STATE OF MAINE PUBLIC UTILITIES COMMISSION

DOCKET NO. 2008-255

CENTRAL MAINE POWER COMPANY
Request for Certificate of Public Convenience
and Necessity for the Maine Power Reliability Program
Consisting of the Construction of Approximately
350 miles of 345 kV and 115 kV Transmission Lines ("MPRP")

Central Maine Power

An Energy East Company

REBUTTAL TESTIMONY
Of
DANIEL PEACO
AND
RICHARD HAHN

EVALUATION OF GRIDSOLAR PROPOSAL

REDACTED

April 3, 2009

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REBUTTAL TESTIMONY
OF
DANIEL PEACO AND RICHARD HAHN
DOCKET NO. 2008-255

We are Principal Consultants in La Capra Associates and previously submitted the "Non-transmission Alternatives Assessment and Economic Evaluation of the Maine Power Reliability Program" in this docket. We have attached as part of this testimony a report we prepared at the request of Central Maine Power Company ("CMP") addressing the economic and financial aspects of a proposal by Competitive Energy Services ("CES"), an intervenor in this proceeding. The CES construct, called GridSolar, proposes solar powered generation (photovoltaic or "PV") to meet peak load in the sub-areas CMP has identified as problematic to NERC reliability standards. GridSolar proposes up to 800 MW of PV along with hundreds of MW of back-up generation as an alternative to the MPRP to address the reliability requirements associated with the CMP bulk power transmission system.

The principal findings and conclusions of the attached report are summarized below:

1. **CES's GridSolar proposal is not economically or financially viable.** Even based on its own assumptions on cost and performance, the project as proposed by CES would not produce sufficient positive cash flows to cause equity investors and lenders to provide the capital needed for construction and successful operation. Using the more realistic $8,500 per kW installed cost value, the financial performance is significantly worse.

2. **The net cost of GridSolar to Maine consumers is significantly higher than MPRP.** The Net Present Value of costs (in 2008$) to Maine electric customers for including GridSolar as an NTA is approximately $350 million to $400 million higher than the MPRP when using GridSolar's publicly filed $4,500 per kW assumption. Using the more realistic $8,500 per kW capital costs for GridSolar, the net costs to Maine electric customers of this project are $1.25 billion higher than the MPRP.

3. **The GridSolar installed costs are significantly understated.** The GridSolar proposal relies on installed cost estimates that are approximately one-half of the cost of documented and recently constructed large-scale PV installations. CES states that the GridSolar PV project with the back-up generation would cost about $4,500 per KW[1], or approximately $3.6 Billion for an 800 MW system. Publicly reported information on comparable large-scale PV installations indicates that the cost of this PV system with back-up generation would be approximately $6.8 Billion, or more than $8,500 per KW.

4. **The GridSolar installed Costs are significantly higher than alternative generation.** The capital cost of the GridSolar system, using CES's publicly available estimate of $4,500 per kW, is more than four times the cost of an equivalent amount of conventional peaking generation ($900 per kW) and more than eight times the capital cost of that conventional peaking generation when compared to the $8,500 per kW

[1] This value is reported in the non-confidential section of the proposal (see page 73 of the public GridSolar Proposal). Other sections of the attached report discuss the actual values used in the confidential materials provided in support of this proposal. In the public version of the report, GridSolar confidential material has been redacted.

cost estimate based on recent solar PV industry experience. When the market value for the PV energy and renewable energy credits are factored in, the net installed cost for the GridSolar proposal would still be four times the cost of the peaking generation.

5. **The GridSolar proposal assumes unattainable energy production levels.** CES's GridSolar proposal utilizes a 20 percent capacity factor, while industry data for Maine indicates that achievable capacity factors range from 13 to 18 percent, depending on the type of tracking system installed. CES has not determined if it will use fixed tilt, one-axis, or two-axis PV systems. CES's proposal overstates the energy production by at least 10 percent and potentially as much as 50 percent.

6. **Maine electric customers would be required to pay 100 percent of the GridSolar costs.** Contrary to CES's assumptions, there is no cost allocation mechanism for PV systems or any other generation source through the ISO-New England regional transmission tariff.

Overall, the GridSolar project is a significantly more expensive solution to Maine's reliability needs than MPRP or any of the non-transmission alternatives evaluated by CMP.

The attached report did not include an assessment of a number of technical and operational issues raised by the CES GridSolar proposal, including, but not limited to: 1) the reliability performance of the PV modules and the back-up generation, 2) the hours of operation of the back-up generation needed to maintain system reliability, 3) the need for distribution system

upgrades to accommodate 800 MW of PV, 4) the differences in the asset life of the PV systems and the transmission investments proposed in MPRP, 5) the ability to manufacture and construct PV systems to this scale by 2012, and 6) the technical and financial expertise, resources and wherewithal of CES to successfully finance and complete the GridSolar proposal. Before the GridSolar proposal is considered as a non-transmission alternative to the MPRP, each of these issues merits careful scrutiny.

