Microgrid Solutions:
From Building to Regions

BuildingEnergy NYC
October 15, 2015

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RENEWABLE NEW YORK, LLC

Highland Falls-West Point Muni-Grid

The Village of Highland Falls, as Host Community for the United States Military Academy, is developing a complete Energy and Infrastructure Support Program – in response to the Department of the Army's goal of privatizing all utility functions and services for the West Point Garrison.

In addition, West Point was initially selected by Assistant Secretary for Installations, Energy, and Environment (IE&E) Katherine Hammack as an Energy Net Zero Demonstration Project.

The opportunity has thus been created by this combination of factors for the Municipality to take the lead in creating a Community Grid, which we call the Muni-Grid, ultimately aggregating electrical loads, generation and storage assets – both existing and new – and Grid Integration measures for the mutual benefit of the Garrison, the Village, and the Town of Highland.

Eaton selected as Energy Partner

The Village conducted a Competitive Solicitation for Water and Wastewater facilities and services, ultimately selecting Veolia. The anticipated investment of approximately $70 million will include replacement of the aging West Point Garrison Wastewater Plant, inundated by Superstorm Sandy and now operating under a Consent Order from the New York State Department of Environmental Conservation.

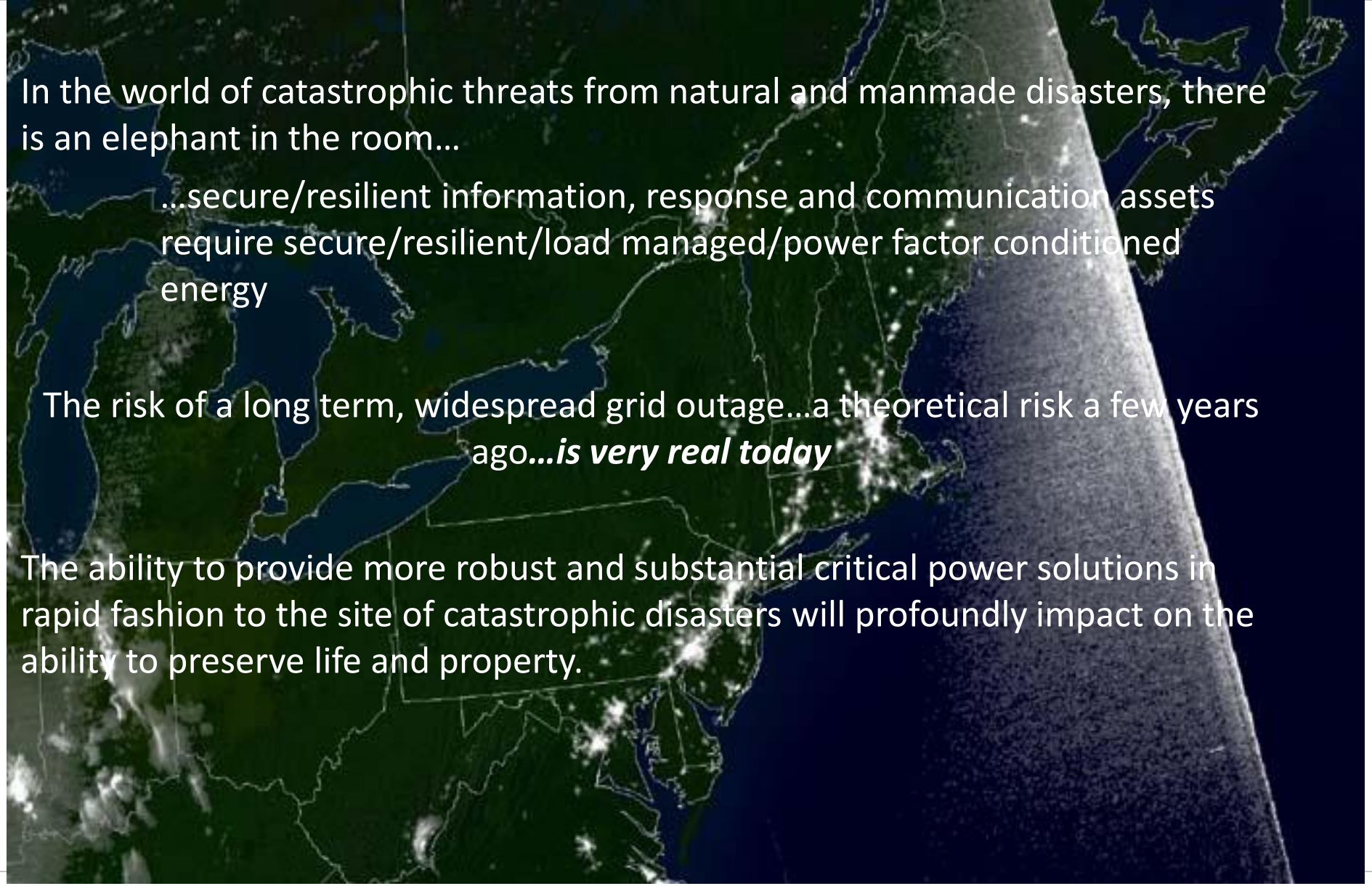
In a similar proceeding, Eaton was chosen to be the Village's Energy Partner for planning, development and implementation of the Highland Falls-West Point Muni-Grid.

