**Testimony of Elinor Haider**
**Vice President, Market Development, Veolia Energy North America**
**On Behalf of the Alliance for Industrial Efficiency**
**Hearing on "Keeping the Lights On"**
**House Committee on Energy and Commerce**
**Subcommittee on Energy and Power**

**May 19, 2015**

Chairman Upton, Subcommittee Chairman Whitfield, Ranking Member Rush, and other members of the Subcommittee, thank you for the opportunity to testify on this important topic. The focus of my testimony will be on the role of Combined Heat and Power and Waste Heat to Power in enhancing the resilience and reliability of our nation's electricity grid and of critical infrastructure.

With 180,000 employees worldwide, Veolia has been creating integrated energy, infrastructure, and environmental solutions for over 160 years. Last year, Veolia supplied 150-million people with drinking and wastewater services, produced 52-million megawatt hours of energy and converted 31-million metric tons of waste into new materials and energy.

In the US, our 8,000 employees ensure the reliable, efficient supply of energy with over 500 MW of owned or operated Combined Heat and Power and the nation's largest portfolio of district energy systems.

Veolia Energy is a member of the Alliance for Industrial Efficiency, a diverse coalition that includes representatives from the business, environmental, labor and contractor communities. The Alliance is committed to enhancing manufacturing competitiveness, reducing emissions, and creating jobs through industrial energy efficiency, especially through the use of Combined Heat and Power (CHP) and Waste Heat to Power (WHP).

The Alliance and Veolia Energy are very supportive of a number of aspects of the Committee's Architecture of Abundance and we are particularly pleased to see the recognition of the grid resiliency benefits of CHP and WHP in Section 1207 of the Committee's discussion draft.

Conventional power generation is incredibly inefficient. In fact, more than two-thirds (68 percent) of fuel inputs are lost from our smokestacks as wasted heat and never converted to useful energy. The energy lost annually in the United States from wasted heat in the power generation sector is greater than the total energy use of Japan.[1] This inefficiency costs consumers and harms America's competitiveness.

By making use of both heat and electricity from a single fuel source, CHP dramatically increases fuel efficiency and eliminates much of this waste – allowing utilities and companies to effectively "get more with less." CHP can use more than 70 percent of fuel inputs. Savings are even larger with WHP, which captures waste heat that would typically be vented from an industrial facility and uses it to make electricity with no additional combustion and no incremental emissions.

Both CHP and WHP offer excellent opportunities to improve the resiliency of the electric grid and the reliability of critical infrastructure, while simultaneously reducing costs, creating jobs, and lowering emissions. CHP is a highly efficient distributed generation resource that produces both heat and electricity from a single fuel source. Significantly, because it produces both heat and electricity on site and can be independent of the grid, a properly sized CHP system functions without interruption during an extreme weather event or other disturbance that may compromise the grid.

At sites that can operate independent of the grid, WHP systems provide additional on-site power at a crucial time. As long as waste heat is being produced, WHP systems can generate electricity. At the same time, CHP and WHP save money by making a facility more efficient and lowering its energy costs. This means that these facilities can put more resources into their bottom line – allowing them to manufacture more steel, provide better medical support, or educate students more cost-effectively.

<u>CHP and WHP Systems Keep the Lights on During Extreme Weather Events</u>

As one of the US's leading owners and operators of CHP systems, Veolia's customers benefit from the energy efficiency and resiliency provided by CHP at universities, hospitals, biotech, R&D and other critical facilities. The benefits of this expertise was on stark display during the $70 billion Superstorm Sandy in October 2012. While nearly eight-million residents across the MidAtlantic lost power, those with resilient CHP systems kept the lights on. There is no more illustrative case than New York University, where Veolia has played a critical role implementing CHP.