The attached report confirms that the proposed solar generation systems are not economic alternatives to address the identified reliability need and that, as documented in CMP's application, the MPRP is the preferred economic and financial option for Maine to address the identified reliability issues.

La Capra Associates

EVALUATION OF THE GRIDSOLAR PROPOSAL

REVIEW OF THE ECONOMICS OF THE PROPOSAL AS AN ALTERNATIVE TO THE *MAINE POWER RELIABILITY PROJECT*

Consultant Report

PREPARED FOR

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April 3, 2009

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EXHIBITS:

CONFIDENTIAL material has been REDACTED

I. EXECUTIVE SUMMARY

In Docket No. 2008-255 before the Maine Public Utilities Commission ("MPUC"), Central Maine Power Company ("CMP") seeks approval to construct the Maine Power Reliability Program ("MPRP"), a proposed set of new transmission facilities designed to alleviate reliability concerns identified by ISO New England and CMP.

Competitive Energy Services ("CES"), an intervenor in this proceeding, has proposed an alternative solution to the reliability issues identified by CMP. CES's alternative, called GridSolar, proposes the installation of solar powered generation (photovoltaic or "PV") to address the reliability requirements associated with the CMP bulk power transmission system CES proposes up to 800 MW of PV along with hundreds of MW of back-up generation as a reliability alternative to the MPRP.

At CMP request, La Capra Associates ("La Capra") conducted an economic and financial review[1] of the proposal as presented by CES in its filing and in subsequent responses to interrogatories, comparing the economics of the GridSolar to the MPRP and the Non-Transmission Alternatives.[2] The key findings and results of La Capra's assessment are:

1. **CES's GridSolar proposal is not economically or financially viable.** Even based on its own assumptions on cost and performance, the project as proposed by CES would not produce sufficient positive cash flows to cause equity investors and lenders to provide the capital needed for construction and successful operation. Using the more realistic $8,500 per kW installed cost value, the financial performance is significantly worse.

2. **The net cost of GridSolar to Maine consumers is significantly higher than MPRP.** The Net Present Value of costs (in 2008$) to Maine electric customers for including GridSolar as an NTA is approximately $350 million to $400 million higher than the MPRP when using GridSolar's publicly filed $4,500 per kW assumption. Using the

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1 This review did not include assessment of a number of technical and operational issues, including, but not limited to, 1) the reliability performance of the PV modules and the back-up generation, 2) the hours of operation of the back-up generation needed to maintain system reliability, 3) the need for distribution system upgrades to accommodate 800 MW of PV, 4) the differences in the asset life of the PV systems and the transmission investments proposed in MPRP, 5) the ability to manufacture and construct PV systems to this scale by 2012, and 6) the technical and financial expertise, resources and wherewithal of CES to successfully finance and complete the GridSolar proposal. Each of these factors would need to be evaluated, in addition to the economic and financial evaluation, before any determination on the suitability of the GridSolar proposal as a reliability alternative to MPRP is made.

2 *Non-Transmission Alternatives Assessment and Economic Evaluation of the Maine Power Reliability Program*, June 30, 2008, La Capra Associates. This report was included in CMP's July 1, 2008 CPCN application to the Commission as Exhibit I-3.

more realistic $8,500 per kW capital costs for GridSolar, the net costs to Maine electric customers of this project are $1.25 billion higher than the MPRP.

3. **The GridSolar installed costs are significantly understated.** The GridSolar proposal relies on installed cost estimates that are approximately one-half of the cost of documented and recently constructed large-scale PV installations. CES states that the GridSolar PV project with the back-up generation would cost about $4,500 per KW[3], or approximately $3.6 Billion for an 800 MW system. Publicly reported information on comparable large-scale PV installations indicates that the cost of this PV system with back-up generation would be approximately $6.8 Billion, or more than $8,500 per KW.

4. **The GridSolar installed costs are significantly higher than alternative generation.** The capital cost of the GridSolar system, using CES's publicly available estimate of $4,500 per kW, is more than four times the cost of an equivalent amount of conventional peaking generation ($900 per kW) and more than eight times the capital cost of that conventional peaking generation when compared to the $8,500 per kW cost estimate based on recent solar PV industry experience. When the market value for the PV energy and renewable energy credits are factored in, the net installed cost for the GridSolar proposal would still be four times the cost of the peaking generation.

5. **The GridSolar proposal assumes unattainable energy production levels.** CES's GridSolar proposal utilizes a 20 percent capacity factor, while industry data for Maine indicates that achievable capacity factors range from 13 to 18 percent, depending on the type of tracking system installed. CES has not determined if it will use fixed tilt, one-axis, or two-axis PV systems. CES's proposal overstates the energy production by at least 10 percent and potentially as much as 50 percent.

6. **Maine electric customers would be required to pay 100 percent of the GridSolar costs.** Contrary to CES's assumptions, there is no cost allocation mechanism for PV systems or any other generation source through the ISO-New England regional transmission tariff.

