



November 27, 2017

Via E-mail to Comentarios@energia.pr.gov

Puerto Rico Energy Commission
Secretary María del Mar Cintrón Alvarado
268 Muñoz Rivera Ave., Suite 202
San Juan, PR 00918

Re: Case No. CEPR-IN-2017-0002 – In Re: Energy Commission Investigation Regarding the State of Puerto Rico’s Electric System After Hurricane María

Dear Secretary Cintrón Alvarado:

Pace Energy and Climate Center (“Pace”), with the generous support of the Institute for Energy Economics and Financial Analysis (“IEEFA”), appreciates this opportunity to submit the attached comments in response to the Puerto Rico Energy Commission’s (the “Commission”) Resolution and Order, issued November 10, 2017 in the above-referenced case, seeking stakeholder feedback regarding the implementation of regulatory actions to facilitate the tasks of restoring electric service and encouraging the deployment of new technologies.

Pace respectfully seeks leave to file these comments after the November 20, 2017 deadline set forth in the Resolution and Order. Due to the short time-frame for responses and Pace’s desire to provide comments that would be maximally useful to the Commission in its efforts, we would appreciate the opportunity to submit the attached comments past the intended deadline.

Should the Commission accept the late filing, please find attached with this letter the following documents:

1. Pace Comments in Case No. CEPR-IN-2017-0002;
2. Pace Background and Qualifications;
3. Bibliography;
4. Pace Attachment 1, *Out of Control: The New Biology of Machines, Social Systems, and the Economic World*;

5. Pace Attachment 2, *Community Microgrids: Smarter, Cleaner, Greener*;
6. Pace Attachment 3, *Microgrids & District Energy: Pathways to Sustainable Urban Development*;
7. Pace Attachment 4, *Combined Heat and Power on Brownfield Sites*;
8. Pace Attachment 5, *Financing CHP in Nonprofit Hospitals*;
9. Pace Attachment 6, *Combined Heat and Power in Hospitals*;
10. Pace Attachment 7, *Powering Through Storms: CHP Delivers Business Continuity, Risk Reduction, and Critical Infrastructure Resiliency Benefits*;
11. Pace Attachment 8, *Rethinking the Grid: Encouraging Distributed Generation*;
12. Pace Attachment 9, *The "Sharing Utility" Enabling & Rewarding Utility Performance Service & Value in a Distributed Energy Age*;
13. Pace Attachment 10, *A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation*;
14. Pace Attachment 11, *The Utilities of Maryland's Future: An Agenda for Transformation*; and
15. Pace Attachment 12, *United Nations Environment Guide for Energy Efficiency and Renewable Energy Laws*.

Respectfully submitted,



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Enclosures



**BEFORE THE COMMONWEALTH OF PUERTO RICO
PUERTO RICO ENERGY COMMISSION**

**In re: Energy Commission Investigation Regarding
The State of Puerto Rico's Electric System After
Hurricane María**

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Case CEPR-IN-2017-0002

November 27, 2017

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Preamble and General Comments

The Pace Energy and Climate Center appreciates this opportunity to submit the below responses to the Puerto Rico Energy Commission’s (the “Commission”) Resolution and Order in the instant proceeding, dated November 10, 2017.¹

The tragic weather events that destroyed so much of the Commonwealth of Puerto Rico’s electricity infrastructure have sent a strong message about the brittle nature of central station-dominated electricity systems. The most important challenge facing the Commission is whether it will honor the grim lessons of recent hurricanes with actions to reduce the consequences of future severe weather events that are certain to follow.

The demography, geography, economy and essential character of Puerto Rico demand a new electricity paradigm and structure that is as tough and smart as the people of the Commonwealth. As recognized by the Commission in its Resolution and Order, the strategies adopted to restore electric service must also deploy new technologies with performance characteristics superior to those chosen in the past. Stated simply, and powerfully, the new Puerto Rico electricity system will fail as it has before unless it is *faster, stronger and more resilient, smaller and smarter, and more diverse*.

What Puerto Rico needs today, and tomorrow, is a break from the mentality of dinosaurs, and with dependence on large, lumbering resources characterized by dimness of wit, lack of flexibility, and constant conflict with the very environment in which they exist. What Puerto Rico needs is an electric system of mammals—smart, nimble, cooperative, mutually supportive, capable of evolving and adapting, and organic.

The potential positive benefits of committing to the development of a new model of electric system within and integrated into the rebuilt electric system could be profound. For the people of the Commonwealth, there are the benefits of security, meaning less fear of privation and want, and sustainability, meaning the ability to meet the needs of today’s generations without compromising the ability of future generations to meet theirs.

The opportunity—and it should be seen as an opportunity—to build a new future while rebuilding the present is also the existential challenge of Puerto Rico’s electric system. It is also

¹ Case No. CEPR-IN-2017-0002, Resolution and Order (November 20, 2017), Request for Public Comments.

the challenge facing electrical systems around the globe. The future dominance and desirability of the central station electric utility model is being forced to give way to the superior economic, operational, environmental, and societal attributes of more distributed energy systems. The inertia of the existing dominant model is huge, and the transformation of the electricity system across the globe will take time and committed effort. Island systems and economies are the logical first place to install and demonstrate a new electric system model that builds from the ground up, that reflects the enhanced security of distributed systems, and that meets the Commission's strategic goals of speed, strength and resilience, scale and intelligence, and diversity of technology and control. What Puerto Rico must now do is what electricity system managers around the world are increasingly sure they, too, must accomplish—to build a new electric system from within older ones that are in various stages of disrepair, age, and limitation.

The challenge has attracted a wide range of offerors, including businesses and organizations seeking to demonstrate the efficacy of technologies they favor or sell, those seeking to profit from the crisis situation that the Commonwealth faces, and expert advisors seeking to demonstrate the superior benefits of their financial, technical, and operational approaches. What all but the most mercenary and greedy of these offerors want is a chance to prove the merits of their ideas, the strength of their technology, and the potential for translation of success into opportunities for replication in electric systems around the globe. Puerto Rico has the opportunity to be the test bed and first demonstration platform for true global electric system transformation. It is therefore all the more vital that the Commission develop a strategic vision for a process that maximizes the benefits available from the universe of distributed energy resources--technologies, systems, approaches, and services made available through intentional transformation and not merely repair of the Commonwealth's electric system.

The Pace Energy and Climate Center ("Pace"), with generous support from the Institute for Energy Economics and Financial Analysis, offers these comments in response to the Commission's Request for Public Comments. These Comments address a number of the specific questions asked by the Commission and provide, in addition, these preamble comments recommending a process for moving ahead. Pace provides detailed technical comments relating to two issues of particular expertise—combined heat and power ("CHP") and microgrids. Pace staff has a deep expertise and long-standing history of policy and education involvement in CHP and microgrids / district energy systems with CHP. Since 2003, through a cooperative agreement

with the U.S. Department of Energy (“DOE”), Pace has been home to the DOE's CHP Technical Assistance Partnership for the Northeast Region (“Northeast CHP TAP”). Pace manages the agreement and Co-Directs the Northeast CHP TAP with our partners at the UMass Amherst School of Mechanical Engineering. As far back as 2010, Pace convened one of the early conferences on Mmicrogrids, held at the Judicial Institute at the Elizabeth Haub School of Law at Pace University. Pace has been principal investigator or major contributing author on dozens of research proposals on policies, regulations, and optimal incentive schemes pertaining to distributed energy resources (“DER”) and microgrids. Pace has provided expert witness testimony in rate cases across the Northeast. In this submission, Pace also references and submits as resources work it has performed in the Northeast states, Maryland, and Missouri, and in published papers, relating to the detailed regulatory and market development work that must accompany a comprehensive agenda of utility transformation.²

Like many of the electricity-oriented not-for-profit organizations offering to share their energy and ideas with the people of Puerto Rico, Pace has significant experience in developing, articulating, and advocating the policies, structures, and pathways necessary to move forward on an aggressive agenda of electricity transformation. Pace is staffed by a team of experts with singularly comprehensive experience and expertise in electricity regulation, policy, and rate making aimed at advancing clean energy. More than just a noise-maker and publisher of papers—though we do both very well—Pace is a public interest intervenor with more than 25 years of experience participating in and leading the conversation and process around the groundbreaking New York “Reforming the Energy Vision” proceeding.³ Unlike most not-for-profit advocacy organizations, Pace staff get their hands “dirty” in the complex process of electric and gas utility rate cases; indeed, our team members have participated in hundreds of rate cases across the United States. What is unique about Pace is the depth of the Pace staff’s experience in venues where cost of service issues, rate design, prudence review, integrated resource planning, grid modernization, and all manner of related regulatory processes are addressed.

² Additional information about Pace Energy and Climate Center can be found in the Qualifications and Background, included as a separate attachment.

³ New York Public Service Commission, Case No. 14-M-0101, Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision.

Like many developers, contractors, and vendors approaching Puerto Rico for an opportunity to work, sell, or advise, the Pace Energy and Climate Center team has hands on experience with established and emerging technologies, services, and resources. Pace staff have worked with some of the largest and most innovative energy developers, operators, and customers in the nation. These include city and state governments, major power companies, international developers, and technology companies. Pace's staff has experience leading research and development efforts at the national level and as a team member for individual advanced energy projects like microgrids. An unabashed champion for clean, efficient, and distributed energy technology solutions, Pace brings more than the typical vendor or developer to these comments; Pace brings more than 100 staff-years of cumulative experience that recognizes that clean energy development rests on a three-legged platform of finance/economics, technology, and policy.

