Implementation Strategies, Business and Financial Models

Moderator: **Mr. Ruediger Lohse**, German Energy Service Hub

Dr. Alexander Zhivov, ERDC CERL

Mr. Joshua Kneifel, NIST

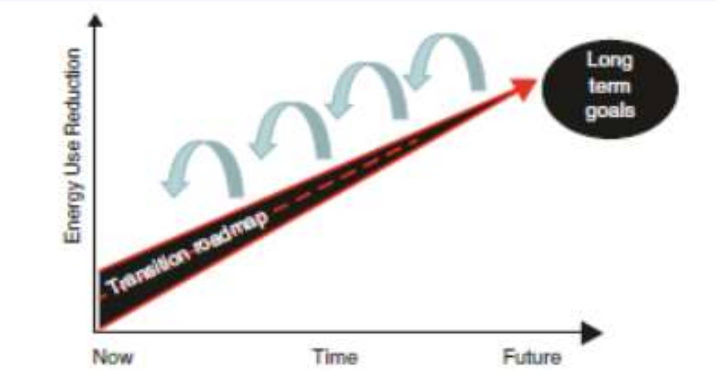
Dr. Timothy Unruh, Executive Director, National Association of Energy Service Companies

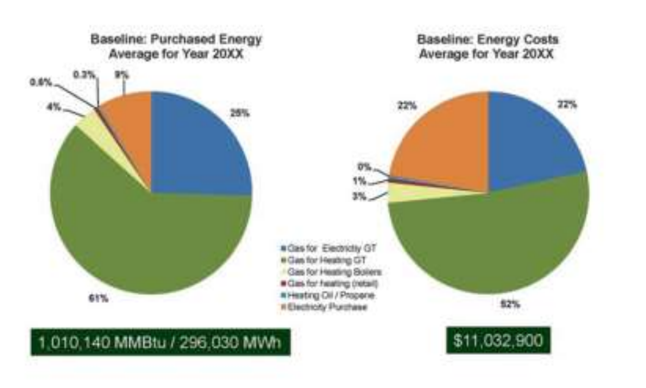
Mr. Bill Taylor, Engineering Manager, Energy Systems Group

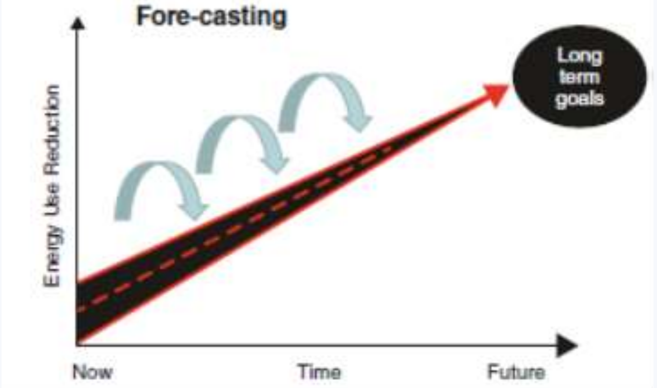
Ms. Kate Anderson and **Nick Laws**, NREL (recorded);

