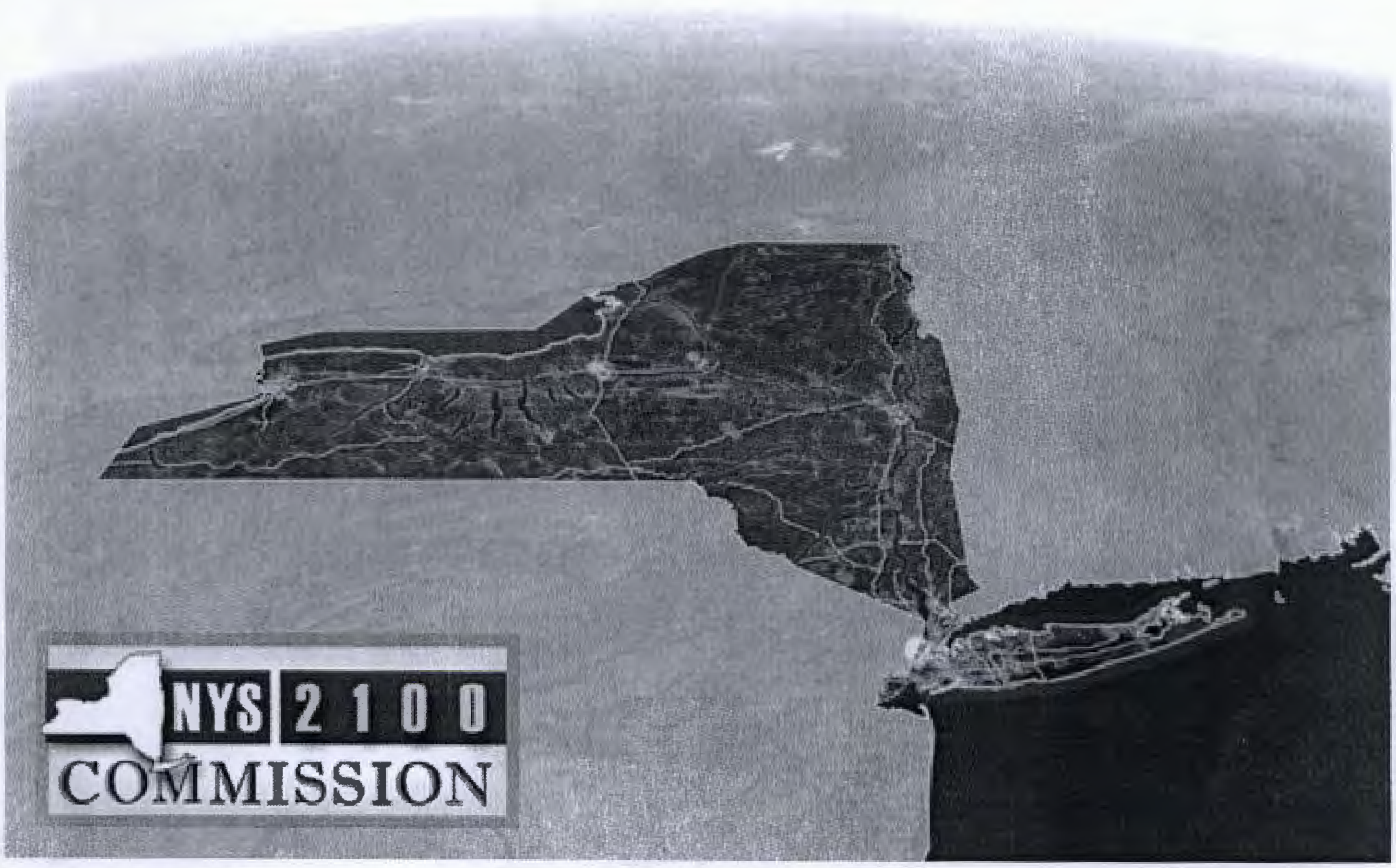
Exh 934

NYS 2100 COMMISSION

Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure



Accelerate the modernization of the electric system and improve flexibility

Today's power system relies heavily on central power generation plants, primarily powered by fossil fuels, nuclear, and hydroelectric sources based in New York (Figure E-12). Power flows almost exclusively in one direction, from power plant to customer. Beyond this, small distributed generators are used in limited applications, primarily for emergency power during grid outages. Much of the distribution grid today employs a system design developed decades ago, and does not incorporate recent technological advances. The system is largely static and not designed to allow for quick reconfiguration to redirect power along alternate routes when damage occurs to the primary sources of power supply in the distribution system.

New York's grid is aging — 59% of the state's generating capacity and 84% of transmission facilities were put into operation before 1980, and over 40% of the state's transmission lines will require replacement within the next 30 years, at an estimated cost of $25 billion.[9] This need represents an opportunity to upgrade the transmission system to a more distributed smart grid network.

Investments should be made to transition the electric grid to a dynamic and flexible system that allows for future technologies, additional clean energy integration, and minimal outages during major storms and events. New designs should not be dependent on specific technologies and should instead be flexible to be able to incorporate new devices as products are developed.

The PSC has previously ordered the electric utilities in New York to make smart grid investments starting at the transmission system level, pursuing investments with an incremental approach. The rationale for this relatively conservative approach is to minimize ratepayer costs and to ensure large investments are not made in technologies that may become obsolete. However, in light of recent extreme weather events, the PSC should review whether readily available smart grid technology could have reduced outages or improved power restoration and communications with customers, and reevaluate and prioritize utility investments in smart grid technology accordingly. The State should build on the existing PSC order and accelerate investments that offer the dual benefit of storm-strengthening and improved outage management while also implementing a smarter, more flexible system that better integrates distributed generation and improves communication flow between the utility and their customers.

