New England Gas-Electric Focus Group

Gas-Electric Study Phase III:
Natural Gas Infrastructure and Electric Generation: Proposed Solutions for New England

New England States Committee on Electricity

October 18, 2013

New England States Committee on Electricity

New England's Regional State Committee governed by a Board of Managers appointed by each of the New England Governors to represent the collective views of the six New England states on regional electricity matters

- **Focus**: Resource Adequacy, System Planning & Expansion
- **Resources**: 6 full-time staff with diverse disciplines & experience. Consultants, primarily for transmission engineering & independent studies
- **More information**: including all filings & comments at www.nescoe.com

Overview

- **Gas-Electric Study Overview**
- **Phase III Approach**
  - Scenario Analysis
  - Assumptions and Solution Details
- **Phase III Results**
  - Costs and Benefits
  - Black & Veatch Findings
  - Some States Observations

Phase III Study Report, detailed slides, & states' Notice of Issuance available at www.nescoe.com

In the fall of 2013, states will consider the path forward

Black & Veatch Gas-Electric Study: Purpose & Limitations

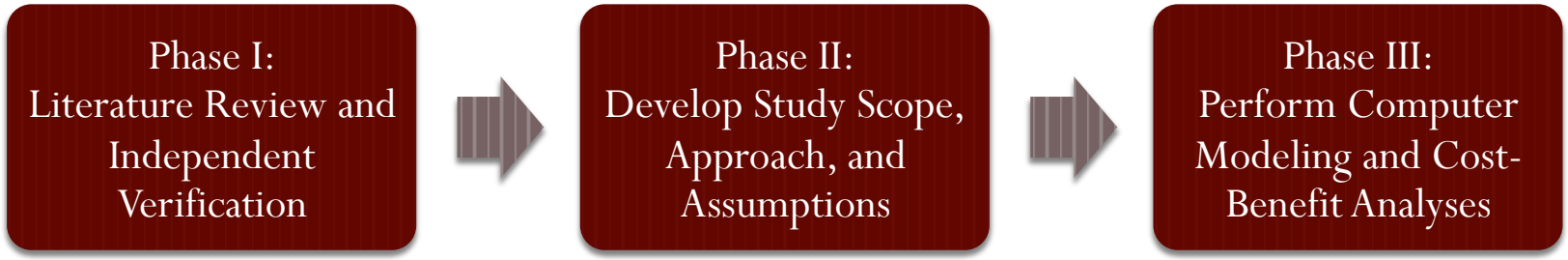
- Assess sufficiency of gas infrastructure to support power generation
- Identify cost-benefit of solutions that could alleviate gas constraint

(Study Period: 2014 - 2029)

Study Limitations

The study is not a plan. It is based on hypothetical assumptions, any one or more of which history may prove wrong. Further, study results are directional and indicative. Studies are not predictions of costs that would emerge in a competitive solicitation, as the result of a negotiation, or that could be identified when a project becomes operational. By assessing different hypothetical futures, the study does not pretend to have perfect foresight. Rather, it assumes policymakers will apply their judgment to the assumptions in each of the hypothetical scenarios studied, and their relation to policymakers' beliefs about of the future. The Gas-Electric Study should be viewed accordingly, and critically.

Gas-Electric Three Phase Study Overview



Phase I: Black & Veatch concluded that the New England natural gas infrastructure will be increasingly under pressure from demand growth from the power sector and that other previous efforts to study the issue had significant information gaps

Phase II, Black & Veatch:

- Concluded that for the 14 New England sub-regions analyzed, 11 will exceed the constraint capacity level by more than 30 days/year under current infrastructure; and
- In consultation with the states, identified scenarios and sensitivities for further analysis

Phase III, Black & Veatch:

- Refined cost estimates associated with potential solutions; and
- Performed computer simulations to estimate benefits of potential solutions, the market price effects of extreme cold weather, and customer cost savings associated with various levels of gas and electricity demand

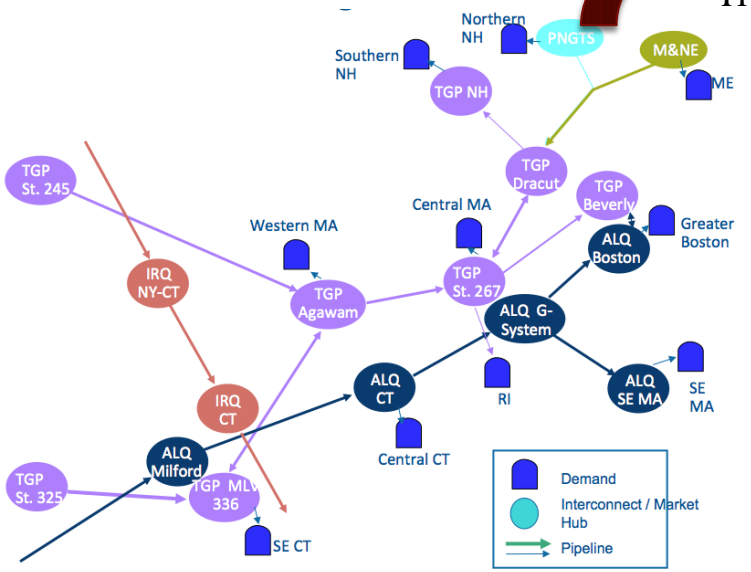
Phase III: Approach

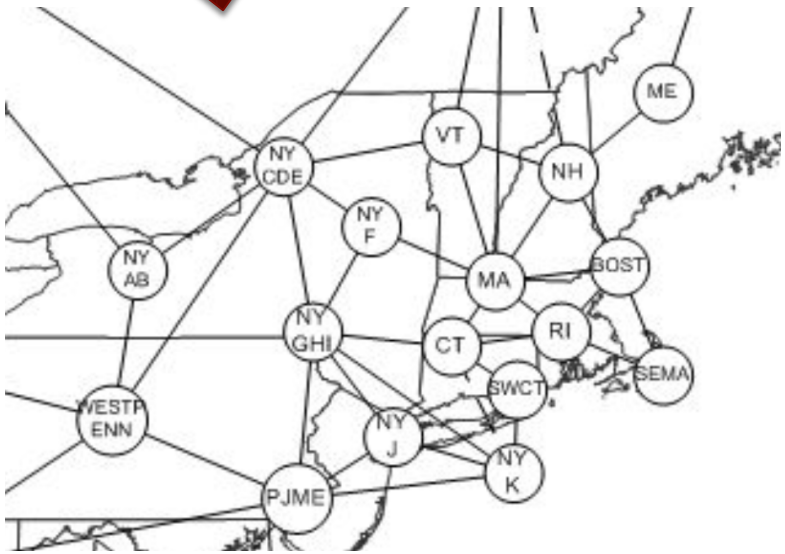
Phase III Methodology

Gas Market - GPCM

Electric Market – PROMOD

Gas Supply and Transportation Prices





Electric Sector Gas Demand

General Approach

- Two gas-sector and two electric sector potential "solutions" to gas pipeline congestion under each scenario
  - Selection and "size" based on anticipated extent and duration of pipeline congestion
    - More Anticipated Congestion ➔ "Larger" Solution
  - High Demand Scenario Exception: testing one less electric-sector solution to enable testing of sensitivity to weather
  - Low Demand Scenario Exception: testing one less gas-sector solution to enable testing of sensitivity to policy escalation

- *Consumer Costs difference between production cost modeling runs* ➔ *Proxy for economic benefits*

Scenario Analysis: Three Possible Futures & Solutions

Base Case

Future with higher gas demand, reduced availability of other power sources

Future with low growth in demand for power & gas

Base Case Scenario 5 Solutions Studied (2, 3, 4a, 4b, 5)	High Demand Scenario 3 Solutions Studied (7, 8, 9)	Low Demand Scenario 3 Solutions Studied (12, 13, 14)
1. No New Infrastructure	6. No New Infrastructure	11. No New Infrastructure
2. Pipeline	7. Pipeline	12. LNG Peak Shaving
3. LNG Import	8. LNG Import	13. Imported Firm Canadian
4. Imported Canadian: a.) Economic* & b.) Firm	9. Imported Firm Canadian	14. Dual Fuel and Demand Response
5. Dual Fuel and Demand Response	10. Weather (Design Day)	15. Negative Demand Growth

*Amount of Canadian imports varies with market prices (economic), rather than a set amount of imports equal to the maximum capacity of infrastructure (firm)

Base Case Solutions: Details and Assumed Costs

	Cross-Regional Pipeline	LNG Imports	Dual Fuel and DR	Economic Imported Energy	Firm Imported Energy
Assumed Cost Components	Annual carrying cost of incremental pipeline	Annual cost of ensuring incremental LNG supply	Out-of-market costs ("uplift") to ensure generator cost recovery	Annual carrying cost of incremental transmission line in the US	Annual carrying costs of: 1. Incremental transmission line in the US 2. Building a new dam
Solution Description	1.2 Bcf/d pipeline into Eastern Massachusetts	4-5 additional cargo ships (~18 Bcf)	2.3 TWh of energy in Jan & Feb, M-F on peak	1200 MW HVDC from HQ to ENE, Economic Dispatch	1200 MW HVDC from HQ to ENE + new dam = 24/7/365

Major Assumptions: Electric Power

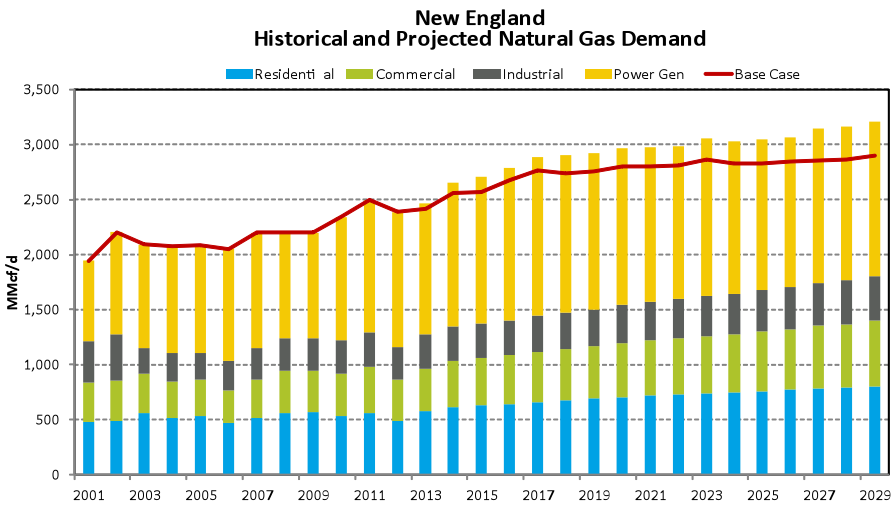
Assumption	Base Case	High Demand	Low Demand
Load Growth	Same as the 2013 ISO-NE Capacity, Energy, Loads and Transmission 2013 – 2022 (CELT)	Same as Base Case	Limited demand growth
Energy Efficiency	As projected by the 2013 ISO-NE CELT	Energy Efficiency declines slightly from the Base Case, leading to slightly higher load growth	Completely offsets load growth
Renewable Portfolio Standards (RPS)	Each New England state meets 100% of its RPS target No stricter regulations on hydraulic fracturing; Federal GHG emissions program in 2020	Each New England state meets 75% of its RPS target	Same as Base Case
Environmental Policy	No stricter regulations on hydraulic fracturing; Fed. GHG emissions program in 2020	Same as Base Case	Same as Base Case
Generation Capacity	Nuclear deactivation occurs between 2032-2035; Later period capacity additions	Nuclear deactivation occurs between 2027-2030	Same as Base Case