NYU has two campuses in Manhattan. Ten years ago, NYU selected Veolia to serve as Owner's Representative to design and manage expansion of its Washington Square campus energy plant. The expanded CHP system generates up to 90,000 pounds of steam per hour and 13 MW of electricity, serving 37 buildings. While the majority of Manhattan was without power during Sandy, that campus had electricity, heat, and hot water. It became a place of refuge during the height of the storm. That NYU campus kept the lights on.

On the other hand, the NYU Langone Medical Center did not have CHP. It lost all power, knocking out its communications systems and leading to the dangerous forced evacuation of critical care patients on gurneys and in dozens of ambulances.

In response to its experience at the two campuses, NYU selected Veolia to support development and operations of a new CHP energy plant for the NYU Langone Medical Center campus. The new plant will have 13 MW of electric generating capacity and 165,000 pounds per hour of steam. It will be completely self-sufficient in the event of a utility power interruption. NYU Langone will also keep the lights on. When we consider energy resiliency, the price of inaction, such as the $540 million in FEMA-funded repair work at Langone following Superstorm Sandy,[1] needs to be considered in the cost-benefits analysis.

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[1] Ginger Adams Otis, July 30, 2014, "NYU's Langone Medical Center to get $1.1 billion for Hurricane Sandy repairs" (http://www.nydailynews.com/life-style/health/nyu-langone-medical-center-1-1b-hurricane-sandy-repairs-article-1.1885109).

Many of these success stories are documented in a 2013 report by DOE's Oak Ridge National Laboratory.[2] Combined, the region's CHP systems provided nearly 270 megawatts (MW) of uninterrupted electric capacity to critical infrastructure during the storm. (Table 1).

**Table 1: CHP Performance during Superstorm Sandy**

| Application | No. Sites | Capacity (MW) |
|---|---|---|
| **Hospitals** | 7 | 19.31 |
| **Universities** | 6 | 84.5 |
| **Multi-family** | 6 | 44.5 |
| **District Energy** | 3 | 79.9 |
| **Data Center** | 1 | 0.07 |
| **Assisted Living** | 1 | 0.08 |
| **Manufacturing** | 1 | 10.7 |
| **WWTP** | 1 | 2.8 |
| **Government** | 1 | 19.3 |
| **Total** | **27** | **268.6** |

I'd like to share four Superstorm Sandy case studies, which capture the tremendous range in opportunity and benefits:

1. Co-Op City

   Co-Op City, the nation's largest cooperative housing development, spans 330 acres in the Bronx. In 2011, the community installed a 40 MW gas-fired CHP system to provide 95 percent of the community's electric and thermal needs. During Superstorm Sandy, the system provided heat and power to Co-Op city's 60,000 residents – along with their schools, shopping centers, and parking garages. The community finances capital projects, like window replacements and façade repairs, with the money it saves on energy costs. The New York City government estimates that the CHP system is saving residents $15 million annually, while emitting 40-percent less pollutants than the CHP system it replaced.[3] With the help of incentives and supportive policies, including valuing the added resilience CHP and WHP provide, communities like Co-Op City will better be able to afford to install these systems.

2. Princeton University

   Princeton University's 15 MW gas-turbine CHP system provided critical services to the University during the storm. Installed in 1995, the system operates at 60 to 80-percent efficiency, depending on the time of year. Since the university's peak energy load is 27 MW (with a 20 MW average), the CHP system is typically supplemented by grid power. The University generally produces its own power during the day (when prices are higher) and

[2] U.S. Dep't of Energy, Oak Ridge National Laboratory, March 2013, "Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities," at 13-31 (http://energy.gov/sites/prod/files/2013/11/f4/chp_critical_facilities.pdf).
[3] ORNL 2013*, supra* note 2, at 21.

purchases from the grid in the evening, when prices fall. During the storm, Princeton was able to disconnect from the grid and use the district energy system to power the campus' key functions. By terminating non-critical loads (e.g., administration buildings and some classrooms), the system was able to provide all of the University's remaining energy needs, including uninterrupted steam and chilled-water service and power to critical university facilities, such as research labs, experiments and data that could have been compromised by a loss of power.[4] Princeton's CHP system not only saves the University money, but also avoids the costs associated with the loss of critical data and priceless experimental materials that would occur if the central power grid goes down, leaving its labs vulnerable.

