RESILIENT POWER

A project of CleanEnergyGroup

Hydrogen and Fuel Cells for Resiliency: Financing Energy Resiliency

February 18, 2016

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Innovation in Finance, Technology & Policy

Northeast Electrochemical energy storage Cluster

Housekeeping

All participants are in "Listen-Only" mode. Select "Use Mic & Speakers" to avoid toll charges and use your computer's VOIP capabilities. Or select "Use Telephone" and enter your PIN onto your phone key pad.

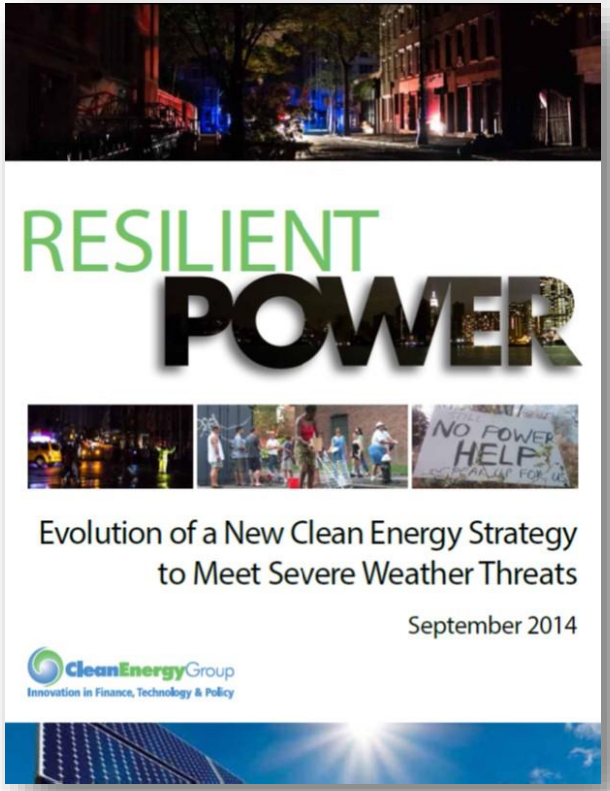
Submit your questions at any time by typing in the Question Box and hitting Send.

This webinar is being recorded.

You will find a recording of this webinar, as well as previous Resilient Power Project webinars, online at:

www.resilient-power.org

Who We Are



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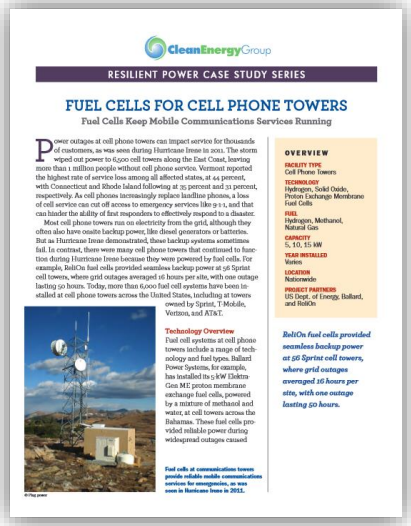
Resilient Power Project

- Increase public/private investment in clean, resilient power systems
- Engage city officials to develop resilient power policies/programs
- Protect low-income and vulnerable communities
- Focus on affordable housing and critical public facilities
- Advocate for state and federal supportive policies and programs
- Technical assistance for pre-development costs to help agencies/project developers get deals done
- See www.resilient-power.org for reports, newsletters, webinars, and more.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RESILIENT POWER CASE STUDY SERIES

FUEL CELLS FOR CELL PHONE TOWERS

Fuel Cells Keep Mobile Communications Services Running

Power outages at cell phone towers can impact service for thousands of customers, as was seen during Hurricane Irene in 2011. The storm wiped out power to 6,500 cell towers along the East Coast, leaving more than 1 million people without cell phone service. Vermont reported the highest rate of service loss among all affected states, at 44 percent, with Connecticut and Rhode Island following at 35 percent and 31 percent, respectively. As cell phones increasingly replace landline phones, a loss of cell service can cut off access to emergency services like 9-1-1, and that can hinder the ability of first responders to effectively respond to a disaster.

Most cell phone towers run on electricity from the grid, although they often also have onsite backup power, like diesel generators or batteries. But as Hurricane Irene demonstrated, these backup systems sometimes fail. In contrast, there were many cell phone towers that continued to function during Hurricane Irene because they were powered by fuel cells. For example, ReliOn fuel cells provided seamless backup power at 56 Sprint cell towers, where grid outages averaged 16 hours per site, with one outage lasting 50 hours. Today, more than 6,000 fuel cell systems have been installed at cell phone towers across the United States, including at towers owned by Sprint, T-Mobile, Verizon, and AT&T.

OVERVIEW

FACILITY TYPE
Cell Phone Towers

TECHNOLOGY
Hydrogen, Solid Oxide, Proton Exchange Membrane Fuel Cells

FUEL
Hydrogen, Methanol, Natural Gas

CAPACITY
5, 10, 15 kW

YEAR INSTALLED
Varies

LOCATION
Nationwide

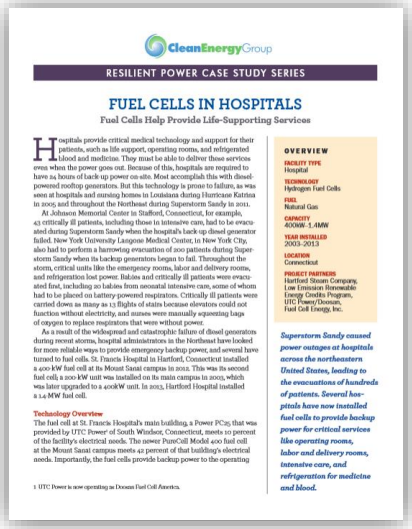
PROJECT PARTNERS
US Dept. of Energy, Ballard, and ReliOn

ReliOn fuel cells provided seamless backup power at 56 Sprint cell towers, where grid outages averaged 16 hours per site, with one outage lasting 50 hours.

Technology Overview

Fuel cell systems at cell phone towers include a range of technology and fuel types. Ballard Power Systems, for example, has installed its 5 kW Elektra Gen ME proton membrane exchange fuel cells, powered by a mixture of methanol and water, at cell towers across the Bahamas. These fuel cells provided reliable power during widespread outages caused

Fuel cells at communications towers provide reliable mobile communications services for emergencies, as was seen in Hurricane Irene in 2011.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RESILIENT POWER CASE STUDY SERIES

FUEL CELLS IN HOSPITALS

Fuel Cells Help Provide Life-Supporting Services

Hospitals provide critical medical technology and support for their patients, such as life support, operating rooms, and refrigerated blood and medicine. They must be able to deliver those services even when the power goes out. Because of this, hospitals are required to have 24 hours of back up power on-site. Most accomplish this with diesel-powered rooftop generators. But this technology is prone to failure, as was seen at hospitals and nursing homes in Louisiana during Hurricane Katrina in 2005, and throughout the Northeast during Superstorm Sandy in 2012.

