APPENDIX C

Maritimes

The Maritimes Assessment Area is a winter-peaking NPCC subregion that contains two Balancing Authorities. It is comprised of the Canadian provinces of New Brunswick, Nova Scotia, and Prince Edward Island, and the northern portion of Maine, which is radially connected to the New Brunswick power system. The area covers 58,000 square miles, with a total population of 1.9 million people.

Summary of Methods and Assumptions

Reference Margin Level
20%

Load Forecast Method
Coincident; 50/50 forecast

Peak Season
Winter

Planning Considerations for Wind Resources
Estimated capacity is derived from a combination of mandated capacity factors and reliability impacts.

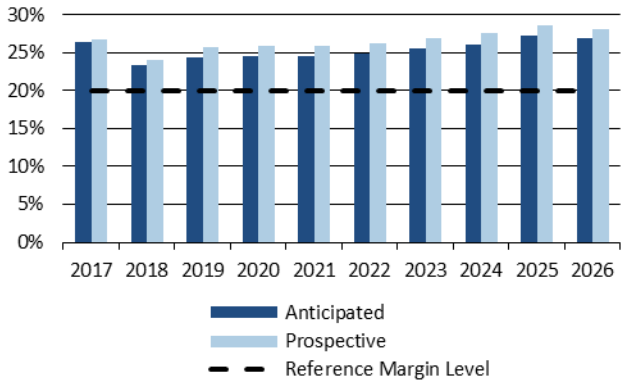
Planning Considerations for Solar Resources
N/A

Footprint Changes
A conceptual tie line to the Canadian province of Newfoundland and Labrador could potentially impact the Maritimes footprint.

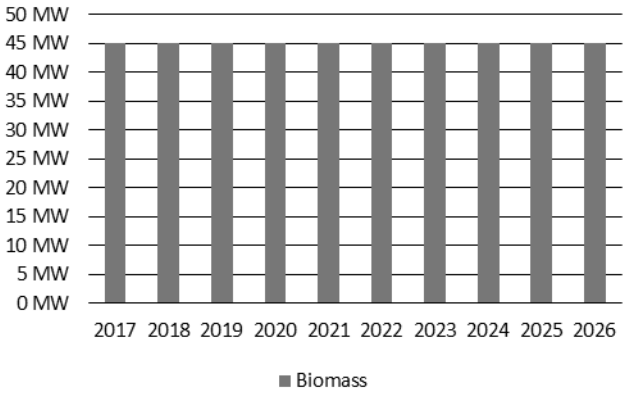
Peak Season Demand, Resources, and Reserve Margins

Demand (MW)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Total Internal Demand	5,584	5,608	5,627	5,623	5,622	5,608	5,580	5,552	5,509	5,518
Demand Response	272	272	272	272	271	271	271	271	271	270
Net Internal Demand	5,312	5,336	5,355	5,351	5,350	5,336	5,309	5,281	5,238	5,248
Resources (MW)	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Anticipated	6,716	6,585	6,661	6,661	6,661	6,661	6,661	6,661	6,661	6,655
Prospective	6,735	6,621	6,735	6,735	6,735	6,735	6,735	6,735	6,735	6,724
Reserve Margins (%)	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Anticipated	26.42%	23.40%	24.37%	24.47%	24.49%	24.82%	25.47%	26.13%	27.16%	26.81%
Prospective	26.79%	24.08%	25.77%	25.87%	25.89%	26.21%	26.88%	27.54%	28.59%	28.13%
Reference Margin Level	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Excess/Shortfall (MW)	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Anticipated	341	181	234	239	240	257	290	324	375	357
Prospective	361	218	309	314	315	332	365	398	450	426