Vision of the electric system operation

The modern electric power system must be a dynamic and flexible network that draws from constantly changing sources of electric energy. A smart grid is a dynamic electrical grid consisting of generation and consumption equipment interacting together to meet the loads on the grid efficiently. Enhanced sensors and controls give grid operators more visibility into the behaviors of electricity consumers, provide consumers a level of understanding of their energy usage, and enable the deployment of distributed generation, energy storage, and demand response. For instance, during times of peak load, a smart grid can automatically shut-down or temper high energy use appliances in homes and businesses. If utilities charge prices that vary by time-of-use, reflecting the actual cost of energy production in real-time, coupled with advanced metering, the system efficiency will increase by reducing peak demand (thereby reducing the need to build costly infrastructure to meet peak demand). Under such a rate design, consumers can shift loads to periods of low demand and pay a lower price for electricity which, in turn, will have a system-wide effect of leveling total demand on the system over time. To increase customer acceptance of these options, the choice of several alternative tariff structures can be offered.

Numerous jobs will also be created through the implementation, operation, and maintenance of smart grid technologies. In addition, the technologies involved in building a smart grid are the focus of extensive research in laboratories such as the Energy Power Research Institute (EPRI).

Operation and control of this increasingly complex and interconnected grid, along with the associated financial transactions of a competitive energy marketplace, will require significant changes to the static nature of today's power system. Smart grids will minimize the impacts of future natural disasters on consumers, by helping to enable individual premises and microgrid "islanding" to provide power to pockets of consumers when central power plants or portions of the transmission and distribution system are inoperable. Robust and highly integrated communications and distributed computing infrastructures utilizing a network of sensors will give utilities greater control over grid operations and customers greater control over their own electricity use. The central power plant's role will be diminished and clean microgrids[b] will become more prevalent, allowing small distributed plants to supply homes, buildings, and neighborhoods with power.

Enhanced sensors and controls also enable utilization of distributed generation networks.[c] Utilizing distributed generation resources, or on-site power generation, reduces dependence on the electric distribution system that is susceptible to damage during a natural disaster. To maximize the storm-resiliency benefits of on-site generation, it must be located appropriately and protected against damage during major weather events. Distributed generation resources, such as solar and wind, can also contribute to a cleaner electricity supply. Central power plants should still play a role in meeting energy demand, but proliferation of microgrids

[b] "Microgrids" refers to clusters of homes and buildings that share a local electric power generation and/or energy storage device while disconnected from the utility grid.

[c] "Distributed generation" refers to small electrical power generators installed in homes, businesses, and office buildings that can supply power to a location when grid power is not available.

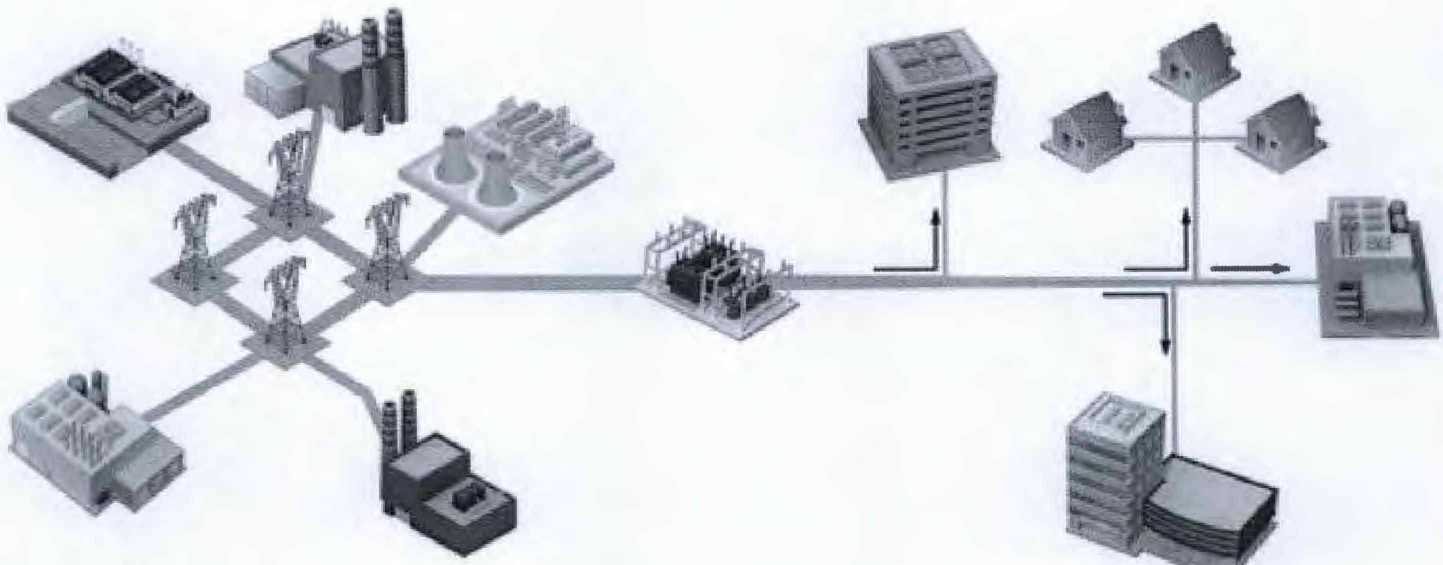


Figure E-13: Today's power system comprised of large central station power generation connected by a high-voltage network or grid to local distributions systems which serve homes, businesses and industry. Electricity flows predominantly in one direction using mechanical controls (EPRI, 2012)[10]

