City of Burlington Electric Department
2020 Integrated Resource Plan

Prepared for the Vermont Public Utilities Commission

September 1, 2020

Executive Summary

In September 2019 the City of Burlington Electric Department ("BED") issued a comprehensive Net Zero Energy Roadmap ("the Roadmap") illustrating how the community could transition to Net Zero Energy ("NZE") by reducing and eventually eliminating fossil fuel consumption across the building and ground transportation sectors. The electric sector has already been converted to NZE with BED's achievement of 100% renewable energy in 2014; importantly, however, to convert transportation and heating to NZE, both the amount of renewable energy and the ability of BED's system to support load will need to increase.

Successfully moving toward NZE will require a significant shift in how the community thinks about and consumes energy in the thermal and transportation sectors. Making the transition will require policy changes, incentives, and significant investment in new technology. However, several key factors are beyond BED's control, including the pace of change for electric transportation and heating technologies, federal policies such as fuel economy standards and tax incentives, state policy initiatives including whether Vermont or the region prices carbon, and the potential for non-linear adoption rates for technology as prices come down. BED is currently working on two potential City policies related to weatherization in rental buildings and electrification of new buildings. Investment in new technologies is expected to be balanced by the financial and societal returns on such investments. Making capital funds available to invest in NZE initiatives such as loan funds tied to energy savings and similar mechanisms will be of material assistance and are already part of BED's approach with our Green Stimulus program.

The key focus areas of the Net Zero Energy Roadmap are:

- **Energy efficiency and electrification of buildings** – including weatherization, switching to efficient electric heating (such as heat pump technologies at residential and commercial properties), and renewable fuels where available;

- **Switching to electric transportation** – converting transportation needs across modes (bike, car, bus, etc.) to electric propulsion;

- **District energy** – successfully constructing and operating a thermal district energy system to reduce fossil fuel use in the commercial sector; and

- **Alternative transportation** – to reduce vehicle miles traveled and provide solutions for "last-mile" needs.

Additionally, moving toward Net Zero Energy will require the following considerations:

- shifting patterns of energy use to encourage increased electricity usage during less expensive and constrained times of the day;

- better integration of renewable resources as the amount of renewable energy demanded regionally increases;
- a focus on equity in the design of every policy and program;
- a rethinking of historic preservation to ensure every building that is renovated will provide an energy-efficient, comfortable, and healthy home or workspace while recognizing its historic character;
- comprehensive planning for community construction projects to ensure:
  - policies allow for increased density in key locations to minimize transportation needs;
  - buildings are designed and built to be high performance;
  - compact, mixed-use development is sited near places where residents work and recreate;
  - redesign of roads to significantly increase multi-modal transportation; and,
  - increased focus on and investment in public transportation so it is more accessible, runs more frequently during peak usage, and therefore can be better used to accommodate expanding needs;
- continuation of BED's practice of sourcing 100% of the City's electricity needs from renewables;
- efficient expansion of BED's distribution system to accommodate increasing load levels and timing, including the possibility of electric storage deployment; and
- a high level of stakeholder engagement including community, State, regional, and federal partners.

BED recognizes it is completing this Integrated Resource Plan ("IRP") during the COVID-19 pandemic, which has impacted our community like so many others. As a City department and community member, BED acknowledges the hardships our customers have been experiencing. Working toward our NZE goals while also addressing and overcoming pandemic-related challenges will require a concerted effort from the BED team. Accordingly, BED remains as committed as ever to its mission:

> *To serve the energy needs of our customers in a safe, reliable, affordable, and socially responsible manner.*

To help support our customers' progress toward NZE while also supporting local economic recovery, in June of this year BED launched its Green Stimulus programs. The Green Stimulus programs are planned to run for a limited time but may prove instructive in improving BED's efficiency and electrification programs in the longer term. Already BED is seeing indications of an increased pace of program uptake based on the Green Stimulus activities, including HVAC contractors fully scheduled for heat pump installations into the fall.

BED recognizes that at a moment of intense focus on social and racial justice issues in our community and across the country, it is imperative that our programs and services be available, accessible, and affordable to all our customers. We are undertaking new efforts, in coordination with City partners, to enhance outreach strategies, and our 2020-2021 Strategic Direction includes the following objective:

Ensure all programs are equitable and accessible, with a priority given to low-to-moderate income, rental, black, indigenous, and people of color (BIPOC), immigrant, and refugee populations.

If we continue to focus on ensuring that all customers have equitable opportunities to participate in our energy services, then attaining the NZE goal City-wide becomes more achievable as all community members are able to engage in the effort.

However, BED cannot achieve NZE status or realize Vermont's clean energy goals in the absence of additional investment and sources of funding for that investment. We are not proposing any additional charges at this time, and the transition cannot be solely funded by the Vermont electric utilities. Any increases to the existing charges for electricity or efficiency services would only result in upward rate pressure over time. If electric rates increase more than the cost of fossil fuels, it will undermine our efforts to encourage customers to transition to electric thermal and transportation measures, such as switching from natural gas heating to heat pumps.

Therefore, where additional expenditure will be necessary, it should be funded in such a way as to not increase the cost of electricity relative to fossil fuels. Additional statewide policy tools may also need to be developed to allow increase flexibility in the use of existing funding sources, such as those envisioned in Senate Bill ("SB") 337, which is currently under legislative review. If SB 337 becomes law, energy efficiency utilities ("EEUs") including BED and Efficiency Vermont ("EVT") would have increased flexibility to implement initiatives that complement Vermont's Tier 3 programs, furthering our efforts to reduce greenhouse gas emissions (but only to the extent they are using funds being collected at current rates). At the City level, BED is engaged in discussion of potential policies that would support NZE such as improving the thermal efficiency of rental properties and increasing existing local efficiency standards for new construction projects.

Finally, policy discussions are often focused on the upfront capital cost of protecting and sustaining our environment. In chapter 8 of this IRP, BED focuses instead on the net benefits. As further discussed in the Net Zero Energy Roadmap report, the net benefits of a transition to

net zero energy are significant.[1] As Table 1 illustrates, net operational savings from pursuing the identified pathways amount to $474 million, resulting in $157 million in net benefits over the next 10 to 20 years. This is in a scenario where the state or region prices carbon at a value similar to the price that the Department of Public Service ("DPS") and the Public Utility Commission ("the Commission") already use to evaluate avoided costs in certain instances.

