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An Evaluation of a Smart Grid Program

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The Challenge

- NYS Climate Leadership and Community Protection Act (2019)
  - 85% reduction in GHG emissions from 1990 levels by 2050
  - 70% of electricity generation from renewable sources by 2030
  - 100% zero-carbon electricity by 2040

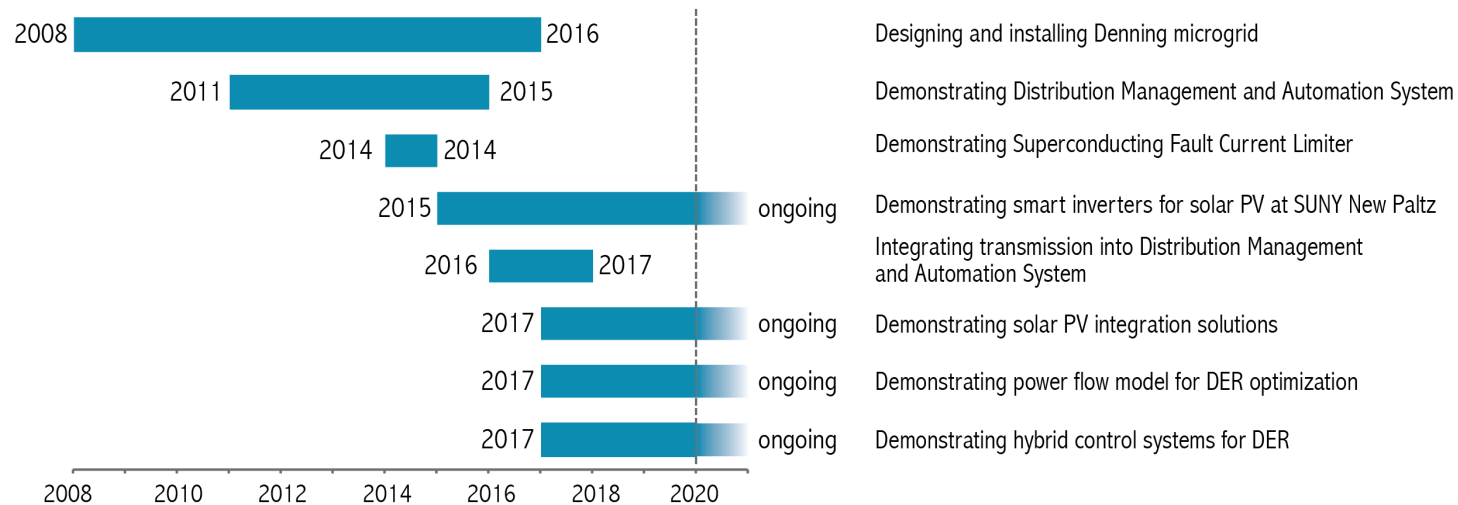- Fundamental improvements to the grid are needed

NYSERDA's Smart Grid Program

- Promotes modernization of NY State's electric grid
- Funds R&D and technology development projects that can be implemented at utility scale

- Examples of smart grid technologies:
  - Remote sensing devices for monitoring grid conditions in real-time
  - Tools enabling two-way communication
  - Automated controls for optimizing grid performance

Central Hudson Gas & Electric
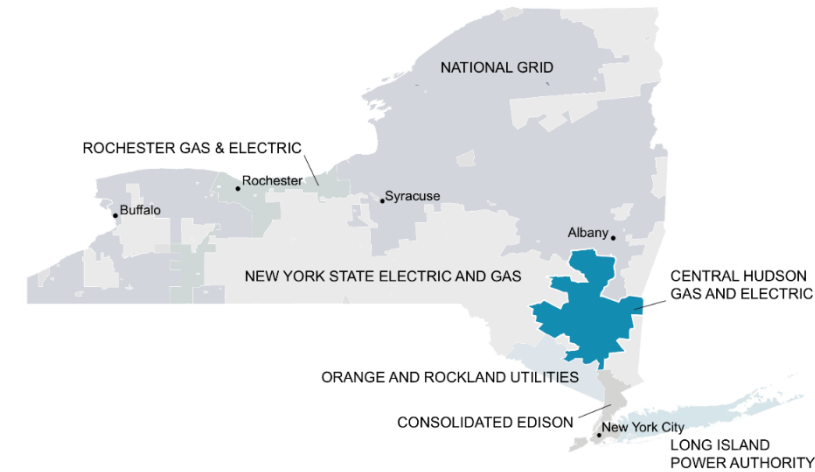
- Automated T&D management systems
- Superconducting fault current limiters
- Sensors, smart inverters and other monitoring and power

