
Sandia National Laboratories

# Scope of Work and Collaborative Partnership Assessment Of a 300kW PV Array Installation At the Kaua'i Test Facility (KTF)

**Solar America Initiative**
**Government Solar Installation Project (GSIP)**
**U.S. Department of Energy, Energy Efficiency and Renewable Energy**

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[1] Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United Sates Department of Energy's National Nuclear Security Administration under contract DE-AC-04-94AL85000.

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## Introduction

As part of the Department of Energy's (DOE) Transformational Energy Action Management (TEAM) Initiative, a DOE solar tiger team led by Sandia National Laboratories Jack Mizner conducted a study to determine if solar applications can be cost-effectively installed at or near Sandia National Laboratories (Sandia) property and can provide a portion of the electric and heating/cooling load. From this July 2008 study, the following project was recommended:

"Installing a 300 kW ground-mounted, crystalline photovoltaic (PV) system at [Kaua'i Test Facility] KTF to provide their day-to-day power is clearly cost-effective and is attractive to an investor. The combination of the Federal tax credit (30%) and the HI state credits produce electricity at a cost of just over $0.143 cents a kWh. These electrical costs are much less than the $0.47/kWh that KTF currently pays. Even at the lower FTC, the investment at KTF is still attractive at $0.196/kWh." The figure below is an aerial view of KTF. The red outlined areas could be used for ground-mounted PV arrays. The estimated initial annual cost savings with an installed PV system is calculated to be $83,745 and the estimated 20-yr. NPV (net present value) life cycle-savings are calculated to be $2,250,260. See PDF file, "KTF Solar Farm" overview slide.


The next step to installing a PV system at KTF is to detail a scope of work and cultivate collaborative partnerships to determine how this solar installation could be done. Due to the current circumstances surrounding the future of the KTF, a private developer model was assumed. With this model, a solar / PV installer finances the hardware using tax credits and renewable energy credits (RECs) or carbon offsets.

In order to establish partnerships and collect information, staff from Sandia National Laboratories participated in a site visit from September 29 – October 3, 2008. Sandra Begay-Campbell's specific assignment was the KTF project. She was invited to participate in two DOE Hawaii Clean Energy Initiative meetings with Sandia's Juan Torres and Abbas Akhil. On September 29 and 30, Sandra Begay-Campbell held an introductory meeting with Forest City Hawaii (FCH) Military Communities Jon C. Wallenstrom, Chief Operating Officer and Senior Vice President, Forest City Military Communities; and Will Boudra (Will), Development Manager, Forest City Military Communities. A meeting with the Director of the Hawaiian Home Lands, Micah Kane was arranged

by Jon Wallenstrom for Sandra Begay-Campbell and FCH's Will Boudra and Race Randle attended. On October 1, Sandra Begay-Campbell and FCH's Will Boudra participated in a field visit to FCH's Oahu Marine Base Housing project. On October 2, Sandra attended a Hawaii Clean Energy technical assistance meeting with State of Hawaii officials by Juan Torres' invitation. On October 3, Sandra Begay-Campbell and Abbas Akhil met with Sandian Jeff Jarry at KTF and also met with the Kaua'i Island Utility Cooperative (KIUC)'s Carey Koide (Engineering Manager) and Michael Yamane (Senior Electrical Engineer).

This report documents the evaluation of the private installer model and provides recommendations to continue the development of recently established collaborative partnerships.

## Background

Sandia National Laboratories (Sandia) is one of the nation's premier multi-program national security laboratories within the DOE/National Nuclear Security Administration (NNSA). Sandia is a government owned, contractor operated, multi-program research and development facility. Sandia Corporation is a wholly owned subsidiary of Lockheed Martin Corporation, which manages and operates Sandia under the M&O Prime Contract, DE-AC04-94AL85000, with the DOE Sandia Site Office (SSO) and the NNSA. Sandia consists of several locations and this report is focused on Sandia's Kaua'i Test Facility (KTF) in Kaua'i, Hawaii.