At Johnson Memorial Center in Stafford, Connecticut, for example, 43 critically ill patients, including those in intensive care, had to be evacuated during Superstorm Sandy when the hospital's back-up diesel generator failed. New York University Langone Medical Center, in New York City, also had to perform a harrowing evacuation of 200 patients during Superstorm Sandy when its backup generators began to fail. Throughout the storm, critical units like the emergency rooms, labor and delivery rooms, and refrigeration lost power. Babies and critically ill patients were evacuated first, including 20 babies from neonatal intensive care, some of whom had to be placed on battery-powered respirators. Critically ill patients were carried down as many as 13 flights of stairs because elevators could not function without electricity, and nurses were manually squeezing bags of oxygen to replace respirators that were without power.

As a result of the widespread and catastrophic failure of diesel generators during recent storms, hospital administrators in the Northeast have looked for more reliable ways to provide emergency backup power, and several have turned to fuel cells. St. Francis Hospital in Hartford, Connecticut installed a 400 kW fuel cell at its Mount Sanai campus in 2012. This was its second fuel cell, a 200 kW unit was installed on its main campus in 2005, which was later upgraded to a 400kW unit. In 2013, Hartford Hospital installed a 1.4 MW fuel cell.

OVERVIEW

FACILITY TYPE
Hospital

TECHNOLOGY
Hydrogen Fuel Cells

FUEL
Natural Gas

CAPACITY
400kW- 1.4MW

YEAR INSTALLED
2003-2013

LOCATION
Connecticut

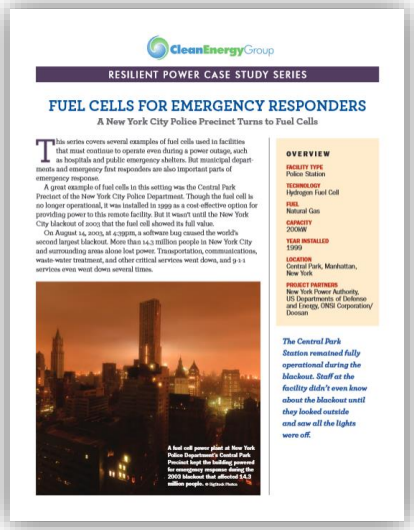
PROJECT PARTNERS
Hartford Steam Company, Low Emission Renewable Energy Credits Program, UTC Power/Doosan, Fuel Cell Energy, Inc.

Superstorm Sandy caused power outages at hospitals across the northeastern United States, leading to the evacuations of hundreds of patients. Several hospitals have now installed fuel cells to provide backup power for critical services like operating rooms, labor and delivery rooms, intensive care, and refrigeration for medicine and blood.

Technology Overview

The fuel cell at St. Francis Hospital's main building, a Power PC25 that was provided by UTC Power of South Windsor, Connecticut, meets 10 percent of the facility's electrical needs. The newer PureCell Model 400 fuel cell at the Mount Sanai campus meets 42 percent of that building's electrical needs. Importantly, the fuel cells provide backup power to the operating

1 UTC Power is now operating as Doosan Fuel Cell America.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RESILIENT POWER CASE STUDY SERIES

FUEL CELLS FOR EMERGENCY RESPONDERS

A New York City Police Precinct Turns to Fuel Cells

This series covers several examples of fuel cells used in facilities that must continue to operate even during a power outage, such as hospitals and public emergency shelters. But municipal departments and emergency first responders are also important parts of emergency response.

A great example of fuel cells in this setting was the Central Park Precinct of the New York City Police Department. Though the fuel cell is no longer operational, it was installed in 1999 as a cost-effective option for providing power to this remote facility. But it wasn't until the New York City blackout of 2003 that the fuel cell showed its full value.

On August 14, 2003, at 4:13pm, a software bug caused the world's second largest blackout. More than 14.3 million people in New York City and surrounding areas alone lost power. Transportation, communications, waste-water treatment, and other critical services went down, and 911 services even went down several times.

A fuel cell power plant at New York Police Department's Central Park Precinct kept the building powered for emergency response during the 2003 blackout that affected 14.3 million people. © Nathan Dykes

OVERVIEW

FACILITY TYPE
Police Station

TECHNOLOGY
Hydrogen Fuel Cell

FUEL
Natural Gas

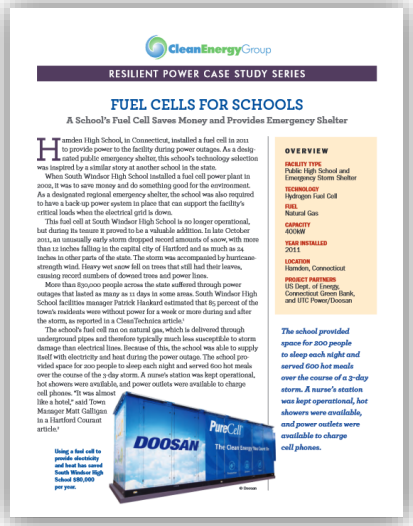
CAPACITY
200kW

YEAR INSTALLED
1999

LOCATION
Central Park, Manhattan, New York

PROJECT PARTNERS
New York Power Authority, US Departments of Defense and Energy, ONSI Corporation/ Doosan

The Central Park Station remained fully operational during the blackout. Staff at the facility didn't even know about the blackout until they looked outside and saw all the lights were off.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RESILIENT POWER CASE STUDY SERIES

FUEL CELLS FOR SCHOOLS

A School's Fuel Cell Saves Money and Provides Emergency Shelter

Hamden High School, in Connecticut, installed a fuel cell in 2011 to provide power to the facility during power outages. As a designated public emergency shelter, this school's technology selection was inspired by a similar story at another school in the state.

When South Windsor High School installed a fuel cell power plant in 2010, it was to save money and do something good for the environment. As a designated regional emergency shelter, the school was also required to have a back-up power system in place that can support the facility's critical loads when the electrical grid is down.

This fuel cell at South Windsor High School is no longer operational, but during its tenure it proved to be a valuable addition. In late October 2011, an unusually early storm dropped record amounts of snow, with more than 12 inches falling in the capital city of Hartford and as much as 24 inches in other parts of the state. The storm was accompanied by hurricane-strength wind. Heavy wet snow fell on trees that still had their leaves, causing record numbers of downed trees and power lines.

More than 830,000 people across the state suffered through power outages that lasted as many as 11 days in some areas. South Windsor High School facilities manager Patrick Haskard estimated that 85 percent of the town's residents were without power for a week or more during and after the storm, as reported in a CleanTechnica article.[1]

The school's fuel cell ran on natural gas, which is delivered through underground pipes and therefore typically much less susceptible to storm damage than electrical lines. Because of this, the school was able to supply itself with electricity and heat during the power outage. The school provided space for 200 people to sleep each night and served 600 hot meals over the course of a 3-day storm. A nurse's station was kept operational, hot showers were available, and power outlets were available to charge cell phones. "It was almost like a hotel," said Town Manager Matt Galligan in a Hartford Courant article.[1]

Using a fuel cell to provide electricity and heat has saved South Windsor High School $80,000 per year.

