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HIGHLAND PARK
SOLAR ISLANDING PROJECT

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Prepared for the Borough of Highland Park, NJ by:

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Executive Summary

Superstorm Sandy deprived thousands of Highland Park, NJ residents of electric power for up to two weeks following the event, highlighting the need for community meeting places that can function independently of the grid. Existing grid-connected solar arrays like those on Borough Hall do not have that capability. Solar arrays outfitted with battery storage and islanding inverters can be expected to provide emergency "power islands" during times of storm or other grid outage. However, the existing solar arrays in Highland Park if converted to solar power islands would be able to provide only modest emergency power. This forces planners to place strict limits on what should be powered during any emergency situation. Moreover, the energy available during the day and night for these or other future systems depends dramatically on the season and the system engineering specifications. It is therefore likely that a conventional backup generator powered by gasoline, diesel fuel, or natural gas will still be needed for certain hours of the day to be prepared for emergencies that could happen any time of the year. For these reasons, solar islanding should be considered as one of several strategies aimed at increasing community resiliency.

This report analyzes the power demands and associated functions that could be sustained by three existing solar installations in Highland Park, if they were converted into solar power islands. It does so through the establishment of a template for estimating critical versus non critical loads, on the demand side, in the context of available solar power supply. This results in a replicable basis for prioritizing which electrical services will be served by solar islanding projects, in Highland Park and beyond. Whereas each of the three sites surveyed could support basic cell phone charging and offer a dry, partially lit, space in which to shelter, their ability to provide full lighting, cooking and especially heating, ventilating and air-conditioning is more constrained, given the more energy intensive requirements of some of these systems. Also, these buildings are differently endowed in terms of their electrical and mechanical services, basic layout, daylighting attributes and also locations. The case study analysis addresses these differences and makes attendant recommendations for existing and future site improvements that would benefit sheltering functionality.

In turn, this analysis helps to guide designs of emergency operations plans. While it would be premature to include solar islanding functions in the Emergency Operations Plan for Highland Park, given that these capabilities do not currently exist, we provide in the Recommendations section generic language consistent with the federal NIMS (National Incident Management System) standard for adoption by other municipalities who may already have solar islands and/or for Highland Park in the future.

Additional recommendations that are specific to Highland Park include the following:

- Future sites for consideration of solar+battery installations;
- Select re-wiring projects for existing locations with solar capabilities that could enhance their sheltering functionality by isolating critical loads such as lighting, cooking, and phone charging so that they can be served by the solar+battery system;
- Consideration given to procurement of gas-fired kitchen appliances (e.g., stoves, refrigerators/freezers) rather than electric in order to support sheltering functions during grid-based emergencies;
- Continued preference for green building strategies in new buildings or large-scale renovations that might serve as shelters, especially daylighting;
- Distribution to residents of English and Spanish versions of educational material on power outage preparation; and
- Participation in any of three funding programs (PSEG Solar-for-all-Extension, Round 2; NJBPU-Renewable Electric Storage, Round 2, NJ Energy Resilience Bank) to facilitate solar islands in Highland Park.

The Recommendations section of the report further profiles the funding/assistance programs in relation to the three specific case-study locations, and includes some basic cost estimation data.

Introduction

Superstorm Sandy affected Highland Park and many other places following its landfall on October 29, 2012. Among the most severe impacts for Highland Park residents were electric power outages lasting up to two weeks for portions of the municipality. This experience highlighted a need to prepare better for similar situations in the future.

The top priority for municipal government in this arena has been to ensure that first responders (fire, police, EMT) have reliable backup electric power supplies so that critical operations can continue during power outages. Highland Park's new police station, which also houses the Borough's emergency operations center, is well equipped with a backup electricity generator and fuel source on site.

The next priority is to equip a set of community gathering spaces with the capability to support basic functions for community residents whose homes have lost power or are otherwise uninhabitable. Needed are sheltered spaces where residents can rest comfortably, charge their phones, and have access to basic heating and cooking facilities enabled by resilient sources of electric power.

Solar photovoltaic electricity generation is emerging as an important technology that improves sustainability by avoiding the use of fossil fuels, while also potentially improving resilience by providing a local, independent source of electric power. However, most current solar electric systems are connected to the utility grid so that when the large-scale electric power system goes down, it takes the small, local solar systems with it. Configuring solar electricity generation systems to operate independently of the grid requires investments in electronics, switching, and battery storage in order to allow successful islanding to take place. Highland Park has several large solar arrays but they are not configured to operate in a stand-alone, islanding mode. There is an opportunity to do better.

The vision that the town should create solar-powered islands of resilience to harbor community residents during prolonged power outages has led to this report. This effort was funded by Sustainable Jersey and has been carried out by the Rutgers Center for Green Building under the supervision of Sustainable Highland Park.

This report summarizes what was learned from a survey of existing solar facilities and community gathering points (current and potential), and an analysis of likely electricity requirements under emergency conditions at the community gathering points. The report evaluates the potential benefits of distinguishing between critical and non-critical loads when planning islands of resilience, and makes recommendations regarding potential islanding sites and basic system designs. It also identifies opportunities to pursue external funding to implement these recommendations; identifies user-friendly public education materials; and develops suggestions for amending emergency management plans. Some of this information is likely to be

helpful to other municipalities interested in replicating Highland Park's "islands of resilience" strategy.

Solar Arrays in Highland Park

Existing Systems

As of 2015, there are only a dozen solar systems scattered atop the roofs of Highland Park's 3000-plus residential and commercial buildings. More visible are the ubiquitous pole-top solar panels installed by Petra Solar for PSE&G on hundreds of utility poles throughout the Borough. The greatest solar presence after utility poles is on or near institutional buildings, including Borough Hall, the Fire Station, and the Reformed Church. These three sites represent opportunities to pursue cost-effective solar islanding capabilities because the solar systems are already in place. Table 1 summarizes their capabilities.

Solar Installation	Peak Generating Capacity (kW)	Location
Borough Hall	6	Roof
Fire Station	28	Parking Canopy
Reformed Church	13	Roof

Table 1: Existing Solar Installations on/near Institutional Buildings in Highland Park

Potential Future Solar Arrays

Several parcels owned by the Borough and the School District could be good candidates for future solar installations, either on roofs or parking lots. The Highland Park Library and the 6th Avenue parking lot nearby could host solar systems. The Senior/Youth Center is an additional possibility. The municipal parking lot on Raritan Avenue between 2nd and 3rd Avenues on the south side of the Borough could host a parking canopy solar array; however since it lies in the redevelopment zone any installation would have to be coordinated with the redevelopment process. While this might add some procedural complexity, a solar array on this site would also increase the site's value, which could prove to be an advantage in future redevelopment negotiations. Several of the schools could host solar systems too, and this was studied in the early 2000's when the bond issue for refurbishing those facilities was proposed. Irving and Bartle Schools could probably host relatively small arrays on their roofs. The High School/Middle School could potentially host a much larger system on its roof and parking lots.

Community Gathering Points in Highland Park

According to the U.S. Census Bureau (2014), Highland Park has 14,136 residents living in 5,705 households, of which 2,339 are detached single-family homes. Some 9.3% of residents are 65 years of age or older and 25.2% of residents are aged 18 or younger. About 59% of occupied

housing units are rentals, with the remainder owner occupied. All housing units are connected to the electric power network. For heat, 73% rely on natural gas, 13% on oil, and 12% on electricity. Based on these and other factors – such as availability of a backup generator, health status -- residents' vulnerability to grid outages vary.

During and after Superstorm Sandy, residents who lost electric power went to luckier neighbors who still had power or backup generators, or to community gathering places that were powered or which retained non electrical services in order to warm up, have a hot meal, and charge their phones. For example, the Reformed Church hosted dozens of people overnight on cots in their community room, and used their institutional kitchen to feed people. Even though the building itself had lost power, the stoves and plumbing facilities still worked.

Potential public gathering spaces in town should fulfill a set of conditions making them conducive for use in any outage scenario. Key criteria for choosing such a space might include:

- History of use as a gathering place during the Sandy or other emergency situation
- Capacity to host residents in large rooms within portions of the site
- Emergency use of this space at the site does not severely conflict with normal use
- Capability to support critical functions (shelter, light, heat, cooking, phone recharging) at this site
- Potential for rewiring electrical circuits to isolate critical loads such as lighting, cooking, and phone charging so that they can be served by the solar+battery system
- Gathering spaces are airy and well lit by sunlight during the day
- Ease of street access by residents, parking availability, and walkable location

These conditions were considered in the choice of case studies presented subsequently in this report.

Figure 1: Some potential community gathering places in Highland Park Borough

Several municipal buildings, most of the schools, and several houses of worship would qualify as community gathering places under these criteria. The Borough is a small enough area that most residents are within a 10-minute walk of several potential locations. To illustrate the potential for transforming some of these gathering places into islands of resilience, we selected three locations with different ownership as case studies:

1. High School/Middle School (School District owned)
2. Reformed Church (non-profit owned)
3. Senior/Youth Center (Borough owned)

Each of these three sites is within about one-half mile of the center of the town. Figure 1 shows the 5-minute (in green) and 10-minute (in yellow) walking radii around each of the three sites, confirming that most residents could conveniently reach at least one of these sites. A plan to serve all neighborhoods with equal convenience would require additional sites, such as Irving School to serve the Triangle, and an unspecified site to serve residents on the north-side of the railroad tracks. However, the objective of this study is to illustrate the potential of different types of sites rather than become a comprehensive guide for the entire town.

Each of the three sites has a different type of owner and during the course of planning and implementation, it is expected that there may be challenges in trying to align the objectives of

this initiative with the original purposes of these facilities. Each site will have different stakeholders and different funding and financing opportunities. Further details on each case study site follow after the discussion of how to determine critical electrical loads.

Critical Electrical Loads to Be Served by Solar Systems

Reliable and efficient provision of emergency backup power requires an accurate balancing of electricity supply and demand. The supply side of emergency power provision by islanding has developed a set of standard industry practices. However, the demand side of islanding has less standardized methods and should reflect local priorities. One purpose of the case studies is to help develop a template for determining those priorities. The intent is to develop a replicable basis for prioritizing which electrical services will be served by solar islanding projects in Highland Park and beyond.

FEMA (2015) provides some guidance based on the International Construction Code (ICC) for hurricane safe rooms, noting that:

> *"ICC 500 requires the standby electrical system to have sufficient capacity to power all the required critical support systems and circuits at the same time continuously for a minimum of 24 hours. For hurricane community safe rooms, the local building code may require standby power for both lighting and ventilation."*

The federal guidance goes on to discuss the importance of providing standby power for life safety systems in hospitals and residential care facilities. However, for regular community shelters, the guidance remains highly contextual and subject to local building codes and definitions of what is locally "critical."

An end-use approach to critical loads is helpful (Andrews 1992). People do not consume electricity directly. Instead, they rely on electricity for end-use services including lighting, thermal comfort, telecommunications, food preparation, hygiene, and activities related to work and recreation. When thinking about which of these many services is critical, it is important to ask several questions.

- Is it feasible to postpone delivery of this end use for a few hours, or must it be continuously available?
- Are there any affordable and convenient substitutes for this end use?
- Are the consequences of going without this end use significant in terms of human health or economic costs, or are they minimal?

Thus, watching television is not a critical end use, because it is easy to postpone TV watching to a different time or day, there are plenty of alternative ways to entertain ourselves such as talking or reading, and forgoing TV will not risk death or financial hardship. Providing a basic level of lighting at night, by contrast, is not postpone-able because people moving in darkness might hurt

themselves, although candles or, preferably, flashlights might be an adequate short-term substitute.

Community gathering spaces have a smaller range of electricity end uses than homes. People do not expect to live in them full-time and hence will not necessarily need to shower, wash clothes, perform work, or entertain themselves. Typically such gathering spaces provide light, heat and ventilation, access to telecommunications, and possibly nourishment. In some Jersey Shore communities that were flooded out during Sandy in 2012, the strain of continuing to live in community spaces day after day took a significant psychological toll, and eventually victims moved on to live with family members or in rental properties elsewhere. Thus, a significant consideration when estimating the critical electricity loads in a facility is the targeted disaster scenario: a 4-hour outage, 8-hour outage, 12-hour outage, 24-hour outage, week-long outage, or longer. The mix of end uses to be satisfied varies accordingly.

Most of Highland Park is not vulnerable to flooding, hence most residential structures will be at least minimally functional during a disaster, and the urban location means that substitutes such as laundromats, motels, and restaurants are often just a short drive away. This reduces the electricity requirements for community shelters in the Borough. Only a few people are likely to need long-term shelter.

Calculating the critical electricity loads in a building requires (1) identification of the critical end uses, (2) determination of the typical rate of power consumption for each end use (measured in watts), and (3) estimation of the number of hours per day it operates (measured in hours). Multiplying the watts and hours together yields watt-hours (1,000 of these is a kilowatt-hour) of energy consumption per day for that end use, summing across end uses yields the amount of electrical energy that the solar system or backup generator must supply. The Appendix lists typical electricity consumption rates of various appliances and end uses.

Three case studies illustrate how to apply the critical loads concept and develop estimates of minimally acceptable energy supply from solar systems and backup generators. The cases specify end uses and estimates of how many kilowatt-hours (kWh) would be needed in the event of an outage. Such a demand analysis helps municipal bodies and citizens to understand the realistic requirements in the case of an emergency and encourage the use of existing solar infrastructure to meet these needs. Rigorous demand analysis of electrical end uses might also discourage the use of diesel generators, which are often oversized relative to actual needs. Again, in an area with the characteristics of Highland Park, substitutes are readily available. For each site, it will be necessary to assess the availability of space for battery storage, prioritize which power end uses should be served, determine the feasibility of rewiring accordingly, and confirm that it is feasible to provide public access.

Case Studies

The case studies include the High School/Middle School, which does not currently have a solar array, the Reformed Church, which does, and the Senior/Youth Center, which has two municipally controlled solar arrays nearby. The following is based on field visits, interviews with facility managers, and document review.

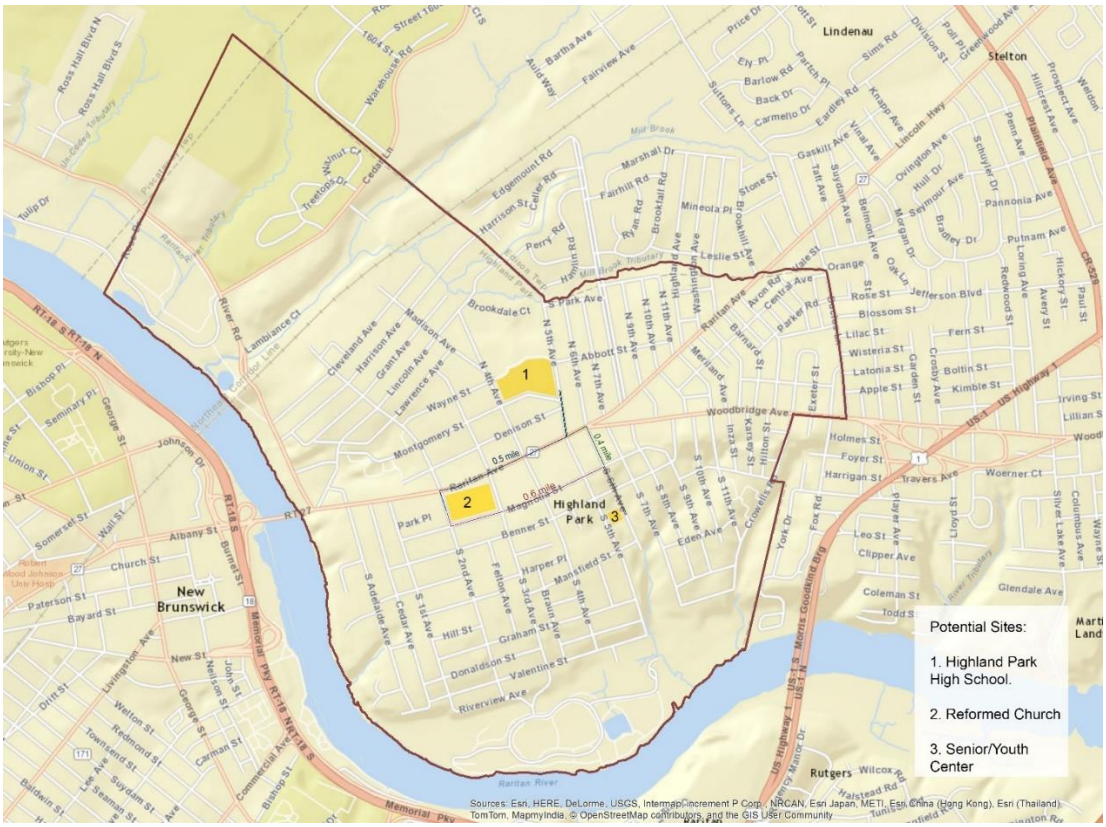

Figure 2: Case Study Sites in Highland Park Borough

Location	Nominal Peak Array Rating[1]	Comments
1. High School/Middle School	None	The Google map image illustrates the potential locations for adding solar to this site. It has to be recognized that this is a relatively dense city location with not much reserve school land. Building roof and parking lot canopy structures are each possible options, but it would probably be hard to get more than 100 kW at this site.
2. Reformed Church	12.8 kW DC	126 panels X 102 Watts. There was a fault indication during the site visit though the unit *was* generating power at a moderate level.[2]
3. Senior/Youth Center	None	Borough Hall is directly adjacent and the Fire Station array is across the street. This roof is flat and relatively clear of HVAC obstacles so might potentially enable circa 13kW solar installation.
(Borough Hall)	6 kW DC	36 panels X 167 Watts. These seem in good condition and were delivering power as would be expected.
(Fire Station)	28 kW DC (estimated)	Individual module rating not known. Not able to climb up to see the rating stickers. They have 119 modules with circa 240W per module. There was a fault indication during the site visit.

Table 2: Highland Park Case Studies

[1] This value gives the output power of a solar module under full solar radiation. Solar radiation of 1,000 watts per square meter is used to define standard conditions. See, IEC 61215, IEC 61646 and UL 1703.
[2] The fault could indicate a problem with a given panel (which would decrease overall output) or another problem.

Highland Park High School & Middle School

Address: 102 N 5th Ave, Highland Park, NJ 08904.

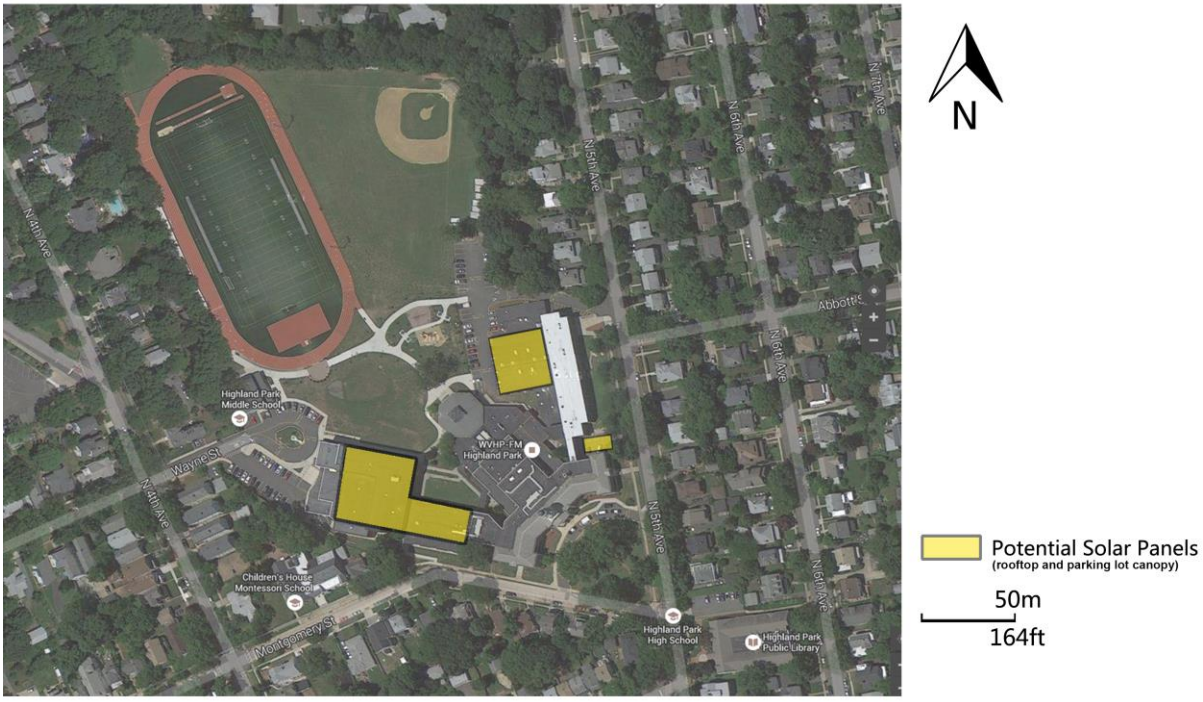

Figure 3: High School / Middle School Site

The High School and the Middle School buildings are internally connected to each other and there is a cafeteria inside each of these buildings. A field visit (5/14/15, 1:00 pm, partly sunny) indicated that there are 3 potential gathering places within these two buildings:

I. High School cafeteria
II. Middle School cafeteria
III. Gymnasium.

Each of these three spaces have direct doors to the outside and so access during school hours would not be an issue for displaced community residents (though it might be imagined that an outage large enough to displace citizens might also interrupt regular school schedules). The two cafeterias are large and roomy with lots of windows and ample natural light. There is a Home Economics Room that serves the Middle and High School and could also be used for emergencies as well. It has 12 gas stoves and sinks.

Figure 4: Highland Park High School Entrance

The octagonal-shaped High School cafeteria (shown below) seems best equipped to serve as an emergency gathering place. It is rated with a safe occupancy of 372, though in emergencies it would be hard to imagine turning citizens away. It has an attached full-featured kitchen with natural gas-fired stoves & ovens, and electric dishwashers, convection ovens, and mixers. The gymnasium is close by so it could also be called into emergency service.

The Middle School cafeteria is smaller with a maximum capacity of 136 people. It is also good sized, and its kitchen is scaled for proportionately smaller output; it is outfitted with mostly electric reheating & serving facilities.

Figure 5: High School Cafeteria

Figure 6: High School Gymnasium

Heating in the building is provided by natural gas-fired boilers and a hot water system driven by electric circulating pumps, which are likely to be too large to be supplied by any backup generation system. Some notable points:

- Access to bathrooms is from the cafeterias.
- There is plenty of room for sleeping bags or cots in both cafeterias and gymnasiums.
- Showers in the Gym do not work. If this space becomes a designated gathering place then showers should be refurbished.
- The schools were **not used** during Sandy, and it is unclear that residents associated the schools as a gathering place although such a future use certainly could be promoted.