Energy Surety a Driver for Microgrids

Particularly in the context of devastating weather events such as Sandy, Irene, and Lee, maintaining energy supply continuity for essential services and community resiliency has increasingly become a driver for Microgrid Development.

Eaton's extensive experience in providing Energy Surety to both civilian and military facilities has enabled the Village to utilize a level of expertise not otherwise available to many New York municipalities.

Here are some of the insights our Energy Partner has provided:



In the world of catastrophic threats from natural and manmade disasters, there is an elephant in the room…

…secure/resilient information, response and communication assets require secure/resilient/load managed/power factor conditioned energy

The risk of a long term, widespread grid outage…a theoretical risk a few years ago***…is very real today***

The ability to provide more robust and substantial critical power solutions in rapid fashion to the site of catastrophic disasters will profoundly impact on the ability to preserve life and property.

Lessons learned:

Katrina and the Louisiana Superdome

- Air conditioning failed
- Lighting failed
- Backup generation faltered
- City's water supply finally gave out

New York City Post-Sandy

- City generator demand significantly exceeded supply
- Public shelters unprepared
- Elderly, sick could not evacuate without elevators

➢ ***Ensure basic infrastructure and services to sustain impacted population until the electrical grid is restored***

The challenge of providing continuous power

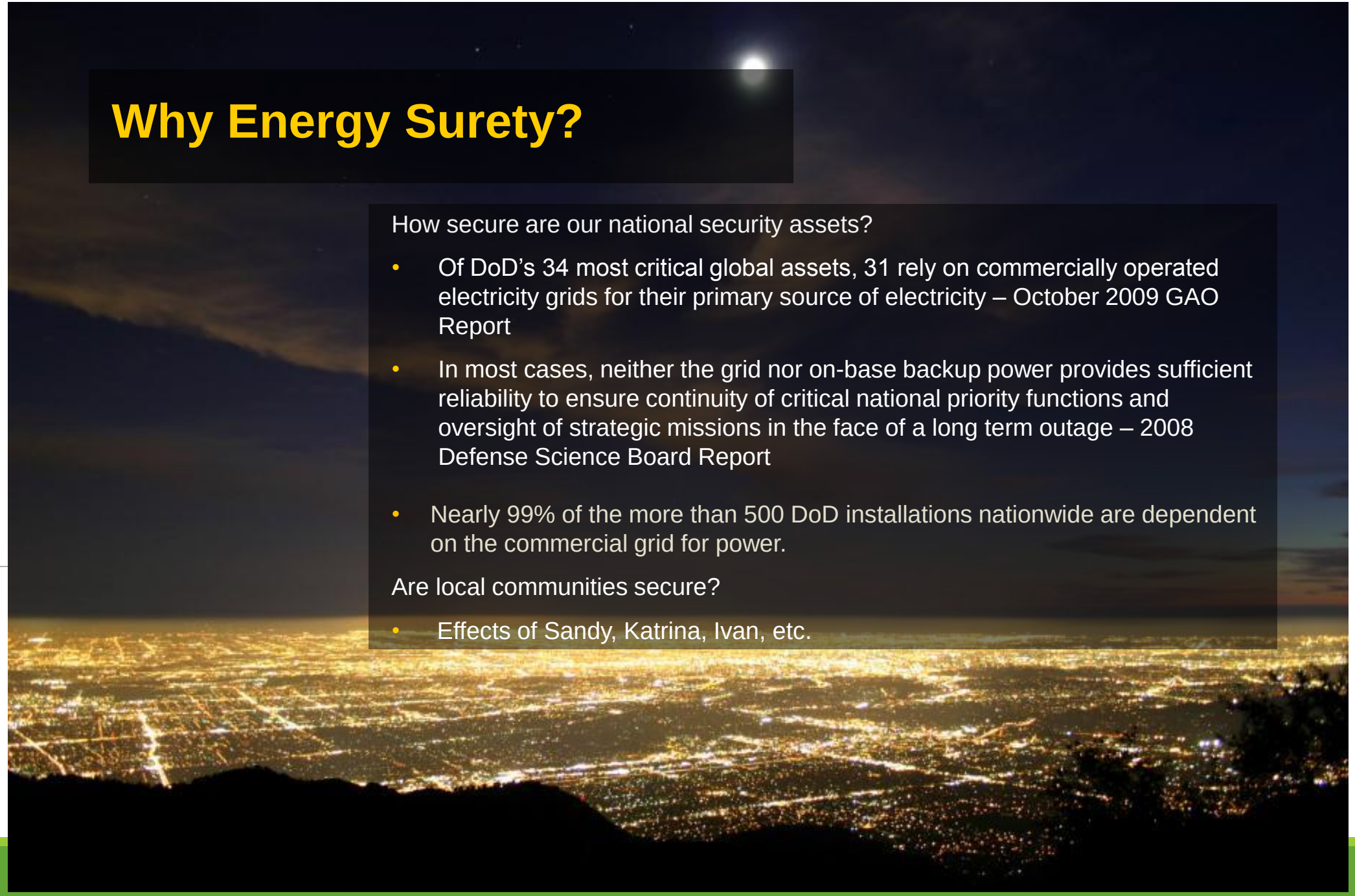
The nation's hardened IT and communication infrastructure rests on a fragile foundation…the grid