Table 1: Cost-effectiveness of NZE transition with a $100/ton CO2e price

Pathway (at $100/ton of CO2 e)	Present Value of Costs and Savings (in millions, 2019$)			Total Net Energy Reduction 2020 - 2040 (trillion BTUs	Cost per Unit of Energy Avoided (2019$/ mmBTU)
	Capital costs	Operational costs	Net benefit/ cost		
Efficient electric buildings	$ 141	$ (202)	$ (61)	27	$ (2)
Electric vehicles	$ 113	$ (242)	$ (129)	7	$ (18)
District energy	$ 63	$ (30)	$ 33	9	$ 4
Total	**$ 317**	**$ (474)**	**$ (157)**	**43**	**$ (17)**

Estimated benefits include construction of a district energy system if it is determined to be feasible by a study BED is currently conducting.[2] Capital costs reflect the upfront capital expenditures incurred for equipment and weatherization projects. Operational savings are mostly from fossil fuel savings, as well as lower maintenance costs, where applicable. The costs and savings have not been allocated among customers or BED, but instead reflect societal costs and savings generally. Importantly, our analysis indicates that moving toward NZE can have a ratepayer benefit in the form of lowering rate pressures relative to the business as usual case. This occurs because the revenue from new loads outpaces the need for system investment to serve that new load, resulting in a more efficient use of the BED grid system.

For additional information on the net benefits of an NZE future, BED would encourage readers to review the Roadmap, as it demonstrates how communities can help their residents, businesses, and institutions transition away from fossil fuels. Furthermore, a recent national

[1] A comprehensive discussion of the benefits of a NZE transition is provided in our Net Zero Energy Roadmap, included in the appendix of this document and at https://burlingtonelectric.com/sites/default/files/inline-files/NetZeroEnergy-Roadmap.pdf

[2] Since the completion of the NZE Roadmap in September 2019, the district energy system has been scaled back in size and scope, thus potentially improving the cost-effectiveness of this pathway in the future. However, additional analyses of the revised system design are still underway. It is hoped any DES would eventually be expanded in scope over time once the initial investment has been made.

study looking at significant decarbonization through electrification over a similar timeframe (2035) found significant jobs and economic benefits of such a transition.[3]

Finally, BED recognizes that NZE requires a shift in our own internal thinking. While BED is a regulated franchise provider for electric service, the electric technologies that move us toward NZE (such as electric vehicles and heat pumps) are not widely adopted and are competing in some instances against unregulated fuels such as gasoline. We see renewably sourced electricity, for example, as a less expensive and cleaner transportation fuel than gasoline. Analysis indicates that electric transportation fuel in Vermont keeps more dollars within the state than fossil fuels.[4] BED therefore must employ strategies first used in our energy efficiency programs to support outreach, customer education, vendor engagement, and partnerships to fully realize the potential for the electric transition.

Utility Facts

The following facts about BED provide additional context to the IRP decision process and illustrate the reasons why BED continues to pursue aggressive clean energy goals that reflect the community's environmental ethos.

- Burlington Electric Department was first established in 1905 as a municipal utility to lower the cost of electricity for residences and the City's streetlights.
- The total population of Burlington is approximately 43,000. The City is widely considered to be the economic, cultural, and educational hub of the State, as many Vermonters and tourists commute into the City to work, shop, and attend events.
- BED serves approximately 21,100 customers: 17,120 residential customers and 3,900 commercial customers.
- BED's service area spans approximately 13 square miles including the Burlington International Airport
- BED revenue bonds and general obligation bonds are investment-grade rated as A3 by Moody's Investors Service. This rating is attributed to solid debt service coverage, high degree of liquidity, a diverse renewably based generation resource mix and a diverse local economy. (Note: none of this debt is associated with the McNeil Generating Station; all debt relating to that facility has been retired.)
- The McNeil Generating Station, a 50 MW biomass plant, commenced operations in June 1984. BED is the majority owner (50%) and operator of the facility. In 2008, the owners installed state-of-the-art pollution control equipment. The equipment reduced local NOx emissions and allowed for the sale of high-value renewable energy credits

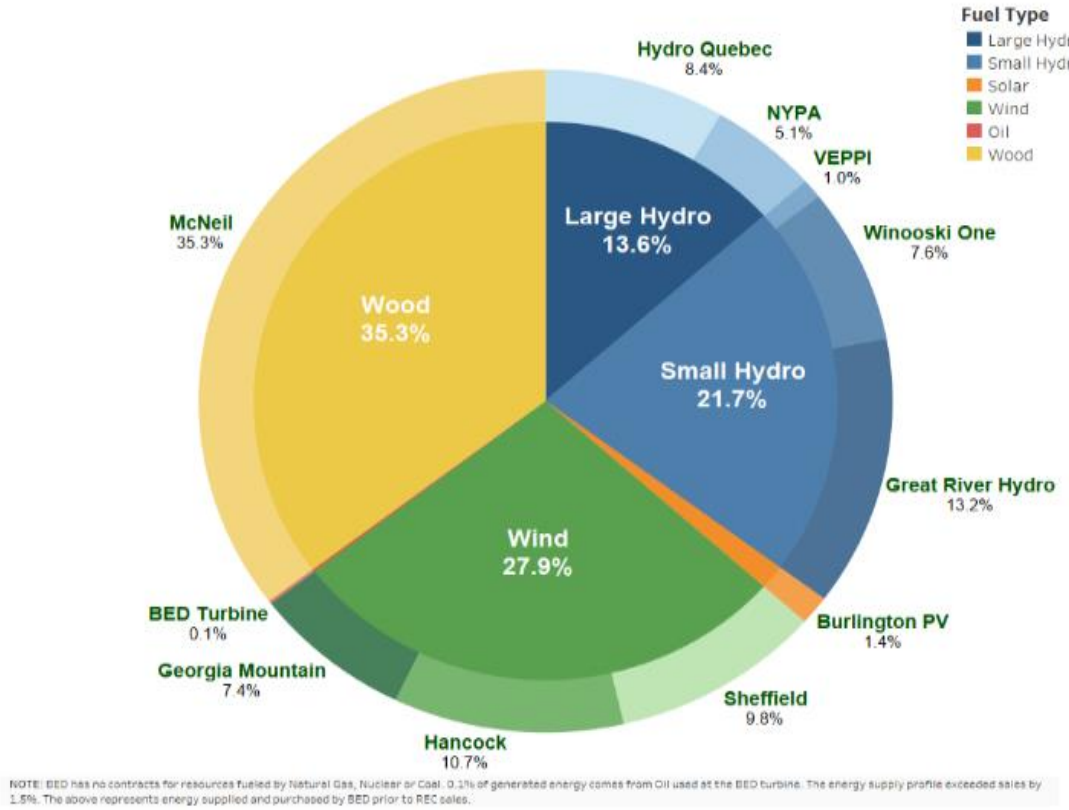
[3] A copy of this report can be found at: https://tinyurl.com/yx6pc99w

[4] See https://www.eanvt.org/wp-content/uploads/2020/02/pg21-staysleaves.png for additional information.

