Municipal Resiliency Practicalities

From analysis to case studies

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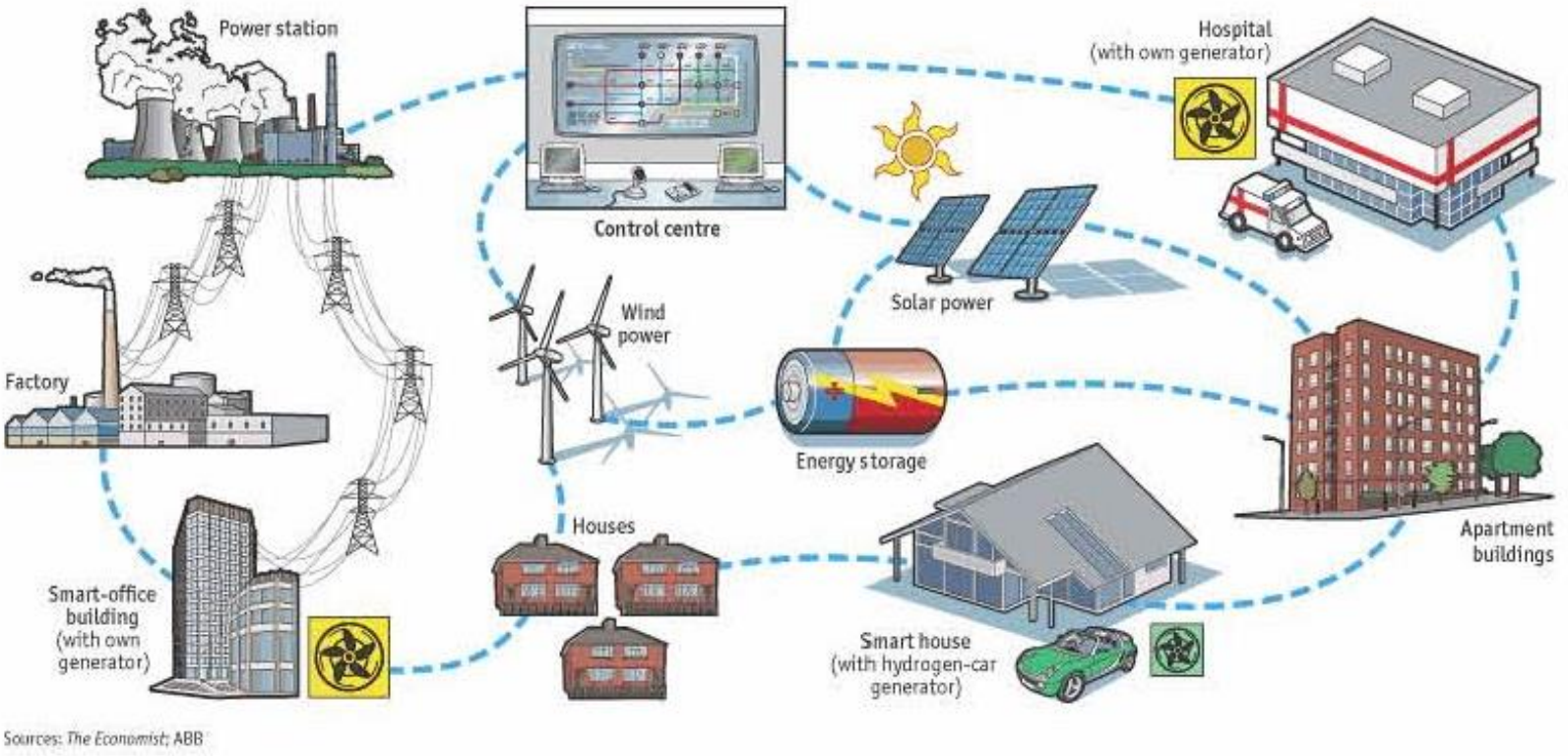
Agenda

- A Microgrid
- An East Coast Project
- A Framework
- A West Coast Project

What is a Microgrid?

