2019 PV Systems Symposium Slide Questions

Albuquerque, New Mexico, May 14-16, 2019

	Submission Date	Submission Time
PV Performance (Tuesday)		
@Propst Are there a lot of coal workers in NM? Or are you attracting them from other states to work in the renewable industry?	05/14/2019	08:14:54
@Propst Of the 950MW of renewable energy capacity additions in NM over the next 5 years,	05/14/2019	08:15:36
@Propst: What is the best way for technical experts to engage with the state to make sure this energy transition is successful?	05/14/2019	08:19:27
@Propst Will nuclear count towards the RPS?	05/14/2019	08:21:54
@propst utilities didn't flinch at 50% rps. What did they push back on?	05/14/2019	08:22:28
@Propst: What storage technologies do you think will be most helpful to achieve 100% by	05/14/2019	08:22:55
@Propst What were the biggest challenges you faced in getting the Energy Transition Act passed? Do you have recommendations for other states?	05/14/2019	08:23:03
@ Propst Are there plans to launch a Community Solar Program similar to the one in IL this	05/14/2019	08:24:28
@Propst Despite cheap PPA pricing, the utility PV segment is struggling to reboot procurement. What is your approach to help curb this issue?	05/14/2019	08:24:32
@propst You mentioned exporting your excellent solar resource. Was there anything in the Energy Transition Act that was related to transmission development?	05/14/2019	08:26:37
@Kees Could remote monitoring be used to reduce or improve the scheduling of the “required” regular manual cleanings of pyranometers?	05/14/2019	08:44:14
@ Kees Could you expand on not mounting on array frame please	05/14/2019	08:45:32
@Kees: 10% of time, unventilated pyranometers don't work, what is the effect on annual measured irradiance? Daily measurements?	05/14/2019	08:45:42
@Kees, could you adderss / recommend the installation height of the albedometer?	05/14/2019	08:48:38
@Kees how long should albedo measurements be conducted for?	05/14/2019	08:49:00
@Kees: How does non-spectrally flat pyranometers bias the performance monitoring of PV	05/14/2019	08:50:12
@Kees: Are there any automatic pyranometer cleaning solutions?	05/14/2019	08:50:21
@Kees: How does non-spectrally flat pyranometers bias the performance monitoring of PV	05/14/2019	08:51:39
@Kees a comment about albedo measurements. Most (if not all) bifacial performance models expect a 'clean' albedo, i.e., without any nearby shadows.	05/14/2019	08:52:13
@Kees measuring ground reflected irradiance with a downward facing pyranometer is also valuable for bifacial modeling. Different from measuring albedo	05/14/2019	08:53:10

@Skoczek Solargis data in east Asia is available only from 2007. How is the progress in processing data from older satellites?	05/14/2019	08:58:47
@Skoczek: How do you get the 250m spatial resolution from the 2km satellite data	05/14/2019	08:58:54
@ Skoczek:Validation with SAM and PVsyst: Can you provide more details on the system?, tracker or fixed? Climate? DC/AC?	05/14/2019	09:01:58
@Skoczek How does the uncertainty and/or error compare to SolarAnywhere for sites in the	05/14/2019	09:02:25
@Skoczek: How does SolarGIS treat the "edge" areas between GOES-E and GOES-W satellites, where the accuracy of two satellites differ?	05/14/2019	09:03:46
@Skoczek Can you import ground irradiance and weather data into Propsect and use it to	05/14/2019	09:04:51
@Skoczek What types of users do you expect? Prospectors only or developers, designers, and	05/14/2019	09:05:34
@Skovzek Where do you derive Albedo data from?	05/14/2019	09:05:42
@Skoczek: How are shading losses captured/calculated?	05/14/2019	09:06:49
@Keelin Can buildings be filtered out of satellite images before calculating albedo?	05/14/2019	09:23:30
@Keelan: are you hearing about engineered (vegetated) ground cover for higher albedo?	05/14/2019	09:27:05
@Keelan How long should ground measurements for albedo be conducted for?	05/14/2019	09:27:07
@Keelin How much does the variation in albedo affect energy estimates?	05/14/2019	09:27:30
@Keelan Have you studied areas with built sites?	05/14/2019	09:28:20
@Keelan Is there a paper that describes the design if the albedometer station? Or would you	05/14/2019	09:29:24
@Keelan Is secondary standard necessary for albedo? Can we use ref cells	05/14/2019	09:29:24
@keelan, how best can utilities improve site albedo. Any ideas?	05/14/2019	09:29:44
@Keelan Is there a method data source to allow for differences in albedo of different snow types or length of time the snow had been deposited?	05/14/2019	09:29:48
@Keelan If ground conditions dont change seasonally, what is a good estimate for changes in albedo based on changes in solar energy throughout the year?	05/14/2019	09:30:29
@Keelan Are there rules of thumb/calculation steps to tune satellite-measured albedo to post-construction condition based on the type of site and region?	05/14/2019	09:30:37
@Gostein How does the Mars instrument take into account the physical optical properties of aerosols/soiling particles? They are highly different.	05/14/2019	09:38:09
@Gostein Has there been a comparison of How soiling measurements from the MARS sensor differs from the kipp and zonen dust IQ?	05/14/2019	09:38:19
@Gostein. Do you see an angle of incidence effect in your measurements? Are there other	05/14/2019	09:39:23
@Gostein Can your sensor be calibrated to be traceable to NIST?	05/14/2019	09:39:44
@Gostein how does the accumulation of dust particles on the Mars lense compare to the dust accumulation on a PV module having a much larger form factor?	05/14/2019	09:40:05

