Institutional Security through Sustainability

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A Mānoa Facilities Lab Project

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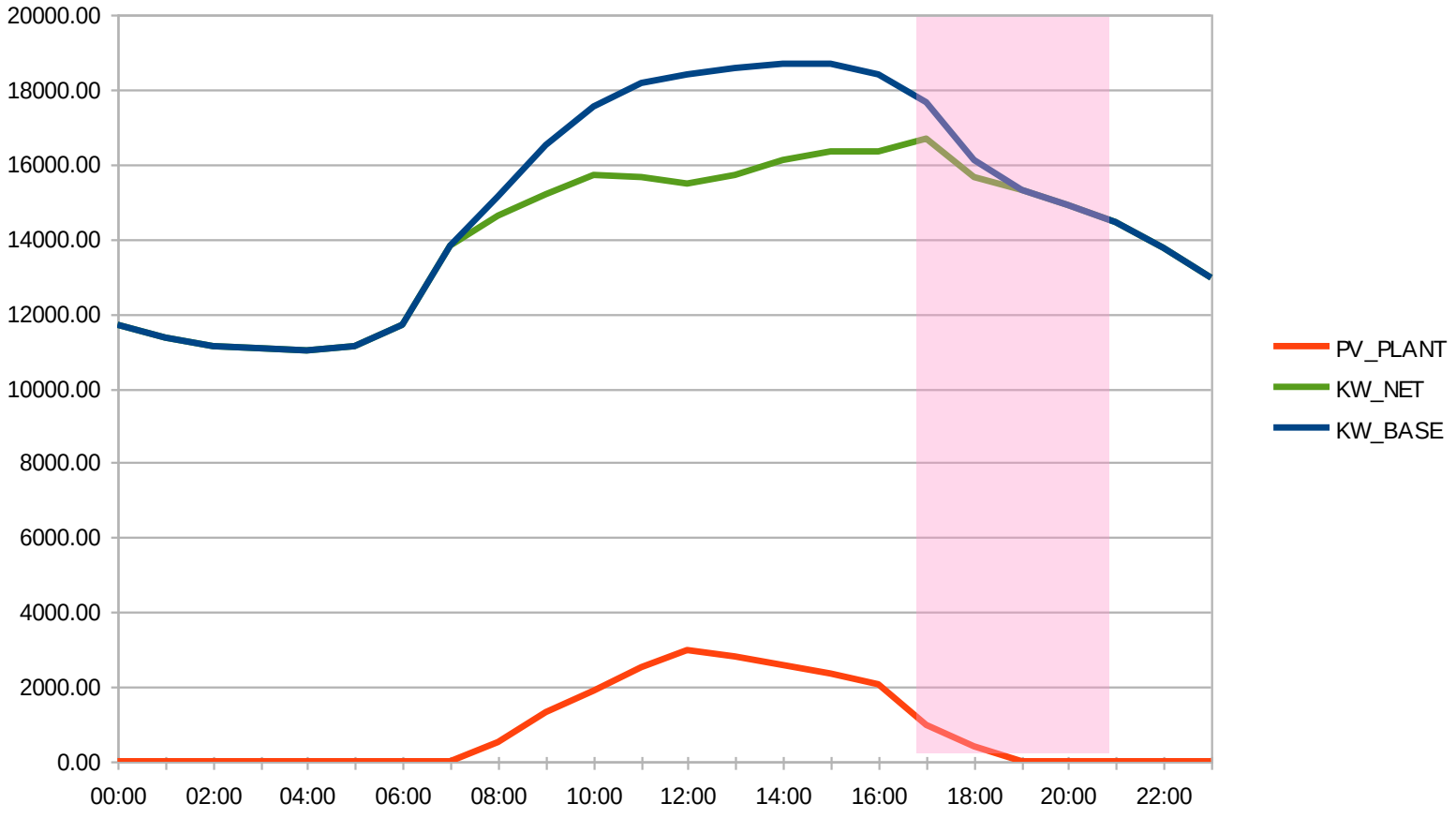
Introduction

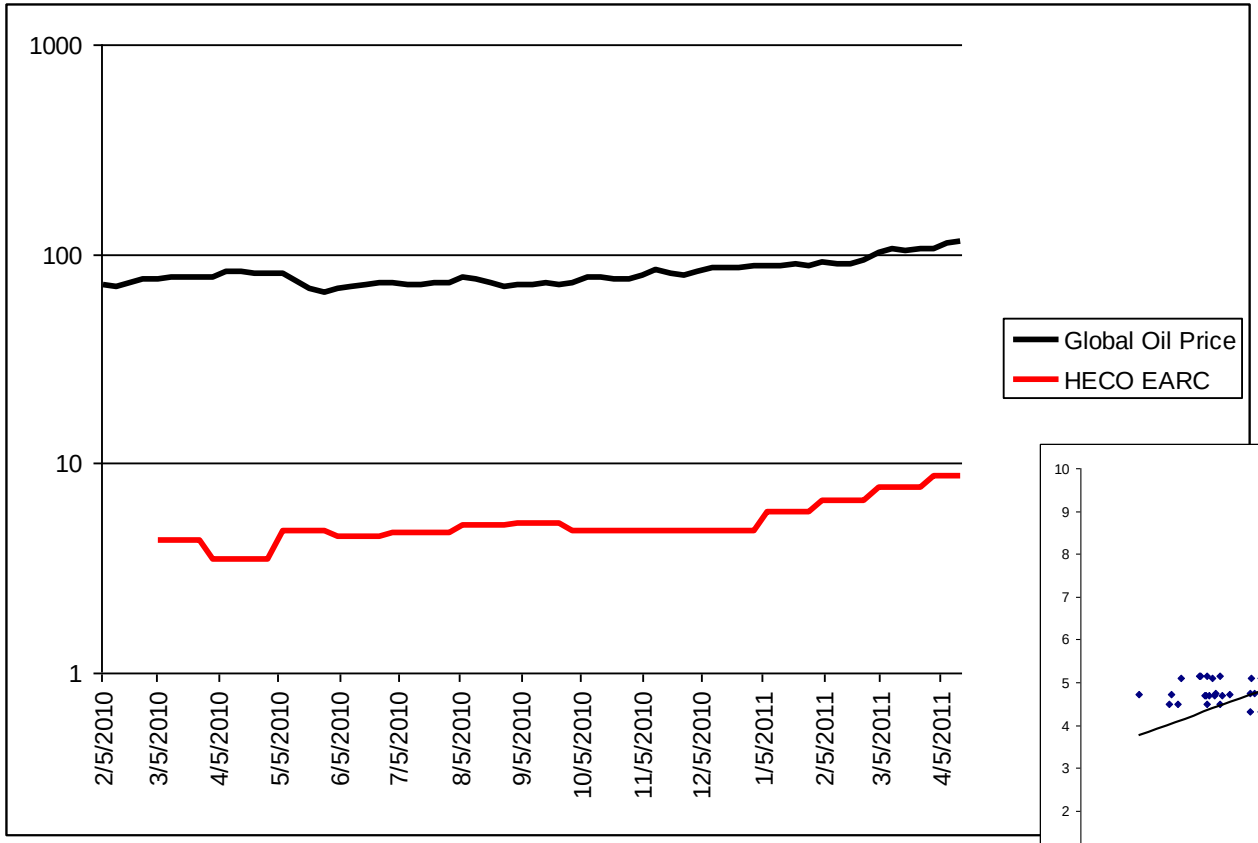
- As the State of Hawai'i's flagship research university the University of Hawai'i at Mānoa currently consumes over 125 $MkWhy^{-1}$ (Gross) at an annual cost of $22 million.
- Institutional Energy Security consists of two key variables:
  - Availability of Stable Power
  - Economic Pricing for energy
- Every dollar increase in the price per of a barrel of oil adds $0.009 per kWh