Mr. Keith Yamanaka, US Army Garrison – Hawaii

Q&A







Energy Master Planning: Implementation Strategies and Scope of LCCA

Dr. Alexander Zhivov

Engineer Research and Development Center

Construction Engineering Research Laboratory

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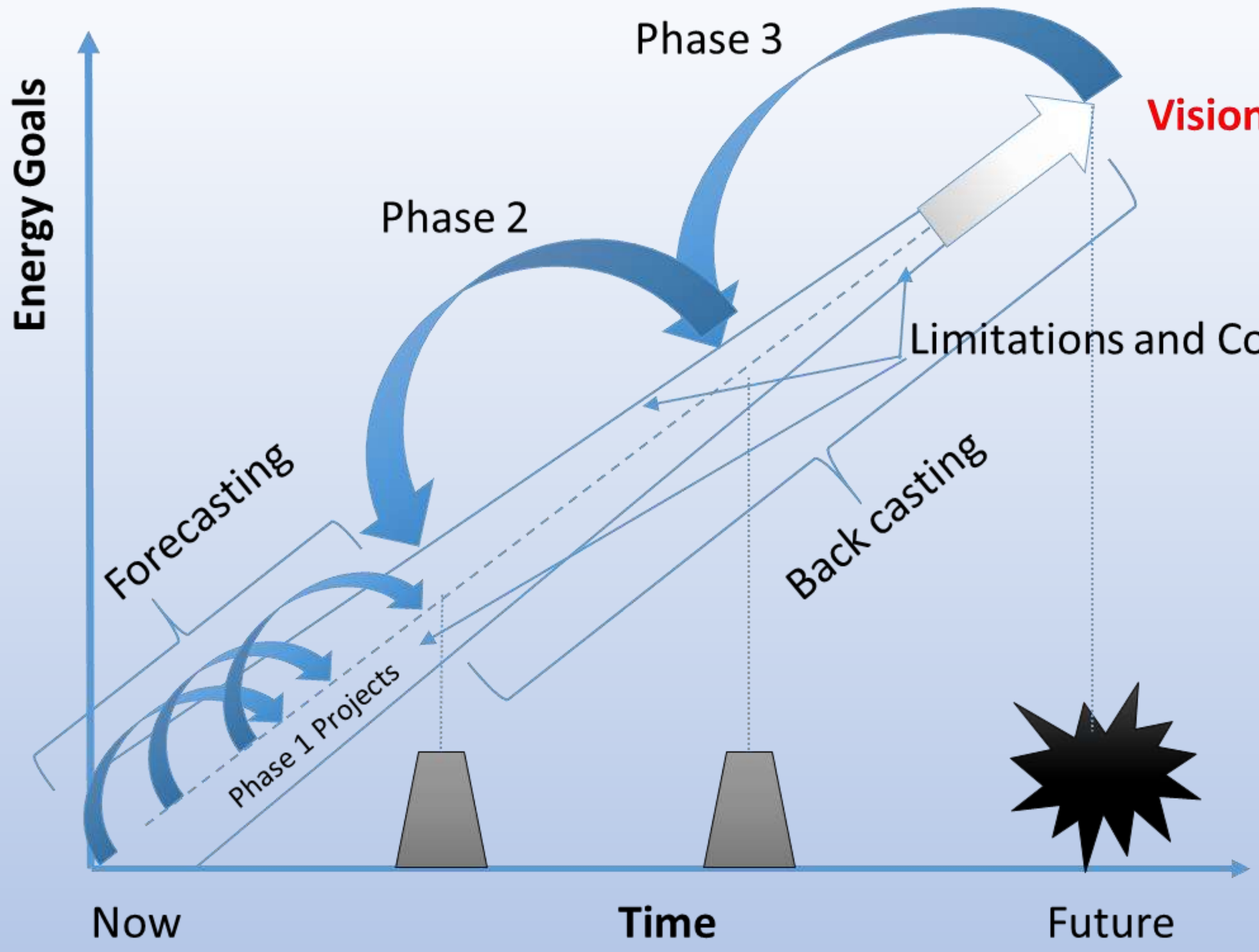
Energy Master Planning = Road Map

