

REVISED
Imperial County
Planning & Development Services Department

**NOTICE OF PREPARATION OF DRAFT EIR FOR IRIS CLUSTER SOLAR FARM PROJECT AND
NOTICE OF PUBLIC EIR SCOPING MEETING**

The Imperial County Planning & Development Services Department intends to prepare an Environmental Impact Report (EIR) for the proposed Iris Cluster Solar Farm Project (Ferrell Solar Farm, Rockwood Solar Farm, Iris Solar Farm, and the Lyons Solar Farm and collectively, the "Projects") as described below. A public scoping meeting for the proposed EIR will be held by the Imperial County Planning & Development Services Department on **May 15, 2014** at 6:00PM. The scoping meeting will be held at the Board of Supervisors Chambers, 2nd Floor, County Administration Center located at 940 Main Street, El Centro, CA 92243. Comments regarding the scope of the EIR will be accepted at this meeting.

SUBJECT: Iris Cluster Solar Farm Project EIR

BOARD OF SUPERVISORS CONSIDERATION: To Be Determined.

PROJECT LOCATION: The proposed Iris Cluster Solar Farm Project (Ferrell Solar Farm, Rockwood Solar Farm, Iris Solar Farm, and the Lyons Solar Farm and collectively, the "Projects") is located approximately 2 miles west of the City of Calexico, California on privately owned, undeveloped agricultural land encompassing approximately 1,422 acres, in southern Imperial County. The Projects are generally located between State Route 98 to the south, Kubler Road and Preston Road to the north, Weed Road to the east, and Brockman Road to the west.

PROJECT DESCRIPTION: The Ferrell, Rockwood, Iris and Lyons Solar Projects involve the construction of four utility-scale Photovoltaic (PV) solar facilities, on four non-contiguous independent sites encompassing approximately 1,422 acres. Each Project would include a ground mounted photovoltaic solar power generating system, supporting structures, inverter modules, pad mounted transformers, a water treatment system, plant control system, access roads and fencing, an O&M building, and an on-site substation. Each Project would have its own O&M building and onsite substation(s); but may utilize shared facilities with one or more neighboring solar project(s). Each Project would also connect to a 230 kilovolt (kV) overhead transmission line which may also be shared with one or more neighboring solar project(s). Each Project is proposed under a separate Conditional Use Permit (CUP). Project Applicant: 85JP 8ME, LLC.

Ferrell Solar Farm (CUP13-0054): The solar array field will encompass a total of 367 acres on two parcels of land (Assessor Parcel Numbers [APNs]: 052-180-042 and 059-050-001). This particular project site is anticipated to generate up to 90 megawatts (MW) of energy.

Rockwood Solar Farm (CUP13-0057): The solar array field will encompass a total of 396.2 acres on three parcels of land (APNs: 052-180-040, 052-180-048, and 052-180-064). This particular project site is anticipated to generate up to 100 MW of energy.

Iris Solar Farm (CUP13-0055): The solar array field will encompass a total of 520.8 acres on three parcels of land (APNs: 059-050-002, 059-050-003, and 059-120-001). This particular project site is anticipated to generate up to 130 MW of energy.

Lyons Solar Farm (CUP13-0056): The solar array field will encompass a total of 138.4 acres on two parcels of land (APNs: 052-180-053 and 052-180-058). This particular project site is anticipated to generate up to 40 MW of energy.

URBAN AREA PLAN: None, located in unincorporated area of County of Imperial

BOARD OF SUPERVISORS DISTRICT: District 2, Supervisor Jack Terrazas

ANTICIPATED SIGNIFICANT EFFECTS: The EIR will analyze potential impacts associated with the following: Aesthetics; Agricultural Resources; Air Quality; Biological Resources; Cultural Resources; Cumulative Impacts; Geology/Soils; Greenhouse Gas Emissions/Climate Change; Growth-inducing Impacts; Hazards/Hazardous Materials; Hydrology and Water Quality; Land Use and Recreation; Public Services; Transportation/Circulation; and Utilities and Service Systems including water supply and energy.

COMMENTS REQUESTED: The Imperial County Planning & Development Services Department would like to know your ideas about the effects this project might have on the environment and your suggestions as to mitigation or ways the project may be revised to reduce or avoid any significant environmental impacts. Your comments will guide the scope and content of environmental issues to be examined in the EIR. Your comments may be submitted in writing to Patricia Valenzuela, Imperial County Planning & Development Services Department, 801 Main Street, El Centro, CA 92243. Available project information may be reviewed at this location.

NOTICE OF PREPARATION REVIEW PERIOD: April 22, 2014 through May 27, 2014

***Initial Study and NOP
for:***

Iris Cluster Solar Farm Project:

| | |
|----------------------------|--------------------|
| Ferrell Solar Farm | CUP 13-0054 |
| Rockwood Solar Farm | CUP 13-0057 |
| Iris Solar Farm | CUP 13-0055 |
| Lyons Solar Farm | CUP 13-0056 |



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April 2014

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SECTION 1 INTRODUCTION

A. PURPOSE

This document is a ☐ policy-level; ☒ project level Initial Study for evaluation of potential environmental impacts resulting with the proposed Iris Cluster Solar Farm Project.

B. CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) REQUIREMENTS AND THE IMPERIAL COUNTY'S RULES AND REGULATIONS FOR IMPLEMENTING CEQA

As defined by Section 15063 of the State California Environmental Quality Act (CEQA) Guidelines and Section 7 of the County's Rules and Regulations for Implementing CEQA, an **Initial Study** is prepared primarily to provide the Lead Agency with information to use as the basis for determining whether an Environmental Impact Report (EIR), Negative Declaration, or Mitigated Negative Declaration would be appropriate for providing the necessary environmental documentation and clearance for any proposed project.

☒ According to Section 15065, an **EIR** is deemed appropriate for a particular proposal if the following conditions occur:

- The proposal has the potential to substantially degrade quality of the environment.
- The proposal has the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
- The proposal has possible environmental effects that are individually limited but cumulatively considerable.
- The proposal could cause direct or indirect adverse effects on human beings.

☐ According to Section 15070(a), a **Negative Declaration** is deemed appropriate if the proposal would not result in any significant effect on the environment.

☐ According to Section 15070(b), a **Mitigated Negative Declaration** is deemed appropriate if it is determined that though a proposal could result in a significant effect, mitigation measures are available to reduce these significant effects to insignificant levels.

This Initial Study has determined that the proposed applications will result in potentially significant environmental impacts and therefore, an Environmental Impact Report is deemed as the appropriate document to provide necessary environmental evaluations and clearance for the proposed project.

This Initial Study and Notice of Preparation are prepared in conformance with the California Environmental Quality Act of 1970, as amended (Public Resources Code, Section 21000 et. seq.); Section 15070 of the State CEQA Guidelines & County of Imperial's Rules and Regulations to Implement California Environmental Quality Act of 1970, as amended (California Code of Regulations, Title 14, Chapter 3, Section 15000, et. seq.); applicable requirements of the County of Imperial; and the regulations, requirements, and procedures of any other responsible public agency or an agency with jurisdiction by law.

Pursuant to the County of Imperial's Rules and Regulations to Implement CEQA, depending on the project scope, the County of Imperial Board of Supervisors, Planning Commission and/or Planning Director is designated the Lead Agency, in accordance with Section 15050 of the CEQA Guidelines. The Lead Agency is the public agency which has the principal responsibility for approving the necessary environmental clearances and analyses for any project in the County.

C. INTENDED USES OF INITIAL STUDY AND NOTICE OF PREPARATION

This Initial Study and Notice of Preparation are informational documents which are intended to inform County of Imperial decision makers, other responsible or interested agencies, and the general public of potential environmental effects of the proposed applications. The environmental review process has been established to enable public agencies to evaluate environmental consequences and to examine and implement methods of eliminating or reducing any potentially adverse impacts. While CEQA requires that consideration be given to avoiding environmental damage, the Lead Agency and other responsible public agencies must balance adverse environmental effects against other public objectives, including economic and social goals.

The Initial Study and Notice of Preparation, prepared for the project will be circulated for a period of 30 days for public and agency review and comments.

D. CONTENTS OF INITIAL STUDY & NOTICE OF PREPARATION

This Initial Study is organized to facilitate a basic understanding of the existing setting and environmental implications of the proposed applications.

SECTION 1

I. INTRODUCTION presents an introduction to the entire report. This section discusses the environmental process, scope of environmental review, and incorporation by reference documents.

SECTION 2

II. ENVIRONMENTAL CHECKLIST FORM contains the County's Environmental Checklist Form. The checklist form presents results of the environmental evaluation for the proposed applications and those issue areas that would have either a significant impact, potentially significant impact, or no impact.

PROJECT SUMMARY, LOCATION AND ENVIRONMENTAL SETTINGS describes the proposed project entitlements and required applications. A description of discretionary approvals and permits required for project implementation is also included. It also identifies the location of the project and a general description of the surrounding environmental settings.

ENVIRONMENTAL ANALYSIS evaluates each response provided in the environmental checklist form. Each response checked in the checklist form is discussed and supported with sufficient data and analysis as necessary. As appropriate, each response discussion describes and identifies specific impacts anticipated with project implementation.

SECTION 3

III. MANDATORY FINDINGS presents Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

E. SCOPE OF ENVIRONMENTAL ANALYSIS

For evaluation of environmental impacts, each question from the Environmental Checklist Form is summarized and responses are provided according to the analysis undertaken as part of the Initial Study. Impacts and effects will be evaluated and quantified, when appropriate. To each question, there are four possible responses, including:

1. **No Impact:** A "No Impact" response is adequately supported if the impact simply does not apply to the proposed applications.
2. **Less Than Significant Impact:** The proposed applications will have the potential to impact the environment. These impacts, however, will be less than significant; no additional analysis is required.
3. **Less Than Significant With Mitigation Incorporated:** This applies where incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact".
4. **Potentially Significant Impact:** The proposed applications could have impacts that are considered significant. Additional analyses and possibly an EIR could be required to identify mitigation measures that could reduce these impacts to less than significant levels.

F. POLICY-LEVEL or PROJECT LEVEL ENVIRONMENTAL ANALYSIS

This Initial Study will be conducted under a ☐ policy-level, ☒ project level analysis.

Regarding mitigation measures, it is not the intent of this document to "overlap" or restate conditions of approval that are commonly established for future known projects or the proposed applications. Additionally, those other standard requirements and regulations that any development must comply with, that are outside the County's jurisdiction, are also not considered mitigation measures and therefore, will not be identified in this document.

G. TIERED DOCUMENTS AND INCORPORATION BY REFERENCE

Information, findings, and conclusions contained in this document are based on incorporation by reference of tiered documentation, which are discussed in the following section.

1. Tiered Documents

As permitted in Section 15152(a) of the CEQA Guidelines, information and discussions from other documents can be included into this document. Tiering is defined as follows:

"Tiering refers to using the analysis of general matters contained in a broader EIR (such as the one prepared for a general plan or policy statement) with later EIRs and negative declarations on narrower projects; incorporating by reference the general discussions from the broader EIR; and concentrating the later EIR or negative declaration solely on the issues specific to the later project."

Tiering also allows this document to comply with Section 15152(b) of the CEQA Guidelines, which discourages redundant analyses, as follows:

"Agencies are encouraged to tier the environmental analyses which they prepare for separate but related projects including the general plans, zoning changes, and development projects. This approach can eliminate repetitive discussion of the same issues and focus the later EIR or negative declaration on the actual issues ripe for decision at each level of environmental review. Tiering is appropriate when the sequence of analysis is from an EIR prepared for a general plan, policy or program to an EIR or negative declaration for another plan, policy, or program of lesser scope, or to a site-specific EIR or negative declaration."

Further, Section 15152(d) of the CEQA Guidelines states:

"Where an EIR has been prepared and certified for a program, plan, policy, or ordinance consistent with the requirements of this section, any lead agency for a later project pursuant to or consistent with the program, plan, policy, or ordinance should limit the EIR or negative declaration on the later project to effects which:

- (1) Were not examined as significant effects on the environment in the prior EIR; or
- (2) Are susceptible to substantial reduction or avoidance by the choice of specific revisions in the project, by the imposition of conditions, or other means."

2. Incorporation By Reference

Incorporation by reference is a procedure for reducing the size of EIRs/MND and is most appropriate for including long, descriptive, or technical materials that provide general background information, but do not contribute directly to the specific analysis of the project itself. This procedure is particularly useful when an EIR or Negative Declaration relies on a broadly-drafted EIR for its evaluation of cumulative impacts of related projects (*Las Virgenes Homeowners Federation v. County of Los Angeles* [1986, 177 Ca.3d 300]). If an EIR or Negative Declaration relies on information from a supporting study that is available to the public, the EIR or Negative Declaration cannot be deemed unsupported by evidence or analysis (*San Francisco Ecology Center v. City and County of San Francisco* [1975, 48 Ca.3d 584, 595]).

When an EIR or Negative Declaration incorporates a document by reference, the incorporation must comply with Section 15150 of the CEQA Guidelines as follows:

- The incorporated document must be available to the public or be a matter of public record (CEQA Guidelines Section 15150[a]). The General Plan EIR is available, along with this document, at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 Ph. (760) 482-4236.
- This document must be available for inspection by the public at an office of the lead agency (CEQA Guidelines Section 15150[b]). These documents are available at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 Ph. (760) 482-4236.
- These documents must summarize the portion of the document being incorporated by reference or briefly describe information that cannot be summarized. Furthermore, these documents must describe the relationship between the incorporated information and the analysis in the tiered documents (CEQA Guidelines Section 15150[c]). As discussed above, the tiered EIRs address the entire project site and provide background and inventory information and data which apply to the project site. Incorporated information and/or data will be cited in the appropriate sections.
- These documents must include the State identification number of the incorporated documents (CEQA Guidelines Section 15150[d]). The State Clearinghouse Number for the 'County of Imperial General Plan EIR is SCH #93011023.
- The material to be incorporated in this document will include general background information (CEQA Guidelines Section 15150[f]).

SECTION II. ENVIRONMENTAL CHECKLIST

1. **Project Title:** Iris Cluster Solar Farm Project
2. **Lead Agency:** Imperial County Planning & Development Services Department
3. **Contact person and phone number:** Patricia Valenzuela, Planner IV, 760-482-4320
4. **Address:** 801 Main Street, El Centro CA, 92243
5. **E-mail:** PatriciaValenzuela@co.imperial.ca.us
6. **Project location:** The proposed Iris Cluster Solar Farm Project (Ferrell Solar Farm, Rockwood Solar Farm, Iris Solar Farm, and the Lyons Solar Farm and collectively, the "Projects") is located approximately 2 miles west of the City of Calexico, California on privately owned, undeveloped agricultural land encompassing approximately 1,422 acres, in southern Imperial County. The Projects are generally located between State Route 98 to the south, Kubler Road and Preston Road to the north, Weed Road to the east, and Brockman Road to the west.
7. **Project sponsor's name and address:** 85JP 8ME, LLC; 5455 Wilshire Blvd, Suite 2010, Los Angeles, CA 90036
8. **General Plan designation:** Agriculture
9. **Zoning:** A-2 (General Agriculture), A-2-R (General Agricultural Rural Zone), A-3 (Heavy Agriculture)
10. **Description of project:**

The Ferrell, Rockwood, Iris and Lyons Solar Projects involve the construction of four utility-scale Photovoltaic (PV) solar facilities, on four non-contiguous independent sites encompassing approximately 1,422 acres. Each Project would include a ground mounted photovoltaic solar power generating system, supporting structures, inverter modules, pad mounted transformers, a water treatment system, plant control system, access roads and fencing, an O&M building, and an on-site substation. Each Project would have its own O&M building and onsite substation(s); but may utilize shared facilities with one or more neighboring solar project(s). Each Project would also connect to a 230 kilovolt (kV) overhead transmission line which may also be shared with one or more neighboring solar project(s). Each Project is proposed under a separate Conditional Use Permit (CUP).

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Lyons Solar Farm (CUP 13-0056): The solar array field will encompass a total of 138.4 acres on two parcels of land (APNs: 052-180-053 and 052-180-058). This particular project site is anticipated to generate up to 40 MW of energy.

11. **Surrounding land uses and setting:** Briefly describe the project's surroundings:

Agricultural uses lie to the north and east, and solar farms are under construction to the west and to the south of the projects.

12. **Other public agencies whose approval is required** (e.g., permits, financing approval, or participation agreement.):

- Caltrans – Encroachment Permit
- Imperial Irrigation District – Right of Way Permit

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

- | | | |
|--|--|--|
| <input checked="" type="checkbox"/> Aesthetics | <input checked="" type="checkbox"/> Agriculture and Forestry Resources | <input checked="" type="checkbox"/> Air Quality |
| <input checked="" type="checkbox"/> Biological Resources | <input checked="" type="checkbox"/> Cultural Resources | <input checked="" type="checkbox"/> Geology / Soils |
| <input checked="" type="checkbox"/> Greenhouse Gas Emissions | <input checked="" type="checkbox"/> Hazards & Hazardous Materials | <input checked="" type="checkbox"/> Hydrology / Water Quality |
| <input checked="" type="checkbox"/> Land Use / Planning | <input type="checkbox"/> Mineral Resources | <input type="checkbox"/> Noise |
| <input type="checkbox"/> Population / Housing | <input checked="" type="checkbox"/> Public Services | <input checked="" type="checkbox"/> Recreation |
| <input checked="" type="checkbox"/> Transportation/Traffic | <input checked="" type="checkbox"/> Utilities / Service Systems | <input checked="" type="checkbox"/> Mandatory Findings of Significance |

ENVIRONMENTAL EVALUATION COMMITTEE (EEC) DETERMINATION

After Review of the Initial Study, the Environmental Evaluation Committee has:

☐ Found that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ Found that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ Found that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ Found that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ Found that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

CALIFORNIA DEPARTMENT OF FISH AND GAME DE MINIMIS IMPACT FINDING: ☐ Yes ☐ No

| EEC VOTES | YES | NO | ABSENT |
|---------------------------|--------------------------|--------------------------|--------------------------|
| PUBLIC WORKS | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ENVIRONMENTAL HEALTH | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| OFFICE EMERGENCY SERVICES | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| APCD | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| AG | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| SHERIFF DEPARTMENT | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ICPDS | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Jim Minnick, Interim Director

Date:

PROJECT SUMMARY

A. Project Location:

The Ferrell, Rockwood, Iris and Lyons Solar Projects are comprised of 1,422 acres of land located on four separate project sites collectively known as the Iris Cluster Solar Farm Project. The solar farm portions of the project sites are located on privately owned, undeveloped agricultural land approximately 2 miles west of the City of Calexico, California in southern Imperial County. The Projects are generally located between State Route 98 to the south, Kubler Road and Preston Road to the north, Weed Road to the east, and Brockman Road to the west.

B. Project Summary:

The Ferrell, Rockwood, Iris and Lyons Solar Projects involve the construction of four utility-scale PV solar facilities, on four non-contiguous independent sites encompassing approximately 1,422 acres. Each Project would include a ground mounted PV solar power generating system, supporting structures, inverter modules, pad mounted transformers, a water treatment system, plant control system, access roads and fencing, an O&M building, and an on-site substation. Each Project would have its own O&M building and onsite substation(s); but may utilize shared facilities with one or more neighboring solar project(s). Each Project would also connect to a 230 kV overhead transmission line (via an on site collector system) which may also be shared with one or more neighboring solar project(s). Each Project is proposed under a separate Conditional Use Permit (CUP).

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Lyons Solar Farm: The solar array field will encompass a total of 138.4 acres on two parcels of land (APNs: 052-180-053 and 052-180-058). This particular project site is anticipated to generate up to 40 MW of energy.

The EIR will address the potential environmental effects associated with the proposed Projects. Although this Initial Study evaluates the significance of environmental issue areas for the Project as a whole, the four Projects (Ferrell, Rockwood, Iris, and Lyons) as described above may be evaluated separately within each section of the EIR depending on the environmental issue area and potential impacts. Project phasing within the Projects will also be discussed in the EIR.

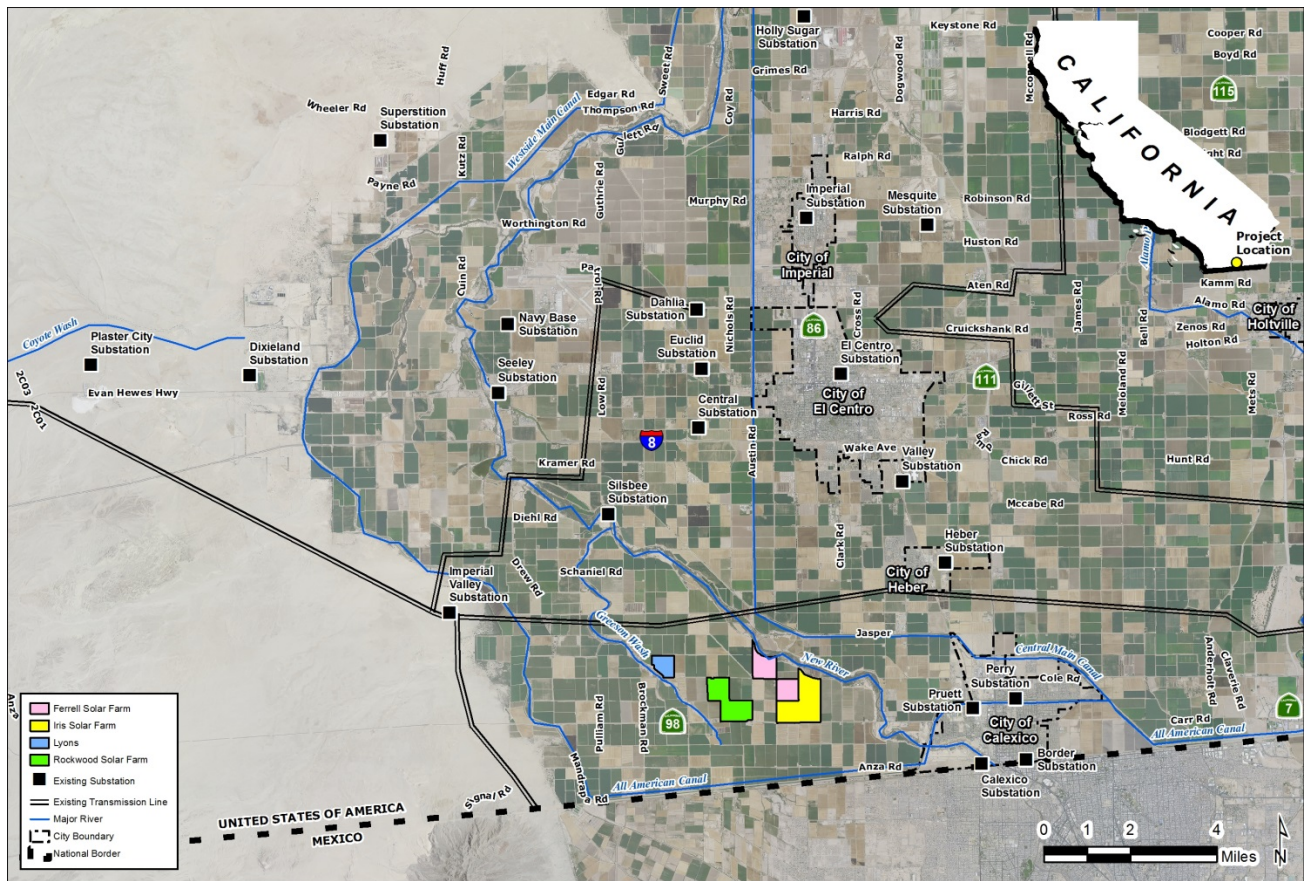
C. Environmental Setting:

The Projects are located in a rural part of southern Imperial County. The surrounding land uses include agricultural uses to the north and east, and solar farms that are under construction to the west and to the south. There are no established residential neighborhoods within the general vicinity of the Projects; however, there are rural residences within and adjacent to the boundary of the Project sites.

D. General Plan Consistency:

The proposed Projects are located within an unincorporated area of the County. The existing General Plan land use designation is "Agriculture." The project sites are currently zoned A-2 (General Agriculture), A-2-R (General Agricultural Rural Zone), and A-3 (Heavy Agriculture). Construction of a solar facility would be allowed within the existing zoning under a Conditional Use Permit.

Figure 1
Project Location



EVALUATION OF ENVIRONMENTAL IMPACTS:

- 1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
- 2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
- 3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.
- 4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses," as described in (5) below, may be cross-referenced).
- 5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
 - a) Earlier Analysis Used. Identify and state where they are available for review.
 - b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
 - c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.
- 6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
- 7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.
- 8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.
- 9) The explanation of each issue should identify:
 - a) The significance criteria or threshold, if any, used to evaluate each question; and
 - b) The mitigation measure identified, if any, to reduce the impact to less than significance.

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|----------------------|
|--|---|---|--|----------------------|

I. AESTHETICS

Would the project:

- | | | | | |
|--|-------------------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Have a substantial adverse effect on a scenic vista or scenic highway? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Substantially damage scenic resources, including, but limited to, trees, rock outcroppings, and historic buildings within a state scenic highway? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Substantially degrade the existing visual character or quality of the site and its surroundings? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

a,b) The Projects involve the construction of separate PV solar facilities on four non-contiguous independent Project sites, which would include a ground mounted PV solar power generating system, supporting structures, inverter modules, pad mounted transformers, a water treatment system, plant control system, access roads and fencing, an O&M building, and an on-site substation. Each Project would have its own O&M building and onsite substation(s); but may utilize shared facilities with one or more neighboring solar project(s). The proposed Projects are not located near any scenic vista or scenic highway, nor would they damage or degrade any designated scenic resources. Thus, no impact is identified for this issue area.

c) Although the Projects are not located near a scenic highway or designated scenic vista, the Projects may result in a change to the look and rural character of the area. A potentially significant impact is identified, and this issue will be addressed in the EIR.

d) Lighting would be installed on the O&M buildings for safety and security. However, all lighting would be directed downward or at a narrow beam angle, in order to focus all light only on the desired areas. The solar panels will not be constructed of reflective materials; therefore, it is not anticipated that they would result in creating a glare. The Projects are located in a rural agricultural area of Imperial County. There are no established residential neighborhoods within the project area or vicinity; however, there are rural residences within and adjacent to the boundary of the Project sites. Although the proposed Projects are not expected to create a new source of substantial light or glare affecting day or nighttime views, this issue will be analyzed further in the EIR. Therefore, a potentially significant impact is identified for this issue area.

II. AGRICULTURE AND FOREST RESOURCES

In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. --Would the project:

- | | | | | |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
| a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|-------------------------------------|
| b) Conflict with existing zoning for agricultural use, or a Williamson Act contract? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Result in the loss of forest land or conversion of forest land to non-forest use? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <p>a,e) According to the farmland maps prepared by the California Department of Conservation (2010), the Project sites contain prime farmland and farmland of statewide importance. Therefore, a potentially significant impact would result from the conversion of Prime Farmland or Farmland of Statewide Importance to non-agricultural use, as proposed on the Projects sites. A Land Evaluation Site Assessment (LESA) will be prepared for the Projects and this issue will be addressed in the EIR.</p> <p>b) The land is currently zoned A-2 (General Agriculture), A-2-R (General Agricultural Rural Zone), and A-3 (Heavy Agriculture) and designated by the General Plan as "Agriculture." Solar energy facilities are allowed within these zones subject to a Conditional Use Permit. However, APNs 059-050-002, 059-050-003, and 059-120-001 are under Williamson Act contracts. The Projects would conflict with the agricultural preservation intended under the Williamson Act for these parcels; therefore, a potentially significant impact is identified. As mentioned above, a LESA report will be prepared for the proposed Projects. This issue will be addressed in the EIR.</p> <p>c) There are no existing forest lands, timberlands, or timberland zoned Timberland Production either on-site or in the immediate vicinity that would conflict with existing zoning or cause rezoning. Therefore, no impact is identified for this issue area.</p> <p>d) There are no existing forest lands either on-site or in the immediate vicinity of the site. The proposed Projects would not result in the loss of forest land or conversion of forest land to non-forest use. Therefore, no impact is identified for this issue area.</p> | | | | |

III. AIR QUALITY

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to the following determinations. Would the Project:

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|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
| a) Conflict with or obstruct implementation of the applicable air quality plan? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|---|---|---|--|-------------------------------------|
| d) Expose sensitive receptors to substantial pollutants concentrations? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Create objectionable odors affecting a substantial number of people? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| <p>a) The Projects are located within the jurisdiction of Imperial County Air Pollution Control District (ICAPCD) in the Salton Sea Air Basin. Construction of the Projects would create temporary emissions of dust, fumes, equipment exhaust, and other air contaminants that may conflict with the ICAPCD Rules and Regulations. No stationary source emissions are proposed from the Projects; however, temporary construction emissions have the potential to result in a significant air quality impact.</p> <p>b) Currently, the Salton Sea Air Basin is either in attainment or unclassified for all federal and state air pollutant standards with the exception of O₃ (8-hour) and PM₁₀ (total suspended particulate matter less than 10 microns in diameter). Air pollutants transported into the Salton Sea Air Basin from the adjacent South Coast Air Basin (Los Angeles, San Bernardino County, Orange County, and Riverside County) and from Mexicali (Mexico) substantially contribute to the non-attainment conditions in the Salton Sea Air Basin. A potentially significant impact is identified for this issue area. An air quality impacts study that will address the proposed Projects' potential air quality impacts will be prepared and included in the EIR analysis.</p> <p>c) The proposed construction phases of the Projects may result in a cumulatively considerable net increase of one or more criteria pollutants as a result of point, and non-point source emissions, for which the project region is in non-attainment under applicable federal and state ambient air quality standards. Thus, a potentially significant impact is identified for this issue area. An air quality impact study that will address the proposed Projects' potential air quality impacts will be prepared and included in the EIR analysis.</p> <p>d) The Projects are located in a rural agricultural area of Imperial County. There are no established residential neighborhoods within the project area or vicinity; however, there are rural residences within and adjacent to the boundary of the Project sites. There are no schools, hospitals or senior homes within or adjacent to the boundary of the Project sites. Although the Projects would not expose a significant number of sensitive receptors to substantial pollutant concentrations, this issue will be addressed in the air quality impact study and EIR.</p> <p>e) The proposed Projects include the installation of solar energy facilities. It is not anticipated to generate objectionable odors as currently developed solar facilities in the area do not create odors. No impact is identified for this issue area.</p> | | | | |

IV. BIOLOGICAL RESOURCES

Would the project:

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|--|-------------------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| | <i>Potentially Significant Impact (PSI)</i> | <i>Potentially Significant Unless Mitigation Incorporated (PSUMI)</i> | <i>Less Than Significant Impact (LTSI)</i> | <i>No Impact (NI)</i> |
|--|---|---|--|-------------------------------------|
| c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Interfere substantially with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Conflict with any local policies or ordinances | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Protecting biological resource, such as a tree preservation policy or ordinance?

- f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan? ☐ ☐ ☐ ☒

a,d,e) A California Department of Fish and Wildlife (CDFW) Natural Diversity Database (CNDDB) search was conducted to identify federally and state endangered, threatened species and CDFW species of special concern with the potential to occur within the project area. No federally listed species were identified on the project sites; however, one state-listed bird was evaluated based on known occurrences in Imperial County and habitat availability in the project area: Greater sandhill crane. The Greater sandhill crane is state listed as threatened and is also on the Migratory Bird Treaty Act list of sensitive birds. The Greater sandhill crane could be found foraging in alfalfa or bermuda fields found on site. The Project sites also may have the potential to be used as burrowing owl foraging habitat as agricultural fields on site support prey for owls. Burrowing owls and burrows are commonly found along canals and drains. Although there are no Imperial Irrigation District (IID) canals or drainage structures located within the Project sites, IID Right-of-Way, access roads, canal and other drainages are located immediately adjacent to the Project sites. The New River is also adjacent to two of the four Project sites (Ferrell and Iris) which could also support owl habitat. Thus, a potentially significant impact is identified for this issue area. A biological resources technical study that will address the proposed Projects' potential impacts on biological resources will be prepared and included in the EIR analysis.

b,c) The Projects are in an agricultural vegetative community. The New River is located adjacent to a portion of the Ferrell and Iris Project sites which may be regulated pursuant to the CWA. No IID canal or drain structures will be removed or relocated, no washes are found within the Project sites, and impacts to the New River are not proposed; therefore, there will be no impact to riparian habitat or sensitive natural communities; and U.S. Army Corps of Engineers (USACE), CDFW, or Regional Water Quality Control Board (RWQCB) resources are not anticipated to be affected.

f) The Projects are not located in a Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP), or other approved local, regional, or state habitat conservation plan. No impact is identified.

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|----------------------|
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V. CULTURAL RESOURCES

Would the project:

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|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
| a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Disturb any human remains, including those interred outside of formal cemeteries? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

a,b,c,d) An archival records search was conducted at the South Coastal Information Center located at San Diego State University. The records search indicated that 43 previous cultural investigations have been conducted within a 1-mile radius of the proposed Projects. The records search indicated that 37 cultural resources have been recorded within a 1-mile radius of the proposed project area. In addition, many paleontological fossil sites are recorded in Imperial County and have been discovered during construction activities. Paleontological resources are typically impacted when earthwork activities such as mass excavation cut into geological deposits (formations) with buried fossils. It is not known if any paleontological resources are located on the Project sites. A cultural resources report that will address the proposed Projects' potential impacts on paleontological, historic and prehistoric resources will be prepared and included in the EIR analysis. Although unlikely, there is also a potential for unknown human remains to be unearthed during earthwork activities. A potentially significant impact is identified for these issues areas and they will be addressed in the EIR.

VI. GEOLOGY AND SOILS

Would the project:

- | | | | | |
|--|-------------------------------------|--------------------------|-------------------------------------|-------------------------------------|
| a) Expose people or structures to potential substantial adverse effects, including risk of loss, injury, or death involving: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 2) Strong Seismic ground shaking? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3) Seismic-related ground failure, including liquefaction and seiche/tsunami? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4) Landslides? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Result in substantial soil erosion or the loss of topsoil? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

| | <i>Potentially Significant Impact (PSI)</i> | <i>Potentially Significant Unless Mitigation Incorporated (PSUMI)</i> | <i>Less Than Significant Impact (LTSI)</i> | <i>No Impact (NI)</i> |
|--|---|---|--|-------------------------------|
| c) Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial risk to life or property? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

a1) The Projects do not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture at the Project sites is considered to be low. No impact is identified.

a2) The primary seismic hazard at the Project sites is the potential for strong ground shaking during earthquakes along the Imperial, Brawley, Laguna Salada, Cerro Prieto, and Superstition Hills Faults. This is identified as potentially significant and will be evaluated in the EIR.

a3,c) Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:

- (1) The soil must be saturated (relatively shallow groundwater);
- (2) The soil must be loosely packed (low to medium relative density);
- (3) The soil must be relatively cohesionless (not clayey); and
- (4) Groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions may exist to some degree at the sites. Thus, the impact is identified as potentially significant. This issue will be evaluated in the EIR.

However, the sites do not lie near any large bodies of water, so the threat of tsunamis, seiches, or other seismically-induced flooding is considered unlikely. No impact is identified for these issue areas.

a4) The hazard of landsliding is unlikely due to the relatively planar topography of the Projects sites. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation. No impact is identified.

b) Soil erosion can result during construction as grading and construction can loosen surface soils and make soils susceptible to wind and water movement across the surface. Impacts are not considered significant since erosion would be controlled on-site in accordance with County standards including preparation, review and approval of a grading plan by the County Engineer. Implementation of County standards would reduce the potential impacts to below a level of significance.

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|----------------------|
| d) In general, much of the near surface soils within the Project sites consist of silty clays and clays having a high to very high expansion potential. More sandy soils are present at the portions of the Project sites along the New River. The clay is expansive when wetted and can shrink with moisture loss (drying). This is a potentially significant impact. This issue will be analyzed in the EIR. | | | | |
| e) The near surface soils at the Projects sites generally consist of silty clays and clays having a very low to low infiltration rate; with the exception of the sandy soils which have a moderate infiltration rate. The near surface soils with low infiltration rates are considered poor in supporting onsite septic systems and leach fields for wastewater disposal. Therefore, a potentially significant impact has been identified for this issue area, and this issue will be addressed in the EIR. | | | | |

VII. GREENHOUSE GAS EMISSIONS

Would the project:

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|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
| a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Conflict with an applicable plan or policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- a,b) The Projects have the potential to generate greenhouse gas emissions during construction, in addition to construction worker trips to and from the Project sites. A potentially significant impact is identified and will be evaluated in the EIR. In the long-term, the Projects are expected to provide a benefit with respect to reduction of greenhouse gas emissions. A Greenhouse Gas Emissions/Climate Change technical report will be prepared for the proposed Projects and this issue will be addressed in the EIR.

VIII. HAZARDS AND HAZARDOUS MATERIALS

Would the project:

- | | | | | |
|---|-------------------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Create a significant hazard to the public or the environment through reasonable foreseeable upset and accident conditions involving the release of hazardous materials into the environment? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Be located on a site, which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| | <i>Potentially Significant Impact (PSI)</i> | <i>Potentially Significant Unless Mitigation Incorporated (PSUMI)</i> | <i>Less Than Significant Impact (LTSI)</i> | <i>No Impact (NI)</i> |
|--|---|---|--|-------------------------------------|
| e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <p>a,b) Operation of the Projects may result in the potential to handle hazardous materials. The hazardous materials handled on-site would be limited to small amounts of everyday use cleaners and common chemicals used for maintenance. Handling of these materials could result in the potential release of these materials during accidental or unforeseen conditions. The applicant will be required to comply with State laws and County Ordinance restrictions, which regulate and control hazardous materials handled on-site. Such hazardous wastes would be transported off-site for disposal according to applicable State and County restrictions and laws governing the disposal of hazardous waste during construction and operation of the Projects. Disposal of hazardous wastes on the Project sites is not proposed. However, a potentially significant impact remains and will be addressed in the EIR.</p> | | | | |
| <p>c) The Projects are not located within one-quarter mile of an existing or proposed school. No impact is identified for this issue area.</p> | | | | |
| <p>d) The Projects sites are not listed as a hazardous materials site pursuant to Government Code, Section 65962.5. No impact is identified for this issue area.</p> | | | | |
| <p>e,f) The Projects are located within two miles of a public airport or a private airstrip. However, no impacts are anticipated for these issue areas.</p> | | | | |
| <p>g) The Projects are not expected to impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. The applicant will be required to prepare a street improvement plan for the Project sites that will include provisions for emergency access points and safe vehicular travel. In addition, local building codes would be followed to minimize flood, seismic, and fire hazard. Therefore, no impact is identified for this issue area.</p> | | | | |
| <p>h) According to the Imperial County Natural Hazard Disclosure (Fire) Map prepared by the California Department of Forestry and Fire Protection (2000), the Project sites are not in a hazard area for wildland. However, construction and operation activities may result in an increased need for fire-fighting personnel and facilities in the area. This impact will be evaluated in the EIR under Public Services for Fire.</p> | | | | |

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|----------------------|
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IX. HYDROLOGY AND WATER QUALITY

Would the project:

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|---|-------------------------------------|--------------------------|-------------------------------------|-------------------------------------|
| a) Violate any water quality standards or waste discharge requirements? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| d) Substantially alter the existing drainage patterns of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| e) Create or contribute runoff water, which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| f) Otherwise substantially degrade water quality? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| g) Place housing within a 100-year flood hazard area as mapped on a Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| h) Place within a 100-year flood hazard area structures which would impede or redirect the flood flows? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| i) Expose people or structures to a significant risk of loss injury or death involving flooding, including flooding as a result of the failure of a levee or dam? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| j) Inundation by seiche, tsunami, or mudflow? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

a,f) The Projects have the potential to create urban non-point source discharge (e.g. synthetic/organic chemicals). No waste discharge requirements have been issued for the proposed Project sites. Potentially significant impacts have been identified. Water quality and waste discharge requirements will be addressed in the EIR.

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|---|---|---|--|----------------------|
| b) During construction, potable water would be brought to the site for drinking and domestic needs, while construction water would be brought to the site for soil conditioning and dust suppression. Depending on whether municipal water is available for use, water for operational use may also be trucked to the site. Because the solar panels will be mounted approximately up to 30 feet above ground, they are not considered "hardscape", such as roads, building foundations, or parking areas, as they do not require a substantial amount of impervious material. The panels and their mounting foundation would not impede groundwater recharge. Impacts would be less than significant. | | | | |
| c,d,e) The proposed Projects are not anticipated to generate a significant increase in the amount of runoff water from water use involving solar panel washing. Water will continue to percolate through the ground, as a majority of the surfaces on the project site will remain pervious. The proposed Projects would not substantially alter the existing drainage pattern of the site, substantially increase the rate of runoff, or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems. No IID drains or canals will be removed or relocated and no washes were found within the project. A less than significant impact is identified for these issue areas. | | | | |
| g,h,i) According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), the Projects sites are located in Zone C which is an area determined to be of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. A less than significant impact is identified for floodplains. The Project sites' potential drainage issues will be addressed through a drainage report and discussed in the EIR. | | | | |
| j) The Projects do not lie near any large bodies of water, so the threat of tsunami or seiches is unlikely. The project site and surrounding area is relatively flat; therefore, the threat of mudflow is less than significant. | | | | |

X. LAND USE AND PLANNING

Would the project:

- | | | | | |
|---|-------------------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Physically divide an established community? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (include, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Conflict with any applicable habitat conservation plan or natural community conservation plan? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
- a) The proposed Projects are located in a rural area within Imperial County. Although the Project sites contain a few residences, the Projects sites are surrounded by existing and/or proposed utility-scale solar farms similar to the proposed Projects; therefore, no impact is anticipated.
- b) The Project sites are currently designated by the General Plan as "Agriculture." The County identifies agricultural land as a form of open space that could be used as passive recreation. The land is currently zoned A-2 (General Agriculture), A-2-R (General Agricultural Rural Zone), and A-3 (Heavy Agriculture). Solar energy facilities are allowed within these zones subject to a Conditional Use Permit. Although the proposed Projects are allowed under the zoning, the proposed Projects would remove the land from public use as passive recreation. This may result in a potentially significant impact. Land use will be addressed in the EIR.
- c) The Project sites are not located in a HCP or NCCP. Thus no impact is identified.

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|----------------------|
|--|---|---|--|----------------------|

XI. MINERAL RESOURCES

Would the project:

- | | | | | |
|---|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

a,b) The Project sites are not used for mineral resource production. According to the Conservation and Open Space Element of the County of Imperial General Plan, no known mineral resources occur within the Project sites nor do the Project sites contain mapped mineral resources. As such, the proposed Projects would not adversely affect the availability of any known mineral resources within the Project sites. No impact is identified.

XII. NOISE

Would the project result in:

- | | | | | |
|--|--------------------------|--------------------------|-------------------------------------|-------------------------------------|
| a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| e) For a project located within an airport land use plan or where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|----------------------|
| a,c,d) The Imperial County Code of Ordinances, Chapter 2, Section 90702.00 - Sound level limits, establishes one-hour average sound level limits for the County's land use zones. Agricultural/industrial operations are required to comply with the noise levels prescribed under the general industrial zones. Therefore, the Projects are required to maintain noise levels below 75 decibels (dB) (averaged over one hour) during any time of day. The Projects would be expected to comply with the Noise Element of the General Plan which states that construction noise, from a single piece of equipment or a combination of equipment, shall not exceed 75 dB, when averaged over an eight hour period, and measured at the nearest sensitive receptor. Construction equipment operation is also limited to the hours of 7 a.m. to 7 p.m., Monday through Friday, and 9 a.m. to 5 p.m. Saturday. A less than significant impact is identified for this issue area. No further analysis is warranted. | | | | |
| b) Groundborne vibration and groundborne noise could originate from earth movement during the construction phase of the proposed Projects. However, significant vibration is typically associated with activities such as blasting or the use of pile drivers, neither of which would be required during project construction. The Projects would be expected to comply with all applicable requirements for long-term operation, as well as with measures to reduce excessive groundborne vibration and noise to ensure that the Projects would not expose persons or structures to excessive groundborne vibration. No further analysis is warranted. | | | | |
| e,f) The Projects are located within two miles of a public airport or a private airstrip. The Projects' potential impacts will be further analyzed under the EIR. | | | | |

XIII. POPULATION AND HOUSING

Would the project:

- | | | | | |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example through extension of roads or other infrastructure)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

a,b,c) The Project sites are currently used for agricultural production. Development of housing is not proposed as part of the Projects. Up to 24 full-time employees will operate the Projects, split roughly evenly between the four Project sites. Personnel may also share their time with other nearby projects. The full time employees will maintain the facility seven days a week during normal daylight hours. Typically, up to twelve staff will work during the day shift (sunrise to sunset), and the remainder during the night shifts and weekend.

To ensure optimal PV output, the solar panels will be maintained 24-hours a day/seven days a week. The proposed Projects would not result in a substantial population growth, as the number of employees required to operate and maintain the facilities is minimal. Therefore, no impact is identified for population and housing.

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|--|---|---|--|-------------------------------------|
| XIV. PUBLIC SERVICES | | | | |
| a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1) Fire protection? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2) Police protection? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3) Schools? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 4) Parks? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 5) Other public facilities? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| a1) Fire protection and emergency medical services in the area are provided by the Imperial County Fire Department. The proposed Projects would be required to comply with all existing regulations and requirements of the Imperial County Fire Department and would be reviewed for adherence to prevention measures for wildland fires. According to the Imperial County Natural Hazard Disclosure (Fire) Map prepared by the California Department of Forestry and Fire Protection (2000), the Project sites are not in a hazard area for wildland. However, construction and operation activities may result in an increased need for fire-fighting personnel and facilities in the area. Therefore, the potential impact on fire services from construction and operation of the proposed Projects will be further evaluated in the EIR. | | | | |
| a2) Police protection services in the proposed Projects' area is provided by the Imperial County Sheriff's Department. Although the potential is low, the proposed Projects may attract vandals or other security risks. The increase in construction related traffic could increase demand on law enforcement services. On-site security would be provided and access would be limited to the areas surrounding the Project sites during construction and operation, thereby minimizing the need for police surveillance. However, the Projects' impacts on sheriff services will be further evaluated in the EIR. | | | | |
| a3) The proposed Projects do not include the development of residential land uses that would result in an increase in population or student generation. Construction of the proposed Projects would not result in an increase in student population within the Imperial County's School District since it is anticipated that construction workers would commute in during construction operations. The proposed Projects would have no impact on Imperial County schools. No further analysis is warranted. | | | | |
| a4, 5) Parks/Libraries/Other Public Facilities: Operation of the proposed Projects would require minimal full-time staff (for security, maintenance, etc.). Therefore, substantial permanent increases in population that would adversely affect local parks, libraries and other public facilities (such as post offices) are not expected. The Projects are not expected to have an impact on parks and other public facilities such as post offices, and libraries. Therefore, no further analysis of these issue areas is warranted. | | | | |

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
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XV. RECREATION

- | | | | | |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Would the project increase the use of the existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse effect on the environment? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

a and b) The proposed Projects would employ a total combined staff of up to 24 employees, which would not significantly increase the use or accelerate the deterioration of regional parks or other recreational facilities. The temporary increase of population during construction that might be caused by an influx of workers would be minimal and not cause a detectable increase in the use of parks. Additionally, the Projects do not include or require the expansion of recreational facilities. No impact will occur and no further analysis is warranted.

XVI. TRANSPORTATION / TRAFFIC

Would the project:

- | | | | | |
|---|-------------------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Conflict with an applicable congestion management program, including but not limited to level of service standard and travel demand measures, or other standards established by the county congestion/management agency for designated roads or highways? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| e) Result in inadequate emergency access | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| f) Conflicts with adopted policies, plans, programs, regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|---|---|---|--|----------------------|
| a,b) The construction phases of the proposed Projects would result in an increase of traffic to the area, which may result in a potentially significant impact. A traffic impact study will be prepared and this issue will be addressed in the EIR. | | | | |
| c,d) The proposed Projects include solar panels that may be elevated up to 30 feet above ground, but would not be at a height that would interfere with air traffic patterns. Additionally, the proposed Projects do not include changes to the existing roadways. The proposed solar PV panels will be arranged in continuous rows of up to approximately 500-feet in length and arrays will be grouped together to form 500-feet by 500-feet grids. An additional 20-foot wide, all weather access roads will be implemented into the project design and located within each 500-foot "grids" to provide emergency units vehicle access and to allow access to the inverter modules. Additionally, a 20-foot wide all weather gravel road with additional clearance area in the corners of the Project sites will exist between the perimeter fence and solar panels allowing easy facility access and maneuverability for emergency unit vehicles. These access roads would not increase hazards due to design features or incompatible uses. No impact is identified. | | | | |
| e) The proposed street improvement plan for the Projects sites will be required to provide provisions for emergency access points and safe vehicular travel. Thus, no impact is identified for this issue area. | | | | |
| f) The proposed Projects are solar array farms. There are currently no pedestrian or bicycle right-of-ways within the Project areas that the Projects would interfere with. There are currently no bus stops located within the Projects boundaries or surrounding area and the proposed Projects do not include changes to the existing county roadway network. The proposed Projects would not conflict with any adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities. Thus, no impact is identified for this issue area. | | | | |

XVII. UTILITIES AND SERVICE SYSTEMS

Would the project:

- | | | | | |
|---|-------------------------------------|--------------------------|-------------------------------------|-------------------------------------|
| a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| b) Require or result in the construction of new water or water treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

| | Potentially Significant Impact (PSI) | Potentially Significant Unless Mitigation Incorporated (PSUMI) | Less Than Significant Impact (LTSI) | No Impact (NI) |
|---|---|---|--|--------------------------|
| g) Comply with federal, state, and local statutes and regulations related to solid waste? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

a,e) The Projects would generate a minimal volume of wastewater during construction. During construction activities, wastewater would be contained within portable toilet facilities and disposed of at an approved site. Operation of the proposed Projects would require a total of up to 24 on-site full time employees and could include up to four O&M buildings. Wastewater generation would be minimal. The Projects' wastewater will be treated via on-site septic systems. The proposed Projects would not exceed wastewater treatment requirements of the Regional Water Quality Control Board. A less than significant impact is identified for this issue area.

b,d) The Projects are not anticipated to result in a significant increase in water demand/use; however, water will be needed for domestic use within the O&M buildings, solar panel washing and fire protection once the Projects are fully operational. An onsite water treatment facility is proposed for each component of the Projects. The Projects would potentially draw water from the IID controlled Wistaria Canal. The Project sites are currently used for agricultural production. The onsite water treatment facilities will be evaluated in the EIR. A Water Supply Assessment will be prepared for the proposed Projects and will be included in the EIR.

c) The Projects do not include the construction of a storm drainage system or the alteration of the existing system. No impact is identified for this issue area. However, site drainage will be discussed in the Hydrology and Water Quality section of the EIR.

f, g) During construction and operation of the Projects, waste generation will be minor. Solid waste will be disposed of using a locally-licensed waste hauling service, most likely Allied Waste. There are over 40 solid waste facilities listed in Imperial County in the CalRecycle database. Trash would likely be hauled to the Calexico Solid Waste Site located in Calexico or the CR&R Material Recovery Transfer Station located in El Centro. The Calexico Solid Waste site has approximately 1.1 million cubic yards of capacity (reporting date July 2009) and is estimated to remain in operation through 2077. The CR&R Material Recovery and Transfer station has a maximum permitted throughput of 99 tons/day. No closure date has been reported for this facility (<http://www.calrecycle.ca.gov/SWFacilities/Directory/13-AA-0109/Detail/>). Therefore, there is ample landfill capacity throughout the County to receive the minor amount of solid waste generated by project construction and operation.

Additionally, because the proposed Projects would generate solid waste during construction and operation, they will be required to comply with State and local requirements for waste reduction and recycling; including the 1989 California Integrated Waste Management Act and the 1991 California Solid Waste Reuse and Recycling Access Act of 1991. Also, conditions of the CUP for each Project site will contain provisions for recycling and diversion of construction waste per policies of the County. A less than significant impact is identified for this issue.

Note: Authority cited: Sections 21083 and 21083.05, Public Resources Code. Reference: Section 65088.4, Gov. Code; Sections 21080(c), 21080.1, 21080.3, 21083, 21083.05, 21083.3, 21093, 21094, 21095, and 21151, Public Resources Code; Sundstrom v. County of Mendocino, (1988) 202 Cal.App.3d 296; Leonoff v. Monterey Board of Supervisors, (1990) 222 Cal.App.3d 1337; Eureka Citizens for Responsible Govt. v. City of Eureka (2007) 147 Cal.App.4th 357; Protect the Historic Amador Waterways v. Amador Water Agency (2004) 116 Cal.App.4th at 1109; San Franciscans Upholding the Downtown Plan v. City and County of San Francisco (2002) 102 Cal.App.4th 656.

Revised 2009- CEQA
Revised 2011- ICPDS

| | <i>Potentially Significant Impact (PSI)</i> | <i>Potentially Significant Unless Mitigation Incorporated (PSUMI)</i> | <i>Less Than Significant Impact (LTSI)</i> | <i>No Impact (NI)</i> |
|--|---|---|--|-------------------------------|
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III. MANDATORY FINDINGS OF SIGNIFICANCE

The following are Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

- | | | | | |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
| a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

a,b,c) The Projects have the potential to result in significant environmental effects, which could directly or indirectly cause adverse effects on human beings and or the environment. Implementation of the proposed Projects has the potential to result in impacts related to: aesthetics, agricultural resources, air quality, sensitive biological resources, cultural resources, geology/soils, hazards and hazardous materials, hydrology and water quality, land use and recreation, public services, transportation/circulation impacts, and water supply. These issues will be further evaluated in the EIR. In addition, the proposed Projects have the potential to result in cumulative impacts with regards to the identified issue areas. Cumulative impacts will be discussed and further analyzed in the EIR.

AIR POLLUTION CONTROL DISTRICT



April 30, 2014

Mr. Jim Minnick, Interim
Planning & Development Services
801 Main Street
El Centro, CA 92243

SUBJECT: Notice of Preparation (NOP) of a Draft Environmental Impact Report (DEIR) for Iris Cluster Solar Farm Project.

Dear Mr. Minnick,

The NOP to prepare a Draft EIR for the Iris Cluster Solar Farm Project has been reviewed by the Imperial County Air Pollution Control District (Air District). As you know, the Air District's established programs to keep the air in Imperial County from declining are found within the Rules and Regulations of the Air District, the California Environmental Quality Act (CEQA), the most current CEQA Air Quality Handbook for Imperial County, the Air District State Implementation Plans (SIP's) for Ozone and PM₁₀, and the Air District non-attainment status. Currently, the "moderate" non-attainment status for ozone, serious" non-attainment status for PM₁₀, non attainment for PM_{2.5} are the driving criteria in establishing the thresholds for NOx, ROG, PM₁₀, SOx and CO. These thresholds and their significance are explained within the pages of the Imperial County CEQA Air Quality Handbook. Section 6 of the CEQA handbook describes the preparation of the Air Quality Analysis for an Environmental Impact Report (EIR). **However, in the event that any of the protocols conflict with the provisions of CEQA or its Guidelines, the provisions of CEQA or its Guidelines shall control.**

The following is a synopsis of the information pertinent to the development of an Air Quality analysis. A **comprehensive Air Quality Analysis** of the construction and operational impacts of the project is required. A thorough analysis should include a description, impacts and health consequences of all air quality and associated emissions. The analysis should be conducted using the Air Districts approved modeling factors.¹ The analysis should include short and long term emissions as well as daily

¹The most current modeling tool recently adopted is CalEEMod.

and yearly emission calculations. Project alternatives should be included along with a thorough emissions analysis per alternative. A description of the Air District attainment status, State and Federal, is required as is describing any regulatory restrictions to the project. All temporary construction and grading impacts should quantify fugitive dust and combustion emissions and propose mitigation measures.

A health risk assessment such as a diesel exhaust screening level should be included for projects anticipating the use of heavy-duty diesel equipment.² A health risk assessment should also be conducted for projects locating near already existing facilities with a potential to emit toxics. Typically, these health risk assessments are of a quantitative nature but can be a mixed qualitative and quantitative analysis. In any case, the relative human exposure, location of the project, distance to sensitive receptors all should be considered when developing the risk assessment.

Projects anticipating heavy volumes of traffic should conduct hot spot modeling.³ Hot spot modeling will help determine compliance with the state CO standard at intersections and roadway links as determined by traffic impact analysis. In addition, existing and proposed projects must have a cumulative impact analysis. For each sub analysis and risk assessment mitigation measures should be identified, quantified for effectiveness and incorporated into the environmental document (i.e. Environmental Impact Report EIR or Environmental Impact Statement EIS). All mitigation measures must follow District Rules and Regulations including the most current CEQA Air Quality Handbook. Consultation with the most recent Clean Air Plans (SIP's), District Rules and Regulations and other Air District approved programs is recommended for effective applicability of standards. When it becomes apparent that on-site mitigation is insufficient to reduce the impacts to insignificance then off-site mitigation should be discussed and appropriately applied. Finally, in accordance with Assembly Bill 32 known as the Global Warming Solutions Act of 2006 and the most recent amendments to the CEQA Guidelines dated March of 2010, a discussion of the impacts from Green House Gas emissions and its relation to Climate Change is required.

15130. Cumulative Impacts Section

- (a) An EIR shall discuss cumulative impacts of a project when the project's incremental effect is cumulatively considerable, as defined in section 15065 (c)(a)(3). Where a lead agency is examining a project with an incremental effect that is not "cumulatively considerable," a lead agency need not consider that effect significant, but shall briefly describe its basis for concluding that the incremental effect is not cumulatively considerable.
 - (1) As defined in Section 15355, a cumulative impact consists of an impact which is created as a result of the combination of the project evaluated in the EIR together with other projects causing related impacts. An EIR

² Guidelines and procedures as approved by the California Air Resources Board and the Office of Environmental Health Hazard Assessment (OEHHA)

³ Using APCD approved hot spot modeling such as CALINE4, developed by and available through the California Department of Transportation.

should not discuss impacts which do not result in part from the project evaluated in the EIR.

- (2) When the combined cumulative impact associated with the project's incremental effect and the effects of other projects is not significant, the EIR shall briefly indicate why the cumulative impact is not significant and is not discussed in further detail in the EIR. A lead agency shall identify facts and analysis supporting the lead agency's conclusion that the cumulative impact is less than significant.
 - (3) An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.
- (b) The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact. The following elements are necessary to an adequate discussion of significant cumulative impacts:
- (1) **Either:**
 - (A) A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or
 - (B) A summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or areawide conditions contributing to the cumulative impact. local, regional or statewide plan, or related planning document, that describes or evaluates conditions contributing to the cumulative effect. Such plans may include: a general plan, regional transportation plan, or plans for the reduction of greenhouse gas emissions. A summary of projections may also be contained in an adopted or certified prior environmental document for such a plan. Such projections may be supplemented with additional information such as a regional modeling program. Any such planning document shall be referenced and made available to the public at a location specified by the lead agency.
 - (2) When utilizing a list, as suggested in paragraph (1) of subdivision (b), factors to consider when determining whether to include a related project should include the nature of each environmental resource being examined, the location of the project and its type. Location may be

important, for example, when water quality impacts are at issue since projects outside the watershed would probably not contribute to a cumulative effect. Project type may be important, for example, when the impact is specialized, such as a particular air pollutant or mode of traffic.