("RECs"). With the proceeds from REC sales, BED was able to achieve a two-year payback on its investment in pollution controls.

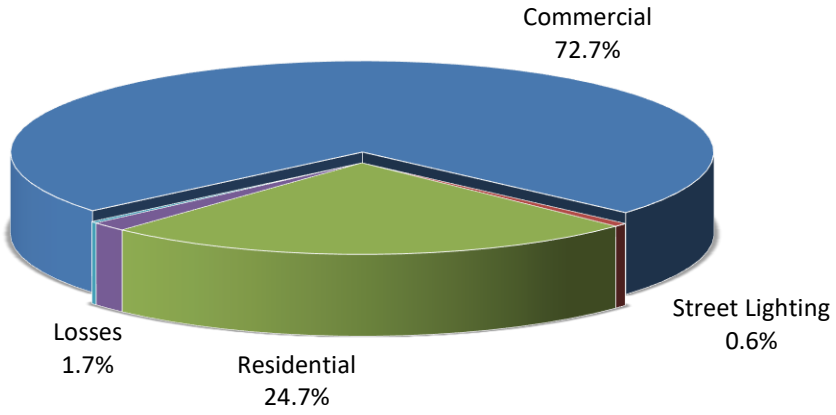
- With the purchase of the Winooski One hydro-electric facility in 2014, the City of Burlington's 15-year quest to source 100% of its electrical needs from renewable resources was achieved. It is important to note BED is recognized as being 100 percent renewable post-REC sales and purchases as well.
- BED's generation mix (before REC sales) includes biomass, large hydro, small hydro, wind, and solar, as highlighted in Figure 1.

Figure 1: BED Energy Supply by Source



- In 2018, total system deliveries (including losses) amounted to 341,234 MWh, a 0. 7% increase over 2017 due to warmer weather. Peak demand in 2018 reached 67.3 MW (summer). Despite the small increase, MWh deliveries have been declining annually since 2010 by as much as 0.4%. Reductions in sales can largely be attributed to strong energy efficiency programs and new appliance standards that have been phasing in over the last 5 to 10 years.
- Commercial customers account for the largest share of electricity use with nearly 73% of the total. Residential customers account for roughly 25% of total energy requirements as shown in Figure 2.

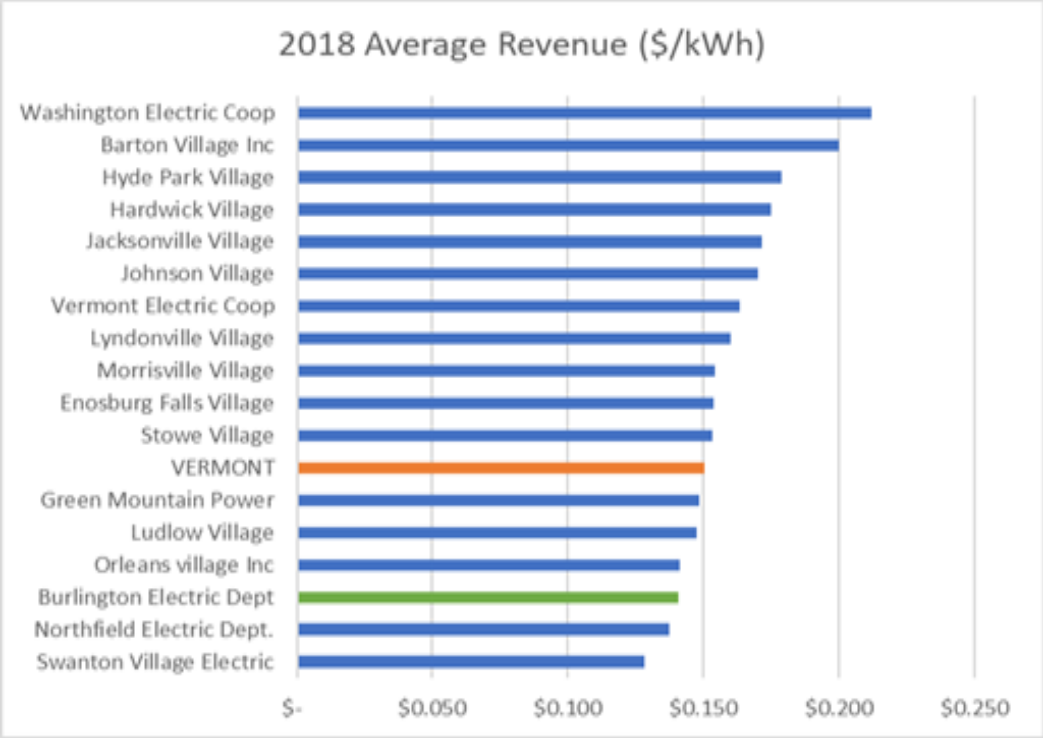
Figure 2: 2018 System Energy Requirements



- The 20 largest commercial accounts account for nearly 50% of the city's total energy load.
- On average, most residential customers use less than 450 kWh per month and incur $75 in monthly electric bills - less than most cellular telephone bills.
- In 1990, the City of Burlington approved an $11.3 million bond to fund demand-side management programs making BED the first "energy efficiency utility" in the state.
- Electric use in 2019 was 8.8 percent lower than in 1989.
- Investments in energy efficiency over the last 20 years have helped to essentially flatten load growth.
- 60% of residential customers rent their homes.
- 70 commercial customers leased their building space.
- Because a high percentage of customers are also college students, 35% of BED's accounts turn over to new customers each year.
- As shown in Figure 3, in 2018, BED collected the third lowest amount of revenues per kWh consumed in the State.[5]

[5] Per email from Department of Public Service.