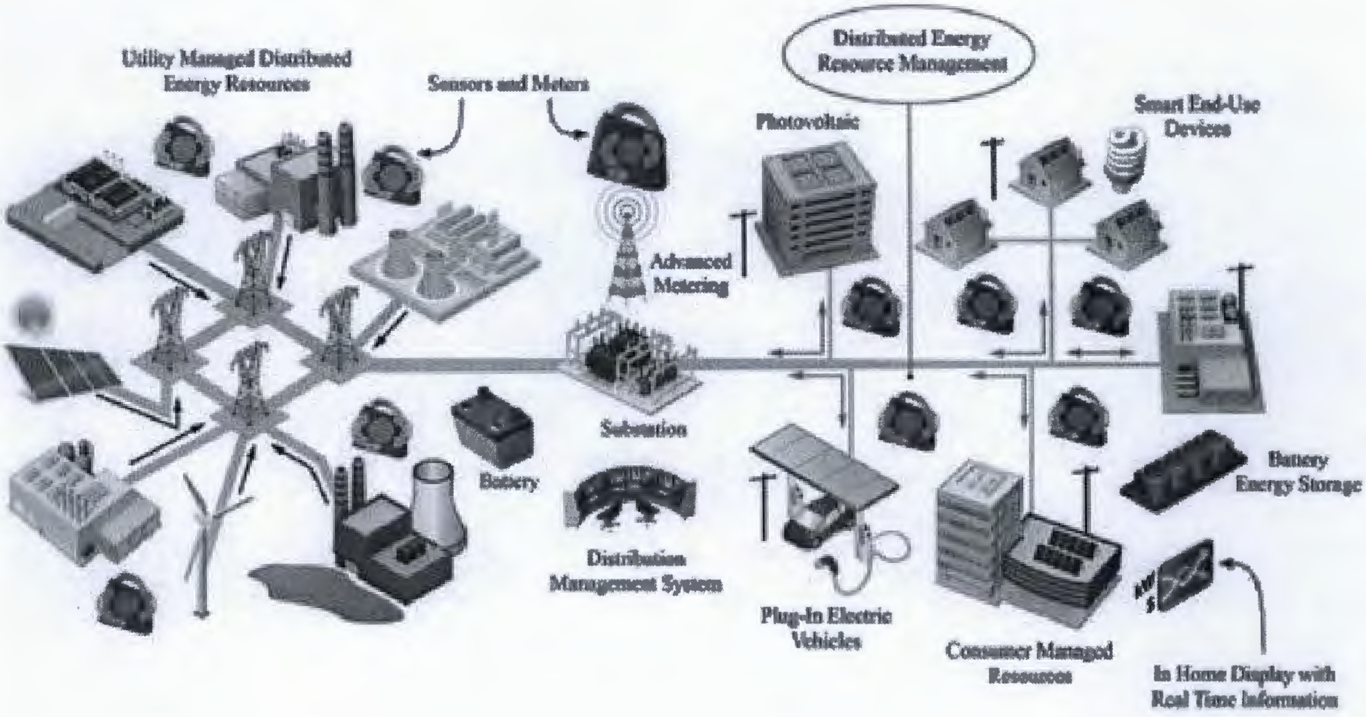


Figure E-14: Tomorrow's power system — the grid of tomorrow enables additional customer-sited clean energy generation and storage, and also provides for two-way communication between customer locations and the utility (EPRI, 2012)[10] can provide resilience through redundancy within the power supply system.

Design a more flexible electric grid to be dynamic and responsive during normal operations and emergencies

The smart grid makes the power system more flexible by employing automatic switching and sectionalizing equipment to reduce the extent and duration of power outages. Such equipment has the capability to automatically redirect power over in-service lines and isolate faulted areas. During Superstorm Sandy, entire neighborhoods were without power. A smart grid with sectionalizing switches and connections to multiple substation supplies would make it possible to restore portions of the neighborhood by using the switches to change power sources. The PSC and utilities should work to incorporate additional automatic switching and sectionalizing of equipment across the grid.

Smart grid technologies should also be used to enable better intelligence regarding the status and availability of electric system equipment, which would improve utility response to equipment and customer outages.

The smart grid includes the following major components:

1. **Distribution Management System (DMS)** – a decision support system for utilities to assist control room and field operating personnel to monitor, control, and optimize the electric distribution system without compromising safety and assets. For example, a modern DMS would enable the utility to identify the precise location of a faulted piece of equipment and mobilize a repair team more quickly to restore service. With many of the DMSs in place today the utility is unable to determine if individual customers are without service unless the outages are caused by a large-scale failure. A modern DMS can be used to provide the utility improved awareness of customer outages, facilitating faster response and restoration.

2. **Distribution Supervisory Control and Data Acquisition (D-SCADA)** – collects and reports voltage levels, current demand, equipment state, operational state, and event logging allowing operators to remotely control capacitor banks, breakers and voltage regulation. For example, the utility can control power flow over its system to prevent overloads before occurring, and in some case remotely correct issues to maintain service.

3. **Automated Metering Infrastructure (AMI) and Meter Data Management** – allows two way communication with smart meters, customer and operational data-bases, and provides customers with the ability to reduce electricity bills by using electricity more efficiently and at selected times when it is cheaper by participating in Demand Response Programs. This will facilitate customers who choose appliances, heating systems, and other technologies that can be programmed to operate based on electricity prices. Additionally, coupled with a Distribution Management System, the increased deployment of smart meters will assist utilities in determining which customers have lost service and inform restoration strategies.