- (3) Lead agencies should define the geographic scope of the area affected by the cumulative effect and provide a reasonable explanation for the geographic limitation used.
 - (4) A summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating where that information is available; and
 - (5) A reasonable analysis of the cumulative impacts of the relevant projects. An EIR shall examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects.
- (c) With some projects, the only feasible mitigation for cumulative impacts may involve the adoption of ordinances or regulations rather than the imposition of conditions on a project-by project basis.
 - (d) Previously approved land use documents such as, including, but not limited to, general plans, specific plans, regional transportation plans, plans for the reduction of greenhouse gas emissions, and local coastal plans may be used in cumulative impact analysis. A pertinent discussion of cumulative impacts contained in one or more previously certified EIRs may be incorporated by reference pursuant to the provisions for tiering and program EIRs. No further cumulative impacts analysis is required when a project is consistent with a general, specific, master or comparable programmatic plan where the lead agency determines that the regional or areawide cumulative impacts of the proposed project have already been adequately addressed, as defined in section 15152(f), in a certified EIR for that plan.
 - (e) If a cumulative impact was adequately addressed in a prior EIR for a community plan, zoning action, or general plan, and the project is consistent with that plan or action, then an EIR for such a project should not further analyze that cumulative impact, as provided in Section 15183(j).

15065. MANDATORY FINDINGS OF SIGNIFICANCE

- (a) A lead agency shall find that a project may have a significant effect on the environment and thereby require an EIR to be prepared for the project where there is substantial evidence, in light of the whole record, that any of the following conditions may occur:
 - (1) The project has the potential to: substantially degrade the quality of the environment; substantially reduce the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self-sustaining levels; threaten to eliminate a plant or animal community; substantially reduce the number or restrict the range of an endangered, rare or threatened species; or eliminate important examples of the major periods of California history or prehistory.

- (2) The project has the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
 - (3) The project has possible environmental effects that are individually limited but cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
 - (4) The environmental effects of a project will cause substantial adverse effects on human beings, either directly or indirectly.
- (b) (1) Where, prior to the commencement of preliminary public review of an environmental document, a project proponent agrees to mitigation measures or project modifications that would avoid any significant effect on the environment specified by subdivision (a) or would mitigate the significant effect to a point where clearly no significant effect on the environment would occur, a lead agency need not prepare an environmental impact report solely because, without mitigation, the environmental effects at issue would have been significant.
- (2) Furthermore, where a proposed project has the potential to substantially reduce the number or restrict the range of an endangered, rare or threatened species, the lead agency need not prepare an EIR solely because of such an effect, if:
- (A) the project proponent is bound to implement mitigation requirements relating to such species and habitat pursuant to an approved habitat conservation plan or natural community conservation plan;
 - (B) the state or federal agency approved the habitat conservation plan or natural community conservation plan in reliance on an environmental impact report or environmental impact statement; and
 - (C)
 - 1. such requirements avoid any net loss of habitat and net reduction in number of the affected species, or
 - 2. such requirements preserve, restore, or enhance sufficient habitat to mitigate the reduction in habitat and number of the affected species to below a level of significance.
- (c) Following the decision to prepare an EIR, if a lead agency determines that any of the conditions specified by subdivision (a) will occur, such a determination shall apply to:
- (1) The identification of effects to be analyzed in depth in the environmental impact report or the functional equivalent thereof,
 - (2) The requirement to make detailed findings on the feasibility of alternatives or mitigation measures to substantially lessen or avoid the significant effects on the environment,
 - (3) When found to be feasible, the making of changes in the project to substantially lessen or avoid the significant effects on the environment, and

- (4) Where necessary, the requirement to adopt a statement of overriding considerations.

Reminder, all construction sites regardless of size must adhere to the requirements of Regulation VIII, Fugitive Dust Control. This regulation is comprised of six individual rules which combined apply Best Available Control Measures to any size construction or earthmoving activity. Aside from the standard of measurement, is the requirement of a dust control plan and notification 10 days prior to the commencement of construction to the Air District is important. Furthermore, all new residential and commercial projects are subject to the requirements of the Air District's Rule 310 – Operational Development Fees by which provide the Air District with a mitigation method for the emissions produced in the operation of the proposed project.

In closing, the Air District is requesting a copy the Conditional Use Permit Conditions for all proposed projects, prior to any clearance associated with the Air District.

The Imperial County's Rule book can be found at <http://www.co.imperial.ca.us> under "Air Pollution Control." We encourage all developers, construction companies, cities and interested parties to obtain of copy of the Regulation VIII, Fugitive Dust Control. Should you have any questions please do not hesitate to call the office at 760-482-4606.

Sincerely,



Belen Leon
APC Environmental Coordinator

NATIVE AMERICAN HERITAGE COMMISSION

1550 Harbor Boulevard, Suite 100
West Sacramento, CA 95691
(916) 373-3715
Fax (916) 373-5471
Web Site www.nahc.ca.gov
Ds_nahc@pacbell.net
e-mail: ds_nahc@pacbell.net

RECEIVED

APR 30 2014



April 28, 2014

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Mr. Patrick Valenzuela, Planning Manager

Imperial County Planning and Development Services Department

801 Main Street
El Centro, CA 92243

Sent by U.S. Mail

No. of Pages:

4

RE: SCH#2014041091; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the **"Iris Cluster Solar Farm Project (comprised of Ferrell Solar Farm, Rockwood Solar Farm, Iris Solar Farm and the Lyons Solar Farm;)"** located all together on about 1,200-acres in south central Imperial County, California

Dear Mr. Valenzuel:

The Native American Heritage Commission (NAHC) has reviewed the above-referenced environmental document.

The California Environmental Quality Act (CEQA) states that any project which includes archeological resources, is a significant effect requiring the preparation of an EIR (CEQA guidelines 15064.5(b)). To adequately comply with this provision and mitigate project-related impacts on archaeological resources, the Commission recommends the following actions be required:

Lead agencies should include in their mitigation plan provisions for the identification and evaluation of accidentally discovered archeological resources, pursuant to California Environmental Quality Act (CEQA) §15064.5(f). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American, with knowledge in cultural resources, should monitor all ground-disturbing activities. Also, California Public Resources Code Section 21083.2 require documentation and analysis of archaeological items that meet the standard in Section 15064.5 (a)(b)(f).

If there is federal jurisdiction of this project due to funding or regulatory provisions; then the following may apply: the National Environmental Policy Act (NEPA 42 U.S.C 4321-43351) and Section 106 of the National Historic Preservation Act (16 U.S.C 470 *et seq.*) and 36 CFR Part 800.14(b) require consultation with culturally

affiliated Native American tribes to determine if the proposed project may have an adverse impact on cultural resources

We suggest that this (additional archaeological activity) be coordinated with the NAHC, if possible. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. Any information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum, and not be made available for public disclosure pursuant to California Government Code Section 6254.10.

A list of appropriate Native American Contacts for consultation concerning the project site has been provided and is attached to this letter to determine if the proposed active might impinge on any cultural resources.

California Government Code Section 65040.12(e) defines "environmental justice" to provide "fair treatment of People...with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations and policies." (The California Code is consistent with the Federal Executive Order 12898 regarding 'environmental justice.' Also, applicable to state agencies is Executive Order B-10-11 requires consultation with Native American tribes their elected officials and other representatives of tribal governments to provide meaningful input into the development of legislation, regulations, rules, and policies on matters that may affect tribal communities.

Lead agencies should consider first, avoidance for sacred and/or historical sites, pursuant to CEQA Guidelines 15370(a). Then if the project goes ahead then, lead agencies include in their mitigation and monitoring plan provisions for the analysis and disposition of recovered artifacts, pursuant to California Public Resources Code Section 21083.2 in consultation with culturally affiliated Native Americans.

Lead agencies should include provisions for discovery of Native American human remains in their mitigation plan. Health and Safety Code §7050.5, CEQA §15064.5(e), and Public Resources Code §5097.98 mandates the process to be followed in the event of an accidental discovery of any human remains in a location other than a dedicated cemetery.

Sincerely,


Dave Singleton
Program Analyst

CC: State Clearinghouse

Attachment: Native American Contacts list

**Native American Contacts
Imperial County California
April 28, 2014**

La Posta Band of Mission Indians
Gwendolyn Parada, Chairperson
8 Crestwood Road Diegueno/Kumeyaay
Boulevard , CA 91905
gparada@lapostacasino.
(619) 478-2113
619-478-2125

Fort Yuma Quechan Indian Nation
Keeny Escalanti, Sr., President
PO Box 1899 Quechan
Yuma , AZ 85366
qitpres@quechantribe.com
(760) 572-0213
(760) 572-2102 FAX

Manzanita Band of Kumeyaay Nation
Leroy J. Elliott, Chairperson
PO Box 1302 Diegueno/Kumeyaay
Boulevard , CA 91905
ljbirdsinger@aol.com
(619) 766-4930
(619) 766-4957 Fax

Ewiiapaayp Tribal Office
Will Micklin, Executive Director
4054 Willows Road Diegueno/Kumeyaay
Alpine , CA 91901
wmicklin@leaningrock.net
(619) 445-6315 - voice
(619) 445-9126 - fax

Campo Band of Mission Indians
Ralph Goff, Chairperson
36190 Church Road, Suite 1 Diegueno/Kumeyaay
Campo , CA 91906
chairgoff@aol.com
(619) 478-9046
(619) 478-5818 Fax

Quechan Indian Nation
Arlene Kingery, THPO
P.O. Box 1899 Quechan
Yuma , AZ 85366
(760) 572-2423
historicpreservation@quech
antribe.com
(760) 572-0515 - FAX

Kwaaymii Laguna Band of Mission Indians
Carmen Lucas
P.O. Box 775 Diegueno -
Pine Valley , CA 91962
(619) 709-4207

Ah-Mut-Pipa Foundation
Preston J. Arrow-weed
P.O. Box 160 Quechan
Bard , CA 92222 Kumeyaay
ahmut@earthlink.net
(928) 388-9456

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting locative Americans with regard to cultural resources for the proposed SCH#2014041091; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Iris Cluster Solar Farm Project; located in the the South Central Area of Imperial County above State Route 98; Imperial County, California.

**Native American Contacts
Imperial County California
April 28, 2014**

Inter-Tribal Cultural Resource Protection Council
Frank Brown, Coordinator
240 Brown Road Diegueno/Kumeyaay
Alpine , CA 91901
frbrown@viejas-nsn.gov
(619) 884-6437

Kumeyaay Cultural Repatriation Committee
Bernice Paipa, Vice Spokesperson
P.O. 937 Diegueno/Kumeyaay
Boulevard , CA 91905
bernicepaipa@gmail.com
(KCRC is a Coalituon of 12
Kumeyaay Governments)

Cocopah Indian Reservation
Attn: H. Jill McCormick, Tribal Archaeologist
County 15th & Avenue G Cocopah
Sommerton , AZ 85350
culturalres@cocopah.com

(928) 530-2291

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting locative Americans with regard to cultural resources for the proposed SCH#2014041091; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Iris Cluster Solar Farm Project; located in the the South Central Area of Imperial County above State Route 98; Imperial County, California.

Comment Form

County of Imperial Iris Cluster Solar Farm Project Environmental Impact Report

PUBLIC SCOPING MEETING
May 15, 2014 6:00pm

On the lines provided below, please list the environmental issues or concerns you feel need to be addressed in the Environmental Impact Report (EIR) for the Iris Cluster Solar Farm Project. Please be as specific and detailed as possible so that the EIR may address all of your concerns or issues. If necessary, please attach additional pages. Once completed, please submit your written comments to: Ms. Patricia Valenzuela, Planner IV, Imperial County Planning & Development Services, 801 Main Street, El Centro, CA 92243, phone: 760-482-4320, email: PatriciaValenzuela@co.imperial.ca.us. Your comments must be postmarked by **May 27, 2014**. (Please print legibly)

I am opposed to conversion of productive agric. land to industrial scale renewable energy projects in part because it is inconsistent with General Plan - local proposals of updating General Plan of Renewable Energy. There are serious heat island effects, water and air quality impacts.

I support position of BAD for this project. These projects also have adverse impacts to birds/wildlife in addition to public health impacts.

Please evaluate the recent increase in numbers of cases of Valley Fever including case that person got in City of Imperial. Need to evaluate cumulative impacts on air quality from ALL industrial scale renewable energy projects both solar wind or public or private lands -

long term cumulative impacts on water resources.

| | |
|--------------------------------------|---|
| Name: Eddie Harmon | Agency/business/group name (if applicable): Self & BAD |
| Address: PO 444 | Phone number: 619-729-7178 |
| City/state/zip: Ocotillo CA 92259 | Date: May 15, 2015 |

AIR POLLUTION CONTROL DISTRICT



April 30, 2014

Mr. Jim Minnick, Interim
Planning & Development Services
801 Main Street
El Centro, CA 92243

SUBJECT: Notice of Preparation (NOP) of a Draft Environmental Impact Report (DEIR) for Iris Cluster Solar Farm Project.

Dear Mr. Minnick,

The NOP to prepare a Draft EIR for the Iris Cluster Solar Farm Project has been reviewed by the Imperial County Air Pollution Control District (Air District). As you know, the Air District's established programs to keep the air in Imperial County from declining are found within the Rules and Regulations of the Air District, the California Environmental Quality Act (CEQA), the most current CEQA Air Quality Handbook for Imperial County, the Air District State Implementation Plans (SIP's) for Ozone and PM₁₀, and the Air District non-attainment status. Currently, the "moderate" non-attainment status for ozone, serious" non-attainment status for PM₁₀, non attainment for PM_{2.5} are the driving criteria in establishing the thresholds for NOx, ROG, PM₁₀, SOx and CO. These thresholds and their significance are explained within the pages of the Imperial County CEQA Air Quality Handbook. Section 6 of the CEQA handbook describes the preparation of the Air Quality Analysis for an Environmental Impact Report (EIR). **However, in the event that any of the protocols conflict with the provisions of CEQA or its Guidelines, the provisions of CEQA or its Guidelines shall control.**

The following is a synopsis of the information pertinent to the development of an Air Quality analysis. A **comprehensive Air Quality Analysis** of the construction and operational impacts of the project is required. A thorough analysis should include a description, impacts and health consequences of all air quality and associated emissions. The analysis should be conducted using the Air Districts approved modeling factors.¹ The analysis should include short and long term emissions as well as daily

¹The most current modeling tool recently adopted is CalEEMod.

and yearly emission calculations. Project alternatives should be included along with a thorough emissions analysis per alternative. A description of the Air District attainment status, State and Federal, is required as is describing any regulatory restrictions to the project. All temporary construction and grading impacts should quantify fugitive dust and combustion emissions and propose mitigation measures.

A health risk assessment such as a diesel exhaust screening level should be included for projects anticipating the use of heavy-duty diesel equipment.² A health risk assessment should also be conducted for projects locating near already existing facilities with a potential to emit toxics. Typically, these health risk assessments are of a quantitative nature but can be a mixed qualitative and quantitative analysis. In any case, the relative human exposure, location of the project, distance to sensitive receptors all should be considered when developing the risk assessment.

Projects anticipating heavy volumes of traffic should conduct hot spot modeling.³ Hot spot modeling will help determine compliance with the state CO standard at intersections and roadway links as determined by traffic impact analysis. In addition, existing and proposed projects must have a cumulative impact analysis. For each sub analysis and risk assessment mitigation measures should be identified, quantified for effectiveness and incorporated into the environmental document (i.e. Environmental Impact Report EIR or Environmental Impact Statement EIS). All mitigation measures must follow District Rules and Regulations including the most current CEQA Air Quality Handbook. Consultation with the most recent Clean Air Plans (SIP's), District Rules and Regulations and other Air District approved programs is recommended for effective applicability of standards. When it becomes apparent that on-site mitigation is insufficient to reduce the impacts to insignificance then off-site mitigation should be discussed and appropriately applied. Finally, in accordance with Assembly Bill 32 known as the Global Warming Solutions Act of 2006 and the most recent amendments to the CEQA Guidelines dated March of 2010, a discussion of the impacts from Green House Gas emissions and its relation to Climate Change is required.

15130. Cumulative Impacts Section

- (a) An EIR shall discuss cumulative impacts of a project when the project's incremental effect is cumulatively considerable, as defined in section 15065 (c)(a)(3). Where a lead agency is examining a project with an incremental effect that is not "cumulatively considerable," a lead agency need not consider that effect significant, but shall briefly describe its basis for concluding that the incremental effect is not cumulatively considerable.
 - (1) As defined in Section 15355, a cumulative impact consists of an impact which is created as a result of the combination of the project evaluated in the EIR together with other projects causing related impacts. An EIR

² Guidelines and procedures as approved by the California Air Resources Board and the Office of Environmental Health Hazard Assessment (OEHHA)

³ Using APCD approved hot spot modeling such as CALINE4, developed by and available through the California Department of Transportation.

should not discuss impacts which do not result in part from the project evaluated in the EIR.

- (2) When the combined cumulative impact associated with the project's incremental effect and the effects of other projects is not significant, the EIR shall briefly indicate why the cumulative impact is not significant and is not discussed in further detail in the EIR. A lead agency shall identify facts and analysis supporting the lead agency's conclusion that the cumulative impact is less than significant.
 - (3) An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.
- (b) The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact. The following elements are necessary to an adequate discussion of significant cumulative impacts:
- (1) **Either:**
 - (A) A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or
 - (B) A summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or areawide conditions contributing to the cumulative impact. local, regional or statewide plan, or related planning document, that describes or evaluates conditions contributing to the cumulative effect. Such plans may include: a general plan, regional transportation plan, or plans for the reduction of greenhouse gas emissions. A summary of projections may also be contained in an adopted or certified prior environmental document for such a plan. Such projections may be supplemented with additional information such as a regional modeling program. Any such planning document shall be referenced and made available to the public at a location specified by the lead agency.
 - (2) When utilizing a list, as suggested in paragraph (1) of subdivision (b), factors to consider when determining whether to include a related project should include the nature of each environmental resource being examined, the location of the project and its type. Location may be

- important, for example, when water quality impacts are at issue since projects outside the watershed would probably not contribute to a cumulative effect. Project type may be important, for example, when the impact is specialized, such as a particular air pollutant or mode of traffic.
- (3) Lead agencies should define the geographic scope of the area affected by the cumulative effect and provide a reasonable explanation for the geographic limitation used.
 - (4) A summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating where that information is available; and
 - (5) A reasonable analysis of the cumulative impacts of the relevant projects. An EIR shall examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects.
- (c) With some projects, the only feasible mitigation for cumulative impacts may involve the adoption of ordinances or regulations rather than the imposition of conditions on a project-by project basis.
- (d) Previously approved land use documents such as, including, but not limited to, general plans, specific plans, regional transportation plans, plans for the reduction of greenhouse gas emissions, and local coastal plans may be used in cumulative impact analysis. A pertinent discussion of cumulative impacts contained in one or more previously certified EIRs may be incorporated by reference pursuant to the provisions for tiering and program EIRs. No further cumulative impacts analysis is required when a project is consistent with a general, specific, master or comparable programmatic plan where the lead agency determines that the regional or areawide cumulative impacts of the proposed project have already been adequately addressed, as defined in section 15152(f), in a certified EIR for that plan.
- (e) If a cumulative impact was adequately addressed in a prior EIR for a community plan, zoning action, or general plan, and the project is consistent with that plan or action, then an EIR for such a project should not further analyze that cumulative impact, as provided in Section 15183(j).

15065. MANDATORY FINDINGS OF SIGNIFICANCE

- (a) A lead agency shall find that a project may have a significant effect on the environment and thereby require an EIR to be prepared for the project where there is substantial evidence, in light of the whole record, that any of the following conditions may occur:
- (1) The project has the potential to: substantially degrade the quality of the environment; substantially reduce the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self-sustaining levels; threaten to eliminate a plant or animal community; substantially reduce the number or restrict the range of an endangered, rare or threatened species; or eliminate important examples of the major periods of California history or prehistory.

- (2) The project has the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
 - (3) The project has possible environmental effects that are individually limited but cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
 - (4) The environmental effects of a project will cause substantial adverse effects on human beings, either directly or indirectly.
- (b) (1) Where, prior to the commencement of preliminary public review of an environmental document, a project proponent agrees to mitigation measures or project modifications that would avoid any significant effect on the environment specified by subdivision (a) or would mitigate the significant effect to a point where clearly no significant effect on the environment would occur, a lead agency need not prepare an environmental impact report solely because, without mitigation, the environmental effects at issue would have been significant.
- (2) Furthermore, where a proposed project has the potential to substantially reduce the number or restrict the range of an endangered, rare or threatened species, the lead agency need not prepare an EIR solely because of such an effect, if:
- (A) the project proponent is bound to implement mitigation requirements relating to such species and habitat pursuant to an approved habitat conservation plan or natural community conservation plan;
 - (B) the state or federal agency approved the habitat conservation plan or natural community conservation plan in reliance on an environmental impact report or environmental impact statement; and
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 - 1. such requirements avoid any net loss of habitat and net reduction in number of the affected species, or
 - 2. such requirements preserve, restore, or enhance sufficient habitat to mitigate the reduction in habitat and number of the affected species to below a level of significance.
- (c) Following the decision to prepare an EIR, if a lead agency determines that any of the conditions specified by subdivision (a) will occur, such a determination shall apply to:
- (1) The identification of effects to be analyzed in depth in the environmental impact report or the functional equivalent thereof,
 - (2) The requirement to make detailed findings on the feasibility of alternatives or mitigation measures to substantially lessen or avoid the significant effects on the environment,
 - (3) When found to be feasible, the making of changes in the project to substantially lessen or avoid the significant effects on the environment, and

- (4) Where necessary, the requirement to adopt a statement of overriding considerations.

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In closing, the Air District is requesting a copy the Conditional Use Permit Conditions for all proposed projects, prior to any clearance associated with the Air District.

The Imperial County's Rule book can be found at <http://www.co.imperial.ca.us> under "Air Pollution Control." We encourage all developers, construction companies, cities and interested parties to obtain a copy of the Regulation VIII, Fugitive Dust Control. Should you have any questions please do not hesitate to call the office at 760-482-4606.

Sincerely,

A handwritten signature in cursive script, appearing to read "Belen Leon".

Belen Leon
APC Environmental Coordinator

MAY 15, 2014

IMPERIAL COUNTY PLANNING AND DEVELOPMENT SERVICES DEPARTMENT

DRAFT EIR SCOPING MEETING FOR IRIS CLUSTER SOLAR FARM PROJECT

(These comments are made by myself, Carolyn Allen, as an individual and as a member of Backcounty Against Dumps.)

These comments cover the Ferrell Solar Farm (CUP 13-0054), Rockwood Solar Farm (CUP 13-0057, Iris Solar Farm (CUP 13-0055) and Lyons Solar Farm (CUP 13-0056).

Some of my concerns with the Iris Cluster Project follow:

- 1) There are 40 categories in the draft EIR marked as POTENTIALLY SIGNIFICANT IMPACT (PSI). These industrial large scale solar projects are leaving hideous scars on our beautiful Valley. Damage , that no matter what public officials claim, CANNOT be mitigated away. Mitigation is woefully inadequate.
- 2) This Project will cover approx. 1,422 acres of farmland . It includes both Prime ground and Farmland of Statewide Importance. This is good ground that should be preserved for agriculture not paved over with solar panels.
- 3) There are several parcels in this Project that are under Williamson Act contracts. These parcels should not even be under consideration for development of any kind.
- 4) These four solar facilities will take away existing long term jobs from agricultural field workers as well as ag support businesses . Farmers who have been renting the ground will lose income and possibly go out of business.
- 5) An in-depth examination of the potential for the solar project to damage adjacent crops and other crops in close proximity .(eg.....excessive weeds, excessive dust, excessive heat etc.)
- 6) Farm crops provide habitat for birds and wildlife. The consequences of this loss needs to be properly studied.
- 7) What will the cumulative effects be of not just these four solar sites but of all of the solar sites, wind sites, geothermal , powerlines , substations, back up energy and all impacts from development in the Imperial Valley?
- 8) The maps in Figure 1 Appendix J appear to misrepresent the area around the proposed 4 sites. The maps do not seem to show the existing solar projects in that area.
- 9) What will happen to any people living in the vicinity of the proposed project?
- 10) Damage to county roads from increased traffic due to the solar Project needs to be evaluated as well as any possible increase in traffic accidents.
- 11) Must take into consideration that the light, glint and glare from this Project as well as those projects nearby could pose a danger to airplanes especially crop dusters.
- 12) There is far too little being estimated for costs associated with the decommissioning of solar projects and returning the land to agriculture (if indeed this is even possible).
- 13) Negative impacts to our dumps not being properly recognized and assessed.

- 14) Imperial Valley already has air quality problems. These projects will further degrade our air.
- 15) The possibility of cultural resources being present on these proposed sites needs to be given special attention.
- 16) As the draft EIR says , the Imperial Valley is a known earthquake area. This could mean broken panels, downed power lines and a disruption to service for the proposed solar facilities.
- 17) The Iris Cluster Solar Project is not consistent with the General Plan.
- 18) The Valley's public services will be negatively impacted. These projects pose the potential for huge industrial fires involving hazardous materials.
- 19) What will the negative impacts be to our existing electrical grid?

THESE SOLAR PROJECTS DO NOT BELONG ON OUR FARMLAND OR OPEN SPACES !!! SOLAR
PANELS SHOULD GO ON OUR ROOF TOPS !

Submitted by Carolyn Allen

P.O. Box 301

Brawley, CA 92227

From: Kay Pricola [<mailto:kay@colabimperial.com>]
Sent: Thursday, May 22, 2014 9:38 AM
To: Jim Minnick
Cc: Patricia Valenzuela
Subject: CEQA-EIR-IRIS CLUSTER SOLAR FARM PROJECT

I am remiss in providing the comments of our membership in a timely manner. I suspect you have already included this concerns as you move forward.

1. Please include in the project parameter to restore road system (county, state, or city managed) at least the condition prior to the start the installation and that maintenance cost to be the responsibility of the developer.
2. Please require the installation of all power line to be underground to preclude overhead power poles and line. The location is in the direct path or near the approach/departure pattern at the Calexico Airport. The planned sites are also in an agricultural area where poles and line would severely impact crop dusting activities.

Thanks

Stephan C. Volker
Joshua A.H. Harris (of Counsel)
Alexis E. Krieg
Stephanie L. Clarke
Daniel P. Garrett-Steinman
Jamey M.B. Volker
M. Benjamin Eichenberg
Lauren E. Pappone

Law Offices of
Stephan C. Volker
436 – 14th Street, Suite 1300
Oakland, California 94612
Tel: (510) 496-0600 ♦ Fax: (510) 496-1366
svolker@volkerlaw.com

11.187.01

May 23, 2014

Via Electronic Mail and U.S. Post
email: PatriciaValenzuela@co.imperial.ca.us

Patricia Valenzuela
Imperial County Planning and Development
Services Department
801 Main Street
El Centro, CA 92243

**Re: Scoping Comments of Backcountry Against Dumps, Donna Tisdale and
Carolyn Allen on the Iris Cluster Solar Farm Project, SCH No. 2014041091**

Pursuant to the California Environmental Quality Act (“CEQA”), Public Resources Code section 21000 *et seq.*, and Imperial County’s (the “County’s”) Notice of Preparation of a Draft Environmental Impact Report (“NOP”),¹ Backcountry Against Dumps, Donna Tisdale and Carolyn Allen (collectively, “Backcountry”) submit the following scoping comments for the Draft Environmental Impact Report (“DEIR”) being prepared by the County for the Iris Cluster Solar Farm Project (“Iris Cluster Solar” or the “Project”).

The Project would involve the construction and operation of four utility-scale photovoltaic solar (“PV”) electrical generation facilities – the 367-acre Ferrell Solar Farm (CUP 13-0054), the 396.2-acre Rockwood Solar Farm (CUP 13-0057), the 520.8-acre Iris Solar Farm (CUP 13-0055) and the 138.4-acre Lyons Solar Farm (CUP 13-0056). Each of the projects would require its own inverter modules, pad-mounted transformers, water treatment systems, “plant control systems,” access roads, operations and maintenance building and on-site substation, among other ancillary facilities, including a shared 230-kilovolt (“kV”) overhead transmission line. NOP at 1 (quote), 2. Combined, the four projects would generate as much as 360 megawatts (“MW”) of electricity.

¹ Counsel for Backcountry, the Law Offices of Stephan C. Volker, received the NOP and the attached Initial Study via certified mail from the County on April 25, 2014. The NOP requires that responses “be sent . . . ***not later than 30 days*** after receipt of this notice,” in our case by May 25, 2014. NOP at 1. Backcountry’s scoping comments, mailed via U.S. Post and emailed to the Project contact Patricia Valenzuela on May 23, 2014, are therefore timely.

The Project would be located on and displace more than 1,422 acres of, according to local farmers, *some of the best and most productive* agricultural land in Imperial County, including at least 520.8 acres that are protected by Williamson Act contracts and substantial acreage of California Department of Conservation-designated Prime Farmland and Farmland of Statewide Importance. This premier farmland is “currently used for agricultural production,” and is truly irreplaceable. Initial Study at 2-22. The food and fiber it produces year in and year out for Americans throughout our country are of inestimable value to present and future generations. Yet the Project would preclude cultivation of the land throughout its operational lifetime – probably decades – and possibly permanently. *Id.* at 2-8 (the Project would cause “the conversion of Prime Farmland or Farmland of Statewide Importance to non-agricultural use”). Furthermore, the Project would likely cause significant additional impacts to agriculture and the agricultural economy countywide by reducing demand for agriculture-serving businesses and interfering with one of the only airports servicing agricultural spraying operations in the County.

Backcountry opposes this Project as an unnecessary industrialization of highly productive farmland. Not only would the Project have significant environmental, agricultural and economic impacts, the proposed industrial-scale electrical generation and transmission uses are forbidden by the Imperial County General Plan (and hence the Planning and Zoning Law, Government Code section 65000 *et seq.*). Thus, echoing a growing chorus of opinions on this subject, Backcountry urges Imperial County to analyze and adopt as an alternative to the proposed Project the development of non-fossil fuel distributed generation projects near demand centers in already-disturbed areas. In further expression of these major concerns and others, Backcountry offers the following comments to assist the County in analyzing the Project and developing a DEIR thereon.

I. THE PROPOSED SOLAR ENERGY GENERATION AND TRANSMISSION USES ARE FORBIDDEN BY THE IMPERIAL COUNTY GENERAL PLAN LAND USE ELEMENT.

A. The County May Not Approve a Conditional Use that Is Forbidden by the County General Plan.

The Project is inconsistent with the County General Plan, and thus its approval would violate the Planning and Zoning Law. As acknowledged in *Neighborhood Action Group v. County of Calaveras* (“*Neighborhood*”) (1984) 156 Cal.App.3d 1176, 1184, the requirement that use permits be consistent with a county’s general plan

is necessarily to be implied from the hierarchical relationship of the land use laws. To view them in order: a use permit is struck from the mold of the zoning law ([Government Code section] 65901); the zoning law must comply with the adopted general plan (§ 65860); the adopted general plan must conform with state law (§§ 65300, 65302). The validity of the permit process derives from

compliance with this hierarchy of planning laws. *These laws delimit the authority of the permit issuing agency to act and establish the measure of a valid permit. . . .* A permit action taken without compliance with the hierarchy of land use laws is *ultra vires* as to any defect implicated by the uses sought by the permit.

Id. (emphasis added).

Because Imperial County is a general law county, the foregoing settled law is dispositive. Since, as shown below, the proposed solar energy generation and transmission uses are specifically forbidden under the Imperial County General Plan, the County lacks authority to approve those uses in contravention of the General Plan. Any “permit action taken without compliance with the hierarchy of land use laws is *ultra vires*.” *Id.*

B. The Imperial County General Plan Forbids the Proposed Solar Energy Generation and Transmission Uses.

The Imperial County General Plan’s Land Use Element specifically *forbids* the proposed solar uses within the “Agriculture” plan designation that applies to entire Project site. Initial Study at 2-4 (“The existing General Plan land use designation is ‘Agriculture’”). The Land Use Element directs that lands designated as “Agriculture” may not be developed with uses that do not preserve and protect agricultural production and related activities. It states in pertinent part as follows:

1. Agriculture.

This category is intended to preserve lands for agricultural production and related industries including aquaculture (fish farms), ranging from light to heavy agriculture. Packing and processing of agricultural products may also be allowed in certain areas, and other uses necessary or supportive of agriculture. . . .

Where this designation is applied, agriculture shall be promoted as the principal and dominant use to which all other uses shall be subordinate. Where questions of land use compatibility arise, the burden of proof shall be on the non-agricultural use to clearly demonstrate that an existing or proposed use does not conflict with agricultural operations and will not result in the premature elimination of such agricultural operations. No use should be permitted that would have a significant adverse effect on agricultural production, including food and fiber production, horticulture, floraculture, or animal husbandry. . . .

Imperial County General Plan, Land Use Element (Revised 2008), page 48 (emphasis added).

It is clear from the foregoing language that lands designated as “Agriculture” in the General Plan must be used *only* for agriculture and related industries that support agricultural production. “Where questions of land use compatibility arise, the burden of proof shall be on the non-agricultural use to *clearly demonstrate* that an existing or proposed use does not conflict with agricultural operations and will not result in the premature elimination of such agricultural operations.” *Id.* (emphasis added).

Here, it is undisputed that the proposed industrial-scale solar facility uses would terminate and prevent all agricultural use on the subject lands for at least the Project’s operational lifetime. Initial Study at 2-8 (the Project would cause “the conversion of Prime Farmland or Farmland of Statewide Importance to non-agricultural use”). As the California Department of Conservation has determined in both the Williamson Act and CEQA contexts, and reiterated in its November 1, 2011, and July 16, 2010 letters (attached hereto as Exhibits 1 and 2) to the Imperial County Planning and Development Services Department regarding other solar projects proposed for lands designated for Agriculture on the County General Plan, commercial solar uses are *completely incompatible* with agricultural uses.

Furthermore, the Project would impede agricultural operations on *surrounding* lands and reduce employment, income, sales and tax revenue in the County. As Imperial County Agricultural Commissioner Valenzuela noted in her February 25, 2011 comments (attached hereto as Exhibit 3) on the DEIR for a similar solar project, “removal of any farmland out of production would have a *direct negative impact on employment, income, sales and tax revenue.*” As these projects convert more and more agricultural land to non-agricultural uses, more and more agriculture-serving businesses will be forced to close. And as the quantity and quality of agriculture-serving businesses decreases in the County, more and more farmers will find it uneconomical or impractical to keep farming and sell, lease or use their lands for non-agriculture purposes.

Because the proposed solar energy generation and transmission uses at the Project sites would “conflict with agricultural operations,” result in the certain “elimination” of agricultural operations and “have a significant adverse effect on agricultural production,” both on the Project sites and elsewhere in the County, the Project is specifically forbidden by the General Plan.

C. The Project’s Incompatibility with the General Plan Agricultural Use Provisions Is Not Cured by Other Conflicting General Plan Provisions or the County Land Use Ordinance.

Despite the fact that the Project would “conflict with” and result in the certain “elimination” of “agricultural operations,” and “have a significant adverse effect on agricultural production,” the Initial Study prepared for the Project states that “[s]olar energy facilities are allowed” by the A-2 (General Agriculture), A-2-R (General Agricultural Rural Zone) and A-3 (Heavy Agriculture) zoning applicable to the Project sites “subject to a Conditional Use Permit.”

Initial Study at 2-8. The Initial Study is mistaken. The existing A-2, A-2-R and A-3 zoning on the Project sites is *inconsistent* with the General Plan's "Agriculture" designation.

As discussed, the Project is incompatible with the General Plan's explicit use standards for lands designated as "Agriculture." Not only would the proposed solar energy generation and transmission use conflict with existing (and future) agricultural operations and have a significant adverse effect on agricultural production *on* the Project sites by terminating and preventing all agricultural use on the sites for decades, it would impede agricultural operations elsewhere in the County as well. To the extent the County Land Use Ordinance – which by law is subordinate to the County General Plan – might be interpreted to allow uses such as the proposed solar facilities that are inconsistent with the General Plan's land use designations, that interpretation is invalid. Government Code § 65860(a); *Neighborhood*, 156 Cal.App.3d at 1184. And to the extent the General Plan Land Use Element's Compatibility Matrix approves zoning regulations that conflict with the Land Use Element's textual land use standards, the General Plan is internally inconsistent and invalid. Government Code § 65300.5 ("the Legislature intends that the general plan and elements and parts thereof comprise an integrated, internally consistent and compatible statement of policies for the adopting agency"); *Concerned Citizens of Calaveras County v. Board of Supervisors* (1985) 166 Cal.App.3d 90, 97 ("a general plan must be reasonably consistent and integrated on its face"); *Sierra Club v. Kern County* (1981) 126 Cal.App.3d 698, 704 ("Since the general plan was internally inconsistent, the zoning ordinance under review . . . could not be consistent with such plan and was invalid when passed.").

The County may not approve a land use in reliance on an invalid zoning regulation or General Plan element. "Under state law, the propriety of virtually any local decision affecting land use and development depends upon consistency with the applicable general plan and its elements. . . . [A]bsence of a valid general plan, or valid relevant elements or components thereof, precludes enactment of zoning ordinances and the like." *Resource Defense Fund v. County of Santa Cruz* (1982) 133 Cal.App.3d 800, 806; *Neighborhood*, 156 Cal.App.3d at 1104; *Concerned Citizens of Calaveras County*, 166 Cal.App.3d at 97. And where there is a clear violation of a specific general plan provision, mere compatibility with the overarching objectives of the plan is not enough to make a project consistent and compliant with the Plan as a whole. *Neighborhood*, 156 Cal.App.3d at 1184; *FUTURE v. Board of Supervisors* (1998) 62 Cal.App.4th 1332, 1342.

II. THE DEIR MUST CONTAIN A COMPLETE AND ACCURATE PROJECT DESCRIPTION, AND A ROBUST ANALYSIS OF PROJECT ALTERNATIVES AND IMPACTS.

Despite the fact that the proposed Project's industrial-scale electrical generation and transmission uses are prohibited by the County General Plan, the County has decided to develop a DEIR for the Project in preparation for considering the Project for approval. While Backcountry maintains that the County may not approve the Project under the current General

Plan, it nonetheless offers the following comments on and suggestions for the DEIR and any subsequent environmental review of the Project.

A. The DEIR Must Provide a Complete and Accurate Project Description.

“An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR.” *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 193. Here, the Initial Study and NOP omit many critical details about the Project that the County must provide in the DEIR.

For example, the Initial Study and NOP make no mention of the expected Project life of the length of the conditional use permits that would be issued for the Project. The County also fails to state who would purchase the electricity generated by the Project and where that electricity would be used.

In addition, the County fails to specify what type of solar PV technology the Project would use. Would the solar panels use silica-based solar cells or something else? Would the Project employ fixed or tracking PV arrays? Would the Project use concentrated PV?

The DEIR must provide all these details.

B. The DEIR Should, at Minimum, Analyze a Distributed Generation Alternative and a Off-Site Location Alternative.

To comply with CEQA, agencies must consider a “reasonable range” of alternatives. CEQA Guidelines §15126.6(a); *Village of Laguna Beach, Inc. v. Board of Supervisors* (1982) 134 Cal.App.3d 1022, 1028. To do so here, the County must analyze a distributed generation alternative (rooftop and other distributed solar generation sources, as well as non-solar options). A distributed generation alternative is both feasible and environmentally preferable to the proposed Project.

1. The DEIR Should Analyze a Distributed Generation Alternative.

a. Distributed Generation Is Feasible.

The evidence is clear: Distributed generation – including such sources as rooftop solar PV, small-scale rooftop wind turbines and combined heat and power plants – is both technically and economically feasible. Indeed, distributed generation is not only feasible, *it is already in use and rapidly expanding*. For example, SDG&E – a likely purchaser of the Project’s generated electricity – is on pace to add between 80 and 100 MW of distributed solar photovoltaic capacity in its service territory each year from 2014 through 2020. This new PV generation will be developed under the auspices of programs such as the Renewable Auction Mechanism program,

which the California Public Utilities Commission (“CPUC”) approved in December 2010.² Under that program, California will add 1,000 MW of local PV by 2015, 80.7 MW of which were allocated to SDG&E. SDG&E will also be allotted approximately 50 MW of local PV under the 750 MW SB 32 feed-in tariff distributed PV program.³ Furthermore, by the end of 2016, approximately 180 MW of distributed PV capacity will be added in SDG&E’s service territory under the California Solar Initiative “million solar roofs” program.⁴ Combined, approximately 410 MW of local PV capacity will be developed in SDG&E’s service territory by the end of 2015. And SDG&E has the ability to add much more, as its territory has at least 7,000 MW of urban and suburban PV potential.⁵

In addition to distributed PV, SDG&E is also on pace to add a substantial number of distributed combined heat and power plants over the next decade. Biogas- or biomethane-fired CHP plants are renewable portfolio standard-eligible, and there are up to 1,700 MW of currently estimated biogas and/or biomethane potential in California to fuel those plants.⁶ California’s AB 32 greenhouse gas compliance strategy calls for the development of 4,000 MW of CHP by 2020.⁷

² CPUC Decision D.10-12-048, “Decision Adopting the Renewable Auction Mechanism,” December 16, 2010, p. 30, Table 1, available at: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/128432.pdf.

³ CPUC feed-in tariff website, description of SB 32, available at: <http://www.cpuc.ca.gov/PUC/energy/Renewables/feedintariffsum.htm>.

⁴ California Center for Sustainable Energy, “Overview of Solar Incentive Programs,” October 9, 2009, p. 7, available at: <http://www.slideshare.net/ccsemedia/overview-ofsolar-incentive-programs>.

⁵ Powers, *San Diego Smart Energy 2020: The 21st Century Alternative*, October 2007, p. 48, available at: http://www.etechnicalinternational.org/new_pdfs/smartenergy/52008_SmE2020_2nd.pdf.

⁶ CEC PIER Program, Consultant Report, “Distributed Renewable Energy Assessment – Final Report,” August 11, 2009, Appendix Bio-Power, p. 49, available at: http://www.cleancoalition.org/storage/references/11-aug-09_Navigant_distributed%20renewable%20energy%20assessment_final%20report.pdf.

⁷ CPUC Decision D.10-12-035, “Decision Adopting Qualifying Facility and CHP Program Settlement Agreement,” December 16, 2010, available at: http://docs.cpuc.ca.gov/WORD_PDF/FINAL_DECISION/128624.PDF.

Since SDG&E supplies about 7 percent of the state's electricity,⁸ about 280 MW of new CHP should be allocated to and added in SDG&E's service territory by 2020 to comply with the AB 32 target.

And, as discussed below, expanding California's renewable energy portfolio with distributed instead of remote, industrial-scale generation will cause much less harm to the environment and public health, while also providing a more robust and sustainable economic stimulus.

b. Distributed Generation Is Better for the Environment and the Economy than Remote, Industrial-Scale Generation Projects Like the Iris Cluster Solar Farm Project.

Distributed energy projects such as rooftop solar PV have substantial environmental, aesthetic, economic and public safety benefits over remote, industrial-scale solar energy facilities such as the Iris Cluster Solar Project.⁹ They do not mar the landscape with massive and unsightly arrays of glare-producing PV and CPV panels, or their associated powerlines, substations and industrial operations and maintenance buildings. They are much less likely to ignite catastrophic wildfires. They do not displace agriculture and wildlife habitat. They present a much smaller threat to wildlife. They do not waste electricity due to conductor resistance and corona discharges along lengthy transmission lines.¹⁰ Their reliability is far greater. And they are easier to upgrade as technology improves.

In addition, as these solar PV technologies improve and the liability costs of utility-scale renewable energy facilities become clearer, the per-watt installed price for distributed solar PV

⁸ California Energy Commission, "2007 Integrated Energy Policy Report, December 2007," p. 27, Figure 1-11, available at: <http://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF.PDF>.

⁹ As former California Public Utilities Commission ("CPUC") Commissioner John Bohn acknowledged, "[u]nlike other generation sources, [distributed generation] projects can get built quickly and without the need for expensive new transmission lines. And . . . these projects are extremely benign from an environmental standpoint, with neither land use, water, or air emission impacts." CPUC, "CPUC Approves Edison Solar Roof Program," Press Release, June 18, 2009, available at: http://docs.cpuc.ca.gov/published/News_release/102580.htm.

¹⁰ The U.S. Energy Information Administration estimates that California lost nearly 18 million kilowatt-hours of electricity in 2010, due primarily to conductor resistance, corona discharges and other transmission and distribution line losses. Energy Information Administration, January 27, 2012, *State Electricity Profiles 2010*, DOE/EIA-0348(01)/2, at p. 30, available at: <http://www.eia.gov/electricity/state/pdf/sep2010.pdf>.

systems should soon drop below that of remote, utility-scale projects like the Iris Cluster Solar Project. In likely recognition of this trend, many utility-scale renewable energy project developers themselves agree that distributed generation is the future of renewable energy power. For example, NRG Energy, Inc., CEO David Crane stated the following in a 2011 call with financial analysts:

Ultimately, however, we fully recognize that the current generation of utility-sized solar and wind projects in the United States is largely enabled by favorable government policies and financial assistance. It seems likely that much of that special assistance is going to be phased out over the next few years, leaving renewable technologies to fend for themselves in the open market.

We do not believe that this will be the end of the flourishing market for solar generation. We do believe that it will lead to a *stronger and more accelerated transition from an industry that is currently biased towards utility-sized solar plants to one that's focused more on distributed and even residential solar solutions on rooftops and parking lots.*

We are already planning for this transition now within NRG, so that any potential decline in either the availability of utility-sized solar projects or in the attractiveness of the returns being realized on these projects, *will be exceeded in aggregate by the increase in the business we are doing on smaller distributed and residential solar projects* (emphasis added).¹¹

In sum, distributed generation is not only feasible, it is environmentally and economically preferable to remote, utility-scale renewable energy generation facilities like the Iris Cluster Solar Project.

2. The DEIR Should Analyze an Off-Site Location Alternative.

If anywhere, utility-scale electrical generation projects should be located on impaired or polluted lands ill-suited for other uses, rather than on some of the County's most productive agricultural land. For example, the County could work with the Project proponent (85JP 8MW, LLC), Westlands Water District, Kings County and Fresno County to locate future utility-scale energy projects within the Competitive Renewable Energy Zone on Westlands' vast expanses of sale- and drainage-impaired lands. The County should analyze this possibility in the DEIR.

¹¹ Seeking Alpha, April 22, 2011, "NRG Energy's CEO Discusses Q4 2010 Results – Earnings Call Transcript," at p. 7, *available at*: <http://seekingalpha.com/article/254272-nrg-energy-s-ceo-discusses-q4-2010-results-earnings-call-transcript> (attached hereto as Exhibit 4)

C. The DEIR Must Analyze the Project's Significant Agricultural Impacts.

As discussed above, the Project would have a significant impact on agricultural production by terminating and preventing all agricultural use of the subject lands for at least the Project's operational lifetime, and potentially indefinitely. In addition to rendering the Project's solar uses impermissible under the County General Plan, which is itself a significant environmental impact under CEQA,¹² the Project's agricultural impacts also constitute significant impacts that must be fully analyzed and mitigated in the County's DEIR.

Among the Project's numerous significant agricultural impacts are the loss of fertile topsoil and disruption of agricultural aircraft operations. With respect to local agricultural aircraft operations, the Project sites are located very close to the lone airport servicing agricultural spraying operations in the southeastern portion of the County (and one of only four such airports in the entire County). The airport and associated airstrip begin just to the east of Weed Road, in between Anza Road and California Route 98, and are owned and managed by Frontier Agricultural Services, Inc. ("Frontier"). The DEIR must analyze the Project's impacts to planes (primarily dusting and seeding planes) that use the Frontier airport, including glint and glare impacts from the Project's solar panels, as well as the significant risk posed to low-flying spraying aircraft from the Project's transmission lines and other facilities.

The DEIR must also analyze the Project's impacts on countywide agricultural operations, which the Project is likely to impede and thereby cause negative impacts on the agricultural economy and job market. The significant impact on agriculture-serving businesses of land

¹² CEQA jurisprudence recognizes that where, as here, general plan requirements are adopted to protect environmental quality, departure from those general plan standards constitutes evidence of a significant environmental impact. The Governor's Office of Planning and Research has made this clear in its *CEQA Technical Advice Series* (September 1994):

The agency should also rely upon its general plan as a source of environmental standards. For instance, policies for the conservation of agricultural land may yield a threshold based on soil type, project size, and water availability.

Id., "Thresholds of Significance: Criteria for Defining Environmental Significance." Here, the General Plan has gone one step further by specifically designating the subject sites for exclusively "Agriculture" use. Thus, it is clear that the General Plan's policy for the conservation of agricultural land plainly forbids the proposed solar use. Violation of this environmental standard demonstrates the significance of the Project's impacts on the environment. *The Pocket Protectors v. City of Sacramento* (2004) 124 Cal.App.4th 903, 930 (holding that "if substantial evidence supports a fair argument that the proposed project conflicts with [the applicable land use policies and regulations, and those policies were adopted *in order to avoid or mitigate environmental impacts*], this constitutes grounds for requiring an EIR").

fallowing and conversion of farmland to other uses is well established. As Agricultural Commissioner Valenzuela stated in her comments on the DEIR for a similar solar project, “removal of any farmland out of production would have a direct negative impact on employment, income, sales and tax revenue.” Exhibit 3. These impacts are substantially greater when the cumulative effects of all the proposed utility-scale energy projects in the County are considered together. The County must assess these cumulative impacts in the DEIR along with the Project-specific impacts.

D. The DEIR Must Analyze the Project’s Impacts on the Greater Sandhill Crane, the Burrowing Owl and Other Listed, Rare and Important Species.

As the Initial Study acknowledges, the Project would have potentially significant impacts to the Greater sandhill crane and burrowing owls. Initial Study at 2-10. According to the Initial Study,

The Greater sandhill crane is state listed as threatened and is also on the Migratory Bird Treaty Act list of sensitive birds. The Greater sandhill crane could be found foraging in alfalfa or bermuda fields found on site. The Project sites also may have the potential to be used as burrowing owl foraging habitat as agricultural fields on site support prey for owls.

Id. The DEIR must thoroughly analyze the Project’s impacts to these important species.

Among the numerous avian impacts that the Project would have and that must be examined in the DEIR are the following. First, the Project may create a dangerous “lake” effect, in which the glare and reflection from the PV solar panels appears as a large body of water to birds flying above the facility, which can in turn entice them to dive downwards and collide with the solar panels.¹³ Second, the thousands of Project photovoltaic panels would present a substantial collision risk to burrowing owls, particularly given that the height of the panels – up to 30 feet above the ground – would likely be about the same height at which the owls typically forage. Third and relatedly, the photovoltaic panels would also greatly hinder the owls’ ability to forage. Fourth, to the extent the Project would eliminate burrowing animals and their burrows from the Project sites, it would significantly impact the owls by (1) reducing the abundance of prey for the owls, and (2) destroying their nesting habitat, as burrowing owls use burrows created by other animals instead of making their own. The County must analyze these impacts prior to Project approval rather than rely on impermissibly deferred mitigation measures such as *post*-approval owl surveys of the Project sites and *subsequent* development of a burrowing owl mitigation plan.

¹³ See Chris Clarke, July 10, 2013, “Endangered Bird Found Dead at Desert Solar Power Facility,” Rewire, *KCET* (attached hereto as Exhibit 5)

The County must also fully investigate, via field surveys and a careful literature review, whether the Project would impact any of the species listed as endangered or threatened under the federal and state Endangered Species Acts. The federally listed species known or believed to occur in Imperial County include those listed in the U.S. Fish and Wildlife Service's Species by County Report for Imperial County.¹⁴ The state-listed species can be found on the California Department of Fish and Game's website.¹⁵

The County should also require that, prior to any Project approval, the Project proponent and/or operator consult with the U.S. Fish and Wildlife Service on complying with the Migratory Bird Treaty Act.

E. The DEIR Must Identify Likely Water Sources for the Project.

CEQA requires the County to identify in its DEIR the likely water sources for the Project, including both the construction and operational phases, and analyze the "environmental impacts of exploiting those sources" and "how those impacts are to be mitigated." *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 421 (quote), 434, 440-441. "An EIR that neglects to explain the likely sources of water and analyze their impacts, but leaves long-term water supply considerations to later stages of the project, does not serve the purpose of sounding an environmental alarm bell." *Id.* at 441 (internal quotations and citation omitted).

F. The DEIR Must Analyze the Project's Electromagnetic Field Impacts.

The County must analyze the Project's electromagnetic field ("EMF") impacts in the DEIR. The Initial Study contains no mention or analysis of these impacts despite increasing scientific evidence that EMF exposure can cause severe health impacts. Recent studies, such as those by Dr. Samuel Milham and Dr. Magda Havas, have linked EMF exposure with an increase in ailments such as diabetes, fibromyalgia, chronic fatigue syndrome and attention deficit disorder, among others.¹⁶ Similarly, as reported in Jeffrey Lovich's and Joshua Ennen's recent

¹⁴ The Fish and Wildlife Service's Species by County Report for Imperial County is available online at:
http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=06025

¹⁵ <http://www.dfg.ca.gov/wildlife/nongame/list.html>

¹⁶ See, e.g., Samuel Milham, "Attention Deficit Hyperactivity Disorder and Dirty Electricity," *Journal of Developmental and Behavioral Pediatrics*, September 2011 (attached hereto as Exhibit 6); Samuel Milham, "Historical Evidence That Electrification Caused the 20th Century Epidemic of 'Diseases of Civilization,'" *Medical Hypotheses*, 74:337-345, 2010 (attached hereto

BioScience article, Doctor Alfonso Balmori (in a 2010 article) found the “possible impacts of chronic exposure to athermal electromagnetic radiation” on mammal species to include “damage to the nervous system, disruption of circadian rhythms, changes in heart function, impairment of immunity and fertility, and genetic and developmental problems.” Exhibit 9 at 987. Furthermore, even though there remains some disagreement over the impacts of EMF, many “authors suggest that [this] . . . should not be cause for inaction. Instead, they argue that the precautionary principle should be applied in order to prevent a recurrence of the ‘late lessons from early warnings’ scenario that has been repeated throughout history.” *Id.*

G. The DEIR Must Analyze the Project’s Audible, Inaudible, High-Frequency and Low-Frequency Noise Impacts.

The Initial Study states that “[n]o further analysis [of noise impacts] is warranted.” Initial Study at 2-18. Not so. The DEIR must fully analyze the Project’s audible, inaudible, high-frequency and low-frequency noise impacts, including noise from the Project’s multiple inverters.

In analyzing the Project’s audible noise impacts, the County should normalize its noise emission estimates to account for the fact that the Project area is a rural community with little to no prior exposure to industrial noise, such as would be produced by Project. In addition, the County should analyze not only the Project’s audible noise emissions and impacts, but its inaudible infrasound and low-frequency noise emissions too, which have recently been shown to have a much greater potential to impact humans than previously thought.¹⁷

as Exhibit 7); Samuel Milham and L. Lloyd Morgan, “A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School,” *American Journal of Industrial Medicine*, 2008 (attached hereto as Exhibit 8); Magda Havas, “Dirty Electricity Elevates Blood Sugar among Electrically Sensitive Diabetics and May Explain Brittle Diabetes,” *Electromagnetic Biology and Medicine*, 27:135-146, 2008; Magda Havas, “Electromagnetic Hypersensitivity: Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis,” *Electromagnetic Biology and Medicine*, 25:259-268, 2006, available at: http://www.next-up.org/pdf/Magda_Havas_EHS_Biological_Effets_Electricity_Emphasis_Diabetes_Multiple_Sclerosis.pdf; The National Foundation for Alternative Medicine, “The health effects of electrical pollution,” available at: http://d1fj3024k72gdx.cloudfront.net/health_effects.pdf.

¹⁷ “[I]nfrasound elicits larger electrical potentials in the apical regions of the cochlea than those generated by any other frequencies in the range of audibility. . . . The apical regions of the cochlea should therefore be regarded as highly responsive to infrasound stimulation with responses occurring at stimulus levels well below the estimated level that is perceived” (*i.e.*

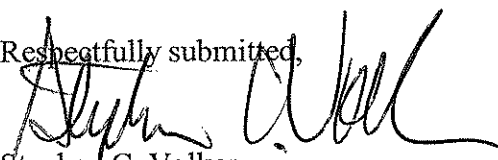
H. The DEIR Must Analyze the Project's Direct, Indirect and Embedded Greenhouse Gas Emissions.

The County admits in the Initial Study that the "Projects have the potential to generate greenhouse gas emissions during construction, in addition to construction worker trips to and from the Project sites." Initial Study at 2-13. But the County must do more in the DEIR than just analyze the global warming impacts of Project construction. The County must also (1) assess the Project's substantial *embedded* greenhouse gas emissions: the GHG emissions associated with production of the materials used to construct the Project, such as the photovoltaic panels; and (2) compute the change in GHG emissions from and carbon sequestration in the soil on the Project site resulting from the Project's conversion of the land from agricultural production to the proposed solar farm. Additionally, the County must ascertain whether the electricity produced by the Project would actually either (1) supplant electricity currently generated by fossil fuel-based systems, or (2) meet a future energy demand that would otherwise be met with fossil fuel-based generation.

III. CONCLUSION

The Project's industrial use of lands designated "Agriculture" is specifically forbidden by the Imperial County General Plan. Therefore the County may not approve the Project. Despite this the County has decided to develop a DEIR for the Project. While Backcountry maintains that the County may not approve the Project under the current General Plan, it nonetheless provides the foregoing scoping comments for the Project DEIR. Among other CEQA tasks, the County must fully analyze in the DEIR the reasonable Project alternatives and adverse impacts identified by Backcountry above, and identify and evaluate mitigation measures that would avoid or reduce those impacts to insignificance.

Respectfully submitted,



Stephan C. Volker
Backcountry Against Dumps, Donna Tisdale and
Carolyn Allen

SCV:taf

heard). Salt *et al.*, 2013, "Large Endolymphatic Potentials from Low-Frequency and Infrasonic Tones in the Guinea Pig," *The Journal of the Acoustical Society of America*, 133(3): 1561-1571, at p. 1569 (attached hereto as Exhibit 10).

LIST OF EXHIBITS

1. John M. Lowrie, California Department of Conservation, Letter to Armando Villa re: Cancellation of Land Conservation (Williamson Act) Contract No. 2001-00706, November 1, 2011;
2. Dan Otis, California Department of Conservation, Letter to Patricia Valenzuela re: Notice of Preparation for a DEIR for Imperial Solar Energy Center South, July 16, 2010;
3. Connie L. Valenzuela, Imperial County Agricultural Commissioner, Letter to Armando Villa re: CUP 10-0035 8 Minutenergy Renewables, LLC, Calipatria Solar Farm II, February 25, 2011;
4. Seeking Alpha, April 22, 2011, “NRG Energy’s CEO Discusses Q4 2010 Results – Earnings Call Transcript;”
5. Chris Clarke, July 10, 2013, “Endangered Bird Found Dead at Desert Solar Power Facility,” Rewire, *KCET*;
6. Milham, Samuel, September 2011, “Attention Deficit Hyperactivity Disorder and Dirty Electricity,” Letter to Editor, *Journal of Developmental and Behavioral Pediatrics*;
7. Milham, Samuel, 2010, “Historical Evidence That Electrification Caused the 20th Century Epidemic of ‘Diseases of Civilization.’” *Medical Hypotheses*, 74:337-345;
8. Milham, Samuel & L. Lloyd Morgan, 2008, “A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated with Increased Cancer Incidence in Teachers in a California School,” *American Journal of Industrial Medicine*;
9. Lovich, Jeffrey E., and Joshua R. Ennen, 2011, “Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States,” *BioScience* 61(12):982-992;
10. Salt *et al.*, 2013, “Large Endolymphatic Potentials from Low-Frequency and Infrasonic Tones in the Guinea Pig,” *The Journal of the Acoustical Society of America*, 133(3): 1561-1571.