Figure 3: Average revenue per kWh, VT electric utilities, 2018



Objectives

The primary objective of this IRP is to outline BED's approach to decision-making to ensure BED can reliably serve the needs of its customers in accordance with 30 V.S.A. §218c. Other themes of this IRP are:

- Environmental stewardship by transitioning to a Net Zero Energy ("NZE") community by reducing and eventually eliminating fossil fuel use in the electric, thermal, and ground transportation sectors by strategically electrifying, managing demand, realizing efficiency gains, and expanding local renewable generation while increasing system resilience
- Reliably and safely serving customers and the community
- Maintaining financial strength
- Modeling and understanding the potential impacts (costs, benefits, risks) to BED of actions taken to advance NZE goals
- Ensuring that BED's operations and capabilities can adapt to significant technological disruptions and customer behavioral changes.

This IRP satisfies the requirements of Vermont's 2016 Comprehensive Energy Plan for the following reasons:

- It identifies key input variables and risks that could impact operations;

- It describes how BED will manage those identified risks;
- It documents how BED can reliably meet the energy needs of its customers, after safety concerns are addressed, at the lowest present value lifecycle costs; and
- It highlights a series of priority action steps to be taken in the future.

Because the electric utility industry is rapidly evolving, BED has used the IRP process as an opportunity to develop, test, and demonstrate how its decision-making framework, methodologies, and tools will provide greater flexibility in the future so that the organization can act on opportunities as economic and technological conditions evolve. BED has used this IRP process to demonstrate how its decision-making methodology and tools can be used to evaluate future investment options for balancing supply and demand while also ensuring low-cost, reliable, and safe electric service.

In the absence of new policy tools or funding injections, in this IRP BED assumes that the current pace of future customer adoption of beneficial electrification, weatherization, and other clean energy initiatives will continue until those changes occur. Consequently, the findings and recommendations of this IRP primarily reflect a base case scenario for load growth, resource adequacy requirements, and infrastructure upgrades to provide a basis for evaluating the impacts of these changes when they are advanced. This baseline scenario is important for planning and for relative comparison to the NZE scenarios, which are discussed in a chapter on BED's commitment to help the City achieve its NZE goals the implications that near-term progress toward those goals could have for BED's delivering reliable energy services in accordance with 30 V.S.A. §218c.

2016 IRP Memorandum of Understanding

As a condition for approval of its 2016 IRP[6], BED agreed to do the following:

a) Research additional commercially available measures and technologies that control customer loads remotely and/or provide incentive programs for these technologies.
b) Provide an assessment of the lessons learned from current and future pilot projects such as the water heater, electric bus, and electric vehicle programs.
c) Provide a cost analysis of the various Tier 3 programs considered by BED in terms of first year acquisition costs. Analysis shall also include a discussion concerning the selection of measures to promote and how customer incentive levels were established.
d) Provide an analysis of the operations and economics of the McNeil power plant.

Items a), b) and d) above are addressed in this IRP's appendices and (c) is addressed in Chapter 5, Comprehensive Energy Services.

[6] Case 17-0638, Petition of BED for approval of its 2016 Integrated Resource plan, final order of 11/15/2017.

Summary of Key Findings

Introduction: The Commission's overarching goal in reviewing and approving IRPs is to ensure that Vermont's electric utilities are engaging in appropriate *processes* to address the planning components defined in statute.[7] Accordingly, BED established a process described in this IRP for identifying operational risks and measuring their impacts on our cost of service.

Burlington's Demand for Electricity: Long-term energy requirements and peak demand forecasts are essential inputs into the planning process. The output from these analyses informs BED on the range of total energy and capacity that may be needed to provide reliable electric service. For this IRP, energy and capacity forecasts are based on statistically adjusted end-use models that rely on historical data related to regional economic growth, weather patterns, seasonality, net metering generation, housing starts, business formation, as well as customer usage and behaviors. This IRP forecast is BED's first to include sales of electric vehicles and heat pumps as customers adopt these technologies over time (but not at the pace of adoption that would be required to reach NZE by 2030 or 2040 per the Roadmap).

As shown in Table 2, BED's base case scenario energy requirements are expected to remain flat, increasing by 0.3% annually (after accounting for the effects of future energy efficiency programs, BAU electrification, and behind the meter generation). Meanwhile, peak demand is expected to increase 0.1% annually.

Table 2: Annual Energy Requirements & Peak Demand, 2019-2039

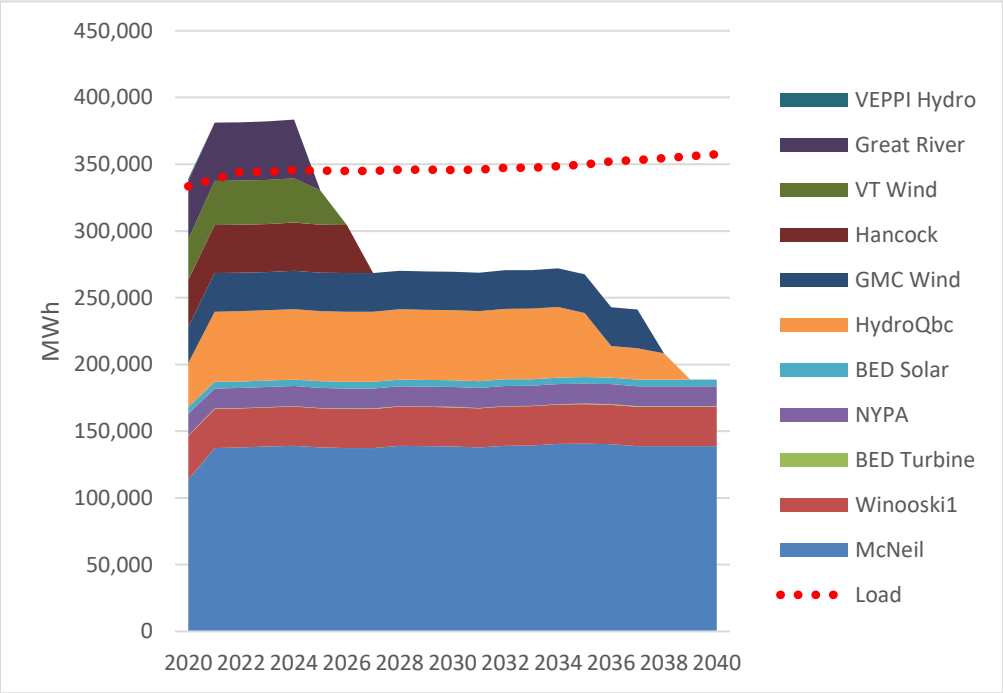
	2019	2024	2029	2034	2039	CAGR
Residential	81,171	82,702	87,053	95,864	107,315	1.4%
Commercial & Industrial	246,572	252,147	248,226	242,255	238,453	-0.2%
Street Lighting	2,160	1,976	1,792	1,608	1,424	-2.1%
Losses & Co. Use	6,499	6,675	6,622	6,518	6,475	0.0%
Total Energy Use (MWh)	336,402	343,500	343,693	346,245	353,667	0.3%
Peak Demand (MW)	64.5	65.4	65.4	65.4	66.0	0.1%