"A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode"
Microgrid Exchange Group Definition



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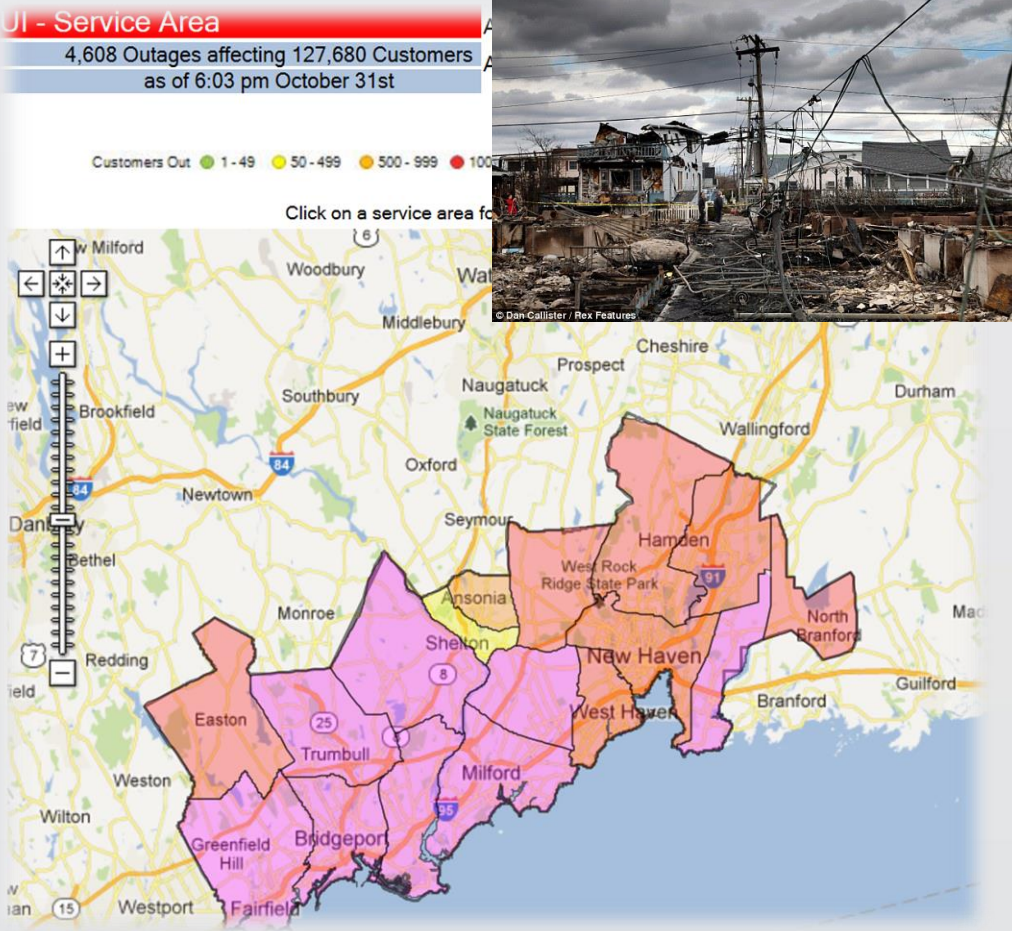
Project Motivation

- Three major extended outage events in 2011-2102 impacting United Illuminating service territory
  - Hurricane Irene
  - October 2011 Snowstorm
  - SuperStorm Sandy
- Options to increase resiliency for critical facilities
  - Reviewed territory for potential microgrid locations
  - Selected two communities for pilot proposals
- Critical facilities defined
  - Police and fire stations
  - City hall
  - Emergency shelters/schools
  - Public works facilities