Major Assumptions: Natural Gas

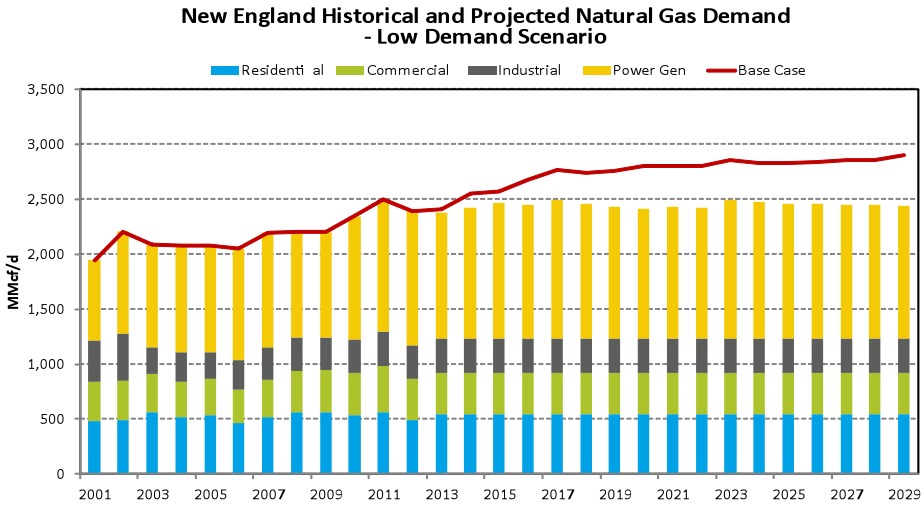
Assumption	Base Case	High Demand	Low Demand
Demand Growth	Residential, Commercial and Industrial (R-C-I) demand growth of 1.6% per year	High R-C-I demand growth, at 2.2%, with policy incentives	No demand growth
LNG Exports and Imports	Exports from Gulf Coast and West Coast; Imports - Distrigas supplies will sharply decline relative to 2011 but gradually increase starting in 2019; Canaport supplies will decline after firm supply contract expires in Oct 2013	Additional 4 Bcf/d of export from the Gulf Coast and West Coast; Imports Same as Base Case	Same as Base Case
Pipeline Infrastructure	Algonquin Incremental Market (AIM) expansion in-service by 2016	AIM in-service by 2016 Maritimes & Northeast Pipeline (M&NP) can reverse flow on an economic basis to meet demand growth from Maine and Maritimes	Same as Base Case
Natural Gas Supply	Marcellus grows at 6% per year; Eastern Canadian production increases sharply in 2014 to >350 MMcf/d and then gradually declines through 2020	Same as Base Case	Same as Base Case

Scenario Analysis:
High and Low Gas Demand Forecasts

High Demand Scenario



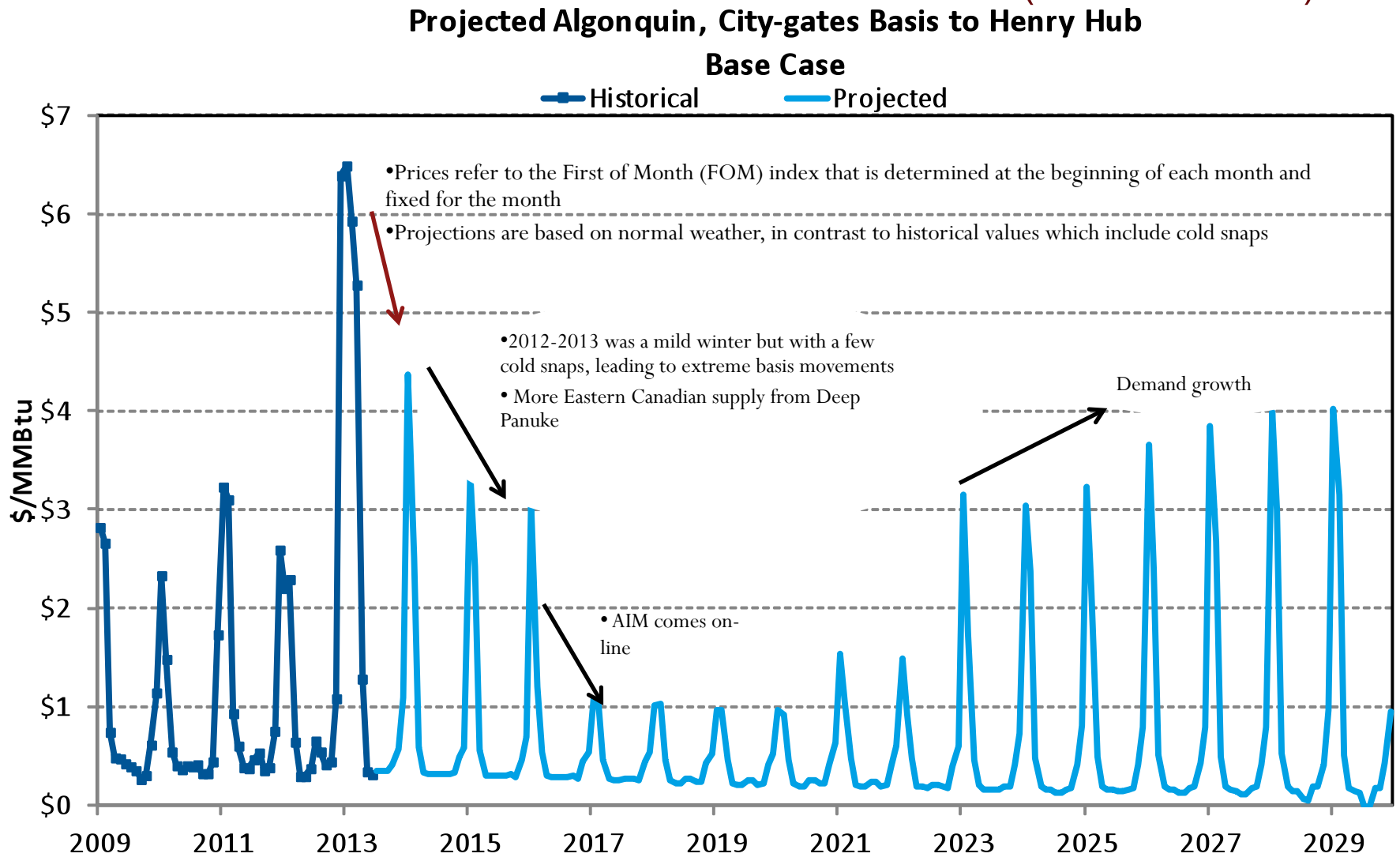
Low Demand Scenario



Source: Black & Veatch Analysis

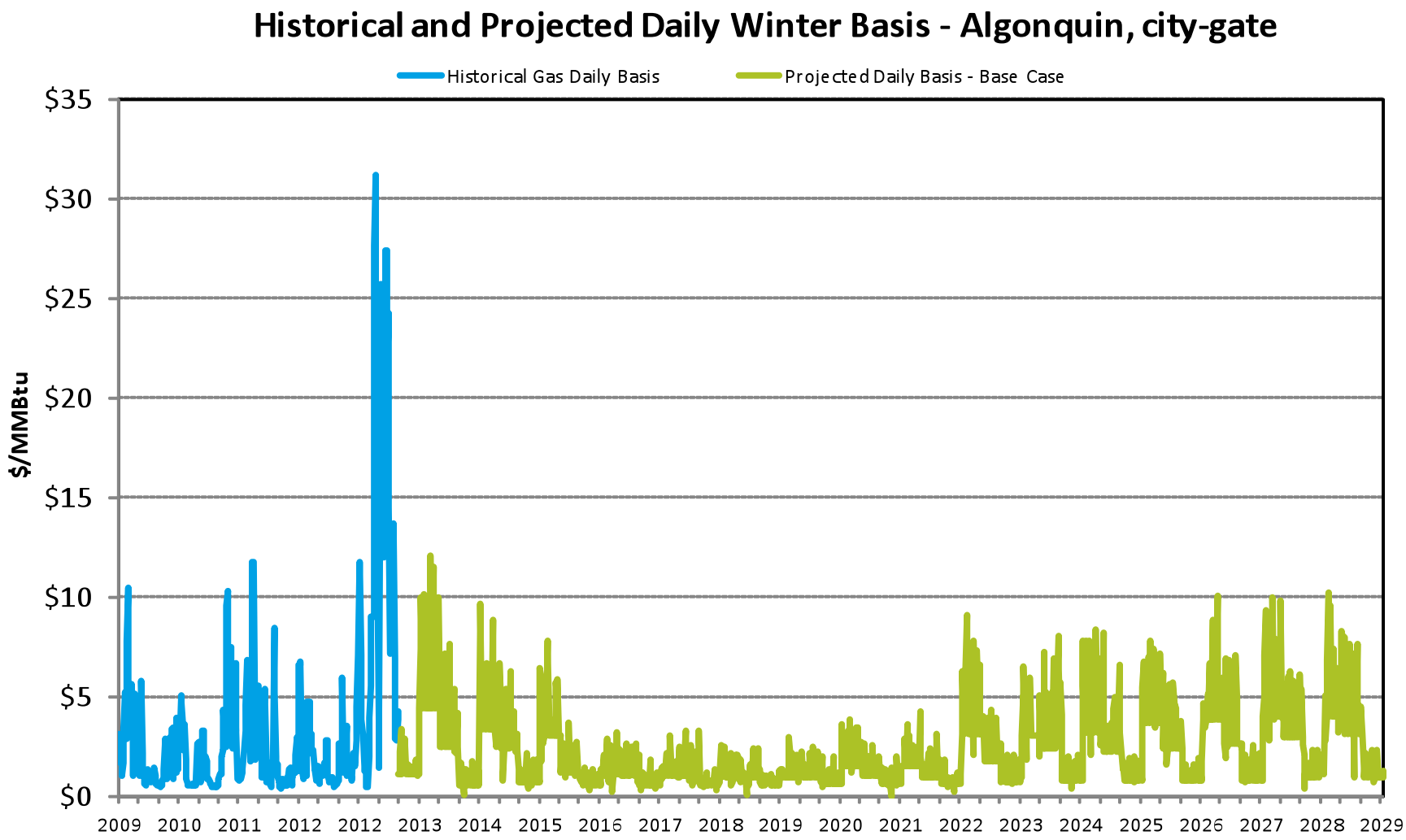
Phase III: Results

Historical and Projected Natural Gas Basis in New England: Base Case - No Incremental Infrastructure (besides AIM)