EXHIBIT

1



DEPARTMENT OF CONSERVATION

Managing California's Working Lands

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-0850 • FAX 916 / 327-3430 • TDD 916 / 324-2555 • WEBSITE conservation.ca.gov

November 1, 2011

Mr. Armando G. Villa, Director
Imperial County
Department of Planning and Development Services
801 Main Street
El Centro, CA 92243

Dear Mr. Villa:

SUBJECT: Cancellation of Land Conservation (Williamson Act) Contract
No. 2001-00706; Landowner: James R. & Barbara A. Smith; Applicant: 8
Minute Energy (Calipatria Solar Farm II); APN 022-170-005

The Department of Conservation (Department) monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act. The Department has reviewed the application submitted by the Imperial County Department of Planning and Development Services (County) regarding the referenced cancellation and offers the following recommendations.

Project Description

The petition proposes to cancel 563 acres of agricultural land subject to Williamson Act Contract in order to build a photovoltaic energy facility (Project) which will generate a total of 50 megawatts. The Project Site is located approximately one mile north of Calipatria, California within Imperial County and is bounded by Blair Road to the east, E. Peterson Road to the north, W. Lindsey Road to the south and the Southern Pacific Railroad to the west. The Calipatria State Prison is located to the northeast of the project site. According to the petition, the applicant has submitted a Conditional Use Permit for a 40 year term.

Cancellation Findings

Government Code (GC) section 51282 states that tentative approval for cancellation may be granted only if the local government makes *either* one of the following findings:

- 1) Cancellation is **consistent** with purposes of the Williamson Act, (not addressed by the cancellation petition) **or**
- 2) Cancellation is in the **public interest**.

The following are the requirements for the public interest findings required under GC section 51282 (above):

The Department of Conservation's mission is to balance today's needs with tomorrow's challenges and foster intelligent, sustainable, and efficient use of California's energy, land, and mineral resources.

2) Cancellation is in the Public Interest

For the cancellation to be in the public interest, the Board must make both of the following findings:

- a. Other public concerns substantially outweigh the objectives of the Williamson Act, and
- b. There is no *proximate, noncontracted land*¹ which is available and *suitable*² for the use proposed on the contracted land, or, development of the contracted land would provide more contiguous patterns of urban development than development of proximate noncontracted land.

Department Comments on the Public Interest Cancellation Findings

The Department has reviewed the petition and additional information supplied by the applicant, and offers the following comments with regards to the submitted public interest findings:

a) Other public concerns substantially outweigh the objectives of the Williamson Act: Renewable energy is energy generated from sources such as the sun, wind, the ocean, and the earth's core. Solar photovoltaic electricity qualifies as a renewable energy source for the purposes of California's Renewables Portfolio Standards. In April, Governor Brown signed Senate Bill 2 (First Extraordinary Session) which extends the current 20% renewables portfolio standard target in 2010 to a 33% renewables portfolio standard by December 31, 2020. Through a number of legislative actions and/or policies, the State has placed an importance on renewable energy as well as preserving farmland.

There are many factors in determining whether the production of solar energy is of a higher public interest than the pre-existing agricultural use of the land. Some factors may include the quality of the soil, current agricultural production and the availability of reliable irrigation water. The Department has no comment regarding this particular finding.

¹ "Proximate, noncontracted land" means land not restricted by contract, which is sufficiently close to land which is so restricted that it can serve as a practical alternative for the use which is proposed for the restricted land. (GC section 51282).

² "Suitable" for the proposed use means that the salient features of the proposed use can be served by the land not restricted by contract. Such nonrestricted land may be a single parcel or may be a combination of contiguous or discontiguous parcels. (GC section 51282).

b) *There is no available and suitable proximate non-contracted land for the use proposed on the contracted land:*

According to the petition, the property was chosen due to its close proximity to the electrical grid which has the capacity for the solar facility. The Department has no comment regarding this particular finding.

Cancellation Findings Conclusion

Imperial County Board of Supervisors could approve the cancellation application based on the required public interest findings only if the Board feels it has adequate amount of information and has built the record to meet the statutory requirements.

Compatible Use

The Department has determined that commercial solar facilities are an industrial use of the land and inconsistent with the intent of the Williamson Act and its protection of open space and agricultural resources. The suggestion that a solar facility is a compatible use as defined by the Williamson Act is misguided. The footprint of a solar facility and the fact that it does not allow for the continuation of agricultural operations or open space activities as the main operation of the land, make it inconsistent with many different sections of the Act. The Department views GC §51238, which cites the compatibility of gas, electric, water, communication, or agricultural labor housing facilities in an *agricultural preserve*, as referring to those structures which have minimal impact on the land, and which are necessary for the needs of a community. The Department has consistently interpreted this section to describe overhead power lines, electrical substations, underground communication lines, and water lines, all of which take up a minimal amount of land.

Additionally, the Williamson Act provides a preferential tax assessment on contracted land in exchange for limiting the land to agricultural or open space uses. Agricultural use means the use of the land for the purpose of producing an agricultural commodity for commercial purposes (GC§51201(a)). Open space is the use or maintenance of land in a manner that preserves its natural characteristics, beauty, or openness for the benefit and enjoyment of the public or for wildlife habitat (GC§51201(o)). A commercial solar facility does not meet the definition of an agricultural use and solar energy does not meet the definition of an agricultural commodity, which means any and all plant and animal products produced in this State for commercial purposes. Nor is it consistent with the definition of an open space use. In addition, GC§51242 requires that land enrolled in a Williamson Act contract be devoted to agricultural use. When a solar project displaces all of the agriculture, and replaces it with a use that has no agricultural utility, the land clearly ceases to be devoted to agriculture.

Mr. Armando G. Villa
November 1, 2011
Page 4 of 4

Neither the Legislature nor City Councils or Boards of Supervisors can override the restrictions included within the Williamson Act or the Constitutional provision enabling the Act. The construction of solar facilities removes and replaces agriculture or open space uses to have a significant impact on agricultural and open space lands, including grazing land. After a review of the proposal, the Department does not believe that the County can consider commercial solar facilities compatible with the Williamson Act contract.

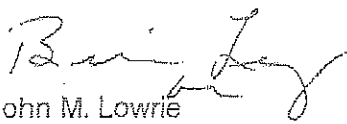
Site Restoration Plan

Since solar technology is advancing rapidly over time, the amount of open land that is needed for the same amount of solar energy production may decrease significantly in the future. That same land may also one day be needed again for the production of food.

It is important that proposals for the conversion of agricultural land to solar energy projects include a detailed site restoration plan describing how the project proponents will restore the land back to its current condition including irrigation supplies if and when some or all of the solar panels are removed. This type of plan would be similar to SMARA-required restoration plans on proposed mining sites. The Department recommends that an acceptable site restoration plan be required by the County for the proposed project.

Thank you for the opportunity to provide comments on the proposed cancellation. Please provide our office with a copy of the Notice of Public Hearing on this matter ten (10) working days before the hearing and a copy of the published notice of the Board's decision within thirty (30) days of the tentative cancellation pursuant to GC section 51284. If you have any questions concerning our comments, please contact Sharon Grewal, Environmental Planner at (916) 327-6643.

Sincerely,


John M. Lowrie
Program Manager
Williamson Act Program

EXHIBIT

2



DEPARTMENT OF CONSERVATION

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-0850 • FAX 916 / 327-3430 • TDD 916 / 324-2555 • WEBSITE conservation.ca.gov

July 16, 2010

VIA FACSIMILE (760) 353-8338

Ms. Patricia Valenzuela, Planner III
Imperial County Planning & Development Services
801 main Street
El Centro, CA 92243

Subject: Notice of Preparation for a DEIR for Imperial Solar Energy Center South
- SCH# 2010061038

Dear Ms. Valenzuela:

The Department of Conservation's (Department) Division of Land Resource Protection (Division) has reviewed the Notice of Preparation (NOP) for a DEIR for Imperial Solar Energy Center South. The Division monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act and other agricultural land conservation programs. We offer the following comments and recommendations with respect to the proposed project's potential impacts on agricultural land and resources.

Project Description:

The project is located on Pullman Road and Anza Road in an unincorporated part of Imperial County on the US/Mexico Border. The project site is 903 acres of agricultural land. The site is designated Prime Farmland and Farmland of Statewide Importance per the Imperial County Farmland Mapping and Monitoring Program maps. The existing General Plan designation is Agriculture and the zoning is General Agriculture Rural Zone and Heavy Agriculture.

The project proposes the development of a solar energy center and would consist of ground mounted photovoltaic solar power generation system, supporting structures, an operations and maintenance building, substation, water treatment facility, plant control system, meteorological station, roads and fencing. The project also plans a 120-foot wide Right-of-Way from the project site, along BLM land, within BLM's designated Utility Corridor "N" to the Imperial Valley Substation.

Division Comments:

The initial study for the NOP stated that because solar generation facilities are an allowed use within the zone district and subject to a conditional use permit, they do not conflict with existing zoning for agriculture and thus no impact is identified. However, the entire purpose of going through the conditional use permit process is to trigger a thorough CEQA review of a project's potential impacts. The development of 903 acres of Prime Farmland and Farmland of Statewide Importance is a substantial amount of development and displacement of agricultural resources.

The Department of Conservation considers the construction of a solar facility that removes and replaces agriculture on agricultural lands to have a significant impact on those agricultural lands, including grazing land. While solar panels may be an allowed use under the County zoning and General Plan, they can and should be considered an impact under CEQA to the project site's agricultural resources.

Although direct conversion of agricultural land is often an unavoidable impact under California Environmental Quality Act (CEQA) analysis, mitigation measures must be considered. A principal purpose of an EIR is to present a discussion of mitigation measures in order to fully inform decision-makers and the public about ways to lessen a project's impacts. In some cases, the argument is made that mitigation cannot reduce impacts to below the level of significance because agricultural land will still be converted by the project, and, therefore, mitigation is not required. However, reduction to a level below significance is not a criterion for mitigation. Rather, the criterion is feasible mitigation that lessens a project's impacts. Pursuant to CEQA Guideline §15370, mitigation includes measures that "avoid, minimize, rectify, reduce or eliminate, or compensate" for the impact. For example, mitigation includes *"Minimizing impacts by limiting the degree or magnitude of the action and its implementation (§15370(b))"* or *"Compensating for the impact by replacing or providing substitute resources or environments (§15370(e))."*

All measures allegedly feasible should be included in the DEIR. Each measure should be discussed, as well as the reasoning for selection or rejection. A measure brought to the attention of the Lead Agency should not be left out unless it is infeasible based on its elements.

Finally, when presenting mitigation measures in the DEIR, it is important to note that mitigation should be specific, measurable actions that allow monitoring to ensure their implementation and evaluation of success. A mitigation consisting only of a statement of intention or an unspecified future action may not be adequate pursuant to CEQA.

Project Impacts on Agricultural Land

When determining the agricultural value of the land, the value of a property may have been reduced over the years due to inactivity, but it does not mean that there is no longer any agricultural value. The inability to farm the land, rather than the choice not to do so, is what could constitute a reduced agricultural value. The Division recommends the following discussion under the Agricultural Resources section of the Draft EIR:

- Type, amount, and location of farmland (Prime, Unique, and Farmland of Statewide Importance) conversion that may result directly and indirectly from project implementation and growth inducement, respectively.
- Impacts on current and future agricultural operations; e.g., land-use conflicts, increases in land values and taxes, etc.
- Incremental project impacts leading to cumulative impacts on agricultural land. This would include impacts from uses allowed with the proposed solar facility, as well as impacts from past, current, and likely projects in the future.

Under California Code of Regulations Section 15064.7, impacts on agricultural resources may also be both quantified and qualified by use of established thresholds of significance. As such, the Division has developed a California version of the USDA Land Evaluation and Site Assessment (LESA) Model. The California LESA model is a semi-quantitative rating system for establishing the environmental significance of project-specific impacts on farmland. The model may also be used to rate the relative value of alternative project sites. The LESA Model is available on the Division's website at:

http://www.consrv.ca.gov/DLRP/qh_lesa.htm

Solar Facility Mitigations and Reclamation Plan

If the solar facility is considered a temporary displacement of agricultural resources, then there should be some assurances that it will be temporary and will be removed in the future. Hence the need for a reclamation plan. The loss of agricultural land (even temporary) represents a reduction in the State's agricultural land resources. The Division has witnessed the negative impacts of non-operational wind power generation facilities and related equipment that have been left to deteriorate on agricultural land. For that reason, the Division offers a variety of permitting conditions the County might use for energy projects on agricultural land:

- Require a reclamation plan suited for solar facilities, based on the principles of the Surface Mining and Reclamation Act (SMARA). As part of this plan, a performance bond or other similar measure may be used.
 - A typical requirement would be for the soil to be restored to the same condition it was in prior to the solar facility's construction. Whatever project-related materials have been brought in, or changes made to the land (i.e. graveling, roads, compaction, equipment), would be removed once the solar facility (or portions of) is no longer active.
- Solar projects are generally considered to be "temporary". The County could require that a new permit must be applied for after a certain period of time. Because this is a new and unprecedented use for agricultural land, this would allow the County more flexibility in determining what conditional uses or conditions may be most appropriate in the longer term.
- Require permanent agricultural conservation easements on land of at least equal quality and size as partial compensation for the direct loss of agricultural land.
 - Conservation easements will protect a portion of those remaining agricultural land resources and lessen project impacts in accordance with California Environmental Quality Act (CEQA) Guideline §15370. The Department highlights this measure because of its acceptance and use by lead agencies as an appropriate mitigation measure under CEQA and because it follows an established rationale similar to that of wildlife habitat mitigation.

Mitigation via agricultural conservation easements can be implemented by at least two alternative approaches: the outright purchase of easements or the donation of mitigation fees to a local, regional or statewide organization or agency whose purpose includes the acquisition and stewardship of agricultural conservation easements. The proposed conversion of agricultural land should be deemed an impact of at least regional significance. Hence, the search for replacement lands can be conducted regionally or statewide, and need not be limited strictly to lands within the project's surrounding area. Mitigation for the loss of Prime Farmland

Ms. Patricia Valenzuela
July 16, 2010
Page 4 of 4

is suggested at a 2:1 ratio due to its importance in the State of California. The use of conservation easements is only one form of mitigation, and any other feasible mitigation measures should also be considered. Mitigations for temporary solar projects can also be flexible, especially in cases where there is a reclamation plan in place that requires the land to be returned to an agricultural state.

The Department also has available a listing of approximately 30 "conservation tools" that have been used to conserve or mitigate project impacts on agricultural land. This compilation report may be requested from the Division at the address or phone number at the conclusion of this letter. Of course, the use of conservation easements is only one form of mitigation that should be considered. Any other feasible mitigation measures should also be considered.

Thank you for giving us the opportunity to comment on the Notice of Preparation for a DEIR for Imperial Solar Energy Center South project. Please provide this Department with a copy of the DEIR, the date of any hearings for this particular action, and any staff reports pertaining to it. If you have questions regarding our comments, or require technical assistance or information on agricultural land conservation, please contact Meri Meraz, Environmental Planner, at 801 K Street, MS 18-01, Sacramento, California 95814, or by phone at (916) 445-9411.

Sincerely,

A handwritten signature in blue ink, appearing to read "Dan Otis", with a stylized flourish at the end.

Dan Otis
Program Manager
Williamson Act Program

cc: State Clearinghouse

Imperial County Farm Bureau
1000 Broadway
El Centro, CA 92243
FAX (760) 352-0232

EXHIBIT

3

Connie L. Valenzuela
Agricultural Commissioner
Sealer of Weights and Measures

Linda S. Evans
Assistant Agricultural Commissioner/
Asst. Sealer of Weights and Measures

IMPERIAL COUNTY
AGRICULTURAL COMMISSIONER
SEALER OF WEIGHTS AND MEASURES

852 Broadway
El Centro, CA 92243

(760) 482-4314
Fax: (760) 353-9420

E-mail: agcom@co.imperial.ca.us

February 25, 2011

Armando G. Villa
Planning & Development Services Director
801 Main Street
El Centro, CA 92243

RE: CUP 10-0035 8 Minutenergy Renewables, LLC, Calipatria Solar Farm II

The project entails the construction, development and operation of a ground mounted 50 MW Photovoltaic solar energy facility. The proposed solar plant will convert approximately 563 acres of privately owned farmland to non-farm use. The project will be located approximately one mile north of Calipatria, California in Imperial County and is bounded by Blair Road to the east, E. Peterson Road to the north, W. Lindsey Road to the south, and the Southern Pacific Railroad to the west. Agricultural lands lie to the immediate north, south, east and west of the project. The Calipatria State Prison is located to the northeast of the project site. An algae farm (Earthrise Farms) is located adjacent to the northwest corner of the site across the Southern Pacific Railroad tracks.

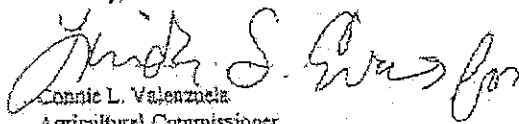
The California Department of Conservation has classified the property as Farmland of Statewide Importance. This farmland supports crops that contribute directly to Imperial County's \$1.45 billion gross agricultural production value. Temporary or permanent removal of any farmland out of production would have a direct negative impact on employment, income, sales and tax revenue.

During the construction phase and perhaps afterwards depending on whether this project will have some level of permanent staffing, neighboring agricultural operations would be impacted and restricted in their ability to use some pesticides or some pesticide application methods. Also, any complaints received by the construction site regarding nearby agricultural operations would need to be investigated; costs incurred to conduct investigations into incidents and complaints are not directly reimbursed by the state.

Since the project will be surrounded by farmland it will be exposed to higher than normal levels of dust and potential pesticide drift which will likely increase the cleaning requirements of the panels.

The land under the solar panels could harbor pests including noxious weeds, plant diseases, insects, and vertebrates which are detrimental to agriculture and could cause damage to adjacent fields and crops. This could be a problem if a cover crop is used for dust control and needs to be addressed or mitigated. In addition to direct crop damage caused by pests, if these solar panels are located next to or near any produce or organic fields, they could create food safety issues (i.e. E. coli in spinach caused by animal dropping getting into the field). Many produce growers today have to comply with Leafy Greens Agreements to ensure product safety.

Sincerely,


Connie L. Valenzuela
Agricultural Commissioner
Sealer of Weights and Measures

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FEB 25 2011

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

EEC ORIGINAL PKG

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4

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NRG Energy's CEO Discusses Q4 2010 Results - Earnings Call Transcript

February 22, 2011 | about: [NRG](#)

Executives

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Christian Schade - Chief Financial Officer and Executive Vice President

Mauricio Gutierrez - Chief Operating Officer and Executive Vice President

Nahla Azmy - Vice President of Investor Relations

Jason Few - SVP of Mass Markets and Operations, Reliant Energy, Inc.

Analysts

Anthony Crowdell - Jefferies & Co

Dan Eggers - Crédit Suisse AG

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

Charles Fishman - Pritchard Capital Partners, LLC

Jonathan Arnold - Deutsche Bank AG

Ameet Thakkar - BofA Merrill Lynch

Theodore Durbin - Goldman Sachs Group Inc.

James Dobson - Wunderlich Securities Inc.

Brian Chin - Citigroup Inc

NRG Energy (NRG) Q4 2010 Earnings Call February 22, 2011 9:00 AM ET

Operator

Good day, ladies and gentlemen, and welcome to the Fourth Quarter and Full Year 2010 NRG Energy Earnings Conference Call. My name is Deanna, and I'll be your operator for today. [Operator Instructions] And I would now like to turn the call over to your host for today, Ms. Nahla Azmy, Senior Vice President of Investor Relations. Please proceed.

Nahla Azmy

Thank you, Deanna. Good morning, and welcome to our Fourth Quarter and Full Year 2010 Earnings Call.

This call is being broadcast live over the phone and from our website at www.nrgenergy.com. You can access the call presentation and press release through a link on the Investor Relations page of our website. A replay of the call will also be available on our website. This call, including the formal presentation and the question-and-answer session, will be limited to one hour. In the interest of time, we ask that you please limit yourself to one question with just one follow-up.

And now for the obligatory Safe Harbor statement. During the course of this morning's presentation, management will reiterate forward-looking statements made in today's press release regarding future events and financial performance. These forward-looking statements are subject to material risks and uncertainties that could cause actual results to differ materially from those in the forward-looking statements. We caution you to consider the important risk factors contained in our press release and other filings with the SEC that could cause actual results to differ materially from those in the forward-looking statements in the press release and this conference call.

In addition, please note that the date of this conference call is February 22, 2011, and any forward-looking statements that we make today are based on assumptions that we believe to be reasonable as of this date. We undertake no obligation to update these statements as the result of future events except as required by law.

During this morning's call, we will refer to both GAAP and non-GAAP financial measures of the company's operating financial results. For complete information regarding our non-GAAP financial information, the most directly comparable GAAP measures and a quantitative reconciliation of those figures, please refer to today's press release and this presentation.

And now with that, I'd like to turn the call over to David Crane, NRG's President and Chief Executive

Officer.

David Crane

Thank you, Nahla, and good morning, everyone, and welcome to our year-end 2010 earnings call. Today, with me, and participating in the presentation is Mauricio Gutierrez, the company's Chief Operating Officer; and Chris Schade, the company's Chief Financial Officer. Also with me today and available to answer questions are Jason Few, who runs NRG's retail company, Reliant; and Chris Moser, who runs the commercial operations function for this company.

So without further ado, to begin -- so ladies and gentlemen, current and perspective shareholders of NRG, as we speak today, it's now been 32 months since natural gas prices began their relentless fall and the economy at large entered into a great recession, the likes of which, I'm sure none of us wish to experience again in our lifetimes, yet the financial performance of NRG during this period has been superb. And that financial performance has been built on the foundation of an equally exceptional operating performance across all phases of our operations and across all our regions.

In 2010, the second full year of the great recession, our financial performance surpassed all previous years of company results, save for fiscal year 2009, which was of course the first year of the great recession, a year in which we performed spectacularly, achieving both record financial performance and the acquisition of Reliant.

While I am, for the most part, extremely pleased with both the company's financial and its operating performance during 2010, I am acutely mindful of the fact that NRG shareholders did not see any of the benefits of our exceptional performance and share price appreciation during that year. As a management team, we recognize that we have a long way to go in presenting NRG's present value and future potential to the market.

In this presentation and in subsequent presentations that Mauricio, Chris and I will be making during the spring Investor Relations season, we intend to make a concerted effort to explain the NRG value proposition. From the competitive strength of our core businesses, even in a low commodity price environment, to the meaningful and measurable value of our growth opportunities, as well as our effective risk mitigation in areas which we believe to be of concern to the investment community.

So starting with 2010, as summarized on Slide 3, the company continued to generate a very high level of EBITDA in excess of \$2.5 billion and also throw off a substantial amount of free cash flow. Indeed, in regard to what should perhaps be the most important metric to shareholders, free cash flow yield, our free cash flow yield for 2010 was a robust 29%, making our seven-year average exceed 23%. And in response to some people who said that we should measure free cash flow for these purposes after both maintenance and environmental CapEx, we have done it in that way but before growth CapEx.

A substantial amount of that free cash flow yield was redeployed back to stakeholders in the form of debt repayment and through our 2010 share buyback program and also into various growth initiatives, which we'll discuss in a minute. But over \$650 million of excess free cash flow was returned as cash into the company's coffers, with the result being that our liquidity position at the end of 2010, \$4.3 billion of total liquidity with \$3 billion of cash on hand, is stronger than it has ever been.

It has always been my position that next to safety, the most important thing that we do as executive management at NRG is capital allocation, and given the amount that we are investing on an annual basis and the record amount that we currently have available either to invest in growth or to return to our equity and debt stakeholders, capital allocation has never been more important than it is now. As

such, I'm going to focus the greater part of my remaining remarks on capital, which we expect to invest in our growth initiatives in the months and years to come. Chris will focus a good deal of his comments on capital to be returned to stakeholders.

In terms of the allocation of capital to our growth initiatives, it's important to start with the obvious point that we want to invest the company's capital in assets and initiatives that not only are likely to yield a return significantly in excess of our risk-adjusted weighted average cost of capital, but also in businesses and initiatives which advance the company's strategy.

As depicted on Slide 4, the company's long-term strategy for some time has been twin-tracked. First, to strengthen and enhance our generation to retail business in our core markets through superior operating performance, continued implementation of our first-lean-enabled, long-term hedging program and pursuit of both select acquisitions and the repowering of our older facilities with advantage locations inside load pockets in our core markets. This comply of our strategy which we have pursued with relentless consistency and a high degree of effectiveness for the past five years was joined a couple years ago with a supplemental strategy that is overtly green and designed to take advantage of the societal trend towards sustainability.

This sustainability trend is, in our opinion, about to accelerate as a result of the emergence of various consumer-oriented disruptive technologies, which will make green energy at the consumer level the focal point of sustainability. We made considerable progress on both strategic fronts during 2010, with substantial advances across every facet of our sustainability initiative.

From our rollout of our eVgo network in Houston, which is centered around an innovative fueling package in approach to electric vehicle infrastructure that is already being replicated in other locations through the smart meter e-Sense applications now being sold by Reliant in quantity, to our unique approach to CCS/EOR being funded in collaboration with the DOE at our Parish facility in Texas. All of these initiatives are exciting and off to a good start. All will, I am confident, return considerable value to NRG to shareholders in the medium term.

You will hear more about these initiatives in the future but not today, because today, consistent with my theme, I want to concentrate my comments on the growth initiatives which are more immediate and which are key priorities for deployment of your investment capital during 2011. This is shown on Slide 6.

By way of background, in 2010, we committed substantial growth capital in four general areas: Zero carbon renewables, with an emphasis on solar; new advanced nuclear development; conventional gas-fired acquisitions and repowerings; and green retail acquisitions in the form of Green Mountain Energy. All four are likely to be areas of additional capital expenditure in 2011 but with very different investment profiles from 2010.

First, we expect an acceleration and significant expansion in our equity capital invested in high-growth, high-return solar projects. At the greater part of our utility scale, solar portfolio should achieve financial close and enter the construction phase during 2011.

Second, investment in conventional generation assets should be relatively flat year-on-year, as spending on GenConn and Cottonwood should give way to spending on El Segundo, but conventional CapEx could increase depending on our development success at Astoria, Saguaro or Encina and also, whether we find any strategic assets that can be acquired at value.

Third, capital invested in green retail should drop precipitously as obviously the big expenditure in this

area in 2010 with the acquisition of Green Mountain. The amount of capital that we will be investing in and around Green Mountains business in 2011 or to expand into new geographic markets, bigger customers segments and new complimentary green product offerings is fairly minimal.

And finally, and similarly and perhaps, contrary to popular investor belief, even if the STP nuclear development project stays on course, the development capital projected to be required of NRG in 2011 will be far less than half of what we invested in 2010 and will be a mere fraction of what we will be investing in solar projects and other capital allocation alternatives.

So this is a lot to digest, so let's go through a little bit more slowly, starting on Slide 7 with Green Mountain. Four months ago, we paid \$357 million for a business that we expect to contribute \$70 million, \$80 million of EBITDA in 2011, plus, we expect Green Mountain to continue to deliver on a 20-plus percent compound annual growth rate trajectory that they have delivered for the past decade. But we didn't acquire Green Mountain just to continue with business as usual. We wanted to take advantage, and we wanted them to take advantage of what we believe are very substantial synergies between Green Mountain and NRG.

Essentially, we want Green Mountain to accelerate the depth and breadth of their growth in close cooperation with us on the same path that they were following on their own, which means expansion into a high retail price Northeast markets, where they start with a natural green-leaning constituency, also, expansion into the larger Commercial segment of the C&I market than they have previously sought to access. And finally, expansion of their value-added product offerings to include distributed green generation.

It's early days yet, but on at least the first two of these, they are already beginning to bear fruit. Green Mountain has established a small but fast-growing footprint in New York Zone J, and in terms of larger C&I customers, they have won landmark business like the Empire State Building. We expect to be reporting on these and many more successes from and with Green Mountain as the year progresses.

Turning to conventional generation on Slide 8. 2010 was an uneven year, with the successful acquisition of Cottonwood and the repowering at Devon and Middletown, balanced by the missed opportunities surrounding Dynegy's California asset. Cottonwood and Devon have been smoothly integrated into our South Central and NEPOOL lineups respectively, and we are very pleased with the results today.

Looking forward to 2011, we're very focused on the successful repowering of El Segundo, an advantage which we hope to derive from having a modern, fast-start, low-heat rate, combined-cycle plant inside the Los Angeles basin load pocket. Beyond El Segundo, we hope to make progress on similar repowering efforts at Astoria in New York City and Encina in San Diego County. Beyond our own Repowering pipeline, the capital we deploy in the acquisition of conventional power plants, obviously, will depend on market conditions and asset availability in our core regions.

While the acquisition market is lumpy, generalities are difficult and predictions are often proved wrong, the optimism I once held at the first half of 2011 would be a buyer's market for CCGTs in the United States has largely dissipated. I see no sign of a flood of assets on the market and the combined cycle of transactions which have been announced recently have been priced at levels significantly above what we could justify to ourselves or explain to our shareholders.

With respect to our nuclear project, while important steps forward have occurred in several areas since our last earnings call, very little of it can be seen with the naked eye. As before, really all critical

aspects of the STP 3 & 4 project run off of our receipt of an acceptable conditional loan guarantee from the government. Certainly, it is a challenge for us to complete meaningful discussions about PPAs with potential off-takers, while the loan guarantee application remains pending.

So our exit ramp analysis, which is set forth on Slide 9, remains largely unchanged from the previous quarter. Likewise, our viewpoint with respect to NRG's continued participation in the project remains at the most challenging of these hurdles, which is the long-term off-take requirement, effectively needs to be addressed no later than the third quarter of 2011 before the project enters the substantial pre-construction phase.

As such, we reiterate the view which is clearly articulated in both our 10-K and in today's earnings release, that NRG will be in a position by late this summer to make a final decision on our continued financial participation in this project. At that point, the market should have substantially greater clarity about the prospects for this project and NRG's role in it.

While we understand that there is skepticism amongst some investors that the project can go forward in the current low gas price environment, we nonetheless, believe it might be helpful to you for us to outline as shown on Slide 10 the future capital commitment of NRG in respect to this project, should it stay on track, with NRG continuing to support it financially.

The overall message is that due to a combination of first, the very substantial sum that NRG has previously committed to the project development, particularly during the first half of 2010 after the settlement with CPS. Second, taking into account our expectation of an optimal hold amount in the project for NRG of approximately 40%, which is down from the 67% that we will own if and when TEPCO invests in a project post-loan guarantee award. And third, due to the value ascribed to NRG for its contribution of the site, NRG's cash commitment to the project going forward is less than what otherwise would be suggested by our projected ownership level.

In summary, should the project proceed to financial closing, the total cash commitment for NRG at our 40% hold level should be something just short of \$800 million in aggregate, including cash invested to date. Beyond that, we are likely to have an LC commitment to a standby equity crossover line facility that will be fixed. And while that number has not yet been finally fixed, you should be thinking in the range of a few hundred million dollars maximum.

In exchange for this size investment in STP 3 & 4, we expect cash flow from dividends and tax benefits in the range of \$500 million a year for the first several years of operations. Obviously, this is a very attractive return but one which we believe is well justified given the extraordinary challenges of the undertaking.

Now pulling it back from where we hope the project will be in 2016 or 2017 to where we are here in the first quarter of 2011, you should be focused on what happens after announcements of acceptance of the loan guarantee. As the loan guarantee acceptance naturally will trigger certain funding obligations from our partners, NRG's share of cash development spent for the remainder of the development phase should approximate \$50 million for all of 2011 and half that for 2012.

While our perspective 2011, 2012 development standard is perhaps substantially less than many in the market were anticipating, it remains a lot of money to us, and we're taking very seriously our commitment to retain our financial discipline around this project and prevent exposure of our balance sheet beyond the specific commitments that I've outlined in this presentation.

Now turning to Slide 11, last but certainly not least, there is the solar pipeline. I've said many times,

and I'll repeat here, that in my 20 years in this business, I had never seen investment opportunities in this sector that offer more attractive combination of high returns, low construction risks, long-term PPAs and repeatable business opportunities than the utility-sized solar projects that we currently have in our advanced development portfolio.

As such, we intend to do as much of this business as we can get our hands on, with the result being that by the end of this year, we may well have a total initial equity investment in our solar portfolio that exceeds the total amount that we may ever invest in STP 3 & 4 at very attractive near-term returns. The limiting item for us in terms of these solar investments is our ability on our own to make optimal use of the considerable tax benefits which will be generated by these projects. This is a topic that Chris Schade will discuss in a few minutes.

What I will end by saying is that this extraordinary pipeline of utility-sized solar projects, which our colleagues at NRG Solar have managed to develop or acquire, provides us with a truly unique opportunity to develop over the next few years a solar portfolio of true scale and significant benefit, even in the context of the larger portfolio of NRG.

Ultimately, however, we fully recognize that the current generation of utility-sized solar and wind projects in the United States is largely enabled by favorable government policies and financial assistance. It seems likely that much of that special assistance is going to be phased out over the next few years, leaving renewable technologies to fend for themselves in the open market.

We do not believe that this will be the end of the flourishing market for solar generation. We do believe it will lead to a stronger and more accelerated transition from an industry that is currently biased towards utility-sized solar plants to one that's focused more on distributed and even residential solar solutions on rooftops and in parking lots.

We are already planning for this transition now within NRG, so that any potential decline in either the availability of utility-sized solar projects or in the attractiveness of the returns being realized on these projects, will be exceeded in aggregate by the increase in the business we are doing on smaller distributed and residential solar projects through our Green Mountain and even our Reliant retail sales channel.

With that, I'll turn it over to Mauricio.

Mauricio Gutierrez

Thank you, David, and good morning, everyone. NRG continued its strong operating and commercial performance during the fourth quarter, making 2010 one of NRG's best years. Slide 13 highlights a few of the key accomplishments achieved in 2010.

Starting with safety, we're particularly pleased with our record performance this year. Our OSHA recordable rate improved 26% over 2009. Our top performance remained strong with 90% availability of our baseload fleet, just shy of our 2009 level. This performance was achieved despite a forced outage event on our STP nuclear plant in November, which I will cover in more detail in the next slide.

On the environmental front, we delivered our second best year, and our FORNRG program far exceeded our 2010 goal. As I mentioned to you on our last call, controlling our cost is a priority, given the challenging economic environment our industry is facing.

Our Commercial Operations Group increased our hedge levels in 2011 and continues to look for opportunities to catch the odd years of favorable prices. We successfully transitioned to the Nodal Market in ERCOT and began integrating Green Mountain Energy and the Cottonwood combined cycle plant into our portfolio.

With respect to our projects under construction, the Indian River Unit 4 environmental back-end control project continues to be on track and on budget to be operational by January 2012. Our Middletown project in Connecticut received all major equipments in the fourth quarter and continues to be on schedule for operation this summer. Finally, the El Segundo Energy Center completed aboveground demolition of two existing units and secured major equipment orders. El Segundo is on track to be operational by the summer of 2013.

Turning to our plant performance metrics on Slide 14. Safety continues to be our number one priority. We are very proud to report that we achieved top decile in the industry, making 2010 our best OSHA recordable year. We have 25 sites with no injuries and nine sites certified or recertified as OSHA VPP Star worksites.

Net generation decreased by 6% in the fourth quarter due to mild weather across Texas and a 22-day on-plan outage at STP Unit 2 during the month of November. The forced outage event was the result of a breaker failure during routine testing and was extended to repair a reactor coolant pump seal. In order to prevent recurrence, similar electric components were checked in both units. Unit 2 has operated without any issues since it was brought back to service on November 26.

For the full year, net generation was flat from 2009 levels. Increased generation in the Northeast and South Central regions driven by the strong summer weather and the addition of Cottonwood, were offset by lower generation in California and Texas.

For 2010, our coal fleet availability finished the year above the sub-quarter performance level for the industry. WA Parish led the fleet with 92.6% availability factor, and Limestone had the best reliability for the year, with a 1.6% forced outage rate.

Our FORNRG 2.0 program exceeded the 2010 goal by \$49 million, and it is on track to achieve our goal of \$150 million by 2011, one year earlier than planned. Savings were achieved through a combination of reliability, capacity and efficiency improvements at generating assets and cost savings across our corporate and regional groups.

Turning to our retail operations on Slide 15, we closed out the year with another strong quarter. Volumes and margins were consistent with our forecast, while Operations delivered better-than-expected asset management and lower operational costs.

The Mass segment continues to drive segment improvement in net customer attrition with a 57% reduction in the fourth quarter versus 2009. This result was driven by marketing, sales and introduction of innovative products to meet our customer needs.

In 2010, we led Texas in innovation, enrolling over 175,000 customers on our Reliant e-Sense product and services that utilize smart grid technology. We also introduced new and unique offers like carbon-state [ph] and home protection products, adding not only incremental EBITDA but increased customer stickiness.

We continue to maintain the lowest PUC customer complaint rate while balancing customer counterpricing. Throughout 2010, we aligned to successfully demonstrate that we have stabilized

customer attrition and expect to achieve zero net attrition in 2011.

In the C&I segment, both renewal and new deal win rates continue to improve. We have expanded our business in several Northeast states where we can leverage existing energy assets and increase product offerings to include products such as backlog generation. These provides a solid platform to grow our business in 2011.

Business continues to show some fundamentals as you can see on Slide 16. Weather-normalized demand grew by 2% year-on-year and ERCOT set a new winter peak low of 57 kilowatts in February, an increase of almost 2.5% from the previous record. I'd like to take this opportunity to address the events in Texas on February 2.

The men and women of NRG Texas worked very hard to help meet the high demand for electricity due to the extreme cold conditions, increasing our generation by more than 60% from the previous day. Although we had some operational issues, of the approximately 9,500 megawatts of power we had available in Texas during the low-shed event, we maintained between 97% and 91% of that capacity online. I want to thank all our employees in Texas for their dedication and extraordinary efforts during these events.

Now moving on to reserve volumes in ERCOT, we see a positive feature of our generation portfolio with reserved margins tightening faster than expected. This is to some extent reflected in the forward heat rates, as you can see on the chart on the lower right-hand quarter. We believe this trend will continue, given the robust growth and the expectation that asset retirement will outpace new builds. We have not seen as much coal-to-gas switching in Texas as we have in the Northeast and Southeast regions. In fact, cash generation was down year-on-year due to increases in new coal and wind generation in Texas.

In the Northeast, the back-end market continues to make some news. In New York, the recent FERC order to increase cost of new entry should provide a boost to capacity prices in New York City and rest of state, benefiting our New York portfolio. In PJM, prices remain uncertain until more clarity is given around the minimum offer price rule, the subsidized generation in New Jersey and Maryland and review demand outlook.

Moving on to Slide 17, you can see our detailed plan to control air emissions for each of our coal plants. As stated in our last earnings call, our plan is to invest approximately \$720 million through 2015 in environmental projects tailored to comply with future regulations.

Just to remind everyone, the proposed CAIR rule does not require additional capital for compliance. The HAP MACT proposed rule should be released in mid-March, and as you can see in the table, our plant considers mercury controls on all our coal units.

Intake modifications and repowering are expected to meet once for cooling requirements. We only have dry fly ash disposals at our all coal facilities. And finally, in most of our facilities, we burn low sulfur, low chlorine PRB coal.

Moving on to our hedge profile and commodity sensitivities on Slide 18. Our baseload portfolio is now 100% hedged in 2011 and 50% hedged in 2012, providing the protection in the short term where gas prices continue to be weaker given the oversupply situation. Beyond 2012, we choose to remain significantly open.

After two years of low gas prices, we believe the downside risk is limited. Our combination of

incremental demand from the power sector, particularly in light of possible coal plant retirements, some signs of the interest rate by producers, indication that drilling to home acreage may be ending, and a move from dry to wet gas production will provide better opportunities to catch our baseload portfolio in the future.

With respect to retail, we have increased our pipe load to 66% in 2011 from 57% in the third quarter. We continue to match as much generation load as possible to start maximum synergies between our retail and wholesale portfolios.

Our power and coal hedges continue to be well managed in 2011 and 2012. Given the shape of the coal curve and steep contango, we have not added any additional occasions since the last quarter. We also remain well hedged in terms of coal transportation now for some time.

Our sensitivity to commodity prices is agreeable for 2011, with 2012 to 2015 largely unchanged from last quarter. Let me remind you that this sensitivity is around our baseload portfolio. Interest expense, our portfolio is well-positioned to benefit, particularly, in the Texas and South Central regions.

With that, I will turn it over to Chris who will discuss our financial results.

Christian Schade

Thank you, Mauricio, and good morning. Beginning with the financial summary on Slide 20, full-year 2010 adjusted EBITDA was \$2.514 billion, just shy of the record 2009 adjusted EBITDA of \$2.618 billion and within our previously stated guidance of \$2.5 billion to \$2.55 billion. As a result of our continued strong operating performance, adjusted cash flow from operations for 2010 was robust at \$1.76 billion.

The company's liquidity position at year end, excluding funds deposited by counterparties, stood at nearly \$4.3 billion, a \$458 million increase from December 31, 2009, liquidity of approximately \$3.8 billion. Our cash balance at year end 2010 available for both working capital as well as our 2011 capital allocation program was approximately \$2.9 billion.

Now turning to a summary of our 2011 guidance in Capital Allocation Plan. First, we reaffirmed the preliminary 2011 EBITDA guidance range of \$1.75 billion to \$1.95 billion. Second, and as part of our 2011 capital allocation program, we are planning to repurchase \$180 million of common stock, and complete \$240 million of term loan debt repayments and \$39 million for additional facilities, all of which is consistent with NRG's commitment to return excess capital to its stakeholders. Third, in 2011, in addition to the amount deferred from 2010 as a result of extending the cash grant availability, we are currently planning to commit an additional \$640 million of net investment to advance our Repowering and renewable development program, particularly, utility-scale solar.

Now turning to a more detailed review of 2010 adjusted EBITDA result from Slide 21. The company reported near record results of \$2.514 billion adjusted EBITDA, only \$104 million lower than the 2009 adjusted EBITDA of \$2.618 billion. These results were achieved despite the decline in forward prices across all of our regions and clearly benefited from our wholesale generation hedging program and the continued strong performance of Reliant Energy.

During the year, Reliant Energy contributed \$711 million of adjusted EBITDA. Comparatively, these results are lower by \$158 million from 2009 as we overlined for only eight months of that year. The year-on-year decline was driven by an 18% decline in Mass margins, which were the direct result of price reductions enacted following the acquisition, as well as lower margins on customer renewals and

new customer acquisitions reflective of the competitive market. All told, for 2010, Reliant saw net customer attrition rates improve to 0.4% from 0.7% in 2009 with total customers at year end steady at 1.5 million.

The wholesale business meanwhile generated \$1.8 billion in adjusted EBITDA, \$173 million lower as compared to a record 2009 EBITDA of \$1.976 billion. The comparative year-to-date decline is largely explained by a 32% drop in baseload hedge prices in the Northeast, as well as lower margins in Texas, caused by a 60% increase in fuel costs, due largely to higher coal transportation costs at our WA Parish facility. These results were partially offset by an increase in adjusted EBITDA of \$28 million from the South Central region due to increases in generation and contracted sales.

Also increasing adjusted EBITDA were our newly acquired assets, including Green Mountain Energy, Cottonwood, Northwind Phoenix, South Trent Wind Farm, as well as the full year of operations from the Blythe solar project.

For the fourth quarter, the company reported adjusted EBITDA results of \$444 million, a \$45 million decline versus 2009. Reliant Energy contributed \$117 million of adjusted EBITDA compared to \$104 million for the fourth quarter of 2009. Reliant's quarterly results were favorable \$13 million driven by an improvement in operating costs primarily due to better customer payment habits as related to a decrease in bad debt expense.

In the fourth quarter of 2010, our Wholesale Generation business contributed \$327 million of adjusted EBITDA, a \$58 million decline compared to fourth quarter '09. The change in results can largely be attributed to the following items: In the Northeast region, 35% lower hedge prices and a 25% decrease in generation resulting in a \$57 million decline in energy margins quarter-over-quarter. The decrease in generation was largely a result of coal-to-natural gas switching and offsetting this decline in energy margins were favorable year-on-year operating and maintenance expenses of \$13 million.

In Texas, the 10% decline in generation at the Limestone and WA Parish facilities due to lower power prices and reduced demand led to a 6% decline in overall generation for the region. Offsetting this decline were favorable year-on-year operating expenses of \$17 million that included gain on land sales of \$6 million in 2010.

Now turning to Slide 22. As I mentioned a moment ago, total liquidity at year-end 2010 excluding funds deposited by hedged counterparts remained strong at nearly \$4.252 billion. Total cash stood at \$2.959 billion, an increase of \$653 million as compared to the 2009 year-end cash balance of \$2.3 billion. The drivers of the cash increase included adjusted cash from operations of \$1.76 billion and debt proceeds of \$1.317 billion.

These increases were offset by several items: First, five completed acquisitions totaling about \$1 billion, which included \$507 million for Cottonwood generation station, \$357 million for Green Mountain, \$100 million for Northwind Phoenix, \$32 million for South Trent Wind Farm and for the U.S. solar portfolio, 720 megawatts of development projects in nine states in California and Arizona. Second, debt and fee payments totaling \$813 million, including Term Loan B payments of \$453 million and a repayment of a common stock fund or CSF of \$190 million.

And third, capital expenditures excluding NINA of \$445 million, including \$199 million of maintenance, \$184 million of environmental, primarily related to the Indian River Air Quality Control System project, and \$62 million of growth investments. For the full year, we made cash contributions to NINA totaling \$170 million primarily in the first half of 2010. And finally, we completed share

repurchases of 8.5 million shares, totaling \$180 million.

Now turning to 2011 guidance on Slide 23. Our EBITDA guidance remains unchanged from our November 24 range of \$1.75 billion to \$1.95 billion. Included in this guidance range are wholesale expectations of \$1.2 billion to \$1.3 billion, retail expectations of \$480 million to \$570 million, and Green Mountain of \$70 million to \$80 million. As Mauricio discussed earlier, we are about 100% hedged on our baseload generation for 2011 and are thus comfortable with our forecasted results.

As we look forward to our Wholesale business in 2012, we are currently in excess 50% hedged with a higher average price in 2011 as indicated in our SEC filings. Due to this position and based on the current forward curves, we expect flat to marginally lower year-on-year wholesale results in 2012 from 2011. These results will be supplemented with adjusted EBITDA of \$85 million from our repowering and solar investments in 2012 that are not subject to market fluctuations.

For our retail business in 2011, our current expectations, assuming normal weather, are an EBITDA range of \$480 million to \$570 million, the decrease in 2011 guidance compared to current 2010 results is largely explained by lower unit margins in Reliant's Mass business. Reliant's C&I business margins are also expected to decline slightly, but be directly offset by higher terawatt-hours served, reflecting our continued dedication to this growing client base in both Texas and PJM.

Finally, we expect Green Mountain Energy to contribute \$70 million to \$80 million of EBITDA. We are very excited about enhancing the growth prospects for our Green Energy Retail business during the process of integrating the business with our growing renewables portfolio to enhance these future growth prospects.

During our Q3 earnings call, we discussed the 2011 free cash flow guidance of \$425 million to \$625 million, and we now currently anticipate free cash flow for 2011 to be in a range of \$150 million to \$350 million. The difference in guidance is largely explained by certain timing of solar projects, due to Congress extending the availability of cash grants for renewable projects through 2011. NRG postponed its large investments in solar projects from 2010 to 2011, resulting in \$267 million of solar expenditures pushed into '11 and relates primarily to our Agua Caliente, Ivanpah and CVSR solar projects.

As we often like to emphasize, we are in a strong cash flow position based on Friday's closing stock price of \$20.89 and our affirmed outlook. Free cash flow before growth yield currently stands at between 16% to 20%, or \$3.36 to \$4.17 per share.

Slide 24 shows the company's projected 2011 year-end cash position which we project to be about \$2.5 billion. Beginning with the portion of the Capital Allocation Plan that includes share repurchases and debt repayments in 2011, the company intends to repurchase \$180 million of common stock, which is within the constraint of the restricted payments basket; repay \$240 million of debt related to our Term Loan B agreement; and approximately \$39 million in other facilities. It's important to note that the company made a Term Loan B prepayment in November that totaled \$200 million.

And finally, complete \$907 million of capital allocation in the following projects: \$50 million in NINA; \$219 million for other Repowering investments including El Segundo, GenConn Middletown, eVgo, Texas Reliability and Princeton Hospital and \$638 million for solar projects, net of cash grant proceeds, and including the \$267 million of deferred payments from 2010.

During the third quarter conference call, I also mentioned that we usually maintain a minimum cash balance of \$700 million largely for working capital margin requirements, the timing of cash payments,

of interests, property taxes, as well as equity for projects we have under construction throughout the year. Thus, for 2011, we estimate a balance of just over \$1.8 billion to allocate between perhaps additional share repurchases, contingent on the restricted payments basket expansion, further investments of high-growth opportunities and continued opportunistic management of our debt structure.

On January 11, the company issued \$1.2 billion of 7 5/8 senior notes due 2018 and announced the simultaneous cash tender for \$1.2 billion of the outstanding 7 1/4 senior notes due 2014. As of January 25, nearly 945 million bonds have tendered, and the remaining 250 million will be redeemed by the end of February pursuant to the embedded call price. As a result, we've improved our debt maturity profile, all of our public debt matures after 2016, and replace the restricted covenant package with one permitting greater efficiency and flexibility to return value to all NRG stakeholders.

On a go forward basis, we will continue to moderately embed in calls in the 2016 and '17 maturities and be opportunistic about replacing those bonds with less restricted covenant packages, similarly to how we handle the 2014 maturity.

Looking at NRG's combined Repowering and Solar portfolio and our EBITDA contribution on Slide 25, you can clearly see the benefit of the program with nearly \$550 million of recurring contribution by 2015.

During the fourth quarter, our El Segundo Repowering project received prior approval from the California Public Utilities Commission for a ten-year Power Purchase Agreement with Southern California Edison. Commercial operation's expected in the summer of 2013.

Our large utility-scale solar projects will also begin to reach commercial operations between the summer of '13 and the first quarter of 2014, and these projects collectively are driving this EBITDA growth. These solar investments are attractive for their high-teens returns, very low construction risks and offtake agreement of 20-plus years with highly rated counterparties. We will continue to provide updates on the progress of these projects as they move into construction and operation.

As we continue to invest and grow our solar portfolio, it's important to highlight a few economic benefits created with these projects. Slide 26 shows how the combination of cash grant, maker's depreciation and strong cash flows from the PPAs for our projects result in a payback for our investments, in some cases by 2014, and retain stable cash flows for the remaining term of the PPAs.

Though we believe there will be a turnaround in commodity markets, we are mindful of our ability to create enough taxable income for us to fully absorb tax benefits created by these solar investments. There is clearly a limit to how much tax efficiency we could absorb in any one year before reducing the total project returns. As such, to both minimize the tax leakage and enhance our returns, in 2011, we will pursue new equity investors for our solar portfolio, who have both the appetite for tax benefits and seek investment to one of the largest utility-scale solar portfolios in the world. New equity investors would not only help to optimize our existing tax position but allow us to continue to invest in future projects with high returns.

We expect to launch this initiative soon and look forward to sharing the progress in the future. Now I'll pass it back to David for final comments.

David Crane

Thank you, Chris, and thank you, Mauricio. And so in conclusion, on Slide 28, we put what we think

are some of the value drivers around the investment proposition at NRG. And it starts with the fact that 2 1/2 years into the commodity price down cycle, it appears to us that the end is in sight, the bottom of the trough has been reached, and the only way to go is up. When or how quickly gas prices will recover remains open to conjecture, but the case for rising heat rates in our core market of Texas is clear and compelling. And we've positioned our portfolio and our hedge both to benefit from that upturn.

Second, even in a political environment that has turned more conservative in the past year, market mandates for renewable generation and for solar power in particular, remain well supported in both the red and blue states. And the result for us has been a fast-growing portfolio of projects that will contribute substantially to shareholder value creation over the short to medium-term.

Finally, there's the inherent value unique amongst our peer group of Wholesale generation combined with the leading retail position. While we have executed to such great success in Texas, together with Reliant, we are now in position to replicate with Green Mountain in the fast-growing green and retail energy sector. It's a bright future indeed, and for all of us at NRG, we'll strive to realize its vantage on behalf of the shareholders of NRG.

So Deanna, with that, we'd be happy to take some questions.

Question-and-Answer Session

Operator

[Operator Instructions] The first question will come from the line of Daniel Eggers, Crédit Suisse.

Dan Eggers - Crédit Suisse AG

David, I was just trying to marry up some of the comments made about some of the solar investment opportunities. If I look at Slides 25 and 26, the cash investment and then the earnings contribution you guys show there, is that based on the things that are in hand right now, or is there a assumption of the amount of incremental projects who would have to get signed this year to help get to those numbers?

David Crane

I think what we're showing, Chris, correct me if I'm wrong, is the Tier 1, which are projects, which in my personal estimation are ones that have a 90-plus percent chance of achieving financial closure.

Christian Schade

Yes, that's actually correct, Dan.

Dan Eggers - Crédit Suisse AG

So these are things that are already in place, and this would be less contribution than what you said in your comments earlier, David, about having equity investment and solar greater than what you do see in South Texas ultimately?

David Crane

I'm sorry. Say it again?

Dan Eggers - Crédit Suisse AG

So this earnings contribution represents an investment less than what you think you can get to from the solar perspective based on your comments earlier in the presentation?

David Crane

I mean there are more projects behind this portfolio.

Dan Eggers - Crédit Suisse AG

When do you see the opportunity this year to announce off projects? And how would you see this sell down equity go as far as changing the earnings contribution profile from these projects? And how much could you sell down, do you think?

Christian Schade

Well, we're going to get to how much we can sell down as we move through the process. But very clearly, any amount we sell down will sort of be a pro rata reduction in EBITDA. And so depending on how much we do, we'll certainly let you know. But we do believe that the sell down will allow us to provide incremental more equity into other projects we have yet to announce. But what David said, we're on the bubble given the benefits from the government largesse, which we think still exist but perhaps will run out in the next couple years. And those projects will also be assumed as sort of returns consistent with what we've seen to date.

Dan Eggers - Crédit Suisse AG

And I guess one last question just on South Texas. David, if you could maybe just -- we go through the numbers as far as how much cash you expect to throw off in the project, and then to clarify that, contribution's based on kind of the pricing you'd need it to be able to receive in order to earn economic return on that project?

David Crane

Well, so you're saying you're -- Dan, you're actually looking forward to 2016 and '17? Yes, I mean, looking at Page 10, I mean, through the first few years, when we've talked about receiving \$500 million of cash, that's based on our view on where gas prices go, which is, obviously, some way up from where they are now, sort of into the \$6 to \$7 range. Having said that, Dan, we've stressed the returns on the nuclear project from an IRR perspective, sort of \$4 gas in perpetuity model. And the IRR in the project, it would still be in double digits, but obviously, the higher gas prices, the better we do. But it works, the numbers work even at a \$4 gas environment. And the reason that is the case, Dan, is because, obviously, the tax benefits associated with nuclear project, particularly, the production tax credits, meaning that through the first several years of the nuclear project, the economics are more driven actually by the tax benefits than they are by the price of electricity.

Dan Eggers - Crédit Suisse AG

Do you see IRR as working in \$4 gas to the equivalent of a mid-30s power price, you would see the plant being economic?

David Crane

In a \$4 gas, the plant is, yes. I mean, again, it's a low-teen return. I'm not sure that -- it's not the return we're seeking, but it's not a single digit return or a negative return.

Operator

The next question will come from the line of Ameet Thakkar, Bank of America Merrill Lynch.

Ameet Thakkar - BofA Merrill Lynch

Mauricio, you kind of indicated that the path with hedging, despite, I guess, some uptick in heat rates in Texas and you also didn't do much in the way of coal as well. I mean is your expectation that PRB prices should follow gas down? Or are you guys a little bit more neutral on gas at this point?

Mauricio Gutierrez

Well, I mean, if you look at our hedge profile, the next few years, we're pretty well hedged on both sides, so power and coal. We can justify the contango that exists with the coal curve. And given the inventory that we have and the hedge profile, we think that we can weigh to be more opportunistic about when to catch the coal prices. With respect to gas, we continue to see further declines in the front part of the curve, which we've been pretty well insulated. But as I mentioned in my remarks, I mean, I think when you look at 2012 and beyond, and where those price levels are, we see very little downside risk from that. And we think that there are several factors that are converging that could potentially move gas prices, assuming they could be higher than where they are today.

Ameet Thakkar - BofA Merrill Lynch

And then David, real quick on STP. I just want to make sure I understood, I guess, some of your answers to the previous questions. You see returns in kind of the teens area, given the \$4 gas for STP?

David Crane

Yes, so the returns would be in the teens area in the \$4, in perpetuity model. Again, this is based on the idea that we're running a model where there's roughly 1,000 megawatts of power sold by long-term contract, and the rest is taken into the merchant market. So the \$4 gas would apply to the 2,000 in the merchant market. And yes, you're right, what it shows is a return in the teens, in that sensitivity. I would also tell you, Ameet, both in response to your question and I should say to Dan, also, we run this with no value associated to the zero-carbon aspect of it, so the price on carbon directly or indirectly would be on top of this.

Ameet Thakkar - BofA Merrill Lynch

And then so is like the 1,000 megawatts of PPA cover, I guess, under that analysis, is that really kind of the goal to kind of continue to move forward and not exit, I guess, exit land for on Slide 9?

David Crane

Well, Ameet, almost as a -- I mean, from the beginning, I think that we have said to our investor base that we, at least, would not proceed with the project unless there was a significant amount of long-term offtake associated with the project. And so, roughly 1,000 megawatts has been something we talked about from the beginning. On top of that, Ameet, the conditional loan guarantee, if and when it's announced, it's called a conditional loan guarantee because there are conditions associated

with it. And probably the most substantive condition, the condition we would be focused on is that the government would require us to have approximately that same amount of long-term offtake agreement contracted, which was a condition, again that we were happy to agree with the government on since we had said that we wouldn't go forward with it either. So that's why we would be doing that.

Operator

And the next question will come from the line of Ted Durbin, Goldman Sachs.

Theodore Durbin - Goldman Sachs Group Inc.

If I could just ask a little bit about the capital allocation. You're obviously coming out of 2010 here with a high cash balance. I'm just trying to understand a little bit better the allocation of the capital towards the renewables and whatnot, maybe extending that relative to between cash to stakeholders. Could you just talk a little bit more about that?

Christian Schade

As we said, we're committing to a \$180 million stock repurchase, and that's within the confines of our restrictive payment basket. We're also going to be making required debt repayments under our term loan program, Term Loan B program. We've also earmarked potential investment in our solar projects, and these are projects which we had -- some of which we're announced late last year and early this year and would be subject to the cash grant program under the government. So all of those projects and repowering projects from El Segundo and GenConn Middletown. But those are the programs at least that were part of the capital allocation program for this year. That's what we've announced. We have \$1.8 billion after which we would be able to deploy into additional repowering should they be available and new solar projects that we see on the horizon, as I've said before, all of which offer us the opportunity for very attractive returns.