OVERVIEW

FACILITY TYPE
Public High School and Emergency Storm Shelter

TECHNOLOGY
Hydrogen Fuel Cell

FUEL
Natural Gas

CAPACITY
400kW

YEAR INSTALLED
2011

LOCATION
Hamden, Connecticut

PROJECT PARTNERS
US Dept. of Energy, Connecticut Green Bank, and UTC Power/Doosan

The school provided space for 200 people to sleep each night and served 600 hot meals over the course of a 3-day storm. A nurse's station was kept operational, hot showers were available, and power outlets were available to charge cell phones.

DOOSAN PureCell The Clean Energy Source © Doosan

Northeast Electrochemical Energy Storage Cluster (NEESC)

NEESC is a network of industry, academic, government and non-governmental leaders working together to help businesses provide energy storage solutions.

Northeast Electrochemical energy storage Cluster

www.neesc.org

Today's Guest Speakers

- **Nicholas Zuba**, Manager, Commercial & Industrial Programs, CT Green Bank
- **Geoff King**, Associate, NY Green Bank

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C-PACE:

Financing resiliency in Connecticut

Resilient Power Webinar

February 18, 2016

Who is the CT Green Bank?

Help ensure Connecticut's energy security and community prosperity by realizing its environmental and economic opportunities through clean energy finance and investments.

Support the Governor's and legislature's energy strategy to achieve cleaner, cheaper and more reliable sources of energy while creating jobs and supporting local economic development

Property Assessed Clean Energy

CONNECTICUT GREEN BANK

CT Green Bank provides 100% , low-cost, long-term funding

Owner repays over time through property taxes

A senior PACE lien is put on the property and stays regardless of ownership

C-PACE Key Benefits

- 100% financing up to 25 years
- Positive cash flow in year 1
- Technical underwriting / SIR > 1
- Tax obligation fixed to the property

What upgrades are eligible?

Anything that saves energy from baseline…*as long as it isn't going anywhere*

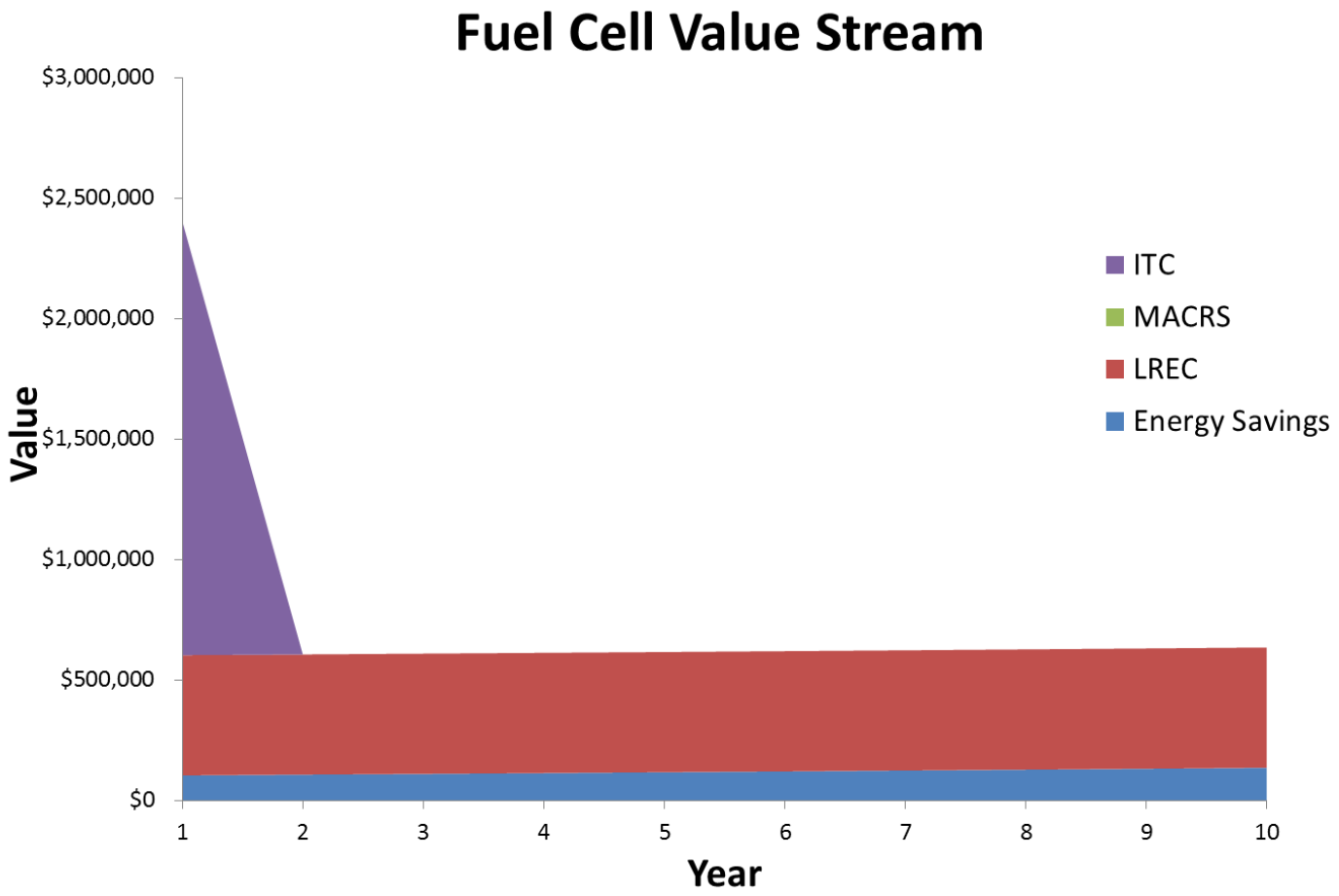
Building Envelope Upgrades

- High efficiency lighting
- HVAC upgrades (chillers, boilers, furnaces)
- High efficiency hot water heating systems
- Building automation and controls
- Building enclosure/envelope improvements
- Variable speed drives on motors, fans, and pumps

