NDCEE

National Defense Center for Energy and Environment

Addressing Key Sustainability Issues for Military Installations in Hawaii

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Presentation Highlights

- Task Overview
- Identification of Key Sustainability Issues
- Technical and Economic Feasibility Study Results
- Siting Issues
- Next Steps

FY07 Regional Sustainability Solutions Technology Development, Demonstration, and Validation – Pacific Rim Region

Identify and conduct a technology demonstration/ validation project in the Hawaiian Island region to support sustainability goals and objectives that span across all Services with a significant presence in the region

Team Members

- Naval Facilities Engineering Command, Hawaii (NAVFAC Hawaii)
- Pearl Harbor Naval Complex (Pearl City Peninsula Family Housing)
- Ohana Military Communities/Forest City Military Communities (FCMC) Hawaii
- National Renewable Energy Laboratory (NREL)
- National Defense Center for Energy and Environment (NDCEE)

Project Approach

- Identify key sustainability issues for Hawaii
- Identify technology opportunities that will address the issues
- Evaluate technology opportunities
- Demonstrate technology opportunity that has transition potential
- Technology transition with focus on Pacific Rim Region

Key Sustainability Issues

- Hawaii 2050 Sustainability Task Force
  - "Act 8" established by 2005 Hawaii state legislature
  - Hawaii 2050 Sustainability Plan
- Hawaii Clean Energy Initiative (HCEI)
- Mayor's Energy and Sustainability Task Force

Outcome

- Reducing energy use and subsequently the high reliance that the Hawaiian Islands have on fossil fuel resources
  - Helps meet numerous local and military initiatives
  - Reduces the military's utility costs
  - Eases energy security concerns
  - Helps protect Hawaii's unique cultural and natural resources by reducing fossil-fuel generated pollution

Renewable Energy

Renewable Energy Categories

1. Biomass: derived from the organic material of agricultural crops, trees, plants, and some types of municipal solid waste
2. Geothermal: heat harvested from the earth and used as thermal energy or converted to electricity
3. Hydropower: energy produced by moving water to power machinery

Renewable Energy Categories (continued)

4. Ocean: can provide energy in the form of heat or mechanical motion created by tides and waves that can be converted to electricity

5. Solar: use of photovoltaic (PV) solar cell systems to convert the light of the sun directly into electricity

6. Wind: produced by wind turbines that convert kinetic energy from the natural motion or flow of air into mechanical energy, which is transformed into electricity

Advantages/Disadvantages

Technology	Advantages	Disadvantages
Biomass	Produced locally	Can produce pollution/GHG
	Low fuel cost	High capital costs
Geothermal	Low air/water pollution	Site specific
	Low land use required	High capital costs
Hydropower	Low air/water pollution	High capital/O&M costs
	Water storage	Ecological impacts
Ocean	Low air/water pollution	Ecological impact
	Local resource	High capital/O&M costs
Solar	Low air/water pollution	Intermittent resource
	Unlimited resource	High capital costs
Wind	Low air/water pollution	Intermittent resource
	Moderate costs	Visual impact

Solar and Wind: Best Renewable Options for O'ahu

- Their energy potential is excellent.
- They are technically feasible and practical.
  - Biomass feedstock is diminishing as agricultural industry declines.
  - Most prime geothermal areas reside within parks or natural reserves.
  - Hawaii's hydropower plants are mostly diversion facilities without dams, which can affect the reliability of energy generation.
  - Ocean energy is experimental.