4. **Distributed Energy Resource Management (DERM)** – coordinates with the dispatch of central power stations and the distribution management system to schedule more efficiently demand response and distributed energy resources (distribution-side generation, energy storage, and demand response technologies). Coordinating the timing and need for distributed generation and demand response resources (e.g., during peak demand periods or system outages) increases the value of these resources for end users.

Certain New York utilities are already implementing variations of these systems in their service territories. For example, utilities have been and continue to incorporate distribution automation devices (reclosers, sectionalizers, looping schemes, etc.) on their electrical system to help make the system smarter and responsive to issues and failures, but barriers including cost and customer acceptance of new technologies have been barriers to woider deployment. Each utility will have unique needs and opportunities to deploy smart grid technologies. To encourage greater deployment of these technologies, the PSC should factor in resiliency benefits in cost justifications.

In addition, the PSC, NYPA, NYSERDA, and others should continue to support investments in smart grid technologies such as those called for in the Energy Highway Blueprint. These include the following:

- advancing the Smart Grid in New York by funding demonstration projects, developing an Advanced Energy Management System Control Center and pursuing federal energy research grants;
- ensuring electric utility capital expenditure plans that include cost-effective smart grid technologies; and
- evaluating polices to encourage technological and commercial innovation in New York State to accelerate deployment of new technologies and capitalize on economic development opportunities.

Increase the deployment of distributed generation and microgrids throughout New York

As noted, distributed generation is customer or neighborhood-scale energy generation, which provides power locally to an individual customer or region in a distributed manner. Distributed generation can defer the need for additional utility transmission and distribution system upgrades while improving owner quality

Con Edison CoolNYC Program (New York City, United States)

This project involves working with building owners and tenants in large apartment buildings throughout New York City to install smart air conditioning controls. The goal of the program is to help residential customers use less energy for air conditioning and provide Con Edison a resource to help maintain high reliability during peak load periods. Con Edison plans to install controls through "modlets" on 10,000 air conditioners. This will result in a 5-MW demand reduction, which is enough to power 5,000 homes. Partnering with ThinkEco, a New York City company, Con Edison installed the modlets in the summer of 2012 on window air conditioning units. There are over six million air conditioning units of this type in New York City, and some of them run unnecessarily when residents are not at home. The modlet is a plug-in smart outlet that a smart air conditioning thermostat can control. Customers are able to remotely turn on or off their air conditioning, set its temperature, and set the schedule, from a smart phone or browser. When needed during peak load periods, Con Edison will alert these customers and adjust the unit's temperature to reduce usage.

National Deployment of Smart Meters (United Kingdom)

The United Kingdom has a two-stage national plan for smart meter deployment.[11] The first stage, which is currently in progress, involves collaboration between the government, the energy industry and the public to determine the best method of installing a smart meter in every home by 2020. This first stage allows all relevant stakeholders to be a part of the decision making process before smart meters are deployed across the entire country. The second stage of the plan encompasses the actual roll-out of the meters after all necessary customer engagement has been completed. The UK's two-stage approach is expected to help improve customer acceptance of smart meters while promoting a better understanding of the technology's benefits.

and reliability. Distributed generation can be based on several technologies, including: solar photovoltaic (PV), small wind, small-scale biomass generation, fuel cell, small hydro or small- to medium-sized gas generation providing both electricity and steam or hot water [referred to as combined heat and power (CHP)]. Energy storage (e.g., batteries) can supplement distributed generation networks to ensure continuous delivery of electricity.

Estimates indicate that developing new power generation facilities closer to high-demand areas can save New York in costs associated with constructing new transmission infrastructure as well as transmission congestion costs. Low-end estimates represent avoided fuel, operation and maintenance costs while high-end estimates also include avoided costs from constructing new power plants and upgrading transmission and distribution systems. Switching from central generation to distributed generation lowers operating costs (and potentially eliminates fuel costs) by providing more efficient energy generation. Generally, there is a trade-off between higher capital expenditures with reduced operating expenditures over time compared to paying for energy over time from a centralized grid.

Although distributed generation systems provide a wide range of benefits, all of these benefits are not captured by existing financial models.[12] Therefore, the avoided costs and added value of these systems are likely to be much higher than current estimates.

Expanding use of natural gas for distributed generation and combined heat and power applications will also improve storm resiliency since the natural gas system often continues to operate during major weather events. Notably, such applications will increase demand on the natural gas system, so the interdependency of these systems needs to be considered and system investments should be planned accordingly.

Microgrids are small-scale distribution systems that link and coordinate multiple distributed energy resources (DERs) into a network serving some or all of the energy needs of users located in close proximity. DERs include distributed generation resources, energy storage technologies, and power system control devices. In a microgrid, such DERs are linked together with multiple local energy users by separate distribution facilities (i.e., wires and pipes) and managed with advanced metering infrastructure, communications, and automated control systems.[13] Microgrids can be configured to operate in tandem with the bulk supply system during normal conditions, but also disconnect and operate as an independent island (i.e., "islanding") in the event of a bulk supply failure or emergency.[14] The microgrid is the natural evolution of distributed resources for areas where conventional power systems do not reliably serve customers or where critical customers need uninterrupted power supply during emergencies. Microgrids can also provide support to conventional power systems that are constrained in meeting demand.