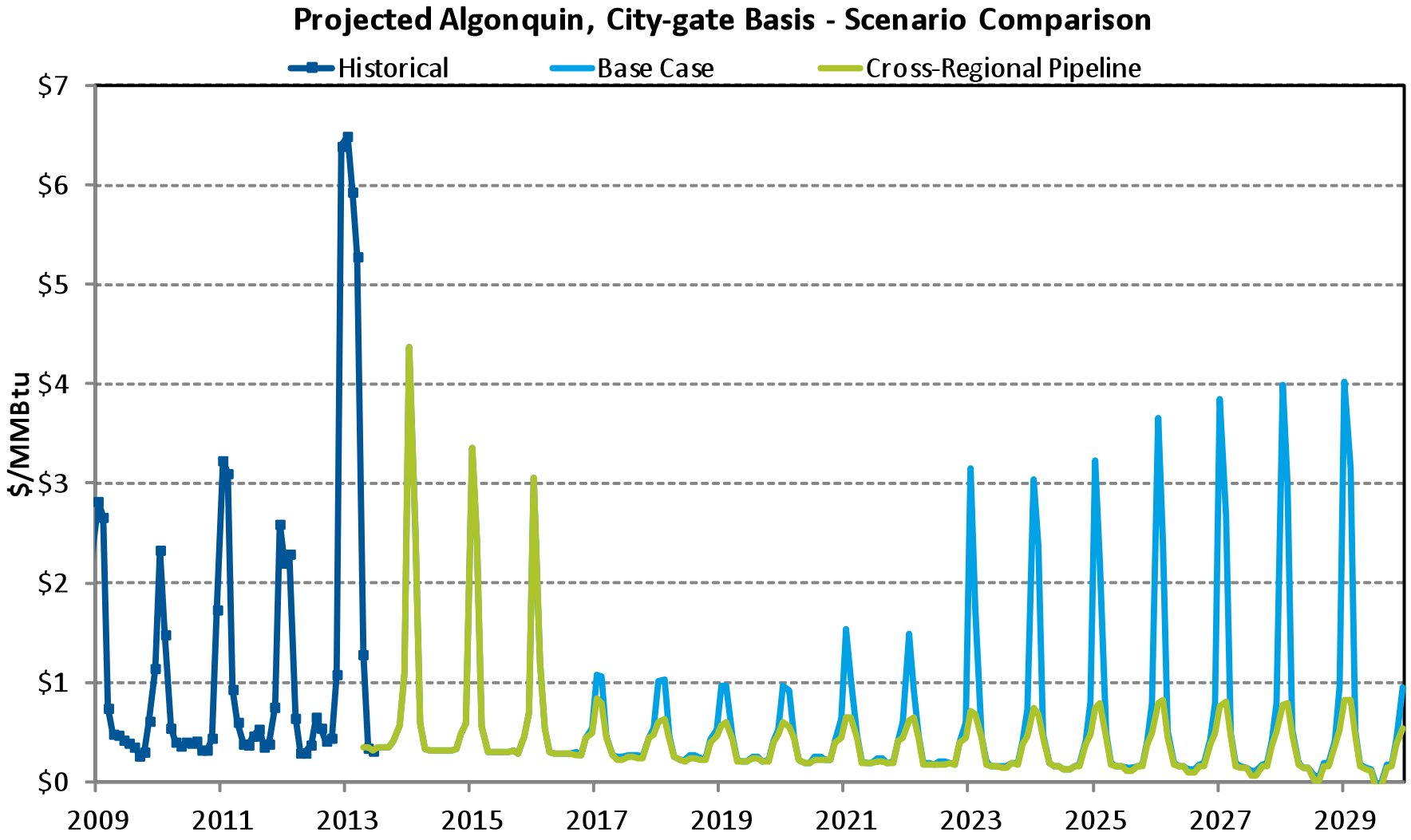
Source: Black & Veatch Analysis

Historical and Projected Winter Daily Basis: Base Case



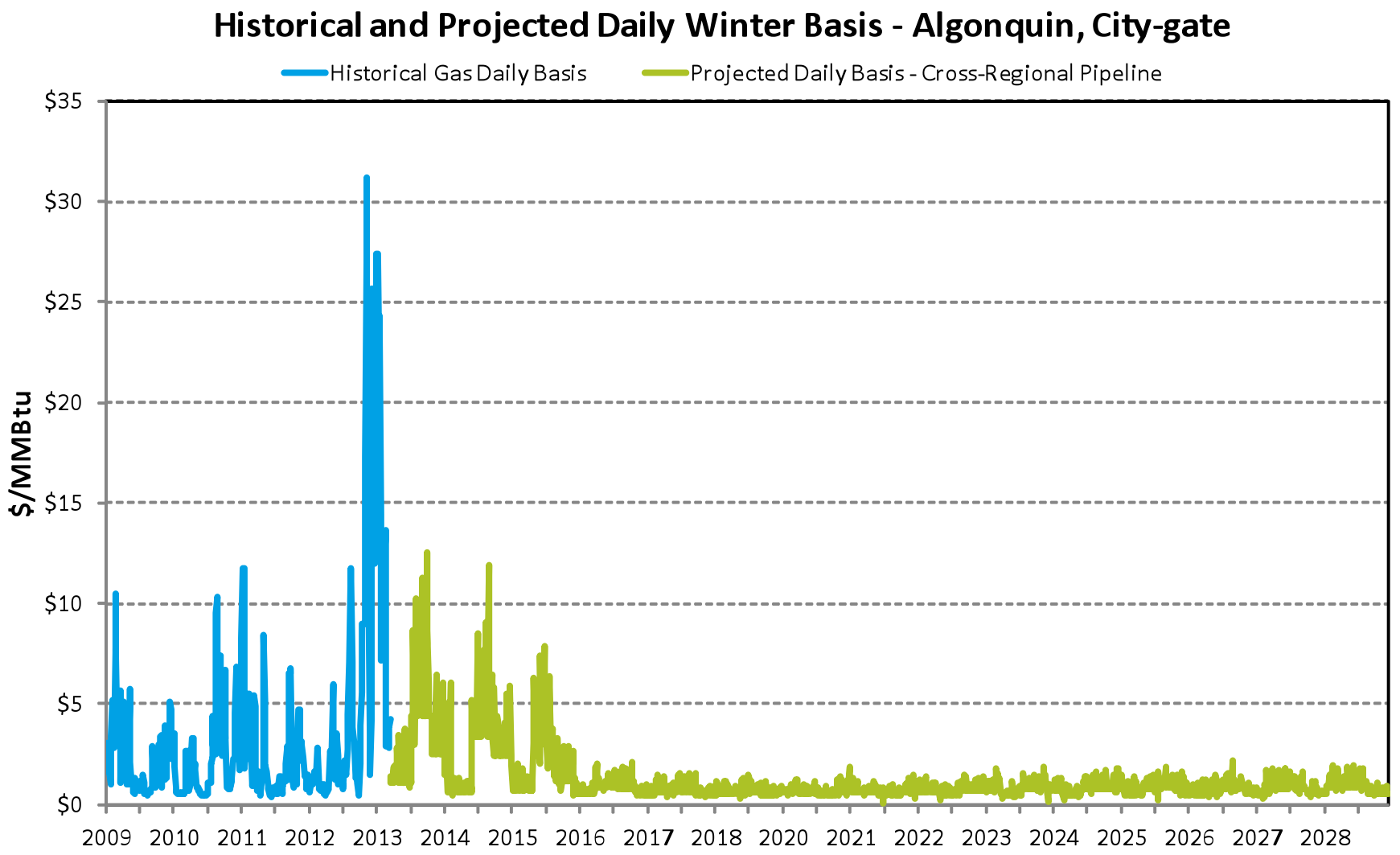
Source: Black & Veatch Analysis

Projected Monthly Natural Gas Basis: Cross-Regional Pipeline



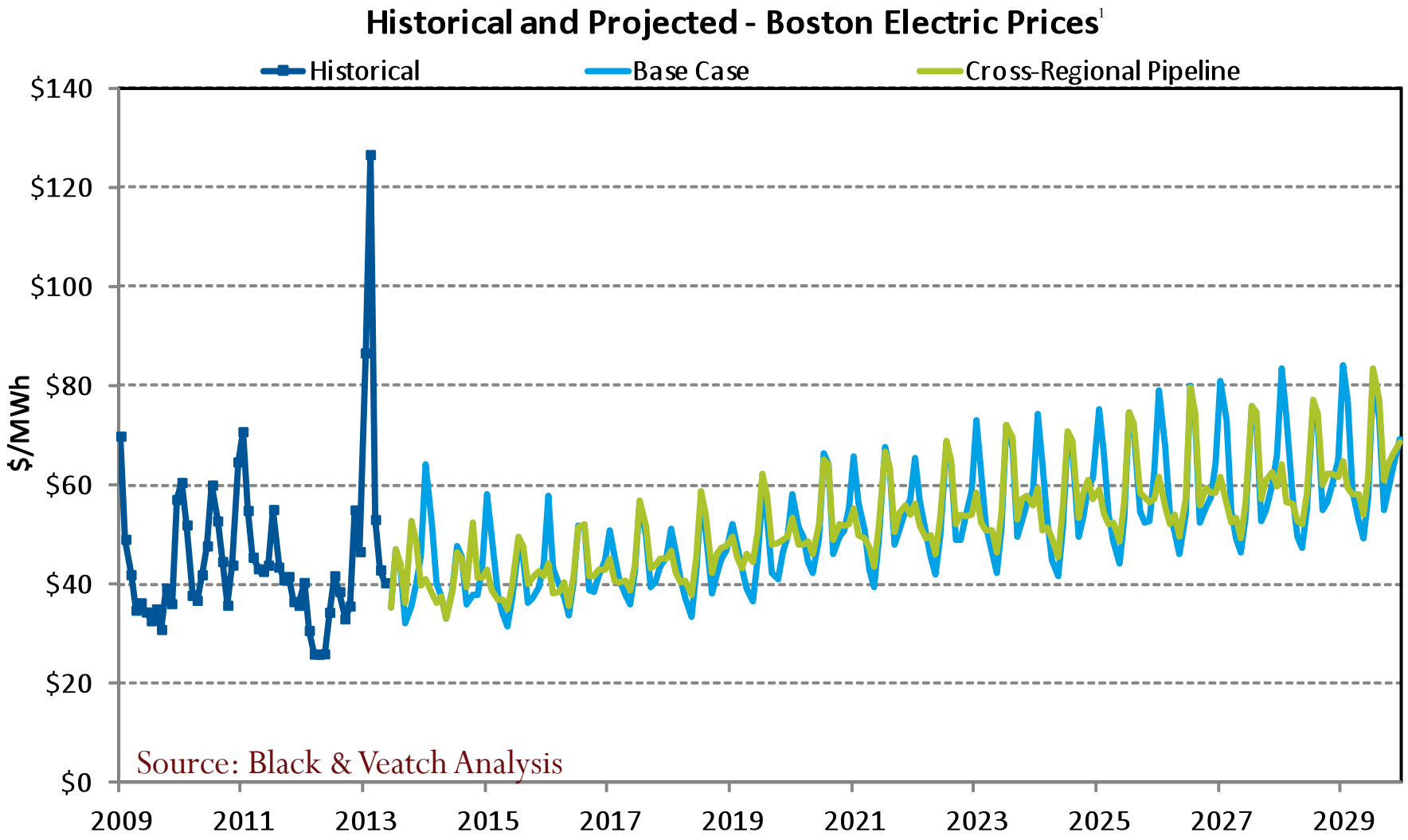
Source: Black & Veatch Analysis

Projected Winter Daily Natural Gas Basis: Cross-Regional Pipeline



Source: Black & Veatch Analysis

Projected Electricity Prices: Cross-Regional Pipeline



For the graphic presentation of the electricity price impacts of different solutions in this analysis, Black & Veatch chose Boston as a corresponding electricity price location to Algonquin City-Gates. Black & Veatch selectively graphed the price impacts at other New England electricity zones to confirm that they are similar to Boston's.