Generation & Supply Alternatives: Under base case assumptions, BED anticipates that its need for energy will exceed existing owned and contracted energy resources by 2025 even absent NZE activities due to contract expirations rather than load growth. Prior to 2025 BED possesses sufficient renewable energy to meet or exceed its BAU load projections. BED will need to supplement its energy resources through new power agreements beginning in 2025 to retain its 100% renewability. Absent such action, purchase of energy in the spot market would occur "automatically" but would not represent renewable energy. As illustrated in Figure 4, the

[7] Docket 17 – 0368, Order of 11/15/2017, at 9.

energy gap results from expiration of the Great River hydro contract in 2024. Extensions of existing contracts are a distinct possibility.

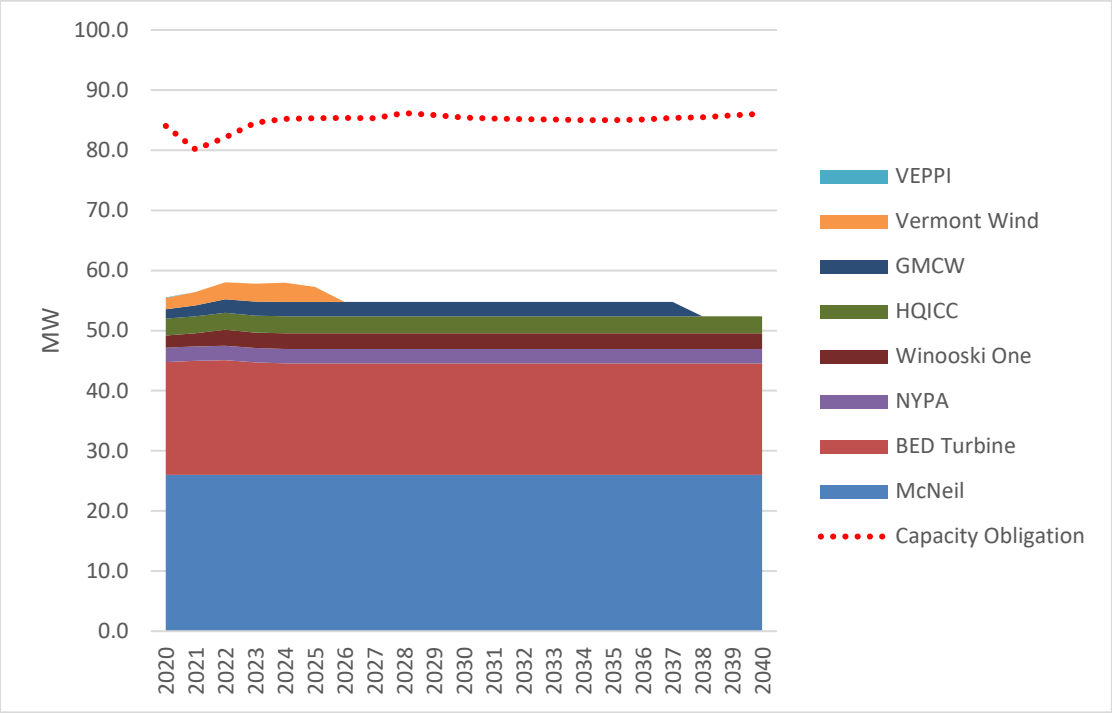
Figure 4: Forecasted Load v. Projected Supply Resources as of July 2020



Presently, BED either controls or contracts for capacity resources that are sufficient to satisfy approximately two-thirds of its capacity obligation, inclusive of the 15% reliability margin imposed on all distribution utilities by ISO-NE. Of the resources that BED controls, two facilities provide most of our capacity resource. These include BED's 25 MW share of the 50 MW McNeil Generating Station and BED's own 25 MW gas turbine.

As shown in Figure 5, BED's capacity obligation is 80.1 MW today but grows slightly to about 85 MW over the next several years. Thereafter, our capacity obligation is expected to remain relatively flat for the foreseeable future, unless customer adoption of beneficial electrification measures exceeds current expectations. BED's capacity position is similar to that of many Vermont distribution utilities and we anticipate the capacity shortfall will persist. Potential means of addressing this shortfall include contracting for energy that includes the associated capacity, building of another traditional peaking facility like BED's existing gas turbine, or, perhaps most promisingly, exploring the potential for capacity provided by battery storage technologies.

Figure 5: BED Projected Capacity Position as of July 2020



Transmission & Distribution: BED is committed to providing the highest system reliability, power quality, and system efficiency to its customers, and has excellent performance in this respect. This commitment is backed up by ongoing investments in distribution upgrades and process improvements to ensure maintenance of BED's high quality of service.

Similar to other utilities, BED tracks power interruptions and outages. An interruption of power is considered an "outage" when an event exceeds five minutes. BED's system reliability is measured by the system average interruption frequency index ("SAIFI") and customer average interruption duration index ("CAIDI"), pursuant to Commission Rule 4.900. Each year, BED analyzes outage information on the City's distribution circuits, identifies the worst performing circuits, and then updates the distribution action plan accordingly to improve service performance across the system.

