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The Mission for Applications of Renewable Energy for Humanity

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Solar Power for Civilian Populations in Combat Affected Areas

Prepared for:

The Honorable Blaise Durante

Deputy Assistant Secretary of the Air Force

for Acquisition Integration

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PASQUALE PAOLI

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Solar Power for Civilian Populations in Combat Affected Areas

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Executive Summary

According to World Bank reports nearly 1/3rd of the current world population of approximately 6 Billion people presently do not have any access to grid electricity. This translates into approximately 2 Billion people, or nearly 300 to 400 Million rural households in the world that use some other means of light in their homes. The lack of electrical power for domestic, educational, and economic development uses is a direct contributor to a sense of hopelessness that becomes the breeding ground for despair and resentment from which terrorist groups recruit. In most of these areas the American Military and/or our allies are currently performing in peace-keeping, anti-terrorist, or humanitarian operations.

Providing reliable energy systems to isolated communities in which American and Allied forces are operating is one of the most effective means by which we can combat the conditions that encourage resentment and hostility against peacekeeping forces. Currently the only solutions available to our forces for quick deployment to these areas are fossil fuel based power units. These are limited by the temporary nature of the operational capability and their requirement for expensive fuels that must be supplied through extensive if not impossible logistical systems. Once our personnel are withdrawn from the area little hope exists for continued access to electrical power that can be maintained by the populations left behind.

The solution lies in transferring and integrating existing renewable energy technology into sustainable and affordable power generation systems that are easily deployable by existing personnel with minimal training in the various theaters of operations.

The Air Force is meeting the President's mandate towards use of renewable energy by making the commitment to "Collaborate with Allies, sister services, agencies, on energy best practices" to "Make Energy a Consideration in All We Do" (Mr. Mike McGhee Acting SAF/IEE, 2009). The use of the proposed sustainable, reliable, and affordable renewable energy technologies to meet the energy security objectives and humanitarian objectives of the United States and our allies operating in underdeveloped regions, is the next logical extension of the current renewable energy programs.

The project proposed by this international team of industrial and academic scientists is to transition existing technology, integrate components, system test, and document renewable energy systems that will provide essential electrical power to homes in rural regions of the world where American and our allies' interests for continued prevention of terrorism is focused.

The deployment of these systems will also serve both strategic and tactical benefits in demonstrating the United States' and our allies' commitment to defined humanitarian aid objectives that serve to provide a better life for indigenous populations of underdeveloped and developing areas of the world that goes hand-in-hand with overcoming terrorism around the world.

Nature of the Problem

- Civilian populations living in substandard conditions are regularly found in and adjacent to areas in which US forces are operating and combating terrorism.
- These areas often have extreme environmental conditions and difficult terrains that naturally limit infrastructure development, or become very expensive.
- Existing infrastructure has often been destroyed or rendered inoperable indefinitely by terrorist related activities.
- Indigenous populations often have little hope of social or economic improvement without being provided sustainable and reliable power systems that do not rely on fossil based fuels.

Effect on US Objectives

- As a direct result of not having access to basic 21st century domestic technology, indigenous populations are often easily turned against US peace keeping objectives and personnel by insurgent forces.
- Unavoidable collateral damage in combat areas exacerbates the problem casting numerous shadows of blame on US forces for the existing substandard living conditions.
- Local populations resent the presence of US Forces, support or hide insurgents, and sometimes participate in direct actions against US personnel.
- US personnel lack an effective social-economic tool to break the cycle of hopelessness that continues to provide new recruits for terrorist groups.

Mitigation of the Threat

- Improve image of American forces (vis-à-vis “The Ugly American”) by providing meaningful and sustainable improvements to local social, economic, and family conditions.
- Focus on solutions that are independent of cultural/philosophical/religious biases and will help bridge cultural gap and provide common ground for friendship building initiatives.
- Can be sustained by local people without continued presence of American forces and support
- Emphasis on women and family domestic needs that are usually overlooked or addressed from the male perspective only, which has previously limited success and sustainability.

Mitigation of the Threat (Cont)

US Forces need a silver bullet that:

- Promotes cooperation between our people and local civilian populations
- Is socially/culturally and militarily benign
- Provides an essential service for the indigenous people in a way that will not attract retaliatory actions by insurgents
- Derived benefits are sustainable and are fully for the use of the Local population
- Promotes 21st Century ideas without the stigma of imposing western culture or politics.

