nationalgrid

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May 1, 2017

VIA ELECTRONIC DELIVERY

Honorable Kathleen H. Burgess
Secretary
New York State Public Service Commission
Three Empire State Plaza, 19th Floor
Albany, New York 12223-1350

RE: Case 14-M-0101 – Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision (REV)

NIAGARA MOHAWK POWER CORPORATION d/b/a NATIONAL GRID: COMMUNITY RESILIENCE REV DEMONSTRATION PROJECT – Q1 2017 REPORT

Dear Secretary Burgess:

Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid") hereby submits for filing its quarterly update to the Community Resilience REV Demonstration Project Implementation Plan covering the period of January 1, 2017 through March 31, 2017 ("Q1 Report") as required by the REV Demonstration Project Assessment Report filed by the New York State Department of Public Service Staff ("Staff") with the Commission on February 10, 2016 in Case 14-M-0101.

Appendices A and C of the Q1 Report provide the names of stakeholder businesses, along with certain proprietary information for each stakeholder, for which National Grid does not have stakeholder authorization to make public. National Grid is submitting a redacted version of Appendices A and C with this filing, and will file an unredacted version, along with a request for confidential treatment, with the Commission's Records Access Officer contemporaneous with this filing.

Please direct any questions regarding this filing to:

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National Grid looks forward to continuing to work collaboratively with Staff as it proceeds with the implementation of the Community Resilience REV Demonstration Project.

Respectfully submitted,

/s/ Karla M. Corpus

Karla M. Corpus
Senior Counsel

Enc.

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Community Resilience

REV Demonstration Project

Potsdam, New York

Q1 2017 Report

May 1, 2017

nationalgrid

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1.0 Executive Summary

Under the New York Public Service Commission's ("PSC") Reforming the Energy Vision ("REV") proceeding, this Community Resilience Demonstration Project (the "Project") focuses on improving the local resiliency during severe weather events in the remote Village of Potsdam ("Potsdam") in Upstate New York with the creation of a community microgrid. Potsdam and surrounding St. Lawrence County have experienced a number of multi-day power outages as a result of microbursts and winter ice storms; most notably the "Ice Storm of 1998" which left over 100,000 customers without power for up to 3 weeks in the North Country and recently, in December of 2013, another ice storm isolated over 80,000 customers for days.

Image 1.1 – Photo of Upstate New York after the 1998 Ice Storm[1]

Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid" or the "Company") has partnered with Clarkson University in order to develop a community resilience microgrid for Potsdam with an underground distribution network and coordination of new and existing distributed energy resources ("DER"). Concurrently, the Company will develop and test new utility services that may be required for further microgrid deployment in New York State.

The four services to be developed and tested are:

1. Tiered recovery for storm-hardened, underground wires;
2. Central procurement for DER;
3. Microgrid control and operations; and
4. Billing and financial transaction services.

[1] Image was taken during the aftermath of 1998 Ice Storm.

While National Grid is leading the Project, this demonstration is actually a close-knit partnership effort between Clarkson University and National Grid. Moreover, it will require significant input from other major Potsdam stakeholders, such as the Village of Potsdam government, the Canton-Potsdam Hospital, and the State University of New York at Potsdam ("SUNY Potsdam").

Image 1.2 – The major stakeholder partners of the Community Resilience demonstration (clockwise, from top left: Clarkson University, SUNY Potsdam, Village of Potsdam Offices, Canton-Potsdam Hospital)

During the first quarter of 2017 the National Grid Project team kicked-off the major efforts of the Detailed Engineering Design and Financial and Business Plan phase (Phase 2) of the project. The Project team collected the necessary data sharing agreements from customers and began a detailed analysis of the most current energy data from 2015 and 2016.

In addition, the Project team continued to receive updates on General Electric ("GE") Global Research's Department of Energy's ("DOE") Office of Electricity Delivery and Energy Reliability Enhanced Microgrid Control System ("eMCS") project as they wrapped up their research study on the proposed microgrid controller. Much of the first quarter activities involved load analysis and continued business model exploration. Contracts were finalized with partners GE Energy Consulting and OBG (formally, O'Brien and Gere) and the Project team met regularly to discuss each partner's responsibilities as Phase 2 got underway.

2.0 Highlights Since Previous Quarter

National Grid and the key Project partners have made substantial progress in the first quarter of 2017, with all parties continuing to push for expected outcomes laid out in the Project Implementation Plan.[2] For a reference timeline emphasizing the major milestones and accomplishments, please see Figure 2.1. Changes and additions are highlighted in yellow and are described in additional detail in Section 3.1.

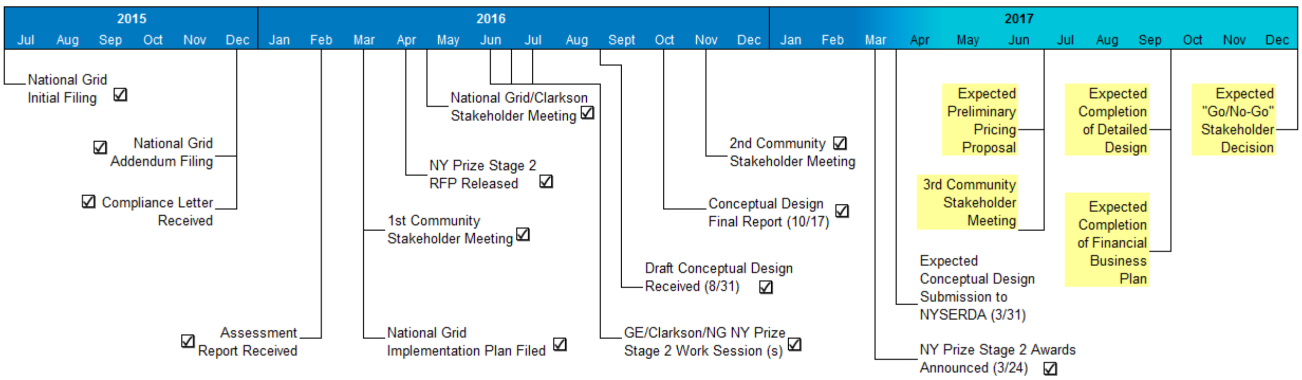


Figure 2.1 – Achievements and Milestones Timeline

2.1 Major Task Activities

1. **Data Sharing Agreements**
   With the kickoff of Phase 2, the Project team looked to analyze recent usage data of the microgrid load members. Given that the previous data sharing agreements expired with the completion of the New York State Energy Research and Development Authority ("NYSERDA") Program Opportunity Notice ("PON") 2715 study in 2016, one of the initial tasks in Q1 2017 was for the Project team to secure new data sharing agreements from potential microgrid participants. Load and generation data could not be shared with partners without these signed agreements.

   This offered the team another opportunity to reach stakeholders and discuss the findings of the study thus far. Overall, potential participants continue to show interest in the Project and are eager to see more financial implications of the microgrid. Table 2.1 shows the timeframe of signed releases as well as the type of data the National Grid team used for the load analysis.

[2] Case 14-M-0101- *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision* ("REV Proceeding"), National Grid Implementation Plan for Community Resilience REV Demonstration Project, Potsdam, New York (filed March 11, 2016).

	2017 Release Signed	Date Release Signed
Clarkson University	x	1/6/2017
SUNY Potsdam	x	1/5/2017
Canton-Potsdam Hospital	x	1/31/2017
Village Water Filtration	x	2/2/2017
Village Civic Center	x	2/2/2017
Village Sewage	x	2/2/2017
Potsdam High School	x	3/2/2017
Potsdam Rescue Squad	x	1/12/2017
Clarkson Inn	x	2/2/2017
North Country Savings Bank	x	3/17/2017
Kinney Drugs	x	3/9/2017
IGA Grocery	x	3/2/2017
Stewart's Shop	x	3/2/2017
National Grid Service Center	N/A	N/A
West Hydro Dam	x	1/6/2017
East Hydro Dam	x	2/2/2017
Solar PV	x	1/6/2017

Table 2.1 – 2017 Signed Data Sharing Agreements

2. Phase 2 Load Analysis

Project partner, OBG submitted a preliminary load analysis report during the last week of the quarter. Acquiring energy usage data from metering devices was required to perform the load analysis. Once the Project team was able to secure all signed data sharing agreements from the potential microgrid participants, OBG was able to analyze the usage data provided by National Grid.

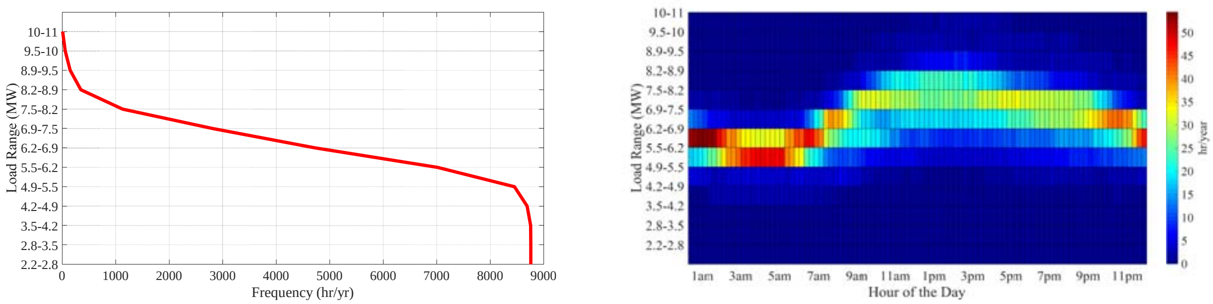
Modeling the load behavior and energy consumption requires an understanding of daily load profile. The resolution of the load profile varies based on the metering capabilities at each load. The meters used at the sites listed in Table 2.1 have different capabilities; some of the meters are capable of storing data in 15-minute interval manner and the rest in monthly fashion.

Given that many of the smaller load profiles do not have hourly or sub-hourly data available, the monthly read data must be converted to a 15-minute interval load profile. The hourly load profile of the monthly load customers can be calculated using their load shape profiles and classification multipliers.[3] In order to provide the 15-minute interval resolution for those loads, OBG assumed that the sub-hour load is equal to the corresponding hour load.

[3] National Grid's load profiles are publically available at: https://www9.nationalgridus.com/niagaramohawk/business/rates/5_load_profile.asp.

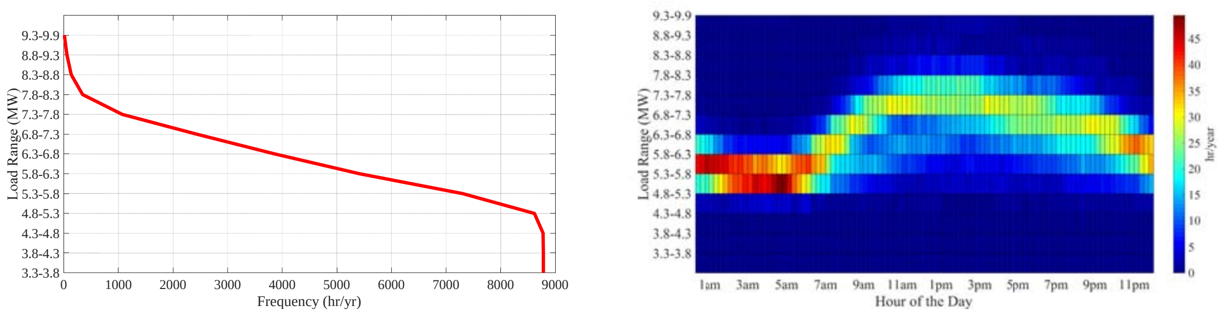
Aggregated Load

The available 15-minute data and extrapolated monthly data were used to calculate the aggregated load. Figures 2.2 and 2.3 show the annual load duration curve and the load heat map for the entire Potsdam microgrid in 2015 and 2016, respectively. From the load duration curve one can understand the load duration, in terms of number of hours, over the course of the year. The load behavior and the likelihood of load value at different time of the day can be observed from the load heat map. For instance, at 1 pm in 2016, the load most likely fall in the range of 7.3 MW to 7.8 MW and then 7.8 MW to 8.3 MW.



(a) (b)

Figure 2.2 - Aggregated Load Annual Load Analysis for 2015: (a) Load Duration Curve and (b) Load Heat Map.



(a) (b)

Figure 2.3 - Aggregated Load Annual Load Analysis for 2016: (a) Load Duration Curve and (b) Load Heat Map.

Comparing Figure 2.2 and Figure 2.3, it can be concluded that the load range in 2015 is higher than the load in 2016. Also, the daily load volatility in 2015 is slightly higher than the daily load volatility in 2016.

Table 2.2 lists the minimum, mean, and maximum values of the aggregated load for years 2015 and 2016. As can be inferred from the table, the energy consumption in 2015 was similar to the energy consumption in 2016. The same analysis performed for the aggregated load has been applied to each individual load, and the results can be found in Appendix A. Peak load in 2015 was 10.89 MW, while the maximum load in 2016 was 9.85 MW. Both coincident peaks occurred in the month of September.

2015												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	3.85	3.67	4.04	3.70	3.33	3.60	3.13	1.51	5.10	5.08	4.79	4.55
Mean	6.28	6.30	6.48	6.46	6.31	6.01	6.56	6.44	7.67	6.77	6.32	5.90
Max	8.04	8.12	8.07	8.07	9.12	7.77	8.69	9.63	10.89	8.65	8.29	7.72
2016												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	3.81	5.22	4.48	4.73	4.32	4.32	4.62	2.96	4.95	4.82	2.79	4.03
Mean	6.16	6.63	6.27	6.18	5.85	5.88	6.21	6.53	7.09	6.33	6.02	5.67
Max	7.81	8.07	7.87	7.88	7.54	8.22	8.61	9.28	9.85	8.35	7.57	7.42

Table 2.2 – Monthly Minimum, Mean, and Maximum Values of the Aggregated Load (in MW).

