BUILDING A WORLD OF DIFFERENCE

April 16, 2013

Gas Demand Growth, Load Distribution and Natural Gas Infrastructure Solutions for New England

Prepared for NESCOE

BLACK & VEATCH
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Discussion Outline

- Phase II Objectives
- Black & Veatch Methodology Overview
- New England Demand Growth
- Geographic Load Distribution and Infrastructure
- Load Duration and Constraint Assessment
- Natural Gas Infrastructure Costs
- Power Side Solutions
- Recommended Scenarios

Phase II Objectives

- **Black & Veatch study in Phase I concluded that the New England natural gas infrastructure will be increasingly under pressure from demand growth from the power sector**
- **In Phase II, Black & Veatch will:**
  - Analyze historical gas demand in New England by sector
  - Project growth requirements by sector for the next 15 years
  - Summarize announced pipeline expansion projects and generic infrastructure options and provide high level cost estimates for infrastructure options
  - Identify demand and power side response
  - Identify scenarios and sensitivities for further analysis

Black & Veatch Infrastructure Adequacy Assessment Framework

- Black & Veatch has constructed a comprehensive framework to assess the natural gas adequacy on a regional basis

How is Adequacy Defined?

- **Probability Risk Assessment**
  - ➢ Reliability
  - ➢ Economic

Is the Existing NG System Adequate?

- **Regional Load Growth by Sector**
  - ➢ Geographic Load Distribution
  - ➢ Sub-region Natural Gas Infrastructure
  - ➢ Daily/Hourly Load Variation

What are the Alternatives?

- ➢ Appropriate to solve periods of capacity duration
- ➢ Implementation feasibility

What are the Costs and Benefits of the Alternatives?

- **Cost estimates**
  - ➢ Regulatory vs. Commercial
- **Price impact and market benefits**
  - ➢ Natural Gas Market
  - ➢ Electricity Energy Market
  - ➢ Capacity Market

Which Alternative(s) Best Meet Objectives?

- **Cost Benefits Comparison**
- **Strategic Considerations**

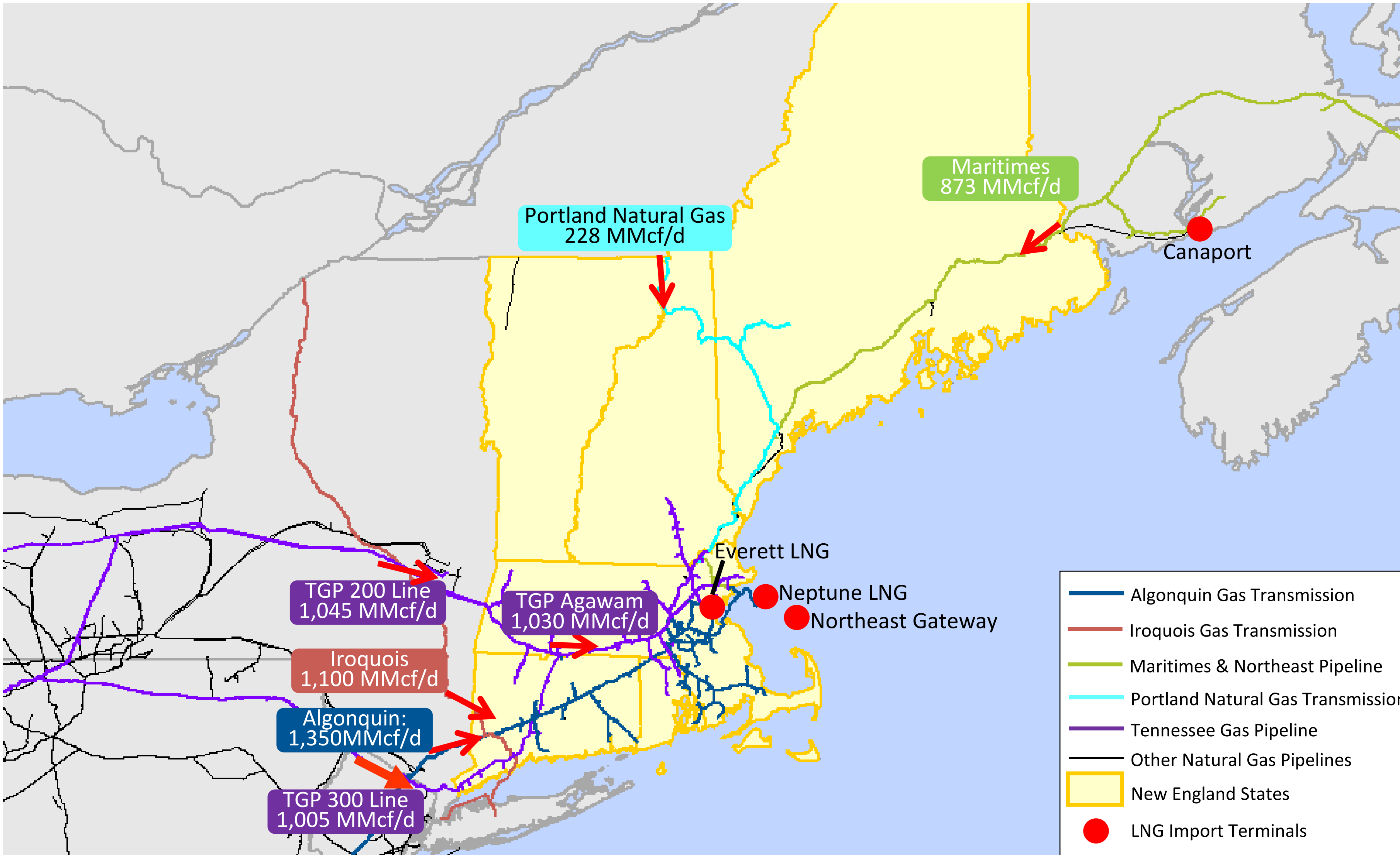
Analysis Methodology – Phase II

- **Black & Veatch analyzed historical natural gas demand by sector in New England by State**
- **Residential, commercial and industrial demand are projected as determined by**
  - Weather
  - Economic Growth
  - Population Growth
  - Efficiency Gains/Usage per Customer
  - Policy Initiatives
- **Demand growth from the power generation sector is projected using a combination of production simulation model ProMod IV and fundamental natural gas model GPCM**
  - Consistent fuel price from GPCM inputs into ProMod
  - Customized assumptions on technology costs, environmental policies, renewable resources, transmission, which were supported by industrial knowledge and project experience
- **Black & Veatch disaggregated demand into local demand centers to account for different infrastructure access**
- **Monthly and daily variation of demand is constructed to provide a comprehensive profile of demand requirements**

Black & Veatch Analysis Tools – GPCM

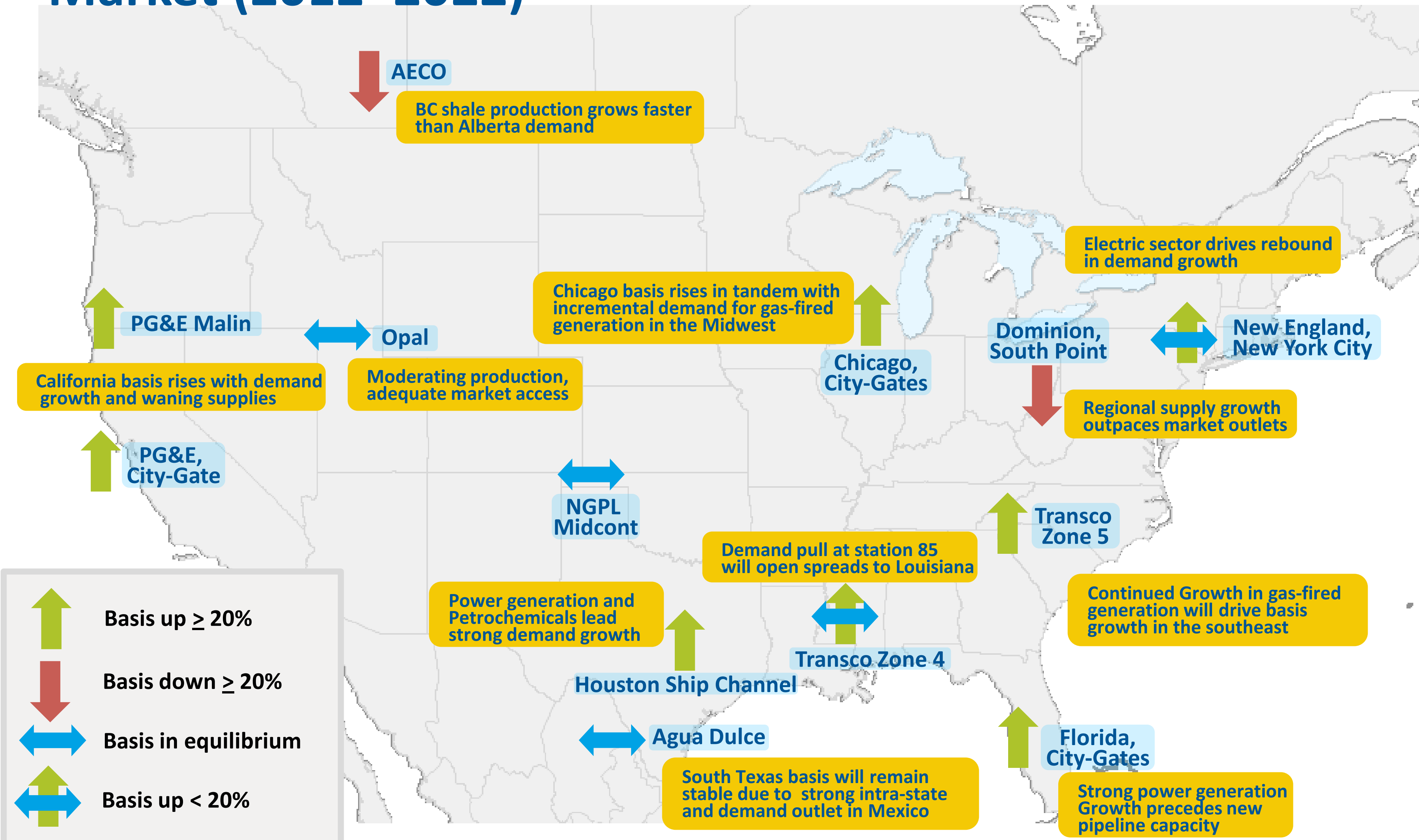
- **Gas Pipeline Competition Model ("GPCM") is a network flow model of the North American natural gas market**
- **The model considers the entire North American natural gas market - including Alaska, Canada, US Lower 48, Mexico and LNG Imports/Exports to/from North America. Major assumptions include**
  - **Supply**
    - Production projections by type – such as shale, coal bed methane, conventional and tight sands by basin
    - All major shale plays (Barnett, Haynesville, Marcellus, Eagle Ford, Utica, etc.) are covered
  - **Demand**
    - Projections by sector and by demand area – at the state and sub-state level
    - All natural gas and electric utility included
  - **LNG**
    - Includes all LNG import/export terminals with pipeline headers
  - **Infrastructure**
    - All existing interstate, intrastate, GOM gathering pipelines
    - Operational natural gas storage fields with individual injection/withdrawal ratchets
    - Proposed infrastructure is included according to the status of the project

New England Natural Gas Pipeline Infrastructure



Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Natural Gas basis change across North American Market (2012–2022)

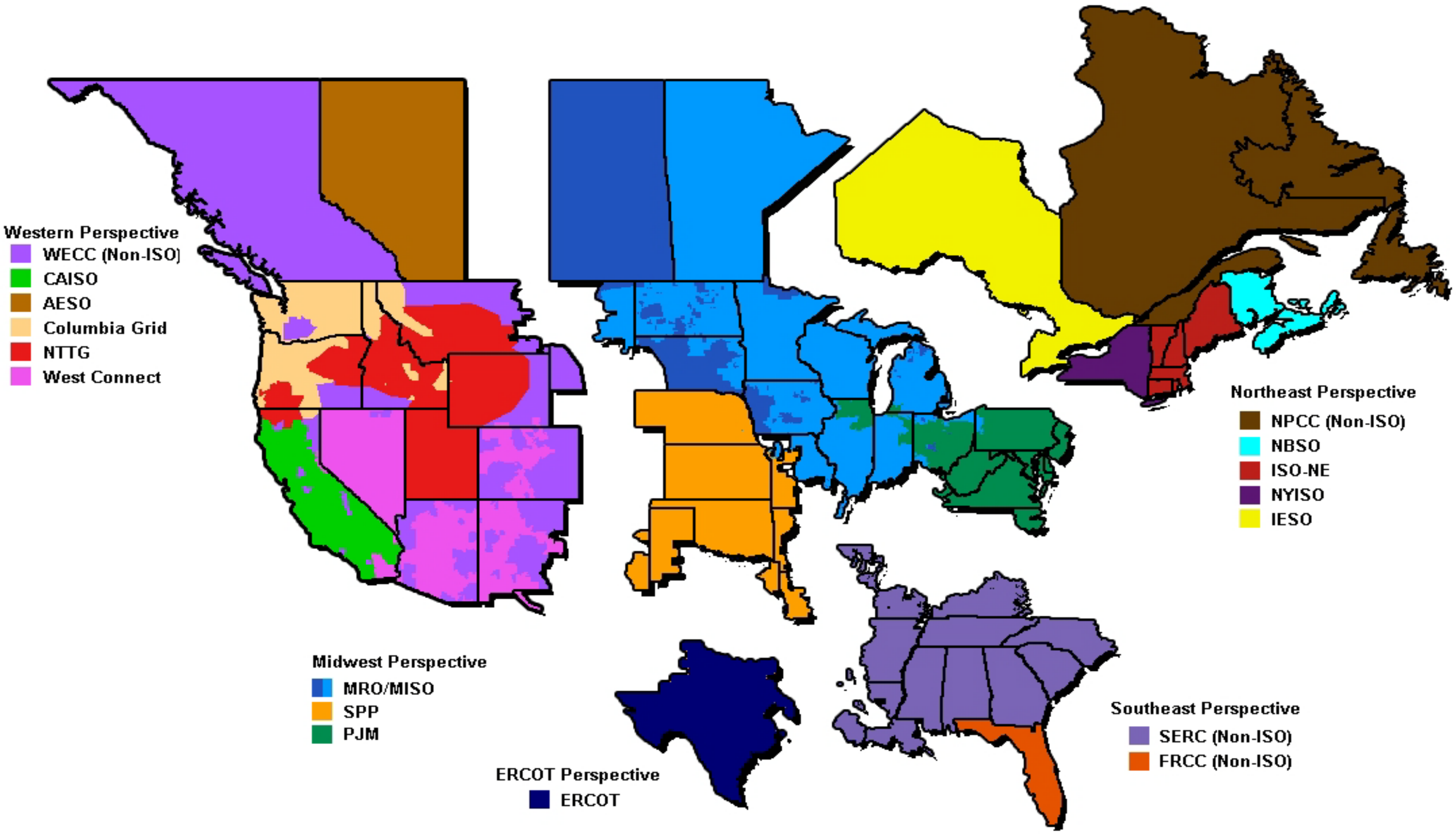


Source: Black & Veatch Energy Market Perspective Analysis

Black & Veatch Analysis Tools – PROMOD IV

- Ventyx PROMOD IV is a generator and portfolio modeling system, provides nodal Locational Marginal Price (LMP) forecasting and transmission analysis by producing algorithms that mimic the decision making process of investment and dispatch of electric generators
    - All generation assets and their operational characteristics
    - Expected renewable resources
    - Major market zones, load centers and hourly load profiles
    - Major transmission capacity between market zones and constraints
- For each hour of the forecast period, the model first clears the local supply and demand within each market zone, and then optimizes electricity transfers to optimize total system production costs to arrive at "arbitrage free" prices
- This simulation process is repeated for each hour of the simulation period, while at the same time capturing the chronological constraints and limitations of each generation asset