- What can cause a utility grid failure?
  - Cyber attack
  - Solar flares (Canada 1989)
  - Circuit overload/failure (2003 Northeast blackout)
  - Sabotage (PGE Santa Clara, CA substation shooting)
- The new threat - Electronic Pulse Detonation (EMP)

- Grid technology is the "Achilles heel"
  - Our system sophistication provides an asymmetric advantage to protagonists who are not as dependent as we are on modern electronics
  - Reliance on internet-based smart grid technology makes it vulnerable

What happens when the grid goes dumb?

Why Energy Surety?



How secure are our national security assets?

- Of DoD's 34 most critical global assets, 31 rely on commercially operated electricity grids for their primary source of electricity – October 2009 GAO Report
- In most cases, neither the grid nor on-base backup power provides sufficient reliability to ensure continuity of critical national priority functions and oversight of strategic missions in the face of a long term outage – 2008 Defense Science Board Report
- Nearly 99% of the more than 500 DoD installations nationwide are dependent on the commercial grid for power.

Are local communities secure?

- Effects of Sandy, Katrina, Ivan, etc.

Achieving energy surety through microgrids

Cornerstone for implementing local power generation that manages critical infrastructure/assets through microgrid applications.

- Goal : The ability to create energy islands for the ***long-term operation*** of critical infrastructure is a ***must*** to provide the level of supply security necessary to ensure continued mission critical operations as well as life sustaining support
- Identify critical sites: Operational readiness; Islands of refuge
- Leverage proven microgrid technology: Demonstration projects prove the viability of the solution
- Budget and financing: Move budgets to grid-tied optimized power generation assets; Engage private financier's to offset costs; Leverage grants
- Engage private public partners: state, local community, utility, financial, federal, energy surety providers

What is critical infrastructure?