@Gostein Does the setup require different calibration to distinguish bright versus dark pixels based on the type of dust/region?	05/14/2019	09:40:38
@Gostein Can you please talk about the accuracy of the small area mars sensor at sites where the soiling over a large module area is non-homogeneous.	05/14/2019	09:41:35
@Gostein - Does dew affect the 'clumping' of soil and the overall measurement of that soil via	05/14/2019	09:42:16
@Gostein Can the Mars technology handle soiling loss due to snow?	05/14/2019	09:44:13
@Gostein Is this system able to capture the impact of dew as well as dust?	05/14/2019	09:44:47
@Gostein How often does the Mars sensor need to be cleaned?	05/14/2019	09:45:06
@Gostein Can you speak about spectral impacts? This seems to only measure the soiling	05/14/2019	09:46:14
@Gostein Have you varied the size of the particles?	05/14/2019	09:46:21
@Gostein Is the Mars system intended to be operational? Can it send signals or alarms, or does a human have to collect and review soiling data?	05/14/2019	09:46:21
@gostein Is there a certain amount of rain that you've observed is necessary to completely clean the panels? Do light rains not sufficiently clean them?	05/14/2019	09:46:48
@gostein Can you alleviate the snall surface area limitation by having mutliple sensors?	05/14/2019	09:46:53
@gostein How well does the particle collection window simulate the surface of a solar	05/14/2019	09:48:44
@Gostein What is the uncertainty of the Soiling ratio measurement for both systems?	05/14/2019	09:48:53
@gostein does mars measure non uniform soiling?	05/14/2019	09:49:13
@Gostein - You mentioned normalizing to 0 soiling after rain events. Is there a minimum amount/duration of rain needed for a full reset of soiling levels?	05/14/2019	09:49:48
@Bourne Have you considered validating these coefficients for floating PV arrays?	05/14/2019	10:24:48
@Bourne: How does the size of the PV system affect the values of the coefficients? Larger	05/14/2019	10:33:51
@Bourne What methods do you suggest for modulating UV for arrays located on the interior	05/14/2019	10:34:52
@Bourne Do you window or filter data before regressions? Are these simple models due for	05/14/2019	10:35:25
@Bourne did you consider estimating windspeed at 10m from site data with standard industry adjustments to different heights?	05/14/2019	10:35:45
@Bourne: Can you recommend a method for correcting wind speed measured at array height	05/14/2019	10:35:57
@Bourne Would the right approach be to derive Uc from onsite measured data and Uv from	05/14/2019	10:36:41
@Bourne Have you investigated using measured test data to derive coefficients such as	05/14/2019	10:37:21
@Bourne Did you evaluate high wind speed conditions >10m/s? The Faiman model has been shown to work poorly at high wind speeds.	05/14/2019	10:38:29
@Bourne Have you considered including wind direction data in your analysis?	05/14/2019	10:38:39
@Bourne Do you make a difference between fixed and single axis trackers Uc and Uv	05/14/2019	10:38:57
@Bourne have you considered validating thermal coefficients for mono-facial vs bi-facial	05/14/2019	10:39:05

@Bourne Accuracy of air temperature is a function of wind speed, did you account for high uncertainty in air temp data at low wind speeds?	05/14/2019	10:39:48
@Bourne Were any data filtration criteria applied? If so, what? e.g., low irradiance filter?	05/14/2019	10:39:52
@Bourne How much energy variation would you see when using site specific coefficients	05/14/2019	10:40:52
@Bourne We're you surprised that there was no difference on thermal coefficients for flat	05/14/2019	10:41:02
@ Bourne: how does this affect capacity testing?	05/14/2019	10:41:03
@bourne how does Uc and Uv correlate to NMOT?	05/14/2019	10:41:30
@Bourne Did your analysis account for expected differences between the BOM sensor and	05/14/2019	10:41:35
@Bourne Your data was based on sunpower modules, or were there other technologies in the dataset? How different might this be from other manufacturers?	05/14/2019	10:41:47
@Reidel: Are there interactions with soiling?	05/14/2019	10:44:14
@Riedel: Is it accurate to say energy losses due to IAM are mainly a function of the glass and	05/14/2019	10:49:46
@Riedel: Can you quantify how the uncertainty between labs translates to uncertainty in annual yields of various PV systems?	05/14/2019	10:55:01
@Riedel: Why are you choosing to measure samples without ARC? All PV glass these days	05/14/2019	10:55:36
@Reidel: When you fit the models do you give equal weight to all angles of incidence?	05/14/2019	10:56:59
@Reidel: Are you recommending using Sandia model? Have you assessed effect of different models and coefficient with real annual performance prediction?	05/14/2019	10:59:08
@Group: Please comment on the IAM measurement indoors vs. outdoors?	05/14/2019	11:00:30
@Reidel: Is there data on repeatability of indoor vs outdoor measurements?	05/14/2019	11:00:42
@Reidel. Do you expect errors to increase when measurements are made on full modules?	05/14/2019	11:01:13
@Group: Nick: Can you comment on the uncertainty in IAM measurements on full modules vs	05/14/2019	11:05:55
@Driesse: What is the easiest way to compare IEC 61853-1 Matrices to PVSyst PAN file	05/14/2019	11:05:59
@Driesse: Why does PVsyst discourage use of the matrix measurement data?	05/14/2019	11:08:12
@Group: Kees: What new features do you foresee in future irradiance instruments? What is	05/14/2019	11:09:06
@Group: Artur: You mentioned dust forecasts. Do you have plans on predicting soiling	05/14/2019	11:12:09
@Driesse: How do low light eff. measurements and the PVSyst model compare?	05/14/2019	11:14:56
@Driesse: Don't test-lab generated PVsyst PAN files already optimize the efficiency curves to match the results of the matrix measurements?	05/14/2019	11:15:29
@Driesse: When you optimize models, do you just optimize to Pmp or do Voc and Isc count?	05/14/2019	11:17:15
@Driesee: Are the module matrix data from individual modules? How do we know how much variability there may be between modules with the same part number?	05/14/2019	11:17:39
@Driesse: Are you using pvlib python or matlab to fit the models (like the CdTe fit you	05/14/2019	11:18:24
@Driesse: How do we determine if the PVsyst defaults are good enough? We need outdoor	05/14/2019	11:20:07
@Walters: Was the soiling uniform over the module? Was there cell mismatch?	05/14/2019	11:25:39