To adopt and integrate microgrids and increase deployment of distributed generation into the current electric system, New York needs to create regulatory and statutory clarity and appropriate incentives. Current regulatory frameworks, laws, and compensation systems do not encourage the widespread deployment of such components (and limit them almost exclusively to campus settings). For example, regulations currently require electricity marketer or public utility status in order to be able to sell electricity to others. Appropriate policy and regulatory mechanisms should be developed by the State and the PSC to incentivize the microgrid investments that will allow expedited development and integration of microgrids. Incentives, such as rate-based cost recovery, should be explored to aid microgrid development. The PSC should create straight-forward protocols for interconnection and cost allocation for microgrids and their components.

Determination of responsible parties for microgrid maintenance and upkeep is also necessary to aid adoption and success of microgrid implementation. Accordingly, the PSC should work with utilities to develop protocols for establishing microgrid ownership to ensure the installations are well maintained.[15]

NYSERDA issued a report in 2010 ("Microgrids: An Assessment of the Value, Opportunities, and Barriers to Deployment in New York State"), which included a roadmap for facilitating microgrids in New York State. The recommendations found in that roadmap should be considered when developing statutory and regulatory changes necessary to integrate microgrids into the State's electric system. The PSC should identify and work to reform local utility policies and practices that hinder the development of clean distributed resources, such as requirements that shut down interconnected distributed resources during outages to prevent back-feeding into the grid. Such requirements are meant to protect utility workers when restoring power, but technology exists to allow the system to continue powering the customer during outages without back-feeding to the grid.

NYSERDA should expand its incentive programs for distributed generation resources, including solar and Combined Heat and Power programs. These programs should give preference to critical facilities

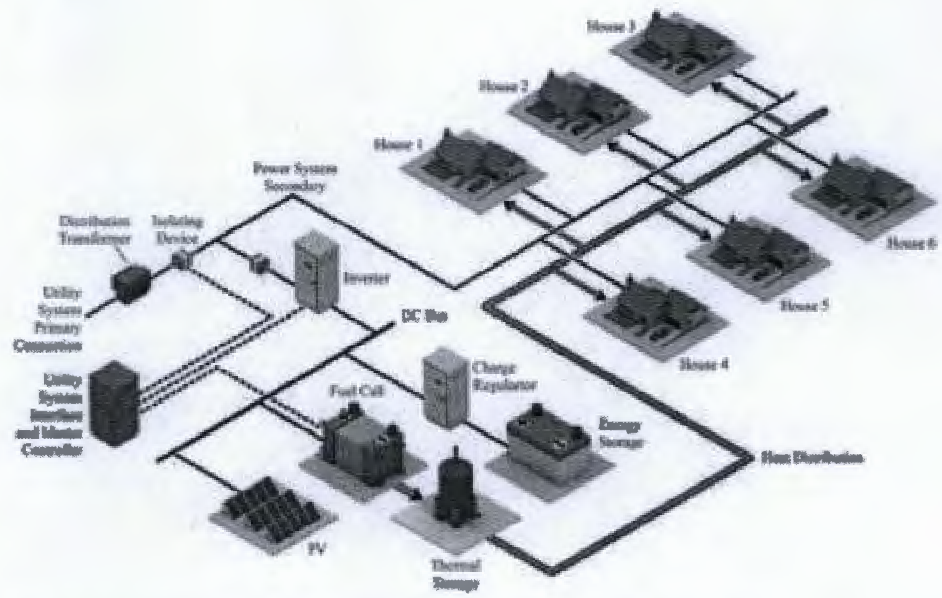


Figure E-15: Community-level microgrid with distributed energy resources (EPRI, 2010)[16]

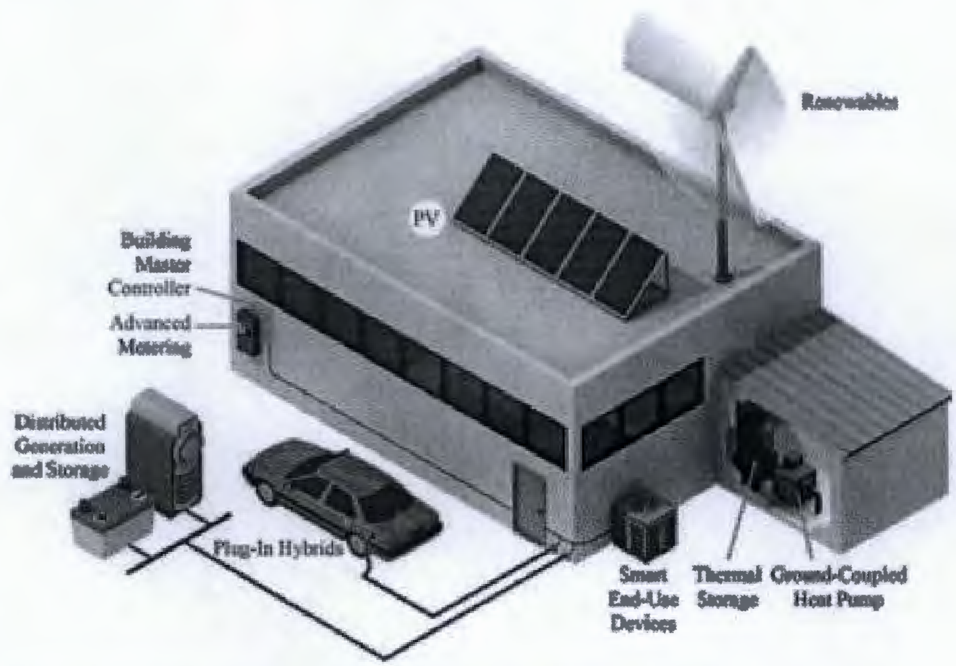


Figure E-16: Building-level microgrid with distributed energy resources (EPRI, 2010)[16]