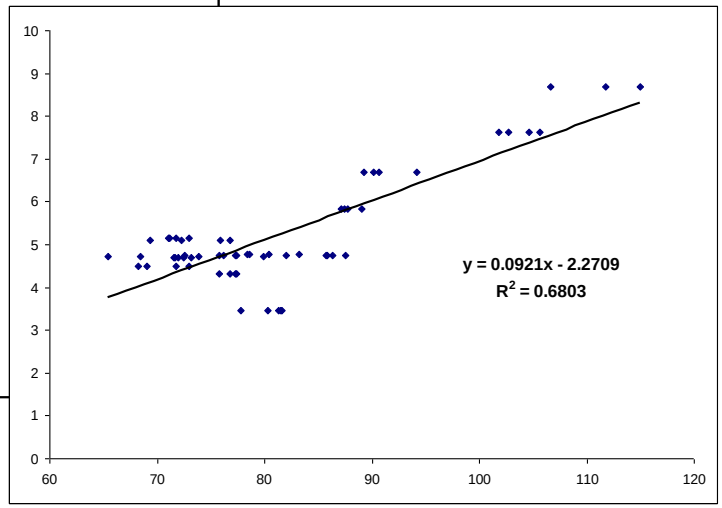
This is not a Drill

Manoa Daily Load Curve

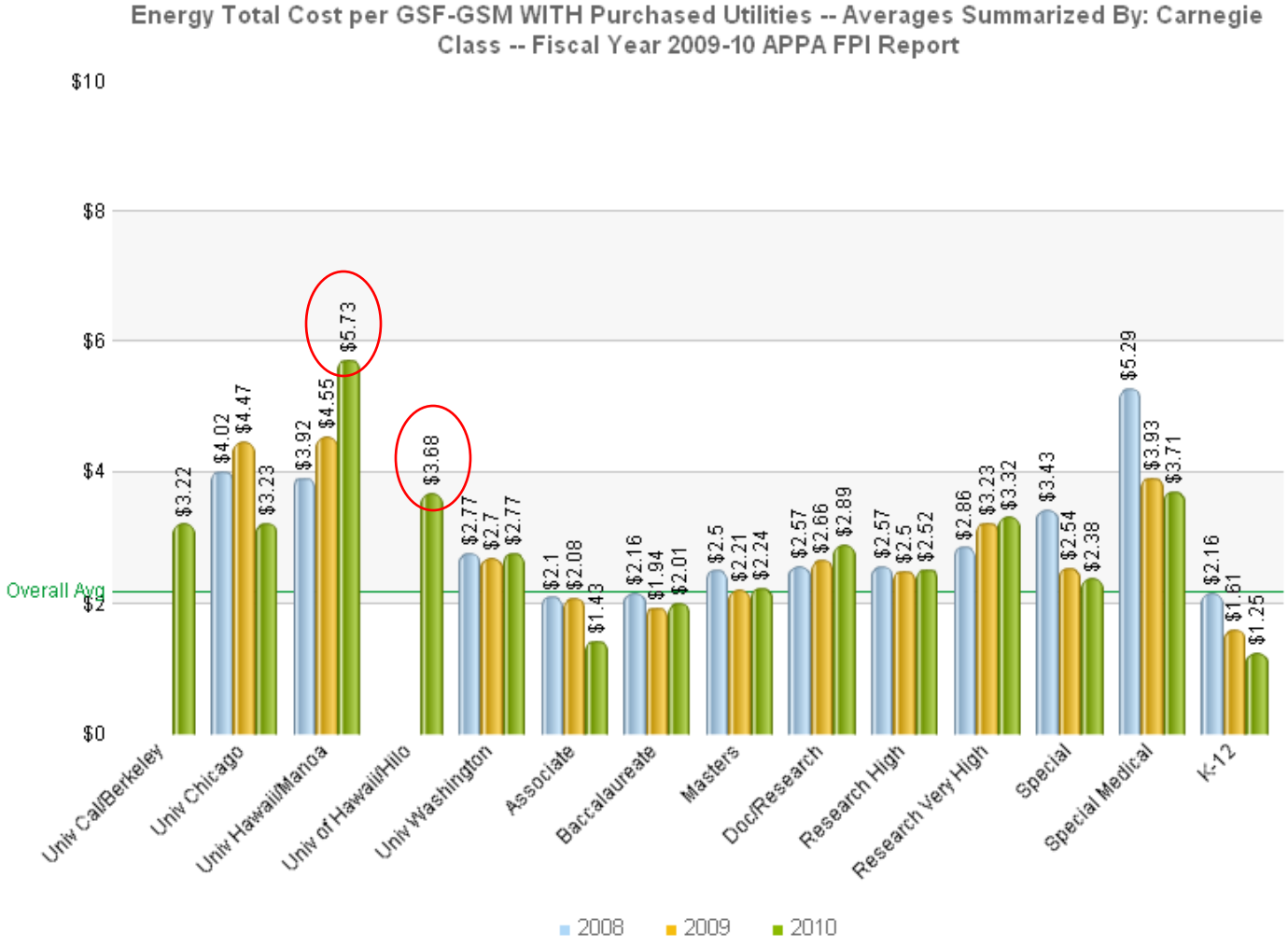


HECO EARC to Global Oil Prices

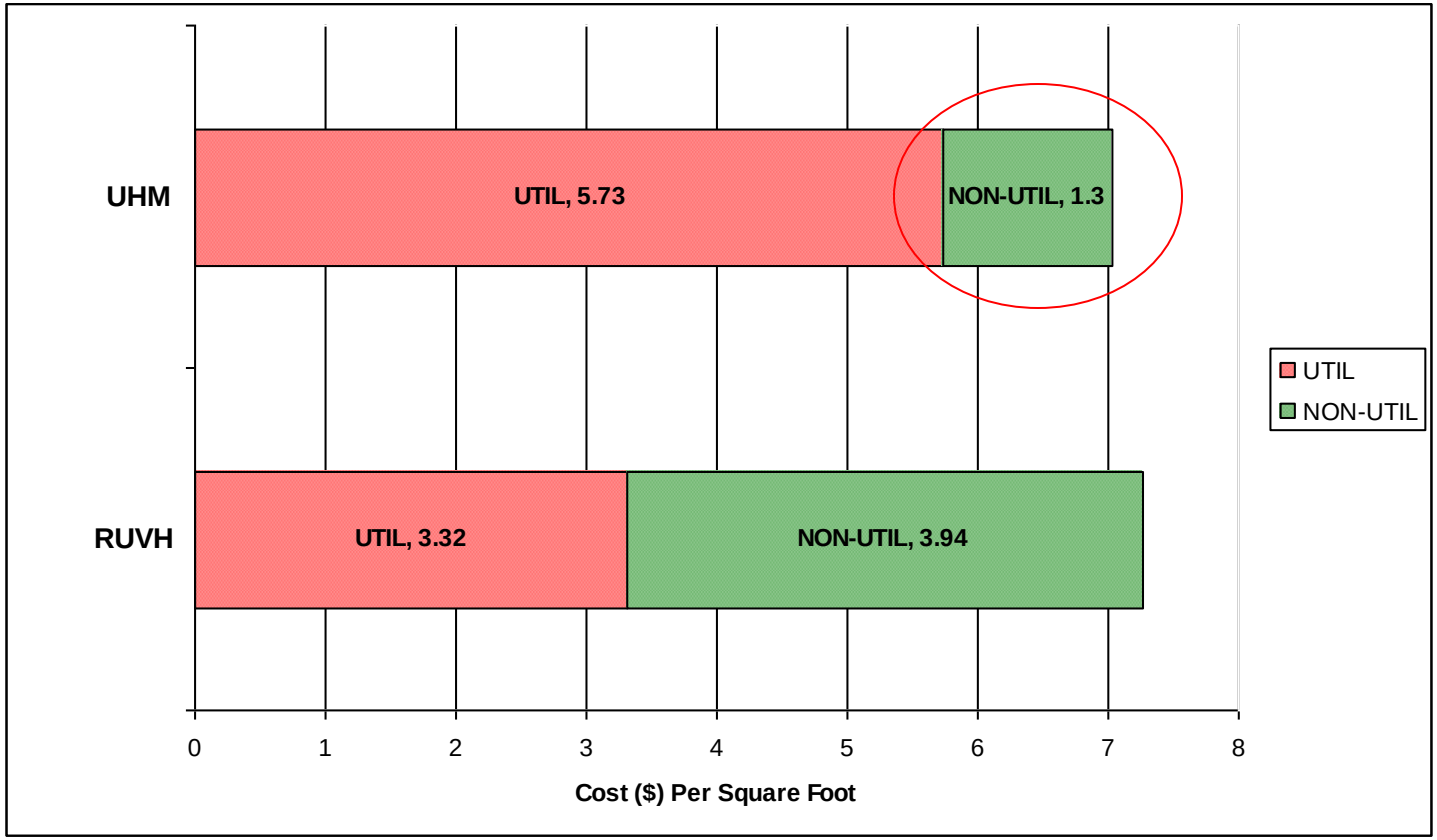




Energy Cost Comparisons



Purchased Utilities as a portion of Total Operations

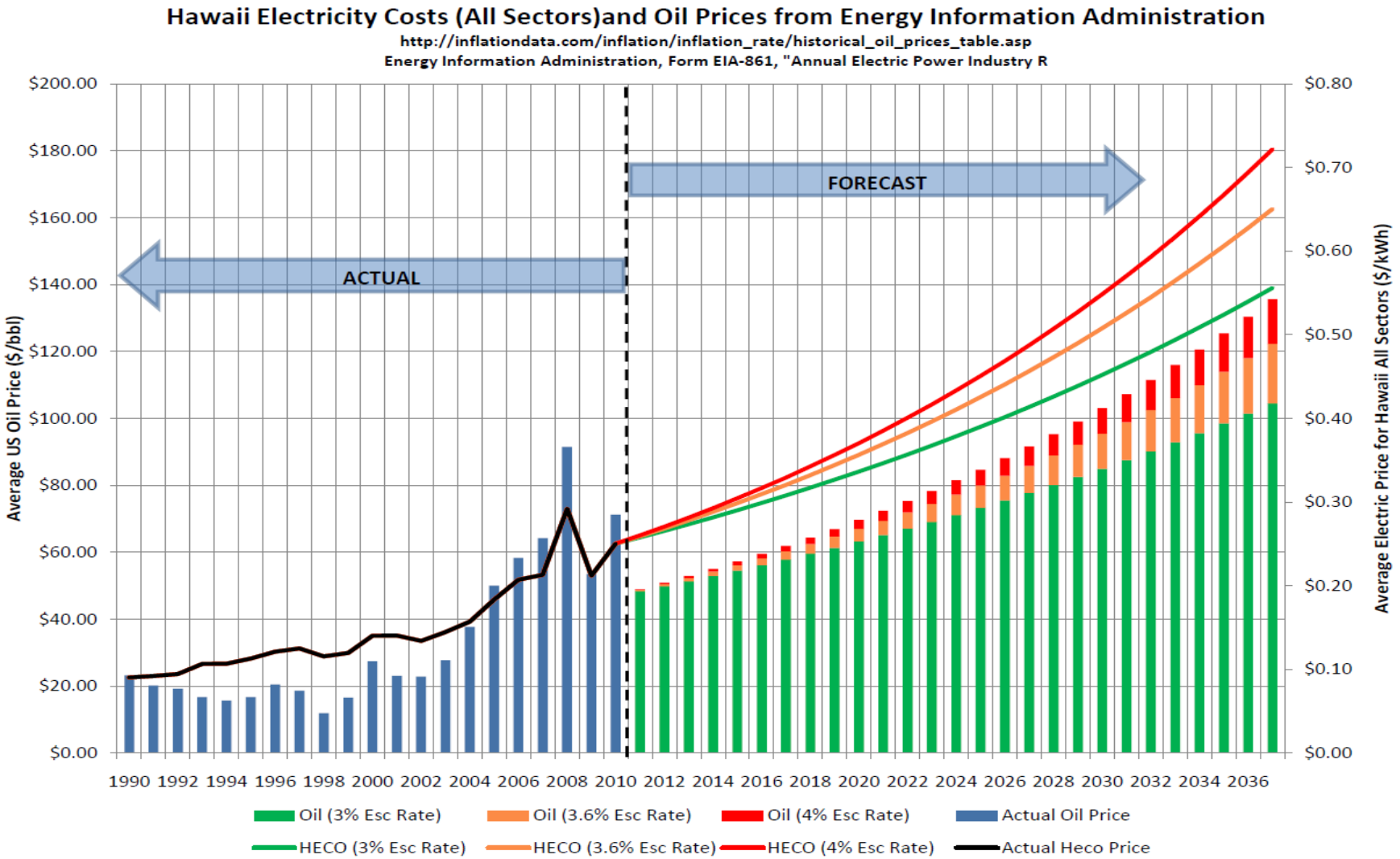


Forecast Financial Assumptions and Sensitivity

The price of energy purchased from HECO and annual escalation rate