Hydro Solution Analysis in the Gas-Electric Study

Economic Based Imports	Firm Imports

Both assume cost of a new 1200 MW line

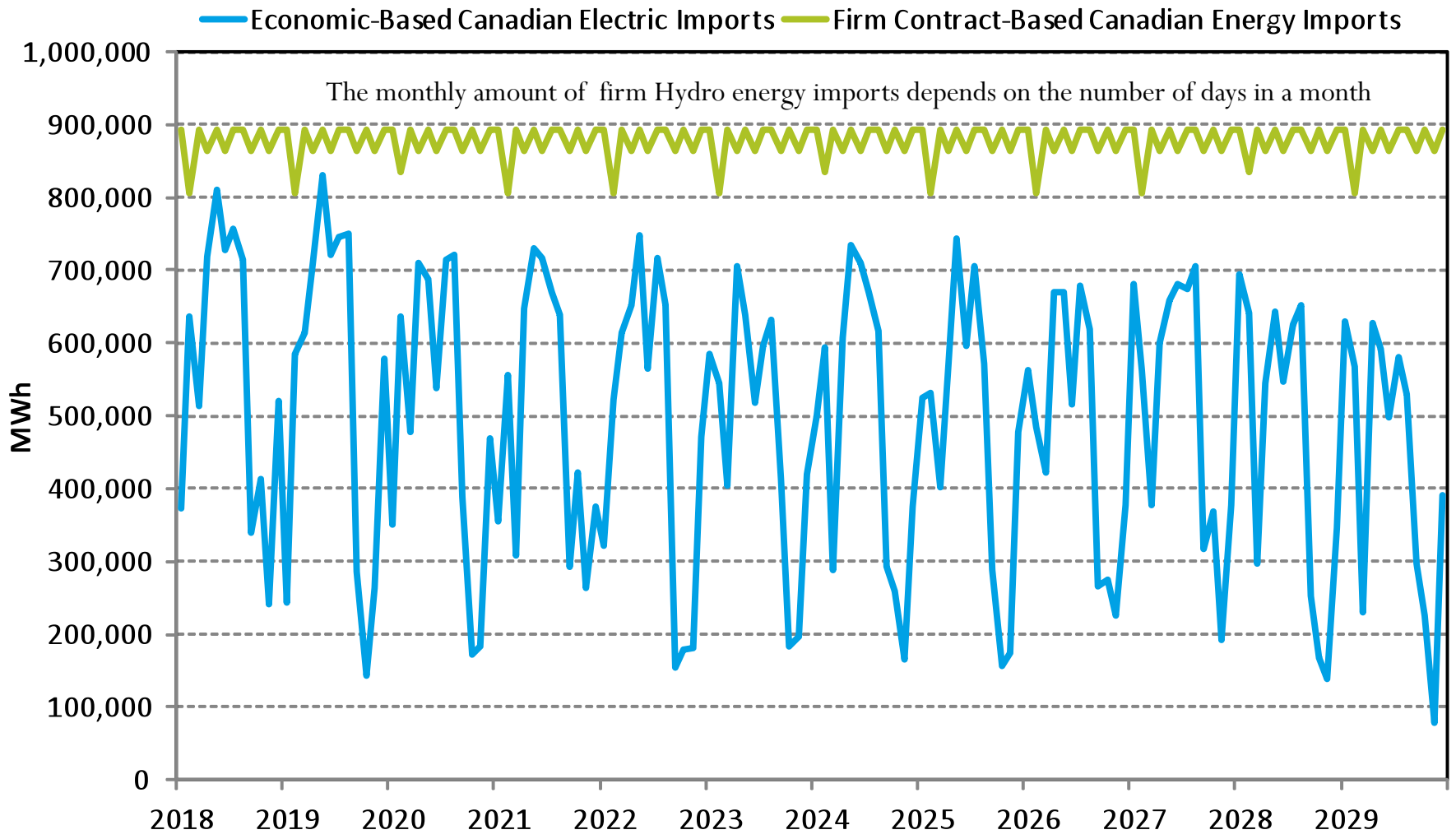
- Assumes import levels determined by energy needs & price differentials in New England & other markets

- Assumes firm import levels by contract (24/7/365)
- *Assumes additional cost of new dam at cost of service*
- Enables imports even during Canadian winter peak

Both reduce natural gas demand in New England
Both lower regional electric prices in New England

- Greater reduction in gas demand during winter peaks
- Greater reduction in electric prices

Economic vs. Firm Hydro Energy Imports



Source: Black & Veatch Analysis

Related Work: Hydro Analysis Update

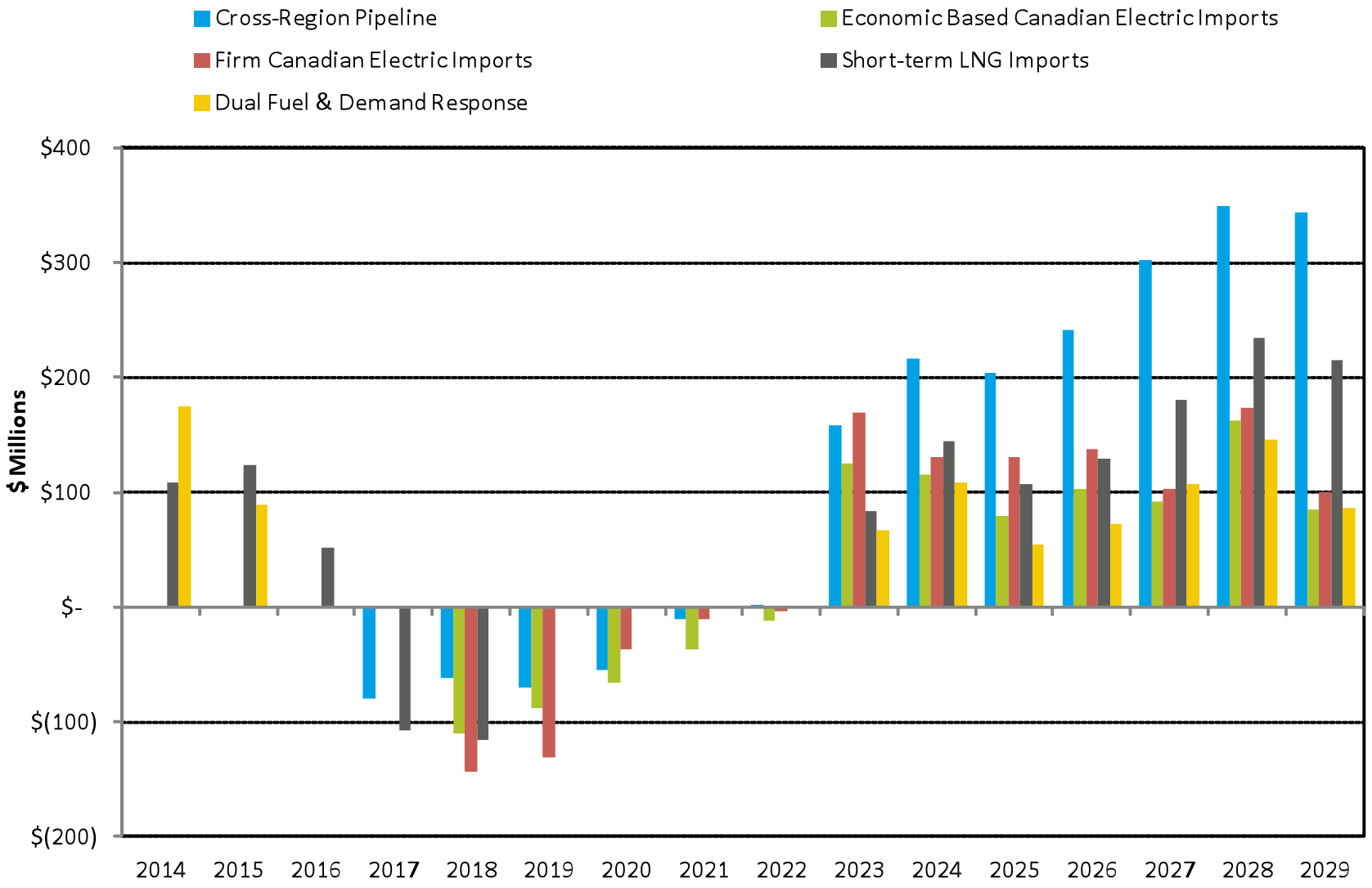
Hydro Whitepaper
Complete

- Context for policymakers
- Overview of New England's competitive energy markets, New England & Eastern Canadian Provinces' generation resource mixes
- Power system synergies between Eastern Canadian Provinces & New England
- Potential benefits & risks associated with increasing hydro imports, need for resource tracking system
- Options for increasing hydro imports & implications for further consideration