3. <u>Sikorsky Aircraft</u>

Sikorsky Aircraft installed a 10.7 MW gas-fired CHP system in its two-million square foot helicopter manufacturing facility in Stratford, Connecticut in 2011. The system provides the vast majority (85 percent) of the facility' thermal and electric needs. Not only did the system function as designed during the storm, but Sikorsky was able to provide free helicopter transport service for disaster-relief personnel in New Jersey, New York, and Connecticut along with meals, hot showers, and a place to charge cell phones to its 6,650 full-time employees and their families. The $26-million system was supported, in part, with a $4.66-million grant from the state and has a payback of less than four years. In addition to these reliability benefits, lowering energy costs makes Sikorsky more competitive and offers significant environmental benefits – cutting the facility's $CO_2$ emissions by an estimated 8,900 metric tons annually.[5]

4. <u>South Oaks Hospital</u>

The South Oaks Hospital is a 245-bed healthcare facility, which includes a psychiatric hospital, nursing home, and assisted living center in Long Island, New York. The hospital relies on five 250-kilowatt natural gas reciprocating engines, with on-site boilers providing supplemental steam. During the storm, the hospital continued to provide critical services, relying solely on its CHP system. South Oaks actively admitted patients from other medical institutions and offered critical refrigeration services. Staff and members of the local community were invited to come to the hospital to shower and charge their phones. Similarly, while the surrounding areas had no electricity for 14 hours during the 2003 blackout, South Oaks did not experience any interruption in service. Additionally, the CHP system offers financial benefits to the hospital – during the summer it sells the surplus power to the grid.[6] Although South Oaks garnered significant resiliency benefits from its CHP system, these benefits are not currently being valued in a way that can be monetized to help reduce the upfront capital costs of installing such systems. The Committee's Discussion Drat helps address this.

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[4] ORNL 2013, *supra* note 2, at 16-17.
[5] ORNL 2013, *supra* note 2, at 31.
[6] ORNL 2013, *supra* note 2, at 13.

CHP and WHP systems have provided similar reliability benefits during Gulf Coast hurricanes and large-scale outages. For instance, a 4.2-megawatt gas-fired system at the Mississippi Baptist Medical Center enabled the 624-bed urban hospital to remain fully operational throughout Hurricane Katrina in August 2005 – when the surrounding area was without power for nearly three days.[7] In contrast, Memorial Herman Baptist Hospital in Beaumont, Texas was forced to shut down for an entire week in 2005 following Hurricane Rita and sustained over $30 million in damages. The facility did not have an on-site CHP system.[8]

The WHP system at Port Arthur Steam Energy (PASE) in Texas uses kiln exhaust energy that was being wasted (vented to atmosphere) from Oxbow Corporation's petroleum coke calcining operation to generate electricity and steam. Oxbow and PASE use some of the electricity and the rest is sold to the grid. The steam turbine-generator is capable of operating independent of the grid (in "island mode") and has self-supported both the PASE and Oxbow plants on a number of occasions during interruptions of incoming utility power.[9] This electric reliability prevents the plant from losing money during power outages.

The vast majority of existing CHP installations (87 percent) are in the industrial sector.[10] (Figure 1). Recent analysis, however, confirms that the remaining technical potential is roughly evenly divided between the industrial and commercial/ institutional sectors – with roughly 65 gigawatts of technical potential remaining in the nation's hospitals, universities, wastewater treatment plants, and other critical infrastructure.[11] Section 1207 of the Committee's discussion draft includes important language to help states develop plans and consider rate recovery to encourage deployment in these areas.