David Crane

And just to add, Ted, I think you phrased the question almost as if it was an either/or, and I guess that may be a little different. I mean, given the company's free cash flow generation and the cash we have on hand, we haven't really seen it as an either/or. In terms of returning capital to shareholders through the share buyback, we do as much as we can under the restrictive payment basket. Over the past years, we've constantly evaluated whether or not we could negotiate a way to have more room to do more, but the expense of doing that has always made that impractical. So from our perspective, it has not been an either/or decision. It's been do both.

Theodore Durbin - Goldman Sachs Group Inc.

Does that cost of getting the ability to do more of a buyback, you're still seeing that as not worth the expense of getting that?

Christian Schade

That's right. We think the expense to negotiate with the bondholders is being punitive. And as I said in the prepared remarks, the approach that we took on the 2014 maturity to wait for the calls to come due than to call away and refinance was we felt unattractive and a cost-beneficial way to do it. We have calls coming up in February for the 2016 maturity which we'll keep an eye on. The 2017 are not yet callable, will be so within a year. The high-yield market remains very attractive from financing

perspectives, so we'll continue to look at that closely. But just to further what David said, with the excess cash in addition to the \$180 million as we said, we'll certainly consider future stock repurchases if it can fall within the confines of hedging expansion we see in our restrictive payments basket throughout the year as well.

Theodore Durbin - Goldman Sachs Group Inc.

I appreciate the commentary on sort of the assets side. It sounds like you're not seeing the values on the CCGT side that you were before, but you did do the Cottonwood transaction. Are there other holes in your portfolio, where you say, "Geez, we'd really like to add some mid-merit assets whether it's more in South Central or whatnot?" And kind of talk about where you'd like to build up the portfolio.

David Crane

Well, I think the place where we'd like to build up the portfolio, and again, we've been fairly -- well, it took us six years to execute on the idea that we needed a load following plant in South Central. So just because I say this, I don't want you to think any sort of announcement's around the corner, because I'm actually skeptical that we can achieve anything. But we would definitely like to have some more baseload-following capability in PJM, particularly Eastern PJM. Having said that, we don't have any optimism about anything coming available in that footprint that we would find probably at a reasonable price. But we keep our ear to the ground. I would say that has been our single greatest priority second to backing up Big Cajun, which we've now achieved with Cotton.

Operator

And the next question will come from the line of Jonathan Arnold, Deutsche Bank.

Jonathan Arnold - Deutsche Bank AG

My question is, on STP, you believe the option for the second 10%, the TEPCO would take -- had a May expiration date on it, we recall from the original 8-K. But is there a similar date around the base 10% investment that's contingent on the loan guarantee acceptance? Is May a kind of drop-dead date for that whole arrangement with TEPCO?

David Crane

I don't believe there's a drop-dead date. And John, Tokyo Electric well understands the pace of development. I don't want to speak to them, but I think their enthusiasm for participating in this project is unchanged from when we announced the deal a year ago. So I don't remember any sense of date, but I have a very high level of confidence that if the loan guarantee comes that Tokyo Electric will participate in the project.

Jonathan Arnold - Deutsche Bank AG

And can you also give us a sense of -- well, obviously, your contribution is relatively small over this '11, '12 period. What would the \$25 million in '12 be absent additional sell downs? And maybe some kind of sense of how much is actually being spent on the project itself during this next couple of years.

Christian Schade

Well, what it would be without the sell down, I'll have to get back to you on that. The amount of money that has to be invested towards in order for us to proceed is it's several hundred million dollars. But Jonathan, it's really hard to put it in those terms. Because like a good portion of it is long lead time materials in Japan which are actually funded with the credit facility from Toshiba. So maybe we can break out and provide it to you or do it next quarter. Just the development spend for now, in order for us to proceed against the sources of capital, because it's really not useful if you look at it as one-lump sum, because various things are paid for with different buckets of money.

Jonathan Arnold - Deutsche Bank AG

And if I may just on one other topic, what indications are you getting from DOE on these discussions at a level of hedging through PPAs that would be acceptable to them on the project?

David Crane

Well, I think that the condition is very specific. And I think back, it's the same as I answered to Ameet. It's something just less than 1,000 megawatts.

Operator

The next question will come from the line of Jay Dobson, Wunderlich Securities.

James Dobson - Wunderlich Securities Inc.

I was hoping you could give us some insight into the offtake discussions. The local media's covered some interesting transactions, or at least, proposals that you had. So I'm just wondering if you can give us some insight into where things stand and sort of what your level of optimism is currently.

David Crane

It's a good question, and I think what I would say without -- I mean, it's difficult to comment with discussions that are underway. And in fact, normally, we don't comment on it but since as you said, there's been discussions by the public, I guess I should say some things. I would say, first of all, I think there's an openness, a willingness, and interest on several load-serving entities, large load-serving entities in the Texas market to talk about long-term offtake. And I would also say that the events of early February in Texas, where a part of the reason the state had rolling brownouts or even blackouts is because people couldn't get gas to some power plants, I think has reinforced the idea that having fuel diversity in the state is something that load-serving entities want to have. So there's a fairly high level of interest from various parties, but the big qualifier I always put on this question is, right now, as you say, it's really discussions. I mean, the project isn't really real to off-takers until we have a loan guarantee. So I would describe anything that we're doing with any counterparty at this point is being preliminary. And so that's what I would tell you. And based on what we're being told by the camp, their interest level, I'm guardedly optimistic. But mainly, my main attitude towards all this is, let's wait and see what happens when the loan guarantee's announced, because that's when ourselves and our counterparties are going to have to get down to business, and people are going to have to make commitments on both sides. So that's the main thing, and what we're trying to empathize here is that, that phase, and hopefully that phase will begin within the coming weeks, is something that basically needs to be resolved by the summer so that we can all have clarity as within the company and U.S. investors and analysts as to where we stand vis-à-vis this project.

James Dobson - Wunderlich Securities Inc.

As an unrelated follow-up, on the solar side, I'm not sure if this is good for your or for Chris. I assume in addition to selling an equity stake, you'd consider selling a tax equity there, and how do you consider those two alternatives?

Christian Schade

Yes, very much so. I think the equity stake that we are contemplating is tax equity, it's a structuring issue. But we're certainly looking to pass off the tax attributes that are generated from this portfolio to tax equity investors. I think, one thing as a follow-up to a question before is that we'd certainly be looking to sell this equity at a premium. The returns that we're seeing perhaps from these investors are below the expected returns that we see in the high-teens, and so that sort of premium or IRR arbitrage gain will certainly benefit us in having development premium for this. But our goal here both is to bring equity into these projects and also, to lay off some of the tax that perhaps, does not necessarily accrue to NRG.

James Dobson - Wunderlich Securities Inc.

And Chris just a last follow-up, the capacity of the RP basket at year end?

Christian Schade

It was about \$160 million. So the \$180 million that we announced today will be spread out for a couple of quarters.

Operator

The next question will come from the line of Brandon Blossman, Tudor, Pickering Holt & Co.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

I guess just a follow-up on the tax equity question, probably for Chris. Just to be clear, is the tax equity partner or sell down required to optimize the tax benefits of the current solar portfolio, or is that something you need to do to increase the size of that portfolio?

Christian Schade

I think it's not necessarily required. I think it benefits the returns of the portfolio and allows us to continue to invest in the space. As David said, we're seeing a lot of opportunities elsewhere, and I think when we start to layer on other utility-sized projects in addition to what we have, there is a limit to the capacity of tax attributes that we can assume. So we think it's important. We're seeing a lot of interest and opportunities to invest in this space by sort of nontraditional investors who want to get green, and so we think it's a big opportunity for us, who are certain taxpayers as well. So it's for us to check a lot of boxes along the way. First and foremost to optimize our tax position in appropriate years, as well as to allow us to continue to invest in the space.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

And how does that dovetail with STP's tax attributes? Is that far enough out so that there's no overlap here or concerns about maximizing that value?

Christian Schade

It is far enough out that we're not perspiring about the tax attributes that it generates. But certainly, it's a topic that we will address at due time. And also, would speak to our underlying business that we hope and certainly think will grow enough to burn through these NOLs and to continue to generate the taxable asset side in those years. So we're confident of that.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

And David, as a follow up, not that anyone wants this to happen, but if there is an exit ramp for STP, can you describe what that looks like? Is there a project to be had at some point in the future, given that this is a particularly attractive development project?

David Crane

Well, Brandon, I guess, what I would say, on a few fronts. I mean it sort of depends on which exit ramp you're talking about. And I'm just speculating on things which of course, we don't hope to happen. I mean from my perspective, I think if something happens during this year that caused the entire project to go away, we would probably finish the licensing process, which is a small fraction of the overall development spend. But we're so far along with the NRC that to stop it this close to the end would not make sense. But beyond that, would the project go forward? I think it depends on which exit ramp it is. And again, I don't mean to speak for the other partners, because I want to emphasize every NRG investor on the call. We do not have the right to kill the STP 3 & 4 project. We just have the right to stop our own financial contribution to it. But I would say, if the exit ramp is that, actually it turns out that there is no loan guarantee in the offing -- I haven't actually asked this question directly, but I think our partners in Japan -- and we would be aligned that there would be, that the project would stop if there's no hope of a federal loan guarantee. If on the other hand, there was a federal loan guarantee, but we were taking the exit ramp because we were unable to lineup the offtake, I don't know what our partners would do in that circumstance. Maybe they would continue with the project, that would be their prerogative to do. I just know that if we don't have that offtake arrangement, then we will stop funding.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

And that would be not the 1,000 megawatts, but isn't that predicated on the loan guarantee or the loan guarantee predicated on the 1,000 megawatts?

David Crane

It is, but one of the reasons why I don't know -- I don't remember the exact terms, the exact words of the conditional loan guarantee, but I know that we do not have the opportunity at NRG to solve for the offtake arrangement, because I think the condition is offtake agreements with investment grade offtakers. Our Japanese partners who are investment grade would have that opportunity should they so choose to correct that on their own. We don't have that type of power, so that's not a question for us.

Operator

The next question will come from the line of Brian Chin, Citigroup.

Brian Chin - Citigroup Inc

What's the rough range of construction cost estimates in dollar per KW for the solar PV facilities that

you are seeing, and also for the solar thermal side?

Christian Schade

The range, well, I think we would say that the range right now is 3,500 to 4,000 per KW, and I don't know, that would be for the PV -- I can't tell you -- the solar thermal would probably be in the same range.

Brian Chin - Citigroup Inc

And then would it be fair to say that \$4 sustaining perpetual natural gas price environment that you'd still see solar generating returns in the double digits as well? And is it higher or lower than nuclear?

David Crane

Well, we haven't compared them side-by-side. I think it's fair to say that like nuclear, the solar projects, at this point, the economics are very heavily driven by the tax benefits. But beyond that, the real difference between the two is that every solar project we're doing is completely not merchant. It's totally PPA. So I don't think -- in fact, when we talk about taking the company's financial performance and sort of de-linking it to natural gas prices, we put renewables together with retail in parts of our EBITDA stream that are not associated with natural gas prices, because of the fact that all of the economics are derived from long-term PPAs.

Brian Chin - Citigroup Inc

Can you talk just a little bit about from your perspective, what the FERC's order in the New York ISO and the capacity market situation up there? What's changed longer-term, and how much of a positive is that for you guys, or is that even material?

Mauricio Gutierrez

Well, I mean it's definitely material. It's difficult to say what is the ultimate impact, because I think the variables are still being flushed out. But the three main changes was the recognition of state taxes and the cost of new entry calculation, inter-connection costs and then the energy offsets. So when you put those three together, you basically have higher cost of new entry, which will push capacity prices for both New York City and the whole state. This will benefit our New York portfolio, but at this point I can't give you the specific mind into it.

Operator

And the next question will come from the line of Anthony Crowdell, Jefferies.

Anthony Crowdell - Jefferies & Co

Just a quick question on the, I guess, the cold stub that hit Texas earlier this month. And it seem like there wasn't much of an impact on the generation side, but was there any impact to the margins that Reliant expected or anything on the quarter?

Jason Few

This is Jason. From the retail side, we actually, faired fairly well through this event. I mean, our hedging strategy and risk policies served as well during the event. We did not see material impact to

our business.

Operator

In interest of time, we have time for two more callers. And the next question will come from the line of Charles Fishman, Pritchard Capital Partners.

Charles Fishman - Pritchard Capital Partners, LLC

Your five-year environmental capital plan, Page 17, I want to make sure I understand this. The \$720 million includes your view of what the math might be, which is less than worst-case, number one. And number two is there are no dollars in the \$720 million to address once thru cooling. Is that correct?

David Crane

No, actually, there is some dollars for 316(b) through the installation of extremes. We've been very successful in New York, in Arthur Kill and Huntley and Dunkirk to address this issue. So while it addresses the Mercury and asymmetric controls across all our coal assets, it also addresses the 316(b).

Charles Fishman - Pritchard Capital Partners, LLC

And if we do end up with the worst case math, I mean could this number increase 50%? Or do you have any feel for that?

Mauricio Gutierrez

Well, we actually disclosed that on our last earnings call. And I believe it's about \$1 billion -- just shy of \$1 billion. If it was the worst case scenario, in terms of unit-specific controls, no averaging. And we just don't believe the EPA will go that route. But the rule is going to come out, the proposal is going to come out in about a month, and I think it's just prudent to wait before we make any changes.

Operator

And there are no more questions in queue at this time.

David Crane

Okay, well, good. Well, thank you all very much, and we look forward to talking to you in the next quarter. Thank you, operator.

Operator

And ladies and gentlemen, this concludes today's presentation. Thank you very much for your participation. You may now disconnect, and have a great day.

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Executives

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Christian Schade - Chief Financial Officer and Executive Vice President

Mauricio Gutierrez - Chief Operating Officer and Executive Vice President

Nahla Azmy - Vice President of Investor Relations

Jason Few - SVP of Mass Markets and Operations, Reliant Energy, Inc.

Analysts

Anthony Crowdell - Jefferies & Co

Dan Eggers - Crédit Suisse AG

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

Charles Fishman - Pritchard Capital Partners, LLC

Jonathan Arnold - Deutsche Bank AG

Ameet Thakkar - BofA Merrill Lynch

Theodore Durbin - Goldman Sachs Group Inc.

James Dobson - Wunderlich Securities Inc.

Brian Chin - Citigroup Inc

NRG Energy ([NRG](#)) Q4 2010 Earnings Call February 22, 2011 9:00 AM ET

Operator

Good day, ladies and gentlemen, and welcome to the Fourth Quarter and Full Year 2010 NRG Energy Earnings Conference Call. My name is Deanna, and I'll be your operator for today. [Operator Instructions] And I would now like to turn the call over to your host for today, Ms. Nahla Azmy, Senior Vice President of Investor Relations. Please proceed.

Nahla Azmy - Vice President of Investor Relations

Thank you, Deanna. Good morning, and welcome to our Fourth Quarter and Full Year 2010 Earnings Call.

This call is being broadcast live over the phone and from our website at www.nrgenergy.com. You can access the call presentation and press release through a link on the Investor Relations page of our website. A replay of the call will also be available on our website. This call, including the formal presentation and the question-and-answer session, will be limited to one hour. In the interest of time, we ask that you please limit yourself to one question with just one follow-up.

And now for the obligatory Safe Harbor statement. During the course of this morning's presentation, management will reiterate forward-looking statements made in today's press release regarding future events and financial performance. These forward-looking statements are subject to material risks and uncertainties that could cause actual results to differ materially from those in the forward-looking statements. We caution you to consider the important risk factors contained in our press release and other filings with the SEC that could cause actual results to differ materially from those in the forward-looking statements in the press release and this conference call.

In addition, please note that the date of this conference call is February 22, 2011, and any forward-looking statements that we make today are based on assumptions that we believe to be reasonable as of this date. We undertake no obligation to update these statements as the result of future events except as required by law.

During this morning's call, we will refer to both GAAP and non-GAAP financial measures of the company's operating financial results. For complete information regarding our non-GAAP financial information, the most directly comparable GAAP measures and a quantitative reconciliation of those figures, please refer to today's press release and this presentation.

And now with that, I'd like to turn the call over to David Crane, NRG's President and Chief Executive Officer.

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Thank you, Nahla, and good morning, everyone, and welcome to our year-end 2010 earnings call. Today, with me, and participating in the presentation is Mauricio Gutierrez, the company's Chief Operating Officer; and Chris Schade, the company's Chief Financial Officer. Also with me today and available to answer questions are Jason Few, who runs NRG's retail company, Reliant; and Chris Moser, who runs the commercial operations function for this company.

So without further ado, to begin -- so ladies and gentlemen, current and perspective shareholders of NRG, as we speak today, it's now been 32 months since natural gas prices began their relentless fall and the economy at large entered into a great recession, the likes of which, I'm sure none of us wish to experience again in our lifetimes, yet the financial performance of NRG during this period has been superb. And that financial performance has been built on the foundation of an equally exceptional

operating performance across all phases of our operations and across all our regions.

In 2010, the second full year of the great recession, our financial performance surpassed all previous years of company results, save for fiscal year 2009, which was of course the first year of the great recession, a year in which we performed spectacularly, achieving both record financial performance and the acquisition of Reliant.

While I am, for the most part, extremely pleased with both the company's financial and its operating performance during 2010, I am acutely mindful of the fact that NRG shareholders did not see any of the benefits of our exceptional performance and share price appreciation during that year. As a management team, we recognize that we have a long way to go in presenting NRG's present value and future potential to the market.

In this presentation and in subsequent presentations that Mauricio, Chris and I will be making during the spring Investor Relations season, we intend to make a concerted effort to explain the NRG value proposition. From the competitive strength of our core businesses, even in a low commodity price environment, to the meaningful and measurable value of our growth opportunities, as well as our effective risk mitigation in areas which we believe to be of concern to the investment community.

So starting with 2010, as summarized on Slide 3, the company continued to generate a very high level of EBITDA in excess of \$2.5 billion and also throw off a substantial amount of free cash flow. Indeed, in regard to what should perhaps be the most important metric to shareholders, free cash flow yield, our free cash flow yield for 2010 was a robust 29%, making our seven-year average exceed 23%. And in response to some people who said that we should measure free cash flow for these purposes after both maintenance and environmental CapEx, we have done it in that way but before growth CapEx.

A substantial amount of that free cash flow yield was redeployed back to stakeholders in the form of debt repayment and through our 2010 share buyback program and also into various growth initiatives, which we'll discuss in a minute. But over \$650 million of excess free cash flow was returned as cash into the company's coffers, with the result being that our liquidity position at the end of 2010, \$4.3 billion of total liquidity with \$3 billion of cash on hand, is stronger than it has ever been.

It has always been my position that next to safety, the most important thing that we do as executive management at NRG is capital allocation, and given the amount that we are investing on an annual basis and the record amount that we currently have available either to invest in growth or to return to our equity and debt stakeholders, capital allocation has never been more important than it is now. As such, I'm going to focus the greater part of my remaining remarks on capital, which we expect to invest in our growth initiatives in the months and years to come. Chris will focus a good deal of his comments on capital to be returned to stakeholders.

In terms of the allocation of capital to our growth initiatives, it's important to start with the obvious point that we want to invest the company's capital in assets and initiatives that not only are likely to yield a return significantly in excess of our risk-adjusted weighted average cost of capital, but also in businesses and initiatives which advance the company's strategy.

As depicted on Slide 4, the company's long-term strategy for some time has been twin-tracked. First, to strengthen and enhance our generation to retail business in our core markets through superior operating performance, continued implementation of our first-lean-enabled, long-term hedging program and pursuit of both select acquisitions and the repowering of our older facilities with advantage locations inside load pockets in our core markets. This comply of our strategy which we

have pursued with relentless consistency and a high degree of effectiveness for the past five years was joined a couple years ago with a supplemental strategy that is overtly green and designed to take advantage of the societal trend towards sustainability.

This sustainability trend is, in our opinion, about to accelerate as a result of the emergence of various consumer-oriented disruptive technologies, which will make green energy at the consumer level the focal point of sustainability. We made considerable progress on both strategic fronts during 2010, with substantial advances across every facet of our sustainability initiative.

From our rollout of our eVgo network in Houston, which is centered around an innovative fueling package in approach to electric vehicle infrastructure that is already being replicated in other locations through the smart meter e-Sense applications now being sold by Reliant in quantity, to our unique approach to CCS/EOR being funded in collaboration with the DOE at our Parish facility in Texas. All of these initiatives are exciting and off to a good start. All will, I am confident, return considerable value to NRG to shareholders in the medium term.

You will hear more about these initiatives in the future but not today, because today, consistent with my theme, I want to concentrate my comments on the growth initiatives which are more immediate and which are key priorities for deployment of your investment capital during 2011. This is shown on Slide 6.

By way of background, in 2010, we committed substantial growth capital in four general areas: Zero carbon renewables, with an emphasis on solar; new advanced nuclear development; conventional gas-fired acquisitions and repowerings; and green retail acquisitions in the form of Green Mountain Energy. All four are likely to be areas of additional capital expenditure in 2011 but with very different investment profiles from 2010.

First, we expect an acceleration and significant expansion in our equity capital invested in high-growth, high-return solar projects. At the greater part of our utility scale, solar portfolio should achieve financial close and enter the construction phase during 2011.

Second, investment in conventional generation assets should be relatively flat year-on-year, as spending on GenConn and Cottonwood should give way to spending on El Segundo, but conventional CapEx could increase depending on our development success at Astoria, Saguaro or Encina and also, whether we find any strategic assets that can be acquired at value.

Third, capital invested in green retail should drop precipitously as obviously the big expenditure in this area in 2010 with the acquisition of Green Mountain. The amount of capital that we will be investing in and around Green Mountains business in 2011 or to expand into new geographic markets, bigger customers segments and new complimentary green product offerings is fairly minimal.

And finally, and similarly and perhaps, contrary to popular investor belief, even if the STP nuclear development project stays on course, the development capital projected to be required of NRG in 2011 will be far less than half of what we invested in 2010 and will be a mere fraction of what we will be investing in solar projects and other capital allocation alternatives.

So this is a lot to digest, so let's go through a little bit more slowly, starting on Slide 7 with Green Mountain. Four months ago, we paid \$357 million for a business that we expect to contribute \$70 million, \$80 million of EBITDA in 2011, plus, we expect Green Mountain to continue to deliver on a 20-plus percent compound annual growth rate trajectory that they have delivered for the past decade. But we didn't acquire Green Mountain just to continue with business as usual. We wanted to take

advantage, and we wanted them to take advantage of what we believe are very substantial synergies between Green Mountain and NRG.

Essentially, we want Green Mountain to accelerate the depth and breadth of their growth in close cooperation with us on the same path that they were following on their own, which means expansion into a high retail price Northeast markets, where they start with a natural green-leaning constituency, also, expansion into the larger Commercial segment of the C&I market than they have previously sought to access. And finally, expansion of their value-added product offerings to include distributed green generation.

It's early days yet, but on at least the first two of these, they are already beginning to bear fruit. Green Mountain has established a small but fast-growing footprint in New York Zone J, and in terms of larger C&I customers, they have won landmark business like the Empire State Building. We expect to be reporting on these and many more successes from and with Green Mountain as the year progresses.

Turning to conventional generation on Slide 8. 2010 was an uneven year, with the successful acquisition of Cottonwood and the repowering at Devon and Middletown, balanced by the missed opportunities surrounding Dynegy's California asset. Cottonwood and Devon have been smoothly integrated into our South Central and NEPOOL lineups respectively, and we are very pleased with the results today.

Looking forward to 2011, we're very focused on the successful repowering of El Segundo, an advantage which we hope to derive from having a modern, fast-start, low-heat rate, combined-cycle plant inside the Los Angeles basin load pocket. Beyond El Segundo, we hope to make progress on similar repowering efforts at Astoria in New York City and Encina in San Diego County. Beyond our own Repowering pipeline, the capital we deploy in the acquisition of conventional power plants, obviously, will depend on market conditions and asset availability in our core regions.

While the acquisition market is lumpy, generalities are difficult and predictions are often proved wrong, the optimism I once held at the first half of 2011 would be a buyer's market for CCGTs in the United States has largely dissipated. I see no sign of a flood of assets on the market and the combined cycle of transactions which have been announced recently have been priced at levels significantly above what we could justify to ourselves or explain to our shareholders.

With respect to our nuclear project, while important steps forward have occurred in several areas since our last earnings call, very little of it can be seen with the naked eye. As before, really all critical aspects of the STP 3 & 4 project run off of our receipt of an acceptable conditional loan guarantee from the government. Certainly, it is a challenge for us to complete meaningful discussions about PPAs with potential off-takers, while the loan guarantee application remains pending.

So our exit ramp analysis, which is set forth on Slide 9, remains largely unchanged from the previous quarter. Likewise, our viewpoint with respect to NRG's continued participation in the project remains at the most challenging of these hurdles, which is the long-term off-take requirement, effectively needs to be addressed no later than the third quarter of 2011 before the project enters the substantial pre-construction phase.

As such, we reiterate the view which is clearly articulated in both our 10-K and in today's earnings release, that NRG will be in a position by late this summer to make a final decision on our continued financial participation in this project. At that point, the market should have substantially greater clarity about the prospects for this project and NRG's role in it.

While we understand that there is skepticism amongst some investors that the project can go forward in the current low gas price environment, we nonetheless, believe it might be helpful to you for us to outline as shown on Slide 10 the future capital commitment of NRG in respect to this project, should it stay on track, with NRG continuing to support it financially.

The overall message is that due to a combination of first, the very substantial sum that NRG has previously committed to the project development, particularly during the first half of 2010 after the settlement with CPS. Second, taking into account our expectation of an optimal hold amount in the project for NRG of approximately 40%, which is down from the 67% that we will own if and when TEPCO invests in a project post-loan guarantee award. And third, due to the value ascribed to NRG for its contribution of the site, NRG's cash commitment to the project going forward is less than what otherwise would be suggested by our projected ownership level.

In summary, should the project proceed to financial closing, the total cash commitment for NRG at our 40% hold level should be something just short of \$800 million in aggregate, including cash invested to date. Beyond that, we are likely to have an LC commitment to a standby equity crossover line facility that will be fixed. And while that number has not yet been finally fixed, you should be thinking in the range of a few hundred million dollars maximum.

In exchange for this size investment in STP 3 & 4, we expect cash flow from dividends and tax benefits in the range of \$500 million a year for the first several years of operations. Obviously, this is a very attractive return but one which we believe is well justified given the extraordinary challenges of the undertaking.

Now pulling it back from where we hope the project will be in 2016 or 2017 to where we are here in the first quarter of 2011, you should be focused on what happens after announcements of acceptance of the loan guarantee. As the loan guarantee acceptance naturally will trigger certain funding obligations from our partners, NRG's share of cash development spent for the remainder of the development phase should approximate \$50 million for all of 2011 and half that for 2012.

While our perspective 2011, 2012 development standard is perhaps substantially less than many in the market were anticipating, it remains a lot of money to us, and we're taking very seriously our commitment to retain our financial discipline around this project and prevent exposure of our balance sheet beyond the specific commitments that I've outlined in this presentation.

Now turning to Slide 11, last but certainly not least, there is the solar pipeline. I've said many times, and I'll repeat here, that in my 20 years in this business, I had never seen investment opportunities in this sector that offer more attractive combination of high returns, low construction risks, long-term PPAs and repeatable business opportunities than the utility-sized solar projects that we currently have in our advanced development portfolio.

As such, we intend to do as much of this business as we can get our hands on, with the result being that by the end of this year, we may well have a total initial equity investment in our solar portfolio that exceeds the total amount that we may ever invest in STP 3 & 4 at very attractive near-term returns. The limiting item for us in terms of these solar investments is our ability on our own to make optimal use of the considerable tax benefits which will be generated by these projects. This is a topic that Chris Schade will discuss in a few minutes.

What I will end by saying is that this extraordinary pipeline of utility-sized solar projects, which our colleagues at NRG Solar have managed to develop or acquire, provides us with a truly unique

opportunity to develop over the next few years a solar portfolio of true scale and significant benefit, even in the context of the larger portfolio of NRG.

Ultimately, however, we fully recognize that the current generation of utility-sized solar and wind projects in the United States is largely enabled by favorable government policies and financial assistance. It seems likely that much of that special assistance is going to be phased out over the next few years, leaving renewable technologies to fend for themselves in the open market.

We do not believe that this will be the end of the flourishing market for solar generation. We do believe it will lead to a stronger and more accelerated transition from an industry that is currently biased towards utility-sized solar plants to one that's focused more on distributed and even residential solar solutions on rooftops and in parking lots.

We are already planning for this transition now within NRG, so that any potential decline in either the availability of utility-sized solar projects or in the attractiveness of the returns being realized on these projects, will be exceeded in aggregate by the increase in the business we are doing on smaller distributed and residential solar projects through our Green Mountain and even our Reliant retail sales channel.

With that, I'll turn it over to Mauricio.

Mauricio Gutierrez - Chief Operating Officer and Executive Vice President

Thank you, David, and good morning, everyone. NRG continued its strong operating and commercial performance during the fourth quarter, making 2010 one of NRG's best years. Slide 13 highlights a few of the key accomplishments achieved in 2010.

Starting with safety, we're particularly pleased with our record performance this year. Our OSHA recordable rate improved 26% over 2009. Our top performance remained strong with 90% availability of our baseload fleet, just shy of our 2009 level. This performance was achieved despite a forced outage event on our STP nuclear plant in November, which I will cover in more detail in the next slide.

On the environmental front, we delivered our second best year, and our FORNRG program far exceeded our 2010 goal. As I mentioned to you on our last call, controlling our cost is a priority, given the challenging economic environment our industry is facing.

Our Commercial Operations Group increased our hedge levels in 2011 and continues to look for opportunities to catch the odd years of favorable prices. We successfully transitioned to the Nodal Market in ERCOT and began integrating Green Mountain Energy and the Cottonwood combined cycle plant into our portfolio.

With respect to our projects under construction, the Indian River Unit 4 environmental back-end control project continues to be on track and on budget to be operational by January 2012. Our Middletown project in Connecticut received all major equipments in the fourth quarter and continues to be on schedule for operation this summer. Finally, the El Segundo Energy Center completed aboveground demolition of two existing units and secured major equipment orders. El Segundo is on track to be operational by the summer of 2013.

Turning to our plant performance metrics on Slide 14. Safety continues to be our number one priority. We are very proud to report that we achieved top decile in the industry, making 2010 our best OSHA

recordable year. We have 25 sites with no injuries and nine sites certified or recertified as OSHA VPP Star worksites.

Net generation decreased by 6% in the fourth quarter due to mild weather across Texas and a 22-day on-plan outage at STP Unit 2 during the month of November. The forced outage event was the result of a breaker failure during routine testing and was extended to repair a reactor coolant pump seal. In order to prevent recurrence, similar electric components were checked in both units. Unit 2 has operated without any issues since it was brought back to service on November 26.

For the full year, net generation was flat from 2009 levels. Increased generation in the Northeast and South Central regions driven by the strong summer weather and the addition of Cottonwood, were offset by lower generation in California and Texas.

For 2010, our coal fleet availability finished the year above the sub-quarter performance level for the industry. WA Parish led the fleet with 92.6% availability factor, and Limestone had the best reliability for the year, with a 1.6% forced outage rate.

Our FORNRG 2.0 program exceeded the 2010 goal by \$49 million, and it is on track to achieve our goal of \$150 million by 2011, one year earlier than planned. Savings were achieved through a combination of reliability, capacity and efficiency improvements at generating assets and cost savings across our corporate and regional groups.

Turning to our retail operations on Slide 15, we closed out the year with another strong quarter. Volumes and margins were consistent with our forecast, while Operations delivered better-than-expected asset management and lower operational costs.

The Mass segment continues to drive segment improvement in net customer attrition with a 57% reduction in the fourth quarter versus 2009. This result was driven by marketing, sales and introduction of innovative products to meet our customer needs.

In 2010, we led Texas in innovation, enrolling over 175,000 customers on our Reliant e-Sense product and services that utilize smart grid technology. We also introduced new and unique offers like carbon-state [ph] and home protection products, adding not only incremental EBITDA but increased customer stickiness.

We continue to maintain the lowest PUC customer complaint rate while balancing customer counterpricing. Throughout 2010, we aligned to successfully demonstrate that we have stabilized customer attrition and expect to achieve zero net attrition in 2011.

In the C&I segment, both renewal and new deal win rates continue to improve. We have expanded our business in several Northeast states where we can leverage existing energy assets and increase product offerings to include products such as backlog generation. These provides a solid platform to grow our business in 2011.

Business continues to show some fundamentals as you can see on Slide 16. Weather-normalized demand grew by 2% year-on-year and ERCOT set a new winter peak low of 57 kilowatts in February, an increase of almost 2.5% from the previous record. I'd like to take this opportunity to address the events in Texas on February 2.

The men and women of NRG Texas worked very hard to help meet the high demand for electricity due to the extreme cold conditions, increasing our generation by more than 60% from the previous

day. Although we had some operational issues, of the approximately 9,500 megawatts of power we had available in Texas during the low-shed event, we maintained between 97% and 91% of that capacity online. I want to thank all our employees in Texas for their dedication and extraordinary efforts during these events.

Now moving on to reserve volumes in ERCOT, we see a positive feature of our generation portfolio with reserved margins tightening faster than expected. This is to some extent reflected in the forward heat rates, as you can see on the chart on the lower right-hand quarter. We believe this trend will continue, given the robust growth and the expectation that asset retirement will outpace new builds. We have not seen as much coal-to-gas switching in Texas as we have in the Northeast and Southeast regions. In fact, cash generation was down year-on-year due to increases in new coal and wind generation in Texas.

In the Northeast, the back-end market continues to make some news. In New York, the recent FERC order to increase cost of new entry should provide a boost to capacity prices in New York City and rest of state, benefiting our New York portfolio. In PJM, prices remain uncertain until more clarity is given around the minimum offer price rule, the subsidized generation in New Jersey and Maryland and review demand outlook.

Moving on to Slide 17, you can see our detailed plan to control air emissions for each of our coal plants. As stated in our last earnings call, our plan is to invest approximately \$720 million through 2015 in environmental projects tailored to comply with future regulations.

Just to remind everyone, the proposed CAIR rule does not require additional capital for compliance. The HAP MACT proposed rule should be released in mid-March, and as you can see in the table, our plant considers mercury controls on all our coal units.

Intake modifications and repowering are expected to meet once for cooling requirements. We only have dry fly ash disposals at our all coal facilities. And finally, in most of our facilities, we burn low sulfur, low chlorine PRB coal.

Moving on to our hedge profile and commodity sensitivities on Slide 18. Our baseload portfolio is now 100% hedged in 2011 and 50% hedged in 2012, providing the protection in the short term where gas prices continue to be weaker given the oversupply situation. Beyond 2012, we choose to remain significantly open.

After two years of low gas prices, we believe the downside risk is limited. Our combination of incremental demand from the power sector, particularly in light of possible coal plant retirements, some signs of the interest rate by producers, indication that drilling to home acreage may be ending, and a move from dry to wet gas production will provide better opportunities to catch our baseload portfolio in the future.

With respect to retail, we have increased our pipe load to 66% in 2011 from 57% in the third quarter. We continue to match as much generation load as possible to start maximum synergies between our retail and wholesale portfolios.

Our power and coal hedges continue to be well managed in 2011 and 2012. Given the shape of the coal curve and steep contango, we have not added any additional occasions since the last quarter. We also remain well hedged in terms of coal transportation now for some time.

Our sensitivity to commodity prices is agreeable for 2011, with 2012 to 2015 largely unchanged from

last quarter. Let me remind you that this sensitivity is around our baseload portfolio. Interest expense, our portfolio is well-positioned to benefit, particularly, in the Texas and South Central regions.

With that, I will turn it over to Chris who will discuss our financial results.

Christian Schade - Chief Financial Officer and Executive Vice President

Thank you, Mauricio, and good morning. Beginning with the financial summary on Slide 20, full-year 2010 adjusted EBITDA was \$2.514 billion, just shy of the record 2009 adjusted EBITDA of \$2.618 billion and within our previously stated guidance of \$2.5 billion to \$2.55 billion. As a result of our continued strong operating performance, adjusted cash flow from operations for 2010 was robust at \$1.76 billion.

The company's liquidity position at year end, excluding funds deposited by counterparties, stood at nearly \$4.3 billion, a \$458 million increase from December 31, 2009, liquidity of approximately \$3.8 billion. Our cash balance at year end 2010 available for both working capital as well as our 2011 capital allocation program was approximately \$2.9 billion.

Now turning to a summary of our 2011 guidance in Capital Allocation Plan. First, we reaffirmed the preliminary 2011 EBITDA guidance range of \$1.75 billion to \$1.95 billion. Second, and as part of our 2011 capital allocation program, we are planning to repurchase \$180 million of common stock, and complete \$240 million of term loan debt repayments and \$39 million for additional facilities, all of which is consistent with NRG's commitment to return excess capital to its stakeholders. Third, in 2011, in addition to the amount deferred from 2010 as a result of extending the cash grant availability, we are currently planning to commit an additional \$640 million of net investment to advance our Repowering and renewable development program, particularly, utility-scale solar.

Now turning to a more detailed review of 2010 adjusted EBITDA result from Slide 21. The company reported near record results of \$2.514 billion adjusted EBITDA, only \$104 million lower than the 2009 adjusted EBITDA of \$2.618 billion. These results were achieved despite the decline in forward prices across all of our regions and clearly benefited from our wholesale generation hedging program and the continued strong performance of Reliant Energy.

During the year, Reliant Energy contributed \$711 million of adjusted EBITDA. Comparatively, these results are lower by \$158 million from 2009 as we overlined for only eight months of that year. The year-on-year decline was driven by an 18% decline in Mass margins, which were the direct result of price reductions enacted following the acquisition, as well as lower margins on customer renewals and new customer acquisitions reflective of the competitive market. All told, for 2010, Reliant saw net customer attrition rates improve to 0.4% from 0.7% in 2009 with total customers at year end steady at 1.5 million.

The wholesale business meanwhile generated \$1.8 billion in adjusted EBITDA, \$173 million lower as compared to a record 2009 EBITDA of \$1.976 billion. The comparative year-to-date decline is largely explained by a 32% drop in baseload hedge prices in the Northeast, as well as lower margins in Texas, caused by a 60% increase in fuel costs, due largely to higher coal transportation costs at our WA Parish facility. These results were partially offset by an increase in adjusted EBITDA of \$28 million from the South Central region due to increases in generation and contracted sales.

Also increasing adjusted EBITDA were our newly acquired assets, including Green Mountain Energy, Cottonwood, Northwind Phoenix, South Trent Wind Farm, as well as the full year of operations from the Blythe solar project.

For the fourth quarter, the company reported adjusted EBITDA results of \$444 million, a \$45 million decline versus 2009. Reliant Energy contributed \$117 million of adjusted EBITDA compared to \$104 million for the fourth quarter of 2009. Reliant's quarterly results were favorable \$13 million driven by an improvement in operating costs primarily due to better customer payment habits as related to a decrease in bad debt expense.

In the fourth quarter of 2010, our Wholesale Generation business contributed \$327 million of adjusted EBITDA, a \$58 million decline compared to fourth quarter '09. The change in results can largely be attributed to the following items: In the Northeast region, 35% lower hedge prices and a 25% decrease in generation resulting in a \$57 million decline in energy margins quarter-over-quarter. The decrease in generation was largely a result of coal-to-natural gas switching and offsetting this decline in energy margins were favorable year-on-year operating and maintenance expenses of \$13 million.

In Texas, the 10% decline in generation at the Limestone and WA Parish facilities due to lower power prices and reduced demand led to a 6% decline in overall generation for the region. Offsetting this decline were favorable year-on-year operating expenses of \$17 million that included gain on land sales of \$6 million in 2010.

Now turning to Slide 22. As I mentioned a moment ago, total liquidity at year-end 2010 excluding funds deposited by hedged counterparts remained strong at nearly \$4.252 billion. Total cash stood at \$2.959 billion, an increase of \$653 million as compared to the 2009 year-end cash balance of \$2.3 billion. The drivers of the cash increase included adjusted cash from operations of \$1.76 billion and debt proceeds of \$1.317 billion.

These increases were offset by several items: First, five completed acquisitions totaling about \$1 billion, which included \$507 million for Cottonwood generation station, \$357 million for Green Mountain, \$100 million for Northwind Phoenix, \$32 million for South Trent Wind Farm and for the U.S. solar portfolio, 720 megawatts of development projects in nine states in California and Arizona. Second, debt and fee payments totaling \$813 million, including Term Loan B payments of \$453 million and a repayment of a common stock fund or CSF of \$190 million.

And third, capital expenditures excluding NINA of \$445 million, including \$199 million of maintenance, \$184 million of environmental, primarily related to the Indian River Air Quality Control System project, and \$62 million of growth investments. For the full year, we made cash contributions to NINA totaling \$170 million primarily in the first half of 2010. And finally, we completed share repurchases of 8.5 million shares, totaling \$180 million.

Now turning to 2011 guidance on Slide 23. Our EBITDA guidance remains unchanged from our November 24 range of \$1.75 billion to \$1.95 billion. Included in this guidance range are wholesale expectations of \$1.2 billion to \$1.3 billion, retail expectations of \$480 million to \$570 million, and Green Mountain of \$70 million to \$80 million. As Mauricio discussed earlier, we are about 100% hedged on our baseload generation for 2011 and are thus comfortable with our forecasted results.

As we look forward to our Wholesale business in 2012, we are currently in excess 50% hedged with a higher average price in 2011 as indicated in our SEC filings. Due to this position and based on the current forward curves, we expect flat to marginally lower year-on-year wholesale results in 2012 from 2011. These results will be supplemented with adjusted EBITDA of \$85 million from our repowering and solar investments in 2012 that are not subject to market fluctuations.

For our retail business in 2011, our current expectations, assuming normal weather, are an EBITDA

range of \$480 million to \$570 million, the decrease in 2011 guidance compared to current 2010 results is largely explained by lower unit margins in Reliant's Mass business. Reliant's C&I business margins are also expected to decline slightly, but be directly offset by higher terawatt-hours served, reflecting our continued dedication to this growing client base in both Texas and PJM.

Finally, we expect Green Mountain Energy to contribute \$70 million to \$80 million of EBITDA. We are very excited about enhancing the growth prospects for our Green Energy Retail business during the process of integrating the business with our growing renewables portfolio to enhance these future growth prospects.

During our Q3 earnings call, we discussed the 2011 free cash flow guidance of \$425 million to \$625 million, and we now currently anticipate free cash flow for 2011 to be in a range of \$150 million to \$350 million. The difference in guidance is largely explained by certain timing of solar projects, due to Congress extending the availability of cash grants for renewable projects through 2011. NRG postponed its large investments in solar projects from 2010 to 2011, resulting in \$267 million of solar expenditures pushed into '11 and relates primarily to our Agua Caliente, Ivanpah and CVSR solar projects.

As we often like to emphasize, we are in a strong cash flow position based on Friday's closing stock price of \$20.89 and our affirmed outlook. Free cash flow before growth yield currently stands at between 16% to 20%, or \$3.36 to \$4.17 per share.

Slide 24 shows the company's projected 2011 year-end cash position which we project to be about \$2.5 billion. Beginning with the portion of the Capital Allocation Plan that includes share repurchases and debt repayments in 2011, the company intends to repurchase \$180 million of common stock, which is within the constraint of the restricted payments basket; repay \$240 million of debt related to our Term Loan B agreement; and approximately \$39 million in other facilities. It's important to note that the company made a Term Loan B prepayment in November that totaled \$200 million.

And finally, complete \$907 million of capital allocation in the following projects: \$50 million in NINA; \$219 million for other Repowering investments including El Segundo, GenConn Middletown, eVgo, Texas Reliability and Princeton Hospital and \$638 million for solar projects, net of cash grant proceeds, and including the \$267 million of deferred payments from 2010.

During the third quarter conference call, I also mentioned that we usually maintain a minimum cash balance of \$700 million largely for working capital margin requirements, the timing of cash payments, of interests, property taxes, as well as equity for projects we have under construction throughout the year. Thus, for 2011, we estimate a balance of just over \$1.8 billion to allocate between perhaps additional share repurchases, contingent on the restricted payments basket expansion, further investments of high-growth opportunities and continued opportunistic management of our debt structure.

On January 11, the company issued \$1.2 billion of 7 5/8 senior notes due 2018 and announced the simultaneous cash tender for \$1.2 billion of the outstanding 7 1/4 senior notes due 2014. As of January 25, nearly 945 million bonds have tendered, and the remaining 250 million will be redeemed by the end of February pursuant to the embedded call price. As a result, we've improved our debt maturity profile, all of our public debt matures after 2016, and replace the restricted covenant package with one permitting greater efficiency and flexibility to return value to all NRG stakeholders.

On a go forward basis, we will continue to moderately embed in calls in the 2016 and '17 maturities

and be opportunistic about replacing those bonds with less restricted covenant packages, similarly to how we handle the 2014 maturity.

Looking at NRG's combined Repowering and Solar portfolio and our EBITDA contribution on Slide 25, you can clearly see the benefit of the program with nearly \$550 million of recurring contribution by 2015.

During the fourth quarter, our El Segundo Repowering project received prior approval from the California Public Utilities Commission for a ten-year Power Purchase Agreement with Southern California Edison. Commercial operation's expected in the summer of 2013.

Our large utility-scale solar projects will also begin to reach commercial operations between the summer of '13 and the first quarter of 2014, and these projects collectively are driving this EBITDA growth. These solar investments are attractive for their high-teens returns, very low construction risks and offtake agreement of 20-plus years with highly rated counterparties. We will continue to provide updates on the progress of these projects as they move into construction and operation.

As we continue to invest and grow our solar portfolio, it's important to highlight a few economic benefits created with these projects. Slide 26 shows how the combination of cash grant, maker's depreciation and strong cash flows from the PPAs for our projects result in a payback for our investments, in some cases by 2014, and retain stable cash flows for the remaining term of the PPAs.

Though we believe there will be a turnaround in commodity markets, we are mindful of our ability to create enough taxable income for us to fully absorb tax benefits created by these solar investments. There is clearly a limit to how much tax efficiency we could absorb in any one year before reducing the total project returns. As such, to both minimize the tax leakage and enhance our returns, in 2011, we will pursue new equity investors for our solar portfolio, who have both the appetite for tax benefits and seek investment to one of the largest utility-scale solar portfolios in the world. New equity investors would not only help to optimize our existing tax position but allow us to continue to invest in future projects with high returns.

We expect to launch this initiative soon and look forward to sharing the progress in the future. Now I'll pass it back to David for final comments.

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Thank you, Chris, and thank you, Mauricio. And so in conclusion, on Slide 28, we put what we think are some of the value drivers around the investment proposition at NRG. And it starts with the fact that 2 1/2 years into the commodity price down cycle, it appears to us that the end is in sight, the bottom of the trough has been reached, and the only way to go is up. When or how quickly gas prices will recover remains open to conjecture, but the case for rising heat rates in our core market of Texas is clear and compelling. And we've positioned our portfolio and our hedge both to benefit from that upturn.

Second, even in a political environment that has turned more conservative in the past year, market mandates for renewable generation and for solar power in particular, remain well supported in both the red and blue states. And the result for us has been a fast-growing portfolio of projects that will contribute substantially to shareholder value creation over the short to medium-term.

Finally, there's the inherent value unique amongst our peer group of Wholesale generation combined

with the leading retail position. While we have executed to such great success in Texas, together with Reliant, we are now in position to replicate with Green Mountain in the fast-growing green and retail energy sector. It's a bright future indeed, and for all of us at NRG, we'll strive to realize its vantage on behalf of the shareholders of NRG.

So Deanna, with that, we'd be happy to take some questions.

Question-and-Answer Session

Operator

[Operator Instructions] The first question will come from the line of Daniel Eggers, Crédit Suisse.

Dan Eggers - Crédit Suisse AG

David, I was just trying to marry up some of the comments made about some of the solar investment opportunities. If I look at Slides 25 and 26, the cash investment and then the earnings contribution you guys show there, is that based on the things that are in hand right now, or is there a assumption of the amount of incremental projects who would have to get signed this year to help get to those numbers?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

I think what we're showing, Chris, correct me if I'm wrong, is the Tier 1, which are projects, which in my personal estimation are ones that have a 90-plus percent chance of achieving financial closure.

Christian Schade - Chief Financial Officer and Executive Vice President

Yes, that's actually correct, Dan.

Dan Eggers - Crédit Suisse AG

So these are things that are already in place, and this would be less contribution than what you said in your comments earlier, David, about having equity investment and solar greater than what you do see in South Texas ultimately?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

I'm sorry. Say it again?

Dan Eggers - Crédit Suisse AG

So this earnings contribution represents an investment less than what you think you can get to from the solar perspective based on your comments earlier in the presentation?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

I mean there are more projects behind this portfolio.

Dan Eggers - Crédit Suisse AG

When do you see the opportunity this year to announce off projects? And how would you see this sell down equity go as far as changing the earnings contribution profile from these projects? And how much could you sell down, do you think?

Christian Schade - Chief Financial Officer and Executive Vice President

Well, we're going to get to how much we can sell down as we move through the process. But very clearly, any amount we sell down will sort of be a pro rata reduction in EBITDA. And so depending on how much we do, we'll certainly let you know. But we do believe that the sell down will allow us to provide incremental more equity into other projects we have yet to announce. But what David said, we're on the bubble given the benefits from the government largesse, which we think still exist but perhaps will run out in the next couple years. And those projects will also be assumed as sort of returns consistent with what we've seen to date.

Dan Eggers - Crédit Suisse AG

And I guess one last question just on South Texas. David, if you could maybe just -- we go through the numbers as far as how much cash you expect to throw off in the project, and then to clarify that, contribution's based on kind of the pricing you'd need it to be able to receive in order to earn economic return on that project?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Well, so you're saying you're -- Dan, you're actually looking forward to 2016 and '17? Yes, I mean, looking at Page 10, I mean, through the first few years, when we've talked about receiving \$500 million of cash, that's based on our view on where gas prices go, which is, obviously, some way up from where they are now, sort of into the \$6 to \$7 range. Having said that, Dan, we've stressed the returns on the nuclear project from an IRR perspective, sort of \$4 gas in perpetuity model. And the IRR in the project, it would still be in double digits, but obviously, the higher gas prices, the better we do. But it works, the numbers work even at a \$4 gas environment. And the reason that is the case, Dan, is because, obviously, the tax benefits associated with nuclear project, particularly, the production tax credits, meaning that through the first several years of the nuclear project, the economics are more driven actually by the tax benefits than they are by the price of electricity.

Dan Eggers - Crédit Suisse AG

Do you see IRR as working in \$4 gas to the equivalent of a mid-30s power price, you would see the plant being economic?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

In a \$4 gas, the plant is, yes. I mean, again, it's a low-teen return. I'm not sure that -- it's not the return we're seeking, but it's not a single digit return or a negative return.

Operator

The next question will come from the line of Ameet Thakkar, Bank of America Merrill Lynch.

Ameet Thakkar - BofA Merrill Lynch

Mauricio, you kind of indicated that the path with hedging, despite, I guess, some uptick in heat rates in Texas and you also didn't do much in the way of coal as well. I mean is your expectation that PRB prices should follow gas down? Or are you guys a little bit more neutral on gas at this point?

Mauricio Gutierrez - Chief Operating Officer and Executive Vice President

Well, I mean, if you look at our hedge profile, the next few years, we're pretty well hedged on both sides, so power and coal. We can justify the contango that exists with the coal curve. And given the inventory that we have and the hedge profile, we think that we can weigh to be more opportunistic about when to catch the coal prices. With respect to gas, we continue to see further declines in the front part of the curve, which we've been pretty well insulated. But as I mentioned in my remarks, I mean, I think when you look at 2012 and beyond, and where those price levels are, we see very little downside risk from that. And we think that there are several factors that are converging that could potentially move gas prices, assuming they could be higher than where they are today.

Ameet Thakkar - BofA Merrill Lynch

And then David, real quick on STP. I just want to make sure I understood, I guess, some of your answers to the previous questions. You see returns in kind of the teens area, given the \$4 gas for STP?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Yes, so the returns would be in the teens area in the \$4, in perpetuity model. Again, this is based on the idea that we're running a model where there's roughly 1,000 megawatts of power sold by long-term contract, and the rest is taken into the merchant market. So the \$4 gas would apply to the 2,000 in the merchant market. And yes, you're right, what it shows is a return in the teens, in that sensitivity. I would also tell you, Ameet, both in response to your question and I should say to Dan, also, we run this with no value associated to the zero-carbon aspect of it, so the price on carbon directly or indirectly would be on top of this.

Ameet Thakkar - BofA Merrill Lynch

And then so is like the 1,000 megawatts of PPA cover, I guess, under that analysis, is that really kind of the goal to kind of continue to move forward and not exit, I guess, exit land for on Slide 9?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Well, Ameet, almost as a -- I mean, from the beginning, I think that we have said to our investor base that we, at least, would not proceed with the project unless there was a significant amount of long-term offtake associated with the project. And so, roughly 1,000 megawatts has been something we talked about from the beginning. On top of that, Ameet, the conditional loan guarantee, if and when it's announced, it's called a conditional loan guarantee because there are conditions associated with it. And probably the most substantive condition, the condition we would be focused on is that the government would require us to have approximately that same amount of long-term offtake agreement contracted, which was a condition, again that we were happy to agree with the government on since we had said that we wouldn't go forward with it either. So that's why we would be doing that.

Operator

And the next question will come from the line of Ted Durbin, Goldman Sachs.

Theodore Durbin - Goldman Sachs Group Inc.

If I could just ask a little bit about the capital allocation. You're obviously coming out of 2010 here with a high cash balance. I'm just trying to understand a little bit better the allocation of the capital towards the renewables and whatnot, maybe extending that relative to between cash to stakeholders. Could you just talk a little bit more about that?

Christian Schade - Chief Financial Officer and Executive Vice President

As we said, we're committing to a \$180 million stock repurchase, and that's within the confines of our restrictive payment basket. We're also going to be making required debt repayments under our term loan program, Term Loan B program. We've also earmarked potential investment in our solar projects, and these are projects which we had -- some of which we're announced late last year and early this year and would be subject to the cash grant program under the government. So all of those projects and repowering projects from El Segundo and GenConn Middletown. But those are the programs at least that were part of the capital allocation program for this year. That's what we've announced. We have \$1.8 billion after which we would be able to deploy into additional repowering should they be available and new solar projects that we see on the horizon, as I've said before, all of which offer us the opportunity for very attractive returns.

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

And just to add, Ted, I think you phrased the question almost as if it was an either/or, and I guess that may be a little different. I mean, given the company's free cash flow generation and the cash we have on hand, we haven't really seen it as an either/or. In terms of returning capital to shareholders through the share buyback, we do as much as we can under the restrictive payment basket. Over the past years, we've constantly evaluated whether or not we could negotiate a way to have more room to do more, but the expense of doing that has always made that impractical. So from our perspective, it has not been an either/or decision. It's been do both.

Theodore Durbin - Goldman Sachs Group Inc.

Does that cost of getting the ability to do more of a buyback, you're still seeing that as not worth the expense of getting that?

Christian Schade - Chief Financial Officer and Executive Vice President

That's right. We think the expense to negotiate with the bondholders is being punitive. And as I said in the prepared remarks, the approach that we took on the 2014 maturity to wait for the calls to come due than to call away and refinance was we felt unattractive and a cost-beneficial way to do it. We have calls coming up in February for the 2016 maturity which we'll keep an eye on. The 2017 are not yet callable, will be so within a year. The high-yield market remains very attractive from financing perspectives, so we'll continue to look at that closely. But just to further what David said, with the excess cash in addition to the \$180 million as we said, we'll certainly consider future stock repurchases if it can fall within the confines of hedging expansion we see in our restrictive payments basket throughout the year as well.

Theodore Durbin - Goldman Sachs Group Inc.

I appreciate the commentary on sort of the assets side. It sounds like you're not seeing the values on the CCGT side that you were before, but you did do the Cottonwood transaction. Are there other holes in your portfolio, where you say, "Geez, we'd really like to add some mid-merit assets whether it's more in South Central or whatnot?" And kind of talk about where you'd like to build up the portfolio.

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Well, I think the place where we'd like to build up the portfolio, and again, we've been fairly -- well, it took us six years to execute on the idea that we needed a load following plant in South Central. So just because I say this, I don't want you to think any sort of announcement's around the corner, because I'm actually skeptical that we can achieve anything. But we would definitely like to have some more baseload-following capability in PJM, particularly Eastern PJM. Having said that, we don't have any optimism about anything coming available in that footprint that we would find probably at a reasonable price. But we keep our ear to the ground. I would say that has been our single greatest priority second to backing up Big Cajun, which we've now achieved with Cotton.

Operator

And the next question will come from the line of Jonathan Arnold, Deutsche Bank.

Jonathan Arnold - Deutsche Bank AG

My question is, on STP, you believe the option for the second 10%, the TEPCO would take -- had a May expiration date on it, we recall from the original 8-K. But is there a similar date around the base 10% investment that's contingent on the loan guarantee acceptance? Is May a kind of drop-dead date for that whole arrangement with TEPCO?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

I don't believe there's a drop-dead date. And John, Tokyo Electric well understands the pace of development. I don't want to speak to them, but I think their enthusiasm for participating in this project is unchanged from when we announced the deal a year ago. So I don't remember any sense of date, but I have a very high level of confidence that if the loan guarantee comes that Tokyo Electric will participate in the project.

Jonathan Arnold - Deutsche Bank AG

And can you also give us a sense of -- well, obviously, your contribution is relatively small over this '11, '12 period. What would the \$25 million in '12 be absent additional sell downs? And maybe some kind of sense of how much is actually being spent on the project itself during this next couple of years.

Christian Schade - Chief Financial Officer and Executive Vice President

Well, what it would be without the sell down, I'll have to get back to you on that. The amount of money that has to be invested towards in order for us to proceed is it's several hundred million dollars. But Jonathan, it's really hard to put it in those terms. Because like a good portion of it is long lead time materials in Japan which are actually funded with the credit facility from Toshiba. So maybe we can break out and provide it to you or do it next quarter. Just the development spend for now, in order for

us to proceed against the sources of capital, because it's really not useful if you look at it as one-lump sum, because various things are paid for with different buckets of money.

Jonathan Arnold - Deutsche Bank AG

And if I may just on one other topic, what indications are you getting from DOE on these discussions at a level of hedging through PPAs that would be acceptable to them on the project?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Well, I think that the condition is very specific. And I think back, it's the same as I answered to Ameet. It's something just less than 1,000 megawatts.

Operator

The next question will come from the line of Jay Dobson, Wunderlich Securities.

James Dobson - Wunderlich Securities Inc.

I was hoping you could give us some insight into the offtake discussions. The local media's covered some interesting transactions, or at least, proposals that you had. So I'm just wondering if you can give us some insight into where things stand and sort of what your level of optimism is currently.