Overall, the GridSolar project represents a significantly more expensive solution to Maine's reliability needs than MPRP or any of the non-transmission alternatives evaluated by CMP, and

[3] This value is reported in the non-confidential section of the proposal (See page 73 of the public GridSolar Proposal). Other sections of this report discuss the actual values used in the confidential materials provided in support of this proposal.

there has been no analysis conducted to confirm that the CMP system can be reliably operated with this magnitude of solar generation[4].

La Capra's assessment of the GridSolar proposal concludes that the proposed solar generation systems are not economic alternatives to address the identified reliability need and that, as documented in CMP's application, the MPRP is the preferred economic and financial option for Maine to address the identified reliability issues.

[4] To provide a reliability solution, CES has proposed a backup system of propane generators to provide firm supply during peak conditions in the event that solar production is impaired at the time they are needed. Because of the intermittency of the solar generation, operability of the power system may require significant hours of operation of these back up units at a very high fuel cost to ensure reliable supply is present at the time of a system contingency. The CES analysis does not include any discussion of this issue and does not include any fuel cost associated with operation of these back-up generation units.

II. OVERVIEW OF THE GRIDSOLAR PROPOSAL

CES proposes PV generation to meet peak load growth in the sub-areas CMP has identified as problematic with respect to NERC reliability standards. CES states that up to 800 MW of PV along with hundreds of MW[5] of back-up generation would be required to alleviate the reliability concerns in Maine as identified by CMP. The proposal calls for large arrays of PV panels each able to produce 2 MW of power to be installed at various points throughout the CMP system. Each 2 MW PV installation would occupy 25 acres of land (at locations that have not been determined) close to a CMP distribution circuit.

Solar electricity will be self scheduled in the real time energy market in the Maine load zone. To provide reliability, CES has proposed that [redacted] During the times when there is inadequate sunlight to provide enough fuel for the distributed solar generation capacity, GridSolar will remotely start up the backup generation units, which, according to CES, will most likely be a combination of distributed propane or natural gas generators and battery powered back-up systems, to meet peak loads. GridSolar estimates that sites of less than 1,000 square feet will be needed for 2 MW installations of propane engine generators distributed throughout the system, requiring 300 sites for the full 800 MW PV installation. The distributed solar generation would be interconnected to CMP's distribution system not to the bulk transmission system.

[redacted]

CES's GridSolar pro forma utilizes an installed cost of $3,730 per KW and a capacity factor of 20 percent for the 800 MW of distributed PV in Maine. The proposal provides no detail as to the type of PV module they expect to install, nor does it provide proposed installation locations.

5 The CES filing states that 500MW of back-up generators are needed, while Appendix B shows [redacted]. Using this formula, 800MW of PV would require [redacted] of back-up generation.

III. ANALYSIS OF GRIDSOLAR PROPOSAL

Overall, CES's GridSolar project proposal reflects overly optimistic assumptions in its limited documentation. Many aspects of the proposal were not fully developed or detailed. CES's responses to data requests confirm that the GridSolar project is at a preliminary stage of development. Nevertheless, enough information is available in the description submitted by CES and from publicly available sources to conclude that GridSolar is vastly inferior to MPRP as a way to ensure transmission system reliability in Maine.

In this section of the report, the key assumptions included in the GridSolar project proposal are reviewed including installed cost, energy production, and sources of revenues. This review highlights the variances from industry data in the GridSolar proposal.

A. Installed Cost Assumptions

[redacted]

A recent Lawrence Berkeley National Laboratory report (LBNL Report) on installed costs for PV systems,[6] highlights recent industry trends and average costs for grid-tied solar systems of various sizes. The LBNL Report states the average installed cost for systems greater than 750 KW is \$6.80/watt in \$2007 (or \$7.5/watt in 2011\$), with costs ranging from \$5.4/watt to \$7.3/watt in2007\$ (or \$5.9/watt to \$8/watt in 2011\$). [redacted]

The average cost of \$6.8/watt (\$7.5/watt in 2011\$) found in the LBNL Report represents a composite of a number of different systems, including data from fixed tilt systems and tracking systems, but the cost does not include the cost of back-up systems.

6 *Tracking the Sun - The Installed Cost of Photovoltaics in the U.S. from 1998-2007.* Lawrence Berkeley National Laboratory (February 2009).

As noted in the LBNL report, the installed costs of large, utility-scale solar (PV) systems are influenced by many factors, including:

- The type of manufactured technology used in the PV module [7](e.g., single crystal silicon or thin film);
- The type of module itself (flat plate or concentrator);
- The type of system installed (fixed-tilt, one-axis tracking and two-axis tracking, and roof-top or ground-mounted); and
- Whether the system is grid-connected or free standing

The main component of the PV module is the semiconductor, which absorbs the sunlight. Historically, crystalline silicon has been used as the light-absorbing semiconductor in most solar cells. While the high cost of silicon has led to the development of thin film solar cells, crystalline silicon cells still comprise 93 percent of the market share. [8]

The modules themselves are either flat plate or concentrator systems. The concentrator systems use lenses or mirrors to concentrate the sunlight on specially designed cells. Concentrator systems require direct sunlight and will not operate in cloudy conditions, requiring installation in the semiarid/desert regions of the Southwestern United States. The remainder of the country installs flat plate collectors which are simpler to design than concentrator systems, and can use both direct and indirect sunlight.