CHP is particularly well-suited for critical infrastructure, like hospitals and assisted-living facilities.[12] With high thermal needs to heat and cool buildings and to sterilize equipment coupled with round-the-clock electricity demand to support patients, these institutions are prime candidates for CHP and WHP systems. WHP systems can turn waste heat from hospital incinerators, laundries and kitchen into electricity without additional fuel or combustion or emissions. That electricity can be used to support on-site needs.

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[7] U.S. Dep't of Energy, Clean Energy Application Center, June 2012, "Combined Heat and Power: Basics and Texas Outlook"(http://seco.cpa.state.tx.us/saeag/docs/presentations/CHPBasicsandTexasOutlook.pdf).

[8] Gulf Coast CHP Application Center, May 11, 2006, "Resiliency to Hurricanes Through CHP: Fact or Fiction" (slide 20)
(http://files.harc.edu/Sites/GulfCoastCHP/Presentations/ResiliencyHurricanesThroughCHP.pdf)

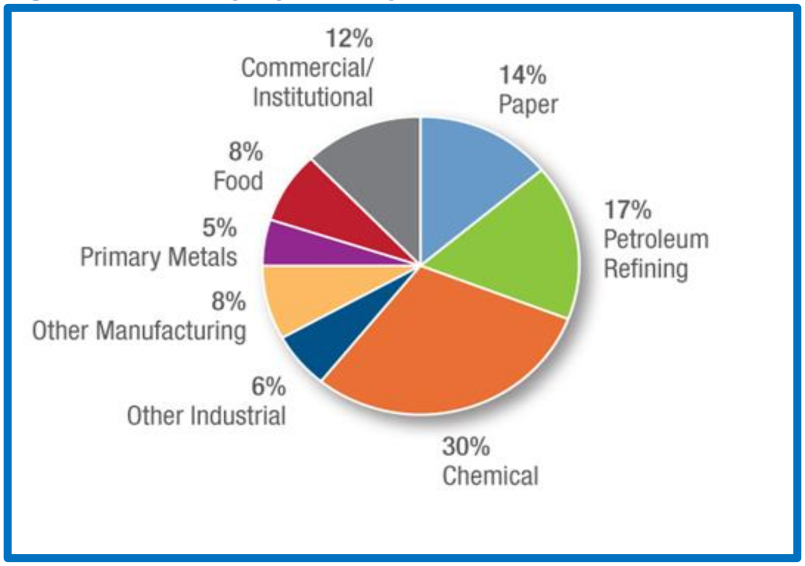
[9] Heat is Power, Project Profile: Waste Heat to Power from Petroleum Coke Calcining (http://www.heatispower.org/wp-content/uploads/2014/03/PASE-Project-Profile-FINAL.pdf).

[10] U.S. Dep't of Energy, U.S. Dep't of Housing and Urban Development, U.S. EPA, Sept. 2013, "Guide to Using Combined Heat and Power for Enhancing Reliability and Resiliency in Buildings," at 5. (http://portal.hud.gov/hudportal/documents/huddoc?id=CHPSept2013.pdf).

[11] U.S. Dep't of Energy and U.S. EPA, Aug. 2012, "Combined Heat and Power: A Clean Energy Solution" (http://www.epa.gov/chp/documents/clean_energy_solution.pdf).

[12] Critical infrastructure refers to those assets, systems, and networks that, if incapacitated, would have a substantial negative impact on national security, national economic security, or national public health and safety. Patriot Act of 2001 Section 1016 (e). In practice, it refers to hospitals and healthcare centers; wastewater treatment plants; police, fire, and public safety stations; centers of refuge (often schools or universities); military sites; food distribution facilities; and telecommunication or data centers.