All of Pace's comments come from a single, and somewhat singular, perspective that Pace recommends the Commission adopt. That is:

The Commission, on behalf of the public interest of the present and future people and economy of Puerto Rico, must assume the leadership role in directing the shape, direction, and velocity of electricity system rebuilding and transformation efforts on Puerto Rico. The Commission is positioned to offer something of great value to businesses and advocates involved in the electricity industry—a chance to participate in perhaps the most important system transformation effort the world has seen since Samuel Insull began the sector consolidation process that now needs replacement. Looking back, Puerto Rico faces the greatest electricity industry change in more than one hundred years. Looking ahead, leadership now can position the Commonwealth's electric system as the global leader in modern electric systems architecture, investments, and architecture—work that must be done before the next round of major storms hits the region. It would be a privilege and great opportunity for any organization to work with the Commission and the people of Puerto Rico on rebuilding and electric system transformation.

Process Recommendations

The Commission will receive an immense amount of information and policy advocacy as a result of this proceeding, and very little time to fully process it. There is certainly no meaningful opportunity to select the best ideas and best technologies, even with the support of an army of advisors and consultants. This is because, first, the amount of time for gathering, analyzing, supplementing, and distilling the volume of information is extremely limited. Second, the range of information is exponentially greater than that the Commission has confronted in the past. A central station model has the appealing advantage of being simple, but the options are limited. A more diverse system comes with complexity. Third, and most importantly, a full implementation of a distributed electrical system infrastructure on the scale appropriate for Puerto Rico is unprecedented. Puerto Rico is in the position of learning by doing, and while components and ideas have some record of experience in other parts of the world, the task before the Commonwealth cannot be addressed simply by selecting the one “right” answer.

Pace recommends that the Commission approach the task of rebuilding-while-transforming as nothing less than creation. To that end, Pace recommends that the Commission adopt a strategy guided by some version of the nine principles enunciated by Kevin Kelly in “Out of Control,” first published in 1994. These principles, explained in Chapter 24 of the book, annexed to these comments as Exhibit 1, are:

Distribute being. *The spirit of a beehive, the behavior of an economy, the thinking of a supercomputer, and the life in me are distributed over a multitude of smaller units (which themselves may be distributed). When the sum of the parts can add up to more than the parts, then that extra being (that something from nothing) is distributed among the parts. Whenever we find something from nothing, we find it arising from a field of many interacting smaller pieces. All the mysteries we find most interesting -- life, intelligence, evolution -- are found in the soil of large distributed systems.*

Control from the bottom up. *When everything is connected to everything in a distributed network, everything happens at once. When everything happens at once, wide and fast-moving problems simply route around any central authority. Therefore overall governance must arise from the most humble interdependent acts done locally in parallel, and not from a central command. A mob can steer itself, and in the territory of rapid,*

massive, and heterogeneous change, only a mob can steer. To get something from nothing, control must rest at the bottom within simplicity.

Cultivate increasing returns. *Each time you use an idea, a language, or a skill you strengthen it, reinforce it, and make it more likely to be used again. That's known as positive feedback or snowballing. Success breeds success. In the Gospels, this principle of social dynamics is known as "To those who have, more will be given." Anything which alters its environment to increase production of itself is playing the game of increasing returns. And all large, sustaining systems play the game. The law operates in economics, biology, computer science, and human psychology. Life on Earth alters Earth to beget more life. Confidence builds confidence. Order generates more order. Them that has, gets.*

Grow by chunking. *The only way to make a complex system that works is to begin with a simple system that works. Attempts to instantly install highly complex organization -- such as intelligence or a market economy -- without growing it, inevitably lead to failure. To assemble a prairie takes time -- even if you have all the pieces. Time is needed to let each part test itself against all the others. Complexity is created, then, by assembling it incrementally from simple modules that can operate independently.*

Maximize the fringes. *In heterogeneity is creation of the world. A uniform entity must adapt to the world by occasional earth-shattering revolutions, one of which is sure to kill it. A diverse heterogeneous entity, on the other hand, can adapt to the world in a thousand daily mini revolutions, staying in a state of permanent, but never fatal, churning. Diversity favors remote borders, the outskirts, hidden corners, moments of chaos, and isolated clusters. In economic, ecological, evolutionary, and institutional models, a healthy fringe speeds adaptation, increases resilience, and is almost always the source of innovations.*

Honor your errors. *A trick will only work for a while, until everyone else is doing it. To advance from the ordinary requires a new game, or a new territory. But the process of going outside the conventional method, game, or territory is indistinguishable from error. Even the most brilliant act of human genius, in the final analysis, is an act of trial and error. "To be an Error and to be Cast out is a part of God's Design," wrote the visionary*

poet William Blake. Error, whether random or deliberate, must become an integral part of any process of creation. Evolution can be thought of as systematic error management.

Pursue no optima; have multiple goals. *Simple machines can be efficient, but complex adaptive machinery cannot be. A complicated structure has many masters and none of them can be served exclusively. Rather than strive for optimization of any function, a large system can only survive by "satisficing" (making "good enough") a multitude of functions. For instance, an adaptive system must trade off between exploiting a known path of success (optimizing a current strategy), or diverting resources to exploring new paths (thereby wasting energy trying less efficient methods). So vast are the mingled drives in any complex entity that it is impossible to unravel the actual causes of its survival. Survival is a many-pointed goal. Most living organisms are so many-pointed they are blunt variations that happen to work, rather than precise renditions of proteins, genes, and organs. In creating something from nothing, forget elegance; if it works, it's beautiful.*

Seek persistent disequilibrium. *Neither constancy nor relentless change will support a creation. A good creation, like good jazz, must balance the stable formula with frequent out-of-kilter notes. Equilibrium is death. Yet unless a system stabilizes to an equilibrium point, it is no better than an explosion and just as soon dead. A Nothing, then, is both equilibrium and disequilibrium. A Something is persistent disequilibrium -- a continuous state of surfing forever on the edge between never stopping but never falling. Homing in on that liquid threshold is the still mysterious holy grail of creation and the quest of all amateur gods.*

Change changes itself. *Change can be structured. This is what large complex systems do: they coordinate change. When extremely large systems are built up out of complicated systems, then each system begins to influence and ultimately change the organizations of other systems. That is, if the rules of the game are composed from the bottom up, then it is likely that interacting forces at the bottom level will alter the rules of the game as it progresses. Over time, the rules for change get changed themselves. Evolution -- as used in everyday speech -- is about how an entity is changed over time. Deeper evolution -- as it might be formally defined -- is about how the rules for changing*

entities over time change over time. To get the most out of nothing, you need to have self-changing rules.

Pace further recommends that the Commission move immediately to establish an overarching process consistent with these principles and dedicated to creating a learning environment in which the creation of Puerto Rico's new electricity system can occur. Pace recommends that the Commission follow these basic steps:

Step 1: Use existing and additional consultants and advisors to identify and characterize desirable traits and performance characteristics—not specify technologies. This characterization requires functionalizing a system for the secure and sustainable provision of electricity service. The comments submitted in this proceeding and the many proposals the Commonwealth has already received provide the feedstock for this process. This task involves answering one basic question: What exactly does the Commission want from its ideal electric system? At the highest level, Pace proposes that this question can be answered as “a growing set of increasingly interconnected ubiquitous microgrids.”

Step 2: The Commission should then work with existing and additional advisors and consultants to develop a catalog and a map of needs. This difficult task requires *not* presuming any solutions, but instead requires an inventory of services required by the people, businesses, and institutions that make up the Commonwealth. The operative question is: Who and what requires electric service? Pace initially recommends that the focus be on communities—the extant coalitions of citizens, businesses, and supporting institutions that make up the common local ecosystem of Puerto Rico's villages, towns, and cities.

Step 3: The Commission should then translate its needs and the desired characteristics into a wide-open solicitation process inviting proposers, and especially *teams* of proposers to develop solutions and methods for meeting the demand for energy services. These proposers should be required to describe precisely how they will provide which services to which users, at what price, and in accordance with the electric system parameters identified by the Commission in Step 1.

Step 4: The Commission should select multiple solution providers for each identified need and plan to run them in parallel. The wide diversity in financing, ownership, and operational structures accompanying most emerging distributed energy resources-based solutions

makes it clear that a “silver buckshot” approach, and not a “silver bullet” approach is in order. Ideal solutions often emerge from the lessons learned from multiple, simultaneous efforts at creation.

Step 5: The Commission should establish the monitoring and feedback loops to support and encourage mid-course corrections and multiple development iterations for the task of rebuilding and transforming Puerto Rico’s electric system. Immediate steps must be viewed as components of a longer, transformative process.

Step 6: The Commission should establish processes of constant change. Evolving technologies and service models succeed on two competing environmental conditions—enough financial certainty to support investment and enough “churn” to support innovation. Unlike the central station model, an electric system built on a backbone of interconnected and interoperable distributed energy resources will not be characterized by lumbering investment requirements with multi-decades long amortization periods.

Step 7: The Commission should establish processes for regular periodic honest assessments of progress and success against outcome-based performance metrics. The task of electric sector transformation is ultimately not about investment rates or amounts of hardware installed or concrete poured. The metrics that matter are security and affordability of service, environmental performance, and customer engagement and satisfaction.

Pace is grateful for an opportunity to provide these comments to the Commission in response to its Notice of Inquiry. Pace stands ready to provide any additional support requested.

