# 1 Project Description

# Contents



## 1.1 Introduction

### 1.1.1 Vision

*This section provides a concise description of the "vision" for our proposed sustainable energy pathway that focuses on energy transmission, distribution, efficiency, and use.*

*We must show in our vision: a combination of scientific knowledge and technical innovation; a recognition of environmental, societal, and economic imperatives; and a promotion of education and workforce development.*

*We need a transformative approach to SEP, not incremental advances or deployment of existing technologies.*

### 1.1.2 Integration

*This section will summarize how we will approach the research from an interdisciplinary perspective that integrates science and engineering with a synergistic, systems approach.*

### 1.1.3 Collaboration (Management Plan)

*The management plan will discuss the roles, qualifications, and synergy of the multi-disciplinary team, the leadership structure, and the integration of the proposed activities among team members. International or industrial collaborations can strengthen the proposal.*

## 1.2 Pathway to Smart, Sustainable Microgrids

*Our proposed pathway involves the development of a testbed consisting of the UH Manoa campus which we will convert into a "smart, sustainable microgrid". Here we provide some background material about the UH Manoa campus, and introduce the four building blocks of a smart, sustainable microgrid.*

### 1.2.1 Sensing and monitoring

*The first step in creation of a smart, sustainable microgrid is the design and installation of appropriate sensing equipment for both electrical and environmental data.*

*Contributions of this part of the research include development of experimental procedures and data that can help other potential microgrid sites to more easily determine what data needs to be collected, where it needs to be collected from, and how frequently it needs to be collected.*

### 1.2.2 Modeling and analysis

*Given appropriate data, the next step is to apply analytic techniques to create real-time and historical information useful for control and optimization of the microgrid.*

*Two important contributions of this part of the research will be: (1) analytic techniques that enable us to adequately characterize the current state of the microgrid without a cost-prohibitive deployment of sensing equipment, and (2) analytic techniques that enable short-term prediction of various useful attributes of the micro-grid (such as future (potentially peak) load and ramp) and the surrounding environment (insolation, wind speed and direction, etc.)*

*It should be noted that there is an interdependence between the "sensing and monitoring" subproject and the "modeling and analysis" subproject: we will "tune" the installation of sensing equipment in order to obtain acceptable quality of analytic outcomes for the next step, control and optimization.*

### 1.2.3 Control and optimization

*The primary goals of a smart, sustainable microgrid is to use electrical energy as efficiently as possible, maximize the amount of energy coming from renewable resources, and minimize the overall cost of energy while retaining acceptable levels of reliability and quality. This section discusses how the data provided by analytical models will be used to achieve those goals. Some of the important capabilities include: voltage and frequency regulation, peak shaving and peak shifting (in order to obtain reduced rates from the utility), and lowered overall consumption. The initial approach will be to implement demand-response for the large-scale chillers in the microgrid. This automated mechanism will be supplemented by community awareness dissemination techniques that can enable interested members of the microgrid to participate in achieving cost savings and more efficient usage of renewable resources.*

*The contributions of this part of the research will include development of the software and hardware systems required to support various control and optimization capabilities, and empirical studies that demonstrate the extent to which those capabilities can be achieved in a real world setting.*

### 1.2.4 Social, economic, privacy, security, and policy implications

*It would be naive to assume that a smart, sustainable microgrid could be implemented transparently and invisibly to its users. Indeed, we believe that part of the problems with our current electrical infrastructure results from lack of public awareness concerning the problems of reliable, sufficient, and sustainable energy production. Many people are used to virtually unlimited, low-cost, and reliable electrical energy produced in an unsustainable, environmentally harmful manner and do not yet understand why this cannot continue.*

*Thus, an important part of this project is to develop information that can not only be used to control the grid, but also be used to inform the inhabitants of the microgrid about its current state in a useful, actionable form. We believe this is important not only to obtain support from consumers for the costs and complexity associated with development of a smart, sustainable microgrid, but also to enable them to become active participants in management of the grid. By actively participating, efficiencies not possible with chiller management alone can be realized. In addition, it will create the data necessary for broader policy decisions by local government that can make future smart, sustainable microgrids easier to develop and deploy.*

*We will also investigate the privacy and security aspects of this technology.*

*Contributions of this part of the research will involve the design and evaluation of user-facing energy awareness and control systems and their impact on overall energy use, and an initial understanding of policy implications.*

### 1.2.5 Education and workforce development

*This project will not only include development of science and technology, but also curriculum materials. We will teach a variety of courses alongside the development of the microgrid which will enable our students to develop skills necessary to deploy these technologies. These curriculum materials will be made publically available.*

*Contributions of this part of the research will include the development of curriculum materials and the creation of engineers and scientists skilled in this area.*

## 1.3 Project plan

*This section provides a timeline of events and activities that show how the project will proceed on a quarterly basis, when milestones will be achieved, etc. We will need to create a list of milestones for the each of the subprojects and how they will interrelated to each other.*

## 1.4 Results from prior NSF research

*From the NSF GPG:*

*If any PI or co-PI identified on the project has received NSF funding in the past five years, information on the award(s) is required. Each PI and co-PI who has received more than one award (excluding amendments) must report on the award most closely related to the proposal. The following information must be provided:*

- *the NSF award number, amount and period of support;*

- *the title of the project;*
- *summary of the results of the completed work, including accomplishments related to the Broader Impact activities supported by the award and, for a research project, any contribution to the development of human resources in science and engineering;*
- *publications resulting from the NSF award;*
- *evidence of research products and their availability, including, but not limited to: data, publications, samples, physical collections, software, and models, as described in any Data Management Plan; and*
- *if the proposal is for renewed support, a description of the relation of the completed work to the proposed work.*

*Reviewers will be asked to comment on the quality of the prior work described in this section of the proposal. Please note that the proposal may contain up to five pages to describe the results. Results may be summarized in fewer than five pages, which would give the balance of the 15 pages for the Project Description.*

## 1.5 Conclusions

*Summarize the expected contributions of the proposed research and how we meet the requirements of this solicitation.*

# References