Potential Gathering Space	**Area (in square feet)**
High School	
Gym	9,384
Cafeteria	5,204
Middle School	
Gym	7,325
Cafeteria	2,034

Table 3: Available area in potential gathering spaces

Critical Functions that can be potentially supported on-site:

- Phones / Laptops Charging
- Wi-Fi communication, provided the telecommunications network is up
- Heating Water
- Basic Cooking
- Storing Food
- Restroom facilities

Typical electricity demands for various end uses are available in the literature, which is useful when direct field evidence is unavailable. This study uses Mudie et al (2013) for commercial kitchen equipment, and Energy Use Calculator (2015), Wholesale Solar (2015), and Santa Clara (2015) for other end uses. At the High/Middle School, there is a planned backup diesel generator system to supply emergency lights and a few other vital functions. A complementary strategy would be to install a solar array and battery storage system to provide backup power more sustainably. To illustrate the potential of the solar strategy, we considered the following scenario:

	Function	Load/Appliance Type	Unit Power Rating(W)	No. of Units (n)	Hours of usage	Energy need (kWh)
High School and Middle School	Food/ Nutrition					
	Storing food	Walk-in Refrigerator	0.6 kW		24	14.4
		Walk-in Freezer	1.63 kW		24	39.2
	Cooking	Gas Stove (light burners with matches)	0	2	8	0
		Convection Oven- Garland Master 200	13kW	1	2	26.0
		Commercial Electrical Steamer (AccuTemp S62083D080)	8 kW	1	2	16.0
		Commercial Dishwasher (Electrolux - EUC3IG8)	6.85 kW	1	3	20.6
		Bain Marie (steam table)	3.4 kW	1	8	27.2
	Electronics					
		Phone charging points	7	25	12	2.1
		Laptop charging points	50	15	12	9.0
	HVAC					
		Gas-fired hot water boilers & pumps, plus air handlers & exhaust fans	6 W/sq. ft. typical	5,204 sq.ft.	6	187.3
	Lighting	Fluorescent overhead lights	2 W/sq. ft. typical	5,204 sq.ft.	12	124.9
	Total					466.7

Table 4: Electricity Demand Calculation for High School Cafeteria – hosting 250 people for a 12-hour window.

The numbers in Table 4 illustrate four important points. First, the heating, ventilating and air-conditioning energy requirements are very large. During an emergency, it may not be possible to operate these systems. Second, lighting is a big energy consumer if operated at normal illumination levels all day long. It may be necessary to keep most lights off and rely on daylighting through the windows wherever possible. Third, some of the kitchen equipment is very electricity intensive. It may be necessary to limit kitchen activities to the refrigerator, freezer, and gas-fired cooktops. Finally, charging cellphones and laptops is less of a concern because these devices do not consume much electrical energy. The Technical Details section of this report discusses additional complications related to the timing of electricity demand (day versus night) that further constrain the extent to which critical loads can be served by a solar system.

The school is owned and operated by the Highland Park School District, which is a separate entity from the Municipality. It has construction and operating standards set by the state and federal governments that make it different than borough buildings or those owned by nonprofits. It also has separate bonding authority, revenue-raising authority, and grant opportunities from the municipality. Its highest priority is student health and safety, which means that special arrangements must be made to designate a portion of a school as a community gathering place.

Reformed Church

19-21 S 2nd Ave, Highland Park, NJ 08904

Figure 7: Reformed Church Site

This Church is more than 120 years old and the complex was built in sections over many decades. As a result, the electric system is segmented and should be easy to rewire the circuits to serve critical loads for emergency scenarios.

The complex has a strong record of serving as a as an emergency gathering place and hosted large numbers of displaced community residents during Sandy.

The community room (Social Hall) of the church is equipped with a full kitchen and dozens of portable cots for overnight emergency guests. Its floor area is approximately 5,000 square feet.

A field visit to the Reformed Church (4/29/15, 11:00 am, sunny) confirmed that two rooftop solar arrays serve the church complex, one on the church roof and the other on the attached residence for young woman aging out of foster care. They appear to be 2 x 6,400 W arrays. They have a shared savings program with Sun Farm Network, so that they pay back the $110k investment through their electricity bills over time.

Heating is provided by a natural gas-fired hot water boiler with electric circulating pumps. Domestic hot water is natural gas-fired. Cooking is natural gas-fired. The dishwasher & refrigerators need electricity.

Figure 8: Street Entrance from S. 2nd Ave

Figure 9: Rack mounted solar panels (42 X 102W) atop one of the 3 buildings at the Reformed Church

Figure 10: Gathering space at Reformed Church - Social Hall

	Function	Load/Appliance Type	Unit Power Rating(W)	No. of Units (n)	Hours of usage	Energy need (kWh)
Reformed Church	**Food/ Nutrition**					
	Storing food	Walk-in Refrigerator	0.6 kW		24	14.4
		Walk-in Freezer	1.63 kW		24	39.2
	Cooking	Gas Stove (light burners with matches)	0	2	8	0
		Convection Oven-Garland Master 200	13kW	1	2	26.0
		Commercial Electrical Steamer (AccuTemp S62083D080)	8 kW	1	2	16.0
	Electronics					
		Phone charging points	7	25	12	2.1
		Laptop charging points	50	15	12	9.0
	HVAC					
		Gas-fired hot water boilers & pumps, plus air handlers & exhaust fans	6 W/sq. ft. typical	5,000 sq.ft.	6	180.0
	Lighting					
	(calculated using gathering space area)	Fluorescent overhead lights	2 W/sq. ft. typical	5,000 sq.ft.	12	120.0
	Total Daily Load					406.0

Table 5: Electricity Demand Calculation for Reformed Church Social Hall – 12 hours.

As seen in the High School/Middle School case study, the electricity demand associated with HVAC, lighting, and cooking can be quite high. These uses will probably have to be pared back significantly during an outage situation where the solar system plays the predominant energy supply role. As will be discussed further in the Technical Details section, a reasonable level of electricity demand that could be served will be limited to phone and computer charging, and emergency lighting. Cooking will have to rely chiefly on natural gas fired equipment.

The Reformed Church is owned and operated by a nonprofit religious organization. It is not a part of municipal government or the school district. It raises revenue mostly from donations, and its ability to take on debt is limited. It must meet building codes but it does not need to follow governmental procurement processes and hence can act nimbly when it desires. The church leadership can pursue donations, grants, and third party financing in order to acquire solar islanding capability.

Highland Park Senior / Youth Center

220 S 6th Ave, Highland Park, NJ 08904

Figure 11: Senior/Youth Center Site

Figure 12: Street Entrance from S. 6th Ave

The Senior/Youth Center serves as a meeting place for local senior citizens and has a wide variety of social, recreational, and educational activities daily for the benefit and enjoyment of Highland Park Seniors. It is also located next to the two senior housing apartment complexes.

A field visit to the facility (4/29/15 12:00 pm, sunny) confirms that it is a 1-story building and has ample parking right near its entrance. As one enters the building, there is a large hall on the left that could be a potential community gathering space. It is already being used as a space for communal meals. This large hall is subdivided by electro-mechanical doors and the configuration can be changed as per event or activities conducted here.

The building is heated by a natural gas-fired hot water boiler with electric circulating pumps (2 x 3/4 HP). Domestic hot water is also gas-fired. The kitchen has an electric stove, dishwasher, refrigerator, and microwave oven. It is unlikely to be able to operate without a substantial backup generator because of the electric stove.

Some rewiring is required to allow the Borough Hall & Fire Station solar arrays to serve the Senior-Youth Center. With about (28,560 + 6,012 = 34,572 W) 35 kW peak available, there should be power available to charge cell phones, provide electric light (probably at a reduced level), and perhaps run the heating hot water circulating pumps. Maybe there is enough to operate a microwave oven, but full service food preparation and heating are likely not achievable, depending on the season and weather patterns (as discussed further below).

From interviews with the Senior Community Director, Ms. Kim Perkins, it is understood that the following electrical loads are critical to host any gathering of people comfortably and maintain the status quo of the facility's operations:

	Function	Load/Appliance Type	Unit Power Rating(kW)	No. of Units (n)	Hours of usage	Energy need (kWh)
	Food Storage	Residential Refrigerator (20.5 CF)	0.14	1	24	3.0
	Cooking	Electric Stove (4 heating elements, oven)	4 @ 2.5 kW, 1 @ 5 kW	1	4	60.0
		Coffee Maker	1.5	1	2	3.0
		Microwave	1.1	1	2	2.2
		Dishwasher	1.0	1	2	2.0
	Handicap Entry	Electromechanical sliding doors	1.0	1	1	1.0
	Electronics	Television	0.15	2	12	3.6
		Phone charging points	0.007	25	12	2.1
		Laptop charging points	0.05	15	12	9.0
	Drinking	Water Fountain	0.36	1	6	2.2
	Space Heating	Gas-Fired Hot Water Boiler with 2 @ 0.75 HP circulating pumps to baseboards	1.2	1	12	14.4
	Lighting	Fluorescent lights	2 W/SF	2000 SF	12	48.0
	Total Daily Electricity Usage					150.5

Table 6: Critical Electricity Load Calculation for the Senior/Youth Center

The all-electric kitchen contributes greatly to the electricity load in the Senior/Youth Center. Lighting, and to a lesser extent the relatively simple space heating system also significantly boost electricity demand. If lighting is used mostly at night, and the stove is parsimoniously used, the total electricity demand would drop significantly. This building is smaller than the other case study buildings and the solar arrays serving it (Borough Hall, Fire Station Parking Lot) are larger, so they may be able to supply adequate electricity even in winter.

A field visit to Borough Hall (4/29/15 11:30 am, sunny) confirmed that the rooftop solar array includes 36 panels in 3 circuits of 12 panels each. Panels are Sharp ND167U3 rated at 167 W peak. Each circuit of 12 panels feeds an inverter in the basement mechanical room. (167 W x 12 panels * 3 circuits = 6,012 W peak). Total system output was about 5,400 W on day of site visit. The Sunny Boy monitoring interface in the front lobby of Borough Hall appears to be only hooked up to one of the 3 inverters since it reported a power output level of 1,202 W on the day of our site visit.

A field visit to the Fire Station Solar Array (4/29/15 12:30 pm, sunny) documented that there is a new solar array on a canopy above the parking area. It includes 7 rows of 17 panels each, with each panel rated at about 240 W peak (SolarWorld). These are grouped into 3 circuits serving 3 inverters. Total output is (7 X 17 x 240 = 28,560 W peak). The operator is Green Power Energy (P.O. Box 483, Annandale, NJ 08801, 908-713-9055). On the day of the site visit, none of the 3 inverters was working so no power was being added to the grid.

Figure 13: Borough Hall Solar Array (visible in left of view). Right side of image is the roof of the Senior/Youth Center.

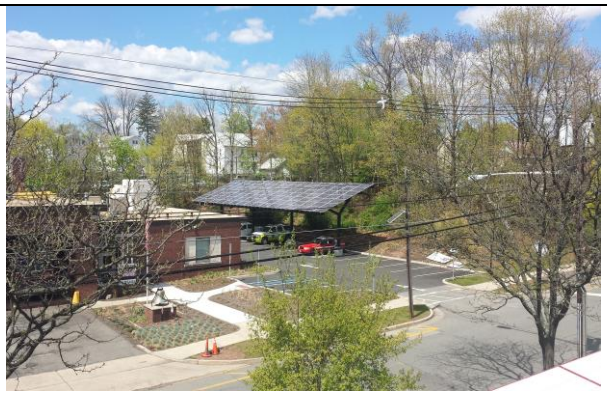

Figure 14: Fire Station Solar Array, across the street from Borough Hall.

The Senior/Youth Center, Borough Hall, and Fire Station Parking Lot are all owned by the Borough of Highland Park. The Borough can incur debt for construction projects, pay for them out of general revenues, or pursue grants. It must follow strict procurement policies. Delivery of electricity from the Fire Station Parking Lot to the Senior/Youth Center requires that a wire cross a public road. Crossing one road is permissible, but if it had to cross two roads then the Borough would probably have to create a municipal utility entity under state law.

Summary of Case Study Findings

Each of the three case studies depicted above has the potential to serve a sheltering function through the addition of a solar islanding capability. Each fulfills at least some of the desirable traits of an emergency shelter in conditions of electrical grid loss noted earlier in this report. However, the needed steps to attain solar islanding status in each case differ as does the complexity involved given different ownership scenarios (municipal, school district, private, faith-based). For example, the electrical system of the Reformed Church is segmented and it should be easy to rewire the circuits to serve critical loads for emergency scenarios, whereas delivery of electricity from the Fire Station Parking Lot to the Senior/Youth Center requires that a wire cross a public road. Whereas the Reformed Church has gas stoves, which can operate independently of the electric grid, the High/Middle School is a mix of gas and electric reheating facilities and the Senior/Youth Center has an all-electric kitchen. The mix of benefits and shortcomings that each case study reveals evidence why it is necessary to conceive of a holistic community sheltering strategy for the Borough of Highland Park, or any other municipality.

As a general finding, heating, ventilating and air-conditioning (HVAC) energy requirements in these (and most other) buildings are very large. During a power emergency, it may not be possible to operate these systems, at least not based solely on a solar+battery power source. Second, lighting is a big energy consumer if operated at normal illumination levels all day long. Therefore, it would be necessary to keep most lights off and rely on daylighting wherever possible. Third, some of the kitchen equipment surveyed is very electricity intensive. It may be necessary to limit kitchen activities to the refrigerator, freezer, and gas-fired cooktops. It would make sense to consider carefully the choice between electric and gas kitchen appliances in these locations and any other ones that might be designated as community shelters in future procurement decisions. Finally, charging cellphones and laptops is less of a concern because these devices do not consume much electrical energy.

An additional finding, pertaining in some measure to each of the three case studies, concerns the operation/maintenance of these solar arrays. There is the potential for operational faults to go undetected or unaddressed for periods of time, potentially resulting in under-performance of the system. If these or future arrays+batteries were to serve as emergency shelters, it would be advisable to institute a close monitoring regime of the systems in order that they are available when needed. This could be accomplished directly, by the owner, or contractually, through a 3rd party vendor. Additional detail on the technical aspects of a solar islanding strategy and the availability of 3rd party financing and operations is giving in the following sections.

Technical Aspects of Solar Islanding Strategy

Solar arrays in New Jersey have mostly been installed with an eye to simplicity (!) and thus to keeping installation costs at a minimum. Current solar arrays in Highland Park are of the type illustrated in Figure 15. The solar array output is used to its fullest, sometimes it is needed to power the house, but when the energy is not needed then it is fed into the local grid.

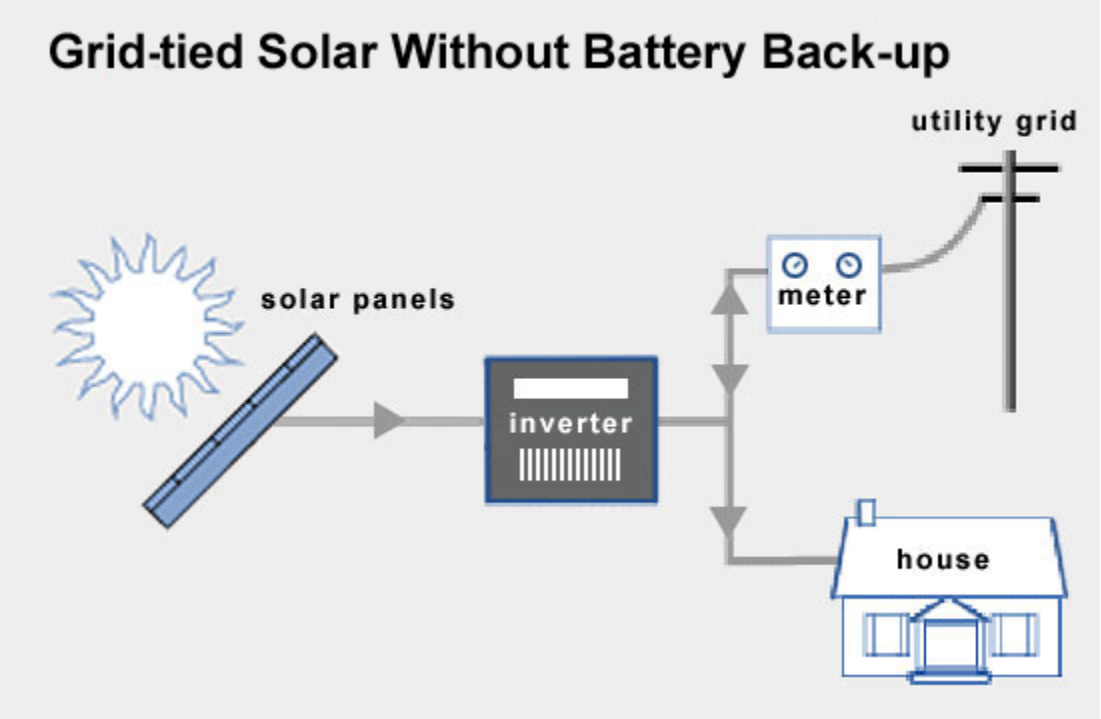

Figure 15: Typical grid-tied solar installation with net-metering and providing residential power (source: solarbizuli.com/images/grid-tie-system.gif). No battery storage is included and most inverters do not provide islanding capability.

Desired systems that would have more resilience value for Highland Park would be Grid-tied solar system with added islanding capability. One variant of such a system is shown in Figure 16. These systems have significantly higher complexity, but provide local power when the grid is otherwise interrupted.

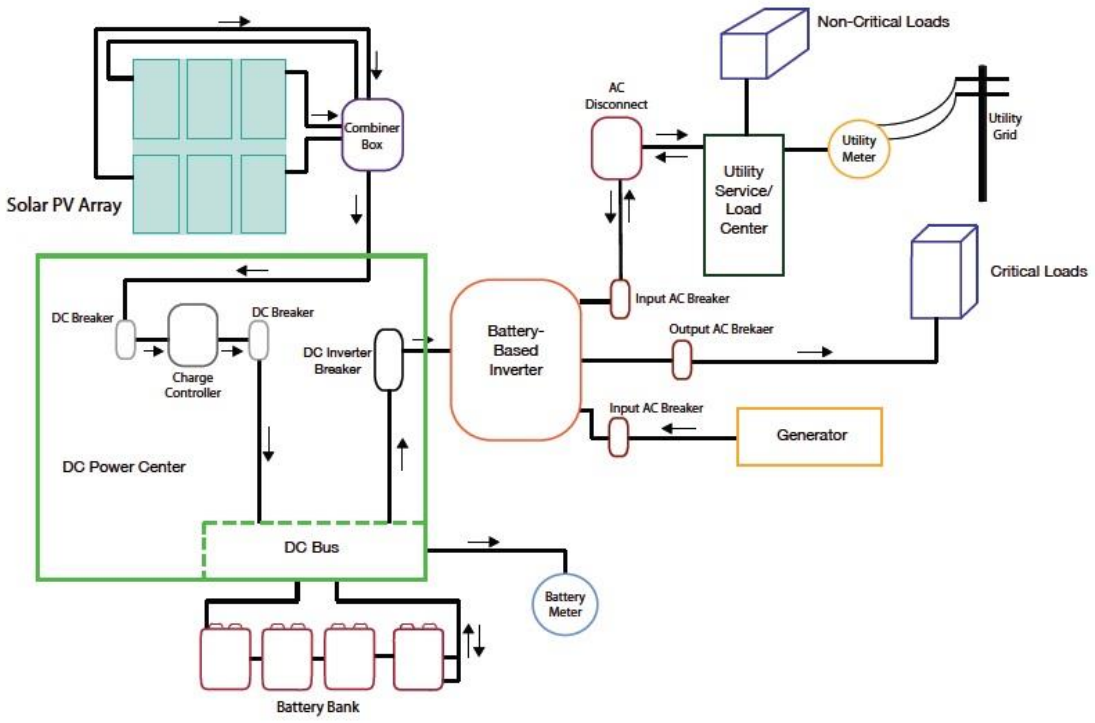

Figure 16: Typical grid-tied islanding system (source: www.aeesolar.com/sites/default/files/Graph-grid-tie-battery-backup.jpg). The solar array is augmented with battery storage (and potentially other generation sources can be added, too.

Understanding the energy and power usage from these resilient systems is also complicated and depends partly on the available sunlight and partly on the system battery size. The trajectory of the Earth's orbit around the sun and the Earth's tilt from a vertical rotation axis are the basis for our seasonal changes and the sunlight differences that go along with all that. For engineering system predications, however it is important to use hard numbers and have a quantitative basis for making design decisions. To provide this quantitative foundation we make use of the standard data for sunlight that have been logged and publicly provided by the US Department of Energy's National Renewable Energy Lab (NREL). The most detailed data come from the Typical Meteorological Year database where 24-hour by 365-day datasets are available for numerous specific locations in the United States (Wilcox & Marion 2008). And, to represent our local climate we use the data-set for the Newark Airport, which is an excellent model for the sunlight/weather patterns that occur in Highland Park.

In a separate analysis of resilient Battery+Photovoltaic designs we focused on the daily total sunlight available and developed an approach for matching the battery size with the solar array size that enabled quantitative reliability estimates based on historical data (Birnie 2014). This examined two possible cases: (a) limited by battery storage capacity, and (b) limited by

availability of sunlight. Given present costs for battery systems it is likely that most new designs will favor smaller battery installations meaning that we'll fall into case (a). While this smaller battery will put limits on the nighttime power that might be possible from the system, it will also mean that there will be excess daytime electrical output that cannot be stored in the battery. This ultimately suggests that site planners can schedule important activities for daytime when this extra power can be used, as we illustrate below.

To account for the very significant seasonal variations in sunlight, we standardize our numbers with respect to the sunlight that would be available if there were no clouds, atmospheric absorption, or light scattering at all. This quantity is known as the Extra-Terrestrial Radiation (ETR) and is one of the quantities provided in the TMY3 database. The actual sunlight for each hour interval is provided as GHI, the Global Horizontal Irradiance. Figure 17 shows one full day's variation of the ETR and GHI data showing the substantial reduction in light caused by clouds and other atmospheric effects, and that these change hour-by-hour depending on the movement of weather patterns. The seasonal variation in sunlight is quite large as illustrated in Figure 18 also using data for Newark, NJ.

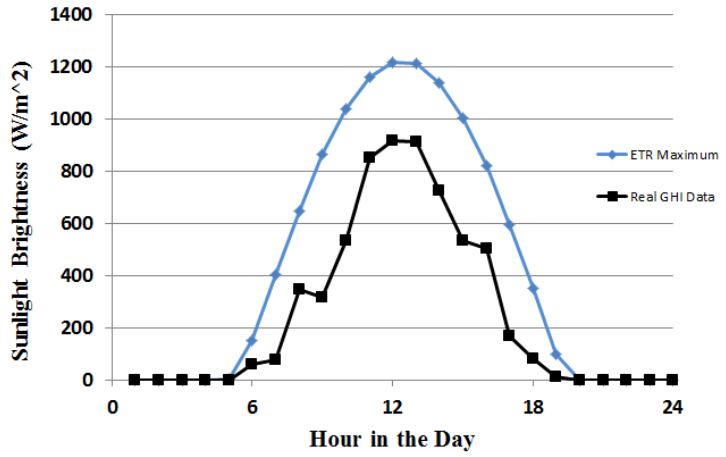

Figure 17: Baseline comparison data for sunlight brightness for a randomly selected 24 hour period. The blue line presents the ETR (Extra-terrestrial radiation) and the black line shows actual ground-level global horizontal irradiance (GHI). The sunlight intensity is reduced by almost 50% by cloud cover and other atmospheric effects.