In the comments below, Pace provides a set of responses to the Commission that arise from our experiences over the last two decades in the Northeast. We approached this task with a large measure of humility, fully recognizing how scant is our specific knowledge of the Puerto Rico energy markets, and the important economic, demographic and geo-spatial characteristics unique to the Commonwealth. While this is a limitation, there are certain sets of general principles and practices that, when employed, should lead to preferred outcomes. With that context, Pace attempted to offer guidance and perspective on regulatory procedures, protocols, optimal incentive design, and the creation of market structures that would best facilitate the development of more robust markets for environmentally superior, high efficiency, economically

advantageous, and resilient energy technologies and systems for the Commonwealth of Puerto Rico.

Responses to Questions in Appendices I and II

1. Microgrid Organization

1.1. What legal authority does the Commission have to regulate actors and actions involved in microgrids? Consider the following actions, among others: Creation of a microgrid business, interconnection with other microgrids, interconnection with PREPA's transmission or distribution system, sales of microgrid output to RREPA (for resale), sales of microgrid output to retail customers (with or without participation by PREPA).

The Puerto Rico Legislative Assembly has recognized the importance of microgrids to a more energy efficient and sustainable electric system,⁴ and has granted the Puerto Rico Energy Commission authority to regulate microgrids, including under Puerto Rico's Renewable Portfolio Standards legislation,⁵ and the Puerto Rico Energy Transformation and RELIEF Act (the "RELIEF Act").⁶

At the broadest level, the Commission's powers and duties include the authority to "[e]stablish by regulations the public policy rules regarding electric power service companies, as well as any transaction, action or omission in connection with the electric power grid and the electric power infrastructure of Puerto Rico, and implement such public policy rules."⁷ The Commission is also required to "establish the regulatory framework that shall guide PREPA in the development of regulations for community solar projects and microgrids."⁸ In regard to interconnection, the Commission is required to "evaluate and make determinations regarding the interconnection of distributed renewable energy and large-scale renewable energy to PREPA's distribution and transmission grid of in order to ensure access thereto fairly and equitably,"⁹ and has the authority, more generally, to "[r]eview and approve minimum technical requirements

⁴ See 12 L.P.R.A. § 8121(21), "The goal of microgrids is to reduce energy consumption based on fossil fuels through local renewable energy generation and strategies to reduce energy consumption. A microgrid can connect and disconnect from PREPA's grid to enable it to operate in both grid-connected or off the grid."

⁵ Public Policy on Energy Diversification by Means of Sustainable and Alternative Renewable Energy in Puerto Rico Act (the Alternative Renewable Energy Act), 12 L.P.R.A. § 8121 *et seq.* "Microgrids" are defined under this title as "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to PREPA's grid." 12 L.P.R.A. § 8121(21).

⁶ 22 L.P.R.A. § 1054 *et seq.*

⁷ 22 L.P.R.A. § 1054b(b).

⁸ 22 L.P.R.A. § 1054b(rr).

⁹ 22 L.P.R.A. § 1054b(qq).

(MTRs), additional technical requirements (ATRs), and any other type of requirement established by PREPA for the interconnection of distributed generators to the electric power grid, and oversee compliance therewith."¹⁰

Taken together, under the broadly-applicable and microgrid-specific powers and duties granted to the Commission, it likely has the authority to regulate each of the actions queried in Question 1.1: the creation of a microgrid business, the interconnection with other microgrids and PREPA's transmission and distribution system, and the sale of microgrid output to PREPA and to retail customers.

1.2. What are the advantages and disadvantages of alternative microgrid ownership structures (e.g., third-party, customer co-op, anchor load)? Consider such factors as reliability, economics, accountability.

Where technically feasible and economically viable, microgrids are faster, smarter, smaller, and more diverse. Compared to central-station power, microgrids are faster to complete, where time to completion is measured in months or tens of months—rather than a decade. Local generation, in close proximity to local electric (and thermal) loads is more efficient, permits the capture and utilization of waste heat, and is more resilient than grid power with emergency or backup generators.¹¹ Pace experts for years have testified to the numerous “uncompensated benefits” of CHP and other forms of clean DER.

Single-owner, campus-style microgrids built around a good anchor load haven proven to be both technically feasible and economically viable. Often the economics of microgrids are very much contingent upon the existence of a strong anchor load, with a high degree of simultaneity between electric and thermal demands.

The ownership structure of a campus-style, single-owner microgrid is far less complex than establishing contractual rights and responsibilities among two or more unaffiliated entities. The simplicity of this ownership structure is an advantage.

¹⁰ 22 L.P.R.A. § 1054b(t).

¹¹ *Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities*. Thomas Bourgeois, Gavin Dillingham, Anne Hampson, Isaac Panzarella. Prepared by ICF International for Oak Ridge National Laboratory. March 2013. Page 6.

All else being equal, the transaction costs can be significantly less onerous when compared to multiple-party microgrids. As a consequence, the fixed costs of involving multiple parties may erode the economics of a potential project.

However, third party ownership structures are desirable in several instances. A third party off balance sheet arrangement may be desirable where the anchor load or major host site has limited access to capital, is capital constrained, or if additional borrowing would increase the entity's cost of capital, or breach bond covenants.

There are a number of public financing options for microgrids.¹² The Massachusetts Development Finance Agency ("MassDevelopment") has been approached to finance microgrids. The Dormitory Authority of the State of New York ("DASNY") has used public financing to support CHP projects in hospitals, nursing homes, and colleges and universities.

Third-party ownership may also be desirable in order to access tax benefits. If electric and thermal demands are concentrated at sites that are not taxpayers, it may be preferable to create a structure that can take advantage of tax-based incentives, such as investment tax credits, accelerated depreciation, and expensing.

Customer co-ops can represent a form of ownership that in theory could open up microgrid development to areas that would otherwise be underserved. This ownership form could provide access to low- and moderate-income ("LMI") communities, in multifamily residential buildings, economic development zones, and local community development areas.

An alternative not mentioned above is a hybrid model—one where some of the assets are owned and controlled by the utility and other assets are owned by the end-users or the microgrid corporation. This model is attractive insofar as it splits the capital cost burden. The utility may desire to have assets on the utility side of the meter over which it retains operational control.

¹² *Public Financing Options for Microgrids*. Rebecca Sullivan, Senior VP, Institutional Finance, MassDevelopment. Presentation. June 29, 2016. Sponsored by the Metropolitan Area Planning Commission, Boston, MA. Available at <http://www.mapc.org/wp-content/uploads/2017/08/Rebecca-Sullivan-MassDevelopment.pdf>.

1.2.1. For each possible ownership structure, what actions by the owners, users and customers should be guided, constrained or rewarded through regulatory actions? What regulatory actions are necessary? What regulatory actions might be unnecessary or problematic?

Regardless of the ownership structure employed, certain actions by owners, users and customers should be guided and rewarded through regulatory action, including those that provide measurable and demonstrable utility system or societal benefits. Appropriately designed, configured, and operated DER can provide a suite of benefits. The regulatory regime, including system planning, system operations, PREPA capital investments, and the design of rates and incentive structures should work in synchronicity with the objective of maximizing the value of DER. It would be a huge missed opportunity if private investment in DER occurred in a fractious and uncoordinated manner so that the inherent capability of microgrids and DER as dynamic assets serving the grid and all ratepayers was lost.

Regulatory actions that are necessary include:

1. Clarifying what is an acceptable microgrid development. The market will not develop if approvals have to be made on a case-by-case basis. In addition, the Commission should provide guidance on the form of regulation that microgrids of different sizes and types will be subject to. Will regulation, registration, and oversight be accomplished in a tiered manner, with a very “light handed” form of regulation at one extreme and “utility-like” regulation at the other?
2. Conducting a collaborative¹³ to determine key barriers and market challenges, including: interconnection; tariffs; standby rates; export sales to PREPA; bilateral sales within the microgrid; terms, conditions, and costs for the leasing, purchase, or rental of existing PREPA equipment; and so on.
3. Clearly establishing what are the various revenue (value) streams that the microgrid can access. For instance, the user, utility, and society all benefit from the increased reliability provided by the microgrid. The user additionally benefits from decreased energy costs and the provision of ancillary services. The utility experiences cost savings as well from delayed transmission and distribution (“T&D”) investment and capacity cost savings. There may also be environmental benefits from cleaner energy generation, higher energy efficiency from decreased line loss, as well as resiliency, safety, and security provided by the microgrid and services supported by the microgrid. Each of these benefits can be

¹³ Pace was a key party to former New York City Mayor Bloomberg’s “Distributed Generation Collaborative,” which was in existence 2011-2013.

valued, with benefits not directly accrued to the user provided through utility, taxpayer, or ratepayer funds, where appropriate.¹⁴

4. Aligning existing incentives, the T&D system planning and capital investment process, and the ratemaking process, with the objective of ensuring extraction of maximum societal and utility system value from the development of microgrids in the Commonwealth.
5. Instituting a robust set of metrics and annual reporting. Metrics should be developed to evaluate a range of microgrid services and benefits, including, but not limited to:
 - a. How much more resilient is the system becoming?
 - b. How much has been saved in traditional T&D capital investments by the substitution of DER?
 - c. What is the year over year and 3-year growth rate in the utilization of Non-Wires Alternatives, or in the measured and recorded value of DER in improving grid utilization and grid operations?¹⁵

1.3. Are there legal or practical obstacles to any desirable ownership structures? If so, what are the solutions, within and outside the Commission's authority?

No response.

1.4. What financing sources are available to support various ownership forms? Consider private investment (both independent investors and commercial entities like large stores), government investment, and foundation and other non-profit sources.