Proposed Solution

- Transition of existing Air Force Photovoltaic based Solar Power System Technology, to provide sustainable electrical power to devastated and developing regions in which US forces are operating or communities adjacent to such regions.
 - Small family sized units to provide basic electrical services for lighting and small appliances.
 - Larger units sized to meet small community needs for sustainable power, clean water, and food production

Proposed Solution (cont)

- A number of projects by secular and non-secular non-profit organizations have shown that low cost photo-voltaic solar power systems to provide domestic power to families in developing countries have:
 - Improved quality of lives for underprivileged families
 - Eased social, political and economic stresses in the region
 - Offered new avenues for collaboration on domestic projects to stabilize and improve on local economies and cultures
 - Raise the quality of life for women and children and increased the sustainability of the social improvements
 - Improved inter-cultural relations in the regions by raising local social standards closer to 21st Century norms.

Proposed Solution (cont)

Family sized solar power unit (100 W to 500 W):

- Provide essential electrical power for a single household.
 - Combines solar power with aquaculture to provide both sustainable power and food/water source for several families in desolated areas.
 - Electricity for community schools, meeting places and places of worships.
- System operates a local power grid, well pumps for fresh water, and power to operate a aquaculture operation providing fresh food.

Proposed Solution (cont)

Small community sized system (12-20 kW):

- Provide essential electrical power for several families or a small community.
 - Combines solar power with aquaculture to provide both sustainable power and food/water source for several families in desolated areas.
 - System operates a local power grid, well pumps for fresh water, and power to operate an aquaculture operation providing fresh food.

Project Return On Investment

Benefits of Renewable Energy:

Based on Mr. Sarkar's personal experience with the Jharkhand Leprosy colony, India (a colony run by Bharat Sevasram Sangha (BSS), an NGO), the following has been observed :

1. In developing countries it is the women who usually run all household activities, and the most improvement in the social and economical conditions of rural households can be achieved through helping the women in performing their usual roles in the family which are: health, education of the children, performing household chores, refrigerating food, and engaging in some income producing activities.

2. Experience shows that women can be easily trained to maintain the solar home light systems (SHS). They also become the strongest advocates and become ardent protectors of their solar home lights, securing them, and guarding them against thefts and misuse.

Project Return On Investment

Benefits of Renewable Energy (cont):

3. *Experience shows that Solar Home Lights improves lives at a minimum in the following areas:*

- ***Health:*** *solar light is pollution free, and does not emit harmful CO₂ and methane gas emitted from a kerosene wick lamp (the common use of light after dark in the homes of rural developing countries) . Women and children who spend most time indoors are most affected by the harmful gases emitted from kerosene lamps. Women are most concerned about these health issues of the family, as they are the prime care-givers of the family.*
- ***Education:*** *The lights from solar system provide luminosity that is much better than that provided by the kerosene lamps. The children's reading and education which are the primary concerns of the women are greatly improved through solar lighting.*

Project Return On Investment

Benefits of Renewable Energy (cont):

- ***Income generating activities:*** Women can engage in many at-home income producing activities ,such as sewing, knitting and making cottage industry items which are marketable, and generate much needed incomes for the family.
- ***Cooking, household chores and social activities:*** Women are primarily responsible for all cooking, and performing household chores. These are greatly facilitated through solar electricity provided lights and small cooking appliances, such as solar cooker, solar hot plates, etc. Small electric grinding mills save many hours of time, and drudgeries for the women husking the rice, wheat, millets and other grains which are the staple source of foods for the family.
- ***Community solar water pumps, agriculture and health centers:*** Solar water pumps provide safe drinking water, aid in watering their vegetable gardens and agricultural land. Without this, women toil many hours fetching and carrying water for irrigation and drinking water. Refrigerators are used for storing the medicines and vaccines needed for their children.

Nature of the Project

Goal:

- Utilize a joint multinational academic and industrial team to transfer existing renewable energy technology into an integrated and sustainable package that can easily be supported logistically by native populations in areas where US forces are operating or where the US has identified the area as one of strategic interest.
- Leverage existing Air Force investments in developing and implementing renewable energy technologies (Photovoltaic Solar Panel Systems), such as 14 Megawatt PV array at Nellis AFB, roof mounted PV array at Luke AFB, and the Proposed PV array for Little Rock AFB.