Since the load dependency on temperature is high, eight (8) typical daily load profiles were also estimated: spring work day; spring weekend/holiday; summer work day; summer weekend/holiday; fall work day; fall weekend/holiday; winter work day, and winter weekend/holiday. Visual representations of each seasonal load profile can be found in Appendix B, Figures 6.1 – 6.8.

From those figures, it can be observed that the load profile of each season's work day is more predictable, with lower volatility, than the same season's weekend/holiday. Also, the summer daily load profile has higher volatility than the spring daily load profile; the fall daily load profile has lower volatility than the spring and summer daily load profiles; and the winter daily load profile has highest volatility of all seasonal daily load profiles.

Load Disaggregation

In order to demonstrate the daily load profile disaggregation, several dates are selected from years 2015 and 2016: September 16, 2015; December 10, 2015, August 1, 2016, and December 8, 2016. On average, throughout 2015 and 2016, three (3) entities make up roughly 90% of the total microgrid load. Daily load figures can be found in Appendix C.

This initial load data analysis indicates a slightly higher load profile compared to the 2013-2014 meter data analyzed during Clarkson University's NYSERDA PON Study of the Conceptual Design. Factors contributing to this increase could be attributable to the inclusion of additional buildings (*i.e.,* National Grid Service Center/Garage) and/or increased load activities by customers. Further analysis and comparison of each load profile is proposed for Q2 2017 to identify any areas of concern.

3. Energy Audits

Project partner, OBG has also completed the Preliminary Energy-Use Analysis ("PEA") and walk-through survey for three (3) customers of the microgrid; Clarkson University (Hill Campus), SUNY Potsdam, and Canton-Potsdam Hospital. The walk-through surveys occurred as follows: Clarkson University- March 8-10, 2017; SUNY Potsdam- February 21-22, 2017; and Canton-Potsdam Hospital- February 23, 2017.

For each site a PEA was developed based on utility data and basic building characteristics to indicate energy performance relative to benchmark peers and to provide a high level ranking of campus buildings for the purpose of focusing walk-through survey efforts. The purpose of this task is to estimate the potential impact on microgrid asset sizing from energy efficiency ("EE") improvements and demand response ("DR"). The work scope is not comprehensive but instead focuses on major electrical loads that would have the greatest impact on microgrid sizing for EE and DR.

Preliminary Energy-Use Analysis
Buildings located on the Clarkson University and SUNY Potsdam campuses were ranked during the Preliminary Energy-Use Analysis to prioritize those that have the highest EE and DR potential based on energy intensity and benchmarking comparisons. The Canton-Potsdam Hospital building was also benchmarked against peer buildings. Two (2) years of interval electric utility meter data were provided for all three (3) sites at the campus level, as well as campus level monthly electric and natural gas bill summaries. SUNY Potsdam does have its own building-level electric submeters in any buildings that provide interval electric data. SUNY Potsdam provided approximately one (1) year of electric submeter interval data to OBG through access to their building energy portfolio management system.

Walk-through Survey
At each site, OBG engineers met with and interviewed facilities management staff to gather important information regarding energy systems, including:

- Utilities and metering
- Building characteristics and operating hours
- Central plant and building level system characteristics and controls
- Recent and planned energy system upgrades
- Current maintenance and operational concerns
- On-site generation, including cogeneration and emergency generators

During walk-through surveys, OBG collected information (*e.g.*, nameplate data, configuration, operation) on major electrical end uses (*e.g.*, cooling, fans, pumps, lights) and considered potential for improved energy efficiency and demand response related to these systems. Documentation, including drawings, specifications, past energy studies, and building automation system screen shots were also collected to support final analysis. On-site facilities staff interviews included discussions of the campus overall as well as buildings that did not receive a walk-through survey.

Clarkson University
Based on PEA results and discussions with Clarkson facilities staff, OBG conducted walk-through surveys of nine (9) major buildings comprising approximately 970,000 square feet ("SF") of the Hill Campus total 1,840,000 SF:

- Center for Advanced Material Processing ("CAMP")
- Cora & Bayard Clarkson Science Center
- Cheel Campus Center
- Student Center (Kitchen)
- Andrew M. Schuler Recreation Building ("IRC")
- William J. Rowley Science & Engineering Laboratories
- Quad Center Core (Kitchen)
- Alumni Gymnasium
- Technology Advancement Center ("TAC") (Cogeneration System)

SUNY Potsdam
Based on PEA results and discussions with SUNY Potsdam facilities staff, OBG conducted walk-through surveys of seven major buildings comprising approximately 580,000 SF of the campus total 2,350,000 SF:

- Maxcy Hall
- Performing Arts Center
- Barrington Student Union
- Timerman Hall
- Crane Music Center
- Raymond Hall
- Physical Plant

Canton-Potsdam Hospital
OBG conducted a walk-through survey of the main hospital building and attached Cancer Center consisting of approximately 122,000 SF and 10,000 SF, respectively.

Analysis and Report
The analysis and reporting for this task are underway. OBG reported preliminary results of some EE and DR analyses for Clarkson University at the March 29, 2017 project meeting. The draft task final report for Clarkson University will be completed by May 1, 2017, followed by final task reports for SUNY Potsdam and Canton-Potsdam Hospital by May 15, 2017.

4. **GE DOE microgrid controller final report**
In March 2017, the Project team received the draft final report of GE Global Research's *Microgrid Plant Control Design and Development* report directed to the Department of Energy ("DOE") under their contract #DE-OE0000728. While the Project team was able to view some of the testing first-hand in Q3 2016, this report provided additional detail on their findings in development of the Potsdam microgrid controller.

The aforementioned report discusses the technical performance of the proposed microgrid controller, eMCS. The findings show that the proposed Potsdam microgrid would have a significant impact on reducing regional carbon dioxide ("CO_2") emissions, reducing the amount of imported energy from the utility, and increasing the resiliency of the critical loads. Additionally, the eMCS developed for this Project was tested to be compliant with the Institute for Electrical and Electronic Engineers ("IEEE") 1547 Standard for Interconnecting Resources with Electric Power Systems, and able to generate revenues to help offset energy costs by way of participation in ancillary services.

Table 2.3 displays the study's performance objectives and measurable outcomes.

Performance Objective	Metric	Data Requirements	Outcome
Reducing regional CO_2 emissions	% reduction in regional CO_2 emissions	Regional generation mix, asset data from target community and renewable integration plan	-30% to -50% (relative to Eastern Interconnection[4] averages)
Reducing utility supplied energy	% reduction in utility supplied energy	Generation asset data from target community and renewable asset production data	-60% to -90% (with additional 4MW of Natural Gas generators)
Reduced outage time for critical loads	% reduction in SAIDI[5] outage time	Voltage and frequency power quality recordings, assessment of system reliability and fuel stores	"significant" reduction from historical norms

Table 2.3 – GE Global Research Objectives and Outcomes

GE Global Research's work on developing the eMCS further supports the conceptual design of the microgrid in Potsdam. The findings provide additional detail for the Project team to understand the possible benefits of CO_2 emission reduction and displaced imported energy costs. However, further analysis is needed to quantify these benefits for the full benefit cost analysis of the microgrid.

GE's team is awaiting feedback from the DOE on the draft report and expects to submit a final version in Q2 2017. The National Grid Project team plans to utilize GE's findings for further analysis with strategic partner Massachusetts Institute of Technology ("MIT") Lincoln Laboratory to evaluate the product using their Hardware in the Loop ("HIL") technology.

5. **Governance Modeling**

While there are still much to finalize with the ownership and governance structure, the Project Team is confident that a unified concept is taking shape that incorporates different parts of the models studied thus far.

Instead of considering all the parts of the microgrid as one large complex investment, the Project team has separated the investment into three logical sections, assigning ownership and responsibility to those who can manage each part best. The model is

[4] The Eastern Interconnection encompasses the area east of the Rocky Mountains and a portion of northern Texas. Sara Hoff, *Today in Energy*, U.S. Energy Information Administration (July 20, 2016), https://www.eia.gov/todayinenergy/detail.php?id=27152.

[5] System Average Interruption Duration Index ("SAIDI").

combining the advantages of National Grid's distribution and operation expertise, with the pricing benefits of the DER Provider and DER Energy Service Company ("DESCO") models considered by the team (as described in Q3 2016 report).

As originally proposed, National Grid will install, own, and operate the underground storm-hardened wire system – recovering the costs partially through the tiered recovery model and partially through other mechanisms. Previous analysis during 2016 showed that the tiered recovery model could recover up to $12M of the utility's investment and still result in bill increase figures congruent with other capital projects. However, as currently configured, the full underground distribution system is currently estimated to cost roughly $23M (including both equipment and installation costs). The remaining $11M will need to be recovered outside of the local customer base in Potsdam or paid for by outside funding (state or federal loan and/or grants). Table 2.4 provides an overview of the tiered recovery model with potential bill impact figures of the $12M investment.

	Customer Tier Parameters[1]	Criteria	Customer Accounts	Bill Impact of $12M Recovery
Tier 1a	Clarkson University, SUNY Potsdam, Village Government	Connected Generators	3	7.94%
Tier 1b	Canton-Potsdam Hospital, Clarkson Inn, North Country Savings Bank, IGA Grocery, Kinney Drug Store, Stewarts Gas Station, PVRS, Potsdam High School, National Grid Service Center	Connected Load only	9	7.48%
Tier 2	Village of Potsdam Border	Police	2,757	5.47%
Tier 3	Town of Potsdam Border	Fire	3,709	4.40%
Tier 4	Village of Norwood, Town of Pierrepont, Town of Colton, Town of Stockholm (portion), Town of Norfolk (portion)[2]	Rescue Squad	4,024	3.48%
Tier 5	Zip codes: 13625, 13695, 13639, 13635, 13684, 13652, 13630, 13687, 13672, 13617, 13676, 13699, 13660, 13668, 13696, 13697, 12965, 12967, 13613, 13667, 13621, 13694, 12922, 12927, 13677, 13647, 13678	Hospital	16,022	2.83%
	Total Customer Accounts:		**26,524**	

[1] All tiers are exclusive of previous tier's customers.
[2] Tier 4 based on Potsdam Volunteer Rescue Squad's ("PVRS") service territory, which covers portions of the Towns of Stockholm and Norfolk.

Table 2.4 – Tiered Recovery Model

In the proposed governance model, National Grid would also act as a Distributed Service Provider ("DSP"), aggregating generation to support the entity's bids into market. This could include separate aggregation of intermittent generation sources from that of dispatchable resources to create a more flexible position in the market. In addition, billing to the microgrid entity's individual customers would be necessary due to the added complexity of the microgrid system. National Grid would charge a settlement service fee to the microgrid entity for billing of individual connected customer and for financial settlement services to the New York Independent System Operator ("NYISO") for market activities.

The conceptual design completed in 2016 showed the need for 4MW of additional generation in order to support the current customer load. A third party investor or one of the current partners would ultimately invest in these new generating capabilities. The ultimate investor of the new generation, along with current generating partners would act as a single legal entity forming a partnership as the "Potsdam Microgrid Partnership." This entity would provide power to the non-generating participants, acting as a mini Energy Service Company ("ESCO") to the connected customers, collecting a return on their asset investment through energy rates, still to be determined. Depending on the price of energy, this partnership would have the choice of generating energy onsite, purchasing energy from the energy market, selling energy on the energy market, or purchasing energy directly from the utility. Pricing analysis is underway to determine the appropriate pricing signal that could be offered to the aggregated DER in each scenario.

Finally, a microgrid controller is needed to operate and control the dispatch of microgrid assets. National Grid still offers to host and finance this part of the project utilizing its expertise in system control and operation. In return, National grid would enter into a Microgrid-as-a-Service ("MaaS") fee contract with the microgrid entity. Similar to products being offered by technology vendors, the MaaS platform will offer offsite control and operation of the microgrid. Additional details regarding vendor selection of this service is yet to be determined.

Image 2.1 provides an overview of the segmented approach to the governance model for the Potsdam microgrid.

Image 2.1 – Governance Model

6. Business Modeling

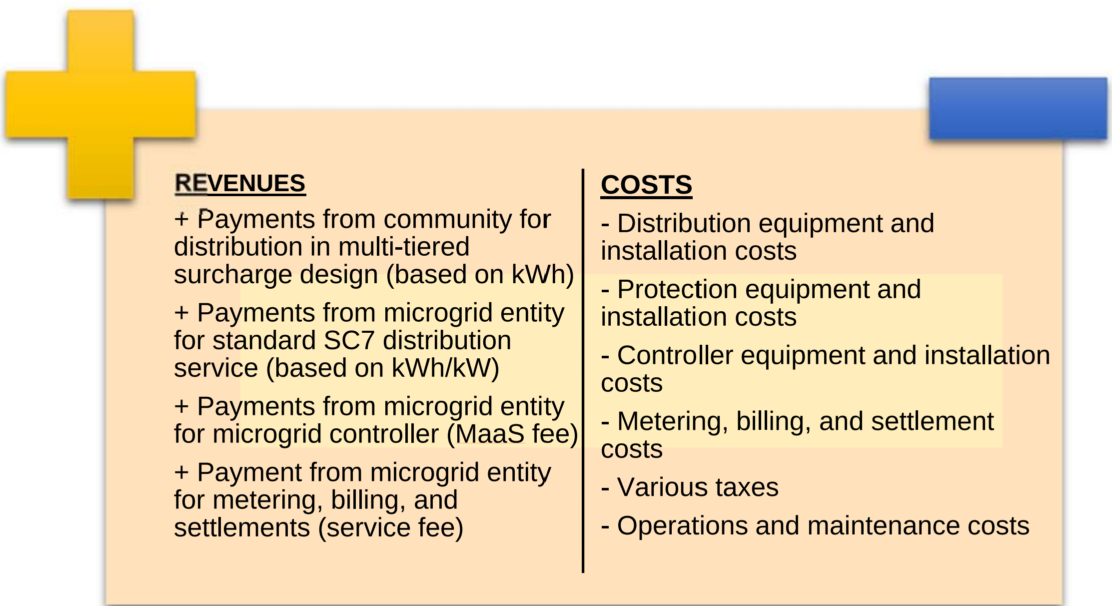
The Project team spent a considerable amount of time transitioning from the qualitative governance modeling exercise to the more quantitative business modeling analysis of the project. Each of the sections described above requires detailed individual financial calculations, as well as analysis of how each relates to the other. In addition, the tiered-recovery model incorporates payments from customers outside of the physical microgrid, requiring inclusion of those bill impact figures into the final analysis. Appendix D provides a visual representation of the proposed business structure. Given that the Project team continues to adjust the financial calculations, the following section describes the pricing strategy and business modeling approach. The actual pricing figures and associated costs will be provided in subsequent quarterly reports.