Hydro Analysis
Underway

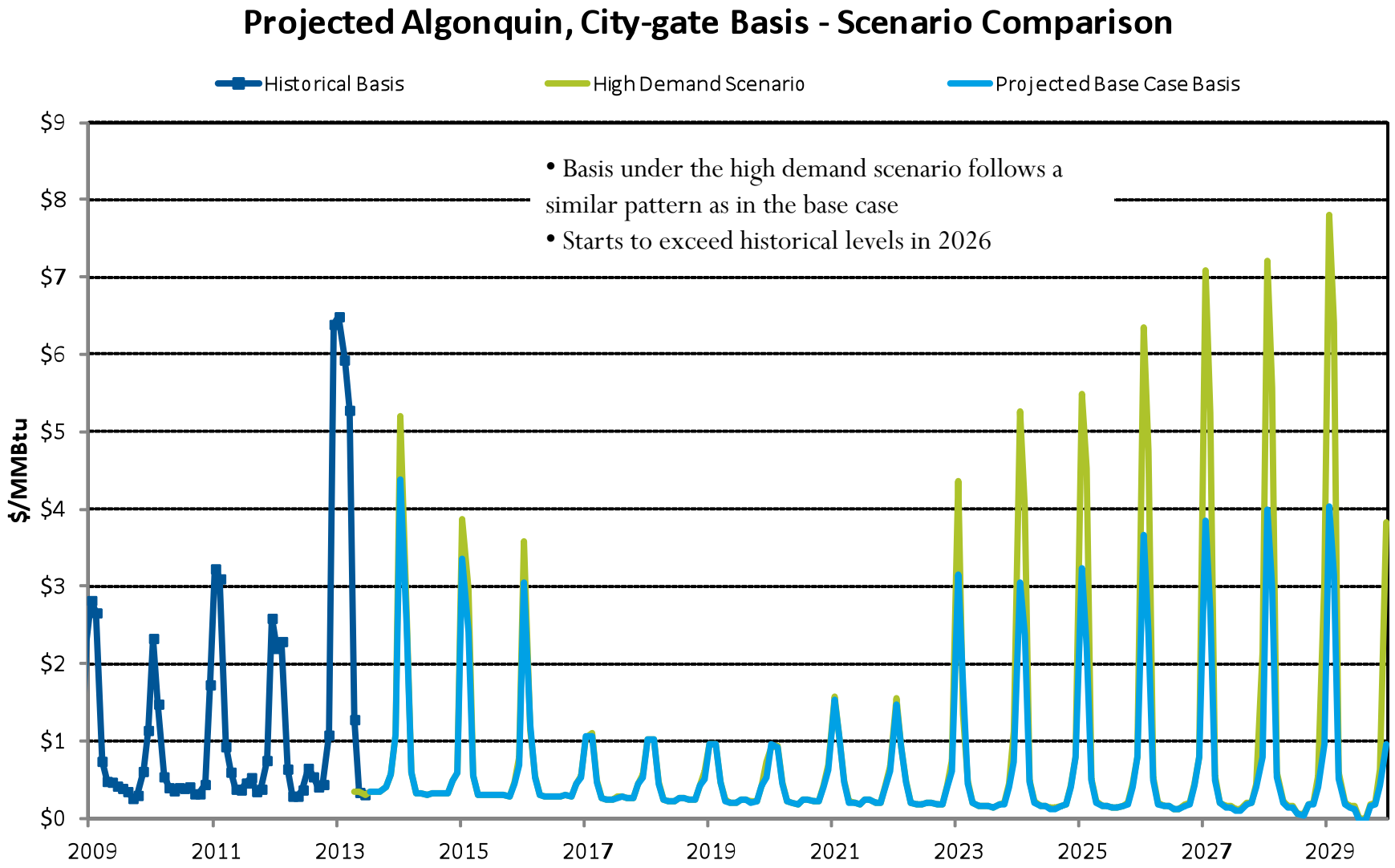
- Analyzing economic & emissions implications of adding 3,600 MW of imports
- Assuming incremental imports via 3 new *hypothetical* 1200 MW lines from different points in Canada into different areas in New England
  1. New Brunswick to MA
  2. Quebec through NY to CT
  3. Quebec to VT
- Assuming 2 hydro supply outlooks
  1. Base Supply Case:
     existing and under construction
  2. Alternative Supply Case:
     Base Case + 5000 MW
     (permitted and proposed)
- Cost of Service basis. Will not reflect prices that would emerge in an RFP or via negotiations

Base Case: Solution Costs and Benefits



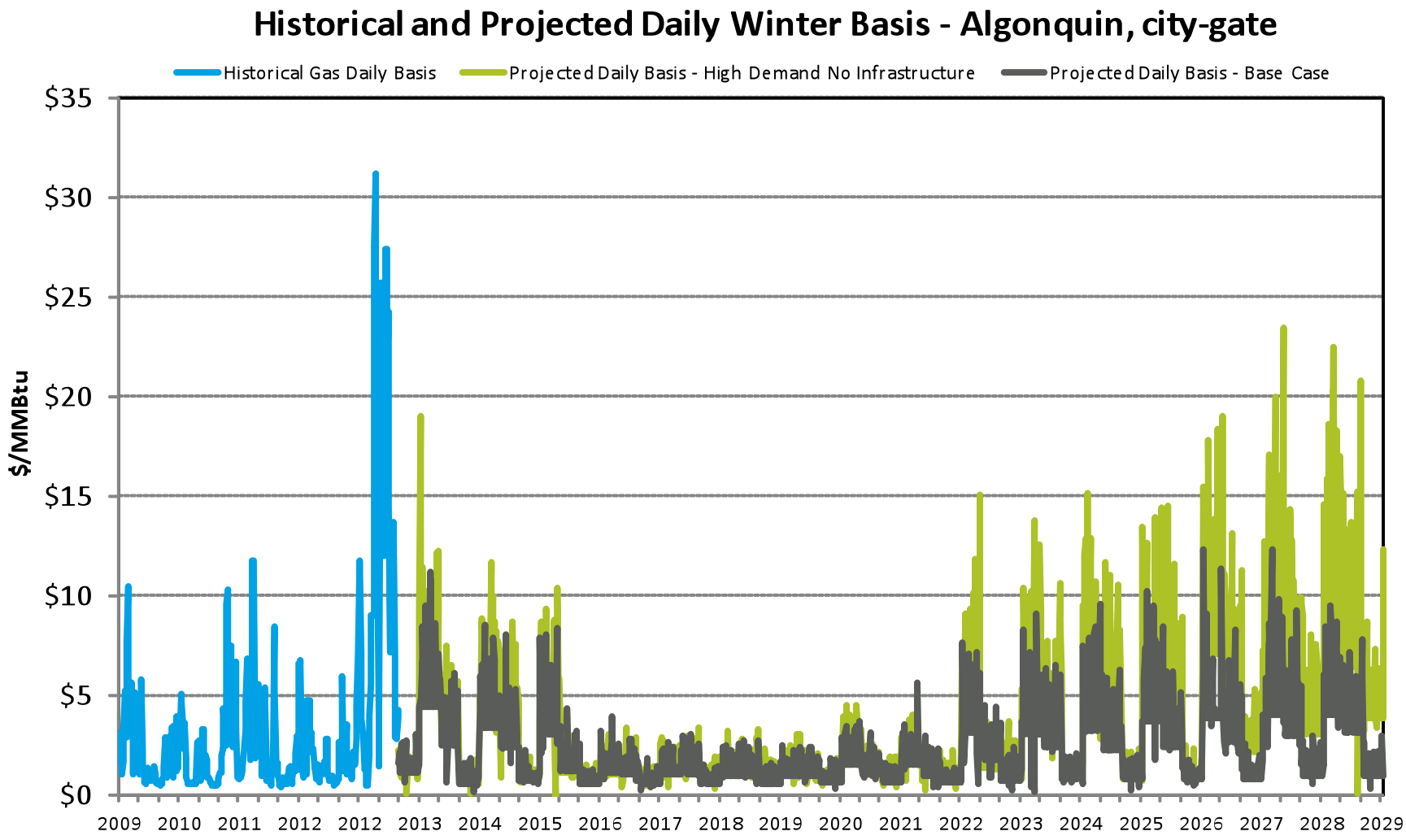
Source: Black & Veatch Analysis

Historical and Projected Natural Gas Basis in New England: High Demand - No Incremental Infrastructure (besides AIM)



