CITY OF HUNTINGTON BEACH ENVIRONMENTAL BOARD

PO Box 190 • Huntington Beach, CA 92648

AGENDA

Wednesday, August 17, 2016 @ 6:00 p.m.
Central Library Room B – 7111 Talbert Avenue, Huntington Beach, CA 92648

I. Call to Order/Roll Call
Soriano (Chair), Budica (Vice-Chair), Killey (Secretary), Claud-Clemente, Coffman, Nicolson, Scrimgeour, Sheldon, and Thompson.

II. Approval of Minutes: July 2016

III. Public Comments (Open to the Public)
This is the time of the meeting for the Environmental Board to receive comments from the public regarding items of interest. Pursuant to the Brown Act, the Environmental Board may not enter into discussion regarding items not on the agenda. Members of the public who wish to speak to a member of the Environmental Board or an item not on the agenda may consider setting up an appointment with the staff liaison. Each speaker is allowed 3 minutes, and time may not be donated to another speaker.

A. Guest Speaker – Garry Brown, Orange County Coastkeeper

IV. Action Items (60 minutes)

A. EIRs (http://www.huntingtonbeachca.gov/government/departments/planning/environmental-reports/)

a. **Air Quality Management Plan - http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan/Draft2016AQMP**

V. Committee Updates

A. Executive Committee
A-1.Committee Assignments

B. Resource Management Committee (Coffman/Budica/Soriano)
B-1. Environmental Board Anti-litter campaign- Art Contest (Budica/Nicolson)
B-2. Water Refill Stations – Water Wall (Budica)

C. Ocean Debris & Water Quality Committee (Coffman/Soriano/Scrimgeour)
C-1. Surfrider Beach Clean-up Update
C-2. Adopt-a-Channel Update
C-3. Ocean Debris Coastal Waste Containers Update – Budget for 16/17

D. Natural Environment (Killey/Nicolson/Thompson/Claud-Clemente)
D-1. Park Clean-up Update – Inner-Coastal Clean-up Day September 2016

E. Energy Issues (Sheldon)
E-1. Streetlight Acquisition and Retrofit
E-2. EPIC Challenge Update and Status (Grant Application & Spark Fellow)

VI. Administrative Items (25 minutes)

A. Elections
B. Environmental Board Tour Schedule
C. Sustainable Business Certification Program Update (Staff)
D. Recycling Market Development Zone Update (Staff)
E. Green Forum and Expo (Killey)

VII. Environmental Board Requests

A. Speaker/Field Trip/Agenda Requests

VIII. Environmental Board Comments

IX. Adjournment until 6 p.m. September 21, 2016

X. Preview of Upcoming Meetings:

Guest Speaker Mary Urashima – Sustainability & Historic Preservation

For further information please contact Staff Liaison Antonia Graham, Assistant to the City Manager/Energy and Sustainability Project Manager, at (714) 536-5537 or Antonia.graham@surfcity-hb.org

ATTACHMENT 2
Executive Summary Form

Huntington Beach Advanced Energy Community Blueprint
A Scalable, Replicable, and Cost-Effective Model for the Future

1. Project description:

The Advanced Power and Energy Program (APEP) at the University of California, Irvine (UCI), is collaboratively teamed with a local government (City of Huntington Beach, the City), a built environment technology developer (Altura Associates, Inc., Altura), utilities (Southern California Edison, SCE, and Southern California Gas, SCG), and a national laboratory (National Renewable Energy Laboratory, NREL), to address the EPIC Challenge of accelerating the deployment of Advanced Energy Communities (AEC). The proposed master community design approaches and the integration of the innovative energy technologies in this project will advance development and establish technical and economic readiness for accelerating the deployment of AEC throughout the State. The design will be replicable to other communities throughout California with transferable knowledge and technologies.

2. Project goals and objectives:

The goal of the proposed project is to develop extensible tools and to plan and design (Phase I) the integrated set of energy infrastructure and advanced energy technology approaches to convert the disadvantaged Oak View community of Huntington Beach into an Advanced Energy Community. The proposed project will develop tools to design and evaluate integrated sets of advanced energy technologies and solutions at a community scale and to verify the benefits of AEC to California Investor-Owned-Utilities (IOUs), ratepayers and the California Independent System Operator (CAISO) in various case studies and AEC designs. To accelerate the deployment of AECs throughout the state, applied research is needed to integrate and optimize the promising new energy innovations into a unified system that efficiently interacts with the existing community electrical grid/infrastructure/buildings, serves various end-uses, obtains performance data for scale-up, and performs cost-benefit analyses for demonstrating economic feasibility. Master community design tools and approaches and integration and control strategies for innovative energy technologies will be advanced in this project, which will accelerate the development of and establish technical and economic readiness for deployment of AECs throughout the State. The tools will be extensible and the AEC designs will be replicable to other communities throughout California with transferable knowledge, technologies, and findings.

Specific objectives of the proposed project are to:

- Develop and establish an AEC Design and Planning Tool to provide insights and recommendations on various integration and deployment options for the community,
- Develop and establish a Smart Community Microgrid Energy Management Model that can simulate and evaluate the impacts and performance characteristics of the suite of clean energy technologies and systems that will be implemented in the AECs,
- Carry out case studies to evaluate various designs and integration strategies; the design effort will include, but not be limited to, combinations of Energy Efficiency Measures (EEM), supplemental local renewable energy sources, energy storage systems, novel uses of the natural gas system, clean power generation systems with combined cooling, heating and power, and Smart-grid technologies that will be evaluated for the best value in terms of economic, environmental and technical performance,

- Propose a Master Community Design for the Oak View community from the case studies, and establish a Master Community Design for a generic community,
- Develop financial and business models for AEC design and develop a market facilitation plan,
- Develop an outreach strategy for educating the building industry, utilities, government agencies, communities and other interested parties regarding the benefits of using an integrated set of advanced energy technologies to revitalize and energize a community, make it an AEC, and produce jobs and educational benefits.

3. Explanation of how project goals and objectives will be achieved, quantified, and measured:

Each of the objectives has a task in the approach that is dedicated to meeting that objective. Each of the tasks has specific deliverables that are delineated and well-defined and which will contribute directly to the successful achievement of the task (and corresponding objective). Successful completion and delivery of all of the deliverables will quantitatively comprise the means by which success in meeting the goals and objectives of the project will be measured.

4. Project task description:

Task 1: General Project Tasks: the tasks specified in the Scope of Work
Task 2: Develop AEC Design and Planning Tool
Task 3: Develop Smart Community Microgrid Energy Management Model
Task 4: Carry Out Case Studies on Various Integration Designs
Task 5: Propose Master Community Design
Task 6: Develop Financial and Business Models
Task 7: Develop Outreach Strategy
Task 8: Evaluation of Project Benefits
Task 9: Technology and Knowledge Transfer Activities

5. Agreement management description:

APEP will be the project lead with a strong history of forming strategic alliances that encompass industries, agencies, and utilities. APEP will leverage this experience and established relationships to assure that the project is successfully accomplished. APEP will manage the project as the prime contractor with CEC and the City of Huntington Beach will provide host site in Oak View Community for the design and planning of the Advance Energy Community in Phase I. The proposed team is uniquely qualified to address all the challenges and requests identified in the GFO. It includes the following entities: City of Huntington Beach, Altura Associates, National Renewable Energy Laboratory, Southern California Edison, and Southern California Gas Company. Each of the team members are experienced in the roles they are to perform, and most of the team have records of collaboration with APEP. This team will be supported by in-kind contributions from a number of California stakeholders, some of which have provided commitment and support letters (see Attachment 11).

ATTACHMENT 3
Fact Sheet

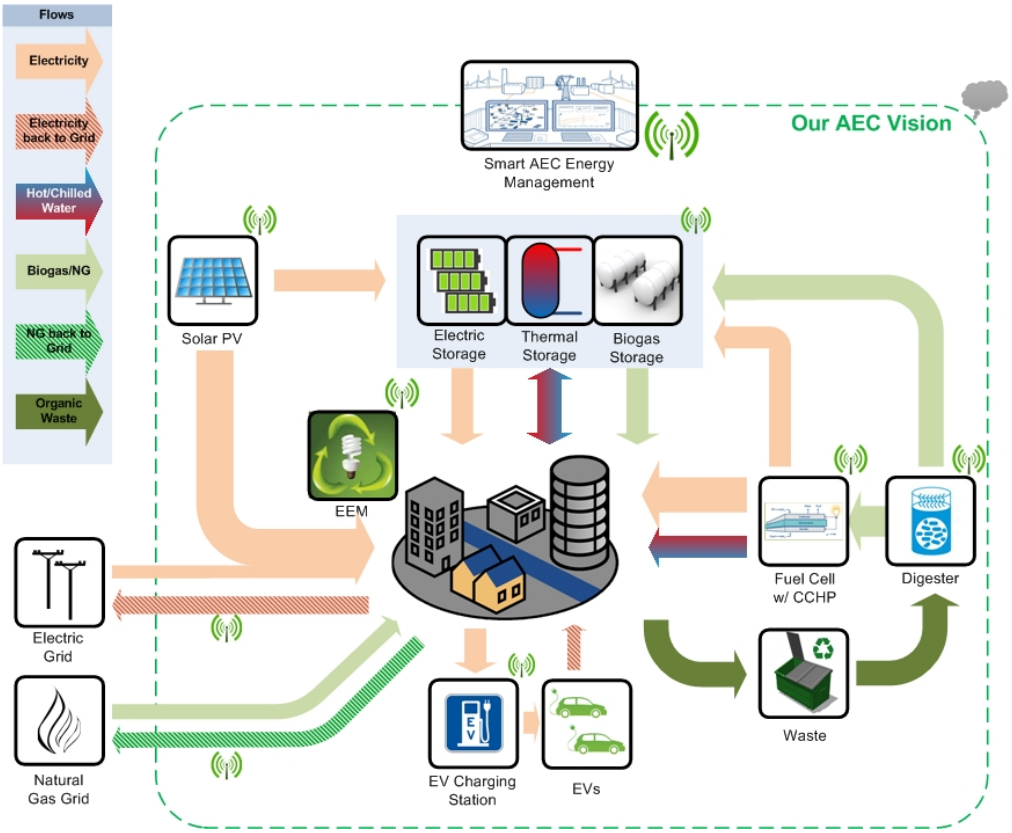
Huntington Beach Advanced Energy Community Blueprint
A Scalable, Replicable, and Cost-Effective Model for the Future

The Issue

The state of California is required by law to meet 33% of its electricity demand by renewable resources by 2020, and towards the goal of 50% in 2030. Many of the renewable resources that will be used and add to the communities (solar, wind, biogas, etc.) are intermittent and uncontrollable, which requires increased various-scales of energy storage system, energy technologies and proper integration designs and strategies. More importantly, there is lack of optimal integration approaches of smart grid technologies, combined cooling heating and power generation with high temperature fuel cells, energy storage technologies, and renewable energy utilization, for greater electricity reliability, lower costs, increased safety and Zero Net Energy (ZNE) future in the community level.

Project Description

The Advanced Power and Energy Program (APEP) at the University of California, Irvine, is collaboratively teamed with a local government (City of Huntington Beach), a built environment technology developer (Altura Associates, Inc.), utilities (Southern California Edison and Southern California Gas), and national laboratory (National Renewable Energy Laboratory) to address the EPIC Challenge of accelerating the deployment of Advanced Energy Communities (AEC).



ATTACHMENT 3
Fact Sheet

The goal of the proposed project is to develop extensible tools and to plan and design (Phase I) the integrated set of energy infrastructure and advanced energy technology approaches to convert the disadvantaged Oak View community of Huntington Beach into an Advanced Energy Community. The proposed project will design and evaluate integrated sets of advanced energy technologies and solutions at a pilot/community scale and to validate its benefits to California Investor-Owned-Utilities ratepayers and California Independent System Operator in various case studies and designs.

Scalable and replicable, the combination of proven clean energy technologies and systems that we propose to evaluate for transforming the Oak View Community will include, but not be limited to: 1) energy efficiency measures, 2) solar and wind energy sources inside the community, 3) use of the natural gas and electric utility grid infrastructure, 4) renewable gas resources, 5) energy storage systems for electric, thermal and chemical energy storage, 6) Electric Vehicles (EV) and EV charging infrastructure, 7) zero emissions backup generators, 8) local zero emissions combined heating, cooling and power generation, 9) smart energy management, and 10) smart-grid technologies.

To accelerate the deployment of AEC, applied research is needed to integrate the promising new energy innovations into a unified system to efficiently interact with the existing community electrical grid/infrastructures/buildings and to serve various end-uses, obtain performance data for scale-up, and perform cost-benefit analysis for demonstrating the economic feasibility. The proposed master community design approaches and the integration of the innovative energy technologies in this project will advance development and establish technical and economic readiness for accelerating the deployment of AEC throughout the State. The design will be replicable to other communities throughout California with transferable knowledge and technologies.