Critical Facilities Hardening Studies

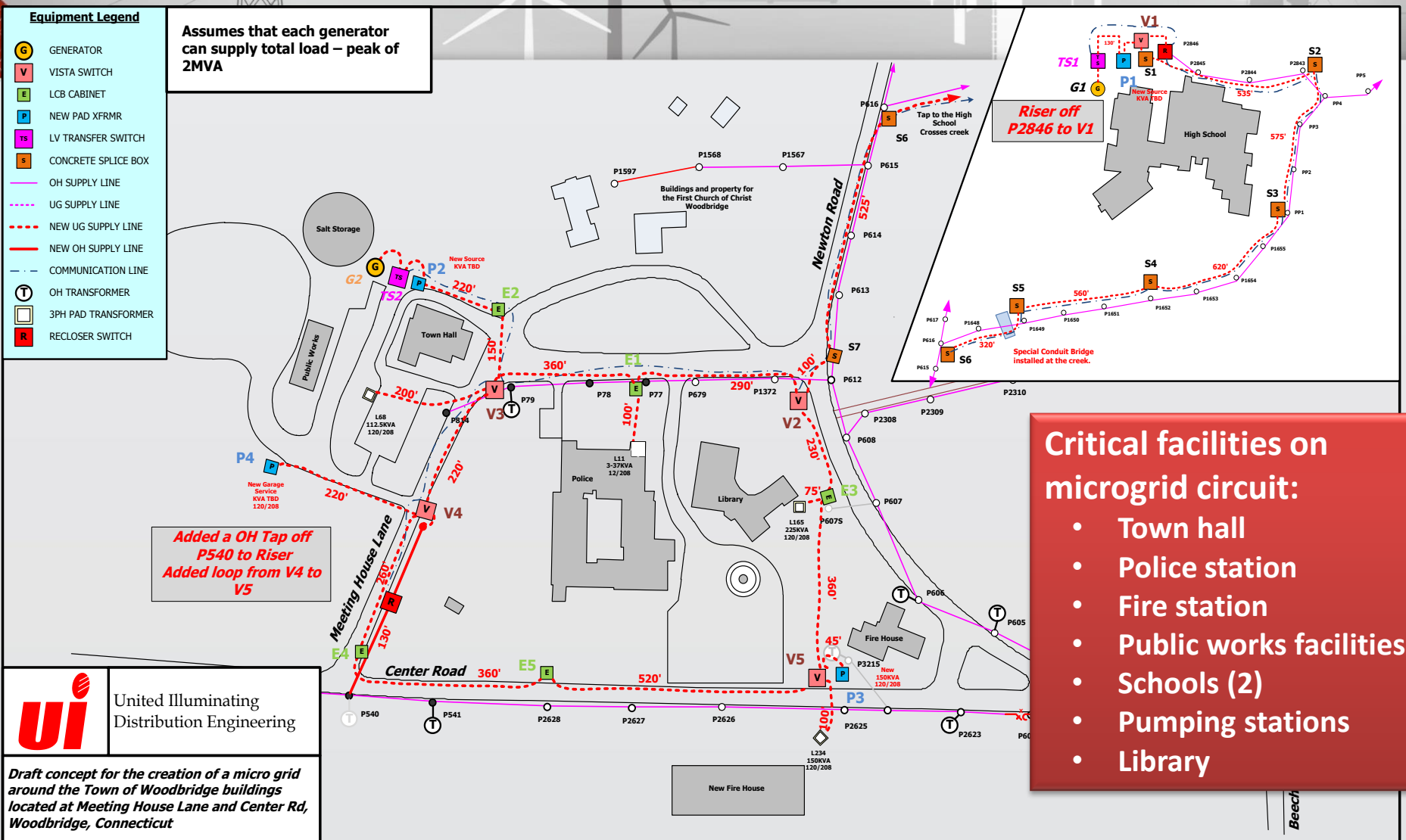
- Consider Two Primary Options
  - Individual natural gas generators for all critical facilities
  - "Hardened" microgrid for centrally-located facilities; natural gas generators for facilities off microgrid circuit
- Microgrid option
  - Defined high level microgrid design/conceptual architecture
  - Defined overall requirements for the system

    Generators, Control systems, Communications systems
  - Designed underground electrical infrastructure needed for community microgrid
  - Evaluated economics of three natural gas-fueled microgrid powering options

Unique Aspects of UI Microgrids

- "Hardened" microgrid
  - Underground electrical infrastructure
  - Underground communications
  - Redundant microgrid controls
- Natural gas-fueled generation, only (no diesel, solar, storage), sized to meet peak demand requirements of all loads on circuit -- with option for fully redundant generator
- Limited demand response requirement
- UI would own the distribution and interconnection infrastructure, microgrid controls and communications -- but generators to be owned by others
- UI would have rights to operate microgrid generators in an emergency condition
- Regulatory approval/cost recovery necessary to implement