KTF is a Sandia missile launch range operated in Hawaii for the DOE/NNSA. The facilities and personnel support a variety of sounding rocket missions, including weapons research and development; operational training, test, and evaluation; and technology development. To ensure maximum utilization of the facilities, Sandia conducts launch projects for other organizations or government agencies on a non-interference basis, which are cost reimbursable to the DOE. KTF is a tenant on the US Navy Pacific Missile Range Facility (PMRF) at Barking Sands.

The KTF was established in 1962 to support high altitude and exoatmospheric testing for the nuclear weapons program through the launch of instrumented sounding rockets. Over time, the mission at KTF has evolved and currently supports the nation's missile defense program through launches of target vehicles and instrumented payloads, and through collection of telemetry data on test flights launched from KTF and Pacific Missile Range Facility (PMRF) in Kaua'i, Vandenberg Air Force Base in California, the Kodiak Launch Complex in Alaska, and from Navy ships operating in the Pacific.

Today, the Department of Defense (DOD) Missile Defense Agency (MDA) is the primary customer for KTF. Through the DOE Work for Others (WFO) program, MDA supports the mission operations at KTF and, through a Congressional earmark, provides funds for the annual operations and maintenance (O&M) of the KTF site infrastructure. These contributions include the provision of utilities and other services supplied by PMRF under an Inter-service Support Agreement (ISA) with the NNSA. Additionally, MDA has been underwriting the mission-critical upgrades to the equipment and property at KTF. NNSA contributes limited funding for the KTF's aging infrastructure through Sandia's Facilities Management Operations Center program for site management. At this time minimal if any infrastructure improvements will be supported by NNSA.

MDA has requested that DOE/NNSA fund the O&M costs of the KTF infrastructure or transfer the site to DOD, namely PMRF. As requested by DOE, Sandia generated and submitted a transition plan to DOE/NNSA on September 11, 2008. This plan provided several options and associated costs for the transition of KTF.

Sandia is continuing to pursue other alternatives to maintain and operate KTF, including collaboration with the University of Hawaii (UH). Several credible and sustainable programs have been identified for a UH and Sandia collaboration, which include the various renewable energy resources. The key to success for this collaboration is DOE's commitment to funding at least a portion of the maintenance of KTF. Another possible collaboration is between DOE and PMRF, also in the area of renewable energy programs.

Grid electric power is provided to KTF for routine operations. KTF also has two diesel generators. When no missile tests are being prepared or done, these diesel generators are used for peak shaving, consuming approximately 250 gallons of diesel per week. When missile tests are being prepared or conducted, KTF disconnects from the grid and relies entirely on the diesel generators. It is estimated that approximately 300 kW of grid-tied solar electric, is required to provide power to KTF for routine operations. This is sufficient to eliminate the need to run the diesels for peak shaving and routine operations. During missile tests, KTF would continue to disconnect from the grid and use the diesel generators.

Forest City Military Communities in Hawaii (FCH), a large-scale housing and urban developer, is integrating solar electric and solar thermal systems into its Forest City Military Communities in Hawaii. Forest City currently includes the installation of solar systems on some 6,500 homes in Hawaii. Forest City is a recipient of the DOE Solar America Showcases Award; the program's goal is to accelerate the demand for solar technologies by supporting projects that inspire and enable local governments, citizens, and organizations to use solar energy technologies. FCH Military Communities is contracted to upgrade Navy military housing at Kaua'i's PMRF and is interested in developing photovoltaic (PV) power for the PMRF residential neighborhood. Sandia and FCH have an existing collaborative partnership which is an advantage to this KTF project.

The mission of NAVFAC Hawaii's Energy program is to assist Navy Region Hawaii in reducing its energy use and attaining energy consumption goals with three areas of focus: operations, awareness, and technology. In an effort to reduce the Region's electrical consumption, the NAVFAC Hawaii Energy Program researches, develops, and implements energy technology measures through a variety of energy projects including renewable energy and other technology. The Public Works Department (PWD) Barking Sands at PMRF is the Kaua'i contact for NAVFAC. As stated by the Commanding Officer of NAVFAC Hawaii, "Your day-to-day touch point for NAVFAC Hawaii is your Public Works Office (PWO). Engage with your PWO frequently, he/she works for you. Your PWO is the linchpin to ensure your priorities are our priorities."