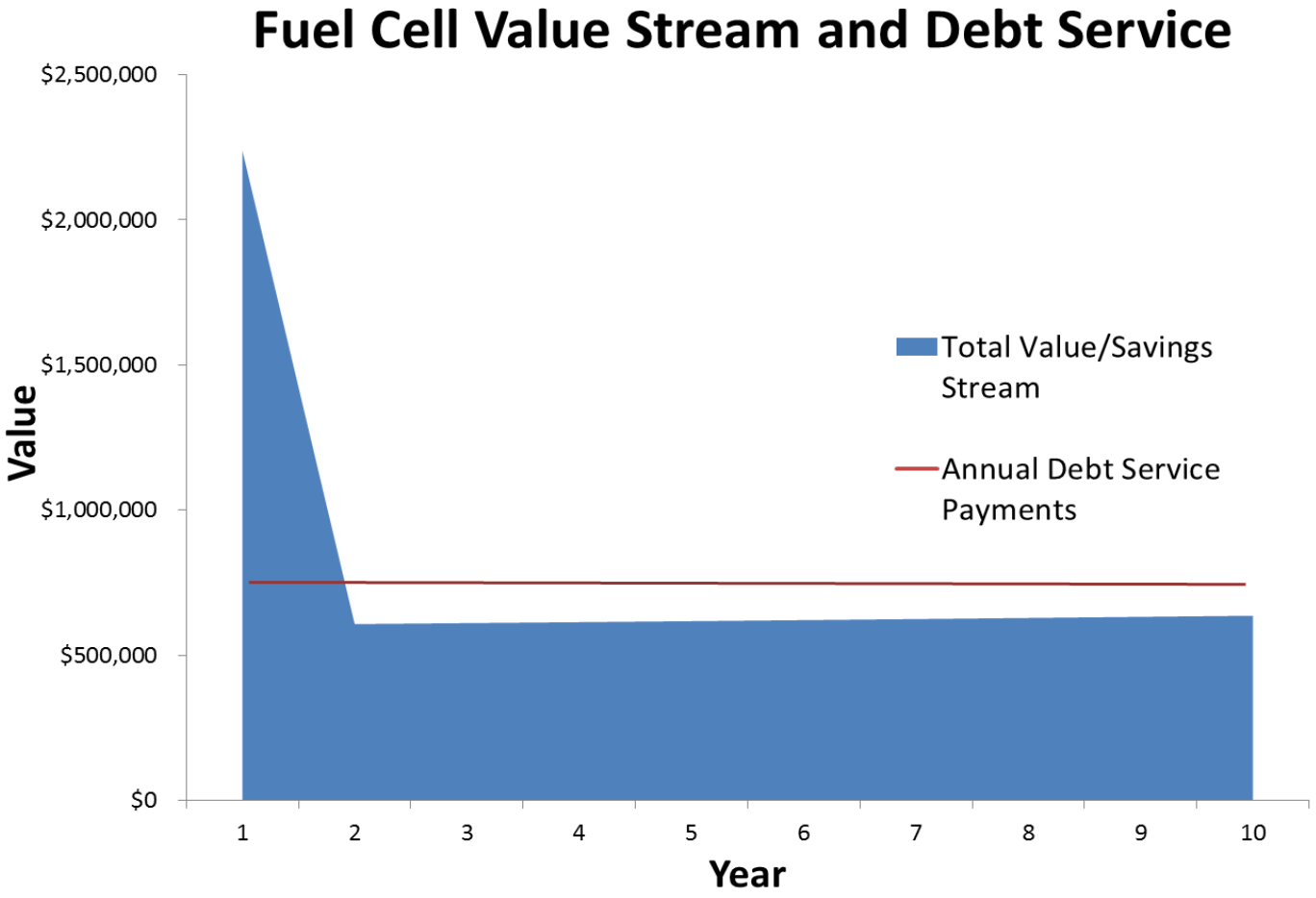
Renewable Energy Systems

- Solar systems
- Microgrids
- Wind systems
- Fuel cells
- Geothermal
- Heat recovery and steam traps

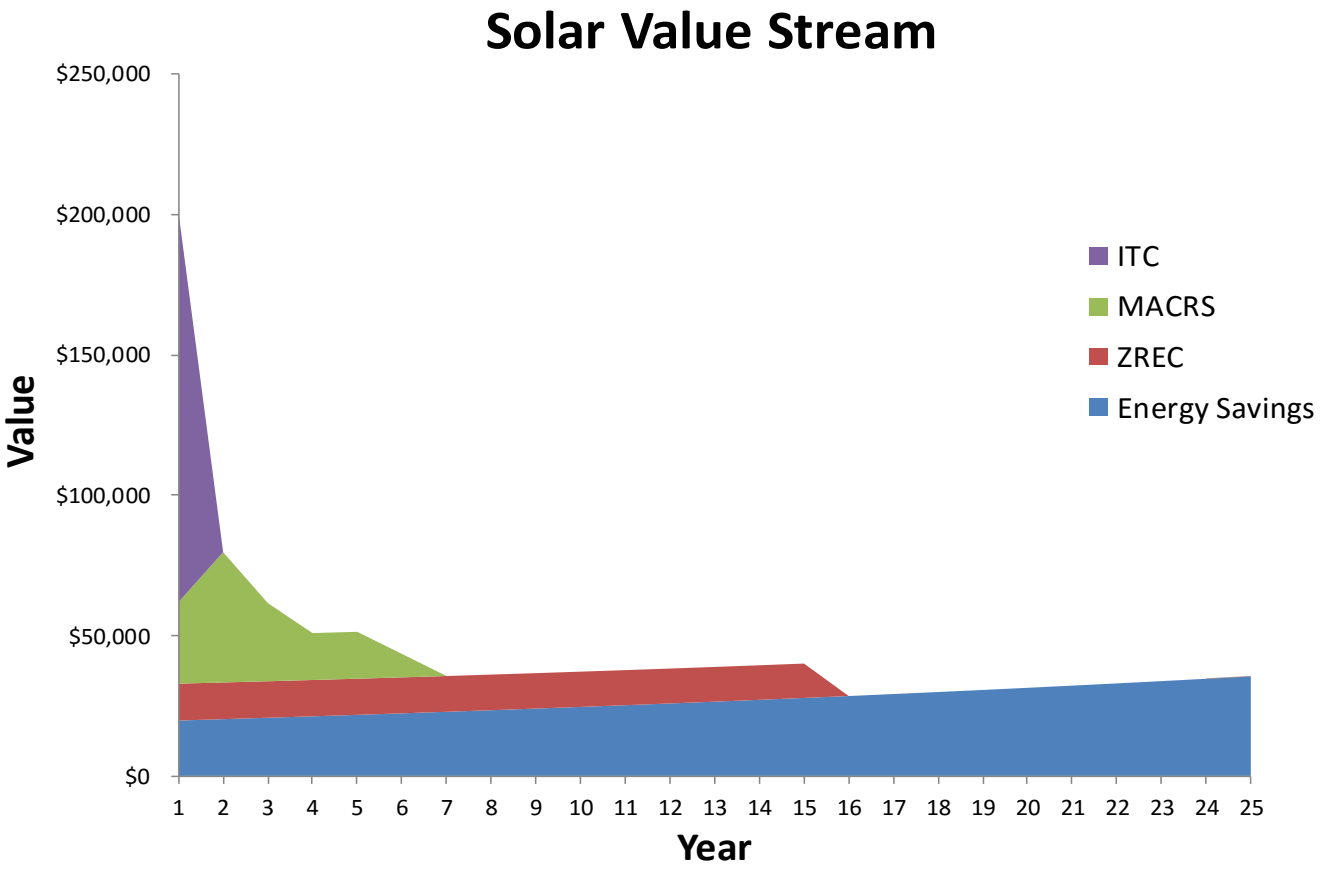
Financing Fuel Cells – Amortization for C-PACE