PROMOD IV covers the entire North American Grid



Source: Black & Veatch Energy Market Perspective Analysis

Load Center and Transmission Zones in PROMOD IV

Zones By Region

Interconnect	U.S.	Canada	Mexico
Eastern	37	5	0
ERCOT	4	0	0
WECC	21	2	1

Zones in New England - 9

Source: Black & Veatch Energy Market Perspective Analysis

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New England Residential, Commercial and Industrial Demand Projections – Approach

- **Black & Veatch analyzed historical data to find statistical relationship of residential, commercial and industrial demand to major market drivers of demand**
- **Data sources reviewed and relied upon in Black & Veatch's analysis:**
  - EIA monthly historical demand by sector by state (January 2000 through August 2012)
  - EIA annual deliveries by state by sector and number of customers by sector – EIA 176 (2000 through 2011)
  - Daily weather data at Logan International Airport (1983 through 2012), Brainard Airport (1997 through 2012) and Concord Municipal Airport (1983 through 2012)
  - Gross State Product (GSP) from 2000 through 2011
  - Population by state from 2000 through 2010
  - Relative price of fuel (heating oil vs. natural gas price from 2000 through 2012)
- **Black & Veatch analyzed average usage per customer and number of customers to create the projections by state by sector**
- **20-year normal weather is utilized in the projection**
- **For most states, historical average population or economic growth rate, customer growth rate are assumed to continue forward for projections. Special assumptions are made to Connecticut to reflect recent policy initiatives**

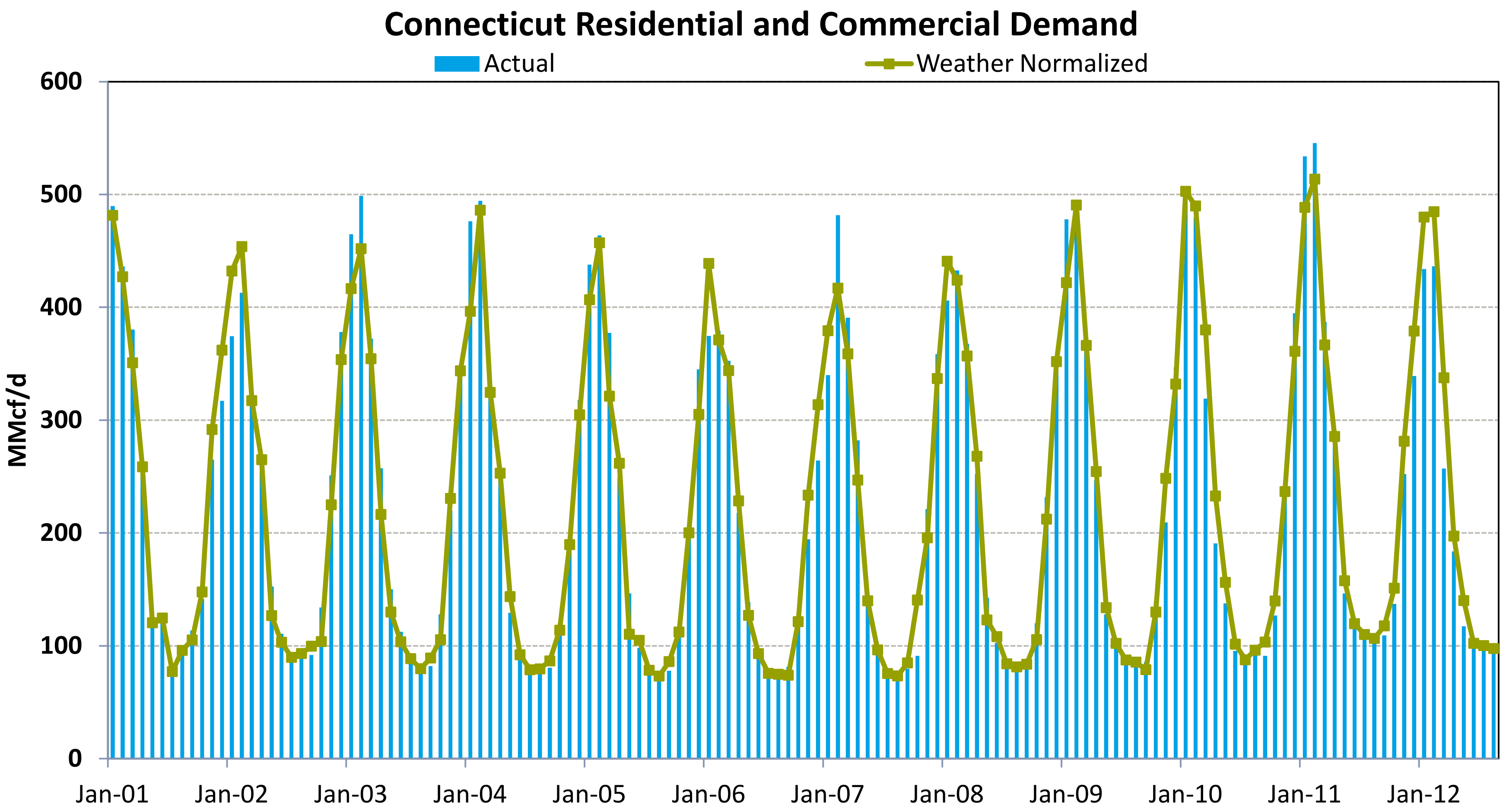
Residential, Commercial and Industrial Demand Projection Assumptions

Compound Annual Growth Rate 2013-2028	Connecticut			Massachusetts			New Hampshire		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Average Customer Usage	-0.76%	-1.02%	2.80%	0.10%	-0.15%	-3.22%	0.32%	4.56%	13.28%
No. of Customers	2.99%	3.16%	-3.10%	0.47%	2.35%	4.00%	1.51%	0.66%	-12.59%
Projected Demand Growth	2.21%	2.11%	-0.30%	0.57%	2.20%	0.78%	1.82%	5.22%	0.69%
2011 Consumption (MMcf/d)	127	126	71	356	211	119	20	25	17
2011 Consumption as % of New England demand for sector	22.48%	30.06%	22.91%	63.06%	50.33%	38.52%	3.57%	6.05%	5.60%

Compound Annual Growth Rate 2013-2028	Rhode Island			Maine			Vermont		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Average Customer Usage	-2.30%	-2.94%	6.45%	1.66%	2.42%	22.40%	-0.07%	-0.76%	1.31%
No. of Customers	3.42%	2.96%	-4.15%	2.52%	1.42%	-13.00%	2.84%	1.81%	-0.55%
Projected Demand Growth	1.12%	0.02%	2.30%	4.18%	3.83%	9.40%	2.78%	1.05%	0.76%
2011 Consumption (MMcf/d)	49	31	21	4	19	73	9	7	8
2011 Consumption as % of New England demand for sector	8.59%	7.41%	6.84%	0.71%	4.48%	23.64%	1.60%	1.67%	2.50%

Source: Black & Veatch Analysis

Projection Methodology – understanding the impact of weather on residential and commercial demand

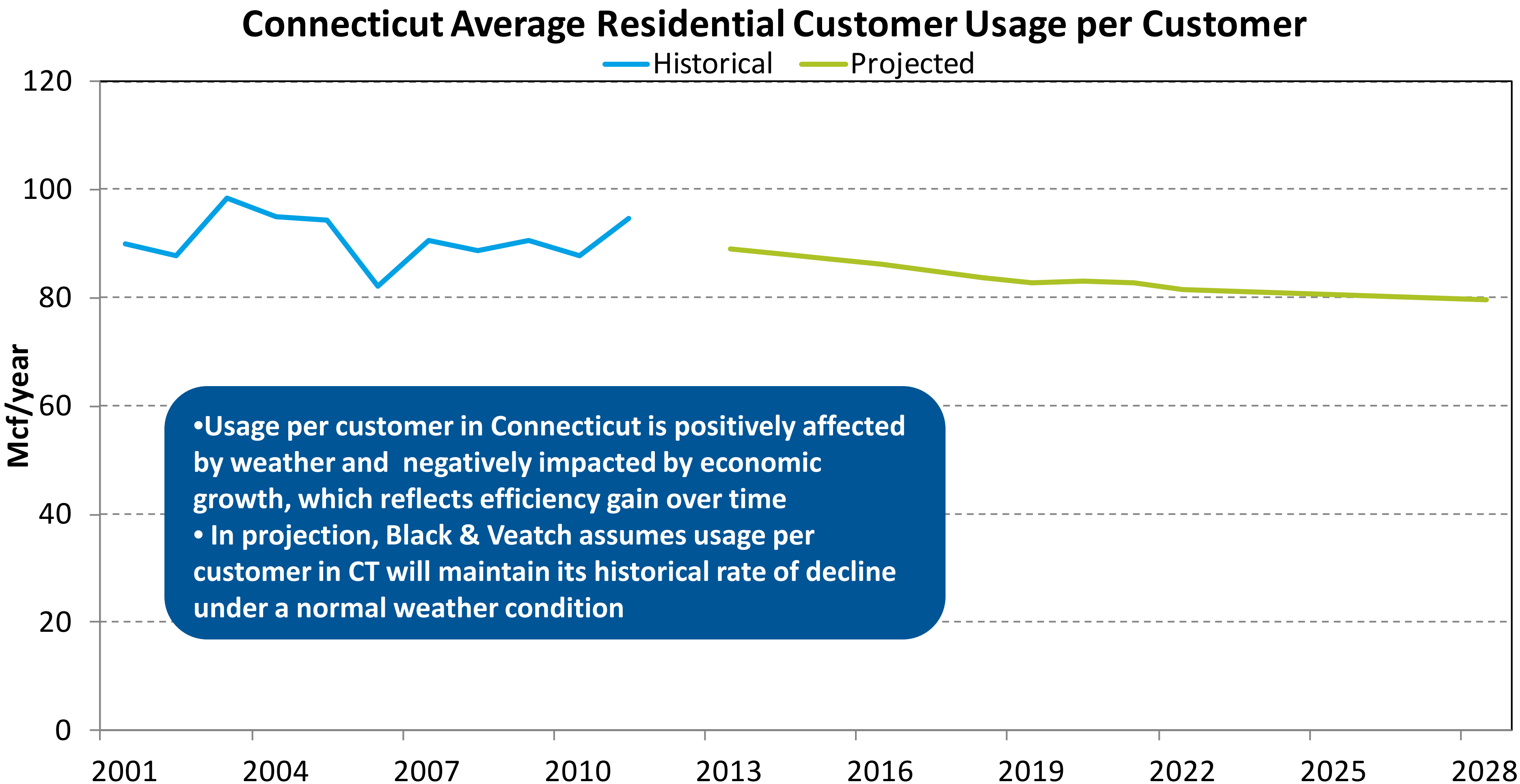


Source: DOE EIA, Black & Veatch Analysis

Black & Veatch Analysis Process

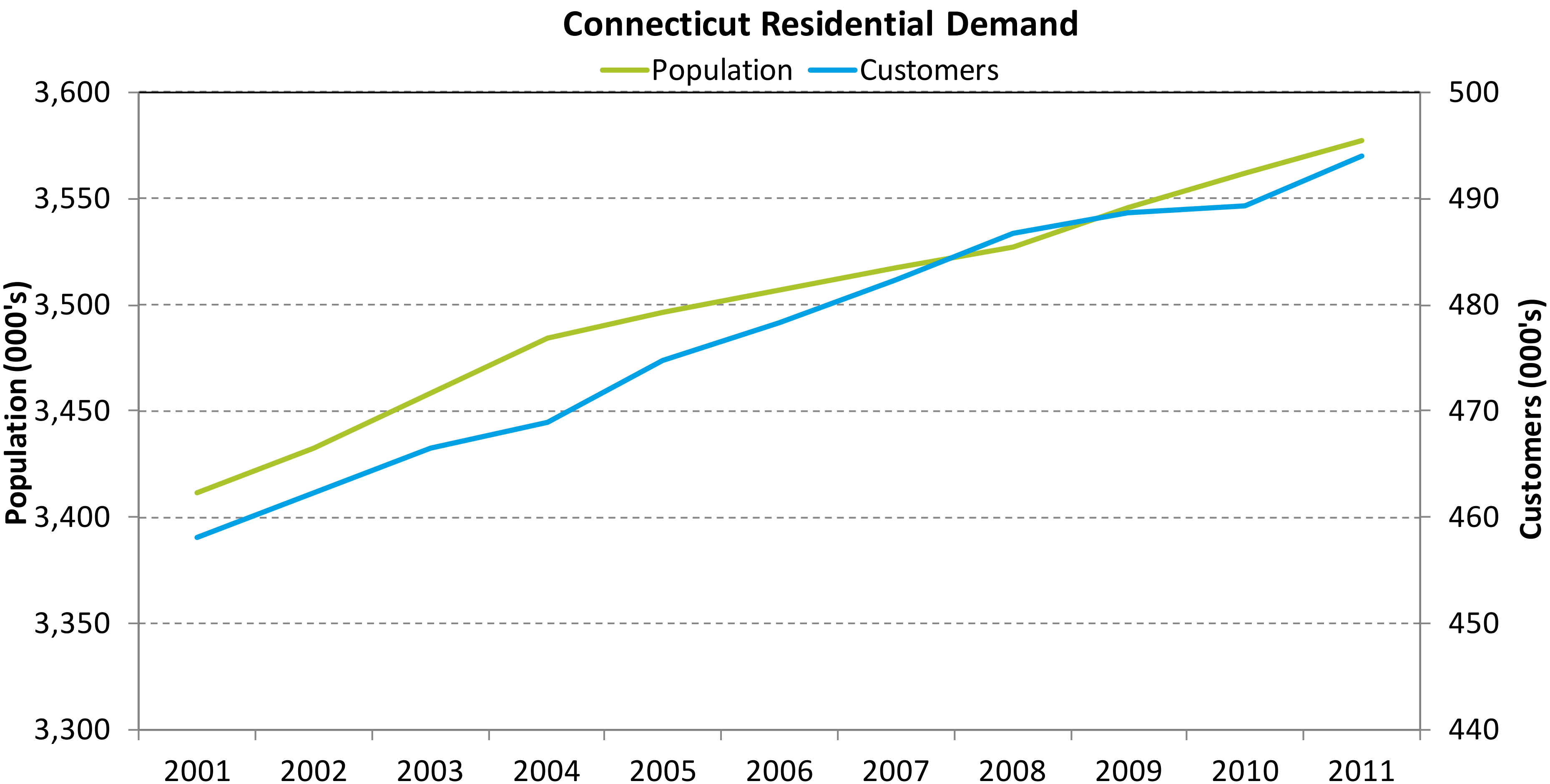
- **For each state and each sector, Black & Veatch has gone through the following process:**
  - Analyze the historical relationship of average customer usage as related to weather or GDP growth
  - Analyze the historical relationship of number of customer growth with that of population growth or GDP growth
  - Assume the historical trend of average customer usage continues into the future under normal weather conditions
  - Assume that the number of customers grow at a rate similar to historical levels
- **We have presented the next several slides for the state of Connecticut to reflect this process and in particular, the fact that our assumed residential and commercial customer growth has reflected the comprehensive energy strategy**

Average residential customer usage was projected using historical weather and gross state product data