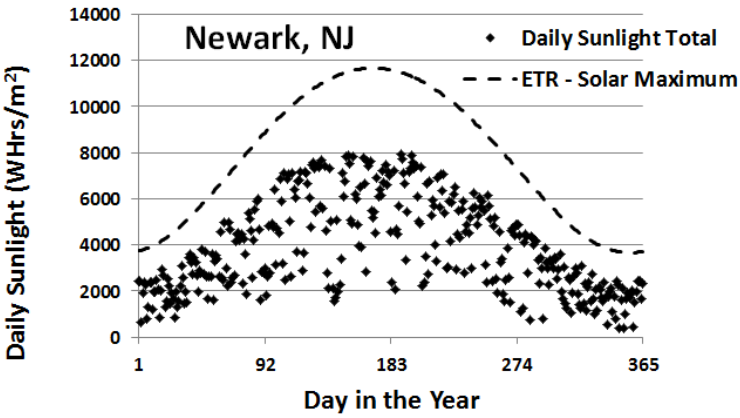

Figure 18: Full year comparison in integrated daily totals of GHI in comparison to the summed ETR totals available above the atmosphere (dashed line). Weather patterns cause substantial variations in possible solar array output, even during the summer season.

Our challenge, then, is to receive sunlight energy during the day and save some in the battery for night-time use. This situation is illustrated in Figure 19 showing a two-day sequence of GHI sunlight brightness numbers. In the simplest cast we might have equipment that would need to be powered at some steady-state level; any excess energy beyond that (shaded blue) could then be

saved in the battery for nighttime used (shaded yellow). In detail, power needs will fluctuate up and down and most battery systems will be able to accept/deliver at different current flow rates. However, the solar array can only deliver power when there is space available in the battery or real-time use of the energy.

As illustrative limiting cases we look at nominal median day representations for winter and summer (based on historical January and July sunlight data). Figure 20 shows these two extremes for the array at the Reformed Church. The integrated winter energy capture value would provide about 22 KWH per day. The integrated summer energy capture would be almost 70KWH per day. And, the variation around these values could be quite large – potentially 50% smaller than this and perhaps up to 25% more than this, again depending on the specific weather patterns that really occur.

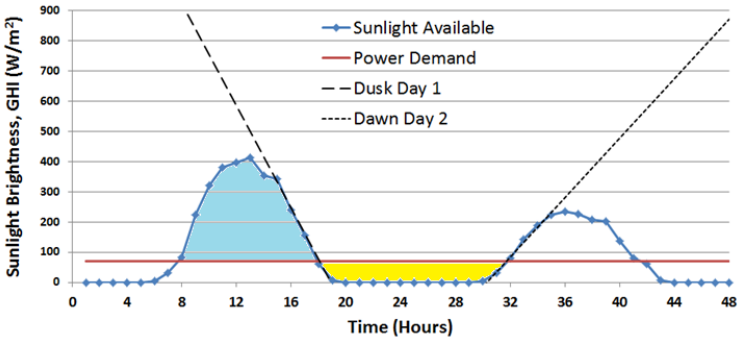

Figure 19: 48 hour time period showing capture of excess energy during day 1 (shaded blue) and delivery of power at night-time for emergency services (shaded yellow).

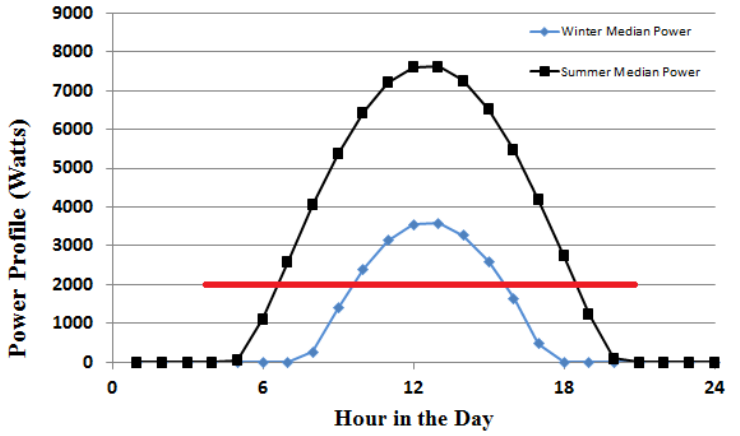

Figure 20: Expected solar array output under median sunlight exposure for typical January and July historical data. AC Power output is calculated based on an array with 12KW nameplate DC rating. Red line is drawn at 2KW power that might be used to charge a battery during the daylight. The winter conditions would provide only 6 hours when this charging rate could be achieved. However, the summer conditions have ample excess, which would have to be used in the daytime as the battery might not have space (see discussion in text).

PRODUCT PERFORMANCE

Testing Performed at 30°C

Embodied Energy (kWh)		Charge Duration (h)				
		4	8	10	12	20
Discharge Duration (h)	4	14.2	17.1	18.0	18.5	20.3
	8	14.4	18.0	19.2	19.9	22.2
	12	14.9	19.1	20.4	21.3	23.8
	20	17.1	22.3	24.0	25.2	28.4

Embodied Capacity (Ah)		Charge Current (A)				
		99.6	52.8	45.6	37.2	24.0
Discharge Current (A)	99.6	314.4	378.0	398.4	410.4	448.8
	52.8	316.8	397.2	422.4	438.0	487.2
	37.2	326.4	416.4	446.4	465.6	520.8
	24.0	342.0	446.4	480.0	502.8	567.6

PHYSICAL CHARACTERISTICS

Height	1,159 mm (45.6")
Width	1,321 mm (52.0")
Depth	1,016 mm (40.0")
Weight	1,140 kg (3,175 lbs)

Figure 21: Specifications for a nominal 20KWH battery module showing how the capacity changes depending on the rate of charge and discharge. This change in apparent capacity results from internal resistance effects inherent to all battery systems. Each manufacturer and battery chemistry will have its own characteristics. Generally speaking slower charging and slower discharging will be more favorable for most efficient energy recovery after storage.

For discussion purposes we consider how these two representative plots of solar power output would interact with a battery system designed with a nominal 20KWH energy storage capacity[3]. Figure 21 shows one important table from an Aquion Energy M100-LS82P Battery Module (Aquion 2014). Looking at the upper table the columns are labeled with the number of hours used to fill an initially-empty battery. Thus to reach ~20KWH in 10 hours it will use 2KW of power continuously. For this battery system, with a nominal 48V design then this would amount to around 40 Amps of current steadily. If we wanted to fill the same capacity, but in the shorter time of 4 hours, then we would need to feed it 5KW of power during that time and that would be around 100 Amps of current. We see that the actual battery capacity values in these two columns are different – with the slower charging providing a better capacity. Next, the rows are labelled with discharge durations in hours. Here again the internal storage is reduced when we use the battery faster.

In our emergency power scenario, though, we would be expecting to charge during the day and discharge during the night and if usage could be scheduled well then slower smoother operation could be achieved; ultimately it is reasonable to map out battery comparisons using the spec-

[3] For discussion purposes we use the data from a specifications sheet provided by Aquion Energy. No endorsement is implied. http://www.aquionenergy.com/

sheet data for 10 or 12 hour charging and discharging durations as these conform to day and night durations in many cases.

Referring again back to Figure 20 we can see that a red line has been drawn at the level of 2KW, which is the rate needed for a nominal 10 hour full charge. However, for the median winter sunlight data then we might have only 6 hours when the solar PV output would be large enough; on the other hand the median summer sunlight would provide 12 hours when the PV output would exceed the 2KW that was desired. Obviously after 10 hours the battery would be full and no further charging could be achieved. Ultimately, the power levels that are above what might be required for battery charging would need to be used in real-time during the day. This suggests that emergency usage scenarios be staged so that many energy-demanding activities would be concentrated during daylight hours when substantial excess solar capacity might be provided. And, the emergency planning should make careful analysis of energy needs in different seasons, as shown above.

It is useful to examine the electricity needs for an emergency scenario. We have cataloged the equipment/usage needs that would be valid at each of the likely shelter locations (see the case studies above). These equipment and usage needs then need to be mapped onto a likely scheduling routine so that the battery size and charging pattern can be planned. Table 7 below shows information about electricity needs using Reform Church location for illustration. Examining the different types of power need we can see that only some of the needs would be required through the night. Many uses could be curtailed and delayed until daylight hours when ample sunlight and array output would likely be available. Here the refrigerator would be needed to preserve fresh food for citizens in shelter mode. Likewise the lighting is primarily a nighttime need, but one could still establish "bed-time" when most lights would be turned off and limit the real load need. Cooking energy can be aimed mostly to daylight times and phone-charging also can be aimed at mostly daylight hours as the phone batteries will still give some hours of usage well into the night after being charged in the daytime. So, the main message is that the battery storage size needs to be connected partly to what the solar array might provide (as shown above), but also to what might reasonably be needed during the nighttime of an emergency situation.

Appliance/Function type	*Unit Power rating (W)*	*Total W*	*Hours of usage*	*No. of units X Wattage X hours of usage*	*NIGHT time WattHours needed*
20 phones need to be charged	7(20)	140	8	1120	
10 laptop computers	100 (10)	1000	8	8000	
1 large refrigerator	410	410	24	9840	5000
Water Kettle	1500 (2)	3000	2	6000	
Lighting	500	500	10	5000	2500
1 TV	250	250	10	2500	
				32,460 W-hrs = 32.5 kWH	7.5 kWH

Table 7: Illustrative Day and Night Critical Loads for the Reformed Church

Recall that the solar array at the Reformed Church is rated at 12.8 kW peak and can deliver approximately 24 kWh of energy during a typical winter day and 70 kWh during a typical summer day. With night-time requirements of 7.5 kWh and daytime requirements of 32.5 kWh (from Table 7), it is clear that the total daily requirements of 40 kWh will not be satisfied during a winter emergency (suggesting that emergency planners establish even stricter usage plans for potential winter outages). During a summer emergency the existing array could handle the projected critical loads. In a winter event, the critical loads should be pared back. For example, usage of the water kettle, television, and most lighting could be prohibited, and only 5 laptops charged, thereby bringing daytime electricity consumption down below 16 kWh.

This illustration shows how tightly constrained users will be if they must rely exclusively on the solar and battery system. It is likely that a conventional backup generator powered by gasoline, diesel fuel, or natural gas will still be needed for certain hours of the day to be confident for emergencies that could happen any time of the year.

Recommendations

Four sets of recommendations emerge from the case studies and analysis. These include actions residents can directly take to improve resiliency, ideas about how to link solar islanding to municipal emergency planning, opportunities to secure external funding for implementation, and recommendations that might generalize to other Sustainable Jersey communities.

Educational Materials for Residents

In evaluating materials that are currently available for residents regarding how to prepare for a power outage, the team found a number of resources. Perhaps the best presented of these is one offered by the American Red Cross, in English and Spanish (Appendix A, B). Associated checklists offer advice on how to prepare for an outage, what to do during an outage and what to do following an outage. If the Borough does not do so already, copies of these checklists could be distributed to residents by mail annually and also made available at the Street Fair, Arts in the Park and other community events. Houses of Worship might and schools might also be encouraged to distribute printed copies, while websites could point to the on-line version.

Inclusion of Supporting Language in Municipal Emergency Operations Plans

A premise of the project proposal is that investments in islanding can vastly increase the value of existing solar arrays throughout New Jersey by transforming them from emblems of sustainability to islands of resilience. It would be logical to integrate these green power generators as part of municipalities' Emergency Operations Plans (EOPs).[4] Using Highland Park as our case study, and drawing upon federal guidance for emergency planning and operations (i.e., Basic Emergency Operations Planning, Emergency Operations Basic Plan Template, National Preparedness Directorate (NPD), September 2009 and associated planning documents, especially Emergency Support Function (ESF) Annex 12) we suggest model language for inclusion in municipal plans wherein solar islanding has been implemented. Note that not all versions of EOPs necessarily contain an energy annex and that the location of data within EOPs remains variable as not all jurisdictions have transitioned to the NIMS (National Incident Management System).

ESF #12 (Energy) is a placeholder for insertion of the following information:

> (1) Describe the process to address significant disruptions in energy supplies for any reason, whether caused by physical disruption of energy transmission and distribution systems, unexpected operational failure of such systems, or unusual economic or international political events. (2) Describe the process to address the impact that damage

[4] See http://www.hsdl.org/ for the referenced templates. This site collates FEMA's old Lessons Learned data and information and the Naval Post graduate school research into a single digital library.

to an energy system in one geographic region may have on energy supplies, systems, and components in other regions relying on the same system. (3) Describe/identify the energy-centric critical assets and infrastructures, as well as the method to monitor those resources to identify and mitigate vulnerabilities to energy facilities.

Of these, item (1) is most directly applicable to solar islanding as an emergency support function, in particular, Sheltering and Mass Care (Guide for All-Hazard Emergency Operations Planning for State, Territorial, Local and Tribal Governments, Interim Version 1.0, July 2008).

As such, jurisdictions with solar islanding capability could include in their EOPs that:

"In the event of a disruption of energy supply, in order to assist the population through the provision of sheltering functions, ____ (jurisdiction) has designated __ locations with solar islanding capability (Map __). These locations differ in their sheltering capabilities according to Table___, below."

In illustration, were the Borough of Highland Park to implement solar islanding capabilities at the 3 study sites, then Figure 1 of this document would serve as a Map and Table 7 or similar would be included for each designated site.

Inclusion of Resiliency Factors in Municipal Energy Planning and Procurement

Correspondingly, municipalities should also consider resiliency factors in their energy planning and procurement activities, to help ensure that critical properties can sustain operations—at least for critical loads—during an extended grid outage (Sustainable Jersey, *Sustainable Energy Transition Plan*)[5] . This frequently implies on-site generation, and appropriate switchgear to isolate the facility from the grid during independent operation. As evaluated in this project, in some cases, on-site energy storage (such as batteries) may be appropriate. Possible funding sources for municipalities interested in solar battery storage are discussed in the following section of this report. Additionally, even small procurement decisions – e.g., whether to specify a gas or electric stove – can make a large difference in the functionality of a designated shelter, or a building capable of providing shelter, in the event of a grid disruption. As an example, it would make sense for municipalities to consider revising procurement guidelines to favor gas stoves over electric ones. At a building-level scale, many green building strategies also convey resiliency benefits. These include an emphasis on daylighting, superior insulation values, thermal massing and even intentional sectioning of lighting and HVAC bearing in mind that this could enable part of the building to function while another part could be left without power. These strategies can help reduce the need for electricity for lighting, cooling and other critical functions.

[5] http://www.sustainablejersey.com/actions-certification/actions/#open/action/530, accessed June 28, 2015.

Funding Opportunities

Through the case-study development above we have demonstrated and quantified the energy needs and likely energy availability for resilient energy systems based on solar collectors at three different locations in Highland Park. Now we turn our attention to possible near-term and longer-range options that might be available for assisting with financing upgrades to make Highland Park more resilient in the face of future storms.

Investments in islanding can vastly increase the value of existing solar arrays throughout New Jersey from emblems of sustainability to islands of resilience. It would be logical to integrate these green power generators as part of municipalities' Emergency Preparedness Plans, but these elements are not traditionally included. Using Highland Park as the case study, it should be possible to develop model language that can be introduced into emergency preparedness plans statewide.

Presently there are three specific funding/assistance programs that we know about. Each of these is profiled below and pros and cons are provided in relation to the specific case-study locations that we have assessed above.

PSEG Solar-for-all-Extension, Round 2

This grant opportunity was just opened up at the "Request for Information" (RFI) stage and covers new solar installations that would qualify as "Grid Security / Storm Preparedness Applications". This is the second round of competition on funding provided by the NJ Board of Public Utilities (BPU) to PSE&G to expand solar installations in their service territory (which includes Highland Park).

This program revolves round installing new solar and covers a kind of public/private partnership scenario as the utility would essentially rent space and would retain ownership of the installed solar array. To satisfy the resilience angle then the system would likely have some battery storage built into the system and also operated by PSEG. Under emergency situations the system would go into island mode and the solar would provide power to the location as well as charge the battery (which then would provide nighttime power). Appendix E shows a system recently described by PSEG that was generated during their Round 1 of this same program. This example shows an array installation at Hopewell Valley Central High School – and is a project that has just broken ground.

Pros:

- This would be suited to the Highland Park School site because there is no existing solar array there.
- The installation would provide a certain level of emergency power, depending on the size of array that could fit and the size of battery that was spec'd with it.
- A contract would be established where PSEG would provide maintenance over 20 year period and would define a certain rental income for the agreement to use the site.

Cons:

- The HP site is more compact, which will limit the size of array that is possible and thus the amount of emergency power that could be possible.
- The PSEG program doesn't include any contractual electricity delivery during non-emergency situations. The power generated belongs to PSEG.

NJ BPU – Renewable Electric Storage, Round 2

This grant opportunity is operating through the NJ Clean Energy Program and funded directly by the BPU. They have already funded one round of projects in FY15. The basic premise is that they will assist in funding batteries that will be added to existing solar arrays. The NJ BPU has an Energy Storage Working Group (ESWG) that is actively working on what possible modifications might be made for their FY16 offering. Recent ESWG meetings have been provided with summary information on the 13 specific FY15 projects funded (see Appendix F, from the April 13th meeting). Possible modifications to the rules for how the FY16 might allow for combined Solar+Battery projects, might change the incentive structure to a set ratio on either battery power (kW) or energy (kWh) or some as-yet-defined combination. Discussion and final decisions on this program will likely be finalized in early fall.

Project Name	Storage Capacity (kW)	Rated Energy (kWh)
Toms River Municipal Utilities Authority	250	125
Paramus High School	250	125
Demasi Middle School	250	125
Monmouth County Bayshore Outfall Authority	500	250
Franklin Township Board of Education	500	250
Rice Elementary School	500	222
Marlton Middle School	500	222
East Amwell School Board of Education	500	222
Borough of Buena Municipal Utilities Authority	750	375
Lawrenceville School	1000	580
Atlantic County Utilities Authority	1000	580
Jersey City Municipal Services Complex	1250	625
Cumberland County Utilities Authority	1500	750

Figure 22: Projects funded through NJ BPU in Round 1. These are specs of batteries added to existing solar arrays. Info excerpted from Appendix F.

Pros:

- This might be suited to the Reform Church site because they have the largest existing solar array among the sites we profiled.
- The added battery would provide a certain level of emergency power, depending on the size of battery that was added with it.
- Some funding would be provided by NJ BPU to assist with the purchase and installation.

Cons:

- The funding doesn't pay for the whole thing. For comparison the costs for the FY15 projects were "fairly constant at between $1,200 and $1,500 per kW" (referencing to the battery's power rating) and the requested subsidy of the proposed projects was just under $400 per kW, essentially paying for 1/3 to ¼ of the system costs.

Most likely a battery would not be purchased only to provide emergency backup. Rather, it could be arranged to operate the battery during regular grid "up" times, as well. These usages could be load shifting, frequency regulation and peak demand reduction. This adds extra complexity and might likely require operation by a third party to ensure good valuation. As such, this remains a somewhat murky, evolving area.

The public gathering emergency angle needs to be stressed and is certainly satisfied by the Reform Church location, but it is not clear if this would qualify on separation of church and state grounds. The closest positive example in the FY15 selected projects would be the Lawrence School (a private school). Before the Borough would invest much time in pursuing this funding source, it would make sense to inquire directly about whether the Reform Church location would qualify.

NJ Energy Resilience Bank

This grant opportunity is broader than the other two and covers a much wider range of energy generation possibilities, including batteries, but also with possible combined heat and power (CHP) plants, or fuel cell generators, but with the goal of providing more resilient systems. A basic overview of this program is provided in Appendix G.

Pros:

- Lots of flexibility, including partial subsidy and loan arrangements.
- Tied to the NJ EDA so company sites might be able to finance growth and energy efficiency improvement while simultaneously providing more resilience for emergencies.

Cons:

- This program is really aimed at bigger projects than we could imagine at any of the locations that we studied in HP.

Cost Projections

The resilient systems that have been the major focus of our analysis here would combine substantial solar photovoltaic generation with reasonably sized battery storage on site, both of which are sizeable investments. Above, we have outlined some grant programs, but each is unique in its terms and none is a certainty as the project applications must compete against other project proposals from around the state. For comparison purposes we examine some recent cost data that would be pertinent to systems being considered by Highland Park.

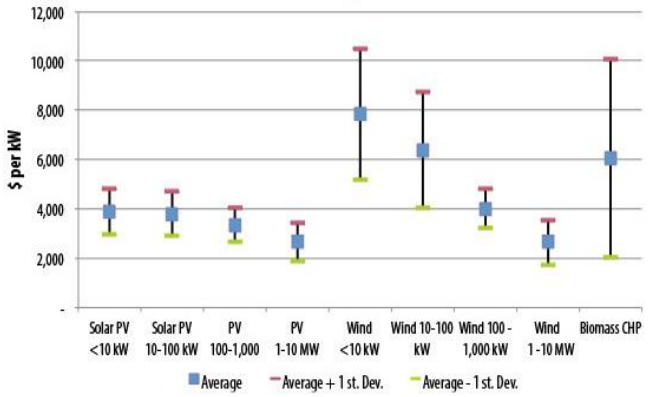

Figure 23: Solar array installed costs for different system sizes and character based on 2013 data collected by DOE's National Renewable Energy Lab (NREL: Energy Analysis. 2013)

Grid-tied solar arrays have a long history and the costs have been coming down gradually with time, as competitive market factors have had their effect. Figure 23 shows some recent data on costs for different kinds of renewable generation sources. The most relevant match to the systems Highland Park might consider would be the "PV 100-1,000" data point, which translates to something like $3.5 to $4 per Watt, installed. This price includes the inverter, fixtures, wiring. Parking structure arrays are probably somewhat higher cost as they involve very sturdy designs intended to withstand very high winds. These systems might be $5/W or more, depending on the configuration.