Wire Company

In the proposed microgrid business model, all responsibilities and financial activities that National Grid would assume for the microgrid are categorized as the 'Wire Company' ("Wire-Co."). Responsibilities of the Wire-Co include:

- Owning and maintaining the microgrid electrical wire infrastructure
- Billing customers outside microgrid a distribution surcharge
- Billing the microgrid partnership a microgrid distribution surcharge
- Managing and operating the microgrid controller
- Providing metering, billing, and settlement functions

Wire-Co.'s Revenue and Cost Structure:



Proposed Pricing for Wire-Co.

When considering the pricing strategy for the microgrid, the Project team's goal is to first utilize existing tariff structure and limitations before expanding the into new rate design. In this model, the Wire-Co. collects on three (3) revenue streams from various customers; tiered recovery of distribution, service fee for microgrid controller, and settlement charge for billing and financial services.

Distribution System:
As stated in the Project Implementation Plan[6], National Grid proposes a cost allocation model where those customers physically connected to the microgrid pay for the greatest portion of the wire investment costs, while the group of customers who live in the surrounding area benefit from added community resiliency and therefore pay a smaller portion of the wires investment costs. In Q4 2016, the Project team proposed a more practical approach focusing on distribution based on the impact that each customer's bill would experience for this investment recovery. This approach would create a model whereas the connected customers' would experience the *greatest impact on their delivery charges* versus a much smaller impact for those in the community.

The Project team used traditional revenue requirement calculations as well as typical bill model approach to calculate the potential revenue stream for this portion of the microgrid.[7, 8] This analysis produced a five-tiered structure allocating the revenue requirement across the population in Potsdam allowing the Company to collect on elements of the incremental annual revenue requirement.[9] Tier 1's contribution will be collected through the microgrid entity as an aggregated delivery surcharge to the entire microgrid while tier 2 through 5 contributions will be collected via individual customer bills throughout the community. Both are based on kilowatt-hour ("kWh") usage.

Microgrid Controller:
As stated in the Project Implementation Plan[10], National Grid proposes offering a service to the microgrid partnership to own, operate, and manage the microgrid controller. To calculate this new offering, the Project team used the cost estimates for the microgrid controller from Phase 1 in a typical revenue requirement method to calculate the costs of the Company's investment in the microgrid controller hardware and software. Included in this calculation are taxes, fees, standard rate of return, and costs associated with continued operation and maintenance of the equipment.

Using the resulting figures, the Project team is in the process of calculating a potential MaaS service fee to cover the operation and maintenance of the microgrid controller. This service fee will be applied to the utility bill for the newly formed microgrid partnership in the form of a flat monthly service contract.

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[6] Case 14-M-0101, s*upra* note 2.
[7] For annual revenue requirement calculated using a levelized approach, s*ee* Case 16-G-0059 *et al*., *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of The Brooklyn Union Gas Company d/b/a National Grid NY for Gas Service et al.,* Joint Proposal (filed September 7, 2016), Appendix 1, Schedule 3.
[8] *See* Case 12-E-0201 *et al*., *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation d/b/a National Grid for Electric Service et al.*, Joint Proposal (filed December 7, 2012), Appendix 2, Schedules 9,10,11 &12.
[9] P.S.C. No. 220 Electricity-Niagara Mohawk Power Corporation d/b/a National Grid Schedule for Electricity Service ("P.S.C. No. 220"), leaf 155-157.
[10] Case 14-M-0101, s*upra* note 2.

Settlement Service:
As stated in the Project Implementation Plan[11], National Grid proposes offering a service to the microgrid for billing of individual customer as well as financial reconciliation with the NYISO. The Project team used a different approach when calculating the fee for this settlement service by using an already established fee structure in the Company's Service Classification 7 ("SC7") Standby rate to apply a customer charge to the microgrid.

National Grid's SC7 tariff states, "An additional Customer Charge of $50.00 per account per billing period, exclusive of the Increase in Rates and Charges, will be applicable to cover incremental billing and administrative costs associated with providing service under this provision. [12] The Project team will utilize this additional customer charge by applying the fee associated with the incremental billing and administrative costs of each individual account holder within the microgrid. This will be charged to the microgrid entity in the form of a flat service fee.

Potsdam Microgrid Partnership
In the proposed microgrid business model, all responsibilities and financial activities that the newly formed microgrid partnership will assume are categorized as the 'Potsdam Microgrid Partnership' ("PMP"). Responsibilities of the PMP include:

- Owning, maintaining, and operating DER assets
- Contracting with customers for power sales
- Contracting with Wire-Co. for distribution services via microgrid surcharge
- Contracting with Wire-Co. for microgrid controller services via MaaS
- Participating in NYISO markets (energy, capacity, ancillary services)
- Participating in DR programs (utility and/or NYISO)

PMP's Revenue and Cost Structure:

[11] Case 14-M-0101, *supra* note 2.
[12] P.S.C. No. 220,), leaf 437.1.

REVENUES	COSTS
+ Payments from customers for energy sales (based on kWh)	- DER equipment and installation costs
+ Revenues from NYISO market participation (energy, capacity, and ancillary services)	- DER fuel costs
+ Payments from NYISO or National Grid from participation in DR programs	- DER fixed operations and maintenance ("FOM") costs
	- DER variable operations and maintenance ("VOM") costs
	- DER emission related costs
	- Cost of power purchase
	- Payments to Wire-Co. for distribution, controller, and metering/billing/settlement services

Proposed Pricing for PMP.
The proposed pricing strategy for the PMP is based primarily on traditional business case investment analysis. The costs attributed to the PMP consist of three (3) main categories; investment in additional generating capabilities, expense to operate the DER, and service fees to the Wire-Co.

Investment in new DER:
The Project team used the costs estimates from Phase 1 of the Project to apply a traditional investment analysis on the costs of new on-site generation for the microgrid. The Conceptual Design indicated the need for 4MW of additional generation capability in order to support the existing load of the microgrid. Either a third-party vendor or one of the stakeholders in Potsdam would invest in this additional capacity and become a member of the PMP. The cost of this investment would be depreciated over twenty (20) years with applicable state tax, federal tax, and discount rates applied.

Operating Expenses:
Other expenses such as property tax, insurance, fixed operating and maintenance expenses (“FOM”), variable operating & maintenance expenses (“VOM”), and fuel costs all need to be attributed to the PMP as a cost of operation. Also included is the cost of purchasing power from NYISO (or bilaterally), when economical, to meet load obligations. Some of these costs were estimated during Phase 1 of the Project, while others have been included based on similar investment costs by the Company and the Project partners.

FOM (in $/kW-year), and VOM (in $/kWh) values are generalized estimates for the type of DER included in the microgrid. Annual FOM costs depend on the total microgrid DER capacity. Annual VOM costs depend on the kWh generation in the year by the DERs in the microgrid. Further “high-level” analysis was required to estimate the total number of hours each unit would be operational in the proposed microgrid. GE Energy Consulting reviewed historic 2016 market prices to analyze when the market price exceeded the microgrid's marginal cost of operation. This established potential hourly dispatch of the unit to calculate annual fuel and VOM costs.

Service Fees:
As described above, the Wire-Co. proposes offering multiple services to the PMP with varying fee structures. While serving as revenue streams for National Grid, these fees act as potential costs to the partnership. The controller service contract, as well as the settlement service, will be charged as a flat monthly fee to the PMP. However, the distribution surcharge would be based on the aggregated kWh usage of the group as a whole.

Possible Revenue:
In order to be successful, the partnership must have the ability to generate revenue from the NYISO market. GE Energy Consulting is currently analyzing historic 2016 market prices to calculate potential revenue streams from market activities. Future commodity prices will dictate when and how often the microgrid will sell to the energy market. Other options include participation in Installed Capacity ("ICAP"), Emergency Demand Response Program ("EDRP"), Demand Response ("DR"), or other ancillary services offered by the NYISO.

Tiered Recovery Customers
In the proposed microgrid business model, the tiered recovery approach incorporates various customers outside of the physical microgrid as participants in the recovery effort of the underground distribution system. All financial implications for these customers will be categorized as the 'Tiered Recovery Customers' ("TRC").
Tier 1's contribution will be collected through the microgrid entity and is included in the PMP analysis. However, contributions for tiers 2-5 will be collected through individual customer bills throughout the community based on kWh usage.
The rate structure and potential bill impacts of the tiered recovery have been discussed at length in previous reports and noted above in the Governance section of this report.

7. **Industry Presentations**
   a. **Microgrid & Distribution Generation for Public & Private Sectors Conference**
   On March 2, 2017 the Project was featured during the 7th Microgrid & Distribution Generation for Public & Private Sectors Conference in Boston, MA. This provided the Project with an opportunity to disseminate some of the learnings understood thus far, while also hearing of other project's experiences in the development of microgrids across the country.

   In general, the Project received positive feedback regarding approach and overall design. Specifically, the tiered recovery model was well received and produced a number of encouraging questions. There were other case studies presented that explained the complexity of potential business models of community microgrids – most with only 2-3 connected buildings within close proximity and a single generating source. However, none compared to the variety of load entities the Potsdam microgrid proposes connecting with over a dozen different load connections and a half dozen different generating sources.

b. Deloitte Dbrief Webcast

On March 30, 2017 the Project was featured in one of Deloitte's reoccurring Dbriefs webcast entitled, "*Reinventing resilience: Defining the model for utility-led renewable microgrids*". The webcast was attended by over 2,500 participants from across the country, including members of the utility and energy industries.

The discussion revolved around on how investor-owned utilities ("IOUs") have begun to demonstrate how distributed, renewable generation in a microgrid setting can be a cost-effective alternative to traditional transmission and distribution investments. The Project team was able to describe the overall goals of the Project while exploring the details behind the Project's governance and business modeling exercise. The tiered recovery model was also featured and discussed at length as a possible cost recovery option.

8. NYISO Meeting

In January 2017, the NYISO unveiled a "DER Roadmap" as a first step to transitioning from a primarily central station-based grid to a diverse bi-directional grid. The purpose of this document is to present the NYISO's vision for integrating DER into the NYISO's Energy, Ancillary Services, and Capacity markets. It outlines high-level concepts to facilitate the emergence of dispatchable DER through a series of economic-based products.[13]

On March 24, 2017 the Project team had the opportunity to meet with representatives from the NYISO to discuss the Project and possible revenue streams from market interaction. This gave the Project team the chance to ask questions regarding the NYISO's DER Roadmap initiative and how it would affect the development of the microgrid in Potsdam as an aggregated DER on the system.

[13] NYISO *Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets*, January 2017, p 5.

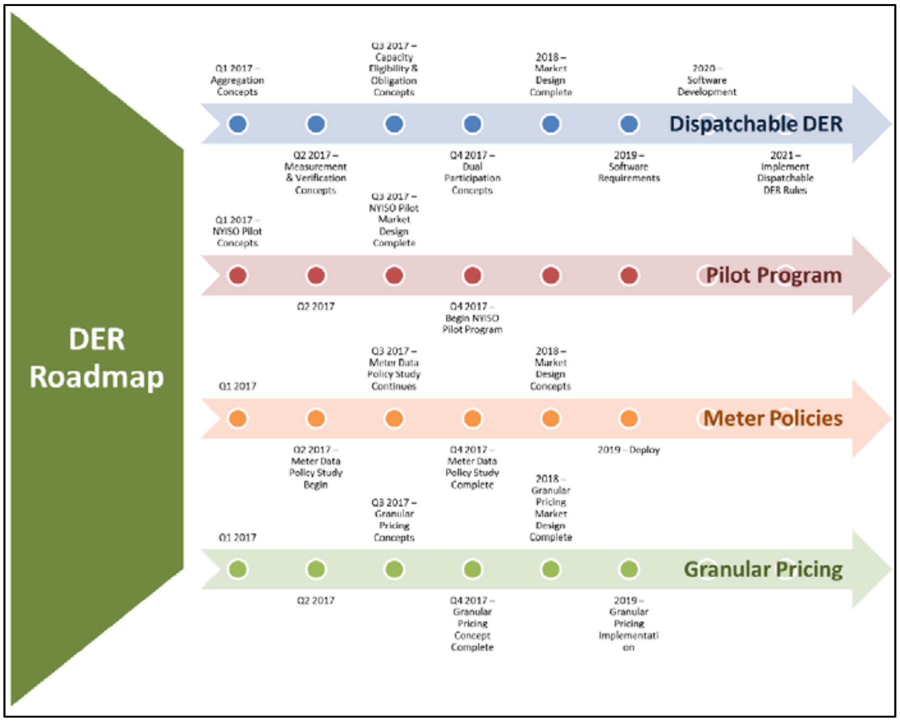

Image 2.4 – NYISO DER Roadmap

One of the major take-aways from that meeting was the manner in which the NYISO will consider different aggregated generation assets as they participate within the markets. The aggregators, labeled as DER Coordinator Entities ("DCE"), will be priced at the transmission node level, as opposed to the current zonal price approach. This indicates that aggregation can take place amongst and between multiple DER assets, as long as their connection points lead to a single transmission feeder. In the case of Potsdam microgrid, all load and generation assets stem from the same transmission line entering the Lawrence Avenue substation.