- The analysis utilizes HECO's TY2009 DS rate as the base rate, with an average electricity price of $0.205/kWh
  - A $0.01/kWh increase in the initial utility prices results in about $2 million additional avoided costs over 25 years, for system ownership
- We assume an annual utility escalation rate of 3.60%, which is based on the average escalation rate for the price of oil since 1990.

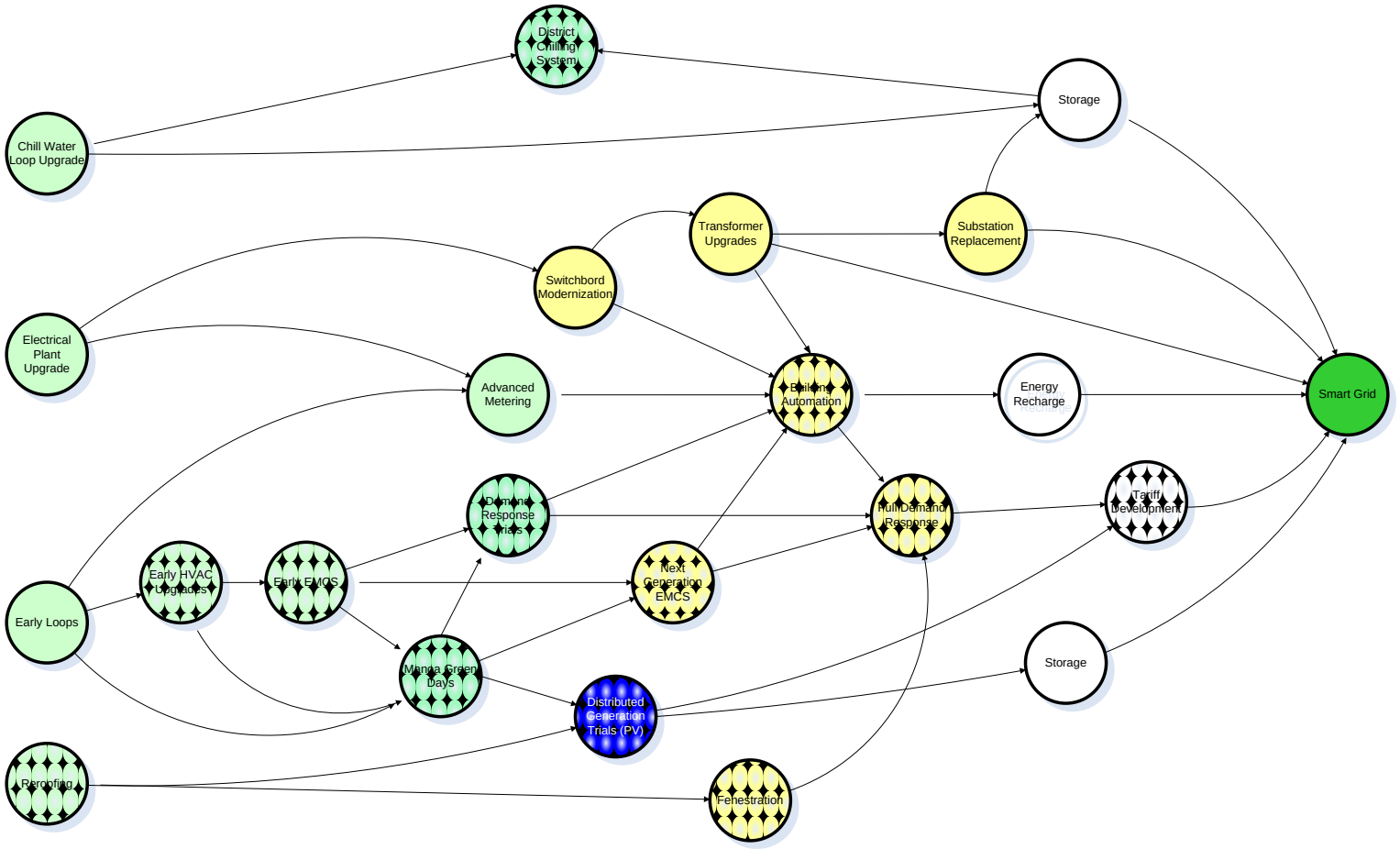
Projections of HECO Rates



Smart Plant Smart Grid

- Hawai'i's future is vitally dependent on the development of sustainable cost-effective energy.
- As the physical plant manager of Hawai'i's flagship research university are committed to the development and application of knowledge and technologies that will sustain and advance the University's mission to serve the State of Hawai'i, the Nation, and the world-at-large.
- It is an urgent and necessary goal to deploy intelligent controls into the energy network to manage the complex optimization tasks.