Critical Load Circuit – Conceptual Design



United Illuminating Distribution Engineering

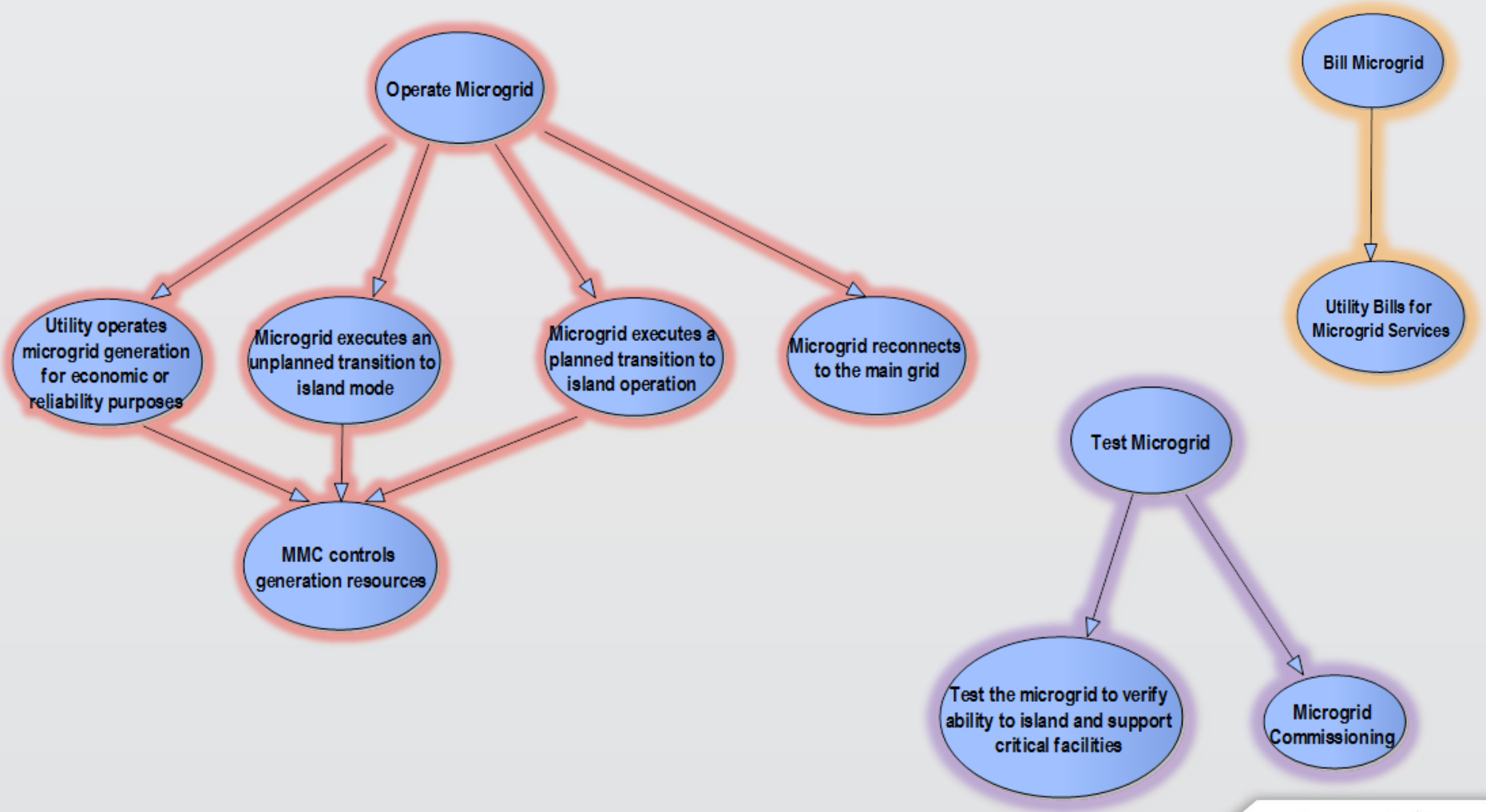
Draft concept for the creation of a micro grid around the Town of Woodbridge buildings located at Meeting House Lane and Center Rd, Woodbridge, Connecticut

File: Woodbridge MicroGrid Drawings 5 Options.vsd	Date : 06/14/2012
	Revised :
By: Chris Hart	Page : 1 of 1

