

**Northfield Electric Department
Integrated Resource Plan
2015 - 2034**

Part 1 – Utility Overview

Presented to the Vermont Public Service Board

July 17, 2015

**Submitted by:
Vermont Public Power Supply Authority**

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1. Overview

The Northfield Electric Department (“NED”) serves customers in Northfield, Berlin, and Moretown. Northfield is located in central Vermont and is home to Norwich University. The NED was incorporated in 1894. NED has no internal generation of its own, but relies on unit entitlements and power contracts to match its retail load obligations.

NED served 2,231 customers in 2013; the system is a mix of residential and commercial loads. Norwich University accounts for approximately 28% of the system load. The breakdown of 2013 sales by class is as follows:

Table 1-1: 2013 Retail Sales by Class

Class	Annual kWh	%
Residential sales (440)	10,653,940	36.3%
Norwich University	8,341,225	28.4%
Small commercial and industrial sales (442) 1000 Kw or less	2,262,253	7.7%
Large commercial and industrial sales (442) above 1,000 Kw	5,877,770	20.0%
Public street and highway lighting (444)	167,603	0.6%
Other sales to public authorities (445)	1,988,222	6.8%
Interdepartmental sales (448)	42,575	0.1%
Total	29,333,588	100%

In 2013, NED’s system Real-Time Load Obligation (RTLO) totaled 31,327,420 kWh; it has increased from an annual RTLO of 29,851,697 kWh in 2004. NED’s historic system peak RTLO of 5,478 kW occurred in December 2009. The system had a peak RTLO in 2013 of 5,334 kW and an annual system load factor of 67.0%.

2. Load Forecast

The NED load forecast is prepared by Vermont Public Power Supply Authority (“VPPSA”), and VPPSA’s methodology is described in detail in the Model section of the IRP. The results of the NED annual load forecast for peaks and energy are as follows:

Table 2-1: Load Forecast

<i>Utility's Name:</i>	Northfield			
<i>Utility ID (1):</i>	NOR	Sub-	On-Peak	
<i>VPPSA Member?</i>	VPPSA	transmission	Energy	
PEAK DEMAND	ENERGY	LOSSES	Utilization	
(kW)	(kWh)	(%)	(%)	
2015	5,204.0	31,271,512	2.94%	54.07%
2016	5,364.0	31,354,515	2.94%	54.09%
2017	5,453.0	31,265,148	2.94%	54.24%
2018	5,490.0	31,280,386	2.94%	53.94%
2019	5,347.0	31,287,782	2.94%	53.86%
2020	5,325.0	31,407,562	2.94%	54.07%
2021	5,304.0	31,346,314	2.94%	54.06%
2022	5,509.0	31,334,862	2.94%	54.36%
2023	5,556.0	31,316,278	2.94%	54.32%
2024	5,408.0	31,411,161	2.94%	54.16%
2025	5,410.0	31,316,278	2.94%	53.97%
2026	5,391.0	31,335,623	2.94%	54.22%
2027	5,403.0	31,354,967	2.94%	54.17%
2028	5,608.0	31,391,817	2.94%	54.33%
2029	5,674.0	31,316,278	2.94%	54.36%
2030	5,531.0	31,316,278	2.94%	54.06%
2031	5,508.0	31,316,278	2.94%	54.18%
2032	5,490.0	31,449,849	2.94%	54.15%
2033	5,691.0	31,335,623	2.94%	54.09%
2034	5,737.0	31,316,278	2.94%	54.34%