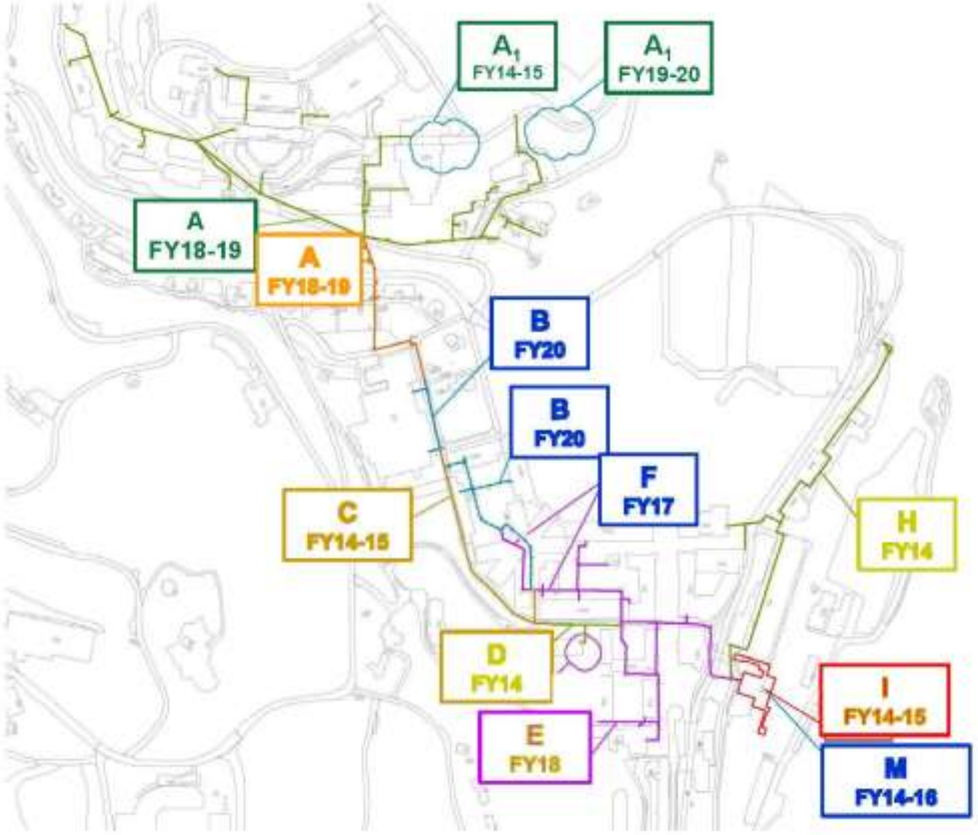


From A to B

Notional Example of Phased Approach

Implementation Schedule for Tri-generation Scenario

Phase	Description	Location	2014	2015	2016	2017	2018	2019	2020
A	Convert North buildings from steam to hot water	North area buildings							
A	Install chilled water lines	North area buildings							
A1	North building boiler plant	Near 687							
A1	North building chiller plant	South of Ike Hal Near Bldg 687)							
B	Replace North steam pipe with Hot Pipe	N campus							
C	New hot water and chilled water mains	New cadet barracks to Arvin							
D	New hot water and chilled water mains	MH G to New cadet barracks							
E	Central chiler plant	New cadet barracks							
F	Steam replace with hot water and chill water pipe	Central area							
G	Hot water and chilled water tanks and piping	South of NCB							
H	Steam replace with hot water and chill water pipe	bldg 604 to 609							
I	Central East area chiller plant	bldg 604							
J	Steam replace with hot water and chill water pipe	MH G to 606							
K	Decentralize south area steam system	Buffalo field area							
L	Convert building steam to hot water								
M	12 MW Cogen plant	bldg 604							
	Convert 604 to HW								
	Electrical upgrades to utilize generators								
	Add remaining barracks to chilled water loop								