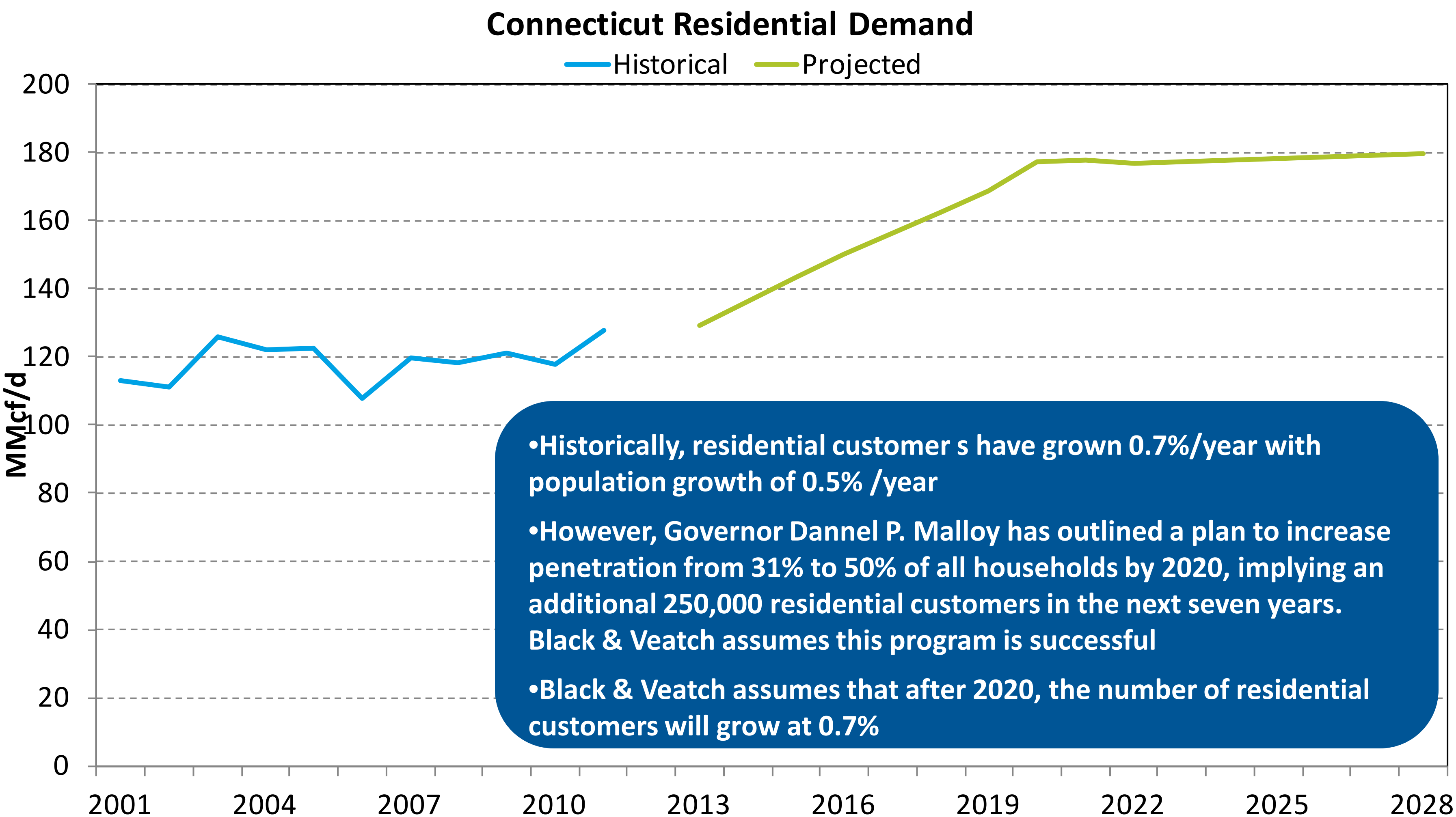
Source: DOE EIA, Black & Veatch Analysis

Connecticut customer growth closely tracks population growth



Source: DOE EIA, Black & Veatch Analysis

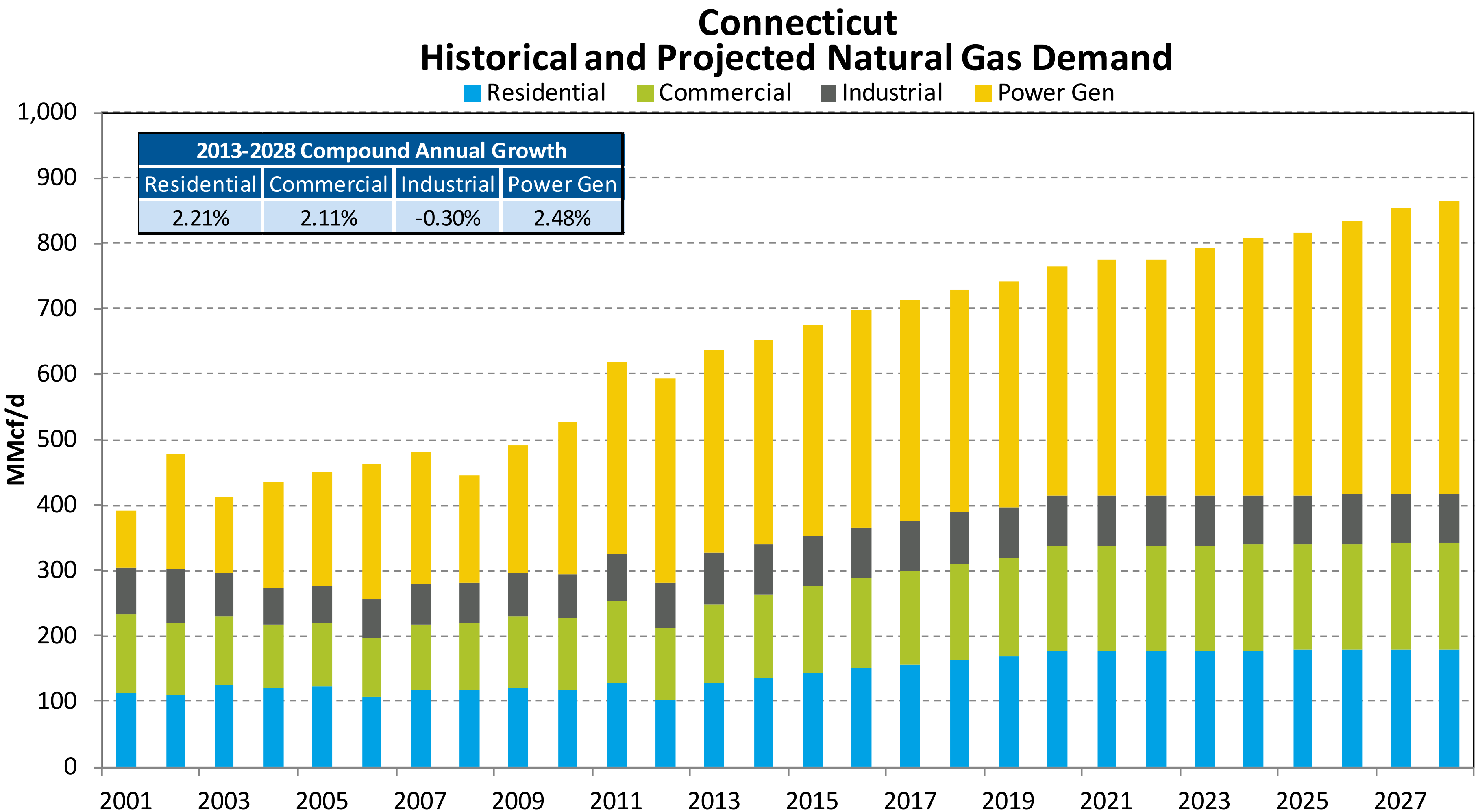
Connecticut residential demand is expected to experience robust growth through 2020



- Historically, residential customer s have grown 0.7%/year with population growth of 0.5% /year
- However, Governor Dannel P. Malloy has outlined a plan to increase penetration from 31% to 50% of all households by 2020, implying an additional 250,000 residential customers in the next seven years. Black & Veatch assumes this program is successful
- Black & Veatch assumes that after 2020, the number of residential customers will grow at 0.7%

Source: DOE EIA, Black & Veatch Analysis

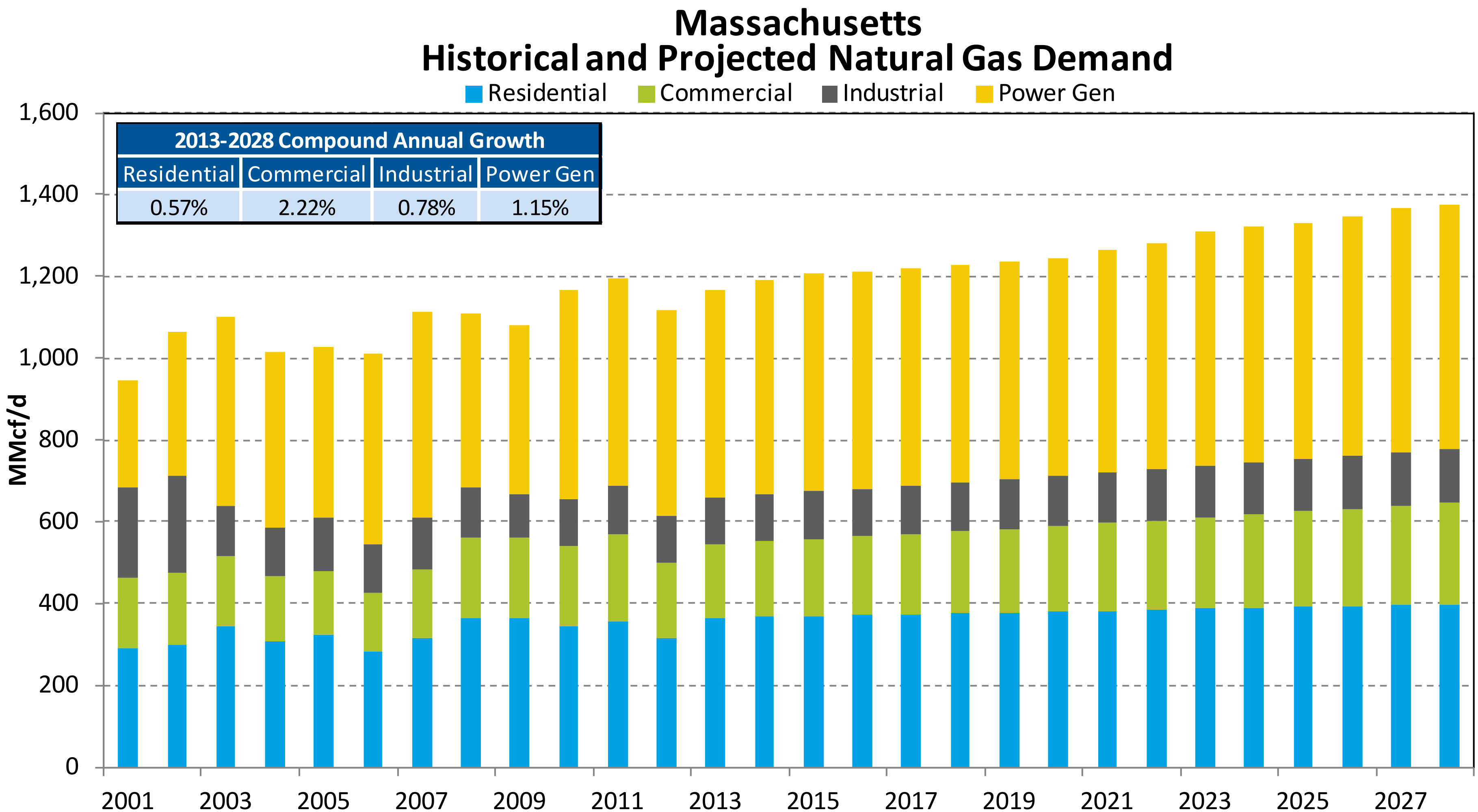
Historical and Projected Residential, Commercial and Industrial Demand for Connecticut



2013-2028 Compound Annual Growth			
Residential	Commercial	Industrial	Power Gen
2.21%	2.11%	-0.30%	2.48%

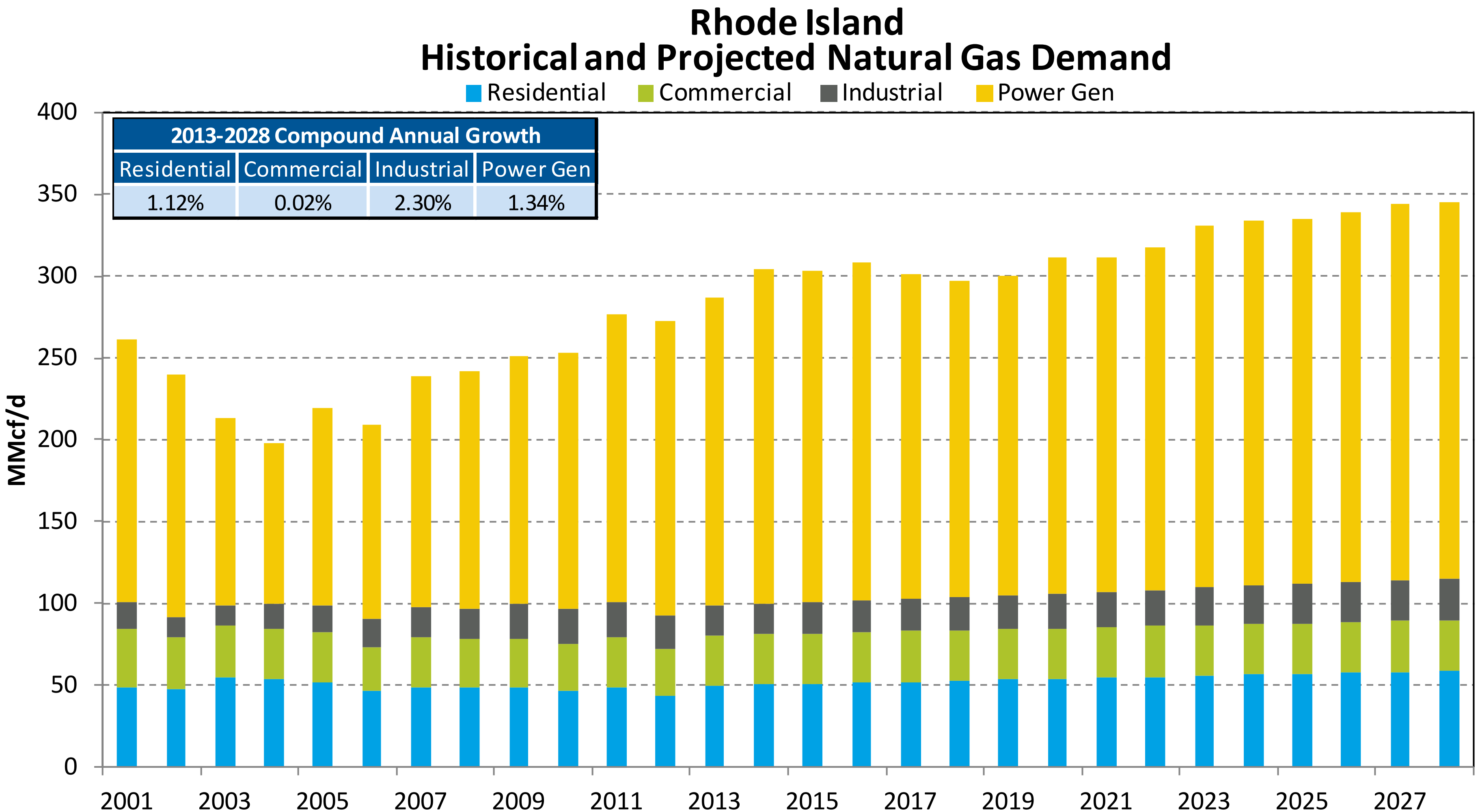
Source: DOE EIA, Black & Veatch Analysis

Historical and Projected Residential, Commercial and Industrial for Massachusetts