Campus style, single-owner microgrids are a tested, proven, economic, and reliable model. Operated at colleges and universities, hospital and health care complexes, large multifamily campuses, and industrial parks, these types of facilities can be financed by a variety of different mechanisms. Potential financing sources and mechanisms include:

1. Tax-exempt authorities providing financing for hospitals, health care, and colleges and universities.

¹⁴ *Capturing the Benefits of Distributed Energy*. Tom Bourgeois, Pace Energy and Climate Center. Presentation, June 1, 2016. New Jersey Utilities Association Annual Conference. Slide 16.

¹⁵ Direct Testimony of Daniel Leonhardt and Thomas Bourgeois, May 27, 2016. New York Public Service Commission. Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service, Case Nos. 16-E-0060 and 16-E-0061. Subjects covered: Advanced Metering Infrastructure, distributed energy resources, time variant pricing rate design.

2. Authorities that provide financing for public and private not-for-profit entities.
3. Economic Development Authorities may be able to provide financing for campus-style microgrids at industrial parks and perhaps for larger institutional or private sector entities.
4. Private equity funds may wish to invest in microgrids, if the rate of return is sufficient. The business model must have enough revenues in excess of costs, to ensure a rate of return that will encourage investment of private capital.
5. Pension funds, insurance, and other sources of capital that have significant future liabilities may be interested in stable, long-term cash flows that could be achieved with investments in microgrids.
6. Project developers, energy service companies (“ESCOs”), and equipment manufacturers are a source of investment capital. They often offer their own financing to an end-user. Some may wish to remain involved in the project through building, ownership, operating, or maintenance arrangements.

In some instances, a large anchor load, for example an industrial customer, may be the hub around which a microgrid is developed. An industrial park or other large user of electric power may sit in close proximity to another entity with large thermal energy requirements. Or, a site that needs more power than can be consumed internally can beneficially export to one or more proximate neighboring establishments.

Connecticut and New Jersey offer examples of various financing arrangements. Connecticut has incentivized microgrids for agricultural customers, municipalities, and state agencies. The Connecticut Department of Energy and Environmental Protection (“DEEP”) is running a microgrid program that assigns grants to promote resilient microgrid and CHP investment. The Connecticut Green Bank also coordinates private investment to provide additional financing for microgrid projects.

Additionally, Connecticut allows virtual net metering, targeted at similar customers to the microgrid program (municipal, state agency, and agricultural). Municipal and state generators can virtually net meter renewable and CHP installations, while agricultural installations may qualify only with renewables. The credit customers receive for net generation is the wholesale generation price, plus a percentage of distribution price (initially 80%, declining to 40% by

2018). The amount of credits is capped at \$10 million annually, and one sector cannot be allocated more than 40% of credits.¹⁶

In New Jersey, the Energy Resiliency Bank was created to distribute \$200 million in resiliency funding provided by the Department of Housing and Urban Development. It met funding shortages for qualifying projects, such as microgrids and CHP.¹⁷ PREPA has been allocated \$215 in Federal Emergency Management Agency (“FEMA”) funding to rebuild infrastructure, and a further \$99 million has been allocated to non-profits such as hospitals, schools, community centers, and shelters.¹⁸ A similar fund for microgrid projects could be created in Puerto Rico to allocate current and future relief and resiliency funding.

1.5. What types of expertise (e.g., planning, engineering, customer education, other) are necessary to make the planning, development and operation of microgrids a success? What are current examples of success and failure?

The success of microgrids is a multi-disciplinary effort. Planning and engineering are key. The smart approach to making a microgrid successful is to start with an energy master plan for the site. Investments in energy efficiency first are the cost-effective approach. Once the economic gains from energy efficiency investments have been realized, the generation requirements of microgrid are right-sized to the load—not over-sized. Planning is essential for understanding any expected future changes in loads. Planning may also uncover opportunities for connecting complementary loads in close proximity, or for converting loads from one energy form to another.

A primer on the process of community microgrid planning is attached to these comments as Attachment 2: “Community Microgrids: Smarter, Cleaner, Greener” was authored by Pace in September 2013. When New York State was running its community microgrid “NY Prize” Competition, the *Community Microgrids* guidebook was posted as a resource for communities that were interested in applying to the program. Though the publication is now four years old, at a recent microgrid conference in Boston, Pace was told by a major microgrid development

¹⁶ *Virtual Net Metering*. Lee Hansen. Office of Legislative Research. Connecticut General Assembly. Available at <https://cga.ct.gov/2015/rpt/pdf/2015-R-0264.pdf>.

¹⁷ New Jersey Economic Development Authority. Energy Resilience Bank. [http://www.njeda.com/erb/erb-\(1\)](http://www.njeda.com/erb/erb-(1)).

¹⁸ Federal Energy Management Administration. *FEMA Approves More Than \$500 Million in Assistance to Puerto Rico*. <https://www.fema.gov/news-release/2017/10/23/4339/fema-approves-more-500-million-assistance-puerto-rico>.

company that they are still using the guidebook when they speak to communities about microgrid development. They noted that this was, and remains, the best *primer* on microgrids for community leaders.

Engineering expertise is essential. Careful consideration of system performance across all potential scenarios is a pre-requisite for operational and economic success. It's vital that engineering design is made (nearly) flawless for execution of the sequence of operations, in isolated and grid-connected modes, and the transition states between the two.

A successful microgrid must have one or more internal “champions.” Pace’s experience in the Northeast US indicates that microgrid development requires strong organizational commitment. This commitment typically is furnished by one or a few individuals who are not deterred by challenges, barriers, and setbacks.

A few examples of successful “microgrids” in the Northeast US include:

Colleges / Universities	Princeton, Cornell, MIT, Harvard, New York University (NYU), Fairfield, Univ. Massachusetts-Amherst
Hospitals / Nursing Homes	Long Island Homes (LIH), Burrstone – Utica, New York Presbyterian,
Multifamily	The Breevort – East (Manhattan), Co-Op City – a housing development in the Bronx, NYC
Industry	Harbec Plastics, Sikorsky CT, Biogen – Cambridge MA

A particularly compelling story is that of the Long Island Home, located in Amityville, NY. As described in the project’s CHP Technical Assistance Partnership project profile, the Long Island Home is “a 325,000 square foot healthcare facility operating South Oaks Hospital, a 197-bed inpatient behavioral health hospital including outpatient and ambulatory programs and Broadlawn Manor Nursing and Rehabilitation Center, which encompasses a 320-bed skilled

nursing and sub-acute center and a 7-day a week Adult Day Health Center.”¹⁹ Below is an excerpt from the project profile:

Case 1: CHP for Resilient Health Care Complexes

The Long Island Home (LIH) CHP system fully powered the campus through the Northeast blackout of 2003 and through Superstorm Sandy, while much of the surrounding areas suffered a prolonged power outage. When Superstorm Sandy hit the region in October of 2012, LIH isolated from the grid and operated in “island mode.” The CHP system supported 100% of the power demands of the campus for 15 consecutive days, providing electricity, heat, and hot water. LIH’s freezers and refrigerators kept food and medications stored safely while the kitchens, on-site laundries, and all other operations continued uninterrupted.



LIH’s resilient CHP system provided benefits to the surrounding community as well. LIH was able to take in patients from other healthcare facilities in the area that were forced to evacuate. Nearby residents were able to charge cell phones and refrigerate medications. Staff remained at the LIH facility while their homes were without

power. Because of LIH’s resilient CHP system, it is recognized as a Center of Refuge.

Another salient case study is the Brevoort East project in Manhattan, New York: CHP for Resilient Multi-Family Buildings. When Superstorm Sandy hit New York and the Northeast in October 2012, the Brevoort, a 290 unit, 1950’s era Co-Op in Greenwich Village, was one of the only buildings operating in the lower third of Manhattan that was able to continuously provide electricity, heat, and hot water to all of its occupants. The CHP installation features four 100kW units fueled by natural gas. They powered all 290 apartments throughout Sandy. Normal occupancy of the Brevoort is 720 people, but during Sandy, the Brevoort housed and provided

¹⁹ U.S. Department of Energy Northeast Clean Energy Application Center. The Long Island Home. *Available at* http://www.northeastchptap.org/Data/Sites/5/documents/profiles/newprofiles/southoaks_case_study_02may13.pdf.

power to 1,500 people throughout the storm. The Brevoort was able to maintain power for central boilers, domestic water pumps, all elevators, and all apartments.

2. Microgrid placement and availability: Given the Commonwealth’s need and desire to getting service restored to all customers as soon as possible, consider these questions:

2.1. What are the advantages and disadvantages of focusing microgrid development on specific types of customer loads (e.g., large industrial loads, urban loads, rural loads, residential neighborhood loads)? Are some types of load profiles, or some geographic areas, better suited than others? What data exist to support your answer?

The advantages of focusing microgrid development on specific types of customer loads, geographic areas, or locations on the grid are numerous and compelling.

The Commission could spur “prospecting” for high-value sites by establishing a checklist of desirable attributes or features that lead to economically viable site selection. The loads ought to be large and should be fairly constant (high load factors). The project should be operated on as many of the 8760 hours of the year as possible.

The best load profiles are those that are large in size and are constant (not “peaky”). These candidates might be found at a large anchor load (such as an industrial facility, or a large campus), or by combining complementary electric and thermal loads (process heat, cooling, hot water) at more than one site that are in very close proximity, so that power and thermal energy can readily be shared without long runs of electrical conduit and thermal piping.