Anticipated Benefits for California

With our replicable AEC vision and design, the California IOU ratepayers benefit from higher reliability and the reliability is increased by 1) local renewable energy resources are being utilized in the AEC and could serve the critical loads inside the community without interruption, 2) providing mobility in case of an emergency through electric vehicle charging stations in adjacent communities, 3) the AEC could provide ancillary services to the grid during normal operations, and 4) the AEC could provide black-start capability. Our AEC design will provide lower costs and economic benefit to the ratepayers by 1) reducing the transmission/distribution losses, 2) reducing the need for new transmission infrastructure and 3) providing a less expensive method in achieving state's 50% renewable goal and environmental goals. The AEC with our design, will maximize the utilization of the local available renewable sources, and will tremendously help the State to reach the 50% renewable goal in a distributed fashion.

Project Specifics

Contractor: Advanced Power and Energy Program, University of California, Irvine
Partners: City of Huntington Beach, Altura Associates, Inc., National Renewable Energy Laboratory, Southern California Edison, Southern California Gas Company
Amount: $1,500,000
Co-funding: $810,998
Term: July 2016 to March 2018

ATTACHMENT 4
Project Narrative Form

Huntington Beach Advanced Energy Community Blueprint
A Scalable, Replicable, and Cost-Effective Model for the Future

1. Technical Merit and Need

1.1. Project Overview, Goals and Objectives

The Advanced Power and Energy Program (APEP) at the University of California, Irvine (UCI), is collaboratively teamed with a local government (City of Huntington Beach, the City), a built environment technology developer (Altura Associates, Inc., Altura), utilities (Southern California Edison, SCE, and Southern California Gas, SCG), and a national laboratory (National Renewable Energy Laboratory, NREL), to address the EPIC Challenge of accelerating the deployment of Advanced Energy Communities (AEC).

The goal of the proposed project is to develop extensible tools and to plan and design (Phase I) the integrated set of energy infrastructure and advanced energy technology approaches to convert the disadvantaged Oak View community of Huntington Beach into an Advanced Energy Community. The proposed project will develop tools to design and evaluate integrated sets of advanced energy technologies and solutions at a community scale and to verify the benefits of AEC to California Investor-Owned-Utilities (IOUs), ratepayers and the California Independent System Operator (CAISO) in various case studies and AEC designs. To accelerate the deployment of AECs throughout the state, applied research is needed to integrate and optimize the promising new energy innovations into a unified system that efficiently interacts with the existing community electrical grid/infrastructure/buildings, serves various end-uses, obtains performance data for scale-up, and performs cost-benefit analyses for demonstrating economic feasibility. Master community design tools and approaches and integration and control strategies for innovative energy technologies will be advanced in this project, which will accelerate the development of and establish technical and economic readiness for deployment of AECs throughout the State. The tools will be extensible and the AEC designs will be replicable to other communities throughout California with transferable knowledge, technologies, and findings.

Specific objectives of the proposed project are to:

- Develop and establish an AEC Design and Planning Tool to provide insights and recommendations on various integration and deployment options for the community,
- Develop and establish a Smart Community Microgrid Energy Management Model that can simulate and evaluate the impacts and performance characteristics of the suite of clean energy technologies and systems that will be implemented in the AECs,
- Carry out case studies to evaluate various designs and integration strategies; the design effort will include, but not be limited to, combinations of Energy Efficiency Measures (EEM), supplemental local renewable energy sources, energy storage systems, novel uses of the natural gas system, clean power generation systems with combined cooling, heating and power, and Smart-grid technologies that will be evaluated for the best value in terms of economic, environmental and technical performance,
- Propose a Master Community Design for the Oak View community from the case studies, and establish a Master Community Design for a generic community,
- Develop financial and business models for AEC design and develop a market facilitation plan,
- Develop an outreach strategy for educating the building industry, utilities, government agencies, communities and other interested parties regarding the benefits of using an

integrated set of advanced energy technologies to revitalize and energize a community, make it an AEC, and produce jobs and educational benefits.

Compared to a normal community, illustrated in Figure 1, our vision for an AEC is illustrated in Figure 2. This vision of an AEC will be elaborated upon throughout this project narrative.

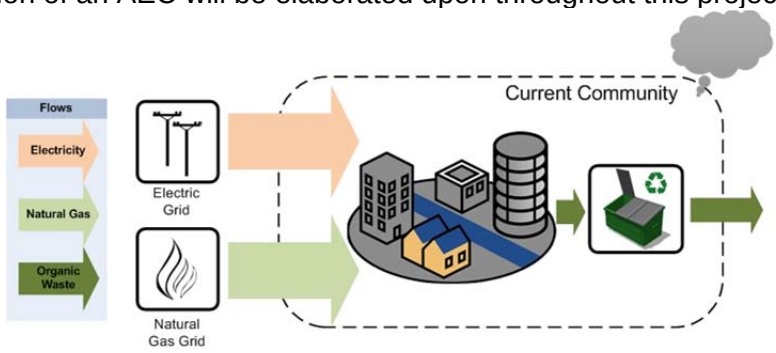


Figure 1. Illustration of the energy flows in a normal community.

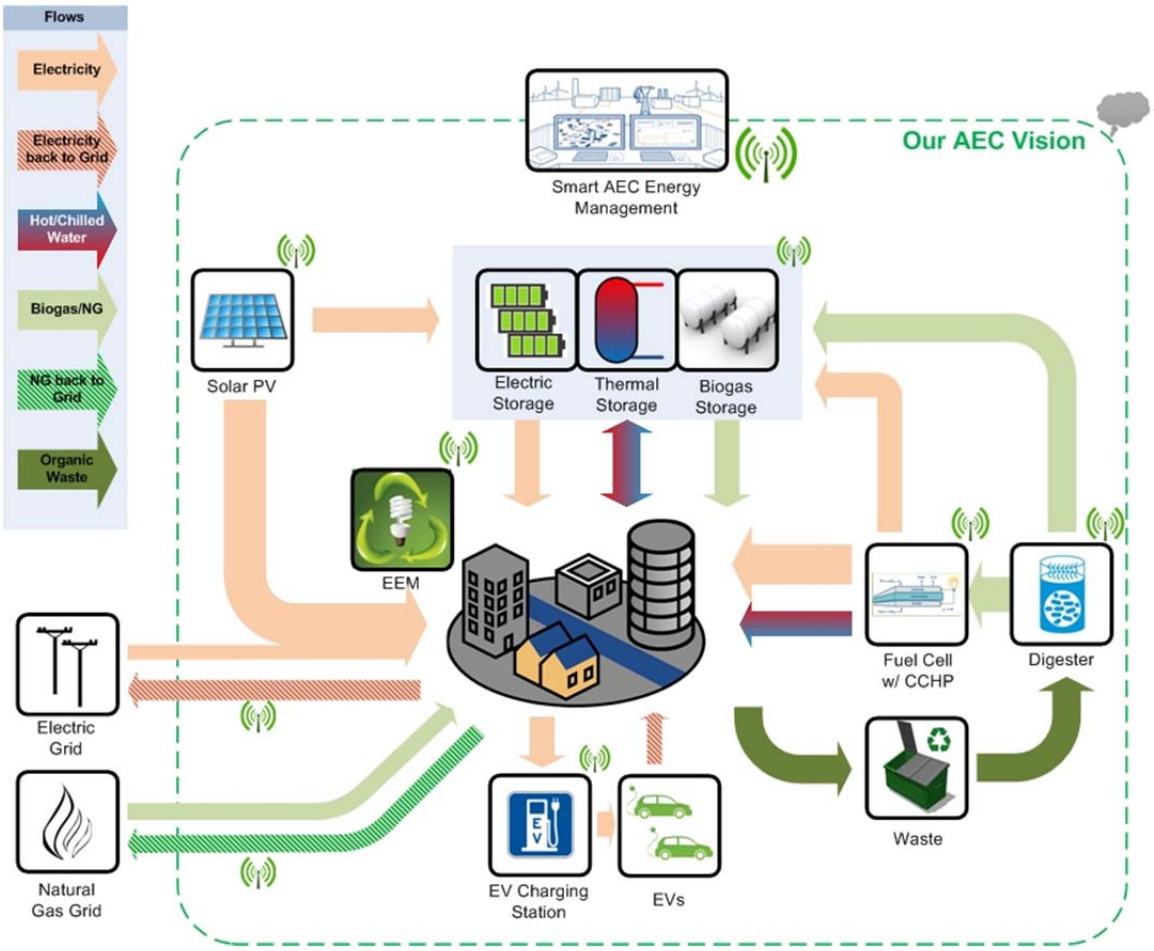


Figure 2. Our vision of an Advanced Energy Community.

As our AEC vision illustrates, our experience with previous integrated energy community projects, like the Irvine Smart Grid Demonstration (ISGD) project and the UCI Microgrid, has

determined that integrated development of a suite of technological and financial means of achieving an AEC is key. Scalable and replicable, the combination of proven clean energy technologies and systems that we propose to evaluate for transforming the Oak View Community will include, but not be limited to: 1) energy efficiency measures, 2) solar and wind energy sources inside the community, 3) novel use of the natural gas and electric utility grid infrastructure,
4) renewable gas resources, 5) energy storage systems for electric, thermal and chemical energy storage, 6) Electric Vehicles (EV) and EV charging infrastructure, 7) zero emissions backup generators, 8) local zero emissions combined heating, cooling and power generation, 9) smart energy management, and 10) smart-grid technologies.

The proposed work will combine regulatory streamlining strategies with a real-world development example to produce a shovel-ready Advanced Energy Community, and a case study that describes the actions, challenges and lessons learned from the project. As identified in the application form (Attachment 1), we will plan and design the integrated set of energy infrastructure and advanced energy technology approaches to convert the disadvantaged Oak View community of Huntington Beach into an Advanced Energy Community. The Oak View community, as shown in Figure 3, is a disadvantaged community located in Southern California (Using the Oak View Resource Center at 17261 Oak Lane as the center, the community scores between a 76-80% on CalEnviro Screen 2.0). Note that the community is comprised of single-family and multi-family housing, a school, a library, a park, some industrial and commercial properties and contains a waste recycling facility that could be converted to produce renewable biogas.

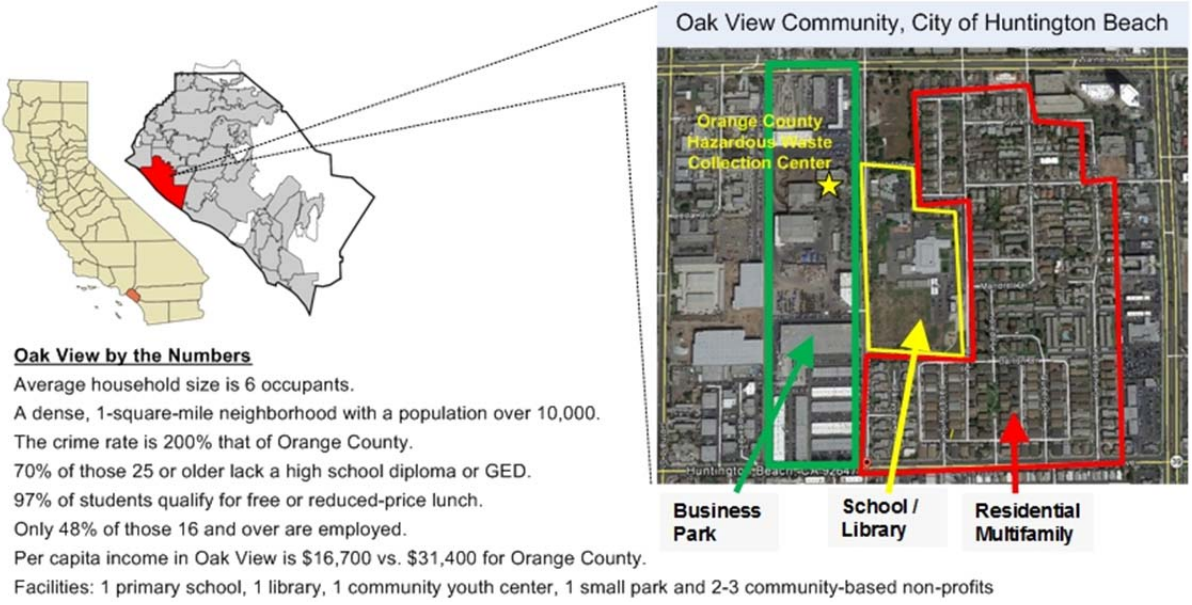


Figure 3. Snapshot of the Oak View Community in the City of Huntington Beach.

1.2. Groundwork for Technology Advancement & Breakthroughs

The State of California has set goals to increase the use of renewable energy and to increase zero net energy (ZNE) building infrastructure to improve sustainability and gain environmental benefits. The power production of several of the most promising renewable energy technologies, such as solar and wind power, are intermittent, and often do not match the

spatial and temporal energy demand dynamics of consumers. The intermittent nature of solar and wind energy could lead to serious issues with grid stability and require significant upgrades to the existing power systems unless smart-grids and AECs are widely implemented. California's electric transmission and distribution systems are undergoing significant changes to accommodate the increasing amount of renewable energy sources that are being integrated into these systems. Integrated sets of EEM, energy storage, local power generation and advanced controls are required to handle renewable intermittencies that act in different time scales, without which high penetrations of renewables could have significant negative impacts on grid management costs and operations including effects on regulation, load following, and scheduling [1]. At current trends and with current policies, higher renewable power penetration in the community level tends to occur with community-scale integration strategies (like that proposed herein). With this proposed effort, a master community design can be deployed to transform many communities to AECs while minimizing the potential negative impacts on the grid, while gaining environment benefits.