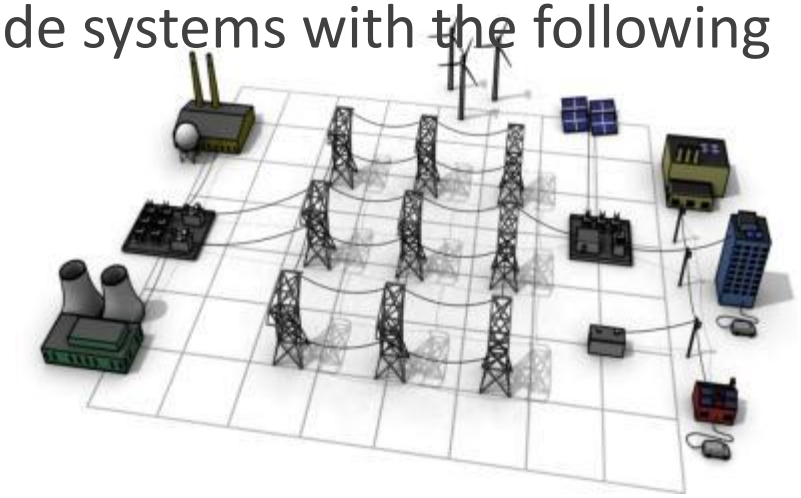
First question… *what is critical?*

Answer depends on the length of the power outage and the community you serve.

LEVEL 4	>1 MONTH	Home Fatigue Supporting Essentials of Home Life Long-Term Medical
LEVEL 3	1 MONTH	Personal Operations Support Support of Nutrition, Sleep, Hygiene Clinic Level Medical
LEVEL 2	1 WEEK	Water Systems Systems Supporting Intel and Communications Medical Triage
LEVEL 1	1 DAY	Mission Critical: Data Centers/Communication Assets Power for to run the mission, area cooling, basic first aid, etc.

Leverage microgrid technology

What is it? Definitions vary, but usually include systems with the following functionality:



- Discrete energy system that can operate on any individual or combination of distributed power generation resources necessary to meet established requirements
- Can operate in both an on-grid and off-grid configuration
- Provide resiliency/redundancy in the case of grid failure
- Design, permitting, construction cycle much faster…assets on line and operational quicker

A ***local*** power solution developed to meet ***local*** needs utilizing ***local*** resources and under ***local*** control…reliable, affordable energy security

Local Power, including Renewables, must be optimized and available, particularly during Grid outages.

Grid-tied Solar assets, as a prime example, produce no power at these times – exactly when locally based resources are most important. Integrated Planning and implementation of Muni-Grid interoperability will prevent this situation.

Michael Burr and the Microgrid Institute are now performing a Stage I Feasibility Study for the proposed New Paltz Microgrid, funded by NY Prize.

MI has provided these valuable insights:

Not all DER deployments are created equal

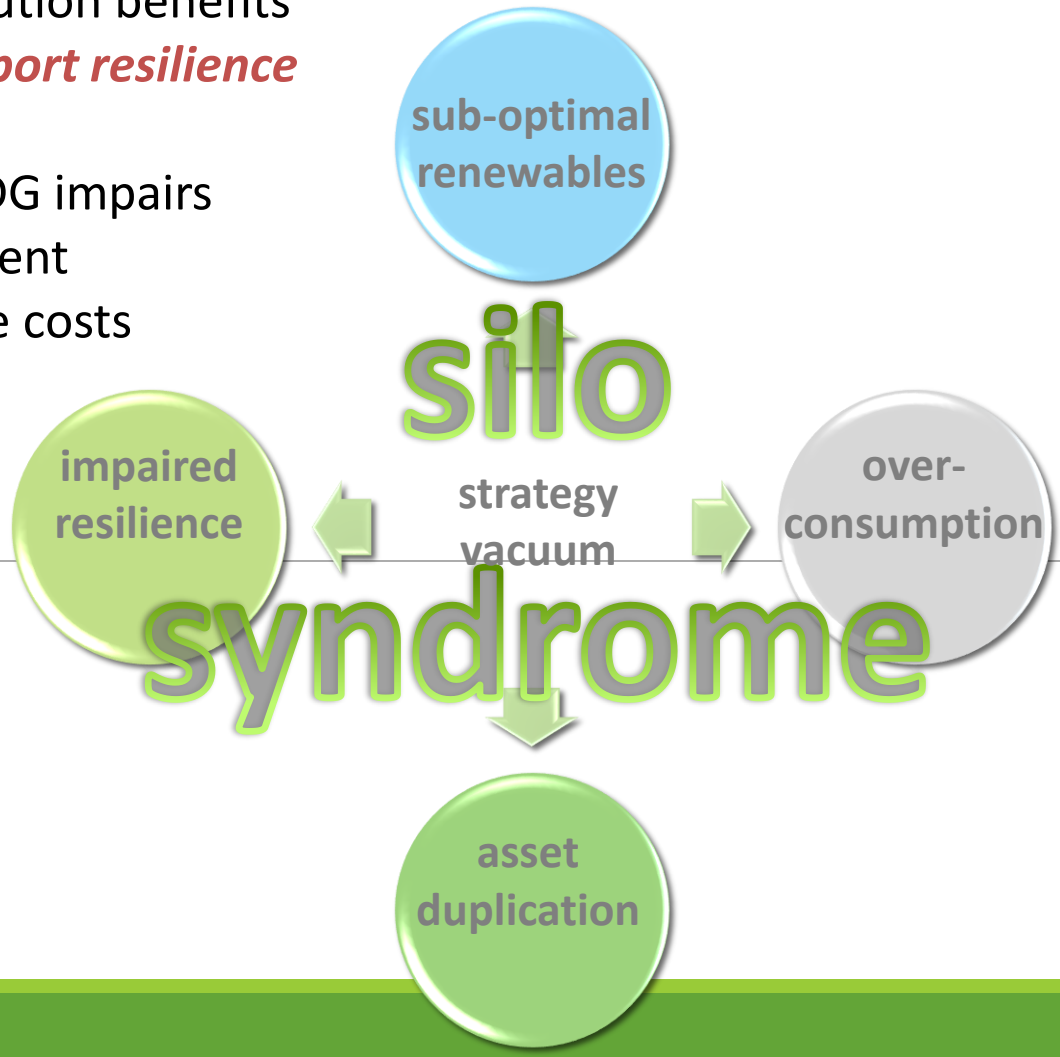
Net metered DG and solar farms are not resilient without microgrids