Nature of the Project (cont.)

Project Scope:

- This is intended to be a technology transition, integration, and insertion effort.
- No new technology development is intended as part of this project.
- University research and analysis activities are focused on integration and specification of sustainable system configurations, resulting in interconnect and interoperability specifications for commercial use.

Nature of the Project (cont.)

Project Objectives:

- **Define** Functional and Sustainability Criteria
- **Integrate** commercially available off-the-shelf components and subsystems into sustainable renewable energy systems for rapid deployment.
- **Evaluate** and verify system performance through controlled operational evaluations at university facilities and limited field testing in intended environments
- **Specify** system interconnect and interoperability criteria to allow for competitive acquisitions of systems from multiple commercial entities.
- **Promote** use of system design and specifications for domestic and foreign applications to help meet national defense and energy objectives.
- **Incubate** regional economic development through formation of new commercial system integration ventures within the university economic regions.

Nature of the Project (cont.)

Project Rational:

- Need exists for transition of existing renewable technologies into an integrated system that provides a sustainable social-cultural-economic solution that is affordable, easily deployable by semi-skilled personnel, furthers the objectives of the US and our allies.
- Current renewable energy systems used in humanitarian efforts are hodgepodge assemblies and cannot meet the technical requirements necessary to help satisfy Air Force objectives and US foreign policy goals.
- This project will integrate and validate currently available technologies into easily procurable and affordable alternative energy system configurations that will provide an invaluable tool to American and allied forces operating in all developing regions of the world.

Nature of the Project

Team Members and Strategy:

- The proposed team was organized based on past performance and technical capabilities.
- It is international so that it allows for the widest possible objectivity, within reason, of the cultural neutrality of specification efforts.
- It combines the proven on-time and on-cost experience of an established certified Small Disadvantaged Business (USAF contractor), with the technical and analytical capabilities of major American and European Universities with past DoD contract experience.

Nature of the Project

Team Members:

- **Mosaic Data Systems**, Bedford MA, a Small Disadvantaged Business that has over ten years of highly successful performance on UASF contracts.
- **Arkansas State University**, Jonesboro AR, a leader in technology research and education with an extensive successful government contract performance record.
- **University of Corsica – Pasquale Paoli**, Corte France, a leader in renewable energy research with a proven record of performance on initiatives with the USAF office of European Research.

Nature of the Project

Principal Investigators:

Mosaic Data Systems

- **Basu Sarkar** – Senior engineer and manager with extensive background in renewable energy system deployments in developing regions. Founder and president of Mosaic Data Systems, a SBA certified business with over ten years experience supporting Air Force acquisition and technology transition contracts.
- **Dr. Robert L. Straitt** – Senior engineer/scientist, program manager, wind turbine technician, and licensed electrician with extensive background in renewable energy related technologies. Extensive Air Force experience as a prior Air Force Acquisition and R&D Program Manager, Chief of International Collaborative Programs, and Flight Test Engineer.
- **Alex Kotov** – Senior technologist and system integrator with extensive background in integration of diverse technologies. Most recently a senior technologist at Amazon.com and a former researcher on Air Force advanced technology projects at The Oregon Graduate Institute.
- **Walter Ellis** – Senior technologist and system integrator with extensive background in total technology based solutions for operational and cultural challenges. Former head of quality for IBM Federal Systems Division, Adjunct Professor, and Air Force Consultant on advanced systems and development projects.

Nature of the Project

Principal Investigators:

Arkansas State University

- **Dr. Rajesh Sharma**– Assistant Professor, Renewable Energy and Technology, and Associate Editor of the IEEE Transactions on Industry Applications and International Journal of Renewable Energy Technology. With extensive experience in alternative energy systems including Hydrogen and Fuel Cells, Photovoltaic Systems, Wind Energy, Photo nanostructured materials for photo-electrochemical processes and Plasma Surface Modification. Developed an electrostatics screen for dust mitigation application for NASA to be used on future Mars and Lunar missions.
- **Rev. Dr. Charles Coleman** – Director Technology Program, College of Agriculture and Technology. Extensive experience in application of technology to improve industrial and social conditions. Understanding of how to create and deliver technical training to individuals with diverse levels and backgrounds of basic technological understanding.
- **Nadine Straitt** – Certified Wind Turbine Technician, formerly of Mitsubishi Power Systems and currently an Engineering Technology student at Arkansas State University, focused on renewable energy systems such as wind and solar power generation.