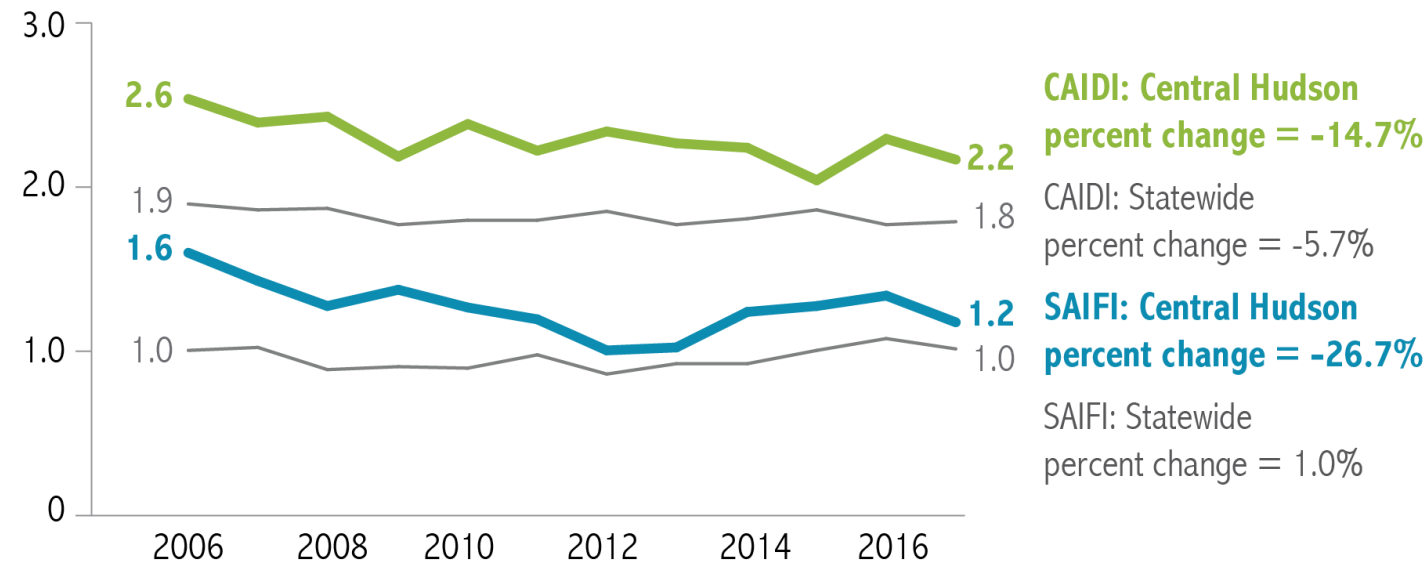|	
2008 — 2016	Designing and installing Denning microgrid
2011 — 2015	Demonstrating Distribution Management and Automation System
2014 — 2014	Demonstrating Superconducting Fault Current Limiter
2015 — ongoing	Demonstrating smart inverters for solar PV at SUNY New Paltz
2016 — 2017	Integrating transmission into Distribution Management and Automation System
2017 — ongoing	Demonstrating solar PV integration solutions
2017 — ongoing	Demonstrating power flow model for DER optimization
2017 — ongoing	Demonstrating hybrid control systems for DER