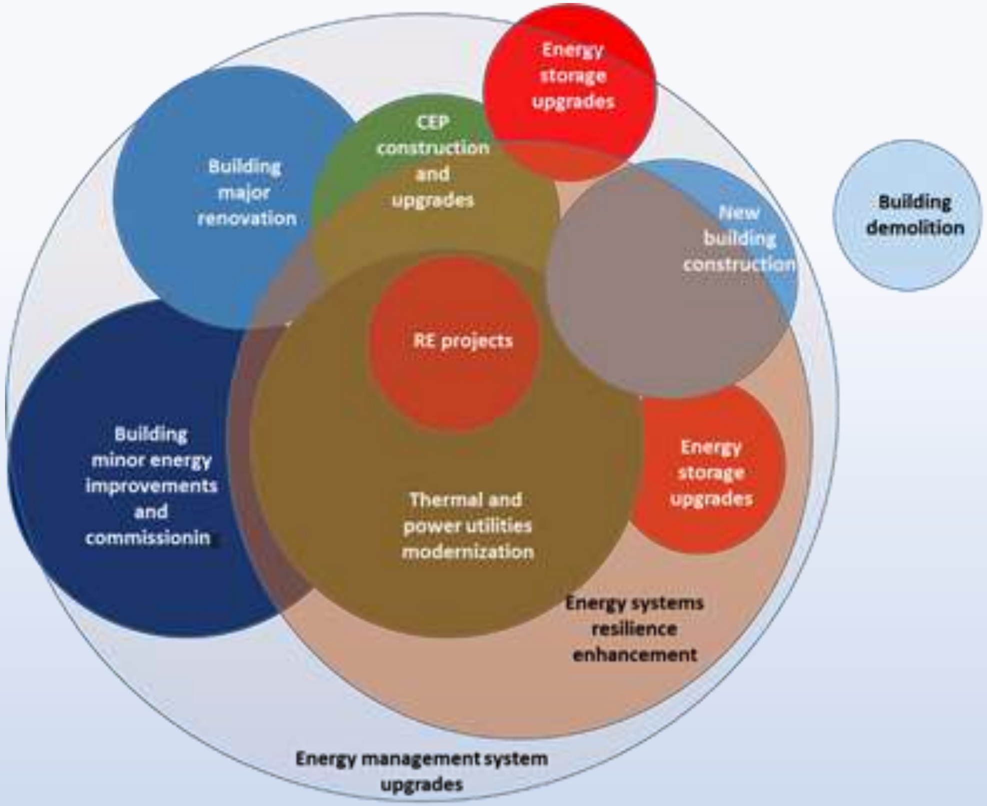
EMP scope and Life-Cycle Cost

The scope of the EMP can include **new construction, demolition and consolidation projects, energy supply**, **energy distribution** and **energy storage components** as well as creative methods to build site-to-grid innovative arrangements that may provide for grid stability or site resiliency.

An EMP is not limited to energy related projects, but rather includes a **spectrum of non-energy related projects**, e.g. new building construction, demolition, and utility modernization projects and non-energy related measures to enhance resilience of energy systems (e.g., **elevation of energy equipment, construction of flood walls, burring cables**, etc.