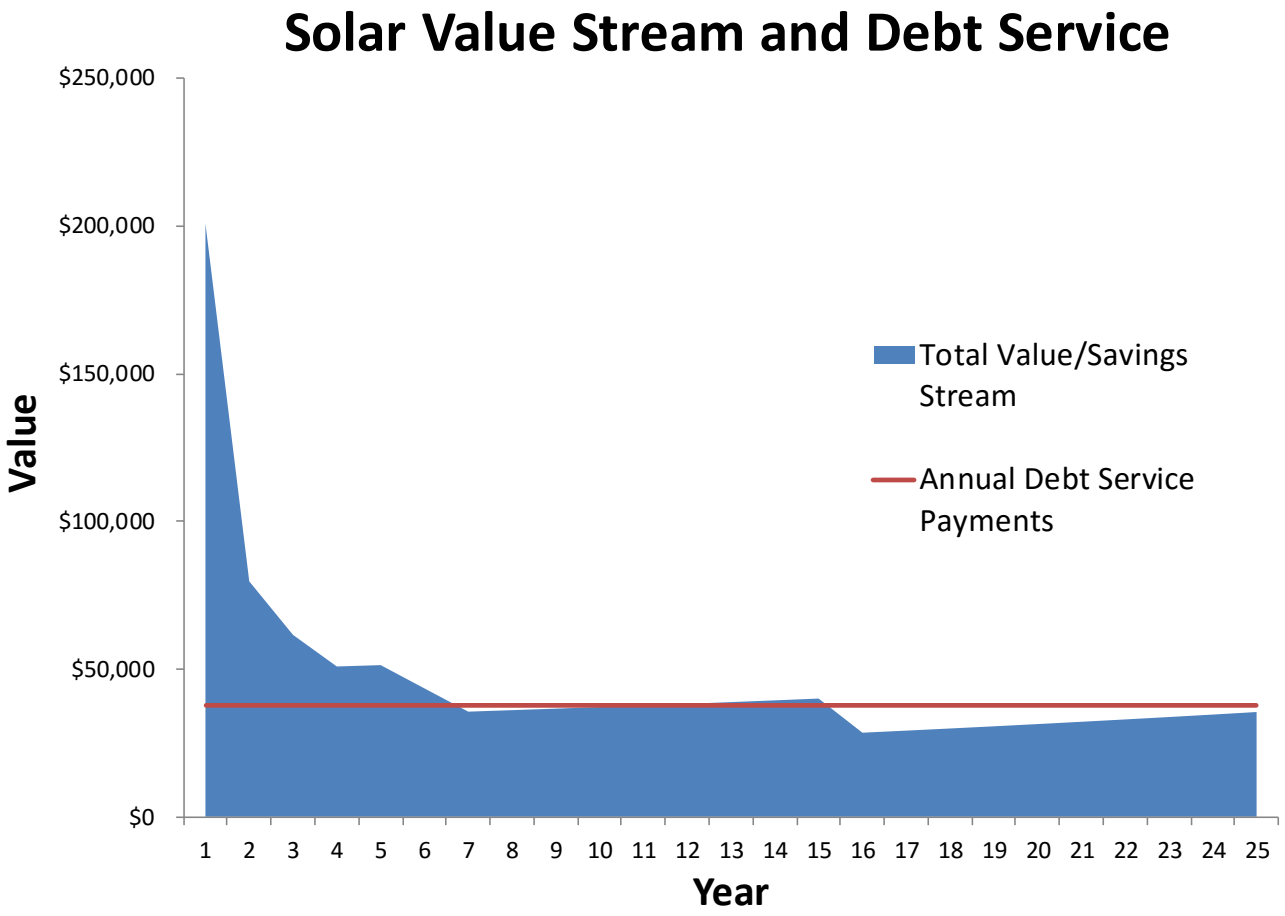
Financing Fuel Cells – Amortization for C-PACE



Financing Solar Systems – Enabling Ownership



Financing Solar Systems – Enabling Ownership



Financing Challenges for Microgrids

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Multiple Technologies

Existing financial structures focused on individual generator types

Microgrids **link one or more generator technologies**

Multiple Credits

Existing tools for financing projects are structured around customer building types

Microgrids may serve a **network** of all customer types (resi., comm., MUSH, etc)

Multiple Revenue Sources

Benefits include reduced energy costs and GHG emissions and/or energy security and reliability

Energy **savings may not pay for investment** - some benefits come at a **cost premium**

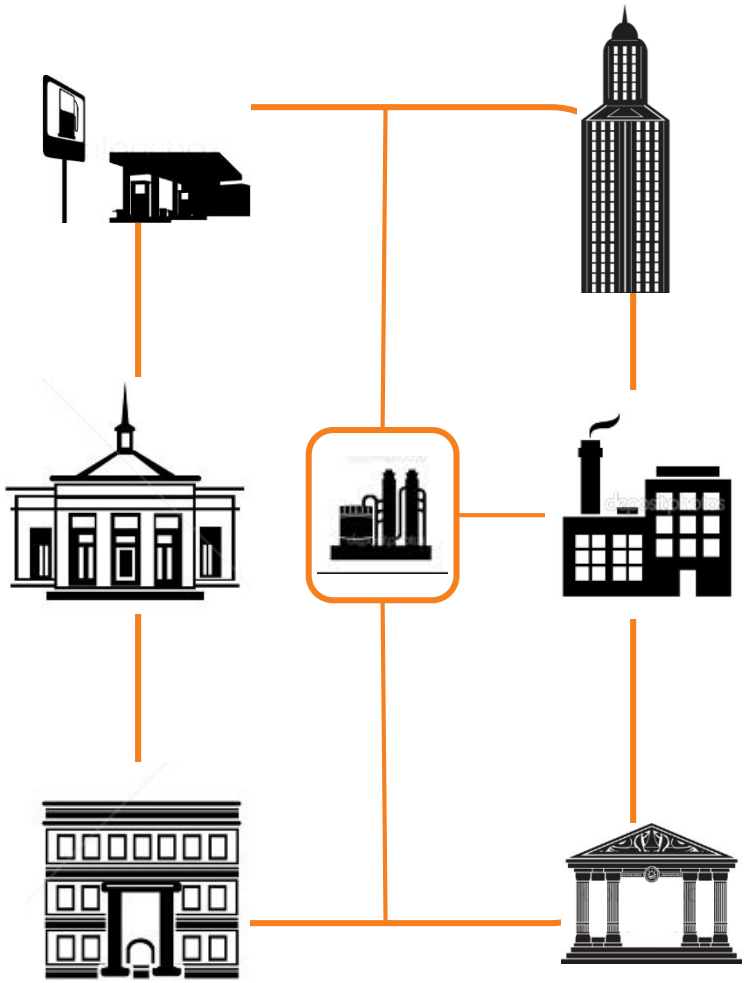
Custom-Fit Solutions

Making microgrids economical is a demand and supply side equation

Microgrid customers **in aggregate** must have **a demand profile fitting for the operating profile of the generator(s)**

C-PACE: Buildings are collateral for microgrid system

- Private capital provides 100% low-cost, long-term financing securing through senior tax lien and repaid through property bills
- Capital costs are assessed to end-users on a pro-rata basis based on their projected ‘benefit’ (e.g. energy savings/R)ECs/et
- Microgrid developer locks in repayment of fixed costs over 20 years. Microgrid owner/operator signs short term ESAs with customers for energy supply, delivery, reliability, etc.