3. Supply Resources

VPPSA

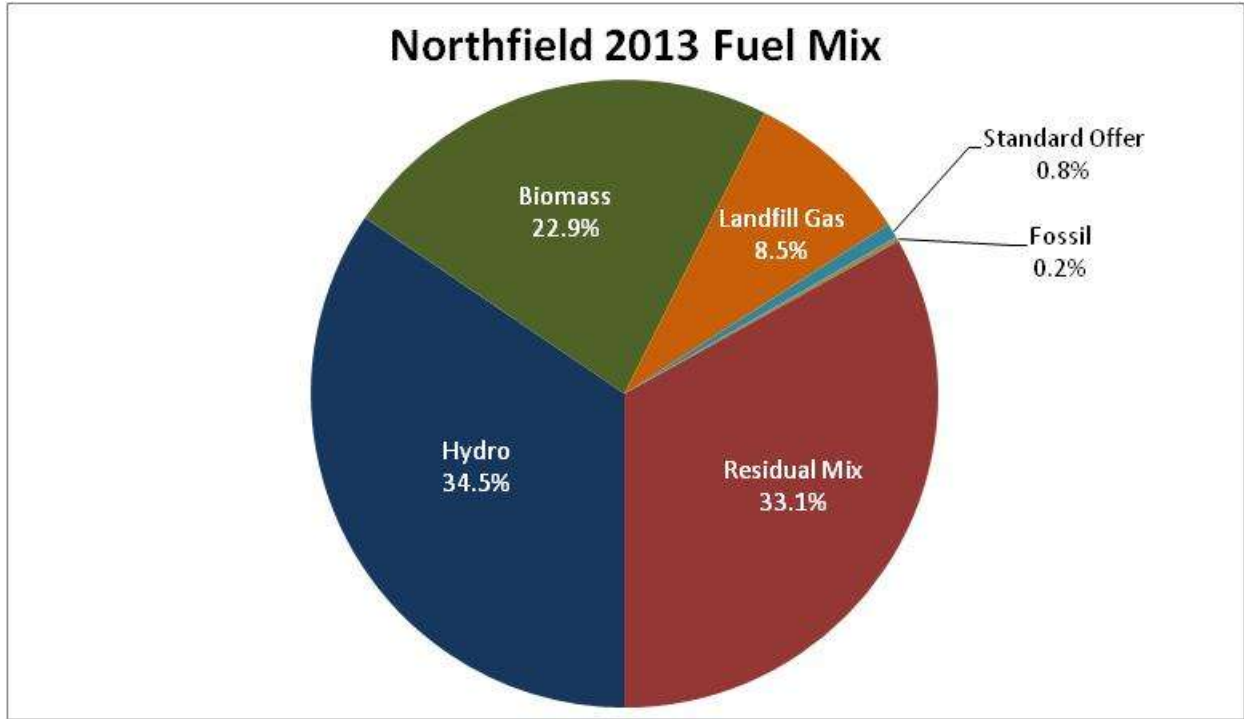
VPPSA is a private authority (and body politic and corporate) of the State of Vermont empowered under 30 VSA, Chapter 84 with broad authority to contract to buy and sell wholesale power and other market products within Vermont and wholesale and retail power outside Vermont, as well as to issue tax-free debt on behalf of municipal and cooperative electric utilities within Vermont. VPPSA presently has twelve Vermont municipal electric utility members, and each member system holds a seat on VPPSA's Board of Directors in accordance with the VPPSA statute. VPPSA has broad authority to provide such services as may be required in support of the activities of its member municipal utilities. As part of these activities VPPSA provides the following portfolio management services to NED.

NED is a signatory to a broad Master Supply Agreement with VPPSA. Under this Agreement and the broad statutory authority of VPPSA, NED's assets are pooled with the assets of other VPPSA members under VPPSA's Independent System Operator – New England ("ISO-NE") identification number. This allows VPPSA to administer NED's loads in the New England power markets operated by ISO-NE, rather than requiring NED to devote the staff and time to do so itself. Under the relevant VPPSA agreements and protocols, NED has given VPPSA the authority to make short term (generally daily to several month but in all cases no longer than one year) purchases on NED's behalf.

3.1. ***Current Resources***

NED's power supply portfolio is made up of generation resources, long-term contracts, and short-term contracts. The diversified portfolio acts as a means to financially hedge the cost of serving load at the Vermont Zone in the ISO-NE market system. NED's 2013 fuel mix is summarized in the following chart. Additional information is provided in the table that follows. A brief description of each resource concludes this section.

Figure 3-1: Northfield Electric Department 2013 Portfolio*



* Prior to sale of any renewable attributes. Residual Mix are market contracts without a known fuel source.