In addition, this more granular pricing strategy may offer the microgrid better pricing options than currently offered through zonal prices. This change in aggregation criteria alters the Project team's consideration of aggregated generation, given that the existing (and proposed) generation assets could now possibly be aggregated as a DCE without the need for physical connection between assets. This opens the possibility of market participation by generating customers without the actual physical microgrid in place.

The NYISO is also revising the minimum size restrictions for participation in the market. Aggregations represented by a DCE will be known as a DCE Aggregation ("DCEA"). The NYISO is not proposing a minimum size restriction for the individual DER that are part of the DCEA, however DCEAs must be a minimum of 100 kW in total size and can be sized in increments of 0.1 MW.[14] To accommodate smaller DCEAs, NYISO will aggregate DCEAs less than 1 MW in size into a "super aggregation" ("SA") for scheduling purposes.

[14] NYISO DER Roadmap, *supra* note 2, p 19.

Moreover, the NYISO is looking at how best to handle intermittent resources, whether to have a homogenous aggregation of resources, or whether heterogeneous aggregation will be more manageable. Their market design study will further analyze this dichotomy to see if it would be advantageous to treat intermittent resources differently from dispatchable resources. Given the Potsdam microgrid contains both intermittent renewable resources (hydroelectric dams and solar PV array) and more flexible, dispatchable resources (combined heat and power ("CHP") and natural gas piston engines), the results of the NYISO's market design study may point to the need for separate aggregation of generation assets – one for renewables and one for dispatchable generation.

In general, it was emphasized that the more flexible the DER asset (or aggregation of DER), the more opportunity for market participation. Such a concept may impact the Project Team's decisions moving forward on new DER assets. The conceptual design revealed the need for 4MW of additional generation to support the Potsdam microgrid load. While the Project team has considered additional CHP units due to the thermal benefits the units offer, they could potentially hinder optimal dispatch due to required thermal needs of the buildings they service. Ultimately, other generation types, such as reciprocating engines or organic Rankine Cycle could provide the microgrid with more flexible dispatch options for participation in the NYISO market.

Overall, the meeting with the NYISO representatives was very education and eye-opening for the Project team. It reshaped the approach to aggregation, and encouraged the Project team to further investigate options for multiple revenue streams through market interaction. The Project team was not, however, able to receive additional guidance on future price indicators to allow for revenue forecasting, one of the major challenges of the business modeling exercise.

9. NY Prize Competition Update

While not technically a participant in the NY Prize competition, the Project team continues to monitor the activities of the multi-stage microgrid competition with the ultimate intent of making a submission for Stage 3 funding.

The Stage 2 RFP was announced in April 2016, with submissions due to NYSERDA in October 2016. Originally, the Stage 2 awards were to be announced in December 2016 but were delayed. While NYSERDA continued to review applications throughout the first quarter of 2017, the official announcement of awards took place on March 23rd, 2017 with eleven (11) winners across the New York State.

Each awardee was given up to $1M to complete the Detailed Engineering Design and Financial Business Plan, similar to this Project's Phase 2 scope of work. Originally described as a 12-month endeavor, NYSERDA has communicated that the Stage 2 final reports will be due in July 2018, giving awardees nearly sixteen (16) months to complete the tasks of Stage 2.

In addition, the Project team is aware that NYSERDA has made alterations to the Stage 2 scope and schedule of work (both of which originally formed the basis for this Project's activities). Given this Project's aggressive Stage 2 schedule, such alterations may impact the Project's anticipated timeline. Additional review and analysis of NYSERDA's changes to the scope of work will be done before any changes are made to the Project timeline.

2.2 Challenges, Changes, and Lessons Learned

The issues or changes chart has been updated to reflect those occurring during the current calendar year with previous learnings being retired from the list.

Qtr. 2017	Issue or Change	What was the resulting change to Project scope/timeline?	Strategies to resolve	Lessons Learned
Q1	NYISO developing new DER pricing model and aggregation guidance.	Market changes could alter the microgrid's potential participation in electricity market activities and how that participation is compensated.	Meet with NYISO to work through changes. Anticipate pricing options during financial analysis.	The changing landscape of DER in New York could have measurable effect on integration into the market.
Q1	OBG load analysis showed higher load in proposed microgrid.	This may require additional generation on site (more than anticipated) and/or removal of some sites from consideration.	Compare 2013-2014 load analysis to 2015-2016 to locate shifts in usage by load site.	Analysis must consider increased demand from customers and build microgrid to accommodate.
Q1	The PSC issued an order on the Value of DER, specifying new valuation of pricing for DER.[15]	Market changes could alter the microgrid's potential participation in market activities and how that participation is compensated.	Work with the PSC and National Grid Regulatory group to monitor changes in DER valuation.	The changing landscape of DER in New York could have measurable effect on integration into the market.
Q1	The Project team became aware that the ownership of the IGA Grocery Store is changing.	The new owners may not see the benefit of the microgrid and withdraw interest.	The Project team is reaching out to the new owners to discuss the Project.	The changing ownership (or governance) of partners complicates stakeholder relations.
Q1	The NY Prize Stage 2 competition is behind its original schedule, including a longer timeline and an altered scope of work.	There may need to be changes in the Project timeline as new requirements may add activities and require a revised schedule.	The Project team is reviewing NYSERDA's changes to gauge impact to the Project timeline. The Project Manager will contact NYSERDA to discuss the changes.	Investigate any changes to the NY Prize competition which may impact the Project timeline.

[15] Case 15-E-0751 and Case 15-E-0082, *Order on Net Energy Metering Transition, Phase One of Value of Distributed Energy Resources, and Related Matters* (issued March 9. 2017).

3.0 Next Quarter Forecast

In the 2nd quarter of 2017, the Project team will continue its efforts on the business modeling and detailed engineering design with its partners. Efforts during Q1 2017 gave the Project team a starting point for many of the activities within the Phase 2 scope of work.

While OBG completed the initial load analysis of the 2015-2016 meter data, further examination of the individual load profiles is needed to identify any change in load demand on the microgrid system. The Project team plans to review each load profile to see if there was an increase in demand or merely an increase in participants. Within that discussion, the inclusion of the National Grid Service Center and Garage is also in-question, due to the unforeseen high load of those buildings. In addition, analysis of the renewable generation data still needs to be completed to identify the amount and timing of their aggregated reduction on the system.

During Q1 2017, OBG completed energy audits on three (3) load centers of the microgrid; Clarkson University, SUNY Potsdam, and Canton-Potsdam Hospital. However, detailed reports for each of these stakeholders will be completed and delivered to the Project team in May 2017, giving the Project team the opportunity to meet with these stakeholders individually to discuss the findings. Included in these reports will be recommendations for energy efficiency, demand response, and possible thermal options for CHP units.

Much of the preliminary information required in the next phase of the Project has already been researched and documented in the NYSERDA PON project. Therefore, Project partners will begin summarizing this information in reports to describe site characteristics, fuel specifications, load profiles, current generation sources, future generation needs, as well as other general information into an initial report. These sections of the Phase 2 report are anticipated to be delivered by Project partners during Q2 2017.

The Project team will continue to work on the business and governance model to present a clear and compelling case that the benefits to the community, stakeholders, and utility outweigh associated costs and risks. This emphasis will be displayed in the description of the value proposition developed by the Project team in the second quarter of 2017. Key to the value proposition will be National Grid's Preliminary Pricing Proposal, expected to be completed by June 2017. This proposal will provide the Company the opportunity to explain the pricing of each of the four (4) proposed services to Project partners and stakeholders. The final version of the tiered recovery of the underground wire network will also be included.

As the business analysis continues, it becomes increasingly clear that the scope and cost of this community microgrid exceeds the possible return the partners and community can reap from its installation. In addition, the Project team's exposure to other planned and commissioned community microgrids solidifies the complexity this project proposes. Therefore, the Project team plans to analyze a possible scaled-back microgrid, with potential staged roll out of additional branches of the microgrid, for future consideration.

3.1 Checkpoints/Milestone Progress

	Checkpoint/Milestone	Anticipated Start-End Date	Revised Start-End Date	Status
1	Clarkson University NYSERDA PON Study *(Conceptual Design)*	10/2015 – 6/30/16	10/2015 – 10/31/16	● Complete
2	Initial Engineering Design Recovery Plan *(Tiered Recovery Plan)*	4/6/2016 – 7/26/16	5/1/2016 – 9/30/16	● Complete
3	Preliminary Service Proposal & Pricing *(Pricing Proposal)*	7/01/16 – 11/01/16	11/01/16 – 6/30/17	● Ongoing
4	Phase 2 Completion *(Detailed Engineering Design and Business Plan)*	3/16/16 – 6/30/17	10/1/16 – 12/31/17	● Ongoing

Key

- ● (green) On-Track
- ● (yellow) Delayed start, at risk of on-time completion, or over-budget
- ● (red) Terminated/abandoned checkpoint

1. Clarkson University NYSERDA PON Study – Task 4 *(Conceptual Design)*

Status: ● - Complete
Start Date: 10/2015
End Date: 10/31/16

While a draft report was presented to the Project team in Q3 2016 and a final version in Q4 2016, the NYSERDA PON cumulative report (the "Report") has yet to be submitted to NYSERDA for final approval (as of March 31, 2017). The Report represents the Conceptual Design for the REV Demonstration Project and signifies the final technical task of the NYSERDA PON project. It aims to accomplish the following items:

- Detailed cost of all aspects of the microgrid;
- Benefit-Cost analysis for the microgrid;
- Further refinement of microgrid performance.

Given that all research tasks associated with the NYSERDA study are now compete, the Project team considers this Conceptual Design checkpoint complete.

2. Initial Engineering Design Recovery Plan *(Tiered Recovery Plan)*

Status: ● - Complete
Start Date: 5/1/16
End Date: 9/30/16

The National Grid Project team continued to refine the tiered recovery analysis as described in section 2.1. The structure of the model defined in the Q3 2016 report did not change significantly during the last quarter of the year or the beginning of 2017. This final approach aims to validate each tier based on access to critical services with decreasing availability as they expand outward from the microgrid itself.

While continued adjustments of the microgrid design will ultimately affect the results of the tiered recovery, the approach and design of the recovery mechanism will, most likely, not change moving forward. Therefore, the Project team considers this checkpoint complete.

3. Preliminary Service Proposal and Pricing *(Pricing Proposal)*

Status: ● - Ongoing
Start Date: 11/1/16
End Date: 6/30/17

In the Project Implementation Plan,[16] National Grid offered this milestone as an opportunity to present the preliminary service and pricing offerings to stakeholders. The Project team was able to begin the process of forming and analyzing a pricing strategy during Q1 2017, but due to delays in precise cost estimates and uncertainty in regulatory pricing, the pricing options have yet to be finalized in a manner to be conveyed to stakeholders. The adjusted timeline shifts the emphasis of this task into the second quarter of 2017, with a presentation of findings to stakeholders anticipated in June of 2017.

4. Phase 2 Completion *(Detailed Engineering Design and Financial and Business Plan)*

Status: ● - Ongoing
Start date: 10/1/16
End date: 12/31/17

National Grid continues to partner with GE Energy Consulting and OBG to work on the Detailed Engineering Design and Financial and Business Plan Assessment in line with NY Prize Stage 2. GE Energy Consulting is subcontracting with Clarkson University and Nova Energy Solutions to perform some of the tasks that are outside of GE Energy Consulting's area of expertise.

While the original timeline for completion of this phase of the Project was twelve (12) months, initial contracting with partners delayed the start of Phase 2 and pushes the completion date beyond the original "Go/No-Go" determination of June 2017 (as stated in the Project Implementation Plan).[17] Furthermore, NYSERDA is allotting Stage 2 awardees up to sixteen (16) months to complete their Stage 2 activities and has also provided noteworthy changes to the Stage 2 scope of work. Given these changes and delays, the Project team currently anticipates completion of the Detailed Engineering Design and Financial and Business Plan Assessment by the end of the fourth quarter of 2017.

[16] Case 14-M-0101, *supra* note 2.
[17] Case 14-M-0101, *supra* note 2.