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

It's a good question, and I think what I would say without -- I mean, it's difficult to comment with discussions that are underway. And in fact, normally, we don't comment on it but since as you said, there's been discussions by the public, I guess I should say some things. I would say, first of all, I think there's an openness, a willingness, and interest on several load-serving entities, large load-serving entities in the Texas market to talk about long-term offtake. And I would also say that the events of early February in Texas, where a part of the reason the state had rolling brownouts or even blackouts is because people couldn't get gas to some power plants, I think has reinforced the idea that having fuel diversity in the state is something that load-serving entities want to have. So there's a fairly high level of interest from various parties, but the big qualifier I always put on this question is, right now, as you say, it's really discussions. I mean, the project isn't really real to off-takers until we have a loan guarantee. So I would describe anything that we're doing with any counterparty at this point is being preliminary. And so that's what I would tell you. And based on what we're being told by the camp, their interest level, I'm guardedly optimistic. But mainly, my main attitude towards all this is, let's wait and see what happens when the loan guarantee's announced, because that's when ourselves and our counterparties are going to have to get down to business, and people are going to have to make commitments on both sides. So that's the main thing, and what we're trying to empathize here is that, that phase, and hopefully that phase will begin within the coming weeks, is something that basically needs to be resolved by the summer so that we can all have clarity as within the company and U.S. investors and analysts as to where we stand vis-à-vis this project.

James Dobson - Wunderlich Securities Inc.

As an unrelated follow-up, on the solar side, I'm not sure if this is good for your or for Chris. I assume in addition to selling an equity stake, you'd consider selling a tax equity there, and how do you

consider those two alternatives?

Christian Schade - Chief Financial Officer and Executive Vice President

Yes, very much so. I think the equity stake that we are contemplating is tax equity, it's a structuring issue. But we're certainly looking to pass off the tax attributes that are generated from this portfolio to tax equity investors. I think, one thing as a follow-up to a question before is that we'd certainly be looking to sell this equity at a premium. The returns that we're seeing perhaps from these investors are below the expected returns that we see in the high-teens, and so that sort of premium or IRR arbitrage gain will certainly benefit us in having development premium for this. But our goal here both is to bring equity into these projects and also, to lay off some of the tax that perhaps, does not necessarily accrue to NRG.

James Dobson - Wunderlich Securities Inc.

And Chris just a last follow-up, the capacity of the RP basket at year end?

Christian Schade - Chief Financial Officer and Executive Vice President

It was about \$160 million. So the \$180 million that we announced today will be spread out for a couple of quarters.

Operator

The next question will come from the line of Brandon Blossman, Tudor, Pickering Holt & Co.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

I guess just a follow-up on the tax equity question, probably for Chris. Just to be clear, is the tax equity partner or sell down required to optimize the tax benefits of the current solar portfolio, or is that something you need to do to increase the size of that portfolio?

Christian Schade - Chief Financial Officer and Executive Vice President

I think it's not necessarily required. I think it benefits the returns of the portfolio and allows us to continue to invest in the space. As David said, we're seeing a lot of opportunities elsewhere, and I think when we start to layer on other utility-sized projects in addition to what we have, there is a limit to the capacity of tax attributes that we can assume. So we think it's important. We're seeing a lot of interest and opportunities to invest in this space by sort of nontraditional investors who want to get green, and so we think it's a big opportunity for us, who are certain taxpayers as well. So it's for us to check a lot of boxes along the way. First and foremost to optimize our tax position in appropriate years, as well as to allow us to continue to invest in the space.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

And how does that dovetail with STP's tax attributes? Is that far enough out so that there's no overlap here or concerns about maximizing that value?

Christian Schade - Chief Financial Officer and Executive Vice President

It is far enough out that we're not perspiring about the tax attributes that it generates. But certainly, it's a topic that we will address at due time. And also, would speak to our underlying business that we

hope and certainly think will grow enough to burn through these NOLs and to continue to generate the taxable asset side in those years. So we're confident of that.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

And David, as a follow up, not that anyone wants this to happen, but if there is an exit ramp for STP, can you describe what that looks like? Is there a project to be had at some point in the future, given that this is a particularly attractive development project?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Well, Brandon, I guess, what I would say, on a few fronts. I mean it sort of depends on which exit ramp you're talking about. And I'm just speculating on things which of course, we don't hope to happen. I mean from my perspective, I think if something happens during this year that caused the entire project to go away, we would probably finish the licensing process, which is a small fraction of the overall development spend. But we're so far along with the NRC that to stop it this close to the end would not make sense. But beyond that, would the project go forward? I think it depends on which exit ramp it is. And again, I don't mean to speak for the other partners, because I want to emphasize every NRG investor on the call. We do not have the right to kill the STP 3 & 4 project. We just have the right to stop our own financial contribution to it. But I would say, if the exit ramp is that, actually it turns out that there is no loan guarantee in the offing -- I haven't actually asked this question directly, but I think our partners in Japan -- and we would be aligned that there would be, that the project would stop if there's no hope of a federal loan guarantee. If on the other hand, there was a federal loan guarantee, but we were taking the exit ramp because we were unable to lineup the offtake, I don't know what our partners would do in that circumstance. Maybe they would continue with the project, that would be their prerogative to do. I just know that if we don't have that offtake arrangement, then we will stop funding.

Brandon Blossman - Tudor, Pickering, Holt & Co. Securities, Inc.

And that would be not the 1,000 megawatts, but isn't that predicated on the loan guarantee or the loan guarantee predicated on the 1,000 megawatts?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

It is, but one of the reasons why I don't know -- I don't remember the exact terms, the exact words of the conditional loan guarantee, but I know that we do not have the opportunity at NRG to solve for the offtake arrangement, because I think the condition is offtake agreements with investment grade offtakers. Our Japanese partners who are investment grade would have that opportunity should they so choose to correct that on their own. We don't have that type of power, so that's not a question for us.

Operator

The next question will come from the line of Brian Chin, Citigroup.

Brian Chin - Citigroup Inc

What's the rough range of construction cost estimates in dollar per KW for the solar PV facilities that

you are seeing, and also for the solar thermal side?

Christian Schade - Chief Financial Officer and Executive Vice President

The range, well, I think we would say that the range right now is 3,500 to 4,000 per KW, and I don't know, that would be for the PV -- I can't tell you -- the solar thermal would probably be in the same range.

Brian Chin - Citigroup Inc

And then would it be fair to say that \$4 sustaining perpetual natural gas price environment that you'd still see solar generating returns in the double digits as well? And is it higher or lower than nuclear?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Well, we haven't compared them side-by-side. I think it's fair to say that like nuclear, the solar projects, at this point, the economics are very heavily driven by the tax benefits. But beyond that, the real difference between the two is that every solar project we're doing is completely not merchant. It's totally PPA. So I don't think -- in fact, when we talk about taking the company's financial performance and sort of de-linking it to natural gas prices, we put renewables together with retail in parts of our EBITDA stream that are not associated with natural gas prices, because of the fact that all of the economics are derived from long-term PPAs.

Brian Chin - Citigroup Inc

Can you talk just a little bit about from your perspective, what the FERC's order in the New York ISO and the capacity market situation up there? What's changed longer-term, and how much of a positive is that for you guys, or is that even material?

Mauricio Gutierrez - Chief Operating Officer and Executive Vice President

Well, I mean it's definitely material. It's difficult to say what is the ultimate impact, because I think the variables are still being flushed out. But the three main changes was the recognition of state taxes and the cost of new entry calculation, inter-connection costs and then the energy offsets. So when you put those three together, you basically have higher cost of new entry, which will push capacity prices for both New York City and the whole state. This will benefit our New York portfolio, but at this point I can't give you the specific mind into it.

Operator

And the next question will come from the line of Anthony Crowdell, Jefferies.

Anthony Crowdell - Jefferies & Co

Just a quick question on the, I guess, the cold stub that hit Texas earlier this month. And it seem like there wasn't much of an impact on the generation side, but was there any impact to the margins that Reliant expected or anything on the quarter?

Jason Few - SVP of Mass Markets and Operations, Reliant Energy, Inc.

This is Jason. From the retail side, we actually, faired fairly well through this event. I mean, our

hedging strategy and risk policies served as well during the event. We did not see material impact to our business.

Operator

In interest of time, we have time for two more callers. And the next question will come from the line of Charles Fishman, Pritchard Capital Partners.

Charles Fishman - Pritchard Capital Partners, LLC

Your five-year environmental capital plan, Page 17, I want to make sure I understand this. The \$720 million includes your view of what the math might be, which is less than worst-case, number one. And number two is there are no dollars in the \$720 million to address once thru cooling. Is that correct?

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

No, actually, there is some dollars for 316(b) through the installation of extremes. We've been very successful in New York, in Arthur Kill and Huntley and Dunkirk to address this issue. So while it addresses the Mercury and asymmetric controls across all our coal assets, it also addresses the 316(b).

Charles Fishman - Pritchard Capital Partners, LLC

And if we do end up with the worst case math, I mean could this number increase 50%? Or do you have any feel for that?

Mauricio Gutierrez - Chief Operating Officer and Executive Vice President

Well, we actually disclosed that on our last earnings call. And I believe it's about \$1 billion -- just shy of \$1 billion. If it was the worst case scenario, in terms of unit-specific controls, no averaging. And we just don't believe the EPA will go that route. But the rule is going to come out, the proposal is going to come out in about a month, and I think it's just prudent to wait before we make any changes.

Operator

And there are no more questions in queue at this time.

David Crane - Chief Executive Officer, President, Executive Director and Member of Nuclear Oversight Committee

Okay, well, good. Well, thank you all very much, and we look forward to talking to you in the next quarter. Thank you, operator.

Operator

And ladies and gentlemen, this concludes today's presentation. Thank you very much for your participation. You may now disconnect, and have a great day.

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EXHIBIT 5



Solar | Photovoltaic (PV)

Endangered Bird Found Dead at Desert Solar Power Facility

(<http://www.kcet.org/news/rewire/solar/photovoltaic-pv/endangered-bird-dead-at-desert-solar-facility.html>)

by **Chris Clarke**

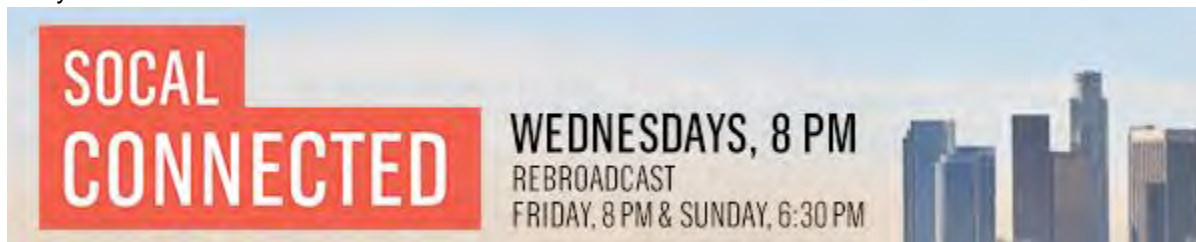
on July 10, 2013 2:50 PM



Yuma clapper rail | Photo: Jim Rorabaugh, FWS

A bird found dead at a Riverside County solar project in May was a Yuma clapper rail, a Federally listed Endangered species. The rail is one of a number of water birds found dead at the site, according to one of the owners of the project. The fatality marks the first reported death of a Federally Endangered bird at a renewable energy generation site in the mainland U.S.

Story Continues Below



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A spokesperson for the Desert Sunlight solar facility near Joshua Tree National Park in Riverside County, confirmed that a rail was found dead on the project site on May 8, further adding that a several dead grebes have also been discovered at the site, and were also reported to relevant agencies for investigation.



The U.S. Fish and Wildlife Service (FWS) wrote an Incidental Take Statement for Desert Sunlight as part of FWS's Biological Opinion on likely impacts of the project, but that statement doesn't mention Yuma clapper rails. If investigation proves the bird died as a result of operation of the project, the death may thus place Desert Sunlight in violation of the Endangered Species Act.

Desert Sunlight's statement pledges that the company will cooperate fully with the investigation. Jane Hendron, a press spokesperson for FWS's Carlsbad office, told ReWire that her office didn't yet know the cause of the rail's death, and that plans to minimize future such mortalities would depend on what turns out to have killed the rail.

[**UPDATE:** Minutes after this piece went live, Hendron informed ReWire that the rail's carcass was too badly decomposed to allow a determination of the cause of death.]

The Yuma clapper rail, which ranges up and down the Colorado River from Mexico to Utah, was listed as Endangered in 1967 under the Endangered Species Preservation Act, a federal law that was a precursor to the 1973 Endangered Species Act. A subspecies of the more widespread clapper rail, numbers of the Yuma clapper rail (*Rallus longirostris yumanensis*) have declined significantly since then as a result of depletion of its freshwater marsh habitat along the river. Fewer than 1,000 Yuma clapper rails are thought to survive in the United States.

The rails, which are wading birds somewhere between a crow and a chicken in size, subsist on a diet of marsh invertebrates -- mainly crayfish, but also including clams, freshwater shrimp, insects, and occasional fish. The birds prefer mixed stands of vegetation near ponds with stable water levels, and likely probe the waterlogged soil with their long bills to feed.

A century of alteration of the Colorado's flow patterns has drastically reduced the amount of habitat available to the rail, both along the river's length and in what was once a braided network of sloughs and channels in the river's delta. The accidental creation of the Salton Sea a century ago did augment the rail's habitat, and some still survive in the marshes at its south end.

According to the statement provided by Desert Sunlight's representative Ashley Hudgens, the site's biologists do not believe construction operations contributed to the bird's death. The statement also claims that the rails are not native to the site. That's true, in the strictest sense: there were no open freshwater ponds on the Desert Sunlight project site.

However, Yuma rails do travel between the river and the Salton Sea, and could reasonably be expected to pass the vicinity of the Desert Sunlight project in doing so. Over the last few decades, rails have been spotted as deep into the desert as Harper Lake west of Barstow.

What would entice a water bird like a clapper rail or a grebe to a field of photovoltaic panels deep in the desert? A photo of the Copper Mountain PV facility in Nevada taken by the group Basin and Range Watch offers a suggestion:



Polarized reflective glare | Photo © Basin and Range Watch

PV panels polarize the light they reflect, much like the surface of a body of water. The resemblance of the PV field pictured to a lake is remarkable, even in bright daylight that reveals the technological underpinnings of the site. For night-flying birds, especially on nights when a new or crescent moon doesn't provide much light, all the birds would have to go on would be the reflection of the stars in the PV panels. A large PV project would seem to offer an oasis for water birds in the desert, but coming in for a landing on such a "lake" could well prove routinely fatal, either at the moment of impact or after a disabled bird wanders off into the desert.

ReWire has heard of other reports of waterfowl injuries at photovoltaic facilities, and we're working to determine the extent of the phenomenon. We'll keep you updated as we learn more. If it turns out that Desert Sunlight is attracting water birds due to polarized reflections from its panels, that raises the question of how FWS will approach minimizing similar risk from the proposed McCoy and Blythe photovoltaic projects, which together might offer as much as 15 square miles of fake "lake" to unwary water birds, less than 15 miles from the Colorado River.

EXHIBIT

6

Attention Deficit Hyperactivity Disorder and Dirty Electricity

To the Editor:

In February 2010, while studying a cancer cluster in teachers at a California elementary school, a fourth-grade teacher complained that her students were hyperactive and unteachable. The classroom levels of high-frequency voltage transients (dirty electricity) in the radio frequencies (RF) between 4 and 100 kHz measured in the outlets of her classroom with a Graham/Stetzer Microsurge meter were very high. Dirty electricity is a term coined by the electrical utilities to describe electrical pollution contaminating the 60 Hz electricity on the electrical grid. A cell phone tower on campus a few feet from this classroom and unshielded fluorescent lights both contributed to the electrical pollution in this room. Cell tower transmitters, like most modern electrical equipment, operate on direct current. The electrical current brought to the tower is alternating current that needs to be changed to direct current. This is done by a switching power supply. These devices interrupt the alternating current and are the likely major source of the dirty electricity in the classroom.

On a Friday afternoon after school, I filtered the 5 outlets in this room with Graham/Stetzer plug-in capacitive filters, reducing the measured

dirty electricity in the room wiring from more than 5000 Graham/Stetzer units to less than 50 units. With no change in either the lighting or the cell tower radiation, the teacher reported an immediate dramatic improvement in the behavior of her students in the following week. They were calmer, paid more attention, and were teachable all week except for Wednesday when they spent part of the day in the library.

In his 1973 book, *Health and Light*,¹ John N. Ott described a 1973 study of 4 first-grade classrooms in a windowless Sarasota, Florida school. Two of the rooms had standard white fluorescent lighting and the other two had full-spectrum fluorescent lighting with a grounded aluminum wire screen to remove the RF radiation produced by fluorescent bulbs and ballasts. Concealed time-lapse cameras recorded student behavior in classrooms for 4 months.² In the unshielded rooms, the first graders developed, "... nervous fatigue, irritability, lapses of attention, and hyperactive behavior." "... students could be observed fidgeting to an extreme degree, leaping from their seats, flailing their arms, and paying little attention to their teachers." In the RF-shielded rooms, "Behavior was entirely different. Youngsters were calmer and far more interested in their work."

The Old Order Amish live without electricity. A pediatric group prac-

tice in Jasper, Indiana, which cares for more than 800 Amish families has not diagnosed a single child with attention deficit hyperactivity disorder (ADHD).³ Dozens of cases of childhood ADHD have been "cured" with no further need for drugs by simply changing their electrical environments (Stetzer D, personal communication [www.StetzerElectric.com]).

Before children are treated with drugs for ADHD, the dirty electricity levels in their homes and school environments should first be examined and reduced if needed.

I present the epidemiologic evidence linking dirty electricity to the other diseases of civilization in a recent book.^{4,5}

Disclosure: The authors declare no conflict of interest.

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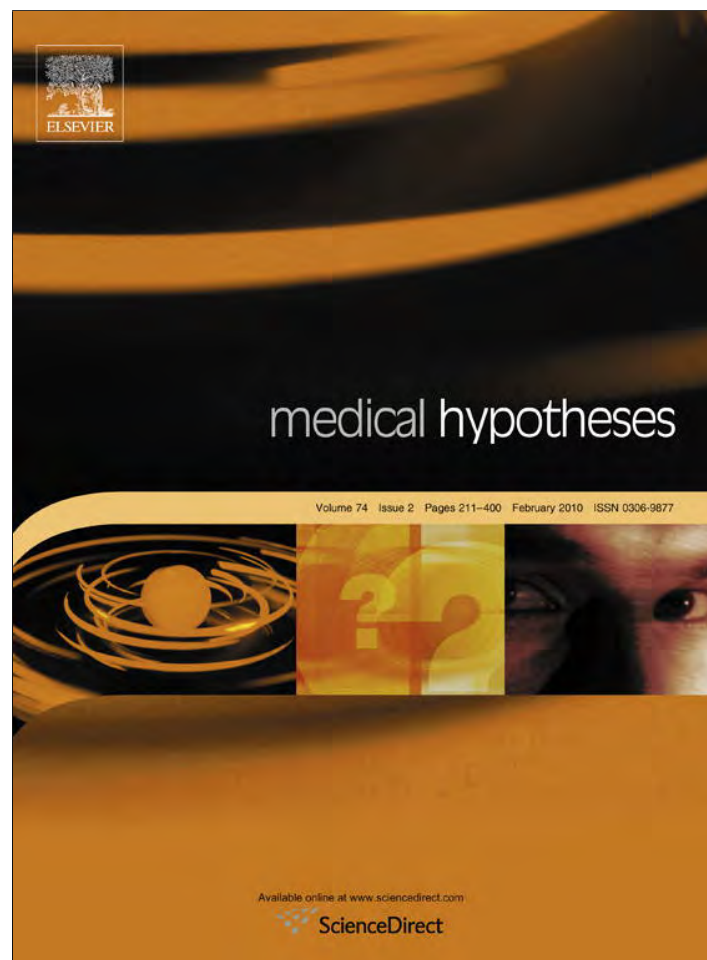
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EXHIBIT

7



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Historical evidence that electrification caused the 20th century epidemic of “diseases of civilization” ☆

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SUMMARY

The slow spread of residential electrification in the US in the first half of the 20th century from urban to rural areas resulted by 1940 in two large populations; urban populations, with nearly complete electrification and rural populations exposed to varying levels of electrification depending on the progress of electrification in their state. It took until 1956 for US farms to reach urban and rural non-farm electrification levels. Both populations were covered by the US vital registration system. US vital statistics tabulations and census records for 1920–1960, and historical US vital statistics documents were examined. Residential electrification data was available in the US census of population for 1930, 1940 and 1950. Crude urban and rural death rates were calculated, and death rates by state were correlated with electrification rates by state for urban and rural areas for 1940 white resident deaths. Urban death rates were much higher than rural rates for cardiovascular diseases, malignant diseases, diabetes and suicide in 1940. Rural death rates were significantly correlated with level of residential electric service by state for most causes examined. I hypothesize that the 20th century epidemic of the so called diseases of civilization including cardiovascular disease, cancer and diabetes and suicide was caused by electrification not by lifestyle. A large proportion of these diseases may therefore be preventable.

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Background

In 2001, Ossiander and I [1] presented evidence that the childhood leukemia mortality peak at ages 2–4 which emerged in the US in the 1930s was correlated with the spread of residential electrification in the first half of the 20th century in the US. While doing the childhood leukemia study, I noticed a strong positive correlation between level of residential electrification and the death rate by state due to some adult cancers in 1930 and 1940 vital statistics. At the time, a plausible electrical exposure agent and a method for its delivery within residences was lacking. However, in 2008 I coauthored a study of a cancer cluster in school teachers at a California middle school [2] which indicated that high frequency voltage transients (also known as dirty electricity), were a potent universal carcinogen with cancer risks over 10.0 and significant dose–response for a number of cancers. They have frequencies between 2 and 100 kHz. These findings are supported by a large cancer incidence study in 200,000 California school employees which showed that the same cancers and others were in excess in California teachers statewide [3]. Power frequency

magnetic fields (60 Hz) measured at the school were low and not related to cancer incidence, while classroom levels of high frequency voltage transients measured at the electrical outlets in the classrooms accurately predicted a teacher's cancer risk. These fields are potentially present in all wires carrying electricity and are an important component of ground currents returning to substations especially in rural areas. This helped explain the fact that professional and office workers, like the school teachers, have high cancer incidence rates. It also explained why indoor workers had higher malignant melanoma rates, why melanoma occurred on part of the body which never are exposed to sunlight, and why melanoma rates are increasing while the amount of sunshine reaching earth is stable or decreasing due to air pollution. A number of very different types of cancer had elevated risk in the La Quinta school study, in the California school employees study, and in other teacher studies. The only other carcinogenic agent which acts like this is ionizing radiation.

Among the many devices which generate the dirty electricity are compact fluorescent light bulbs, halogen lamps, wireless routers, dimmer switches, and other devices using switching power supplies. Any device which interrupts current flow generates dirty electricity. Arcing, sparking and bad electrical connections can also generate the high frequency voltage transients. Except for the dimmer switches, most of these devices did not exist in the first half of the 20th century. However, early electric generating equipment

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and electric motors used commutators, carbon brushes, and split rings, which would inject high frequency voltage transients into the 60 Hz electricity being generated and distributed.

With a newly recognized electrical exposure agent and a means for its delivery, I decided to examine whether residential electrification in the US in the first half of the last century was related to any other causes of death. Most cancers showed increasing mortality in this period, and many are still increasing in incidence in the developed world.

Thomas Edison began electrifying New York City in 1880, but by 1920, only 34.7% of all US dwelling units and 1.6% of farms had electric service (Table 1). By 1940, 78% of all dwelling units and 32% of farms had electric service [4]. This means that in 1940 about three quarters of the US population lived in electrified residences and one quarter did not. By 1940, the US vital registration system was essentially complete, in that all the 48 contiguous United States were included. Most large US cities were electrified by the turn of the century, and by 1940, over 90% of all the residences in the northeastern states and California were electrified. In 1940 almost all urban residents in the US were exposed to electromagnetic fields (EMFs) in their residences and at work, while rural residents were exposed to varying levels of EMFs, depending on the progress of rural electrification in their states. In 1940, only 28% of residences in Mississippi were electrified, and five other southern states had less than 50% of residences electrified (Table 2). Eleven states, mostly in the northeast had residential electrification rates above 90%. In the highly electrified northeastern states and in California, urban and rural residents could have similar levels of EMF exposure, while in states with low levels of residential electrification, there were potentially great differences in EMF exposure between urban and rural residents. It took the first half of the 20th century for these differences to disappear. I examined US mortality records by urban and rural residence by percent of residences with electric service by state.

Hypothesis

The diseases of civilization or lifestyle diseases include cardiovascular disease, cancer and diabetes and are thought to be caused by changes in diet, exercise habits, and lifestyle which occur as countries industrialize. I think the critical variable which causes the radical changes in mortality accompanying industrialization is electrification. Beginning in 1979, with the work of Wertheimer and Leeper [5], there has been increasing evidence that some facet of electromagnetic field exposure is associated epidemiologically with an increased incidence of leukemia, certain other cancers and non-cancers like Alzheimer's disease, amyotrophic lateral sclerosis, and suicide. With the exception of a small part of the electromagnetic spectrum from infra red through visible light, ultraviolet light and cosmic rays, the rest of the spectrum is man-made and foreign to human evolutionary experience. I suggest that from

Table 2

Percent of residences with electric lighting 1930 and 1940 by state.

| Code | State | 1930 | 1940 |
|------|----------------|------|------|
| AL | Alabama | 33.9 | 43.3 |
| AZ | Arizona | 68.8 | 70.5 |
| AR | Arkansas | 25.3 | 32.8 |
| CA | California | 93.9 | 96 |
| CO | Colorado | 69.6 | 77.6 |
| CT | Connecticut | 95.3 | 96.5 |
| DE | Delaware | 78.4 | 81.8 |
| FL | Florida | 60.9 | 66.5 |
| GA | Georgia | 35.5 | 46.6 |
| ID | Idaho | 64.5 | 79.1 |
| IL | Illinois | 86.1 | 89.9 |
| IN | Indiana | 74.8 | 84 |
| IA | Iowa | 65.6 | 76.7 |
| KS | Kansas | 62 | 71.5 |
| KY | Kentucky | 44.2 | 54.2 |
| LA | Louisiana | 42.2 | 48.9 |
| ME | Maine | 76.1 | 80.4 |
| MD | Maryland | 81.8 | 85.9 |
| MA | Massachusetts | 97.1 | 97.6 |
| MI | Michigan | 84.8 | 92.1 |
| MN | Minnesota | 65.9 | 75.8 |
| MS | Mississippi | 19.4 | 28.3 |
| MO | Missouri | 65.5 | 70.6 |
| MT | Montana | 58.2 | 70.7 |
| NE | Nebraska | 61 | 70.5 |
| NV | Nevada | 76.2 | 80.8 |
| NH | New Hampshire | 84.9 | 87 |
| NJ | New Jersey | 95.8 | 96.6 |
| NM | New Mexico | 39.8 | 49.2 |
| NY | New York | 94.5 | 96.4 |
| NC | North Carolina | 40.8 | 54.4 |
| ND | North Dakota | 41.6 | 53.8 |
| OH | Ohio | 85.2 | 90.6 |
| OK | Oklahoma | 45.3 | 55.1 |
| OR | Oregon | 79.5 | 85.8 |
| PA | Pennsylvania | 89.5 | 92.3 |
| RI | Rhode Island | 97.3 | 97.7 |
| SC | South Carolina | 34.3 | 46.2 |
| SD | South Dakota | 44.4 | 56.6 |
| TN | Tennessee | 42 | 50.9 |
| TX | Texas | * | 59 |
| UT | Utah | 88.4 | 93.9 |
| V | Vermont | 71.9 | 80.2 |
| VA | Virginia | 50.5 | 60.6 |
| WA | Washington | 86.3 | 90.9 |
| WV | West Virginia | 63.4 | 69.1 |
| WI | Wisconsin | 74.5 | 83.9 |
| WY | Wyoming | 60 | 70.9 |

*No data.

the time that Thomas Edison started his direct current electrical distribution system in the 1880s in New York City until now, when most of the world is electrified, the electricity carried high frequency voltage transients which caused and continue to cause what are considered to be the normal diseases of civilization. Even today, many of these diseases are absent or have very low incidence in places without electricity.

Evaluation of the hypothesis

To evaluate the hypothesis, I examined mortality in US populations with and without residential electrification. Vital statistics tabulations of deaths [6], US census records for 1920–1970 [7], and historical US documents [8,9] were examined in hard copy or downloaded from the internet. The same state residential electrification data used in the childhood leukemia study [1] was used in this study. Crude death rates were calculated by dividing number of deaths by population at risk, and death rates by state were then correlated with electrification rates by state using downloaded software [10]. Time trends of death rates for selected causes

Table 1

Growth of residential electric service US 1920–1956 percent of dwelling units with electric service.

| Year | All | | Urban and rural non-farm |
|------|-----------|------|--------------------------|
| | Dwellings | Farm | |
| 1920 | 34.7 | 1.6 | 47.4 |
| 1925 | 53.2 | 3.9 | 69.4 |
| 1930 | 68.2 | 10.4 | 84.8 |
| 1935 | 68.0 | 12.6 | 83.9 |
| 1940 | 78.7 | 32.6 | 90.8 |
| 1945 | 85.0 | 48.0 | 93.0 |
| 1950 | 94.0 | 77.7 | 96.6 |
| 1956 | 98.8 | 95.9 | 99.2 |

of death by state were examined. Most rates were calculated by state for urban and rural residence for whites only in 1940 deaths, since complete racial data was available by urban/rural residence by state for only 13 of 48 states. Data was available for 48 states in the 1940 mortality tabulations. District of Columbia was excluded because it was primarily an urban population. Excel graphing software [11] and “Create a Graph” [12] software was used.

I had hoped to further test this hypothesis by studying mortality in individual US farms with and without electrification, when the 1930 US census 70 year quarantine expired in 2000. Unfortunately, the 1930 US farm census schedules had been destroyed.

Findings

Rural residential electrification did not reach urban levels until 1956 (Table 1). Table 2 shows the level of residential electrification for each state for 1930 and 1940. In 1930 and 1940 only 9.5% and 13%, respectively, of all generated electricity was used in residences. Most electricity was used in commercial and industrial applications.

Figs. 1–4 were copied and scanned from “Vital statistics rates in the United States 1940–1960”, by Robert Grove Ph.D. and Alice M. Henzel. This volume was published in 1968. Fig. 1 shows a gradual decline in the all causes death rate from 1900 to 1960 except for a spike caused by the 1918 influenza pandemic. Death rates due to tuberculosis, typhoid fever, diphtheria, dysentery, influenza and pneumonia and measles all fell sharply in this period, and account for most of the decline in the all causes death rate. Figs. 2–4 show that in the same time period when the all causes death rate was declining, all malignant neoplasms (Fig. 2), cardiovascular diseases (Fig. 3), and diabetes (Fig. 4) all had gradually increasing death rates. In 1900, heart disease and cancer were 4th and 8th in a list of 10 leading causes of death. By 1940 heart disease had risen to first and cancer to second place, and have maintained that position ever since. Table 3 shows that for all major causes of death examined, except motor vehicle accidents, there was a sizable urban excess in 1940 deaths. The authors of the extensive 69 page introduction to the 1930 mortality statistics volume noted that the cancer rates for cities were 58.2% higher than those for rural areas. They speculated that some of this excess might have been due to rural residents dying in urban hospitals. In 1940, deaths by place of residence and occurrence are presented in separate volumes. In 1940 only 2.1% of all deaths occurred to residents of one state dying in another state. Most non-resident deaths were residents of other areas of the same state. Table 4 presents correlation coefficients for the relationship between death rates by urban rural areas of each state and the percent of residences in each state with

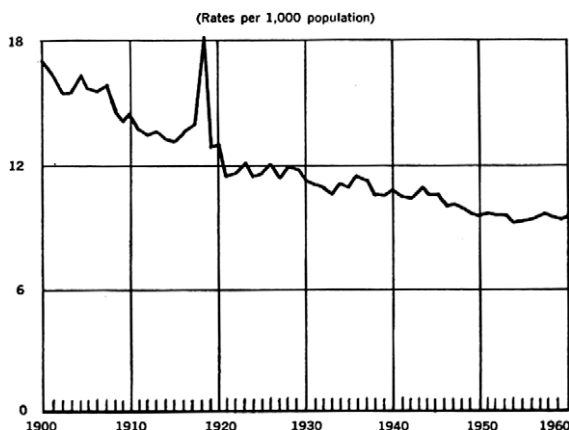


Fig. 1. Death rates: death registration states, 1900–32, and United States, 1933–60.

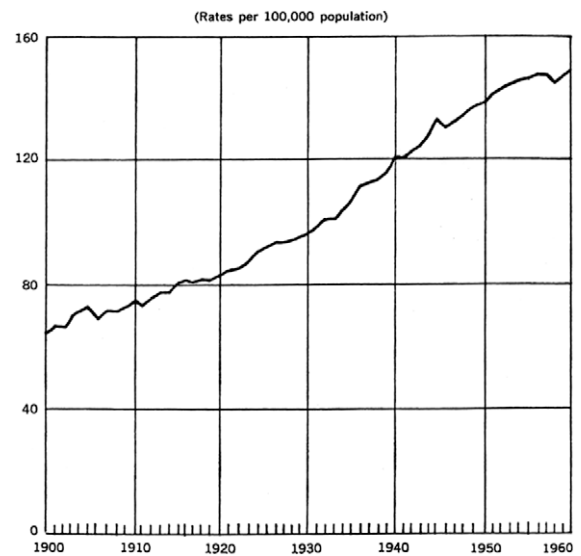


Fig. 2. Death rates for malignant neoplasms: death registration states, 1900–32, and United States, 1933–60.

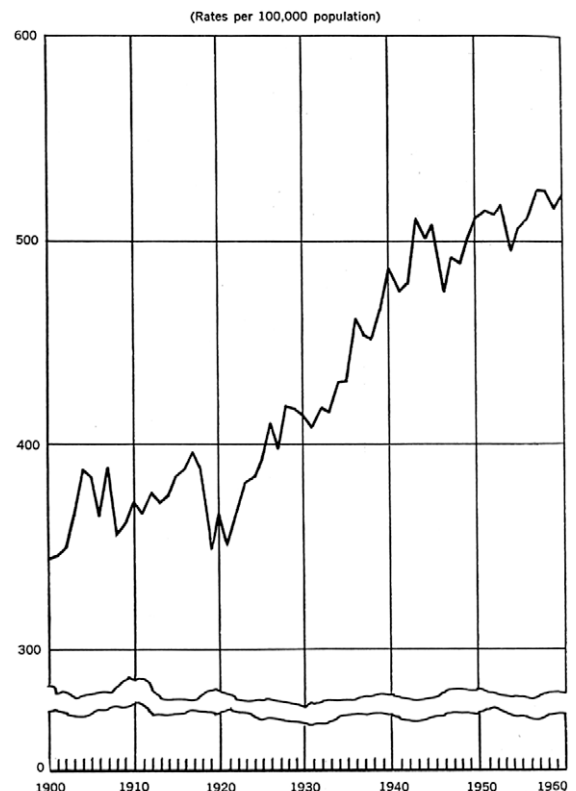


Fig. 3. Death rates for major cardiovascular renal diseases: death registration states, 1900–32, and United States, 1933–60.

electric service. In 1940 urban and rural residence information was not available for individual cancers as it was in 1930, but death rates for each cancer were available by state. They were used to calculate correlations between electric service by state and respiratory cancer, breast cancer and leukemia mortality.

All causes of death

There was no correlation between residential electrification and total death rate for urban areas, but there was a significant

correlation for rural areas ($r = 0.659$, $p = <0.0001$). Fig. 5 shows the 1940 resident white death rates for urban and rural areas of states

having greater than 96% of residences electrified and states having less than 50% of residences electrified. In the highly electrified states, urban and rural death rates were similar, but in low electrification states, the urban death rates were systematically higher than the rural death rates. The urban death rates were similar in both high and low electrification states.

All malignant neoplasms

In 1940, the urban total cancer rate was 49.2% higher than the rural rate. Both urban and rural cancer deaths rates were significantly correlated with residential electrification. Fig. 6 shows the 1940 resident white total cancer rates for urban and rural areas of states having greater than 96% of residences electrified and states having less than 50% of residences electrified. Four of the five high electrification states had similar urban and rural total cancer rates, while all the low electrification states had urban rates about twice as high as rural rates. Both urban and rural total cancer rates were lower in low electrification states than in high electrification states. Fig. 7 shows the time trend of the total cancer rate between 1920 and 1960 for Massachusetts (1940 electrification rate = 97.6%) and Louisiana (1940 electrification rate = 48.9%). The Massachusetts cancer rate was about twice that of Louisiana between 1920 and 1945. The Massachusetts rate leveled off in 1945, but the Louisiana rate increased steadily between 1920 and 1960. A declining urban–rural gradient for cancer is still evident in 1980–1990 US cancer incidence data [13]. Swedish investigators [14] have reported increasing cancer mortality and incidence time trend breaks in the latter half of the 20th century.

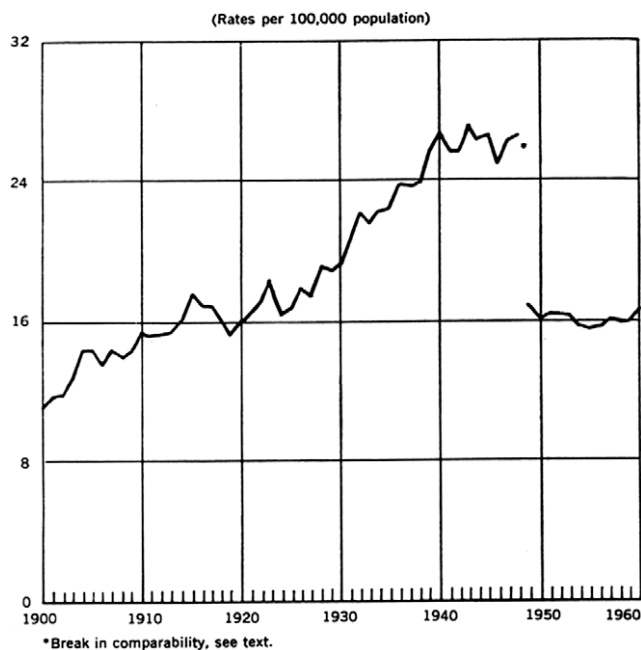


Fig. 4. Death rates for diabetes mellitus: death registration states, 1900–32, and United States, 1933–60.

Table 3
1940 US white resident crude death rates per 100,000 by urban/rural residence.

| Cause of death | ICD No. ^a | Urban rate | Rural rate | (%) Urban excess |
|-------------------------|--------------------------------------|------------|------------|------------------|
| All | 1–200 | 1124.1 | 929.5 | 20.9 |
| All cancers | 47–55 | 145.8 | 97.7 | 49.2 |
| Coronary disease | 94 | 92.4 | 69.1 | 33.7 |
| Other diseases of heart | 90b,91,92a,d,e 93a,b,d,e 95a,c | 217.0 | 162.8 | 33.3 |
| Diabetes | 61 | 33.2 | 20.0 | 66.0 |
| Suicide | 163–164 | 17.1 | 13.2 | 29.5 |
| Motor vehicle accidents | 170 | 26.6 | 26.3 | 1.1 |

^a 1938 Revision International classification of disease.

Table 4
Correlation coefficients (r) 1940 crude US death rates by state by electrification for white resident deaths.

| Cause | ICD No. ^A | Residence | r | r^2 | p One tailed | Slope | Y intercept |
|---------------------------------|----------------------|-----------|--------|-------|----------------|--------|-------------|
| All causes | 1–200 | Urban | 0.083 | 0.007 | 0.285 | 0.007 | 11.114 |
| | | Rural | 0.659 | 0.434 | <0.0001 | 0.070 | 4.185 |
| All cancers | 45–55 | Urban | 0.667 | 0.445 | <0.0001 | 0.883 | 75.970 |
| | | Rural | 0.758 | 0.575 | <0.0001 | 1.502 | –10.040 |
| Respiratory cancer ^B | 47 | State | 0.611 | 0.374 | <0.0001 | 0.071 | 1.020 |
| Breast cancer female | 50 | State | 0.794 | 0.630 | <0.0001 | 0.170 | –1.506 |
| Diabetes | 61 | Urban | 0.666 | 0.444 | <0.0001 | 0.278 | 8.168 |
| | | Rural | 0.693 | 0.480 | <0.0001 | 0.366 | –6.184 |
| Leukemia ^B | 72a | State | 0.375 | 0.140 | 0.0042 | 0.021 | 1.980 |
| Coronary artery | 94 | Urban | 0.400 | 0.160 | 0.0024 | 0.494 | 61.570 |
| Disease | | Rural | 0.781 | 0.610 | <0.0001 | 1.252 | 25.319 |
| Other diseases of the heart | 90b, 91 | Urban | 0.449 | 0.202 | 0.0006 | 1.236 | 100.35 |
| | 92a,d,e | Rural | 0.799 | 0.639 | 0.0001 | 2.887 | –48.989 |
| | 93a,b,d,e 95a,c | | | | | | |
| Suicide | 163–4 | Urban | 0.077 | 0.006 | 0.2993 | 0.028 | 16.235 |
| | | Rural | 0.729 | 0.532 | <0.0001 | 0.181 | 0.299 |
| Motor vehicle | 170 | Urban | –0.254 | 0.064 | 0.0408 | –0.171 | 44.572 |
| Accidents | | Rural | 0.451 | 0.203 | 0.0006 | 0.195 | 12.230 |

^A International classification of diseases 1938 revision.

^B Age adjusted death rate both sexes.

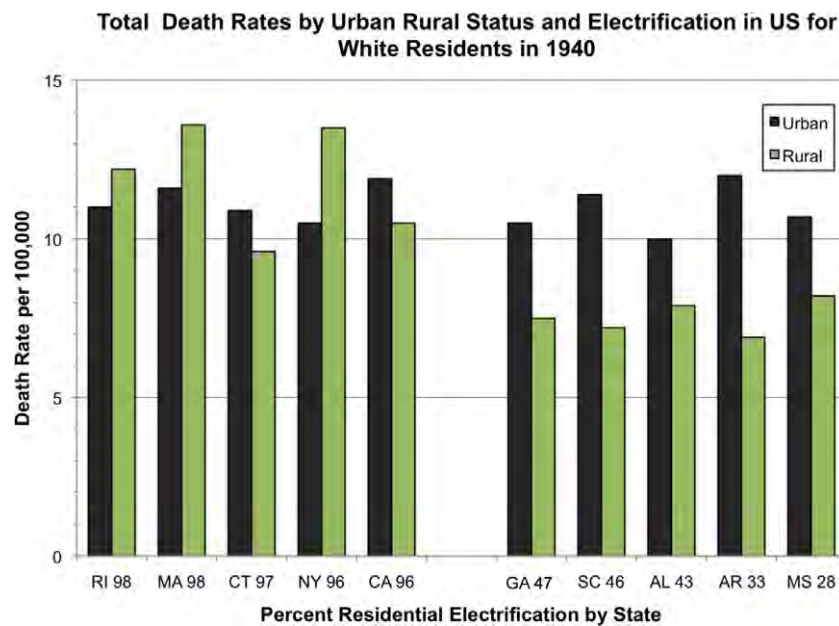


Fig. 5. All causes death rates by urban rural status and electrification in the US for white residents in 1940.

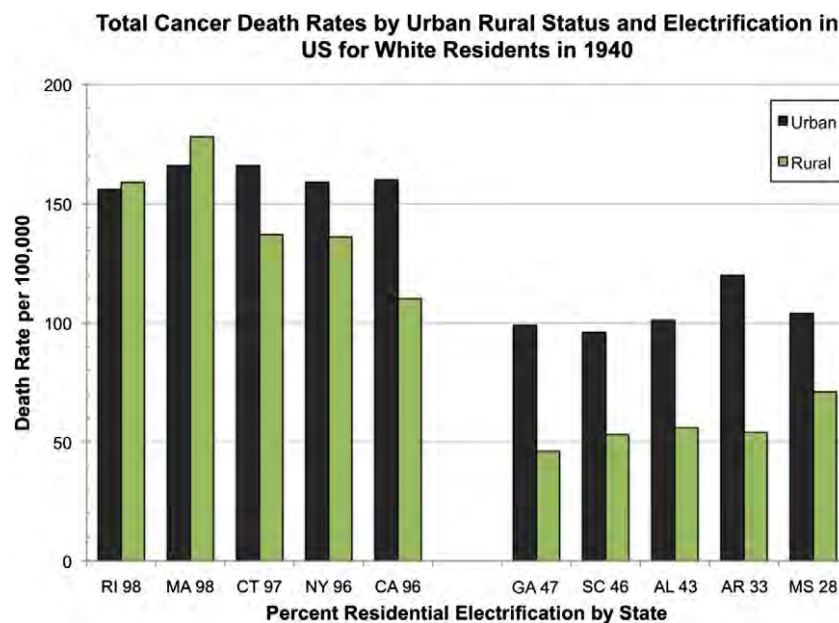


Fig. 6. Total cancer death rates by urban rural status and electrification in the US for white residents in 1940.

Respiratory cancer

No urban/rural information was available for respiratory cancer, but the correlation between residential electrification and state death rates was $r = 0.611$; $p < 0.0001$. This cancer is etiologically strongly related to cigarette smoking, so the correlation with electrification is surprising. A large electrical utility worker cohort study found a high respiratory cancer incidence related to high frequency EMF transient exposure independent of cigarette smoking with a significant dose–response relationship [15].

Breast cancer

Although urban/rural information was not available for breast cancer, the 1940 state breast cancer death rates have a correlation

of $r = 0.794$; $p < 0.0001$ with residential electrification. Fig. 8 shows the typical time trend of breast cancer death rates for a state with a high level of electrification (96%) and one with a low level of electrification (<50) in 1940. The California breast cancer death rate increased from 1920 to 1940, and then gradually decreased until 1960. The Tennessee breast cancer death rate is less than half of the California rate in 1920 and continues a steady increase until 1960.

Diabetes

This cause has a 66% urban excess. In spite of this, the correlation coefficients for urban and rural areas are similar at $r = 0.66$; $p < 0.0001$. There is some animal and human evidence that EMFs can effect insulin production and blood glucose levels [16]. Fig. 9

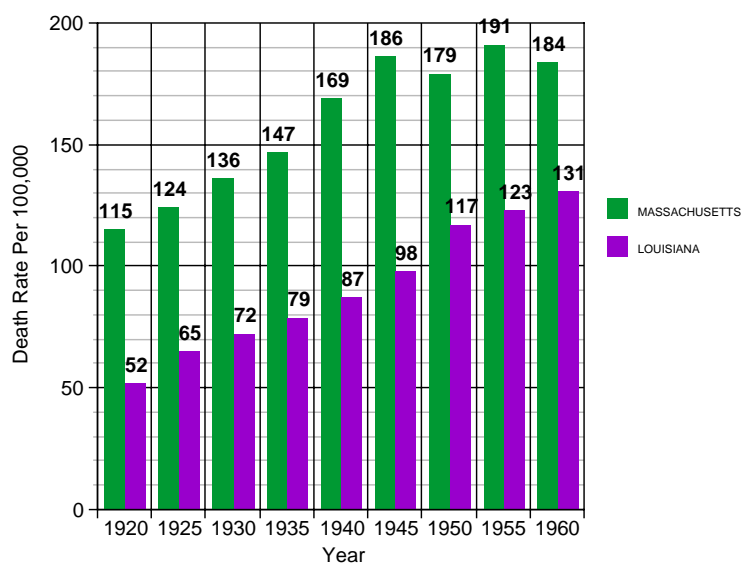


Fig. 7. US white resident total cancer death rates for Massachusetts (97.6% elect.) and Louisiana (48.9% elect.) by year.

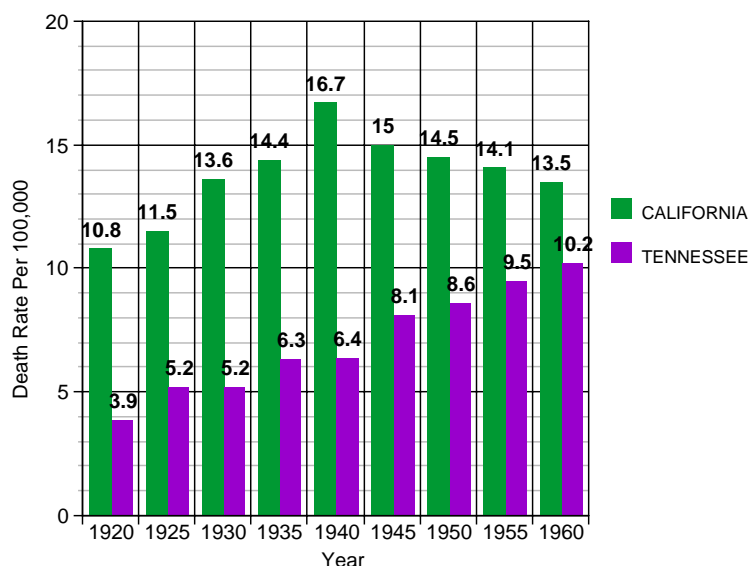


Fig. 8. US white resident breast cancer death rates for California (96% elect.) and Tennessee (50% elect.) by year.

shows that in states with low levels of electrification in 1940, the urban diabetes death rates are consistently higher than the rural rates, but are always lower than the urban and rural rates in the high electrification states.

Leukemia

Since the childhood leukemia age peak is strongly associated with residential electrification, it was interesting that the all leukemia death rate correlation was $r = 0.375$; $p = 0.0042$. Most of these deaths are in adults and are of different types of leukemia. A study of amateur radio operators showed a selective excess only of acute myelogenous leukemia [17].

Coronary artery disease and other heart disease

These two cause groups had the same percentage urban excess (33%), and very similar patterns of urban and rural correlation

coefficients with residential electrification. The urban correlations were about $r = 0.4$ and rural deaths had correlations of 0.78 and 0.79, respectively. Fig. 10 shows the 1940 resident white coronary artery disease death rates for urban and rural areas of states having greater than 96% of residences electrified and states having less than 50% of residences electrified. Four of the five high electrification states had similar urban and rural total cancer rates, while all the low electrification states had urban rates about twice as high as rural rates. Urban and rural coronary artery death rates were lower in low electrification states than in high electrification states.

Suicide

The urban suicide death rate is about 30% higher than the rural rate. The urban suicide rate is not correlated with residential electrification ($r = 0.077$; $p = 0.299$), but the rural death rate is correlated with 1940 state residential electrification levels ($r = 0.729$; $p < 0.0001$). Fig. 11 shows the 1940 resident white suicide for

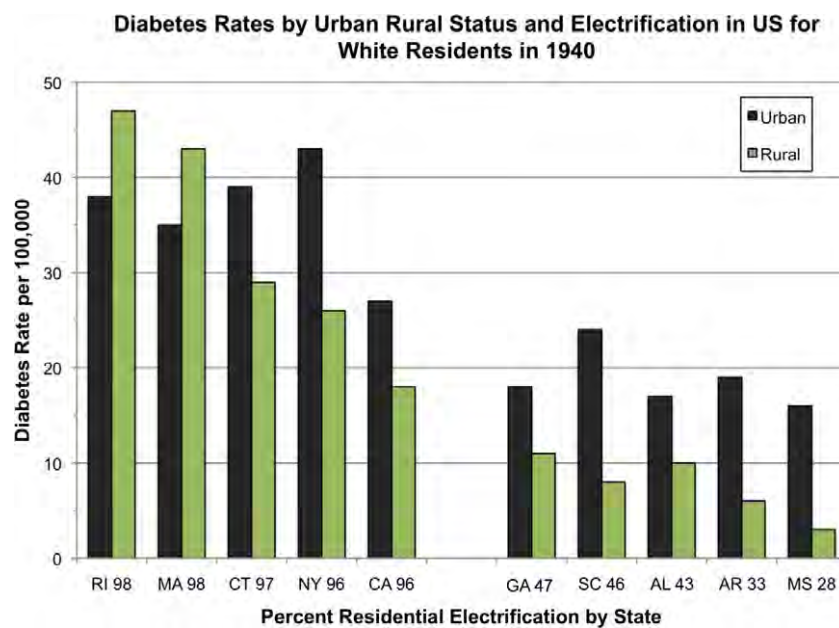


Fig. 9. Total diabetes rates by urban rural status and electrification in the US for white residents in 1940.

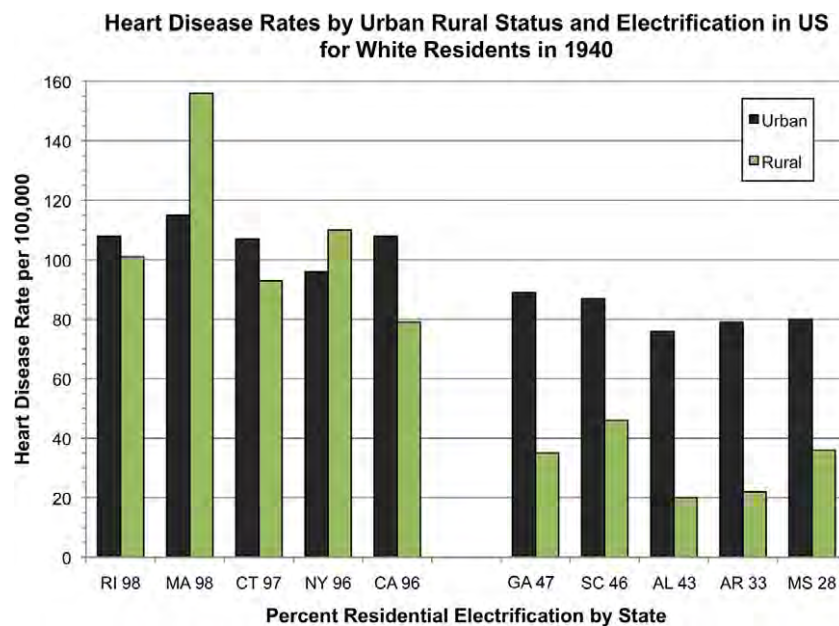


Fig. 10. Total heart disease rates by urban rural status and electrification in the US for white residents in 1940.

urban and rural areas of states having greater than 96% of residences electrified and states having less than 50% of residences electrified. In four of five high electrification states, rural suicide rates are higher than the urban rates. In all of the low electrification states, the urban rate is higher. The rural rates in the high electrification states are higher than the rural rates in the low electrification states. Fig. 12 shows X Y scatter plots for urban and rural suicide by electrification for 48 states. Suicide has been associated with both residential [18] and occupational [19] EMF exposure. Suicide is probably the visible peak of the clinical depression iceberg.

Motor vehicle accidents

Although the mortality rates are similar in urban and rural areas, the correlations with residential electrification levels are dif-

ferent. There is a slight negative correlation ($r = -0.254$) in urban areas and a positive correlation ($r = 0.451$) in rural areas. Since motor vehicle fatality is related to access to a vehicle and to speed. It may be that in the larger cities it was difficult to go fast enough for a fatal accident, and in rural areas especially on farms, a farmer who could afford electrification could also afford a car.

Discussion

When Edison and Tesla opened the Pandora's box of electrification in the 1880s, the US vital registration system was primitive at best, and infectious disease death rates were falling rapidly. City residents had higher mortality rates and shorter life expectancy than rural residents [8]. Rural white males in 1900 had an expectation of life at birth of over 10 years longer than urban residents.

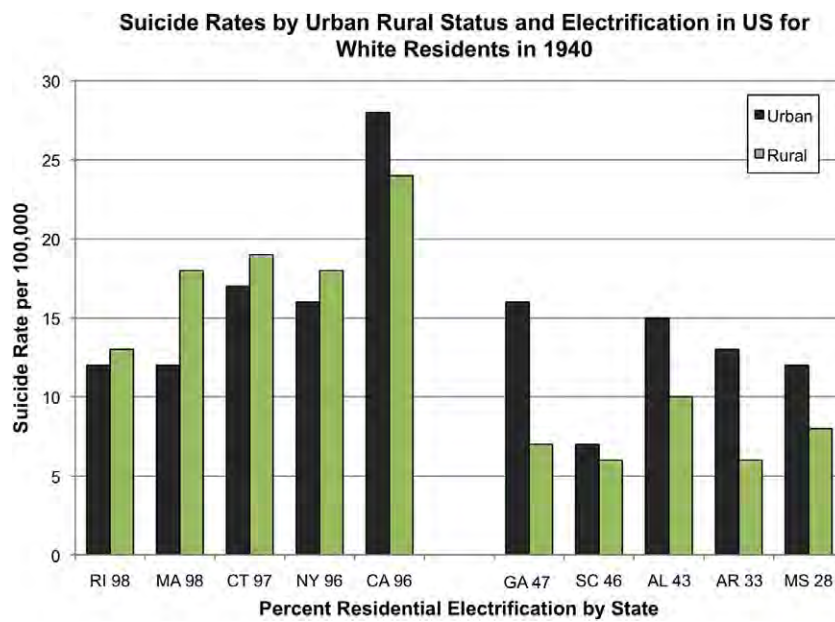


Fig. 11. Total suicide death rates by urban rural status and electrification in the US for white residents in 1940.

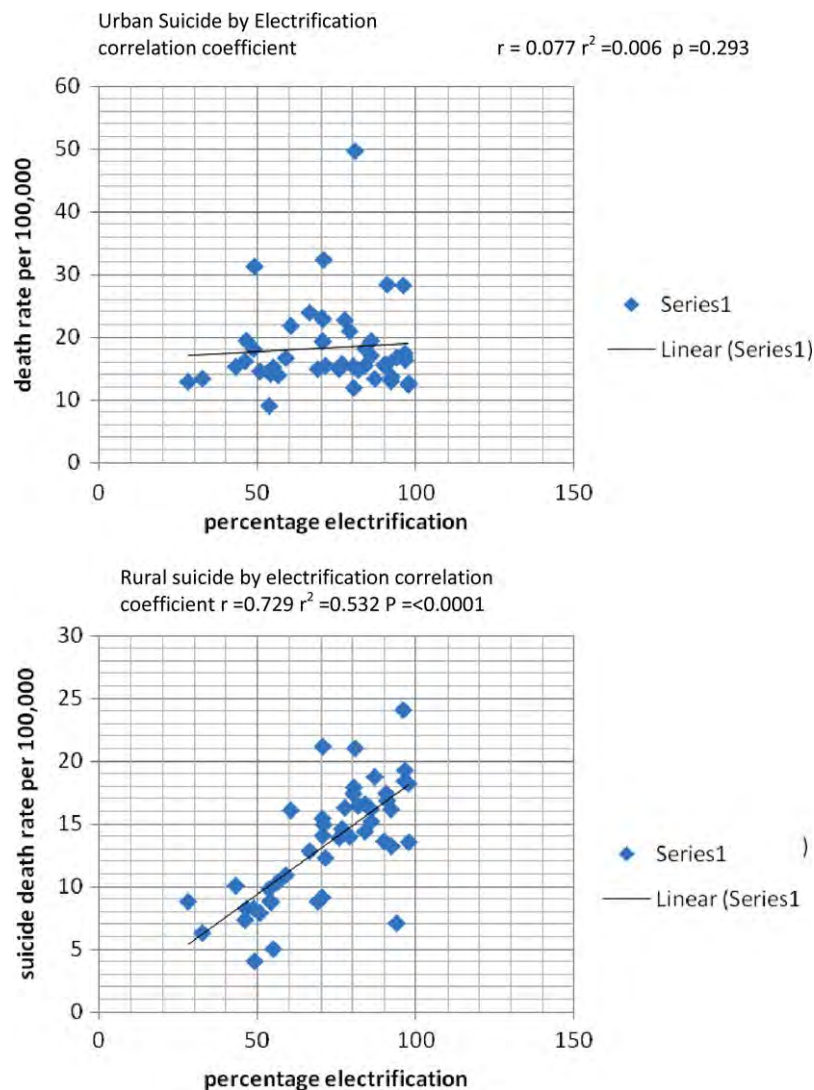


Fig. 12. 1940 US white resident urban rural suicide death rates by state and electrification.