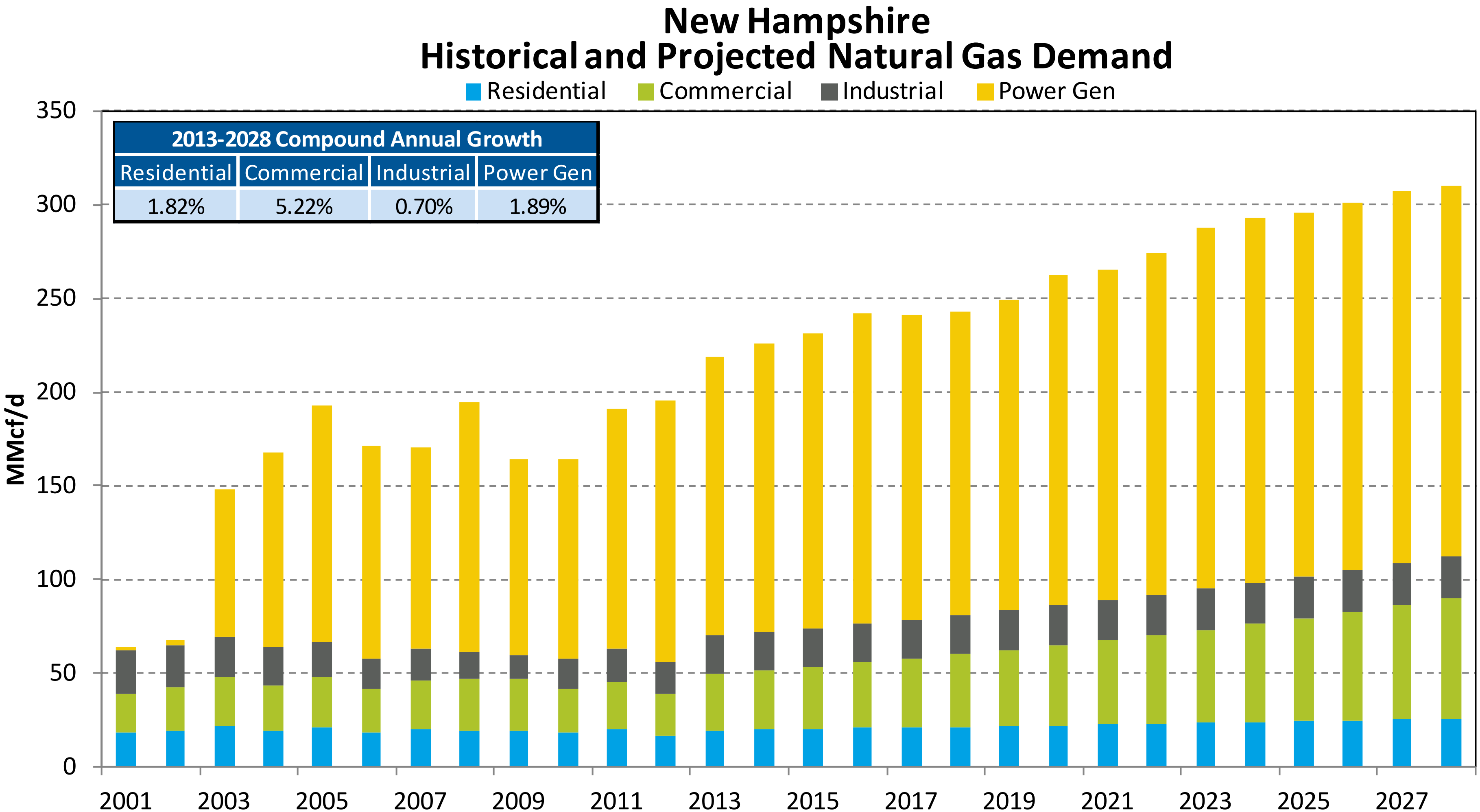
Source: DOE EIA, Black & Veatch Analysis

Historical and Projected Residential, Commercial and Industrial for Rhode Island



Source: DOE EIA, Black & Veatch Analysis

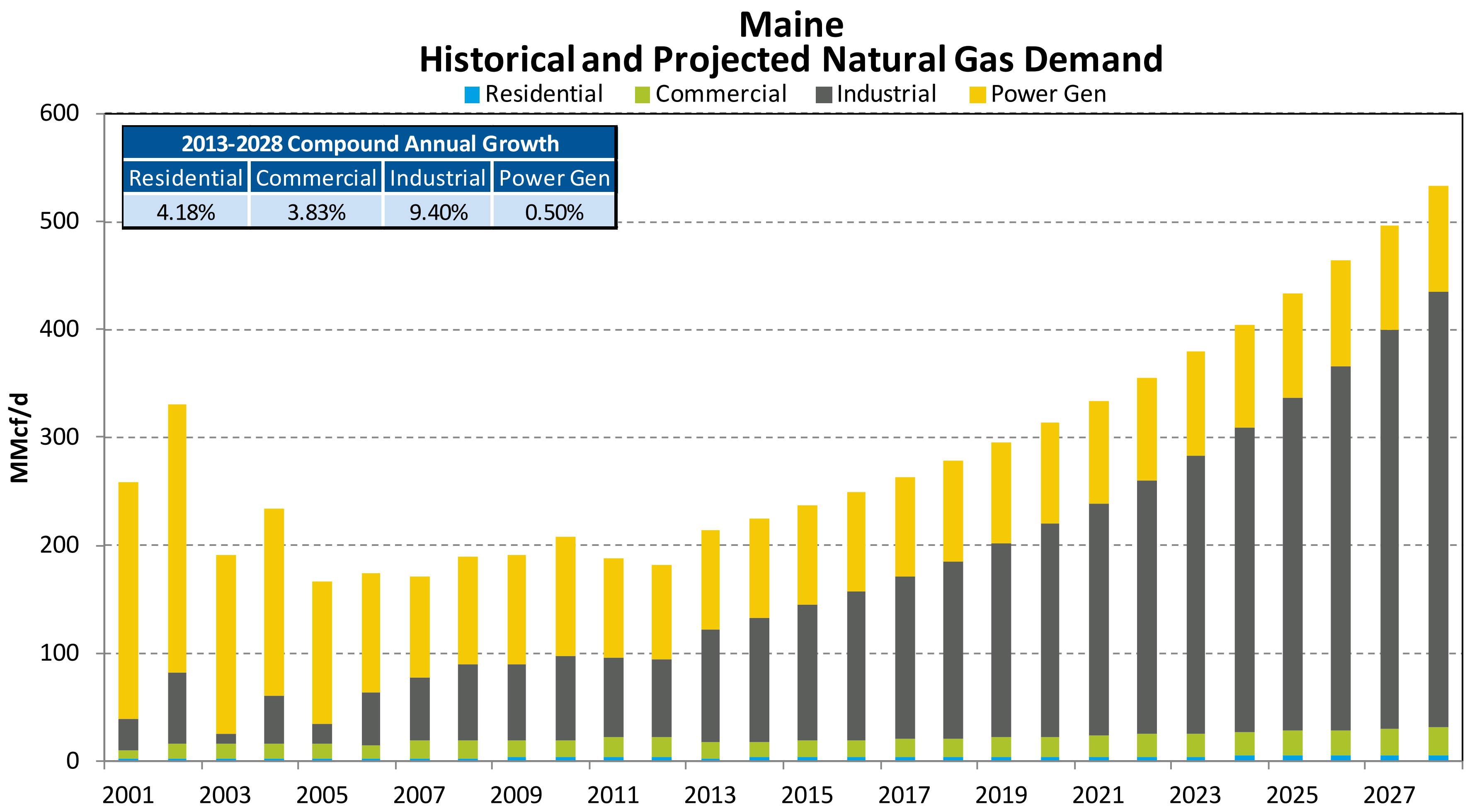
Historical and Projected Residential, Commercial and Industrial and Power Generation for New Hampshire



2013-2028 Compound Annual Growth			
Residential	Commercial	Industrial	Power Gen
1.82%	5.22%	0.70%	1.89%

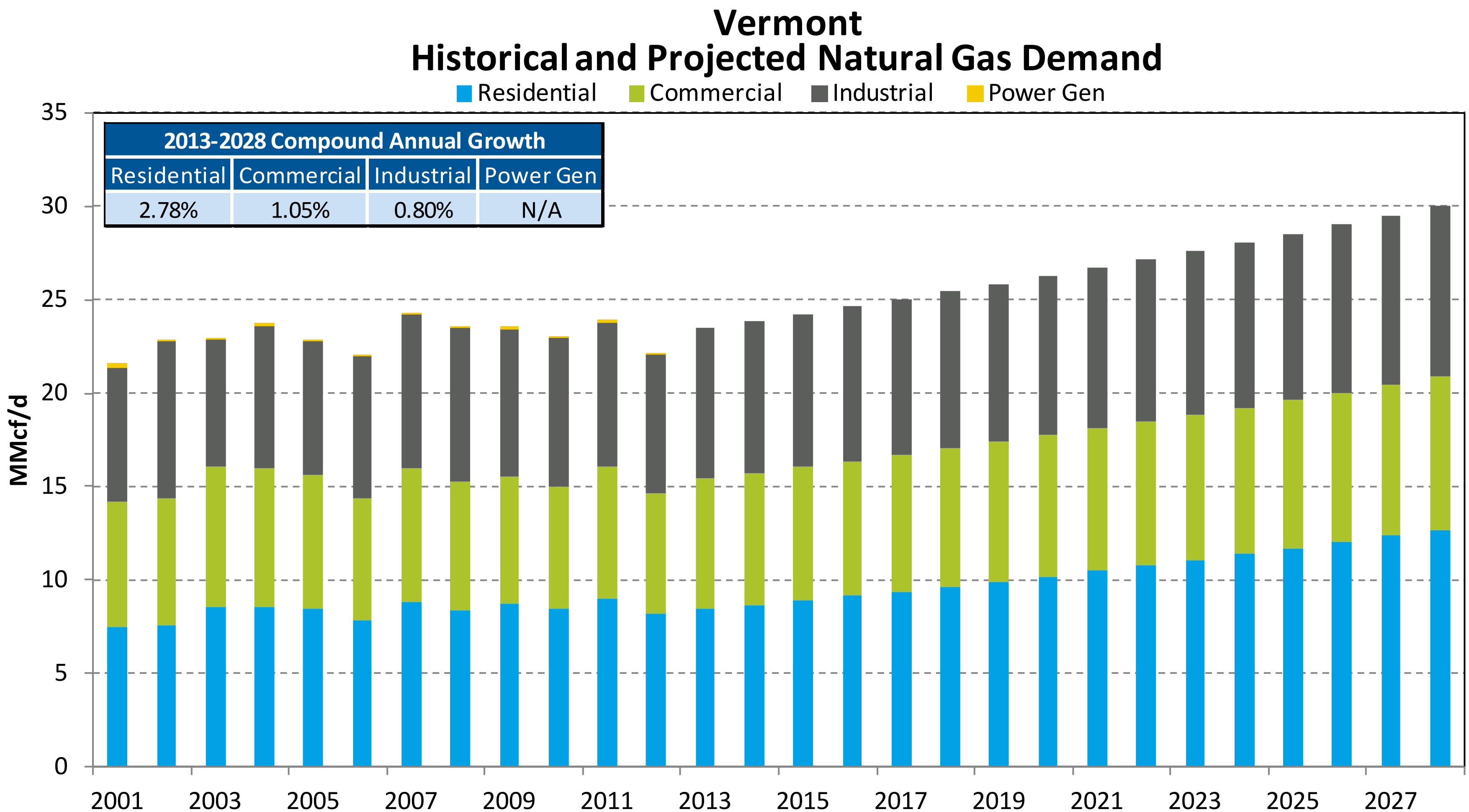
Source: DOE EIA, Black & Veatch Analysis

Historical and Projected Residential, Commercial and Industrial for Maine



Source: DOE EIA, Black & Veatch Analysis

Historical and Projected Residential, Commercial and Industrial for Vermont



2013-2028 Compound Annual Growth			
Residential	Commercial	Industrial	Power Gen
2.78%	1.05%	0.80%	N/A

Source: DOE EIA, Black & Veatch Analysis

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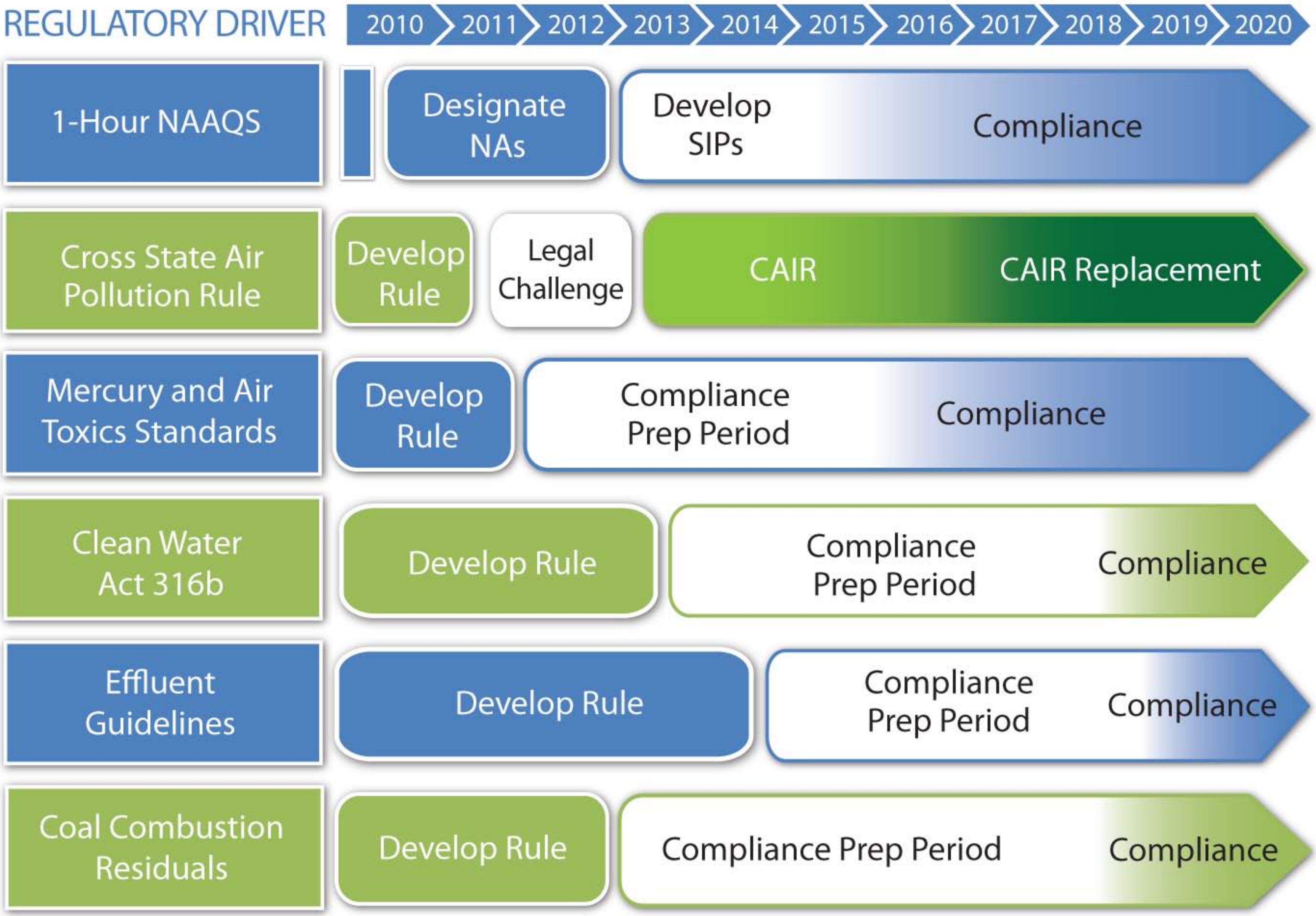
Compliance Deadline Assumptions



Greenhouse gas Regulation Assumptions

Assumes national CO_2 reductions are called for by a cap and trade program with delays in targeted emission reductions

- Legislative delays and CO_2 reductions resulting from implementation of a regime similar to CSAPR in 2016 and other regulation drives our assumption of 2020 being the first year of implementation for a carbon policy
- Covers electric generation, transportation and other fossil fuels used by residential, commercial and industrial sectors
- Until 2020, northeastern states continue to comply with RGGI. California compliance to begin in 2013

CO_2 emission caps are estimated by some to produce stable world temperatures by 2070.