4.0 Work Plan & Budget Review

4.1 Updated Work Plan

Updated Gantt chart from Project Implementation Plan is below:

	Task Name	Duration	Start	Finish
7	**REV Demonstration**	**534 days**	**Tue 12/15/15**	**Fri 12/29/17**
8	Demonstration Approval	1 day	Tue 12/15/15	Tue 12/15/15
9	**General Project Management**	**335 days**	**Mon 3/21/16**	**Fri 6/30/17**
23	Benefit Analysis for Stakeholder Engagement	3.2 mons	Mon 1/2/17	Thu 3/30/17
24	**Stakeholder engagement and community outreach**	**403 days**	**Wed 12/16/15**	**Fri 6/30/17**
25	Initial Stakeholder Engagement	64 days	Wed 12/16/15	Mon 3/14/16
26	Initial Stakeholder Meeting	0 days	Mon 3/14/16	Mon 3/14/16
27	Second Stakeholder Meeting	0 days	Mon 10/24/16	Mon 10/24/16
28	Third Stakeholder Meeting	0 days	Fri 6/30/17	Fri 6/30/17
29	Conceptual Design Complete Milestone	0 days	Mon 10/17/16	Mon 10/17/16
30	Initial Engineering Design Recovery Plan (Capital Costs)	4 mons	Mon 6/13/16	Fri 9/30/16
31	Initial Tariff Design (Commodity Costs)	6 mons	Mon 9/12/16	Fri 2/24/17
32	Preliminary Service Proposals & Pricing Milestone	89 days	Tue 2/28/17	Fri 6/30/17
33	Stakeholder feedback on initial cost estimates and recovery/payment plan & additional community outreach	1.5 mons	Mon 7/3/17	Fri 8/11/17
34	Coordinate and incorporate stakeholder feedback with Detailed Design Study team	1.5 mons	Mon 8/14/17	Fri 9/22/17
35	Revise tariffs based on possible changes to NY Prize technical study	1 mon	Mon 9/25/17	Fri 10/20/17
36	Draft contracts for Go/No-Go meeting with refined tariffs and business cases	1 mon	Mon 10/23/17	Fri 11/17/17
37	Financial/Business Plan & Contracting	1.5 mons	Mon 11/20/17	Fri 12/29/17
38	Completion of Financial/Business Plan ("Go/No-Go")	0 days	Fri 12/29/17	Fri 12/29/17

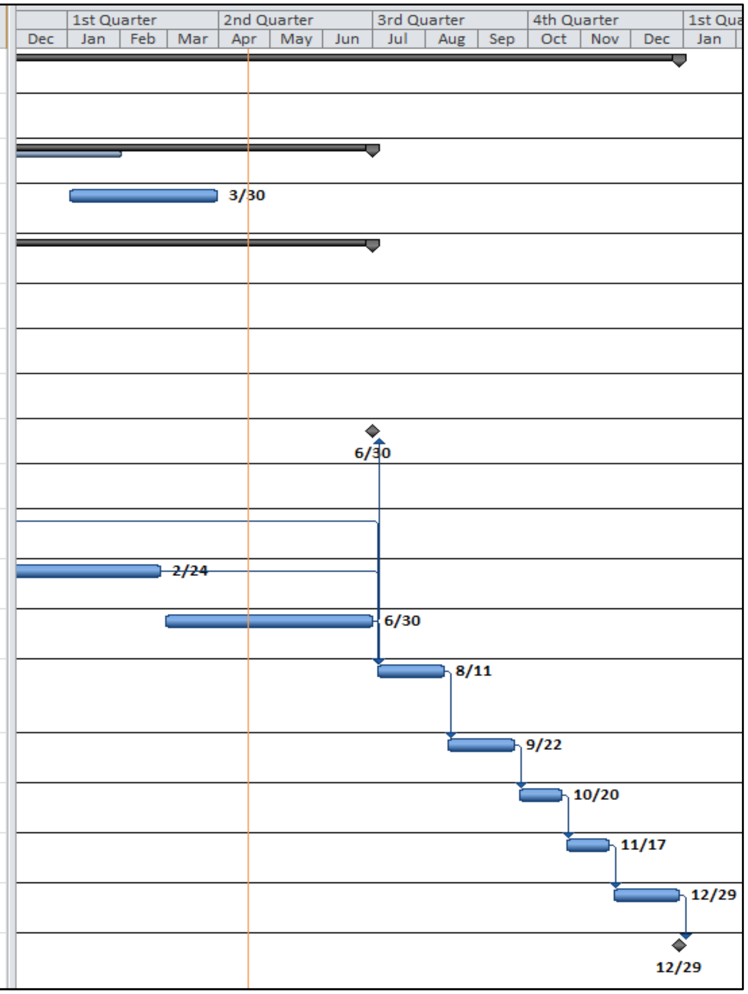

Figure 4.1 – Updated Gantt Chart from Project Implementation Plan.

4.2 Updated Budget

Table 4.1 below displays the updated total expenditures through March 31, 2017.

Task	Budget	Quarterly Spend	Spend to Date	Remaining Balance
Project Administration and Planning	$131,000	$30,983	$202,822	($71,822)
Marketing and Community Engagement	$200,000	$12,649	$76,977	$123,023
Implementation	$275,000	$18,830	$51,522	$223,478
Audit Grade Detailed Engineering Design	$1,000,000	$10,161	$24,400	$975,600
Totals:	**$1,606,000**	**$72,623**	**$355,722**	**$1,250,278**

Table 4.1 – Updated Budget

The incremental costs associated with the Project as of March 31, 2017 total $6,375. Continued monitoring and reporting of incremental costs will be included in subsequent quarterly reports.

As the Project continues out of the initial planning and Conceptual Design phase and into the Detailed Engineering Design and Implementation phase, the budget has shifted reliance to the latter's expense line items. While the majority of the Project Administration and Planning budget has been depleted, the Project team will continue to record expenses in this category to track categorical administrative expenses of the Project.

5.0 Progress Metrics

The size and number of participants in the microgrid will dramatically change the projected cost and configuration of the microgrid construction. This section will track the current projected cost range of the microgrid depending on the most recent engineering estimates as well as the projected resiliency duration of the detailed design.

5.1 Total Cost of Microgrid

Metric	As of Q3 2016	As of Q4 2016	As of Q1 2017
Projected Cost Range of Microgrid Construction	\$35M - \$60M[1]	\$26.4M - \$61.3M[2]	\$26.4M - \$61.3M[2]
Underground Wire Cost Range	\$11.3M - \$11.8M	\$7.4M - \$12.0M	\$15.4M - \$23.8M[3]
Projected Resiliency Duration	14 Days	14 Days	14 Days

[1] *Range includes three (3) generation equipment options and two (2) distribution equipment options.*
[2] *Range includes three (3) generation equipment options and three (3) distribution equipment options.*
[3] *Range includes cost of equipment and installation. Previous estimates only included equipment costs.*

Table 5.1 – Cost of Microgrid

5.2 Tiered Recovery Population

The National Grid team's final approach to the tiered recovery model used the customer counts displayed in Table 5.2.

	Commercial	Residential	Total
Tier 1	12	0	12
Tier 2	518	2,239	2,757
Tier 3	463	3,246	3,709
Tier 4	331	3,693	4,024
Tier 5	1,718	14,304	16,022
Total	**3,042**	**23,482**	**26,524**

Table 5.2 – Tiered-Recovery Customers

Other metrics may be added to subsequent quarterly reports as they become more relevant as the Project progresses.

6.0 Appendices

Appendix A: Load Breakdown Summary

	2015											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	2.07	2.32	2.15	2.14	1.98	2.12	2.42	0.90	2.25	2.23	1.96	1.75
Mean	2.77	2.89	2.72	2.76	2.85	2.86	3.20	3.05	3.42	2.93	2.59	2.28
Max	3.29	3.33	3.42	3.48	4.09	3.60	4.35	4.46	5.00	3.96	3.76	3.01
	2016											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	1.99	2.08	1.90	1.88	1.37	1.94	2.05	1.21	2.02	1.97	1.86	1.77
Mean	2.56	2.55	2.40	2.39	2.35	2.58	2.73	2.82	3.02	2.65	2.45	2.25
Max	3.14	3.26	3.05	3.15	3.26	3.54	3.85	3.89	4.37	3.67	3.33	2.93

Table 6.1 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

	2015											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	0.21	0.29	0.55	0.37	0.46	0.22	0.28	0.52	2.05	1.88	1.97	0.84
Mean	2.55	2.43	2.82	2.78	2.49	2.13	2.27	2.23	3.14	2.84	2.71	2.57
Max	3.67	3.69	3.58	3.58	4.00	2.93	3.19	3.76	4.43	3.67	3.46	3.53
	2016											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	0.38	1.01	0.64	2.00	1.46	1.42	0.96	0.10	1.28	1.96	0.00	0.59
Mean	2.49	2.96	2.79	2.74	2.45	2.10	2.22	2.43	2.89	2.63	2.67	2.50
Max	3.52	3.60	3.60	3.51	3.39	3.07	3.12	3.80	4.12	3.52	3.39	3.39

Table 6.2 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

	2015											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	65.92	92.16	69.76	84.48	0.00	265.60	198.40	83.84	189.44	165.76	275.20	108.16
Mean	453.59	462.66	438.51	468.53	540.10	552.88	578.21	574.88	548.42	456.48	455.70	451.76
Max	603.52	620.16	698.24	721.28	769.92	770.56	791.68	800.00	759.68	682.24	688.64	705.92
	2016											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	90.24	91.52	64.64	121.6	100.48	70.40	220.80	236.16	242.56	173.44	152.96	86.4
Mean	486.63	472.20	448.51	470.40	488.97	608.56	662.37	683.04	604.12	521.94	480.32	495.33
Max	634.88	638.08	654.08	680.32	762.88	860.80	924.80	920.96	890.88	823.04	718.08	686.08

Table 6.3 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

	2015											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	24.48	28.00	28.00	24.00	12.00	12.00	12.00	12.00	16.00	12.00	12.00	20.00
Mean	85.13	91.70	98.64	89.59	70.95	57.59	58.51	62.00	75.44	71.29	77.65	73.46
Max	141.80	180.00	180.00	148.00	128.00	128.00	269.80	120.00	136.00	128.00	132.00	144.00
	2016											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	24.00	32.00	16.00	16.00	12.00	12.00	12.00	20.00	20.00	20.00	24.00	24.00
Mean	84.34	98.61	93.87	89.24	75.59	65.29	64.86	74.27	83.09	73.53	73.15	78.95
Max	144.00	156.00	172.00	196.00	140.00	124.00	124.00	136.00	140.00	132.00	136.00	144.00

Table 6.4 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

2015												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	70.03	71.16	66.02	55.37	55.37	59.82	61.36	59.82	56.27	56.67	61.12	70.94
Mean	99.40	99.55	97.60	86.87	86.23	94.54	104.63	95.97	87.88	87.69	88.87	98.98
Max	137.16	136.48	136.48	128.23	138.97	140.69	156.65	156.65	147.76	126.47	127.35	136.48
2016												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	63.46	63.46	63.23	53.89	50.81	54.64	54.64	54.64	50.62	50.62	54.81	63.23
Mean	88.74	89.96	89.22	81.30	79.25	86.70	87.34	87.74	82.97	78.10	80.06	89.14
Max	136.58	126.34	126.50	123.45	130.03	138.30	138.30	138.30	132.67	121.5	126.45	126.50

Table 6.5 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

2015												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	74.35	74.35	73.80	60.18	59.72	64.07	65.77	64.07	64.07	65.50	62.24	74.35
Mean	93.92	94.13	92.52	77.42	72.84	82.81	85.73	82.92	82.41	84.14	86.14	93.43
Max	117.60	116.39	116.39	111.69	93.14	99.22	106.38	106.38	106.29	104.83	109.28	116.39
2016												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	75.16	78.68	75.16	59.00	55.90	56.73	56.73	56.73	53.41	53.41	54.19	75.16
Mean	98.30	99.39	98.06	83.60	80.62	85.34	86.24	86.12	83.62	80.57	87.01	98.44
Max	133.69	130.53	130.53	127.23	127.24	130.92	130.92	130.92	127.37	116.08	132.31	130.53

Table 6.6 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

2015												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	20.16	20.16	20.04	18.10	18.10	20.34	20.34	20.34	18.40	17.82	17.82	20.16
Mean	26.35	26.28	25.95	23.69	24.28	28.40	31.42	28.97	25.72	23.92	23.53	26.13
Max	33.79	33.71	33.71	31.87	34.85	39.67	44.46	44.46	37.92	32.92	31.25	33.71
2016												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	21.48	21.51	20.77	19.30	18.85	19.73	19.73	19.73	18.28	18.28	18.39	20.89
Mean	27.32	27.36	26.96	25.03	25.72	28.64	30.37	29.11	25.83	23.85	24.25	27.06
Max	36.25	33.85	33.85	33.23	37.04	43.68	43.68	43.68	36.53	32.96	33.10	33.85

Table 6.7 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

2015												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	54.94	55.82	51.79	43.43	43.43	46.93	48.14	46.93	44.14	44.46	47.95	55.65
Mean	77.98	78.10	76.57	68.15	67.65	74.16	82.08	75.28	68.94	68.79	69.72	77.65
Max	107.60	107.07	107.07	100.60	109.02	110.37	122.89	122.89	115.92	99.22	99.90	107.07
2016												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	54.70	54.70	54.50	46.45	43.79	47.09	47.09	47.09	43.64	43.64	47.24	54.502
Mean	76.49	77.54	76.90	70.07	68.31	74.74	75.28	75.63	71.52	67.32	69.01	76.84
Max	117.72	108.91	109.04	106.41	112.08	119.21	119.21	119.21	114.36	104.73	109.00	109.04

Table 6.8 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	19.78	19.78	19.66	17.75	17.75	19.96	19.96	19.96	18.05	17.49	17.49	19.78
Mean	25.85	25.78	25.46	23.24	23.82	27.86	30.82	28.42	25.23	23.47	23.08	25.64
Max	33.14	33.07	33.07	31.26	34.19	38.92	43.62	43.62	37.20	32.29	30.66	33.07
						2016						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	21.48	21.51	20.77	19.30	18.86	19.74	19.74	19.74	18.29	18.29	18.40	20.89
Mean	27.32	27.36	26.96	25.03	25.73	28.65	30.37	29.11	25.83	23.86	24.25	27.06
Max	36.25	33.85	33.85	33.23	37.05	43.68	43.68	43.68	36.54	32.96	33.10	33.85

Table 6.9 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	21.99	21.99	20.49	19.74	19.74	22.19	22.19	21.36	20.06	19.44	19.44	21.99
Mean	28.74	28.53	28.36	25.87	26.63	30.94	34.30	31.51	27.99	25.91	25.91	28.47
Max	36.85	36.76	36.76	35.04	42.39	43.27	48.49	48.49	41.36	35.90	36.04	36.76
						2016						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	23.42	23.45	22.64	21.04	20.55	21.51	21.51	21.51	19.93	4.93	20.05	22.78
Mean	29.78	29.83	29.39	27.29	28.04	31.23	33.10	31.73	28.16	26.01	26.44	29.57
Max	39.51	36.90	36.90	36.23	40.38	47.62	47.62	47.62	39.83	35.93	36.09	36.90