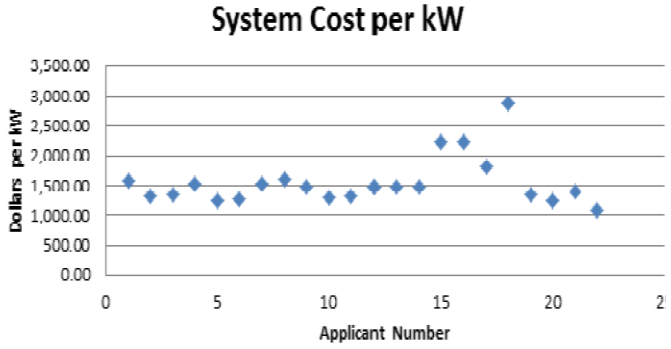

Figure 24: Energy storage system costs for project proposals submitted to NJ BPU in Round 1. These are costs scaled to battery power rating. Info excerpted from Appendix F.

Battery systems installed to provide resilient power backup have less track record. And, retrofit projects added onto existing solar will require an upgrade to the existing power inverter for the system. Newer inverters can provide the islanding capability that was not designed into the earlier New Jersey installations. The most relevant comparison in this regard is by reference to the first round of resilient storage system awards provided by the NJ BPU, as profiled above. Figure 24 gives the BPU's digestion of the 22 applicants to their first round. If we ignore a few high priced outliers then the nominal resilient battery upgrade costs have been something under $1500/kW, with the BPU subsidizing that cost at a level of ~$400/kW.

Applicability to other communities

A solar islanding plan and subsequent implementation could fit well as new actions for municipalities and schools under the Sustainable Jersey certification system, or could augment existing actions such as the *Sustainable Energy Transition Plan*.[6] .

Within such a framework, municipalities would first need to assess their community shelter needs and prioritize them according to the constraints revealed in the analysis presented herein. Implementation would include making an amendment to the municipality's Emergency Operations Plan. Efforts to build emergency management and energy resilience into municipal planning efforts could help establish future "best-practices" that could be adopted state-wide by the more than 500 municipalities contained in New Jersey

[6] http://www.sustainablejersey.com/actions-certification/actions/#open/action/530, op cit.

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Appendices

Appendix A - Be Red Cross Ready, Power Outage Checklist

Appendix B - Be Red Cross Ready, Power Outage Checklist – Spanish Version

Appendix C - ESF EOP Format Template

Appendix D - EOP Basic Plan Template

Appendix E - PSEG - Hopewell Valley Central High School, Pilot Project Update.

Appendix F - Energy Storage Working Group

Appendix G – ERB General Program Requirements

Appendix A - Be Red Cross Ready, Power Outage Checklist

Be Red Cross Ready

Power Outage Checklist

Sudden power outages can be frustrating and troublesome, especially when they last a long time. If a power outage is 2 hours or less, you need not be concerned about losing your perishable foods. For prolonged power outages, though, there are steps you can take to minimize food loss and to keep all members of your household as comfortable as possible.

Energy Conservation Recommendations

- ❑ Turn off lights and computers when not in use.
- ❑ Wash clothes in cold water if possible; wash only full loads and clean the dryer's lint trap after each use.
- ❑ When using a dishwasher, wash full loads and use the light cycle. If possible, use the rinse only cycle and turn off the high temperature rinse option. When the regular wash cycle is done, just open the dishwasher door to allow the dishes to air dry.
- ❑ Replace incandescent light bulbs with energy-efficient compact fluorescent lights.

How do I prepare for a power outage?

To help preserve your food, keep the following supplies in your home:

- ❑ One or more coolers—Inexpensive Styrofoam coolers work well.
- ❑ Ice—Surrounding your food with ice in a cooler or in the refrigerator will keep food colder for a longer period of time during a prolonged power outage.
- ❑ A digital quick-response thermometer—With these thermometers you can quickly check the internal temperatures of food to ensure they are cold enough to use safely.

Put together an emergency preparedness kit with these supplies in case of a prolonged or widespread power outage:

• Water—one gallon per person, per day (3-day supply for evacuation, 2-week supply for home) • Food—non-perishable, easy-to-prepare items (3-day supply for evacuation, 2-week supply for home) • Flashlight *(NOTE: Do not use candles during a power outage due to the extreme risk of fire.)* • Battery-powered or hand-crank radio (NOAA Weather Radio, if possible) • Extra batteries • First aid kit • Medications (7-day supply) and medical items • Multi-purpose tool • Sanitation and personal hygiene items • Copies of personal documents (medication list and pertinent medical information, deed/lease to home, birth certificates, insurance policies) • Cell phone with chargers • Family and emergency contact information • Extra cash

- ❑ If someone in your home is dependent on electric-powered, life-sustaining equipment, remember to include backup power in your evacuation plan.
- ❑ Keep a non-cordless telephone in your home. It is likely to work even when the power is out.
- ❑ Keep your car's gas tank full.

What should I do during a power outage?

Keep food as safe as possible.

- ❑ Keep refrigerator and freezer doors closed as much as possible. First use perishable food from the refrigerator. An unopened refrigerator will keep foods cold for about 4 hours.
- ❑ Then use food from the freezer. A full freezer will keep the temperature for about 48 hours (24 hours if it is half full) if the door remains closed.
- ❑ Use your non-perishable foods and staples after using food from the refrigerator and freezer.
- ❑ If it looks like the power outage will continue beyond a day, prepare a cooler with ice for your freezer items.
- ❑ Keep food in a dry, cool spot and keep it covered at all times.

Electrical equipment

- ❑ Turn off and unplug all unnecessary electrical equipment, including sensitive electronics.
- ❑ Turn off or disconnect any appliances (like stoves), equipment or electronics you were using when the power went out. When power comes back on, surges or spikes can damage equipment.
- ❑ Leave one light turned on so you'll know when the power comes back on.
- ❑ Eliminate unnecessary travel, especially by car. Traffic lights will be out and roads will be congested.

Using generators safely

- ❑ When using a portable generator, connect the equipment you want to power directly to the outlets on the generator. Do not connect a portable generator to a home's electrical system.
- ❑ If you are considering getting a generator, get advice from a professional, such as an electrician. Make sure that the generator you purchase is rated for the power that you think you will need.

What should I do when the power comes back on?

- ❑ Do not touch any electrical power lines and keep your family away from them. Report downed power lines to the appropriate officials in your area.

Throw out unsafe food.

- ❑ Throw away any food that has been exposed to temperatures 40° F (4° C) for 2 hours or more or that has an unusual odor, color or texture. When in doubt, throw it out!
- ❑ Never taste food or rely on appearance or odor to determine its safety. Some foods may look and smell fine, but if they have been at room temperature too long, bacteria causing food-borne illnesses can start growing quickly. Some types of bacteria produce toxins that cannot be destroyed by cooking.
- ❑ If food in the freezer is colder than 40° F and has ice crystals on it, you can refreeze it.
- ❑ If you are not sure food is cold enough, take its temperature with the food thermometer. Throw out any foods (meat, poultry, fish, eggs and leftovers) that have been exposed to temperatures higher than 40° F (4° C) for 2 hours or more, and any food that has an unusual odor, color or texture, or feels warm to touch.

Caution: Carbon Monoxide Kills

- ❑ Never use a generator, grill, camp stove or other gasoline, propane, natural gas or charcoal-burning devices inside a home, garage, basement, crawlspace or any partially enclosed area. Locate unit away from doors, windows and vents that could allow carbon monoxide to come indoors.
- ❑ The primary hazards to avoid when using alternate sources for electricity, heating or cooking are carbon monoxide poisoning, electric shock and fire.
- ❑ Install carbon monoxide alarms in central locations on every level of your home and outside sleeping areas to provide early warning of accumulating carbon monoxide.
- ❑ If the carbon monoxide alarm sounds, move quickly to a fresh air location outdoors or by an open window or door.
- ❑ Call for help from the fresh air location and remain there until emergency personnel arrive to assist you.

Let Your Family Know You're Safe

If your community experiences a disaster, register on the American Red Cross Safe and Well Web site available through **RedCross.org** to let your family and friends know about your welfare. If you don't have Internet access, call **1-866-GET-INFO** to register yourself and your family.

American Red Cross

For more information on disaster and emergency preparedness, visit **RedCross.org**.

Appendix B - Be Red Cross Ready, Power Outage Checklist – Spanish Version

Prepárate con la Cruz Roja

Seguridad en caso de apagones

Los apagones eléctricos repentinos podrían causar frustración y molestias, en especial si duran mucho tiempo. Si la electricidad vuelve en 2 o menos horas, no necesitas preocuparte por los alimentos perecederos. Pero, si el corte se prolonga, podrás tomar medidas para reducir al mínimo la pérdida de alimentos y mantener a la familia lo más cómoda posible.

Recomendaciones para conservar energía

- ❒ Apaga las luces y las computadoras que no estés usando.
- ❒ En lo posible, lava la ropa con agua fría, llena por completo la lavadora y limpia el filtro de la secadora después de cada ciclo.
- ❒ Si usas un lavaplatos, llénalo por completo y usa el ciclo de lavado ligero. En lo posible, emplea el ciclo para enjuagar solamente y apaga la opción de enjuague de alta temperatura. Al terminar el ciclo de lavado normal, abre la puerta del lavaplatos para dejar que la vajilla se seque con el aire.
- ❒ Reemplaza las bombillas incandescentes por luces fluorescentes compactas de eficiencia energética.

¿Cómo me preparo para un apagón?

Conserva mejor los alimentos con:

- ❒ Una o más neveras portátiles: las baratas de poliestireno funcionan bien.
- ❒ Hielo: rodear la comida con hielo en una nevera portátil o en el refrigerador mantendrá la comida fría por más tiempo si hay un apagón prolongado.
- ❒ Termómetro digital rápido: usarlo para verificar la temperatura interna de los alimentos y saber si están suficientemente fríos para consumir sin peligro.

Reúne suministros para un equipo de preparación para emergencias en caso de un apagón generalizado o prolongado:

• un galón de agua por persona, por día (para 3 días en caso de desalojo, para 2 semanas en la casa) • alimentos no perecederos y de fácil preparación (para 3 días en caso de desalojo, para 2 semanas en la casa) • linterna *(NOTA: Nunca uses velas durante un apagón porque son un gran peligro de incendio.)* • radio que funcione con pilas o una radio de manivela (si es posible, la radio meteorológica de la NOAA) • pilas de repuesto • botiquín de primeros auxilios • medicamentos (para 7 días) y artículos médicos • herramienta multiuso • artículos sanitarios y de higiene personal • copias de documentos personales (lista de medicamentos y de datos médicos pertinentes, título de propiedad o contrato de alquiler, certificados de nacimiento, pólizas de seguro) • teléfono celular y cargador • datos de contacto para emergencias • dinero en efectivo

- ❒ Si alguien depende de equipo eléctrico para el mantenimiento de funciones vitales, anticipa una fuente eléctrica de reserva.
- ❒ Ten a mano un teléfono que no sea inalámbrico en tu casa. Es probable que funcione aunque no haya electricidad.
- ❒ Conserva el tanque de gasolina de tu automóvil lleno.

¿Qué hago durante un apagón?

Protege la seguridad de tus alimentos.

- ❒ Mantén cerradas las puertas del refrigerador y el congelador en la medida de lo posible. Primero, usa los alimentos perecederos que están en el refrigerador. Si no se abre el refrigerador, los alimentos se mantendrán fríos durante unas 4 horas.
- ❒ Luego, usa los alimentos que están en el congelador. Si el congelador está todo lleno, mantendrá la temperatura durante 48 horas (o 24 horas si está lleno por la mitad) cuando la puerta se mantenga cerrada.
- ❒ Come los alimentos del refrigerador y del congelador antes de consumir los alimentos no perecederos.
- ❒ Si sospechas que el apagón durará más de un día, pon hielo en una nevera portátil para guardar las cosas del congelador.
- ❒ Almacena los alimentos en un lugar seco y fresco. Es importante que se mantengan cerrados en todo momento.

Aparatos electrónicos

- ❒ Apaga y desenchufa todos los aparatos electrónicos que no necesites.
- ❒ Apaga o desconecta electrodomésticos (como el aparato de cocina) y artefactos o equipos electrónicos que estaban encendidos cuando se cortó la electricidad. Al volver la luz, las fluctuaciones en la tensión podrían dañarlos.
- ❒ Deja una luz encendida para saber cuándo vuelve la electricidad.
- ❒ No viajes a menos que sea indispensable, en especial en automóvil. Los semáforos no funcionarán y habrá congestión de tráfico.

Seguridad en el uso de generadores

- ❒ Si usas un generador, enchufa los aparatos directamente al generador. No conectes un generador portátil al sistema eléctrico de la vivienda.
- ❒ Si piensas comprar un generador, pide consejo a un profesional (electricista). Asegúrate de que el generador corresponda al voltaje que piensas que necesitarás.

¿Qué hago cuando vuelve la electricidad?

- ❒ No toques ningún cable eléctrico y mantén a tu familia alejada de ellos. Notifica a las autoridades sobre cables caídos.

Desecha alimentos que no sean seguros.

- ❒ Desecha los alimentos que hayan estado expuestos a temperaturas superiores a 40°F (4°C) durante dos o más horas, o que tenga un olor, color o textura fuera de lo común. Recuerda: “En la duda, a la basura”.
- ❒ Nunca pruebes un alimento para determinar si es seguro comerlo ni te guíes por su olor. Aunque tengan buen aspecto y sabor, algunos alimentos que están a temperatura ambiente por mucho tiempo desarrollan muy pronto bacterias que causan enfermedades transmitidas por los alimentos. Algunas bacterias producen toxinas que no se eliminan con la cocción.
- ❒ Si los alimentos que están en el congelador tienen cristales de hielo y su temperatura no supera los 40°F (4°C) podrás volver a congelarlos.
- ❒ Si no estás seguro de que un alimento en particular esté lo suficientemente frío, prueba la temperatura con un termómetro para alimentos. Desecha alimentos (como carne de vaca, ave, pescado, huevos y comida sobrante) que hayan estado a más de 40°F (4°C) durante dos o más horas, y todo alimento que tenga un olor, color o textura fuera de lo común, o que se sienta tibio al tacto.

Atención: el monóxido de carbono mata

- ❒ Nunca uses un generador, parrilla, estufa de campamento u otro aparato que funcione con gasolina, gas natural o propano, o carbón adentro de la vivienda, garaje, sótano, espacios para cables o tuberías, u otros sitios parcialmente cerrados. Coloca el aparato afuera, lejos de las puertas, ventanas y rejillas de ventilación que dejen pasar el monóxido de carbono al interior.
- ❒ Los peligros principales que deben evitarse al usar fuentes alternativas para la electricidad y la calefacción o para cocinar son la intoxicación por monóxido de carbono, descargas eléctricas e incendios.
- ❒ Instala detectores de monóxido de carbono en lugares centrales en cada piso de tu casa y afuera de los dormitorios.
- ❒ Si suena la alarma del detector de monóxido de carbono, sal rápidamente al aire libre o acércate a una ventana o puerta abierta.
- ❒ Llama para pedir ayuda desde el lugar donde hay aire fresco y quédate allí hasta que llegue el personal de emergencia a ayudarte.

Avisa a tus familiares que estás a salvo

Si ocurre una catástrofe en tu comunidad, anótate en el sitio “Sano y salvo” de la Cruz Roja Americana en **cruzrojaamericana.org** para avisar a tus familiares y amigos sobre tu situación. Si no tienes acceso a Internet, llama al **1-866-438-4636** para anotarte y anotar a tus familiares.

Cruz Roja Americana

Infórmate sobre la preparación en caso de desastres y emergencias.
Visita **cruzrojaamericana.org**.

Appendix C - ESF EOP Format Template

Section I - Base Plan

A. Introduction

1. Promulgation document / signature
   Promulgation is the process that officially announces/declares a plan (or law). The promulgation document gives the plan official status. It gives both the authority and the responsibility to organizations to perform their tasks. It should also mention the responsibilities of tasked organizations with regard to preparing and maintaining their own procedures/guidelines and commit those organizations to carrying out the training, exercises, and plan maintenance needed to support the plan. In addition, the promulgation document allows senior officials to affirm their support for emergency management.
2. Approval and Implementation
   The approval and implementation page introduces the plan, outlines its applicability, and indicates that it supersedes all previous plans. It should include a delegation of authority for specific modifications that can be made to the plan and by whom they can be made without the senior official's signature. It should also include a date and should be signed by the senior official(s) (e.g., governor, tribal leader[s], mayor, county judge, commissioner[s]).
3. Record of Changes
   Each update or change to the plan should be tracked. The record of changes, usually in table format, contains, at a minimum, a change number, the date of the change, the name of the person who made the change, and a summary of the change. Other relevant information could be considered.
4. Record of Distribution
   The record of distribution, usually in table format, indicates the title and the name of the person receiving the plan, the agency to which the recipient belongs, the date of delivery, and the number of copies delivered. Other relevant information could be considered. The record of distribution can be used to prove that tasked individuals and organizations have acknowledged their receipt, review, and/or acceptance of the plan. Copies of the plan can be made available to the public and media without SOPs/SOGs, call-down lists, or other sensitive information.
5. Table of Contents
   The table of contents should be a logically ordered and clearly identified layout of the major sections and subsections of the plan that will make finding information within the plan easier.

B. Purpose, Scope, Overview, and Assumptions

1. Purpose
   The purpose sets the foundation for the rest of the EOP. The basic plan's purpose is a general statement of what the EOP is meant to do. The statement should be supported by a brief synopsis of the basic plan and annexes.
2. Scope

The EOP should also explicitly state the scope of emergency and disaster response and the entities (e.g., departments, agencies, private sector, citizens) and geographic areas to which the plan applies.

3. Situation Overview

The situation section characterizes the "planning environment," making it clear why an EOP is necessary. The level of detail is a matter of judgment; some information may be limited to a few specific annexes and presented there. At a minimum, the situation section should summarize hazards faced by the jurisdiction and discuss how the jurisdiction expects to receive (or provide) assistance within its regional response structures.

a. Hazard Analysis Summary
b. Capability Assessment
c. Mitigation Overview

4. Assumptions

These identify what the planning team assumes to be facts for planning purposes in order to make it possible to execute the EOP. During operations, the assumptions indicate areas where adjustments to the plan have to be made as the facts of the incident become known. These also provide the opportunity to communicate the intent of senior officials regarding emergency operations priorities.

C. Concept of Operations

The audience for the basic plan needs to be able to visualize the sequence and scope of the planned emergency response. The CONOPS section is a written or graphic statement that explains in broad terms the decision maker's or leader's intent with regard to an operation. The CONOPS should describe how the response organization accomplishes a mission or set of objectives in order to reach a desired end-state. Ideally, it offers clear methodology to realize the goals and objectives to execute the plan. This may include a brief discussion of the activation levels identified by the jurisdiction for its operations center. The CONOPS should briefly address direction and control, alert and warning, and continuity matters that may be dealt with more fully in annexes.

D. Organization and Assignment of Responsibilities

The basic plan establishes the operational organization that will be relied on to respond to an emergency situation. It includes a list of the kinds of tasks to be performed, by position and organization, without all of the procedural details included in functional annexes. When two or more organizations perform the same kind of task, one should be given primary responsibility, with the other(s) providing a supporting role. For the sake of clarity, a matrix of organizations and areas of responsibility (including functions) should be included to summarize the primary and supporting roles. Shared general responsibilities, such as developing SOPs / SOGs, should not be neglected, and the matrix might include organizations not under jurisdictional control, if they have defined responsibilities for responding to emergencies that might occur in the jurisdiction. Organization charts, especially those depicting how a jurisdiction is implementing the ICS or Multiagency Coordination System structure, are helpful. This section should also outline agency and departmental roles related to prevention and protection activities.

E. Direction, Control, and Coordination

This section describes the framework for all direction, control, and coordination activities. It identifies who has tactical and operational control of response assets. Additionally, Direction, Control, and Coordination explain how multijurisdictional coordination systems support the efforts of organizations to coordinate efforts across jurisdictions while allowing each jurisdiction

to retain its own authorities. This section also provides information on how department and agency plans nest into the EOP (horizontal integration) and how higher-level plans are expected to layer on the EOP (vertical integration).

F. Information Collection, Analysis, and Dissemination

This section describes the critical or essential information common to all operations identified during the planning process. It identifies the type of information needed, the source of the information, who uses the information, how the information is shared, the format for providing the information, and any specific times the information is needed. State and local prevention and protection assets must develop the Information Collection, Analysis, and Dissemination section in close cooperation with each other. The contents of this section are best provided in a tabular format. This section may be expanded as an annex.

G. Communications

This section describes the communication protocols and coordination procedures used between response organizations during emergencies and disasters. It discusses the framework for delivering communications support and how the jurisdiction's communications integrate into the regional or national disaster communications network. It does not describe communications hardware or specific procedures found in departmental SOPs / SOGs. Planners should identify and summarize separate interoperable communications plans. This section may be expanded as an annex and is usually supplemented by communications SOPs / SOGs and field guides.

H. Administration, Finance, and Logistics

This section covers general support requirements and the availability of services and support for all types of emergencies, as well as general policies for managing resources. Planners should address the following in this section of the plan: (1) References to intrastate and interstate MAAs, including the Emergency Management Assistance Compact; (2) Authorities for and policies on augmenting staff by reassigning public employees and soliciting volunteers, along with relevant liability provisions; (3) General policies on keeping financial records, reporting, tracking resource needs, tracking the source and use of resources, acquiring ownership of resources, and compensating the owners of private property used by the jurisdiction.

I. Plan Development and Maintenance

This section discusses the overall approach to planning and the assignment of plan development and maintenance responsibilities. This section should: (1) Describe the planning process, participants in that process, and how development and revision of different "levels" of the EOP (basic plan, annexes, and SOPs / SOGs) are coordinated during the preparedness phase; (2) Assign responsibility for the overall planning and coordination to a specific position; (3) Provide for a regular cycle of training, evaluating, reviewing, and updating of the EOP.

J. Authorities and References

This section provides the legal basis for emergency operations and activities. This section of the plan includes: (1) Lists of laws, statutes, ordinances, executive orders, regulations, and formal agreements relevant to emergencies (e.g., MAAs); (2) Specification of the extent and limits of the emergency authorities granted to the senior official, including the conditions under which these authorities become effective and when they would be terminated; (3) Pre-delegation of emergency authorities (i.e., enabling measures sufficient to ensure that specific emergency-related authorities can be exercised by the elected or appointed leadership or their designated successors); (4) Provisions for COOP and COG (e.g., the succession of decision-making authority and operational control) to ensure that critical emergency functions can be performed.

Section II - Emergency Support Function Annexes

These annexes contain detailed descriptions of the methods that government agencies and departments follow for critical operational functions during emergency operations. Functional annexes support the EOP as they do hazard-specific annexes. There are core functional support activities that should be incorporated, and specific functional support activities that support incident response. The essence of these support functions should be incorporated into plans, rather than be stand-alone. The checklists in this section can be used for emergency support function annexes.