This proposed effort will 1) maximize the cost-effective use of the renewable energy sources in the community, 2) help mitigate the increasing renewable intermittency impacts on the local utility grid, 3) reduce the emissions in the community (4) reduce life cycle costs of energy consumption for rate payers, and 5) improve the grid reliability and resiliency. The proposed project will support development and commercialization of technological advancements that overcome barriers to achieving the state's increased use of renewable energy goals. The proposed effort will advance the integration of emerging and proven green energy technologies, with various end-uses in the community. The knowledge gained from the integration of these technologies with various end-uses will be valuable to communities throughout California.

This proposed project will lay the regulatory and policy groundwork for facilitating similar projects by testing out technologies, research methodologies for energy management and control, and actually implementing an AEC with thorough engagement of local and State regulatory agencies. The proposed project creates a diverse team that has the ability to work collaboratively with regulatory agencies at the local, regional, and State levels. The City of Huntington Beach has a proven track record of working with regulatory agencies to fund grant proposals from the California Department of Resources, Recycling & Recovery to the Department of Toxic Substances Control, County agencies, and the Department of Energy.

This project will lay the groundwork for communities to create replicable and scalable AECs that will help the State meet our ambitious climate and renewable energy goals. California has a wealth of natural resources and talent; the same can be said for Orange County – home to a highly intelligent and skilled workforce and beautiful natural resources. As the State continues to be an international leader in environmental stewardship and climate policy, the City of Huntington Beach has been a leader in Orange County. While the County as a whole possesses very conservative values, the City of Huntington Beach has been successful in all endeavors to become more sustainable and create a more viable energy future for our residents and business owners. The City Council of Huntington Beach understands that it makes good business sense to be sustainable and in 2008 created the Energy Project Manager position, the first of its kind in the County. This position oversaw the installation of three large solar arrays in the City.

The City's Community Development Department is responsible for administering land use and development in the City and will assist the project team with the California Environmental Quality Act permitting and regulatory processes. The staff of 12 planners and a Planning

Manager will be able to work hand-in-hand with the Huntington Beach/UCI project team. This will serve as a model for the project and will advance a policy and regulatory framework for creating AECs that can be replicated in communities throughout the State.

As California continues to make progress on our energy efficiency goals so does the City of Huntington Beach; by partnering with UCI, the City is poised to continue leading the way. The proposed project will enable the City to maneuver through the regulatory process in a way that sets the tone for communities to follow by working collaboratively with regulatory agencies in creating AECs. These communities will rely less on traditional energy infrastructure and will be able to harness natural resources so that they are not only helping to reduce greenhouse gases and pollutants from entering the environment, but they are providing an economic development tool to their business and residential community. This project seeks to not only transform a disadvantaged community but also create economic opportunity for the residents within Oak View and the surrounding area. By funding this project, the City and UCI will be able to create design tools and a roadmap for communities to create their future and move the needle further and faster when it comes to cleaner energy resources.

1.3. Regulatory Structures and Designs, Current and Proposed Advancement

Ratepayer programs are typically categorized into specific resources – e.g., Energy Efficiency, Demand Response, and Integrated Demand Side Management - and are often prohibited from using the same funding source to analyze and deploy multiple resources to the same project. This prohibits multiple technologies or resources from being integrated and optimized. Furthermore, the program offerings are often segmented between market sectors (i.e., residential, commercial, industrial, etc.). An overarching strategy is needed that crosses all sectors and resources. What is needed is clearer communication amongst policy makers and regulators (e.g., the CPUC and the CEC); when such agencies are out of sync then optimal and desirable results are not possible. This is troublesome especially when the State has set such ambitious goals to decarbonize the electricity sector and reduce greenhouse gases.

In addition, advanced energy projects are often stalled or in some cases never started because participating in the savings incentive/rebate programs of the investor owned utilities (IOUs) is onerous and there is often a high uncertainty about the financial impacts of such projects. The tools and AEC concepts developed in this project will assist communities in overcoming these hurdles. In his 2015 inaugural speech, Governor Brown set a goal to double the efficiency savings achieved in existing buildings; this is an ambitious goal, but, it will be increasingly difficult to unless tools such as those proposed are developed to enable one to navigate the IOU reimbursement process and work with property owners to spur them into action to rehabilitate their buildings and neighborhoods.

The proposed project crosses multiple regulatory structures and will establish an exemplary manner by which communities can work with existing regulatory structures and suggest modifications to regulatory structures that will bring to fruition these types of projects within communities of all shapes and sizes. A project of this size and nature will set the tone and serve as a scalable and replicable model. The Oak View neighborhood is a microcosm of the most urban areas of the State, where marginalized populations lives in older less efficient buildings.

Finally, both Southern California Edison and Southern California Gas Company have committed to support the effort with personnel time and providing match funding. The

engagement of these utilities and their interest in contributing to the policy, planning and regulatory reform concepts will facilitate positive evolution and use of modified regulatory structures.

1.4. Justification for the Need of EPIC Funding

With the EPIC funding support, the success of the proposed project will not only benefit the ratepayers of three IOUs, including Pacific Gas and Electric Co., San Diego Gas and Electric Co., and Southern California Edison, but will promote optimal integration approaches of smart grid technologies, combined cooling, heating and power generation with high temperature fuel cells, energy storage technologies, renewable energy utilization, and advanced microgrid controls, for greater electricity reliability, lower costs, increased safety and Zero Net Energy (ZNE) future in the community level. More importantly, the design, integration and evaluation approaches in this project will be highly applicable to the deployment of AECs across the State. Using the Master Community Design and the integration approaches developed in this proposal, more AECs could be built out throughout the State to support modernization of the State electric grid providing additional benefits to ratepayers beyond grid investments alone. In addition to providing ratepayer benefits, the proposed project will lead to technological advancement and breakthroughs to overcome the barriers that prevent the achievement of ZNE goals. This project will develop extensible tools and use them to design and evaluate the optimal integration and control of clean energy technologies in an operational disadvantaged community. Before this funding opportunity, there were few opportunities from government agencies or the market to support such diverse and integrated projects at the community scale. This is mainly due to the need for involvement and commitment from applied research, key industrial, utility, local government, and consulting partners, and the need to integrate diverse sets of expertise to successfully execute such project. The team in this proposed project is well positioned to tackle and accomplish the proposed work, is well suited to address the technical, economic and social challenges, and is determined to make an impact on AEC deployment throughout California.

The impact that EPIC funding would have on the proposed project is dramatic, since the Oak View community will not be transformed into an AEC without EPIC funding. In addition, EPIC funding will opportunistically capture established resources of an impressive team with significant expertise, previous experience with advanced energy technologies, and existing research investments by the Department of Energy, the California Energy Commission, and the California Public Utilities Commission. In addition, key stakeholders ranging from major utilities (e.g., SCE, SCG), to community organizations, to national labs (e.g., NREL), to leading building design and operation consulting firms (e.g., Altura) are engaged in the project. The engagement of such key stakeholders assures that practical boundary conditions are considered, and enhances both the probability and rate at which lessons learned are deployed into the communities, all leading to establishing viable scenarios for the design and deployment of AECs.

1.5. Technical Feasibility and Achievability

The proposed work is technically feasible and achievable. Firstly, the integrated set of energy infrastructure and advanced energy technology approaches proposed are all proven to be technically and economically feasible with proper design. The set of green energy technologies targeted to be integrated in the community (as listed in Section 1.7) have both a mature level of technology readiness and commercial readiness. The design in this project will select commercial and emerging components that with novel and innovative integration and control will produce breakthrough results. APEP and the entire project team have extensive

experience with the proposed set of advanced energy technology approaches and system integration strategies [1-10]. APEP has also collaboratively worked with key industrial, utility, and consulting partners and established an operational Micro-Grid as a test bed. The operational Micro-Grid test bed encompasses the university community as a generic community of residences, business, education, and industry that is served by a 30MW 66kV circuit from the same substation as that serving the U.S. DOE Irvine Smart Grid Demonstration (ISGD) project. APEP is engaged in a variety of research programs with key partners such as those in the current proposed effort that have advanced the Micro-Grid resource to its current state, and demonstrated the skill and expertise to advance integrated energy systems and work in collaboration with industry to successfully execute projects.

The proper and effective integration of the technologies with the community is the key to the success of the design and deployment of the AEC. The motivation of the city, the community itself, and the extensive experience of the project partners (APEP, NREL, Altura, SCE, SCG) with previous integrated energy community projects, like the ISGD and the UCI Microgrid, will be directly applied and utilized in this project to make it highly feasible and achievable. The collaborative team for this proposed work, and all the team members have established track records of accomplishing similar projects (see Attachment 9). What is lacking primarily are: (1) tools for thorough analyses and design of the community, and (2) funding to design, and eventually demonstrate and build out our vision for the AEC.

1.6. Minimize the Risks in Design, Permitting, Planning and Financing

To minimize and address the risks and uncertainties in the design of the AEC, we will carefully select and propose a set of proven advanced energy technologies with high levels of maturity and readiness, for integration in the master community design. In addition, the AEC Planning and Evaluation Tool that will be developed will generate case studies and comparisons with various integration and deployment options to further minimize the risks and uncertainties in the design phase. This tool will establish an applicable framework for any community that desires to become an AEC and provide insights for local governments and communities to make decisions. Furthermore, both SCE and SCG are committing to support the effort with personnel time and providing match funding. These commitments will enable the widespread implementation of AEC with minimal risk of utility opposition or policy challenge.

To minimize the risks and uncertainties in the permitting and planning phase, first not that photovoltaic, battery and, and fuel cell technologies have been selected to serve as the major energy resources of our proposed AEC integration case studies. These technologies are zero to ultra-low emitting and clean resources that are all exempt from air permitting in South Coast Air Quality Management District (SCAQMD) territory and throughout state. Such systems do not need to acquire air permits or purchase nitrogen oxide, particulate, or other emissions offsets. In addition, these technologies are inherently quiet and low to zero water consuming, which features further lower the risks for permitting and planning.

To minimize the risks of financing the AEC implementation in Oak View, the City of Huntington Beach is evaluating the use of low-interest financing mechanisms that are available to the City, and clean energy funding that the City may garner from the SCAQMD. In addition, Altura Associates has established financing mechanisms, including debt, lease, power purchase agreement (PPA), property assessed clean energy (PACE), insurance and other financial models, that it has access to and has previously used for implementation of large scale clean energy built environment projects. These tools and financing mechanisms could all but eliminate the financial risk for converting Oak View into an AEC.

1.7. Integration of a Set of Clean Energy Technologies that Offers the Best Value

In our opinion, a combination of diverse energy efficiency measures, supplemental local renewable energy sources, energy storage systems, clean combined heat and power generation, together with smart-grid technologies and advanced controls will offer the best value in terms of economic, environmental and technical performance for building an AEC from scratch or retrofit. The combination of clean energy technologies and systems we propose to deploy in a community has the potential for the community to achieve zero net energy (or even export energy) with ultra-low criteria pollutant and greenhouse gas emissions, as illustrated in Figure 2. Note also that these integrated energy technologies and infrastructure will not require new electric transmission and distribution system upgrades in the community. Finally, integrating this diverse set of advanced energy technologies with a diverse set of end uses (residential, school, commercial, industrial, and transportation demand dynamics) is one of the best ways to synergistically meet economic and environmental goals. ***Our experience with previous integrated energy community projects, like ISGD and the UCI Microgrid, has determined that integrated development of technological and financial means of achieving an AEC is key.*** Scalable and replicable, the combination of proven clean energy technologies and systems we propose to evaluate for transforming the Oak View Community will include, but not be limited to:

- Deploy Energy Efficiency Measures (EEM) on existing buildings to increase the energy efficiency and reduce energy (electrical and gas) usage and emissions.
- Utilize available renewable energy sources inside the community by 1) installing solar photovoltaic (PV) systems on the rooftops of residential, commercial, and industrial buildings and in parking lots, and 2) designing and installing an anaerobic digester for organic industrial waste that is being processed in the community. The biogas from the community digester will become another renewable energy source that is dispatch-able. By using these renewable sources, less electricity and gas will be used to lower overall emissions.
- Install and integrate energy storage systems for electric, thermal and chemical energy storage. The electric energy storage systems in the AEC could potentially complement renewable intermittency and improve the ability to integrate increasing amounts of renewable generation in the community level and the State level. Thermal energy storage (TES) could be used for storing heated or chilled water for later use and energy arbitrage. Chemical energy storage (e.g., renewable hydrogen or biogas) could be used in the community and enable the flexible use of renewable fuels. These renewable fuels could be used in a fuel cell system for producing power and heat, or for sale and injection into the natural gas pipeline system, or for local use in natural gas vehicles, homes, etc.
- Deploy Electric Vehicles (EV) and EV charging infrastructure. As vehicle powertrains become electrified with commercialization of fuel cell and plug-in vehicles, well-planned integration electric generation and charging infrastructure becomes important for reliability and cost.
- Make optimal use of the full spectrum of existing energy resources including electric utility infrastructure, natural gas infrastructure, and natural and renewable gas resources in the community, focused upon the potential of creating ZNE AECs.
- Install zero emissions backup power at critical loads to serve as backup/emergency generators to increase reliability and reduce emissions from traditional backup generators.
- Install and integrate a High Temperature Fuel Cell (HTFC) system using the renewable fuel produced locally, for producing power, heating or cooling through an absorption chiller. Such a combination of fuel cell system and renewable fuel source in the community will improve

the reliability and resiliency of the AEC. Renewable fuel HTFC systems have near zero greenhouse gas and criteria pollutant emissions and are acoustically benign.