Energy Network Roadmap



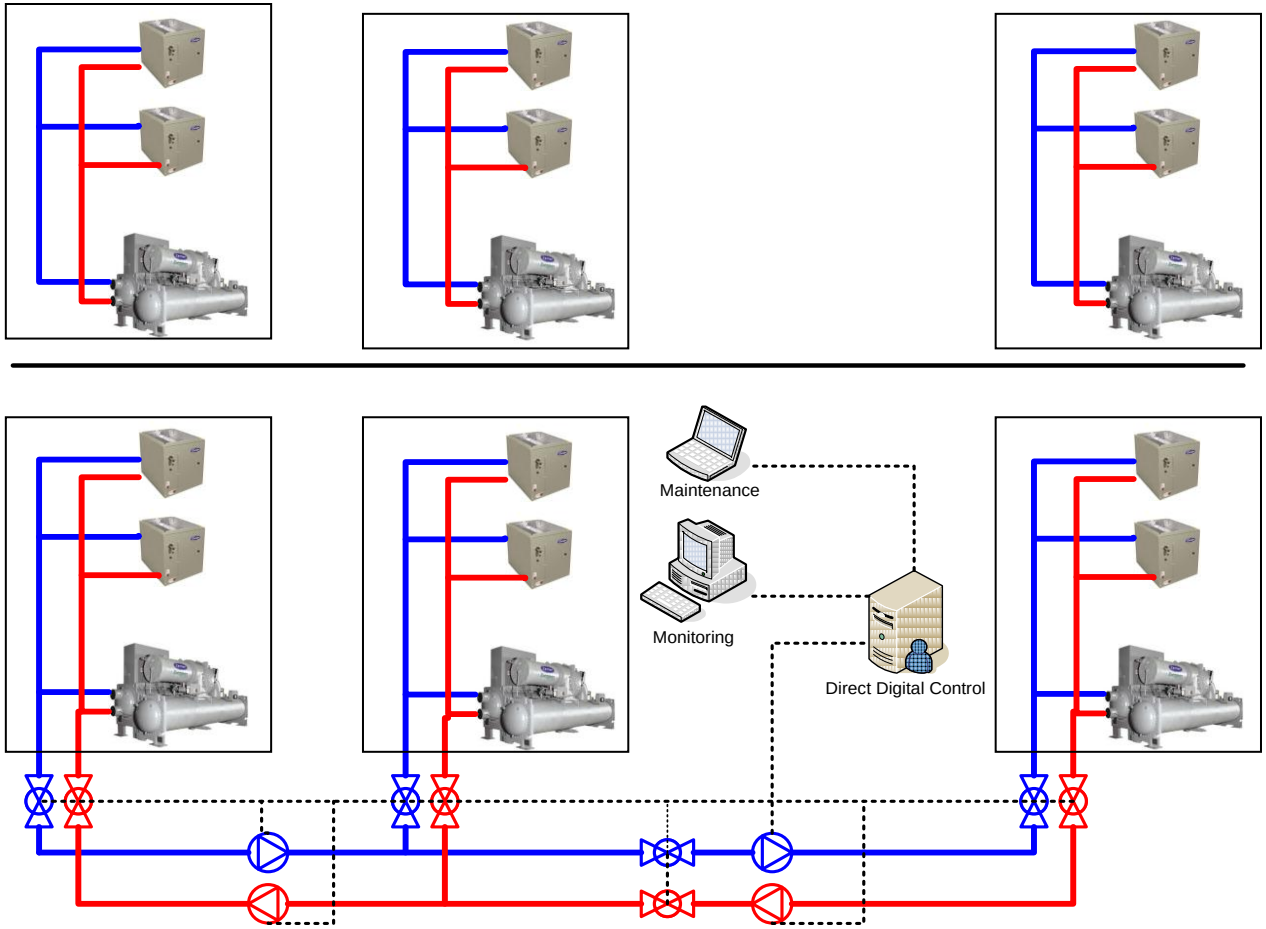
The First Step: Smart Grids to Smart Loops

- 75% of all Energy Savings comes from HVAC optimization
  - Retrofits and RxC
- UHM adapted the intelligent or "Smart Grid" concept to chill-water "Smart Loop Systems" that leverages the sharing of interconnected building chill-water plants to optimize total system performance.