PV module costs typically comprise 50- 60 percent of the total installed cost.

Balance-of-system ("BOS") is the term used for the equipment and activities of a PV system other than the actual PV modules. Many items can be included on the BOS list. Typically, the term BOS is identified with the DC-to-AC inverter; the foundation and structure that mounts the PV modules; and the electrical wiring and connection equipment. Internal electrical connections and module mounting techniques are critical determinants of panel cost, reliability, and endurance in an exposed environment. The BOS list can also include other PV system "soft" costs such as project management, engineering and design, testing, training, and operation and maintenance costs.

PV panels can be installed on a fixed-tilt facing south, or on a tracking device that allows the panel to follow the sun (one-tilt tracking and two-axis tracking), affecting both the installed cost and the energy production of the installation. Tracking the sun increases the energy output of the

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7 The term "module" is used here to refer to the PV panels only. Other components of a PV system installation, such as land, mounting, control systems, electrical, and other balance of plant items are not included in the term "module".

8 Solarbuzz website, solar cell technologies page, www.solarbuzz.com/technologies.htm, 3/09

array, but at increased cost and complexity.[9] O&M costs are also higher for tilt systems as they involve moving parts.

CES's GridSolar proposal does not directly specify whether it will be fixed tilt or tracking, although, as is discussed below, CES has assumed capacity factors which could only be attained under favorable conditions using two-axis tracking. However, CES's claimed installed costs are well below the costs of even the fixed-tilt systems reported in the LBNL Report.

In addition to the LBNL report, La Capra identified and reviewed eight additional projects for installed cost information shown in the table below.

Cost Per KW of Active and Proposed US Solar Photovoltaic Installations					
Utility	**Location**	**MW**	**Completion Date**	**Total Cost in Millions**	**$/watt**
Duke Energy	NC	16.1	2010	$ 173	$ 10.7
Duke Energy	NC	8	TBD	$ 50	$ 6.2
PSE&G	NJ	120	2014	$ 773	$ 6.4
Napa Valley College	CA	1.2	October-07	$ 8	$ 6.2
Florida Power & Light	Kennedy Space Center, FL	10	2010	$ 79	$ 7.9
Florida Power & Light	De Soto County FL	25	2009	$ 174	$ 6.9
Southern California Edison	CA	250	TBD	$ 962	$ 3.9
San Diego Gas & Electric	San Diego, CA	52	TBD	$ 250	$ 4.8

Finally, a February 2009 proposal submitted to the Massachusetts Department of Public Utilities (MA DPU) by the Western Massachusetts Electric Company (WMECo) to install up to 15 MW of distributed solar (PV) in their Western MA service territory estimated its installed cost at $6.80/watt, and indicated this cost "reflects installed projects, industry estimates and preliminary site assessments."[10]

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9 Solar Electric Power Association, PV Basics: PV Facts Sheet, www.solarelectricpower.org/index.php?page=basics, 3/09

10 Commonwealth of Massachusetts Department of Public Utilities D.P.U.09-05 Application of Western Massachusetts Electric Company for Authority to Implement and Recover in Rates the Cost of its Proposed Solar Photovoltaic Program, February 2009.

The range for eight of the nine PV installations (including the WMECo project noted above) vary in price from $4.8-$10.7 per watt installed. Excluding the two outliers, the remaining seven installed prices range from $6,250 - $7,890 per KW installed. An eighth project (SoCalEd) reflects $3,850 per KW installed, but review of the proposal itself revealed a statement indicating current costs of $6,560-$7,080 per KW installed. The proposal states that the lower rate (presented in the chart above) reflects "anticipated lower costs over the life of the project through economies of scale and improvements in technology and efficiency."[11]

There is some information available indicating an expectation that installed costs of PV systems have declined and will decline further. The LBNL Report states that installed costs declined an average of 3.5 pe rcent/year between 1998 and 2007. However, most of the cost declines experienced during that period occurred in the small and medium size systems, not the larger systems. *Renewable Energy World* (12/23/08) reported that cost declines in module costs are expected to continue, with module costs dropping as much as 30 percent in 2009 due to increased PV module production and declines in material costs, which would translate to roughly a 15 percent reduction in overall installed costs.

This information from the industry makes clear that the [redacted] value used in the GridSolar proposal is [redacted] of the cost experienced recently in the industry. In addition, it is well below even a highly optimistic future outlook for reduced installed costs in large scale PV systems.