**Figure 1 CHP Deployment by Sector**




<u>CHP Offers Significant Benefits over Emergency Generators</u>

While hospitals typically have emergency back-up generators in the event of a grid failure, CHP is a far superior reliability option. Generators are seldom designed to provide full system coverage, forcing them to scale back operations during emergency events. Even where multiple generators can theoretically replace electricity needs, unlike CHP, generators are incapable of satisfying thermal demand. As such, essential building functions – like heating, cooling and hot water – are often the first services to be eliminated during emergencies. Generators are only tested periodically for performance, whereas CHP systems are used daily. This routine use makes it significantly more likely that any problems with the system will be detected – and repaired - *before* an emergency. Strikingly, during the blackout of 2003, half of New York's 58 metropolitan hospitals reported failures in their backup generators, often with dramatic consequences. For instance, lack of backup power led to 145-million gallons of raw sewage being released from a Manhattan pumping station.[13] In contrast, a survey of the city's 24 CHP systems by the New York State Energy Research and Development Authority (NYSERDA) following Superstorm Sandy found that all of the systems that were designed to operate during a grid outage performed as expected.[14] Critical, life-sustaining facilities like hospitals,are typically required to include generators in their system design – even if they have a CHP unit. This means the emergency generator can operate as "back up to the back up," further enhancing system reliability.

CHP systems also offer substantial environmental benefits over emergency generators. While generators typically run on diesel, over 70 percent of CHP systems operate on natural gas, which has lower emissions. Finally, as compared to diesel generators, which rely on limited fuel storage, natural-gas-fired CHP systems utilize a hardened, underground fuel-delivery network, meaning that they can continue operations during a sustained outage.

[13] ORNL 2013*,* *supra* note 2*,* at 7.
[14] ORNL 2013, *supra* note 2*,* at 7 (citing Email communication from Elizabeth Markham, NSERDA Assistant Project Coordinator on Jan. 14, 2013 to Northeast CEAC Staff, Timothy Banach and Tom Bourgeois).

CHP and WHP Offer Many Additional Benefits

In addition to these on-site reliability benefits, CHP systems also enhance grid reliability. CHP systems can be installed in areas where the local electricity distribution network is constrained or where there are high concentrations of intensive power use and inadequate transmission capability to reliably meet electric demand. By encouraging coordination with electric utilities, the discussion draft ensures that these considerations are incorporated into state resiliency plans.

CHP and WHP benefits in critical infrastructure go beyond reliability and resiliency. The increased energy efficiency can dramatically lower energy costs, providing a hedge against rising electricity prices. According to a report by "Health Care without Harm" and the Boston Green Ribbon Commission, adding a one megawatt CHP system to a hospital can save $700,000 annually due to increased efficiency.[15] In cases where facilities are able to sell back to the grid, CHP provides a potential source of revenue.

Members of the Alliance for Industrial Efficiency are responsible for producing many of these benefits. For instance, a typical 6-megawatt Recovered Energy Generation facility built by Ormat Technologies on a natural gas pipeline results in:

- 84 new construction jobs,
- 6 new operations jobs,
- $100,000 in annual property taxes to the local community, and
- 50,000 tons of $CO_2$ avoided every year.[16]

Grid Outages Impose Substantial Economic Costs

Grid outages impose substantial economic costs, which could be avoided with CHP and other reliable distributed generation. Superstorm Sandy precipitated a series of significant economic losses, including a two-day shutdown of the New York Stock Exchange, at an estimated cost of approximately $7 billion. The economic research firm, Moody's Analytics, estimates an additional $20 billion from "suspended business activity." Additional losses included the cancellation of thousands of flights and other transportation services.[17] All told, ICF reports $70 billion in economic losses associated with Superstorm Sandy alone.[18] Multi-billion dollar losses were also incurred during Hurricane Katrina in 2005 ($40 billion) and the 2003 blackout ($10 billion). At a recent electric industry meeting, a representative from the Electric Power Research Institute (EPRI) stated that U.S. industries lose over $150-billion annually due to grid disruptions, and that 500,000 customers are without electricity for a minimum of one hour every day in the US.[19] When properly accounted for, these costs support the capital investment needed to install a CHP or WHP system.