Drake Landing Solar Community – Solar Hot Water District Energy (Okotoks, Canada)

A new housing development in Okotoks, Alberta, Canada, which started operation in 2007, incorporated a localized district energy system to provide heat to 52 single family homes almost entirely from solar energy. The innovative system stores heat energy captured during the summer in tanks and boreholes underground for use during the winter. A network of underground tubes transfers the captured heat into the surrounding rock and soil, which act as a natural heat storage reservoir. The underground boreholes and tubes are covered with sand, a waterproof membrane and high-density insulation to prevent heat from escaping. The stored heat is then transferred back to the tubes when heat is needed during the cold winter months. Over 90% of the energy used throughout the year comes from solar panels on the houses and garages of the development, decreasing dependence on fossil fuels.[17] Since the system is distributed, with the many components contributing to energy generation, and most of the pipework and tanks underground, it is resilient against weather-related disasters. Although the Drake Landing system is the first in the world to achieve a solar fraction of heating of over 90%, similar community-scale solar energy systems exist in Northern Europe.[18]

Figure E-17: Aerial view of the 52-home Drake Landing Solar Community, 2007 (Natural Resources Canada, 2007. Reproduced with the permission of the Minister of Natural Resources of Canada, 2012)

such as schools, hospitals and municipal buildings that are designated as safe havens during storms. Such facilities should have clean on-site generation designed to operate when the grid goes down. Private facilities, such as big box stores and shopping malls, willing to serve as such sanctuaries, should receive expedited permitting for installing distributed generation systems.

Make the grid electric vehicle ready

Plug-in electric vehicles (PEVs) are battery-powered vehicles that are charged via the electricity grid. According to a recent study by the Rocky Mountain Institute and a number of other partners including the International Energy Agency and C40 cities, New York City is one of the leading cities pursuing electric vehicle integration.[22]

The State (via agencies including the DOT, PSC, NYPA and NYSERDA) and local governments should continue to aid PEV deployment through the promotion of PEV charging installations, consumer incentives and education, and regulatory reform. Electric vehicles provide a benefit to the utility grid when they charge during off-peak times, providing a balancing service. Studies suggest that the integration of smart grid management and electric vehicle energy storage can limit increases in peak electricity loads.[23]

Electric vehicle readiness involves supporting PEV purchases, use, and education through a wide variety of channels. New York State, through NYSERDA, the DOT, and the private sector, should increase its electric vehicle readiness by installing more public and workplace charging stations statewide in areas where PEV users drive. This includes municipal and private parking lots, transit stations and park-and-ride lots, retail and tourist destinations, major travel corridors,

New York University Natural Gas Combined Heat and Power Plant (New York City, United States)

Distributed generation can function well even in the heart of bustling Manhattan. During Superstorm Sandy, when the electricity from Con Edison's distribution network failed, the cogeneration plant installed at New York University (NYU) in 2010 began running full-throttle in "island-mode". Although normally connected to the grid to export and import electricity when needed, the plant switched to microgrid operation. The plant burns natural gas in combined cycle gas turbines to produce both electricity (13.4 MW) and heat. The entire process operates at almost 90% efficiency, compared to 30% to 60% for traditional centralized fossil fuel power plants. Steam is even used to drive a chiller to produce cold air in the summer. Although the system does not cover the entire campus, it was able to keep the larger buildings and core of the Washington Square campus heated and powered throughout the storm and in the weeks that followed, while surrounding buildings were cold and dark. Since the natural gas infrastructure was well-protected during the storm, this system didn't suffer the same fate as Con Edison's steam and electricity distribution networks. As an additional benefit, the carbon dioxide output of the system is 23% smaller than that of NYU's previous system. The cost of the system was $125 million, with utility savings of $5-8 million per year. The cost-benefit analysis favored this system compared with decommissioning the existing district energy plant and using electricity and steam from Con Edison.[19,20,21]

Other cogeneration facilities were also able to keep the lights on during the hurricane using microgrids, such as Co-Op City (the largest cooperative housing development in the world), Princeton University, and One Penn Plaza.

and workplaces of all sizes, including state government lots.

Operational costs can be stabilized by transitioning drivers and fleet owners away from the volatile and escalating price of gasoline and diesel toward the relatively more stable costs of grid electricity. With time-of-use rates, PEVs can charge using lower cost off-peak electricity. In addition, if power is lost, distributed generation (recommended above) could help fuel PEVs. Fleet owners, who put many miles on their vehicles and can afford higher upfront costs in exchange for lower operating costs, will find the technology attractive today. This is especially true for state government agencies and local municipalities with long-term outlooks on operational costs

Electric vehicle deployment could be accelerated with expanded public charging stations, including fast charging capabilities (current technology can provide an 80% charge within 30 minutes). In addition, some fleets of government or commercial vehicles could benefit from technologies such as battery "swapping", which is a business model to replace the battery rather than recharging it, which can significantly reduce "recharging" time (such a model has been embraced by Renault in some European markets).

The Commission recommends prompting electric vehicle readiness by:

- Promoting PEV deployment by conducting a PSC proceeding to address PEV barriers to more rapid consumer and government agency adoption. Electricity distribution investments needed to support increased use of vehicles should also be addressed.
- Promoting State-sponsored investments (NYPA, NYSDOT, NYSERDA, etc.) in public charging stations. Deployment of charging stations powered by distributed generation with pricing that incentivizes the use of clean and off-peak energy should also be considered.[d]
- Requiring NYSDOT, utilities and vendors to collaborate and map PEV charging stations, and centrally track perational status in 2013.
- At the local level, streamlining permitting for charging stations and introducing updates to zoning and parking ordinances and building codes that encourage charging station installations and use in 2013.
- Developing State-led general public education campaign, supported by utilities and auto manufacturers, to increase consumer understanding of PEVs and the benefits they provide.
- Investing in vehicle-to-grid technology R&D to accelerate deployment.[e]
- Leveraging Public Private Partnerships (PPP) that expand state incentives for charging stations.