In 2019, the SAIFI measured 1.03 interruptions per customer, significantly better than the service quality and reliability target performance of 2.1 interruptions per customer. The CAIDI in 2019 amounted to 0.75 hours, well below the target performance of 1.2 hours. Figures 6 and 7 below provide an historical account of BED's record for meeting the above performance measures. BED's system energy losses are extremely low as well, at just 1.8 percent on average. These metrics (reliability and system losses) are generally superior to those of any other Vermont utilities.

Figure 6: BED Historical SAIFI Values

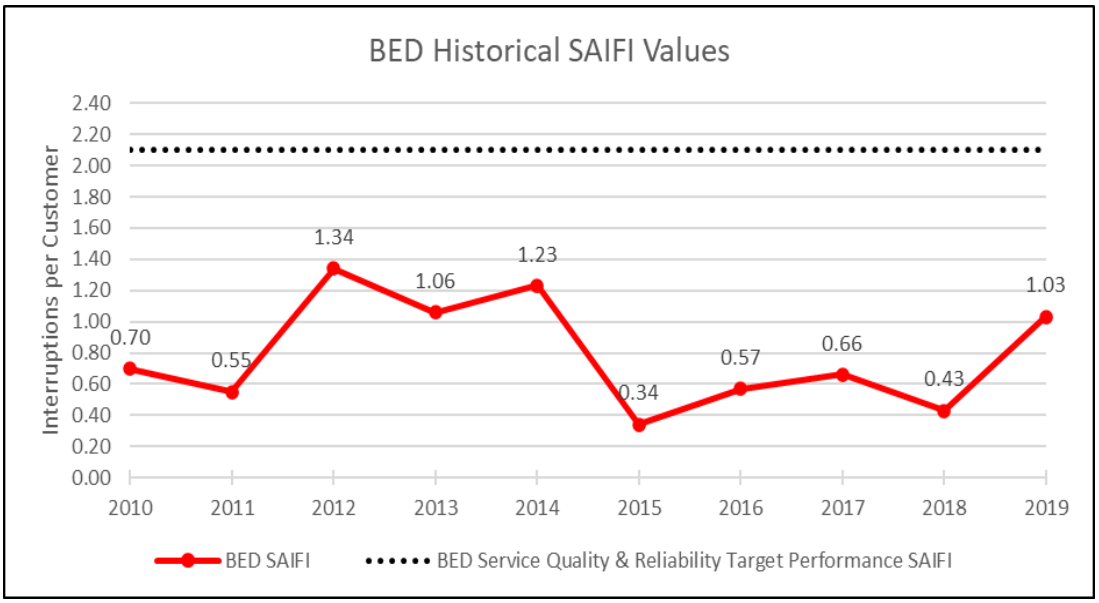
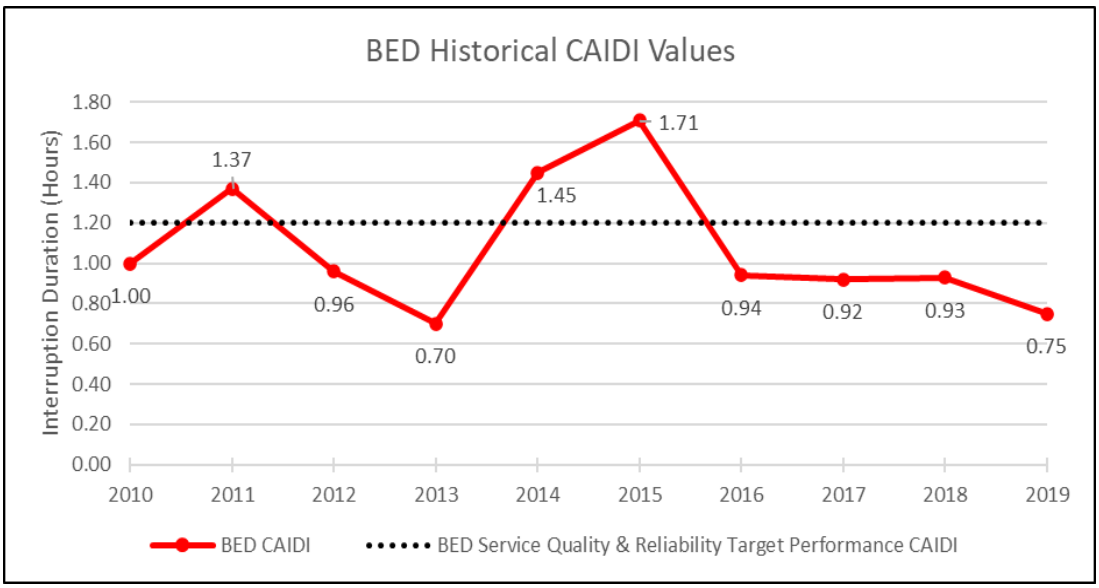


