	1.11
3 miles	21.57	21.67	23.84	12.89	12.27	2.22

Note: These average housing counts are based on estimated homes near 956 utility-scale solar installations with verified coordinates only. They do not include all known utility-scale solar installations in the United States.

Sources: U.S. Census Bureau 2012-2016 American Community Survey 5-Year Estimates, Unweighted Sample Housing Units. Solar installation coordinates based on EIA's Form 860 2016 Early Release and Lawrence Berkeley National Lab's proprietary Solar Installation data.

Chart A.1: The chart below provides a count of utility-scale solar shown by capacity and year online, shown as a percentage. While 1MW are steadily increasing, larger utility-scale solar installations appear to be gaining prominence.

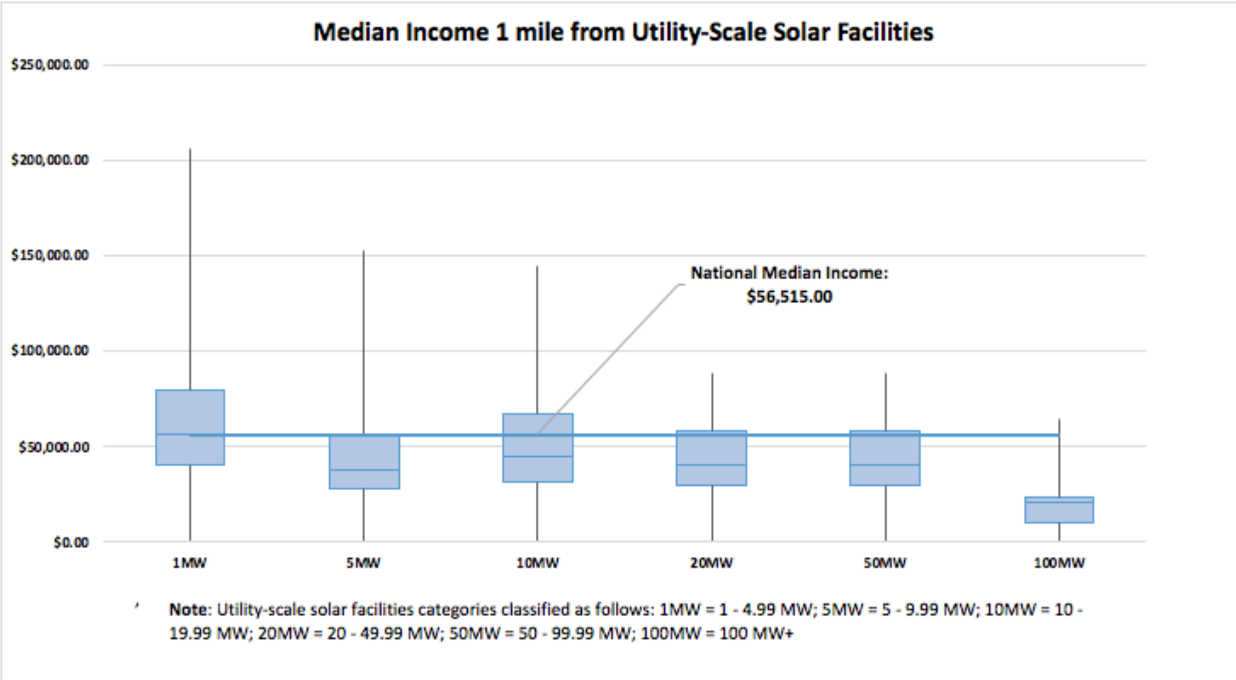


These housing density estimates inform the survey analysis discussed below by estimating the magnitude of property value impacts, if present. These total housing estimates are conservative as they only consider the 956 confirmed utility-scale solar sites, rather than all known solar sites in the United States. While an extrapolation is made in the appendix (**C.8**), the estimates are less certain. Further analysis should be expanded to all utility-scale solar sites in the U.S. with corrected coordinates, and continued analysis that stretches beyond 2015-2016 will be critical given the rapid growth of utility-scale solar. In regards to the average housing density estimates, they follow the trend that fewer homes will be expected at increasing facility sizes and decreasing distance from a facility. This housing data can be used to estimate the number of transactions that occur within these buffer zones. Transaction estimates can be adjusted based on region and current market trends.

This analysis also considered median household incomes surrounding solar installations. The estimates of 2015 median income by block group is displayed below as a box plot with a horizontal line indicating the national median household income for that year ($56,515) (See **Chart A.2**). The highest median income was located within three miles of 1MW facilities ($59,579), while the lowest median income was located within one mile of 50MW facilities ($34,223). Most notable were the consistencies of the median income near 1MW facilities with that of the national average; and that the interquartile ranges for 100MW facilities are lower than the interquartile ranges of 50MW facilities, at all distances. These findings highlight that larger facilities tend to be sited in areas with lower incomes. However, because only 27 100MW facilities were included in this analysis – in contrast to the 521 1MW facilities – the fewer observations will make the median income reported near the 27 100MW facilities more impactful to the analysis. Overall, less variability in median income of nearby residents was observed with increasing distance from a facility. Residents living within 100 feet to three miles of a 1MW utility-scale solar facility maintained relatively similar incomes ranging from approximately $57,000 to $59,000.

While not definitive, these findings raise preliminary concerns regarding equity in the locating of utility-scale solar. Our analyses suggest that the largest utility-scale solar facilities are most likely to be located in areas where residents earn lower incomes than the national average. This is consistent with the expectation that the largest facilities would require hundreds of acres of land, which will more likely be located in rural areas. Issues with unreported median incomes by some block groups influenced the calculations performed. An estimated median income of $58.89 within one mile of a 50MW facility was calculated here, but is unlikely. These low estimates are the result of unreported median income data in some block groups. While the null values were not included in the analysis, the values nevertheless affected the weighted sum calculations. Despite unreported median incomes, examination of the interquartile ranges provide valuable insight on the economic status of residents living near utility-scale solar. With the rapid expansion of utility-scale solar, our research suggests that property value impacts, whether positive, neutral or negative, could disproportionately affect homeowner’s with lower incomes.

Chart A.2: *These box plots display reported median income of all residents living within one mile of utility-scale solar installations. The horizontal line displays the national median income. In general the interquartile ranges of reported median income appear to decline as installation size increases. Extreme minimums are the result of unreported income by block groups, as noted above. For a complete overview of median income, see* ***Appendix C.***



Survey of Home Assessors

Data

In addition to evaluating the scope of potential property value impacts, this research sought to quantify the scale and direction of those impacts. We distributed an online survey to public sector property assessors in 430 unique counties identified by the EIA Form 860 data as having at least one utility-scale solar PV installation. The aim of this survey was to collect opinions as to the effects of utility-scale solar PV installations on property values. Survey questions sought to evaluate, a) whether assessors believe there is an impact on home prices from utility-scale solar installations, b) the scale and direction of those impacts, and c) the sources of those impacts. Assessors, appraisers and real estate agents were all considered as possible targets for this survey research. We ultimately selected assessors, or appraisers hired by the public sector (herein referred to jointly as “assessors”), because of their work as public servants responsible for providing assessments of property values, in accordance with professional standards.

The survey asked respondents to provide several control variables, including their state and county, years of professional experience, and whether their manual provides instructions regarding utility-scale solar PV installations. They were also asked to provide their opinion of solar energy in the United States, using a 7-point Likert scale. For a full copy of the survey, see **Appendix D.1**.

To address our research questions regarding possible property value impacts, respondents were asked to estimate the impact on residential property values of three sizes of solar PV installations – 1.5MW, 20MW and 102MW – at distances ranging from 100 feet to three miles from the nearest home. These questions took the form of sliders with a range of negative 50 percent to positive 50 percent. A satellite image indicating the approximate size of each installation was also provided as a visual aid. In preparing these questions, we hoped to capture actual adjustments made by assessors in their professional practice, but allowed for perceptions of potential impacts for those assessors that have not made such adjustments. Additionally, the respondents were asked to indicate on a 5-point Likert scale whether various features of solar installations, such as their size, height, and presence of a fence or other visual barriers, would have a positive or negative impact on property values.

This survey was determined by the University of Texas at Austin IRB to be exempt from review.[2] The survey was distributed via email to approximately 400 email addresses obtained via publicly available websites. In addition, 53 counties with high numbers of installations, high total PV solar capacity, and/or older installations were identified as high priority survey targets, and were selected for phone follow-up to request their county's participation. Phone follow-ups occurred over two weeks and not all counties were reached. This follow-up procedure motivated an additional eight responses.

[2] IRB Study Number 2017-12-0067 was determined to be exempt for the qualifying period 03/20/2018 to 03/19/2021.

Survey Results

Of the approximately 400 assessors contacted via email, 37 consented to participate in the survey (a 10 percent response rate, approximately). Survey respondents were geographically dispersed across the United States, and represented 23 states of the 42 known to have utility-scale solar facilities, according to the EIA Form 860. North Carolina provided the most respondents (8), followed by Florida (3), Massachusetts (2), Connecticut (2) and Utah (2). All other states represented had one respondent. Notably, no responses were recorded from California, despite efforts to contact 13 California counties by phone. Below, **Figure B.1** provides a map of responses by state. For a more detailed breakdown of response rates by state and question, see **Appendix D.2**.

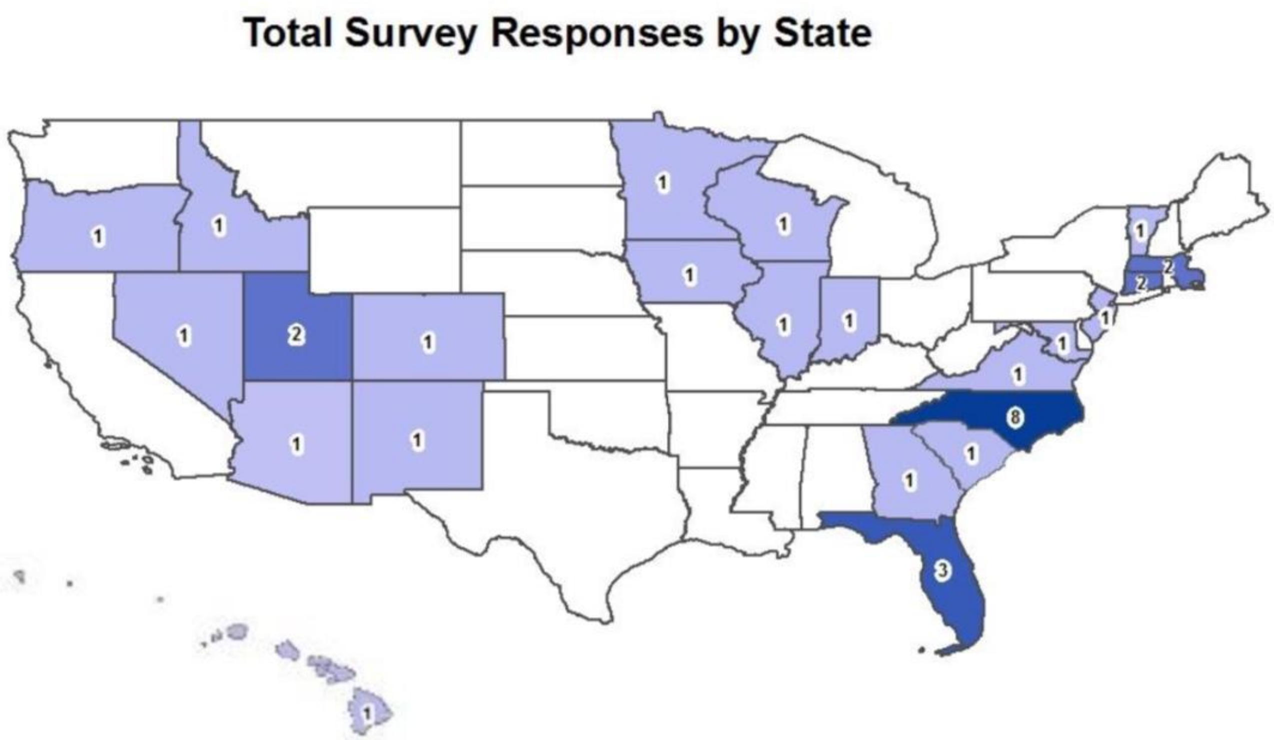
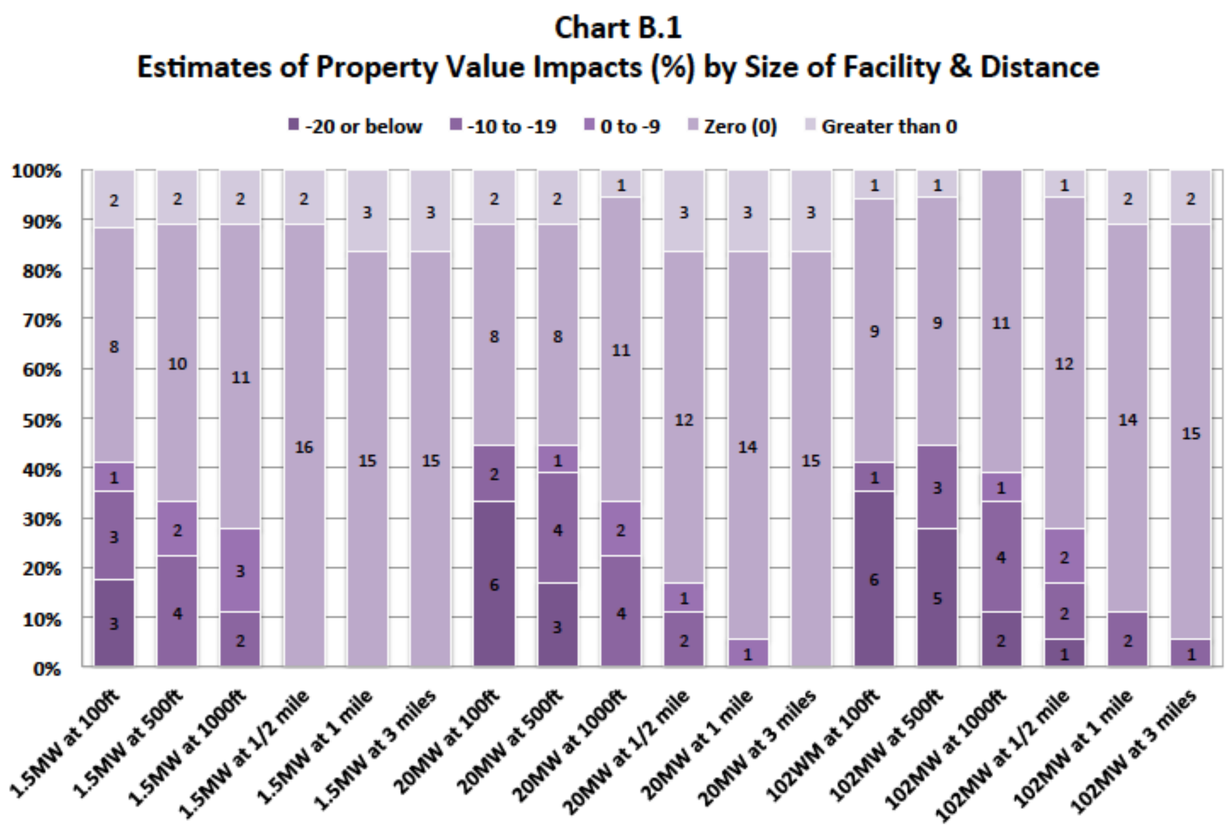


Figure B.1: *A map with the county of respondents by state is shown above.*

The number of responses varied per question, from a low of 18 to a high of 36, with more respondents providing information for control variables than for research questions surrounding estimates of property value impacts. Of the respondents that elected to participate, all were current assessors with between two years and over 40 years of assessment experience, and a mean of 21 years. The majority of respondents have completed a residential home assessment within the last two years (77 percent). Almost all respondents have completed a residential home assessment since a solar facility came online in their county (91 percent). About half of respondents that provided an answer indicated they had assessed a home near a utility-scale solar installation (45 percent), while the remainder had not (55 percent). Only one respondent (5 percent) had actually adjusted the value of a home based on the presence of a solar installation, while 21 (95 percent) had not, with the remainder declining to answer. Finally, on a 5-point Likert scale, all respondents indicated having either a neutral, positive, or extremely positive opinion of solar.

To estimate the scale and direction of property value impacts from solar installations, if any, respondents were asked to estimate this impact in percentage terms at varying distances from three sizes of solar facilities: 1.5MW, 20MW and 102MW. A summary of these responses can be seen in **Chart B.1** below. Additional descriptive statistics of the results can be seen in **Appendices D.3 - D.5**.