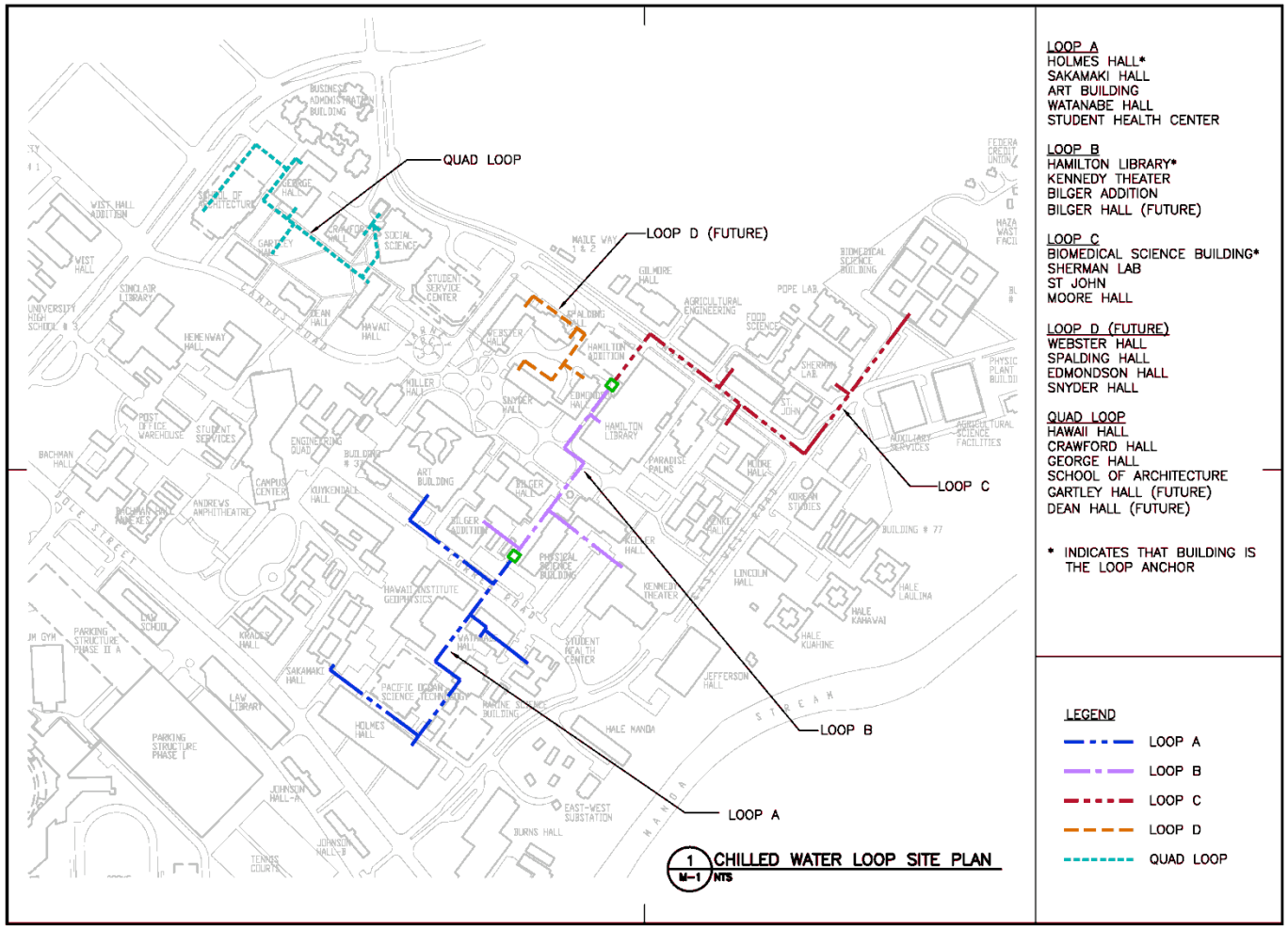
Shared Chiller Plants

Old

New



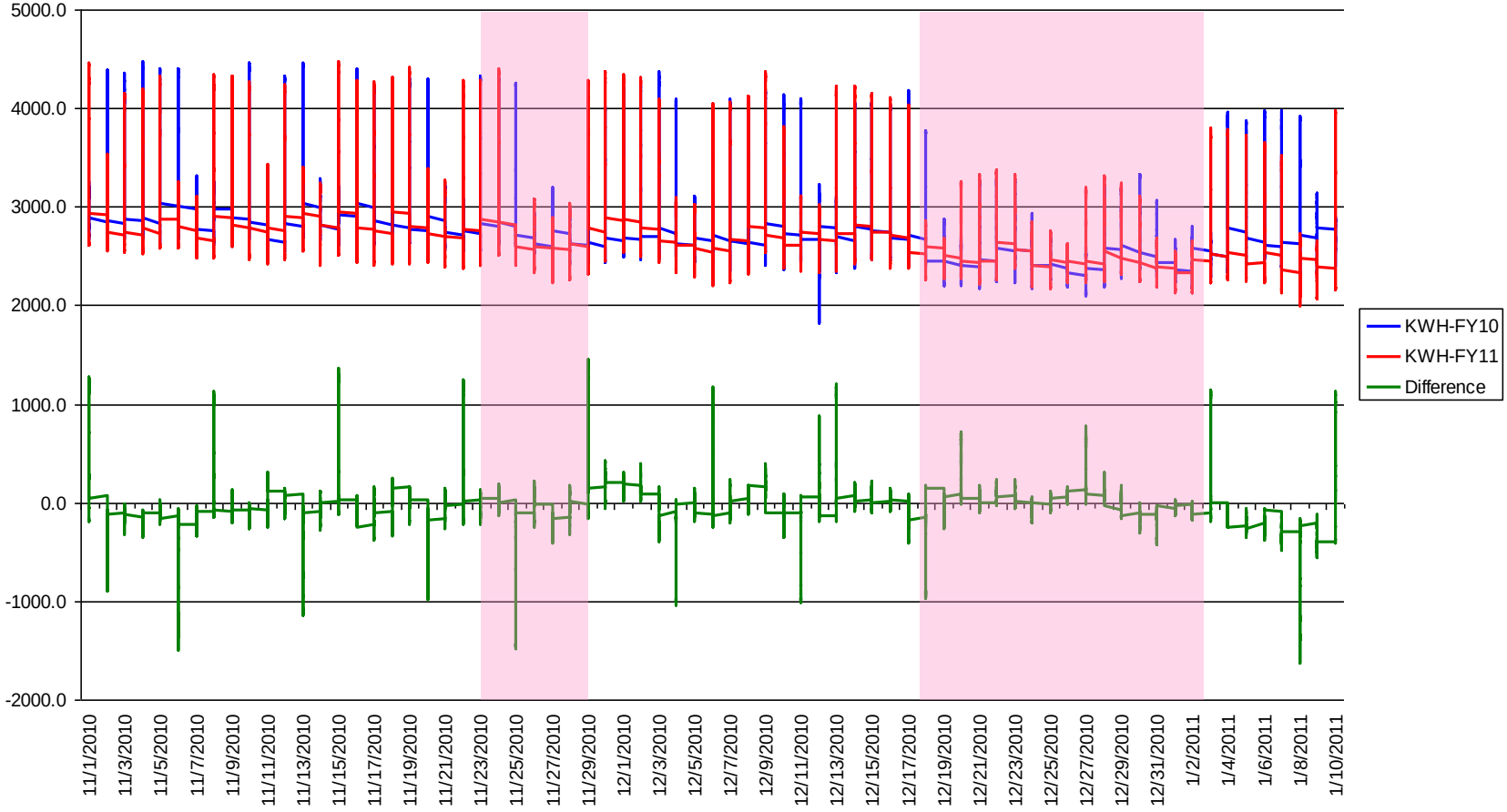
Campus Loops



Next Task: Mastering Digital Control Systems

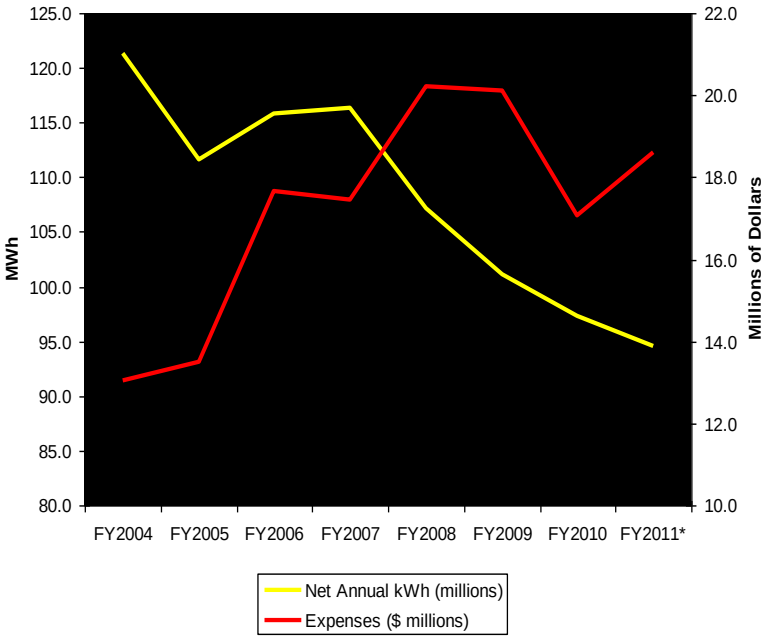
- The effective evolution of adaptive energy distribution systems (i.e. "Smart Grids") requires the implementation of control technologies that leverage user behaviours.
- Manoa Green Days was implemented to take advantage of Furlough Days and Holidays to reduce consumption and to test new HVAC control technologies and procedures.
- Over twenty main campus buildings currently participate in the program representing nearly 1,000,000 GSF of campus floor space.
- Starting July 2009 pilot "power-downs" were implemented on the participating buildings during the weekends, Thanksgiving break, and Christmas break (November 1 – January 10, 2011).

MGD Daily Loads



Results

- MGD saved over 800,000 kWh or 1% of the annual net usage.
- Facilities demonstrated the necessary expertise to perform real-time control over its chill-water and electrical distribution system.