Peak Season Reserve Margins



10-Year On-Peak Generation Anticipated Additions



Probabilistic Assessment Overview

- **General Overview –** The Maritimes Area is a winter peaking area with separate jurisdictions and regulators in New Brunswick, Nova Scotia, Prince Edward Island (PEI), and Northern Maine. The GE MARS model developed by the NPCC CP-8 Working Group was used; modeling demand uncertainty, scheduled outages and deratings, forced outages and deratings, assistance over interconnections with neighboring Planning Coordinator Areas, transmission transfer capabilities, and capacity and/or load relief from available operating procedures, as prescribed by the NPCC resource adequacy criterion (ref: NPCC Regional Reliability Reference Directory No. 1 "*Design and Operation of the Bulk Power System*").[20]
- **Results trending:** The previous study, "*NERC RAS Probabilistic Assessment – NPCC Region*" [21] estimated an annual LOLH = 0.001 hours/year and a corresponding EUE equal to 0.0 (ppm) for the year 2018. The 2018 Forecast 50/50 Peak Demand Forecast is 262 MW greater in this assessment than reported in the previous assessment, reflecting increases in electric heating loads which were not quite offset by declines in industrial loads and demand shifting programs. Forecast Capacity Resources increased by 81 MW in the 2016 Probabilistic Assessment as compared to the previous assessment. No material difference in estimated LOLH and EUE is observed between the two assessments. Increased capacity resources, coupled with reliance on operating procedures and tie benefits contribute to this result.
- **Probabilistic Vs. Deterministic Reserve Margin Results:** The Maritimes Area employs a reserve criterion of 20% of firm load. To relate the Maritimes Area reserve criterion of 20% to the NPCC resource adequacy criterion, LOLE was evaluated with the Maritimes Area firm load scaled so that the reserve was equal to 20%. The results showed that a Maritimes Area reserve of 20% corresponds to an LOLE of approximately 0.086 days per year.
- **Modeling:** Assumptions used in this probabilistic assessment are consistent with those used in "*NPCC 2016 Long Range Adequacy Overview"* and described in the "*2016 NERC RAS Probabilistic Assessment – NPCC Region.*" [22]

[20] See: https://www.npcc.org/Standards/Directories/Directory_1_TFCP_rev_20151001_GJD.pdf
[21] See: https://www.npcc.org/Library/Resource%20Adequacy/2014%20NERC%20RAS%20Probabilistic%20Assessment%20NPCC%20Region%20(March%2031,%202015).pdf
[22] See: https://www.npcc.org/Library/Resource%20Adequacy/Forms/Public%20List.aspx

Base Case Study

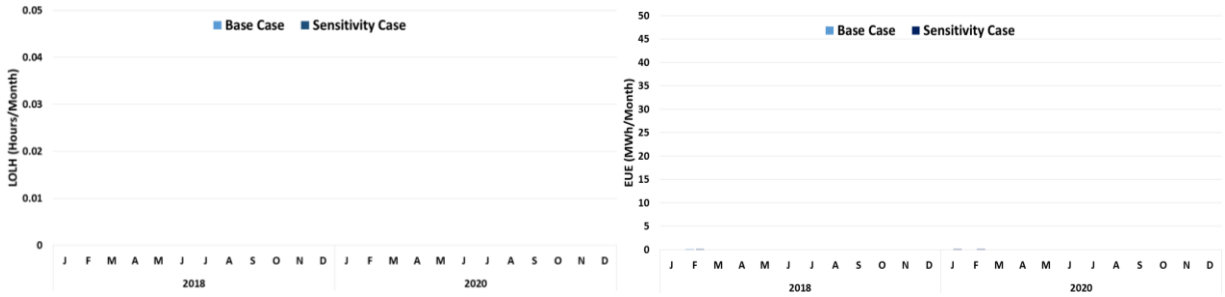
- No significant LOLH is observed. EUE is 0.005 in 2018 and negligible in 2020. Anticipated Reserve Margins are well above 20% in both years. The greatest contribution to the LOLH and EUE occur during the peak (winter) monthly period.

Sensitivity Case Study

- LOLH is also not significant in this case, the EUE values are negligible: 0.03 and 0.004 MWh for 2018 and 2020, respectively. Anticipated Reserve Margins remain above 20% in 2018 and near 20% in 2020.

Summary of Results Reserve Margin (RM) %	Base Case		Sensitivity Case	
	2018	**2020**	**2018**	**2020**
Anticipated	26.42	24.37	23.8	19.4
Prospective	26.79	25.77	-	-
Reference	20.0	20.0	-	-
ProbA Forecast Planning	26.4	24.4	23.8	19.4
ProbA Forecast Operable	20.0	18.1	17.5	13.3

Annual Probabilistic Indices	Base Case		Sensitivity Case	
	2018	**2020**	**2018**	**2020**
EUE (MWh)	0.005	0.000	0.030	0.004
EUE (ppm)	0.000	0.000	0.001	0.000
LOLH (hours/year)	0.000	0.000	0.000	0.000



Summary

The Maritimes Area is comprised of four sub-areas, New Brunswick (NB), Nova Scotia (NS), Prince Edward Island (PEI), and Northern Maine (NM) where a 20% reserve margin target is used. This reserve level correlates closely to the amount of reserve necessary to meet the 0.1 days per year loss of load expectation criterion required by the Northeast Power Coordinating Council (NPCC). The close correlation is confirmed annually during NPCC resource adequacy reviews.