Kaua'i Island Utility Cooperative (KIUC) is the local cooperative utility governed by a nine-member Board of Directors. In its strategic plan, KIUC committed to generate at least 50% of its electricity renewably within 15 years and KIUC members have stated their need to increase renewable energy alternatives toward this end. KIUC currently relies on highly refined oil products for a majority of its energy supply and the 2006 average KIUC residential rate was $0.32/kWh. KIUC has a goal to increase energy diversity so that no one source amounts to 50% or more of their energy supply.

## Prospective Project

The core assessment tiger team is composed of renewable energy experts from the Sandia National Laboratories (Sandia). The team leader is Sandra Begay-Campbell. The technical assistance team was made available to the Kaua'i Test Facility through the Solar America Initiative (SAI) Government Solar Installation Program (GSIP), a program at the Department of Energy that supports renewable energy technology diffusion and integration into Federally-owned facilities.

The approach to the assessment includes the following: information gathering; one site visit; review and refine the results of previous studies; and publish a final report in January 2009. The final report identifies the scope of work, key stakeholders and collaborative partners and a path forward to install PV at KTF.

This report provides a broad scope of work for the installation of a 300 kW ground-mounted, crystalline PV system which could be financed by a private investor to take advantage of tax and other credits. The combination of the Federal tax credit (FTC) (30%) and the HI state credits produce electrical production (2008 dollars) at a cost of just over $0.143 cents a kWh. These electrical costs are much less than the $0.47/kWh that KTF currently pays. Even at the lower FTC, the investment at KTF is still attractive at $0.196/kWh. Future increased electricity costs further enhance the investment attraction of the project.

The July 2008 Solar Assessment relied on industry average costs for PV installation, and operations and maintenance. To move forward a detailed construction cost estimate is required as well as a site assessment, including a NEPA (National Environmental Protection Act) analysis. The assessment will include a more detailed approach to KTF's electricity needs with analysis of base and peak loads. The initial assessment should also include an analysis of the size and type of transmission line needed if FCH should decide to expand its solar PV residential program to sell electricity to KTF.

The Kauai Island Utility Cooperative (KIUC) requires oversight of any program involving the electrical grid and net metering. Additional analysis includes assessment of existing hardware and distribution lines. Recent electrical upgrades were completed, including lightning protection systems for the launch pads; the funding came from MDA and the upgrades were managed through Sandia's Facilities Management Operations Center.

On January 21, 2009, "shovel ready" projects for the planned Obama Economic Stimulus package were requested by the Sandia's Facilities Management Operations Center Planning group. A short description of the KTF project size and electrical cost savings were provided. At the time of this report, it is understood that the KTF solar project (non-New Mexico site project) was forwarded in the final response to the original request.

## Community Engagement / Collaborative Partners Assessment

The Background Section of this report provides an overview of the Collective Partners.

Because of the complexity of the relationship between the owner, operator and tenant at KTF and the power supplier, regulatory agencies and other stakeholders, it is essential to establish roles and responsibilities of all parties and gain their buy-in.

A key customer and necessary champion for this project is Al Lopez, Sandia's Program Manager for the KTF site. Mr. Lopez is very supportive of this collaborative effort and helped to identify key personnel with the PMRF Naval Facilities Engineering Command (NAVFAC). He will be instrumental in the continuation of this effort. Local KTF support will be needed from Sandia staff member Jeff Jarry as the project progresses.

The PMRF NAVFAC Public Works Office (PWO) is Lieutenant Commander (LCDR) Don George and the Assistant PWO (APWO) is LTJG Nathan Deunk. LCDR George is currently on an extended leave and LTJG Deunk has been unavailable for a face-to-face meeting until mid-January 2009. From an initial conversation with LTJG Deunk, there is support for a PV installation project from the administration of the PWO, but it is critical to obtain support from the PMRF Command and from the programmatic leaders. The PWO has been trying to install PV for many years.