DRAFT CONCEPT #4D – NOT TO SCALE – NOT FOR CONSTRUCTION

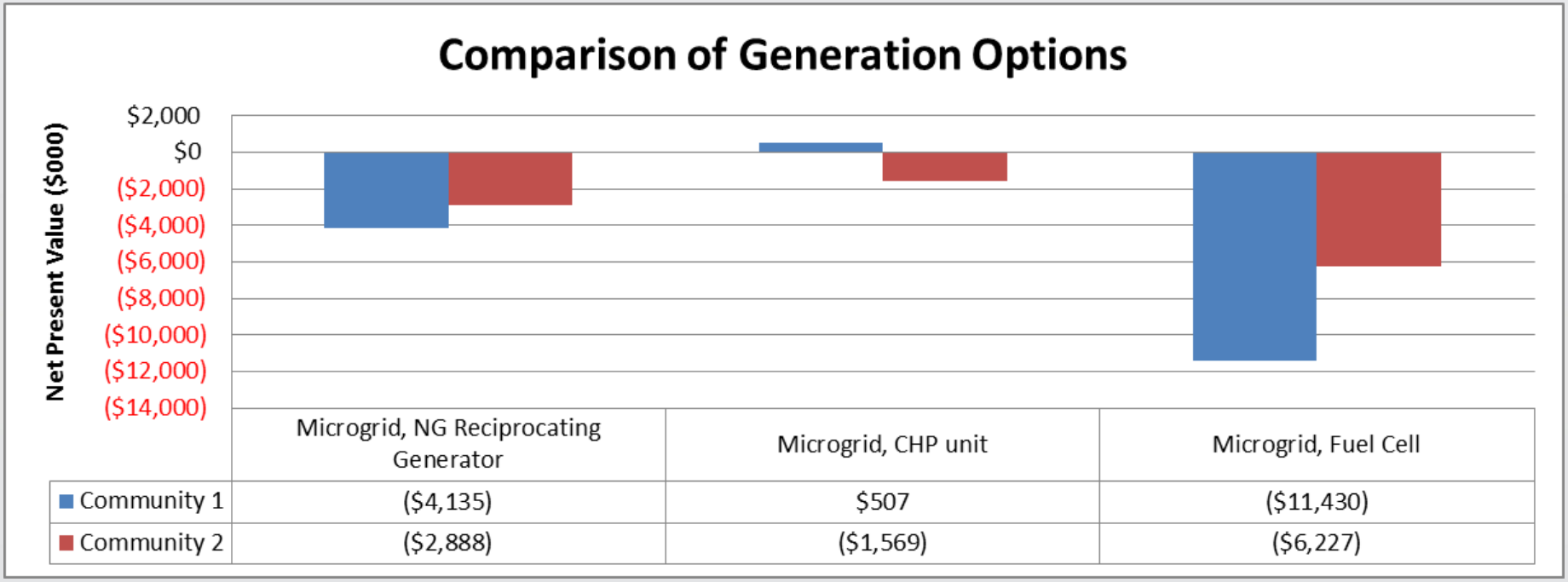
High Level Microgrid Use Cases

Operate Microgrid / Bill Microgrid / Test Microgrid



Economics

- Even without considering the more intangible socio-economic, public health and safety benefits, CHP-based microgrid produced slightly positive NPV for one community; slightly negative NPV for the other



	Microgrid, NG Reciprocating Generator	Microgrid, CHP unit	Microgrid, Fuel Cell
Community 1	($4,135)	$507	($11,430)
Community 2	($2,888)	($1,569)	($6,227)

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Triggering Events

Sept. 8, 2012 San Diego Outage

- Power out to 7 million people in southern California, Baja and Arizona
- Gridlock ensued minutes after the outage
- 70 elevator rescues, many people trapped for 3+ hours
- Emergency communications overwhelmed in first 30-60 minutes
- Scripps Mercy hospital without power for 90 minutes due to generator failure
- Gas pumps inoperable without electricity

Outage in Downtown San Diego

Impact Summary

- $100M in economic losses
- 3.5 million gallon sewage spills
- Schools and Universities closed the following day

Key Lesson Learned

Critical facilities and infrastructure should be identified, prioritized, and protected for resiliency

Prioritization

- **Tier 1: Emergency responders and medical facilities**
  - Use UPS to protect critical systems e.g. 911 call system
  - Redundant power supply in addition to grid supplied power
    - Microgrid for co-located critical facilities
    - Or multiple generators (backup or distributed generation)
    - Bulk energy storage
    - Consider resiliency and economic benefits of on-site base load generator
  - Test on-site generation monthly
  - Test microgrid under simulated grid outage scenario at least annually (perhaps during an overall emergency preparedness exercise) and under varied scenarios

Prioritization

- **Tier 2: Continuity of operations & communications**
  - Use UPS's to protect communications systems
    Emergency radio, reverse 911 call system, web, email, text messages
  - If co-located near Tier 1 facilities consider microgrid

