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## Sustainable Energy at Coastal Facilities

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Monterey, California: Naval Postgraduate School

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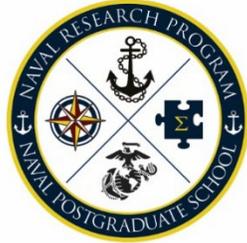
## NPS NRP Executive Summary

Sustainable Energy at Coastal Facilities

Period of Performance: 10/19/2020 – 10/22/2021

Report Date: 10/15/2021 | Project Number: NPS-21-N014-A

Naval Postgraduate School, Graduate School of Engineering and Applied Sciences (GSEAS)



NAVAL RESEARCH PROGRAM

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

SUSTAINABLE ENERGY AT COASTAL FACILITIES

EXECUTIVE SUMMARY

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**Student Participation:** No students participated in this research project.

**Prepared for:**

Topic Sponsor Lead Organization: N4 - Material Readiness & Logistics

Topic Sponsor Organization(s): NAVFAC EXWC

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### Project Summary

This research effort examined the paths to further adoption of sustainable energy at coastal facilities. It examined current technical, financial, legal, and policy challenges that have hindered past efforts to incorporate more renewable energy and that are priorities to be considered for future renewable energy projects.

The research team gathered data and information through an examination of literature and interviews with subject matter experts familiar with coastal facilities and with experts in the renewable energy sector. The team conducted two case studies of US Coast Guard Station Monterey (CA) and Naval Air Station Corpus Christi (TX) to provide additional context for the adoption of sustainable renewable energy at coastal facilities. Additionally, research was conducted on mechanisms for microgrid financing to demonstrate how a facility may finance microgrid installation and further adoption of renewable energy and microgrids.

Researchers found that there are some common core challenges for installing and using microgrids. These challenges include zoning issues, environmental considerations, infrastructure barriers, financing issues, conflicting safety standards, technical obstacles, and administrative hurdles. Researchers found that some challenges can be lessened, avoided, or accounted for with advance preparation and awareness ahead of time.

Further analysis of region-specific challenges would provide more context for consideration of sustainable energy and implementation of microgrids. Further study is also required to understand the details of an appropriate financial acquisition agreement with a quantification of the benefits and costs of microgrids over time. Finally, the processes for contracting out microgrid design and construction and identifying suitable contractors is recommended.

**Keywords:** *energy, renewable, sustainment, solar, wind, battery, microgrid, storage, infrastructure, resilience, adoption, photovoltaic, PV, business model, technology, land use, zoning, permitting, regulation, regulatory, law, legal, policy, interconnection, utility, power, power purchase agreement, PPA, financing, funding, institutional, administrative, barriers, challenges, procedure, environmental, coastal, navy, coast guard, EUL, enhanced use lease*

### Background

Recent extreme climate events and adversary actions have highlighted the importance of resilient energy supplies. While energy costs are expected to continue to rise, Department of Defense (DoD) facilities' reliance on the fragile civilian electrical grid creates vulnerability towards outages.

Renewable onsite generation is an excellent candidate for improving energy security and can help meet new DoD climate goals. Although renewable energy is now cost-competitive with traditional energy sources,



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there are challenges to implementing new technologies at installations. According to DoD renewable energy users, renewable generation assets by themselves have merely served to help lower energy costs and potentially free up funding for other efforts. In order to improve resilience, renewable generation must be paired with grid-forming energy storage or microgrids that are able to continue operating and supplying power to facilities even if the primary energy source (i.e., the power grid) is unavailable.

Energy is generally highly regulated and changes to energy infrastructure on installations are covered by a variety of laws and policies. With the rapid changes in energy technology, microgrids may be subject to policies and laws that were not drafted for this type of technology or the emerging energy systems. While renewable energy assets and microgrids have been in use for many years, they are often seen as emerging technology. Thus, implementing renewables effectively requires overcoming a number of technical, financial, legal, and policy challenges. Awareness of these barriers to implementation and maintenance ahead of time enables facilities to address common hurdles early in the process rather than as they arise or after commitment to a microgrid is made. This preparation means facilities can be in a better position to meet resiliency goals and manage adverse energy conditions.