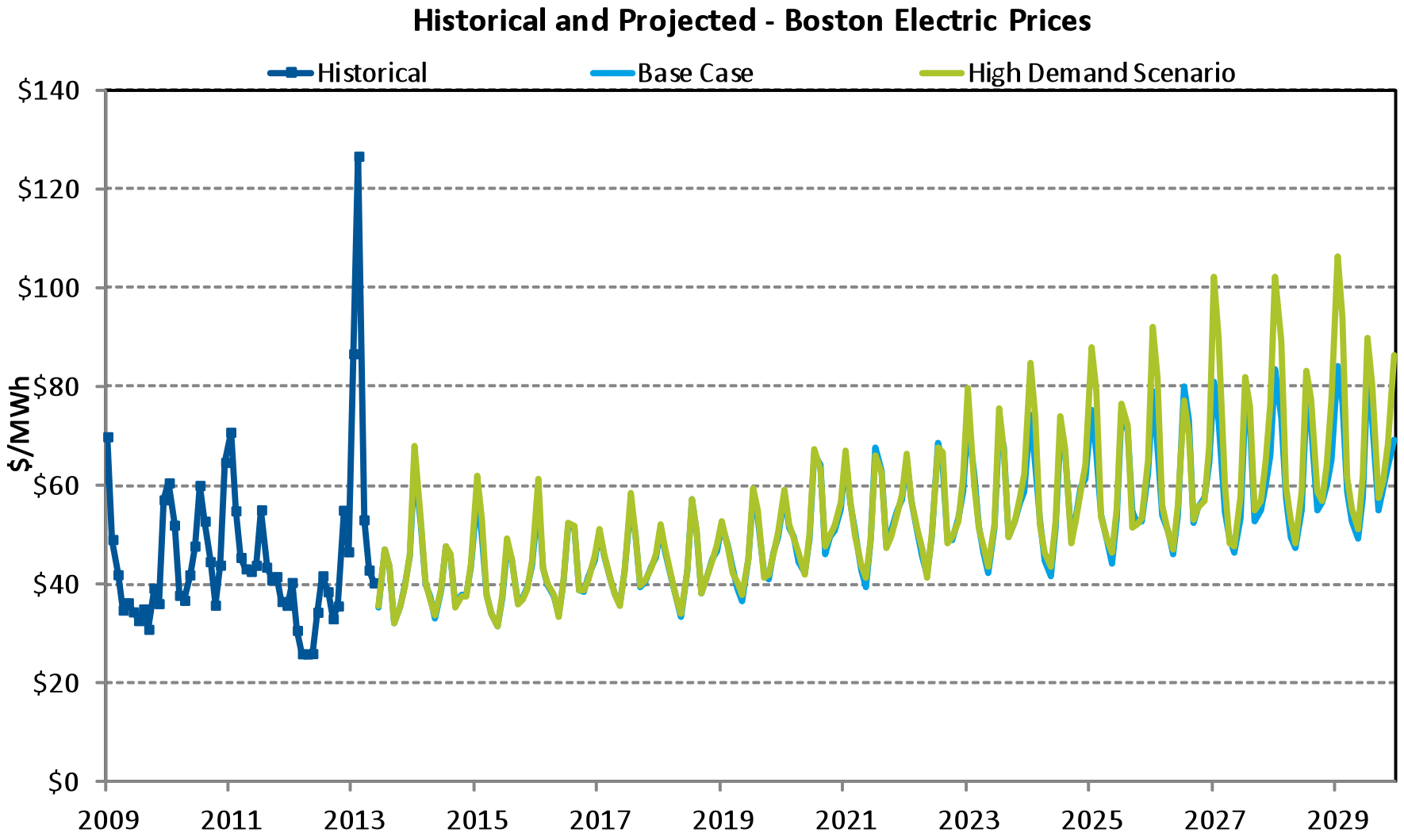
Source: Black & Veatch Analysis

Historical and Projected Winter Daily Basis: High Demand Scenario



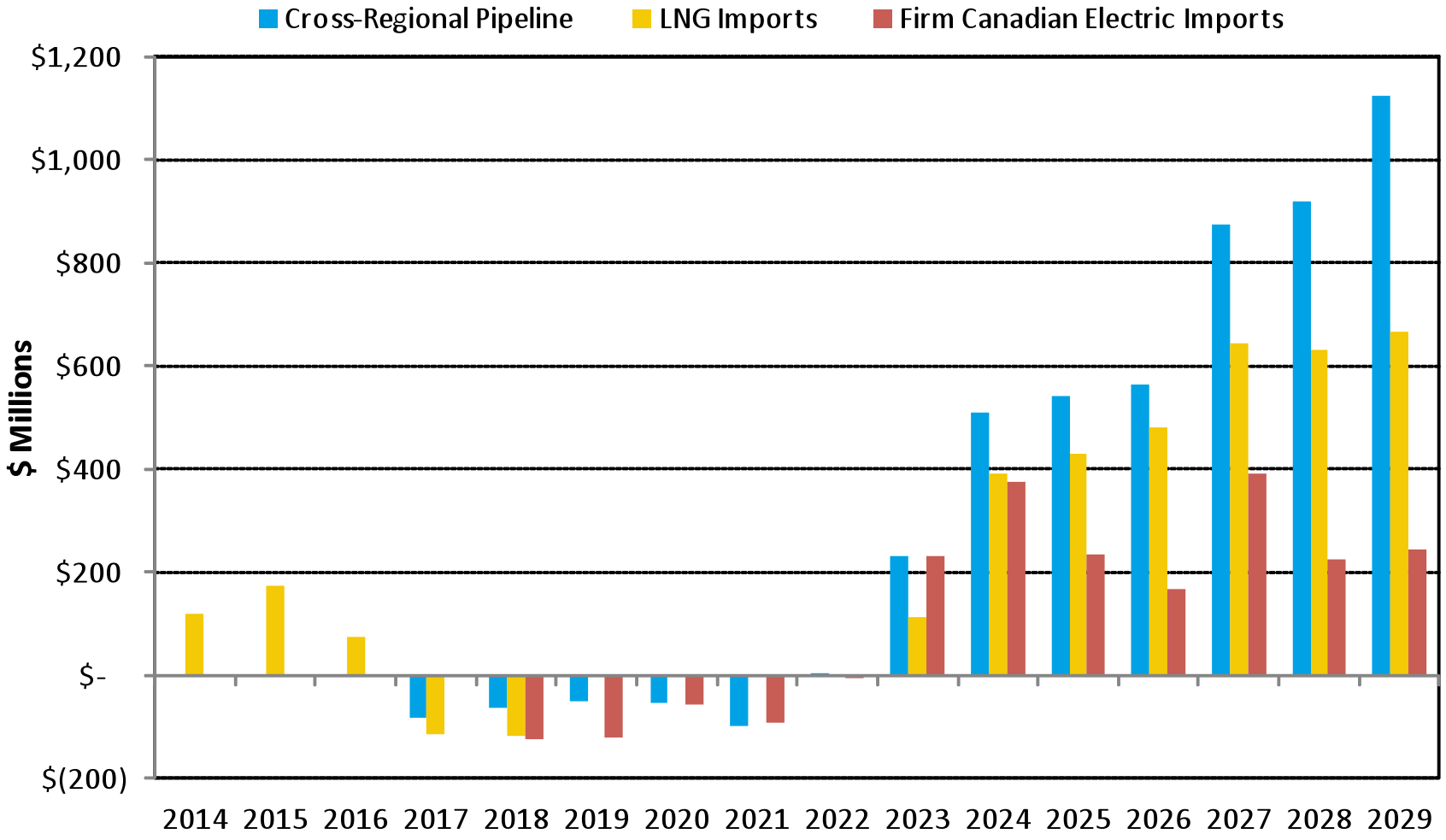
Source: Black & Veatch Analysis

Historical and Projected Electricity Prices in New England: High Demand - No Incremental Infrastructure (besides AIM)