Based on the industry data described above, the economic analysis presented in Sections IV and V of this report use the LBNL figure of $6,800 per KW for base case Pro Forma analysis. The LBNL figure was presented in 2007$. To account for the possibility that PV manufacturing costs will decline, the economic analysis below evaluates GridSolar using $6,800 per KW in 2012$, effectively assuming that any escalation would be offset by declining PV solar costs. As will be shown later in this report, even if PV prices decline further, the GridSolar project would not be an economic choice.

[11] Application of Southern California Edison Company for Authority to Implement and Recover in Rates the Cost of Its Proposed Solar Photovoltaic (PV) Program, 3/27/08, p.13, http://docs.cpuc.ca.gov/efile/A/80609.pdf

B. Capacity Factor Assumptions

The GridSolar proposal assumes a capacity factor for PV solar in Maine to be 20 percent, though, as noted in the prior section, CES has not explicitly specified the type of PV module they expect to install.

Data from other northeastern US systems and information from the National Renewable Energy Laboratory (NREL) indicate that this 20 percent capacity factor performance is very optimistic for Maine locations[12] even assuming a two-axis tracking installation.

NREL has developed a publicly-available Performance Calculator for Grid-Connected PV Systems (PV Watts). NREL's PV Watts can be used to calculate the electricity produced from a specified PV system based on location and certain additional assumptions regarding the technology. A range of capacity factors were developed for Portland, Maine using PV Watts for the three array types (Fixed-Tilt, 1-Axis Tracking and 2-Axis Tracking) using a DC to AC derate factor of 0.70:[13] as follows:

1. CF of 13 percent for Fixed Tilt
2. CF of 16.75 percent for 1-Axis Tracking
3. CF of 17.78 percent for 2-Axis Tracking

ISO-NE also developed solar capacity factors for New England using the PV Watts software as part of its 2007 Scenario Analysis. A New England capacity factor was developed using an average of PV Watts data from Hartford and Boston. The presentation entitled *Final Scenario Analysis Modeling Assumptions* shows the capacity factor to be 15.5 percent.

For comparison purposes, we reviewed the WMECO proposal previously mentioned. That proposal uses an estimated capacity factor of 13 percent for its proposed 15 MW solar installation in Western Massachusetts.

Additionally, a presentation delivered by two Lawrence Berkeley National Lab scientists[14] estimates and summarizes potential impacts of state RPS solar set-asides on solar PV capacity

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12 The energy production of a PV system is a function of both the angle and the amount of solar insulation. A Portland Maine location, in contrast to the desert Southwest, will produce lower capacity factors due to the more northern latitude and the more extended periods when cloud cover and haze are a factor.

13 PV Modules produce direct current (DC) electricity which must be converted to alternating current (AC) to deliver electricity to the grid. The derate factor is applied to the DC power rating to convert to an AC power rating. A derate factor of .70 means that the AC power rating is 70 percent of the nameplate DC power rating. [redacted]

14 Projecting the Impact of State Portfolio Standards on Renewable Energy and Solar Installations (Wiser, R. and Bolinger, M. January 2005, slide 4), www.newrules.org/de/solarestimates0105.ppt

and supply. In this report, the two Northeastern states used in the analysis are New York and New Jersey. A capacity factor of 15 percent was used for both states.

This information from the industry makes clear that the 20 percent capacity factor value used in the GridSolar proposal is well above the values expected by others in the industry for the Northeastern US.

The La Capra Base Case pro forma analysis described below assumes a 13 percent capacity factor. That analysis uses a calculated solar capacity factor for Portland using the fixed tilt PV system hourly performance data from the PV Watts cases described above.

C. Revenue Stream Assumptions

CES states that it can address the reliability concerns identified by CMP at a lower cost than the proposed MPRP transmission projects. The revenues available to the GridSolar project are an important part of that analysis.

Currently, three revenue streams would be available to the GridSolar project:

- **Energy.** Revenues from ISO-NE energy market for energy produced by the PV panels and the back-up generators.

- **Capacity.** Revenues from ISO-NE Forward Capacity Market ("FCM") for generating capacity produced by the PV panels and the back-up generators.

- **Renewable Energy Certificates (RECs).** Revenues from the sale of Renewable Energy Certificates ("RECs") associated with the energy output of the PV panels.

ISO-NE FCM rules give PV systems credit for performance during summer peak hours. La Capra Associates calculated the capacity credit a PV system would receive using the hourly solar output data from PV Watts. The analysis showed that PV systems would receive the following fraction of their DC nameplate capacity in the FCM:

- Fixed tilt: 0.22;
- One-axis tilt: 0.33; and
- Two-axis tilt: 0.36.

The capacity, energy and REC revenue streams projected by CES differ somewhat from those projected by La Capra Associates in the NTA analysis. Exhibit 1 shows the revenue streams projected by both La Capra Associates (using the energy, capacity and REC forecasts from the NTA study) and CES.