Although the authors of the 1930 US vital statistics report noted a 58.2% cancer mortality excess in urban areas, it raised no red flags. The census bureau residential electrification data was obviously not linked to the mortality data. Epidemiologists in that era were still concerned with the communicable diseases.

Court Brown and Doll reported [20] the appearance of the childhood leukemia age peak in 1961, forty years after the US vital statistics mortality data on which it was based was available. I reported a cluster of childhood leukemia [21] a decade after it occurred, only because I looked for it. Real time or periodic analysis of national or regional vital statistics data is still only rarely done in the US.

The real surprise in this data set is that cardiovascular disease, diabetes and suicide, as well as cancer seem to be strongly related to level of residential electrification. A community-based epidemiologic study of urban rural differences in coronary heart disease and its risk factors was carried out in the mid 1980s in New Delhi, India and in a rural area 50 km away [22]. The prevalence of coronary heart disease was three times higher in the urban residents, despite the fact that the rural residents smoked more and had higher total caloric and saturated fat intakes. Most cardiovascular disease risk factors were two to three times more common in the urban residents. Rural electrification projects are still being carried out in parts of the rural area which was studied.

It seems unbelievable that mortality differences of this magnitude could go unexplained for over 70 years after they were first reported and 40 years after they were noticed. I think that in the early part of the 20th century nobody was looking for answers. By the time EMF epidemiology got started in 1979 the entire population was exposed to EMFs. Cohort studies were therefore using EMF-exposed population statistics to compute expected values, and case-control studies were comparing more exposed cases to less exposed controls. The mortality from lung cancer in two pack a day smokers is over 20 times that of non-smokers but only three times that of one pack a day smokers. After 1956, the EMF equivalent of a non-smoker ceased to exist in the US. An exception to this is the Amish who live without electricity. Like rural US residents in the 1940s, Amish males in the 1970s had very low cancer and cardiovascular disease mortality rates [23].

If this hypothesis and findings outlined here are even partially true, the explosive recent increase in radiofrequency radiation, and high frequency voltage transients sources, especially in urban areas from cell phones and towers, terrestrial antennas, wi-fi and wi-max systems, broadband internet over power lines, and personal electronic equipment, suggests that like the 20th century EMF epidemic, we may already have a 21st century epidemic of morbidity and mortality underway caused by electromagnetic fields. The good news is that many of these diseases may be preventable by environmental manipulation, if society chooses to.

Conflicts of interest statement

None declared.

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EXHIBIT

8

A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School

Samuel Milham, MD, MPH^{*,†} and L. Lloyd Morgan, BS[‡]

Background In 2003 the teachers at La Quinta, California middle school complained that they had more cancers than would be expected. A consultant for the school district denied that there was a problem.

Objectives To investigate the cancer incidence in the teachers, and its cause.

Method We conducted a retrospective study of cancer incidence in the teachers' cohort in relationship to the school's electrical environment.

Results Sixteen school teachers in a cohort of 137 teachers hired in 1988 through 2005 were diagnosed with 18 cancers. The observed to expected (O/E) risk ratio for all cancers was 2.78 ($P = 0.000098$), while the O/E risk ratio for malignant melanoma was 9.8 ($P = 0.0008$). Thyroid cancer had a risk ratio of 13.3 ($P = 0.0098$), and uterine cancer had a risk ratio of 9.2 ($P = 0.019$). Sixty Hertz magnetic fields showed no association with cancer incidence. A new exposure metric, high frequency voltage transients, did show a positive correlation to cancer incidence. A cohort cancer incidence analysis of the teacher population showed a positive trend ($P = 7.1 \times 10^{-10}$) of increasing cancer risk with increasing cumulative exposure to high frequency voltage transients on the classroom's electrical wiring measured with a Graham/Stetzer (G/S) meter. The attributable risk of cancer associated with this exposure was 64%. A single year of employment at this school increased a teacher's cancer risk by 21%.

Conclusion The cancer incidence in the teachers at this school is unusually high and is strongly associated with high frequency voltage transients, which may be a universal carcinogen, similar to ionizing radiation. Am. J. Ind. Med. 2008. © 2008 Wiley-Liss, Inc.

KEY WORDS: high frequency voltage transients; electricity; dirty power; cancer; school teachers; carcinogen

Abbreviations: EMF, electromagnetic fields; O, observed cases; E, expected cases; O/E, risk ratio; p, probability; Hz, Hertz or cycles per second; OSHA, Occupational Safety and Health Administration; OCMAP, occupational mortality analysis program; AM, amplitude modulation; GS units, Graham/Stetzer units; G/S meter, Graham/Stetzer meter; MS II, Micro-surge II meter; mG, milligauss; EKG, electrocardiogram; LQMS, La Quinta Middle School.

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BACKGROUND

Since the 1979 Wertheimer–Leeper study [Wertheimer and Leeper, 1979] there has been concern that exposure to power frequency (50/60 Hz) EMFs, especially magnetic fields, may contribute to adverse health effects including cancer. Until now, the most commonly used exposure metric has been the time-weighted average of the power-frequency magnetic field. However, the low risk ratios in most studies suggest that magnetic fields might be a surrogate for a more important metric. In this paper we present evidence that a

new exposure metric, high frequency voltage transients existing on electrical power wiring, is an important predictor of cancer incidence in an exposed population.

The new metric, GS units, used in this investigation is measured with a Graham/Stetzer meter (G/S meter) also known as a Microsurge II meter (MS II meter), which is plugged into electric outlets [Graham, 2005]. This meter displays the average rate of change of these high frequency voltage transients that exist everywhere on electric power wiring. High frequency voltage transients found on electrical wiring both inside and outside of buildings are caused by an interruption of electrical current flow. The electrical utility industry has referred to these transients as “dirty power.”

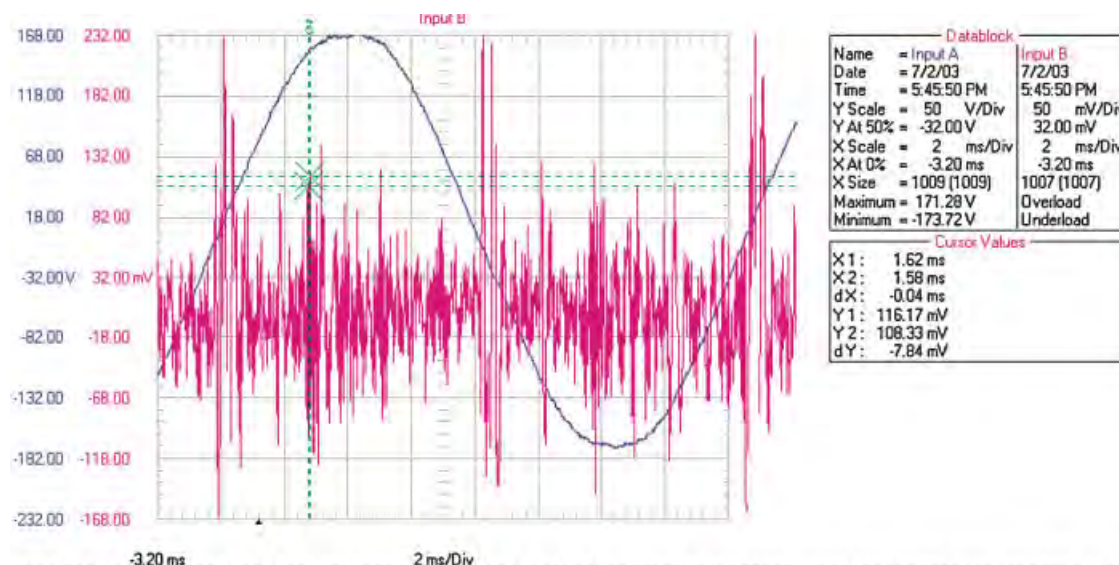
There are many sources of “dirty power” in today’s electrical equipment. Examples of electrical equipment designed to operate with interrupted current flow are light dimmer switches that interrupt the current twice per cycle (120 times/s), power saving compact fluorescent lights that interrupt the current at least 20,000 times/s, halogen lamps, electronic transformers and most electronic equipment manufactured since the mid-1980s that use switching power supplies. Dirty power generated by electrical equipment in a building is distributed throughout the building on the electric wiring. Dirty power generated outside the building enters the building on electric wiring and through ground rods and

conductive plumbing, while within buildings, it is usually the result of interrupted current generated by electrical appliances and equipment.

Each interruption of current flow results in a voltage spike described by the equation $V = L \times di/dt$, where V is the voltage, L is the inductance of the electrical wiring circuit and di/dt is the rate of change of the interrupted current. The voltage spike decays in an oscillatory manner. The oscillation frequency is the resonant frequency of the electrical circuit. The G/S meter measures the average magnitude of the rate of change of voltage as a function of time (dV/dT). This preferentially measures the higher frequency transients. The measurements of dV/dT read by the meter are defined as GS (Graham/Stetzer) units.

The bandwidth of the G/S meter is in the frequency range of these decaying oscillations. Figure 1 shows a two-channel oscilloscope display. One channel displays the 60 Hz voltage on an electrical outlet while the other channel with a 10 kHz hi-pass filter between the oscilloscope and the electrical outlet, displays the high frequency voltage transients on the same electrical outlet [Havas and Stetzer, 2004, reproduced with permission].

Although no other published studies have measured high frequency voltage transients and risk of cancer, one study of electric utility workers exposed to transients from pulsed



THE WAVEFORM WAS COLLECTED IN ROOM 114 AT THE ELGIN/MILLVILLE MN HIGH SCHOOL. CHANNEL 1 WAS CONNECTED TO THE 120 VAC UTILITY SUPPLIED POWER RECEPTACLE. CHANNEL 2 WAS CONNECTED TO THE SAME POTENTIAL, EXCEPT THROUGH THE GRAHAM UBIQUITOUS FILTER. (REMOVES THE 60 HERTZ) THE AREA BETWEEN THE CURSORS REPRESENTS A FREQUENCY OF 25 KILO HERTZ. A TEACHER WHO PREVIOUSLY OCCUPIED THE ROOM DIED OF BRAIN TUMORS AND THE TEACHER IN THE ADJOINING ROOM DIED OF LUEKEMIA.

FIGURE 1. Oscilloscope display of dirty power: 60 Hz electrical power (channel1) with concurrent high frequency voltage transients (channel2). A 10 kHz hi-pass filter was used on channel 2 in order to filter out the 60 Hz voltage and its harmonics. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

electromagnetic fields found an increased incidence of lung cancer among exposed workers [Armstrong et al., 1994].

INTRODUCTION

In February 2004, a Palm Springs, California newspaper, *The Desert Sun*, printed an article titled, “Specialist discounts cancer cluster at school,” in which a local tumor registry epidemiologist claimed that there was no cancer cluster or increased cancer incidence at the school [Perrault, 2004]. An Internet search revealed that the teacher population at La Quinta Middle School (LQMS) was too small to generate the 11 teachers with cancer who were reported in the article. The school was opened in 1988 with 20 teachers hired that year. For the first 2 years, the school operated in three temporary buildings, one of which remains. In 1990, a newly constructed school opened. In 2003, the teachers complained to school district management that they believed that they had too many cancers. Repeated requests to the school administration for physical access to the school and for teachers’ information were denied. We contacted the teachers, and with their help, the cancers in the group were characterized. One teacher suggested using yearbooks to develop population-at-risk counts for calculating expected cancers. We were anxious to assess the electrical environment at the school, since elevated power frequency magnetic field exposure with a positive correlation between duration of exposure and cancer incidence had been reported in first floor office workers who worked in strong magnetic fields above three basement-mounted 12,000 V transformers [Milham, 1996]. We also wanted to use a new electrical measurement tool, the Graham/Stetzer meter, which measures high frequency voltage transients.

The Graham/Stetzer Microsurge II meter measures the average rate of change of the transients in Graham/Stetzer units (GS units). Anecdotal reports had linked dirty power exposure with a number of illnesses [Havas and Stetzer, 2004]. We decided to investigate whether power frequency magnetic field exposure or dirty power exposure could explain the cancer increase in the school teachers.

METHODS

After the school administration (Desert Sands Unified School District) had refused a number of requests to assist in helping us evaluate the cancers reported by the teachers, we were invited by a teacher to visit the school after hours to make magnetic field and dirty power measurements. During that visit, we noted that, with the exception of one classroom near the electrical service room, the classroom magnetic field levels were uniformly low, but the dirty power levels were very high, giving many overload readings. When we reported this to Dr. Doris Wilson, then the superintendent of schools (retired December, 2007), one of us (SM) was threatened

with prosecution for “unlawful.. trespass,” and the teacher who had invited us into the school received a letter of reprimand. The teachers then filed a California OSHA complaint which ultimately led to a thorough measurement of magnetic fields and dirty power levels at the school by the California Department of Health Services which provided the exposure data for this study. They also provided comparison dirty power data from residences and an office building, and expedited tumor registry confirmation of cancer cases.

Classrooms were measured at different times using 3 meters: an FW Bell model 4080 tri-axial Gaussmeter, a Dexsil 310 Gaussmeter, and a Graham-Stetzer (G/S) meter. The Bell meter measures magnetic fields between 25 and 1,000 Hz. The Dexsil meter measures magnetic fields between 30 and 300 Hz. The G/S meter measures the average rate of change of the high frequency voltage transients between 4 and 150 KHz.

All measurements of high frequency voltage transients were made with the G/S meter. This meter was plugged into outlets, and a liquid crystal display was read. All measurements reported were in GS units. The average value was reported where more than one measurement was made in a classroom.

We measured seven classrooms in February 2005 using the Bell meter and the G/S meter. Later in 2005, the teachers measured 37 rooms using the same meters. On June 8, 2006, electrical consultants for the school district and the California Department of Health Services (Dr. Raymond Neutra) repeated the survey using the G/S meter and a Dexsil 320 Gaussmeter, measuring 51 rooms. We used results of this June 8, 2006 sampling in our exposure calculations, since all classrooms were sampled, multiple outlets per room were sampled, and an experienced team did the sampling. Additionally, GS readings were taken at Griffin Elementary school near Olympia, Washington, and Dr. Raymond Neutra provided GS readings for his Richmond California office building and 125 private California residences measured in another Northern California study.

All the cancer case information was developed by personal, telephone, and E-mail contact with the teachers or their families without any assistance from the school district. The local tumor registry verified all the cancer cases with the exception of one case diagnosed out of state and the two cases reported in 2007. The out-of state case was verified by pathologic information provided by the treating hospital. The teachers gathered population-at-risk information (age at hire, year of hire, vital status, date of diagnosis, date of death, and termination year) from yearbooks and from personal contact. The teachers also provided a history of classroom assignments for all teachers from annual classroom assignment rosters (academic years 1990–1991 to 2006–2007) generated by the school administration. The school administration provided a listing of school employees, including

the teachers, to the regional tumor registry after the teachers involved the state health agency by submitting an OSHA complaint. The information we obtained anecdotally from the teachers, yearbooks, and classroom assignment rosters was nearly identical to that given to the tumor registry. None of the cancer cases were ascertained initially through the cancer registry search.

Published cancer incidence rates by age, sex, and race for all cancers, as well as for malignant melanoma, thyroid, uterine, breast, colon, ovarian cancers, and non-Hodgkin's lymphoma (NHL) were obtained from a California Cancer Registry publication [Kwong et al., 2001]. We estimated the expected cancer rate for each teacher by applying year, age, sex, and race-specific cancer incidence rates from hire date until June 2007, or until death. We then summed each teacher's expected cancer rate for the total cohort.

Using the California cancer incidence data, the school teacher data, and the GS exposure data, we calculated cancer incidence and risks. A replicate data set was sent to Dr. Gary Marsh and to Mike Cunningham at the University of Pittsburgh School of Public Health for independent analysis using OCMAP software. We calculated cancer risk ratios by duration of employment and by cumulative GS unit-years of exposure. We calculated an attributable risk percent using the frequencies of total observed and expected cancers, and performed trend tests [Breslow and Day, 1987] for cancer risk versus duration of employment and cumulative GS unit-years of exposure. Poisson *P* values were calculated using the Stat Trek website (Stat Trek, 2007). We also performed a linear regression of cancer risk by duration of employment in years and by time-weighted exposure in GS unit-years.

Since neither author had a current institutional affiliation, institutional review board approval was not possible. The teachers requested the study, and their participation in the study was both voluntary and complete. All the active teachers at the school signed the Cal OSHA request. The authors fully explained the nature of the study to study participants and offered no remuneration to the teachers for participation in the study. The authors maintained strict confidentiality of all medical and personal information provided to us by the teachers, and removed personal identifiers from the data set which was analyzed by the University of Pittsburgh. Possession of personal medical

information was limited to the two authors. No patient-specific information was obtained from the tumor registry. With the individual's permission we provided the registry with case information for a teacher with malignant melanoma diagnosed out of state. The exposure information was provided by the California Department of Health Services. The basic findings of the study were presented to the Desert Sands Unified School District School Board and at a public meeting arranged by the teachers.

RESULTS

Electrical Measurements

In our seven-room survey of the school in 2005, magnetic field readings were as high as 177 mG in a classroom adjacent to the electrical service room. A number of outlets had overload readings with the G/S meter. Magnetic fields were not elevated (>3.0 mG) in the interior space of any of the classrooms except in the classroom adjacent to the electrical service room, and near classroom electrical appliances such as overhead transparency projectors. There was no association between the risk of cancer and 60 Hz magnetic field exposures in this cohort, since the classroom magnetic field exposures were the same for teachers with and without cancer (results not shown).

This school had very high GS readings and an association between high frequency voltage transient exposure in the teachers and risk of cancer. The G/S meter gives readings in the range from 0 to 1,999 GS units. The case school had 13 of 51 measured rooms with at least one electrical outlet measuring "overload" ($\geq 2,000$ GS units). These readings were high compared to another school near Olympia Washington, a Richmond California office building, and private residences in Northern California (Table I). Altogether, 631 rooms were surveyed for this study. Only 17 (2.69%) of the 631 rooms had an "overload" (maximum, $\geq 2,000$ GS units) reading. Applying this percentage to the 51 rooms surveyed at the case school, we would expect 1.4 rooms at the school to have overload GS readings ($0.0269 \times 51 = 1.37$). However, thirteen rooms (25%) measured at the case school had "overload" measurements above the highest value (1,999 GS units) that the G/S meter can

TABLE I. Graham/Stetzer Meter Readings: Median Values in Schools, Homes and an Office Building

| Place | Homes | Office bldg | Olympia WA School | LQMS | Total |
|---|-------|-------------|-------------------|------|----------|
| No. of rooms surveyed | 500 | 39 | 41 | 51 | 531 |
| Median GS units | 159 | 210 | 160 | 750 | $<270^a$ |
| Rooms with overload GS units ($\geq 2,000$) | 4 | 0 | 0 | 13* | 17 |

^aExcludes homes as specific room data was not available.

* $P = 3.14 \times 10^{-9}$.

TABLE II. Risk of Cancer by Type Among Teachers at La Quinta Middle School

| Cancer | Observed | Expected | Risk ratio (O/E) | P-value |
|---------------------------|----------|----------|------------------|----------|
| All cancers | 18 | 6.51 | 2.78* | 0.000098 |
| Malignant melanoma | 4 | 0.41 | 9.76* | 0.0008 |
| Thyroid cancer | 2 | 0.15 | 13.3* | 0.011 |
| Uterus cancer | 2 | 0.22 | 9.19* | 0.019 |
| Female breast cancer | 2 | 1.5 | 1.34 | 0.24 |
| All cancers less melanoma | 14 | 6.10 | 2.30* | 0.0025 |

* $P \leq 0.05$.

measure. This is a highly statistically significant excess over expectation (Poisson $P = 3.14 \times 10^{-9}$).

We noticed AM radio interference in the vicinity of the school. A teacher also reported similar radio interference in his classroom and in the field near his ground floor classroom. In May 2007, he reported that 11 of 15 outlets in his classroom overloaded the G/S meter. An AM radio tuned off station is a sensitive detector of dirty power, giving a loud buzzing noise in the presence of dirty power sources even though the AM band is beyond the bandwidth of the G/S meter.

Cancer Incidence

Three more teachers were diagnosed with cancer in 2005 after the first 11 cancer diagnoses were reported, and another former teacher (diagnosed out-of-state in 2000) was reported by a family member employed in the school system. One cancer was diagnosed in 2006 and two more in 2007. In the years 1988–2005, 137 teachers were employed at the school. The 18 cancers in the 16 teachers were: 4 malignant melanomas, 2 female breast cancers, 2 cancers of the thyroid, 2 uterine cancers and one each of Burkitt's lymphoma (a type of non-Hodgkins lymphoma), polycythemia vera, multiple myeloma, leiomyosarcoma and cancer of the colon, pancreas, ovary and larynx. Two teachers had two primary cancers each: malignant melanoma and multiple myeloma, and colon and pancreatic cancer. Four teachers had died of cancer through August 2007. There have been no non-cancer deaths to date.

The teachers' cohort accumulated 1,576 teacher-years of risk between September 1988 and June 2007 based on a 12-month academic year. Average age at hire was 36 years. In 2007, the average age of the cohort was 47.5 years.

When we applied total cancer and specific cancer incidence rates by year, age, sex, race, and adjusted for cohort ageing, we found an estimate of 6.5 expected cancers, 0.41 melanomas, 0.15 thyroid cancers, 0.22 uterine cancers, and 1.5 female breast cancers (Table II). For all cancers, the risk ratio (Observed/Expected = 18/6.5) was 2.78 ($P = 0.000098$, Poisson test); for melanoma, (O/E = 4/0.41) was 9.8 ($P = 0.0008$, Poisson test); for thyroid cancer (O/E = 2/0.15) was 13.3 ($P = 0.0011$, Poisson test); for uterine cancer (O/E = 2/0.22), was 9.19 ($P = 0.019$, Poisson test).

Table III shows the cancer risk among the teachers by duration of employment. Half the teachers worked at the school for less than 3 years (average 1.52 years). The cancer risk increases with duration of employment, as is expected when there is exposure to an occupational carcinogen. The cancer risk ratio rose from 1.7 for less than 3 years, to 2.9 for 3–14 years, to 4.2 for 15+ years of employment. There was a positive trend of increasing cancer incidence with increasing duration of employment ($P = 4.6 \times 10^{-10}$). A single year of employment at this school increases a teacher's risk of cancer by 21%.

Using the June 8, 2006 survey data (Table IV), the cancer risk of a teacher having ever worked in a room with at least one outlet with an overload GS reading (≥ 2000 GS units) and employed for 10 years or more, was 7.1 ($P = 0.00007$, Poisson test). In this group, there were six teachers diagnosed

TABLE III. Cancer Risk by Duration of Employment

| Time at school | Average time | Teachers | % of teachers | Cancer observed | Cancer expected | Risk ratio (O/E) | Poisson p |
|----------------|--------------|----------|---------------|-----------------|-----------------|------------------|-----------|
| <3 years | 1.52 years | 68 | 49.6 | 4 | 2.34 | 1.72 | 0.12 |
| 3–14 years | 7.48 years | 56 | 40.9 | 9 | 3.14 | 2.87* | 0.0037 |
| 15+ years | 16.77 years | 12 | 8.8 | 5 | 1.02 | 4.89* | 0.0034 |
| Total | | 137 | 100 | 18 | 6.51 | 2.78* | 0.000098 |

Positive trend test (Chi square with one degree of freedom = 38.8, $P = 4.61 \times 10^{-10}$).

* $P \leq 0.05$.

TABLE IV. Cancer in Teachers Who Ever Taught in Classrooms With at Least One Overload GS Reading (≥ 2000 GS Units) by Duration of Employment

| Ever in a room >2,000 GS units | Employed 10 + years | Total teachers | Cancers observed | Cancers expected | Risk ratio (O/E) | Poisson p |
|-----------------------------------|------------------------|----------------|------------------|------------------|------------------|-----------|
| Yes | Yes | 10 | 7 ^a | 0.988 | 7.1* | 0.00007 |
| Yes | No | 30 | 3 ^a | 0.939 | 3.2 | 0.054 |
| Total | | 40 | 10 | 1.93 | 5.1* | 0.00003 |
| No | Yes | 19 | 2 | 1.28 | 1.6 | 0.23 |
| No | No | 78 | 6 | 3.25 | 1.8 | 0.063 |
| Total | | 97 | 8 | 4.56 | 1.8* | 0.047 |
| Grand total | | 137 | 18 | 6.49 | 2.8* | 0.000098 |

^aOne teacher had two primary cancers.* $P < 0.05$.

with a total of seven cancers, and four teachers without a cancer diagnosis, who were employed for 10 or more years and who ever worked in one of these rooms. Five teachers had one primary cancer and one teacher had two primary cancers. These teachers made up 7.3% of the teachers' population (10/137) but had 7 cancers or 39% (7/18) of the total cancers. The 10 teachers who worked in an overload classroom for 10 years or more had 7 cancers when 0.99 would have been expected ($P = 6.8 \times 10^{-5}$ Poisson test). The risk ratio for the 8 teachers with cancer and 32 teachers without cancer, who ever worked in a room with an overload GS reading, regardless of the time at the school, was 5.1 ($P = 0.00003$, Poisson test). The risk ratio for 8 teachers with cancer and 89 teachers without cancer who never worked in a room with an overload G-S reading was 1.8 ($P = 0.047$, Poisson test). Teachers who never worked in an overload classroom also had a statistically significantly increased risk of cancer.

A positive dose-response was seen between the risk of cancer and the cumulative GS exposure (Table V). Three categories of cumulative GS unit-years of exposure were selected: <5,000, 5,000 to 10,000, and more than 10,000 cumulative GS unit-years. We found elevated risk ratios of 2.0, 5.0, and 4.2, respectively, all statistically significant, for each category. There was a positive trend of increasing cancer

incidence with increasing cumulative GS unit-years of exposure ($P = 7.1 \times 10^{-10}$). An exposure of 1,000 GS unit-years increased a teacher's cancer risk by 13%. Working in a room with a GS overload ($\geq 2,000$ GS units) for 1 year increased cancer risk by 26%.

An attributable risk percentage was calculated: (observed cancers-expected cancers)/observed cancers = $(18-6.51)/18 = 63.8\%$.

The fact that these cancer incidence findings were generated by a single day of G/S meter readings made on June 8, 2006 suggests that the readings were fairly constant over time since the school was built in 1990. For example, if the 13 classrooms which overloaded the meter on June 8, 2006 were not the same since the start of the study and constant throughout, the cancer risk of teachers who ever worked in the overload rooms would have been the same as the teachers who never worked in an overload room.

Although teachers with melanoma and cancers of the thyroid, and uterus, had very high, statistically significant risk ratios, there was nothing exceptional about their age at hire, duration of employment, or cumulative GS exposure. However, thyroid cancer and melanoma had relatively short latency times compared to the average latency time for all 18 cancers. The average latency time between start of

TABLE V. Observed and Expected Cancers by Cumulative GS Exposure (GS Unit-Years)

| Exposure group | <5,000 GS unit-years | 5,000 to 10,000 | >10,000 GS unit-years | Total |
|-----------------------|----------------------|-----------------|-----------------------|----------|
| Average GS unit-years | 914 | 7,007 | 15,483 | |
| Cancers obs. | 9 | 4 | 5 | 18 |
| Cancers exp. | 4.507 | 0.799 | 1.20 | 6.49 |
| Risk ratio (O/E) | 2.01* | 5.00* | 4.17* | 2.78* |
| Poisson p | 0.0229 | 0.0076 | 0.0062 | 0.000098 |

Positive trend test (Chi square with one degree of freedom = 38.0, $P = 7.1 \times 10^{-10}$).* $P < 0.05$.

employment at the school and diagnosis for all cancers was 9.7 years. The average latency time for thyroid cancer was 3.0 years and for melanoma it was 7.3 years (with three of the four cases diagnosed at 2, 5, and 5 years).

An independent analysis of this data set by the University of Pittsburgh School of Public Health using OCMAP software supported our findings.

DISCUSSION

Because of access denial, we have no information about the source, or characterization of the high frequency voltage transients. We can assume, because the school uses metal conduit to contain the electrical wiring, that any resultant radiated electric fields from these high frequency voltage transients would radiate mainly from the power cords and from electrical equipment using the power cords within a classroom.

The school's GS readings of high frequency voltage transients are much higher than in other tested places (Table I). Also, teachers in the case school who were employed for over 10 years and who had ever worked in a room with an overload GS reading had a much higher rate of

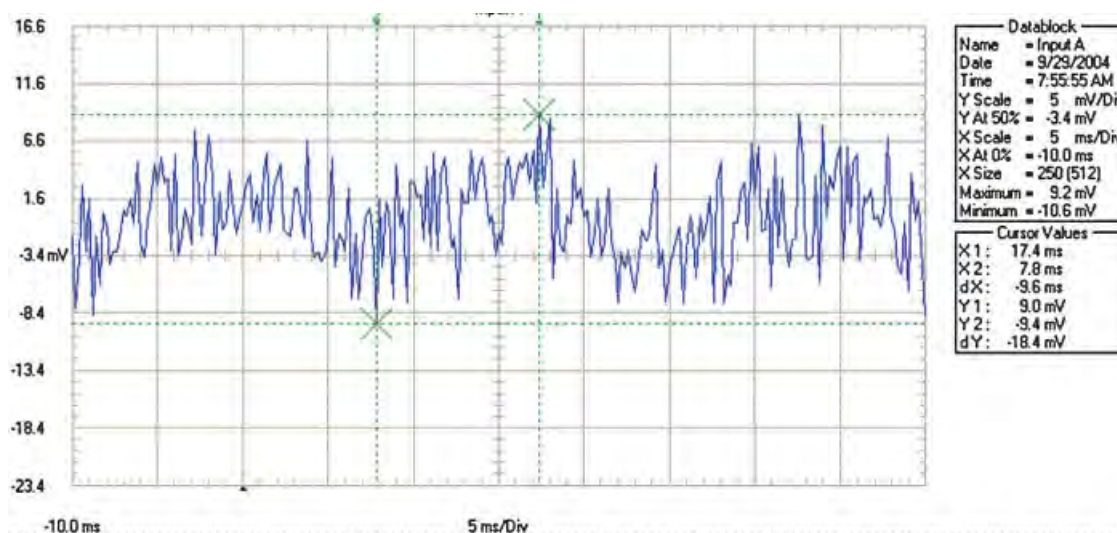
cancer. They made up 7.3% of the cohort but experienced 39% of all cancers.

The relatively short latency time of melanoma and thyroid cancers suggests that these cancers may be more sensitive to the effects of high frequency voltage transients than the other cancers seen in this population.

In occupational cohort studies, it is very unusual to have a number of different cancers with an increased risk. An exception to this is that cohorts exposed to ionizing radiation show an increased incidence of a number of different cancers. The three cancers in this cohort with significantly elevated incidence, malignant melanoma, thyroid cancer and uterine cancer, also have significantly elevated incidence in the large California school employees cohort [Reynolds et al., 1999].

These cancer risk estimates are probably low because 23 of the 137 members of the cohort remain untraced. Since exposure was calculated based on 7 days a week for a year, this will overstate the actual teachers' exposure of 5 days a week for 9 months a year.

We could not study field exposures in the classrooms since we were denied access to the school. We postulate that the dirty power in the classroom wiring exerted its effect by capacitive coupling which induced electrical currents in the



The waveform was recorded between 2 EKG patches placed on the ankles of XXXXXX XXXXXXXXXX standing in front of his kitchen sink at his home near Bright Ontario. It shows a distorted 60 cycle sine wave containing high frequencies applied to each foot, allowing high frequency current to freely oscillate up one leg and down the other. XXXXXX has been diagnosed with prostate cancer since moving to the house in less than a year. He was standing with feet shoulder width apart, wearing shoes, at the time of the readings. The amplitude increased as the feet were placed farther apart.

FIGURE 2. Oscilloscope display of 60 Hz current distorted with high frequencies taken between EKG patches applied to the ankles of a man standing with shoes on at a kitchen sink. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

teachers' bodies. The energy that is capacitively coupled to the teachers' bodies is proportional to the frequency. It is this characteristic that highlights the usefulness of the G/S meter. High frequency dirty power travels along the electrical distribution system in and between buildings and through the ground. Humans and conducting objects in contact with the ground become part of the circuit. Figure 2 [Havas and Stetzer, 2004, reproduced with permission] shows an oscilloscope tracing taken between EKG patches on the ankles of a man wearing shoes, standing at a kitchen sink. The 60 Hz sine wave is distorted by high frequencies, which allows high frequency currents to oscillate up one leg and down the other between the EKG patches.

Although not demonstrated in this data set, dirty power levels are usually higher in environments with high levels of 60 Hz magnetic fields. Many of the electronic devices which generate magnetic fields also inject dirty power into the utility wiring. Magnetic fields may, therefore, be a surrogate for dirty power exposures. In future studies of the EMF-cancer association, dirty power levels should be studied along with magnetic fields.

The question of cancer incidence in students who attended La Quinta Middle School for 3 years has not been addressed.

CONCLUSION

The cancer incidence in the teachers at this school is unusually high and is strongly associated with exposure to high frequency voltage transients. In the 28 years since electromagnetic fields (EMFs) were first associated with cancer, a number of exposure metrics have been suggested. If our findings are substantiated, high frequency voltage transients are a new and important exposure metric and a possible universal human carcinogen similar to ionizing radiation.

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EXHIBIT

9

Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States

JEFFREY E. LOVICH AND JOSHUA R. ENNEN

Large areas of public land are currently being permitted or evaluated for utility-scale solar energy development (USSED) in the southwestern United States, including areas with high biodiversity and protected species. However, peer-reviewed studies of the effects of USSED on wildlife are lacking. The potential effects of the construction and the eventual decommissioning of solar energy facilities include the direct mortality of wildlife; environmental impacts of fugitive dust and dust suppressants; destruction and modification of habitat, including the impacts of roads; and off-site impacts related to construction material acquisition, processing, and transportation. The potential effects of the operation and maintenance of the facilities include habitat fragmentation and barriers to gene flow, increased noise, electromagnetic field generation, microclimate alteration, pollution, water consumption, and fire. Facility design effects, the efficacy of site-selection criteria, and the cumulative effects of USSED on regional wildlife populations are unknown. Currently available peer-reviewed data are insufficient to allow a rigorous assessment of the impact of USSED on wildlife.

Keywords: solar energy development, Mojave Desert, Sonoran Desert, wildlife, desert tortoises

The United States is poised to develop new renewable energy facilities at an unprecedented rate, including in potentially large areas of public land in the Southwest. This quantum leap is driven by escalating costs and demand for traditional energy sources from fossil fuels and by concerns over global climate change. Attention is focused largely on renewable forms of energy, especially solar energy. The potential for utility-scale solar energy development (USSED) and operation (USSEDO) is particularly high in the southwestern United States, where solar energy potential is high (USDOI and USDOE 2011a) and is already being harnessed in some areas. However, the potential for USSEDO conflicts with natural resources, especially wildlife, is also high, given the exceptional biodiversity (Mittermeier et al. 2002) and sensitivity (Lovich and Bainbridge 1999) of arid Southwest ecosystems, especially the Mojave (Randall et al. 2010) and Sonoran Deserts, which are already stressed by climate and human changes (CBI 2010). In addition, the desert Southwest is identified as a “hotspot” for threatened and endangered species in the United States (Flather et al. 1998). For these reasons, planning efforts should consider ways to minimize USSEDO impacts on wildlife (CBI 2010). Paradoxically, the implementation of large-scale solar energy development as an “environmentally friendly” alternative to conventional energy sources may actually increase environmental degradation on a local and on a regional scale (Bezdek 1993, Abbasi and Abbasi 2000) with concomitant negative effects on wildlife.

A logical first step in evaluating the effects of USSEDO on wildlife is to assess the existing scientific knowledge. As renewable energy development proceeds rapidly worldwide, information is slowly accumulating on the effects of USSEDO on the environment (for reviews, see Harte and Jassby 1978, Pimentel et al. 1994, Abbasi and Abbasi 2000). Gill (2005) noted that although the number of peer-reviewed publications on renewable energy has increased dramatically since 1991, only 7.6% of all publications on the topic covered environmental impacts, only 4.0% included discussions of ecological implications, and less than 1.0% contained information on environmental risks. A great deal of information on USSEDO exists in environmental compliance documents and other unpublished, non-peer-reviewed “gray” literature sources. Published scientific information on the effects on wildlife of any form of renewable energy development, including that of wind energy, is scant (Kuvlesky et al. 2007). The vast majority of the published research on wildlife and renewable energy development has been focused on the effects of wind energy development on birds (Drewitt and Langston 2006) and bats (Kunz et al. 2007) because of their sensitivity to aerial impacts. In contrast, almost no information is available on the effects of solar energy development on wildlife.

From a conservation standpoint, one of the most important species in the desert Southwest is Agassiz’s desert

tortoise (*Gopherus agassizii*; figure 1). Distributed north and west of the Colorado River, the species was listed as *threatened* under the US Endangered Species Act in 1990. Because of its protected status, Agassiz's desert tortoise acts as an "umbrella species," extending protection to other plants and animals within its range (Tracy and Brussard, 1994). The newly described Morafka's desert tortoise (*Gopherus morafkai*; Murphy et al. 2011) is another species of significant conservation concern in the desert Southwest, found east of the Colorado River. Both tortoises are important as ecological engineers who construct burrows that provide shelter to many other animal species, which allows them to escape the temperature extremes of the desert (Ernst and Lovich 2009). The importance of these tortoises is thus greatly disproportionate to their intrinsic value as species. By virtue of their protected status, Agassiz's desert tortoises have a significant impact on regulatory issues in the listed portion of their range, yet little is known about the effects of USSEDO on the species, even a quarter century after the recognition of that deficiency (Pearson 1986). Large areas of habitat occupied by Agassiz's desert tortoise in particular have potential for development of USSED (figure 2).



Figure 1. Agassiz's desert tortoise (*Gopherus agassizii*). Large areas of desert tortoise habitat are developed or being evaluated for renewable energy development, including for wind and solar energy. Photograph: Jeffrey E. Lovich.

In this article, we review the state of knowledge about the known and potential effects, both direct and indirect, of USSEDO on wildlife (table 1). Our review is based on information published primarily in peer-reviewed scientific journals for both energy and wildlife professionals. Agassiz's desert tortoise is periodically highlighted in our review because of its protected status, wide distribution in areas considered for USSEDO in the desert Southwest, and well-studied status (Ernst and Lovich 2009). In addition, we identify gaps in our understanding of the effects of USSEDO on wildlife and suggest questions that will guide future research toward a goal of mitigating or minimizing the negative effects on wildlife.

Background on proposed energy-development potential in the southwestern United States

The blueprint for evaluating and permitting the development of solar energy on public land in the region, as is required under the US National Environmental Policy Act (USEPA 2010), began in a draft environmental impact statement (EIS) prepared by two federal agencies (USDOJ and USDOE 2011a). The purpose of the EIS is to "develop a new Solar Energy Program to further support utility-scale solar energy development on BLM [US Bureau of Land

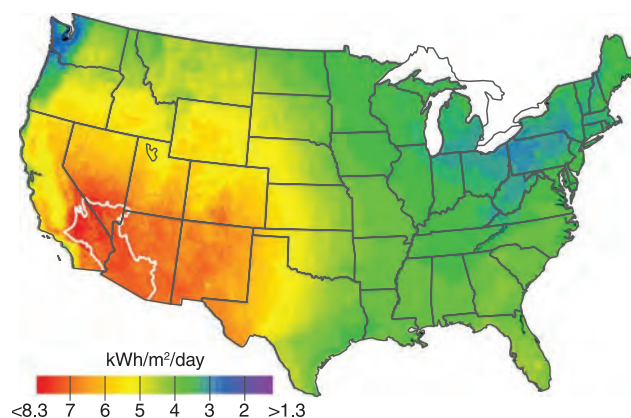


Figure 2. Concentrating solar energy potential (in kilowatt-hours per square meter per day [$\text{kWh}/\text{m}^2/\text{day}$]) of the United States. The map shows the annual average direct normal solar resource data based on a 10-kilometer satellite-modeled data set for the period from 1998 to 2005. Refer to NREL (2011) for additional details and data sources. The white outline defines the approximate composite ranges of Agassiz's (west of the Colorado River) and Morafka's (east of the Colorado River) desert tortoises (Murphy et al. 2011) in the United States, both species of significant conservation concern. This figure was prepared by the National Renewable Energy Laboratory for the US Department of Energy (NREL 2011). The image was authored by an employee of the Alliance for Sustainable Energy, LLC, under Contract no. DE-AC36-08GO28308 with the US Department of Energy. Reprinted with permission from NREL 2011.

Table 1. List of known and potential impacts of utility-scale solar energy development on wildlife in the desert Southwest.

| Impacts due to facility construction and decommissioning | Impacts due to facility presence, operation, and maintenance |
|--|--|
| Destruction and modification of wildlife habitat | Habitat fragmentation and barriers to movement and gene flow |
| Direct mortality of wildlife | Noise effects |
| Dust and dust-suppression effects | Electromagnetic field effects |
| Road effects | Microclimate effects |
| Off-site impacts | Pollution effects from spills |
| Destruction and modification of wildlife habitat | Water consumption effects |
| | Fire effects |
| | Light pollution effects, including polarized light |
| | Habitat fragmentation and barriers to movement and gene flow |
| | Noise effects |

Management] -administered lands... and to ensure consistent application of measures to avoid, minimize, or mitigate the adverse impacts of such development” (p. ES-2). As of February 2010, the BLM had 127 active applications for solar facilities on lands that the BLM administers. According to USDOJ and USDOE (2011a), all of the BLM-administered land in six states (California, Arizona, Utah, Nevada, New Mexico, and Colorado) was considered initially, for a total of 178 million hectares (ha). Not all of that land is compatible with solar energy development, so three alternative configurations are listed by USDOJ and USDOJ (2011a) for consideration, ranging from 274,244 to 39,972,558 ha. The larger figure is listed under the *no action alternative* where BLM would continue to use existing policy and guidance to evaluate applications. Of the area being considered under the two action alternatives, approximately 9 million ha meet the criteria established under the BLM’s preferred action alternative to support solar development. Twenty-five criteria were used to exclude certain areas of public land from solar development and include environmental, social, and economic factors. The preferred alternative also included the identification of proposed *solar energy zones* (SEZs), defined as “area[s] with few impediments to utility-scale production of solar energy” (USDOJ and USDOE 2011a, p. ES-7). By themselves, these SEZs constitute the nonpreferred action alternative of 274,244 ha listed above. Maps of SEZs are available at <http://solareis.anl.gov/documents/dpeis/index.cfm>.

Several sensitive, threatened, or endangered species are being considered within the EIS, but Agassiz’s desert tortoise is one of only four species noted whose very presence at a site may be sufficient to exclude USSED in special cases (see table ES.2-2 in USDOJ and USDOE 2011a). The potential effects of USSED are not trivial for tortoises or other wildlife species. Within the area covered in the draft EIS by USDOJ and USDOE (2011a), it is estimated that

approximately 161,943 ha of Agassiz’s desert tortoise habitat will be directly affected. However, when including direct and indirect impacts on habitat (excluding transmission lines and roads that would add additional impacts; see Lovich and Bainbridge 1999, Kristan and Boarman 2007), it is estimated that approximately 769,230 ha will be affected. Some SEZs are adjacent to critical habitat designated for the recovery of Agassiz’s desert tortoise, and this proximity is considered part of the indirect impacts.

On 28 October 2011, while this paper was in press, the BLM and US Department of Energy released a supplement to the EIS (USDOJ and USDOE 2011b, 2011c) after receiving more than 80,500 comments. The no action alternative remains the same as in the EIS. The new preferred alternative (slightly reduced to 8,225,179 ha as the modified program alternative) eliminates or adjusts SEZs (now reduced to 115,335 ha in 17 zones as the modified SEZ alternative) to ensure that they are not in high-conflict areas and provides incentives for their use. The new plan also proposes a process to accommodate additional solar energy development outside of SEZs and to revisit ongoing state-based planning efforts to allow consideration of additional SEZs in the future.

The impacts of USSED on wildlife: Effects due to construction and decommissioning

The construction and eventual decommissioning of solar energy facilities will have impacts on wildlife, including rare and endangered species, and on their habitats in the desert (Harte and Jassby 1978). These activities involve significant ground disturbance and direct (e.g., mortality) and indirect (e.g., habitat loss, degradation, modification) impacts on wildlife and their habitat (Kuvlesky et al. 2007). Solar energy facilities require large land areas to harness sunlight and convert it to electrical energy. According to Wilshire and colleagues (2008), photovoltaic panels with a 10% conversion efficiency would need to cover an area of about 32,000 square kilometers, or an area a little smaller than the state of Maryland, to meet the current electricity demands of the United States. Many of the areas being considered for the development of solar energy in the Mojave and Sonoran Deserts are, at present, relatively undisturbed (USDOJ and USDOE 2011a).

The extent of surface disturbance of USSED is related to the cooling technology used. Because of the scarcity of water in the desert Southwest region, dry-cooling systems, which consume 90%–95% less water than wet-cooling systems (EPRI 2002), are becoming a more viable option for concentrating solar facilities. Although wet-cooling systems are more economical and efficient, they consume larger amounts of water per kilowatt-hour (Torcellini et al. 2003). Unlike wet-cooling systems, dry-cooling systems use ambient air, instead of water, to cool the exhaust steam from the turbines. However, to achieve a heat-rejection efficiency similar to that in a wet-cooling system, Khalil and colleagues (2006) estimated that a direct dry-cooling system will require a larger footprint and would thus affect more wildlife habitat.

Although we found no information in the scientific literature about the direct effects of USSED on wildlife, the ground-disturbance impacts are expected to be similar to those caused by other human activities in the desert (Lovich and Bainbridge 1999).

Dust and dust suppressants. USSED transforms the landscape substantially through site preparation, including the construction of roads and other infrastructure. In addition, many solar facilities require vegetation removal and grading. These construction activities produce dust emissions, especially in arid environments (Munson et al. 2011), which already have the potential for natural dust emission. Dust can have dramatic effects on ecological processes at all scales (reviewed by Field et al. 2010). At the smallest scale, wind erosion, which powers dust emission, can alter the fertility and water-retention capabilities of the soil. Physiologically, dust can adversely influence the gas exchange, photosynthesis, and water usage of Mojave Desert shrubs (Sharifi et al. 1997). Depending on particle size, wind speed, and other factors, dust emission can physically damage plant species through root exposure, burial, and abrasions to their leaves and stems. The physiological and physical damage to plant species inflicted by dust emissions could ultimately reduce the plants' primary production and could indirectly affect wildlife food plants and habitat quality.

From an operational perspective, dust particles reduce mirror and panel efficiency in converting solar energy into heat or electricity. To combat dust, solar energy facilities apply various dust suppressants to surfaces with exposed soil (e.g., graded areas, areas with vegetation removed, roads). There are eight categories of common dust suppressants used for industrial applications: water, salts and brines, organic nonpetroleum products, synthetic polymers, organic petroleum, electrochemical substances, clay additives, and mulch and fiber mixtures (reviewed in Piechota et al. 2004). In a study conducted in the Mojave Desert in which the hydrological impacts of dust suppressants were compared, Singh and colleagues (2003) reported that changes did occur in the volume, rate, and timing of runoff when dust suppressants were used. In particular, petroleum-based and acrylic-polymer dust suppressants drastically influenced the hydrology of disturbed areas by increasing runoff volume and changing its timing. When it is applied to disturbed desert soils, magnesium chloride (MgCl_2), a commonly used salt-based dust depressant, does not increase runoff volume but does, however, increase the total suspended solids loads in runoff (Singh et al. 2003).

Others have highlighted the fact that there is a dearth of scientific research and literature on the effects of dust suppressants on wildlife, including the most commonly used category of dust depressant: brines and salts (Piechota et al. 2004, Goodrich et al. 2008). However, the application of MgCl_2 to roads was correlated with a higher frequency of plant damage (Goodrich et al. 2008). Because chloride salts, including MgCl_2 , are not confined to the point of application

but have the ability to be transported in runoff (White and Broadly 2001), the potential exists for a loss of primary production associated with plant damage in the habitats surrounding a solar facility, which could directly affect wildlife habitat.

Mortality of wildlife. We are not aware of any published studies documenting the direct effects of USSED on the survival of wildlife. However, subterranean animals can be affected by USSED, including species that hibernate underground. In the Sonoran Desert portion of California, Cowles (1941) observed that most reptiles in the Coachella Valley hibernated at depths of less than 33 centimeters (cm), with many at considerably shallower depths. Included in his observations were flat-tailed horned lizards (*Phrynosoma mcallii*)—a species of special concern in the region because of solar energy development (USDOI and USDOE 2011a)—and the federally protected Coachella Valley fringe-toed lizard (*Uma inornata*). Even lightweight vehicles like motorcycles are capable of causing greatly increased soil density (soil compaction) at a depth of 30–60 cm as their tires pass over the surface (Webb 1983). These observations suggest that vehicular activities in the desert have the potential to kill or entrap large numbers of subterranean animals (Stebbins 1995) through compressive forces or burrow collapse. Similar or greater impacts would be expected from the heavy equipment associated with the construction activities at an energy facility.

Destruction and modification of wildlife habitat. Despite the absence of published, peer-reviewed information on the effects of USSED on wildlife and their habitats, a considerable body of literature exists on the effects of other ground-disturbing activities on both ecological patterns and processes that are broadly comparable. Ground-disturbing activities affect a variety of processes in the desert, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts (for reviews, see Lovich and Bainbridge 1999, Webb et al. 2009). All of these processes have the ability—individually and together—to alter habitat quality, often to the detriment of wildlife. Any disturbance and alteration to the desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production (Sharifi et al. 1997, Field et al. 2010) and food availability for wildlife.

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure (Abbasi and Abbasi 2000). Channeling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in the desert, as was shown by Schlesinger and colleagues (1989). Areas deprived

of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns.

The impacts of roads. Roads are required in order to provide access to solar energy infrastructure. Both paved and unpaved roads have well-documented negative effects on wildlife (Forman and Alexander 1998), and similar effects are expected in utility-scale solar energy facilities. Although road mortality is most easily detected on the actual roadway, the effects of roads extend far beyond their physical surface. In a study of the effects of roads on Agassiz's desert tortoise populations in southern Nevada, von Seckendorff Hoff and Marlow (2002) examined transects along roads with traffic volumes varying from 25 to 5000 vehicles per day. Tortoises and tortoise sign (e.g., burrows, shells, scat) decreased with their proximity to a road. On roads with high traffic volumes, tortoises and tortoise sign were reduced as far as 4000 meters from the roadside. Roads with lower traffic volumes had fewer far-reaching effects.

Another effect of roads in the desert is the edge enhancement of plants and arthropod herbivores (Lightfoot and Whitford 1991). Perennial plants along the roadside are often larger than those farther away, and annual plant germination is often greatest along the shoulders of roads. It is possible that increased runoff due to impervious pavement or compacted soil contributes to this heterogeneity of vegetation in relationship to a road. Agassiz's desert tortoises may select locations for burrow construction that are close to roads, perhaps because of this increased productivity of food plants (Lovich and Daniels 2000). Although this situation suggests potentially beneficial impacts for herbivorous species of wildlife, such as tortoises, it increases their chance of being killed by vehicle strikes, as was shown by von Seckendorff Hoff and Marlow (2002).

Off-site impacts. Direct impacts on wildlife and habitat can occur well outside the actual footprint of the energy facility. Extraction of large amounts of raw materials for the construction of solar energy facilities (e.g., aggregate, cement, steel, glass); transportation and processing of those materials; the need for large amounts of water for cooling some installations; and the potential for the production of toxic wastes, including coolants, antifreeze, rust inhibitors, and heavy metals, can affect wildlife adjacent to or far from the location of the facility (Abbasi and Abbasi 2000). Abbasi and Abbasi (2000) summarized data suggesting that the material requirements for large-scale solar facilities exceed those for conventional fossil-fuel plants on a cost-per-unit-of-energy basis. In addition, water used for steam production at one solar energy facility in the Mojave Desert of California contained selenium, and the wastewater was pumped into evaporation ponds that attracted birds that fed on invertebrates. Although selenium toxicity was not considered a threat on the basis of the results of one study, the possibility exists for harmful bioaccumulation of this toxic

micronutrient (Herbst 2006). In recognition of the hazard, Pimentel and colleagues (1994) suggested that fencing should be used to keep wildlife away from these toxic ponds.

The impacts of USSED on wildlife: Effects due to operation and maintenance

This category includes the effects related to the presence and operation of the solar facility, not the physical construction and decommissioning of the same. Some of the effects (e.g., mortality of wildlife and impacts caused by roads) are similar to those discussed previously for construction and decommissioning and are not discussed further.

Habitat fragmentation. Until relatively recently, the desert Southwest was characterized by large blocks of continuous and interconnected habitat. Roads and urban development continue to contribute to habitat fragmentation in this landscape. Large-scale energy development has the potential to add to and exacerbate the situation, presenting potential barriers to movement and genetic exchange in wildlife populations, including those of bighorn sheep (*Ovis canadensis*), deer (*Odocoileus* spp.), tortoises, and other species of concern and social significance. Research conducted on the effects of oil and gas exploration and development (OGED) on wildlife in the Intermountain West provides a possible analog to USSEDO, since comparable data are not available for the desert Southwest. The potential effects on mule deer (*Odocoileus hemionus*) and other wildlife species include impediments to free movement, the creation of migration bottlenecks, and a reduction in effective winter range size. Mule deer responded immediately to OGED by moving away from disturbances, with no sign of acclimation during the three years of study by Sawyer and colleagues (2009). Some deer avoidance resulted in their use of less-preferred and presumably less-suitable habitats.

Despite a lack of data on the direct contributions of USSEDO to habitat fragmentation, USSEDO has the potential to be an impediment to gene flow for some species. Although the extent of this impact is, as yet, largely unquantified in the desert, compelling evidence for the effects of human-caused habitat fragmentation on diverse wildlife species has already been demonstrated in the adjacent coastal region of southern California (Delaney et al. 2010).

Noise effects. Industrial noise can have impacts on wildlife, including changes to their habitat use and activity patterns, increases in stress, weakened immune systems, reduced reproductive success, altered foraging behavior, increased predation risk, degraded communication with conspecifics, and damaged hearing (Barber et al. 2009, Pater et al. 2009). Changes in sound level of only a few decibels can elicit substantial animal responses. Most noise associated with USSEDO is likely to be generated during the construction phase (Suter 2002), but noise can also be produced during operation and maintenance activities. Brattstrom and Bondello (1983) documented the effects of noise on Mojave

Desert wildlife on the basis of experiments involving off-highway vehicles. Noise from some of these vehicles can reach 110 decibels—near the threshold of human pain and certainly within the range expected for various construction, operation, and maintenance activities (Suter 2002) associated with USSEDO. This level of noise caused hearing loss in animals, such as kangaroo rats (*Dipodomys* spp.), desert iguanas (*Dipsosaurus dorsalis*), and fringe-toed lizards (*Uma* spp.). In addition, it interfered with the ability of kangaroo rats to detect predators, such as rattlesnakes (*Crotalus* spp.), and caused an unnatural emergence of aestivating spadefoot toads (*Scaphiopus* spp.), which would most likely result in their deaths. Because of impacts on wildlife, Brattstrom and Bondello (1983) recommended that “all undisturbed desert habitats, critical habitats, and all ranges of threatened, endangered, or otherwise protected desert species” (p. 204) should be protected from loud noise.

Although many consider solar energy production a “quiet” endeavor, noise is associated with their operation. For example, facilities at which wet-cooling systems are used will have noises generated by fans and pumps. As for facilities with dry-cooling systems, only noise from fans will be produced during operation (EPRI 2002). Because of the larger size requirements of dry-cooling systems, there will be more noise production associated with an increase in the number of fans.

Electromagnetic field generation. When electricity is passed through cables, it generates electric and magnetic fields. USSEDO requires a large distribution system of buried and overhead cables to transmit energy from the point of production to the end user. Electromagnetic fields (EMFs) produced as energy flows through system cables are a concern from the standpoint of both human and wildlife health, yet little information is available to assess the potential impact of the EMFs associated with USSEDO on wildlife. Concerns about EMFs have persisted for a long time, in part because of controversy over whether they’re the actual cause of problems and disagreement about the underlying mechanisms for possible effects. For example, there is presently a lack of widely accepted agreement about the biological mechanisms that can explain the consistent associations between extremely low-frequency EMF exposure from overhead power lines and childhood leukemia, although there is no shortage of theories (Gee 2009).

Some conclude that the effects of EMFs on wildlife will be minor because of reviews of the often conflicting and inconclusive literature on the topic (Petersen and Malm 2006). Others suggest that EMFs are a possible source of harm for diverse species of wildlife and contribute to the decline of some mammal populations. Balmori (2010) listed possible impacts of chronic exposure to athermal electromagnetic radiation, which included damage to the nervous system, disruption of circadian rhythm, changes in heart function, impairment of immunity and fertility, and genetic and developmental problems. He concluded that enough evidence exists to confirm harm to wildlife but suggested that

further study is urgently needed. Other authors suggest that the generally inconsistent epidemiological evidence in support of the effects of EMFs should not be cause for inaction. Instead, they argue that the precautionary principle should be applied in order to prevent a recurrence of the “late lessons from early warnings” scenario that has been repeated throughout history (Gee 2009).

Magnetic information is used for orientation by diverse species, from insects (Sharma and Kumar 2010) to reptiles (Perry A et al. 1985). Despite recognition of this phenomenon, the direct effects of USSEDO-produced EMFs on wildlife orientation remains unknown.

Microclimate effects. The alteration of a landscape through the removal of vegetation and the construction of structures by humans not only has the potential of increasing animal mortality but also changes the characteristics of the environment in a way that affects wildlife. The potential for microclimate effects unique to solar facilities was discussed by Pimentel and colleagues (1994) and by Harte and Jassby (1978). It has been estimated that a concentrating solar facility can increase the albedo of a desert environment by 30%–56%, which could influence local temperature and precipitation patterns through changes in wind speed and evapotranspiration. Depending on their design, large concentrating solar facilities may also have the ability to produce significant amounts of unused heat that could be carried downwind into adjacent wildlife habitat with the potential to create localized drought conditions. The heat produced by central-tower solar facilities can burn or incinerate birds and flying insects as they pass through the concentrated beams of reflected light (McCrary et al. 1986, Pimentel et al. 1994, Tsoutsos et al. 2005, Wilshire et al. 2008).

A dry-cooled solar facility—in particular, one with a concentrating-trough system—could reject heated air from the cooling process with temperatures 25–35 degrees Fahrenheit higher than the ambient temperature (EPRI 2002). This could affect the microclimate on site or those in adjacent habitats. To our knowledge, no research is available to assess the effects of USSEDO on temperature or that of any other climatic variable on wildlife. However, organisms whose sex is determined by incubation temperatures, such as both species of desert tortoises, may be especially sensitive to temperature changes, because small temperature changes have the potential to alter hatchling sex ratios (Hulin et al. 2009).

Pollutants from spills. USSEDO, especially at wet-cooled solar facilities, has a potential risk for hazardous chemical spills on site, associated with the toxicants used in cooling systems, antifreeze agents, rust inhibitors, herbicides, and heavy metals (Abbasi and Abbasi 2000, Tsoutsos et al. 2005). Wet-cooling solar systems must use treatment chemicals (e.g., chlorine, bromine, selenium) and acids and bases (e.g., sulfuric acid, sodium hydroxide, hydrated lime) for the prevention of fouling and scaling and for pH control of the water used in their recirculating systems (EPRI 2002).