2008 2010 2012 2014 2016 2018 2020

Benefits and Methods

- **Reliability:** CAIDI and SAIFI (reliability indices); ICE Calculator

- **Energy:** Reduced electricity consumption

- **Economic:** Avoided capital costs; reduced electricity costs

- **Environmental:** Reduced CO_2 emissions; social cost of carbon

- **Replication:** Utility interviews; investment plan review

Central Hudson (CH) has shown the most pronounced reliability improvement over the last decade among New York State utilities.
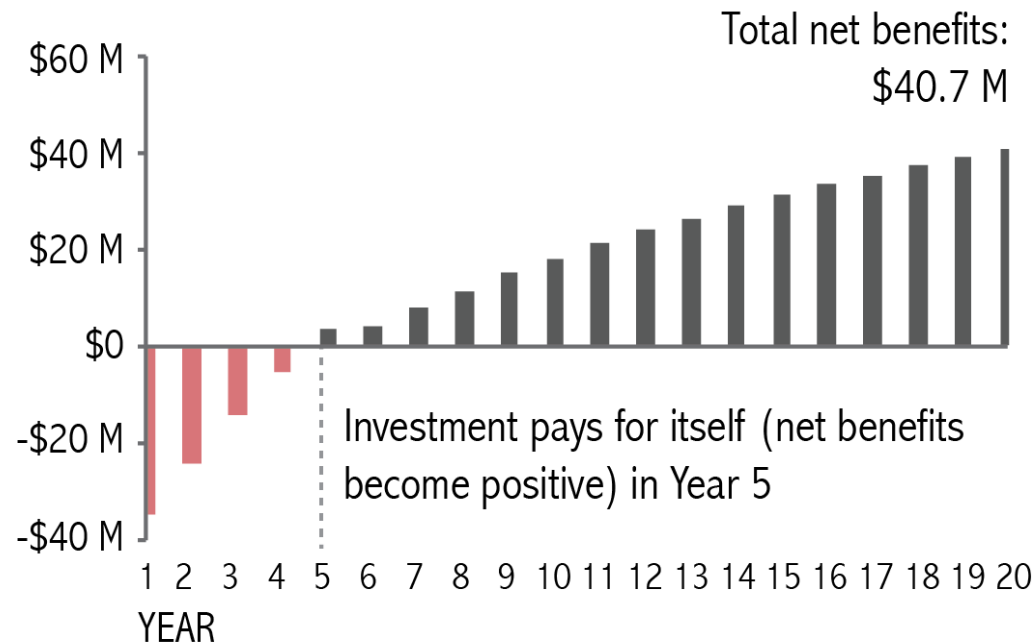
Grid Interruption Measures

CAIDI: Central Hudson
percent change = -14.7%

CAIDI: Statewide
percent change = -5.7%

SAIFI: Central Hudson
percent change = -26.7%

SAIFI: Statewide
percent change = 1.0%

$19.4M in benefits to customers from 2006-2017 resulted from CH's reliability improvements.

Measuring Grid Reliability			
Grid Reliability Metric	**2006**	**2017**	**Percent Change**
SAIFI: Central Hudson	1.61	1.18	-26.7%
SAIFI: Statewide	1.00	1.01	1.0%
CAIDI: Central Hudson (hours)	2.58	2.20	-14.7%
CAIDI: Statewide (hours)	1.92	1.81	-5.7%
Economic Value of Grid Reliability Improvements			
Scenario	**2006 Impact (2019$, millions)**	**2017 Impact (2019$, millions)**	**Change in Annual Impact (2019$, millions)**
ICE Calculator Valuation	$79.1	$59.7	$19.4
100% Attribution			$19.4
61.2% Attribution (improvements beyond statewide average)			$11.9
37.4% Attribution (10% reduction due to automation)			$7.3

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Net benefits of Central Hudson's investments are estimated to be $40.7 million.

Total net benefits: $40.7 M

Investment pays for itself (net benefits become positive) in Year 5

YEAR

Costs:

$46.3 million in costs incurred over the 5-year financial planning period of the rate case, and $5.0 million in subsequent costs

Benefits:

Reduced energy consumption ($5.9 million annually) and two avoided capital upgrades ($2.7 million annually each over the 5-year planning period)

Equipment lifespan: 20 years

Discount rate: 7% (WACC)

Distribution automation (DA) results in ~741,000 metric tons CO_2 avoided over 20 years, valued at $28M using the social cost of carbon.

Calculating Energy and Emissions Reductions	
Benefit	**Value**
Annual reduction in energy consumption ($ millions)	$5.9
Annual reduction in energy consumption (kWh, millions)	73.8
20-year reduction in energy consumption (MWh, millions)	1.5
Annual reduction in CO2e emissions (metric tons)	37,059
20-year reduction in CO2e emissions (metric tons)	741,188

Valuing Emissions Reductions		
	Value	
Metric	**Central SCC**	**Higher SCC**
Annual damages avoided, 2019 ($2019 millions, present value)	$1.9	$2.8
Annual damages avoided, 2019 – Net of RGGI ($2019 millions, present value)	$1.6	$2.5
20-year damages avoided – Net of RGGI ($2019 millions, present value)	$28.0	$45.4