Table 6.10 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	16.18	16.18	16.08	14.52	14.52	16.32	16.32	16.32	14.76	14.30	14.30	16.18
Mean	21.14	21.08	20.82	19.01	19.48	22.78	25.21	23.24	20.63	19.19	18.88	20.97
Max	27.11	27.04	27.04	25.57	27.96	31.83	35.67	35.67	30.42	26.41	25.07	27.04
						2016						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	16.65	16.67	16.09	14.95	14.61	15.29	15.29	15.29	14.17	14.17	14.25	16.19
Mean	21.17	21.20	20.89	19.39	19.93	22.20	23.53	22.55	20.01	18.48	18.79	20.99
Max	28.09	26.23	26.23	25.75	28.70	33.84	33.84	33.84	28.31	25.54	25.65	26.23

Table 6.11 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	22.77	22.78	22.64	20.44	20.44	22.98	22.98	22.98	20.78	20.13	20.13	22.78
Mean	29.77	29.68	29.31	26.77	27.43	32.08	35.49	32.72	29.05	27.03	26.58	29.52
Max	38.17	38.08	38.08	36.00	39.37	44.82	50.22	50.22	42.84	37.18	35.30	38.08
						2016						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	22.44	22.47	21.69	20.16	19.69	20.61	20.61	20.61	19.10	19.10	19.22	21.82
Mean	28.53	28.58	28.16	26.14	26.87	29.92	31.72	30.40	26.98	24.92	25.33	28.30
Max	37.86	35.36	35.36	34.71	38.69	45.62	45.62	45.62	38.16	34.43	34.58	35.36

Table 6.12 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	6.73	6.73	6.69	6.04	6.04	6.79	6.79	6.79	6.14	5.95	5.95	6.73
Mean	8.80	8.77	8.66	7.91	8.10	9.48	10.49	9.67	8.58	7.99	7.85	8.72
Max	11.28	11.25	11.25	10.64	11.63	13.24	14.84	14.84	12.66	10.99	10.43	11.25
						2016						
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	6.84	6.85	6.61	6.14	6.00	6.28	6.28	6.28	5.82	5.82	6.11	6.65
Mean	8.70	8.71	8.58	7.97	9.44	9.12	9.67	9.26	8.22	7.59	7.72	8.63
Max	11.54	10.77	10.77	10.58	11.79	13.90	13.90	13.90	11.63	10.49	10.54	10.77

Table 6.13 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	32.03	32.03	31.83	28.75	28.75	32.32	32.32	32.32	29.22	28.31	28.31	32.03
Mean	41.86	41.74	41.22	37.64	38.57	45.11	49.91	46.02	40.85	38.01	37.38	41.52
Max	53.67	53.55	53.55	50.62	55.36	63.02	70.63	70.63	60.24	52.29	49.64	53.55
						2016						
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	26.31	26.35	25.44	23.63	23.09	24.17	24.17	24.17	22.40	22.40	N.A.	N.A.
Mean	33.46	33.51	33.02	30.65	31.51	35.08	37.19	35.65	31.63	29.37	N.A.	N.A.
Max	44.39	41.46	41.46	40.70	45.37	53.49	53.49	53.49	44.74	40.37	N.A.	N.A.

Table 6.14 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

						2015						
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	82.14	71.00	66.79	67.26	72.54	84.20
Mean	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	131.93	113.90	104.30	104.08	105.48	117.48
Max	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	182.91	185.92	175.37	150.11	151.14	161.98
						2016						
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Min	102.17	102.17	101.80	86.76	81.80	87.97	87.97	87.97	81.51	81.51	N.A.	N.A.
Mean	142.88	144.83	143.65	130.88	127.60	139.59	140.61	141.27	133.59	127.15	N.A.	N.A.
Max	219.89	203.42	203.67	198.76	209.35	222.66	222.66	222.66	213.61	195.61	N.A.	N.A.

Table 6.15 – Monthly Minimum, Mean, and Maximum Values of Load at [redacted]

Appendix B: Seasonal Aggregated Load Profiles[18]

Spring Daily Load Profiles:

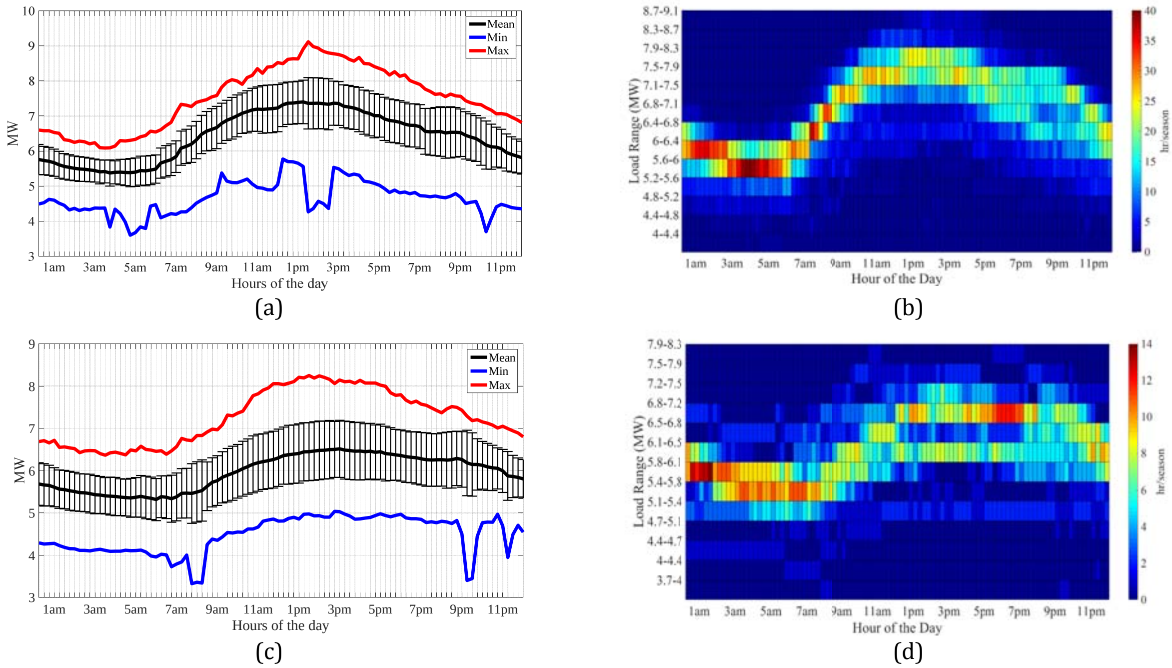

Figure 6.1 – Aggregated Load Profile in Spring: (a) Work Day in 2015, (b) Load Heat Map for Work Day in 2015, (c) Weekend/Holiday in 2015, and (d) Load Heat Map for Weekend/Holiday in 2015.

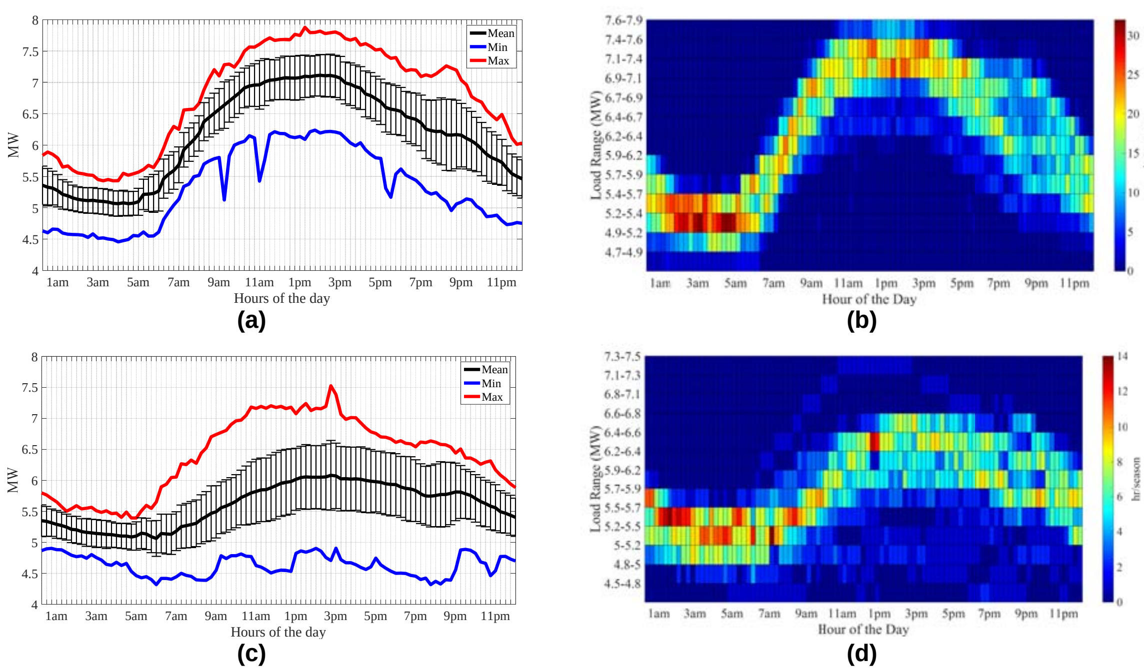

Figure 6.2 – Aggregated Load Profile in Spring: (a) Work Day in 2016, (b) Load Heat Map for Work Day in 2016, (c) Weekend/Holiday in 2016, and (d) Load Heat Map for Weekend/Holiday in 2016.

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[18] Note that the bars in figures represent the standard deviation of the load.

Summer Daily Load Profiles:

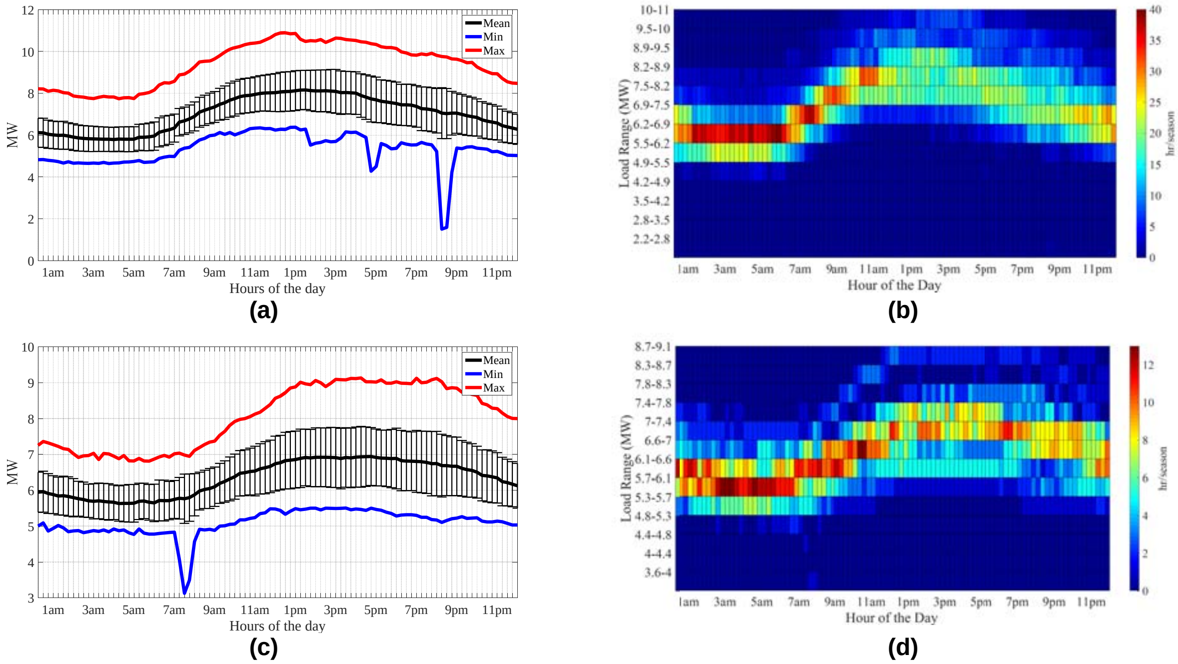

Figure 6.3 – Aggregated Load Profile in Summer: (a) Work Day in 2015, (b) Load Heat Map for Work Day in 2015, (c) Weekend/Holiday in 2015, and (d) Load Heat Map for Weekend/Holiday in 2015.