- **Tier 3: Social-economic continuity: Shelters, grocery stores, fuel stations, water supply, sewage, & business case inclusion**
  - Encourage grocery stores and fuel stations to install on-site rotating generation, fuel cells or other distributed generation
  - Cite economic advantages e.g. revenue generated during outages, food storage advantages, and customer service
  - Ensure all pumping stations have backup power generators, even those with 2 grid connections to protect against area-wide power outages
  - If co-located near Tier 1 facilities consider microgrid

Ten Resilient Energy System Characteristics

Supports life safety, restoration effectiveness, and socio-economic continuity during a major event	Aware
Survivable	Responsive and adaptive
Modular or loosely-coupled architecture	Planned, modeled, and prepared; ready for immediate and reliable deployment
Incorporates redundancy or spare capacity	Actively monitored and maintained
Supports a diversity of energy sources	Leverages multiple value streams

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Local Energy Action Plan (LEAP)

- Inaction can be more expensive than action on energy assurance
- LEAPs
  - Are complementary to your energy efficiency efforts
  - Go hand-in-hand with your sustainability efforts
- Emergency management personnel are key players in the energy assurance area, offering a wealth of experience and wisdom
- Active utility involvement is crucial to virtually all energy assurance efforts
- California specific resources available at CaLEAP website

CaLEAP

http://www.caleap.org/

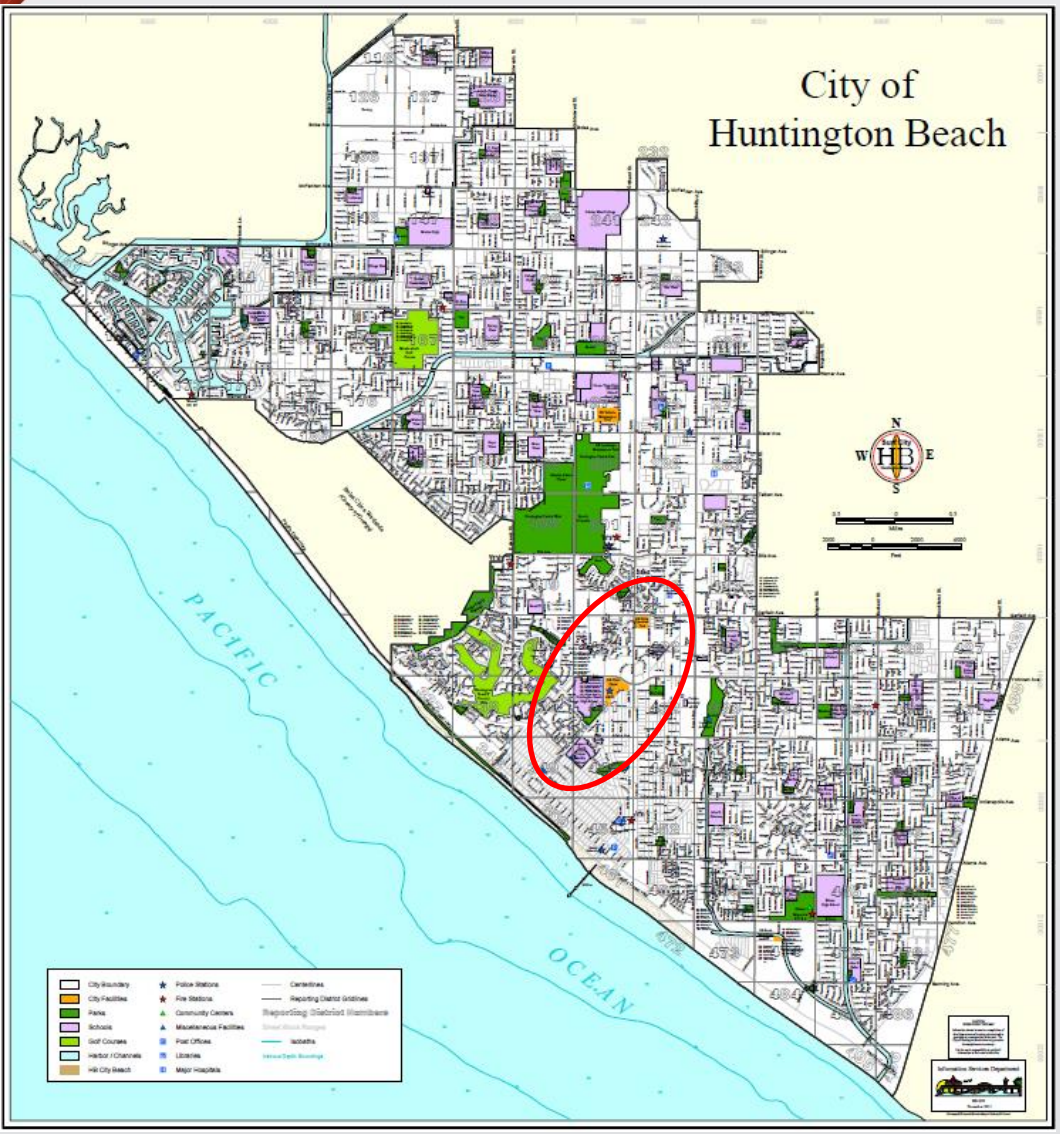
What is Energy Assurance?