A. ESF #1 - Transportation

(1) Describe/identify the process for monitoring and reporting the status of, and damage to, the transportation system and infrastructure as a result of an incident. (2) Describe alternative transportation solutions that can be implemented when systems or infrastructure are damaged, unavailable, or overwhelmed. (3) Describe the methods by which appropriate aviation, maritime, surface, railroad, and pipeline incident management measures will be implemented. (4) Describe the method of coordinating the restoration and recovery of the transportation systems and infrastructure.

B. ESF #2 - Communications

(1) Identify and describe the actions that will be taken to manage communications between the on-scene personnel/agencies (e.g., radio frequencies/tactical channels, cell phones, data links, command post liaisons, communications vehicle/van) in order to establish and maintain a common operating picture of the incident. (2) Identify and describe the actions that will be taken to identify and overcome communications shortfalls (e.g., personnel with incompatible equipment) with the use of alternative methods (e.g., Amateur Radio Emergency Services/Radio Amateur Civil Emergency Service at the command post/off-site locations, CB radios). (3) Identify and describe the actions that will be taken to manage communications between the on-scene and off-site personnel/agencies (e.g., shelters, hospitals, emergency management agency). (4) Identify and describe the actions that will be taken by 911/dispatch centers to support/coordinate communications for the on-scene personnel/agencies, including alternate methods of service if 911/dispatch is out of operation (e.g., resource mobilization, documentation, backup). (5) Describe the arrangements that exist to protect emergency circuits with telecommunications service priority for prompt restoration/provisioning. (6) Describe how communications are made accessible to individuals with communication disabilities working in emergency operations, in accordance with the Americans with Disabilities Act. (7) Identify and describe the actions that will be taken by an EOC to support and coordinate communications between the on- and off-scene personnel and agencies. (8) Describe / identify the interoperable communications plan and compatible frequencies used by agencies during a response (e.g., who can talk to whom, including contiguous jurisdictions and private agencies). (9) Identify and describe the actions that will be taken to notify neighboring jurisdictions when an incident occurs. (10) Describe how 24-hour communications are provided and maintained.

C. ESF #3 - Public Works and Engineering

(1) Identify and describe the actions that will be taken to determine qualified contractors offering recovery / restoration services. (2) Identify and describe the actions that will be taken to coordinate credentialing protocols so personnel have access to critical sites following an incident. (3) Identify and describe the actions that will be taken to identify, prioritize, and coordinate the work to repair/restore local roads, bridges, and culverts (e.g., along city, county, township, state, interstate, and U.S. routes). (4) Identify and describe the actions that will be taken to repair/restore local water and wastewater systems (e.g., water / waste treatment plants, water/sewer lines, public/private wells),

including providing temporary water distribution and wastewater collection systems until normal operations resume.

D. ESF #4 - Firefighting

(1) Describe the process used to detect and suppress wildland, rural, and urban fires resulting from, or occurring coincidentally with, an incident response. (2) Describe existing interstate and intrastate firefighting assistance agreements. (3) Describe the methods by which situation and damage assessment information will be transmitted through established channels.

E. ESF #5 - Emergency Management

(1) Describe the purpose and functions of an EOC during an emergency or declared disaster. (2) Describe/identify under what conditions the jurisdiction will activate a primary and/or alternate EOC and who makes this determination. (3) Identify the primary and alternate sites that will likely be used as an EOC for the jurisdiction (e.g., city hall, fire department, emergency management agency, dedicated facility). (4) Describe the process used to activate the primary or alternate EOC (e.g., staff notification, equipment setup), including the process for moving from one EOC to another. (5) Identify who is in charge of the EOC (e.g., emergency management agency director, senior official, fire / police chief, department/agency director), and describe how operations will be managed in the EOC. (6) Describe/identify the EOC staff and equipment requirements necessary for an EOC (e.g., first response liaisons, elected or appointed officials, support agencies, communications, and administrative support). (7) Identify and describe the actions that will be taken to gather and share pertinent information between the scene, outside agencies, and the EOC (e.g., damage observations, response priorities, resource needs), including sharing information between neighboring and state EOCs. (8) Describe the EOC's ability to manage an emergency response that lasts longer than 24 hours (e.g., staffing needs, shift changes, resource needs, feeding, and alternate power). (9) Identify and describe the actions that will be taken to transition from response to recovery operations. (10) Describe the process used to deactivate/close the EOC (e.g., staff releases, equipment cleanup, and documentation). (11) Identify the lead official and at least two alternates responsible for staffing each key position at the primary EOC, as well as the alternates (if different) to be consistent with NIMS. (12) Identify and describe the actions that will be taken to routinely brief senior officials not present in the EOC on the emergency situation (e.g., governor, commissioner, administrative judge, mayor, city council, trustees) and to authorize emergency actions (e.g., declare an emergency, request state and Federal assistance, purchase resources).

F. ESF #6 - Mass Care, Emergency Assistance, Housing, and Human Services

(1) Identify and describe the actions that will be taken to identify, open, and staff emergency shelters, including temporarily using reception centers while waiting for shelters to open officially. (2) Describe the agencies and methods used to provide essential care (e.g., food, water) to promote the well-being of evacuees throughout the entire process (including household pets and service animals). (3) Describe the partnership between the jurisdiction's emergency management agency, the animal control authority, the mass care provider(s), and the owner of each proposed congregate household pet sheltering facility. (4) Describe the agencies and methods used to provide care and support for institutionalized populations (e.g., long-term care and assisted living facilities, group homes), individuals with disabilities, and others with access and functional needs (e.g., medical and prescription support, personal assistance services, durable medical equipment, consumable medical supplies, childcare, transportation [including accessible transportation], foreign language interpreters), including their caregivers. (5) Describe how the jurisdiction will ensure physical and programmatic accessibility of shelter facilities, effective communication using multiple methods, full access to emergency services, and reasonable modification of programs or policies where needed. (6) Identify and describe the actions that will be taken to ensure that the Americans with Disabilities Act Accessibility Guidelines govern shelter site selection and operation. (7) Describe the method for ensuring adequate shelter space

allocation is provided for children, as well as individuals with disabilities and others with access and functional needs who may need additional space for assistive devices (e.g., wheelchairs, walkers). (8) Identify and describe the actions that will be taken to provide alternate shelter accommodations for evacuees from domestic violence shelters.

G. ESF #7 - Logistics Management and Resource Support

(1) Identify and describe the actions that will be taken for resource management in accordance with the NIMS resource typing and include the pre-positioning of resources to efficiently and effectively respond to an incident. (2) Describe the process used to identify, deploy, use, support, dismiss, and demobilize affiliated and spontaneous unaffiliated volunteers. (3) Describe the process used to manage unsolicited donations. (4) Describe plans for establishing logistical staging areas for internal and external response personnel, equipment, and supplies. (5) Describe plans for establishing points of distribution across the jurisdiction. (6) Describe plans for providing support for a larger, regional incident. (7) Describe strategies for transporting materials through restricted areas, quarantine lines, law enforcement checkpoints, and so forth that are agreed upon by all affected parties.

H. ESF #8 - Public Health and Medical Services

(1) Describe the agencies and methods used to maintain efficient surveillance systems supported by information systems to facilitate early detection, reporting, mitigation, and evaluation of expected and unexpected public health conditions. (2) Describe the agencies and methods used to identify the public health issues created by the disaster (e.g., food / water safety, biological concerns) and to prioritize how the issues will be managed, including how this process is coordinated with the incident command post/EOC (e.g., issue vaccinations, establish quarantines). (3) Describe the agencies and alternate methods used to provide potable water, bulk water, and temporary water distribution systems to the jurisdiction when the water systems are not functioning (e.g., private sources, boil orders, private wells). (4) Describe the agencies and methods used to provide alternate sources for human waste disposal (e.g., arrange portable latrines, encourage sharing with those who have their own septic systems). (5) Identify the lead agency for providing health and medical support to individuals with disabilities and others with access and functional needs. (6) Describe the mechanisms or processes to effectively identify children and families who will need additional assistance, as well as individuals with disabilities and others with access and functional needs, with their specific health-related needs in advance of, during, and following an emergency. (7) Identify and describe the actions that will be taken to secure medical records to enable children with disabilities and/or other special health care needs, as well as individuals with disabilities and others with access and functional needs, to receive health care and sustained rehabilitation in advance of, during, and following an emergency. (8) Identify and describe the actions that will be taken to assess and provide mental health services for the general public (including individuals with disabilities and others with access and functional needs) impacted by the disaster. (9) Identify and describe the actions that will be taken to assess and provide vector control services (e.g., insect and rodent controls, biological wastes/contamination, use of pesticides). (10) Identify and describe the actions that will be taken to assess and provide food production and agricultural safety services (e.g., conducting a coordinated investigation of food and agricultural events or agricultural or animal disease outbreaks).

I. ESF #9 - Search and Rescue

(1) Identify and describe the actions that will be taken to conduct structural collapse (urban) search and rescue, waterborne search and rescue, inland/wilderness search and rescue, and aeronautical search and rescue operations. (2) Identify and describe the actions that will be taken to monitor distress, communications, location of distressed personnel, coordination, and execution of rescue operations including extrication or evacuation along with the provisioning of

medical assistance and civilian services through the use of public and private resources to assist persons and property in potential or actual distress.

J. ESF #10 - Oil and Hazard Materials Response

(1) Describe the actions to prevent, minimize, or mitigate an oil or hazardous materials release. (2) Describe the methods to detect and assess the extent of contamination (including sampling and analysis and environmental monitoring). (3) Describe the methods to stabilize a release and prevent the spread of contamination. (4) Describe the options for environmental cleanup and waste disposition; implementation of environmental cleanup; and storage, treatment, and disposal of oil and hazardous materials.

K. ESF #11 - Agriculture and Natural Resources

(1) Describe the process to determine nutrition assistance needs, obtain appropriate food supplies, and arrange for delivery of the supplies. (2) Describe the plan to respond to animal and plant diseases and pests, including an outbreak of a highly contagious or economically devastating animal / zoonotic disease or an outbreak of a harmful or economically significant plant pest or disease. (3) Describe the methods to ensure the safety and security of the food supply. (4) Describe the response actions to preserve, conserve, rehabilitate, recover, and restore natural and cultural resources and historic properties.

L. ESF #12 - Energy

(1) Describe the process to address significant disruptions in energy supplies for any reason, whether caused by physical disruption of energy transmission and distribution systems, unexpected operational failure of such systems, or unusual economic or international political events. (2) Describe the process to address the impact that damage to an energy system in one geographic region may have on energy supplies, systems, and components in other regions relying on the same system. (3) Describe/identify the energy-centric critical assets and infrastructures, as well as the method to monitor those resources to identify and mitigate vulnerabilities to energy facilities.

M. ESF #13 - Public Safety and Security

(1) Describe the method by which public safety and security resources will be provided to support incident operations, including threat or pre-incident and post-incident situations. (2) Describe the process to determine public safety and security requirements and to determine resource priorities. (3) Describe the process to maintain communication with supporting agencies to determine capabilities, assess the availability of resources, and track resources.

N. ESF #14 - Long – Term Community Recovery

(1) Describe the coordination mechanisms and requirements for post-incident assessments, plans, and activities. (2) Describe the methods of identifying long-term recovery needs of special needs populations and incorporating these needs into recovery strategies. (3) Describe the methods of identifying long-term environmental restoration issues. (4) Describe the method of coordination with animal welfare and agricultural stakeholders and service providers in long-term community recovery efforts.

O. ESF #15 - External Affairs

(1) Identify and describe the actions that will be taken to provide continuous and accessible public information about the disaster (e.g., media briefings, press releases, cable interruptions, EAS, text messages, door-to-door warnings), secondary effects, and recovery activities. (2) Identify and describe the actions that will be taken to ensure that information provided by all sources includes the content necessary to enable reviewers to determine its authenticity and potential validity. (3) Identify and describe plans, programs, and systems to control rumors by correcting misinformation rapidly. (4) Identify and describe the actions that will be taken to inform individuals with sensory, intellectual, or cognitive disabilities; individuals with limited English proficiency; and others with access and functional needs in the workplace, public venues, and in their homes. (5) Describe the role of a public information officer and the actions this

person will take to coordinate public information releases (e.g., working with media at the scene, using a Joint Information Center, coordinating information among agencies/elected and appointed officials), including household pet evacuation and sheltering information. (6) Describe how responders/local officials will use and work with the media during an emergency (e.g., schedule press briefings; establish media centers on-scene; control access to the scene, responders, and victims). (7) Include prepared public instructions for identified hazards, including materials for managers of congregate care facilities, such as childcare centers, group homes, assisted living centers, and nursing homes. (8) Identify and describe the actions that will be taken to manage

P. Other ESF – type annexes can be added at the discretion of the jurisdiction

Section III - Support Annexes

A. Continuity of Government / Operations

Continuity of government (COG) / continuity of operations (COOP) may have a separate plan from the EOP. If a separate COG / COOP plan is used, it should be identified in the EOP. (1) Describe essential functions, such as providing vital services, exercising civil authority, maintaining the safety and well-being of the populace, and sustaining the industrial/economic base in an emergency. (2) Describe plans for establishing recovery time objectives, recovery point objectives, or recovery priorities for each essential function. (3) Identify personnel and/or teams needed to perform essential functions. (4) Describe orders of succession and delegations of authority. (5) Describe continuity/alternate facilities and continuity communications methods. (6) Describe plans for vital records and human capital management. (7) Describe plans for devolution or direction and control. (8) Describe plans for reconstitution of operations.

B. Warning

(1) Identify and describe the actions that will be taken to initiate/disseminate the initial notification that a disaster or threat is imminent or has occurred (e.g., Emergency Alert System [EAS] activation, door-to-door warnings, sirens, cable/TV messages). (2) Describe the use of emergency condition levels in the public notification process (e.g., snow emergencies, HAZMAT incidents, nuclear power plant incidents). (3) Identify and describe the actions that will be taken to alert individuals with sensory or cognitive disabilities and others with access and functional needs in the workplace, public venues, and in their homes. (4) Include pre-scripted EAS messages for identified hazards.

C. Population Protection

(1) Identify and describe the actions that will be taken to coordinate evacuations and sheltering-in-place for all segments of the population, including children, individuals with disabilities, and others with access and functional needs. (2) Describe the protocols and criteria used to decide when to recommend evacuation or sheltering-in-place. (3) Describe the conditions necessary to initiate an evacuation or sheltering-in-place and identify who has the authority to initiate such action. (4) Identify and describe the actions that will be taken to conduct the evacuation (e.g., of high-density areas, neighborhoods, high-rise buildings, subways, airports, schools, special events venues, areas with a high concentration of children and individuals with disabilities) and to provide security for the evacuation area. (5) Identify and describe the actions that will be taken to perform advanced/early evacuation, which is often necessary to accommodate children and others with mobility issues. (6) Identify and describe the actions that will be taken to provide safe evacuation/transportation assistance to unaccompanied minors. (7) Identify and describe the actions that will be taken to track unaccompanied minors and to reunite children with their families. (8) Identify and describe the actions that will be taken to protect target at-risk groups and/or facilities (e.g., racial, ethnic, religious) in the event of a terrorism alert. (9) Describe the plan for receiving those evacuated as a result of hazards in neighboring jurisdictions, including household pets and service animals. (10) Describe the methods used to keep children and others with disabilities with their caregivers, mobility devices, other durable medical equipment, and/or service animals during an evacuation.

D. Financial Management

Identify and describe the actions that will be taken to ensure that funds are provided expeditiously and that financial operations are conducted in accordance with established law, policies, regulations, and standards.

E. Mutual Aid / Multi-Jurisdictional Coordination

Describe the processes to establish and execute mutual aid agreements and multijurisdictional coordination in support of incident response.

F. Private Sector Coordination

(1) Describe the processes to ensure effective coordination and integration with the private sector, both for-profit and not-for-profit, engaged in incident response and recovery activities. (2) Describe the processes to ensure a shared situational awareness across sectors and between the jurisdiction and the private sector as a whole.

G. Volunteer and Donations Management

(1) Describe the method by which unaffiliated volunteers and unaffiliated organizations will be managed and their resources applied to incident response and recovery activities. (2) Identify and describe the actions that will be taken to establish and staff donation management functions (e.g., set up toll-free hotlines, create databases, appoint a donations liaison/office, use support organizations). (3) Identify and describe the actions that will be taken to verify and/or vet voluntary organizations and/or organizations operating relief funds. (4) Identify and describe the actions that will be taken to collect, sort, manage, and distribute in-kind contributions, including methods for disposing of or refusing goods that are not acceptable. (5) Identify and describe the actions that will be taken to coordinate donation management issues with neighboring districts and the state's donations management system. (6) Describe the process used to tell the general public about the donations program (e.g., instructions on items to bring and not bring, scheduled drop-off sites and times, the way to send monies), including a process for issuing routine updates. (7) Identify and describe the actions that will be taken to handle the spontaneous influx of volunteers. (8) Identify and describe the actions that will be taken to receive, manage, and distribute cash contributions. (9) Pre-identify sites that will likely be used to sort and manage in-kind contributions (e.g., private warehouses, government facilities).

H. Worker Safety and Health

Describe the processes to ensure response and recovery worker safety and health during incident response and recovery.

I. Prevention and Protection

This process is used to identify prevention activities designed to reduce the risk of terrorism. (1) Describe the process for managing and ensuring operational and threat awareness among government organizations and sectors. (2) Describe the process for sharing information between the fusion center(s) and the EOC(s). (3) Describe the integration of prevention activities in support of response and recovery operations. This process is used to identify protection activities designed to reduce the risk of terrorism. (1) Describe the process for managing the CIKR identification and protection efforts involving all threats and hazards. 92) Describe the integration of protection activities in support of response and recovery operations.

Section IV – Hazard-, Threat-, or Incident Specific Annexes

[These include those hazards or threats that historically or potentially could impact your jurisdiction. Remember a hazard in a neighboring jurisdiction could have consequences for your jurisdiction. For each Annex, include the description of the hazard or threat (a good source of information in either the jurisdiction's or the State Natural Hazards Mitigation Plan, http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251595686517), agencies involved and their specific responsibilities, concept of operations, information needs, etc.]

A. Avalanche
B. Biological
C. Civil Unrest
D. Dam break
E. Earthquake
F. Flooding
G. Landslide
H. Severe Winter Weather
I. Terrorism
J. Tornado
K. Wildland Fire

Appendix D - EOP Basic Plan Template

Basic Emergency Operations Planning

Emergency Operations Basic Plan Template

National Preparedness Directorate (NPD)

September 2009

FEMA

How to Use this Template

The Basic Plan Template follows the format established in the Federal Emergency Management Agency's (FEMA) *Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining State, Territorial, Tribal, and Local Government Emergency Plans*, March 2009. Predecessor materials to CPG 101 can be traced back to the 1960s-era Federal Civil Defense Guide. Long-time emergency management (EM) practitioners will also recognize the influence of the *Civil Preparedness Guide 1-8, Guide for the Development of State and Local Emergency Operations Plans* and the *State and Local Guide (SLG) 101: Guide for All-Hazard Emergency Operations Planning*. Local, State, territorial, and tribal governments should refer to CPG 101 for detailed guidance regarding emergency operations planning.

Please note that this template contains guidance language and sample language that can be discarded or used in part or in whole at the decision of the jurisdiction. **Bold** text in parentheses is guidance information and regular text is sample language. Guidance information should be deleted before finalizing your Emergency Operations Plan (EOP), and sample language should be modified to reflect your jurisdiction. All underlined text in parentheses must be replaced with jurisdiction-specific input, such as the name of your jurisdiction, name of your emergency management agency, etc.

This template follows a traditional, functional EOP format. Within the template are formatting functions that create main headings, subheadings, and multiple listings with ease. The following is a sample portion of the basic plan with instructions for using the template in an efficient and effective manner. All instructions will be in bold and enclosed in brackets. Following the basic plan sample is a quick reference chart of features and functions, with their corresponding actions.

I. Purpose, Scope, Situation, and Assumptions [*At the **main heading level**, Roman numeral bullet numbering is used, and is defined as **Outline** in the **STYLE** feature. To enter body text following a main heading, hit the **ENTER** key and change the **STYLE** feature to **Body Text**. To proceed to the next main heading and to the next Roman numeral, hit the **ENTER** key and change the **STYLE** feature to **Outline**.*]

A. [*At the **subheading level**, the template uses capitalized letters and is defined as **OL2** in the **STYLE** feature. To get to this level after writing body text, hit the **ENTER** key and change the **STYLE** feature to **OL2**. If a subheading is needed immediately following a main heading, then simply hit the **ENTER** key and then the **TAB** key and the subheading style will change and update automatically. If text is needed following the **subheading level**, hit the **ENTER** key and change the **STYLE** feature to **OL2_Text**. The next section demonstrates these features. This template is designed to continue in this manner through outline level 7 (i.e., **OL7** and **OL7_Text**).*]

B. Purpose

It is the purpose of this plan to define the actions and roles necessary to provide a coordinated response within (Name of Jurisdiction).

This plan provides guidance to agencies within (Name of Jurisdiction) with a general concept of potential emergency assignments before, during, and following emergency situations.

C. Scope

Explicitly state the scope of emergency and disaster response to which the plan applies, and the entities (departments, agencies, private sector, citizens, etc.) and geographic areas to which it applies.

D. Situation Overview

1. [*At the **multiple listing level**, the template uses a standard numbering format and is defined as **OL3** in the **STYLE** feature. As with moving from a main heading to a subheading, hitting the **TAB** key after a subheading will change and update the new multiple listings automatically.*]

2. Characteristics

3. Hazard Profile

4. [T*o move back and create a new subheading or main heading after completing a multiple listing, hit the **ENTER** key and change the*

STYLE *feature to either* ***OL2*** *for a subheading or* ***Outline*** *for a main heading.*]

E. Planning Assumptions

1. Terrorist attacks may be directed at government facilities, public and private institutions, business or industry, transportation, and individuals or groups. Such acts may involve arson, shootings, and bombings, including the use of chemicals, biological agents, radiological dispersion devices, or nuclear detonations.

2. Terrorist attacks may or may not be preceded by a warning or a threat, and may appear at first to be an ordinary hazardous materials incident. Attacks may occur at multiple locations and may be accompanied by fire, explosion, or other acts of sabotage.

3. Devices may be set off to attract and then injure emergency responders.

4. Effective response to the use of chemical, biological, radiological, nuclear, and high-yield explosives (CBRNEs) may require:

   a. [*At times, a* ***multiple sub-listing level*** *is required. To achieve this, the template uses lowercase lettering and is defined as* ***OL4*** *in the* ***STYLE*** *feature. As with moving from a subheading to a multiple listing, hitting the* ***TAB*** *key after a multiple listing will change and update a new multiple sub-listing automatically. To continue adding multiple sub-listings, hit the* ***ENTER*** *key after each sub-listing until the listing is complete. To move back to another heading or listing level, change the* ***STYLE*** *feature to* ***OL3*** *for the* ***multiple listing level****,* ***OL2*** *for the* ***subheading level****, or* ***Outline*** *for the* ***main heading level****.*]

   b. Specialized equipment to detect and identify chemical, biological, or radiological hazards.