Resources in the Maritimes Area are subject to capacity de-ratings that account for variances in seasons and, in the case of variable generation, the likelihood of the resource being available if called upon. If de-rated resources result in inadequate margins looking forward in time, then new resources must be acquired.

The aggregated load growth for the four combined sub-areas of the Maritimes Area is practically flat for both the summer and winter seasonal peak load periods with average growth rates of 0.2% per year in summer and a decline of 0.13% per year in winter.

Load growth for the southeastern corner of the NB sub-area (including the much smaller PEI sub-area) is not specifically identified in the load projections but has historically outpaced growth in the rest the Maritimes Area. NB Power has added UVLS equipment at 2 new sites and applied temperature compensation to restricting lines to increase transfer capabilities. In addition, Demand Side Management (DSM) programs aimed at reducing and shifting peak demands and potential

imports to NB from NS that may begin after the completion of the HVDC interconnection to the Canadian province of Newfoundland and Labrador could reduce transmission loading in the southeastern NB area. No other reinforcements are planned at this time.

During the 10 year LTRA assessment period in the Maritimes Area, annual amounts for summer peak demand reductions associated with Energy Efficiency programs rise from 7 MW to 92 MW while the annual amounts for winter peak demand reductions rise from 43 MW to 555 MW. Most of this amount is related to intensive demand shifting programs in New Brunswick that will focus mainly on reducing and/or shifting water and space heater demands during peak load periods by using smart metering technology to control their consumption patterns. Interruptible loads are the only specifically forecasted Demand Response programs in the Maritimes Area. During the assessment period, no significant changes from previously reported amounts for interruptible loads are expected to occur.

Nova Scotia is projecting three installed capacity additions, 49 MW of wind, 3.6 MW of solar, and 23 MW of biomass/biogas, by January 2020. In addition, transmission restrictions on a 45 MW formerly energy only biomass generator in Nova Scotia are being removed before January of 2018 and the generator's capacity will then be counted as firm capacity. An unconfirmed retirement of a 153 MW coal-fired unit in Nova Scotia is expected in mid-2020. The capacity will be offset by an expected firm purchase of hydro capacity over the new HVDC link with the Canadian province of Newfoundland and Labrador. Should a delay occur in the introduction of energy from the new hydro capacity, the retirement of the coal unit will be correspondingly delayed?

Renewable Energy Standards (RESs) have led to the development of substantially more wind generation capacity than any other renewable generation type. Reduced frequency response is associated with wind generation and may, with increasing levels in the future, require displacement of wind generation with conventional generation during light load periods. With the significant amount of large scale wind energy currently being balanced on the NB system, the next phase of renewable energy development in NB will focus on smaller scale projects with a particular emphasis on non-intermittent forms of generation, such as wood-based biomass. In NS, the Maritimes Link project will provide renewable hydro resources which may otherwise have been provided by intermittent resources and would have further reduced frequency response capability.

With respect to capacity deratings for renewable variable generation, NB derates wind capacity using a calculated year round equivalent capacity of 20% for the Maritimes Area. NS and PEI derate wind capacity to 12% and 15% of nameplate based on calculated year round equivalent capacities for their respective sub areas. NM derates wind to 26% and 46% of nameplate based on summer and winter seasonal capacity factors respectively.

There are no trends developing for either imports or exports but a long term import contract starting in mid-2020 is expected to offset the unconfirmed retirement of a coal unit in Nova Scotia with replacement hydro capacity over the HVDC cable link to Newfoundland and Labrador. The capacity of the import and the unit retirement are comparable and are planned to coincide in timing so that the overall resource adequacy is unaffected by these changes. This HVDC cable project is currently under construction.