[d] Solar array covered parking lots could provide the electricity for the vehicles and provide shading to the vehicles during summer months, increasing vehicle efficiency from reduced cooling loads

[e] PEV applications can also provide a reverse flow power capability such as vehicle-to-grid (dis), however there are elements of these systems such as battery durability, utility/automotive/consumer acceptance, and economics that have yet to be demonstrated. V2G, therefore, remains an R&D and pilot project agenda.

FedEx Delivery Vehicle Pilot (New York City, United States)

A FedEx package distribution center in lower Manhattan started operating a pilot using ten electric delivery vehicles in Spring of 2012.[24] The pilot is a collaboration between Columbia University, General Electric and FedEx to explore convenient and cost-effective mechanisms to charge the vehicles. Putting a large amount of electric vehicles on the grid at once generates a fundamental shift in transport energy from liquid fuels to electricity. FedEx has a 500-vehicle fleet in New York City, and shifting one-third of its fleet to electric trucks would require a megawatt of generating capacity.[25] The pilot project is developing software to prevent the peak load draw during charging from spiking by providing each vehicle with the appropriate amount of energy in the evening to run the delivery route the next morning.

Electric vehicles are good workhorses for the urban delivery industry since they make frequent stops allowing for recapturing braking energy, cover short, predictable routes within the range of the batteries, and can be recharged overnight at distribution facilities. There is a potential for air pollution reductions in cities by removing a large source of diesel emissions from vehicles. The shift to much quieter electric vehicles also reduces noise pollution.

Figure E-18: FedEx electric delivery vehicle (FedEx, 2012)

Smith Electric Vehicles (Bronx, New York)

Smith Electric Vehicles, a leader in zero-emission, all-electric commercial vehicles, is establishing an electric truck assembly plant in the South Bronx, adding 100 jobs to the region. Working with bus fabricator Trans Tech of Warwick, NY, Smith will also be producing electric school buses. Smith was recruited to New York State based on an incentive package including an industry-wide electric truck incentive program announced by Governor Cuomo that provides up to $20,000 per vehicle to partially defray the incremental costs of an EV over an internal combustion engine. By replacing the average diesel truck of this size with a zero emission alternative, more than 26 tons of GHGs are offset each year per vehicle, along with 2,228 gallons of fuel saved annually. The Smith plant is currently in the later stages of refurbishment expected to begin assembling trucks in 2013.