Table 3-2: Northfield Electric Department 2013 Power Supply Resource Summary

Resource	2013 Max Qualified Capacity	2013 kWh	Type	Description	Fuel	Location	Expiration
J.C. McNeil	1,070	6,342,043	On Peak	Wood Unit	Wood	Essex Node	Life of Unit
NYPA	266	1,592,162	ATC	Block Power	Hydro	Roseton Interface	Varies
VEPPI	87	754,821	Varies	PURPA Units	Wood/Hydro	Various VT nodes	Varies
Hydro Quebec	1,512	8,459,280	Dispatchable	Dispatched	Hydro	HQHighgate120	2012 - 2038
Fitchburg Landfill	367	2,677,932	ATC	Landfill Gas	Landfill Gas	Ashbrnhm115	2026 (extendable to 2031)
P10	5,735	73,044	Peaker	Dispatched	Fuel Oil	UN.HIGHGATE1 3.8SWC1	Life of Unit
Standard Offer	5	35,856	Varies	In-State Renewable	Various Renewable	Varies	Varies
Market Contracts	N/A	8,621,397	Daily	ISO-NE bilateral	System Mix	Mass Hub	Varies from 2009-2017

J. C. McNeil

The McNeil wood-fired generating facility is located in Burlington, Vermont. The facility has a maximum generating capability of 54 MW. NED's entitlement to McNeil is provided through an agreement with VPPSA (which owns 19% of McNeil) for the life of the power plant. NED expects the generation to be mostly composed of wood, but natural gas is used periodically as an alternate fuel source and for startup. Oil is also available and is used primarily as a startup fuel.

New York Power Authority (NYPA)

The New York Power Authority provides hydroelectric power to the utilities in Vermont under two contracts. The first contract is a 1 MW entitlement to the Robert Moses Project (a.k.a. "St. Lawrence") located in Massena, New York. The second contract, known as the "Niagara Contract," is for a 14.3 MW entitlement to the Niagara Project located at Niagara Falls, New York. The contract for St. Lawrence has been extended through April 30, 2017. The Niagara Contract has been extended through September 1, 2025.

Vermont Electric Power Producers (VEPP Inc.)

NED receives power from several independent power projects (IPP) through a state mandated arrangement administered by the Rule 4.100 appointed purchasing agent. All current IPP generation resources in Vermont are hydroelectric. Vermont Electric Power Producers (VEPP Inc.) assigns power to all Vermont utilities under Vermont Public Service Board (PSB) Rule 4.100 based on a pro-rata share of electric sales which is updated annually. Contracts between VEPP Inc. and its constituent power producers began to terminate in 2008. The last VEPP Inc. contract is scheduled to end in 2021.

Hydro-Quebec/Vermont Joint Owners' (HQ/VJO) Contract

NED's existing entitlement in the HQ/VJO contract is 1,512 kW. NED's entitlements are broken into multiple schedules and are summarized as follows:

HQ Schedule	Entitlement (kW)	End Date
B	1,198	2015
C3	2	2015

During the term of the contract the VJO were permitted to reduce or increase the annual capacity factor between 70% and 80% on five occasions. Hydro-Quebec was allowed to implement three reductions. The VJO and HQ have utilized all options to increase or decrease allowances of the HQ contract. HQ's permanent annual energy deliveries were set at 75% capacity factor starting with the contract year beginning November 1,

2007, and will stay at that level for the remainder of the contract. Under the terms of the contract monthly capacity factors can range from 25% to 95%. However, in order to comply with ISO-NE's Standard Market Design rules the monthly capacity factor cannot be less than 47%, on average.

In 2010 a new statewide Hydro Quebec contract was negotiated and executed. Energy deliveries are scheduled to phase in slowly as existing schedules expire. NED's entitlements under the new contract are as follows:

Time Period	Entitlement (kW)
Nov 1, 2012 – Oct 31, 2015	18
Nov 1, 2015 – Oct 31, 2016	217
Nov 1, 2016 – Oct 31, 2020	256
Nov 1, 2020 – Oct 31, 2030	256
Nov 1, 2030 – Oct 31, 2035	264
Nov 1, 2035 – Oct 31, 2038	65

Fitchburg Landfill

NED holds an allotment of 10.19% in a contract for the output of a landfill gas-fired generation facility at Fitchburg Landfill in Westminster, MA. Beginning in 2012 the 15 year contract provides nine VPPSA members with 3 MW of firm energy, capacity and renewable attributes for years 1-5, 3MW of firm energy, capacity and renewable attributes plus 1.5MW of unit contingent energy, capacity and renewable attributes for years 6-10, and 4.5MW of unit contingent energy, capacity and renewable attributes for years 11-15. The contract includes an option to extend deliveries for 4.5MW of unit contingent energy for an additional five years (years 16-20).