Thank you!

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NY Green Bank Overview

Hydrogen and Fuel Cells for Resiliency: Financing Energy Resiliency

Geoff King, Associate
February 18, 2016

Agenda

1. **New York's Evolving Energy Landscape**
   - Challenges: New York's Energy Infrastructure
   - Solution: Reforming the Energy Vision
   - Pillars of REV
2. **New York's Clean Energy Marketplace & NY Green Bank**
   - The Opportunity
   - Market Barriers & Financing Gaps
   - NY Green Bank Overview
   - NY Green Bank Team
3. **Partnering with Us**
   - Market-Responsive Solutions
   - Investment Criteria
   - Market Response & Current Portfolio
   - Open Solicitation
   - Elements of a Strong Proposal
   - Recently Announced Transactions
   - Examples of What's to Come
   - Additional NYSERDA Resources
   - Contact Us

New York's Evolving Energy Landscape

Challenges: New York's Energy Infrastructure

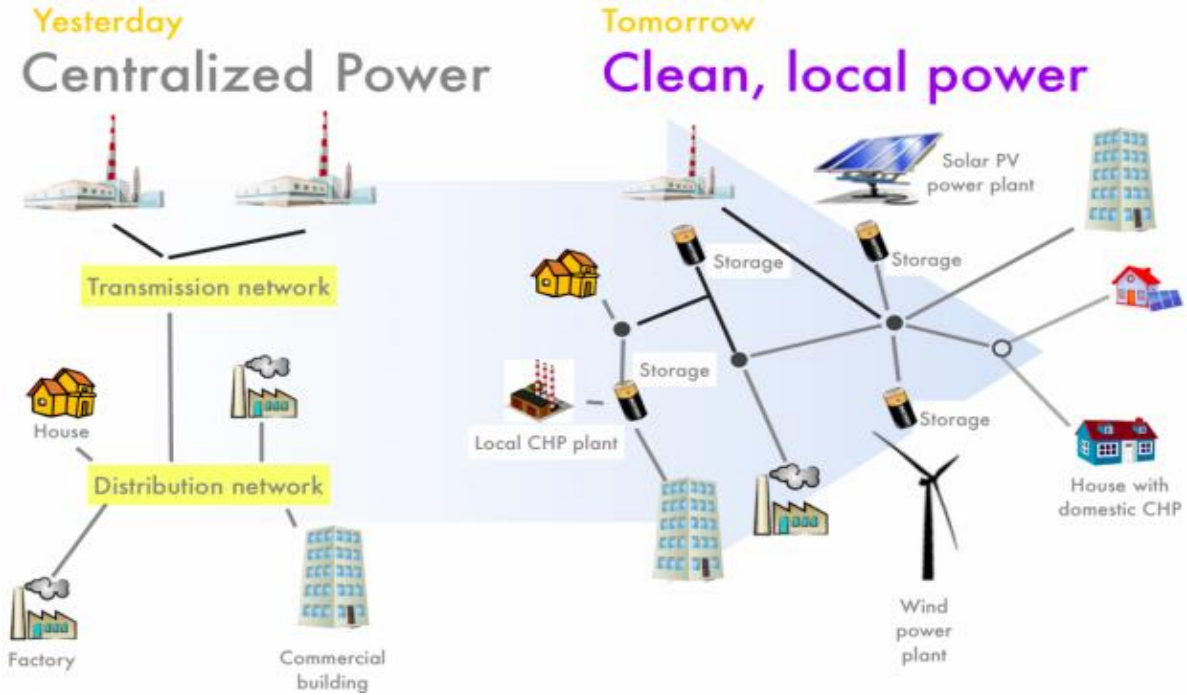
$30 Billion

Investment required to replace New York's energy infrastructure just to meet currently projected energy demand over next 10 years*

** 2015 New York State Energy Plan*

Solution: Reforming the Energy Vision

Reforming the Energy Vision (REV) is New York's comprehensive strategy to create an efficient, reliable and affordable clean energy system



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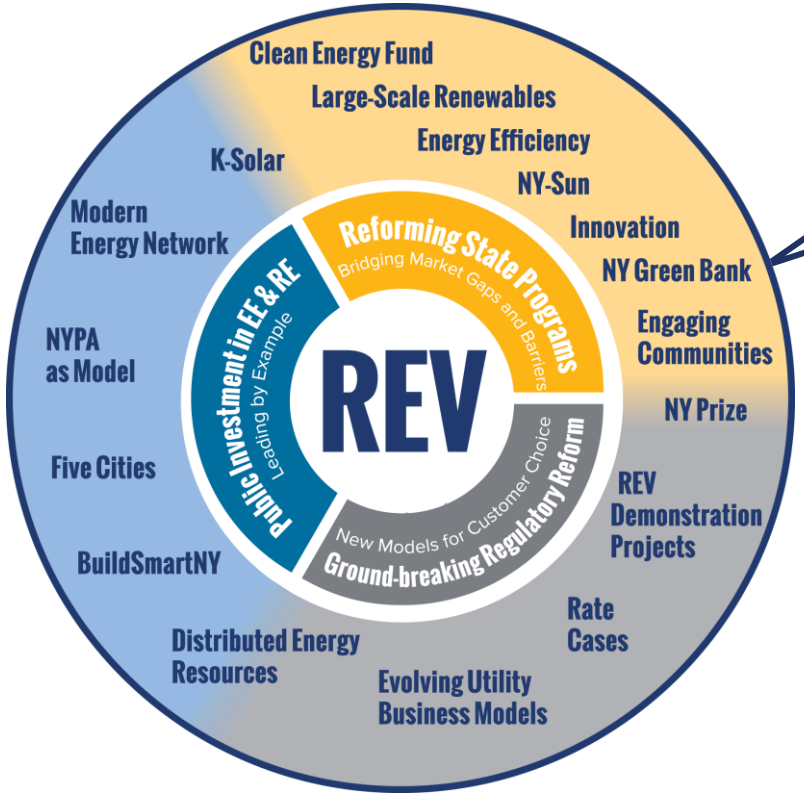
Pillars of REV

REV is comprised of three main pillars that underlie all energy-related state-backed initiatives, agencies, and authorities



NY Green Bank

Strategically positioned to mobilize greater private sector activity in New York's clean energy markets

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New York's Clean Energy Marketplace & NY Green Bank