Template User Instructions Quick Reference

Feature/Function	Corresponding Action
ENTER Key	Moves to next sequential item within a specific heading or listing level (e.g., moves from **I. Purpose** to **II. Concept of Operations**)
TAB Key	Changes to the item within the next heading or listing level (e.g., moves from **II. Concept of Operations** to **A. Location**)
SHIFT + TAB Keys	Changes to the item within the previous heading or listing level (e.g., moves from **A. Location** to **II. Concept of Operations**)
STYLE Feature: • **Outline** • **Body Text** • **OL2** • **OL3** • **OL4**	**I. Main Heading Level (Outline)** Paragraph containing subject matter specific to the topic covered in the Annex. **(Body Text)** **A. Subheading Level (OL2)** 1. **Multiple Listing Level (OL3)** a. **Multiple Sub-Listing Level (OL4)**

Promulgation Statement

(The promulgation statement enters the plan "in force." Promulgation is the process that officially announces/declares a plan (or law). It gives the plan official status and gives both the authority and the responsibility to organizations to perform their tasks. It should also mention the responsibilities of tasked organizations with regard to preparing and maintaining standard operating procedures and should commit those organizations to carry out the training, exercises, and plan maintenance needed to support the plan. The promulgation document also allows the chief executives to affirm their support for emergency management. The following is sample language.)

(NAME OF CHIEF ELECTED OFFICIAL)
(TITLE)
(NAME OF JURISDICTION)

(NAME OF JURISDICTION) EMERGENCY OPERATIONS PLAN
PROMULGATION

The primary role of government is to provide for the welfare of its citizens. The welfare and safety of citizens is never more threatened than during disasters. The goal of emergency management is to ensure that mitigation, preparedness, response, and recovery actions exist so that public welfare and safety is preserved.

The (Name of Jurisdiction) Emergency Operations Plan provides a comprehensive framework for (Jurisdiction)-wide emergency management. It addresses the roles and responsibilities of government organizations and provides a link to local, State, Federal, and private organizations and resources that may be activated to address disasters and emergencies in (Name of Jurisdiction).

The (Name of Jurisdiction) Emergency Operations Plan ensures consistency with current policy guidance and describes the interrelationship with other levels of government. The plan will continue to evolve, responding to lessons learned from actual disaster and emergency experiences, ongoing planning efforts, training and exercise activities, and Federal guidance.

Therefore, in recognition of the emergency management responsibilities of (Jurisdiction) government and with the authority vested in me as the Chief Executive Officer of (Name of Jurisdiction), I hereby promulgate the (Name of Jurisdiction) Emergency Operations Plan.

_____

(Name)
(Title), (Name of Jurisdiction)

Approval and Implementation

(The approval and implementation page introduces the plan, outlines its applicability, and indicates that it supersedes all previous plans. It should also include a delegation of authority for specific modifications that can be made to the plan and by whom they can be made without the senior official's signature. It should include a date and must be signed by the senior official(s) such as the governor, Tribal leader(s), mayor, county judge, commissioner. The following is sample language.)

This plan supersedes the (Name of Jurisdiction) Emergency Operation Plan dated (Month, Day, Year).

The transfer of management authority for actions during an incident is done through the execution of a written delegation of authority from an agency to the incident commander. This procedure facilitates the transition between incident management levels. The delegation of authority is a part of the briefing package provided to an incoming incident management team. It should contain both the delegation of authority and specific limitations to that authority.

The (Name of Jurisdiction) Emergency Operations Plan delegates the (Chief Elected Official)'s authority to specific individuals in the event that he or she is unavailable. The chain of succession in a major emergency or disaster is as follows:

1. Emergency Management Director
2. (Position Title)
3. (Position Title)
4. (Position Title)

_____
Date

_____
(Name)
(Senior Official Title), (Name of Jurisdiction)

Signature Page

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

(Name), (Title)
(Jurisdiction)

Record of Changes

Change #	Date	Part Affected	Date Posted	Who Posted

Record of Distribution

Plan #	Office/Department	Representative	Signature
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Basic Plan

I. Purpose, Scope, Situation, and Assumptions

(The purpose section should describe the purpose of the plan. The scope section should describe to whom the plan applies. The situation overview should describe the geographic characteristics and hazards. The assumption section should include reasonable statements assumed to be true. The following is sample language.)

A. Purpose

It is the purpose of this Plan to define the actions and roles necessary to provide a coordinated response within (Name of Jurisdiction). This plan provides guidance to agencies within (Name of Jurisdiction) with a general concept of potential emergency assignments before, during, and following emergency situations. It also provides for the systematic integration of emergency resources when activated and does not replace county or local emergency operations plans or procedures.

B. Scope

This plan applies to all participating departments and agencies of the jurisdictions contained within the geographical boundary of (Name of Jurisdiction).

C. Situation Overview

1. Characteristics
    a. Location
        i. (Name of Jurisdiction) includes (Name of City/County 1) and (Name of City/County 2).
    b. Geographic
        i. (Name of City/County 1) is the fifth largest (City/County) in the state. (Name of City/County 2) lies west of (Name of City/County 1) and is the gateway to the jurisdiction. A map illustrating the areas covered by the plan is shown as follows.
    c. Demographic
        i. (Name of Jurisdiction) has a population of 950,000 residents as of July 1, 2007. Daytime population in (Name of Jurisdiction) exceeds 1,020,000 due to large commercial and industrial areas in the southeastern portion of the jurisdiction. The

jurisdiction is also a popular base for outdoor adventurists, attracting a large number of tourists each year.

d. Designated Areas of Interest

i. Two State parks within the jurisdiction are visited by over 1 million tourists during the months of June, July, August, and September.

e. Special Events

i. In mid-August, (Name of Jurisdiction) hosts the State County Fair for two weeks. The fair is usually attended by 750,000 people.

f. Economic Base and Infrastructure

i. (Name of Jurisdiction)'s economy has evolved from its traditional tourism and textile dependence into one of great diversity. Today's commercial and industrial manufacturing base is complemented by solid and growing trade and service sectors. Much tourism activity is centered around (Capital City/County Seat). This economic diversification has helped create new employment and smooth the impact of cyclical swings. As a result, unemployment rates have been below State and national averages since 1987. Finances have improved with three years of surplus operations and are expected to be further strengthened by solid operating results in 2008.

2. Hazard Profile

a. Potential Hazards

(City/County/State) is subjected to the effects of many disasters, varying widely in type and magnitude from local communities to statewide in scope.

Disaster conditions could be a result of a number of natural phenomena such as avalanches, earthquakes, floods, severe thunderstorms, high water, drought, severe winter weather, fires (including urban, grass, and forest fires), epidemics, severe heat, or high winds. Apart from natural disasters, (City/County/State) is subject to a myriad of other disaster contingencies, such as derailments, aircraft accidents, transportation accidents involving chemicals and other hazardous materials, plant explosions, chemical oil and other hazardous material spills, leaks or pollution problems,

dumping of hazardous wastes, building or bridge collapses, utility service interruptions, energy shortages, civil disturbances or riots, terrorism, warfare, applicable criminal acts, or a combination of any of these.

3. Vulnerability Assessment

   a. (Name of City/County 1)

      The vulnerability assessment checklist for (Name of City/County 1) is shown below.

   b. (Name of City/County 2)

      The vulnerability assessment checklist for (Name of City/County 2) is shown below.

D. Planning Assumptions

1. Effective prediction and warning systems have been established that make it possible to anticipate certain disaster situations that may occur throughout the jurisdiction or the general area beyond the jurisdiction's boundaries.

2. It is assumed that any of the disaster contingencies could individually, or in combination, cause a grave emergency situation within (Name of Jurisdiction). It is also assumed that these contingencies will vary in scope and intensity, from an area in which the devastation is isolated and limited to one that is wide-ranging and extremely devastated. For this reason, planning efforts are made as general as possible so that great latitude is available in their application, considering they could occur in several locations simultaneously.

3. Initial actions to mitigate the effects of emergency situations or potential disaster conditions will be conducted as soon as possible by the local government.

4. Assistance to the affected jurisdictions(s) by response organizations from another jurisdiction(s) is expected to supplement the efforts of the affected jurisdiction(s) in an efficient, effective, and coordinated response when jurisdiction officials determine their own resources to be insufficient.

5. Federal and State disaster assistance, when provided, will supplement, not substitute for, relief provided by local jurisdictions.

6. It is the responsibility of officials under this plan to save lives, protect property, relieve human suffering, sustain survivors, repair essential facilities, restore services, and protect the environment.

7. When a jurisdiction receives a request to assist another jurisdiction, reasonable actions will be taken to provide the assistance as requested.

II. Concept of Operations

(The concept of operations section should describe the general sequence of the planned response.)

A. General

(This section should contain general information about the tasks that need to be completed to ensure an effective response. This section can also serve as an introduction to the response tasks outlined below. The tasks below represent a logical flow of response from the time an impending or actual emergency or disaster situation is perceived through recovery.)

1. Communications is maintained between affected jurisdictions and area emergency management branch offices. Branch office personnel may respond to the jurisdiction to facilitate ongoing information exchange.

2. (City/County) commissioners may declare local states of emergency and request State assistance. All requests for State assistance should go through the local emergency management area coordinator and the appropriate emergency management branch manager to the State Emergency Operations Center (EOC).

3. When the State EOC is activated, the (Name of Emergency Management Agency) becomes the office of primary responsibility for the State Emergency Response Team (SERT). The director of emergency management will normally serve as SERT leader.

4. (County) EOCs will serve as clearinghouses for response and recovery operations and for deployment of resources within the counties, including cities within the counties.

5. Planning for recovery will be implemented at the same time local governments are taking the emergency response actions necessary to protect the public. Preparations will be made for rapid deployment of resources necessary to facilitate recovery.

B. Hazard Control and Assessment

(This section should describe, in general, the capabilities and processes the jurisdiction has in place to identify, analyze, gain control of, and monitor hazards that may affect the jurisdiction. The response activities listed below normally take place at a scene. Not all emergency and disaster situations have a scene, so these activities apply to many but not all hazards. The first activity, which is to perceive the threat, applies to all hazards. The activities are ordered steps listed below. The following is sample language.)

1. Perceive the threat
2. Assess the hazard
3. Select control strategy
4. Control hazard
5. Monitor hazard

C. Protective Action Selection

(This section should describe, in general, the capabilities and processes the jurisdiction has in place to select protective action strategies and actions. The response activities listed below normally take place at an EOC. In some cases, information from the scene must be communicated to the EOC for these tasks to be done properly. Ordered steps for protective action selection are as follows. The following is sample language.)

1. Analyze the hazard
2. Determine protective action
3. Determine public warning
4. Determine protective action implementation plan

D. Public Warning

(This section should describe, in general, the capabilities and processes the jurisdiction has in place to disseminate public warning messages to the public as to the nature of the hazard, the timing, and the recommended or required protective actions the public should implement. The following is sample language.)

1. Determine message content
2. Select appropriate public warning system(s)

3. Disseminate public warning

E. Protective Action Implementation

(This section should describe, in general, the capabilities and processes the jurisdiction has in place to implement the range of protective actions that may be required for various hazards. The response activities listed below are examples of activities that may be required to implement protective actions in response to certain types of hazards. The following is sample language.)

1. Monitor progress of protective action implementation
2. Control access and isolate danger area
3. Evacuation support
4. Decontamination support
5. Medical treatment
6. Special population support
7. Search and rescue

F. Short-term Needs

(This section should describe, in general, the capabilities and processes the jurisdiction has in place to address the short-term needs of the population once the population has been protected from the hazard. The response activities listed below are examples of activities that may be required in the early stages after a disaster has occurred. These activities can help stabilize the jurisdiction and the affected population. The following is sample language.)

1. Shelter operations
2. Unite families
3. Continued medical treatment
4. Increase security
5. Stabilize the affected area

G. Long-term Needs

(This section should describe, in general, the capabilities and processes the jurisdiction has in place to restore the jurisdiction and its affected population to a "normal" state. The response activities

listed below are examples of activities that may be addressed in this section. The following is sample language.)

1. Re-entry

2. Recovery

III. Organization and Assignment of Responsibilities

(The organization and assignment of responsibilities section establishes the organizations and agencies that will be relied upon to respond to a disaster or emergency situation. This section also includes tasks that these organizations and agencies are expected to perform. The following is sample language.)

A. General

Most departments/agencies of government have emergency functions in addition to their normal, day-to-day duties. These emergency functions usually parallel or complement normal functions. Each department/agency is responsible for developing and maintaining its own emergency management procedures.

B. Organization

(The EOP should include the organizations and agencies that should be typically involved in an emergency. The EOP should ensure that any unique organizational arrangements pertinent to the emergency function are adequately described. Several strata of organizations should be included. Each organization should be listed separately and by its official title. The following is an example of the types of agencies and organizations included in many EOPs.)

1. Chief elected officials

2. Homeland security and emergency management agencies

3. Law enforcement agencies

4. Fire departments

5. Emergency medical services agencies

6. Health departments

7. Hospitals

8. Public works agencies

9. Departments of education

10. Legal department

11. Finance department

12. Local emergency planning committee

13. Office of family support or social services

C. Assignment of Responsibilities

(Primary and supporting emergency function responsibilities should be assigned to specific departments, agencies, and other organizations. The Basic Plan assigns general responsibilities for emergency functions during emergencies. These tasks should be clearly defined and assigned to the departments and agencies that have the capability to perform them. Coordination requirements should also be described. The assignment of responsibilities listed below is an example of what can be found in many emergency operations plans, but remember that each assignment of responsibilities list must be tailored for each particular jurisdiction. In order to be compliant with the National Incident Management System (NIMS), this section should pre-designate functional area representatives to the EOC or to work within the multi-agency coordination system. A simple statement indicating that each organization listed below will send a representative to the EOC upon activation of the EOP will ensure that the plan is NIMS compliant.)

1. Chief Elected Officials
    a. Disaster declarations
    b. Evacuation orders
    c. Re-entry decisions
    d. Other protective action decisions as necessary

2. Homeland Security and Emergency Management Agencies
    a. EOC staffing and functioning
    b. Communications
    c. Operations of the shelter system in conjunction with the American Red Cross
    d. Emergency public information
    e. Alert and warning systems
    f. Assistance from other jurisdictions
    g. State assistance
    h. Federal assistance

i. Emergency control and use of resources

j. Homeland security and emergency preparedness training and education

k. Rumor control

l. Damage assessment

m. Comprehensive homeland security and emergency preparedness planning

3. Law Enforcement Agencies

a. Maintaining law and order

b. Controlling traffic

c. Protecting vital installations

d. Controlling and limiting access to the scene of the disaster

e. Supplementing communications

f. Assisting with all evacuation efforts

g. Search and rescue

4. Fire Departments

a. Providing fire protection and the combating of fires

b. Search and rescue

c. Decontamination

d. Damage assessment

5. Emergency Medical Services Agencies

a. Emergency medical transportation

b. Emergency medical treatment

c. Triage or assisting with triage

d. Assisting with special needs evacuation

6. Health Departments

a. Emergency medical care information and coordination

b. Emergency hospital treatment information and coordination

c. Medical support to shelters

d. Health advisories

e. Identification of local health facilities, including hospitals, clinics, dialysis centers, and nursing or rehabilitation centers, and supplying and using medical and health items

f. Identification of special needs populations, including the elderly and very young, and populations requiring specific life-saving services (e.g., dialysis or assistance with breathing)

g. Emergency interment coordination

h. Insect and rodent control

i. Pest control as required

j. Inoculations for the prevention of disease

k. Sanitation

7. Hospitals

a. Emergency medical care

b. Limited on-site decontamination

c. Hospital evacuation

d. Traditional hospital medical services

8. Public Works Agencies

a. Maintaining designated major streets and avenues, highways, and other designated routes of travel

b. Assisting with heavy rescue

c. Decontamination

d. Engineering services as required

e. Transportation

f. Debris removal

g. Inspection of shelter sites for safe occupancy

h. Inspection of damaged buildings, public and private, for safe occupancy

i. Enforcement of building codes

j. Maintenance of vehicles and other essential equipment of the various departments and agencies

k. Development of a plan of priorities to be used during the period of increased readiness that addresses the repair of vehicles and equipment

l. Maintenance of a reserve supply of fuel

m. Provisions for the immediate repair of emergency service vehicles and equipment, both in the field and in the shop, as the situation permits

9. Departments of Education
    a. Providing the use of facilities for emergency public education
    b. Providing facilities for emergency housing of evacuees and relief forces
    c. Providing facilities for emergency first aid stations, emergency hospitals, or emergency morgues
    d. Providing personnel for shelter managers and staff
    e. Providing recreation plans for shelter occupants' use during shelter-stay period
    f. Coordinating transportation

10. Legal Department
    a. Providing legal advice as required
    b. Performing other necessary legal functions
    c. Serving as a liaison with other legal and judicial agencies and sections of the government

11. Finance Department
    a. Maintaining economic stabilization as required
    b. Maintaining a list of suppliers, vendors, and items of critical emergency need (through the appropriate procurement division)

12. Local Emergency Planning Committee
    a. Furnishing information, including maps or materials, as needed, for the emergency management agency or emergency preparedness coordinator. This includes Tier II reports and other industry-specific information to produce general detailed planning for chemical, transportation, or industrial accidents.
    b. Augmenting EOC staff as necessary

13. Office of Family Support or Social Services
    a. Supporting shelter managers
    b. Emergency welfare services
    c. Emergency lodging
    d. Emergency feeding
    e. Emergency clothing

f. Emergency registration and inquiry

g. Coordinating services for the area homeless population

h. Coordinating religious services

i. Coordinating private welfare groups

j. Identifying non-English-speaking persons and provisions for translation

k. Identifying special needs population (by culture, language, or age-specific requirements)

l. Maintaining an up-to-date list and supporting memorandums of agreement (MOAs) with shelter facilities and their points of contact

D. Support Functions

(This section describes responsibilities or capabilities of other entities beyond direct jurisdictional control that are known to support, or are capable of supporting, disaster response or recovery within the jurisdiction. Examples of some support functions are shown below.)

1. Support from the National Guard may be requested through the State office of emergency management. Military assistance will complement and not be a substitute for local participation in emergency operations. Military forces will remain at all times under military command, but will support and assist response efforts.

2. Support from other State government departments and agencies may be made available in accordance with the State plan.

3. Private sector organizations within the jurisdiction may assist with a wide variety of tasks based on their capabilities.

4. Volunteer agencies, such as the American Red Cross, local church/synagogue congregations, and assistive organizations, such as the Salvation Army, are available to give assistance with sheltering, feeding, and other issues, as necessary.

5. Assistance from surrounding jurisdictions may be available through the execution of a memorandum of understanding (MOU) or MOA.

E. Continuity of Government

(This section should describe the essential elements of the EOP for maintaining continuity of government (COG) in the jurisdiction. If a separate plan has been developed for continuity of operations (COOP)

and COG for the jurisdiction, this section should reference that plan. Effective comprehensive emergency management operations depend upon two important factors to ensure COG from the highest to lowest levels: (1) lines of succession for officials/agency heads/authorized personnel and (2) preservation of records. The following is sample language.)

1. Succession of Command

   Describes the hierarchy of command succession at the State and local levels.

   a. State Government Succession

      This will be arranged in accordance with the State Constitution. In general, the line of succession may be designated in a manner similar to the following:

      i. Governor

      ii. Lieutenant Governor

      iii. Secretary of State

      iv. Attorney General

      v. Treasurer

      vi. Presiding Officer of the State

      vii. Presiding Officer of the House of Representatives

   b. Local Government Succession

      Each jurisdiction has its own local government succession that usually is referred to within the local EOP.

2. Relocation of Government

   Each jurisdiction is responsible for designating facilities that will accommodate the relocation of government. Refer to local EOPs for individual jurisdictions.

3. Preservation of Records

   a. State Level

      Each agency/department is responsible for maintaining and recording all legal documents affecting the organization and administration of emergency management functions. It is the further responsibility of State officials to ensure that all records are secure and protected from elements of damage or destruction at all times.

   b. Local Level

It is the responsibility of elected officials to ensure that all legal documents of both public and private nature recorded by the designated official (i.e., tax assessor, sheriff's office) be protected and preserved in accordance with applicable State and local laws. Examples include ordinances, resolutions, meeting minutes, land deeds, and tax records.

IV. Direction, Control, and Coordination

(This section should describe the framework for all direction, control, and coordination. The following is sample language.)

A. Authority to Initiate Actions

1. Describe who is responsible for activating the EOP. The decision will be made by the responsible public official(s) and the on-scene commander within the jurisdiction.

2. Assign responsibility for implementation of the EOP.

B. Command Responsibility for Specific Actions

1. General guidance of emergency operations

   Assign responsibility for general guidance of emergency operations.

2. Direction of response

   Responsible for overall direction of the disaster response activities of all of the jurisdiction's departments and agencies. During emergencies, those responsibilities will be carried out normally from the EOC.

   a. Each jurisdiction's chief elected official has the responsibility for addressing threats to his or her jurisdiction. This authority shall include, but not be limited to, the declaration of an emergency condition or disaster declaration within the political jurisdiction.

   b. Each homeland security and emergency preparedness director will act as the chief advisor to his jurisdiction's chief elected official during any declared emergency affecting the people and property of the jurisdiction. Various agencies and departments under the direction of the jurisdiction's homeland security and emergency preparedness agency director will conduct emergency operations.

   c. In order to be NIMS compliant, information in this section should include, where required by law, that a State agency

assumes command of an incident scene in this section. This section should also include information about the agency having designated personnel trained in the NIMS Incident Command System (ICS).

d. State and Federal officials will coordinate their operations through the jurisdiction's elected or appointed officials or their designated representatives.

3. Incident Command System

The local incident command structures are responsible for directing on-scene emergency operations and maintaining command and control of on-scene incident operations. If a disaster affects multiple widely separated facilities or jurisdictions, separate incident command operations and an area command may be set up.

4. Assistance

If the jurisdiction's own resources are insufficient or inappropriate to respond to the emergency situation, a request may be made for assistance from other jurisdictions, the State, or Federal government. All response agencies are expected to fulfill mission assignments directed by the incident commander.

V. Information Collection and Dissemination

(This section describes the required critical or essential information common to all operations identified during the planning process. In general terms, it identifies the type of information needed, where it is expected to come from, who uses the information, how the information is shared, the format for providing the information, and any specific times the information is needed.)

A. Disaster information managed by the (Name of Jurisdiction) Emergency Operations Center is coordinated through agency representatives located in the EOC. These representatives collect information from and disseminate information to counterparts in the field. These representatives also disseminate information within the EOC that can be used to develop courses of action and manage emergency operations.

B. Detailed procedures that identify the type of information needed, where it is expected to come from, who uses the information, how the information is shared, the format for providing the information, and specific times the information is needed are maintained at the (Name of Jurisdiction) Emergency Operations Center.