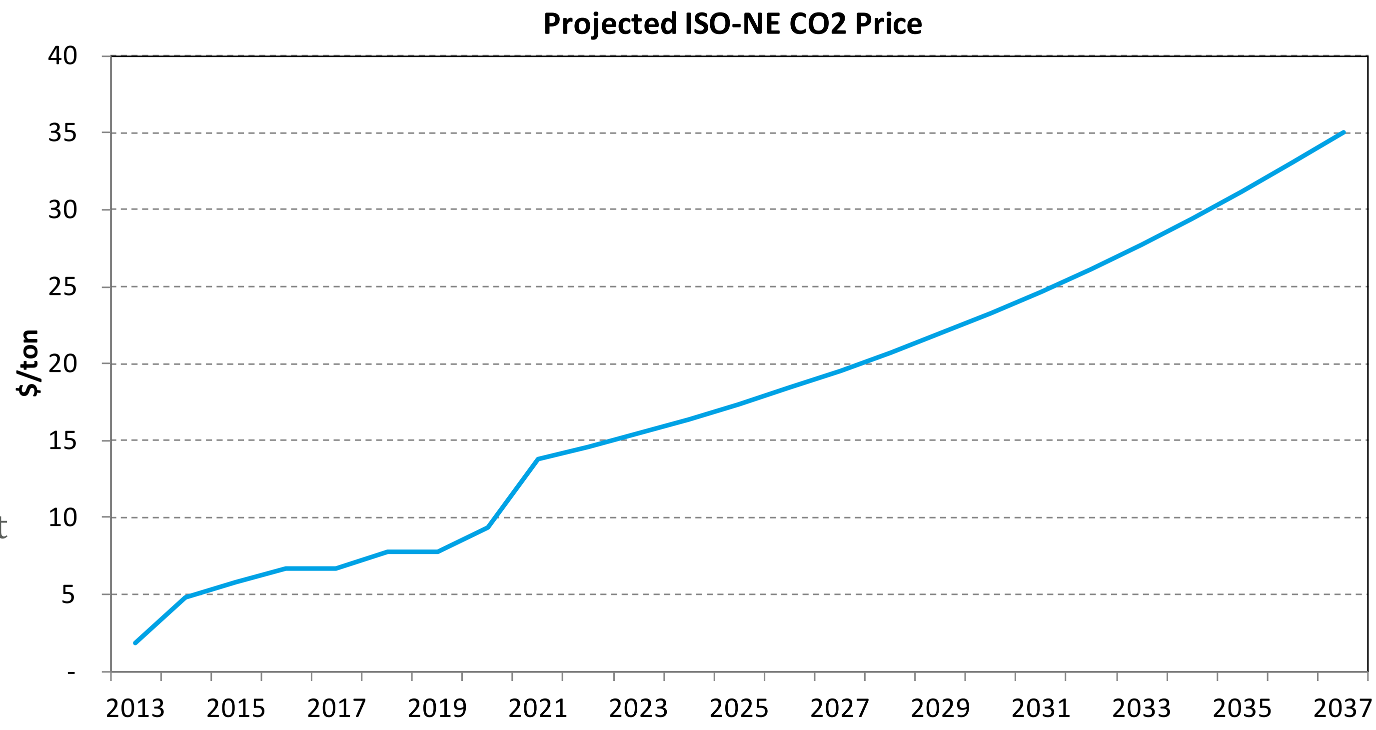
Technical assumptions inherent in Black & Veatch Baseline Forecast

- Allowances can be banked for future use
- Use of 2 billion metric tons (2.2 billion short tons) of emission offsets is allowed economy-wide
- A CO_2 cap & trade program will induce the application of the most cost-effective avoidance and abatement measures first and additional measures in order of increasing cost until total emissions are under the targeted cap – Allowance prices are determined by the marginal cost of control of the last measure required to meet the cap
- Electric industry caps and use of offsets are in proportion to economy-wide caps. Currently electric generation contributes 39% of covered emissions
- New combined cycle capital costs and lower near-term natural gas prices reduce resulting CO_2 prices

Offsets are permanent greenhouse gas emission reductions or avoidance (including sequestration) not required by any law or regulation. The offset project developer is issued one credit for each CO_2e that the project reduces, avoids or sequesters.

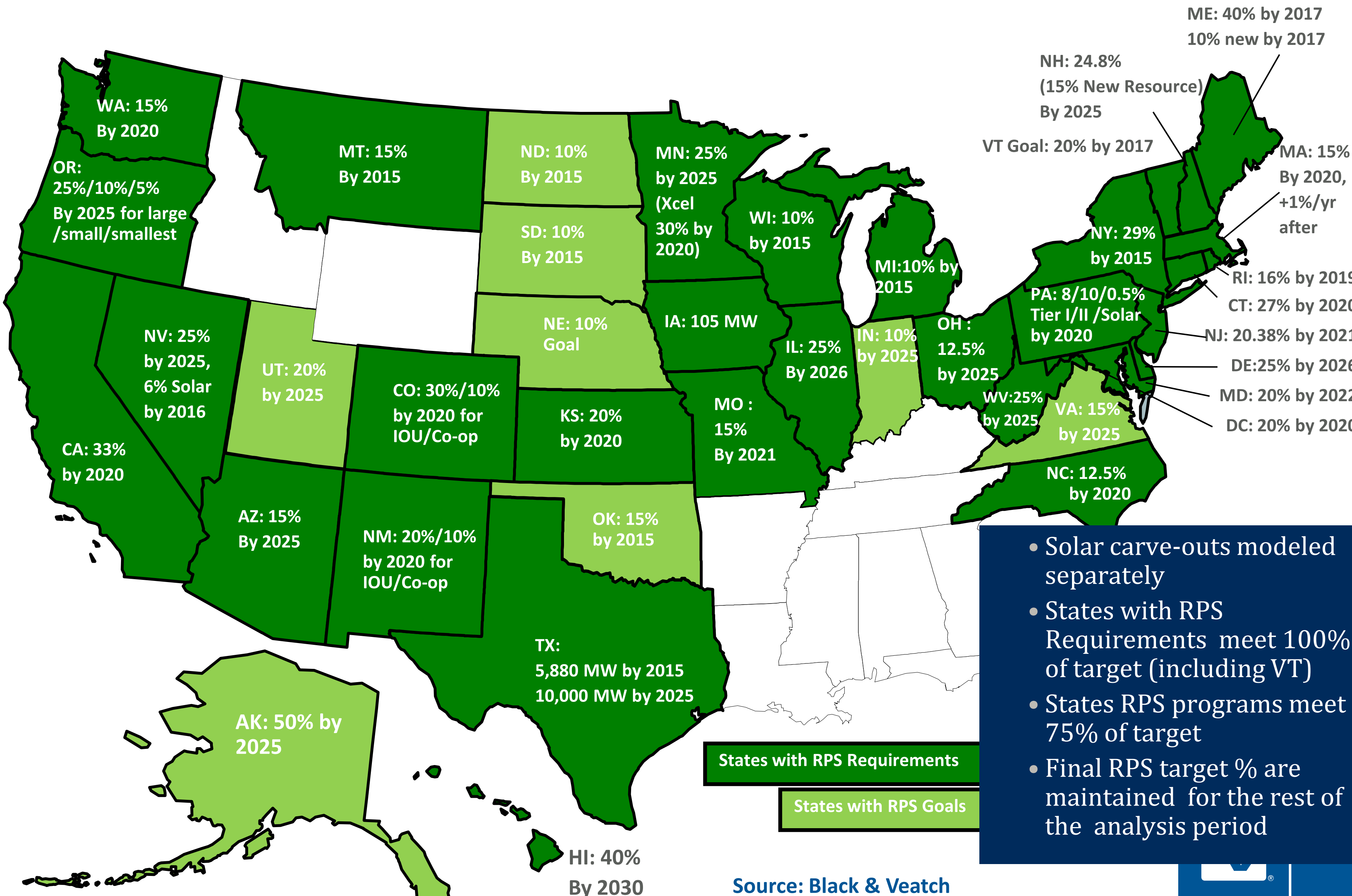
New England States will be subject to RGGI before national carbon legislation in 2020

- Emission allowance prices depend upon projected trading between states, coal unit retirements, and EPA regulations, among other factors
- RGGI price is an average based on IPM modeling performed for the RGGI program review
- Black & Veatch assumes that MATS compliance will be in effect from end of 2015
- Black & Veatch assumes carbon legislation will come into effect in 2020, and have assumed the CO2 prices shown to model the impact of carbon legislation on our forecast



Source: Black & Veatch Analysis

State Renewable Portfolio Standards



- Solar carve-outs modeled separately
- States with RPS Requirements meet 100% of target (including VT)
- States RPS programs meet 75% of target
- Final RPS target % are maintained for the rest of the analysis period

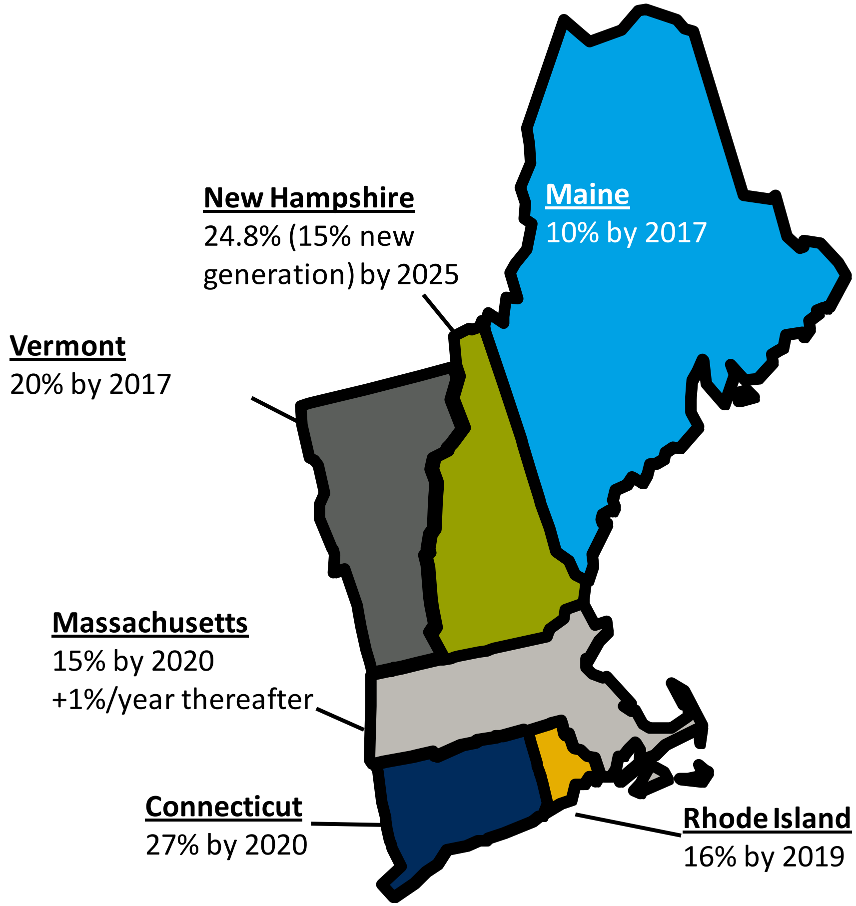
Source: Black & Veatch

New England Renewable Portfolio Standards

- Vermont's SPEED program has a voluntary goal of reaching 20% of load by 2017 being served by new (post-2005 vintage) renewables

- The Renewable Energy Certificates (RECs) generated by Vermont's renewables projects are not used toward the state's SPEED goals

- For the RECs that are sold to Massachusetts and Connecticut, the same number of renewable deducted from the Massachusetts and Connecticut renewable capacity additions



Source: Black & Veatch Analysis

Black & Veatch's Approach For Plant Retirements

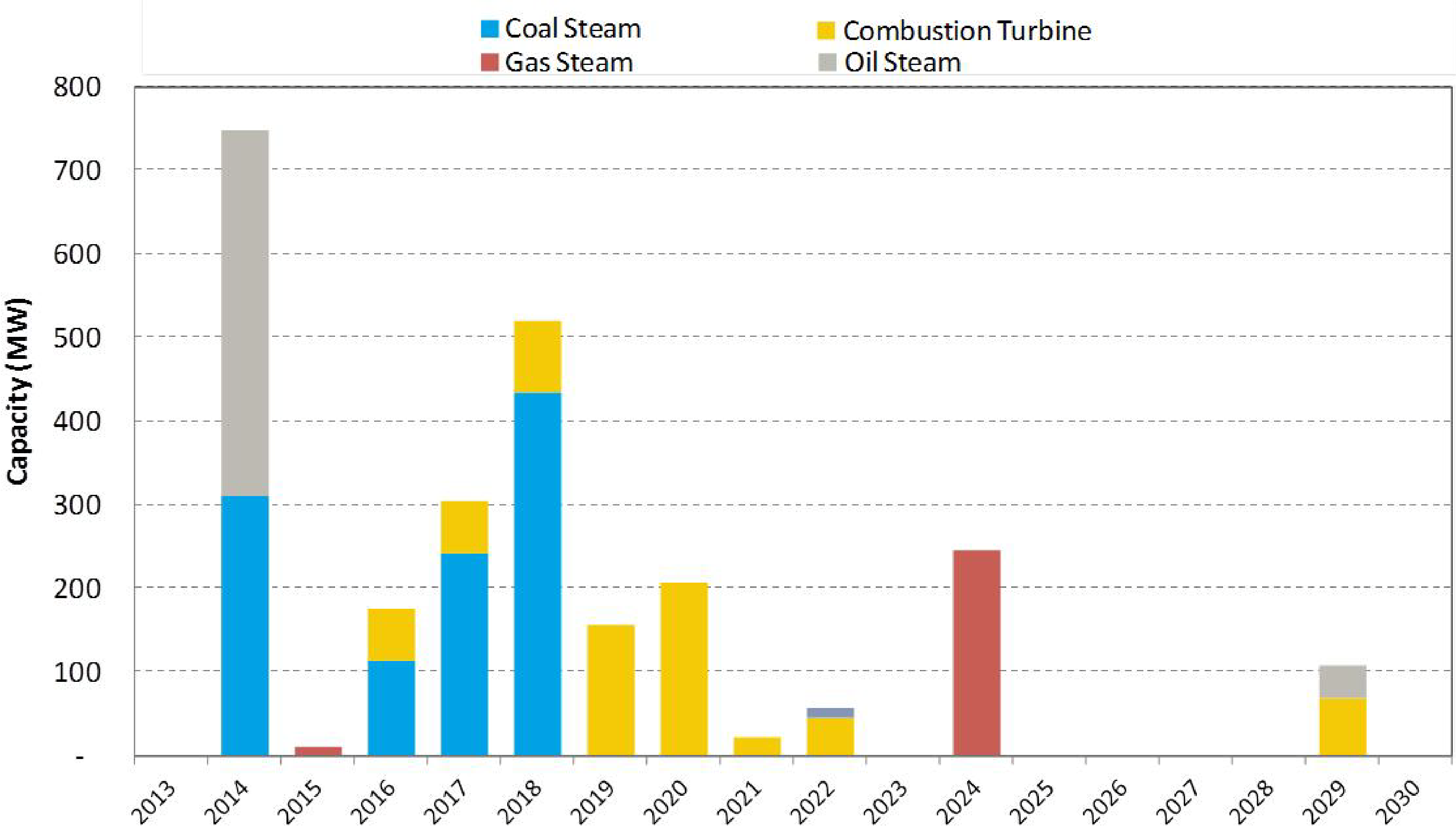
- **Black & Veatch applies a five-stage approach to determine unit retirements for the analysis period**

- **Retrofit and related economic analysis is based upon publically available information on each plant and industry average cost for retrofits**

- **Oil and old natural gas units are retired according to public announcement or age**

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
• Announced retirements	• Retirements of uneconomical units	• Assessment of units (on an individual unit basis), that would need different emission control equipment to be installed in order to be compliant	• Retirement of old units	• Retirement of units that are unable to recover cost of retrofits

