Chapter 1 - Analysis Methodology

Background

The 2016 IRP was developed during a period of fundamental transition in the electric utility industry, in Vermont, and at the Burlington Electric Department. BED's previous IRP was completed in September 2012. As with other prior IRPs, the 2012 IRP's primary considerations were somewhat typical utility resource issues, such as energy resource choices, energy efficiency programs, capacity supply options, and levels of renewability. However, since 2012, there have been several significant developments that suggested a new focus for the 2016 IRP was needed. Among the most notable changes since 2012 are the deployment of smart meters throughout the BED service territory, passage Vermont's Renewable Energy Standard (RES), and an update to Vermont's Comprehensive Energy Plan.

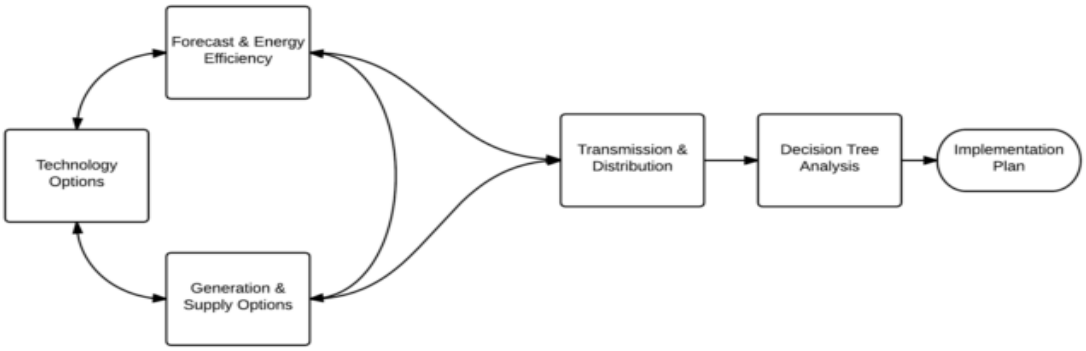
Concurrent with the regulatory, statutory, and industry changes that have affected distribution utilities, several advancements in electro-technologies could also impact BED's energy needs and future business practices. BED believes increasingly viable and available technology options, which could increase, decrease, or shift load, require a new level of analysis. The technology options, when combined with generation and supply options and other key utility questions, could lead to a vast number of possible outcomes. Therefore, to create a manageable and meaningful IRP analysis that effectively captures these dynamic circumstances, BED developed a methodology and approach for the 2016 IRP, described below.

To help staff develop an IRP that will enable BED to accomplish its goals, the Burlington Electric Commission appointed a four-member IRP Committee consisting of two Electric Commission members and two Burlington residents. Over a period of more than 12 months (from November 2015 to January 2017), the IRP Committee assisted with the design and implementation the new analysis methodology, offered important information on local priorities, and provided valuable feedback at each stage of the IRP development process. In addition, BED staff attended all of the Neighborhood Planning Association meetings early in the process (October to December 2015) to discuss the IRP in those forums. Finally, BED staff has had numerous discussions and meetings with Department of Public Service staff during the IRP process to keep them up-to-date and solicit their feedback.

Analysis Methodology Overview

The flow chart below illustrates the major components of BED's 2016 IRP, the general order in which topics were evaluated, and the interaction between them. The brief descriptions of each

component below are further supplemented with a more robust discussion within each topic's individual chapter.



Technology Options

The development of new technologies and the RES-led advancement of distributed generation and energy transformation projects have the potential to introduce variations into BED's energy and peak demand forecasts. To focus the IRP load forecasting and subsequent analyses on plausible alternatives, BED began with an analysis of the technologies to identify those that were reasonable to incorporate into future sections of the IRP. Essentially, a "mini model" was developed for each technology at the beginning of the IRP process in order to understand whether any technologies fundamentally did not make sense from an economic or societal perspective. Each technology was tested for its sensitivity to variables, which impacted each technology's value and/or cost to BED, its customers, and society. The results of the mini-model analysis provided BED with an understanding of the potential value streams and costs for each technology, which were the basis for determining whether the technology moved forward in the IRP analysis. However, even for technologies that were not incorporated into BEDs decision making processes at this time, BED acquired useful insight for future use. The technologies for which a "mini-model" analysis was completed are:

- Electric Vehicles
  - Personal Automobiles
  - Transit Buses
- Advanced Heat Pump technologies
- Solar PV
  - Residential Scale - Behind the Customer Meter
  - Utility Scale - Behind the Utility Meter
- Battery Storage
  - Residential Scale – Behind the Customer Meter
  - Utility Scale – Behind the Utility Meter
- Passivhaus (New Construction)

The technology option analysis was the genesis of BED's filed Tier III plan, and also provided for modifications to the load forecast based on this plan. The load forecast, modified for Tier III technology impacts, was used for subsequent resource and decision tree evaluations.