Project 10

NED held a municipal vote to authorize the execution of a Power Sales Agreement (PSA) with the VPPSA for 12.00% of a 40 MW peaking facility constructed in Swanton, Vermont. Eleven municipal utilities and one Vermont cooperative have signed Purchase Sales Agreements for the project which is 100% owned by VPPSA and which came online in 2010.

The project constructed 46 MW of fast-start generation capacity designed to provide reliability services to the participating municipal utilities at prices below projected New England market prices over the life of the facility. Additionally, the facility runs during peak price times to mitigate price spikes that occur when New England loads reach peak levels in the summer and winter.

Standard Offer

NED receives power from several independent power producers according to the state mandate set forth in the Vermont Energy Act of 2009 (i.e. Act 45) which is administered by the Sustainably Priced Energy Enterprise Development (SPEED) facilitator. The prices paid to developers under Act 45 were initially standardized based on the type of renewable energy technology; however, in April 2013 the SPEED facilitator implemented a price-based Request for Proposals for developers of Standard Offers projects. NED receives a share of all Standard Offer contracts based on its pro rata share of Vermont's prior-year kWh retail sales. The duration of standard offer contracts is permitted to be between 10 and 20 years with the exception of solar, which is permitted to contract for 25 years.

In July 2015, VPPSA was awarded two Standard Offer contracts for two solar projects to be located in Lyndonville, VT. The projects, 475 kW and 500 kW in size, will be included in the Standard Offer provider block. They are expected to come online prior to January 2017 and the generation from these projects will be distributed to the state's utilities in the same manner as the generation from developer projects.

Market Purchases

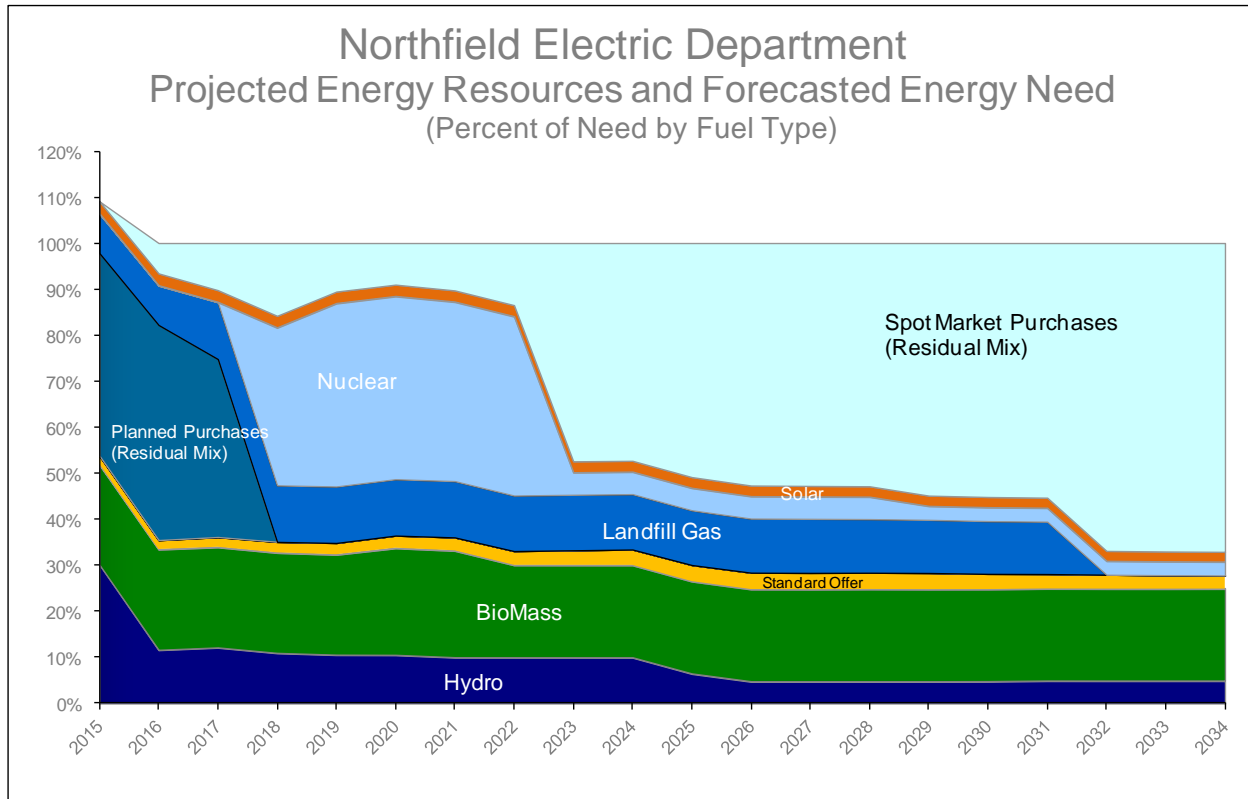
NED meets the remainder of its load obligations through ISO-NE's day-ahead and real-time energy markets, physical bilateral transactions, and financial transactions. NED participates in the wholesale markets based on its forecasted energy requirements. Short-term transactions are made periodically to adjust the portfolio in an effort to match resources to NED's load obligations. Market purchases range in size, duration, and by provider and can be transacted in small amounts. It should be noted that market purchases longer than five years in duration or above certain quantities of historic peak load require Vermont Public Service Board approval.