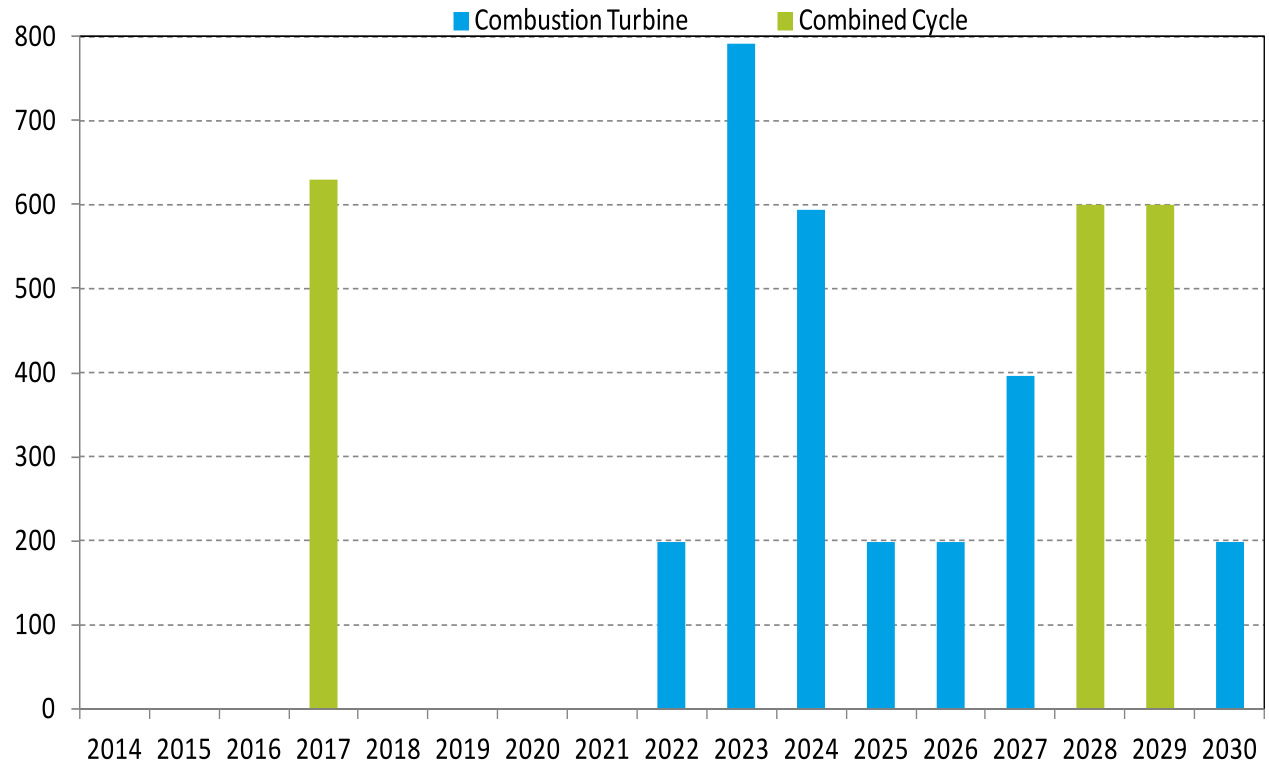
Assumed ISO-NE Retirements



Source: Black & Veatch Analysis

Future Resources are likely to be an even mix of CTS and CCS

- Black & Veatch assumes new Combined Cycle and Combustion Turbine units with improved heat rates), low installation costs, and lower operating costs will be available in the region.
- New capacity is anticipated after 2020-21 when the reserve margin falls below the target level
- Initially only CTs are built to provide peaking capacity and energy. Subsequently as energy demand goes up, CCs are added along with CTs to provide efficient baseload energy in addition to fulfilling capacity needs.
- New combined cycles are added in Massachusetts and Connecticut
- CTs are added throughout the region
- This capacity addition plan is based on Energy Efficiency forecast extrapolated flat after 2022, which may be revised



Source: Black & Veatch

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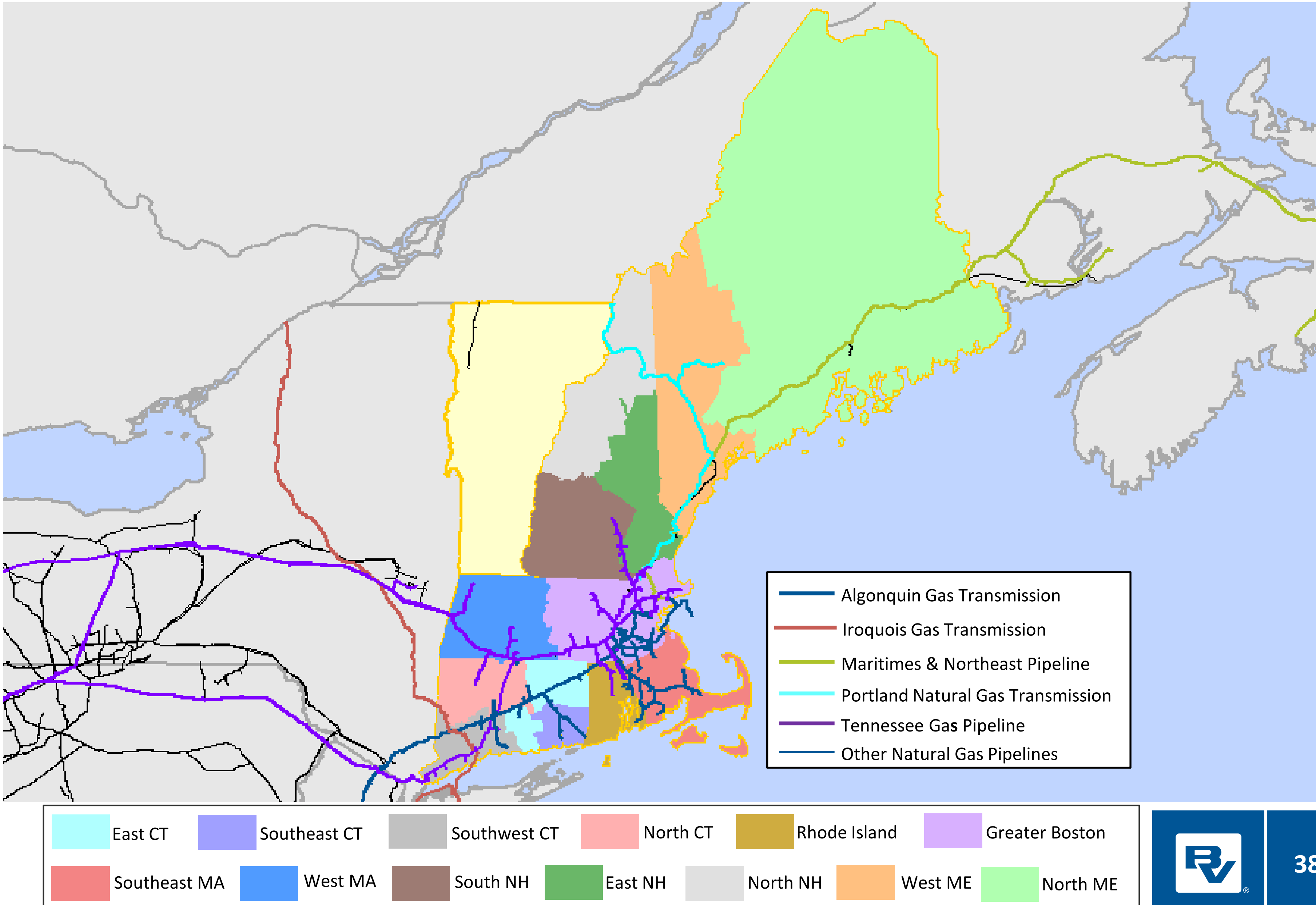
Overview of Geographic demand disaggregation within New England

- **Black & Veatch separated New England into 14 sub-regions to reflect physical access to natural gas supply and capacity constraints**
  - Black & Veatch considers VT demand in total demand for gas in New England, however, since the volume is relatively small, no separate load duration and constraint assessment is performed for VT
- **The regional breakout is at an aggregated county level and considers service territories of Local Distribution Companies ("LDC") and physical access to interstate pipelines**
- **The following map shows the geographic demand nodes that Black & Veatch has evaluated individually**

New England Demand Sub-Regions



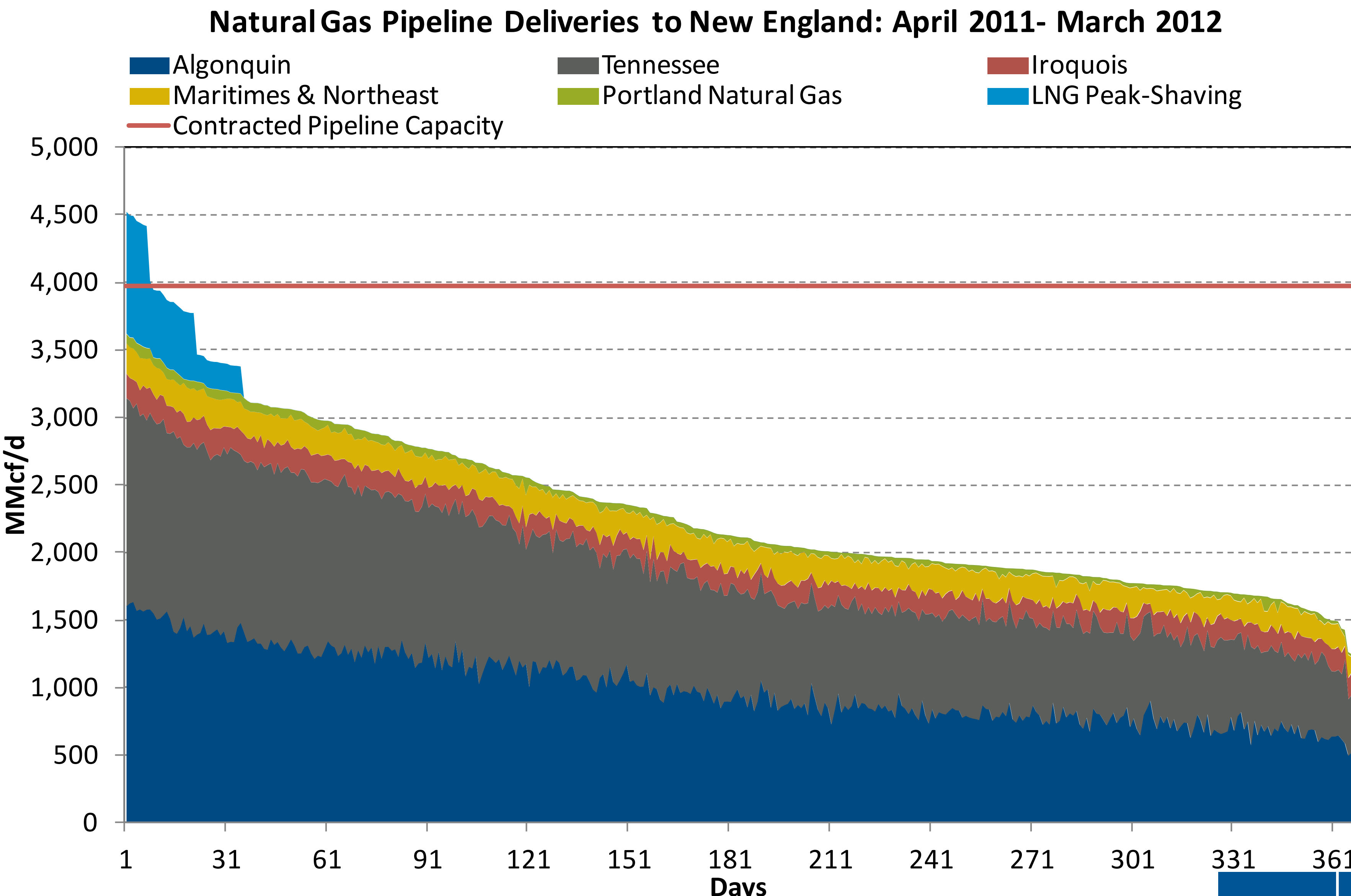
Load Duration Curves for Each Sub-region and Existing Capacity

- Black & Veatch undertook an analysis to convert the static demand projection into a visual load duration curve over a year. The “load shape” of a region provides a summary of the range of demand experienced as well as how often various levels of demand were experienced over a period of time
- Gas capacity is compared against with the daily load duration, Black & Veatch assessed the physical capacity on existing natural gas pipelines as well as the current firm contracted capacity to delivery points serving the sub-region
- Black & Veatch constructed hourly load duration curves for select sub-regions that have the largest proportion of gas fired generation load to assess hourly variation of power load could exacerbate the gas infrastructure adequacy issues during summer periods of peak electric demand

Load Duration Curves for Each Sub-region and Constraint Capacity

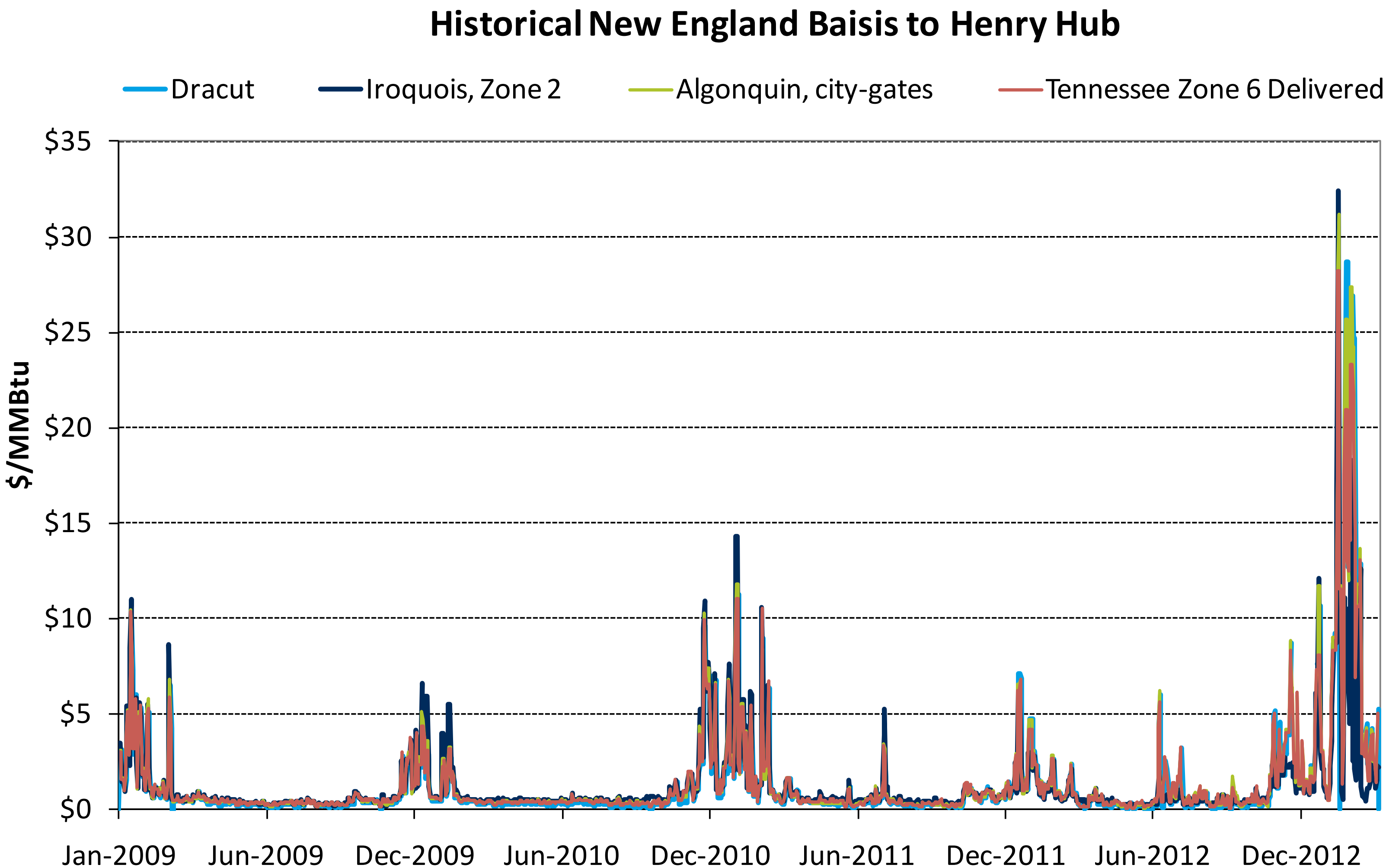
- Black & Veatch's review of the historical daily and hourly load duration curves for sub-regions only identified limited occurrences of total load requirements exceeding the existing pipeline contract capacity at certain sub-regions
- This is inconsistent with the increasing New England market constraints expressed by significantly higher levels of natural gas price volatility than other parts of the US
- Black & Veatch constructed a statistical analysis to conclude that when total deliveries in a sub-region approaches 75% of existing contract capacity serving the sub-region, basis frequently spikes up
- To reflect these dynamics that are characteristic of the New England market, Black & Veatch constructed an "Existing Constraint Capacity" which is 75% of existing contracted capacity