Solar facilities at which a recirculating system is used also have treatment and disposal issues associated with water discharge, known as *blowdown*, which is water with a high concentration of dissolved and suspended materials created by the numerous evaporation cycles in the closed system (EPRI 2002). These discharges may contain chemicals used to prevent fouling and scaling. The potentially tainted water is usually stored in evaporative ponds, which further concentrates the toxicants (Herbst 2006). Because water is an attraction for desert wildlife, numerous species could be adversely affected. The adverse effects of the aforementioned substances and similar ones on wildlife are well documented in the literature, and a full review is outside the scope of this article. However, with the decreased likelihood of wet-cooling systems for solar facilities in the desert, the risk of hazardous spills and discharges on site will be less in the future, because dry-cooling systems eliminate most of the associated water-treatment processes (EPRI 2002). However, there are still risks of spills associated with a dry-cooling system. More research is needed on the adverse effects of chemical spills and tainted-water discharges specifically related to USSEDO on wildlife.

Water consumption (wet-cooled solar). The southwestern United States is a water-poor region, and water use is highly regulated throughout the area. Because of this water limitation, the type of cooling systems installed at solar facilities is limited as well. For example, a once-through cooling system—a form of wet cooling—is generally not feasible in arid environments, because there are few permanent bodies of water (i.e., rivers, oceans, and lakes) from which to draw cool water and then into which to release hot water. Likewise, other wet-cooling options, such as recirculating systems and hybrid systems, are becoming less popular because of water shortage issues in the arid region. Therefore, the popularity of the less-efficient and less-economical dry-cooling systems is increasing on public lands. Water will also be needed at solar facilities to periodically wash dust from the mirrors or panels. Although there are numerous reports in which the costs and benefits were compared both environmentally and economically (EPRI 2002, Khalil et al. 2006) between wet- and dry-cooled solar facilities, to our knowledge no one has actually quantified the effects of water use and consumption on desert wildlife in relation to the operation of these facilities.

Fire risks. Any system that produces electricity and heat has a potential risk of fire, and renewable energy facilities are no exception. Concentrating solar energy facilities harness the sun's energy to heat oils, gases, or liquid sodium, depending on the system design (e.g., heliostat power, trough, dish). With temperatures reaching more than 300 degrees Celsius in most concentrated solar systems, spills and leaks from the coolant system increase the risk of fires (Tsoutsos et al. 2005). Even though all vegetation is usually removed from the site during construction, which reduces the risk of a fire propagating on and off site, the increase of human activity

in a desert region increases the potential for fire, especially along major highways and in the densely populated western Mojave Desert (Brooks and Matchett 2006).

The Southwest deserts are not fire-adapted ecosystems: fire was historically uncommon in these regions (Brooks and Esque 2002). However, with the establishment of numerous flammable invasive annual plants in the desert Southwest (Brown and Minnich 1986), coupled with an increase in anthropogenic ignitions, fire has become more common in the deserts, which adversely affects wildlife (Esque et al. 2003). For Agassiz's desert tortoise, fire can translate into direct mortality at renewable energy facilities (Lovich and Daniels 2000) and can cause reductions in food and habitat quality. To our knowledge, however, there is no scientific literature related to the effects of USSEDO-caused fire on wildlife.

Light pollution. Two types of light pollution could be produced by solar energy facilities: ecological light pollution (ELP; Longcore and Rich 2004) and polarized light pollution (PLP; Horváth et al. 2009). The latter, PLP, could be produced at high levels at facilities using photovoltaic solar panels, because dark surfaces polarize light. ELP can also be produced at solar facilities in the form of reflected light. The reflected light from USSEDO has been suggested as a possible hazard to eyesight (Abbasi and Abbasi 2000). ELP could adversely affect the physiology, behavior, and population ecology of wildlife, which could include the alteration of predation, competition, and reproduction (for reviews, see Longcore and Rich 2004, Perry G et al. 2008). For example, the foraging behavior of some species can be adversely affected by light pollution (for a review, see Longcore and Rich 2004). The literature is limited regarding the impact of artificial lighting on amphibians and reptiles (Perry G et al. 2008), and, to our knowledge, there are no published studies in which the impacts on wildlife of light pollution produced by USSEDO have been assessed. However, light pollution is considered by G. Perry and colleagues (2008) to be a serious threat to reptiles, amphibians, and entire ecological communities that requires consideration during project planning. G. Perry and colleagues (2008) further recommended the removal of unnecessary lighting so that the lighting conditions of nearby habitats would be as close as possible to their natural state.

Numerous anthropogenic products—usually those that are dark in color (e.g., oil spills, glass panes, automobiles, plastics, paints, asphalt roads)—can unnaturally polarize light, which can have adverse effects on wildlife (for a review, see Horváth et al. 2009). For example, numerous animal species use polarized light for orientation and navigation purposes (Horváth and Varjú 2004). Therefore, the potential exists for PLP to disrupt the orientation and migration abilities of desert wildlife, including those of sensitive species. In the review by Horváth and colleagues (2009), which was focused mostly on insects but included a few avian references, they highlighted the fact that anthropogenic products that produce PLP can appear to be water bodies to wildlife and can become ecological traps for insects and, to a lesser degree, avian species. Therefore,

utility-scale solar energy facilities at which photovoltaic technology is used in the desert Southwest could create a direct effect on insects (i.e., ecological trap), which could have profound but unquantified effects on the ecological community surrounding the solar facility. In addition, there may be indirect effects on wildlife through the limitation of plant food resources, especially if pollinators are negatively affected. As was stated by Horváth and colleagues (2009), the population- and community-level effects of PLP can only be speculated on because of the paucity of data.

Unanswered questions and research needs

In our review of the peer-reviewed scientific literature, we found only one peer-reviewed publication on the specific effects of utility-scale solar energy facility operation on wildlife (McCrary et al. 1986) and none on utility-scale solar energy facility construction or decommissioning. Although it is possible that we missed other peer-reviewed publications, our preliminary assessment demonstrates that very little critically reviewed information is available on this topic. The dearth of published, peer-reviewed scientific information provides an opportunity to identify the fundamental research questions for which resource managers need answers. Without those answers, resource managers will be unable to effectively minimize the negative effects of USSEDO on wildlife, especially before permitting widespread development of this technology on relatively undisturbed public land.

Before-and-after studies. Carefully controlled studies are required in order to tease out the direct and indirect effects of USSEDO on wildlife. Pre- and postconstruction evaluations are necessary to identify the effects of renewable energy facilities and to compare results across studies (Kunz et al. 2007). In their review of wind energy development and wildlife, with an emphasis on birds, Kuvlesky and colleagues (2007) noted that experimental designs and data-collection standards were typically inconsistent among studies. This fact alone contributes measurably to the reported variability among studies or renders comparisons difficult, if not impossible. Additional studies should emphasize the need for carefully controlled before-after-control-impact (BACI) studies (Kuvlesky et al. 2007) with replication (if possible) and a detailed description of site conditions. The potential payoff for supporting BACI studies now could be significant: They could provide answers for how to mitigate the negative impacts on wildlife in a cost-effective and timely manner.

What are the cumulative effects of large numbers of dispersed or concentrated energy facilities? Large portions of the desert Southwest have the potential for solar energy development. Although certain areas are targeted for large facilities because of resource availability and engineering requirements (e.g., their proximity to existing transmission corridors), other areas may receive smaller, more widely scattered facilities. A major unanswered question is what the cumulative impacts of these facilities on wildlife are. Would it be better for

wildlife if development is concentrated or if it is scattered in smaller, dispersed facilities? Modeling based on existing data would be highly suspect because of the deficiency of detailed site-level published information identified in our analysis. Except for those on habitat destruction and alteration related to other human endeavors, there are no published articles on the population genetic consequences of habitat fragmentation related to USSED, which makes this a high priority for future research.

What density or design of development maximizes energy benefits while minimizing negative effects on wildlife?

We are not aware of any published peer-reviewed studies in which the impacts on wildlife of different USSED densities or designs have been assessed. For example, would it benefit wildlife to leave strips of undisturbed habitat between rows of concentrating solar arrays? Research projects in which various densities, arrays, or designs of energy-development infrastructure are considered would be extremely valuable. BACI studies would be very useful for addressing this deficiency.

What are the best sites for energy farms with respect to the needs of wildlife?

The large areas of public land available for renewable energy development in the desert Southwest encompass a wide variety of habitats. Although this provides a large number of choices for USSED, not all areas have the same energy potential because of resource availability and the limitations associated with engineering requirements, as was noted above. Detailed information on wildlife distribution and habitat requirements are crucially needed for proper site location and for the design of renewable energy developments (Tsoutsos et al. 2005). Public-resource-management agencies have access to rich geospatial data sets based on many years of inventories and resource-management planning. These data could be used to identify areas of high value for both energy development and wildlife. Areas with overlapping high values could be carefully studied through risk assessment when it appears that conflicts are likely. Previously degraded wildlife habitats, such as old mine sites, overgrazed pastures, and abandoned crop fields, may be good places to concentrate USSED to minimize its impacts on wildlife (CBI 2010).

Can the impacts of solar energy development on wildlife be mitigated?

The construction of solar energy facilities can cause direct mortality of wildlife. In addition, building these facilities results in the destruction and fragmentation of wildlife habitat and may increase the possibility of fire, as was discussed above. Beyond these effects, essentially nothing is known about the operational effects of solar energy facilities on wildlife. Current mitigation strategies for desert tortoises and other protected species include few alternatives other than translocation of the animals from the footprint of the development into other areas. Although this strategy may be appealing at first glance, animal translocation has a checkered history of success, especially for reptiles and amphibians (Germano and Bishop 2008, CBI 2010). Translocation

has yet to be demonstrated as a viable long-term solution that would mitigate the destruction of Agassiz's desert tortoise habitat (Ernst and Lovich 2009, CBI 2010).

Conclusions

All energy production has associated social and environmental costs (Budnitz and Holdren 1976, Bezdek 1993). In their review of the adverse environmental effects of renewable energy development, Abbasi and Abbasi (2000) stated that "renewable energy sources are not the panacea they are popularly perceived to be; indeed, in some cases, their adverse environmental impacts can be as strongly negative as the impacts of conventional energy sources" (p. 121). Therefore, responsible, efficient energy production requires both the minimization of environmental costs and the maximization of benefits to society—factors that are not mutually exclusive. Stevens and colleagues (1991) and Martín-López and colleagues (2008) suggested that the analyses of costs and benefits should include both wildlife use and existence values. On the basis of our review of the existing peer-reviewed scientific literature, it appears that insufficient evidence is available to determine whether solar energy development, as it is envisioned for the desert Southwest, is compatible with wildlife conservation. This is especially true for threatened species such as Agassiz's desert tortoise. The many other unanswered questions that remain after reviewing the available evidence provide opportunities for future research, as was outlined above.

The shift toward renewable energy is widely perceived by the public as a "green movement" intended to reduce greenhouse-gas emissions and acid rain and to curb global climate change (Abbasi and Abbasi 2000). However, as was noted by Harte and Jassby (1978), just because an energy technology is simple, thermodynamically optimal, renewable, or inexpensive does not mean that it will be benign from an ecological perspective. The issue of wildlife impacts is much more complex than is widely appreciated, especially when the various scales of impact (e.g., local, regional, global) are considered. Our analysis shows that, on a local scale, so little is known about the effects USSEDO on wildlife that extrapolation to larger scales with any degree of confidence is currently limited by an inadequate amount of scientific data. Therefore, without additional research to fill the significant information void, accurate assessment of the potential impacts of solar energy development on wildlife is largely theoretical but needs to be empirical and well-founded on supporting science.

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EXHIBIT

10

Large endolymphatic potentials from low-frequency and infrasonic tones in the guinea pig

Alec N. Salt,^{a)} Jeffery T. Lichtenhan, Ruth M. Gill, and Jared J. Hartsock

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Responses of the ear to low-frequency and infrasonic sounds have not been extensively studied. Understanding how the ear responds to low frequencies is increasingly important as environmental infrasounds are becoming more pervasive from sources such as wind turbines. This study shows endolymphatic potentials in the third cochlear turn from acoustic infrasound (5 Hz) are larger than from tones in the audible range (e.g., 50 and 500 Hz), in some cases with peak-to-peak amplitude greater than 20 mV. These large potentials were suppressed by higher-frequency tones and were rapidly abolished by perilymphatic injection of KCl at the cochlear apex, demonstrating their third-turn origins. Endolymphatic iso-potentials from 5 to 500 Hz were enhanced relative to perilymphatic potentials as frequency was lowered. Probe and infrasonic bias tones were used to study the origin of the enhanced potentials. Potentials were best explained as a saturating response summed with a sinusoidal voltage (V_o), that was phase delayed by an average of 60° relative to the biasing effects of the infrasound. V_o is thought to arise indirectly from hair cell activity, such as from strial potential changes caused by sustained current changes through the hair cells in each half cycle of the infrasound. © 2013 Acoustical Society of America.
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I. INTRODUCTION

The ear possesses numerous mechanisms to reduce the sensitivity to low-frequency sounds. Mechanically, the middle ear attenuates low-frequency sounds by ~ 6 dB/octave as frequency is lowered below 1 kHz (Dallos, 1973; Cheatham and Dallos, 2001). The helicotrema shunts pressure between scala tympani (ST) and scala vestibuli, attenuating low-frequency stimulation by ~ 6 dB/octave below 100 Hz both in humans (Dallos, 1970) and in guinea pigs (Franke and Dancer, 1982; Salt and Hullar, 2010). The stereocilia of the inner hair cells (IHCs) are not directly coupled to the tectorial membrane but are stimulated by fluid movements in the subreticular space (Nowotny and Gummer, 2006; Guinan, 2012); this causes IHCs to be sensitive to basilar membrane velocity and attenuates low-frequency input by 6 dB/octave below ~ 470 Hz (Cheatham and Dallos, 2001). As hearing is mediated by IHCs, these mechanisms combine to make hearing very insensitive to low-frequency sounds and infrasound. As an example, a 5 Hz tone must be presented at ~ 109 dB SPL for humans to hear it (Møller and Pederson, 2004).

The studies reported here were performed with guinea pigs, a species for which the perception of infrasonic frequencies has never been measured. The ability to detect low frequencies has been correlated with cochlear length for species such as humans and guinea pigs with results showing that shorter cochleae are typically less sensitive to low frequencies (West, 1985; Echterler *et al.*, 1994). As compared to humans, guinea pigs require an average of 15 dB higher sound pressure level over the low-frequency range that has

been measured (50–500 Hz; Heffner *et al.*, 1971; Miller and Murray, 1966; Prosen *et al.*, 1978; Walloch and Taylor-Spikes, 1976). We therefore expect guinea pigs to be less sensitive to infrasonic stimulation than humans and estimate the perceptual threshold for 5 Hz to be ~ 124 dB SPL. Thus responses to infrasonic frequencies are expected to be more robust in human cochleae than in guinea pigs.

In contrast to the IHCs, which are fluid coupled to the mechanical input, the stereocilia of the outer hair cells (OHCs) are directly coupled to the tectorial membrane, thus making OHCs sensitive to organ of Corti displacement (Dallos *et al.*, 1982; Dallos, 1986). Early studies by von Békésy (1951, 1960) showed that when the organ of Corti was displaced in a sustained manner by a mechanical probe, such as with a trapezoidal stimulus, the voltage response was sustained for the duration of the stimulus. These classic studies demonstrated that OHCs are capable of responding to very low frequencies. Salt and DeMott (1999) applied low-frequency stimulation by fluid injections into the perilymph and showed that large potentials, over 20 mV peak to peak (pk/pk) in amplitude, were generated in the endolymphatic space at stimulus frequencies from 10 Hz down to 0.1 Hz. Although stimulus delivery in this study was not by a normal, physiological route, responses of comparable magnitude were found during spontaneous middle-ear muscle contractions; this demonstrated that large potentials can indeed be elicited by physiologic stimuli. The amplitude of the cochlear microphonics (CMs) from stimuli in the range of audibility are typically less than ~ 2 – 3 mV pk/pk when measured in perilymph but have been shown to be up to ~ 8 mV pk/pk when recorded from the endolymph space of the apical cochlear turns (Honrubia and Ward, 1968; Honrubia *et al.*, 1973; Dallos, 1973). Salt *et al.* (2009) showed that

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increases of endocochlear potential (EP) by more than 10 mV occurred when the organ of Corti was displaced toward scala tympani for a period of minutes by the slow injection of gel into the cochlear apex. These studies suggest that when the organ of Corti is displaced by low-frequency sounds, CM changes associated with OHC stimulation are greatest when recorded from the endolymphatic space.

In the present report, we examine the cochlear responses elicited by infrasonic and low-frequency acoustic stimulation. The issue of sensitivity to low-frequency sounds is becoming of greater importance because low-frequency environmental sounds are becoming more pervasive. People with wind turbines located near their homes can be exposed to low-frequency stimulation for prolonged periods of time (Jakobsen, 2005; van den Berg, 2006; O'Neal *et al.*, 2011; Møller and Pedersen, 2011). Because infrasound is not heard, it is commonplace to high-pass filter the measured sounds with cutoff frequencies derived from the human audibility curve (A-weight) thereby diminishing low-frequency components (e.g., Møller and Pedersen, 2011). Other weighting functions give greater emphasis to infrasonic frequencies, such as G-weighting, which filters below 1 Hz and above 20 Hz at 24 dB/octave and emphasizes frequencies between 1 and 20 Hz according to their perceptual audibility (Broner, 2008). Wind turbines of contemporary design typically generate infrasonic levels of ≤ 70 dB G that are well below the 90 dB G level required for subjective hearing (Jakobsen, 2005; ISO, 1996). As infrasound levels from wind turbines are typically below the threshold of hearing, it has been widely concluded that the low-frequency components of the sound can be ignored. This has been encapsulated by the widely used quotation "What you can't hear, won't hurt you," which was attributed to an engineer named Campanella by Alves-Pereira and Castelo Branco (2007). Found elsewhere are numerous additional reports of wind-turbine noise assessments concluding that the infrasound level is insignificant because it is not heard (e.g., O'Neal *et al.*, 2011). This particular subgenre of noise measurement and regulation is therefore almost entirely based on human *perception*. Our objective measures, such as those reported here, lead us to strongly advocate that before effects on humans can be dismissed, we must better understand the nature of the ear's response to infrasound in much greater detail.

II. METHODS

A. Animal preparation

This study used 13 guinea pigs under animal protocols 20070147 and 20100135 approved by the Animal Studies Committee of Washington University. Guinea pigs were initially anesthetized with 100 mg/kg sodium thiobutabarbital and maintained on 0.8%–1.2% isoflurane in oxygen. The trachea was cannulated, and the animal was artificially ventilated. End-tidal CO_2 was monitored with a capnograph (CapnoTrueAMP, Zevenaar, The Netherlands), and the tidal volume of the ventilator was adjusted to maintain an end-tidal CO_2 level of 5%. Body temperature was maintained at 38.5°C with a DC-powered thermistor controlled heating pad. Pavulon (muscle relaxant) was given intravenously to

suppress middle ear muscle contractions. The auditory bulla was exposed by a ventral approach and opened for the placement of recording electrodes.

B. Stimulus generation and delivery

Acoustic stimuli were delivered in a closed sound system. The external canal was sectioned and a hollow ear bar was inserted. An Etymotic Research ER-10C acoustic assembly terminated near the tip of the earbar that also incorporated a Sennheiser HD 580 driver mounted in an acrylic coupler used to deliver low-frequency sounds. A probe tube to connect to a B&K 4134, [1/4]-in. reference microphone was also routed to the earbar. The B&K microphone was used to verify low-frequency calibrations, as it had a flat frequency response while the ER10C microphone incorporated low-frequency filtering.

Stimulus generation and data collection were performed with Tucker Davis System 3 hardware, driven by a custom written program (Microsoft Visual Basic) with ActiveX drivers. Three output channels were utilized, each routed through a Tucker Davis PA5 attenuator and Tucker Davis HB7 headphone amplifier. Sounds were calibrated in [1/4] octave steps from 4 Hz to 8 kHz for the Sennheiser transducer and 125 Hz to 22 kHz for the ER10C drivers.

C. Recording procedures

Most of the cochlear responses reported here were recorded through glass microelectrodes beveled to 4–6 μm tip outer diameter and filled with 500 mM KCl or 500 mM NaCl for endolymphatic and perilymphatic recordings, respectively. Electrodes were connected through Ag/AgCl wires and high input impedance ($>10^{14} \Omega$) DC-coupled amplifiers to the data acquisition system. The reference electrode was an Ag/AgCl pellet [RC1, World Precision Instruments (WPI), Sarasota, FL] connected through a fluid bridge to the muscles of the neck. In most cases, responses from endolymph and perilymph in the same cochlear turn were recorded simultaneously. Some responses (e.g., CAPs to high-frequency stimuli) were also recorded from an Ag/AgCl ball electrode placed on the edge of the round-window membrane near the bony annulus that was routed to a Tucker-Davis DB4 amplifier with the high-pass filter set at 5 Hz.

Four input channels of the Tucker-Davis system were sampled simultaneously, typically representing signals from the round window electrode, the ear canal microphone and two dc-coupled inputs from electrometers. An automated CAP audiogram was initially performed (1–22 kHz in [1/4] octave steps) to verify normal cochlear function. Measuring responses to low stimulus frequencies required collection windows of 4–6 s duration—a time consuming process when multiple response are averaged. Collection windows were therefore varied when measuring responses to stimuli of different frequency. For potential amplitude measurement algorithms, windows of 2 s, 200 ms, and 20 ms were used for frequencies below 25 Hz, from 25 to 250 Hz, and above 250 Hz, respectively. In most cases, dc-coupled responses were recorded. When responses to low-level stimuli were recorded for isopotential curves, band-pass filtering centered at the stimulus

frequency was used to reduce noise. At each frequency, a response average with no stimulus was performed to verify that the background noise was less than 60% of the criterion response amplitude of 100 μ V.

D. Cochlear fluids manipulations

The sites of origin of cochlear responses were evaluated using an injection of isotonic KCl into perilymph at the apex to ablate sensory function progressively from apex to base. KCl solution was injected from a glass pipette coupled to a gas-tight syringe mounted on a digitally controlled pump (Ultrapump, WPI, Sarasota, FL). The pipette was sealed into the apex using established procedures that are documented elsewhere (Salt *et al.*, 2009). The mucosa covering the cochlear bone was removed at the apex, the bone was dried, and a thin layer of cyanoacrylate glue was applied that was covered with a thin layer of two-part silicone (Kwik-Cast, WPI, Sarasota, FL) to create a hydrophobic surface. A ~ 50 μ m diameter fenestration was made through the adhesives and bone at the cochlear apex, and the tip of the injection pipette was inserted into perilymph. A tissue wick was used to remove the fluid droplet accumulating at the perforation site, and a drop of cyanoacrylate was immediately applied to seal the fenestration. Injection from a pipette sealed into the cochlea causes fluid flow to be directed toward the cochlear aqueduct at the basal turn of ST, displacing perilymph through the aqueduct into the ventricles. This results in an apical-to-basal progression of KCl that progressively ablates sensory cell function. Because the cross-sectional area of ST increases from apex to base, a constant injection rate would have caused the KCl front to slow as it approached the basal turn. We therefore progressively increased flow rate, from 50 nl/min (0–10 min), 100 nl/min (10–30 min), and 200 nl/min (≥ 30 min). The movement of KCl along the cochlea with this injection protocol was calculated using our established model of the cochlear fluids (available at <http://oto.wustl.edu/cochlea/>), which takes into account scala dimensions with distance, diffusion, flow rate, and communications with adjacent compartments.

E. Cochlear microphonic waveform analysis

To interpret CM response waveforms measured from endolymph, an analysis was performed in which the saturating response of the cochlear transducer was represented by a Boltzmann function driven by input sinusoids corresponding to the probe and bias stimuli. This approach is comparable to prior studies (Patuzzi and Moleirinho, 1998; Sirjani *et al.*, 2004; Brown *et al.*, 2009). The Boltzmann function used was similar to that described by Brown *et al.* (2009):

$$V_t = V_{EP} + (-V_{sat} + 2 \cdot V_{sat} / (1 + \exp(-2 \cdot S_B / V_{sat}(P_t)))) \quad (1)$$

where V_{EP} is a DC potential representing the endocochlear potential magnitude (mV), V_{sat} is the saturation voltage of the Boltzmann curve (mV), S_B represents the slope of the Boltzmann curve at its mid-point (mV/Pa), P_t represents the input pressure (Pa) as a function of time.

Input to the function (P_t) was calculated as the sum of three independent inputs

$$P_t = P_{probe,t} + P_{bias,t} + OP,$$

where $P_{probe,t} = A_{probe} \cdot \sin(2\pi f_{probe}t + \Phi_{probe})$ represents the probe tone (Pa) and $P_{bias,t} = A_{bias}/S \cdot \sin(2\pi f_{bias}t + \Phi_{bias})$ represents the bias tone. OP represents the operating point of the transducer (Pa), defined as the pressure (i.e., the location on the Boltzmann curve) when probe and bias pressures are both zero. The variables A , f , and Φ define the amplitude, frequency and phase of the input tones respectively. S is a scale factor used to compensate for the difference in sensitivity to probe and bias tones at the specified sound pressure levels.

For some conditions, an additional sinusoidal potential at the frequency of the bias tone (f_{bias}) was summed with the Boltzmann output as shown in Eq. (2).

$$V_t = V_{EP} + (-V_{sat} + 2 \cdot V_{sat} / (1 + \exp(-2 \cdot S_B / V_{sat}(P_t)))) + V_o \cdot \sin(2\pi f_{bias}t + \Phi_{bias} + \Phi_o), \quad (2)$$

where V_o defines amplitude and Φ_o defines the phase of the potential relative to that of the bias tone Φ_{bias} . Calculated waveforms from Eqs. (1) and (2) were fitted to measured CM waveforms (5086 points) using the Solver add-in of Microsoft EXCEL. Best fit was established by minimizing the sum of squares of differences between measured and calculated waveforms.

III. RESULTS

A. Response amplitudes

Figure 1 shows an example recording from endolymph of the third turn of a guinea pig cochlea using a 5 Hz stimulus presented at 120 dB SPL. The pk/pk response amplitude was 19.1 mV—a sizable (23%) modulation of the resting EP that was 83.1 mV in this animal. The large amplitude of responses poses a scientific conundrum as 5 Hz presented at this level should be close to the subjective threshold, which we estimated earlier in Sec. I to be approximately 124 dB SPL in guinea pigs.

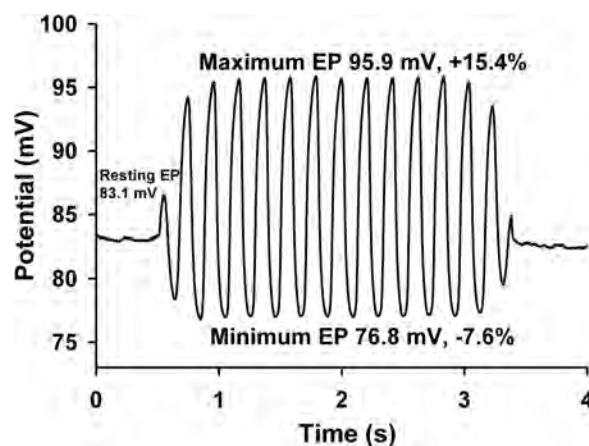


FIG. 1. Measured endolymphatic potential from cochlear turn 3 during stimulation with a single 5 Hz tone burst at 120 dB SPL. The sinusoidal potential represents a modulation of the normal (83.1 mV) endocochlear potential by over 20%.

CM response amplitudes (input/output functions) to low-frequency stimuli (5, 50, and 500 Hz) measured at four cochlear locations are summarized in Fig. 2. At each location, CM amplitudes exhibit the classic linear response with lower level stimuli and saturation with high level stimuli. In endolymph of turn 3 [Fig. 2(A)], although the response to 5 Hz at low levels (60 dB SPL, for example) was smaller than that to 50 or 500 Hz, the responses to 5 Hz at high levels did not saturate to the same degree as the higher frequencies such that the 5 Hz response was substantially larger (as indicated by the arrow). At the highest stimulus level tested (115 dB SPL) the peak amplitudes in endolymph of the third turn averaged 17.1 mV, and the largest individual responses were above 20 mV. These large responses to infrasound appear to be an apical endolymphatic phenomenon. Responses to 5 Hz were lower both in basal first turn endolymph [Fig. 2(B)] and in third turn perilymph [Fig. 2(C)]. Responses to 5 Hz were extremely small in first turn perilymph [Fig. 2(D)] and would likely be not detectable by conventional recordings from the round window membrane. The response amplitudes for infrasonic (5 Hz) stimuli in endolymph of the third turn were substantially larger than the maximum generated by tones in the normal range of audibility presented at any level.

The relative sensitivity across frequency from 5 to 1000 Hz measured as isoamplitude functions is shown in Fig. 3. In perilymph of the first and third cochlear turns, sensitivity decreased as frequency was lowered by approximately 7 and 10 dB/octave, respectively, from 500 to 50 Hz and 6 dB/octave for both turns between 50 and 5 Hz. In

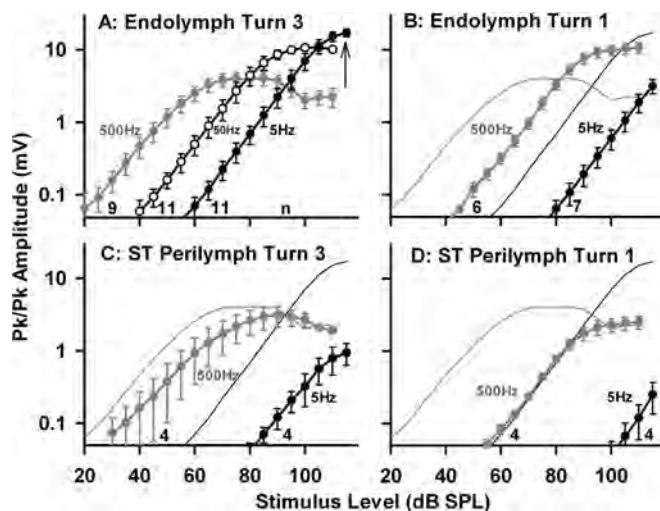


FIG. 2. Cochlear microphonic response amplitudes for 500 Hz (gray symbols), 50 Hz (open symbols), and 5 Hz (black symbols) stimulation recorded from four cochlear locations. Bars indicate s.d. Data for 50 Hz are only shown on (A) for clarity but were always intermediate between 5 and 500 Hz. Data from turn 3 endolymph are shown as thin lines on (B) through (D) for comparison. Responses from endolymph of turn 3 to 5 Hz were less sensitive than to 500 Hz at low stimulus levels but did not saturate to the same degree and markedly exceeded 500 Hz responses at high levels [indicated by the arrow on (A)]. Responses to 5 Hz were substantially lower in basal turn endolymph (B) and in third turn perilymph (C) and were almost absent from basal turn perilymph (D). At high stimulus levels, third turn endolymphatic potentials from infrasound (5 Hz, solid black symbols) were larger than for higher-frequency sounds presented at any level.

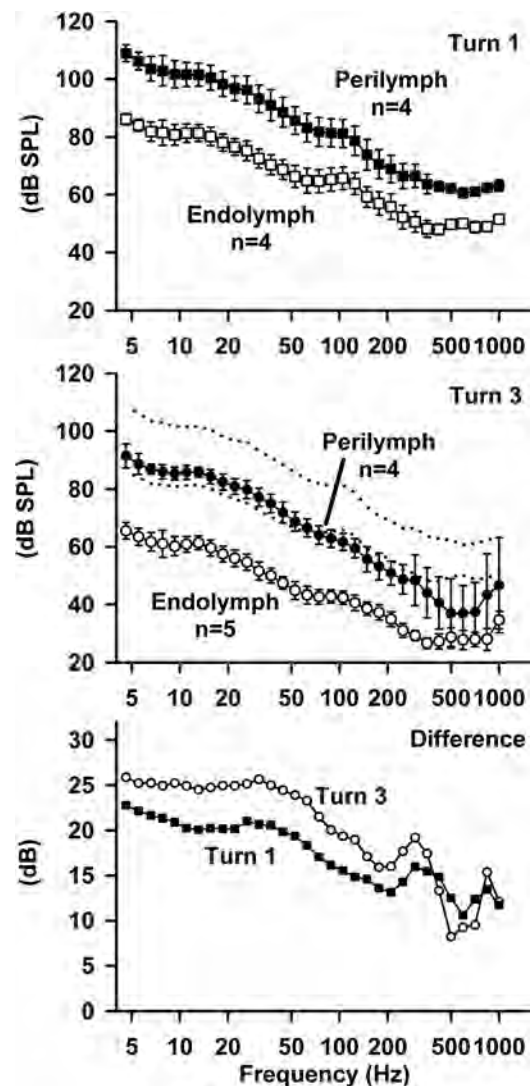


FIG. 3. Isoamplitude curves (100 μ V) measured from 5 to 1000 Hz. Bars indicate s.d. Potentials were measured from endolymph (open symbols) and scala tympani perilymph (solid symbols) in cochlear turn 1 (top panel) and turn 3 (middle panel). At all probe-tone frequencies, a lower stimulus level was needed to evoke a 100 μ V endolymphatic potential than for a perilymphatic potential. For comparison to cochlear turn 3 data, turn 1 data from the upper panel are shown as dotted lines in the middle panel (highest dotted line from perilymph and lowest dotted line from endolymph). Lower stimulus levels were needed to achieve a 100 μ V turn 3 response in both scalae compared to turn 1. Turn 3 perilymph potentials from higher frequency probes were more variable due to higher background noise levels. The lower panel shows the mean endolymph-perilymph difference for the cochlear turns 1 and 3. The difference increased as frequency is lowered.

endolymph, the decline of sensitivity as frequency was lowered was less with slopes near 5 dB/octave from 500 to 5 Hz. The difference in sensitivity between endolymph and perilymph in each turn is shown in the lower panel of Fig. 3. The difference is in the 10–15 dB range around 500 Hz but increases progressively as frequency is lowered, so that endolymph measurements are 20–25 dB more sensitive than perilymph measurements in the 5–50 Hz range. This further demonstrates that responses measured from endolymph of the third turn to very low frequencies are far more sensitive than measured at other cochlear locations.

B. Origins of the large endolymphatic potentials

The origins of the large potentials recorded in endolymph were studied by injection of isotonic KCl from a pipette sealed into the cochlear apex. Injections into the sealed cochlea at rates 50 nl/min increasing to 200 nl/min result in a progressive apical to basal elevation of K^+ in ST; this ablates sensory cell function. The calculated K^+ concentration increases at different cochlear locations, based on the injection protocol used and guinea pig cochlear dimensions, are shown in the top panel of Fig. 4. The middle panel shows changes of

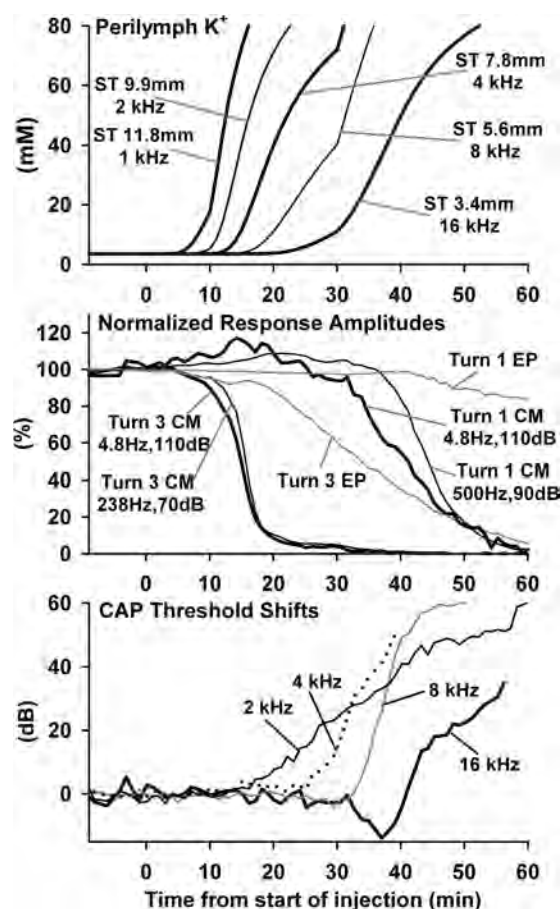


FIG. 4. Demonstration that third turn endolymphatic potentials are locally generated. Top: Calculated perilymph K^+ concentration increases at different locations along scala tympani (ST) resulting from the apical injection of KCl solution, starting at zero time. Labels indicate the distances along ST from the base in millimeters together with the best frequency of each location. The rate of injection increased with time so that the progression of KCl concentration increase occurred more uniformly even as the cross-sectional area of ST was increasing toward the base. Middle: Measured potentials from different cochlear locations repeated at 1 min intervals during the injection. All evoked potential measurements shown here were recorded in the same experiment. Responses from the third turn with 4.8 Hz, 110 dB SPL and 238 Hz, 70 dB SPL stimuli began decreasing after ~10 min while responses from turn 1 with 4.8 Hz, 110 dB SPL and 500 Hz, 90 dB SPL took much longer to decrease. The endocochlear potentials from the third and first turns declined more slowly than the sound induced responses. Bottom: Compound action potential (CAP) threshold shifts recorded at the round window at specific tone-burst frequencies as indicated. CAP thresholds increased sequentially from low to high frequencies as the KCl solution progressively moved down the cochlea with time. The 4.8 Hz response recorded from turn 3 (middle panel) was substantially reduced before the 2 kHz CAP—the lowest CAP tone-burst frequency—threshold was elevated, clearly showing that it was generated from an apical region.

EP and CM recorded from different locations, and the bottom panel shows CAP thresholds, each repeatedly measured through time during the injection in the same experiment. The CM to 4.8 and 238 Hz recorded from endolymph of turn 3 are the first responses to be affected by the injection. Around 17 min, the responses had both been reduced to less than 20% of the original amplitude—a decrease that occurred before CAP thresholds at any frequency had been affected. Responses recorded from the turn 1 electrode declined more slowly, consistent with their basal turn origins. CAP thresholds were progressively elevated in sequence from low to high frequencies, demonstrating the progressive and systematic dysfunction apex to base. EP magnitude from turns 1 and 3 declined more slowly than the sound-evoked potentials. These data, which were replicated in other experiments, demonstrate that the 5 Hz responses recorded from turn 3 endolymph have local origins in the apical regions of the cochlea.

C. Infrasound biasing studies

The existence of potentials generated locally in the third turn with amplitudes larger than the voltage at which CM saturates with higher frequency stimuli led us to consider how such large potentials could be generated by cochlear transduction. We studied this by combining a probe tone that saturated the transducer with an infrasonic bias tone that would normally generate responses of large amplitude. In previous biasing studies, the focus has typically been on how slow displacements of the sensory structures caused by bias tones influence responses to higher-frequency probe stimuli. The present study differs in that we wanted to understand the influence of probe tones on response to bias tones to study the origins in the infrasonic responses. For this purpose, we needed a probe tone to partially saturate mechanoelectric transduction to define the transducer characteristics. However, probe tones at the required levels strongly suppressed the response to infrasonic bias tones. Figure 5 shows a paradigm in which a 500 Hz probe tone was superimposed on a 4.8 Hz infrasonic bias tone. As the level of the 500 Hz tone was increased, the response to 4.8 Hz was strongly suppressed. Suppression of bias responses has been reported elsewhere (Cheatham and Dallos, 1982, 1994). The response amplitude during the 4.8 Hz-alone segment (Infra Alone) was measured as the amplitude of a 4.8 Hz sinusoid that was best fit to the CM. The response amplitudes to both the probe and bias components when both were presented simultaneously were measured by fitting the sum of a 4.8 Hz sinusoid and a 500 Hz sinusoid passed through a Boltzmann function (representing the saturating response to the probe). This allowed both bias- and probe-response amplitudes to be independently quantified, as shown in the middle panel. It is apparent that the response to the infrasonic tone in the presence of the probe [Fig. 5(B) labeled “Infra + (probe)”] was suppressed at probe levels as low as 65 dB SPL, which is well below the 80–85 dB SPL where saturation of the probe occurs [Fig. 5(B) labeled “Probe + (infra)”]. However, the suppression was caused by the saturation associated with the response to the probe as shown in Figs. 5(C) and 5(D). In Fig. 5(C), the amplitude of the response to the probe was compared with a linear, theoretical

response in which response amplitude increases by 1 dB/dB. Deviations from this line became progressively greater as the probe level increased and responses became saturated. This shows that saturation starts occurring at probe levels well below those that produce maximum response amplitude. In Fig. 5(D), the response to infrasound was multiplied by the ratio of the probe response to the theoretical line, thus scaling the infrasound response to the same extent as the probe response saturates. The calculated curve [Fig. 5(D), dark solid line] closely matched the measured reduction of infrasound responses with increasing probe level, suggesting that physiological processes associated with saturation of the probe accounted for the suppression of the infrasound response.

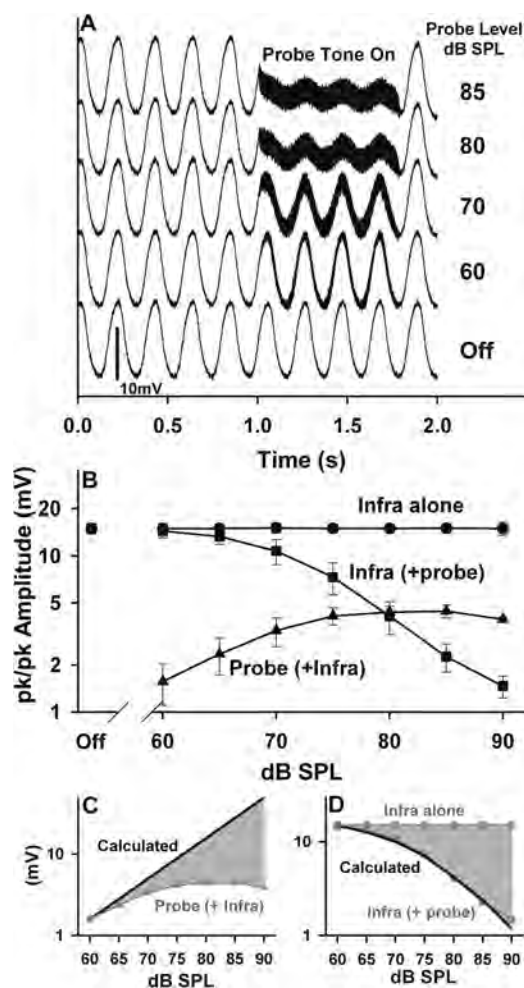


FIG. 5. (A) Influence of a 500 Hz probe tone added to an infrasonic (infra) stimulus (4.8 Hz, 110 dB SPL). Endolymphatic potentials were recorded from the third turn as a single epoch with no averaging. As the level of the probe tone increased, the response to infrasound was strongly suppressed. (B) Measured response amplitudes averaged in three animals. Bars indicate s.d. “Infra alone” indicates the amplitude of the infrasound response when presented alone. “Infra(+probe)” indicates the amplitude of the infrasound response when the probe was simultaneously on. “Probe(+infra)” indicates the amplitude of the probe response measured with the infrasound simultaneously on. (C) The measured response to the probe is compared with a linear (1 dB/dB) function. (D) The calculated curve shows the response to the infrasound tone alone corrected for the amplitude ratio of the probe relative to the calculated line from (C). The calculated curve closely fits the measured infrasound amplitude with the probe on. This demonstrates that the suppression of the infrasound response arose from probe-tone-induced changes in the mechanoelectric transducer function.

An analysis of CM responses to infrasound in the presence of probe tones therefore needed to consider the suppression of the infrasound response by the probe at levels that even partially saturated the transducer. We were primarily interested in the origins of the large infrasound responses in the absence of a probe. Responses were therefore initially measured at a constant level of infrasound as the probe tone was varied in level. dc-coupled CM measurements from endolymph of the third turn with a fixed-level infrasonic bias tone (4.8 Hz, 110 dB SPL) and varied level of 238 Hz stimulation are illustrated in Fig. 6. Responses averaged to 10 bias-tone cycles are displayed as a single bias cycle. At low probe levels, the response to 238 Hz was highly modulated but as probe level was increased the degree of modulation decreased and the amplitude of the response to the 4.8 Hz bias tone was reduced. A notable feature in these recordings is that the regions where there was most saturation of the probe tone—indicated by asterisks on the 75 dB SPL trace—did not coincide with the times of minimum or maximal potential produced by the bias. This was a consistent finding in all animals tested. This means that the greatest influence of biasing on the probe response did not coincide in time with the largest bias-induced endolymphatic potentials.

A theoretical calculation showing the output from a saturating transducer represented by a first-order Boltzmann curve [Eq. (1)] in response to combined probe-plus-bias input stimuli is shown in Fig. 7. An asymmetry between the calculated output during negative and positive bias half-cycles, as seen in the experimental data, was produced by setting the operating point to a non-zero value [indicated by the black circle on Fig. 7(B)]. The operating point represents the resting position on the curve with no stimulus present. With a Boltzmann function of this type, the maximum and minimum voltages to

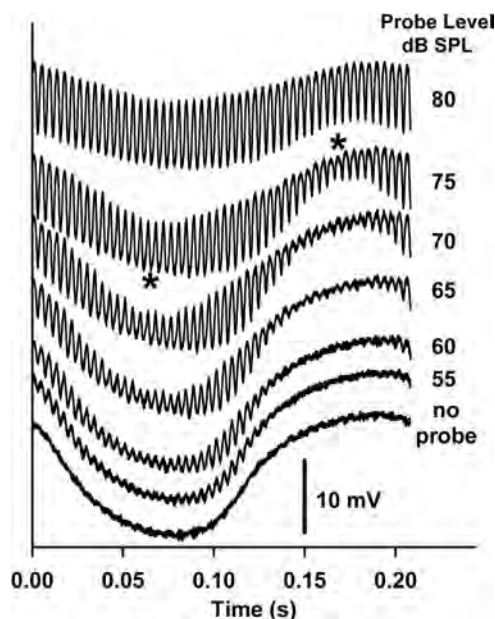


FIG. 6. Responses measured from the endolymphatic space of the third turn with a 4.8 Hz bias tone at 110 dB SPL and a 238 Hz probe tone that was varied in level. Responses are shown for a single cycle of the bias tone. As the probe level increased, the degree of modulation of the probe and the response amplitude to the bias both decreased. Additionally, the time when there was maximum saturation of the probe-tone response (asterisks) did not coincide with the times of maximum or minimum voltage generated by the bias.

the bias tone occur when the probe response is displaced at extremes of the curve and cause maximum saturation of the probe response. Single probe-tone cycles at extreme displacements are shown as dark thin lines on Fig. 7(C). This analysis did not provide a good representation of the measured responses from endolymph.

A solution that better represented the measured data was provided by a modification of the analysis in which a separate bias-generated sinusoidal potential was summed with the Boltzmann output, as represented in Eq. (2). This approach was initially justified by prior observations that tone-induced responses in endolymph could be offset by many millivolts during gel injections into the cochlear apex causing sustained displacements of the organ of Corti (Salt *et al.*, 2009). Adding a phase-delayed potential at the bias frequency to the model allowed it to closely fit the measured CM waveforms as shown in Fig. 8. Figure 8(A) shows a CM waveform (from Fig. 6; probe level 75 dB SPL). Figure 8(B) shows the measured and calculated waveforms superimposed, and Fig. 8(C) shows the calculated waveform alone. Figure 8(D) shows individual components as a function of time, and Fig. 8(E) shows the same components plotted as a function of input pressure (i.e., as a transducer function). In both of these panels, the gray curves show the Boltzmann output to the combined probe-plus-bias. Panels (D) and (E) show that in addition to modulating the probe-tone response, bias-induced displacements also produce a potential change, as previously shown by the analysis presented in Fig. 7. This can be considered as the bias moving operating point up and down the Boltzmann curve, generating the potential change V_B (i.e., the voltage predicted from the Boltzmann curve), which is shown as a dotted line on both panels. The dashed line, appearing as an ellipse in Fig. 8(E) shows the additional potential V_o from

Eq. (2), in this case delayed in phase by 40° with respect to the mechanical effects of the bias. This analysis suggests that the large low-frequency potentials recorded in endolymph may be accounted for by additional components that are not directly generated by the saturating transducer that the Boltzmann curve represents. The same analysis was not possible with data recorded from perilymph due to the far smaller 4.8 Hz response component in the measurement.

A summary of the most relevant parameters derived from the Boltzmann-plus- V_o [i.e., Eq. (2)] analysis of CM from the first and third cochlear turns are presented in Fig. 9. In the third turn, parameters were more dependent on probe level than in the basal turn due to the lower levels required to cause response saturation by the probe. The V_o component in the third turn was smaller than V_B with mean ratios varying from 0.3 (90 dB probe) to 0.7 (75 dB probe). This means that in the third turn, a potential with amplitude of approximately half that generated by the transducer's response to the bias may be present in the CM. In contrast, V_o was lower in the basal turn, but V_B was far lower there, so mean ratios varied from 0.3 (95 dB probe) to 2.4 (75 dB probe). Waveforms to the lower probe levels and to the no-probe condition were fitted by holding the parameters for the probe- and the bias-offset phase constant at values established with higher-level probes, showing that results with the bias alone were generally consistent with those at low-probe levels. In experiments where bias levels were varied holding probe tone level constant (Fig. 9, bottom row), both V_B and V_o components varied in a near-linear manner for both the apical and basal turns with ratios that were relatively uniform across bias level. The ratios were similar in the basal and third turns just by chance based on the choice of probe levels used as seen in the top panel. The slope parameter S_B is also

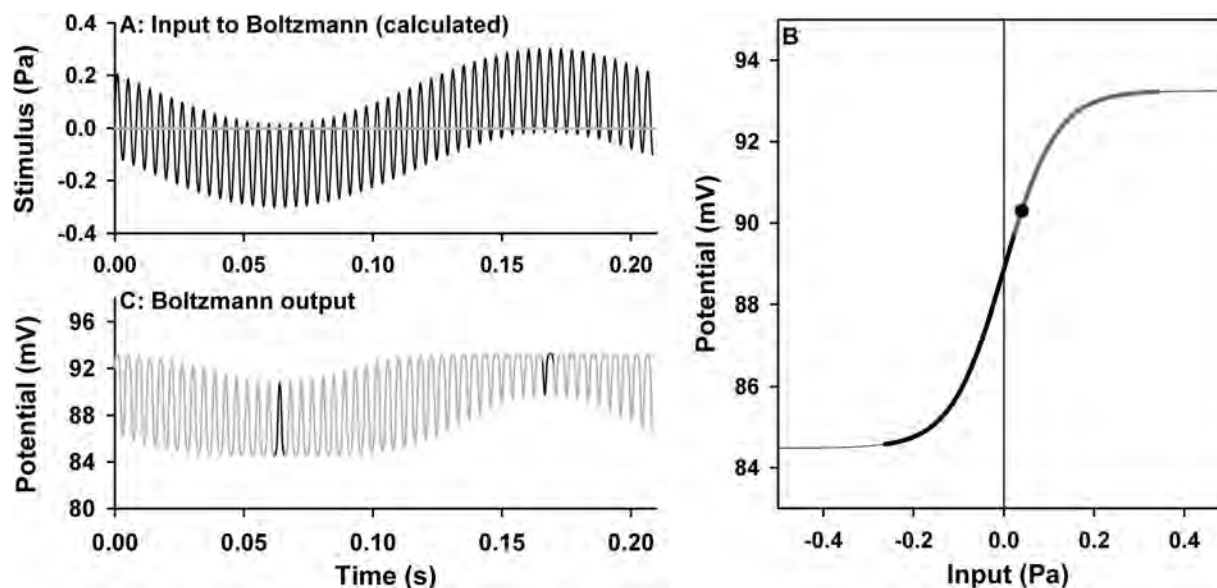


FIG. 7. (A) Combined infrasound bias plus probe stimulus combination that was the input for the calculation. The input is shown for a single cycle of the bias tone. (B) First-order Boltzmann curve relating output potential (y) to input pressure (x). A non zero operating point (black dot) is summed with the input to introduce asymmetry into the output waveform. (C) Calculated output from the Boltzmann function showing an asymmetric modulation as seen in the physiologically measured responses in Fig. 6. However, unlike the physiologically measured responses, the maximum and minimum potential from the low-frequency bias tone always coincided with the maximum degree of saturation of the probe response. This shows that a simple Boltzmann analysis cannot account for the measured response waveforms. Single cycles of the probe tone at the negative and positive limits of the bias tone are shown in (C) and are represented by the heavy gray and black lines on the curve in (B).

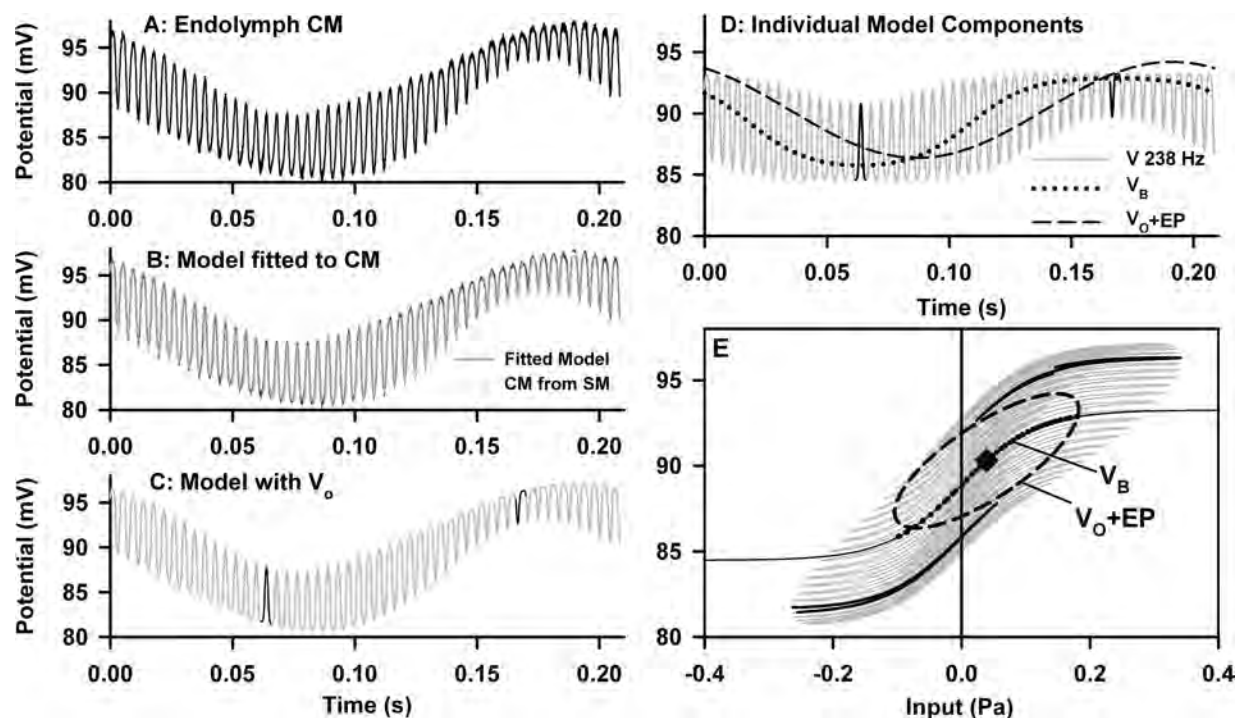


FIG. 8. Simulation in which a phase-delayed sinusoidal “offset” component (V_o) is summed with the Boltzmann output to represent the measured waveforms. (A) Physiologic data (the trace from Fig. 6 at the 75 dB probe level). (B) Calculated and measured curves overlaid showing that the analysis closely represents the measured waveform. (C) Calculated output curve with two individual cycles of the probe shown at the minimum and maximum bias pressures. (D) Components of the model, with the Boltzmann output shown in gray and the phase-delayed offset component (V_o) shown dashed. A constant voltage (the EP value at the operating point) has been added to so it can be displayed in the figure. In this example, the phase delay was -40° . The dotted line shows the output voltage change from the bias tone displacing operating point on the Boltzmann curve (V_B). (E) Input/output relationship shown as a Boltzmann curve (thin black line) with added potential $V_o + EP$ (dashed circle) that produces the overall the output waveform (gray lines). Single cycles of the probe at the minimum and maximum bias pressures are shown in black. The dotted line labeled V_B shows the voltage change caused by the bias tone displacing the operating point (black diamond) on the curve. This simulation illustrates that the salient characteristics of the physiologically measured waveforms are represented by this analysis.

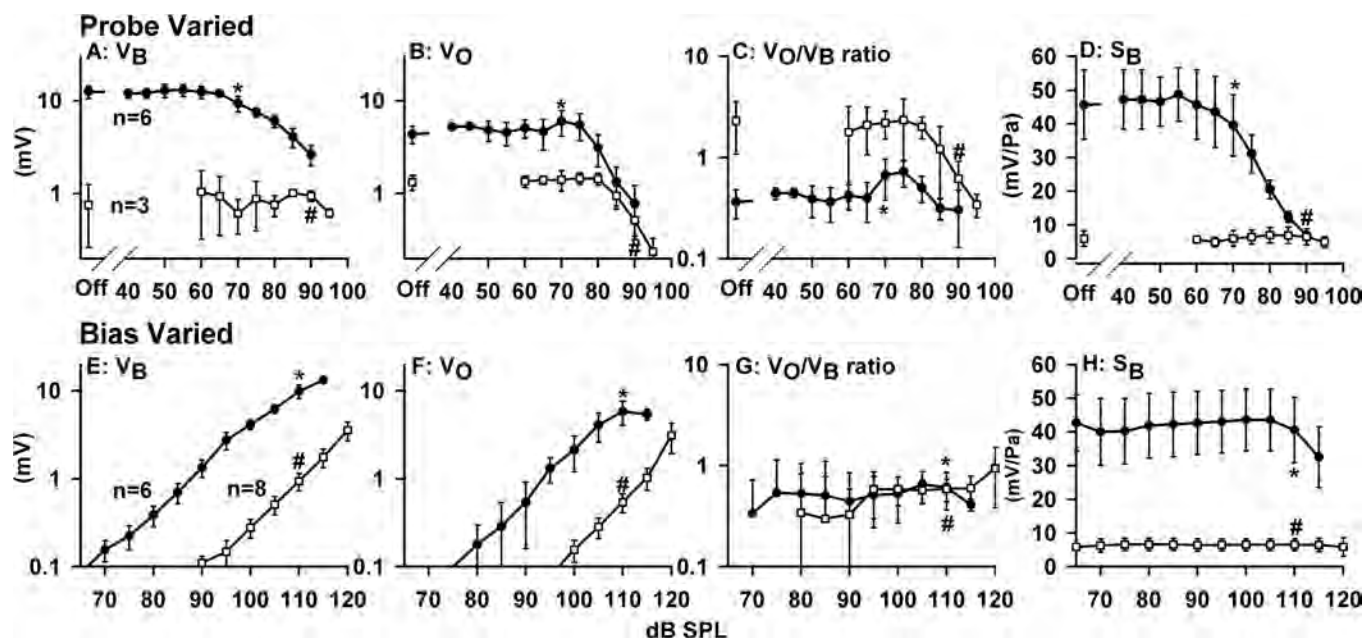


FIG. 9. Parameters derived from analysis of response waveforms recorded from the basal turn (open symbols, probe stimulus 476 Hz) and from the third turn (solid symbols, probe stimulus 238 Hz); When the probe was varied (top row), the bias level was fixed at 110 dB SPL. When the bias was varied (bottom row) the probe was set to 70 dB SPL (third turn) and 90 dB SPL (basal turn). In each row, the potential generated by the bias displacing operating point on the Boltzmann curve (V_B), the offset component (V_o) and their ratio under each condition are shown. Also shown in (D) and (H) are values of the slope parameter, S_B , that remained nearly constant for basal turn data but fell markedly as probe level was increased above 55 dB SPL for third turn data. The labels * and # represent those conditions that were replicated in both series. The number of experiments in each condition are shown on (A) and (E).