The CES proposal also included two additional revenue streams:

- [redacted]**Back-up Generation.** Revenues from the provision of back-up generation to customers located near each GridSolar installation for [redacted]

- **MPRP Avoided Costs.** A payment from CMP, equal to [redacted]. We refer to this payment as the MPRP avoided costs.

IV. ANALYSIS OF THE GRIDSOLAR FINANCIAL PRO FORMA

CES claims that GridSolar can address the reliability concerns expressed by CMP for less cost than the MPRP. CES supports that claim with a project a financial pro forma contained in the confidential Appendix B of their proposal. This section of our Report presents a critique of that CES pro forma financial analysis and demonstrates that, in fact even under its optimistic assumptions, GridSolar has questionable financial viability at best and, more importantly, is substantially more costly than MPRP.

In performing economic and financial evaluations of such large projects, there are two generic types of models that are typically used: 1) the cost-based model, and 2) the profit-based model.

A. Cost-Based Model

The cost-based model projects the total costs over time associated with a proposed project, including an estimate of the return on equity to be earned and any offsetting revenues or benefits. This type of model is frequently used to evaluate regulated investments, as the revenue requirements needed to recover the invested capital, including a target return on equity plus any on-going net expenses.[15] An example of this type of model is the scorecard model used in the La Capra Associates NTA study filed in this proceeding. ISO-NE also uses this type of model to determine the level of its Regional Network Service ("RNS") rates, which is the mechanism

[15] Since GridSolar in its testimony proposes to become a regulated transmission and distribution utility under Maine law, a cost-based analysis of the GridSolar proposal may be appropriate, though GridSolar did not do such an analysis. La Capra provides such an analysis in Section 5.

through which investments in Pool Transmission Facilities ("PTF"), such as MPRP, are recovered.

B. Profit-Based Model

The profit-based model projects both annual revenues and expenses, including any principal and interest payments associated with the portion of the capital costs that are funded by debt and income taxes. The resulting annual net income and cash flows are then compared to the capital provided by equity investors to fund the balance of the capital costs not funded by debt. Specifically, the net present value ("NPV") of the after tax cash flows less the equity capital provided up front represents the net value delivered to equity investors over time. Another common way to estimate the return to equity investors in a profit-based model is to calculate the internal rate of return ("IRR") earned by the projected cash flows. The internal rate of return is that discount rate that will cause the NPV of the after-tax cash flows to exactly equal the equity capital. If this rate of return is sufficiently high and the annual cash flows are high enough, a project is assumed to be financeable. A profit-based model is frequently used to evaluate non-regulated investments, such as merchant power plants that rely upon revenues from ISO-NE energy and capacity markets. A profit-based model is more suitable for these sorts of investments, because their revenues are not tied to their costs, but rather are dependent upon market prices.

C. CES's GridSolar Financial Model

In its confidential Appendix B, CES has used a profit-based model to evaluate GridSolar. This financial model assesses the GridSolar system by examining a 1 MW installation located in the Western Maine – Midcoast area[16]. A summary description of the components of the model follows.

Projected revenue streams included in the GridSolar financial model are:

- Revenues from ISO-NE energy market for energy produced by the PV panels and the back-up generators.
- Revenues from ISO-NE FCM for generating capacity produced by the PV panels and the back-up generators.
- Revenues from the sale of RECs associated with the energy output of the PV panels.
- Revenues from the provision of back-up generation to customers located near each GridSolar installation.

16 In the NTA Study, the Western Maine and Midcoast regions are geographically separate. The GridSolar proposal combines these diverse areas when calculating MPRP Avoided Costs.

- A payment from CMP, equal to [redacted] We refer to this payment as the MPRP avoided costs.

Projected annual expenses included in the GridSolar financial model are:

[redacted]

Exhibit 2 summarizes the results of the GridSolar filed financial model, showing NPV of after-tax cash flows, the IRR calculations, and the projected debt coverage ratios.

D. Assessment of the GridSolar Financial Model

In theory, it would be reasonable to assess the financial performance of GridSolar using a profit-based model. However, the financial model presented by CES for GridSolar has a number of problems, including 1) the omission of certain expense items, 2) the inclusion revenue streams which currently do not exist in energy markets, and 3) the use of capital cost and operating assumptions that are significantly understated and unsubstantiated. La Capra believes that the combination of these assumptions results in the significant overstatement of economic and financial benefits of the GridSolar proposal as presented in the CES filing.

[redacted]

[17] CES discovery response to CMP-07-22 in DOCKET NO. 2008-255

[18] CES would need to include replacement equipment at the end of the [redacted] life of the original equipment to perform a correct financial analysis.