Aggregate New England Load Duration Curve



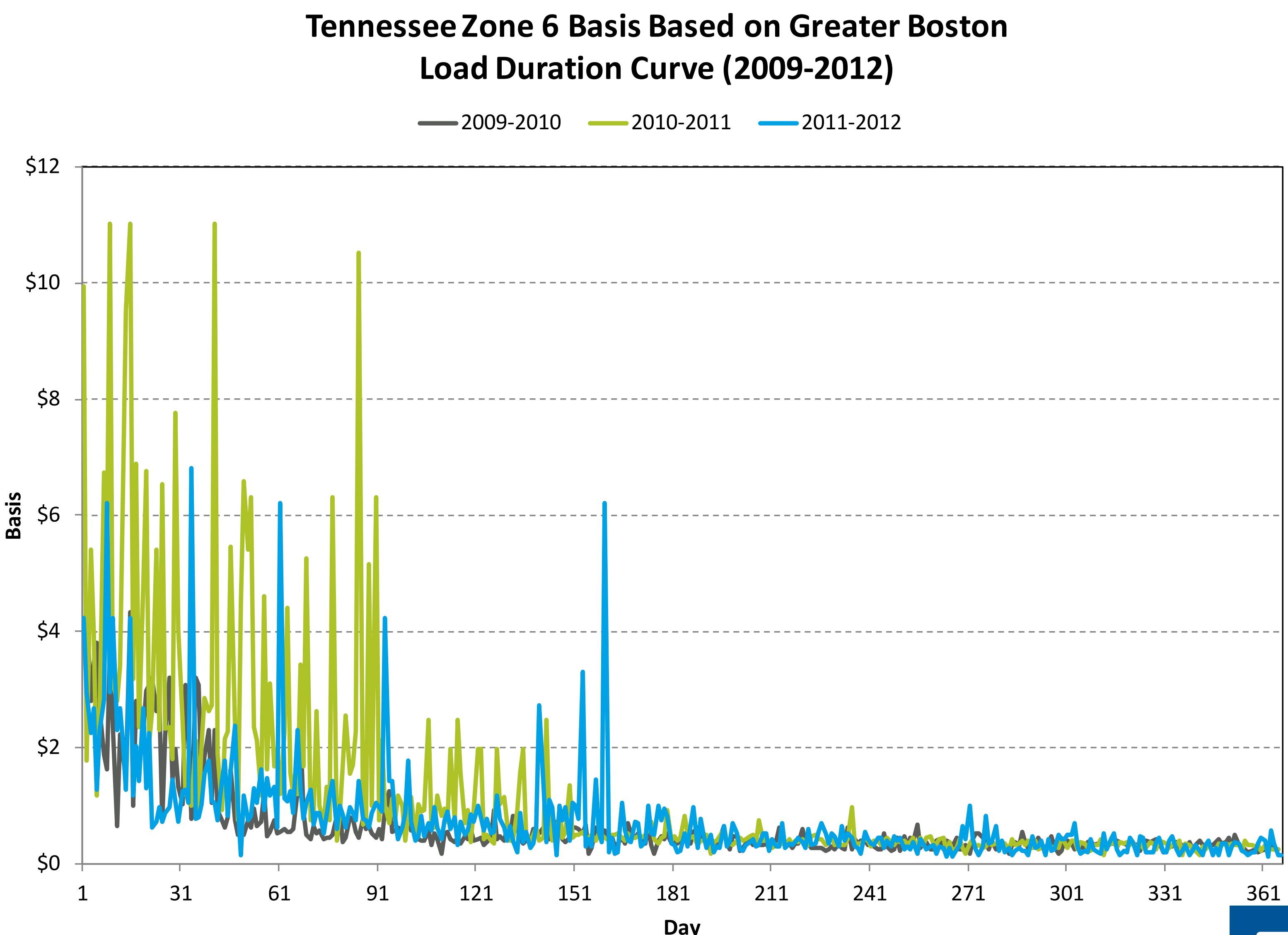
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

New England Natural Gas Price Volatility Has Risen this Past Winter



Source: Black & Veatch Analysis, Platts Gas Daily Prices

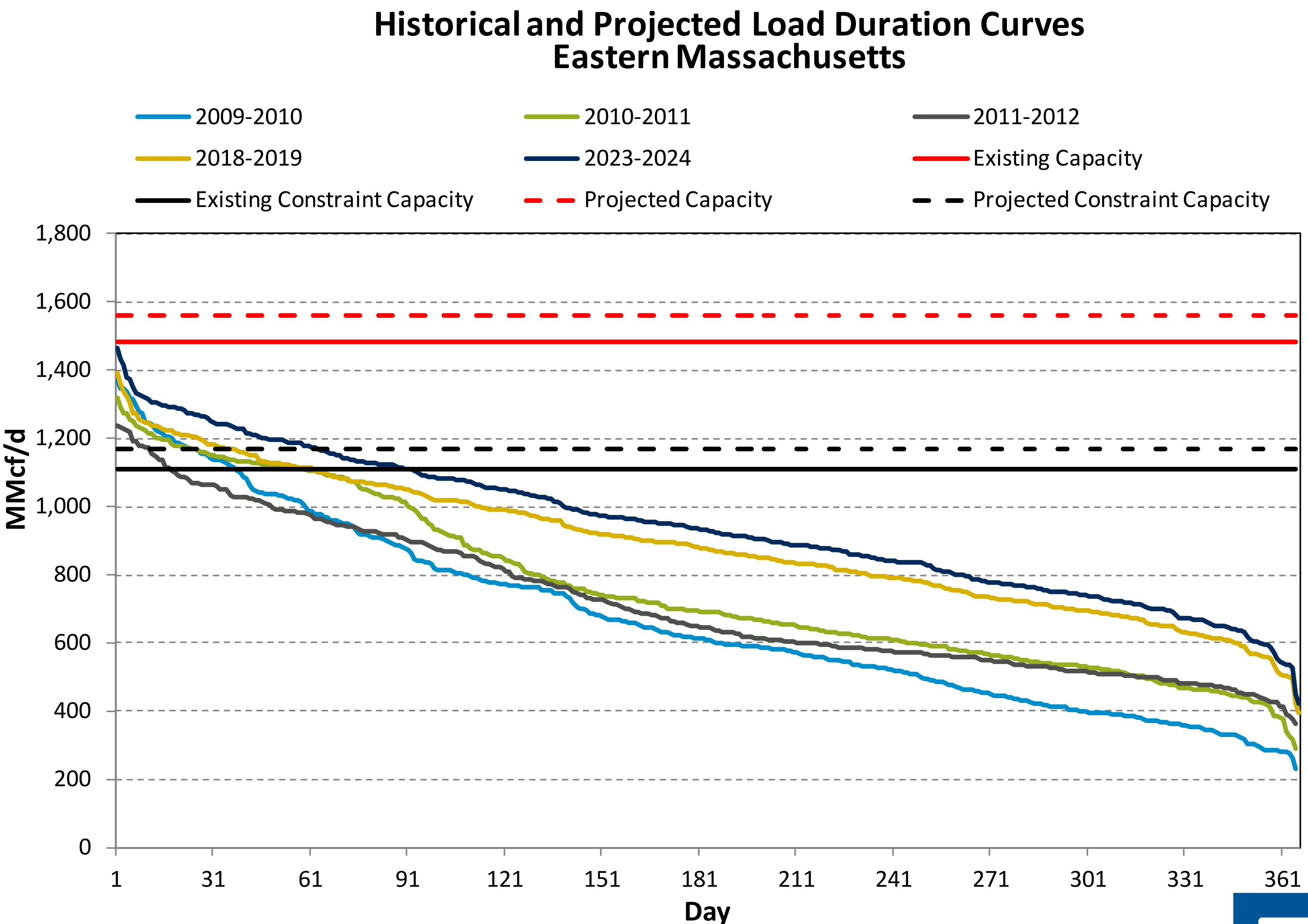
Strong Relationship between Daily Load Duration and Natural Gas Price Basis Blowouts



Source: Black & Veatch Analysis, Platts Gas Daily Prices

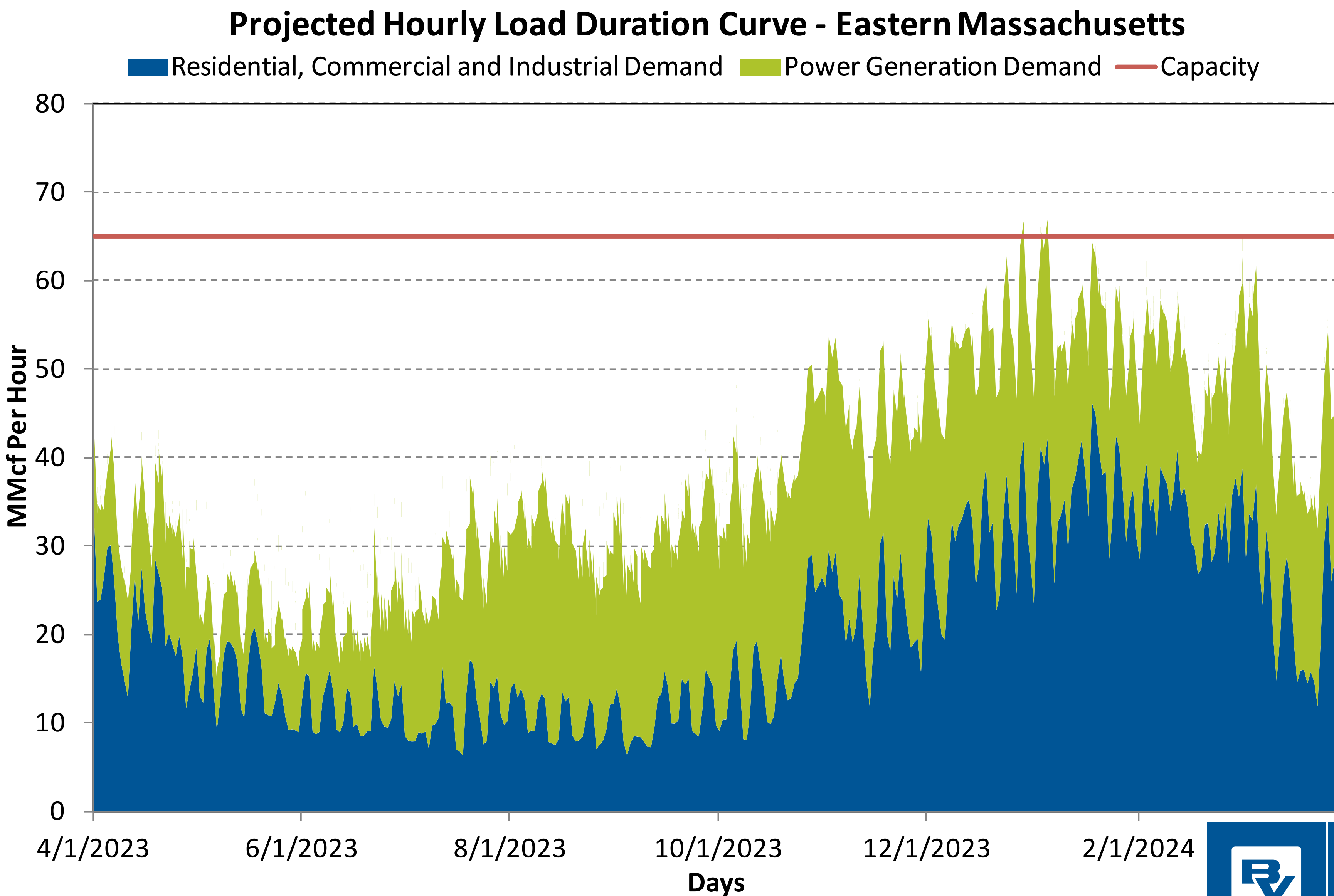
Pipelines & Natural Gas Power Generation Eastern Massachusetts

Eastern Massachusetts Load Duration Curve



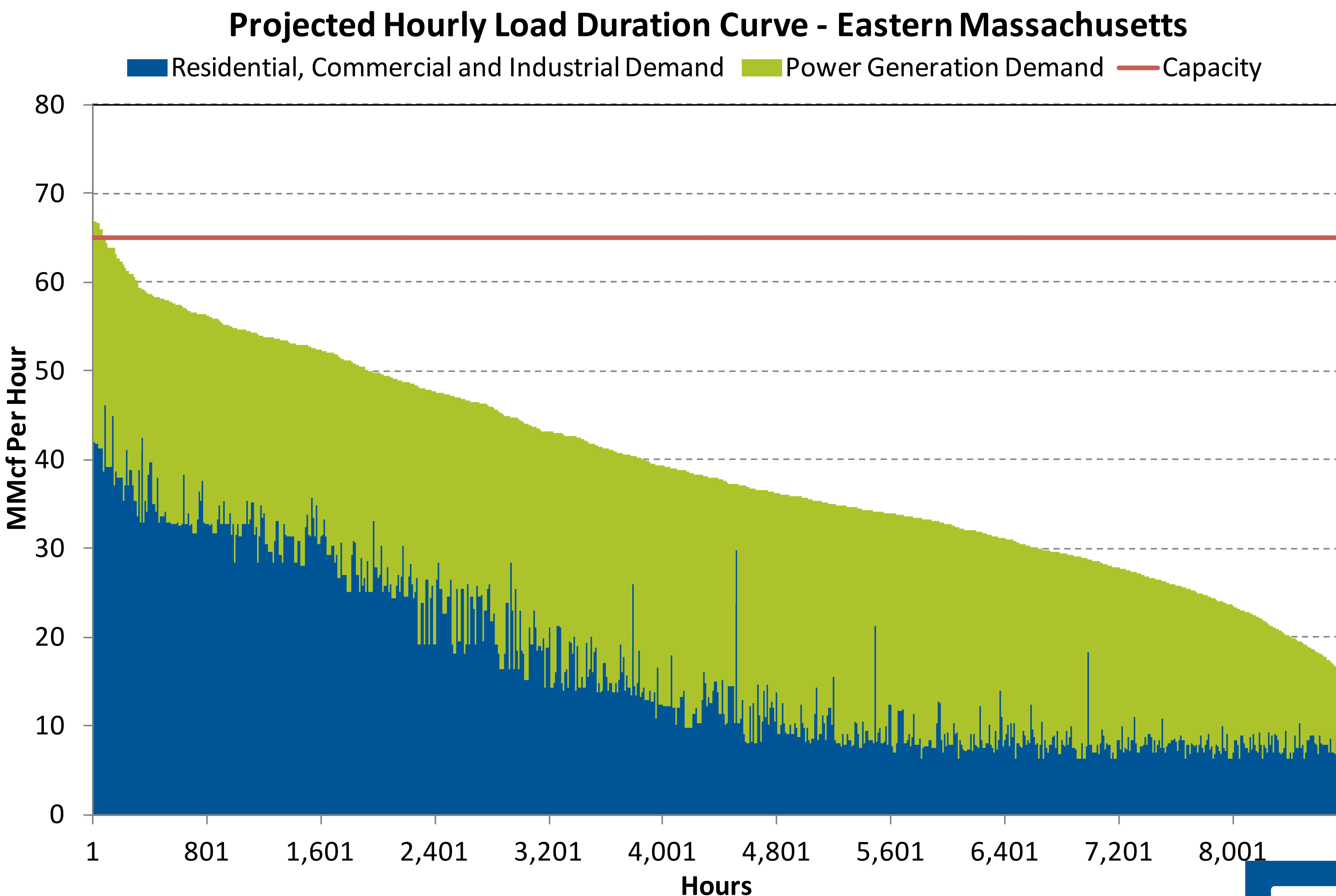
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Projected Hourly Load Duration Curve from April 2023 thru March 2024- Eastern Massachusetts