- Grid-tied systems deactivate during outages – they can't support critical services when they are most badly needed
- "Afterthought planning" yields duplicative and unnecessary expenses
- Solar sites selected only for convenience or net-metering revenue may be too distant to supply critical facilities

Not all DER deployments are created equal

Isolated development – "silo syndrome" - inflates costs and impairs resilience

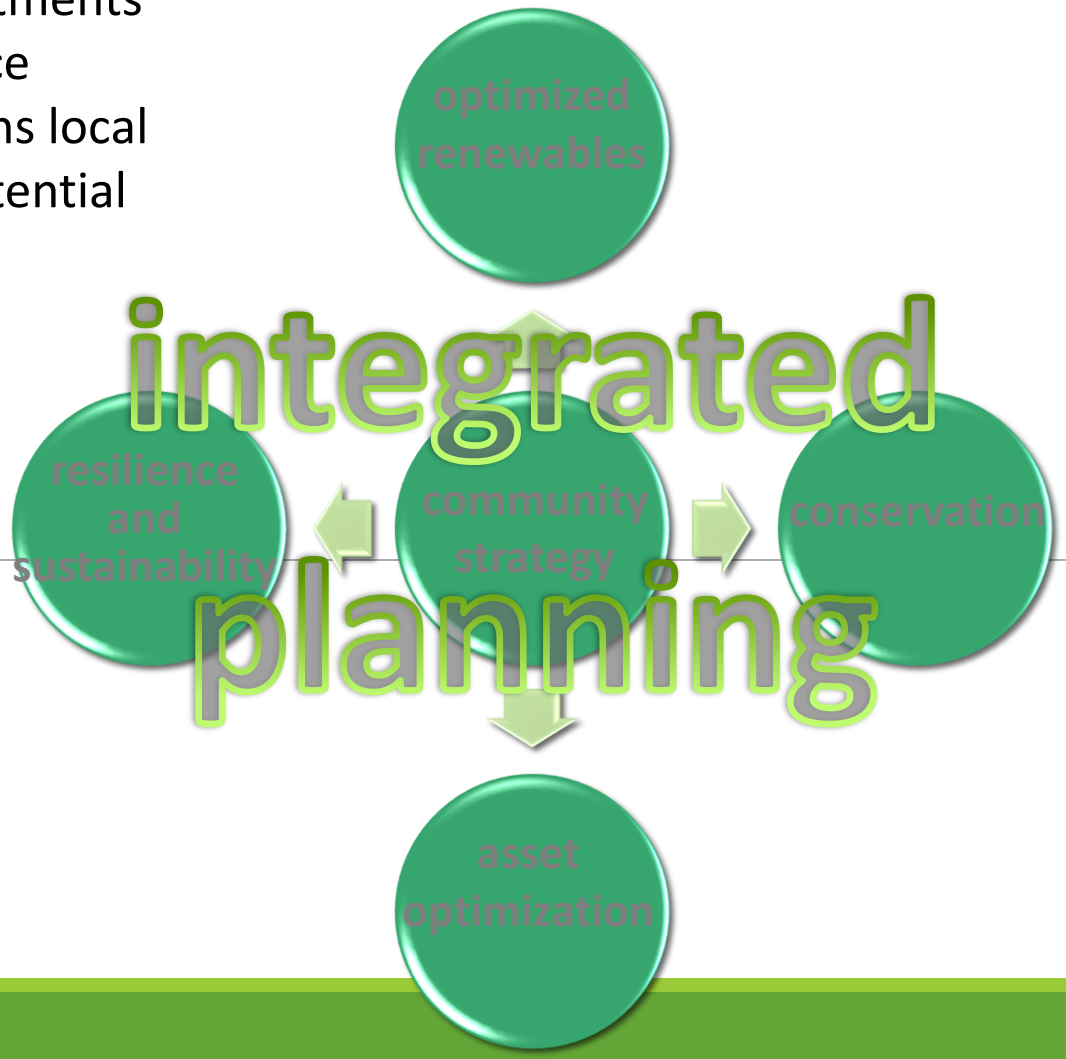
- Wasted potential for distribution benefits
- ***Grid-tied systems can't support resilience and even can reduce it!***
- "Competing" net-metered DG impairs resilient generation investment
- Duplicative systems increase costs