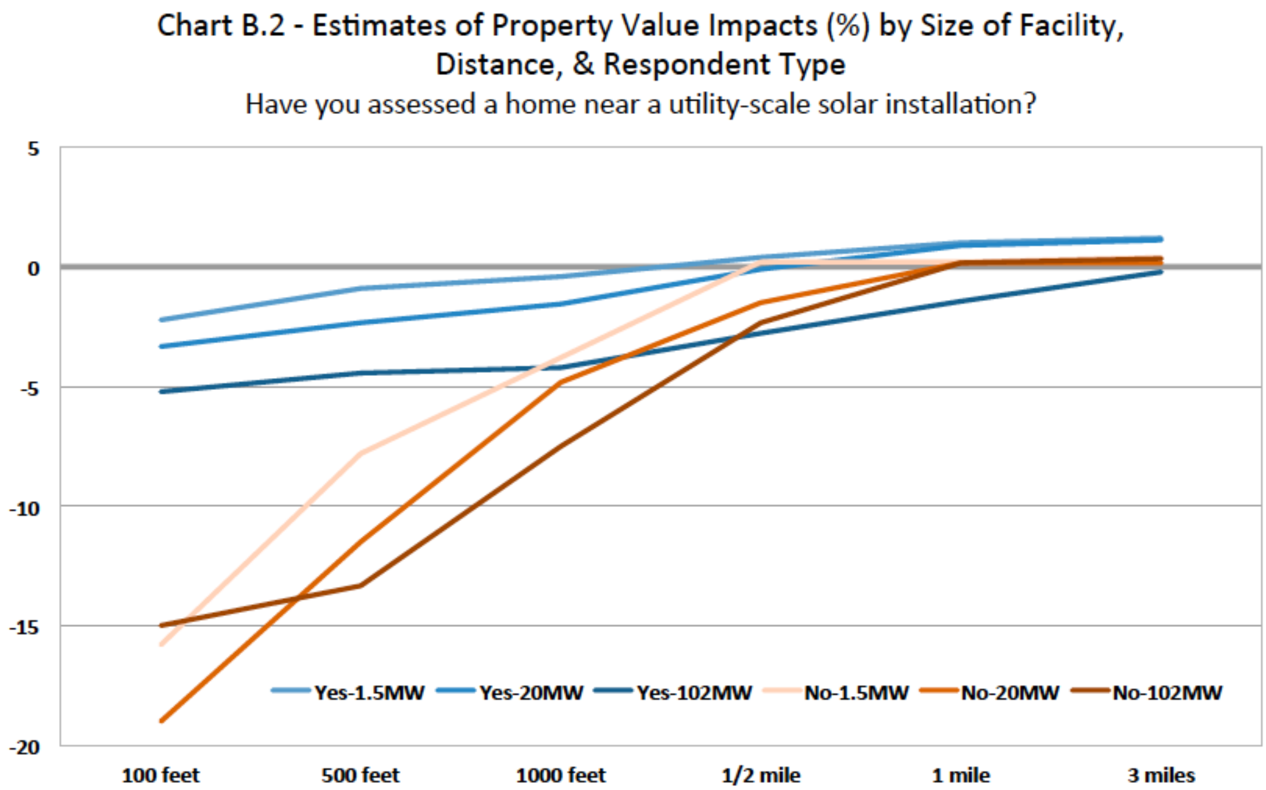
Chart B.1: *The below chart shows the estimates of home value impacts for all respondents, broken down by share of responses in various groups, at each distance for the three facility sizes.*



Estimated property value impacts at all distances and all facility sizes had a median and mode of zero percent. The majority of responses suggested either no impact (66 percent of all estimates) on home prices, or a positive impact (11 percent of all estimates), as a result of proximity to solar installations. However, some respondents did estimate a negative impact on home prices associated with solar installations. When averaging estimates across all respondents, the estimated impact was negative up to 1,000 feet, one half mile and one mile for 1.5MW, 20MW and 102MW facilities, respectively. The averages suggest that respondents estimate that greater proximity to utility-scale solar installations is linked to a more negative property value impact, and that those impacts would be larger as the size of the solar installation increases. In discussing the averages, however, it is worthy of note that highly negative estimates from a few respondents appeared to be pulling the average away from the median. For a discussion of property value impacts in dollars, see **Appendix D.7**.

Survey respondents were also asked to indicate whether they have assessed a home near a utility-scale solar installation. When comparing results of the estimated property value impacts of those that have assessed homes near solar installations to those that haven't, the data suggest that those with experience assessing near these installations are more conservative in their estimates of impact. The average estimated impact at each facility size, distance, and by assessor group is shown in **Chart B.2**. On average, respondents that have assessed near solar installations (n = 10) estimated that home value would decline by 3 percent, on average, when within 100 feet of a 20MW installation. Respondents that have not assessed near solar installations (n = 6), by contrast, estimated a 19 percent drop, on average, for the same facility size and distance. These differences were statistically significant at 100 feet and 500 feet, for 1.5MW and 20MW facilities, respectively, at the 5 percent significance level. While the responses of these two groups are different at closer proximities, they appear to converge at around one half mile.

Chart B.2: *The below chart shows the average estimate of home value impacts for two groups of respondents - those that have assessed a home near a utility-scale solar installation ("Yes") and those that have not ("No"). It shows the average of responses for each group for each distance and facility size.*



Facility size, distance, and an assessor's experience assessing near a solar installation all appear to influence estimates of impact provided by the respondent. A linear regression with clustered standard errors by respondent was used to evaluate the scale and significance of those effects. Results from this regression are shown below in **Table B.1**. The results indicate that distance does impact estimates, with greater distance between the home and the installation being associated with less negative estimates (0.04 percent per 100 feet). The results also suggest that experience assessing near a solar installation is associated with a much less negative estimate of impact (4.2 percent). Finally, the results suggest that an increase in the installation's size is associated with a more negative estimate (-0.02 percent per MW), although this result is not significant at the 10 percent level. Overall, this model has an R^2 value of 0.16, indicating relatively low explanatory power.

Table B.1: *The below table provides results from a regression model with estimates of property value impact, in percentage terms, due to proximity to solar installations as the dependent variable, and facility size (in MW), distance (in 100 feet), and a dummy variable for whether the respondent has assessed a home near a utility-scale solar installation in the past as independent variables.*

Table B.1
Regression of Estimated PV Impact (%) against Size, Distance, and Prior Assessment Near Solar

Variable	Coefficient (St. Error)	p-value
Facility Size (MW)	-0.022 (0.013)	0.121
Distance (in 100 ft)	0.042 ** (0.015)	0.014
Prior Assessment Near Solar	4.200 * (2.335)	0.092
Constant	-6.420 ** (2.356)	0.016
R^2	0.164	
No. of Observations	268	

Note: ** significant at the 5% level
* significant at the 10% level

Further, to control for the explanatory power of individual respondent's own opinions underlying their estimates of impact, we add fixed effects for each respondent to the model, removing the flag for prior assessment experience. The resulting model has an R^2 of 0.44. The coefficients on size (-0.02 percent per MW) and distance (0.04 percent per 100 feet) show little change, while size has become significant at the 10 percent level. Results for this regression are shown in **Table B.2** below.

Table B.2: *The below table provides results from a regression model with estimates of property value impact, in percentage terms, due to proximity to solar installations as the dependent variable, and facility size (in MW), distance (in 100 feet), and fixed effects for each respondent as independent variables.*

Table B.2
Regression of Estimated PV Impact (%) against Size, Distance, and Respondent ID

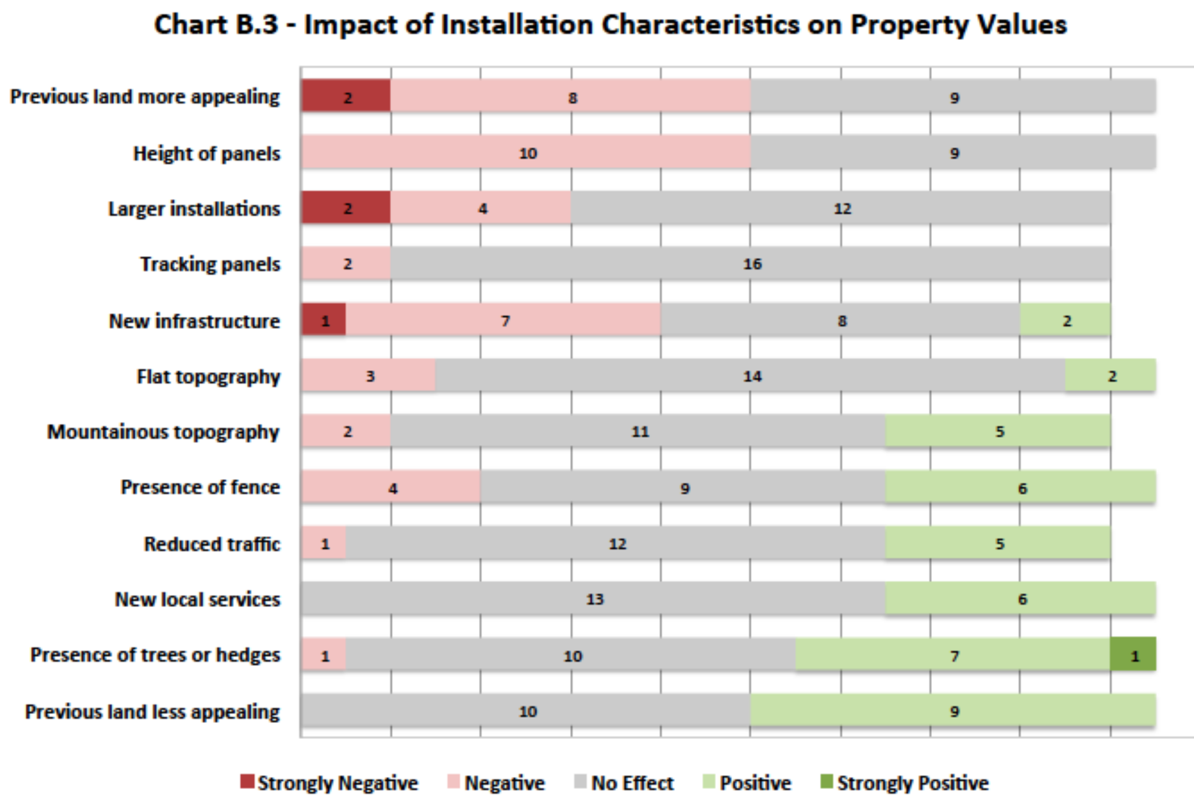
Variable	Coefficient (St. Error)	p-value	Prior Assessment
Facility Size (MW)	-0.022 * (0.011)	0.070	
Distance (in 100 ft)	0.043 *** (0.014)	0.005	
Respondent 2	7.500 *** (0.000)	0.000	Y
Respondent 3	7.500 *** (0.000)	0.000	Y
Respondent 4	7.500 *** (0.000)	0.000	--
Respondent 5	7.500 *** (0.000)	0.000	Y
Respondent 6	6.269 *** (0.523)	0.000	Y
Respondent 7	7.500 *** (0.000)	0.000	N
Respondent 8	-3.730 *** (0.227)	0.000	N
Respondent 9	0.000 (0.000)	0.387	N
Respondent 10	7.500 *** (0.000)	0.000	Y
Respondent 11	2.667 *** (0.000)	0.000	Y
Respondent 12	8.722 *** (0.000)	0.000	Y
Respondent 13	9.167 *** (0.000)	0.000	Y

Respondent 14	7.500 *** (0.000)	0.000	Y
Respondent 15	-3.330 *** (0.000)	0.000	--
Respondent 16	4.722 *** (0.000)	0.000	--
Respondent 17	-2.778 *** (0.000)	0.000	Y
Respondent 18	8.444 *** (0.000)	0.000	N
Respondent 19	-2.684 *** (0.065)	0.000	N
Constant	-8.422 *** (0.513)	0.000	
R^2	0.439		
No. of Observations	322		

Note: *** significant at the 1% level
** significant at the 5% level
* significant at the 10% level

In addition to estimates of impact, this survey aimed to identify which features of utility-scale installations, if any, might influence whether the facility is an amenity or disamenity. Respondents were asked to indicate on a 5-point Likert scale whether 12 distinct features of a solar installation would have a positive or negative impact on nearby residential property values. For full results, see **Chart B.3.** In general, the installation of a solar facility on land that was previously more appealing is opined to have a negative impact. By contrast, the installation of solar on land that had an unappealing use previously is believed to have a positive property value impact. Other features associated with negative property value impacts included higher panels, larger installations, and new infrastructure, such as power lines. The presence of trees or hedges around the array, the introduction of new local services, and reduced traffic flow were considered to have positive property value impacts. Noteworthy, however, is that the majority of respondents indicated that any given feature had no impact on property values, suggesting the features of the installation itself will not impact whether it is an amenity or disamenity.

Chart B.3: *The below bar chart shows the count of responses of each type about the impact of each characteristic of solar installations on property values. Responses ranged from "Strongly Negative" to "Strongly Positive".*



Other noteworthy observations can be drawn from the survey data. Respondents were asked to indicate if they have adjusted a home's value due to proximity to a solar installation. Only one respondent out of 18 that had assessed homes near solar facilities, indicated they had made such an adjustment. This respondent estimated a negative impact of 10 percent, 15 percent, and 25 percent for homes within 100 feet of a 1.5MW, 20MW and 102MW installation, respectively. Meanwhile, only two respondents indicated that their professional manual or other training materials provide instructions regarding residential assessments near utility-scale solar installations. These respondents were located in North Carolina and Wisconsin, states with a very large number of utility-scale solar installations and very few, respectively. Of those two, only the respondent from North Carolina provided estimates of value impacts, estimating zero percent impact across all three facility sizes at all distances.

While the survey results suggest there could be negative residential property value impacts at some proximity to solar installations, the results of the geospatial analysis suggest these impacts are unlikely to be felt by many homeowners. Estimated negative impacts from proximity to solar installations were greatest at 100 feet from the installation. However, the results of the solar-siting analysis suggest that there is less than one home, on average, within 100 feet of a utility-scale solar installation. Within half a mile of solar installations – a distance at which the average estimated impact was negative for all facility sizes – there are only seven homes near a 1MW installation, on average, and even fewer as the size of the installation increases. At the highest estimated housing density, there are 22 homes, on average, within three miles of a 1MW solar installation. However, at this distance survey respondents estimated a positive property value impact of 0.8 percent, on average.

Discussion

The results of our solar-siting analysis and survey provide some information on which to begin to estimate potential property value impacts due to proximity to solar installations. Survey responses were mixed; estimates were zero or positive for most responses, but were negative at some distances on average. Our regression models suggested that estimates were more negative at closer proximity to the installation, with greater installation size, and when provided by assessors that had not previously assessed a home near a utility-scale solar facility. In reviewing the survey results, the role of an assessor's experience working near solar facilities is worthy of note. Assessors with experience assessing near solar installations perceived considerably smaller impacts than those without such experience. In addition, the majority of assessors with experience assessing homes near solar installations did not adjust property values based on that proximity. We cannot determine from the survey whether this is because the assessors see no evidence of value impacts, or because they lack professional instructions on how make such adjustments. Even where respondents estimated negative impacts, these were typically at close proximity to the facilities. At these proximities, our solar-siting analysis suggested the number of homes likely to be impacted would be low.

The research team faced several challenges when cleaning and collecting the data for our analysis. For the solar-siting analysis, determining the accuracy of installation coordinates via satellite imagery was subject to human error. In addition, the missing block group data for median income estimates led to lower estimates than are feasible in some regions. For the survey, the geographic distribution of respondents was not representative of the distribution of solar facilities across the United States. In particular, there were no responses from California which is home to the largest number of utility-scale solar facilities. In addition, due to our small sample size, we were unable to conduct many statistical tests to test relationships in our data. These low sample sizes also led responses from a few respondents to shift the mean far from the median values. Finally, some respondents expressed hesitation in completing the survey given the lack of statistical evidence to support any estimates of property value impacts. This was difficult to address given our goal of establishing such evidence. In addition, some assessors were not aware of installations in their county, despite EIA installation data demonstrating otherwise.

Despite these challenges, the survey illuminated the opinions of assessors nationwide regarding large solar projects. Multiple assessors noted in the survey that installations in their counties are located in rural areas. These isolated settings led one respondent assessor to indicate they, "have seen no impact on real estate (home) values." Multiple respondents also noted that there is insufficient data to answer the survey questions, either due to a lack of statistical evidence or because there was only one installation in their area for reference. Our data show a discrepancy between the actual number of installations in a given county and the number perceived to be there by the assessor, which suggests that assessors may be unaware of installations within their own counties. It also indicates a lack of responsiveness to the presence of installations in such a case. One respondent cited “reasonable setback/buffers and screening” as neutralizing any potential property value impacts. Finally, another respondent introduced the importance of homeowner perception, in that “the initial fears of homeowners are the worst, being clear and upfront about how scale, potential reflection and appearance are important.” Overall, we see that the assessors surveyed often see no impact due to rurality or do not feel they can make a judgment due to lack of data or evidence.