Nature of the Project

Principal Investigators:

University of Corsica – Pasquale Paoli

- **Dr. Christophe Paoli** – Director of the Computer Science Department at Università di Corsica Pasquale Paoli and Associate Professor at Università di Corsica Pasquale Paoli. Applied research work focused on the study of renewable energy sources and systems: decision support to assist policymakers in thinking about the linkages between energy, environmental, and economy; and the use of artificial neural networks to predict solar radiation. Previous research support on projects funded by the European Office of Air Force Research and Development.
- **Dr. Gilles Notton** – Associate professor in Energy Management – Responsible for a research network on renewable energy systems between France and Oriental/Central European Countries. Responsible for Renewable Energy Management Professional Licensing. Research area are focused on renewable energy sources estimation, renewable hybrid systems for electrification, solar collectors for building integration and electrical problematic of islands.
- **Dr. Marc Muselli** – Director of the Physics Department at University of Corsica and Associate Professor at University of Corsica. Applied research work focused on the study of renewable energy sources and systems: Hybrid photovoltaic systems with storage, H2 electrolyzer and fuel cells; alternative water production from air by radiative cooling; decision support to assist policymakers in thinking about the linkages between energy, environmental, and economy; and the use of artificial neural networks to predict solar radiation.

Why the Air Force?