The net societal benefit of NYSERDA's funding is $71.0 million. For each $1 of NYSERDA funding, CH is expected to achieve ~$12.83 in benefits.
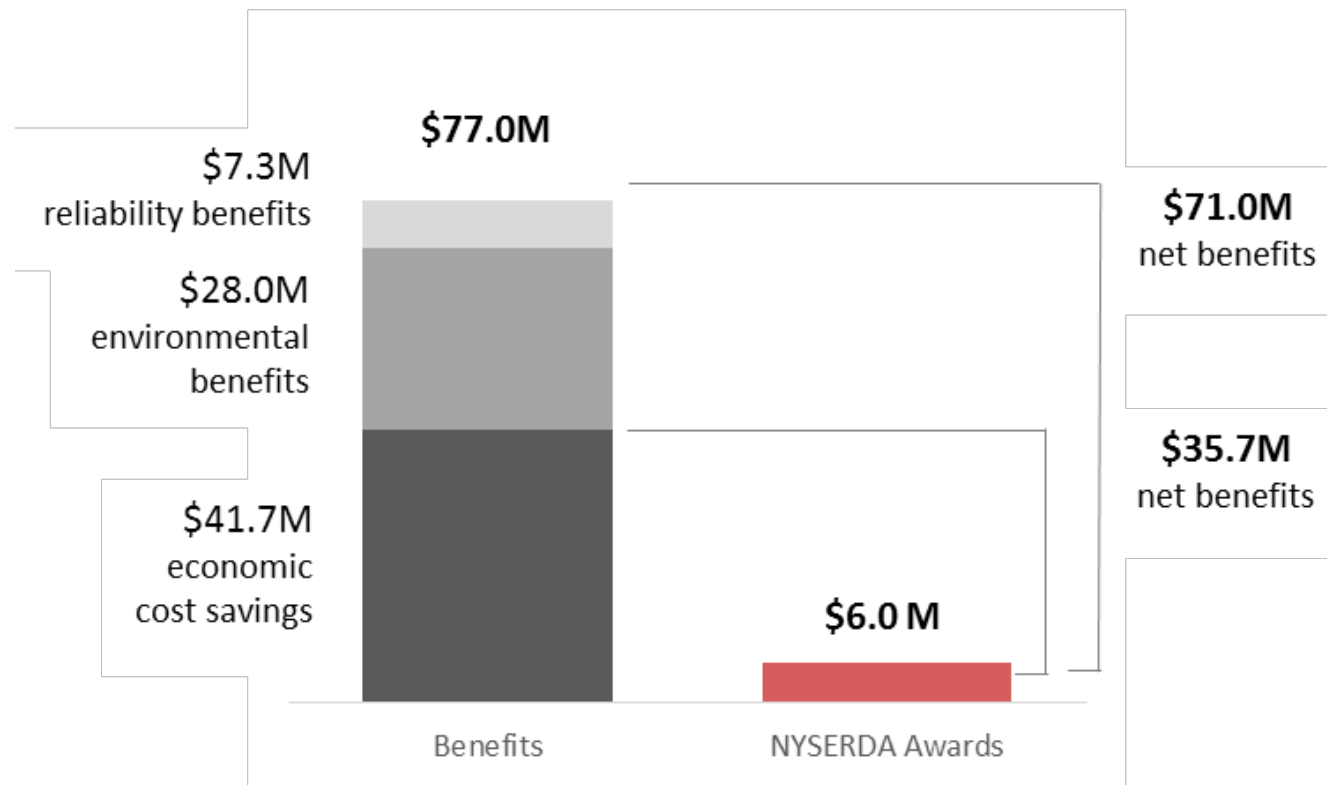
NYSERDA-funded demos influenced CH's future investments and replications by other utilities.

- Con Edison and National Grid have learned from and adopted elements of CH's smart grid strategy.

- National Grid emulated CH's approach to grid communications and load forecasting in its efforts to roll out a DA system.

- CH set the standard for integrating GIS into utility operations.
  - Con Edison is in process of implementing an enterprise-wide GIS
  - Deployed online portal for RE developers that is same tool used by CH

Takeaways

- Massive investment is needed to modernize the grid and achieve climate and resiliency goals.

- Publicly funded programs can't do this on their own, but they can catalyze investment through demos & knowledge sharing.

- Evaluators and decision-makers should factor in the benefits and costs of program-inspired utility investments –– not only direct investments made by publicly-funded programs.

- Utility-scale grid modernization efforts can yield significant non-energy impacts (NEIs); these NEIs can and should be evaluated and considered in investment decisions.

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