- As of June 2011 UH Manoa Facilities Engineering will have achieved a **22% net reduction** in electrical usage from 2004
- On a cumulative basis this will have saved more than $13.7 million dollars and reduced the amount of carbon released into the atmosphere by an estimated 124,445,809 pounds of CO2
- At the present cost per kWh this represents $4.2 million in annual savings going forward.



After Control: Distributed Generation

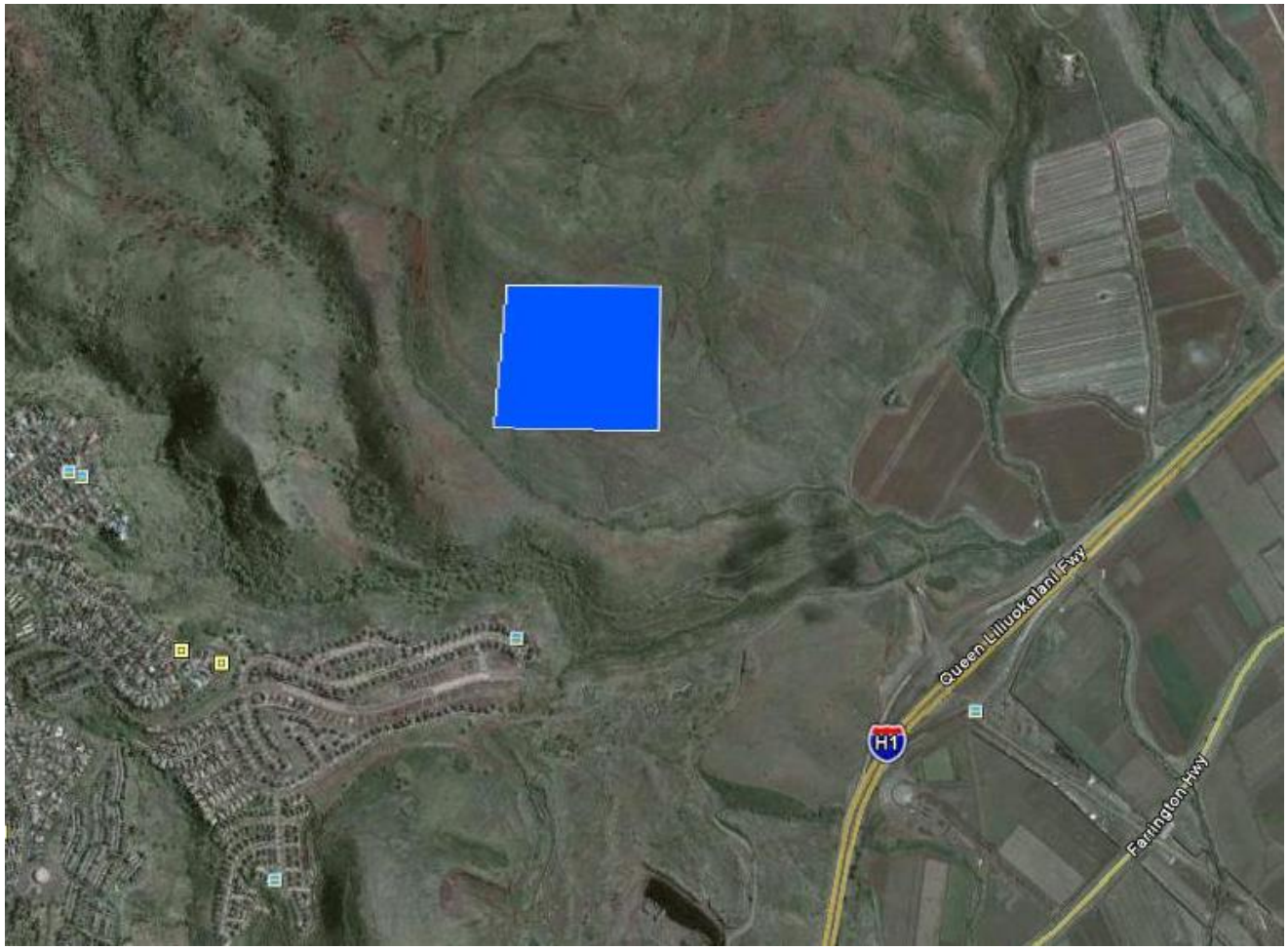
- To achieve energy sustainability the University will need apply these Smart Grid technologies to alternative/distributive generation.
- A key factor to large-scale alternative/distributive generation is the interconnection to the local utility.
- Distributed generation must be intricately meshed with the local grid to avoid production restrictions.
- UH Mānoa is planning to install the first 5 MW array of photovoltaic generating capacity in the next 24 months with an additional eleven 5 MW arrays to follow over the next three years.
- To be successful the University will need to meet the challenges of control, storage, **and real estate constraints** to achieve energy sustainability.