- Install a smart energy management system in the residential units, industrial buildings, and school within the community. This requires installing advanced meters with high resolution data provided to the Community Microgrid Model and sub-metering of building loads. The data will help the energy management software to make decisions as more intermittent renewables are installed in the community and allow the community to operate as a smart power and demand response asset for the grid. Smart controls will be implemented throughout the community for automated demand management to support both infrastructure first cost and on-going energy cost optimization.
- Implement other Smart-grid technologies such as automated demand response, smart appliances, smart electric vehicle charging systems, and electric energy storage systems in the residences, commercial and industrial buildings.

1.8. Innovative Financing Strategies

A Public Private Partnership is proposed as a financing strategy that is attractive and will support the development of these types of communities. This type of partnership is more palatable to local jurisdictions who are bracing for yet another economic downturn. Many municipalities are faced with growing pension liabilities that hinder their ability to invest in innovative energy projects. A Public Private Partnership (PPP) is essentially a long term contract between a private party and a government entity providing a public asset or service in which the private party bears significant risk and management responsibility, and remuneration is linked to performance. The proposed project has the perfect balance between the public (Huntington Beach, UCI, NREL) and private (SCE, SCG, and Altura) entities and has significant engineering backing and research capabilities (NREL, APEP, and Altura). According to the World Bank and the Public-Private Partnership in Infrastructure Resource Center, "the threat of climate change has added a new dimension to the selection, location, design and implementation of PPP projects…Private investment in clean technologies, in particular technologies that utilize renewable energy sources for energy production or increase energy-efficiency as well as carbon capture and storage technologies can help promote economic growth sustainably." [11]

1.9. Optimal Locations for AEC

The optimal locations within a jurisdiction and desire for designing and deploying these AEC that offer the most benefits to ratepayers and the electric grid should have (but not be limited to) ones that have the following characteristics: 1) disadvantaged communities with aged buildings and infrastructure with low energy efficiency, 2) communities with available renewable energy sources such as available rooftop for solar PV, and/or organic industrial waste that can be processed to produce biogas, 3) a mixed area of residential flats, industrial and commercial buildings, and public spaces such as schools of parks, and 4) a mixed set of building types and time-of-use energy end-uses. The Oak View community is one community within Huntington Beach that has these features. Of course, other communities that do not have all of these features may also be good candidates for conversion to an AEC.

1.10. Potential Business Models and Collaborative Strategies

The proposed project is a perfect example of a potential business model for AECs. The City along with UCI has partnered with Altura Associates, the Southern California Gas Company, Southern California Edison, and the National Renewable Energy Laboratory to create a Public

Private Partnership. Leveraging the technical skills possessed by APEP, Altura and NREL along with those at the City and the IOUs will likely lead to a very successful PPP that can transform Oak View into an AEC.

2. Technical Approach

The proposed project is to develop extensible tools and to plan and design the integrated set of energy infrastructure and advanced energy technology approaches to convert the disadvantaged Oak View community of Huntington Beach into an Advanced Energy Community. The project will design and evaluate integrated sets of advanced energy technologies and solutions at a community scale and validate its benefits to California IOUs and the California Independent System Operator (CAISO) in various case studies and designs. Our approach to accelerate the deployment of AEC, is to **develop AEC integration tools** and to **actually integrate** the promising energy innovations and technologies into a community system that efficiently interacts with the existing community electrical and gas infrastructures and buildings. In addition, the team will obtain performance data for scale-up, and perform cost-benefit analyses for demonstrating the economic feasibility of AECs. The master community design and integration approaches developed in this project will advance AEC development and establish technical and economic readiness for accelerating the deployment of AEC throughout the State.

2.1. Tasks

APEP at UCI, will work with City of Huntington Beach, Altura Associates, Inc., Southern California Edison, Southern California Gas, NREL and other partners to accomplish the following tasks. The complete Scope of Work and Project Schedule can be found in Attachments 6 and 6a.

Task 1: General Project Tasks: in this task, all of the team members will work together to fully comply with the tasks specified in the Scope of Work.

Task 2: Develop AEC Design and Planning Tool to provide insights and recommendations on various integration and deployment options for the community. Basic information of the community will be provided by the team members (the City and utilities) as inputs to establish the baseline case. Potential clean energy technology and integration strategy candidates will be provided in this tool. APEP will work with Altura and NREL to develop and provide various building energy simulation tools to assist this task.

- Altura will work with the City and APEP to conduct site investigation to explore opportunities for multiple energy efficiency, control and generation technologies, analyze site constraints, opportunities and needs, meet and interview stake holders.
- NREL will work with the entire team to identify key building- and community-scale energy systems and strategies that could be employed in the AEC, potential examples include: advanced HVAC strategies and controls, advanced lighting and controls, zero energy buildings, recovering waste heat from commercial and industrial buildings for use in residential heating, waste-to-energy district thermal systems, and rooftop/community solar.

Task 3: Develop Smart Community Microgrid Energy Management Model that can simulate and evaluate the impact and performance characteristics of the suite of clean energy technologies and systems that will be implemented in the AEC. The Model will also enable the evaluation of multiple energy and resource dispatch control approaches and support the development of optimized control strategies for the AEC. APEP will be primarily responsible for

model development, working with all of the team members who will provide inputs and feedback to assist the model development. In support of accomplish this task.

- Altura will work with NREL and APEP to conduct building energy modeling and utilities analysis to: 1) support overall energy needs analysis, both current and future, 2) perform risk / sensitivity analysis for load growth and fluctuations (due to weather, building usage changes, technology adoption, etc.), 3) perform energy efficiency measure optimization, analyzing multiple energy efficiency strategies in concert with production and storage solutions for micro-grid optimization from a control and first cost basis, and 4) perform demand management analysis, in concert with the energy efficiency analysis, to support effective active control of the micro-grid with usage, production and storage constraints on multiple time scales.

Task 4: Carry Out Case Studies on Various Integration Designs to develop an optimized roadmap for the AEC development both technically and financially. The design effort will include a combination of energy efficiency measures, supplemental local renewable energy sources, energy storage systems, the electric and natural gas utility systems, clean power generation systems with combined heat and power, together with Smart-grid technologies. The case studies will quantify the economic and environmental benefits and technical performance, will also identify the technical challenges encountered for various combinations of technologies. The case studies will focus on the optimal use of the full spectrum of energy resources including renewable electricity and fuels. The case studies will also analyze regulatory and administrative issues, planning and permit processes, focused on developing solutions to hurdles working with the local government partner.

- APEP will work with Altura, NREL and the City to develop a technology and infrastructure plan regarding: 1) Micro-grid controls platform, 2) communications infrastructure, 3) building controls integration and 4) measurement and verification and metering infrastructure for the AEC case studies.
- NREL will enhance and utilize the capabilities of the existing OpenStudio energy modeling software platform with new AEC analysis capabilities, as well as advise and teach the project partners on how to apply these capabilities in the design of the AEC and the case studies.

Task 5: Propose Master Community Design: a master community design will be proposed for Oak View community based upon the findings from the case studies. A more generic Master Community Design for other community will also be collectively developed and proposed, the design will be evaluated and reviewed by all the team members from different perspectives.

- APEP will work with Altura, NREL and the City to support development of the Master Community Design including technology deployment, phasing, procurement, funding and operations strategies.
- NREL will develop new open source capabilities as a part of the OpenStudio platform to support integrated design of the AEC, as well as provide technical assistance to project partners as they apply OpenStudio analysis capabilities to support the design the AEC.

Task 6: Develop Financial and Business Models: for the proposed Master Community Design for AEC, and also showcase the innovative financing strategies that can help make AEC financially attractive relative to similar community developments without advanced energy attributes. Financing models that enable long term infrastructure investments that benefit multiple private and public stakeholders have historically been a significant roadblock to AEC and advanced microgrid deployment.

- Altura will lead the team, based upon previous experience in built environment development, to develop and present multiple financial structures and models based on the case studies of Task 4 and the master design recommendations of Task 5. These models will be vetted by key project stakeholders and financial institutions to assess feasibility, risk, and total costs. Key financial elements that will be explored include a robust combination of private and public debt financing, equipment leases, PPAs, PACE financing, and on-bill repayment mechanisms. It is envisioned that a combination of structures and finance sources will be required to appropriately capture the flow of risks and benefits to all stakeholders in the community, including the utilities, local government, residents, business owners, etc. The City will ultimately select a financial plan and business model to actually build the AEC.

Task 7: Develop Outreach Strategy: to educate the building industry, government agencies, other communities and other interested parties on the benefits of using an integrated set of advanced energy technologies to revitalize and energize a community, and to produce educational benefits. To design and install a visitor's center for the AEC where the monitoring and control of all of the advanced energy technologies can be viewed by interested parties. To produce educational benefits such as local school children teaching events, professional training opportunities and job creation within the community especially focused upon the Green Energy sector for the Community.

- APEP will lead this task and collaborate with all team members.

Task 8: Evaluation of Project Benefits to report the benefits resulting from this project. All the team members will collaboratively put together and deliver the products required in this GFO.

Task 9: Technology and Knowledge Transfer Activities to develop a plan to make knowledge gained, experimental results, and lessons learned available to the public and key decision makers. All the team members will collaboratively put together the products required in this GFO.

- All team members will publish project results and advocate for transfer of knowledge to other communities. NREL will particularly promote the replicability of the AEC design process by making the analysis capabilities developed under this project available for free as part of the open-source OpenStudio platform of design tools.

2.2. Factors Critical for Success

While many entities/groups are advancing individual component technologies that support certain aspects of the future AEC and the electric grid, few are advancing the essential "unit-grid" elements ("Micro-Grids" at community scale) and more importantly, **a proper and optimal integration of the set of clean energy technologies**, which are required to transform the disadvantaged communities and their current utility grid network. Installing an individual clean technology or a set of technologies inside a community does not necessarily make it an AEC. **The critical factor to successfully create an AEC is proper, efficient and synergistic integration of the advanced energy technologies with the various resources and end-uses inside the community, combined with proper finance structures and mechanisms to capture benefits and risks across multiple public and private parties.** This project will transform the disadvantaged Oak View community by synergistically designing and integrating the set of technologies that has been proven and well demonstrated in a robust generic operational UCI Micro-Grid and the ISGD project. Previously developed and verified dynamic models of the power generation and distribution infrastructure, of the loads, and of the energy storage resources will be used to understand, integrate and eventually transform the disadvantaged community [3, 4, 12-14]. The data and dynamic characterization will then be coupled

to the performance and evaluation tool that is being developed to extend results to other communities throughout the State.

From the City of Huntington Beach's perspective, the most critical factor for success is a successful collaboration amongst the project team, private property owners, and the Oak View Renewal Partnership (OVRP), a neighborhood non-governmental organization (NGO). The plan to address this includes in-person monthly meetings and an open door policy where all issues and comments are welcome. By understanding everyone's perspective and goals the coalition will be able to work on a common goal – creating a replicable AEC. A barrier and risk to success is not having enough participation from the OVRP and property owners in the neighborhood. Their support and active participation is critical as we will need to work with the property owners to convince them of the benefits of EEM and AEC improvements and also work with their tenants. The tenants come from a population that is often undocumented and marginalized, and their children represent some of the most vulnerable in society. The existing population is also home to criminal gang activity, which may pose a challenge. But, the City and the Police Department are firm believers in the Broken Windows Theory. This theory comes from a model of policing that was first described in 1982 by James Q. Wilson and George L. Kelling. The theory states that maintaining and monitoring urban environments to prevent small crimes such as vandalism, etc. prevents more serious crimes from happening. When residents feel that their buildings and infrastructure are taken care of, then crime decreases. Another critical factor for success is an engaged residential population which includes the property owners themselves and OVRP. This can happen in a few ways, the City already meets with the property owners and OVRP on a regular basis. The goal would be to engage both groups separately and then together in a manner that enables understanding the perspectives of all stakeholders. OVRP has submitted a supportive stakeholder letter that encourages this effort.

A significant opportunity for this AEC project involves cleaning up and using the materials recovery facility of Rainbow Environmental Services (Rainbow) for energy purposes to address risks associated with ongoing litigation between the Ocean View School District and Rainbow. Environmental Services (Republic). Finally, jobs and training will be provided through an existing City program at Golden West College.

2.3. Dissemination Plan

The knowledge gained, tools developed, and results will be available to the public through reports, journal publications, conferences, and meetings with stakeholders and policy makers. Communication of project results to the market will occur through several channels: APEP already serves as a hub of interaction among industry, agencies, and university researchers that expedites the transfer of research progress into practice; the partnering with two major IOUs (SCG and SCE); and the two major annual conferences organized by APEP, "International Colloquium on Environmentally Preferred Advanced Generation" and "Microgrid Global Summit" will serve as major platforms for the conveyance of research results to the public and key decision-makers. Task 7 and Task 9 are both integral parts of our dissemination activities. The proposed team will also develop other effective dissemination strategies, which are directly related to the AEC design and development tools that will be developed in the effort (e.g., OpenStudio AEC tool). The team members assembled have extensive experience disseminating research materials and findings, as well as synthesizing and publishing data to make it understandable and useable for academic communities and other audiences. Some of the innovative dissemination methods the APEP will use are: individual consultations, group training events, conference workshops, newsletters, magazines and newspapers, Science to

Community reports, Fact Sheets and the APEP website. To ensure that results of this work are used by researchers, policymakers and the general public, the team will: 1) make the research progress available to the public and other researchers through the APEP web page and the City of Huntington Beach website and on social media (in both English and Spanish), 2) peer review of all published products with collaborators, 3) reporting of the results at conferences that target the built environment community, 4) reporting of the progress in city council meetings, 5) publishing academic journal articles in high impact journals, and 6) write articles for the community and city newsletters.