VI. Communications

(This section describes communication protocols between response organizations and coordination procedures used during emergencies and disasters. It does not describe communications hardware or specific procedures found in departmental standard operating procedures (SOPs). The following is sample language.)

A. Communication protocols and coordination procedures are described in detail in the (City/County/State) (Name of Communications Plan). Please refer to this plan for additional information.

VII. Administration, Finance, and Logistics

(This section should describe administration, finance, and logistics policies that support the implementation of the plan. At a minimum, this section should contain information about agreements and understandings that support regional response. The following is sample language.)

A. General Policies

This section outlines general policies for administering resources, including the following:

1. Appointment of Officials

   Identify the positions of officials who have been appointed to participate in the decision-making process.

2. Funding and Accounting

   Reference should be made to administrative requirements that are applicable to emergency operations (e.g., emergency purchasing procedures), which appear in other documents.

3. Records and Reports

   The plan should include requirements for tracking the source and use of resources and expenditures.

   a. Responsibility for submitting local government reports to the State office of homeland security and emergency preparedness rests with each jurisdiction's homeland security and emergency preparedness director.

   b. Each jurisdiction's homeland security and emergency preparedness director maintains records of expenditures and obligations in emergency operations. They should also support the collection and maintenance of narrative and long-type records of response to all declared disasters.

4. Agreements and Understandings

This section references any mutual aid agreements or emergency response and recovery contracts that exist. It also indicates who is authorized to activate those agreements or contracts.

Elements that should be addressed in MOA/MOUs include the following:

a. General

i. Emergency use of resources and capabilities of organizations that are not part of a government structure will be pre-arranged through agreements to the maximum extent feasible. Duly authorized officials will enter into agreements, which will be formalized in writing whenever possible.

ii. Agreements between elements of the same government will be included in their respective plans. Details of such agreements, which are inappropriate for inclusion in these plans, will be set forth in an SOP, instructions, or other directives of the units of government concerned.

iii. Unless otherwise provided, agreements remain in effect until rescinded or modified. Annual or other periodic updates will prevent them from becoming outdated.

iv. A clear statement of agreement regarding payment reimbursement for personal services rendered, equipment costs, and expenditures of material is mandatory.

b. Agreements
Agreements with private relief organizations provide immediate aid to disaster victims and provide some types of aid that the government is unable to render.

c. Understandings
MOUs with adjoining counties or local governments recognize that certain situations require effective coordination and cooperation between jurisdictions to achieve effective response and provide for the general safety and health of residents. These documents formalize and focus attention on commitments and help avoid misunderstandings.

5. Assistance Stipulations

   Local policies that have been established regarding the use of volunteers or accepting donated goods and services should be summarized. Elements that should be addressed in this section include:

   a. Administration of insurance claims

   b. Consumer protection

   c. Duplication of benefits

   d. Nondiscrimination

   e. Relief assistance

   f. Preservation of environment and historic properties

B. Additional Policies

1. When the resources of local government are exhausted or when a needed capability does not exist within a local government, the local units of government call for assistance from the State.

2. The incident commander will submit periodic situation reports to the appropriate authority during a major disaster using standard ICS formats.

VIII. Plan Development and Maintenance

(This section should describe the overall approach to plan development and maintenance. The following is sample language.)

A. Development

(Identify by position the individuals responsible for developing, revising, and approving the Basic Plan, annexes, appendices, and supplementary documents, such as checklists, SOPs, etc. The following is sample language.)

1. The State office of homeland security and the emergency preparedness coordinator are responsible for coordinating emergency planning.

2. The director of each jurisdiction's homeland security and emergency preparedness agency is responsible for supporting emergency planning.

B. Maintenance

(The EOP is a living document. Problems emerge, situations change, gaps become apparent, Federal requirements are altered, and the EOP must be adapted to remain useful and up-to-date. This section identifies the requirements and the individuals responsible for maintaining, reviewing, and updating the Basic Plan, annexes, appendices, and supplementary documents, such as checklists, SOPs, etc. Once planning documents are developed, a system of maintenance must be established to ensure they are current. The following sub-sections provide an example of types of information that should be addressed in this section of the EOP, and is provided as a starting point for developing language for this section. The following is sample language.)

1. Requirements

   a. The emergency management coordinator will maintain, distribute, and update the EOP. Responsible officials in State or local agencies should recommend changes and provide updated information periodically (e.g., changes of personnel and available resources). Revisions will be forwarded to people on the distribution list.

      i. To comply with requirements outlined in Nuclear Regulatory Commission Regulation 0654/FEMA-REP-1, the plans of jurisdictions located within the emergency planning zones with nuclear power plants must annually review, update (if needed), and certify plans to be current.

   b. Directors of supporting agencies have the responsibility of maintaining internal plans, SOPs, and resource data to ensure prompt and effective response to and recovery from emergencies and disasters.

2. Review and Update

   a. Review

      The Basic Plan and its appendices should be reviewed annually by local officials. The emergency management coordinator or, if no coordinator has been appointed, the local chief elected official, should establish a process for the annual review of planning documents by those tasked in those documents, and for preparation and distribution of revisions or changes.

b. Update

i. Changes

Changes should be made to plans and appendices when the documents are no longer current. Changes in planning documents may be needed:

1) When hazard consequences or risk areas change

2) When the concept of operations for emergencies changes

3) When departments, agencies, or groups that perform emergency functions are reorganized and can no longer perform the emergency tasks laid out in planning documents

4) When warning and communications systems change

5) When additional emergency resources are obtained through acquisition or agreement, the disposition of existing resources changes, or anticipated emergency resources are no longer available

6) When a training exercise or an actual emergency reveals significant deficiencies in existing planning documents

7) When State/territorial or Federal planning standards for the documents are revised

ii. Methods of updating planning documents

1) Plan Revision

A revision is a complete rewrite of an existing EOP or appendix that essentially results in a new document. Revision is advisable when numerous pages of the document have to be updated, when major portions of the existing document must be deleted or substantial text added, or when the existing document was prepared using a word processing program that is obsolete or no longer available. Revised documents should be given a new date and require new signatures by officials.

2) Formal Plan Change

A formal change to a planning document involves updating portions of the document by making specific changes to a limited number of pages. Changes are typically numbered to identify them, and are issued to holders of the document with a cover memorandum that has replacement pages attached. The cover memorandum indicates which pages are to be removed and which replacement pages are to be inserted in the document to update it. The person receiving the change is expected to make the required page changes to the document and then annotate the record of changes at the front of the document to indicate that the change has been incorporated into the document. A change to a document does not alter the original document date; new signatures on the document need not be obtained.

IX. Authorities and References

(This section should describe the legal basis for emergency operations and contain references to important documents the plan supports, such as the jurisdiction-level emergency operations plan. The following is sample language.)

A. Legal Authority

1. Federal

   a. The Robert T. Stafford Disaster Relief and Emergency Assistance, Public Law 93-288 as amended

   b. Other executive orders and acts pertaining to disasters enacted or to be enacted

   c. Public Employees Occupational Safety and Health Act (PEOSHA) regulations

2. State

   a. Insert State laws pertaining to homeland security and emergency management.

3. Local

   a. Insert applicable ordinances.

4. Volunteer, Quasi-Governmental

    a. Act 58-4-1905, American National Red Cross Statement of Understanding, December 30, 1985.

    b. Mennonite Disaster Services – Agreement with FDAA, 1974.

    c. Public Law 93-288.

B. References

1. Federal

    a. Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining State, Territorial, Tribal, and Local Government Emergency Plans, March 2009.

    b. Homeland Security Exercise and Evaluation Program (HSEEP), February 2007.

    c. National Incident Management System (NIMS), December 2008.

    d. National Response Framework, Federal Emergency Management Agency, January 2008.

2. State

    a. State EOP

    b. State map with homeland security and emergency management regions

3. Local

    a. Local EOPs

    b. Inter-local agreement(s)

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Appendix E - PSEG - Hopewell Valley Central High School, Pilot Project Update

PSE&G Solar 4 All Extension

Grid Security / Storm Preparedness

Hopewell Valley Central High School

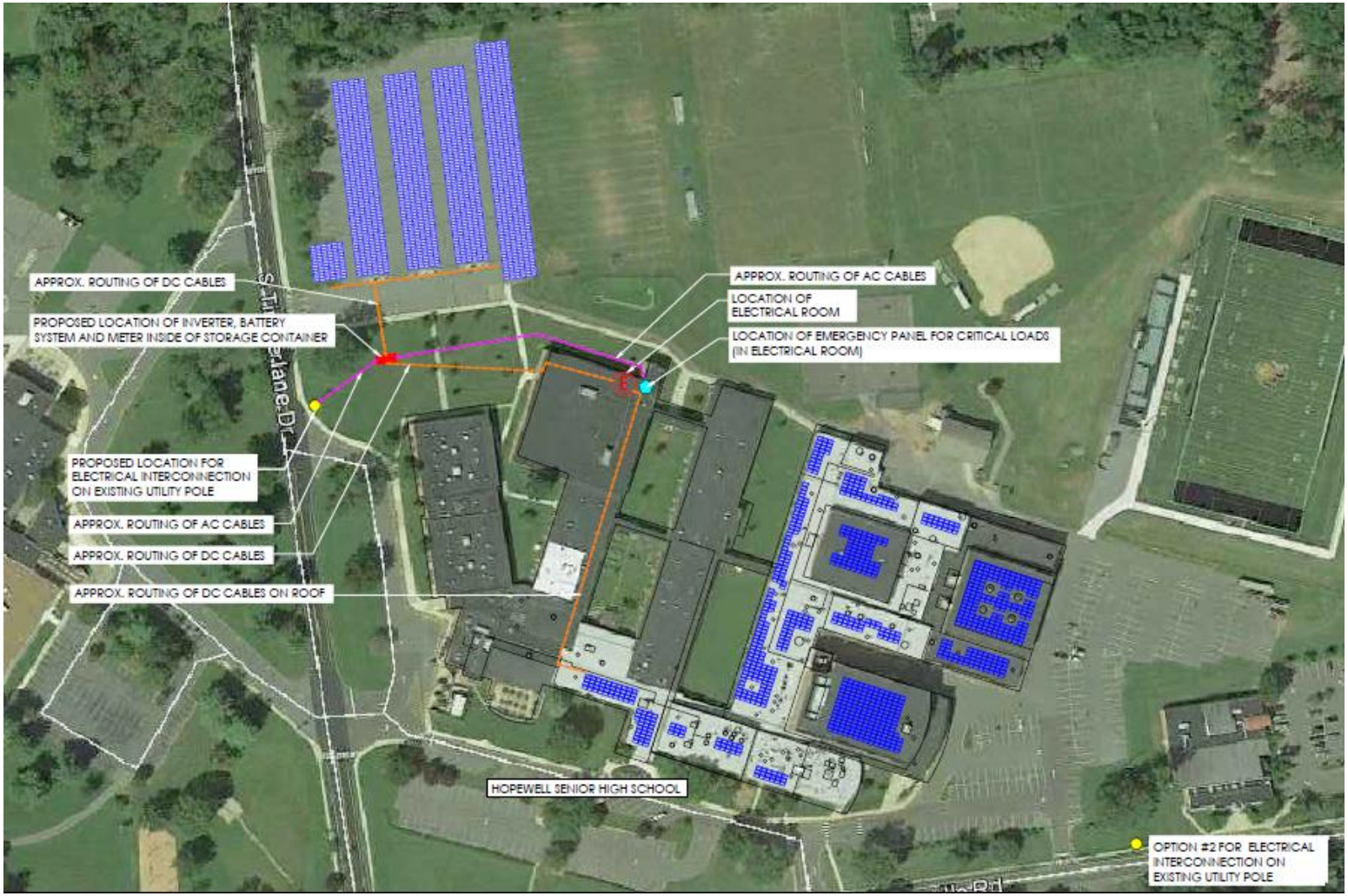
Pilot Project Update

June 24, 2015

Andrew Powers
PSE&G – S4A
Program Manager

Hopewell Valley Central High School

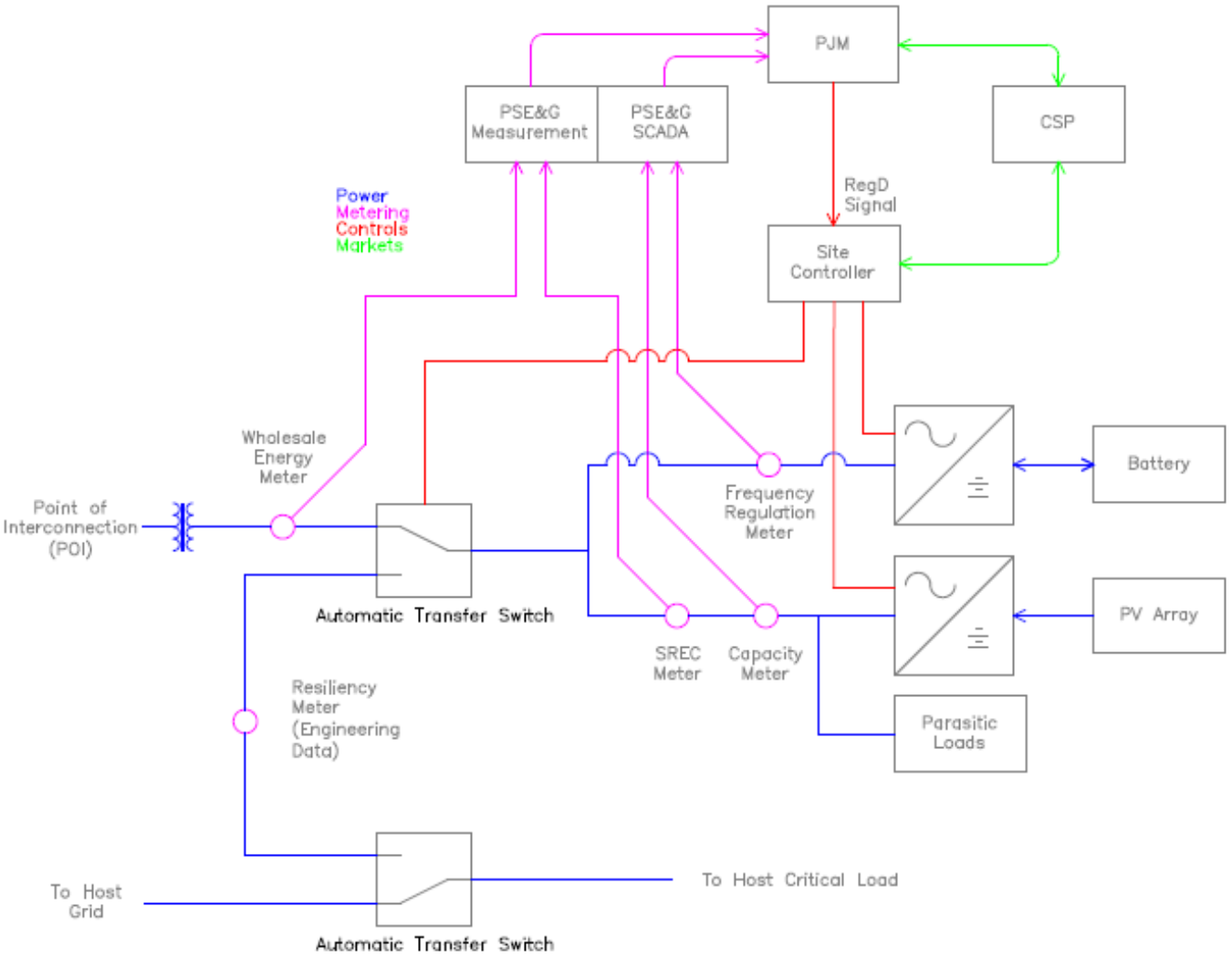
Hopewell, NJ



Hopewell Valley Central High School
Hopewell, NJ

- Grid Security / Storm Preparedness Pilot Program
- EPC: Advanced Solar Products (NJ)
- Solar Size : 882 kW-dc
- Structure : Parking Lot Canopy (658 kW-dc), Rooftop (224 kW-dc)
- Inverter: Dynapower Dual-Port
- Batteries: AllCell Li-Ion, 444 kW-hr, 0.5 hour capacity at full discharge rate
- Operating Mode: Frequency Regulation, Battery Backup for High School (Storm Shelter)
- Contract Execution: May 2015
- Construction Start: June 2015
- In-Service : Dec 2015

Simplified One Line



Market Integrator / Storage System Operator

- Frequency Regulation market requires PJM Curtailment Service Provider
- Operate storage system in various operating modes
- Prepare batteries in case of major storm

Lessons Learned / Challenges

- Battery storage adds complexity to operation and metering
- Battery storage is not a mature technology. Choice of bi-directional inverters are limited. UL listing may not exist.
- Emergency tie-in to Host site may require involvement of local building inspectors
- Storage operation requires real-time communication for active control for participating in the frequency regulation market.

Appendix F - Energy Storage Working Group

New Jersey's Clean Energy Program

FY16 Renewable Electric Storage Program Plan Overview

Renewable Electric Working Group
April 13, 2015

Introduction and Purpose of Renewable Electric Storage Working Group

- FY2016 Renewable Electric Storage Proposed Budget $6M
- The NJBPU has directed Staff and the Market Manager to reconvene the Renewable Electric Storage Working Group to provide stakeholder input into the future direction of the energy storage program.
- The working group will discuss program delivery options for the FY2016 program and will also consider the proposed incentive budgets for FY2016 through FY2018 for the purpose of informing the Comprehensive Resource Analysis (CRA) process.
- The discussion of program delivery options will include the creation of a prescriptive rebate program, releasing another round of the recently completed solicitation or structure a rolling solicitation process.

Results of FY15 Renewable Electric Storage Solicitation

FY2015 Renewable Electric Storage Incentive Solicitation, a first-of-its-kind initiative to support the installation of renewable electric storage systems in government, commercial, institutional and industrial entities (including public and critical facilities) for the purpose of providing emergency back-up power for essential services, offsetting peak loads by shifting electricity to hours of higher demand and, or helping to stabilize the electric distribution system through the provision of frequency regulation services.

- FY2015 Total Budget $3M
- 22 applications submitted requesting $4.6M in total incentives
- Solicitation Evaluation Committee scored each application on four categories:
  - Financial and Economic Viability
  - Project Readiness
  - Technical Feasibility
  - Resilience
- NJCEP (Board) approved 13 incentive commitments totaling $2.908M
- NJCEP (Board) denied 9 incentive requests ranked below the cut-off point for budgeted funds

FY15 Electric Storage Solicitation Results
(13) Approved Projects

Project Name	Storage Capacity (kW)	Rated Energy (kWh)
Toms River Municipal Utilities Authority	250	125
Paramus High School	250	125
Demasi Middle School	250	125
Monmouth County Bayshore Outfall Authority	500	250
Franklin Township Board of Education	500	250
Rice Elementary School	500	222
Marlton Middle School	500	222
East Amwell School Board of Education	500	222
Borough of Buena Municipal Utilities Authority	750	375
Lawrenceville School	1000	580
Atlantic County Utilities Authority	1000	580
Jersey City Municipal Services Complex	1250	625
Cumberland County Utilities Authority	1500	750

Data Point Analysis

Financial and Economic Viability

Total Amount of Incentives Requested	$4,694,642
Highest Incentive Requested	$500,000
Lowest Incentive Requested	$70,000
Average Incentive Requested	$213,393
Total Estimated Cost of All Projects	$19,143,982
Highest Estimated Project Cost	$1,860,000
Lowest Estimated Project Cost	$308,360
Average Estimated Project Cost	$870,181
Average Incentive as % of Project Cost	24.5%

Project Readiness

Earliest Estimated Start Date	Nov. 4, 2014*
Latest Estimated Start Date	July 1, 2015
Earliest Estimated Completion Date	April 1, 2015*
Latest Estimated Completion Date	Sept. 3, 2015
Shortest Estimated Completion Time	30 days
Longest Estimated Completion Time	5 months
Average Estimated Completion Time	2.6 months

Technical Feasibility

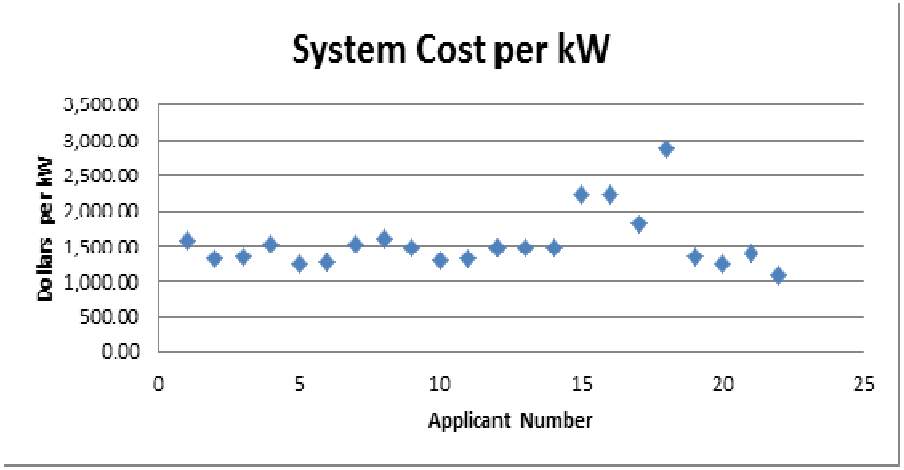
Battery type: Lithium ion	19
Battery type: Lead carbon	3
Total Capacity of All Projects	13,430 kW
Highest Capacity Proposed	1,500 kW
Lowest Capacity Proposed	200 kW
Average Capacity Proposed	610.5 kW

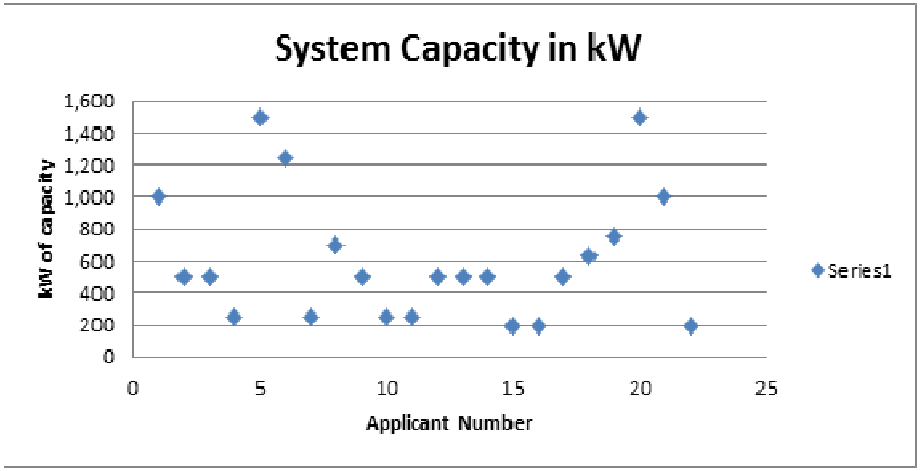
Resilience

Customer Type	
Municipal or County Utility Authorities	5
Public or Private Schools (ES, MS & HS)	11
Government – Non-utility Authority	1
Privately-owned Facilities	5
Type of Facility	
Public & Critical Facilities (self-defined)	18
Non-Public & Critical Facilities	4

Data gathered from all 22 applications submitted in Solicitation

Scatter Plot Analysis





Installed cost is fairly constant at between $1,200 and $1,500 per kW regardless of system size (ignoring a few outliers)

Average Requested Incentive per kW Total Storage Capacity $397.41

Data based on all 22 applications

Comprehensive Resource Analysis (CRA)

- CRA timeline
- Funding levels
- Next steps

Other Considerations

- Should we open to private sector projects? Why?
- Should we open to projects without renewables previously installed?
- What are the benefits to the ratepayer for public/private sector projects?
- Should we establish minimum warranty requirements?
- Application transparency and timing? (After commercial operation? What forms?)