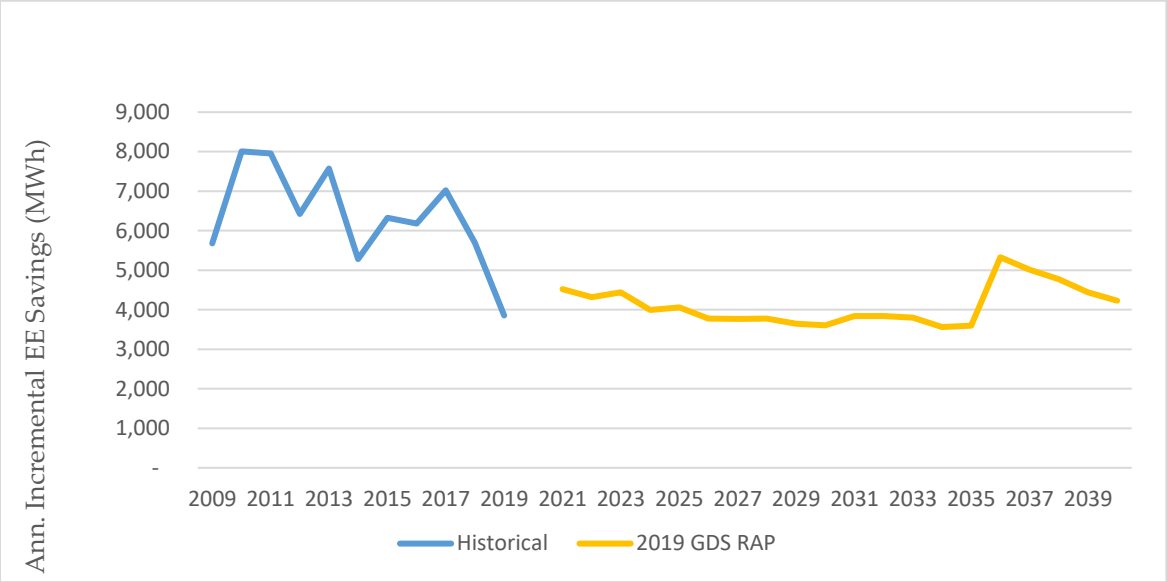
Figure 7: BED Historical CAIDI Values



Comprehensive Energy Services: To effectively address the energy needs of our customers, BED combines traditional electric energy efficiency with beneficial electrification services in a comprehensive, customer-centric manner. BED is unique in this respect as the only electric utility in Vermont that is also an efficiency utility, which has multiple beneficial effects such as lowering the cost of traditional electric savings by spreading delivery costs over additional services, reducing greenhouse gas emissions while lowering customer's energy bills, and improving grid utilization as customers begin to consume electricity during off-peak times by managing the load impacts of strategic electrification.

Assuming the Commission adopts our 2021–2023 demand resource plan, BED expects that its electric efficiency programs will reduce loads by roughly 4,000 MWh annually, as shown in Figure 8. The expected levelized cost of such savings should range between $0.04 and $0.06 per kWh.

Figure 8: Electric Energy Efficiency Historical vs. Forecasted Portfolio-Wide



On the other hand, beneficial electrification programs may increase electrical loads if new technologies are adopted in significant numbers, thereby potentially offsetting much of the forecasted savings. Under the base case scenario, however, BED does not expect adoption of such technologies to materially increase load in the near future. BED plans to provide incentives on a number of transportation and building technologies under its Tier 3 programs that will likely increase loads by 981 MWh, assuming all of the planned technologies are actually adopted by customers.

Financial Assessment and Potential Rate Pressures: This chapter discusses the pressures that could cause BED's to need to increase rates over time, represented in a graphical depiction of possible rate changes over time in terms of the average cost per KWh delivered to customers. This method of looking at cost pressures has the merit of recognizing that cost increases that are accompanied by increases in sales and thus revenue may actually reduce pressure on the need to increase rates.

BED's base case scenario does reflect an ongoing pressure to increase rates over time, however. This is not surprising as all organizations are exposed to cost increases from inflation. Although BED's cost-controlling measures and energy portfolio (which is not seriously exposed to fuel price changes) have allowed BED to avoid raising electric rates since 2009, at some point unavoidable pressures will cause the need to adjust rates. Establishing this base metric on

pressure to increase rates allows BED to evaluate whether future decisions tend to increase or decrease this pressure, as well as to understand which variables that may be out of BED's control in whole or in part are most important to monitor and track ("key variables").

The Financial Assessment chapter also discusses BED's activities related to BED's rates for electric service, which are focused on rate modifications to support Burlington's NZE goals and to reduce or remove disincentives to efficiently use electricity for heating and transportation.

Decision Processes: This chapter outlines how BED reviews decisions in an IRP context. It is important to understand that BED does not attempt to use IRP decision methodology for all organizational decisions. Use of the level of rigor discussed in the Decision Processes chapter is particularly warranted when:

1. The decision is of a large magnitude
2. The decision is subject to significant uncertainty
3. Alternate competing options (including doing nothing) are viable

The IRP filing is an illustration of a utility decision-making process, and the basis for those decisions over the time before the next IRP (three years by statute). The evaluation period in an IRP is longer than three years to allow consideration of utility decisions that typically have long term impacts, and to make sure that current decisions do not have adverse impact or are not driven solely by short-term considerations, but it must also be remembered that where decisions will not be made for more than three years, another IRP will have been prepared and filed. In fact, if an IRP is approved by the Commission, all that is approved is the decision-making process. Any decisions discussed or contemplated in the context of an IRP still need to receive normal approvals.

BED has discussed above that its resource position is generally sufficient for energy through 2025. BED's capacity position is not well covered, but capacity prices are known though May 2024, and are falling through that period to extremely low levels. For the next several years BED believes its most important decisions will relate to climate change and will occur outside BED's direct control. Accordingly, BED has not evaluated a specific course of action that it will be taking in the near future but has instead provided a detailed consideration of the most interesting emerging technology (battery storage) that could meet BED's capacity needs effectively. BED believes that the IRP, along with this sample decision evaluation, will provide the Commission with the basis to approve BED's IRP.