The research team initially consulted with Naval Facilities Expeditionary Warfare Command and other facilities that were interested in acquiring renewable or microgrid technologies. Inquiries revealed that many facilities have difficulty maintaining existing renewable systems. Researchers originally planned to create a Do-It-Yourself guide to implementing small scale renewables and microgrids, but based on these consultations, the research team explored alternative means of microgrid acquisition and ownership. This process included law and policy analysis to understand challenges involved in the process of design and implementation.

The team examined a financing model where energy generation and storage assets on bases would be owned and operated by one or more contractors and financed through purchasing the power generated at a premium. With this approach, the federal government can better examine the various paths to implementing and sustaining renewable energy generation, and have examples of an acquisition method whereby a contractor will maintain the assets without large upfront acquisition costs.

Data was collected through study of academic literature, industry reports, and government publications, as well as interviews with subject matter experts representing coastal facilities and the renewable energy sector. Additionally, the research team consulted with installation staff at U.S. Coast Guard Station Monterey (California) and Naval Air Station Corpus Christi (Texas).

### Findings and Conclusions

The research team found that some renewable energy generation assets that exist on naval facilities are inoperable due to the lack of personnel qualified to service them. Some simply serve to lower energy costs as opposed to increasing resilience and decreasing their carbon footprint to meet state and federal emissions



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targets. Compounding this problem, many of these systems are custom-built for the facility in which they operate, so the knowledge of these systems' inner workings is concentrated in just a few individuals. Challenges also exist in the implementation of new projects due to legal, regulatory, and implementation hurdles that affect the time for a project to be implemented. Financing barriers exist in funding renewable energy and energy storage projects because of the large upfront cost, slow payback for renewable generation, and lack of means to adequately quantify the resilience benefits of energy storage when conducting Return On Investment analyses.

Results demonstrated that in order to promote the successful adoption of renewable energy assets, facilities should understand restrictions with land use boards and pursue zoning exceptions in the face of potential antiquated zoning laws. Environmental and safety considerations should be incorporated early, as well as the training of personnel prepared to support maintenance of the assets. Facilities need to address their relationship with the utility provider in order to incorporate a microgrid into existing energy infrastructure, identifying interconnection issues early on and factoring time for collaboration with local, state and federal partners to implement new technology. Site-specific institutional and administrative barriers resulting in slow and/or complicated implementation may also need to be addressed. Additionally, adopting a paradigm of contractor-owned and operated microgrids on facilities, financed through a Power Purchase Agreement (PPA), Enhanced Use Lease (EUL), or similar mechanism is recommended.

### Recommendations for Further Research

Sustainable energy at Department of Defense (DoD) installations is subject to a dynamic context: increased demand for resilient energy supplies, lower costs of renewable energy, increased availability and use, government incentives and reduced emission targets are transforming some energy systems. This transition likely will include decentralized energy generation and storage systems, new technology, and new financial and contractual mechanisms to account for energy users also being energy producers. Researchers' findings and this reality sets the tone for future research.

Further analysis of region-specific challenges would provide more context for consideration of sustainable energy and implementation of microgrids, including legal and policy issues and climate-specific design factors.

In addition, further research is needed to determine the most viable contractual means to secure acquisition of contractor-owned and operated renewable and microgrid systems. Researchers concluded that the most viable path forward would be similar in nature to a Power Purchase Agreement (PPA), where the DoD buys energy generated from the renewable and microgrid system at a premium, but it is unclear if a specific contractual vehicle will allow the DoD to do this in a way with a higher-than-market-rate energy cost.



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Further research is also recommended to quantify the benefits of microgrids and energy storage over time, so that the DoD can properly assess the value of their resilience benefits and assign an appropriate price tag.

### **Acronyms**

EUL	Enhanced Use Lease
DoD	Department of Defense
PPA	Power Purchase Agreement