Load Forecasts

Burlington Electric Department's 2016 Long Range Forecast, which provides input to the planning of future resources, focuses in part on the forecasted total annual consumption of electric energy. This is referred to as the base case system energy forecast and is expressed in terms of kilowatt-hours (kWh), megawatt-hours (MWh), or Gigawatt-hours (GWh). It is made up of forecasts of sales to consumers, company use, and associated distribution and transmission losses, which together make up the electrical energy requirements that must be supplied by generating plants to meet customer needs.

BED's projected load requirements also consider the expected maximum rate of use of electricity (also referred to as peak demand), measured in kilowatts (kW) or megawatts (MW). Peak demand, or peak load, in this context, is the highest one-hour average power requirement placed on the system. In order to reliably serve customers, BED must have sufficient resources to meet the peak hour demand. This is a key input into assessing BED's future capacity needs.

The technology mini model process provided important data about the potential load impact of each technology. For those technologies deemed viable at this time and included in BED's filed Tier III plan, BED developed projected deployment rates within its service area and used that information to adjust BED's base case load forecast. Depending on the combination of technologies adopted by customers, the system load impact ranges from net increases in load to net decreases in load. As part of the assessment of BED's Transmission & Distribution system as well as the energy and capacity needs considered in the Generation & Supply chapter, BED considered whether there were any significant load impacts due to the adoption of the technology options.

Generation & Supply Options

The evaluation of potential generation and supply options begins with an analysis of any gaps between BED's existing resource mix and the projected energy and peak demand forecasts. By completing the base load forecast, technology analysis, and load forecasts in advance of considering generation and supply options, BED gained insight into the range of potential energy and capacity needs over the IRP time horizon and the type and magnitude of additional resources needed. Included in the generation and supply options analysis is consideration of potential in-city generation, which would then be incorporated into local distribution analysis in the Transmission & Distribution chapter.

Transmission & Distribution Analysis

The technology mini-models and the load forecasting process provide key inputs into understanding future needed upgrades to BED's transmission and distribution systems. By paring down the technology variables that were used to develop the load forecasts to those that are viable at this time, the transmission and distribution analysis could be more focused and tied to a smaller range of probable outcomes. The cost of transmission and distribution infrastructure projects that could be avoided or caused by a technology option will impact its value stream and viability, so there is an iterative quality to the analysis.

Decision Tree Analysis & Selection of the preferred pathway

The decision tree analysis bring together the key questions facing BED over the IRP time horizon, the technology options deemed currently viable, and the identified feasible generation and supply options. The 2016 IRP key questions are: 1) How can BED best take advantage of its renewable portfolio (REC sales), 2) What resource (energy or capacity) actions does BED need to take, and 3) What is the best approach to meet the Renewable Energy Standard Tier 3 requirements? The results of the decision tree analysis, along with the financial analysis, will provide information for the IRP Committee and staff to develop a set of recommendations that ultimately lead to the selection of a preferred path.

Financial Analysis

The financial analysis is intended to provide a high level sense of the financial and rate impacts of the various scenarios. The financial analysis provides key information used in the development of the preferred path and could require specific tasks be added to the Implementation Plan. The financial analysis is a component of the decision tree analysis and includes estimated cost of service and rate trajectories for modeled paths.

Implementation Plan

Unchanged from earlier IRPs, the final section of the IRP is the development of an Implementation Plan. The Implementation Plan sets specific and measurable targets intended to help BED actively move towards the identified preferred path. As noted in the executive summary, the steps contained in the implementation plan do not represent a commitment to undertake those actions nor a request for approval of those actions. Most (perhaps all) courses of action contained in the implementation plan will need to be brought forward for appropriate approvals before actual commitments are entered. For example, tariff changes require approval of the Burlington Electric Commission, Burlington Board of Finance, Burlington City Council, and must be filed with, and approved by, the Vermont Public Service Board.