FY2016 Renewable Electric Storage Program Design

- Electric Storage Incentive Program
    - Solicitation
    - Rolling Solicitation
    - Incentive Program (Open Enrollment)
- Incentive Structure and Caps
- Application Process
- Local Inspection/Permitting Issues
- Interconnection and Net Metering Update-Next Interconnection and Net Metering Meeting on Monday April 20th at 1pm in Trenton
- Next Steps

Solicitation

Solicitation	
PROS	**CONS**
Although lengthy there is an established timeline	Heavy Administrative Support from multiple representatives (Evaluation Committee)
Evaluation Committee brings Subject Matter Experts from multiple representatives with knowledge from unique areas	No Program Support for Application process
Maintain and control budget	Extended Timelines for application review and approvals
Funding most cost effective projects	Lengthy and detailed review process
Application Transparency	Planning and budgeting cycles may not align (Public projects)
	Deactivated projects must wait for next Solicitation

Rolling Solicitation

Rolling Solicitation	
PROS	**CONS**
Intake forms/Applications submitted on rolling basis	Two step application process-Intake form and application packet-Prequalification step
Intake Phase One to include project specifics and establish program eligibility	Multiple applications steps-cumbersome process
Manage and control budget	Heavy Administrative Support from multiple representatives (Evaluation Committee)
Evaluation Committee brings Subject Matter Experts from multiple representatives with knowledge from unique areas	No Program Support for Application process
Deactivated projects can replenish budget for new projects and can be applied for immediately	Multiple applications steps-cumbersome process Prolonged notification and award
Allows the applicant to submit at their convenience	Extended timelines for application review and approval
First come First serve-Remove element of competition against other projects	Application approval subject to minimum standard based on project viability
	May exclude more worthwhile projects if funding runs out

Incentive Program (Open Enrollment)

Incentive program (Open Enrollment)	
PROS	**CONS**
Program Administrative support handled by Market Manager team eliminating need for multiple personnel	Application Submittal -First come first serve (Not competitive)
Program Support during Application process available	Funds all projects that apply with complete applications regardless of cost effectiveness
Requested incentive based on specific calculation for individual projects	
Quicker turnaround time for application review and approvals	
Planning and budgeting cycles-public projects	
Marketing can be adjusted on basis of available funds	
Deactivated projects can replenish budget for new projects and can be applied for immediately	
Offers greater flexibility for budget adjustments	

Funding Cycle vs. One Application Round

Funding Cycle	
PROS	**CONS**
Spreads funding out through entire fiscal year	Restricts applicants to apply when ready
Allows for data capture and review to determine if program changes should occur in next funding cycle	Administratively burdensome
	Impacts project readiness-no flexibility

Recap of Discussions

Program:

- Replace Solicitation with open enrollment (incentive) program
- Number of Application Rounds
- Critical and Public facility
- Entity cap limited to ownership
- 100% inspection rate

Incentive:

- Flat incentive
- 10% reduction in incentive for extension (12 month/6 month)
- Incentive paid at 100% at completion
- Performance reporting after completion
- Reimbursing Level 3 interconnection (adder) $3000-5000 range-studies become public info by EDC-

For More Information

Visit NJCleanEnergy.com

Call (866) NJSMART

For the latest updates on program announcements
or new incentives, subscribe to the NJ Clean Energy Program
E-Newsletter at: NJCleanEnergy.com.

Appendix G – ERB General Program Requirements

New Jersey Energy Resilience Bank

Overview

NEW JERSEY
ENERGY
RESILIENCE
BANK

Building a solid foundation for the future

SECTION 1

Introduction to the ERB

NEW JERSEY ENERGY RESILIENCE BANK

New Jersey Energy Resilience Bank (ERB) Overview

The extensive damage and outages caused by Superstorm Sandy prompted the state to prioritize its efforts to minimize the potential impacts of future major power outages and increase energy resiliency

BPU and EDA have partnered to commit $200 million in funding for the ERB to assist critical facilities with securing resilient energy technologies that will make them – and, by extension, the communities they serve – less vulnerable to future severe weather events and other emergencies

NEW JERSEY ENERGY RESILIENCE BANK

Mission

"Realizing energy resilience for New Jersey's critical facilities through financing and technical assistance"

NEW JERSEY ENERGY RESILIENCE BANK

SECTION 2

Financing Support for Resilience

NEW JERSEY ENERGY RESILIENCE BANK

Product terms will consider resiliency benefits in addition to economic benefits

Economically Positive Investment

Energy Savings

\+

ERB Incentives

\-

Incremental Cost of Islanding

\-

Sizing for Resiliency

\+

Resiliency Benefits

Avoided Revenue Loss

\+

Avoided Litigation/Liability Cost

\+

Lives Saved

\+

Environmental Benefits

=

Economically healthy and resilient healthcare facility with functionality during a storm or disaster

NEW JERSEY ENERGY RESILIENCE BANK

Illustrative Pro Forma CHP Economics

ILLUSTRATIVE

Our assumptions:

- Engine / system size (kW) **2050**
- Average electric load (kW) **2000**
- Our best understanding of your critical load (kW) **2000**
- Estimated capex for system ($/kW)Installation **$3,200**
- Estimated islanding costs ($/kWh) **$400**
- Operating and maintenance ($); yearly cost for 15 years **$200 K**

Summary of Project Costs

- Generation Cost ($) **$6.5M**
- Islanding Cost ($) **$0.9M**
- Total System Cost **$7.4M**

Summary of Project Benefits

- Annual electrical savings **$1.8M**
- Annual resiliency benefits **$100K**

Benefit Cost Ratio: 1.14

NEW JERSEY ENERGY RESILIENCE BANK

Including the Value of Resiliency Reduces the Size of Grants: Value of Lost Load Example

	Facility 1	Facility 2	Facility 3	Facility 4
Facility size (000 sq. ft)	554	651	664	3,400
Engine Size (kW)	2,350	3,600	2,050	8,375
Resilient cost ($/kW)	3,557	3,309	3,640	2,868
Total capex, Y_0 ($M)	8.4	11.9	7.5	24.0
Net Present Value w/o ERB ($M)	(4.5)	(3.8)	(3.2)	(12.8)
Average annual cash flow ($M)	(0.5)	(1.0)	(0.5)	(1.4)
ERB grant percentage (%)	**39.9%**	**10.9%**	**25.3%**	**38.5%**

Resiliency – annual VOLL ($M)	0.3	0.4	0.2	1.0
ERB grant percentage (%)	12.4%	0%	0%	4.4%

SOURCE: NJ DEP, Facility interview, Team analysis

NEW JERSEY ENERGY RESILIENCE BANK

The ERB will be providing financing for unmet need

FOR DISCUSSION

Calculation of duplication of benefits worksheet:

SOURCES	USES	UNMET NEED ($M)
• Insurance	•	
• FEMA	•	
• SBC Funding	•	
• Other State Funding	•	
• Other Federal Funding	•	
	Total	

- **100% provided by ERB**
  - % incentive
  - % loan

NEW JERSEY ENERGY RESILIENCE BANK

ERB Financing – WWTP/WTP Product Overview (1/2)

Funding Allocation: $65 million

Total ERB Funding:

100% Unmet Funding

Incentive:

40% of unmet funding need:

- **Grant:** 20% after equity contribution, if applicable
- **Loan Forgiveness:** 20% after equity contribution, if applicable
  - Principal forgiveness based on proof of successful operation of equipment and evidence of minimum required performance
  - Forgiven in equal percentages over five years (4% per year)
  - If project does not meet required performance level in any year, forgivable portion of that year's loan will not be forgiven. In following year, if performance level returns to required level, then forgivable portion of current and previous year's principal will be forgiven

Loan:

60% of unmet funding need

NEW JERSEY ENERGY RESILIENCE BANK

ERB Financing – WWTP/WTP Product Overview (2/2)

Terms

- **Interest Rate**
  - 2%, fixed interest rate for bond rating of BBB- or higher at the time of approval
  - 3% fixed interest rate for applicants with bond rating lower than BBB- or which are not rated at time of approval
- **Term:** Up to 20-year term, based on useful life of majority of assets

Principal Moratorium

- **Up to 2 years' principal moratorium, according to the following:**
  - Based on length of construction period, subject to the lesser of construction period and 2 years
  - Up to two, six-month extensions may be provided
  - Interest during construction period will be based on disbursements of loan capital
  - Disbursement – grant funding disbursed before loan capital
    - Based on milestones with evidence of cost incurred and site visit to verify
    - First milestone will be purchase and delivery of equipment and feasibility study, if applicable.

NEW JERSEY ENERGY RESILIENCE BANK

Projects that do not qualify for ERB funding may be eligible for other programs offered by the state, or could seek private funding

	NJ Energy Resilience Bank	NJ Economic Development Authority	NJ Clean Energy Program	NJ Environmental Infrastructure Trust	NJ Healthcare Facilities Financing Authority
Mission	• Increase resiliency of critical facilities to extreme events	• Finance small and mid-sized businesses, administer tax incentives, redevelopment initiative	• Promote energy efficiency and use of clean energy	• Provide financing for environmental infrastructure projects to protect water sources and safety	• Provide healthcare providers with low cost capital
Target Sectors	• Critical facilities (e.g. hospital, WWTP, education)	• NJ-based businesses and communities	• NJ residents, businesses and local governments	• Drinking water, wastewater, equipment purchase, storm water, landfill etc.	• Hospitals, nursing homes, assisted living etc.
Products Offered	• Partial grants, loan forgiveness and discounted loan	• Low interest lending, training, mentoring	• Partial rebates for installation of energy efficient equipment**	• Loans with some principal forgiveness	• Municipal bond issuance • Direct lending
Eligibility Requirements	• Public facilities • Damage from specific storms • Other	• Size of business • Number of employees • Business location • Other	• Varies – based on location, building type, fuel source	• Various – projects must fall in list of eligible sectors	• Health care related service in NJ lending
Funds Disbursed to Date	• $200M available	• $23B in assistance; • $52B in public/private investment	• TBD	• >$4.3B to local and county government and some private facilities	• >$16B in bonds to ~150 organizations in NJ

NEW JERSEY ENERGY RESILIENCE BANK

** CHP program includes up to a 30% rebate subject to a cap on dollars per kW basis

SECTION 3

Potential Resilience Solutions

NEW JERSEY ENERGY RESILIENCE BANK

The ERB will Fund Resilient Energy Systems for Critical Facilities

RESILIENT TECHNOLOGY IS…

RESILIENT TECHNOLOGY IS NOT…

…distributed generation or other technologies…

CHP plants can use a reciprocating natural gas engines

Gas Turbine CHP Plant

…emergency backup generators

Generator

… that is islandable, capable of blackstart and can operate at critical load

Inverter system

Black Start Controls

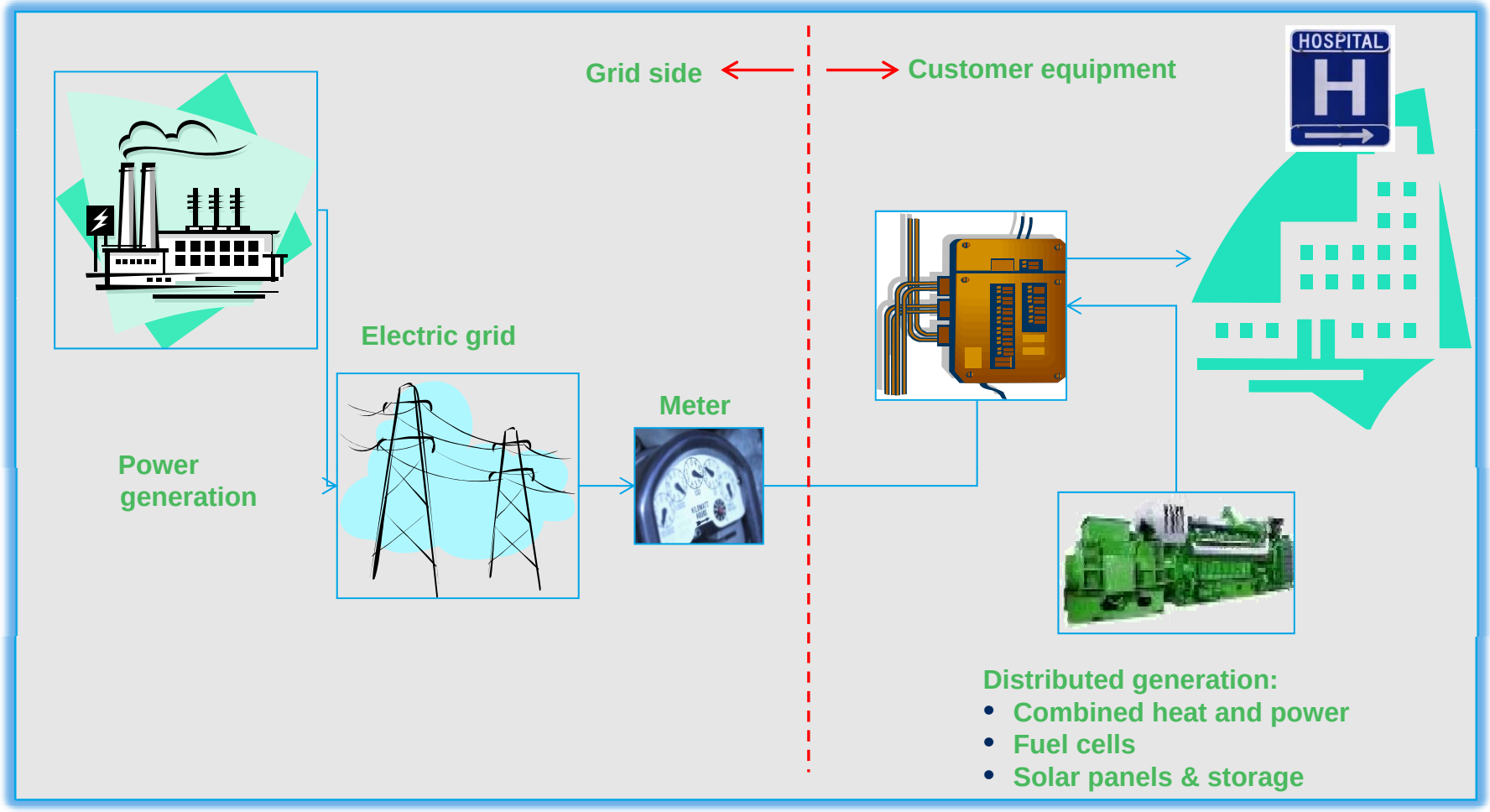
Fuel Cells

NEW JERSEY ENERGY RESILIENCE BANK

SOURCE: DOE, NREL

ERB Support for Critical Facilities will Support Distributed Generation at the Customer Site

ILLUSTRATIVE



NEW JERSEY ENERGY RESILIENCE BANK

The ERB can Cover a Range of Costs for New Systems

ELIGIBLE COSTS

New Resilient Systems

- Core equipment
- Piping & wiring
- Islanding equipment
- Interconnection
- Fuel pre-treatment (e.g., biogas treatment, or gas compression)
- Installation
- Site work
- Engineering and project management
- Hardening of resilient energy system (e.g., elevation)

NON-ELIGIBLE COSTS

Backup Generators

- Emergency backup generators
- Onsite fossil fuel storage for emergency generators

Other non-energy hardening

- Flood walls
- Elevation

Other

- Used, refurbished equipment
- Solar PV panels

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SECTION 4

Eligibility

NEW JERSEY ENERGY RESILIENCE BANK

Eligibility Criteria

Eligibility Overview

- **Eligible ERB Applicants**
  - Public facilities – municipal and county authorities
  - Non-profits
  - For-profit businesses that meet the SBA definition of “small business”
- **All other entities, and all privately owned utilities, are currently ineligible**
- **BPU/NJEDA are working with HUD toward regulatory flexibility for the ERB that would expand the list of eligible entities**

NEW JERSEY ENERGY RESILIENCE BANK

Eligible Disasters

- **To be eligible for funding under the Energy Resilience Bank, according to the Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-288), as amended by the Disaster Relief Act of 1974 (P.L. 93-288), projects must:**

  - Demonstrate a tie Superstorm Sandy, or;

  - Have incurred physical damage from one of the six additional nationally-declared disasters dating from December 2010.

NEW JERSEY ENERGY RESILIENCE BANK

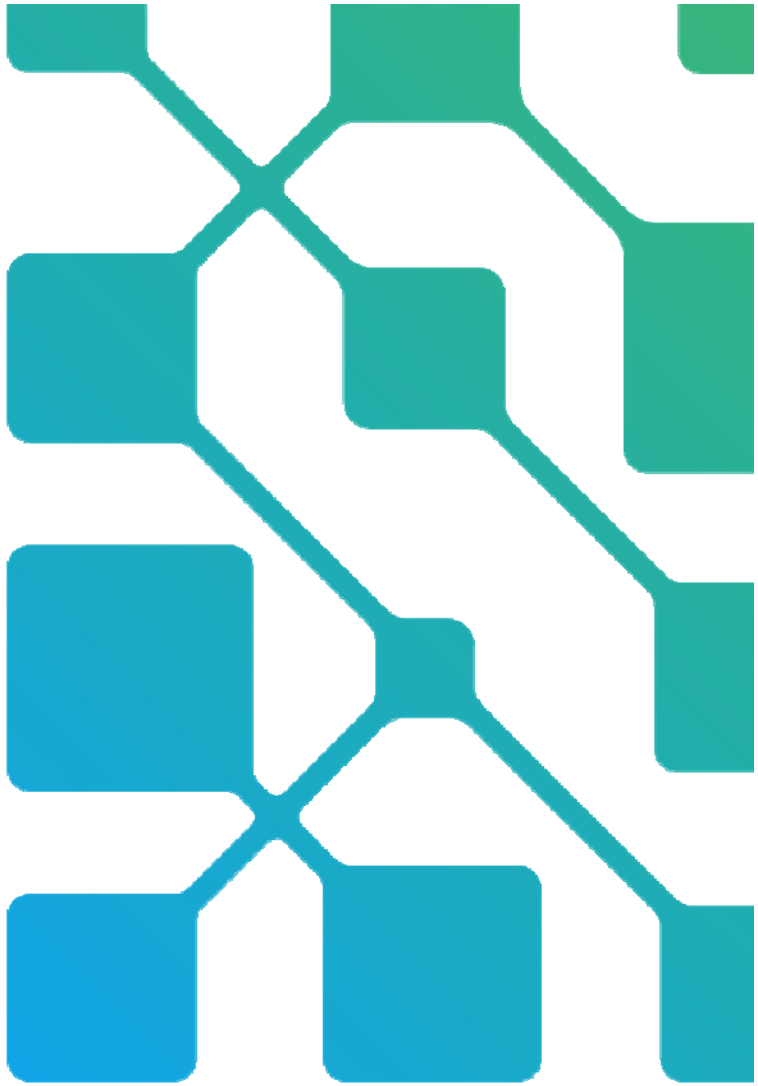
HUD Requirements

- **Direct impact by Sandy or other qualifying disaster.**
- **With limited exceptions, per federal regulation, CDBG-DR funding may not be used within a Coastal Barrier Resource Area (CBRA).**
- **Project equipment must be installed at a facility and be operational within two years of the closing of the ERB grant and loan.**

NEW JERSEY ENERGY RESILIENCE BANK

Scoring Criteria

- **Tech. Efficiency / Economic Cost Effectiveness**
- **LMI National Objective**
- **Most Impacted Communities**
- **Readiness to Proceed**
- **Criticality**
- **Microgrid**
- **Facility Energy Efficiency**



Additional detail on these criteria available

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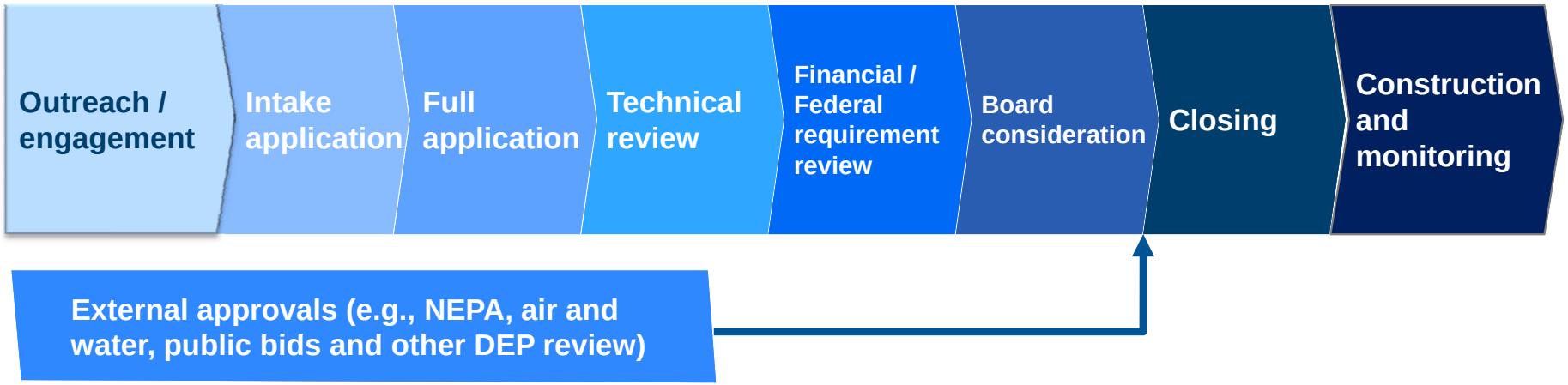
Application Overview



Some steps in the application process will take place concurrently

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SECTION 5

Questions and Next Steps

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How the ERB Team can Help You

- **Provide technical support on feasibility and possible options**
- **Assist with financial analysis**
- **Connect you to other sources of funding**
- **Support you in enhancing the community and improving energy resilience**
- **Help you communicate with your stakeholders to explain the benefits of energy resilience**
- **Provide you with a single point of contact at ERB**

Any questions or concerns?

NEW JERSEY ENERGY RESILIENCE BANK

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