The City has a very active and engaged community. The City Council and the City's Environmental Board will be kept apprised of the study and, if approved, the Phase II project development status through Study Session presentations and one-on-one meetings with Council Members. Additionally, the City is revamping its website and progress will be featured on the Sustainable HB page. The City will also set up a micro site dedicated to the collaborative effort where all parties can update the public on all aspects of the EPIC challenge and each entities contributions. The City of Huntington Beach will also utilize the City's Public Information Officer to disseminate project updates and information to the public through a variety of social and traditional media platforms. Ms. Graham is also an adjunct professor at Cal State Fullerton and Irvine Valley College (and UCI and UCLA extension) and will utilize this project as a case study for students to learn about the collaboration, technologies, and community involvement. The City has established a record of sharing best practices with cities through the Coalition for Affordable Streetlights (CASL) and through the Association for California Cities – Orange County's Energy and Environment Committee. The City's Energy and Sustainability Manager, Antonia Graham offers advice and technical assistance on sustainability issues that will now include AEC as she is the only person within the entire County that holds this specialized position.

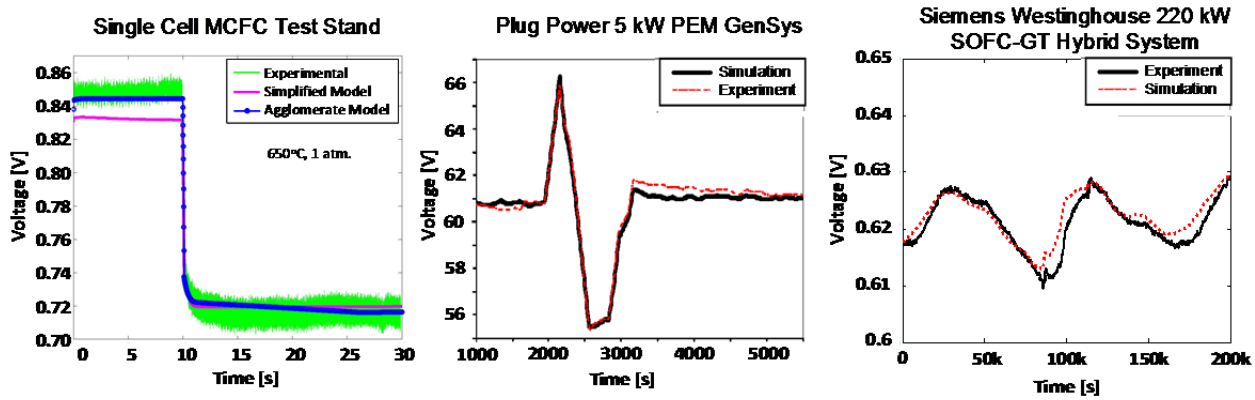
2.4. Actions Adopted to Meet the State Energy Plans and How the Proposal Fits In

The City of Huntington Beach has been a leader in the sustainability field, especially in Orange County. For nearly three decades the City has taken numerous actions to increase energy efficiency. Over the years, the City Council has implemented a number of strategies and projects that reduce energy related waste. Even with turnover on the City Council the commitment to sustainability has not wavered. The City has completed numerous energy projects that conserve both scarce fiscal and environmental resources. In 2011 the City adopted Resolution No. 2011-25, "A Resolution of the City Council of the City of Huntington Beach Adopting an Energy Action Plan." The plan is currently under revision. The City is also in the midst of a General Plan update that includes creating a Sustainable Action Plan and a Greenhouse Gas emissions inventory. Environmental protection and sustainability is also evident in the action of the city to put in place an Environmental Board over forty years ago. The board studies the environment of the City and investigates potential threats to a clean environment for the city and its inhabitants. In 2010, the City Council approved an amendment to the Municipal Code reflecting the addition of the term "sustainability" as a keyword and way of thinking that supports (a) economic development, (b) water and energy conservation, (c) recycling and resource stewardship, (d) transportation, (e) open space preservation, and (f) community engagement.

2.5. Tools, Applications and Data that will be Used

APEP will utilize existing energy system models, integrated system models, electric power system simulation tools, and data collected in the UCI Microgrid and ISGD projects to improve

the design and planning of the AEC. High fidelity first principles dynamic models of the energy conversion, distribution and end-use technologies, integrated energy systems used throughout the utility grid network are required to develop the smart micro-grids in the AEC. APEP has many years of experience in developing dynamic models, controls and system integration for gas turbines, fuel cells, inverters and alternative energy conversion/storage devices and systems [15-23]. These individual energy system models and the integrated hybrid system models can be directly utilized in the design and evaluation of the AEC. The APEP dynamic models are generally coded in the Simulink platform to enable the use of Matlab control tools and developed using a quasi-dimensional physics-based model of the primary energy conversion component. For fuel cell technology, APEP's previous research has shown that integrated fuel cell system dynamic models compared favorably with experimental data for single cell transients, integrated SOFC systems, SOFC-gas turbine hybrid systems, and PEM stationary fuel cell systems [15-20]. Sample model comparisons to dynamic experimental data are presented in Figure 4. These models and those of other distributed energy resources will be used in the AEC designing and planning as the first means of testing the abilities of the developed AEC.



(a) **(b)** **(c)**

Figure 4. Sample model comparisons to dynamic experimental data from (a) molten carbonate fuel cell, (b) proton exchange membrane fuel cell system, and (c) solid oxide fuel cell gas turbine system.

The APEP team has also developed and applied energy storage models to complement renewable energy sources. Figure 5 depicts the seasonal load shifting capabilities of the hydrogen energy storage system [1]. The APEP team has developed various type of battery models including Ultracapacitor, Li-ion batteries, Lead-acid batteries, Ni-Cd batteries, and Ni-MH batteries that re capable of discharge times in minutes with corresponding sizes of 1kW to 100kW. The team also applied the models to study the energy storage deployment requirements in a data center. Figure 6 shows the voltage response of the energy storage devices simulated during a typical discharging and charging process under transient conditions in a data center.

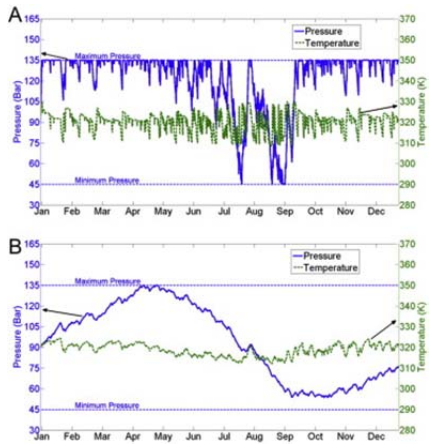


Figure 5. Pressure and temperature in the cavern when the peak demand is 800 MW, (A) Compressed air energy storage system and (B) compressed hydrogen energy storage system.

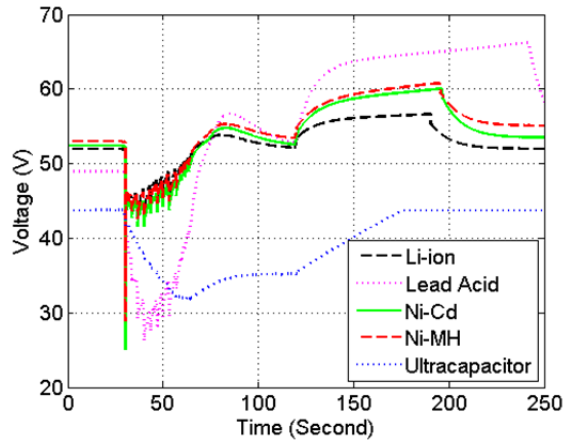


Figure 6. Simulated voltage of various energy storage devices during discharging and charging processes.

High fidelity first principles dynamic models of the energy conversion, distribution and end-use technologies used throughout the utility grid network are required to develop smart micro-grids. APEP researchers have developed an accurate and robust methodology for dynamic simulation of these integrated energy systems applied to communities. Using these dynamic simulation tools and methodologies, APEP can accurately simulate distribution circuits and entire micro-grids like that of the UCI community. The UCI Microgrid is comprised of 10 individual 12 kV circuits. A model of the UCI Microgrid, as shown in Figure 7, has been created and will be adapted to the Oak View electric infrastructure in collaboration with SCE. Parameters of line impedance, transformer size, distributed generator (DG) real/reactive power output, and load real/reactive power demand are included in the model. The microgrid model together with experience from the UCI Microgrid uniquely allows investigation of controlled metrics in the context of the emerging smart grid paradigm, which can be applied to the design of AEC. The UCI Microgrid includes significant PV power, natural gas-powered distributed generators, energy storage devices, a large thermal storage tank, and smart demand response capabilities. Insights from the UCI Microgrid will be exercised and explored to discover how best to design and control energy resources and provide reliable, high-quality, low-noise energy services to the AEC.

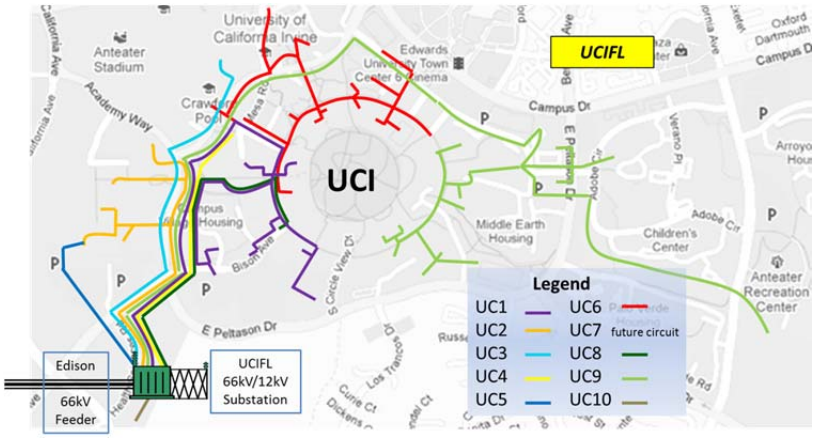


Figure 7. Geographic representation of the UCI Micro-Grid

Figure 8. A 10kW PEMFC system ready to be installed in Oak View Community

The data collected, lessons learned, and models developed in the ISGD project and UCI Microgrid will be utilized in the designing and planning of the AEC. Working with Southern California Edison and several other partners, APEP has accomplished world-leading research and development in smart-grid technology in the ISGD project. The ISGD project was an $80 million U.S. Department of Energy sponsored project in which the team installed, tested, investigated, and analyzed smart grid technologies from the individual residence, through the residential circuit, utility distribution system and all the way into the utility grid network transmission system. Relevant energy storage and smart control technologies of the ISGD project include the following 1) smart meters with communication and control functions, 2) residential battery energy storage systems, 3) residential smart inverter-based photovoltaic systems, 4) solar-shade photovoltaic and electric vehicle charging system with battery energy storage, 5) community battery energy storage systems, and 6) utility distribution circuit battery energy storage system. The data collected and the system integration experiences gained in the ISGD project will be directly applied to this proposed AEC work. The APEP team also possesses a 10kW PEMFC that is ready to be installed as a zero emissions on-site backup power generator for critical loads as shown in Figure 8.

The City of Huntington Beach will provide a computer program tool that is being used to track energy usage at City facilities such as streetlight and community center usage in this area.

NREL will provide and enhance the capabilities of the existing OpenStudio energy modeling software platform with new Advanced Energy Community (AEC) analysis capabilities, as well as advise project partners on the application of those capabilities in the design of the AEC. NREL serves as the lead developer of OpenStudio and its underlying simulation engine, EnergyPlus. As a part of its leadership role, NREL has been tasked by the U.S Department of Energy to facilitate contributions from other national laboratories and academic institutions. Additionally, NREL-funded efforts are currently underway that will enhance OpenStudio through the creation of an open-source urban modeling platform and an Urban Renewable Building and Neighborhood Optimization (URBANopt) design tool. These enhancements are focused on optimizing energy generation and use at the district, neighborhood, and community scales, and will allow users to easily evaluate the potential of large-scale district energy systems that make efficient use of previously wasted energy. To this end, NREL is currently working with the City of Denver and the Denver Housing Authority on the National Western Center and Sun Valley urban redevelopment projects, respectively, to (1) demonstrate how emerging zero-energy districts represent the future building blocks of thriving cities; and (2) develop an advanced urban modeling platform that will enable cities and their partners across the U.S. to achieve zero energy districts.

Natural gas system information and data of the Oak View Community and other communities will be provided from Southern California Gas Company, to improve the design, planning, and permitting of the AEC.