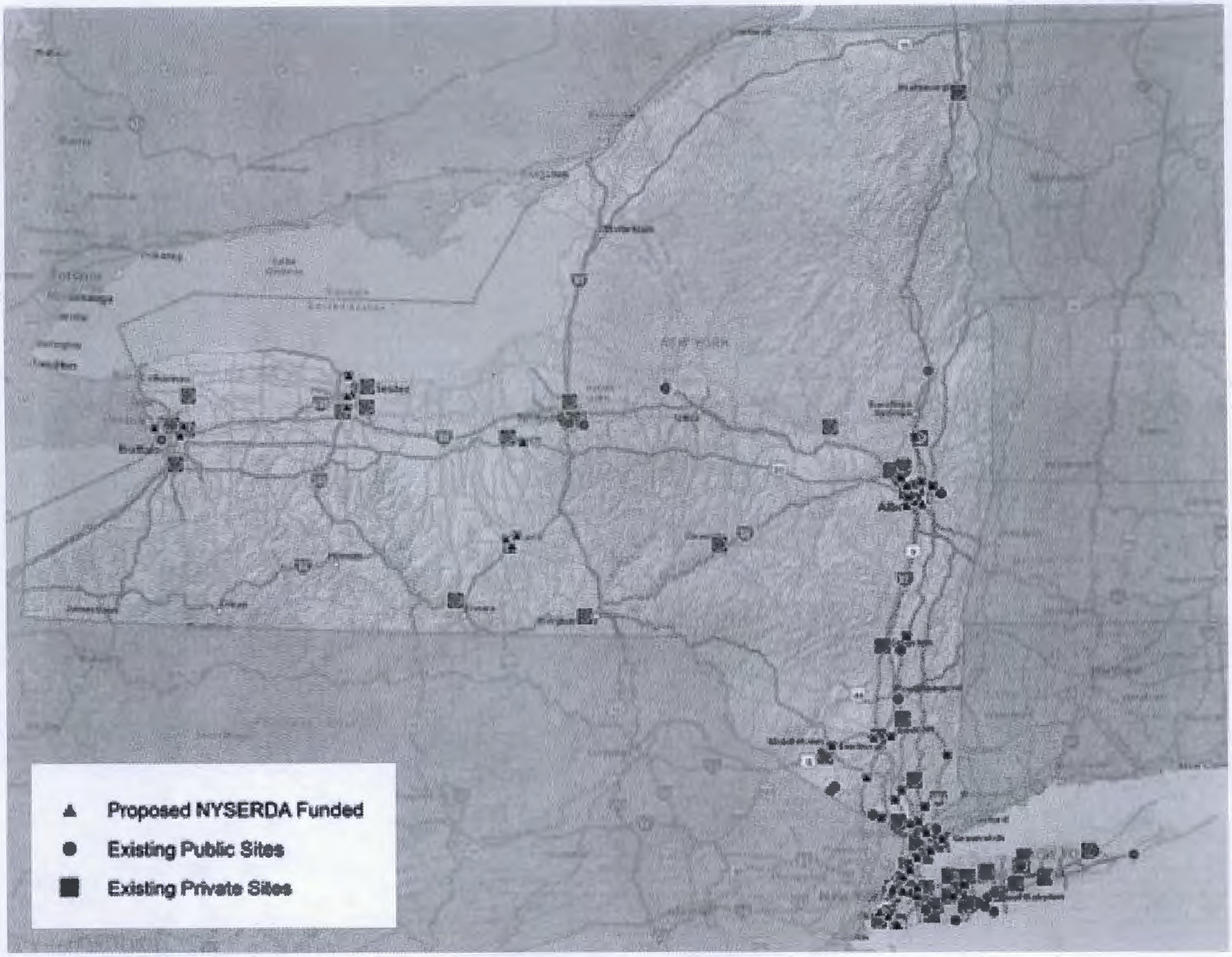


Figure E-19: Existing and proposed electric vehicle charging locations in New York State (NYSERDA, 2012)

Electric Vehicle and the Smart Grid in Denmark (Bornholm, Denmark)

Since 2009, a consortium of research institutions, energy companies and private technology developers has been testing the integration of electric vehicles and smart grid infrastructure in a small city in Denmark.[26] The project aspires to assess the viability of an integrated charging and grid system that uses information and communication technology to control stored energy in vehicle batteries. The system allows stored energy in vehicle batteries to power the grid during times of high demand or when intermittent power generation sources, such as wind, are not actively producing power. Denmark's high proportion of wind power makes it the perfect location to test the feasibility of a vehicle-to-grid system. Furthermore, the project will help support Denmark's long-term objective of having 200,000 electric vehicles on the road.

Design rate structures and create incentives to encourage distributed generation and smart grid investments

The existing energy regulatory framework was designed for large, centrally coordinated systems of generation, transmission and delivery of energy to consumers. There are a number of initiatives that could help support a shift to distributed energy that improve the efficiency of the power system and resilience for the State and benefit both providers and customers.

Price energy markets to all customers in real-time to maximize grid efficiency and enhance resilience

The electricity system is built to meet peak demand. This means that some of the infrastructure is only utilized for a relatively small number of hours each year. To meet higher demand for electricity at peak periods, higher-cost power generation units come online causing the wholesale price of electricity to vary with demand in real time. The vast majority of residential and small commercial electricity customers are informed of the price of electricity only upon receipt of a monthly bill.

Employing a utility rate plan based on prices that vary by time-of-use, and reflects the actual cost of energy in near real-time, coupled with advanced metering could improve electric system efficiency by reducing peak demand. Under this rate design, consumers can shift loads to periods of low demand and pay a lower price for electricity — this could provide system-wide leveling of demand and reduce the need for additional infrastructure to meet what would otherwise be higher peak demand. The PSC should work with utilities to develop these market mechanisms to help make the grid more efficient by allocating/distributing resources to where they are needed most.

Real-time pricing and the advanced metering necessary to support it need to be demonstrated (perhaps with several demonstration projects) and carefully explained to the rate payer, as well as made user friendly, so that they understand how and where these savings are generated and are thus motivated to support their use. Due consideration should be given to the practical hardships and difficulties related to implementing time-of-use rates for certain residential customers (e.g., elderly or disabled customers unable to shift load), and all possible means taken to mitigate any such hardship, such as including tiered rate structures for residential customers that do not penalize lower income citizens and those who use less electricity. Real-time pricing and the advanced metering to create it need to be explained to rate payers so that they understand how these savings are generated.

The Commission recommends the State consider requiring electricity to be priced to reflect the real-time cost, including exploring tiered pricing structures for residential and smaller commercial customers.[f] This will require a statutory change to eliminate the current prohibition of mandated real-time rates to residential customers.

Such pricing mechanisms will help make the grid more efficient by sending the economic signals that result in allocating and distributing resources to where they are needed most.

[f] This will also require digital metering equipment

Energy Storage Innovation (New York, United States)

The US Advanced Battery Consortium (USABC) is a research and development partnership of the major US automakers, EPRI and electric utilities to develop electrochemical energy storage technologies that support commercialization of fuel cell, hybrid, and electric vehicles. The Consortium's long-term goal to enable electric vehicles with energy storage systems costing $100/kWh, which is approximately 20 to 25% of current cost. At this level, electric vehicles would be less expensive to purchase and operate than internal combustion vehicles enabling large-scale deployment. Electric vehicles would also produce fewer emissions than internal combustion vehicles, even based on the nation's current power generation mix which includes significant amounts of coal. New battery chemistries continue to be developed for electrified transportation including advanced lithium-ion and sodium-metal halide batteries. Further improvements in energy density, power, cycle life, and cost will continue for existing technologies while new chemistries such as metal-air batteries will continue to be developed.

Similar benefits can be provided to the electric grid through medium and heavy-duty transportation storage, such as electrified delivery trucks and electrified rail. Energy storage options for distributed energy storage at customer locations and at the transmission and distribution level also include electrochemical systems, fuel cells with hydrogen storage, thermal storage, kinetic storage such as flywheels, and hydroelectric storage. New York academia, industry and government are seeking to capitalize on these benefits through the work of the New York Battery and Energy Storage Technology (NY BEST) Consortium.