In the future, several modifications could be made to improve upon this research. In the geospatial analysis, coordinate accuracy was reviewed via satellite imagery. However, rather than excluding inaccurate coordinates, future research could improve upon this by correcting those coordinates. While our geospatial analysis relied on pseudo-polygons to estimate the surface area of facilities, generating polygon shapefiles for every site would provide more accurate estimates of housing density and median income surrounding those facilities. In addition, while the pseudo-polygons provide a significant improvement upon housing and income estimates, they were limited by the use of buckets for the size of the facilities. These polygons were based on estimates of the sizes of 1MW, 5MW, 10MW, 20MW, 50MW, and 100MW facilities only, and therefore do not estimate the exact area of each individual facility based on its capacity. As a result, these pseudo-polygons are conservative estimates of the facility’s total area. There are also multiple options for continued survey research on this topic. A contingent valuation (Type III) survey could ask respondents to comment on the property values of two homes that are identical except for proximity to a utility-scale solar installation. Alternatively, a survey tool like the one used in this research could gauge perceptions of realtors or homeowners and ask about willingness to pay as a proxy for property values.

In addition to the analyses conducted here, future analyses could be improved by focusing on solar sites that are both of an appropriate size to potentially impact home values, and near a sufficient number of properties. In addition, current housing estimates could estimate the number of home transactions occurring near utility-scale solar installations. The number of homes transactions needed to generate sufficient statistical power and effect size for a hedonic regression model, for example, can inform future disamenity research. To better incorporate the effect of visual disturbance, future studies could also incorporate ArcGIS Viewshed analysis, elevation contours, or dummy variables for visibility. This study did not differentiate between ground-mounted and rooftop installations, although the vast majority of the analyzed plants are assumed to be ground-mounted. Future research could make this distinction and remove rooftop installations from the dataset. In addition, multiple assessors indicated that the installations in their counties were rural and not proximate to residential properties. Subsequent studies could pivot by investigating effects on land values, rather than home values, to account for rurality. Finally, to shift from perceived to actual property value impacts, future research can conduct analyses on home sales data to collect empirical evidence of actual property value impacts.

Conclusion

This study has investigated utility-scale solar facilities as a potential amenity or disamenity. To do so, it aimed to understand both the scope of homes potentially impacted by proximity to solar installations, and the scale and direction of those impacts, if any. The results of the solar-siting analysis indicate that very few homes, on average, are located around these utility-scale solar installations. On average, we estimate 0.53 homes or fewer are located within 100 feet of the solar installations analyzed in this research. Within three miles, we estimate only 23.84 homes surrounded 10MW facilities, on average. These results suggest the number of homes that could potentially be impacted by the presence of utility-scale solar installations are relatively few. However, as the cumulative numbers of solar installations continues to grow, the number of homes potentially impacted also grows. This is particularly true if installations are located in more dense, urban areas. In addition, the solar-siting analysis suggests that median income surrounding large solar installations may be lower than those surrounding smaller installations. Given the authors' expectations that smaller solar facilities are more likely to be located in urban areas, which typically have higher median incomes, this is not unexpected. However, it brings in questions surrounding the equity of potential property value impacts due to proximity to installations, on the basis of income level.

Results from our survey of residential home assessors show that the majority of respondents believe that proximity to a solar installation has either no impact or a positive impact on home values. However, variation in responses by size of the facility, distance from the home, and the assessor's experience assessing near such an installation previously, all impacted those estimates. Regression analyses suggest that closer proximity to an installation is associated with more negative estimates of property value impacts, as is larger installation size. Prior experience assessing near a solar installation, by contrast, was associated with more conservative estimates of impact. Meanwhile, the median and mode of all estimates of impact was zero, suggesting negative estimates from a few respondents were pulling down the mean. Additionally, the survey results indicate that respondents believe some features of solar installations may be associated with positive impacts. These include a location on land that previously had an unappealing use, or the presence of trees or other visual barriers around the array. Meanwhile, features such as being located on land that previously had an appealing use and higher installations are expected to have a negative impact, according to the respondents.

The results of this research may be of interest to solar developers, public officials, home assessors, and homeowners. In particular, solar developers should be conscientious of potential impacts on property values from their selection of a solar site and potential pushback they may face from homeowners in the process. Public officials are often tasked with approving the proposed locations of new solar installations, and, therefore, would be interested to know about the benefits or adverse consequences of those decisions. Public assessors, meanwhile, are tasked with assessing the value of homes including those located near solar facilities. The results of our survey indicate that very few assessors currently receive any instructions in their professional manual or other training materials surrounding assessments near solar installations. Finally, homeowners have an interest in the value of their home as an asset, and may be inclined to resist any modifications to nearby land use that could hurt their home's value.

This research suggests several policy interventions may be appropriate as additional research is conducted around impacts from solar installations. First, regulations around an installation's appearance and land use may help minimize impacts on property values. For example, incorporating vegetation to block the visibility of solar panels, keeping panels low to the ground, or using land with a previously unappealing use, such as an animal feedlot, may prove helpful. Second, engaging the public in the design process for these installations may help allay homeowner concerns. Third, a consideration of housing density by distance around the proposed facility should help identify the scope of potential impact for any particular facility, with the expectation that greater distance between the facility and the home is likely to see fewer impacts, if any. Finally, the results of our survey suggest a need to provide consistent and thorough instructions to property assessors on when and how to incorporate these installations into their assessment practice. Given the interest of various stakeholders, we expect continued research to better understand whether utility-scale solar causes negative price impacts to be a valuable addition to current amenity and disamenity literature.

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Appendices

Appendix C.1 - Descriptive Statistics of Analyzed & Actual Utility-Scale Solar Installations

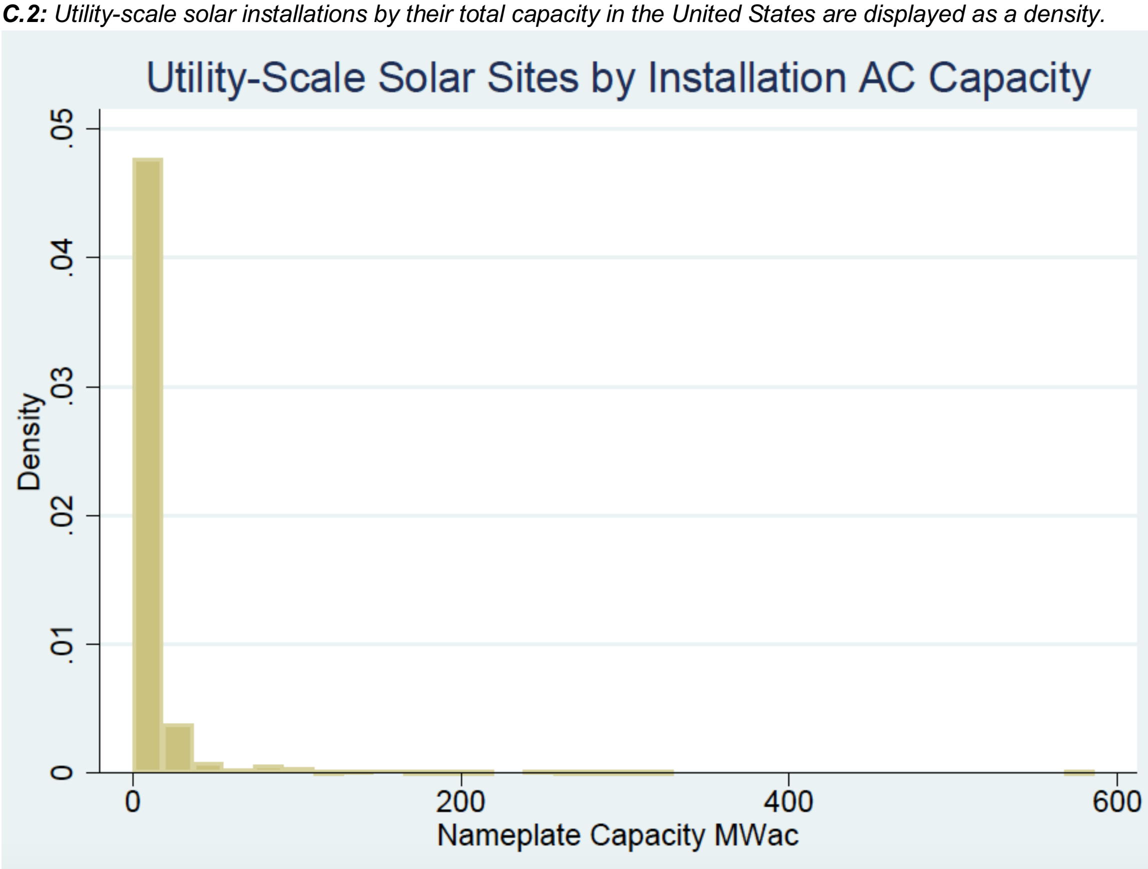
C.1: The table below provides a comparison of the sites used in the analysis (row 1) and the complete number of utility-scale solar (row 2).

Appendix C.1
Descrpitive Statistics of Analyzed and Total Utility-Scale Solar Installations

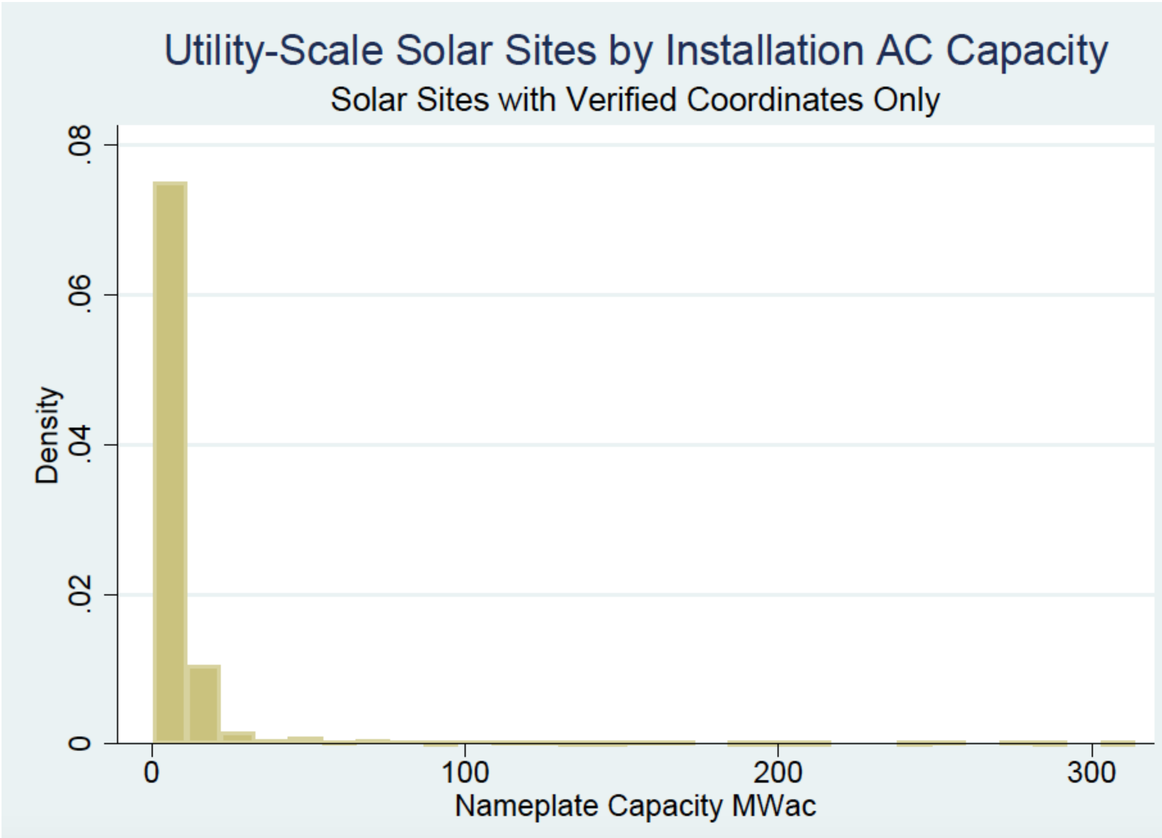
Mean	Standard Deviation	Min	25th Percentile	Median	75th Percentile	Max	n
11.3	32.7	0.1	1.6	3.2	5.5	585.9	1805
12.2	32.6	0.4	1.7	4.0	7.0	313.7	956

Appendices C.2 & C.3 - Histograms of Installation Capacity

C.2: *Utility-scale solar installations by their total capacity in the United States are displayed as a density.*



C.3: *Utility-scale solar facilities by capacity used in this analysis are displayed as a density. Comparison of the two charts shows that this research contained a greater proportion of low capacity facilities.*



Appendix C.4 - Pseudo-Polygon Calculations

C.4: *The table below shows the calculations used to create the pseudo-polygons. The team estimated approximately*

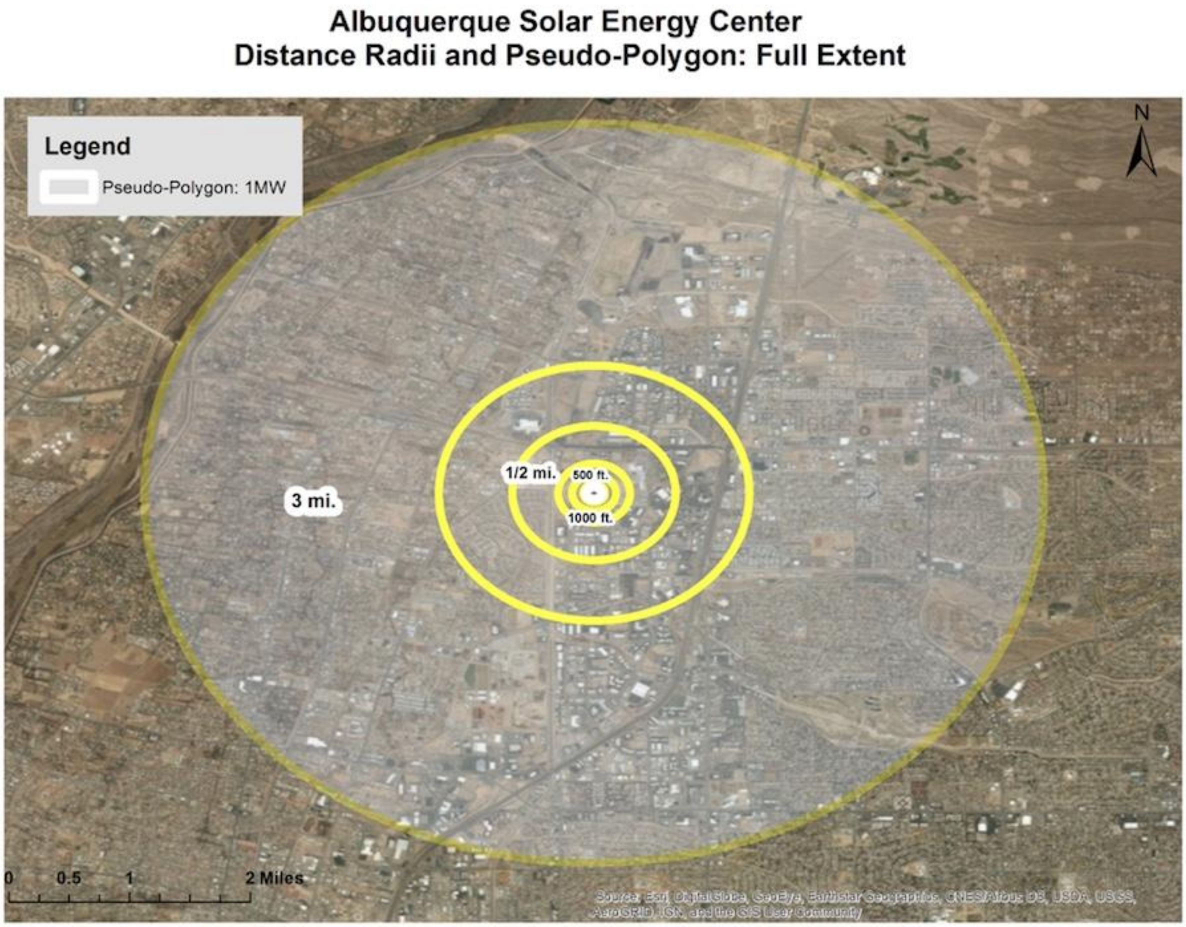
Appendix C.4
Pseudo-Polygon Calculations

Facility Size (MW)	Area (Acre)	Radius (Acre)	Area (sq. ft.)	Radius (ft.)
1	6	1.382	261,360	288.4253
5	30	3.090	1,306,800	644.9385
10	60	4.370	2,613,600	912.0808
20	120	6.180	5,227,200	1,289.88
50	300	9.772	13,068,000	2,039.47
100	600	13.820	26,136,000	2,884.25