Technical Feasibility

Stakeholders' Objectives	Solar	Wind
Technology Readiness	X	X
Electricity Production Costs	Evaluated during Cost Feasibility	Evaluated during Cost Feasibility
Sufficient Local Resources	X	X
Compatibility with Family Housing Locations	X	X
Sustainable Energy Portfolio	X	X
Reliability	X	X
Interconnectivity	X	X
Technology Transfer Potential	X	X

Economic Feasibility

- Economic Feasibility: f(system production, utility rates)
- Cost Avoidance
- *Electricity Production:*
  - PV system: 150,000 kilowatt-hours per year
  - Wind turbine: 50 kilowatt (75,000 – 95,000 kWh/year)
- *Electricity Utility Rates:*
  - Historical data
  - Government projections

Economic Analysis Data, Assumptions and Sources

Electricity Rate		Value	Unit	Source
	Fiscal Year 2008	0.19362	$/kWh	Ohana Military Communities
	Ohana Historical Escalation Rate: 1996-2008	5.16	%	Calculated based on Ohana data
	Ohana Recent Escalation Rate: 2004-2008	12.04	%	Calculated based on Ohana data
Inflation Rate				
	Assumed Future Inflation Rate	3.00	%	Assumption
Discount Rate				
	Normal Discount Rate	4.90	%	OMB Circular, Appendix C, revised January 2008. http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html

PV Data, Assumptions and Sources

Photovoltaics	Value	Unit	Source
Capital Cost	828,587	$	Ohana Military Communities
Solar Production	158,472	kWhr/yr	Ohana Military Communities
Operation and Maintenance (O&M) Costs			
System Size	110	kW	Assumption based on DOE estimated output for O'ahu
Annual O&M costs for 110 kW system in 2005	28.00	$/kW/yr	Estimated using *Energy, Economic, and Environmental Benefits of the Solar America Initiative.* S. Grover, ECON Northwest, Subcontractor report, NREL/SR-640-41998. August 2007.
Annual O&M costs in 2008 dollars	29.73	$/kW/yr	Calculated
Equipment Life	30	years	*Photovoltaics Value Analysis*. J.L. Contreras, L. Frantizis, S. Blazewicz, D. Pinault, and H. Sawyer *Navigant Consulting Inc. Burlington, Massachusetts.* **NREL/SR-581-42303. February 2008.**

Wind Data, Assumptions and Sources

Wind	Value	Unit	Source
Capital Cost	231,000	$	Vendor Quote
Minimum Expected Production	75,000	kWhr/yr	Vendor Quote
Maximum Expected Production	95,000	kWhr/yr	Vendor Quote
Operating and Maintenance Costs	1,500	2008 $	Vendor Quote
Equipment Life	30	years	American Wind Energy Association http://www.awea.org/smallwind/toolbox2/factsheet_econ_of_smallwind.html; accessed August 2008.

Economic Evaluation Results

Scenario	Rate	Photovoltaics		Wind			
				Minimum Production		Maximum Production	
		Payback (yrs)	30-Year NPV	Payback (yrs)	30-Year NPV	Payback (yrs)	30-Year NPV
Scenario A	Ohana Historical Escalation Rate: 1996-2008	18	$53,951	12	$194,874	10**	$315,700*
Scenario B	Ohana Recent Escalation Rate: 2004-2008	13	$2,087,967*	9	$1,157,512	8**	$1,535,041
Scenario C	DOE Projected Fuel Price Indices	22	($207,300)	15	$71,232	12**	$159,086*

*Highest NPV for Rate; **Lowest Payback for Rate

Summary

- Value of renewable energy demonstration for the Pacific Rim Region
  - No fossil fuel resources, thereby reliance on imported fuel
  - High energy costs
  - Foreign oil dependence raises energy security concerns
  - Unique cultural/natural resources that could benefit from the reduction in fossil-fuel generated pollution
- Aggressive and conservative utility rates used
  - Economic feasibility highly dependent on unknown future electricity rates
  - Lower paybacks for the wind turbine indicate the fastest investment recovery and the lowest financial risk

Proposed Site

Wind Resource

Grid Tie-in

Next Steps

- Government Demonstration Approval
- Military Site Approval
- Development of Equipment Specifications
- Procurement and Installation
- Demonstration/Validation
- Technology Transition

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