@Walters: Were there any considerations to non-uniformity of field soiling while applying	05/14/2019	11:27:30
@Walters: Did you compare the cracks from the dynamic load tester with the types of cracks	05/14/2019	11:34:19
@Walters: Did you consider any backsheet or endorsement degradation?	05/14/2019	11:36:10
@Walters, how is the placement of the cuts affecting the hotspot creation in the module and	05/14/2019	11:37:07
@Walters: What about going after root causes like series and shunt resistance issues?	05/14/2019	11:37:12
@Walters, how is the placement of the cuts affecting the hotspot creation in the module and	05/14/2019	11:37:55
@Bourne Is it safe to assume the data from the 90 sites are using Sunpower modules. How would these results change for other manufacturers?	05/14/2019	11:38:16
@Walters, how is the placement of the cuts affecting the hotspot creation in the module and	05/14/2019	11:38:17
@Gostein Is it possible (or even useful) to add anti-reflective or anti-soiling coatings to the	05/14/2019	11:38:20
@Bourne: can you derive Uc and Uv from NMOT data?	05/14/2019	11:38:51
@Kees @Keelin Is there a standard for conducting ground albedo measurements?	05/14/2019	11:39:11
Ben Bourne: Isn't the derivation of PVsyst thermal parameters heavily dependent on data filtration criteria like low light filter? What criteria did you apply?	05/14/2019	11:39:18
@Bourne did you evaluate your methods at wind speeds >10m/s.	05/14/2019	11:39:37
@Driesse Is the goal to have 61853-1 results for every power bin from a series of modules? Manufacturers we've spoken to are reluctant to do that many tests	05/14/2019	11:40:26
@Gostein What amount of rain in your experience cleans the panel completely? Does light rain have the same effect as heavy or high rain amounts?	05/14/2019	11:40:49
Panel: PVSYST sometimes seems to underestimate low light and wintertime performance (hourly). Any theories about why?	05/14/2019	11:41:05
@Patrick, is there a rule of thumb or experimentally derived formula to adjust satellite-based albedo for local onsite conditions?	05/14/2019	11:41:06
@Bourne Did you tests the thermal and wind speed coefficients for bifacial models?	05/14/2019	11:41:12
@Bourne Any thoughts on how Uv and Uc would change when considering a smaller time interval for the data (1 minute data versus 1 hour)?	05/14/2019	11:41:15
@Bourne Were you surprised to see that there was no difference on thermal coefficients for open racks and flat roof systems?	05/14/2019	11:41:23
@group: Are PVsyst PAN and IAM defaults good enough now? In the sense that you can't distinguish Optimized from Default in an outdoor model validation study?	05/14/2019	11:41:25
@Keelin Is there guidance for estimating seasonal albedo values for sites with minimal or no ground condition changes when a baseline albedo value is obtained?	05/14/2019	11:41:49
@Bourne What methods do you suggest for modulating Uv for arrays located on the interior	05/14/2019	11:41:57
@Bourne Did your analysis account for expected differences between the BOM sensor and	05/14/2019	11:42:30
@artur does Prospect allow for the input of ground data to tune satellite data bias?	05/14/2019	11:43:40

@Keelin What is the best resource for albedo that is currently available?	05/14/2019	11:44:05
@artur does Propsect calculate long term inter annual variability and other relevant	05/14/2019	11:44:55
@Nick, have you encountered differences in IAM test results for regular modules versus half-cut cell modules for the same glass type?	05/14/2019	11:45:15
@Group: what are the tradeoffs of measuring BOM temp directly vs using ambient temp and	05/14/2019	11:45:50
@roundtable How do we bring individual models like IAM, IEC Matrix, Dust forecasts etc., discussed here into a useful open source code like PVlib-Python?	05/14/2019	11:46:42
@Gostein - do small soiling sensor measurements translate directly to PV energy losses in simple linear manner? Does MARS do this translation?	05/14/2019	11:47:52
@artur what makes Solaris prospecting from PVGis	05/14/2019	11:48:59
@ Group Bourne: Do you make a difference between fixed and single axis trackers Uc and Uv	05/14/2019	11:49:30
@Anton What was the modeling technique that enabled fits from the meausrd data?	05/14/2019	11:53:26
@Keelin How does climate change effect TMY data? Is historical TMY still really TMY for	05/14/2019	11:54:25
@Freeman: Please provide more info on the SAM developers conference. Date, Topics?	05/14/2019	13:09:37
@Freeman: New bifacial update; does it support input of reverse POA irradiance or albedo	05/14/2019	13:10:10
@Freeman: Will SAM have self heating from off-MPP operation at cell or module level?	05/14/2019	13:11:18
@Freeman: How does Bifacial gain in SAM compare to the Bifacial gain in PVSyst?	05/14/2019	13:11:36
@Freeman: Will SAM be able to model backtracked Single Axis Trackers on a East-West (or W-	05/14/2019	13:14:39
@Freeman: Will SAM have battery profiles for simulating common battery varieties, e.g.	05/14/2019	13:16:09
@Freeman: There's a poster that shows linear wire loss in SAM (vs. quadratic in PVsyst).	05/14/2019	13:17:53
@Freeman: How does SAM treat differences between different types of irradiance sensors?	05/14/2019	13:20:04
@Stark - Are there any plans to generate PV module models from 61853 matrix data?	05/14/2019	13:25:38
@Stark: How is variable tracker position input? Just for a 24 hour period or 8760? Or finer	05/14/2019	13:27:26
@Stark: Is first solar planning on selling c-Si panels?	05/14/2019	13:30:06
@Stark: Are there recommendations for First Solar shading settings for trackers?	05/14/2019	13:30:20
@Stark: 100% power loss suggests that you do not consider diffuse irradiance. Do you?	05/14/2019	13:32:43
@Stark Any plans to implement solar cells' reverse breakdown characteristics and more realistic bypass diode behavior? BPDs can "partially" turn on as a result.	05/14/2019	13:33:49
@Stark: Does the model consider interactions among shade, bypass diodes, and inverter	05/14/2019	13:35:42
@Stark: Are the losses calculated on annual energy basis?	05/14/2019	13:36:58
@Stark: How to access python api?	05/14/2019	13:38:44
@Stark: Does this model consider impact of non-uniform shade at the string level?	05/14/2019	13:39:29
@Prilliman any potential to use this research to investigate snow shedding differences in	05/14/2019	13:48:07
@Prilliman: How much effect would this transient behavior affect the yearly power	05/14/2019	13:55:15
@Prilliman: Have you tried using the impulse response of your system as your window	05/14/2019	13:56:08