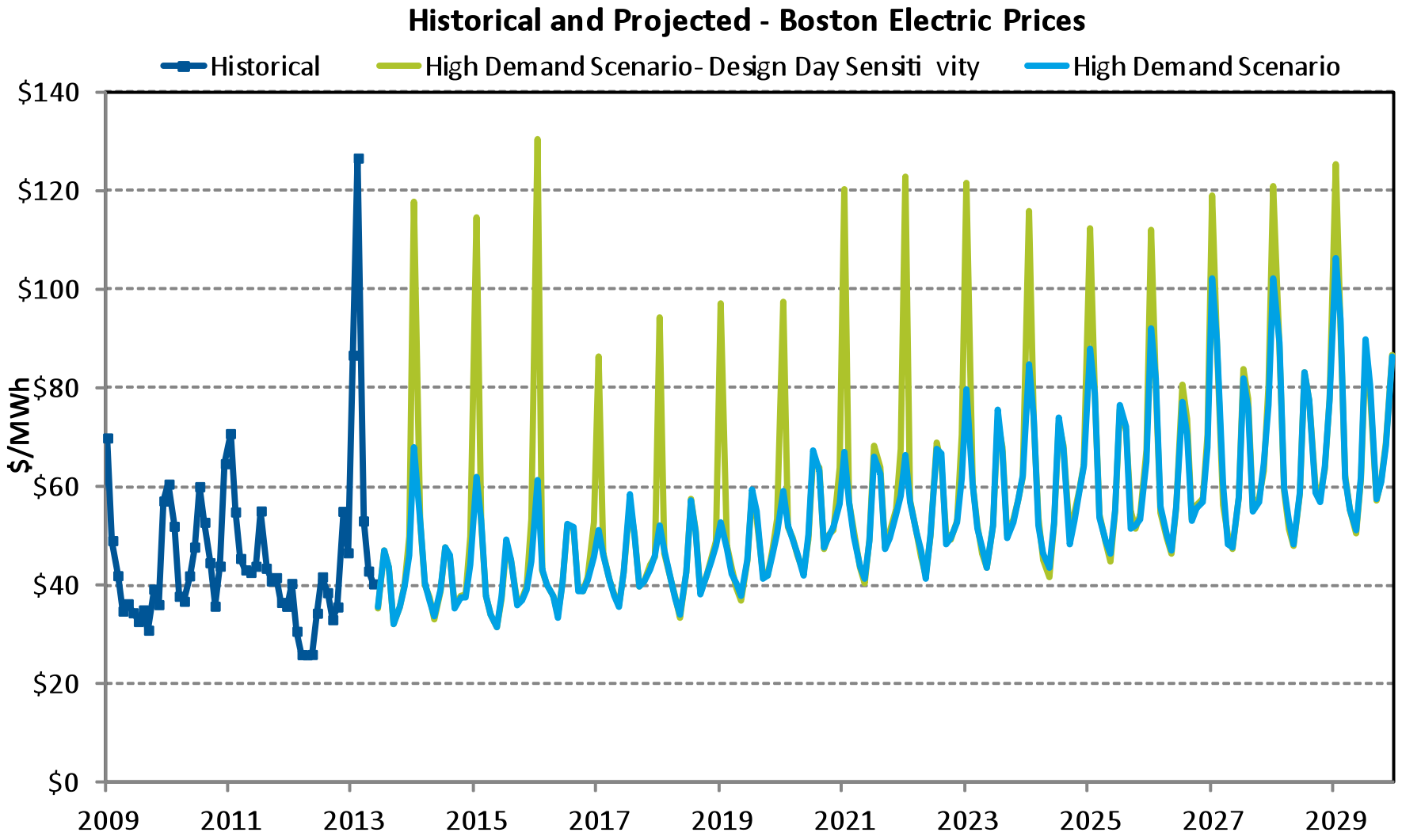
Source: Black & Veatch Analysis

High Demand Scenario: Costs and Benefits



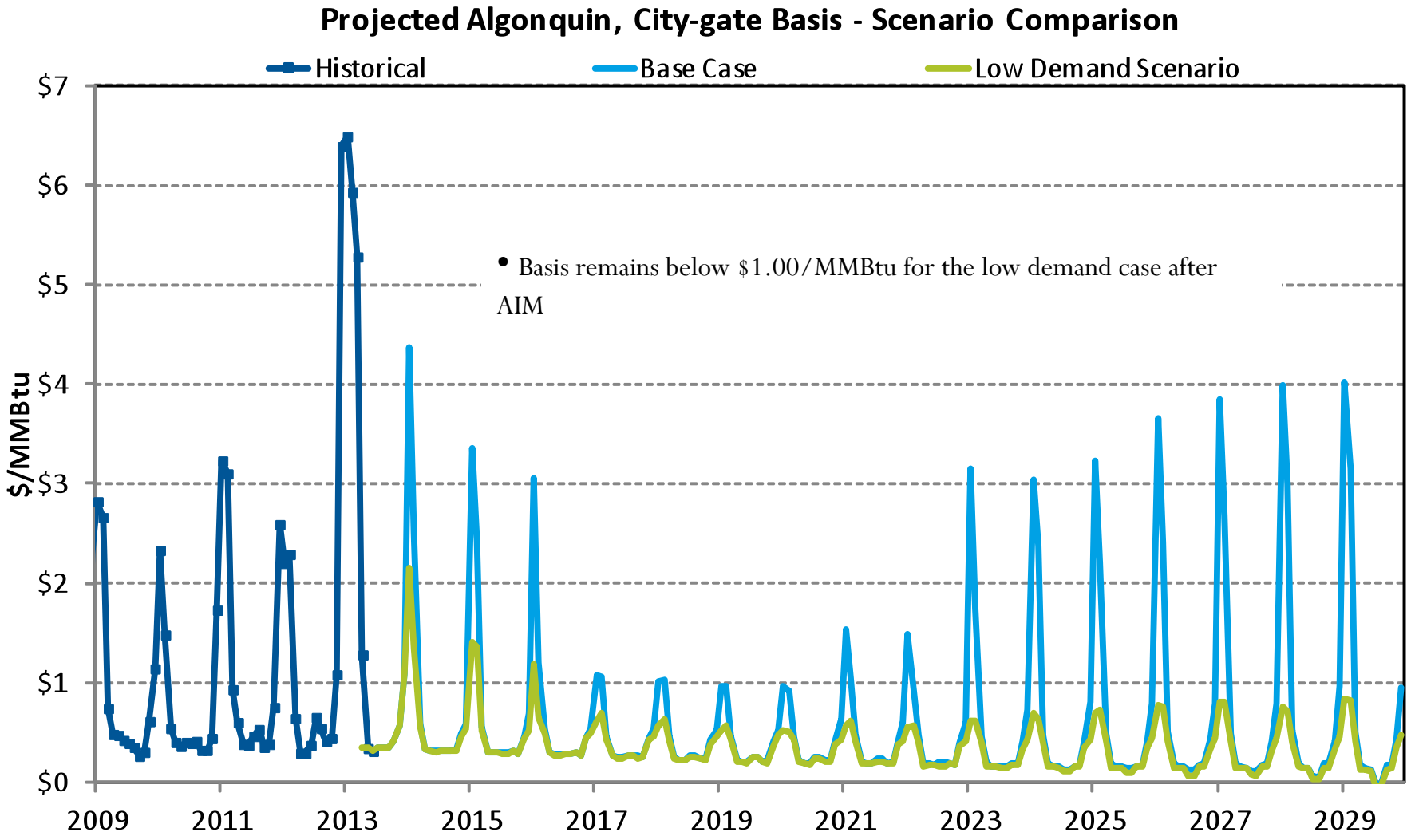
Source: Black & Veatch Analysis

Design Day Conditions: Electricity Price Spikes



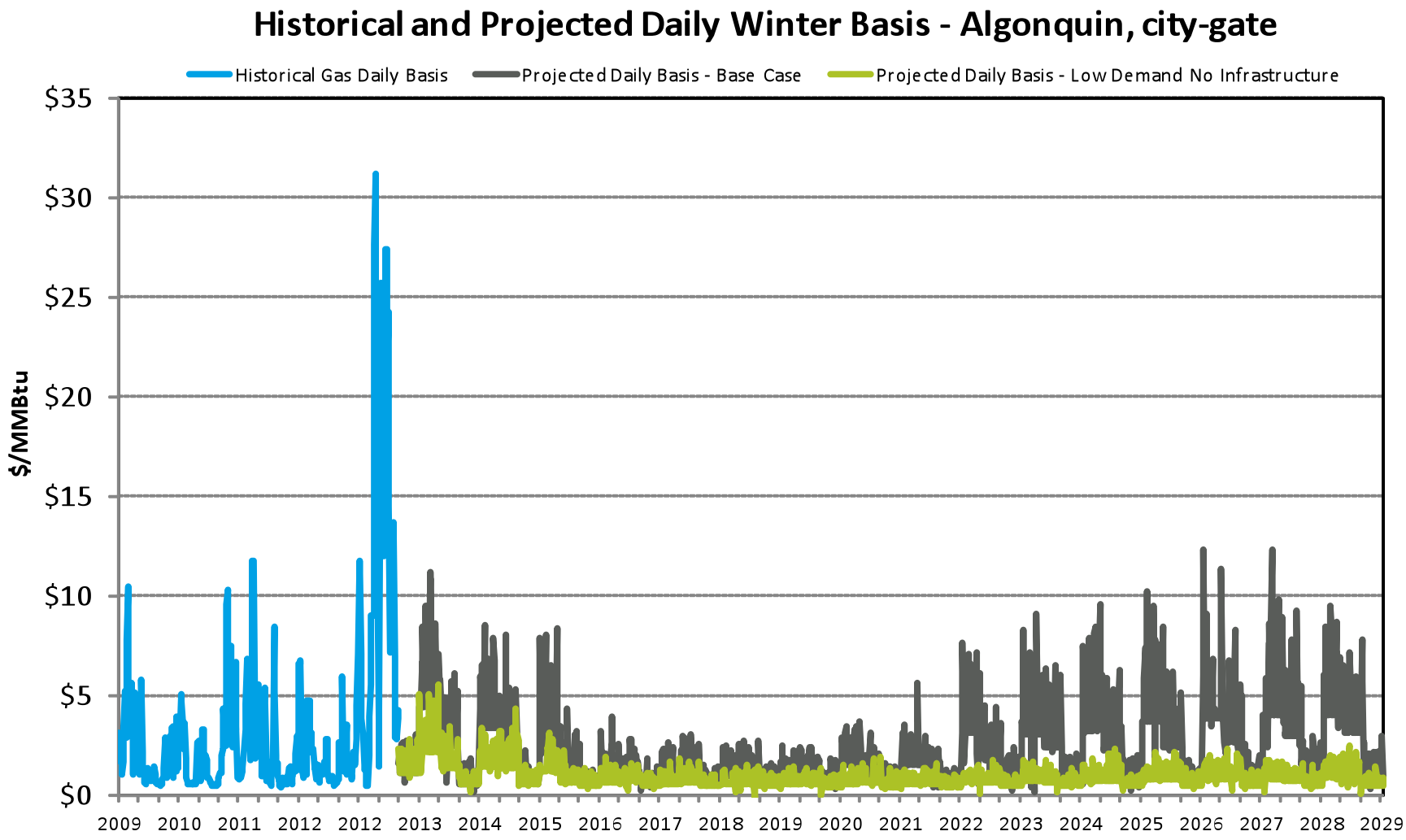
Source: Black & Veatch Analysis

Historical and Projected Natural Gas Basis in New England: Low Demand - No Incremental Infrastructure (besides AIM)



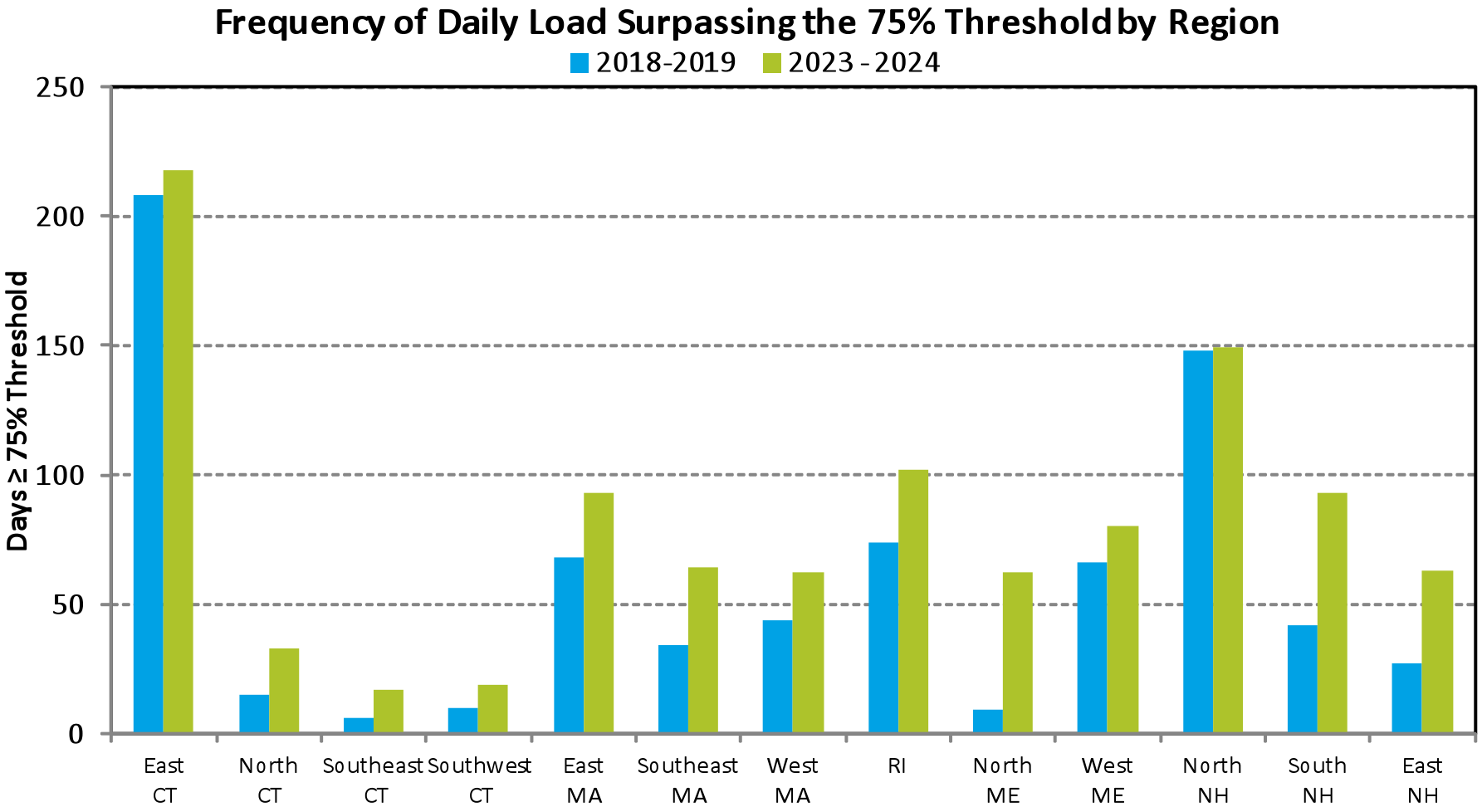
Source: Black & Veatch Analysis

Historical and Projected Winter Daily Basis in New England: Base Case vs. Low Demand - No Incremental Infrastructure