[redacted] These cost estimates are not substantiated with supporting documentation in the proposal and appear to be below what such assets would actually cost. As noted in Section III. A. above, the LBNL Report estimates installed costs of $6,800 per KW ($6.8/watt in $2007) for systems > 750 KW. Currently, back-up generators in the 750 KW size range are expected to cost $1,500 per KW in 2011$, [redacted]

The GridSolar financial model also assumes as a revenue stream a payment from CMP [redacted]

[redacted] La Capra believes this assumption is erroneous on two levels. The first is that the amount of MW relief needed to displace the MPRP is not fixed as GridSolar assumes, but increases each year as load grows. The second flaw is that the annual carrying charges for the MPRP are also not fixed, but decline each year as the initial plant investment is depreciated. Exhibit 4 provides the corrected MPRP Avoided Costs and compares them to the original assumptions in the GridSolar financial model. This comparison demonstrates that the revenue streams for the assumed payment from CMP are overstated.

Exhibit 5 provides a summary of the results of using the filed GridSolar financial model but with revised assumptions. Specifically, Revision A shows what happens to the GridSolar financial model results if costs for PV solar panels and back-up generators are updated to reflect current industry costs. The total installed capital costs of the GridSolar combined PV / backup generation proposal increases to $8,538 per KW [redacted]. The NPV of after-tax cash flows is negative even after 30 years. This one correction renders the GridSolar project both uneconomic and not financeable.

Revision B in Exhibit 5 shows the impact of corrected MPRP Avoided Costs while keeping all other assumptions the same. [redacted] The NPV of after-tax cash flows is negative even after 30 years. This one correction, even with the higher percentage "avoided cost" payment, also renders the GridSolar project uneconomic and not financeable.

Other assumptions made by GridSolar were also found to be overstated based on current industry research. As noted in Section III. B. above, GridSolar assumed the capacity factor for PV solar in Maine to be 20 percent per year. La Capra used NREL's Performance Calculator for Grid-Connected PV Systems (PV Watts), to generate a range of capacity factors for Portland, ME.

Revision C in Exhibit 5 shows the impact of a capacity factor adjustment from the 20percent level assumed by GridSolar to 13 percent, which is the result from PV Watts using a fixed tilt PV system. A 13 percent capacity factor results in a negative NPV after 30 years.

GridSolar's projection of REC prices was also higher than the REC price projection used in La Capra's NTA analysis. Revision D in Exhibit 5 shows the impact of using La Capra's NTA REC price. Modeling at a lower REC price has a smaller effect on the project cash flows than the other revisions discussed above, but still yields a negative NPV after 20 years.

Revision E in Exhibit 5 shows the combined impact of the capital cost, MPRP avoided cost, capacity factor and REC price adjustments described above. The combined effect shows very large negative NPV cash flows over the life of the asset, leading to the conclusion that the GridSolar project is not economically feasible or financeable.

CES did utilize some assumptions which understate the benefits of GridSolar. In estimating revenues from ISO-NE energy markets, GridSolar assumed that Maine LMPs were a [redacted]. In La Capra Associates' NTA study LMPs were approximately $70 per MWH in 2012, [redacted]. Revision F in Exhibit 5 shows the impact of higher LMPs over time. The FCM prices assumed by GridSolar were lower than the

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assumptions in La Capra Associates filed NTA Study[19]. In order to produce comparable results to the NTA study, we replaced the GridSolar estimates with the La Capra projections. Revision G of Exhibit 5 shows the impact of this change on the CES projections. The combined impact of using the NTA study LMPs and FCM revenues (while using GridSolar's other assumptions) is that GridSolar has a positive NPV by the 5 year mark as shown in Revision H of Exhibit 5.

All of the alternative assumptions discussed above were combined into one scenario, the results of which are shown in Revision I in Exhibit 5. When all the alternative assumptions are combined the project has a negative 30-year NPV and IRR. This clearly demonstrates that the GridSolar proposal is uneconomic and not financeable.

Lastly, we estimated the reduction in the level of capital costs for GridSolar that would have to be achieved for GridSolar to break even after 15 years, i.e. result in an NPV of cash flows after 15 years equal to the equity capital invested. As shown in Revision J of Exhibit 5, capital costs would have to be reduced by [redacted] the already unrealistically low levels assumed by CES in their filed analysis in order to reach this breakeven point.

There are other assumptions in the filed GridSolar financial model, besides those discussed above, which raise concerns. For example, GridSolar excluded estimates for fuel costs and O&M costs for the back-up generators.

GridSolar assumed that their project would receive FCM revenues from ISO-NE Forward Capacity Markets, and that customers would pay GridSolar additional revenues for back-up service. It is unclear whether this constitutes selling the same capacity twice. In this assessment, we did not attempt to correct these items. However, these assumptions clearly bias the filed GridSolar analysis in favor of their proposed project.

19 It is important to note that the La Capra projection of FCM prices was made before any auction results were made public. At this time, the results of the first two auctions and the qualifications for the third auction are known. If FCM prices were forecast today, they would be considerably lower than La Capra's original estimates.