@Chaudhari: If a string combines multiple orientations, can bypass diodes be triggered? Can this be modeled in PVMismatch?	05/14/2019	14:06:04
@Chaudhari: Are the efficiency diagrams for dc dc optimizers based on test results from	05/14/2019	14:08:01
@Chaudhari:, Can PVMismatch model rearside mismatch on bifacial systems? Could you address if DC optimizer can help reduce the spectral mismatch?	05/14/2019	14:08:53
@Chaudhari : How do you simulate the shade of the obstacle?	05/14/2019	14:09:27
@Chaudhari: If you have a DC optimizer, and a string inverter, can you have clipping?	05/14/2019	14:10:35
@Chaudhari: Optimizers typically have a minimum and maximum number per string. How would you expect minimum string length to affect this model?	05/14/2019	14:10:46
@Chaudhari: Did you consider MPPT selecting an incorrect optimum?	05/14/2019	14:11:43
@Chaudhari Are practical limitations like input current range and one type of DC optimizer only boosting current but decreasing current implemented?	05/14/2019	14:14:05
@Brown: Why is there so little data from New Mexico, Arizona, Florida and Colorado?	05/14/2019	15:05:36
@Brown: Do you used the openPV dataset? If No , why Not?	05/14/2019	15:08:09
@Brown: Does your method have the resolution to determine the change in value due to any individual plant coming online?	05/14/2019	15:15:23
@Brown: Do the models that calculate the total cost of solar (including public health, global warming, etc) take into account carbon output of PV manufacturing?	05/14/2019	15:15:57
@Brown: What is the model that explains the cost per ton of carbon? The cost that keeps us in safe CO2 levels, $100/tonmakes all markets profitable two years ago? (!!!)	05/14/2019	15:19:44
@Brown: What if rate profile changes for a non south azimuth?	05/14/2019	15:20:31
@Jones. Have you studied degradation from the increased mismatch as modules age?	05/14/2019	15:30:59
@Jones VT stressor-based slopes are different from the other three sites. Any ideas why that	05/14/2019	15:32:56
@Jones: Have you investigated module degradation in colder climates, in PJM or Canada?	05/14/2019	15:34:30
@Jones: Do you have any plans or proposals to continue this data collection and develop	05/14/2019	15:35:20
@Jones why do you think the residuals for time and stressor degradation models increased	05/14/2019	15:35:25
@Jones: Does module tech play a role?	05/14/2019	15:38:56
@Jones: What about cumulative UV dose?	05/14/2019	15:39:26
@Fregosi. How do you separate degradation of PV modules vs inverters or other?	05/14/2019	15:53:08
@Fregosi. Why do you use nameplate capacity and not flash tests data of the modules provided by the manufacturers especially for the first year degradation?	05/14/2019	15:54:38
@Fregosi: How do you account for soiling loss confounding the degradation analysis?	05/14/2019	15:55:16
@Fregosi: In the older sites, did you look at the original module production guarantee as a	05/14/2019	15:56:46
@Fregosi: What was the thought process involved in choosing the lower 200 POA limit?	05/14/2019	15:57:56

@Fregosi: How should we use rdtools if the results depend on the filtration criteria inputs? Do we need a fundamentally different approach like degradation=f(stressor)?	05/14/2019	15:58:40
@MacAlpine: The previous talk from EPRI said that system degradation rates are expected to be higher than module degradation rate. Do you think this might cancel out the effect you	05/14/2019	16:13:08
@MacAlpine: How do you reconcile the degradation rates presented here vs. the previous	05/14/2019	16:15:59
@MacAlpine: Can you elaborate again on the reasons for non linear degradation?	05/14/2019	16:16:51
@MacAlpine: Does inverter sizing optimally account for module degradation?	05/14/2019	16:17:27
@MacAlpine: Which method do you apply to calculate the non-linear degradation?	05/14/2019	16:18:11
@MacAlpine: Are there any studies showing that your non-linear degradation example is a	05/14/2019	16:18:41
@MacAlpine. Why the degradation stays at 0% for several years even with high DC/AC ratio? What about degradation of module when the inverter is not clipping?	05/14/2019	16:19:10
@Deceglie: Could the “positive degradation rates” be due to underestimated early	05/14/2019	16:31:48
@Deceglie: Why are the estimated degradation rates so different compared to EPRI's presentation when only US systems where reported and same methodology was applied?	05/14/2019	16:33:34
@Deceglie. Have you studied if the daily soiling rate changes seasonally? For example, higher daily soiling during active agriculture months, etc.	05/14/2019	16:37:28
@Deceglie: Can you combine the soiling and degradation analyses, so that you can remove the effect of soiling from degradation analysis?	05/14/2019	16:37:50
@Deceglie: Can you elaborate on the physics/equipment reasons why residential degradation rates are higher than non-residential degradation rates?	05/14/2019	16:39:31
@Deceglie: What do we do about the fact that rdtools is highly sensitive to filtration criteria? Like low light filter, as shown in a previous talk	05/14/2019	16:41:30
@Deceglie: Do you have evidence that rooftops run hotter? Degrade faster?	05/14/2019	16:41:31
@All: What is the minimum number of years of data to establish a good degradation rate?	05/14/2019	16:43:27
@Sara MacAlpine.Why the degradation stays at0% for several years even with high DC/AC ratio? What about degradation of module when the inverter is not clipping?	05/14/2019	16:43:33
@Deceglie:. Have you studied if the daily soiling rate changes seasonally? For example higher soiling rates during active agricultural months?	05/14/2019	16:43:43
What do we do about the fact that degradation rate appears to be a function of filtration criteria? Do we need a fundamentally new approach like Rd=f(stressor)?	05/14/2019	16:44:10
Are the PV Fleet data set and the EPRI utility scale data set overlapping? Room for	05/14/2019	16:44:13
Is there a good case for the “first year loss” variable based on your research?	05/14/2019	16:44:33
@All: do you expect that IEs will revise degradation assumptions based on the operational	05/14/2019	16:45:04
@All: Has anyone worked on differentiating between module degradation vs balance of	05/14/2019	16:45:42
All: can it be demonstrated (mathematically) that the year on year method is not affected by	05/14/2019	16:46:06