Altura has extensive experience modeling single family and multi-family resident, as well as non-residential energy loads to support analysis of energy efficiency and demand management measures throughout the community. Altura will work with NREL and the entire team to select the appropriate modeling environments, such as eQuest, Energy Pro, IES VE, etc., to ensure adequate temporal modeling of systems and buildings to support Baseline development and Case study analysis.

Additionally, Altura is a pioneer in the deployment of advanced analytics tools in the built environment to support real time data analytics and fault detection. Based on the open source Haystack convention, Altura will leverage the SkySpark platform to support real time data gathering throughout the community, including implementations with existing metering and building automation systems. This will lay the foundation for measurement and verification of future implementations, while support the Phase 1 analysis.

2.6. Develop a Replicable Approach for AEC

The proposed project and the specified tasks herein focus on developing an overall replicable approach for local governments to plan permit, and finance an AEC in the future. On the technology side, the AEC Design and Planning Tool in Task 2 and Smart Community Microgrid Energy Management in Task 3 will be readily available after the execution of this project for use by local governments and decision makers. These tools will be designed for a generic community. And the tools developed could enable local governments using their communities' characterizes in energy related aspects as inputs, to provide AEC designs that fit their communities the best. The tools developed could also replicable for other communities to be able to quantify energy savings, emission reduction and perform economic analyses for various AEC designs. In addition, the component clean energy technologies being deployed and integrated in the AEC, are widely commercially available. This proposed project will also share and provide system integration guidelines/recommendations, which will help the local governments and other communities achieve their most optimal AEC design and performance. With available clean energy technologies and design tools, and transferable integration knowledge, the overall technical approach is replicable for local governments to design AEC.

The City of Huntington Beach has a good working relationship with all regulatory agencies and will prepare a white paper on the collaboration process for this project. This paper will include best practices and will include the permitting process, planning process, and financing (including public/private partnership opportunities). The City will work with UCI, Altura, and local property owners to create a robust stakeholder group. It is one thing to create a stakeholder group and work collaboratively but at the end of the day, this has to be a project that will be almost turn-key and would enable other communities to easily replicate the planning, permitting, and finance process. The City plans to engage in a meaningful engagement process with all stakeholders so that all facets of the process for creating an Advanced Energy Community are replicable. In order to create a replicable process for communities who wish to create Advanced Energy Communities we will initiate a five step approach to stakeholder engagement, as shown in Figure 9.

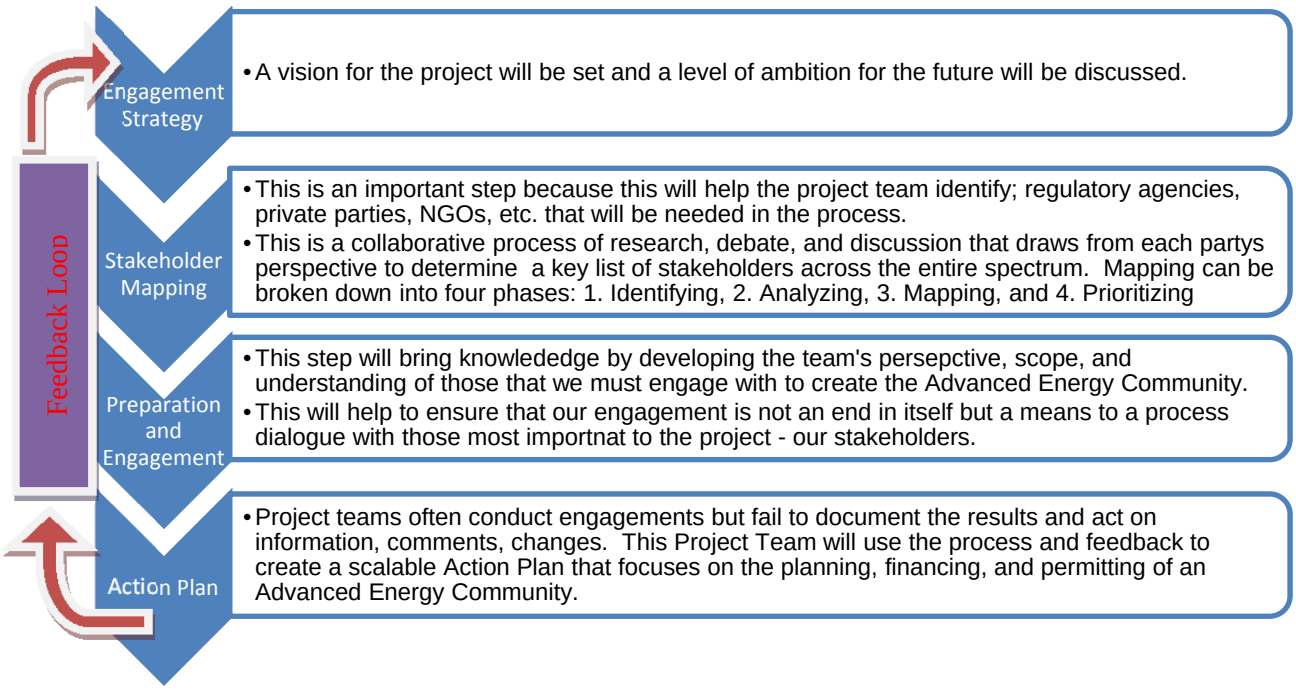


Figure 9. The Stakeholder engagement strategy.

As a team member, NREL will enhance the capabilities of the existing OpenStudio energy modeling software platform with Advanced Energy Community analysis capabilities, these capabilities will enable other AEC projects across the State. Because OpenStudio is developed in a collaborative public manner, with contributions from multiple independent sources, the platform encompasses a more diverse scope than any one entity would be capable of developing and sustaining long term. Additionally, the open-source development approach produces reliable, high quality software quickly and inexpensively. For this project in particular, the open-source nature of the software will allow for the replication of AEC design best-practices across California and the rest of the U.S., leading to greater market penetration and a more robust built environment.

2.7. Capturing Experiences and Best Practices to Provide Guidance for Future AEC

The team will capture lessons learned and best practices, and will turn these into useful guidance for future AECs. As with any project there are always best practices and lessons learned from things that did not work out. City staff will serve as the primary record keepers of these lessons and best practices and they will compile these into a white paper that can be used when replicating the Huntington Beach Advanced Energy Community. This will enable capture of experiences and best practices that are especially relevant from a city and community planning perspective. This will help communities who are interested in replicating these types of projects understand what works and what does not work in Huntington Beach so that they may scale down or scale up or modify the practices depending upon their particular community or city needs and practices. Project staff will be able to present these findings through research publications, trade journals, professional associations, and conferences.

3. Impacts and Benefits to California Ratepayers

ATTACHMENT 4
Project Narrative Form

The state of California is required by law to meet 33% of its electricity demand by renewable resources by 2020, and towards the goal of 50% in 2030. Many of the renewable resources that will be used and add to the communities (solar, wind, biogas, etc.) are intermittent and uncontrollable, which requires increased various-scales of energy storage system, energy technologies and proper integration designs and strategies. The proposed project will plan and design a generic AEC by integrating more local renewable resources and set of advanced energy technology approaches. If successful, more optimized and integrated energy systems can be deployed and integrated with intermittent renewable sources in the communities throughout the State. This could be followed by much more widespread commercial viability and marketability of clean energy technology with significant reduction of GHG emissions, and support the California renewable power market to enable it to reach the required levels. It will be shown that this project will benefit the California ratepayers by increasing reliability, reducing criteria pollutants and GHG emissions, and providing economic benefits.

3.1. Greater Reliability, Lower Costs and Increased Safety

With our replicable AEC vision and design, the California IOU ratepayers benefit from higher reliability and the reliability is increased by 1) local renewable energy resources are being utilized in the AEC and could serve the critical loads inside the community without interruption, 2) providing mobility in case of an emergency through electric vehicle charging stations in adjacent communities, 3) the AEC could provide ancillary services to the grid during normal operations, and 4) the AEC could provide black-start capability. Our AEC design will provide lower costs and economic benefit to the ratepayers by 1) reducing the transmission/distribution losses, 2) reducing the need for new transmission infrastructure and 3) providing a less expensive method in achieving state's 50% renewable goal and environmental goals. The AEC with our vision and design, will maximize the utilization of the local available renewable energy sources, and will tremendously help the State to reach the 50% renewable goal in a distributed fashion. Firstly, more local renewable generation lead to less electricity imports from the grid, thus the AECs will eliminate the transmission and distribution losses (7-12%) for the reduced amount of electricity needed to be transmitted and distributed to the communities. Secondly, the AECs will reduce the need for new transmission infrastructure in remote areas where the new centralized renewable generation resources such as wind/solar farms are usually located and being deployed to reach the State goals. In addition, having on-site generation in the AEC not only eliminates the transmission and distribution losses, it results in decreased use of these infrastructures as well. Thus decreasing the need to upgrade or replace the infrastructure as often. This will reduce the infrastructure costs and benefit the ratepayers. This benefit, however, can be observed in long-term and when the number of AECs across the State is significant enough to impact the infrastructure planning. This will be further studied in the proposed project. The proposed AEC will also be able to provide cheaper renewable electricity to customers or other communities that are adjacent to it. Lastly, our replicable AEC design will also significantly reduced GHG emissions and criteria emissions compared, leading to increased ratepayer safety (health benefits).

3.2. Estimations of Potential Benefits

Our AEC vision is essentially the integration of set of energy infrastructure and advanced energy technology approaches. The potential benefit of each of the component/approach to be deployed in the AEC is relatively straightforward to quantify, which are presented below stated with timeframe and assumptions. Benefits of some of the integration of components are also quantified herein. However, the actual benefits from synergistic integration and optimization of

all the technologies need to be carefully evaluated and that is one major goal of this proposed project.

- Benefits of utilizing local renewable sources and eliminating T&D losses:
  The total gross solar area including residential, school and library in the Oak View community is 330,143 ft^2. Gross Solar Area was estimated at 75% roof area for flat roofs, and for sloped roofs it was estimated that 50% of the roof area of each building type is optimal for solar installation and 75% of that area will be covered by solar PV panels. Assuming that 1ft^2 solar PV translates to 12W capacity, the maximum PV installation in the community is 4MW. Thus it is reasonable that PV systems were installed in the community from 200kW to 2MW total as shown in Table 1. Column 2 in Table 1 shows the total energy generated from the PV with a capacity factor of 0.3. If the same amount of electricity had been generated by California's grid average, the amount of electricity the eliminated losses in transmission and distribution systems (assuming 10%) are shown in Column 3 for various installation cases. Using the emission factor of 0.000283 metric tons/kWh and the electricity cost of $0.15/kWh from the solicitation Attachment 12, the emission reductions and savings on electricity charges are shown in Table 1. The benefits of utilizing local organic waste are shown in Table 2. In our AEC planning, the local industrial waste could be converted to biogas using anaerobic digesters with the biogas converted to electricity using a fuel cell. With various fuel cell system sizes, the energy savings from T&D losses are calculated and also the resulting emission reductions and savings on electricity bills.

Table 1. Benefits of utilizing renewable sources to eliminate T&D losses, PV generation in Oak View.

PV installed (kW)	Energy produced (kWh/year)	Energy saved by eliminating the T&D losses each year (kWh)	Eliminated CO_2 emission (metric tons)	Saving in electricity cost
200	525,600	52,560	15	$ 7,884
600	1,576,800	157,680	45	$ 23,652
1,000	2,628,000	262,800	74	$ 39,420
1,400	3,679,200	367,920	104	$ 55,188
2,000	5,256,000	525,600	149	$ 78,840

Table 2. Benefits of utilizing renewable sources to eliminate T&D losses, fuel cell with biogas generation.

Fuel cell installed (kW)	Energy produced (kWh/year)	Energy saved by eliminating the T&D losses each year (kWh)	Eliminated CO_2 emission (metric tons)	Saving in electricity cost
200	1,401,600	140,160	40	$ 21,024
600	4,204,800	420,480	119	$ 63,072
1,000	7,008,000	700,800	198	$ 105,120

- Benefits of utilizing local renewable sources and reducing emissions:
  One of the approaches in this proposed project for designing AECs is to cost effectively maximizing the use of the renewable sources inside the communities. Generally, the more renewable electricity generated locally within the community, the less greenhouse gas emission and less. Figure 10 shows the reduction in emissions with a reasonable levels of local renewable sources utilized in Oak View Community for a year. In this estimation, the total PV capacity installed is assumed to be 1MW (with capacity factor of 0.3) and the HTFC system installed assumed to be 1MW (with capacity factor of 0.8). As shown in the figure, this use of renewable sources significantly reduces criteria pollutant and CO_2 emissions.

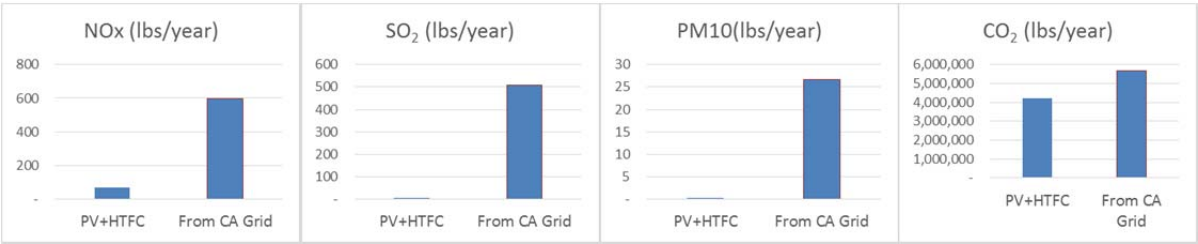


Figure 10. Reduction in emissions with a reasonable level of local renewable utilized in Oak View Community for a year. (Emission factors: http://www.fuelcellenergy.com/why-fuelcell-energy/benefits/ultra-clean/, http://www.eia.doe.gov/cneaf/electricity/epa/epates.html, Attachment 12)

- Benefits of utilizing an anaerobic digester for processing the waste in the community:
  In our vision of an AEC, we propose to utilize the available solid organic waste in the community in an anaerobic digester. With CNG as the potential end use, the final well-to-tank carbon intensity could be significantly reduced as shown in Table 3.