V. EVALUATION OF GRIDSOLAR AS AN ALTERNATIVE TO MPRP

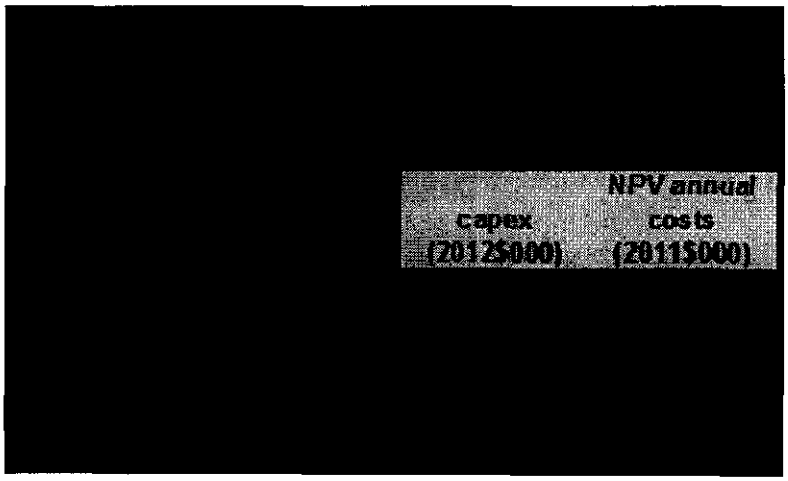
A. Cost-Based Comparison of the GridSolar Costs to NTA Generation

As mentioned previously, proposals to install regulated assets are frequently evaluated using a cost-based model. Therefore, La Capra compared the GridSolar proposal to non-transmission alternatives analyzed in the NTA study on a cost-basis.

Specifically, we compared the cost of the GridSolar project to the cost of simple cycle peaking units that were found to be the lowest cost generation-based NTA alternatives in the NTA Study. The NPV of the O&M and carrying charges for the peaking units were calculated, as were the NPV of the GridSolar project O&M and carrying charges, less any revenues for energy, RECs, and back-up service. Since both types of assets would earn the same FCM revenues, these revenues were excluded from this comparison.

The results of this comparison for 800 MW of PV capacity installed in 2012 are shown in the following table. [redacted]

Details of these calculations are provided in Exhibits 6, 7, and 8. Thus, this cost-based analysis confirms the conclusion made in the previous section, that the GridSolar project is not economically or financially viable.



B. Assessment of the GridSolar Proposal as an NTA

The final aspect of this review of the GridSolar proposal is to repeat the detailed analysis in La Capra's NTA Study, but with GridSolar generation included as an option. Specifically, we modeled 800 MW of PV / back-up generation as proposed by GridSolar in place of the 800 MW of conventional generation in 2012. La Capra used the highest capacity factor of 17.78 percent from a 2-axis tilt system for Portland from PV Watts, thereby giving GridSolar the most beneficial capacity factor assumption for the PV panels. Other NTAs, such as energy efficiency ("EE"), demand response ("DR"), and additional generation-based NTAs installed after 2012 remained the same as in the original NTA study. Fixed O&M for the back-up generators was added, but no costs for variable O&M or propane fuel was added for the back-up generating units. This assumption again represented the most optimistic scenario possible for GridSolar. Two levels of capital costs for the GridSolar option, the costs assumed in the GridSolar filing and the corrected capital costs discussed above, were evaluated. The results of this analysis are provided as a revised scorecard summary in Exhibit 9.

[redacted]

The second scenario used the updated, higher capital costs for the GridSolar option. The results show that the NTA scenario with Grid Solar was [redacted] than CMP's transmission with EE solution and the rate impacts were nearly [redacted] higher. Total capital expenditures under this scenario were [redacted].

These results confirm what the other analyses presented in this assessment did and demonstrate that the GridSolar option is not an economically or financially viable alternative to the MPRP.

In addition, we note that Maine electricity customers would be required to pay 100 percent of the GridSolar costs. Contrary to CES's assumption, there is no cost allocation mechanism for PV systems or any other generation source through the ISO-New England regional transmission tariff or other tariff. The analysis we have conducted here has assumed that the net cost (after considering energy, capacity, and REC revenues) would be borne by Maine ratepayers, as was the case for the NTA cases studied earlier.

Finally, CES claims that Gridsolar offers modularity benefits. The modularity characteristics of the GridSolar proposal are very similar to the modularity characteristics of the NTA cases previously studied. The analysis we have conducted shows that GridSolar is more costly than MPRP and the generation-based NTA alternatives. The head to head economics of a

GridSolar installation to a peaking generation unit shows that the peaking generation is a lower cost solution if a modular solution is desired. However, the needs assessment case shows substantial capacity needed in 2012. In this case, GridSolar would need to demonstrate the ability to install as much as 800 MW of its system by 2012.

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Exhibit 1

Revenue Comparison for GridSolar Project compared to La Capra's NTAs

Exhibit 2
Summary of GridSolar Filed Financial Model Results

Exhibit 3

Exhibit 4

Exhibit 5

Exhibit 6

Exhibit 7

Exhibit 8

Exhibit 9

Scorecard for NTA Analysis with GridSolar