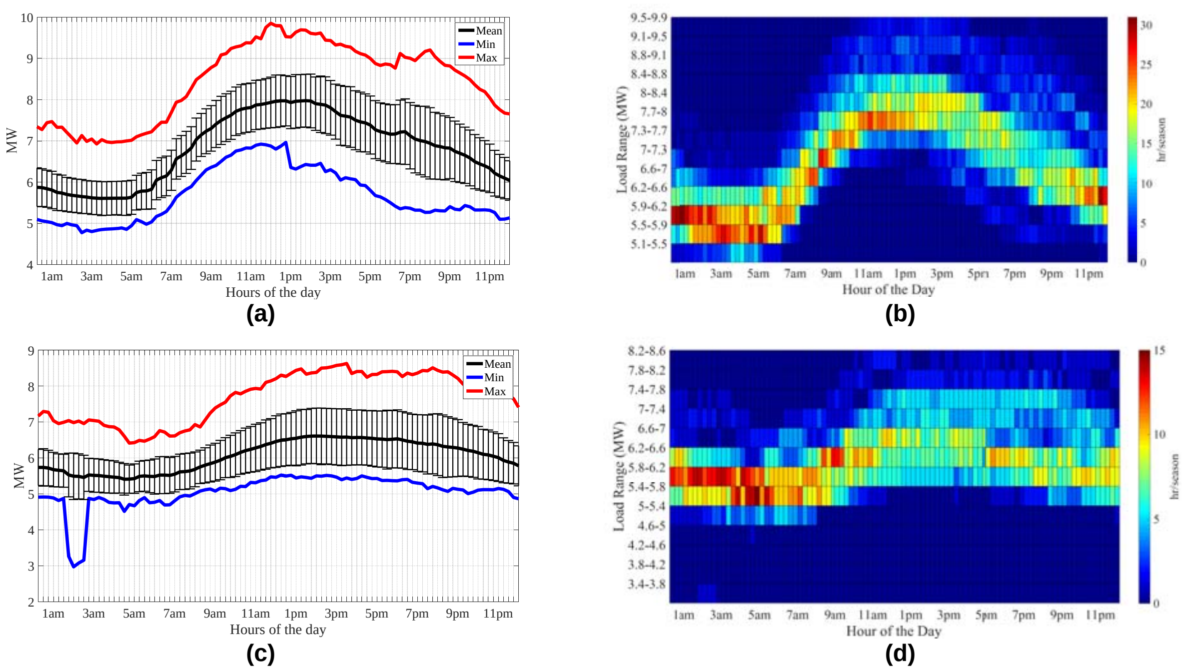

Figure 6.4 – Aggregated Load Profile in Summer: (a) Work Day in 2016, (b) Load Heat Map for Work Day in 2016, (c) Weekend/Holiday in 2016, and (d) Load Heat Map for Weekend/Holiday in 2016.

Fall Daily Load Profiles:

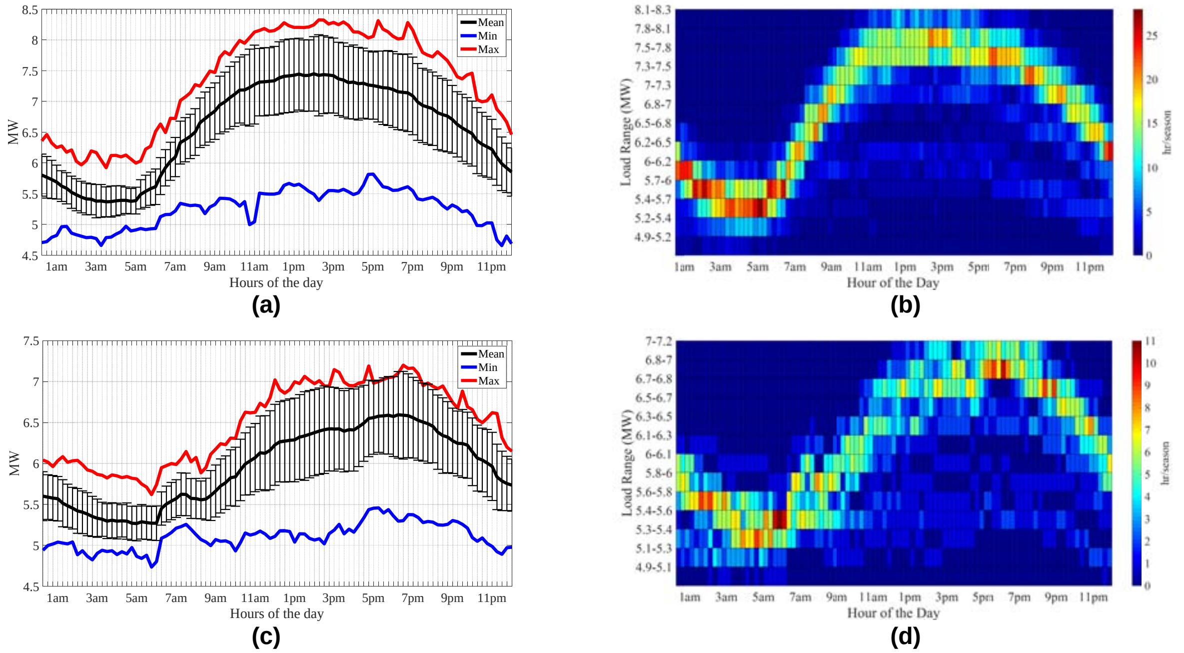

Figure 6.5 – Aggregated Load Profile in Fall: (a) Work Day in 2015, (b) Load Heat Map for Work Day in 2015, (c) Weekend/Holiday in 2015, and (d) Load Heat Map for Weekend/Holiday in 2015.

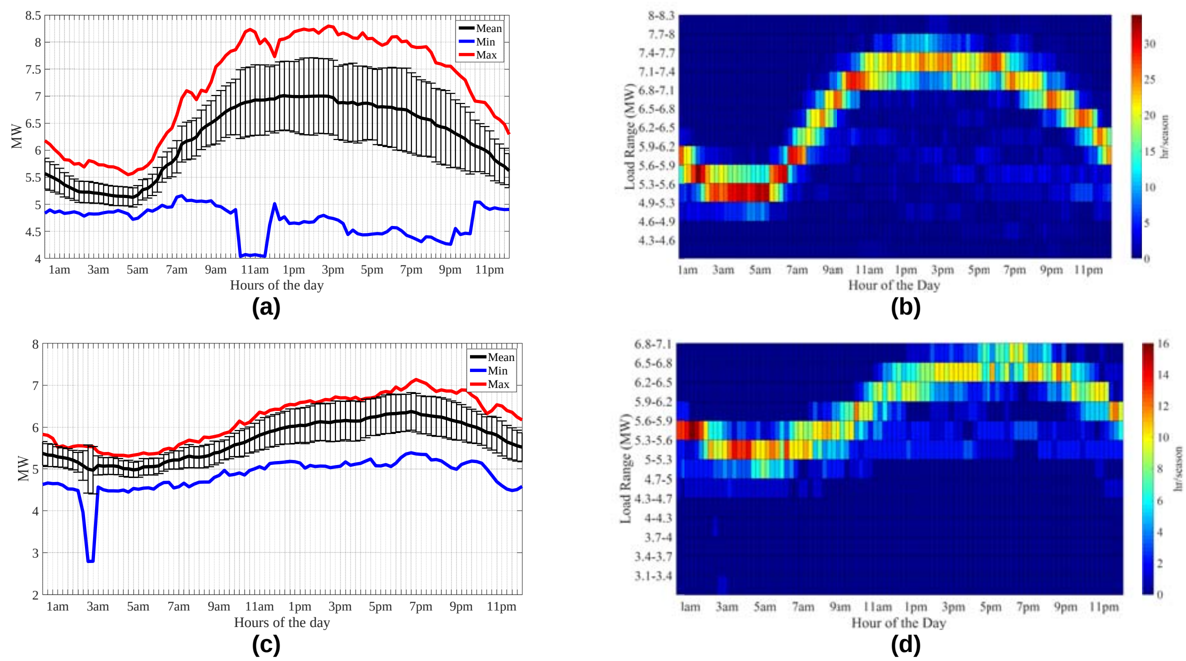

Figure 6.6 – Aggregated Load Profile in Fall: (a) Work Day in 2016, (b) Load Heat Map for Work Day in 2016, (c) Weekend/Holiday in 2016, and (d) Load Heat Map for Weekend/Holiday in 2016.

Winter Daily Load Profiles:

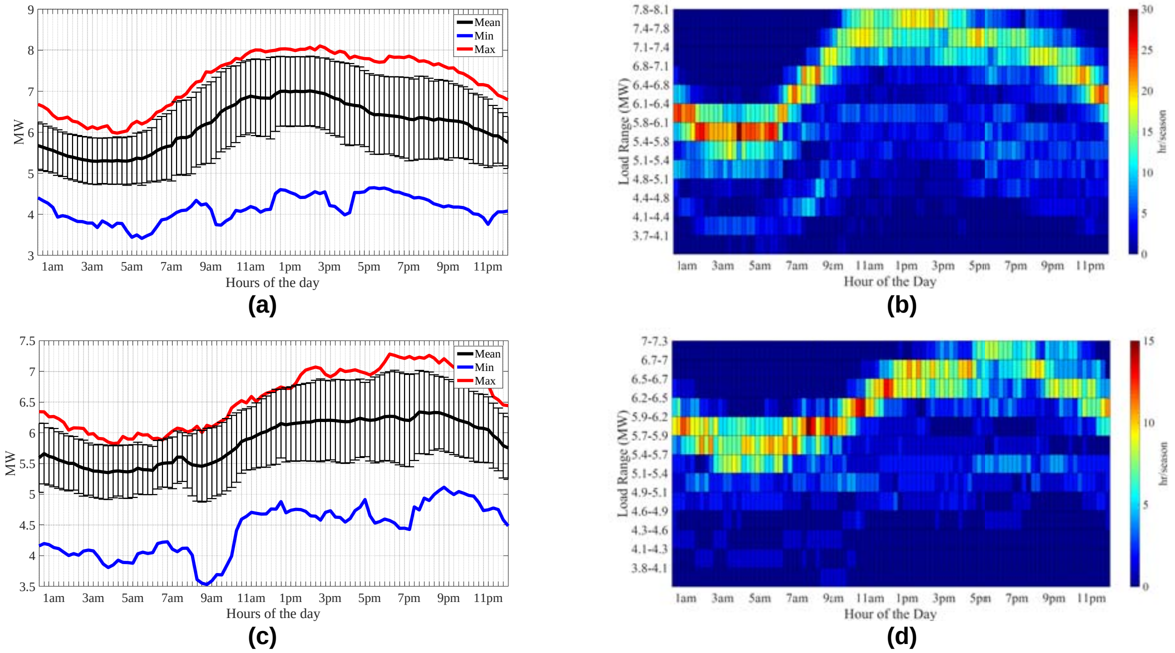

Figure 6.7 – Aggregated Load Profile in Winter: (a) Work Day in 2015, (b) Load Heat Map for Work Day in 2015, (c) Weekend/Holiday in 2015, and (d) Load Heat Map for Weekend/Holiday in 2015.

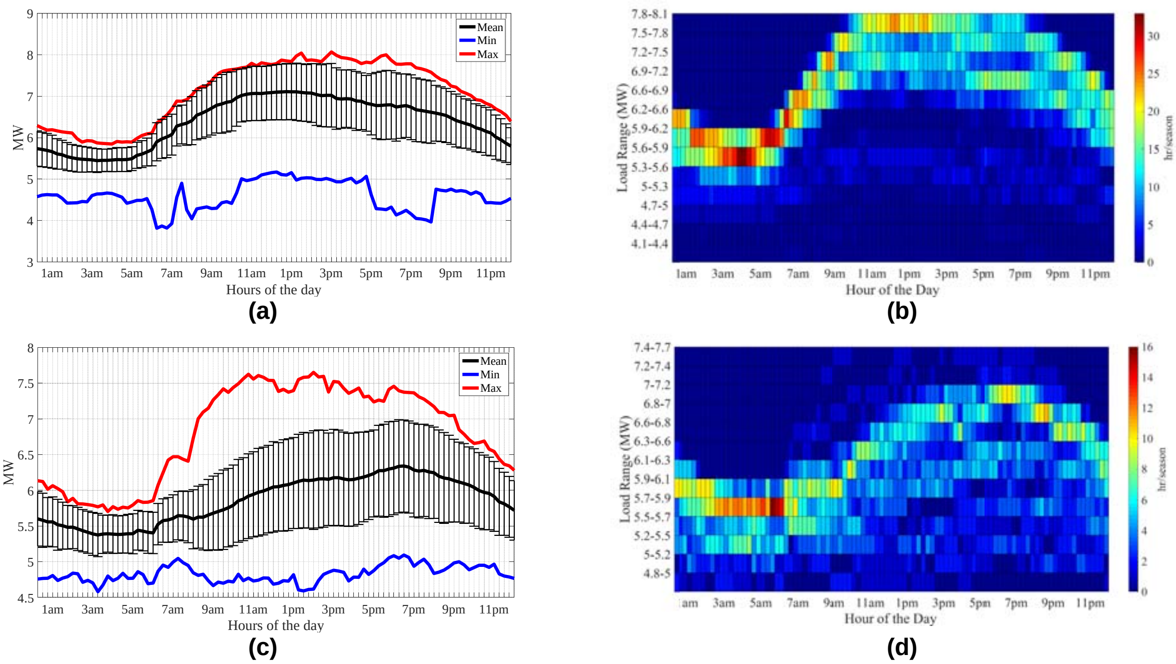

Figure 6.8 – Aggregated Load Profile in Winter: (a) Work Day in 2016, (b) Load Heat Map for Work Day in 2016, (c) Weekend/Holiday in 2016, and (d) Load Heat Map for Weekend/Holiday in 2016.