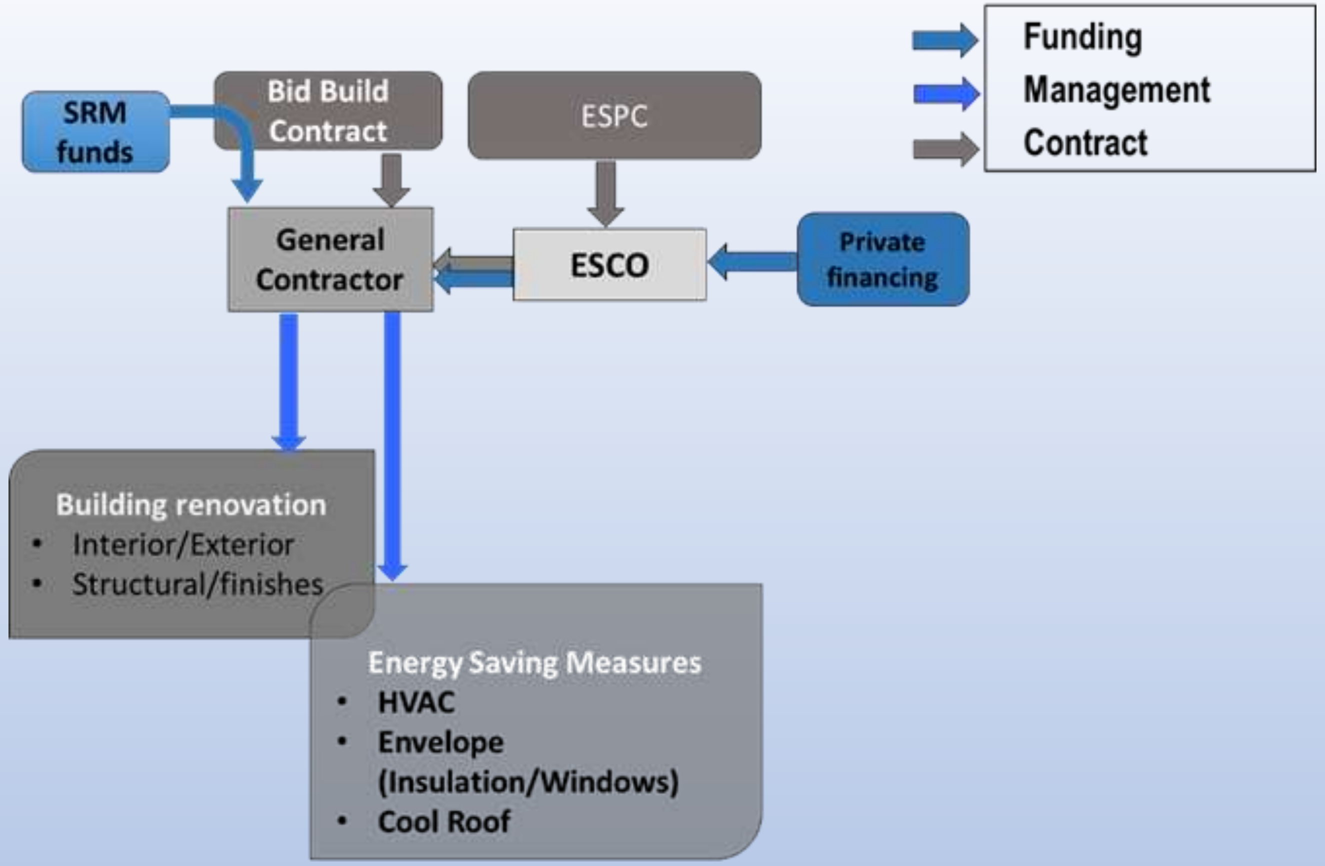
Interrelation of Projects under EMP

- EMP covers multiple interrelated projects where the outcome of one project or a group of projects influences one or many other projects, e.g.
  - Impact of building efficiency improvement on the size of required energy generation capacity,
  - Thermal energy supply to a new building requires installation of pipe connection to existing district system,
  - Connection of additional buildings to the hot water district system allows increase of CHP base load, etc.