Table 3. Well-to-Tank carbon intensity comparison.

	Final CI, gCO2eq/MJ	Source
Natural Gas to CNG	16.64	CA-GREET 2.0*
Landfill Gas to CNG	-36.71	CA-GREET 2.0*
WWTP to CNG	-50.37	CA-GREET 2.0*
Animal Waste to CNG	-38.75	CA-GREET 2.0*
High Solids Anaerobic Digestion to CNG	-75.98***	CARB**

*http://www.arb.ca.gov/fuels/lcfs/ca-greet/ca-greet.htm
**http://www.arb.ca.gov/fuels/lcfs/2a2b/internal/hsad-rng-rpt-062812.pdf
***Assumes that 60.69 gCO_{2eq}/MJ are removed for tank to wheel emissions that are NOT included for this

- Benefits of an integrated Energy Storage - Fuel Cell (ES-FC) system:
  In our vision of AEC, we propose and plan to evaluate a hybrid energy storage system for rapid-response and modular design with flexible capacity for distributed energy reserve in the AEC. This hybrid system is highly innovative, efficient, and offers multiple benefits for grid support and ancillary services to IOU's for increasing use of intermittent renewable power. The key element of this proposed energy storage system is a battery and fuel cell hybrid system (ES-FC system), which uniquely utilizes high-performance batteries for rapid-response and fuel cells for capacity. It will provide an opportunity to locally balance and level renewable power and loads, and provide demand response and other ancillary services. As shown in Table 4, this integrated system could significantly reduce GHG emissions compared to conventional spinning reserves, leading to increased ratepayer safety (health benefits).

Table 4. CO_2 emission associated with meeting a 1MW peak demand for 1 hour.

	Emission Factor (tons/kWh)	**CO_2 Emission (tons)**
Conventional Spinning Reserves (high)[a]	0.000681	0.681
Conventional Spinning Reserves (low) [a]	0.000306	0.306
California Grid Average [b]	0.000283	0.283
ES-FC System (2MWh, 1MW), case #1[c]	0.000278	0.278

ES-FC System (2MWh, 1MW), case #2[d]	0.000272	0.272
ES-FC System (2MWh, 1MW), case #3[e]	0	0

a. Natural Gas Combined Cycle plants serve as conventional spinning reserves.
b. Attachment 12
c. ES system is charged by the fuel cell system running on natural gas (50%) and grid average power (50%).
d. ES is charged by the fuel cell system that is running on natural gas (100%).
e. ES is charged by the fuel cell running on hydrogen from digester gas or otherwise curtailed renewable energy.

- Benefits of EEM:
  The benefits of EEMs used in the AEC will be quantified using the URBANopt design tool of NREL. The URBANopt design tool optimizes energy conversion and use at the district, neighborhood, and community scales. As a part of the optimization, the tool will quantify the aggregate energy and cost benefits associated with the EEMs and power generation technologies, when applied at the district scale. Capabilities also allow users to evaluate the potential of large-scale EEMs, such as district energy systems, that make efficient use of previously wasted energy. Results allow quantification and reporting of annual electricity and thermal savings, and peak load, energy cost, and emission reductions to the California IOU electricity ratepayers. For example, the U.S. DOE Building Technologies Office Prioritization Tool estimates that installation of residential energy and enthalpy recovery ventilation can save 7% of the energy consumption at a cost of $912 per unit. URBANopt will predict this type of building-specific information, across numerous EEMs and at scale, with the goal to optimize total energy conversion of the community. The optimization will maximize total energy and emission reductions that the chosen EEMs provide across the evaluated community.

- Benefits of Combined cooling, heat and power (CCHP):
  Combined cooling, heat and power will be evaluated for use in the AEC. CCHP provides thermal resources in addition to electricity by utilizing by-product heat from a generator. In doing this, CCHP systems reduce fuel input per unit of useful energy output. Overall fuel utilization in well-matched CCHP systems can range from 70% to 90%, compared to typical electrical generators that range from 30% to 50%. In addition to reducing fuel use, CCHP systems also reduce emissions since less fuel is used to meet demands. Using a fuel cell CCHP system also reduces pollutant emissions. Southern California's mild climate requires low heating loads making cooling more valuable. Cooling needs are generally met by electric vapor compression cycles, and on hot summer days this load places an extra burden on the grid. CCHP can thus significantly reduce demand during summer peak hours of high emission.

3.3. Impacted Market Segments in California

While the current effort is aimed at converting a disadvantaged community of mixed residential, commercial and industrial use into an AEC, the tools and results will be applicable to communities across the spectrum of end-uses and market segments. The major market segment is an integrated built environment market segment, which includes a large fraction of the current built environment in California. It is estimated that up to 50% of the entire built environment in California could benefit from the integrated set of technologies of our AEC vision and tools.

3.4. Cost-benefit Analysis

The project will produce multiple benefits, including (1) reduced energy cost and energy cost risk for residents and business owners, (2) reduced infrastructure cost for investor owned utilities, (3) reduced GHG emissions, and (4) increased economic activity for the local jurisdiction through community investments and on-going local energy systems management. The benefits will be distributed across multiple stakeholders, including (1) local residents and businesses, (2) investor owned utilities, (3) the residents of California, and (4) the local government and Hunting Beach residents. As such, the approach to analyzing cost-benefit throughout the project will include an alignment of these benefits to costs by stakeholder, enabling financing mechanisms that are attractive universally.

Costs of all design strategies and scenarios will be presented, and first-cost as well as lifecycle energy/ maintenance costs will be presented for each scenario. Recommendations for the assignment of costs to the benefits by stakeholder will also be presented and discussed in concert with the financial structuring, breaking down historical barriers such as the split incentive dilemma.

4. Team Qualifications, Capabilities and Resources

4.1. Organizational Structure

APEP will be the project lead with a strong history of forming strategic alliances that encompass industries, agencies, and utilities. APEP will leverage this experience and established relationships to assure that the project is successfully accomplished. The project team and the overall organization structure is presented in Figure 11. The project team members are: City of Huntington Beach, Altura, NREL, SCE and SCG.

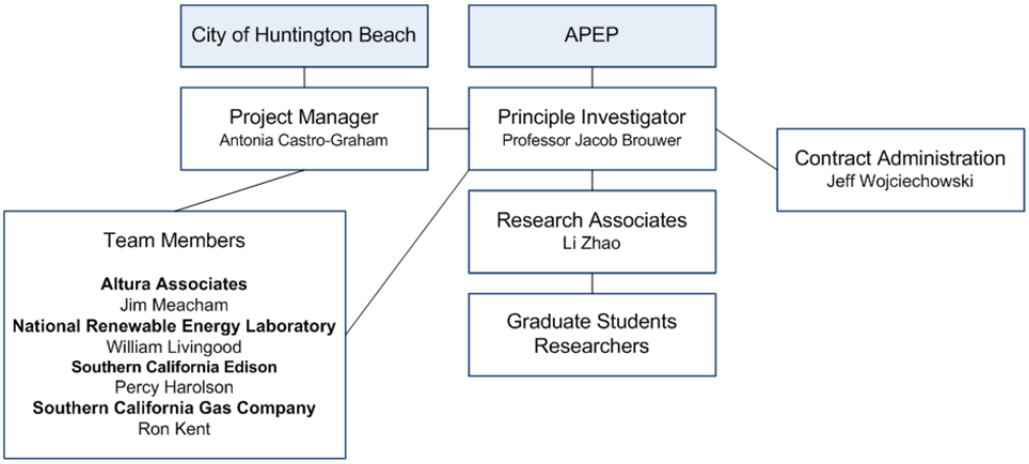


Figure 11. Organizational Chart

4.2. Project Leadership

Led by Professor Jacob Brouwer, Principal Investigator (PI), in collaboration with Project Manager (PM) Antonia Castro-Graham, the APEP project team includes graduate students, research staff, subcontractors, and partners. Professor Brouwer will lead the project and interactions between APEP, the subcontractors, the industry and utility program partners, and the CEC. The PM has overall responsibility for project management, including timing and meeting milestones, appropriating resources and their distribution, outreach, and coordination with the UCI complementary research programs. Professor Brouwer provides experience in the

management and technical leadership of advanced technology demonstration and deployment projects, and monitors closely the details of both the administrative and technical dimensions of the research initiative while emphasizing the overall "large perspective" of energy integration, reliability, control and cost issues that are critical to the success of a project. Through his experience with forming and managing strategic alliances from research to policy, Professor Brouwer places emphasis on the effort needed to bridge between disparate stakeholders in the development and deployment of both the technology and associated public policy.

4.3. Project Team Members

The project team is comprised of the UCI APEP which is the Prime contractor and overall program manager, the City of Huntington Beach, Altura Associates, NREL, SCE, and SCG. Each of the team members are experienced in the roles they are to perform, and most of the team has a long record of previous collaborations with APEP.

- APEP –extensive experience in executing research and demonstration programs in power and energy, and smart grid and microgrid related fields. Examples of such projects include:
    a. Renewable-Based Energy Secure Community (RESCO) under CEC support. This effort developed and leveraged the HiGRID tool to develop a phased road map for the increased deployment of renewable energy sources for the community's needs.
    b. The Orange County Sanitation District biogas tri-generation energy station: A first-of-a-kind tri-generation energy station has been developed and installed by the team comprised of APEP, FuelCell Energy, and Air Products and Chemicals, Inc.
    c. Investigation of high levels of solar PV use on PG&E distribution circuits in "Development and Analysis of a Progressively Smarter Distribution System" under a California Solar Initiative (CSI) program.
    d. Investigation of the integration of Concentrated PV (CPV) on a UCI campus 12 kV circuit in "Improved PV Production Technologies and Innovative Business Model" under a California Solar Initiative (CSI) program.
    e. Participation in SCE's Irvine Smart Grid Demonstration (ISGD) project, specifically involving the use of synchrophasor technology to identify small changes in substation loading in order to validate the performance of power aggregators in the power market under a DOE program.
    f. Installation, operation and testing of the very first pressurized SOFC/GT hybrid system at UCI. This system was tested at UCI with support from the U.S. Department of Energy and Siemens Power Corporation together with Southern California Edison.
    g. Working with Microsoft and SolidPower to design, install, operate and test two 2.5 kW SOFC systems operating on natural gas to power servers and next generation data centers.
    h. Development and investigation of novel controls and algorithms for optimal application of Combined Cooling, Heating and Power (CCHP) in buildings in cooperation with Siemens and with funding from the U.S. DOE and CEC.
    i. Investigation of combined solar and gas heat utilization in absorption cooling for buildings funded by the CEC.
    j. Investigating various biomass and biogas strategies for California in terms of their environmental and economic impacts with UC Davis funded by the CEC.

- City of Huntington Beach – is the site provider for the Oak View community AEC design and planning project. The City of Huntington Beach is a leader in the sustainability field in

Orange County. For nearly three decades the City has taken numerous actions to increase energy efficiency. Over the years, the City Council has implemented a number of strategies and projects that reduce energy related waste. Even with turnover on the City Council the commitment to sustainability has not wavered. The City has completed numerous energy projects that conserve both scarce fiscal and environmental resources.

- Altura Associates – Altura has years of experience facilitating energy efficiency investment projects and programs. Their team's expertise includes feasibility analysis, energy strategy development, design support, renewable energy planning, finance structuring, controls system development and commissioning. Examples of Altura's experience include:
    a. Principal and co-founder of Altura Associates Jim Meacham worked on the APEP RESCO (CEC-PIR-08-033) project leading the tasks associated with piloting demand response experiments on the campus. This project was designated as an 'exceptional project' by the CEC.
    b. Altura recently completed the first phase of an initiative to complete a sustainable redevelopment of a historic landmark in the District of Columbia. Principal Jim Meacham led a renewable power generation feasibility study to explore opportunities to redevelop an abandoned coal-fired power plant into a renewable energy powerhouse for a public housing community. Altura supported the development of multi-property equipment lease arrangements, combined with solar PPAs, to support the development of a comprehensive Energy Conservation Investment Program (ECIP), recently approved by HUD. The project includes well over $100M in infrastructure, energy generation, controls, and EEM deployment, while delivering more than $3M per year in positive cash flow for the public housing authority.
    c. Altura principal Jim Meacham led an effort to develop an energy master plan to inform the redevelopment of the 50-acre, 785-dwelling unit Sunnydale community within the Visitacion Valley neighborhood in San Francisco. The purpose of the energy master plan was to guide the design and development team in targeting cost effective strategies to reduce energy demand, incorporate on-site renewable and non-renewable energy, and enhance the long-term sustainability of the community. The plan is currently being implemented as the community is being developed.
    d. Altura completed a feasibility analysis for multi-building and neighborhood-scale energy-related projects for Mercy Housing. The project included analysis of energy projects for Mercy-owned properties (with an emphasis on Northern California), with the goal of identifying strategies capable of achieving neighborhood revitalization, resident wealth creation, and reducing Mercy Housing operating expenses. The analysis included analyzing energy issues on a multi-building or neighborhood scale, and included micro-grid and distributed energy storage, generation, and purchase.
    e. Altura principal Jim Meacham was responsible for leading the development of an Energy Assurance and Master Plan which was completed in conjunction with planning for a 400-acre mixed-use redevelopment parcel within the Town of Speedway, IN. The energy master plan was completed to help diversify the Town's energy supply, reduce risks associated with grid vulnerabilities, and inform strategic and renewable energy planning. Mr. Meacham helped the Town create a plan which incorporated energy efficiency standards for buildings, on-site energy generation, transportation fuel management, and energy infrastructure improvements to support water supply and treatment.