Note: *Team assumed 6 acres/MW to estimate the average facility area*

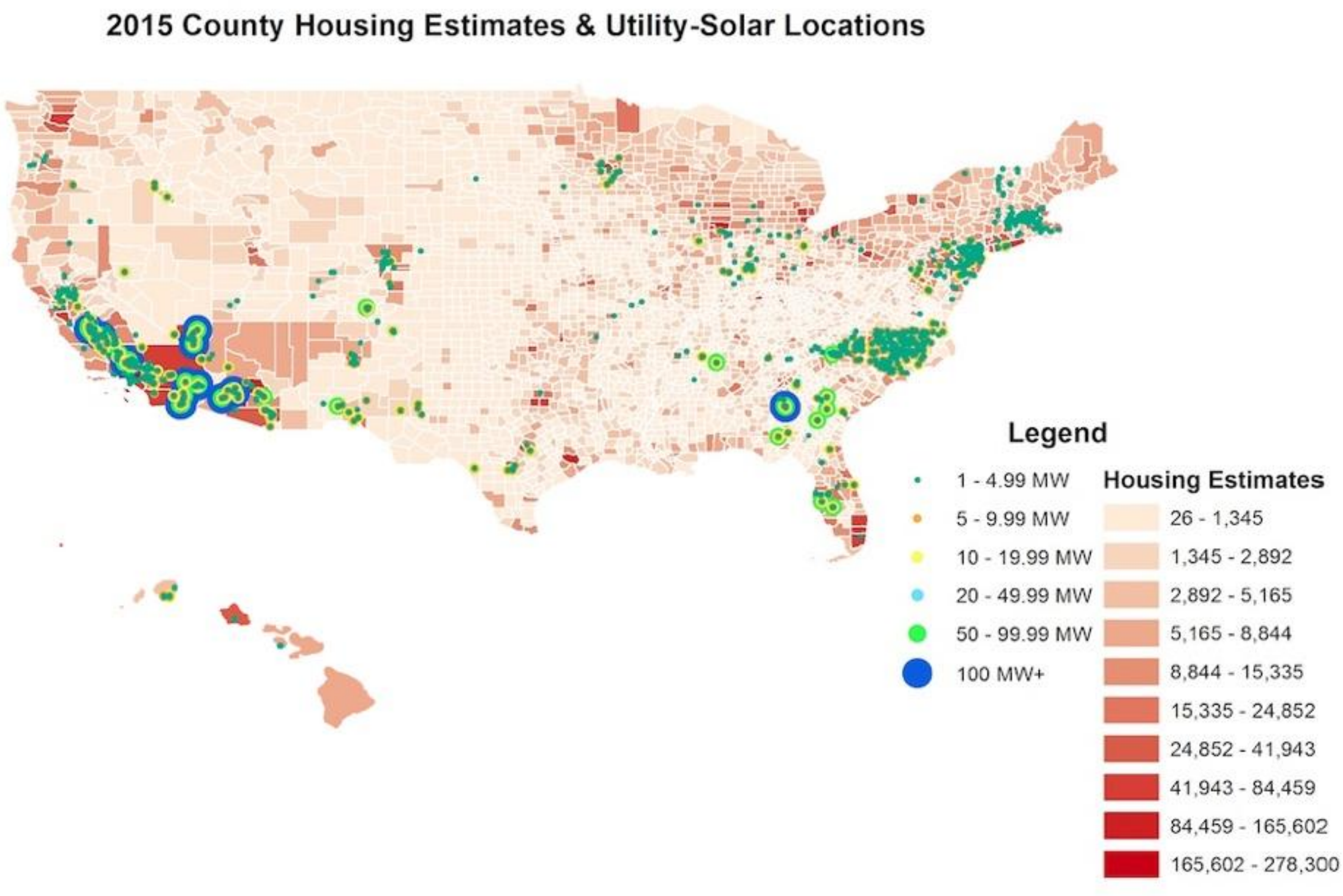
6 acres/MW, which was evidently conservative.

Appendix C.5 - Full Extent of Buffer Zones



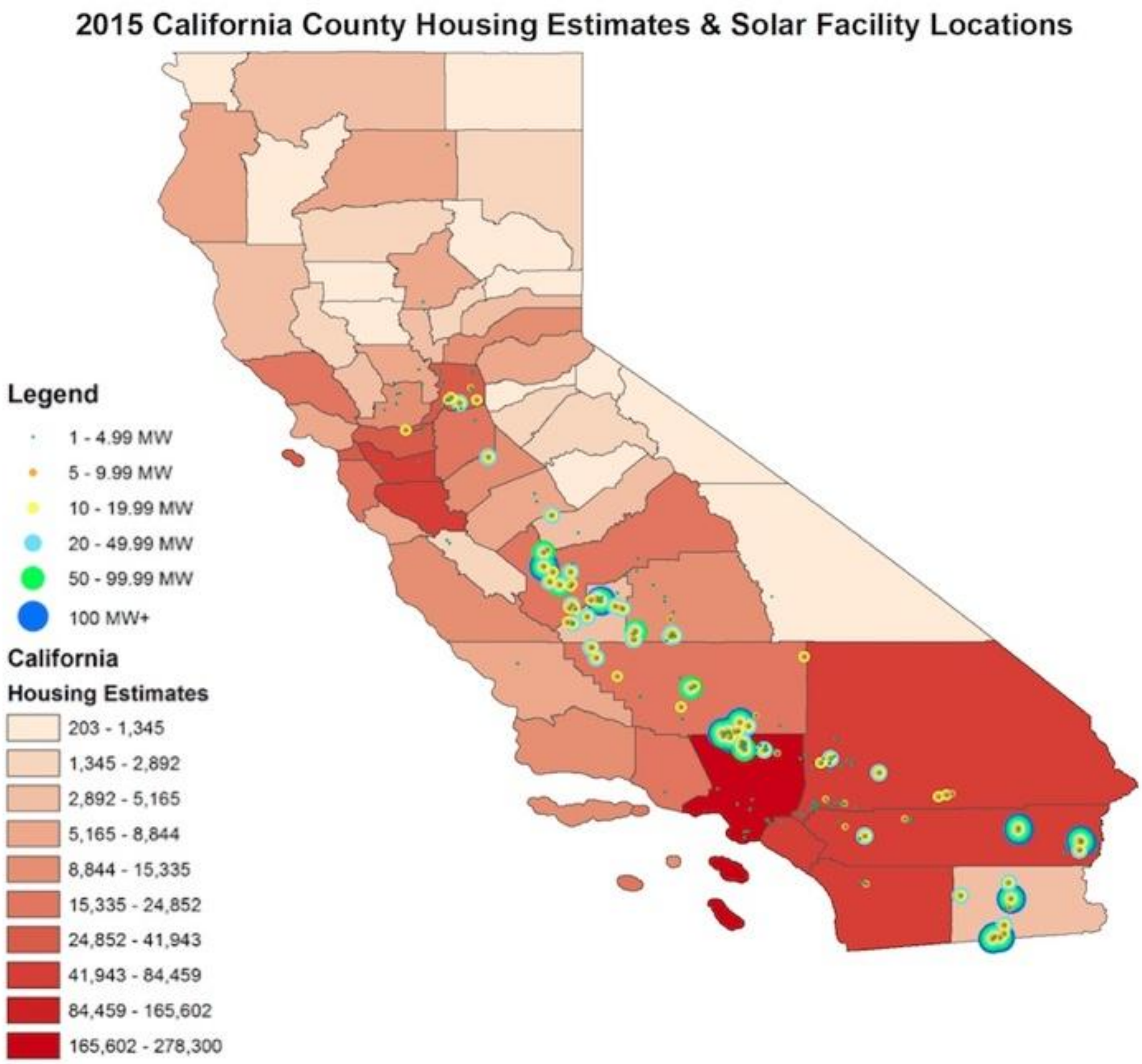
C.5: *A satellite image of the buffers (in yellow) beginning at 100ft (shown at 500ft) out to three miles are shown above. Total and average estimates of homes are made within these buffer zones and select distances.*

Appendix C.6 - Map of Housing Density Near Select Solar Sites in the U.S.



C.6: *A heat map of 2015 population in the United States with the location of utility-solar installations displayed by county. Population data was aggregated at the county level to display U.S. housing density. While block groups provide the most specific data on the location of housing populations, the are often too small to display on a nationwide map.*

Appendix C.7 - Map of Housing Density Near Select Solar Sites in California



C.7: *California housing density with utility-scale solar installations. A heat map of 2015 county population in California underscores that California is a region of high-interest to utility-scale solar research. The state is both populous and contains the most and largest utility-scale solar in the country.*

Appendix C.8 - Total Number of Homes Near Utility-Scale Solar Installations, Extrapolated to 1,805 Installations

C.8: *The table below provides a count of the total number of homes within certain distances of utility-scale solar installations. The following estimates were extrapolated to 1,805 installations using the estimates made with the 956 confirmed utility-scale solar installations.*

Appendix C.8
Extrapolated Total Number of Homes Near Select Utility-Scale Solar Installations in the United States
by Proximity and Installation Size

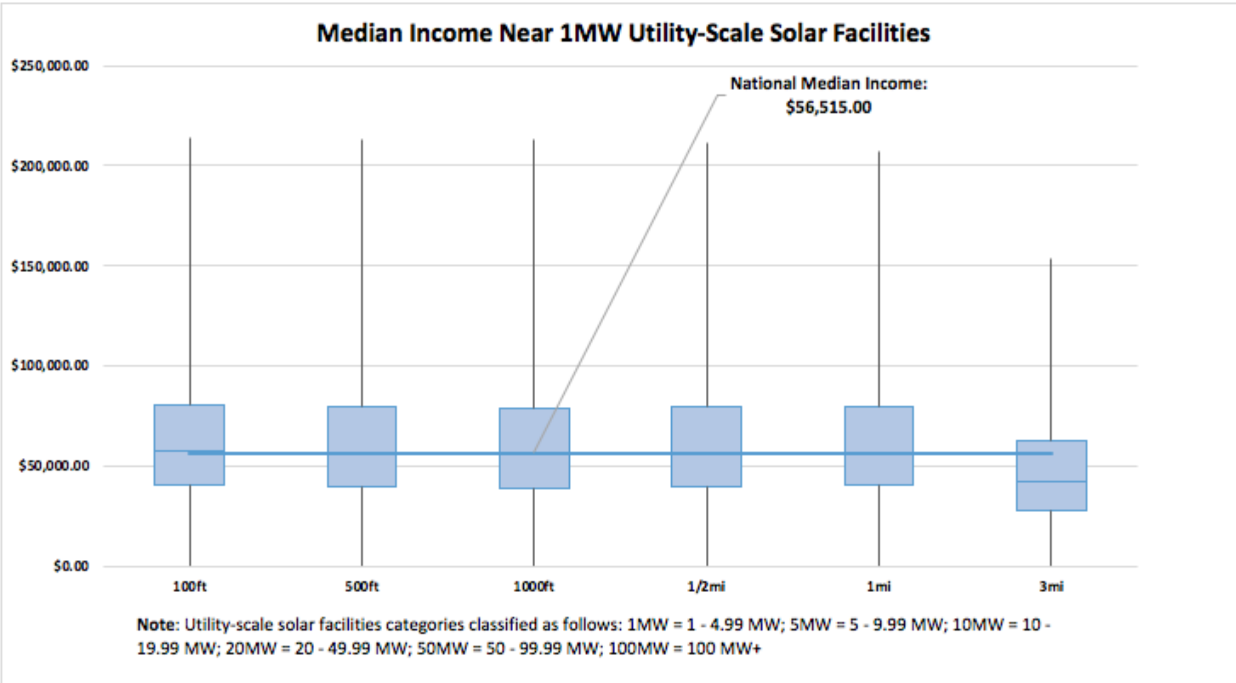
	Facility Size					
Distance from Installation	1 - 4.99MW	5 - 9.99MW	10 - 19.99MW	20 - 49.99MW	50 - 99.99MW	100 MW+
100 feet	348	244	79	77	27	19
500 feet	1,550	592	170	131	39	25
1000 feet	4,421	1,253	368	217	57	32
1/2 mile	26,709	5,187	1,778	828	145	63
1 mile	110,446	18,267	6,324	2,656	385	137
3 miles	1,009,601	165,389	52,834	20,711	3,568	792

Note: These housing counts are inlcusive of estimated homes near 956 utility-scale solar installations with verified coordinates, extrapolated to 1,805 existing solar installations

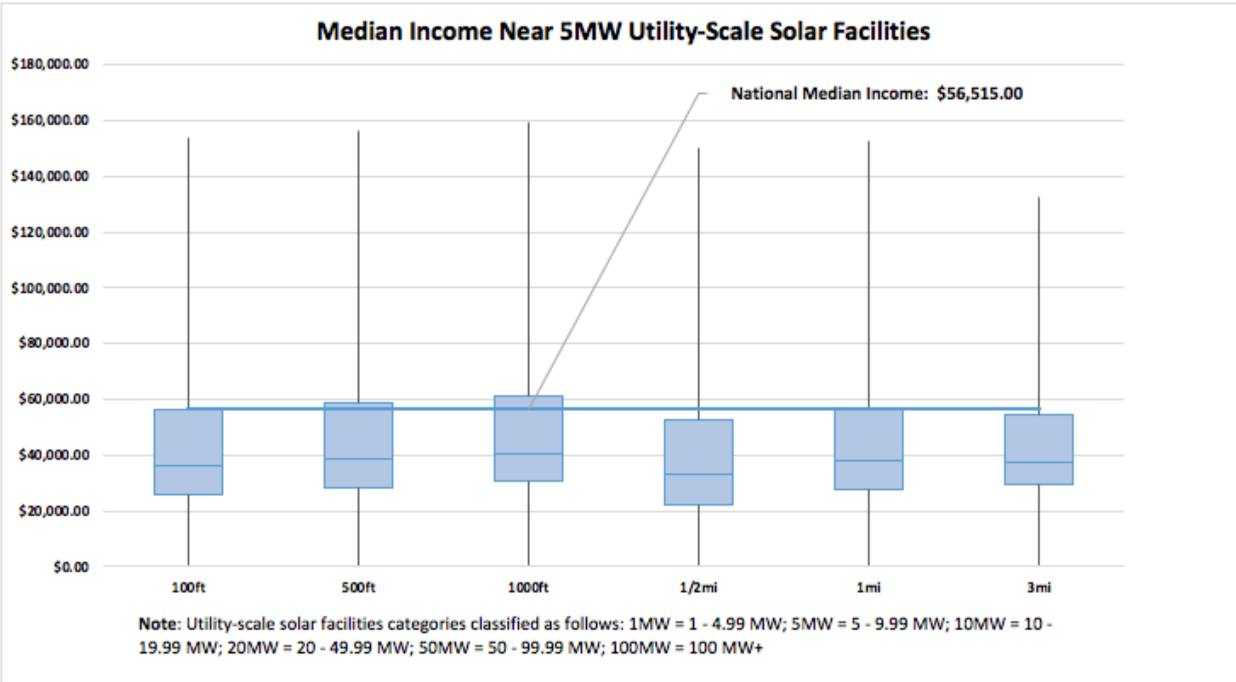
Sources: U.S. Census Bureau 2012-2016 American Community Survey 5-Year Estimates, Unweighted Sample Housing Units. Solar installation coordinates based on EIA's Form 860 2016 Early Release and Lawrence Berkeley National Lab's proprietary Solar Installation data.