Appendix C: Disaggregated Load Profiles

Disaggregated load profile for September 16, 2015:

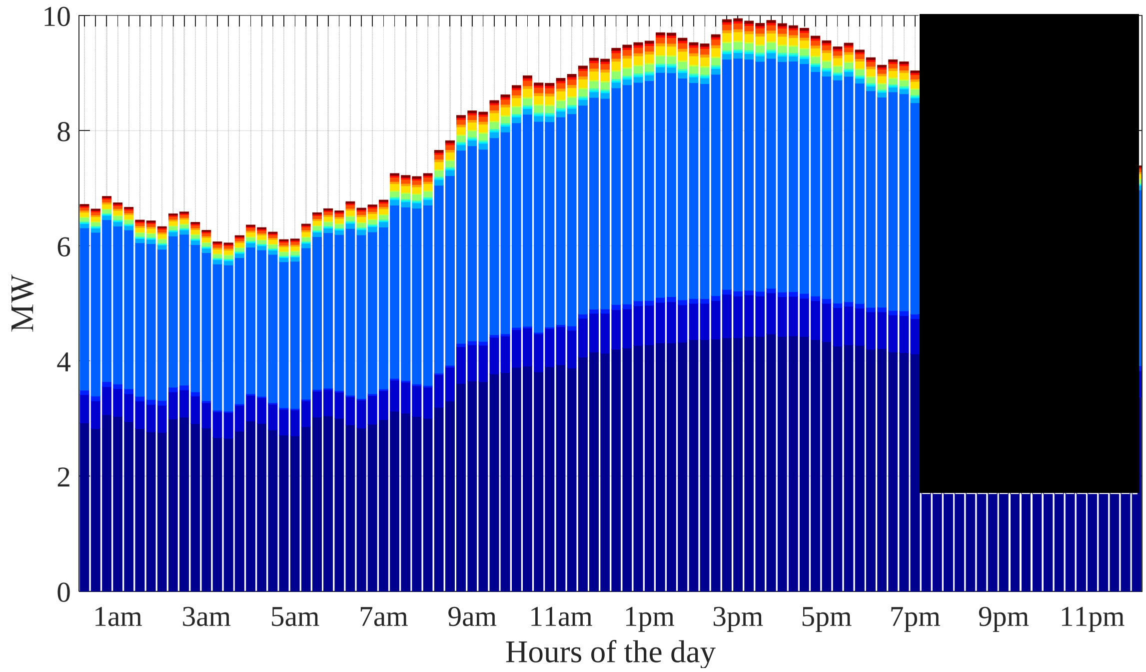

Figure 6.9 – Load Disaggregation of Potsdam Microgrid for September 16, 2015.

[redacted]

Figure 6.10 – Daily Energy Consumption of Potsdam Microgrid for September 16, 2015.

Disaggregated load profile for December 10, 2015:

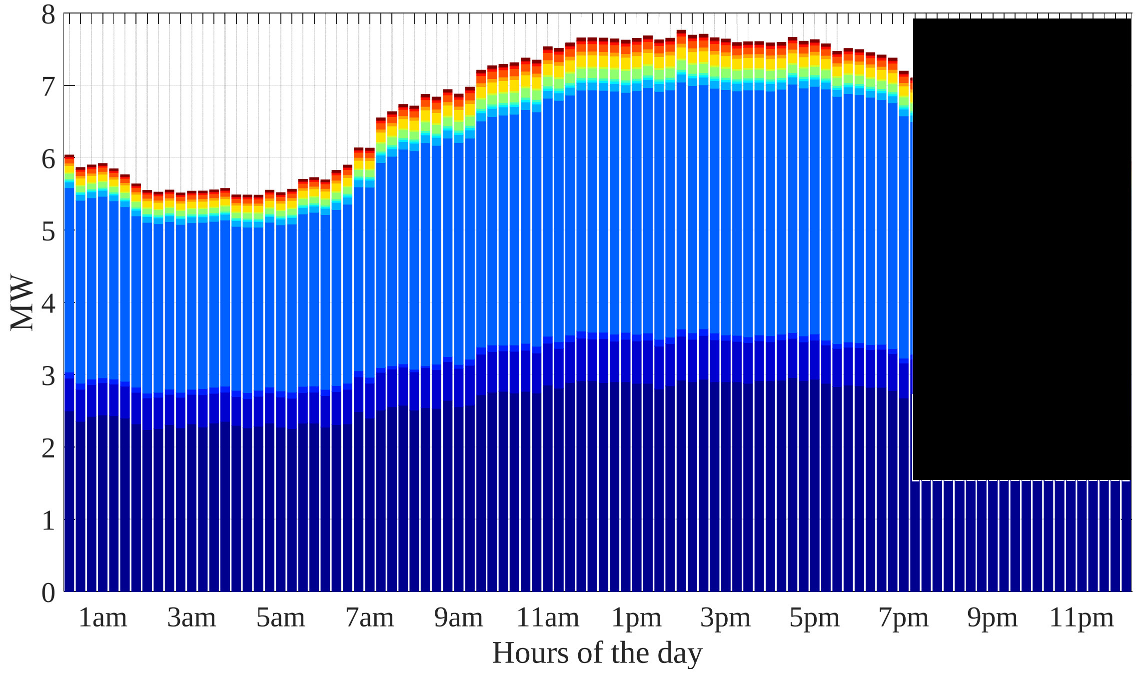

Figure 6.11 – Load Disaggregation of Potsdam Microgrid for December 10, 2015.

[redacted]

Figure 6.12 – Daily Energy Consumption of Potsdam Microgrid for December 10, 2015.

Disaggregated load profile for August 1, 2016:

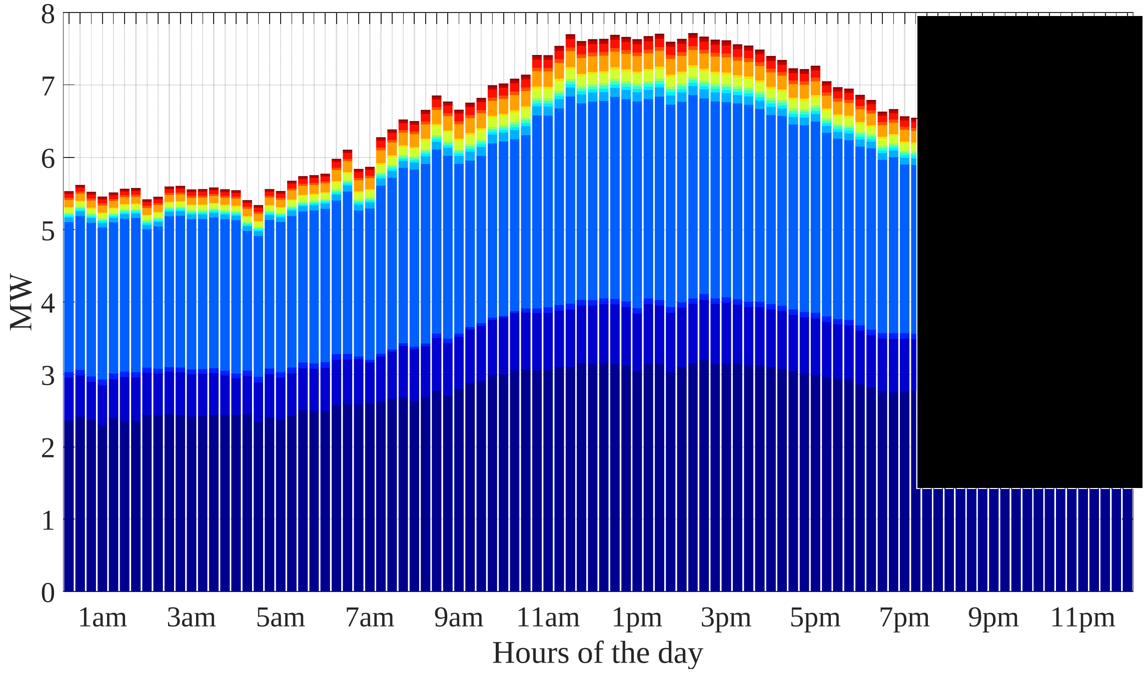

Figure 6.13 – Load Disaggregation of Potsdam Microgrid for August 1, 2016.

[redacted]

Figure 6.14 – Daily Energy Consumption of Potsdam Microgrid for August 1, 2016.

Disaggregated load profile for September 8, 2016:

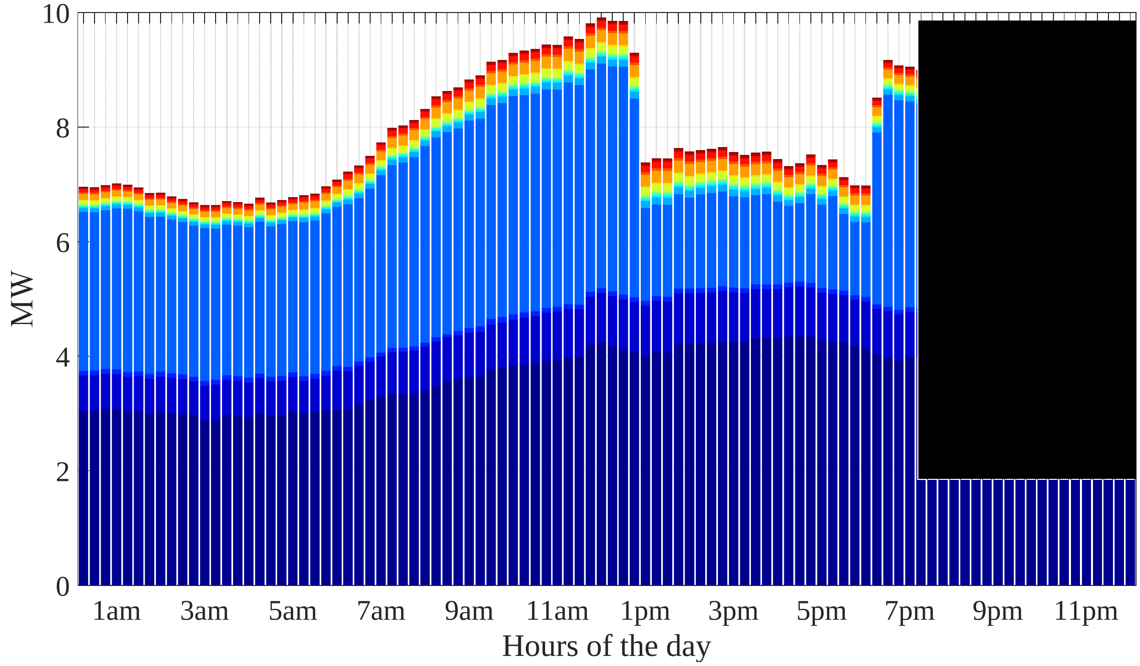

Figure 6.15 – Load Disaggregation of Potsdam Microgrid for September 8, 2016.[19]

[redacted]

Figure 6.16 – Daily Energy Consumption of Potsdam Microgrid for September 8, 2016.

[19] As can be seen in Figure 6.15, there is a significant load reduction at [redacted]

Appendix D: Proposed Business Structure

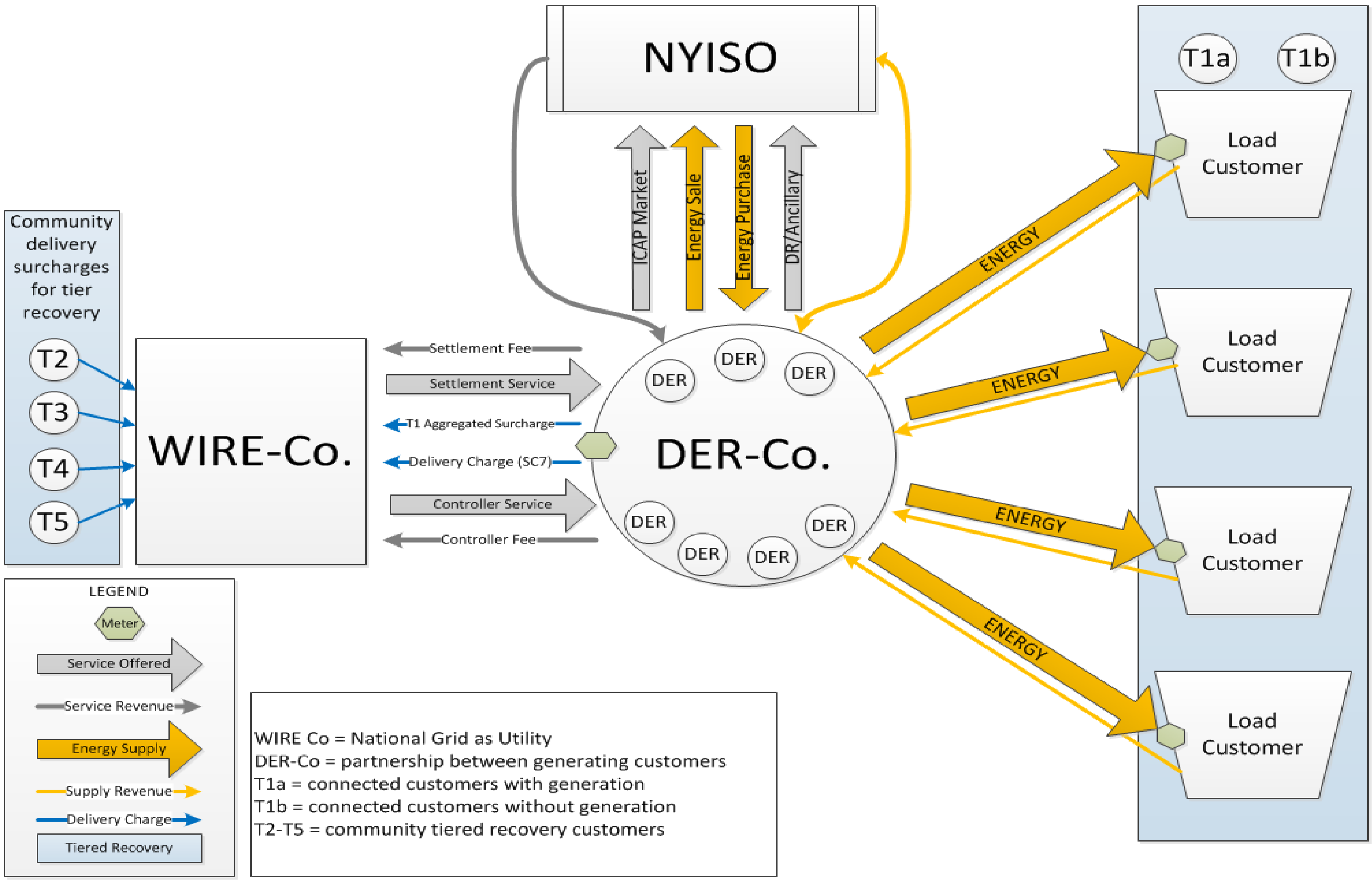

Figure 6.17 – Proposed Business Structure