Program Goals

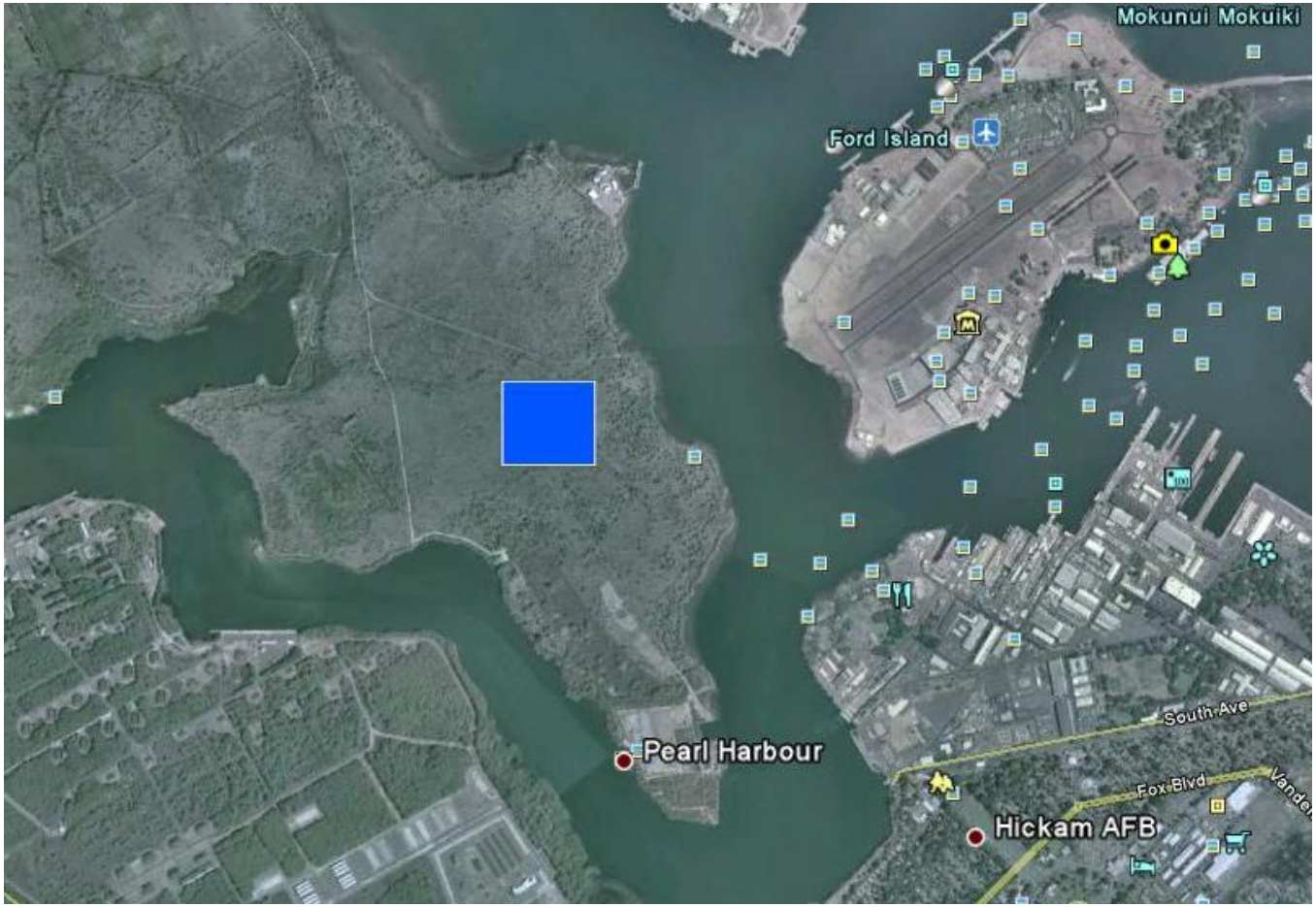
- UHM Facilities is currently teamed with the San Francisco energy consultants Newcomb | Anderson | McCormick (NAM) to Develop 60 MW DC of Photovoltaic Electricity
- Sites: (5 MW = 25 acres)
  - UHM Main Campus 5 MW
  - UHM Waihila Valley 5 MW
  - UH West Oahu 30 MW
  - USN/UHM Waipio 5-20 MW
    - Proposed Partnership with USN to supply strategic reserve power in the event of supply disruptions in exchange for PV sites.

Wahila Valley Site (UHM)

Sugarland Site (UH)



Waipio Site (USN)



How we structure it

- On-Campus and Waihila sites as large-scale interconnects (inside our district utility system on our network)
- Of-Campus as Tier-3 Feed-In-Tariffs
  - Arbitrage the difference between the FIT and the new DS rate
  - Sell to HECO Off-Campus and purchase from HECO On-Campus

How We Finance It

- We are currently running financials models to determine the best mix of:
  - Commercial Power Purchase Agreement (i.e. Coconut Island)
  - UH Direct Ownership (i.e. Sinclair and PBRC)
  - Public/Private Partnership (mixed financing)
  - EFI+O&M Sale and Leaseback
  - Current Investment and Depreciation Tax Incentives

Next Steps

- Complete Manoa Campus Roof-top Inventory and issue competitive PPA RFP based on lessons learned from Coconut Island.
- Negotiate Expanded Interconnection Agreement with HECO to accommodate On-Campus PV capacity.
- Open discussions with USN on the feasibility of using either Waipio peninsula or Lualualei
- Determine if UH Sugarland site is available
- Determine the entity structure
- Complete financing and site acquisition for the proposed entity
- Implement Feed-in-Tariff Agreements with HECO as soon as feasible.

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