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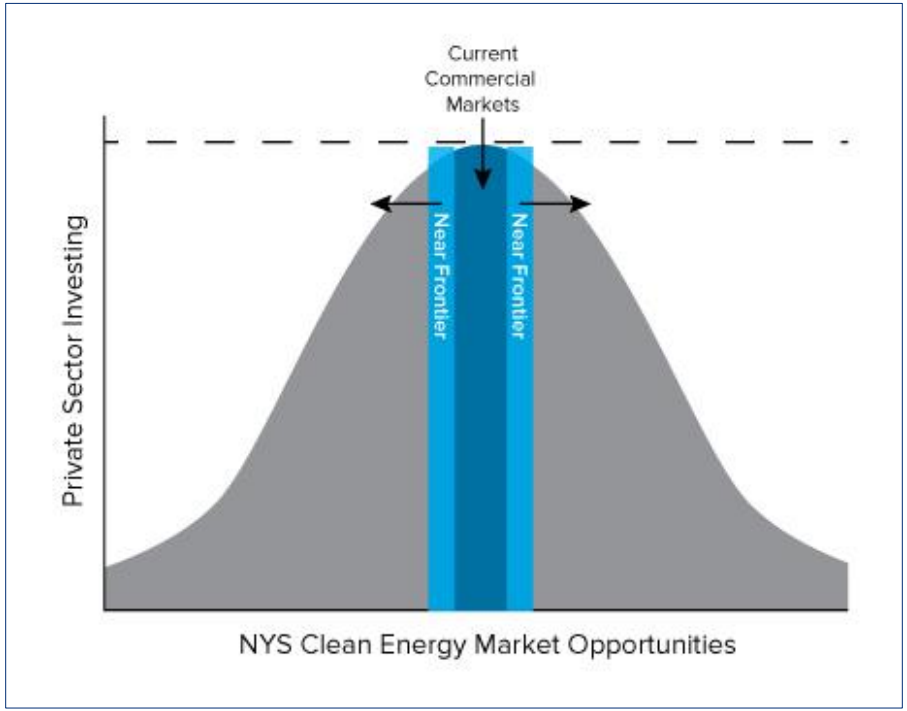
The Opportunity

Market opportunities for New York-based clean energy projects over the next ten years ~ $85 billion*



** Booz & Co., August 2013 - Estimate does not take into account potential utility scale generation, total potential for any other generation types other than distributed solar electric, CHP, onshore wind, biomass or anaerobic digesters.*

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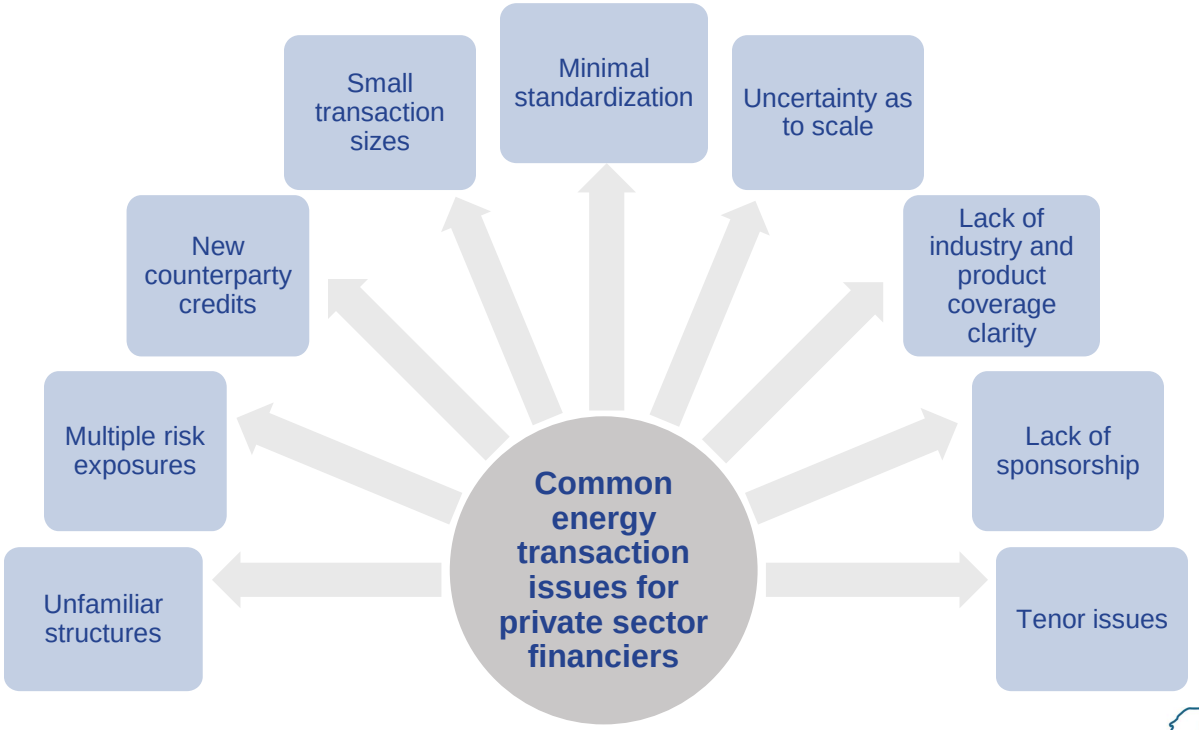
Market Barriers & Financing Gaps

Private sector is constrained by current market barriers and financing gaps



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NY Green Bank Overview

$1 billion State-sponsored specialized financial entity working with the private sector to alleviate financing gaps in New York's clean energy markets

Key Elements and Objectives

Market focused, responsive and transformative. Capital provided at market, rather than subsidized rates	Reduce greenhouse gas (GHG) emissions	Mobilize greater private sector capital in New York's clean energy markets

NY Green Bank Team

NY Green Bank Senior Leadership has extensive and varied transactional backgrounds

Past Firms	Specialized Expertise
• Citigroup	• Alternative Energy
• JP Morgan	• Structured Finance
• Bank of America	• Project Finance
• UBS	• Securitization
• Goldman Sachs	• Commodities
• Jeffries	• Rates
• US Department of Energy	• Syndicated Loans
• NRG	• Debt Capital Markets

Partnering with Us

Market-Responsive Solutions

Private sector project developers and financiers propose creditworthy clean energy transactions through open solicitation

Broad Categories of Capital Solutions

- Credit Enhancement
- Warehousing/Aggregation
- Asset Loans & Investments
- Composite Products

Product Pricing

- Rates reflect risk, comparables, and commercial expectations
- Demonstrate NY Green Bank is prudent steward of ratepayer funds
- Serve as agent for greater private investment

Investment Criteria

Credit quality is paramount in the evaluation, structuring and negotiation of NY Green Bank's investments