Not all DER deployments are created equal

Integrated planning ensures investments are efficient and resilient

- Optimize distribution investments for lower cost, better service
- Modernized grid strengthens local economic development potential
- ***Strategic planning can keep more community energy dollars local***



Clean Coalition was among the initial NY Prize Stage I Awardees.

The Long Island Community Microgrid Project, as with Clean Coalition's similar installations, will incorporate many of the community benefits planned for the Highland Falls-West Point Muni-Grid.

As in the case of Clean Coalition's close collaboration with PSE&G-Long Island, our Muni-Grid will coordinate extensively with Orange & Rockland Electric Utility to provide a remarkable Demonstration of REV attributes and benefits significant across New York State and beyond.

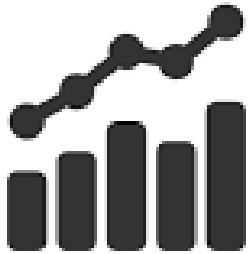
Community Microgrid = Pathway to DER Future

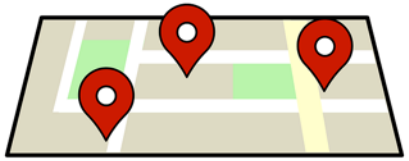
Clean Coalition

Community Microgrid definition

A coordinated local grid area served by one or more distribution substations and supported by high penetrations of local renewables and other Distributed Energy Resources (DER). Community Microgrids reflect a new approach for grid operations that achieve a more sustainable, secure, and cost-effective energy system while generally providing long-term power backup for prioritized loads. The substation-level foundation of a Community Microgrid facilitates cost-effective replication for optimizing grid operations and customer satisfaction across utility service territories.

Expertise Supporting Utilities & Communities





Analysis & Planning	Grid Modeling & Optimization	Program Design	Community Microgrid Projects
DG siting surveys; full DER cost and value analysis • PG&E • PSEG • SCE	Powerflow modeling; DER optimization • PG&E • PSEG	Procurement and interconnection • LADWP, Fort Collins, PSEG • City of Palo Alto (FIT and solar canopy RFP) • RAM, ReMAT • Rule 21 & FERC	Design and implementation • San Francisco, CA • Long Island, NY • U.S. Virgin Islands

Long Island Community Microgrid Project

Clean Coalition

Overview

- Collaboration with PSEG Long Island, Long Island Power Authority (LIPA), and NYSERDA covering a substation in East Hampton, NY that serves thousands of customers
- 15 MW of local solar (via Feed-In Tariff) combined with a 5 MW / 25 MWh battery system
- 50% of total annual energy from local renewables while minimizing use of existing fossil generators, including local diesel peakers and backup facilities
- Indefinite and ongoing power backup to multiple critical facilities, including a fire station and two water pumping/filtration facilities
- Sets the stage to preempt hundreds of millions of dollars in transmission and fossil generation investments

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PSEG LONG ISLAND
We make things work for you.