Air Force Energy Program Supports More Than Energy Security

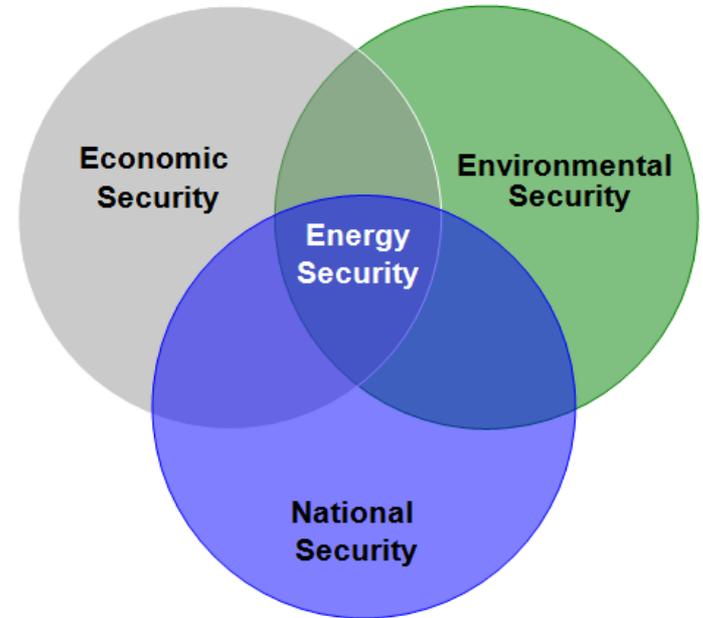
Air Force 3-Part Energy Strategy

Reduce Demand - Increase Supply -
Change the Culture

Collaborate with Allies, sister services,
agencies, on energy best practices

***Make Energy A Consideration In
All We Do***

-Mr. Mike McGhee Acting SAF/IEE, 2009

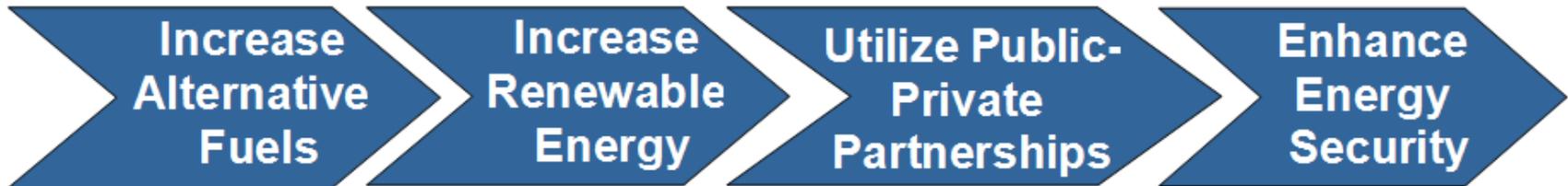
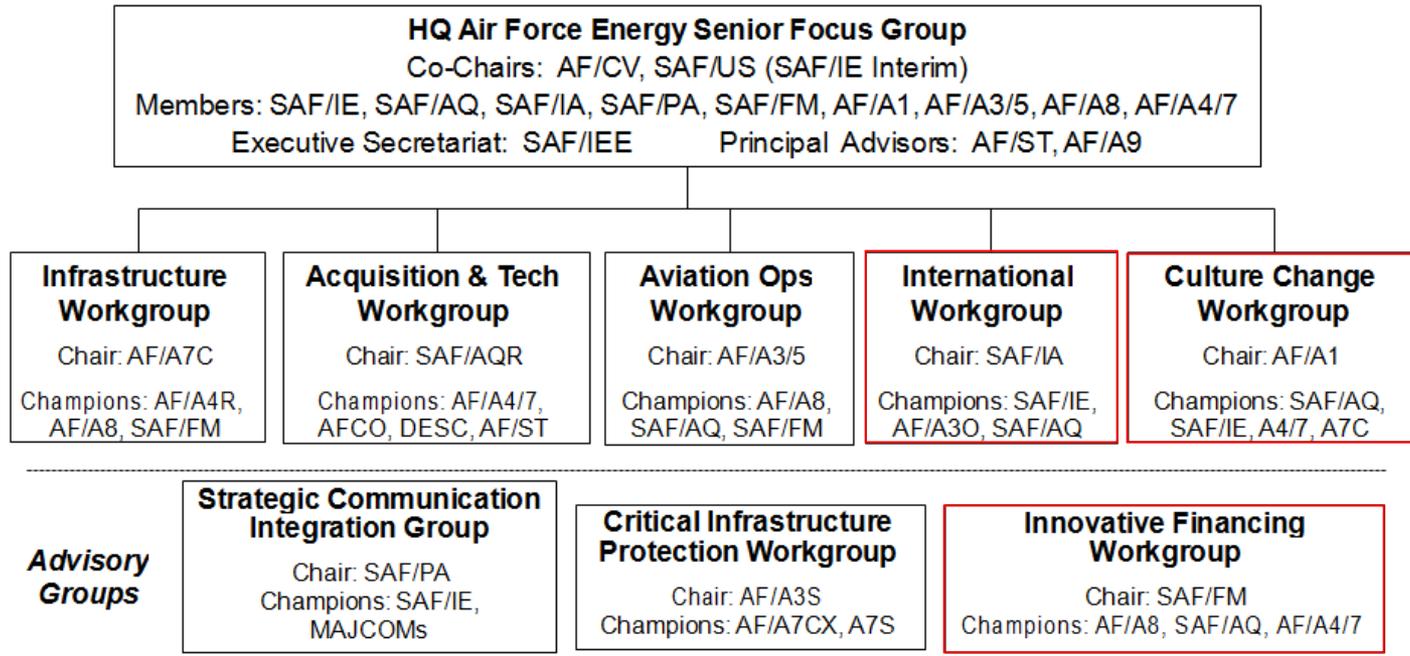


-Mr. Mike McGhee Acting SAF/IEE, 2009

We can't rest until we harness the renewable energy that can create millions of new jobs and new industries. ...That's how we can grow our economy, enhance our security, and protect our planet at the same time. —President Obama, 29 April 2009

Why the Air Force?

Renewable Energy Based Initiatives are Championed by Senior Air Force Management



-Mr. Mike McGhee Acting SAF/IEE, 2009

Summary

- US forces need a multifaceted set of solutions for successfully instituting stable and sustainable opportunities for peace and prosperity amongst indigenous peoples in regions where they are combating terrorism.
- Solutions should be non-culturally/religious invasive, include both men and women of the population group and provide sustainable technology that doesn't require continued US Forces presence to keep the benefits flowing.

Conclusion

- Combating Terrorism requires more than combat, it also requires limiting the growth of terroristic ideals amongst the populations from which terrorists recruit by providing an alternative hope for a better tomorrow.
- Solar Powered domestic lighting and power systems provide an affordable, reliable, and self sustainable method of winning the confidence and trust of indigenous people, by allowing them to share in the benefits of 21st century technology in their homes and communities.