Minimum Investment Requirements

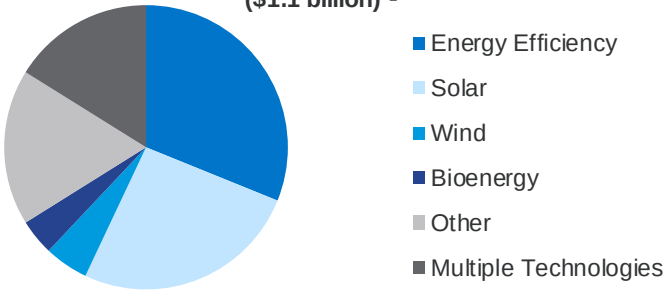
- Capital will be repaid and will earn appropriate market rate
- Project will result in reduced GHG emissions
- Transaction involves one or more private sector financial parties

Additional Considerations

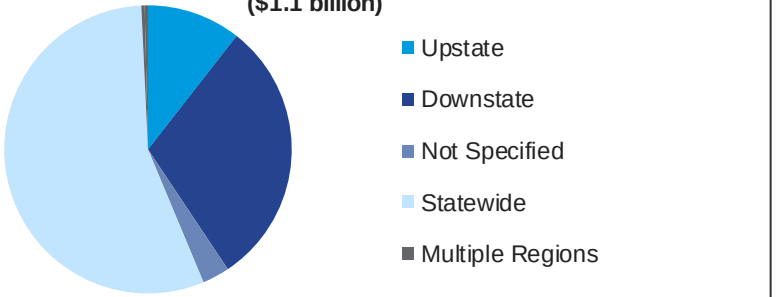
- **Market transformation**: Operate in wholesale (not retail) markets
- **Additionality**: Unique NY Green Bank role in addressing a specific market barrier
- **Scalability**: Transaction can be replicated in the private market

Market Response & Current Portfolio*

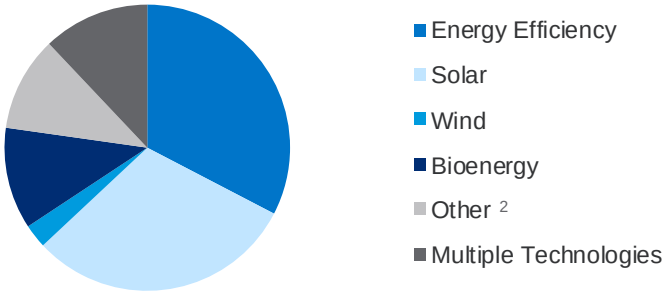
Technology Distribution by Proposed NYGB Investment ($1.1 billion) [1]



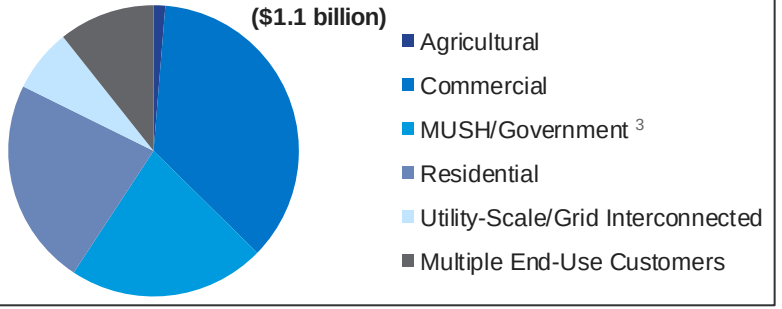
Geographic Distribution by Proposed NYGB Investment ($1.1 billion)



Technology Distribution by Proposed Total Investment (~$4.0 billion)



End-Use Customer Segment Distribution by Proposed NYGB Investment ($1.1 billion)



[1] Other includes fuel cell, micro-grid, electric vehicle infrastructure and battery storage

[2] 74% of the proposals received by NYGB identify the total project value of the investments proposed at $3.3 billion. While 26% of proposals received do not specify the total project value of investments, these have been estimated at just under $1.0 billion.

[3] MUSH/Government segment includes municipalities, universities, schools, and hospitals and City/State/Federal Government

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Open Solicitation

Visit www.greenbank.ny.gov for open solicitation and instructions for online submission

- Open solicitation seeks financing arrangements meeting the NY Green Bank mandate and investment criteria
- Proposals evaluated on a rolling basis
- NY Green Bank team is available to discuss potential investment ideas. Please reach us at info@greenbank.ny.gov

Elements of a Strong Proposal

- Capable experienced management team
- Quality counterparties
- Interested and engaged private sector capital providers
- Identified and well articulated role for NY Green Bank
- Traditional project finance / ‘bankability’ concerns have been evaluated
  - Construction Risk
  - Operating Risk
  - Offtaker / Demand Risk
  - Regulatory Risk
  - Commodity & Rate Risk
  - Refinancing Risk
- A financial model with realistic assumptions

Recently Announced Transactions

NY Green Bank's recently announced deals will allow its private sector partners to provide and improve access to cleaner and more affordable energy for their residential, commercial and agricultural customers

$25 Million Warehouse Credit Facility for Level Solar

- Together with U.S. Bank tax equity, this allows Level Solar to expand business by providing up to an additional 6,000 New York households with residential solar

$4 Million Revolving Construction Loan for United Wind

- Together with U.S. Bank tax equity, this allows United Wind to install distributed wind energy systems at 160+ sites in upstate NY for residential, commercial and agricultural customers

$20 Million Subordinated Capital for Renew Financial

- In conjunction with a $50 million senior secured nationwide warehouse facility provided by Citi, this allows Renew Financial to expand its consumer lending program throughout New York State. Offered through a contractor network, this program will provide 12,000+ New York homeowners with up to $20,000 in low-cost financing for clean energy and energy efficiency improvements

$5.5 Million Letters of Credit for Energy Improvement Corporation

- NY Green Bank has provided two letters of credit to Energy Improvement Corporation (EIC). EIC's Energize NY Finance product uses the PACE loan mechanism to finance qualified energy improvements to buildings for commercial property owners and non profits located in participating municipalities

Examples of What's to Come

- Energy Services Contract Monetization Portfolios
- Community Solar Debt Portfolio
- Energy Efficiency Loan Warehouse
- Middle Market Commercial Solar Warehouse
- C&I Energy Efficiency ESA Loan Portfolios
- Battery Storage/Demand Response Debt Portfolios
- Residential Solar PPA Back-leverage Warehouse
- Energy Efficiency Residential ESA Monetization Warehouse
- Utility On-Bill Warehouse
- Residential Solar Loan Portfolio
- C&I CHP Debt Portfolio
- Electric Vehicle Infrastructure Financing Solutions
- Streetlighting Savings Monetization Warehouse
- Utility-Scale Wind Project with Merchant Risk Element

Additional NYSERDA Resources

- In addition to NY Green Bank's resources, NYSERDA has approval for a 2016 Main Tier solicitation of $150 million to support the construction of large scale renewable projects through its Renewable Portfolio Standard (RPS)
- Hydrogen and fuel cells are eligible to participate in NYSERDA's RPS by applying for Provisional Certification during an active solicitation
- http://www.nyserda.ny.gov/All-Programs/Programs/Main-Tier

Contact Us

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Upcoming Webinar

- **Fuel Cells for Telecommunication**, Thursday, March 17, 2-3 pm ET

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