[15] "Report Shows Mass. Hospitals Can Save $700,000/ Year, Increase Disaster Resilience and Climate Change Preparedness with Combined Heat and Power Systems," Sept. 10, 2013 (http://www.prweb.com/releases/2013/9/prweb11106862.htm).
[16] Personal Communication with Ormat Technologies, May 12, 2015.
[17] ORNL 2013, *supra* note 2, at 10-12.
[18] Anne Hampson, ICF, Oct. 2013, "Energy Resiliency: A Study of CHP in Critical Infrastructure" (Power Point slide 3).
[19] ORNL 2013, *supra* note 2, at 11 (reporting annual costs of $45 to 150 billion from grid outages).

Critical Infrastructure Policies Support Deployment

Recognizing the reliability benefits and the cost of inaction, many jurisdictions have adopted policies to expand CHP deployment. Texas and Louisiana were always national leaders in CHP deployment because of the region's strong industrial base. Following devastating losses during Hurricanes Katrina, Rita and Ike, both states adopted legislation to encourage deployment in critical facilities as well. The storms revealed vulnerabilities in the region's infrastructure – and the potential role of CHP to address these problems.

While Hurricane Katrina left the region without power for nearly three days, facilities like the Mississippi Baptist Medical Center were able to remain fully operational and did not lose power during this time. To encourage similar projects elsewhere, Texas adopted the Energy Security Technologies for Critical Government Facilities Act, which requires all government entities to identify government-owned buildings and facilities that are critical in an emergency situation and to obtain a feasibility study to consider the technical opportunities and economic value of implementing CHP during any renovation or new construction.[20] Subsequent law (Texas HB 1864) requires this assessment to consider whether the expected energy savings associated with such a system would exceed the costs of the system. This requirement extends to critical facilities that are operational 6,000 hours per year with a peak electric load exceeding 500 kW. The analysis should be based on a potential CHP system with greater than 60 percent efficiency that can provide 100 percent of a facility's critical electricity needs and sustain emergency operations for at least 14 days.[21] Louisiana adopted identical legislation.[22]

Following the Northeast Blackout in 2003, Superstorm Sandy, and ongoing security threats, states in the Midatlantic and Northeast have likewise recognized the reliability and economic benefits of CHP. Accordingly, Connecticut, Massachusetts, New York, and New Jersey have incorporated CHP commitments into their master plans and launched a variety of incentive programs:

- **Connecticut**'s Department of Energy and Environmental Protection (DEEP) instituted a Microgrid Grant and Loan Pilot Program, which awarded $18 million to nine microgrid projects (including five CHP systems).
- **Massachusetts**' Department of Energy Resources adopted a $40 million Community Clean Energy Resiliency Initiative, which provided $7.4 million in grants to six projects (including three CHP projects) in September 2014.
- **New York** City issued "A Stronger, More Resilient New York," which included recommendations for rebuilding the communities impacted by Superstorm Sandy and increasing the resilience of infrastructure and buildings citywide. The state

[20] Texas Code § 10-G- 2311 (http://www.statutes.legis.state.tx.us/Docs/GV/htm/GV.2311.htm).

[21] H.R. 1864, 81st Texas State Legislature, Regular Session, May 2013 (enacted), (http://www.legis.state.tx.us/tlodocs/83R/billtext/pdf/HB01864F.pdf).

[22] SR 171, Louisiana State Legislature, Regular Session, June 2012 (enacted), (https://legiscan.com/LA/text/SR171/id/649813).