Appendices C.9 - C.19 - Boxplots of Median Income by Installation Size

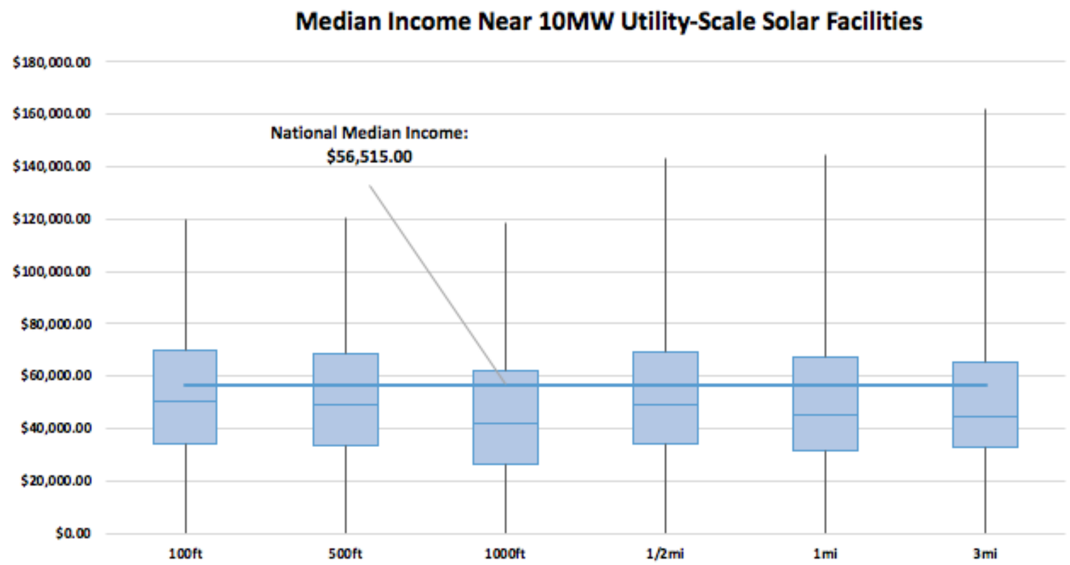
C.9: *Median income near all 1MW facilities in the United States is shown as box plots. Distance from facility increases from right to left. The national median income is displayed as a horizontal line. The national median income corresponds with the median income near 1MW facilities relatively well. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



C.10: *Median income near all 5MW facilities in the United States is shown as box plots. Distance from facility increases from right to left. The national median income is displayed as a horizontal line. The national median income appears to be higher than that of residents who live in proximity to 5MW utility-scale solar facilities. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*

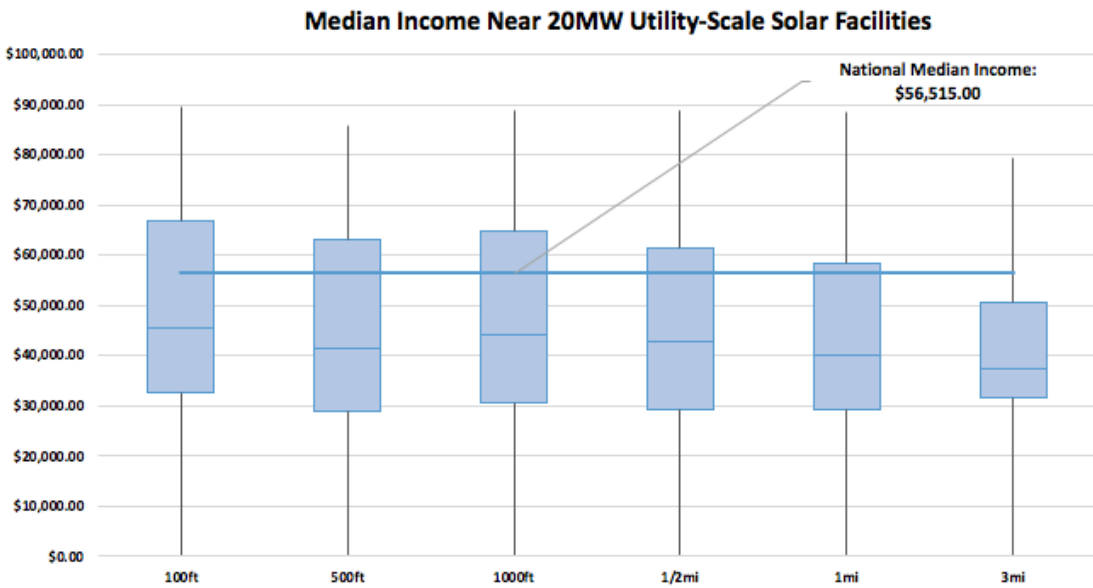


C.11: *Median income near all 10MW facilities in the United States is shown as box plots. Distance from facility increases from right to left. The national median income is displayed as a horizontal line. The national median income appears to be higher than that of residents who live in proximity to 10MW utility-scale solar facilities. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



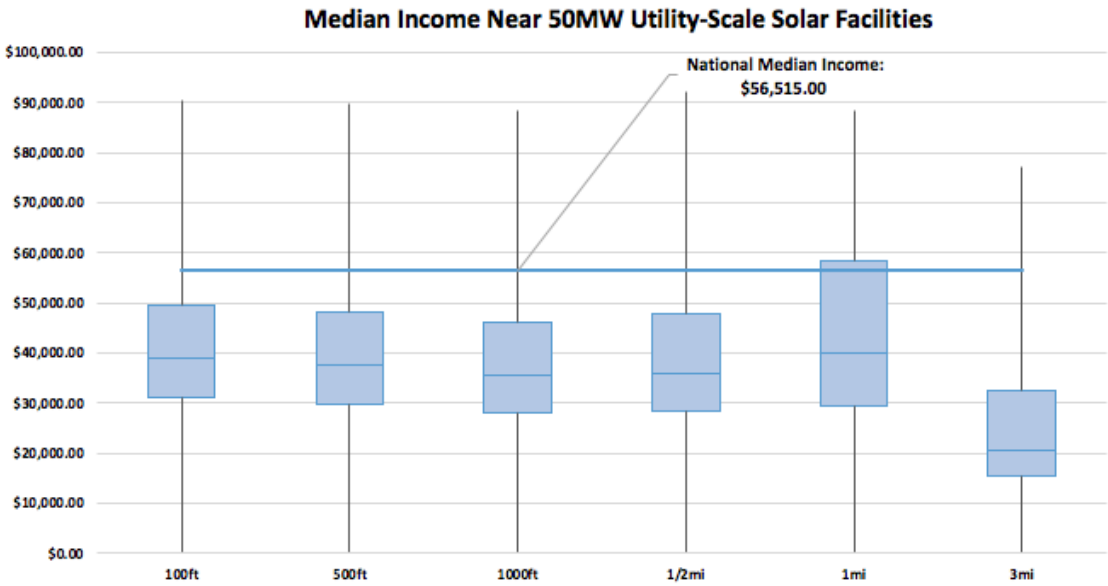
Note: Utility-scale solar facilities categories classified as follows: 1MW = 1 - 4.99 MW; 5MW = 5 - 9.99 MW; 10MW = 10 - 19.99 MW; 20MW = 20 - 49.99 MW; 50MW = 50 - 99.99 MW; 100MW = 100 MW+

C.12: *Median income near all 20MW facilities in the United States is shown as box plots. Distance from facility increases from right to left. The national median income is displayed as a horizontal line. The national median income appears to be higher than that of residents who live in proximity to 20MW utility-scale solar facilities. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



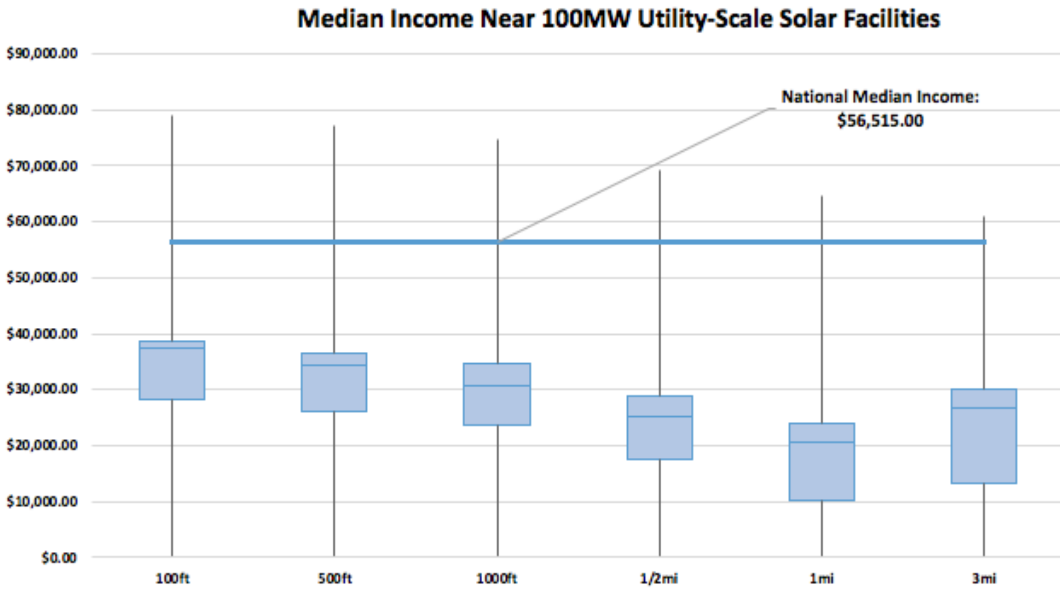
Note: Utility-scale solar facilities categories classified as follows: 1MW = 1 - 4.99 MW; 5MW = 5 - 9.99 MW; 10MW = 10 - 19.99 MW; 20MW = 20 - 49.99 MW; 50MW = 50 - 99.99 MW; 100MW = 100 MW+

C.13: *Median income near all 50MW facilities in the United States is shown as box plots. Distance from facility increases from right to left. The national median income is displayed as a horizontal line. The national median income appears to be higher than that of residents who live in proximity to 50MW utility-scale solar facilities. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



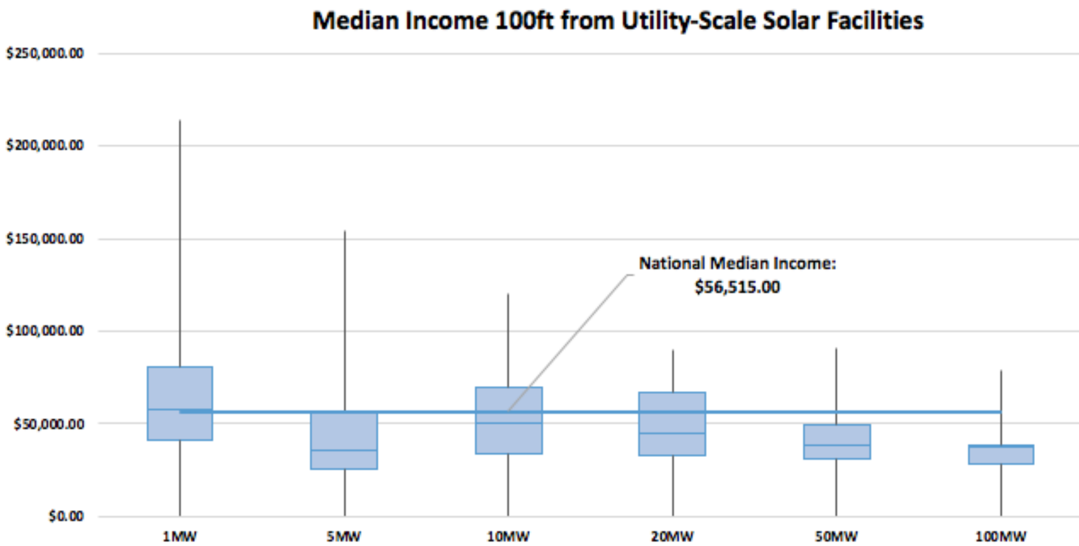
Note: Utility-scale solar facilities categories classified as follows: 1MW = 1 - 4.99 MW; 5MW = 5 - 9.99 MW; 10MW = 10 - 19.99 MW; 20MW = 20 - 49.99 MW; 50MW = 50 - 99.99 MW; 100MW = 100 MW+

C.14: *Median income near all 100MW facilities in the United States is shown as box plots. Distance from facility increases from right to left. The national median income is displayed as a horizontal line. The national median income appears to be much higher than that of residents who live in proximity to 100MW utility-scale solar facilities. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



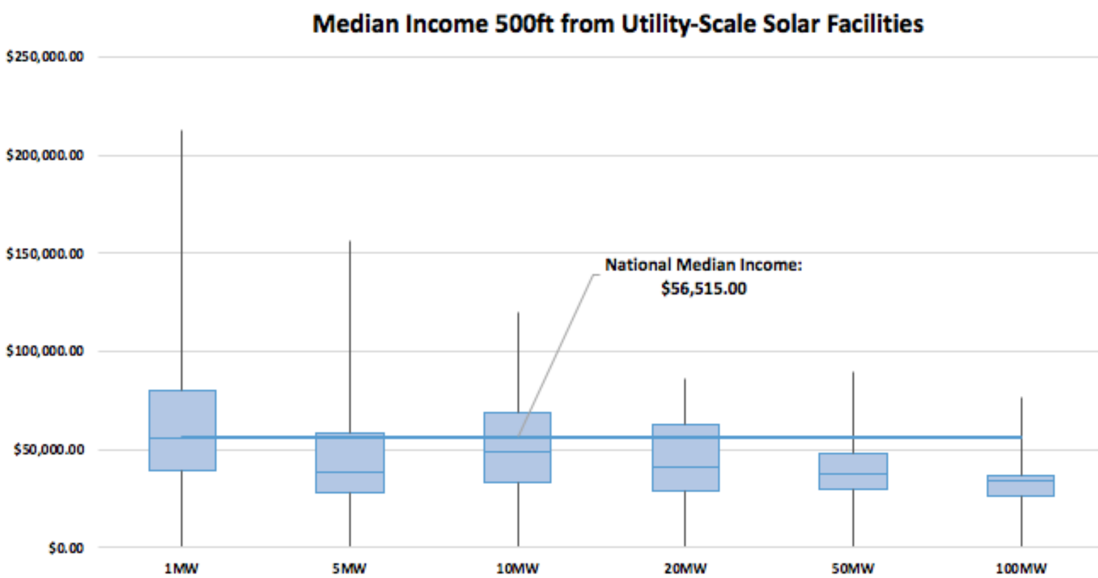
Note: Utility-scale solar facilities categories classified as follows: 1MW = 1 - 4.99 MW; 5MW = 5 - 9.99 MW; 10MW = 10 - 19.99 MW; 20MW = 20 - 49.99 MW; 50MW = 50 - 99.99 MW; 100MW = 100 MW+

C.15: *Median income 100ft from all facilities in the United States is shown as box plots. Installation size increases from right to left. The national median income is displayed as a horizontal line. The interquartile range for median income appears to roughly decrease as facility size increases. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



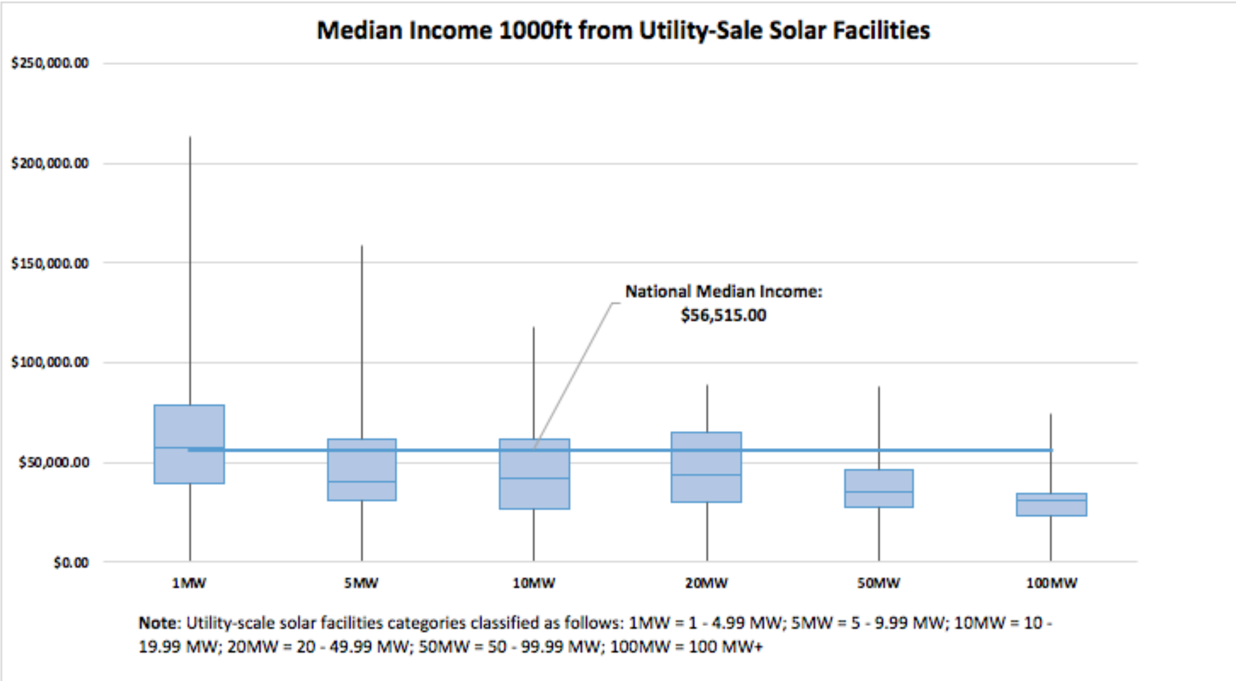
Note: Utility-scale solar facilities categories classified as follows: 1MW = 1 - 4.99 MW; 5MW = 5 - 9.99 MW; 10MW = 10 - 19.99 MW; 20MW = 20 - 49.99 MW; 50MW = 50 - 99.99 MW; 100MW = 100 MW +