Source: Black & Veatch Analysis

Base Case Scenario: without Spectra's AIM Project



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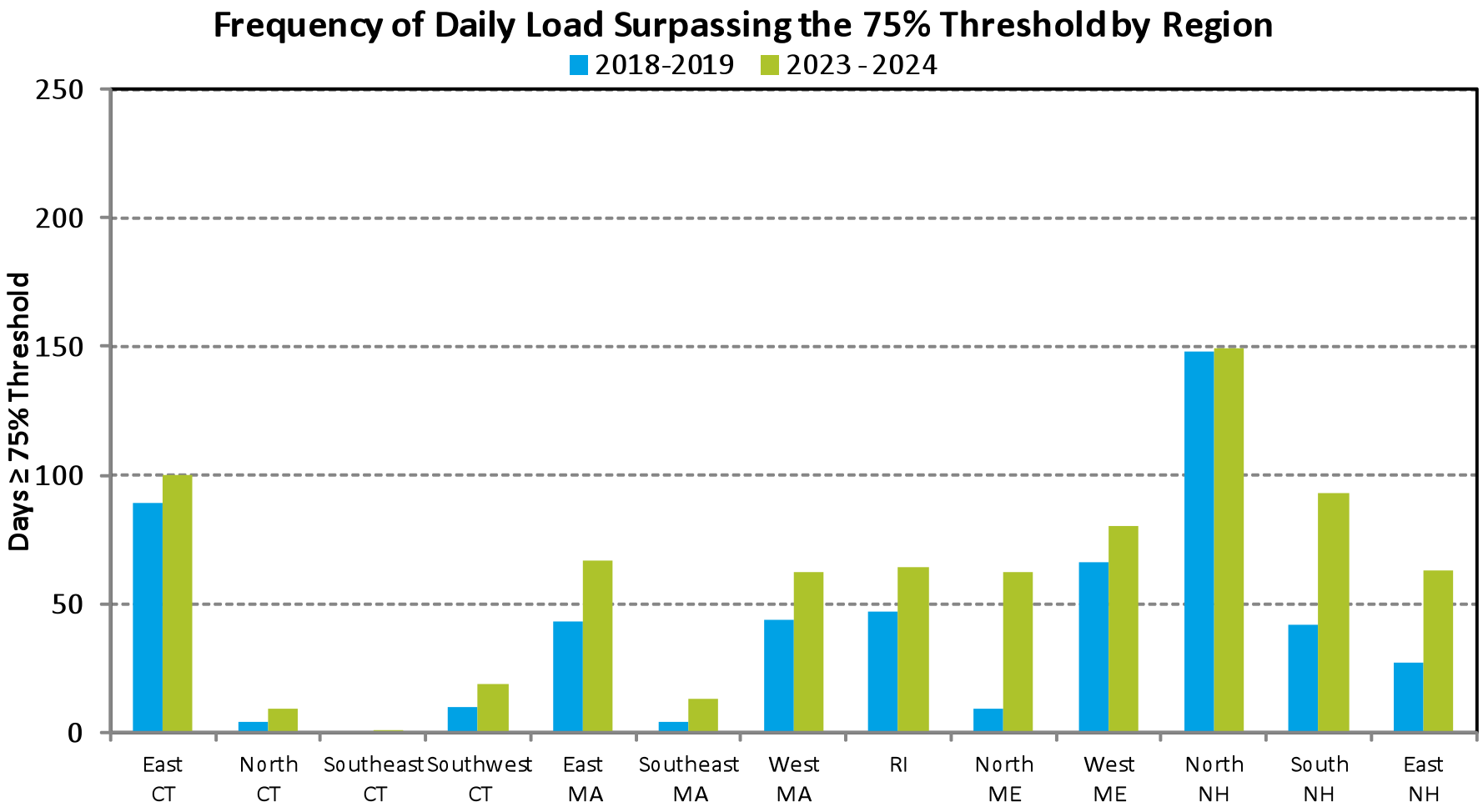
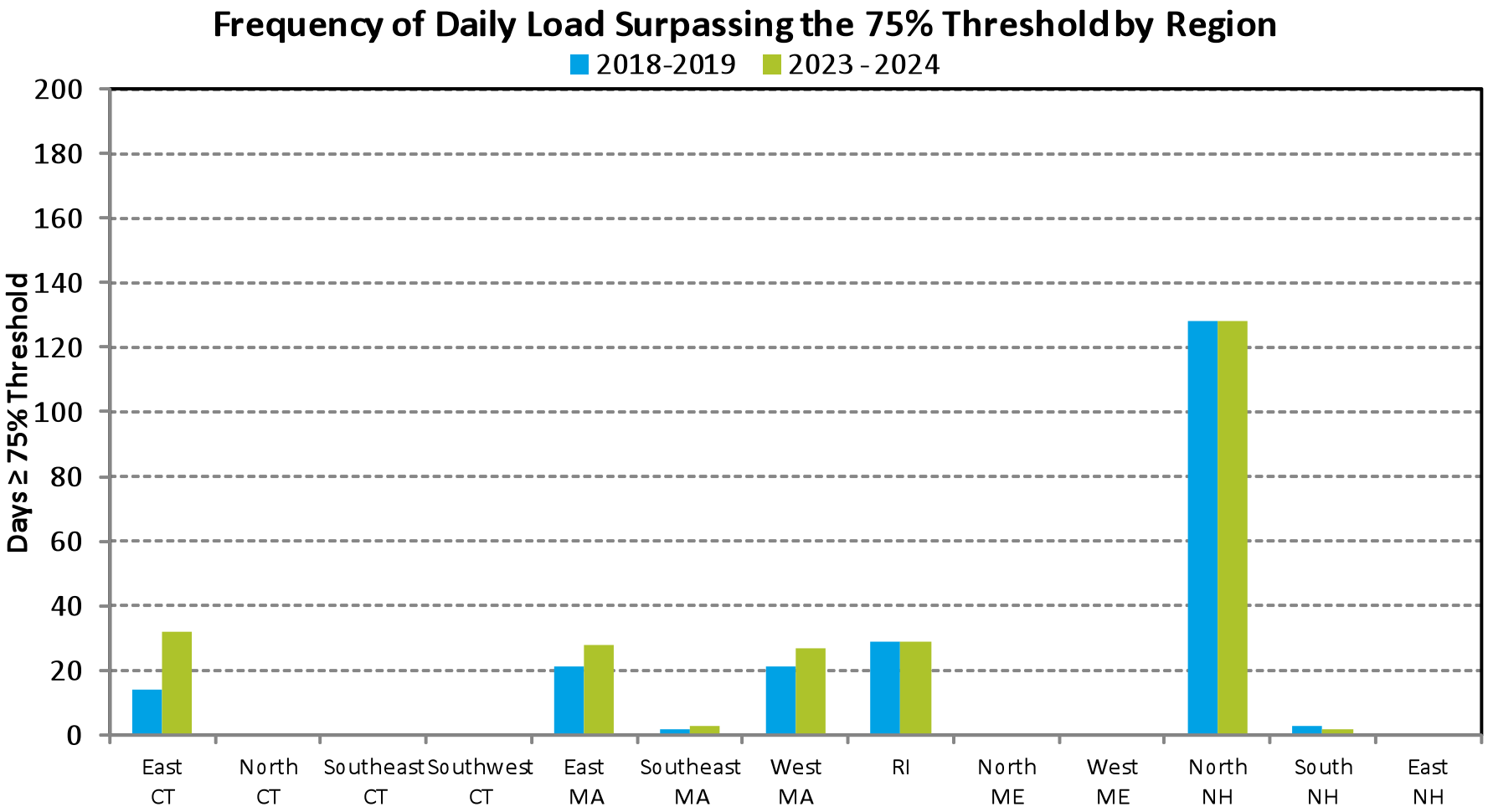
Base Case Scenario: with Spectra's AIM Project



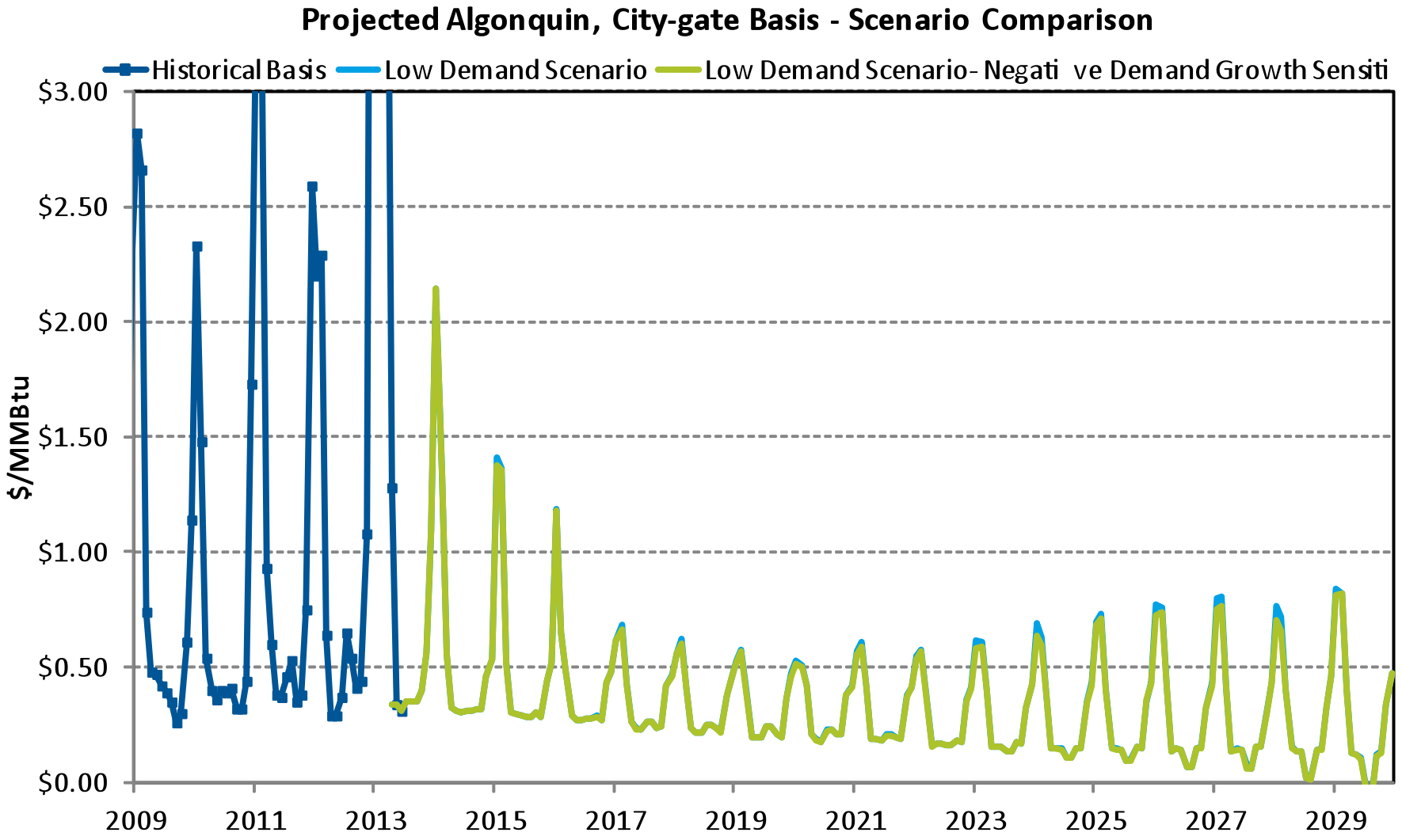
Source: Black & Veatch Analysis

Low Demand Scenario: with Spectra's AIM Project



Source: Black & Veatch Analysis

Negative Demand Growth: Projected Natural Gas Basis



Source: Black & Veatch Analysis

Black & Veatch Findings

- In the absence of infrastructure or demand reduction solutions, New England will experience capacity constraints that will result in high natural gas & electric prices
- Gas-supply requirements driven by episodes of extremely cold weather can be very costly & create significant reliability risks
- Short- & long-term solutions are needed to relieve the natural gas market constraints under the Base Case & High Demand Scenarios
- No long-term infrastructure solutions are necessary under the Low Demand Scenario; The costs of measures that could bring about the Low Demand Scenario, an additional alternative, would require study
- In the absence of demand reduction solutions, a Cross-Regional Natural Gas Pipeline solution, after construction and operational costs, presents higher net economic benefits to New England consumers than do alternative long-term solutions studied

Some State Observations

- A new natural gas pipeline currently in process toward operation provides significant economic benefits to electricity customers under all scenarios studied.

- An *additional* hypothetical pipeline provides the most substantial economic net benefits to electricity consumers of all solutions studied under the Base Case & High Demand Case.

- The actual cost to consumers for incremental hydroelectric power is currently unknown. Study assumes cost of service based pricing.

- Reducing consumers' demand for electricity & natural gas to the extent assumed in the Low Demand Case eliminates the need for consumers to invest in infrastructure. Further analysis would be required to determine whether policies that would result in a Low Demand Scenario are cost-competitive with infrastructure investments.

Study Limitations

- The study is designed to provided policymakers with economic analysis
  - It is not a plan
  - It will not simulate gas pressures or power flows – not a hydraulic model
- The study relies on simplistic representations of the natural gas pipeline network & of the electric transmission system
  - Computer models use city gates (gas) & load zones (electric) to develop prices
    - Forecasts of gas market prices are on a monthly basis.
    - Forecasts of electricity prices are on an hourly basis.
- **Input assumptions & cost estimates are not facts**
  - Fuel prices, whether & when generators may retire or expand, implications of environmental requirements & the extent to which states achieve policy objectives are subjective
  - Assumptions in this study are based on NESCOE's best judgment at a point in time and Black & Veatch's industry knowledge & project experience

Feedback on Assumptions

- **Gas-Electric Study's Purpose**:
  - Assess sufficiency of gas infrastructure to support power generation
  - Identify cost-benefit of solutions that could alleviate gas constraint

- **NESCOE welcomes data or specific information on the study's assumptions**: gaselectric@nescoe.com

  - The more *specific information* in the public domain the better informed policymakers will be about potential ways forward
  - *Data* is more helpful to policymakers than are generalized critiques or opinions about the directional nature of assumptions
  - NESCOE will make data and feedback received public for the benefit of policymakers and market participants

In the fall of 2013, states will consider the path forward

Questions?

For additional information:

www.nescoe.com/Gas_Supply_Study.html