3.2. Supply Outlook

Energy

Presented below is a graph of projected energy available from existing contracts and resources from 2015 through 2034 as compared with NED's projected energy needs. Energy is the largest component of utility costs at this time. The resources included on the graph are those committed resources as of the time of this report. As supply falls below load, NED will acquire new resources that meet the utility's decision making criteria. It should be noted that a growing gap between these two lines is a normal part of the utility business with expirations of existing contracts occurring over time and a continuing search for economical ways to provide energy.

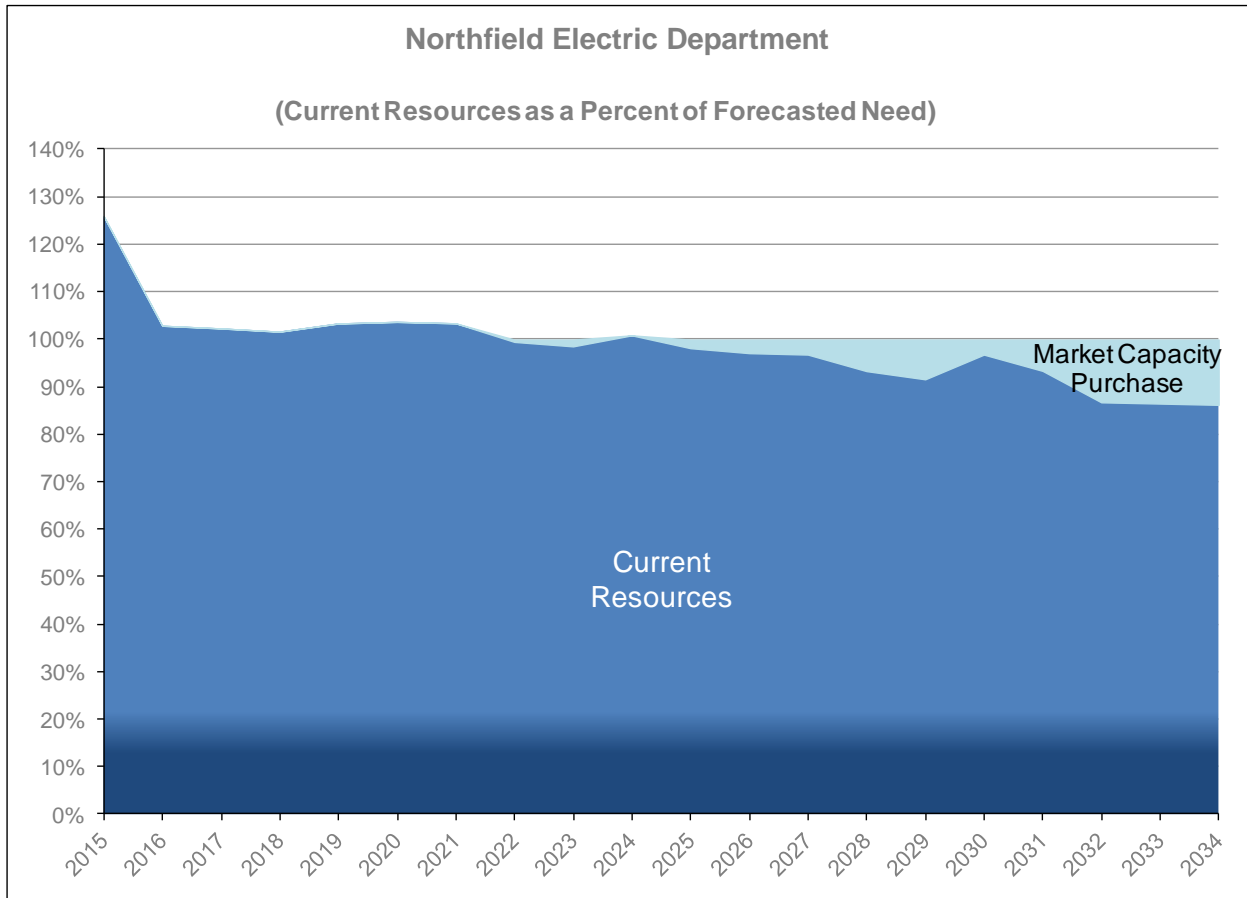
Figure 3-2: Projected Energy Resources and Forecasted Energy Need