C.16: *Median income 500ft from all facilities in the United States is shown as box plots. Installation size increases from right to left. The national median income is displayed as a horizontal line. The interquartile range for median income appears to roughly decrease as facility size increases. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*

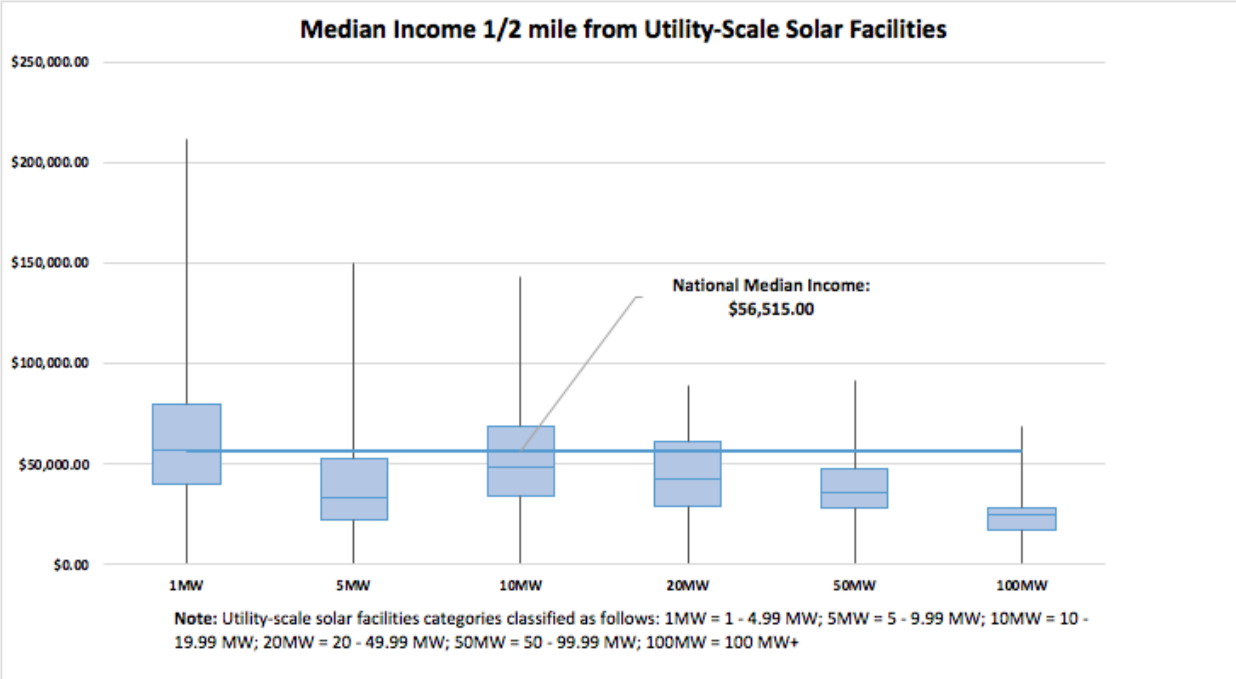


Note: Utility-scale solar facilities categories classified as follows: 1MW = 1 - 4.99MW; 5MW = 5 - 9.99 MW; 10MW = 10 - 19.99 MW; 20MW = 20 - 49.99 MW; 50MW = 50 - 99.99 MW; 100MW = 100 MW+

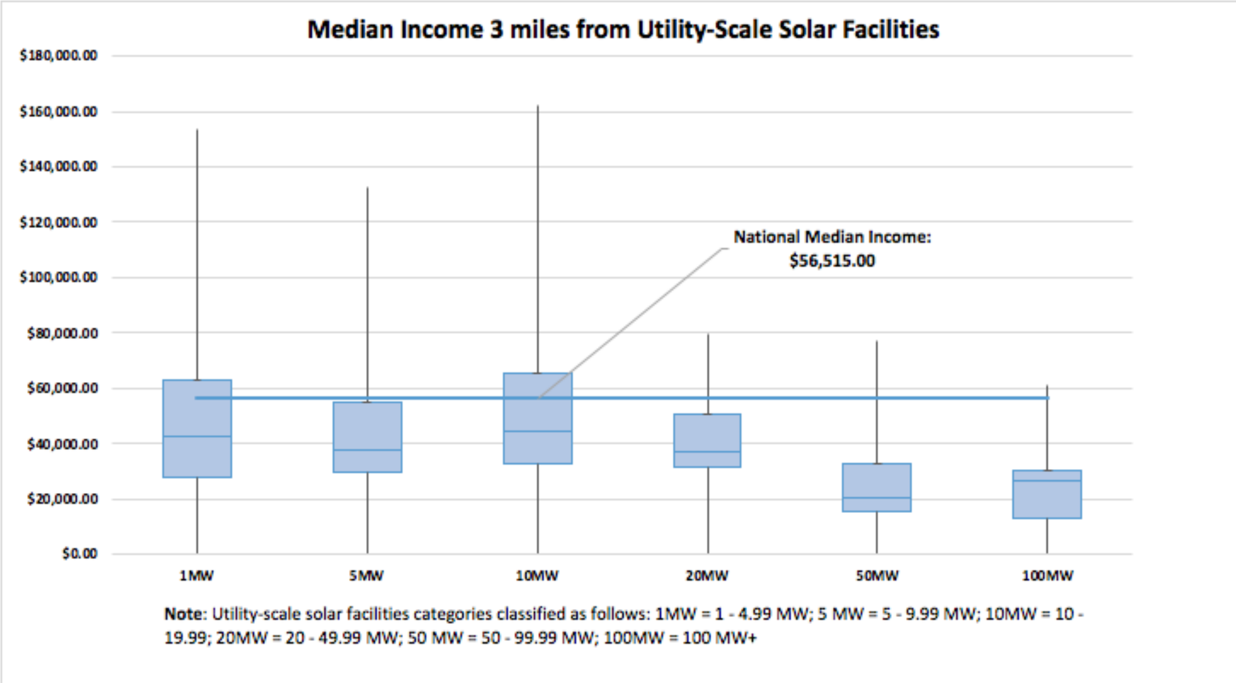
C.17: *Median income 1,000ft from all facilities in the United States is shown as box plots. Installation size increases from right to left. The national median income is displayed as a horizontal line. The interquartile range for median income appears to roughly decrease as facility size increases. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



C.18: *Median income half a mile from all facilities in the United States is shown as box plots. Installation size increases from right to left. The national median income is displayed as a horizontal line. The interquartile range for median income appears to roughly decrease as facility size increases. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



C.19: *Median income three miles from all facilities in the United States is shown as box plots. Installation size increases from right to left. The national median income is displayed as a horizontal line. The interquartile range for median income appears to roughly decrease as facility size increases. Extreme minimums were caused by unreported median income by about 3 percent of block groups, which affected the weighted sum calculations.*



Appendix C.20 - Median Income Near Solar Facilities

C.20: *The table below provides estimates of median income by facility size and distance from a solar facility.*

Appendix C.20
Median Income Near Select Utility-Scale Solar Installations in the United States
by Proximity and Installation Size

Facility Type & Distance	Median Income				
	Min	1st Quartile	Median	3rd Quartile	Max
1 MW					
100 ft	$ 36	$ 41,047	$ 57,729	$ 80,801	$ 213,688
500 ft	$ 860	$ 40,622	$ 57,109	$ 80,608	$ 213,688
1000 ft	$ 355	$ 39,778	$ 57,600	$ 79,467	$ 213,688
1/2 mile	$ 27	$ 40,299	$ 57,296	$ 79,983	$ 211,761
1 mile	$ 128	$ 40,949	$ 56,887	$ 79,848	$ 206,895
3 miles	$ 17,139	$ 44,831	$ 59,579	$ 80,339	$ 170,451
5 MW					
100 ft	$ 6,114	$ 31,901	$ 42,188	$ 62,289	$ 159,833
500 ft	$ 3,531	$ 31,882	$ 42,120	$ 62,289	$ 159,833
1000 ft	$ 767	$ 31,572	$ 41,548	$ 62,111	$ 159,833
1/2 mile	$ 9,479	$ 31,810	$ 42,770	$ 62,089	$ 159,783
1 mile	$ 4,621	$ 32,490	$ 42,563	$ 61,549	$ 157,272
3 miles	$ 5,400	$ 35,226	$ 43,080	$ 60,130	$ 138,211
10 MW					
100 ft	$ 2,162	$ 36,467	$ 52,234	$ 72,143	$ 122,061
500 ft	$ 3,229	$ 36,467	$ 52,159	$ 71,828	$ 123,411
1000 ft	$ 9,984	$ 36,467	$ 51,856	$ 71,828	$ 128,343
1/2 mile	$ 1,998	$ 36,402	$ 50,788	$ 71,157	$ 145,389
1 mile	$ 4,135	$ 35,730	$ 49,397	$ 71,564	$ 148,741
3 miles	$ 3,548	$ 36,121	$ 47,984	$ 69,120	$ 165,564
20 MW					
100 ft	$ 517	$ 33,335	$ 45,888	$ 67,378	$ 90,134
500 ft	$ 4,347	$ 33,416	$ 45,860	$ 67,378	$ 90,134
1000 ft	$ 1,274	$ 31,882	$ 45,500	$ 66,006	$ 90,134
1/2 mile	$ 1,130	$ 30,424	$ 43,882	$ 62,489	$ 90,025
1 mile	$ 1,046	$ 30,482	$ 41,179	$ 59,530	$ 89,594
3 miles	$ 3,835	$ 35,420	$ 41,090	$ 54,269	$ 83,252
50 MW					
100 ft	$ 40	$ 31,338	$ 38,929	$ 49,581	$ 90,505
500 ft	$ 1,425	$ 31,305	$ 38,929	$ 49,581	$ 91,194
1000 ft	$ 3,333	$ 31,277	$ 38,929	$ 49,581	$ 91,907
1/2 mile	$ 1,156	$ 29,679	$ 37,009	$ 49,076	$ 93,230
1 mile	$ 59	$ 28,622	$ 34,223	$ 48,405	$ 94,386
3 miles	$ 13,508	$ 29,061	$ 34,270	$ 46,109	$ 90,734
100 MW					
100 ft	$ 1,344	$ 29,444	$ 38,834	$ 39,889	$ 80,383
500 ft	$ 3,312	$ 29,444	$ 37,725	$ 39,870	$ 80,383
1000 ft	$ 5,632	$ 29,444	$ 36,467	$ 40,249	$ 80,383
1/2 mile	$ 11,146	$ 28,649	$ 36,467	$ 39,870	$ 80,383
1 mile	$ 15,869	$ 26,115	$ 36,467	$ 39,870	$ 80,383
3 miles	$ 9,767	$ 22,936	$ 36,467	$ 39,870	$ 70,747

Note: These estimates are based on the median income in areas surrounding 956 utility-scale solar installations with verified coordinates. It does include all known utility-scale solar installations in the United States.

Sources: IPUMS National Historical Geographic Information System: Version 12.0. 2015 American Community Survey: 5-Year Data [2011-2015, Block Groups & Larger Areas], Minneapolis: University of Minnesota. 2017.
Solar installation coordinates based on EIA's Form 860 2016 Early Release and Lawrence Berkeley National Lab's proprietary Solar Installation data.

Appendix D.1: Survey Instrument

University of Texas - Lawrence Berkeley National Lab Solar Installations and Property Values Study

Hello and thank you for taking the time to participate in our survey on property values near solar installations. Below is a consent form with information about our study. We appreciate your feedback.

Identification of Investigator and Purpose of Study

Thank you for participating in this research study, entitled “Property-Value Impacts Near Utility-Scale Solar Installations.” The study is being conducted by Dr. Varun Rai, Leila Al-Hamoodah, Eugenie Schieve, and Kavita Koppa at the LBJ School of Public Affairs of The University of Texas at Austin, PO Box Y, Austin, TX, 78713. You can reach the team via email at varun.rai@mail.utexas.edu.

The purpose of this research study is to examine the effects of utility-scale solar installations on residential property values. Your participation in the study will contribute to a better understanding of how these effects, if they exist, are incorporated into property value assessment. You are free to contact the research team at the above email address to discuss the study. You must be at least 18 years old to participate.

If you agree to participate:

- You will complete a survey about if and how utility-scale solar installations affect property values.
- The survey will take approximately 10 to 15 minutes of your time.
- You will not be compensated for your participation.

Risks/Benefits/Confidentiality of Data

There are no known risks to participation in this survey. There will be no costs to you for participating, nor will you be compensated. Your email address will be kept during the data collection phase for tracking purposes, and to share final results with you if you indicate you want them. A limited number of research team members will have access to the data during data collection and analysis. Personally identifying information, including email address, will be stripped from the final dataset. Email addresses will not be shared.

Participation or Withdrawal

Your participation in this survey is voluntary. You may decline to answer any question and you have the right to withdraw from participation at any time. Withdrawal will not affect your relationship with The University of Texas in any way. If you do not want to participate you may close your browser window at any time to exit the survey. If you do not want to receive any more reminders about the survey, please click the opt-out link in the invitation email you received.

Contacts

If you have any questions about the study or need to update your email address, send an email to varun.rai@mail.utexas.edu. This study has been reviewed by The University of Texas at Austin Institutional Review Board and the study number is [STUDY NUMBER].

Your Rights as a Research Participant

If you have questions about your rights or are dissatisfied at any time with any part of this study, you can contact, anonymously if you wish, the Institutional Review Board by phone at (512) 471-8871 or email at orsc@uts.cc.utexas.edu.

This page serves as your formal consent to participate in this study. Please print a copy of this page for your records. If you agree to participate in this study, click indicate your consent below.

Please indicate your consent to participate in this survey.

◯ **I consent** to participate in this survey

◯ I **do not** consent to participate in this survey

Thank you for taking the time to complete this survey. This survey is intended for individuals who are currently or were recently employed as a home assessor or home appraiser in the United States for the public sector. We recommend completing this survey on a laptop or desktop computer, rather than on a phone or tablet.

While completing this survey, please consider the following definitions as used in this survey:

1. **Utility-scale solar installations** include any ground-mounted photovoltaic (PV) solar arrays that sell electricity to a utility rather than providing electricity for residential use. These installations can be of any size but utility-scale are typically considered to be at least 1 megawatt (MW), which may cover between 5 and 9 acres of land per MW. See the images below for examples of utility-scale solar installations.
2. **Assessment** refers to the process of assessing or appraising the value of a home for the public sector.
3. **Assessment value or appraisal value** refers to the monetary value public assessors or public appraisers estimate for a home. For the purposes of this survey, assessment value and appraisal value may be referred to simply as "value". Impacts on home prices refer to monetary impacts (i.e. a change in the value of the home).

   If you have any questions while completing the survey, please contact varun.rai@mail.utexas.edu. Thank you for your time.

Examples of utility-scale solar installations in the United States.

We would like to know more about the role in which you assess homes. Which of the following best describes you?

- ○ I am **currently** an assessor or appraiser for the public sector (i.e. I am employed by a county or town to perform assessments)
- ○ I was **formerly** an assessor or appraiser for the public sector
- ○ I have **never** been an assessor or appraiser for the public sector
- ○ I prefer not to answer

How many years of experience do you or did you have in assessing for the public sector? *Please indicate the number of years only in your response. For example, please indicate "9" rather than "nine" or "9 years."*

____

What was the approximate date of the most recent residential assessment you completed?

Year: 2015

Month:
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

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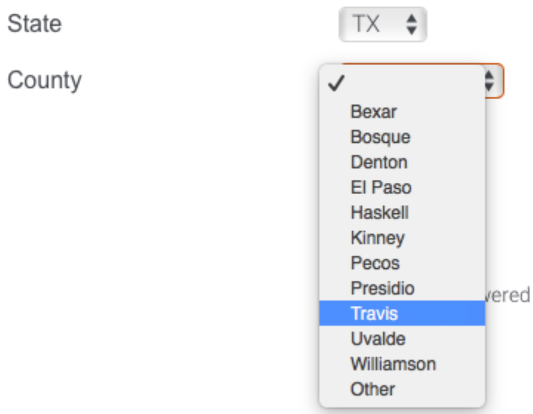
In which state and county (or county equivalent) are/were you most recently employed as an assessor or appraiser for the public sector?



Because you selected "other", please indicate the county (or county equivalent) you are or were most recently employed as an assessor or appraiser for the public sector?

____

To the best of your knowledge, approximately how many utility-scale solar installations are currently operating in the county (or county equivalent) where you are/were most recently employed as an assessor for the public sector?
Please indicate the number of installations only in your response. For example, please indicate "5" rather than "five" or "about five."