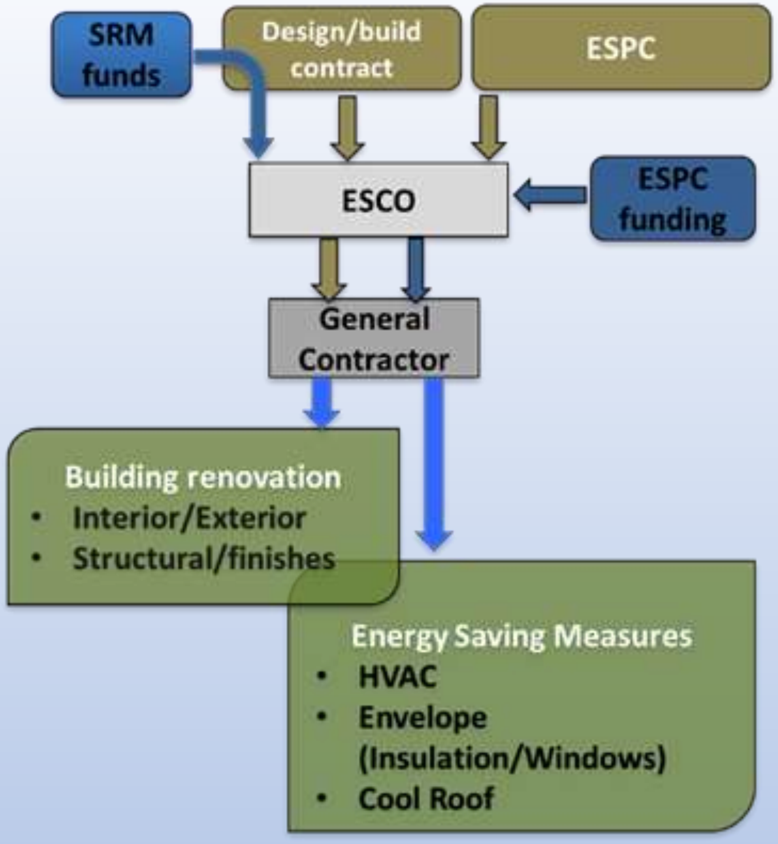
- Therefore, selection of alternatives for the EMP shall be based on cost effectiveness of the whole plan Vs. cost effectiveness of individual projects it is comprised of.
- It is assumed, that **some individual projects will not be cost effective.**

Using Combined Funding to Execute Energy and Non-Energy Related Projects - Model 1



In Model #1 the general contractor (GC) constructs the entire project, but energy-related portion is implemented under a subcontract with ESCO. GC has two managers (the government customer and the ESCO), but the government customer is ultimately in charge of entire project.

Using Combined Funding to Execute Energy and Non-Energy Related Projects - Model 2



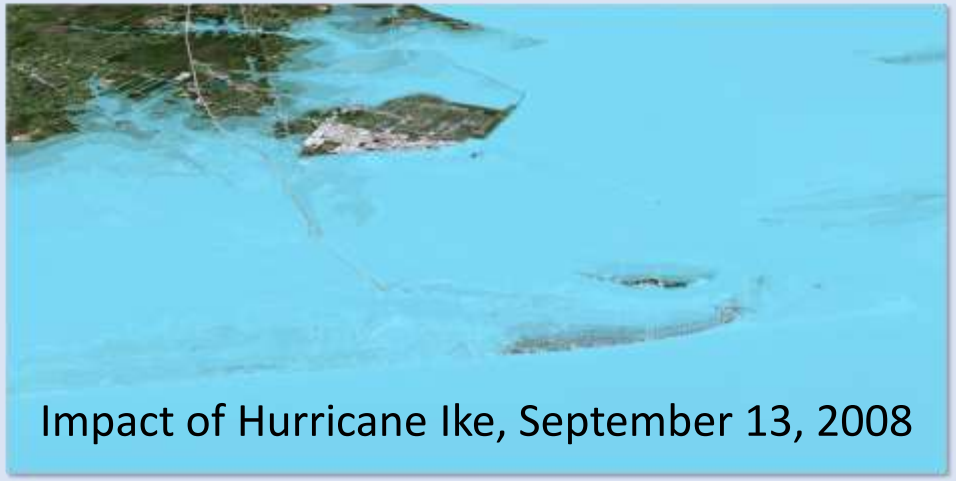
ESCO is awarded design/build contract for non-energy-related building renovation, and ESPC for energy-related measures. ESCO hires a GC but provides single point of contact for the government customer.

Also, ESCO can be allowed some limited non-energy work, but substantial non-energy-related work performed by the ESCO or a subcontractor to the ESCO would not be allowed.