TABLE I. Average parameters derived from Boltzmann-plus- V_o waveform analysis.

| | Probe varied | | | | <i>N</i> |
|---------------|-------------------|----------------------|----------------------|----------------|----------|
| | V_o phase (deg) | Bias correction (dB) | Operating point (Pa) | P_{sat} (mV) | |
| Turn 3 | −58.2 | −33.51 | 0.007 | 5.99 | 38 |
| | SD 18.0 | SD 2.9 | SD 0.042 | SD 1.23 | |
| Turn 1 | −73.6 | −42.27 | −0.108 | 4.17 | 17 |
| | SD 16.9 | SD 2.7 | SD 0.114 | SD 0.76 | |
| Bias varied | | | | | |
| Turn 3 | −61.64 | −34.4 | −0.002 | 6.11 | 47 |
| | SD 22.0 | SD 3.3 | SD 0.02 | SD 1.31 | |
| Turn 1 | −60.68 | −41.02 | −0.007 | 4.17 | 59 |
| | SD 10.2 | SD 3.38 | SD 0.089 | SD 0.53 | |

shown to change markedly in the third turn at higher probe levels and at the highest bias levels, while it was near constant for basal-turn data. The remaining parameters that did not vary systematically with level are shown averaged in Table I. Low probe levels (with probe varied) and low-bias levels (with bias varied) were excluded from the summary. The phase of V_o with respect to V_B averaged approximately −60 deg and was relatively consistent across all animals tested. The average bias scaling factor (S) derived from the analysis, shown in Table I in decibels, was approximately −34 dB for the third turn and −42 dB for the basal turn. These factors were derived from the waveform fitting procedure based on the amount of bias-induced displacement that accounted for the waveform shape of the response to the probe. The values were also consistent across animals and were comparable to differences in sensitivity across frequency shown for the two locations in Fig. 3.

IV. DISCUSSION

This study demonstrated that infrasound elicits larger electrical potentials in the apical regions of the cochlea than those generated by any other frequencies in the range of audibility. This confirms the existence of large endolymphatic responses seen in prior studies with low-frequency stimulation from 0.1 to 10 Hz (Salt and DeMott, 1999), although in this present study with sounds delivered acoustically via the external ear canal. The apical regions of the cochlea should therefore be regarded as highly responsive to infrasound stimulation with responses occurring at stimulus levels well below the estimated level that is perceived.

The large potentials recorded from endolymph of the third turn are locally generated and are not generated at some distant site such as the saccule. This is demonstrated by the rapid loss of responses recorded from cochlear turn 3 as KCl solution was injected at the apex. Responses to infrasound undoubtedly originate from stimulation of the OHC but are enhanced in a manner that we have quantified as an additional voltage component (V_o). CM measurements can be difficult to interpret as they are vectorally summed voltages from different regions, weighted with distance from the recording site. Gross CM measures typically do not reflect cochlear amplification

because rapid frequency-dependent phase changes near the best frequency of a tone produce opposing voltages that cancel and so are not represented in the measurement (Whitfield and Ross, 1965; Cheatham and Dallos, 1982). The picture becomes simplified for CM to stimulation below the best frequency of the recording site. Phase-frequency changes are less rapid presumably because broader regions of the basilar membrane vibrate with similar phase. Phase-frequency changes are expected to be similar for infrasonic stimuli. The KCl ablation experiments (Fig. 4) show that the sites of origin of the infrasound and probe responses are similar, especially for the third turn responses. As both the infrasonic and probe stimuli are well below the best frequency of our recording site, which for the cochlear turn 3 recording site corresponds to ~1 kHz, responses likely arise from passive cochlear mechanics.

There are a limited number of mechanisms that may give rise to V_o . If V_o arose as a dc component in the bodies of the OHCs, rather than at the mechanoelectrical transducer (MET), it would be seen in the endolymph through the resistance of the MET channels and modulated by both the probe and bias accordingly. A dc component in the OHC bodies can therefore be excluded. The IHC are also an unlikely source of V_o . Cheatham and Dallos (1994) reported that IHC dc responses were only minimally affected by a 20 Hz tone presented alone. In our measures, we found the difference between endolymph and perilymph responses increased as frequency was lowered; this is not consistent with decreasing IHC sensitivity for lower frequencies. The observation that sustained displacements of the organ of Corti by gel injection at the apex yielded V_o -like potentials when velocity and IHC stimulation would be negligible also argues against an IHC origin (Salt *et al.*, 2009). If the OHC and IHC are not the source of V_o , this leads to the possibility that non-sensory tissues of the inner ear may be contributing to the endolymphatic potentials. One possibility is that when under increased or decreased current load for a long duration, as in each half-cycle of an infrasonic stimulus, ion transport processes in the lateral wall generating EP are affected. This is comparable to a high current load on a battery causing the voltage to fall and a reduction in current load causing the voltage to rise. The possibility of changes in current drawn by the hair cells altering K^+ levels in the intrastrial space, thereby causing greater EP changes was considered in a model of EP generation (Quraishi and Raphael, 2008). Indeed, the use of low-frequency or sustained displacements of the organ of Corti to change potential in endolymph may provide a tool to evaluate the current generation capacity of stria vascularis, analogous to testing a battery by applying a high current load. This putative mechanism accounts for both the data presented here and for the large EP changes when the organ of Corti was displaced by gel injections into the apex (Salt *et al.*, 2009). Nevertheless, there may be alternative explanations if other stimulation modes of either IHCs or OHCs occur at infrasonic frequencies (Nowotny and Gummer, 2006; Guinan, 2012) or if significant potential can be generated by ion transport at other loci in the endolymphatic boundary.

The saturation, and subsequent decline, of CM growth functions with stimulus level increases (Fig. 2) has been

well-documented in classical studies although the mechanism underlying the phenomenon has not been well-described. The saturation is partly accounted for by the response characteristic of OHC that is sigmoidal and saturating with sinusoidal input. The limits of the saturating characteristics to extreme displacements represent all-channels-open and all-channels-closed—saturated states but do not explain the subsequent response decline as stimulus levels are further increased. In our analysis of waveforms, the saturating response characteristic of the Boltzmann curve is taken into account, and amplitude changes that are not accounted for by saturation are represented in the slope parameter S_B . In the fixed-bias-plus-varying-probe paradigm with low-level 238 Hz probe stimuli, S_B for third turn measurements averaged ~ 48 mV/Pa but declined progressively for probe levels of 60 dB and higher [Fig. 8(D)]. In contrast, in the fixed-probe-plus-varying-bias paradigm S_B was quite insensitive to the infrasonic bias level, declining only at the highest probe levels [Fig. 8(H)]. This leads us to conclude that in the absence of a probe stimulus, the endolymphatic potential in response to infrasound remains large and does not saturate because the sensitivity S_B remains high. In contrast, when a high level probe is added, S_B is reduced, which influences response amplitudes from both the probe and the bias tones. This is reflected in the suppression of the bias tone in Fig. 5 as the probe tone level is increased with the decline in bias response being accounted for by the reduction in sensitivity caused by the probe. S_B may be reduced by mechanical or electrical influences. Cooper and Rhode (1995) reported substantial two-tone suppression on the low-frequency side of the best frequency in apical mechanical measures in their study that focused quantifying the effects of a low-frequency bias tone on a higher-frequency probe rather than the effects of higher frequencies on the low-frequency bias response. In our study, one can think of this effect as the sensitivity to infrasound stimulation being maximal unless frequencies within the range of audibility are present at sufficient level to decrease the sensitivity of the *in vivo* transducer.

The endolymphatic potentials evoked by infrasound that we reported here were made through dc-coupled instrumentation and would not be detected with extracochlear recordings, such as from an electrode near the round window membrane. The response magnitude from perilymphatic sites was shown to be substantially lower and the high-pass filtering and ac coupling typically employed in extracochlear recordings would attenuate the responses further.

The EP plays a pivotal role as the battery for cochlear transduction, providing a substantial part of the electrochemical voltage driving current through the transduction channels of the hair cells. Small EP changes have been shown to substantially influence auditory sensitivity at high frequencies. A classic study by Sewell (1984) found that auditory sensitivity in cats was elevated by ~ 1 dB for every ~ 1 mV decrease in EP. Schmiedt *et al.* (2002) found a similar relationship in aged and furosemide-treated gerbil cochleae although they found far less dependence of low-frequency sensitivity on EP in higher turns that they attributed to there being less cochlear amplifier gain for low-frequency sounds. The EP changes we observed with infrasound would be expected to modulate

cochlear amplifier gain for tones at their best frequency region, which would be perceived as an amplitude modulation of the tone. Biasing studies suggest the IHC respond to extracellular potentials generated by very low-frequency tones presented at high levels (Cheatham and Dallos, 1997), but the degree of sensitivity of IHC to EP and other extracellular responses to infrasonic tones (i.e., the infrasound levels at which IHC stimulation occurs) remains unknown. Objective physiologic measures of responses to low-frequency and infrasonic stimulation are not readily available. CAPs utilize onset synchrony are not sensitive indicators of low-frequency neural function but new methods, utilizing phase synchrony of low-characteristic frequency single-auditory-nerve-fibers, are becoming available to quantify apical function (Lichtenhan *et al.*, 2012). These new techniques will allow infrasound-induced modulation of neural function to be measured and compared with EP changes.

We previously estimated that with low-frequency stimulation the OHC can respond at levels as low as 40 dB below the sensitivity of the IHC; i.e., 40 dB below the threshold of hearing (Salt and Hullar, 2010). Based on the measurements in the current study, the 40 dB figure could have been an underestimate because here we have found that the apical regions of the ear are more sensitive to infrasound than we previously appreciated. We found responses to infrasound levels as low as 60–65 dB SPL (Figs. 2 and 3), in part due to the enhancement of infrasonic responses in the endolymphatic space relative to the perilymphatic space. Comparing endolymphatic potentials with hearing thresholds in guinea pigs requires consideration of the experimental conditions under which they are made. The measures were made with the auditory bulla open, the effects of which are shown to be uniform across frequency below 300 Hz but increase sensitivity by 10–15 dB (Manley and Johnstone, 1974; Wilson and Johnstone, 1975). When frequency-dependent sensitivity is considered, we would estimate that free field stimulation of 70–80 dB SPL (i.e., 44–54 dB below hearing threshold) is stimulating the cochlear apical regions of the guinea pig to a degree where a 100 μ V response amplitude is generated. If the human cochlea is about 15 dB more sensitive than the guinea pig, we estimate that apical regions of the human could be stimulated with 5 Hz stimulation at 55–65 dB SPL, which corresponds to -38 to -28 dBA. This estimate awaits some form of direct experimental confirmation in humans.

There is currently intense debate over whether infrasound exposure can influence human health. As wind turbines have become larger in recent years, they generate higher levels of low-frequency noise and infrasound (Møller and Pedersen, 2011). Some people who live near wind turbines report being sickened with symptoms that resolve when they move away. The wind industry generally dismisses such reports on basis that humans cannot be affected by sounds that are not heard. The present studies show that the cochlear apex is highly sensitive to low-frequency stimulation. The potentials we observed are initiated by the OHC and enhanced in the endolymphatic space by additional mechanisms, making them larger than responses to stimuli within the range of audibility. The degree of IHC stimulation caused by the changes in endolymphatic potentials remains uncertain. A scientific conundrum remains

over why the cochlea would transduce such sounds and generate large potentials and then discard this information from conscious hearing. The answer may be that the majority of low-frequency sound is unwanted noise, such as from respiration, heartbeat, head movements, etc. There may be mechanisms present both to transduce the sound and then cancel it from conscious hearing (analogous to a noise-canceling headphone). Neural pathways exist from the OHC to the cochlear nucleus, which are potentially inhibitory to hearing (Kaltenbach and Godfrey, 2008) and could suppress perception of responses mediated by the IHC. Although there is clearly a need to understand how the ear responds to low-frequency sounds in more detail and how it affects the body as a whole, the present study confirms that the inner ear is highly sensitive to infrasonic and low-frequency stimulation. It seems unreasonable to believe that infrasound cannot influence the animal or person when it generates such large endolymphatic potentials.

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COUNTY OF
IMPERIAL

DEPARTMENT OF
PUBLIC WORKS

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Public Works works for the Public



May 27, 2014

Mr. Jim Minnick, Interim Director
Planning & Development Services Department
801 Main Street
El Centro, CA 92243

RECEIVED

MAY 27 2014

PLANNING & DEVELOPMENT SERVICES

Attention: Patricia Valenzuela, Planner IV

SUBJECT: Conditional Use Permit #13-0056; Iris Cluster Solar Farm (Lyon) 2 miles west of the City of Calexico

Dear Mr. Minnick:

This letter is in response to your copy of Conditional Use Permit package received on May 5, 2014 for the above-mentioned permit. The project proposes to build a solar farm.

Department staff has reviewed the package information and the following comments shall be Conditions of Approval:

SURVEY:

1. Kubler Road is classified as Minor Collector – Local Collector, two (2) lanes, requiring seventy (70) feet of right of way, being thirty-five (35) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**
2. A Transportation Permit shall be required from road agency(s) having jurisdiction over the haul route(s) for any hauls of heavy equipment and large vehicles which impose greater than legal loads on riding surfaces, including bridges. **(Per Imperial County Code of Ordinances, Chapter 12.10.020 B).**
3. The applicant for Encroachment Permits in County Roads and Right of Way is responsible for researching, protecting, and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted.
4. The applicant for grading plans and/or improvement plans is responsible for researching, protecting and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted by the project whether it be on-site or off-site.

5. The applicant shall be required to obtain easements for any permanent overhead or underground electrical crossings that service their project that cross ICROW maintained roadways. The electrical easements shall terminate at that time the CUP expires.

CONSTRUCTION ENGINEERING:

6. If a temporary certificate of occupancy (C of O) is requested, the applicant shall provide grading certification letters (or as Built Plans) from the project's Engineer of Record prior to issuance of each temporary C of O.
7. As-Built Plans shall be required prior to ICPWD signing the final Certificate of Occupancy letter.
8. Prior to construction a routing plan shall be provided which indicates the ingress and egress from the project site. The routing plan shall make a distinction between paved and unpaved roads which will be used to access the site. In the event public unpaved roads are utilized the applicant shall provide improvements to said unpaved roads to mitigate PM10 impacts. Improvements shall be in accordance with the Air Pollution Control Districts rules governing unpaved roadways and ICPWD design standards.
9. Ingress and egress over Imperial Irrigation District (IID) canal and drainage facilities may require additional structural improvement depending upon the applicant's loading requirements. In the event the IID requires additional structural improvements over their facilities, the applicant shall provide securities to the County of Imperial to ensure compliance with IID's standards.

TRAFFIC ENGINEERING:

10. A traffic study was not provided for consideration for the project. Prior to issuance of building permits and ICDPW encroachment permits a traffic study shall be provided to ICDPW by a registered traffic engineer for the project for review and approval. The study shall be in accordance with ICDPW traffic study and report policy dated 2007.

DESIGN ENGINEERING:

11. The applicant shall furnish a Drainage and Grading Plan/Study, with associated fees, to provide for property grading and drainage control, which shall also include prevention of sedimentation of damage to off-site properties. The Study/Plan shall be submitted to the Department of Public Works, with associated fees, for review and approval. The applicant shall implement the approved plan. Employment of the appropriate Best Management Practices (BMP's) shall be included. **(Per Imperial County Code of Ordinances, Chapter 12.10.020 B).**
12. The Applicant shall retain a professional civil engineer to survey and evaluate the condition of roads along the proposed haul routes prior to commencing construction. The

pre-construction conditions shall be documented for each roadway with photo and text description. Video of haul routes may also be used to document pre-construction conditions. The photographs and/or videos are to include documentation of bridges and other appurtenances such as signs, striping, drainage, and other utilities as determined in consultation with the County. The Applicant shall submit the completed report to the Imperial County Department of Public Works for review and comment.

13. The Applicant shall be responsible for maintaining acceptable pavement conditions during and immediately after construction as specified by ICDPW for roadways identified as the project's main hauling routes. Special consideration shall be given to Ferrell Road, Weed Road, Brockman Road, and Kubler Roads.

GENERAL INFORMATIVE:

- As this project proceeds through the planning and the approval process, additional comments and/or requirements may apply as more information is received

Should you have any questions, please do not hesitate to contact this office. Thank you for the opportunity to review and comment on this project.

Respectfully,



William S. Brunet, PE
Director of Public Works

dm

RECEIVED

MAY 27 2014

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES



COUNTY OF
IMPERIAL

DEPARTMENT OF
PUBLIC WORKS

155 S. 11th Street
El Centro, CA
92243

Tel: (760) 482-4462
Fax: (760) 352-1272

Public Works works for the Public



May 27, 2014

Mr. Jim Minnick, Interim Director
Planning & Development Services Department
801 Main Street
El Centro, CA 92243

Attention: Patricia Valenzuela, Planner IV

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MAY 27 2014

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

SUBJECT: Conditional Use Permit #13-0057; Iris Cluster Solar Farm (Rockwood) 2 miles west of the City of Calexico.

Dear Mr. Minnick:

This letter is in response to your copy of Conditional Use Permit package received on May 5, 2014 for the above-mentioned permit. The project proposes to build a solar farm.

Department staff has reviewed the package information and the following comments shall be Conditions of Approval:

SURVEY:

1. Kubler Road is classified as Minor Collector – Local Collector, two (2) lanes, requiring seventy (70) feet of right of way, being thirty-five (35) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**
2. Corda Road and George Road are classified as Local Roads, requiring sixty (60) feet of right of way, being thirty (30) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**
3. A Transportation Permit shall be required from road agency(s) having jurisdiction over the haul route(s) for any hauls of heavy equipment and large vehicles which impose greater than legal loads on riding surfaces, including bridges. **(Per Imperial County Code of Ordinances, Chapter 12.10.020 B).**
4. The applicant for Encroachment Permits in County Roads and Right of Way is responsible for researching, protecting, and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted.
5. The applicant for grading plans and/or improvement plans is responsible for researching, protecting and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted by the project whether it be on-site or off-site.

6. The applicant shall be required to obtain easements for any permanent overhead or underground electrical crossings that service their project that cross ICDPW maintained roadways. The electrical easements shall terminate at that time the CUP expires.

CONSTRUCTION ENGINEERING:

7. If a temporary certificate of occupancy (C of O) is requested, the applicant shall provide grading certification letters (or as Built Plans) from the project's Engineer of Record prior to issuance of each temporary C of O. As-Built Plans shall be required prior to ICPWD signing the final Certificate of Occupancy letter prior to construction a routing plan shall be provided which indicates the ingress and egress from the project site. The routing plan shall make a distinction between paved and unpaved roads which will be used to access the site. In the event public unpaved roads are utilized the applicant shall provide improvements to said unpaved roads to mitigate PM10 impacts. Improvements shall be in accordance with the Air Pollution Control Districts rules governing unpaved roadways and ICPWD design standards. Ingress and egress over Imperial Irrigation District (IID) canal and drainage facilities may require additional structural improvement depending upon the applicant's loading requirements. In the event the IID requires additional structural improvements over their facilities, the applicant shall provide securities to the County of Imperial to ensure compliance with IID's standards.

TRAFFIC ENGINEERING:

8. A traffic study was not provided for consideration for the project. Prior to issuance of building permits and ICDPW encroachment permits a traffic study shall be provided to ICDPW by a registered traffic engineer for the project for review and approval. The study shall be in accordance with ICDPW traffic study and report policy dated 2007.

DESIGN ENGINEERING:

9. The applicant shall furnish a Drainage and Grading Plan/Study, with associated fees, to provide for property grading and drainage control, which shall also include prevention of sedimentation of damage to off-site properties. The Study/Plan shall be submitted to the Department of Public Works, with associated fees, for review and approval. The applicant shall implement the approved plan. Employment of the appropriate Best Management Practices (BMP's) shall be included. **(Per Imperial County Code of Ordinances, Chapter 12.10.020 B).**
10. The Applicant shall retain a professional civil engineer to survey and evaluate the condition of roads along the proposed haul routes prior to commencing construction. The pre-construction conditions shall be documented for each roadway with photo and text description. Video of haul routes may also be used to document pre-construction conditions. The photographs and/or videos are to include documentation of bridges and other appurtenances such as signs, striping, drainage, and other utilities as determined in consultation with the County. The Applicant shall submit the completed report to the Imperial County Department of Public Works for review and comment.
11. The Applicant shall be responsible for maintaining acceptable pavement conditions during and immediately after construction as specified by ICDPW for roadways identified as the

project's main hauling routes. Special consideration shall be given to Ferrell Road, Weed Road, Brockman Road, and Kubler Roads.

GENERAL INFORMATIVE:

- As this project proceeds through the planning and approval process, additional comments / *Requirements may apply as more information is received*

Should you have any questions, please do not hesitate to contact this office. Thank you for the opportunity to review and comment on this project.

Respectfully,



William S. Brunet, PE
Director of Public Works

RECEIVED

MAY 27 2014

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES



COUNTY OF
IMPERIAL

DEPARTMENT OF
PUBLIC WORKS

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Public Works works for the Public



May 27, 2014

Mr. Jim Minnick, Interim Director
Planning & Development Services Department
801 Main Street
El Centro, CA 92243

Attention: Patricia Valenzuela, Planner IV

RECEIVED

MAY 27 2014

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

SUBJECT: Conditional Use Permit #13-0054; Iris Cluster Solar Farm (Ferrell) 2 miles west of the City of Calexico.

Dear Mr. Minnick:

This letter is in response to your copy of Conditional Use Permit package received on May 5, 2014 for the above-mentioned permit. The project proposes to build a solar farm.

Department staff has reviewed the package information and the following comments shall be Conditions of Approval:

SURVEY:

1. Ferrell Road is classified as Major Collector – Collector, four (4) lanes, requiring eighty-four (84) feet of right of way, being forty-two (42) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**
2. Kubler Road is classified as Minor Collector – Local Collector, two (2) lanes, requiring seventy (70) feet of right of way, being thirty-five (35) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**
3. The applicant for Encroachment Permits in County Roads and Right of Way is responsible for researching, protecting, and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted.
4. The applicant for grading plans and/or improvement plans is responsible for researching, protecting and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted by the project whether it be on-site or off-site.

5. A Transportation Permit shall be required from road agency(s) having jurisdiction over the haul route(s) for any hauls of heavy equipment and large vehicles which impose greater than legal loads on riding surfaces, including bridges. **(Per Imperial County Code of Ordinances, Chapter 12.10.020 B).**
6. The applicant shall be required to obtain easements for any permanent overhead or underground electrical crossings that service their project that cross ICDPW maintained roadways. The electrical easements shall terminate at that time the CUP expires.

CONSTRUCTION ENGINEERING:

7. If a temporary certificate of occupancy (C of O) is requested, the applicant shall provide grading certification letters (or as Built Plans) from the project's Engineer of Record prior to issuance of each temporary C of O.
8. As-Built Plans shall be required prior to ICPWD signing the final Certificate of Occupancy letter.
9. Prior to construction a routing plan shall be provided which indicates the ingress and egress from the project site. The routing plan shall make a distinction between paved and unpaved roads which will be used to access the site. In the event public unpaved roads are utilized the applicant shall provide improvements to said unpaved roads to mitigate PM10 impacts. Improvements shall be in accordance with the Air Pollution Control Districts rules governing unpaved roadways and ICPWD design standards.
10. Ingress and egress over Imperial Irrigation District (IID) canal and drainage facilities may require additional structural improvement depending upon the applicant's loading requirements. In the event the IID requires additional structural improvements over their facilities, the applicant shall provide securities to the County of Imperial to ensure compliance with IID's standards.

TRAFFIC ENGINEERING:

11. A traffic study was not provided for consideration for the project. Prior to issuance of building permits and ICDPW encroachment permits a traffic study shall be provided to ICDPW by a registered traffic engineer for the project for review and approval. The study shall be in accordance with ICDPW traffic study and report policy dated 2007.

DESIGN ENGINEERING:

12. The applicant shall furnish a Drainage and Grading Plan/Study, with associated fees, to provide for property grading and drainage control, which shall also include prevention of sedimentation of damage to off-site properties. The Study/Plan shall be submitted to the Department of Public Works, with associated fees, for review and approval. The applicant shall implement the approved plan. Employment of the appropriate Best Management Practices (BMP's) shall be included. **(Per Imperial County Code of Ordinances, Chapter 12.10.020 B).**

13. The Applicant shall retain a professional civil engineer to survey and evaluate the condition of roads along the proposed haul routes prior to commencing construction. The pre-construction conditions shall be documented for each roadway with photo and text description. Video of haul routes may also be used to document pre-construction conditions. The photographs and/or videos are to include documentation of bridges and other appurtenances such as signs, striping, drainage, and other utilities as determined in consultation with the County. The Applicant shall submit the completed report to the Imperial County Department of Public Works for review and comment.
14. The Applicant shall be responsible for maintaining acceptable pavement conditions during and immediately after construction as specified by ICDPW for roadways identified as the project's main hauling routes. Special consideration shall be given to Ferrell Road, Weed Road, Brockman Road, and Kubler Roads.

GENERAL INFORMATIVE:

- As this project proceeds through the planning and the approval process, additional comments and/or requirements may apply as more information is received

Should you have any questions, please do not hesitate to contact this office. Thank you for the opportunity to review and comment on this project.

Respectfully,



William S. Brunet, PE
Director of Public Works

ga/dm

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MAY 27 2014
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES



COUNTY OF
IMPERIAL

DEPARTMENT OF
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155 S. 11th Street
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Public Works works for the Public



May 27, 2014

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MAY 27 2014

PLANNING & DEVELOPMENT SERVICES

Mr. Jim Minnick, Interim Director
Planning & Development Services Department
801 Main Street
El Centro, CA 92243

Attention: Patricia Valenzuela, Planner IV

SUBJECT: Conditional Use Permit #13-0055; Iris Cluster Solar Farm (Iris) 2 miles west of the City of Calexico.

Dear Mr. Minnick:

This letter is in response to your copy of Conditional Use Permit package received on May 5, 2014 for the above-mentioned permit. The project proposes to build a solar farm.

Department staff has reviewed the package information and the following comments shall be Conditions of Approval:

SURVEY:

1. Weed Road is classified as Local Roads, requiring sixty (60) feet of right of way, being thirty (30) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plant of the General Plan).**
2. Ferrell Road is classified as Major Collector – Collector, four (4) lanes, requiring eighty-four (84) feet of right of way, being forty-two (42) feet from existing centerline. It is required that sufficient right-of-way be provided to meet this road classification. **(As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**
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5. The applicant for grading plans and/or improvement plans is responsible for researching, protecting and preserving survey monuments per the Professional Land Surveyor's Act (8771 (b)). This shall include a copy of the referenced survey map and tie card(s) (if applicable) for all monuments that may be impacted by the project whether it be on-site or off-site.
6. The applicant shall be required to obtain easements for any permanent overhead or underground electrical crossings that service their project that cross ICDPW maintained roadways. The electrical easements shall terminate at that time the CUP expires.

CONSTRUCTION ENGINEERING:

7. If a temporary certificate of occupancy (C of O) is requested, the applicant shall provide grading certification letters (or as Built Plans) from the project's Engineer of Record prior to issuance of each temporary C of O.
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TRAFFIC ENGINEERING:

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Management Practices (BMP's) shall be included. (Per Imperial County Code of Ordinances, Chapter 12.10.020 B).

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14. The Applicant shall be responsible for maintaining acceptable pavement conditions during and immediately after construction as specified by ICDPW for roadways identified as the project's main hauling routes. Special consideration shall be given to Ferrell Road, Weed Road, Brockman Road, and Kubler Roads.

GENERAL INFORMATIVE:

- As this project proceeds through the planning and the approval process, additional comments and/or requirements may apply as more information is received

Should you have any questions, please do not hesitate to contact this office. Thank you for the opportunity to review and comment on this project.

Respectfully,



William S. Brunet, PE
Director of Public Works

ga/dm

RECEIVED
MAY 27 2014
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

May 27, 2014

Via Electronic and U.S. Mail

Patricia Valenzuela
Imperial County Planning &
Development Services Department
801 Main Street
El Centro, California 92243

Email: patriciavalenzuela@imperialcounty.net

RECEIVED

MAY 28 2014

**IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES**

**Re: Comments on Notice of Preparation of Draft Environmental Impact Report
to evaluate the impacts of the Iris Cluster Solar Farm Project**

Dear Ms. Valenzuela:

The Iris Cluster Solar project consists of the construction of four utility scale photovoltaic solar facilities on four non-contiguous sites (Ferrell, Rockwood, Iris and Lyons Solar Projects) encompassing approximately 1,422 acres of land. This project, while defined as an independent project, is one portion of a larger group of photovoltaic projects to be constructed upon existing farm land within the southwestern corner of the Imperial Irrigation District that will rely upon the exportation of power through SDG&E's Sunrise Powerlink. In order to inform the public of the cumulative impacts of this project and other associated projects proposed in the area, the EIR should provide for the comprehensive analysis of environmental impacts on a collective basis.

The EIR should also identify and describe any prior environmental studies that have been performed of the proposed large scale development of solar facilities within this portion of Imperial County upon which this project may be tiered.

As an owner of lands within the vicinity of the project area, I have the following specific concerns.

Impacts to Existing Agricultural Lands

The conversion of agricultural lands to solar farms will alter the existing climate within the area of development and at adjoining properties with respect to both ground temperature and humidity. The EIR should provide a detailed analysis of the cumulative impact of this project and other photovoltaic projects in the area in this regards. The current irrigation of agricultural lands in the project area has the effect of reducing ground surface temperatures and increasing humidity levels during most months of the year. The removal these lands from agricultural production will result in general temperature increases and reduced humidity. In addition, the installation of large scale

photovoltaic projects in and of themselves is known to raise ambient temperatures by as much as 3.4° Fahrenheit (Fthenakis V. and Yu Y., *Analysis of the Potential for a Heat Island Effect in Large Solar Farms* 39th IEEE Photovoltaic Specialists Conference, Tampa, Fl., June 17-23, 2013). The EIR should quantify the combined effects of these mechanisms, identify impacts to agricultural lands resulting therefrom, and provide for appropriate mitigation.

Air Quality Impacts

The EIR should address air quality impacts both during construction and during operation. Previous environmental assessments of air quality impacts from solar facility developments within the County typically assume few if any impacts during project operation contrary to experience at existing projects. The lack of ground cover on solar project lands which have been disturbed poses an air quality threat to receptors downwind if not appropriately mitigated. The EIR should incorporate the latest findings concerning air quality impacts from similar projects within Imperial County and recommend appropriate mitigation measures to eliminate those impacts.

Impacts Resulting from Reflection and Glare

The EIR should provide a detailed analysis as to impacts resulting from reflection and glare from the photovoltaic facilities especially during early morning and late afternoon hours. These impacts should include both physical impacts to adjoining properties as well as visual impacts to more distant lands. Reflection and glare from solar farms generally have a negative impact on the value of surrounding lands and appropriate mitigation measures should be incorporated into the project to mitigate adverse visual impacts. This is especially appropriate to the extent that the project lands are zoned for agricultural uses as opposed to industrial uses which would be a more appropriate designation for these types of projects.

Alternatives to the Project

The EIR should discuss alternatives to this project including the relocation of the project to lands not presently dedicated to agriculture. The relocation of the project to undeveloped lands would reduce potential adverse impacts to developed lands within the project area as well as provide for the continued economic benefit of the existing agricultural land uses. Alternatively, the relocation of the project to lower value or less productive agricultural lands should be considered. Agricultural lands within this portion of the County are generally of higher quality as compared to many other areas in the County such as near Calipatria.

Critical to the development of a reasonable range of alternatives is a clear statement as to the objectives of the project. The statement should include the underlying purpose of the project upon which alternatives may be established. *"An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially*

Patricia Valenzuela
May 27, 2014
Page 3 of 3

lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives" (CEQA Guidelines 15126.6(a)).

Thank you for the consideration of these comments.

Best regards,

A handwritten signature in dark ink, appearing to read "Michael Abatti", written in a cursive style.

Michael Abatti
El Centro, California

COMMENTS PREPARED FOR THE IMPERIAL COUNTY AIRPORT LAND USE PUBLIC HEARING ON

WED. July 16, 2014

SUBMITTED BY CAROLYN ALLEN ON BEHALF OF MYSELF AND BACKCOUNTRY AGAINST DUMPS

WED. July 16, 2014

Please DENY THE VARIANCE # 14-0003 for the Iris Cluster proposed solar facilities with 4 CUPs (Iris, Lyons, Rockwood and Ferrell Solar) . There are many reasons for concern regarding these industrial solar projects. Here are just a few of those reasons:

- 1) GLARE & GLINT --- The solar cluster poses danger to crop dusters, military flights, private planes and any other type of aircraft due to glare and glint issues. Developers often claim there is no glare or glint but when I've seen pictures of solar installations or when getting an elevated view of a solar field , there is often evidence of glare and glint
- 2) Height issues pose dangers to aviation and wildlife as well.
- 3) LOSS OF AG PRODUCTION----Loss of farmland due to industrialization, loss of long term ag jobs , potential damage to surrounding fields. If crop dusters refuse to treat fields surrounding solar facilities because of the dangers they pose , the farmers could suffer .
- 4) EMF, DIRTY ELECTRICITY and other related electrical issues created by large scale industrial solar projects and the accompanying transmission infrastructure could cause health problems for the public.
- 5) AIR QUALITY & VISIBILITY -----These projects could have an adverse impact on air quality and visibility especially during construction. There has been reports of this problem on other southend solar sites. Poorer air quality and visibility could pose danger to pilots.
- 6) BACKUP ENERGY----- Every solar project that is approved will require additional backup energy. This will mean even more transmission and infrastructure will need to be built to handle the backup energy. These new power structures also will pose danger to pilots.
- 7) CUMULATIVE IMPACTS-----Your Board needs to take into consideration how air traffic will be impacted not just by the Iris Cluster but also the total impacts by existing and proposed development .

Once again, I respectfully implore you to DENY the Variance for Iris Cluster.

Carolyn Allen P.O. Box 301 Brawley, CA 92227

DATE: 7-16-14

TO: IMPERIAL COUNTY AIRPORT LAND USE COMMISSION

FROM: Donna Tisdale & Backcountry Against Dumps; PO Box 1275, Boulevard, CA 91905; 619-766-4170;
tisdale.donna@gmail.com

RE: IRIS CLUSTER SOLAR VARIANCE #14-0003 IS PREMATURE – NO DRAFT EIR DOCUMENT OR OTHER PROJECT DOCUMENTS /MAPS ARE YET AVAILABLE TO THE PUBLIC FOR REVIEW

These public comments are being submitted under my name as an individual; an Imperial County Native and owner of Imperial County farm land with active farming interests; and on behalf of the non-profit group Backcountry Against Dumps.

The “project” reportedly consists of portions of 10 parcels totaling 1,425 acres of west of Calexico including prime farm land, farm land of state wide importance, and Williamson Act land. A variance of the 120 foot height limit to allow for 140 foot tall structures is on today’s agenda.

OMISSIONS/ LACK OF PUBLICLY AVAILABLE PROJECT INFORMATION:

As of today, the County’s website did not appear to include any of the following documents that are necessary for informed decisions by your commission, by other boards and commissions, and by the public. They were not posted where the public would expect to find them with the Commission agenda or on the County’s Planning and Development Services site:

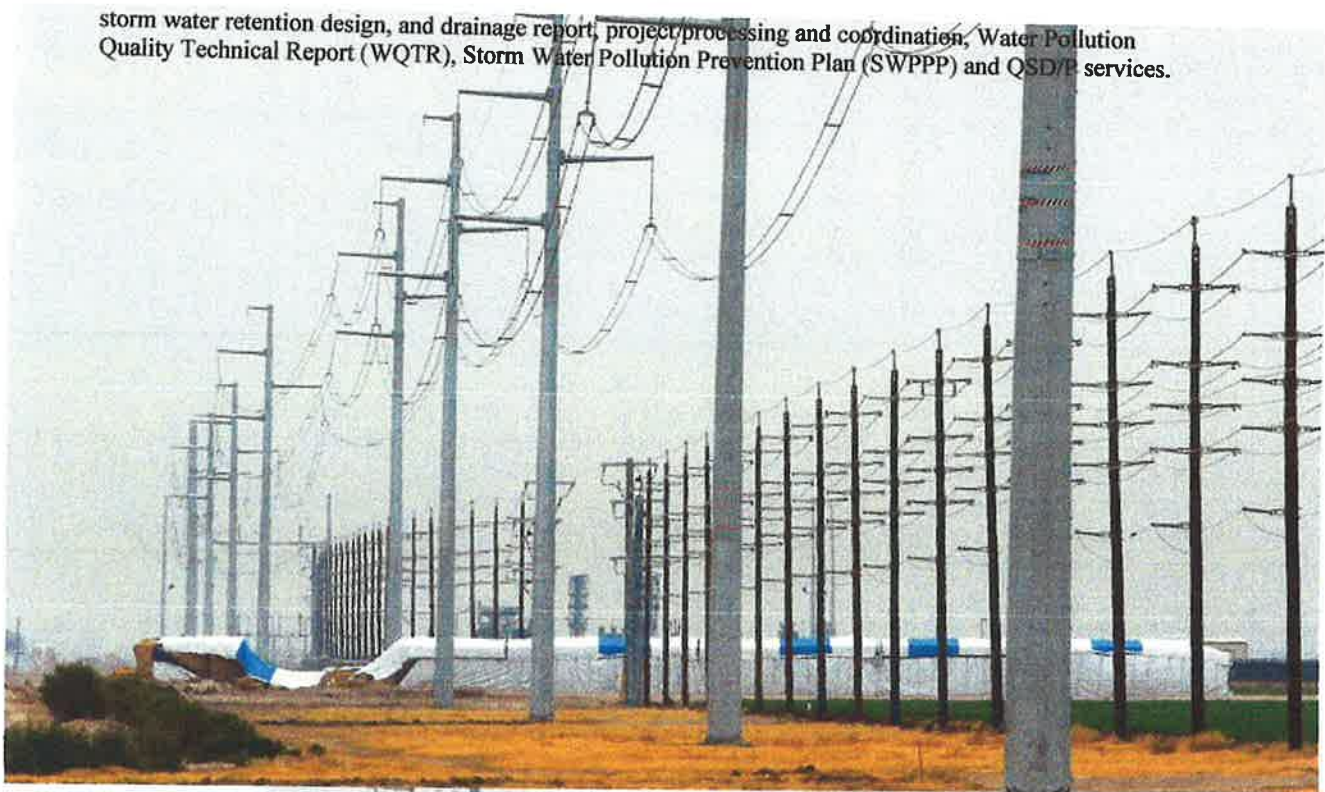
- No agenda package with project details for today’s variance decision by your Commission
- No Notice of Preparation (NOP) documents as prepared for the Office of Planning and Research by HDR or others (I do have a hard copy of a 32-page NOP Appendix J that I specifically requested previously)
- No detailed Iris Cluster project location maps, other than the solar project maps that most people are not aware of
- No maps or details for any new 230kv transmission lines for individual projects on non-contiguous parcels
- No maps showing location, size or potential co-location of utilities/ transmission infrastructure for cumulative impact solar / transmission infrastructure projects –as described in the NOP for the Draft EIR
- No map showing proximity of the crop dusting airstrip just one field away from the SE corner of the Iris Solar project
- No information on adjacent solar projects and total height of any existing 230 kV lines
- No IID information related to existing, proposed, approved, cumulative impact transmission lines / infrastructure in the same general area.
- The Imperial County Renewable Energy Projects map¹ does not disclose all the Imperial County airports/airstrips within the project impact zone
- No alternative plan to underground the new 230kV lines to avoid or reduce incompatible uses, adverse impacts, or potential hazards: SDG&E was required to underground 6 miles of the Sunrise Powerlink twin 230kV lines through Alpine.²

¹ <http://icpds.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=46320f2c70f64ed98c0cf054dfd9da89>

² <http://www.geosyntec.com/UI/Default.aspx?m=ViewProject&p=191>



storm water retention design, and drainage report, project processing and coordination, Water Pollution Quality Technical Report (WQTR), Storm Water Pollution Prevention Plan (SWPPP) and QSD/P services.





UPDATED: October 29, 2013

— US Highways
 — Interstate
 — Route
 ■ IV Substation
 ■ Cities
Project Status
 ■ Approved
 ■ In Process
Solar Projects
 ■ Calaveras SA
 ■ Calaveras SA-1
 ■ Calaveras SA-2
 ■ Calaveras SA-3
 ■ Campo Verde
 ■ Centinela Solar
 ■ Pinnel Solar Farm
 ■ Imperial Solar 1 LLC
 ■ Imperial Solar South
 ■ Imperial Solar West
 ■ Yre Solar Farm
 ■ Lyons Solar Farm
 ■ Mount Signal Solar
 ■ Outlook Solar
 ■ Rockwood Solar Farm
 ■ Westville Ranch Solar



Imperial County Planning & Development Services

Planning Project Status Report

April 10, 2014

| Projects | | | | Public Hearing Dates | | | |
|-------------------------------------|-------------------------------------|-----------------|--------------|---------------------------------|---------|----------|----------|
| Project/No. | Project Name | APN | Planner | [scheduled or projected for PC] | | | |
| | | | | ALUC | EEC | PC | B/S |
| General Plans | | | | | | | |
| GP 07-0005 | Procalamos RES | 059-014-007-000 | Richard | | 5/29/08 | TBD | |
| GP 07-0007 | Desert Springs Oasis SP | 034-300-011-000 | Tony/Richard | | 6/26/08 | TBD | TBD |
| GP 12-0004 | California Ethanol | 040-240-007-000 | David | | | | |
| Specific Plans | | | | | | | |
| SP 06-0003 | Alder 70 | 054-290-004-000 | David | | n/a | n/a | |
| SP 07-0003 | Procalamos RES | 059-014-007-000 | Richard | | 5/29/08 | TBD | |
| SP 07-0005 | Desert Springs Oasis SP | 034-300-011-000 | Tony/Richard | | 6/26/08 | TBD | TBD |
| SP 12-0002 | California Ethanol | 040-240-007-000 | David | | | | |
| Zone Changes | | | | | | | |
| ZC 10-0001 | Alder 70 | 054-290-004-000 | David | | | | |
| ZC 07-0007 | Procalamos RES | 059-140-007-000 | Richard | | | TBD | |
| ZC 07-0009 | Desert Springs Oasis SP | 034-300-011-000 | Tony/Richard | | 6/26/08 | TBD | TBD |
| ZC 12-0003 | California Ethanol | 040-240-007-001 | David | | | | |
| Environmental Impact Reports | | | | | | | |
| SP 06-0003 | Alder 70 SP [MBA] | 054-290-004-000 | David | | | n/a | |
| SP 07-0005 | Desert Springs Oasis SP [BRG] | 034-300-011-000 | Tony/Richard | | 6/26/08 | TBD | TBD |
| CUP 12-0009 | Imperial Valley Solar 2 LLC | 003-240-009-000 | Joe | | | | |
| SP 07-0003 | Procalamos RES [Recon] | 059-140-007-000 | Richard | | 5/29/08 | TBD | |
| G10-0004 | ORNI 21 | 003-200-020-000 | Richard | | | TBD | |
| CUP 12-0015 | CA Ethanol | 040-240-007-000 | David | | | | |
| CUP13-0036-52 | Wistaria | 052-210-025-000 | David | | | | |
| CUP13-0054 | Iris Cluster | 059-050-001-000 | Pat | | | | |
| CUP13-0011 | Seville Solar | 018-170-012-000 | David | | | | |
| CUP 13-0030 | Canergy | 037-070-044-000 | David | | | | |
| Tract Maps | | | | | | | |
| TR 00970 | Alder 70 | 054-290-004-000 | David | | | n/a | |
| TR 00972 | Procalamos RES | 059-140-007-000 | Richard | | 5/29/08 | TBD | |
| TR 00980 | Desert Springs Oasis SP | 034-300-011-000 | Tony/Richard | | 6/26/08 | TBD | |
| TR 00987 | County Center II-ICOE | 054-510-001-000 | Richard | | | | |
| TR 00988 | Seville Solar | 018-170-010-000 | David | | | | |
| CUPs (Major/Intermediate) | | | | | | | |
| APP 13-0003 | Minor Amendment | 037-140-006-000 | Richard | | | 7/24/13 | 10/22/13 |
| CUP 12-0009 | Imperial Valley Solar 2, LLC | 003-240-009-000 | Joe | | | | |
| CUP 12-0015 | California Ethanol | 040-240-007-000 | David | | | | |
| CUP 12-0016 | American Tower | 040-310-018-000 | Jared | | | 11/14/12 | |
| CUP 13-0005 | Oscar Linn - Truck Parking Facility | 059-363-013-000 | Jared | | | | |
| CUP 13-0008 | Lake Enterprises | 042-220-002-000 | Patricia | | | | |
| CUP 13-0009 | At&t - Communication Tower | 055-110-053-000 | Jared | | | | |
| CUP 13-0010 | At&t - Communication Tower | 062-050-003-000 | Jared | | | | |
| CUP 13-0011 | Seville Solar | 018-170-012-000 | David | | | | |
| CUP 13-0012 | Seville Solar | 018-170-011-000 | David | | | | |

| Projects | | | | Public Hearing Dates | | | |
|--------------------------------|--|-----------------|----------|---------------------------------|---------|----------|----------|
| Project/No. | Project Name | APN | Planner | [scheduled or projected for PC] | | | |
| | | | | ALUC | EEC | PC | B/S |
| General Plans | | | | | | | |
| Parcel Maps | | | | | | | |
| PM 2459 | Abatti Farms | 040-280-003-000 | Jared | | | | |
| PM 2445 | Ralph Taylor | 026-130-028-000 | Patricia | | 1/28/10 | 2/24/09 | |
| PM 2449 | Ormat (Orni 21) | 003-200-020-000 | Richard | | | TBD | |
| PM 2452 | Strahm | 045-040-051-000 | Joe | | | 7/11/12 | |
| PM 2453 | Hudson Ranch - Simbol | 020-100-044-000 | Joe | | | | |
| PM 2454 | Jackson | 052-160-023-000 | Joe | | | | |
| PM 2456 | Joel Shank | 040-400-003-000 | Jared | | | | |
| PM 2457 | Hudson Ranch Power II | 022-010-009-000 | Joe | | | | |
| PM 2460 | Oscar Kamp Farms | 045-470-018-000 | Joe | | | | |
| PM 2461 | Full Throttle Enterprises | 063-270-022-000 | Robert | | | | |
| PM 2462 | Full Throttle Enterprises | 062-040-030-000 | Jared | | | | |
| Initial Studies | | | | | | | |
| IS 12-0018 | California Ethanol | 040-240-007-001 | David | | | | |
| IS 13-0006 | County Land Use Ordinance | N/A | David | | | | |
| IS 13-0043 | Heber Community Center | 054-540-036-000 | Patricia | | | | |
| IS 14-0002 | County of Imperial / City of El Centro | | Jared | | | | |
| IS 14-0012 | Synthetic Geonomics | 025-280-006-000 | Robert | | | | |
| Lot Mergers | | | | | | | |
| MERG00117 | Family Dollar | 051-232-017-000 | Jared | | | | |
| MERG00119 | CANERGY | 037-070-004-000 | David | | | | |
| MERG00120 | Cristina Hernandez | 001-332-005-000 | Jared | | | | |
| MERG00121 | Francisco Parga | 063-040-002-000 | Jared | | | | |
| MERG00122 | Marta Enriquez | 021-093-026-000 | Jared | | | | |
| MERG00123 | John & Patricia Connelley | 007-093-005-000 | Jared | | | | |
| MERG00124 | Phillip A & Sandra Johnson | 001-106-017-000 | Robert | | | | |
| MERG00125 | William Brandt | 020-120-019-000 | Jared | | | | |
| Lot Line Adjustments | | | | | | | |
| LLA00269 | Campo Verde Solar | 051-350-014-000 | Robert | | | | |
| LLA00271 | Al Dahara Farms | 025-280-006-000 | Robert | | | | |
| | | | | | | | |
| | | | | | | | |
| Variances | | | | | | | |
| V 11-0001 | Orni 21 | 003-200-020-000 | Richard | 2/16/11 | | | |
| V 13-0001 | CANERGY | 037-070-004-000 | David | | | | |
| V 13-0002-18 | Wistaria | 052-210-025-000 | David | | | | |
| Reclamation Plans | | | | | | | |
| RP 13-0001 | G2 BIO LLC | 040-220-002-000 | Patricia | | | | |
| RP13-0002 | Granite Jimenez | 033-220-024-000 | Patricia | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Approved CUP Monitoring | | | | | | | |
| CUP 10-0017 | Centinela | 052-170-018-000 | David | | | | |
| CUP 12-0014 | Oberon Fuels | 037-070-013-000 | Jared | | | | |
| CUP 12-0002 | Spectrum | 002-020-032-000 | Jared | | | 10/10/12 | |
| CUP 12-0001 | Waste water treatment plant | 045-500-012-000 | Joe | | | 10/10/12 | |
| CUP 11-0007 | Campo Palo Verde/USS MT. Signal | 051-270-037-000 | David | | | | |
| CUP 10-0034 | Calipat Solar Farm I | 023-020-012-000 | Richard | | | 7/11/12 | 8/21/12 |
| CUP 10-0036 | Midway Solar Farm I | 022-130-008-000 | Richard | | | 7/11/12 | 8/21/12 |
| CUP 10-0037 | Midway Solar Farm II | 022-130-005-000 | Richard | | | 7/11/12 | 8/21/12 |
| G 10-0002 | Hudson Ranch II (E+E, Inc) | 022-010-001-000 | Richard | | | 9/12/12 | 10/23/12 |
| CUP 12-0005 | Simbol SMCP-2 | 022-010-009-000 | Richard | | | 9/12/12 | 10/23/12 |
| CUP(3) | Solar Gen II | various | David | | | | |

| Projects | | | | Public Hearing Dates | | | |
|---------------|-----------------------------|------------|---------|--|-----|----|-----|
| | | | | <i>[scheduled or projected for PC]</i> | | | |
| Project/No. | Project Name | APN | Planner | ALUC | EEC | PC | B/S |
| General Plans | | | | | | | |
| | CEQA Lead Agency for County | Countywide | All | | | | |
| | Code Enforcement Amendments | | All | | | | |



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Executive-ES

May 15, 2014

Ms. Patricia Valenzuela
Planner IV
Planning & Development Services Department
County of Imperial
801 Main Street
El Centro, CA 92243

SUBJECT: Iris Cluster Solar Farm NOP of an EIR

Dear Ms. Valenzuela:

On April 23, 2014 we received from the Imperial County Planning & Development Services Department, the Initial Study (IS) and Notice of Preparation (NOP) of an Environmental Impact Report (EIR) for the Iris Cluster Solar Farm project. 8minute Renewables (85JP 8ME, LLC) is proposing to construct a project which consisting of four (4) photovoltaic solar facilities (Ferrell Solar Farm, Rockwood Solar Farm, Iris Solar Farm, and the Lyons Solar Farm), collectively estimated to generate up to 360 MW, on four (4) non-contiguous independent sites encompassing approximately 1,422 acres, about 2 miles west of the City of Calexico, CA; and generally located between State Route 98 to the south, Kubler Road and Preston Road to the north, Weed Road to the east, and Brockman Road to the west.

The Imperial Irrigation District (IID) has reviewed the IS and NOP and has the following comments:

1. Given that the project's impacts to the IID transmission system is virtually impossible to evaluate due to the lack of details of its transmission interconnection facilities contained in the IS and NOP (e.g. there is no specifics of how the solar facilities substations will interconnect with the neighboring solar projects), it is very difficult at this point in time to provide explicit comments about impacts to IID's electrical facilities. Nonetheless, we reserve the right to comment on these issues in the future as we deem necessary and as additional information becomes available.
2. Furthermore, in view of the lack of detail in the layout of the four solar facilities in regards to location of collector lines, on-site substations etc., the facilities; collectively or individually, could potentially conflict with future transmission right-of-way alignment and siting of IID's upcoming system upgrades. Thus IID may require easements across the front of the project site's parcels.

3. The electric service for the project's construction, station service and the O&M building shall be provided by IID. Thus, it is important to note that all costs associated with the relocation and/or upgrade of IID electrical infrastructure to service the project will be the responsibility of the project proponent. Project proponent is urged to contact IID Energy - Customer Operations & Planning Section at 760-482-3402 or (760) 482-3300 for additional information regarding electrical service for the project.
4. However, IID's energy deliverability has been identified as limited around the project area; a circuit analysis will be needed in order to identify what kind of upgrades to IID electrical distribution infrastructure would be necessary to provide service, which can include but are not limited to new, relocated, modified or re-constructed substations, transmission and/or distribution lines.
5. The IS and NOP state that there are no IID canals or drainage structures located within the project sites, that IID rights-of-way, access roads, canal and drains are located immediately adjacent to the project sites and that no IID canal or drain structures will be removed or relocated; nevertheless, we strongly recommend that the project proponent be advised that modifications to IID canals and drains may have project level environmental impacts that should be analyzed on a site specific basis.
6. In addition, the project proponent should be informed that IID's canal or drain banks may not be used to access the project site. Any abandonment of easements or facilities shall be approved by IID based on its systems (Irrigation, Drainage, Power, etc.) needs.
7. The proposed project may impact IID's drains with site runoff flows. To mitigate impacts, the proposed project will require a comprehensive IID hydraulic drainage system analysis.
8. The project's storm water runoff should be designed to connect to drains at existing agricultural discharge locations.
9. Be advised that the project's upcoming EIR should address impacts to IID's drains. 33.3% of water delivered to agricultural users is discharged into the IID's drainage system. Reduction in field drainage due to land use conversion has an incrementally negative effect on both drain water quality and volume of impacted drain and subsequent drainage path to the Salton Sea. This affects drainage habitat (flora and fauna) and the elevation of the Salton Sea (shoreline habitat and exposed acreage that may have air quality issues). Additionally certain direct-to-Sea drains have been identified as pupfish drains which require additional protections under state and federal Endangered Species Acts.

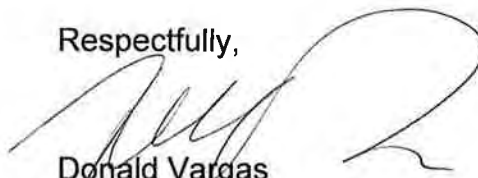
10. Furthermore, the EIR should also contain an assessment or analysis of cumulative impacts considering other non-agricultural facilities whose water use (or potential water use) would reduce the inflow conveyed to IID drains and subsequently, the Salton Sea.
11. Taking into account that the project proponent plans to potentially draw water from the Wistaria Canal, be advised that all new non-agricultural water project supply requests are processed in accordance with the IID's Interim Water Supply Policy for Non-Agricultural Projects (IWSP) (see <http://www.iid.com/index.aspx?page=152> for a link to the IWSP) and require a water supply agreement prior to operation. In order to enter into a water supply agreement with the IID and obtain canal water service for the project, the applicant will be required to comply with all applicable IID policies and regulations. Such policies and regulations require, among other things, that all potential environmental and water supply impacts of the project have been adequately assessed, appropriate mitigation has been developed and appropriate conditions have been adopted by the relevant land use permitting/approving agencies. Furthermore, the applicant will be required to meet standards for water use efficiency and best management practices, including but not limited to those established by the County, as well as other water use efficiency standards, adopted by IID or local government agencies.
12. On May 8, 2012 the IID Board of Directors adopted a Temporary Land Conversion Fallowing Policy (TLCFP) that will require participation from certain project developers and/or landowners as a condition of water service for new non-agricultural projects. In particular, this policy will target lower water demand projects, such as photovoltaic solar facilities, that require a temporary land use conversion and are permitted by conditional use permits on agriculturally-zoned lands. Fallowing contracts in support of the TLCFP may be required to implement this policy and in order to process a project's water supply agreement as described previously (see <http://www.iid.com/Modules/ShowDocument.aspx?documentid=5646> or the IID MCI webpage at <http://www.iid.com/index.aspx?page=152>). For additional information regarding the IWSP or TLCFP, contact the IID Water Department representative at (760) 339-9755.
13. Any construction or operation on IID property or within its existing and proposed right of way or easements will require an encroachment permit, including but not limited to: surface improvements such as proposed new streets, driveways, parking lots, landscape; and all water, sewer, storm water, or any other above ground or underground utilities. A copy of the encroachment permit application is included in the IID's *Developer Project Guide 2008*, and can be accessed at: <http://www.iid.com/Modules/ShowDocument.aspx?documentid=2328>. Furthermore, instructions for the completion of encroachment applications can be found at <http://www.iid.com/Modules/ShowDocument.aspx?documentid=2335>. The IID Real

Estate Section should be contacted at (760) 339-9239 for additional information regarding encroachment permits.

14. In addition to IID's recorded easements, IID claims, at a minimum, a prescriptive right of way to the toe of slope of all existing canals and drains. Where space is limited and depending upon the specifics of adjacent modifications, the IID may claim additional secondary easements/prescriptive rights of ways to ensure operation and maintenance of IID's facilities can be maintained and are not impacted and if impacted mitigated. Thus, IID should be consulted prior to the installation of any facilities adjacent to IID's facilities. Certain conditions may be placed on adjacent facilities to mitigate or avoid impacts to IID's facilities.
15. Any new, relocated, modified or reconstructed IID facilities required for and by the project (which can include but is not limited to electrical utility substations, electrical transmission and distribution lines, canals, drains, etc.) need to be included as part of the project's CEQA and/or NEPA documentation, environmental impact analysis and mitigation. Failure to do so will result in postponement of any construction and/or modification of IID facilities until such time as the environmental documentation is amended and environmental impacts are fully mitigated. **Any and all mitigation necessary as a result of the construction, relocation and/or upgrade of IID facilities is the responsibility of the project proponent.**

Should you have any questions, please do not hesitate to contact me by phone at 760-482-3609 or by e-mail at dvargas@iid.com. Thank you for the opportunity to comment on this matter.

Respectfully,



Donald Vargas
Environmental Analyst

Kevin Kelley – General Manager
Kristine Fontaine – Asst. General Manager & Interim Portfolio Management Officer
Carl Stills – Manager, Energy Dept.
Ismael Gomez – Interim Manager, Water Dept.
Vance Taylor – Asst. General Counsel
Tom King – Deputy Energy Manager, Engineering & Operations
Paul G. Peschel – Interim Manager Planning & Engineering, Energy Dept.
Angela Evans – Manager Distribution Services & Maintenance Operations
Juan Carlos Sandoval – Asst. Mgr., Transmission Expansion Development, Energy Dept.
Michael P. Kemp – Superintendent, Real Estate & Environmental
Shayne Ferber – Asst. Supervisor, Real Estate
Vikki Dee Bradshaw – Environmental Compliance Officer