____

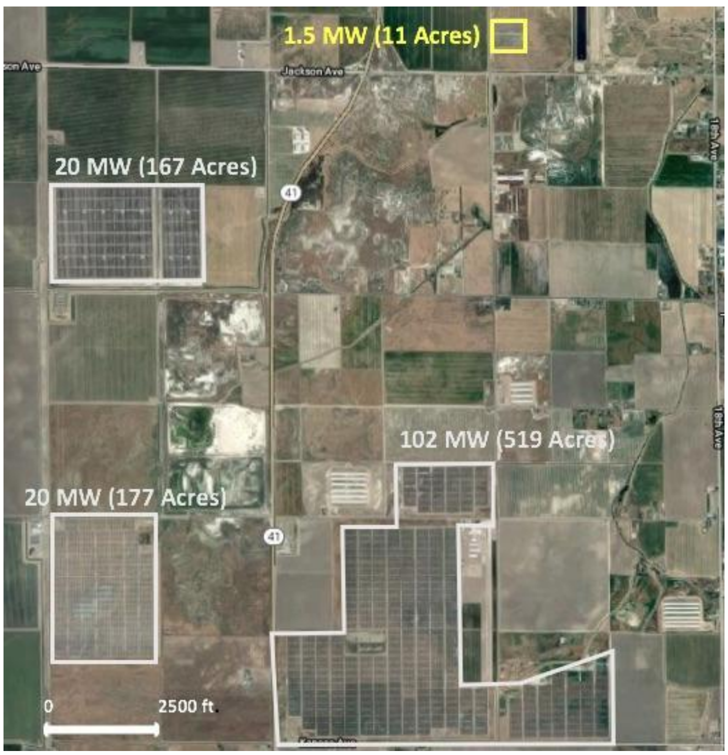
Does your professional manual or do your professional training materials provide instructions regarding assessing home values that are located near a utility-scale solar installation?

- ◯ Yes
- ◯ No
- ◯ I don't know
- ◯ I don't have a manual or other professional materials
- ◯ I prefer not to answer

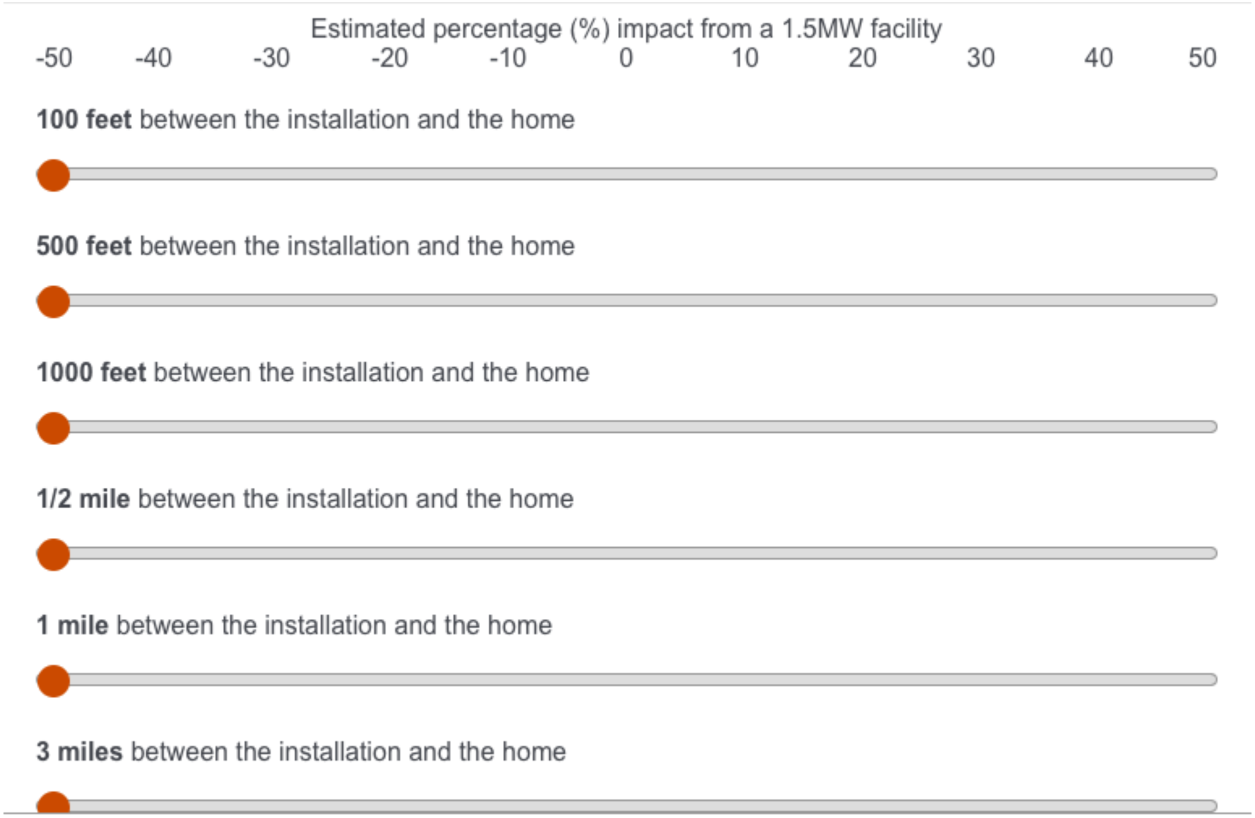
Part I: 1.5MW Facilities

Please use the sliders below to estimate if and how the presence of a **1.5MW** utility-scale solar installation would impact a nearby home's assessment value **in percentage terms**. Please do so at the varying distances between the home and the nearest solar panel.

1.5MW utility-scale solar installations may cover between 7.5 to 13.5 acres. For an example of a 1.5MW solar installation, please refer to the image below.



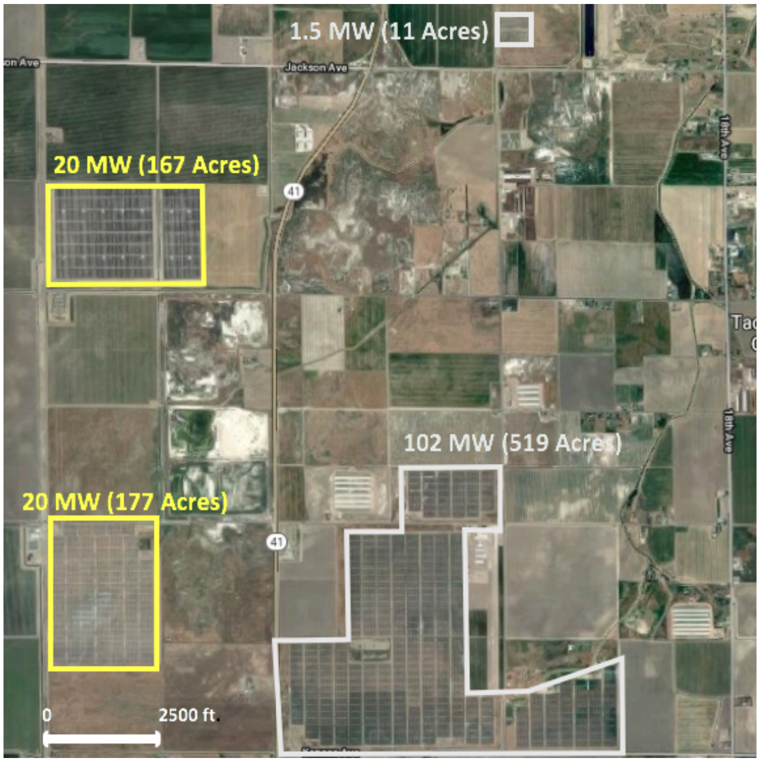
- Please indicate a value of **0** if the value of the home would not be impacted in any way by the presence of a 1.5MW solar installation at a given distance, in percent terms.
- Please indicate the corresponding value **greater than 0** if the value of the home would increase by the presence of a 1.5MW solar installation at a given distance, in percent terms.
- Please indicate the corresponding value **less than 0** if the value of the home would decrease by the presence of a 1.5MW solar installation at a given distance, in percent terms.



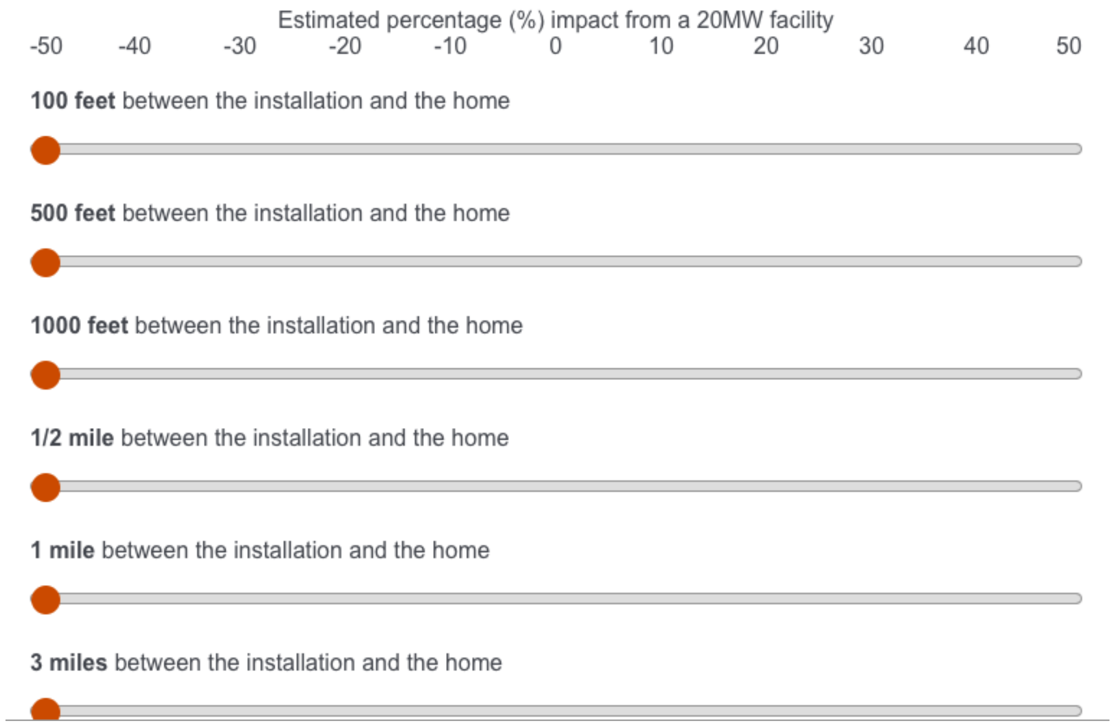
Part II: 20MW Facilities

Please use the sliders below to estimate if and how the presence of a utility-scale solar installation of 20MW would impact a nearby home's assessment value in percentage terms. Please do so at the varying distances between the home and the nearest solar panel.

Utility-scale solar installations of 20MW may cover 100 to 180 acres. For an example of a solar installation of 20MW, please refer to the image below.



- Please indicate a value of **0** if the value of the home would not be impacted in any way by the presence of a 20MW solar installation at a given distance, in percent terms.
- Please indicate the corresponding value **greater than 0** if the value of the home would increase by the presence of a 20MW solar installation at a given distance, in percent terms.
- Please indicate the corresponding value **less than 0** if the value of the home would decrease by the presence of a 20MW solar installation at a given distance, in percent terms.


Estimated percentage (%) impact from a 20MW facility

-50 -40 -30 -20 -10 0 10 20 30 40 50

100 feet between the installation and the home

500 feet between the installation and the home

1000 feet between the installation and the home

1/2 mile between the installation and the home

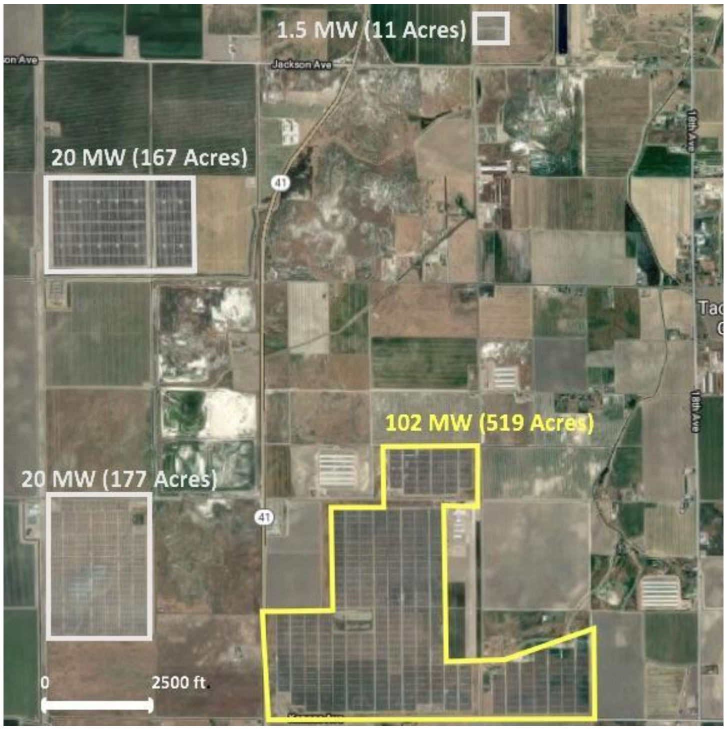
1 mile between the installation and the home

3 miles between the installation and the home

Part III: 102MW Facilities

Please use the sliders below to estimate if and how the presence of a **102MW** utility-scale solar installation would impact a nearby home's assessment value in percentage terms. Please do so at the varying distances between the home and the nearest solar panel.

Utility-scale solar installations 102MW may cover 510 to 918 acres. For an example of a 102MW solar installation, please refer to the image below.



- Please indicate a value of **0** if the value of the home would not be impacted in any way by the presence of a 102MW solar installation at a given distance, in percent terms.
- Please indicate the corresponding value **greater than 0** if the value of the home would increase by the presence of a 102MW solar installation at a given distance, in percent terms.
- Please indicate the corresponding value **less than 0** if the value of the home would decrease by the presence of a 102MW solar installation at a given distance, in percent terms.

Estimated percentage (%) impact from a 102MW facility

-50 -40 -30 -20 -10 0 10 20 30 40 50

100 feet between the installation and the home

500 feet between the installation and the home

1000 feet between the installation and the home

1/2 mile between the installation and the home

1 mile between the installation and the home

3 miles between the installation and the home

Do you have any other comments on the value impacts from proximity to utility-scale solar installations?

Please indicate whether the following features or aspects of a utility-scale installation would have a positive or negative impact on nearby residential property values:

	Strongly negative	Negative	No effect	Positive	Strongly positive
Panels that move to track the sun's position	○	○	○	○	○
Increase in the installation's size	○	○	○	○	○
Increase in the height of the panels from the ground	○	○	○	○	○
Presence of visual barriers around the solar array (e.g. trees, hedges, fence, etc.)	○	○	○	○	○
Mountainous topography surrounding the installation	○	○	○	○	○
Flat topography surrounding the installation	○	○	○	○	○
New infrastructure associated with the installation (e.g. power lines)	○	○	○	○	○

Have you assessed a home near a utility-scale solar installation?

- ○ Yes
- ○ No
- ○ Other (please explain) ________________________________
- ○ I prefer not to answer

Have you adjusted for the value of a home based on the presence of a utility-scale solar installation in the past?

◯ Yes

◯ No

◯ Other (please explain) ____

◯ I prefer not to answer

Do you have any comments on your experience assessing homes near utility-scale solar installations that you would like to share?

____

In general, what is your opinion of solar energy in the U.S.?

◯ Extremely positive

◯ Somewhat positive

◯ Neither positive nor negative

◯ Somewhat negative

◯ Extremely negative

◯ I prefer not to answer

Is there anything in this survey that we should clarify or that you would like to comment on? *This will help us refine our survey to ensure it is as clear as possible.*

____

Would you like to be informed via email of the results of this research upon study completion?

◯ Yes

◯ No

May we follow up with you via email if we need to clarify your survey responses?

◯ Yes

◯ No

What is your email address?
Your email address will not be shared and will be used for survey validation and related communication purposes only.

____

Are you ready to submit?
If you are done with the survey, please click the forward button below. If not, please use the back button at the bottom of the screen to return to your previous answers.