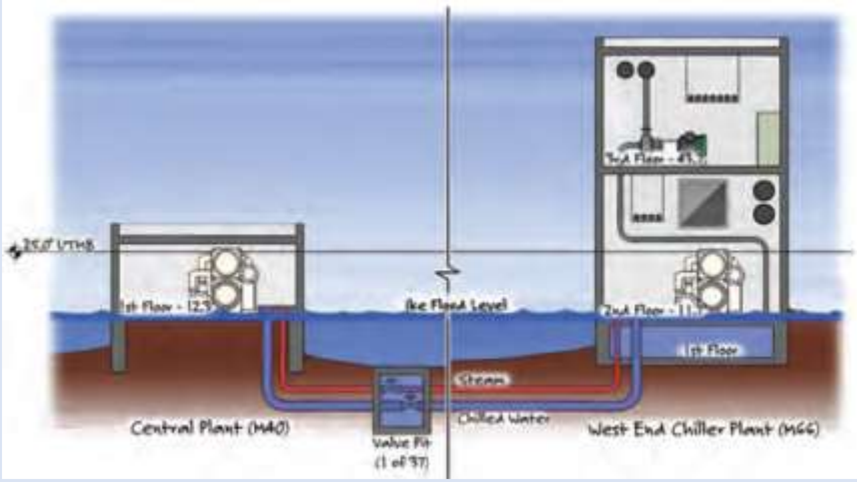
Value of Resilience

- While the cost of a given resilience measure is well understood, the resulting benefits are more difficult to assess, particularly because of a lack of supporting data. Resilience has been acknowledged as a distinct benefit, but not quantified or valued. Even if the health, safety, and economic impacts of a threat could be quantified, it is very challenging to translate those impacts into financial consequences, which will ultimately indicate to a given stakeholder whether a change in investment or operations is warranted.
- In the following presentation, Kate Andersen and Nick Laws will discuss some practical approaches to Resilience Value.
- Several other approaches are described in Chapter 10 of the Energy Master Planning for Resilient Public Communities Guide.

The University of Texas Medical Branch at Galveston



Impact of Hurricane Ike, September 13, 2008



Cost of stabilization: $14,000,000
Unable to operate hospital: 90 Days
Lost business revenue: $2,000,000/day

Underground steam distribution system a complete loss
Lost research materials
Estimated over 1 billion dollars in damages

UTMB: A Three Step Plan

Step One: Go Away from Buried Steam Pipe

- Convert most buildings to heating with hot water.
- Distribute steam overhead to research buildings