The value created by microgrids is contingent upon a variety of factors. The Commission can play an important role by designing optimum incentive systems and regulatory frameworks designed to direct investment into areas of greatest value.

Both thermal and electric loads need to be considered. Combined heat and power makes an ideal anchor generator for a microgrid, around which can be integrated photovoltaics, storage, and other renewable energy resources. Favorable economics for CHP occur where there is a large and simultaneous need for electric power *and* thermal energy (including thermally activated technologies—*e.g.*, absorption chillers).

Dense geographic areas that include critical infrastructure and/or business establishments that place a high value on very reliable electricity supply are clearly high priority sites.

Because microgrids are not uniformly valuable across all economic sectors, all types of buildings, or all areas of the electric grid, targeting is an essential component of a microgrid strategy.²⁰

2.2. Regardless of the possible priorities to place on different types of loads, what are the most cost-effective paths to getting microgrid service universally available to all customers regardless of their locations?

A very important point to keep in mind is that the value of microgrids to the end-user, utility system, and society varies markedly across a number of dimensions, including economic sectors, customer profiles, geography, energy consumption density, and location on the utility T&D system.

The most cost-effective paths to creating a robust market for microgrids requires a multi-faceted strategy.

There must be close collaboration and coordination of PREPA's grid (T&D) capital investment plans and grid operations protocols with renewable energy, energy efficiency, economic, and infrastructure development. A new focus on a modern grid initiative is essential. The capital investment plan for the grid must be harmonized with the expected future functions of a clean, reliable, affordable, and resilient grid.

Puerto Rico's renewable energy portfolio standard calls for PREPA to supply 20% of retail electricity sales from eligible "green energy" resources by 2035.²¹ It is essential that new DER investments are designed to be dynamic assets that will serve the grid, improve grid productivity and capacity utilization, and lower costs for all the Commonwealth's energy users.

The metrics that are currently used in assessing distribution system performance and guiding distribution system investments are not likely to give signals as to how amenable the

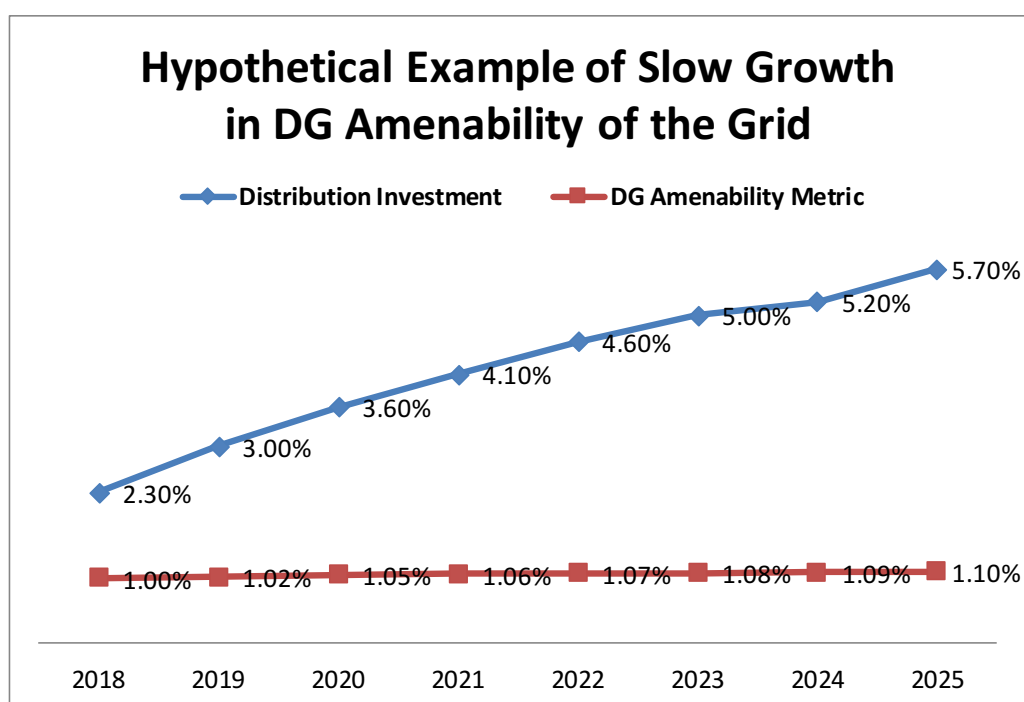
²⁰ Thomas Bourgeois, Brad Bradford, Jordan Gerow, Daniel Leonhardt, Nick Martin, Laxmi Rao. Microgrids & District Energy: Pathways to Sustainable Urban Development (June 2015). Subject covered: benefits and practices of microgrid development. A copy of the report is annexed hereto as Attachment 3.

²¹ NC Clean Energy Technology Center, DSIRE, Puerto Rico-Renewable Energy Portfolio Standard, Last Updated May 6, 2015. <http://programs.dsireusa.org/system/program/detail/4267>.

grid is to incorporating distributed power, the extent to which its capabilities are being effectively captured, and how the functionality of the grid is evolving in certain areas (*e.g.*, its "agility," "flexibility," and "resilience").

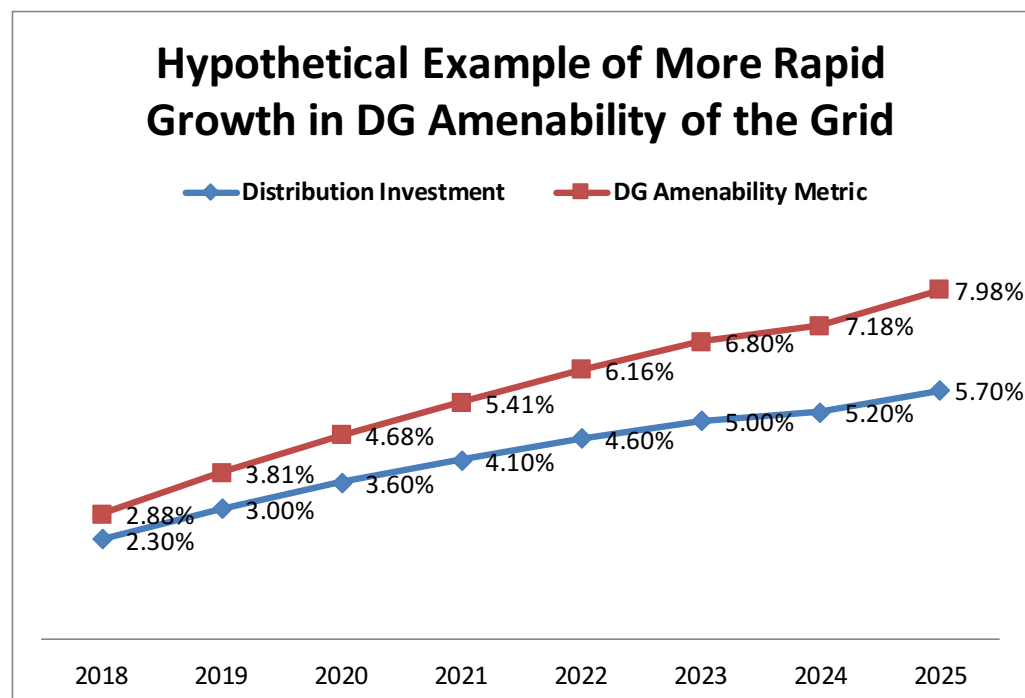
Fundamental changes in the configuration of our electric power generation assets, and their interaction with loads and other generation sources, will require concomitant changes in distribution planning, the structure and composition of the assets on the distribution system, and the operation of the system itself (*e.g.*, the network protection schemes).

T&D capital equipment typically has a very long expected service life. Investments made today may lock in grid functionality for 20 or 30 years, or more. As the Commonwealth makes new investments in its electric grid, it needs to ensure that the direction in which it is heading doesn't look like this:²²



²² *From Evolution to Revolution: Enabling Clean Energy at the Edge of the Electric Grid*. Thomas Bourgeois & William Pentland. The Sallan Foundation: Snapshot. February 14, 2013. Available at https://www.sallan.org/Snapshot/2013/02/from_evolution_to_revolution.php#.WhyUylWnEnQ.

If Puerto Rico creates the right system, it can more readily insure that as it makes new investments in the T&D system, the direction in which it is heading looks more like this:²³



To guarantee realization of the full benefits of renewable and distributed energy resources, Puerto Rico must fundamentally alter its grid capabilities and the planning and approval process that guides the investments that determine the grid’s functionality.

Achieving *universal* microgrid service regardless of customer location may not be the most desirable end-state, from a total societal value perspective. As noted below, a careful, empirical analysis is required to ascertain what the optimum end-state goals ought to be.

The existing costs to serve certain remote areas may make local microgrids the more economically viable option. See, for example, the case of the “Full Utility Microgrid model” in New York State, as reported in the New York State Microgrid report, “Microgrids for Critical Facility Resiliency in New York State.”²⁴ For example, the local utility serving the town of Denning, New York, Central Hudson Gas and Electric, developed a microgrid system to serve an

²³ *From Evolution to Revolution: Enabling Clean Energy at the Edge of the Electric Grid*. Thomas Bourgeois & William Pentland. The Sallan Foundation: Snapshot. February 14, 2013. Available at https://www.sallan.org/Snapshot/2013/02/from_evolution_to_revolution.php#.WhyUyIWnEnQ

²⁴ Microgrids for Critical Facility Resiliency in New York State. Final Report December 2014. NYSERDA Report Number 14-36, at page 112.

electric load center located more than 14 miles from the distribution substation, after an evaluation of the electric service reliability of the area found service to be unacceptable.²⁵

2.3. What level of financial assurance will microgrid developers reasonably require before investing their own funds in Puerto Rico microgrids?