Appendix D.2 - Responses by Geographic Region and Question

Appendix D.2: *The above table indicates where respondents come from for each question, as well as the number of respondents per question.*

Respondents by Geographic Region

State	Years of Experience n = 36	Last Assess. Date n = 35	Perceived Install. Count n = 33	Solar PV in Prof. Manual n = 34	Estimates of PV Impacts (%) n = 18	Impact of Solar Features n = 19	Near Assessed Near Solar? n = 22	Adjusted Near Solar? n = 22	Opinion of Solar n = 23
AZ	X	X	--	--	--	--	--	--	--
CO	X	X	X	X	--	--	--	--	--
CT	X	X	X	X	X	X	X	X	X
FL	X	X	X	X	X	X	X	X	X
GA	X	X	X	X	X	--	--	--	--
HI	X	--	X	X	X	X	X	X	X
IA	X	X	X	X	X	X	X	X	X
ID	X	X	X	X	--	--	--	--	--
IL	X	X	X	X	--	--	--	--	--
IN	X	X	X	X	X	X	X	X	X
MA	X	X	X	X	X	X	X	X	X
MD	X	X	X	X	--	--	X	--	X
MN	X	X	X	X	X	X	X	X	X
NC	X	X	X	X	X	X	X	X	X
NJ	X	X	X	X	X	X	X	X	X
NM	X	X	X	X	--	X	X	X	X
NV	X	X	X	X	--	--	--	--	--
OR	X	X	X	X	--	--	X	X	--
SC	X	X	X	X	--	X	X	X	X
UT	X	X	X	X	X	X	X	X	X
VA	X	X	X	X	X	X	X	X	X
VT	X	X	X	X	--	--	--	--	--
WI	X	X	X	X	--	--	X	X	X

Appendix D.3 - Descriptive Statistics for Estimates of Property Value Impacts (%)

Table B.1: *The below table contains descriptive statistics on all respondents' estimates of home value impacts due to proximity to solar installation. These impacts were estimated at several distances between the home and the installation, and for three facility sizes. The table also includes p-values from t-tests measuring whether the mean of responses was statistically different than zero.*

Estimates of Impact on Property Values from Solar Installations by Size and Distance (%)

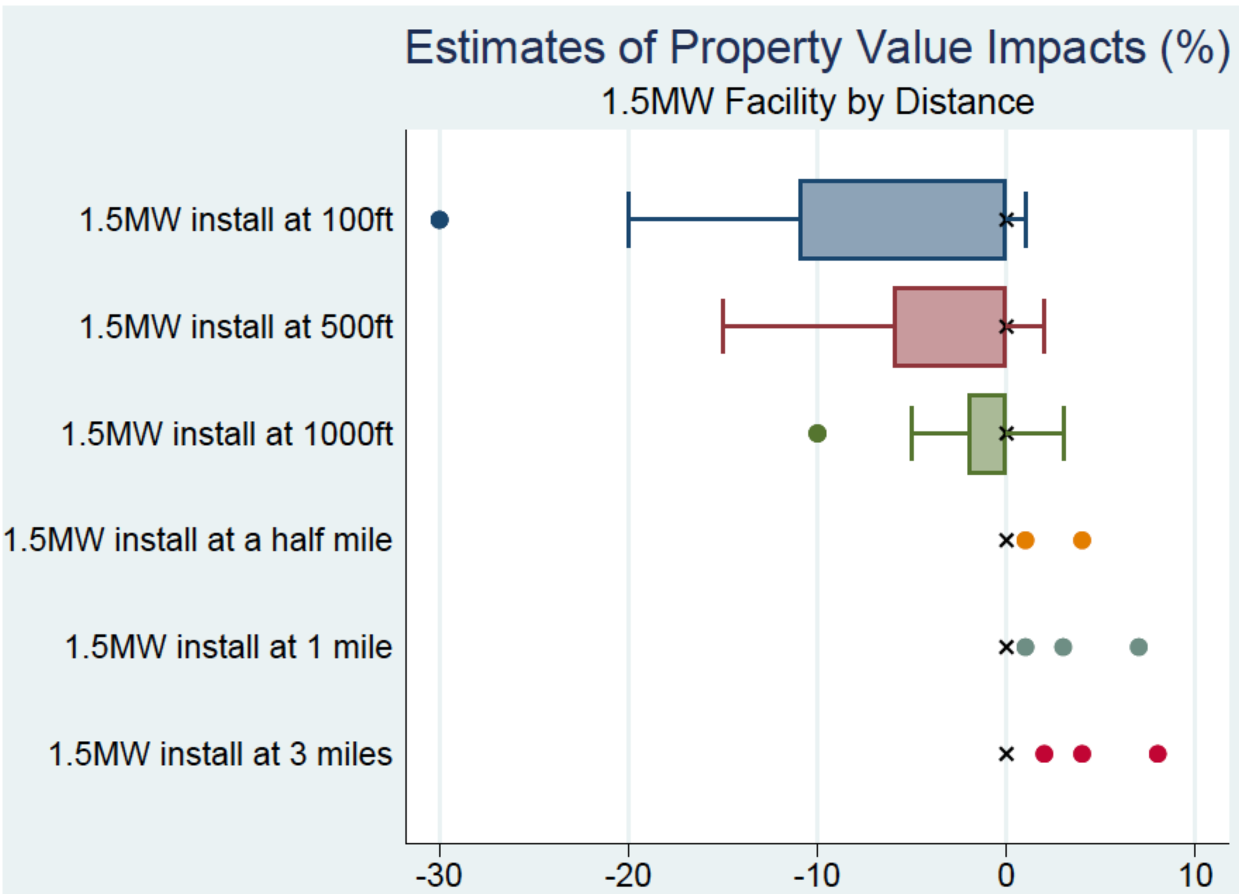
	Mean	Standard Deviation	Min	10th Percentile	Median	90th Percentile	Max	t-test p-value	n
1.5 Megawatts									
100 feet	-7.0	10.7	-30	-30	0	1	1	0.016 **	17
500 feet	-3.2	5.6	-15	-15	0	1	2	0.025 **	18
1000 feet	-1.6	3.6	-10	-10	0	1	3	0.084 *	18
1/2 mile	0.3	1.0	0	0	0	1	4	0.236	18
1 mile	0.6	1.8	0	0	0	3	7	0.158	18
3 miles	0.8	2.1	0	0	0	4	8	0.130	18
20 Megawatts									
100 feet	-10.2	13.9	-40	-30	0	1	5	0.006 **	18
500 feet	-6.4	8.8	-20	-20	0	1	5	0.007 **	18
1000 feet	-3.2	5.5	-15	-15	0	0	1	0.023 **	18
1/2 mile	-1.1	3.5	-10	-10	0	1	3	0.201	18
1 mile	0.2	2.0	-5	0	0	2	6	0.636	18
3 miles	0.6	1.9	0	0	0	2	8	0.193	18
102 Megawatts									
100 feet	-9.8	14.1	-32	-30	0	0	10	0.011 **	17
500 feet	-8.3	11.8	-30	-25	0	0	10	0.008 **	18
1000 feet	-5.7	8.3	-25	-20	0	0	0	0.010 **	18
1/2 mile	-2.7	5.5	-20	-10	0	0	1	0.052 *	18
1 mile	-1.2	4.2	-15	-10	0	1	2	0.236	18
3 miles	0.0	3.1	-10	0	0	2	8	1.000	18

Notes: t-tests test the mean against the null hypothesis of zero
** significant at the 5% level, * significant at the 10% level

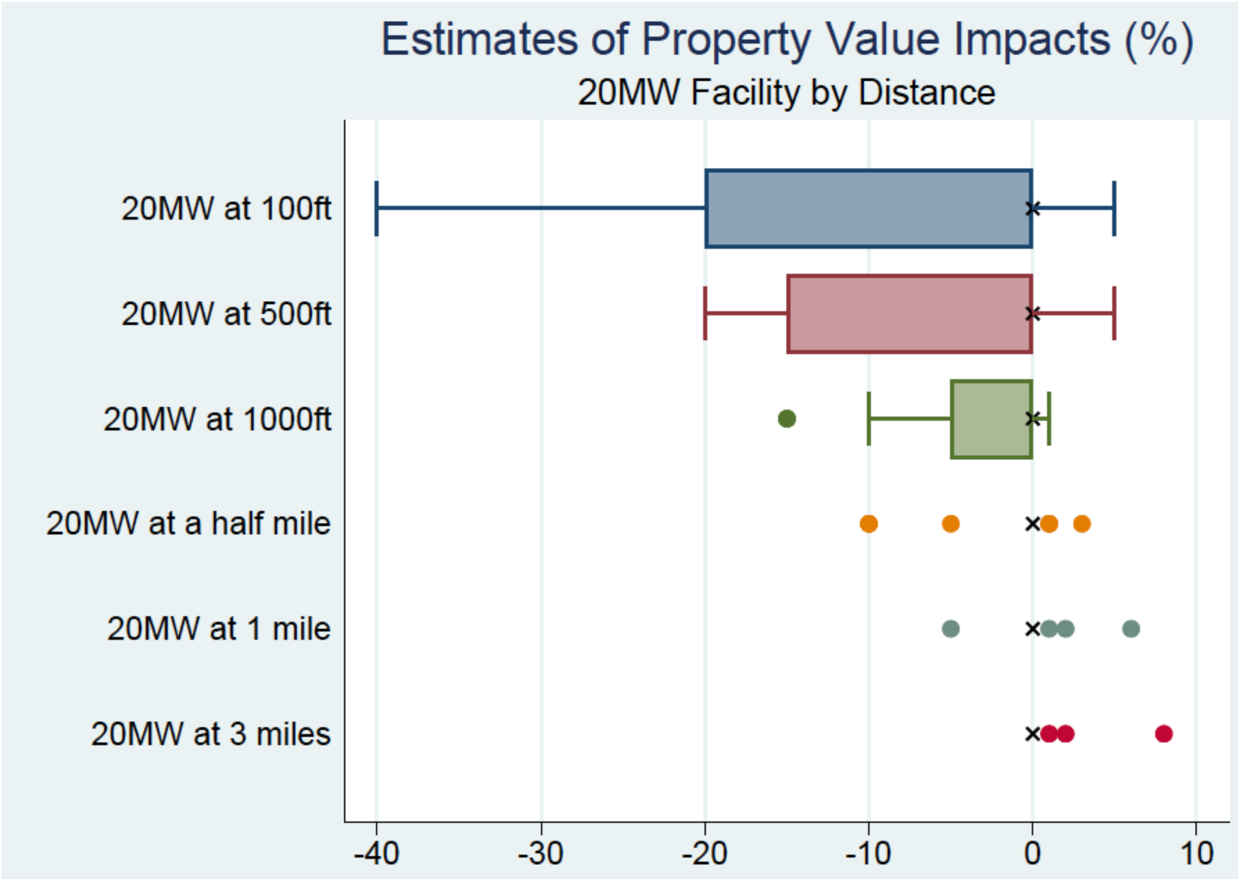
Appendices D.4 - D.6 - Estimates of Property Value Impacts in Boxplots

The following boxplots provide additional information on the variation in survey responses for estimates of property value impacts by facility size and distance.

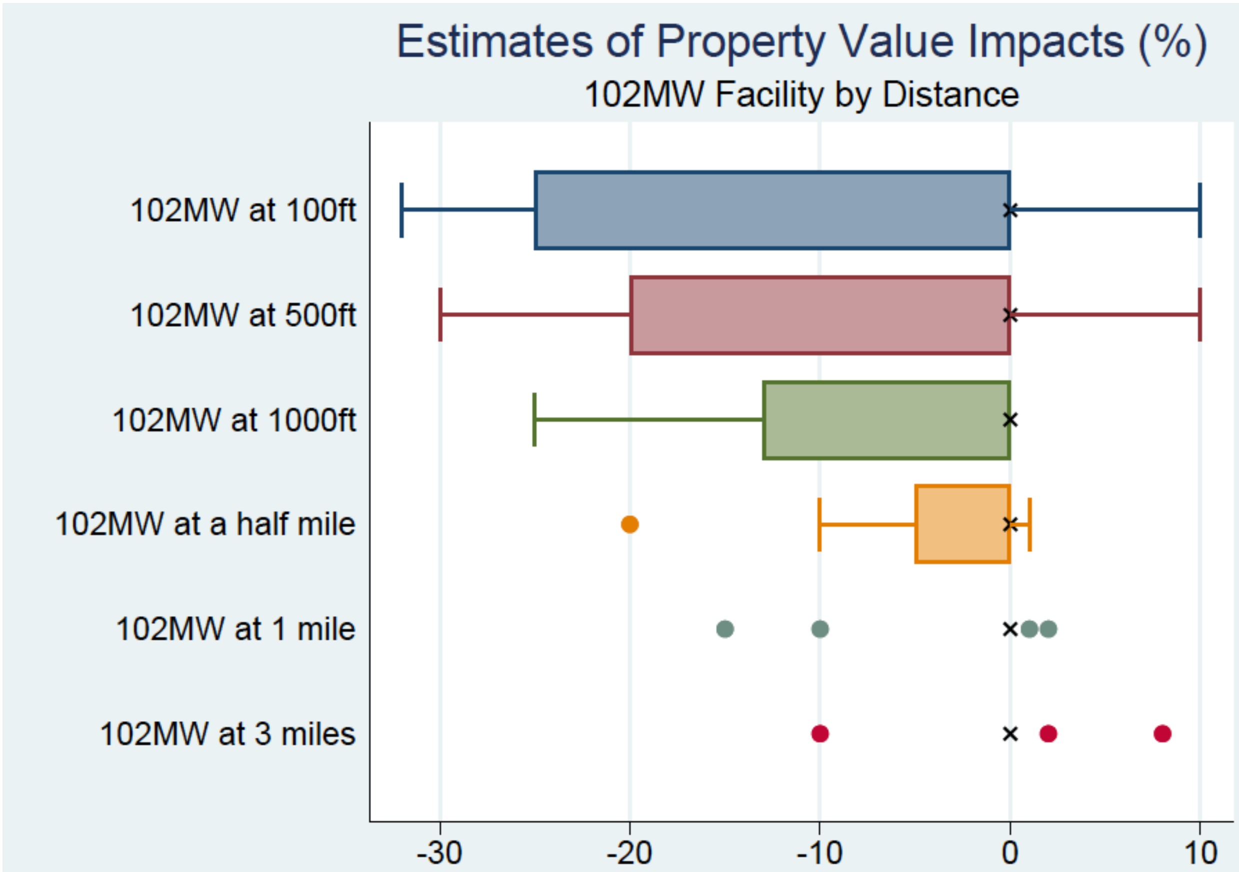
Appendix D.4: *The below boxplots indicate the range of estimates from survey respondents for property value impacts near a 1.5MW facility. The median is indicated with an "X".*



Appendix D.5: *The below boxplots indicate the range of estimates from survey respondents for property value impacts near a 20MW facility. The median is indicated with an "X".*



Appendix D.6: *The below boxplots indicate the range of estimates from survey respondents for property value impacts near a 102MW facility. The median is indicated with an "X".*



Appendix D.7 - Estimating Property Value Impacts in Dollar Terms ($)

To estimate property value impacts in dollar terms, we pulled county-level median home value from the U.S. Census Bureau's 2016 American Community Survey. The below table converts the estimates of property value impacts provided by survey respondents into dollars, based on the median home value in each respondent's county. If this impact were the true impact and the home values were the same for the whole county, then the results suggest that being located 100 feet from a 20MW solar installation would be associated with a $26,252 decline in home value, on average. By contrast, living three miles from a 1.5MW installation would be associated with an average $1,098 gain in value. Of course, variations in median home values and effect sizes across the United States could lead to significant differences by region.

Table: *The below table provides descriptive statistics on the estimate of home value impact translated into dollars. The dollar impacts are estimated by multiplying each respondent's estimate of impact (%) with the median home price in their county.*

Estimates of Property Values Impacts($) by Size and Distance

	Median	Mean	Min	Max	St. Dev.	n
1.5 Megawatts						
100 feet	$0	-$18,874	-$98,760	$1,613	$31,621	17
500 feet	$0	-$9,926	-$74,070	$3,226	$19,841	18
1000 feet	$0	-$5,787	-$49,380	$4,839	$13,427	18
1/2 mile	$0	$411	$0	$6,452	$1,524	18
1 mile	$0	$877	$0	$9,989	$2,547	18
3 miles	$0	$1,098	$0	$11,416	$3,008	18
20 Megawatts						
100 feet	$0	-$26,252	-$119,400	$6,330	$40,673	18
500 feet	$0	-$17,230	-$76,600	$6,330	$27,051	18
1000 feet	$0	-$9,842	-$59,700	$951	$18,367	18
1/2 mile	$0	-$3,475	-$39,800	$4,281	$10,398	18
1 mile	$0	-$398	-$19,900	$8,562	$5,301	18
3 miles	$0	$866	$0	$11,416	$2,745	18
102 Megawatts						
100 feet	$0	-$24,136	-$119,400	$12,660	$38,859	17
500 feet	$0	-$20,998	-$79,600	$12,660	$31,354	18
1000 feet	$0	-$14,961	-$61,950	$0	$23,540	18
1/2 mile	$0	-$6,971	-$49,560	$951	$14,704	18
1 mile	$0	-$4,065	-$39,800	$2,854	$12,549	18
3 miles	$0	-$637	-$24,780	$11,416	$6,601	18