Step Two Elevate the Boilers and Chillers

Step Two: West Plant Flood Walls

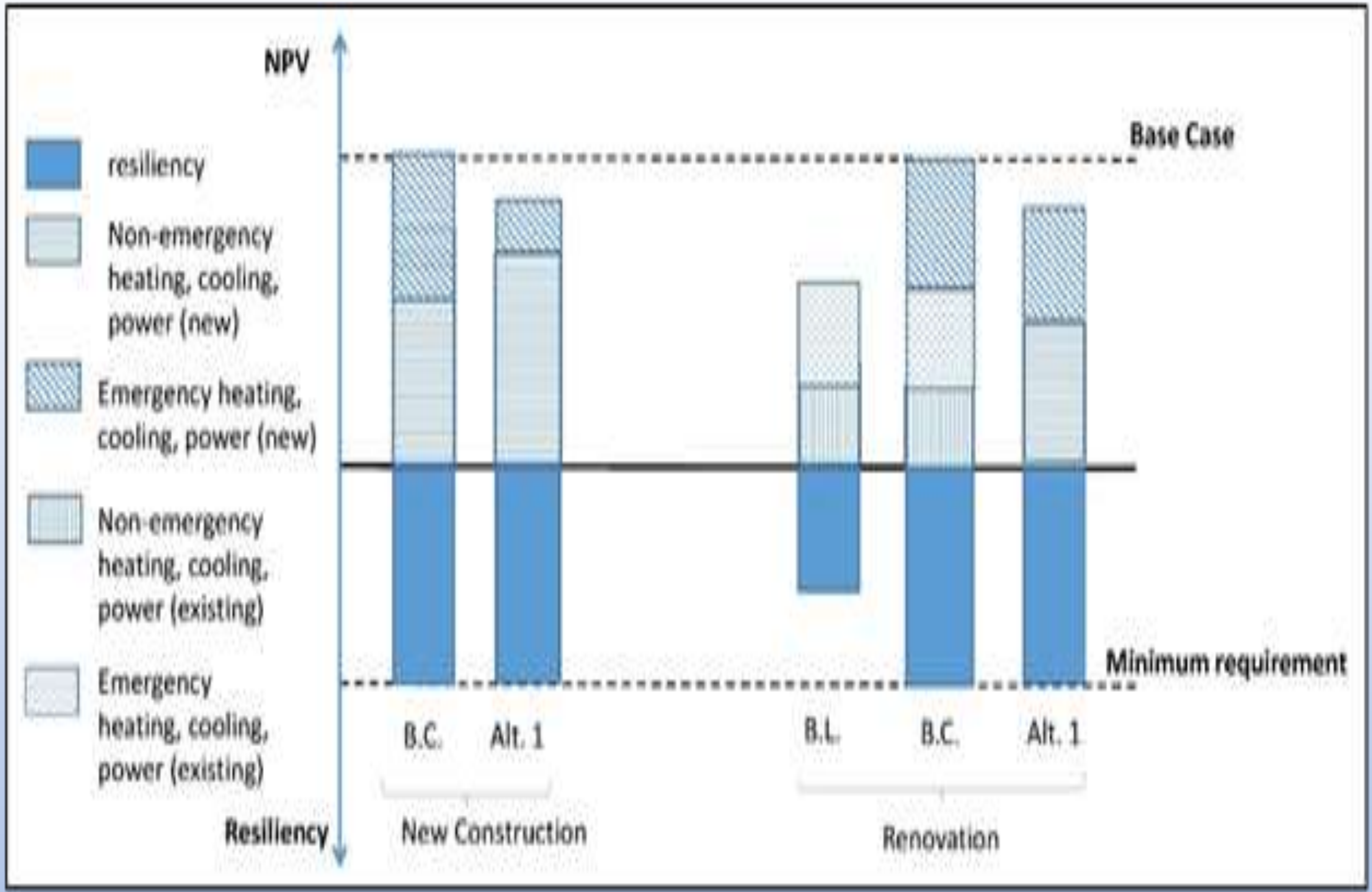
Step Three: Produce On-Site Electricity via Combined Heat & Power (CHP)

New Challenges: Hurricane Harvey (2017) vs. UTMB Galveston

- Local utility lost two electrical feeders due to a flooded transformer vault, *no problem*
    - The East Plant CHP system operated trouble free in "Island Mode"
- Heavy rainfall caused minor street flooding, *no problem*
    - For the new overhead steam and underground heating hot water distribution systems "It was just another day at the office".
    - As a precaution, the gates in the new floodwall surrounding the older West Plant were secured.

For more information:
Jerry A. Schuett, PE
Principal, Energy and Utilities
jschuett@aeieng.com

Concept of LCCA for new Construction and Renovation Projects



Recommendations

- Configuration of the base case of emergency generation and storage systems shall provide adequate resiliency for the specified common threats with the capacities to meet minimum requirements specified by mission operators or the National framework.
- Alternative cases shall provide the same or better level of resilience as the base case.
- In both cases, new construction and renovation, life-cycle cost analysis of alternatives shall be made against the base case scenario. System architectures to be compared may include those servicing individual mission critical operations (distributed system solutions), clusters of mission critical and safety and health related operations/facilities or areas, which include both mission critical and non-critical operations.
- Life-cycle cost analysis shall include all systems providing power and thermal energy to facilities served throughout the year-round cycle including non-emergency, emergency and testing operation modes.