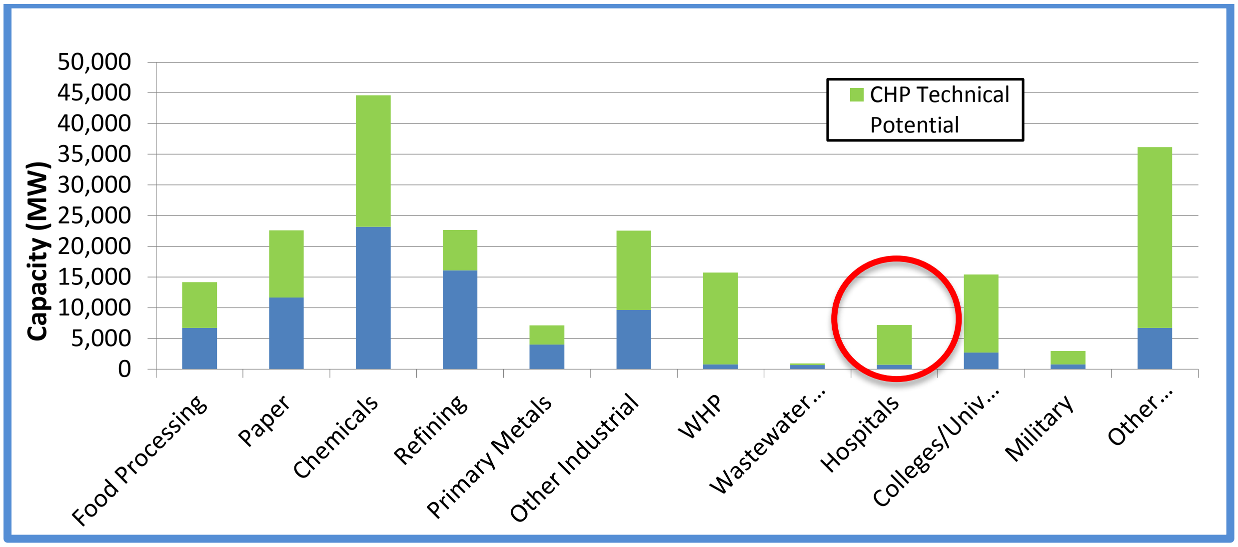
[19] ICF International, May 2013, "The Opportunity for CHP in the United States," (https://www.aga.org/sites/default/files/legacy-assets/Kc/analyses-and-statistics/studies/efficiency_and_environment/Documents/The%20Opportunity%20for%20CHP%20in%20the%20United%20States%20-%20Final%20Report.pdf).

energy office (NYSERDA) has instituted a $66-million CHP program to fund CHP systems with black-start capability.

- **New Jersey**'s Energy Master Plan emphasizes electricity resilience and provides funding to improve grid reliability. The Board of Public Utilities has also launched a $200-million energy resilience bank.

Such policies are needed because CHP deployment lags far behind its extensive potential. As noted above, the vast majority (87 percent) of existing installations are in the industrial sector, despite roughly equal technical potential in commercial and institutional buildings. As one example, CHP technical potential in hospitals is more than seven times current deployment – with 737 MW deployed to date, compared to 5,722 MW technical potential in this sector.[19] (Figure 2) Because CHP and WHP can more than double a system's efficiency, this means that thousands of critical facilities are needlessly wasting energy – and money.

**Figure 2 CHP and WHP Technical Potential**




The federal government has likewise recognized the need to support favorable CHP and WHP policies. In August 2013, the Department of Housing and Urban Development's Federal Hurricane Sandy Rebuilding Task Force included distributed generation as a key component of its "Hurricane Sandy Rebuilding Strategy." The Committee's final report included the following recommendations:

- Recommendation 12: "Ensur[e] that Sandy recovery energy investments in critical infrastructure are resilient."
- Recommendation 14: "Encourage Federal and State cooperation to improve electric grid policies and standards."

<u>Conclusion</u>

By encouraging electric utilities to "develop a plan to increase the utilization of resiliency related technologies" and supporting cost recovery for such systems, the Committee's Discussion Draft takes an important step to help keep the lights on during extreme weather events, improve grid reliability, capture wasted energy, and make our nation more competitive.

Thank you for the opportunity to testify. Both Veolia Energy and the Alliance for Industrial Efficiency look forward to working with the Committee as it continues to develop the Architecture of Abundance.