Capacity

Also presented is a graph of the forecast of market capacity available from existing resources and a forecast of the utility’s capacity obligations. Capacity is the second largest dimension in utility power costs, and represents the ability to generate electricity when needed (as opposed to energy which is the actual energy generated). In broad terms, capacity is important in providing reliability and avoiding prices spikes during peak demand. The graph below shows the utility’s capacity available from existing resources as compared to its projected capacity need. Similar to energy, the chart shows a gap occurs in the future. NED will acquire resources that meet the utility’s decision making criteria in the future.

Figure 3-3: Capacity Resources and Forecasted Capacity Obligations



3.3. **Supply Options Inventory**

As one of twelve municipal members of VPPSA, NED is afforded ongoing opportunities for inter-utility coordination, coordinated procurement and power pooling.

Near-Term Resource Adequacy – 0-6 Months:

On a regular basis, each VPPSA member’s resources are evaluated against its load individually to determine the need for balancing transactions. VPPSA operates an internal power pool to the extent possible, allowing members to match needs with each other before transacting with the open market. Transactions between members occur at market prices, ensuring that each system is treated equitably, but allowing for the elimination of market-making spreads to which each utility would otherwise be exposed if they acted independently.

Mid-Term Resource Adequacy – 6 Months to 5 Years:

VPPSA employs a planned purchasing program which evaluates members' resource coverage incrementally every six months. While each evaluation does not necessarily result in a recommendation to transact, the periodic nature provides the opportunity for evaluation of conditions impacting each system, and the wider market. Forward transactions made in this manner complement long-term resources already in the portfolio.

Long-Term Resource Adequacy – Greater than 5 Years:

VPPSA maintains an active inventory of long-term resources which includes both existing generation and projects proposed for development. Each resource is evaluated for its economic impact to VPPSA's portfolio, including potential volatility and risks associated with the generation technology and counterparty. Resources meeting VPPSA's goals are offered to members on a pro-rata basis. VPPSA targets resources that diversify NED's exposure and include predictable pricing mechanisms that are not indexed.

Using these procurement methods, VPPSA has secured a significant portion of NED's resource needs over the coming years. Due to the stable pricing mechanisms targeted, NED's exposure to volatility has been minimized. By executing balancing trades among VPPSA's members NED can eliminate some of the associated costs charged by market makers.

At this time VPPSA is targeting the development of approximately 10MW of solar generation within a member territory. As a VPPSA member, NED will be offered a share of any VPPSA generation project. It is anticipated that NED would not initially own any of the facility, instead employing an ownership strategy which maximizes available incentives to reduce total cost to NED's ratepayers. Further, NED anticipates that solar energy is attainable for costs within existing rate structure.

Additional resources with a variety of technology types have historically approached VPPSA and its members seeking long-term purchase-power-agreements. From those interactions it seems most likely that generation developed in the future will be in the form of solar, wind and natural gas. Existing resources employing biomass and natural gas technologies appear to be abundantly available in the future; however, price volatility makes them less suitable for VPPSA's stability goals.