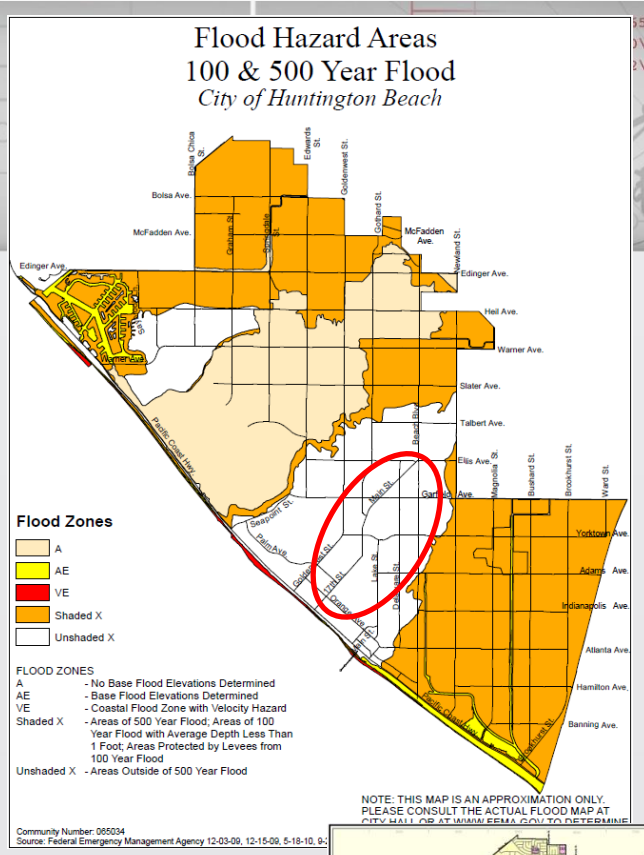
- Identifying and prioritizing your critical facilities and energy infrastructure
- Risk Management and Distributed Strategies (e.g. mix of fuels for transportation options, etc.)
- Establishing new communications networks with the private sector and state and federal government officials.
- Building redundancy and resiliency into your government systems and processes
- Includes both Recovery & Restoration
- Ensuring commerce and minimizing economic disruptions
- Ensuring citizen well being via access to energy during event recovery

CHB: Project Parameters

- Identify specific “best bang for the buck” projects to enhance energy assurance:
- A Civic Center microgrid, to include reconfiguration of existing emergency circuits, replacement of existing backup generation, and eventually addition of energy storage
- Providing backup generation for the sewage lift stations, in some cases with permanent generation, in others a recommended standard, portable, non-diesel solution where possible
- A solution for backup generation for the tertiary EOC located at the Central Library
- 'As-is' assessment of City's critical facilities, documentation, and related infrastructure
- Prioritization according to CaLEAP's three-tier priority strategy
- Reconfiguration of existing assets where deficiencies are known
- Resiliency/hardening priorities and recommendations
- Proposed additional follow-on conceptual projects the City may consider in its longer term planning strategy
- Recommendations and Next Steps