@patrick: is the future E-W fixed tilt (not tracking)?	05/14/2019	16:46:24
@NREL folks: Do we know why PSM v3 DNI is biased high (4-5%) relative to ground stations in	05/14/2019	16:47:22
@deceglie What is a plausible use of the soiling analysis in energy estimation calculations by IEs? Can the monthly soiling loss estimates be improved upon?	05/14/2019	16:47:26
Has anyone looked at hail impact effect on degradation?	05/14/2019	16:48:04
@all is there any good method for estimating first year degradation and initial mismatch	05/14/2019	16:48:04
@Brown: How would storage systems influence the optimal azimuth suggestions that you	05/14/2019	16:48:15
@McAlpine: how would extended lifetimes past 25 years (as seen in some financial models) influence the COE for long-term modeling assumptions for degradation?	05/14/2019	16:51:30
Any reason to believe degradation affects clear sky and cloudy sky conditions differently? Asking because a common approach is to filter for clear days	05/14/2019	16:51:58
@Deceglie: what is the typical soiling loss uncertainty you calculated (e.g., 5% +_ what %)?	05/14/2019	16:55:19
@NREL Any ideas on sharing soiling info to allow corroboration for more robust analysis	05/14/2019	16:56:44
PSM GHI has been higher than other sources for many sites we have checked. And we see sites under-performing compared to other sources. Seems PSM is high.	05/14/2019	16:56:50
@All: Is it possible to say whether degradation for systems made today is better or worse	05/14/2019	16:58:27
PV Performance (Wednesday AM)	05/15/2019	08:04:55
@Johnson: How do you evaluate bifacial Isc for electrical protection sizing?	05/15/2019	08:07:35
@Johnson: 35% GCR still seems very high. Have you compared the impact of 20%~25% GCR? Does it yield higher bifacial benefit than the 3-9%?	05/15/2019	08:11:09
@Johnson: How important is ground shade patterns underneath the albedometer	05/15/2019	08:11:42
@Johnson: What are appropriate, general assumptions for bifacial modeling in PVsyst for mismatch, structure shading, and module transmission factor?	05/15/2019	08:13:43
@Johnson: Are there any special considerations for temperature assumptions for glass/glass bifacial modules? Reports have shown similar or lower temperatures than monofacial	05/15/2019	08:15:30
@Johnson: Is there any value to measuring preconstruction albedo at a site if the ground cover material is not identical to the post construction material?	05/15/2019	08:19:19
@Johnson Why is the P99 for bificial lower than monofacial?	05/15/2019	08:20:24
@Johnson How can we take into account near and far shading due to trees as it impacts albedo, such as buildings, or nearby hills/mountains?	05/15/2019	08:21:03
@Johnson: What is the magnitude of typical backside soiling that that you are assuming?	05/15/2019	08:21:06
@Martin: Does the proximity of the different reflector tests to each other cause interacting effects, that is, do adjacent reflectors influence the measurements of other bifacial	05/15/2019	08:30:57
@Martin: Have you considered using a ray tracing method to help optimize the design of the	05/15/2019	08:31:44

@Martin:The modules under test in the photo of your test setup are very close together. How do you ensure adjacent reflectors are not influencing the measurements?	05/15/2019	08:32:18
@Martin: did you observe bifacial module to be operating at lower temperatures than	05/15/2019	08:33:45
@Martin: could you address the Operational costs of maintaining these reflector?	05/15/2019	08:35:40
@Martin: Would height still play a factor if bifacial modules were in an array?	05/15/2019	08:36:30
@Mikofski: Is SolarFarmer bankable?	05/15/2019	08:43:15
@Mikofski: can SolarFarmer simulate bifacial single axis trackers or is it currently limited to	05/15/2019	08:46:34
@Mikofski: How is this approach different than the Marion model? Why didn’t you choose to	05/15/2019	08:47:24
@Mikofski: Can you talk about DNVs sun spot program for estimating albedo?	05/15/2019	08:50:03
@Martin Are all bifacial modeling programs assuming a smooth surface? How does the surface (short grass, rough grass, rocks, dirt, etc) affect diffuse light?	05/15/2019	08:51:24
@Mikofski: does SolarFarmer account for incidence angle losses on backside POA?	05/15/2019	08:51:39
@Mikofski: Are all bifacial modeling programs assuming a smooth surface? How does the surface (short grass, rough grass, rocks, dirt, etc) affect diffuse light?	05/15/2019	08:51:58
@Mikofski: If the torque blocks the middle of the back of the panel, doesn't that reduce the entire contribution of the backside, as the shade crosses all cell-strings and bypass diodes	05/15/2019	08:52:50
@Mikofski: How can we get access to SolarFarmer to check it out?	05/15/2019	08:53:46
@Mikofski: How do the modeled results compare to other models (PVsyst, Marion...)?	05/15/2019	08:54:26
@Mikofski Do you believe the difference in ideal tilt from mono to bifacial is directly tied to	05/15/2019	08:54:48
@Mikofski: If there's no difference than the Marion View Factor model, the height of modules do impact bifacial gain. Do you see the same trend in SolarFarmer?	05/15/2019	08:57:07
@Ayala: Are there typical values for torque tube shading factors that can be used in SAM and	05/15/2019	09:03:54
@Ayala: Would we have to specify the detailed racking dimensions to run this model	05/15/2019	09:06:27
@Ayala: How long does it take to run a TMY?	05/15/2019	09:07:10
@Ayala: This is awesome! How does system size affect number of rays required and runtime on decent workstation, not Eagle HPC?	05/15/2019	09:08:26
@Ayala: Can this implement a varying terrain/slope and its impact on bifacial irradiance loss	05/15/2019	09:10:06
@Ayala: Is there an SDK available?	05/15/2019	09:10:22
@Ayala Does the new GUI allow for introducing obstructions such as reflective surfaces or is this only possible in the base code?	05/15/2019	09:11:03
@Ayala: Does this run on Windows or Linux?	05/15/2019	09:13:58
@Ayala, are there libraries for different tracking designs? Any shading loss on the panel	05/15/2019	09:14:22
@Ayala Is this suitable to model a full plant? Can this model surrounding objects such as	05/15/2019	09:14:25
@ayala where do we get this software?	05/15/2019	09:15:21
@Ayala: Is HPC available to non-NREL users?	05/15/2019	09:15:51