- NREL – has the capabilities of the existing OpenStudio energy modeling software platform. The team at NREL has been tasked by the U.S Department of Energy with the lead role in the development of OpenStudio and its underlying simulation engine, EnergyPlus. As a part of this leadership role, NREL facilitates contributions from other National Laboratories and academic institutions.
    a. There are currently NREL internally-funded efforts to enhance the OpenStudio platform through the creation of an urban modeling platform (open source) and an Urban Renewable Building and Neighborhood Optimization (URBANopt) design tool. These enhancements are focused on optimizing energy at a district, neighborhood, and community scale, including the evaluation of district energy systems that make use of economies of scale and wasted energy.
    b. NREL is currently working with the City of Denver and the Denver Housing Authority on the National Western Center and Sun Valley urban redevelopment projects, respectively, to: 1) demonstrate how emerging zero energy districts are the future building blocks of thriving cities; 2) develop an advanced urban modeling platform that will enable cities and their partners across the U.S. to achieve zero energy districts.

- SCE – Southern California Edison is the electric Energy Service Provider partner for the project. SCE is the electric power provider to the City of Huntington Beach and UCI Microgrid and a past and current partner with APEP in numerous research and development activities. SCE is the prime recipient of two DOE grants directly related to the proposed project, one of which, the Irvine Smart Grid Demonstration (ISGD) is located on the UCI campus and adjacent communities (Newport Beach and Irvine). APEP is a major collaborator in the ISGD project.

- SCG – Southern California Gas Company is Gas Service Provider partner for the project. SCG is the gas service provider to the City of Huntington Beach and UCI and a past and current partner with APEP in numerous research and development activities.

4.4. Role of Participants and Task Assignments

The project team includes APEP, City of Huntington Beach, National Renewable Energy Laboratory, Altura Associates, Southern California Edison and Southern California Gas. The PI (Jack Brouwer) will provide overall responsibility for project management, including timing and meeting milestones, appropriating resources and their distribution, outreach, and coordination with the complementary APEP research programs. City of Huntington Beach will contribute to the project in planning, permitting and overall AEC design including feasibility study and financing model. Altura Associates will focus upon improving energy, environmental, and financial performance of the community using a data-driven, people-centric approach. Altura will provide professional guidance on data collection, building retrofit, energy management and EEM implementation. Altura will also provide the energy modeling and analysis capability and professional guidance on the AEC modeling and evaluation, as well as finance structuring and multi-stakeholder cost-benefit analyses. NREL will enhance the capabilities of their existing OpenStudio energy modeling software platform with new Advanced Energy Community (AEC) analysis capabilities, as well as work with and advise project partners on the application of these capabilities in the design of the AEC. OpenStudio is a cross-platform collection of software tools to support whole building energy modeling using EnergyPlus and advanced daylight analysis using Radiance. OpenStudio is an open source project to facilitate community development,

extension, and private sector adoption. Southern California Edison will provide significant demand response and ZNE design and implementation experience coupled with the interaction of a microgrid with the utility grid. Southern California Gas will provide expertise in evaluating the potential of the natural gas system to support AECs and ZNE communities. SCG will also provide expertise in the case study with building of a green waste conversion system in the AEC and the multitude of options for use of the renewable gas that it will produce. The task assignments for each team member are shown in Table 5.

Table 5. Task assignments for the team.

TASK #	**Team Member (underlined is lead)**
TASK 1 General Project Tasks	APEP, HB
TASK 2 Develop AEC Design and Planning Tool	APEP, HB, Altura, NREL
TASK 3 Develop Smart Community Microgrid Energy Management Model	APEP, HB, Altura, NREL, SCG, SCE
TASK 4 Carry Out Case Studies on Various Integration Designs	APEP, HB, Altura, NREL, SCG, SCE
TASK 5 Propose Master Community Design	APEP, HB, Altura, NREL, SCG, SCE
TASK 6 Develop Financial and Business Models	APEP, HB, Altura, NREL, SCG, SCE
TASK 7 Develop Outreach Strategy	APEP, HB
TASK 8 Evaluation of Project Benefits	APEP, Altura, NREL
TASK 9 Technology and Knowledge Transfer Activities	APEP, HB

4.5. Facilities, Infrastructure, and Resources Available to the Team

The proposed effort will utilize the readily available facilities such as previously developed community and microgrid models, computational resources and the unique advanced energy community comprised by the operational UCI Microgrid. The UCI Microgrid serves a community of more than 30,000 people and encompasses a wide array of building types (residential, office, research, classroom), transportation options (automobiles, buses, shared-cars, bicycles), and a wide array of distributed energy resources. Through an array of prior and current research programs, the APEP has teamed and worked with the UCI Administration and Facilities Management (FM) to integrate key microgrid hardware, software, and simulation assets into the UCI Microgrid. The facilities and resources available to APEP and the knowledge gained from the Microgrid research are all available to the team for this proposed project.

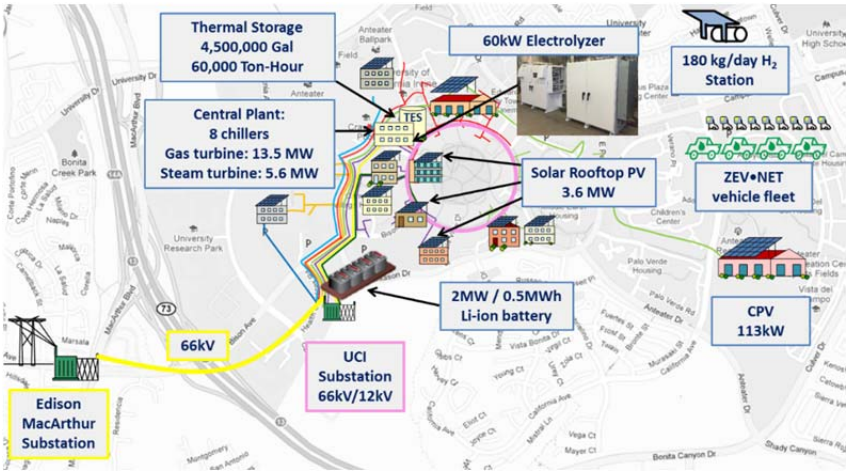


Figure 12. University of California, Irvine Microgrid

As shown in Figure 12, the UCI Microgrid is a test bed that (1) is served by Southern California Edison (SCE) through the UCI Substation which steps down voltage from 66kV to 12kV using two 15 MVA transformers, (2) encompasses ten 12kV circuits, (3) includes nearly 4 MW of solar power, (4) is served by a 19MW natural gas fired combined cycle plant, (5) incorporates centralized chilling including a large thermal energy storage tank (4.5 million gallons/60,000 ton-hours), and (6) serves all major buildings with district heating and cooling. The UCI Microgrid also contains a unique set of distributed energy resources that is unparalleled in the world including: (1) electric vehicle charging at multiple parking locations, (2) 60 kW electrolyzer for producing hydrogen for pipeline injection, (3) hydrogen fueling for fuel cell vehicles, (4) two-axis tracking concentrated solar photovoltaic systems, (5) advanced building energy efficiency measures, (6) advanced building monitoring and control, and (7) advanced power, power quality, and thermal metering. Each of these assets has been inventoried, characterized and modeled by APEP. These resources allow Microgrid model development and verification via comparison to data acquired by conventional metering deployed throughout the microgrid, and advanced high-resolution and high-response metering at over 100 key locations, will all be available to the team for the execution of this proposed project.

The team will have access to the City of Huntington Beach's resources, including but not limited to information technology infrastructure, the City's enterprise energy management system, planning documents (as-builts, building plans, and GIS data) and City staff (Planning, Public Works, Finance, Community Services, and Police). This will be a multi-departmental project as many resources are already deployed into this neighborhood. The team will utilize the existing NREL OpenStudio energy modeling software platform with new AEC analysis capabilities developed in this project. NREL will provide its OpenStudio built environment design tools and their advancement together with instructional materials and teaching for the entire team to use the tools in the AEC project. Altura will provide computational and design resources (built environment simulation software) extant in their current facilities, together with previous financial experience and secured lending mechanisms that can be exercised in Phase II. Altura will also provide the use of the SkySpark analytics platform to support real time data gathering and analysis for energy data from within the community.

4.6. Team's Previous Successful Projects/Products

APEP has successfully worked with UCI Business and Administrative services to create and operate the UCI Microgrid and successfully worked with Southern California Edison to implement and evaluate the Irvine Smart Grid Demonstration project. These successful actual implementations of advanced energy technologies in community contexts are directly relevant to the proposed AEC effort, and bode well for success. The City of Huntington Beach has experience with managing multi-million dollar federal and state grants to construct capital improvements. Details on the team's previous successful projects and products can be found in Section 4.3.

4.7. Questionnaire

a. Has your organization been involved in a lawsuit or government investigation within the past five years? **NO**
b. Does your organization have overdue taxes? **NO**
c. Has your organization ever filed for or does it plan to file for bankruptcy? **NO**
d. Has any party that entered into an agreement with your organization terminated it, and if so for what reason? **NO**

e. For Energy Commission agreements listed in the application that were executed (i.e., approved at a Commission business meeting and signed by both parties) within the past five years, has your organization ever failed to provide a final report by the due date indicated in the agreement? **NO**

4.8. Commitment and Support Letters

The applicant has received commitment letters from 1) City of Huntington Beach, 2) Altura Associates, 3) National Renewable Energy Laboratory, 4) Southern California Edison, and 5) Southern California Gas Company. The applicant has also received support letters from 1) Assembly member Matthew Harper, 74th District, 2) Community for Innovation, Entrepreneurship, Leadership & Opportunities, 3) Oak View Renewal Partnership, and 4) Siemens. These letters are presented in *Attachment 11.*

5. Budget and Cost Effectiveness

Completed Budget forms are presented in the Attachment 7 indicating a significant cost-share and direct funding from investor-owned utilities (IOUs). With the EPIC funding support, the success of the project will not only benefit ratepayers of IOUs, but also promote optimal integration approaches of smart grid technologies, CCHP with high temperature fuel cells, energy storage technologies, and renewable energy utilization, for greater electricity reliability, lower costs, increased safety with ZNE applied at the community level. More importantly, these design, integration and evaluation approaches will be highly applicable to the deployment of AEC across the State. This project will fill the void by designing and evaluating the developed technologies in an operational disadvantaged community. Before this funding opportunity, there was a lack of funding from government agencies or the market to support such a project at the community scale. This is mainly due to the need for involvement and commitment from applied research, key industrial, utility, local government, and consulting partners, and the need to integrate expertise to successfully execute such project. The team is well positioned to accomplish the proposed work, well suited to address the technical, economic and social challenges, and determined to make a significant impact on AEC deployment throughout California. The costs for direct labor are very reasonable, especially since graduate students and interns are significantly contributing to the proposed effort. In addition, we propose a very significant cost-share that is committed by each team member and by SCE and SCG. Only 5% of the funding is proposed for project management tasks and UCI has a very low overhead rate of 25% for Energy Commission contracts. Thus, the proposed effort maximizes funds for technical tasks and minimizes expenditure of funds for program administration and overhead.

6. Funds Spent in California

All of the funds will be spent in California. All work performed by NREL and funded by the California Energy Commission will be performed by individuals who are working in the state of California and paying California state income taxes.

7. Ratio of Unloaded Labor Rates to Loaded Labor Rates

Please see *Attachment 7*, the Rates Summary worksheet (Tab B-7).

ATTACHMENT 4
Project Narrative Form

8. Match Funding

The team commits to a significant amount of match funding, $810,998, comprised of the following:

- University of California, Irvine commits to provide $28,770 of match funding in support of this proposed project.
- City of Huntington Beach commits to provide $152,900 of match funding in support of this proposed project. Please see Attachment 11 for the commitment letter #1.
- Altura Associates commits to provide $62,000 of match funding in support of this proposed project. Please see Attachment 11 for the commitment letter #2.
- National Renewable Energy Laboratory commits to provide $200,000 of match funding in support of this proposed project. Please see Attachment 11 for the commitment letter #3.
- Southern California Edison commits to provide $200,000 of match funding in support of this proposed project. Please see Attachment 11 for the commitment letter #4.
- Southern California Gas Company commits to provide $150,000 of match funding in support of this proposed project. Please see Attachment 11 for the commitment letter #5.

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