LICMP Overview & Goals

The LICMP features 5 MW / 25 MWh energy storage and up to 15 MW of solar serving the two Bank 4 feeders of the East Hampton GT substation. Goals:

1. **Provide local power backup for the identified critical facilities: two SCWA filter/pumping stations, one Fire District facility**

1. **Optimize the 5 MW / 25 MWh energy storage across cost and energy, utilizing both the local solar and import from transmission at night**

1. **Maximize the interconnection and use of local solar generation, integrating up to 15 MW into Bank 4 of the substation**

1. **Optimize other DER such as Demand Response and Energy Efficiency across cost and energy, in context of the local solar and load profiles**

1. **Minimize the use of local diesel generators (e.g. during summer peaks)**

2. **Prove both the economic and operational viability of the LICMP solution while setting the stage for deferring $100s of millions in Transmission costs**

1. **Serve as a model for the State of NY and across the country (and everywhere else that distribution grids exist)**

LICMP Area Map

Community Microgrid Initiative: Objectives

1. **Bring high levels of local renewables to communities & utilities while maintaining or improving grid reliability and power quality**

2. **Demonstrate financially and technically feasible solutions that achieve industry adoption and scale**

3. **Partner with utilities, utility commissions, technology providers, and other community stakeholders to accelerate deployments**

4. **Strengthen local economies through community investment, more stable energy prices, and reduced transmission-related costs**

Community Microgrid Optimization

Utility Data
- Customer & transformer loads
- Network model & circuit map
- Equipment list & upgrade plans
- O&M schedule

Other data
- Solar insolation
- Weather forecasting
- Assumptions for DR/EE/EV charging, etc.
- Product performance specs, e.g. storage

Baseline Powerflow
- Acquire all data sets, validate accuracy
- Model existing powerflow

Baseline Capacity
- Vary location & size of local generation to define existing capacity
- Use advanced inverter features, e.g. for voltage (VAr) control

Medium Capacity
- Add low-cost options such as DR/EE, EV charging, & cost-effective storage
- Optimize via locations & costs, etc.

Higher Capacity
- Add higher-cost solutions such as major upgrades, outage performance goals, etc.
- Optimize via locations & costs, etc.

- Validate with utility & technology vendors
- Maintain or improve grid reliability and power quality

No Cost local renewable capacity

Low Cost local renewable capacity

More Cost local renewable capacity

UGE a RISE-NYC Awardee

Urban Green Energy, a microgrid Developer active internationally, is proceeding in a post Sandy Resiliency Program in parallel to NY Prize.

CASE STUDIES

RISE:NYC

PROJECT DETAILS

- **Project Goal:** Enhance resiliency of businesses in areas that were affected by Hurricane Sandy
- **UGE Solution:**
  - Deploy microgrid solutions across 17 sites; platform consists of one or both of solar panels and wind turbines, as well as advanced power management and battery storage

PROJECT OVERVIEW

In May of 2015, UGE was selected as a winner of the RISE:NYC competition, which will see the Company install microgrid renewable energy systems to help power relief efforts in New York City communities affected by Hurricane Sandy. The $30 million award is being split amongst 11 companies, with solutions expected to be implemented over the next 24 months.

"Clean distributed power systems will be a significant part of protecting our infrastructure. UGE's microgrid systems will help mitigate the impact of these disasters and provide a lifeline to small businesses during such an event." "- Nick Blitterswyk, Chief Executive Officer of UGE.

Larger Implications for New York City

Renewable New York has proposed that the Renewable Energy Procurement Initiative sponsored by Mayor de Blasio and undertaken by the Mayor's Office of Sustainability and the Department of Citywide Administrative services be the catalyst for a parallel development agenda for neighborhood, community, institutional, and commercial microgrid funding and implementation.

These Distributed Energy Resources (DER) will be integrated into the Consolidated Edison Distribution System – in the Utility's role as Distribution Services Provider (DSP) under the Reforming the Energy Vision (REV) Proceedings of the Public Service Commission.

In order to de-carbonize the New York Energy System, substantial remotely-sited Solar+Storage and Wind Generation resources can also provide Clean Power to the City over enhanced transmission facilities.

Do not hesitate to be in touch!

Looking forward to sharing good ideas for community-based Renewables and Distributed Energy Resources for New York.

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