Forest City (FCH) Military Communities in Hawaii is a crucial partner for this project and a solid rapport was established for the KTF project. Sandia and FCH have an existing collaborative partnership. FCH is interested in developing PV power for their PMRF residential neighborhood. There is a high probability and initial interest from FCH to expand a potential residential PV project and to possibly develop a Power Purchase Agreement (PPA) or other joint venture with KIUC in order to sell excess solar power to neighboring partners like KTF and or PMRF NAVFAC.

As a side note: FCH's Jon Wallenstrom introduced the project and assessment team to the Director of the Hawaiian Home Lands, Micah Kane. Strategic conversations regarding Kaua'i renewable energy development and Indigenous People / Native issues were discussed.

The established relationships between Sandia, FCH and KIUC are beneficial for establishing a more cohesive framework of collaborative partners for this project. The initial meeting for the KTF project with the KIUC was productive and identified some key personnel and management.

Momentum and rapport with the collaborative partners was initiated during this scope assessment. Timely, responsive and consistent communication regarding this project is necessary for the continuation of the project's development even if a PPA is developed by a third party.

## Risks

There are several risks that should be considered prior to final project funding. One of the more important is that of the present economy in Hawaii. The Bank of Hawaii reports that the decline in the tourism industry has understandably had a significant impact on Hawaiian economy. Consequently, there may not be an investor who is attracted to Hawaiian tax or other credits. However the housing market seems to be among the most stable in urban markets across America and mortgage delinquency rates remain among the lowest nationwide according to the fore mentioned Bank of Hawaii report. These trends indicate more stability in the housing market than may have been previously concluded.

The Navy has formed a public/private venture (PPV) with Forest City Hawaii (FCH) called Ohana Military Communities which will lease, manage, and improve the housing on Navy and Marine Corp bases on Oahu and Kauai. The Navy owns the land where Ohana homes are located, and Ohana has a 50-year lease on that land. The open land around KTF could be incorporated into this 50 year lease potentially providing leasing stability for a third-party solar power provider under a PPA or other option. This way, changes in the leasing or ownership of KTF itself may not negatively affect a long-term PPA. Thus the risk of maintaining an interested investor may be mitigated by these considerations.

Other possible risks may include that of necessary upgrades to the existing system resulting in more 'up-front' costs than initially anticipated. Particular consideration should be given to the south electrical loop connecting FCH Housing area, which may not have the capacity for added load. (NOTE: KTF is located to the north of the FCH Housing area.) To mitigate these concerns and determine any utility interconnection issues, a detailed electrical assessment of the area is needed. Additionally, due to the aging infrastructure at KTF, it may be necessary to upgrade transmission and distribution lines as well as transformers and other existing equipment. This upgrade may become part of the PPA but does necessitate a more in-depth site assessment.

It is possible to mitigate financial risks, but more time for analysis and establishing partnerships is needed.

## Recommendations

With the ground work conducted in the 2008 SNL Solar Assessment and this scoping study and identified potentially large energy cost savings, the project fits perfectly with the immediate goals of the new Obama administration. Below are recommendations that will enable implementation of PV at KTF and assist in additional solar market penetration in HI.

1) Authorize and continue Sandia's involvement through the DOE GSIP Tiger Team. This is necessary to manage recently established and focused collaboration with the KTF management, FCH, PMRF, KIUC and Sandia Facilities Management Operations Center and foster continued collaboration. More rapport needs to be built with NAVFAC. It is critical to keep NAVFAC up-to-date, to develop rapport with the PMRF Command and to give them credit for their support. Specifically, the project coordinator needs to communicate proactively with the local champions who have a vested interest in outcome. They include the following: KTF Manager, Al Lopez; FCMC Management, Jon Wallenstrom; NAVFAC PWO, Lieutenant Commander (LCDR) Don George and APWO,LTJG Nathan Deunk; KIUC Management, Carey Koide; Sandia's Facilities Management Operations Center Building Operations Manager, David Saxton; Sandia's Facilities Management Operations Center Program Manager; Stan Harrison; and the DOE GSIP sponsors Tom Kimbis and Kevin Lynn.