Microgrid developers will need to have an economic pro forma that provides assurances of the return of capital and the return on capital, with a high degree of confidence, over a reasonable period of time. Therefore, there needs to be a reasonable bound of certainty around the expected costs and revenues from the project development.

The Commission possesses a considerable array of instruments and authority to affect both the costs borne by, and the revenues accruing to, microgrid development projects. The Commission should consider the following actions to provide greater assurance to investors:

1. The elements of the interconnection schedules need to be clearly spelled out, with timetables for utility response to interconnection requests.
2. An Office of DER Ombudsman should be established within the utility. The DER Ombudsman's office would be the point of contact between the DER development community and all of the internal utility programs and procedures that touch upon the DER development process.
3. A dispute resolution process should be instituted with the expectation that judgements will be rendered in an expeditious manner.
4. The regulatory definition of what constitutes a legal microgrid must be absolutely clear. Developers should not have to come to the Commission for a regulatory opinion on a case-by-case basis.
5. The rights and the responsibilities of the microgrid developer need to be well defined.
6. The terms of access to the existing assets of the utility must be certain. Developers will need to know if they can sell power over existing utility wires, and what are the costs and terms for accessing the utilities' T&D assets.

²⁵ *Microgrids for Critical Facility Resiliency in New York State*. Final Report December 2014. NYSERDA Report Number 14-36, at page 112. Available at <https://www.nyseda.ny.gov/-/media/Files/.../Microgrids-for-Critical-Facility-NYS.pdf>.

7. If the microgrid owner/developer wishes to purchase existing utility assets, the conditions for ascertaining fair value for the sale must be codified.

2.4. What can the Commission do to facilitate universal service in the restoration?

The Commission can create an environment conducive to the development of microgrids. That is accomplished in part by clarification of key uncertainties that deter private investment in microgrids.

First, there should be a clear set of rules to guide a microgrid developer, to mitigate uncertainty and market risk.

In addition, the Commission ought to encourage the utilization of microgrids as a non-wires alternative (“NWA”) option. Properly designed, configured, and operated microgrids can serve as a substitute for traditional utility T&D capital expenditures. New York State’s Consolidated Edison utility is undertaking a major initiative to demonstrate the feasibility of NWA alternatives in its Brooklyn Queens Demand Management (“BQDM”) project. Other NWA pilots are underway in New York State and elsewhere.

All forms of models ought to be tested, including utility owned and operated models, hybrid utility / private ownership, and private ownership. In some instances, control may be separated from ownership, under terms that permit the utility to utilize privately owned assets as a dynamic resource serving the grid. This can create joint rewards for the microgrid owner, capturing an additional revenue stream, as well as for the utility, which will have greater flexibility to meet its grid planning and operations requirements.

3. Microgrid Regulation

3.1. What form of registration and/or approval by the Commission should be required for microgrids?

Microgrids should be registered by the Commission. The registration and approval process must have a dual mandate:

1. To ensure that all public health and safety concerns under the Commission’s purview are adequately addressed; and

2. That the registration and/or approval process be conducted in a manner such that undue time delays, complexities, or process costs do not create any inadvertent barriers to the development of qualifying microgrid projects.

3.1.1. What regulatory changes would be needed to permit various microgrid arrangements?

No response.

3.1.2. What aspects of microgrid operations should be regulated?

No response.

3.1.3. What are the advantages and disadvantages of the Commission establishing technical and financial qualifications for the microgrid developers?

No response.

3.1.4. What are the risks of incompetent or unscrupulous developers and what are reasonable ways to prevent such problems?

No response.

3.2. What technical standards should apply to islanded microgrids?

No response.

3.2.1. What safety standards should apply?

No response.

3.2.1.1. Are the existing standards—IEEE Standard 1547 for design; UL Standard 1703, UL Standard 1741, or IEEE Standard 1547 for equipment; and the 2011 National Electric Code—sufficient? Why or why not?

No response.

3.2.2. What are the advantages and disadvantages of requiring inspections? If the Commission requires inspections, what types of professionals and entities should be responsible for conducting them and certifying compliance? Consider registered engineers (working for the developer, for the Commission nor for some other independent entity, municipal construction permit inspectors, others). What technical specifications should apply to the process of interconnecting a microgrid to PREPA's transmission or distribution system?

No response.

3.2.3. Based on what factors should the Commission determine whether microgrids be interconnected only to PREPA's distribution system vs. to PREPA's transmission or sub-transmission system?

No response.

3.3. How should the location of microgrids be determined?

The location of microgrids should be determined by the market. However, the Commission ought to use all available regulatory tools to inform the market of the highest-value sites for locating a microgrid.

The Commission should design incentive structures that direct investment to areas where the societal value, and the utility system value (the T&D grid), is greatest. Microgrid customers and participants ought to have the ability to develop wherever they desire, subject to meeting all regulatory, public health, and safety standards. However, incentive structures that involve rewarding or motivating utility or microgrid end-user participants, must be designed to inform and reward locations and microgrid operating capabilities that lead to the highest level of societal and utility system value.

The U.S. Department of Energy CHP Technical Assistance Centers ("DOE CHP TAPs") have screening and assessment tools for evaluating potential CHP and microgrids with CHP sites. The Southeast CHP TAP, operated from North Carolina State University, can provide, and has provided, no-cost services to assist sites in Puerto Rico.²⁶ The process might evolve in the following manner: First, identify and rank critical infrastructure that will be included in potential

²⁶ Conversation with Isaac Panzarella, P.E. Director US DOE's Southeast CHP TAP North Carolina State University.

microgrids (government services, economic centers such as data, manufacturing, hospitals, and residences). Then, identify sectors with high load factors and high coincidental thermal and electric loads that are well suited to CHP. Then, determine facility-specific considerations, such as size, heating and cooling, and operating hours to find the minimum requirements for CHP. Lastly, identify specific resiliency priorities such as life safety, government operations, economic impact, and CHP optimization such as site load factor.

This screening, if positive, should then be followed by an individual site assessment. The CHP TAPs can assist in conducting detailed feasibility analyses, as a follow on to higher level opportunity screenings.

DER can reduce reliance on remote large-scale T&D lines that lead to outages and expensive repairs and maintenance. PREPA has outages at four times the rate of most US utilities, caused by lack of distribution maintenance and forced outages from deferred maintenance of generation and transmission infrastructure. In the first 110 days of Fiscal Year 2016, PREPA experienced 38 transmission outages.²⁷

The cost of T&D maintenance is increased by the remoteness of many lines from the load, increasing time to repair and potential scope of repairs. The primary causes of outages are:

- Tree Trimming Conditions – about 35 - 45%;
- Weather Deterioration – about 15 - 25% (this includes heavy rain, normal rain, strong winds, etc.);
- Structural/Mechanical conditions of poles and cables – 10 – 25%;
- No Cause Reported – 15 – 20% (this is mainly due to undetected conditions at the moment of the failure); and
- Other causes – 10-20%.²⁸

²⁷ Case No. CEPR-AP-2015-0001. Expert Report: State of PREPA's System, Load Forecast, Capital Budget, Fuel Budget, Purchased Power Budget, Operations Expense Budget. Jeremy Fisher and Ariel Horowitz. Synapse Energy Associates. November 23, 2016.

²⁸ *Id.*

3.3.1. Should the Commission establish limits on the size of a microgrid? On what factors should that limit be based (geographic extent, capacity, number of customers, other)?

The Commission should consider a tiered regulatory approach to microgrids, based upon size. Smaller sized microgrids should be subject to a “light handed” regulatory regime. Whereas, beyond some reasonable threshold size of geographic extent and number of customers, a microgrid might be considered a “regulated utility.”

3.3.2. Should the Commission issue franchise rights for microgrids? What conditions should be applied for a franchisee to maintain franchise rights?

No response.

3.4. What consumer protections are required, and how should those vary with the ownership of the microgrid?

Some measure of consumer protection ought to be incorporated in the microgrid regulatory framework.

Any program that receives public funds (federal, Commonwealth, or local government incentives) ought to include some form of protection and oversight pertaining to the project development. Incentive programs ought to be structured on a pay-for-performance basis.

Incentives should be apportioned at various points in the design, development, and commission process, and the funds should be released only upon demonstration of meeting the milestone performance requirements.

Microgrids comprised largely of residential customers, such as large multifamily complexes, should be subject to a higher level of consumer protection and oversight, the general principle being that the less technically sophisticated the customer base, the greater the need for oversight and regulatory protections.

3.4.1. Prices and costs.

3.4.1.1. Assuming (for purposes of this question) that microgrid owners can sell their output directly to retail customers, what are the advantages and disadvantages of different pricing methods (including traditional cost-based pricing, price caps based on reasonable projected cost, and allowing market forces to set prices)? Is it reasonable for there to be an administrative charge to cover the Commission's oversight costs?

The Commission should exercise some oversight over pricing mechanisms established by microgrids above a certain size threshold. Traditional cost-based pricing is unlikely to be a preferred approach. Cost-based pricing is time intensive and the administrative requirements are high.

Allowing market forces to set prices is least burdensome for the project developer, but places the highest risk on the buyer or end-user of the microgrid. Other advantages include the decentralization of decision making.