@Ayala: do you have examples of the post processing in pvmismatch?	05/15/2019	09:16:23
@Ayala: Did the full year simulation that took 4 days utilize multiprocessing?	05/15/2019	09:16:44
@Ayala Did you model Nextracker, Soltec, or Array tech tracker design for rear shading factor and mismatch inputs values for PVSYST?	05/15/2019	09:17:08
@McIntosh: Forward ray tracing or back tracing? How would it differ?	05/15/2019	09:27:04
@McIntosh: Have you done comparisons to show the benefit of the lack of assumptions compared to simpler software/models?	05/15/2019	09:27:56
@McIntosh: Is the mismatch values presented the total (front + rear) mismatch or only the	05/15/2019	09:32:54
@McIntosh: Can you say how much ignoring spectrum would matter in your simulation	05/15/2019	09:33:32
@McIntosh What was the torque tube to module backside distance for the 1P case?	05/15/2019	09:35:06
@McIntosh: Is PVlighthouse tracker model able to model several rows of modules and inter-	05/15/2019	09:35:25
@McIntosh What are some mismatch values for an entire system or string?	05/15/2019	09:36:58
@McIntosh: have you compared the rear mismatch impacts between 144 half-cell module vs	05/15/2019	09:37:00
@McIntosh: how do the mismatch losses you discuss translate to backside mismatch in tools	05/15/2019	09:37:00
@McIntosh: How does the spice model account for front and back ?	05/15/2019	09:37:59
@McIntosh: Could we separate the front from rear?	05/15/2019	09:38:03
@McIntosh: Is SPICE model available (Github,...)?	05/15/2019	09:39:58
@McIntosh: How long does a full year simulation take? Can tracking modeling be done?	05/15/2019	09:40:06
@McIntosh: For a smaller system, do you think edge module mismatch would dominate?	05/15/2019	09:41:13
@Stein: How would a bifacial latitude tilt compare (rather than the monofacial latitude tilt	05/15/2019	10:36:34
@Stein: Will northern lights in high latitude regions have impact on system yield?	05/15/2019	10:37:36
@Stein: What row spacing (or ground coverage ratio) would you assume for a large vertical	05/15/2019	10:38:39
@Stein: this summer, will you measure module temperature, if so how?	05/15/2019	10:39:02
@Stein: for E-W vertical configurations, is there a recommended practice for facing E vs facing	05/15/2019	10:39:19
@Stein Wind loading can be very detrimental in cold locations. Do you consider vertical mounting to be practical for high wind?	05/15/2019	10:39:33
@Stein how do you handle periods where snow is covering front of module and back side irradiance is elevated due to high albedo?	05/15/2019	10:39:42
@Richards: What's the cut off frequency for the analog filter?	05/15/2019	10:46:39
@Richards: how is the current measured? Shunt or hall-effect sensor?	05/15/2019	10:49:18
@Richards: do you sell these devices?	05/15/2019	10:51:28
@Richards will you measure module temp on your test site, if so how?	05/15/2019	10:51:58
@Richards. Is your monitoring device commercially available?	05/15/2019	10:52:07
@Richards The second filter loses synchronization between current and voltage, so IV data	05/15/2019	10:52:19
@Richards: Can the hardware/software design be open-sourced?	05/15/2019	10:52:39

@Richards: What questions are you hoping to answer with the bifacial rest yard?	05/15/2019	10:52:57
@Richards: What questions are you hoping to answer with the bifacial test yard?	05/15/2019	10:53:09
@Richards: Are you losing any resolution in your mismatch calculation by just using Imp/Vmp	05/15/2019	10:53:14
@Richards, Do you think that the edge effect can be eliminated with high AC/DC ratio which leads to clipping around noon?	05/15/2019	10:53:15
@Richards: Could you describe the ADC resolution and what minimum current and voltage	05/15/2019	10:55:12
@Richards: how is the measurement data managed? Is there a user interface (how does it	05/15/2019	10:55:32
@Sutterlueti: how to you fit the baseline system coefficients? Can you fit from PVSyst model	05/15/2019	11:06:03
@Sutterlueti: How do you deal with inverter clipping on high AC/DC ratio systems?	05/15/2019	11:08:36
@Sutterlueti: How do you maintain accuracy for low irradiance performance evaluation	05/15/2019	11:09:40
@sutterlüti: do you have performance issues with solar position calculation in pvlib?	05/15/2019	11:16:37
@Theristis: Did you experiment with using multiple hidden layers in the neural network?	05/15/2019	11:29:58
@Theristis: How does the ML model account for seasonality with just one year of training	05/15/2019	11:31:44
@Theristis: Have you considered training on a structured sampling of data rather than	05/15/2019	11:33:28
@Theristis: Are there things to gain by looking at the current and voltage separately, instead	05/15/2019	11:33:42
@theristis: what is the setup effort required for the two techniques and how scalable each of	05/15/2019	11:35:42
@theristis: when you apply no filter to ML model, did you include night data in training and	05/15/2019	11:36:44
@Theristis: How often do you anticipate needing to retrain model?	05/15/2019	11:37:41
@Theristis Did you use any other filters other than Irradiance?	05/15/2019	11:38:23
@Lassahn: Did you already verify your prediction model with real performance data?How	05/15/2019	11:53:44
@Lassahn: What density of meter readings do you need to improve forecasts across an area?	05/15/2019	11:55:04
@Ayala: Is it possible to use BRDF data in bifacial radiance? If no, do you have plans to	05/15/2019	11:56:50
@Mikofski: On the difference between ideal tilt for mono and bifacial, do you believe there is a direct relationship between difference in tilt and latitude?	05/15/2019	11:56:53
@Lassahn: Have you paired your solar forecasting methodology with battery storage?	05/15/2019	11:59:01
@Sutterlueti: how can you combine simulation result and your MPM performance model?	05/15/2019	11:59:41
@Ayala: Did you model Nextracker, Soltec, or Array Tech tracker design for rear shading factor and mismatch inputs values for PVSYST?	05/15/2019	12:00:09
@Theristis: In PV performance analysis, what filters do you use apart from setting a limit on	05/15/2019	12:02:45
@Richards How much does your module device cost to build?	05/15/2019	12:05:22
@McIntosh Any meaningful difference between circular torque tubes vs octagonal ones?	05/15/2019	12:06:41
@McIntosh Do you expect to have results on mismatch for string or system level	05/15/2019	12:08:39
@marios @juergen Are there insights from your predictive algorithms that could help with modelling degradation? E.g. finding the stressors mentioned yesterday	05/15/2019	12:09:28