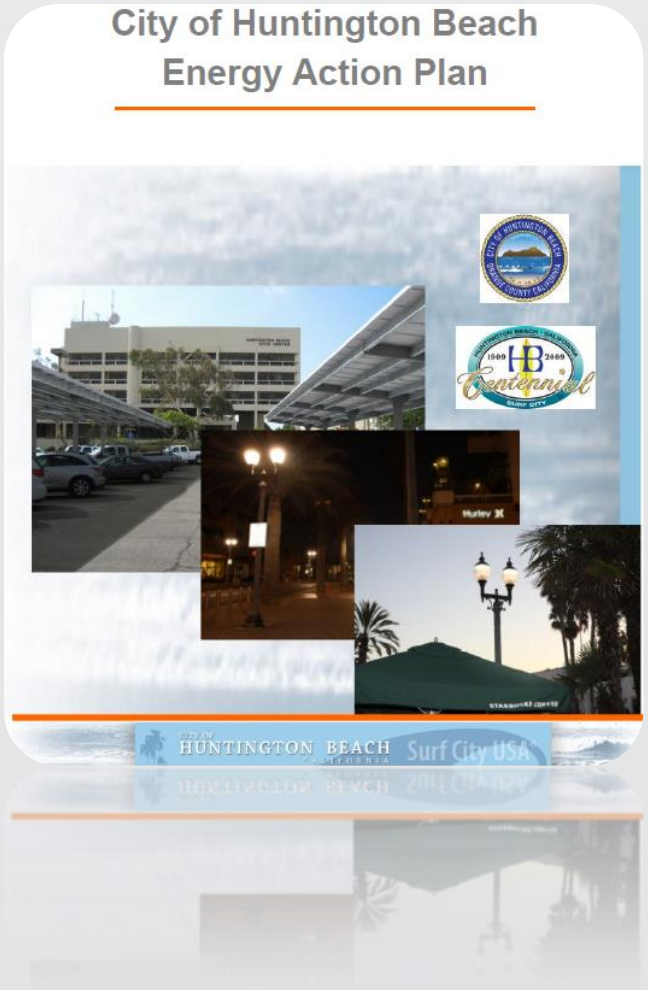
CHB 'As-is'





CHB Notable EAP Projects

- Civic Center
  - Lighting, exit signs, chillers, motors, water pump, air handlers, cooling tower, boiler, lighting
- Central Library
  - Motors, water pump, air handlers, boiler, lighting
- EMS and updated maintenance for both
- Solar feasibility → PPA
- Streetlights: GIS audit, LED retrofit ($2M/yr., 14k lights)

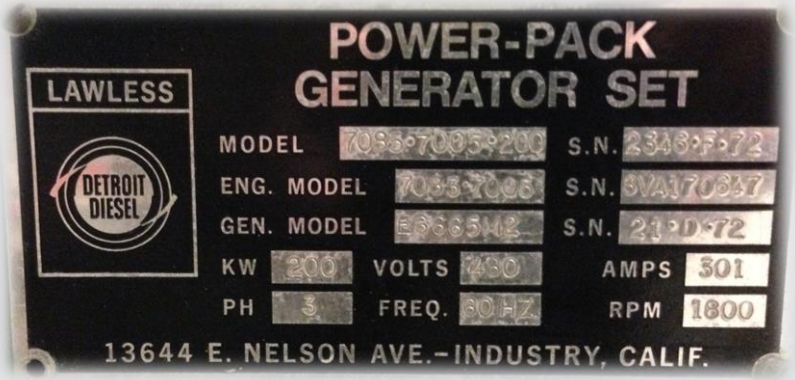


CHB ‘As-is’: City Hall

- 400kW of diesel backup generation (2x200kW)
- 200kWh of UPS backup for the IT systems (roughly two hours’ worth)
- EOC (Primary) and emergency circuits tied to the backup UPS and/or generators
- 1.0MW of onsite solar generation, not currently capable of being used in a power outage (2.3MW PPA total citywide)
- On-site gasoline (24,000 gal.) and diesel fuel storage (5,000 gal.)
- Natural gas pipeline connection

Backup Generators

"Automatic" Control System



Manual Start Process

30-minute UPS in parallel

Example Recommendations

Example Recommendation:

- Proper configuration of emergency circuits for entire site
- Replacement of existing diesel backup with bi-fuel (NG/LPG) backup and ATS
- Better management of systems tied to 200kWh UPS
- Consider a civic center site-wide microgrid that incorporates storage and the generators to automatically manage the loads

Example Recommendations

Long-term:

- Operation of 1.0MW array when grid not available
- Full EE/DR/transactive energy controls to maximize solar and microgrid investments
- Engage SCE and High School to get past barriers of incorporating HS into civic center microgrid (as a powered central shelter and distribution point)

Delivered Comprehensive Plans

- City Hall microgrid
- Sewage lift station backup generation
- City Yard fuel station backup generation
- Street light LED retrofit
- Solar expansion at City Water, City Yard, and City Library

Thank You

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