The disadvantage of relying on unfettered market forces is the problem of asymmetrical information and the opportunity for the seller of microgrid development and services to take advantage of a less well-informed buyer of the microgrid development and services.

3.4.2. Contract terms.

3.4.2.1. What are the advantages and disadvantages of the Commission

Establishing standard contract terms for retail and wholesale sales to PREPA is advantageous in providing greater transparency. It can contribute to the development of markets by giving parties clarity on the terms of the sales.

As a general principle, the more that the Commission can do to reduce uncertainty concerning the expected revenue sources and the cost obligations (including costs of time delays), and the more that can be done to standardize and routinize the process, the more likely it is that good project development can flourish.

3.4.2.2. How does the answer to the preceding question vary by customer group? For customers?

No response.

3.4.2.3. Should the standard terms be required only for microgrids owned or operated with the main purpose of selling energy at retail?

No response.

3.4.2.4. Should contract provisions be subject to Commission review?

In order to protect less sophisticated buyers of microgrid developments and services, contract provisions should be subject to Commission review. The review process, if instituted, should be clearly defined, reasonably brief, and developed with consideration of minimizing unnecessary process and transaction costs.

3.4.2.5. Should the Commission set limits on contract duration?

No response.

3.4.2.6. How should the Commission address customers who decide they no longer wish to be part of a microgrid?

The matter of customer defection ought to be addressed in a process that more generally defines “best practice” in contracting, and specifically as it pertains to the rights and responsibilities of end-use consumers. Customers who decide they no longer wish to be part of the microgrid might reduce the expected revenues and return on the microgrid investment. The seller of microgrid services, justifiably, will want to protect itself from revenue erosion that occurs with customer defection over time.

The Commission’s role here might take a couple of different forms. One approach is to be prescriptive and define a set of contract terms and conditions, informed by a study of best practices in balancing the legitimate interests of the parties. Another type of approach is to be a conduit to information, so that the buyers and sellers of microgrid services are informed in advance of what are generally deemed to be best-case examples of equitable practice.

3.4.2.7. Should the development of microgrids require unanimous approval of customers within the area to be served by microgrids?

No, unanimous approval of customers within the area should not be required.

Experience elsewhere demonstrates that energy consumption and investment decisions that require unanimous approval can be halted by a single or tiny minority, even where the vast majority involved favor the project or initiative. The individual’s right not to be coerced into

participation can be accommodated up to a point. But representative democracy is preferable to unanimous consent, if requiring unanimous consent would thwart the will and desire of the vast majority.

3.4.2.8. What are the advantages or disadvantages of allowing specific customers to opt in or opt-out from being served by a microgrid?

No response.

3.4.3. What types of pre-payment or deposits are appropriate? How does the answer vary by customer group?

No response.

3.4.4. Are non-discrimination rules necessary?

No response.

3.4.5. Are other protections necessary?

No response.

3.5. Must all microgrids (at least those serving multiple customers) charge for services by metering delivered energy, or are other pricing structures acceptable?

All microgrids serving multiple customers ought to meter delivered energy, with the possible exception of those for which metering costs are demonstrably an economic burden (small power systems with high fixed metering costs). Metering can be a barrier if inflexible and unreasonable demands are made on the requirements, such as highly prescriptive standards on meter make and model. As long as the functionality is similar, wide flexibility ought to be permitted. Having the metered data facilitates system performance adjustments and benchmarking.

3.6. To ensure that a microgrid project is cost-effective, safe and reliable, what information should the Commission receive from a microgrid developer prior its connecting customers? For example, should the Commission require developers to specify:

3.6.1. Maximum set of customers to be served? Type of customers to be served?

No response.

3.6.2. Maximum generation and storage capacity anticipated?

No response.

3.6.3. Costs?

No response.

3.6.4. Pricing?

No response.

3.7. What timing requirements, in terms of the development process, must the Commission take into account, when determining how long it will take to approve or reject a microgrid proposal?

For guidance on this matter, Pace suggests that the Commission examine the empirical experience of the Northeast States. The Northeastern US has become an epicenter of activity for state-assisted microgrid project development. The first state Microgrid RFP Pilot program was initiated by the State of Connecticut in 2011. New York State and the State of Massachusetts followed with their own community microgrid initiatives in 2015.²⁹ New Jersey established the NJ Energy Resilience Bank (“ERB”), the first public infrastructure bank in the nation to focus on energy resilience, utilizing \$200 million through New Jersey’s second Community Development Block Grant-Disaster Recovery (“CDBG-DR”) allocation.³⁰

²⁹ Pace partnered on 16 winning New York Prize Stage 1 submissions and is part of the team for two of the 11 New York Prize Stage 2 winning proposals. Pace staff assisted the State of Connecticut by providing education, outreach, and support for the Connecticut Microgrid Pilot RFP Round 1 and Round 2.

³⁰ State of New Jersey Board of Public Utilities. Energy Resilience Bank. <http://www.nj.gov/bpu/commercial/erb/>.

4. Microgrid Generation Technology: Solar photovoltaics, supplemented with storage, have been employed to power microgrids. The Commission is interested in the range of other options for reenergizing the disconnected portions of the island.

4.1. Information provided to the Commission by Pattern Santa Isabel, LLC suggests that the Santa Isabel wind farm is operable, but lacks load and a source of energizing power. This condition could affect other renewable independent power producers, whose installations are operable but require power from PREPA to get back online.

4.1.1. Is there a technical solution to add a small solar or diesel generator to restart the wind farm, and storage to firm up the supply?

As future PV and wind capacity is constructed, the Commission should encourage renewable developments to add the design capability to safely disconnect from the utility grid and operate independently of the grid, during outages of extended duration.

4.1.2. Is there load close to the wind farm that could be served from a microgrid based on the wind farm?

As a general matter, the Commission should consider developing and widely distributing information on Puerto Rico's geospatial energy demand—both thermal as well as electric. Potential thermal demand should include those loads that could be served by thermally activated technologies, such as absorption chillers.

4.1.3. What legal or contractual obstacles would prevent or limit the ability of the Santa Isabel wind farm from (i) procuring a small-scale generation source to power up its turbines and (ii) serve surrounding communities directly through the use of microgrids?

No response.

4.2. Are there any existing solar facilities that could be firmed up with storage and connected to load?

Future T&D system planning ought to examine the benefits of encouraging customer-side investments in firming up renewables, and must direct the utility to invest in T&D capital equipment and protection schemes that accommodate the use of distributed energy as a dynamic asset providing a much higher degree of resiliency.

4.3. For generation facilities under contract with PREPA, how would use of those facilities to serve a microgrid affect PREPA's contract?

No response.

4.3.1. Can a party other than PREPA develop a microgrid from such a facility?

No response.

4.4. Can any of PREPA's hydro-electric facilities be firmed up with storage and connected to load?

No response.

4.4.1. Can other parties use those facilities to serve local load?

No response.

4.4.2. What arrangements would be needed with PREPA to implement this option?

No response.

4.5. Is it legal, practical, and necessary for solar-storage or wind-storage microgrids to have some fossil fuel back-up capacity?

No response.

4.5.1. How much fossil fuel based back-up capacity can be used in a microgrid without compromising its renewable status and ability to sell to customers?

There are examples that the Commission could reference from the many existing community microgrid programs in the Northeast States. Pace has been party to several of these programs and examples are provided herein and in the attachments to these comments.

5. Restoring operation of existing industrial generation using combined heat and power (CHP) systems.

An economically advantageous CHP system is typically at the heart of a successful microgrid project. The cost savings from productively utilizing the waste heat from power generation is a significant value stream that can make the project economically viable.

Sites that place a high value on power quality and reliability are top tier candidates for microgrid project development.

The Commonwealth ought to target incentives for CHP to sites in a manner that favors those with the greatest positive impact on the T&D system. All else equal, the Commission should create an incentive structure that maximizes grid benefits,³¹ including resiliency benefits.

The New York State Energy Research and Development Authority's ("NYSERDA") CHP incentive program is a model to consider. Following the August 2003 blackout in the Northeastern U.S., NYSERDA altered its incentive program to require that any site obtaining state incentives must demonstrate the following:

*In order to receive an incentive under this Program, all CHP Systems with an aggregate nameplate rating greater than 50kW (except back pressure steam turbines and ORC devices) must be capable of grid-independent operation during grid outages (black-start capable), and must be installed to provide priority power (to on-site priority loads as determined by the customer) during grid outages.*³²

5.1. How much CHP is currently installed on the island? (The Commission would be interested in anecdotal information about specific facilities, as well as more comprehensive data.)

Pace is organizing information on existing CHP facilities and facilities under consideration. There are opportunities for CHP development in the Commonwealth, with the following considerations in mind:

³¹ For example, the New York State Energy Research and Development Authority offers a bonus incentive for grid benefits. In 2016, Consolidated Edison offered a program that doubled the NYSERDA incentive for CHP that was located in a particularly valuable area (the Brooklyn-Queens Demand Management area).

³² NYSERDA CHP Program Opportunity Notice (PON) 2568. Updated January 2017. Page 5.

Of the top 50 employers in Puerto Rico:

- 16 are hospitals, employing 11,149 people;
- 8 are hotels/resorts, employing 3,966;
- 8 are large retail/supermarket stores, employing 2,470;
- 3 are manufacturing, employing 1,735;
- and 3 are academic institutions, employing 915.³³

Hospitals, hotels and resorts, large retail and supermarket developments, academic campuses, and certain manufacturing sectors are all potentially good candidates for CHP.