@raytracing_modelers Have you tried integration of GPUs in your model computation? If so can you describe your method?	05/15/2019	12:09:57
@Mikofski Is the ground assumed to be a smooth surface in standard bifacial modeling tools? How does surface texture affect diffuse?	05/15/2019	12:10:33
@All: Most of the PV performance analysis presented today and yesterday consider the high irradiance and neglect low irradiance data. Reason for this trend?	05/15/2019	12:10:59
@All: Is anyone here obtaining inverter sensor data from manufacturers (thermocouples on mosfets etc) to use for predictive maintenance? Challenges/opportunities?	05/15/2019	12:14:11
@All: Any chance/scenarios backside mismatch activates bypass diodes?	05/15/2019	12:22:07
Grid Integration (Wednesday PM)		
@Broderick: In what areas have you seen the largest improvements in resiliency over the	05/15/2019	13:45:35
@Broderick: Are PV systems properly engineered for the events that can cause resiliency	05/15/2019	13:51:45
@Broderick: can we do without storage?	05/15/2019	13:53:07
@lave price of solar looks to be very competitive compared to utility rates. How rapidly is solar penetrating the utility service territory	05/15/2019	14:05:57
Are people under grounding grid distribution lines for wind resistance?	05/15/2019	14:15:22
@Lane Are there plans for some sort of smart grid solution?	05/15/2019	14:16:08
@lave Are protection constraints included in the hosting capacity analysis? What about transmission constraints or backfeeding onto the transmission system?	05/15/2019	14:16:59
@lave Did you have a chance to visit? How about the rum?	05/15/2019	14:18:06
@lave Hawaii hit ramp rate limits before they had significant distribution issues. is that	05/15/2019	14:18:54
@sandoval What is the largest system (number of buses) that you have run for combined T&D	05/15/2019	14:27:30
@sandoval: You mentioned NRECA as a partner, is this software integrated into OMF? What power flow solvers does it work with (Synergi, GridLAB-D, OpenDSS, CYME, etc.)?	05/15/2019	14:29:38
@sandoval: For the HPC and AWS, are you doing parallelization of code onto multiple servers, or running separate cloud processes?	05/15/2019	14:31:50
@Sandoval: Is PV curtailment included in your DER optimization or hosting capacity analysis?	05/15/2019	14:34:12
@sandovalFor Puerto Rico, did you analyze the whole system or a subset of feeders?	05/15/2019	14:40:00
@sandoval:hosting capacity for islands / microgrids is much different than grid-connected systems. how are you considering stability / ramping constraints?	05/15/2019	14:41:07
@sandoval:Did you assume grid-forming inverters for all PV and/or energy storage for the	05/15/2019	14:41:48
@blair: energy/water nexus for reopt? What are you addressing with this latest functionality.	05/15/2019	14:56:17
@blair: critical load identification tool?	05/15/2019	14:57:58
@blair: does your analysis allow PV energy excess to be curtailed or dumped?	05/15/2019	15:00:32

@blair: For residential systems, REopt and SAM answer many common questions. Could the two be merged to get all the answers in the same tool?	05/15/2019	15:05:26
@reno do you think communication based protection can realistically work with ubiquitous inverters or across very long feeders?	05/15/2019	15:59:25
@Reno - Do you have any concerns about interactions between different brands of inverters in response to protection settings, especially on the fly changes?	05/15/2019	16:00:50
@reno: How do you decide on changes to protection settings - are there defaults that will work give a certain grid state, or will this be specific to each system?	05/15/2019	16:02:04
@salmani. Your opinion on blanket rules such as no back-flow on a substation transformer?	05/15/2019	16:19:17
@salmani:Do you think that direct transfer trip is required? If so, when?	05/15/2019	16:22:00
@salmanai: The transition in power factor on PV systems changed response times for protection. Would you presume the same issue could arise with faulty cap banks?	05/15/2019	16:23:15
@ropp: What about FLISR systems designed without consideration of PV? What problems will this create for legacy systems?	05/15/2019	16:36:49
@ropp: What is the cost comparison between a synchronous condenser vs. larger inverters for contributing more fault current?	05/15/2019	16:38:12
@ropp: Did you say voltage gradient goes up near the fault point? Is that right?	05/15/2019	16:38:58
@ropp:What type of signatures would relays be looking for from inverters?	05/15/2019	16:41:02
@ropp:How about changing role of grounding transform in protection with pv? Is this another protection challenge beyond comm.	05/15/2019	16:43:40
@ropp: Since a majority of inverters in distribution network typically have could based communication why can't this be used as low cost distributed communication.	05/15/2019	16:43:49
@hambrick: In your opinion, why not use trustworthy inverter on board for island	05/15/2019	17:00:06
@Since OpenFMB is using a translator on the recloser, is OpenFMB fast enough for communication-assisted protection, or only for adaptive protection?	05/15/2019	17:05:47
@hambrrick: In the test case for Distributed FLISR, what is the expected improvement in latency between operations as opposed to a centralized FLISR? What about the costs?	05/15/2019	17:07:33
@hambrick:How would a utility update the system model on the relay?	05/15/2019	17:09:27
Grid Integration (Thursday)		
@Wittmer: How do you model excess energy production from PV when battery full: mppt	05/16/2019	08:17:39
@Wittmer: Is the Peak Shaving mode capable of doing both AC-coupled and DC-coupled	05/16/2019	08:17:48
@Wittmer: Is batch mode with hourly data output available also for non-storage simulations ("traditional" PV systems without batteries)?	05/16/2019	08:21:53
@Wittmer: In Peak Shaving mode, can you specify discharge times that vary by month?	05/16/2019	08:23:18

@Wittmer: in the financial analysis for Peak Shaving mode, can you input different FIT rates that are time, day, month dependent?	05/16/2019	08:23:39
@Wittmer: Is the battery ac or dc coupled, or is there option for both? If ac coupled is possible, is it low-voltage coupled or medium-voltage coupled?	05/16/2019	08:24:23
@Wittmer: Does PVsyst calculate ohmic losses differently to account for the wiring runs that	05/16/2019	08:24:49
@Wittmer: will the DC:DC converter manufacturers provide the converter parameter profiles to PVsyst just like inverter, modules, etc?	05/16/2019	08:25:57
@Wittmer: Will the financial parameters include hourly variations in FIT so that peak shaving can prefer battery charging over pushing to grid?	05/16/2019	08:28:55
@blair How did you set default values for different battery chemistrys?	05/16/2019	08:51:46
@Blair: Is ReOPT a separate tool or part of SAM?	05/16/2019	08:58:33
@Blair: does SAM take in account different type of DC:DC converters? Will SAM construct DC:DC converter database similar to inverter database?	05/16/2019	09:04:12
@Blair: How do you take into consideration grid constraints?	05/16/2019	09:05:24
@headley are any of the locational values at the distribution level?	05/16/2019	09:09:49
@Headley: In practice, how far ahead of time are the iCap (alternative 3) 1-hour windows known? Or are they assessed after the fact?	05/16/2019	09:18:46
@headley for alt 3, as more battery systems come into the market, how does the difficulty	05/16/2019	09:21:06
@Headley: Is there a way to include risk of incentive changes into the model?	05/16/2019	09:24:24
@nagarajan: what are examples of good rate structures you have seen for residential	05/16/2019	09:40:23
@nagarajan can you elaborate on flow batteries and utility scale? Why are they the best	05/16/2019	09:44:25
@nagarajan: With the advent of residential energy storage (in particular Lithium ion) do you see have any concerns involving fire risk due to wear and tear or improper use?	05/16/2019	09:44:36
@nagarajan: What are main needs in battery characterization?	05/16/2019	09:45:19
@nagarajan:Are you looking at integration with technology like that of Ice Energy?	05/16/2019	09:48:24
@Key (recommendation for next year): Presentations on impacts to estimated energy production from PV inverters providing reactive support for voltage regulation	05/16/2019	09:48:27
@Key (recommendation for next year): Presentations on examples of requirements and case studies of PV inverters providing voltage regulation support.	05/16/2019	09:49:08
@johnson: intrusion detection: difficulty for transmission vs distribution? (Most of transmission operation/ power system protection is already comm based?	05/16/2019	10:36:00
@Johnson: What is a worst case scenario for attacks on DERs? You showed voltage increased to 1.1 p.u. at one particular node...this doesn't seem all that scary.	05/16/2019	10:41:25
@Johnson: What types of networks were studied, fiber,copper and what protocols TCP udp? Did a choice better for securing the network for control of der?	05/16/2019	10:42:59