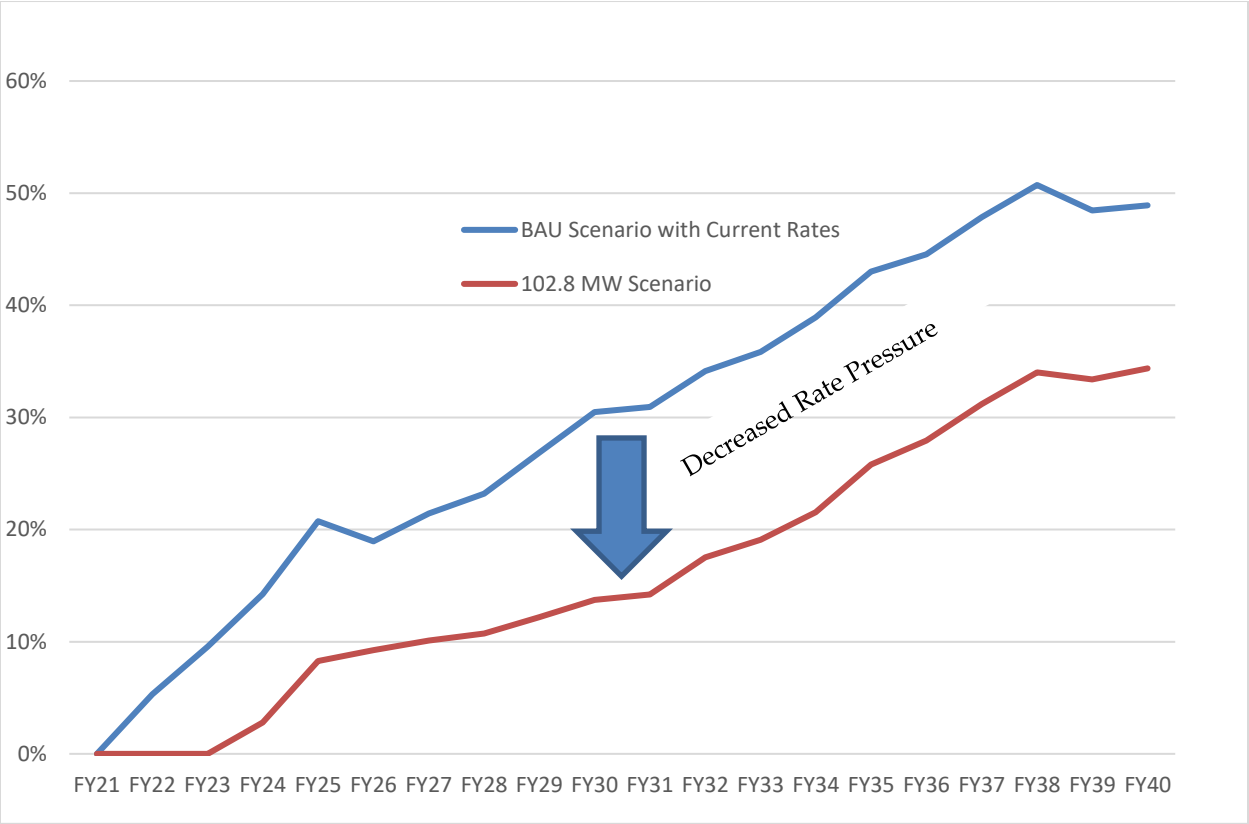
Net Zero Energy Roadmap Implications: As a part of its research into the benefits and costs of attaining NZE status by 2030, BED established a process for evaluating the incremental cost of service and associated revenues as more beneficial electrification technologies are deployed in

Burlington. Given the complexity of the engineering work involved in estimating the demands on the system of the full impact of the Roadmap (which is being performed), BED has evaluated the impacts of earlier stages of the Roadmap. For the purposes of the IRP, BED evaluated a load level of 102.8 MW from the Roadmap, along with the changes in load shape associated with that level of strategic electrification. A load of 102.8 MW was selected as being sufficiently large to require material upgrades to BED's system, but to be able to be evaluated in the time granted by the Commission in extending BED's IRP due date.

This process led to the conclusion that growth in winter peak demand to 102.8 MW (associated primarily with prospective heat pump installations) will require material upgrades and additions to BED's distribution system. Capital costs associated with these upgrades/additions are anticipated to be on the order of $19 to $24 million.

Although those capital upgrades would increase annual distribution costs ($1.8MM to $2.0MM) and the load that caused the need for those upgrades will add incremental power supply costs ($8MM to $10MM), so too would they add incremental revenue for BED related to the new load ($13MM - $14MM). Thus, working toward the NZE goal would likely lower rate pressure over time as beneficial electrification technologies are adopted (at least to the 102.8 MW load level). It is also noteworthy that alternative compliance payments, or their equivalent (i.e., customer incentives) that are used by BED to comply with Tier 3 of the renewable energy standard have not been included in this analysis as such costs are considered to be existing regulatory costs.

Figure 9: Rate Pressure by Scenario



In order to evaluate the impacts of providing service above the 102.8 MW, BED will need to perform additional distribution upgrades to ensure service reliability. The costs associated with such upgrades are currently expected to be significant. BED is evaluating the engineering requirements of the full Roadmap upgrades but conducting a full engineering study of the distribution upgrades needed to serve up to 140 MW of peak demand will take additional time.

BED believes that the current pace of electric technology adoption will not materially affect the cost of service over the next three to four years unless changes are made in the policies, rules, and laws surrounding heating and transportation. BED will monitor the rate of technology adoption and the effects in terms of loads, if any, to determine when additional investments will be needed to ensure continued reliable service.

Planning Priorities & Action Steps: The table below summarizes the priority actions that BED will take in the next several years, in accordance with our strategic plan:

Table 3: Action Steps

Functional Area	*Priority Actions*
Distribution & Operations	Continue capital replacement an improvement activities in support of system reliability and efficiency. Monitor customer adoption of beneficial electrification technologies in order to determine whether peak demand is increasing faster than our base case scenario assumptions and examine whether such adoption is affecting load shapes in the city.
Generation	Maintain and/or improve reliability of existing generating assets. Investigate opportunities to improve the efficiency and value of our generating resources.
Power Supply & Planning	Maintain 100% renewability Seek options to renew or extend existing renewable energy contracts at favorable prices Monitor the evolving market for storage for opportunities to deploy storage cost effectively Continue to monitor/participate in changes in tariffs and market rules that would impact the value of BED's resources Continue program design of new Tier 3 programs in support of NZE and to ensure equitable access to electrification programs for all customers.
Energy Services	Encourage and support customer participation in incentive and energy efficiency programs. This responsibility extends beyond traditional electric efficiency services and includes technical assistance and incentives for beneficial electrification measures (i.e. EVs, heat pumps, e-bikes etc.)
Customer Care/ Engagement	Provide service to customers that surpasses their expectations for meeting their energy related questions and needs.
Finance & Rates	Continue to closely monitor our financial performance and take any actions necessary to maintain our exemplar credit rating. Make additional improvements to the long-range financial forecast to better inform planning and decision making.

	Continue to research the feasibility of implementing additional innovative rate design practices, such as extending our residential EV rate to commercial customers, creating a new end use rate for cold climate heat pumps and revising our existing small general rate structure.
Information Services	Complete conversion of BED's core utility and business information systems Establish a new data center Enhance cybersecurity capabilities
Safety, Risk Management, and Facilities	Continued investment in BED equipment and facilities in support of NZE Support R&D efforts that relate to BED facilities Participate in the risk assessment related to pilot projects and devices
Net Zero Energy	Advance the City's NZE goal by working collaboratively with City and State officials and other stakeholders to establish effective supporting policies and regulations.