Though it represents only 8.4% of employment, manufacturing constitutes 46.9% of Puerto Rico's gross domestic product ("GDP"). The primary manufacturing industries are pharmaceuticals, electronics, and food products.³⁴ Each of these industries may have strong CHP candidates. Other potential industries that are good CHP candidates, and are represented in Puerto Rico, according to the Bureau of Labor Statistics, include:

- Manufacturing employs 70,900 (8.1%);
- Information and financial services 60,100 (6.8%) (potential use of data centers, etc.);
- Education and Health Services 124,900 (14.2%); and
- Leisure and Hospitality 82,500 (9.4%).³⁵

5.1.1. What portion of the installed CHP capacity is operating interconnected with PREPA?

PREPA should regularly report to the Commission and make publicly available the amount of interconnected CHP, and all interconnected DER, on its system. Reports should include existing development and projects in the interconnection queue.

³³ Bureau of Labor Statistic. State Profile: Largest Employers, Puerto Rico.
<https://www.careerinfonet.org/oview6.asp?printer=true&printer=true,&next=oview6&id=&nodeid=12&stfips=72&group=1>.

³⁴ Puerto Rico Fact Sheet. Puerto Rico Fiscal Agency and Financial Advisory Authority (FAFAA), as of January 2017.

³⁵ As percentage of non-farm employment. Bureau of Labor Statistics: Puerto Rico. August 2017.
https://www.bls.gov/regions/new-york-new-jersey/puerto_rico.htm#tab-1.

A system of metrics should be developed to track on an annual and 3- and 5-year average basis the development and market trajectory of existing DER and planned DER.

Metrics should include the characteristics and the functionality of the DER, including, but not limited to:

- Whether or not the DER is interconnected with PREPA;
- What portion of the installed CHP capacity is physically capable of operating if utility power were restored to the host facility; and
- What facilities operated in islanded mode during outages of extended duration.

5.1.2. What portion of the installed CHP capacity is operating in islanded mode, without PREPA supply?

No response.

5.1.3. What portion of the installed CHP capacity is physically capable of operating, if utility power were restored to the host facility?

No response.

5.2. Are those systems capable of operating in islanded mode?

No response.

5.2.1. For those that cannot operate islanded, would a small amount of additional on-site generation allow the CHP to restart?

No response.

5.3. For CHP installations that could operate now, but are sitting idle, what else would be needed to bring those plants back into service, to serve the host facility, feed power back to PREPA and/or power a microgrid?

No response.

5.4. Do any CHP facilities have unused electrical capacity that could be delivered to PREPA or a microgrid?

No response.

5.5. What regulatory actions would be required to allow a CHP to sell excess power to PREPA?

To the extent that the Commission finds, or has found, that certain types and sizes of CHP facilities qualify under Puerto Rico's net metering statute,³⁶ that is a reasonable path forward for such facilities at this time. In the near-term, the Commission should evaluate the merits of expanding net metering eligibility to include more types and sizes of generating facilities. Ultimately, a comprehensive "value of DER" proceeding should determine the compensation rate for generation and energy savings for all distributed energy resources. The Commission should initiate such a proceeding, which may require several months or a year to complete, as soon as reasonably possible.

5.6. What regulatory actions would be required to allow a CHP to sell excess power to a microgrid?

Regulatory oversight of transactions related to microgrid operation must strike an appropriate balance between ensuring consumer and grid protection, and stimulating a climate of innovation in the provision of electric service. It may be appropriate to target early-stage microgrid development at customers who have high expertise and capabilities in energy transactions. Excess production from a CHP facility could be the ideal source of energy for a microgrid in both connected and islanded modes. The most important lessons guiding the Commission's scoping of appropriate regulations for microgrids and their suppliers are going to be gained through practical application. Demonstration and pilot projects, with detailed monitoring and reporting, as well as outcome-based metrics, will inform the appropriate nature of the regulatory structure that the Commission should ultimately adopt.

³⁶ 22 L.P.R.A. § 1011, *et seq.*

6. Coordination of Islanded Microgrids with PREPA:

6.1. To PREPA: Please provide the Commission with any information relating to plans for serving rural communities with solar/storage microgrids. Such information should include responses to the following questions: If so,

6.1.1. What details are available regarding this plan?

No response.

6.1.2. When will the first of these systems be installed?

No response.

6.1.3. What duties does PREPA propose to assume for these communities?

No response.

6.1.4. How would PREPA's rates and role in these areas differ from areas served by central generation?

No response.

6.1.5. For all commenters: What are the advantages and disadvantages of the Commission requiring PREPA to develop microgrids in some areas? Would such a requirement avoid duplication of effort and conflict? Would it discourage competitors from entering the Puerto Rico microgrid market?

No response.

6.2. Are there areas that should be reserved for PREPA restoration, or should microgrids be encouraged everywhere?

No response.

7. Use of Stranded PREPA Equipment: This set of questions addresses the possibility of assisting microgrid development by using existing PREPA equipment that PREPA is temporarily unable to use.

7.1. Should microgrids be allowed to deliver power to customers through existing PREPA metering equipment?

Yes, as a general rule to avoid unnecessary purchase of redundant capital equipment, microgrids ought to be able to utilize existing PREPA distribution equipment, including metering equipment.

7.1.1. If so, how and when should PREPA be compensated for that use?

No response.

7.1.1.1. Should the Commission set a fixed rate per meter, based on the average embedded costs of PREPA meters?

No response.

7.1.1.2. Should the microgrid pay a monthly fee, or purchase the equipment outright?

No response.

7.2. Should microgrids be allowed to purchase distribution equipment (poles, primary lines, secondary lines, service drops, and transformers) that PREPA is not currently able to use due to lack of connection to central generation?

Yes, microgrids ought to be allowed to purchase distribution equipment (poles, primary lines, secondary lines, service drops, and transformers) from PREPA.

Microgrid projects can be made more economically viable if they aren't forced to make redundant purchases of capital equipment. The microgrid ought to have an option to buy, rent or lease the existing utility equipment, if that is an economically viable alternative to the purchase and installation of newly acquired distribution equipment.

7.2.1. If so, how and when should PREPA be compensated for that use?

PREPA should be compensated in a manner that accounts for the fair market value of the asset as well as the accumulated return that the company has made on the asset.

8. What tools are available to the Commission or other parties to enable behind-the meter resources in areas without electric service?

No response.

8.1. Are there technical resources (such as pile drivers for ground mount systems) in short supply in Puerto Rico? If so, what can be done to alleviate those shortages?

No response.

8.2. Do firms that are new to Puerto Rico need information about local design and approval processes and standards? If so, how can that information be efficiently shared?

Firms need clear, concise, and readily accessible information about local design and approval processes and standards. In New York, in response to a confusing maze of utility and local processes and standards, the office of “DG Ombudsman” was established. As another example, the New York City Department of Buildings authored a CHP Guide to further assist the development process.

The Commission can, and should, coordinate with other agencies and authorities that touch upon energy usage and investment decisions from the economic development, infrastructure development, master planning process, and so on. More detailed guidance on these processes is available in Pace’s report, prepared for the Urban Sustainability Directors Network, *Microgrids and District Energy: Pathways to Sustainable Urban Development*.³⁷ A copy of the report is annexed to these comments as Attachment 3.

There are critical points in time in the development process, where parties ought to consider the technical feasibility and the economic viability of developing microgrids and district energy systems with CHP. For example, whenever there is a planned public excavation of roads or other excavation for infrastructure development, that is an ideal time to consider whether establishments along the planned development might take advantage of the development process to lay the networks for carrying electric power and thermal energy to proximate sites.

³⁷ *Microgrids and District Energy: Pathways to Sustainable Urban Development*. Thomas Bourgeois, Brad Bradford, Jordan Gerow, Daniel Leonhardt, Nick Martin, Laxmi Rao. (June 2015).

In campus master planning processes, or in urban planning, there should be a close coordination with the energy capital equipment decision making. The Commission can establish formal or informal ties with sister agencies and authorities. One example is the “Power of Two” in New York State. In this instance, a program was established that brought together the financing capabilities of the Dormitory Authority of the State of New York (“DASNY”), with the suite of energy initiatives, incentives and services available from NYSERDA. The cross marketing of programs available from the two agencies brought together financing with energy assistance.

There is a precedent for large cities to require consideration of district energy and CHP for developments above a threshold size. The City of Boston hired a “Microgrids / District Energy Fellow” who worked in close coordination with the development projects being carried out through public-private partnerships.

Finally, remediated brownfield sites may be an attractive location for siting clean distributed generation and combined heat and power in newly constructed and renovated buildings located on a brownfield.³⁸ In New York, for example, developers who remediate a contaminated site can be eligible for financial incentives from both state programs and federal tax credits. However, developers, municipalities, and community-based organizations involved in brownfield site redevelopment are not always aware of these programs. Education and outreach is necessary to make developers aware of local standards, processes and opportunities.

³⁸ Pace has a long history of experience conducting analyses of the opportunities for combining brownfields development with CHP and other forms of clean energy development. Pace was lead author of *Combined Heat and Power on Brownfield Sites*, prepared by Pace Energy and Climate Center, White Plains, NY (Tom Bourgeois Deputy Director), Future Energy Development, LLC, Rochester, NY (Linda Shaw, Esq. Principal), The Northeast Midwest Institute, Washington, D.C. (Colleen Cain, PhD Senior Policy Analyst), and Redevelopment Economics (Evans Paull Principal). NYSERDA Contract No. 15912. March 2012. A copy of the report is annexed hereto as Attachment 4.



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