2) Assess the state of the Sandia's KTF transition plan to PMRF. Al Lopez is the contact for the KTF programmatic information and for Sandia's management information.

3) Examine the probability and initial interest for FCH and KIUC to establish a joint venture. This would benefit both KIUC and FCH in that KIUC would be able to gain experience with a relatively large scale PV system, and FCH would not have to take sole technical responsibility for a stand-alone PV system. Additionally, some of the cost uncertainty in terms of the interconnection costs may be reduced if KIUC takes an active role in the design, construction and operation of the PV plant. One option for establishing a joint venture would be to establish an Enhanced Use Lease with a FCH and KIUC partnership.

Another option for partnership between FCH, KIUC and PMRF may be to establish a PPA in order to sell excess solar power to neighboring partners such as KTF and PMRF. The PPA could be developed between the investor, KIUC, FCH and the PMRF.

Request for proposals for either partnership should include pertinent information from the SNL Facilities Management Operations analysis.

4) Work with Sandia's Facilities Management Operations Center to make the KTF project a priority. It is highly recommended that an analysis of the existing electrical distribution at KTF be completed. This should include a detailed analysis of KTF electrical needs including base and peak loads the size and type of transmission line needed (if FCH should decide to expand its solar PV residential program to sell electricity to KTF), the system feeding into the KTF from KIUC transmission and distribution lines, and the existing equipment such as transformers and breakers.

5) Investigate KIUC net metering policies. The KIUC serves the PMRF and KTF; thus KIUC may require supervision of any program involving the electrical grid and net metering. Note that any renewable resources added at the PMRF may be beneficial to KIUC either as a resource or as a negative load that effectively displaces new capacity addition.

6) Participate in the HI Clean Energy Kaua'i Renewable Energy Roadmap meeting to be held in April 2009. The KTF project is one of many renewable energy initiatives within Kaua'i which will assist KIUC and the State of Hawaii to meet its energy goals. This road-mapping exercise may yield an opportunity for this project's analysis.

Final comments relative to the timing to complete the KTF project from the nominee for DOE Secretary, Steven Chu. *"Renewable energy is something we really have to work on as quickly as possible. . . It will be my primary goal as secretary to make the Department of Energy a leader in these critical efforts,"* Chu, a Nobel Prize winner and director of the Lawrence Berkeley National Laboratory, told members of the Senate Energy and Natural Resources Committee at his confirmation hearing.

Note the energy paragraph's of President-elect Barack Obama's remarks on the economy, delivered on January 8, 2009 at George Mason University: *"...That work begins with this plan - a plan I am confident will save or create at least three million jobs over the next few years. It is not just another public works program. It's a plan that recognizes both the paradox and the promise of this moment - the fact that there are millions of Americans trying to find work, even as, all around the country, there is so much work to be done. That's why we'll invest in priorities like energy and education; health care and a new infrastructure that are necessary to keep us strong and competitive in the 21st century. That's why the overwhelming majority of the jobs created will be in the private sector, while our plan will save the public sector jobs of teachers, cops, firefighters and others who provide vital services.*

*To finally spark the creation of a clean energy economy, we will double the production of alternative energy in the next three years. We will modernize more than 75% of federal buildings and improve the energy efficiency of two million American homes, saving consumers and taxpayers billions on our energy bills. In the process, we will put Americans to work in new jobs that pay well and can't be outsourced - jobs building solar panels and wind turbines; constructing fuel-efficient cars and buildings; and developing the new energy technologies that will lead to even more jobs, more savings, and a cleaner, safer planet in the bargain."*

From President Obama's Inaugural Address, January 20, 2009*: "...We will harness the sun and the winds and the soil to fuel our cars and run our factories…All this we can do. All this we will do…."*