Transmission development in the Maritimes Area during the assessment period includes installation of a 345 kV breaker in series with an existing breaker at NB's Point Lepreau terminal in the spring of 2016 to mitigate contingencies and reduce import restrictions from New England. During the winter of 2016/17, the installation of two undersea 138 kV cable connections, each with a capacity of 200 MVA and a length of 9 miles, will be completed and will increase capacity and improve the ability to withstand transmission contingencies in the area between NB and PEI. A 475 MW High Voltage Direct Current (HVDC) undersea cable link (Maritime Link) between that Newfoundland and Labrador and NS will be installed by early 2018. The Maritime Link could also potentially provide a source for imports from NS into NB that would reduce transmission loading in the southeastern NB area. In addition, during the fall of 2018, a second 345/138 kV

transformer will be added in parallel with an existing unit at the Keswick terminal in NB to mitigate the effects of transformer contingencies at the terminal. No delays are expected for these projects.
No modifications have been made to the Assessment Area's planning assumptions or methods in response to extreme weather events. The hydro-electric power supply system in the Maritimes Area with a capacity of approximately 1330 MW is predominantly run of the river as opposed to storage based. Large quantities of energy cannot be held in reserve to stave off drought conditions. If such conditions occur, the hydro system would still be used to follow load in the area and respond to sudden short term capacity requirements. Thermal units would be used to keep the small storage capability of the hydro systems available only for load following and/or peak supply. The Maritimes Area is not overly reliant on wind capacity to meet resource adequacy requirements. The lack of wind during peaks or very high wind speeds and/or icing conditions that would cause wind farms to suddenly shut down should not affect the dependability of supply to the area as ample spinning reserve is available to cover the loss of the largest base loaded generator in the area. The latter situation is mitigated further by wide geographic dispersal of wind resources across the Area.

The Maritimes Area has a diversified mix of capacity resources fueled by nuclear, oil, coal, natural gas, dual fuel oil/natural gas, hydro, wind (de-rated), biomass, and tie benefits with no one type feeding more than about 26% of the total capacity in the area. There is not a high degree of reliance upon any one type or source of fuel. The Maritimes Area does not anticipate fuel disruptions that pose significant challenges to resource adequacy in the area during the assessment period. This resource diversification also provides flexibility to respond to any future environmental issues such as potential restrictions to greenhouse gas emissions.

The Maritimes Area has begun tracking ramp rate variability trend but does not yet have enough historical years of data for the Area as a whole to identify any trends. Given the essentially flat load growth and small degree of anticipated VER installations, little change in either ramp rates or the Area's resource mix is expected to occur for the duration of the LTRA assessment period. The maximum Net Demand Ramping Variability 1 hour up, 1 hour down, 3 hours up, and 3 hours down values for two historical years of 2014 and 2015 and a future year of 2020 were calculated along with the percentage contributions of Variable Energy Resources versus the loads. The majority of the maximums occurred during the late fall shoulder and winter peak seasons. The Maritimes Area is a winter peaking area. Five minute interval samples were used for these calculations. The values for 2020 were scaled up from the actuals used for 2015. The following table outlines the results of the Maritimes area review. NDRV stands for Net Demand Ramping Variability and VER stands for Variable Energy Resource.

Year	Variable	NDRV (MW)	Date	VER (MW)	Load (MW)	VER/load (%)
2014	1 hour UP	637	Dec. 8, 2014	281	4295	6.5%
2014	1 hour DOWN	-617	Nov. 17, 2014	576	3372	17.1%
2014	3 hours UP	1262	Dec. 5, 2014	415	3622	11.5%
2014	3 hours DOWN	-1072	Nov. 17, 2014	546	3683	14.8%
2015	1 hour UP	606	Feb. 2, 2015	354	4653	7.6%
2015	1 hour DOWN	-416	Dec. 17,2015	485	3546	13.7
2015	3 hours UP	1172	Oct. 28, 2015	417	2702	15.4%
2015	3 hours DOWN	-953	Dec. 17,2015	403	3785	10.6%
2020	1 hour UP	629	Feb. 2, 2020	373	4828	7.7%
2020	1 hour DOWN	-434	Dec. 17,2020	511	3679	13.9%
2020	3 hours UP	1219	Oct. 28, 2020	439	2804	15.7%
2020	3 hours DOWN	-993	Dec. 17,2020	425	3927	10.8%