@johnson: what is a " bump in the wire" device?	05/16/2019	10:45:54
@Johnson: Have ISPs been considered to help secure DER or the bulk system in general?	05/16/2019	10:47:24
@jjohns Do you have any insight into resources available to hone in on preferred Linux distributions from a security perspective?	05/16/2019	10:51:22
@shamina what is the difference between minimega and other virtualization / container environments (virtualbox, docker, etc.)?	05/16/2019	11:08:33
@shamina: what is the greatest research need in intrusion detection?	05/16/2019	11:08:58
@Shamina: The Raspberry PI set up for cyber detection looks berry good. How can other parts of the industry interested in this technology/study get a slice of the pie?	05/16/2019	11:19:09
@Shamina: What kind of delays does the IDS add?	05/16/2019	11:19:37
@Shamina: What is your plan for generating a wide range of "good" data and "bad" data.	05/16/2019	11:20:07
@Tansy: IDS and keys are used by military/financial systems why not copy these systems?	05/16/2019	11:26:31
@Tansy: Will the PKI blacklist certain manufactures from certain countries for joining?	05/16/2019	11:33:29
@Tansy: Do MICAs issue unique or identical keys to the DERs? Do the certificates become unique only from the 2030.5 DER ID?	05/16/2019	11:34:03
@Tansy: What are the main differences between SunSpec certification and FIPS certification	05/16/2019	11:37:26
@tansy does Sunspec intend to expand PKI to other devices?	05/16/2019	11:38:57
@Tansy: How could blockchain be integrated into the PKI?	05/16/2019	11:39:43
@Tansy: Any overlap w/ Orange Button and PKI?	05/16/2019	11:40:20
@Tansy: Does the SunSpec protocol work with any protection devices?	05/16/2019	11:40:29
@Tansy: Who is the root CA for DNP SA?	05/16/2019	11:45:14
@Jones: Don't these IDS machines expand the attack surface? How are you addressing that	05/16/2019	11:58:25
@Jones: Besides from cost, why not use a FPGA or NI for the IDS	05/16/2019	12:00:50
@Jones For the single board computer performance, what other types of metrics are you	05/16/2019	12:01:41
@jones How did you get a second RJ45 port on RPI for 'bump in middle'	05/16/2019	12:04:41
@Jones Can you describe how your RPi emulates an inverter? What are the software tools?	05/16/2019	12:04:47
@Jones: how could ML be trained this in the real world? Specifically, how could you filter intrusion during the training period?	05/16/2019	12:05:14
@broderick:Test	05/16/2019	13:05:26
@dhople: Why are there so few grid forming inverters on the market?	05/16/2019	13:29:17
@dhople: how accurate does the synchronization need to be practically?	05/16/2019	13:34:44
@dhople: Subcycle response is impressive here in lab conditions. Have you tried the surge	05/16/2019	13:41:57
@dhople: Does your 3-phase implementation guarantee correct rotation?	05/16/2019	13:43:39
@dhople: How fast does your control loop need to function to ensure stability?	05/16/2019	13:44:26
@dhople:Why are all your Droop curve are reversed ?	05/16/2019	13:45:17

@dhople: Why are grid forming inverters more expensive if it is only a controls change?	05/16/2019	13:46:35
@dhople: What if their is a mismatch in the filters? will the condition for synchronization be	05/16/2019	13:46:46
@dhople:Is a PLL still used to remain synchronized with the grid after a transient or	05/16/2019	13:48:06
@flicker: best control scheme work for both grid connected and standalone mode? Any trade	05/16/2019	14:10:27
@flicker Are there proposed requirements for grid forming inverters in Puerto Rico and/or	05/16/2019	14:15:26
@flickerWhat about a system that needs to shift between grid-tied mode to islanded mode?	05/16/2019	14:18:48
@lin: what do you see as the key research need for grid forming inverters? Next steps?	05/16/2019	14:41:05
@lin: During the black start, one of the GFM inverters was overloaded. How long would a GFM inverter stay online when it is overloaded to black start the grid?	05/16/2019	14:41:24
@lin: How does VOC share load for different inverter sizes?	05/16/2019	14:42:34
@lin: Why your grid current of the GFL inverters are polluted with low order harmonics?	05/16/2019	14:43:28
@lin: What kind of control was used in the GFL invertes ? grid-side current feedback or	05/16/2019	14:44:22
@eddy: what are typical design objectives that the tool can handle?	05/16/2019	15:24:07
@Eddy: What does the financial model module handle?	05/16/2019	15:43:12
@wachtel: what public sources are available for the required inputs to the RENCAT model?	05/16/2019	15:55:20
@Wachtel Great logo!!	05/16/2019	15:55:23
@wachtel: minimum service level= 30... what does this mean?	05/16/2019	15:58:07
@wachtel Has Puerto Rico followed up on any of these microgrid recommendations?	05/16/2019	15:59:31
@wachtel: what was randomized for the scatter chart	05/16/2019	16:03:39
@Broderick, did you consider having Solar Home Systems (with home batteries) for remote	05/16/2019	16:30:26