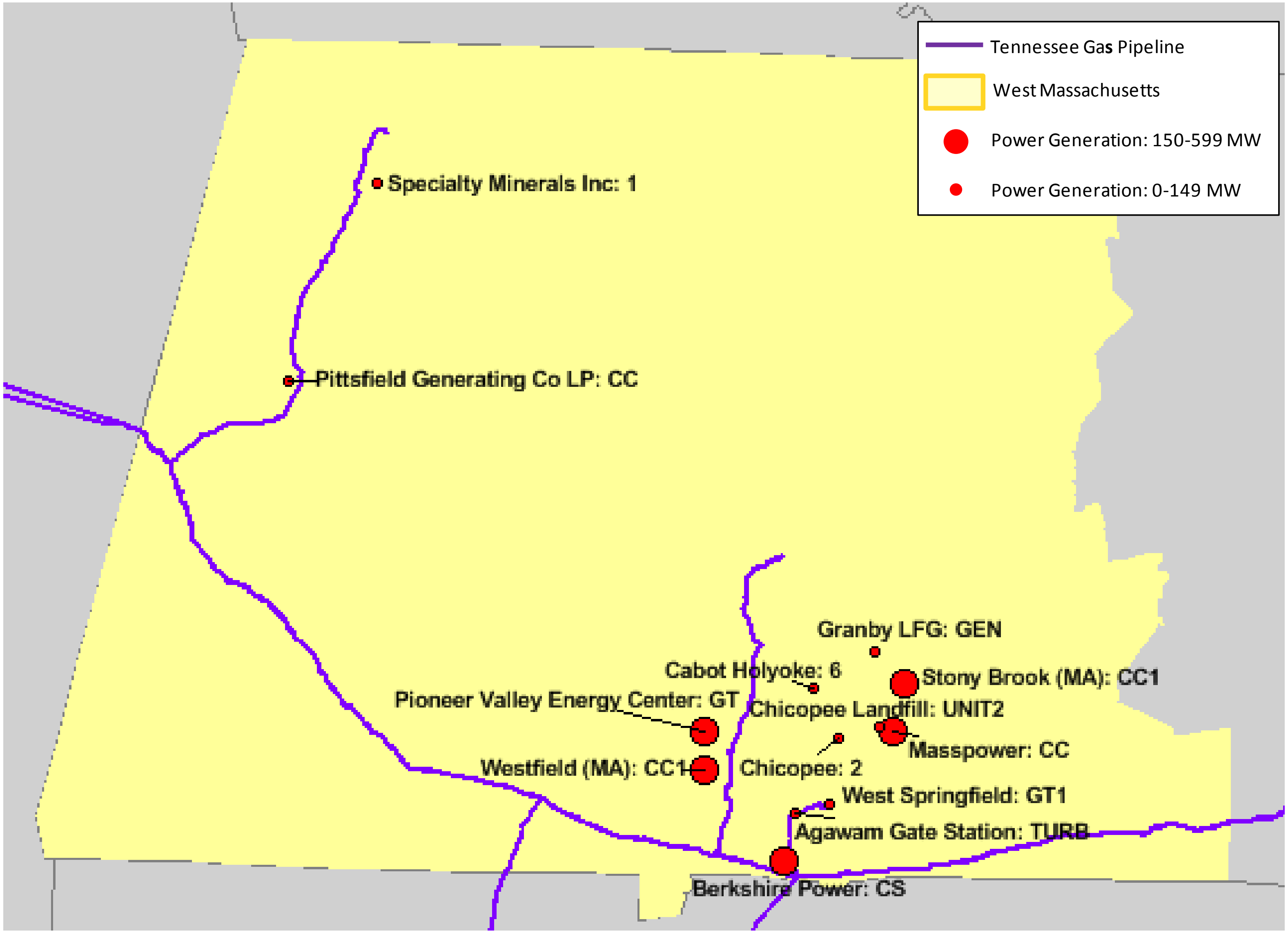
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Projected Hourly Load Duration Curve for 2023 to 2024 Gas Year – Eastern Massachusetts

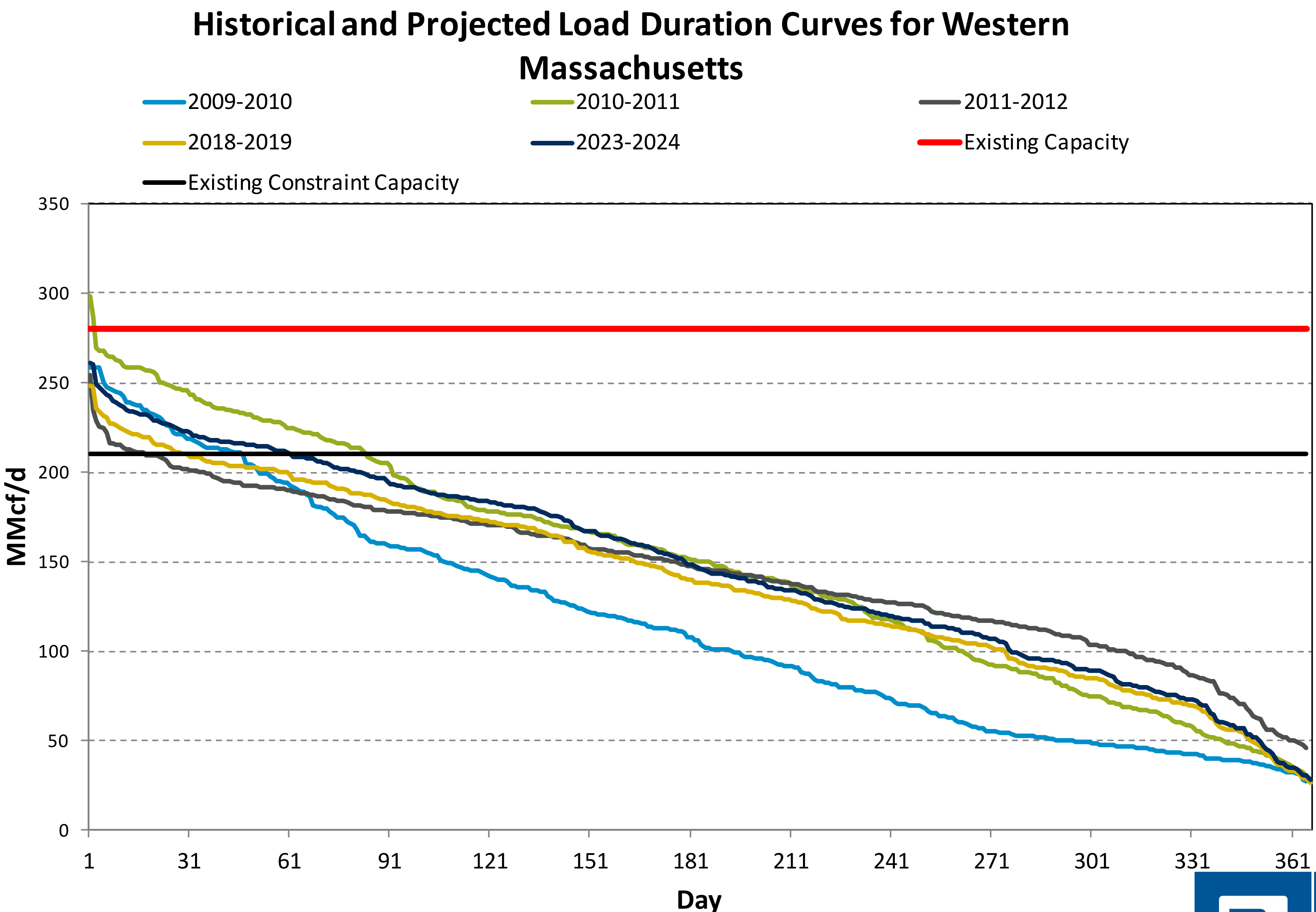


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Western Massachusetts

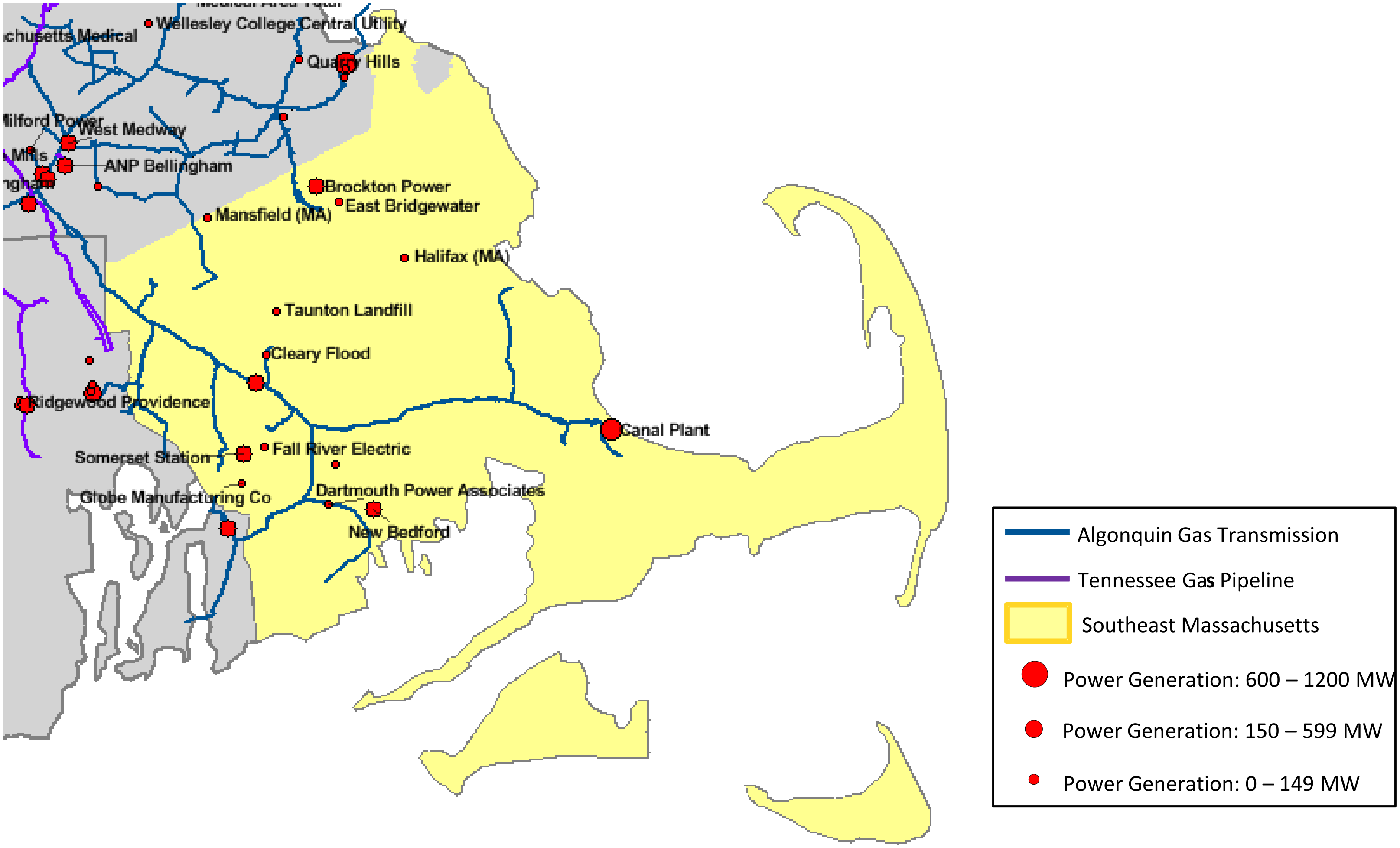


Western Massachusetts Load Duration Curve

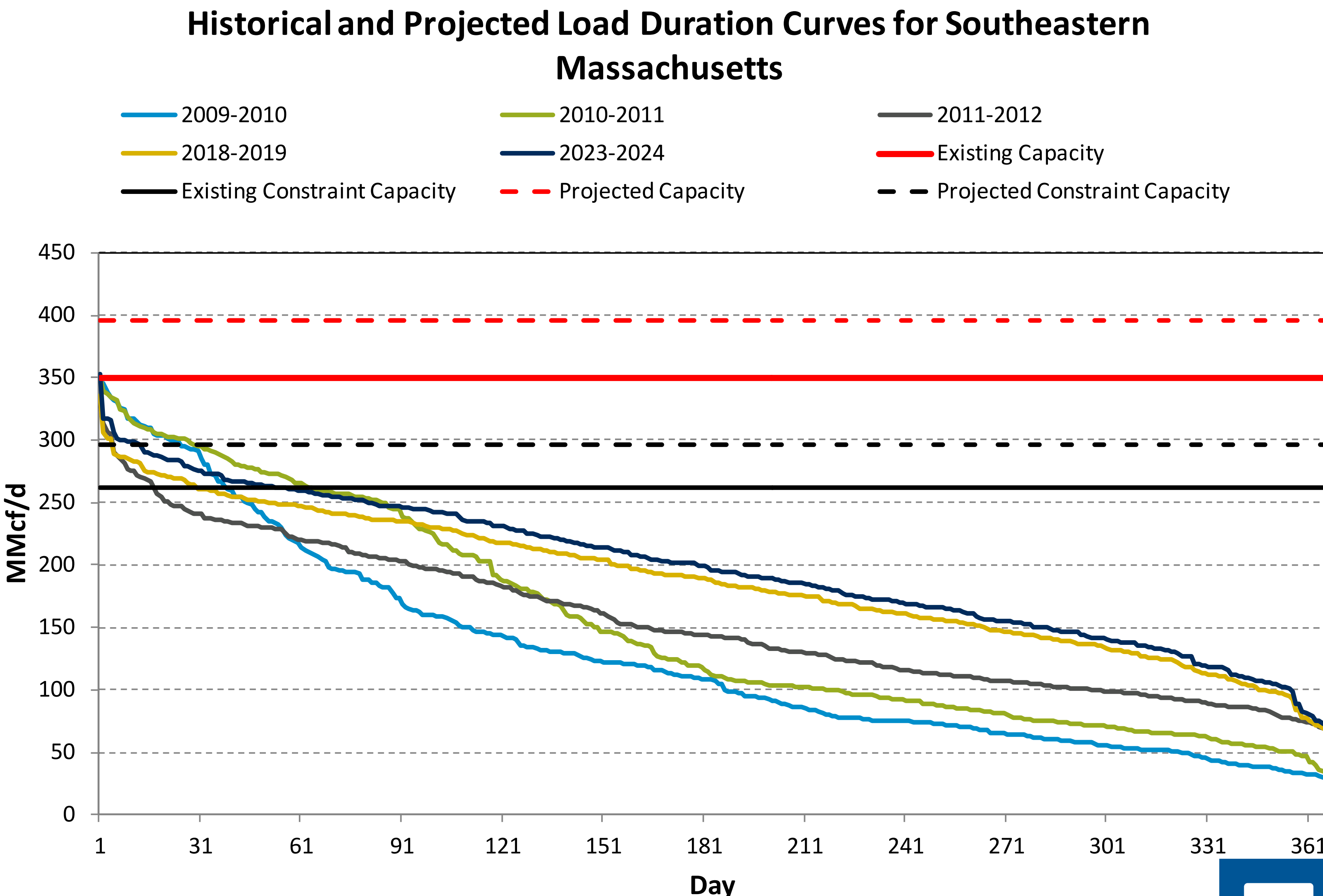


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Southeastern Massachusetts

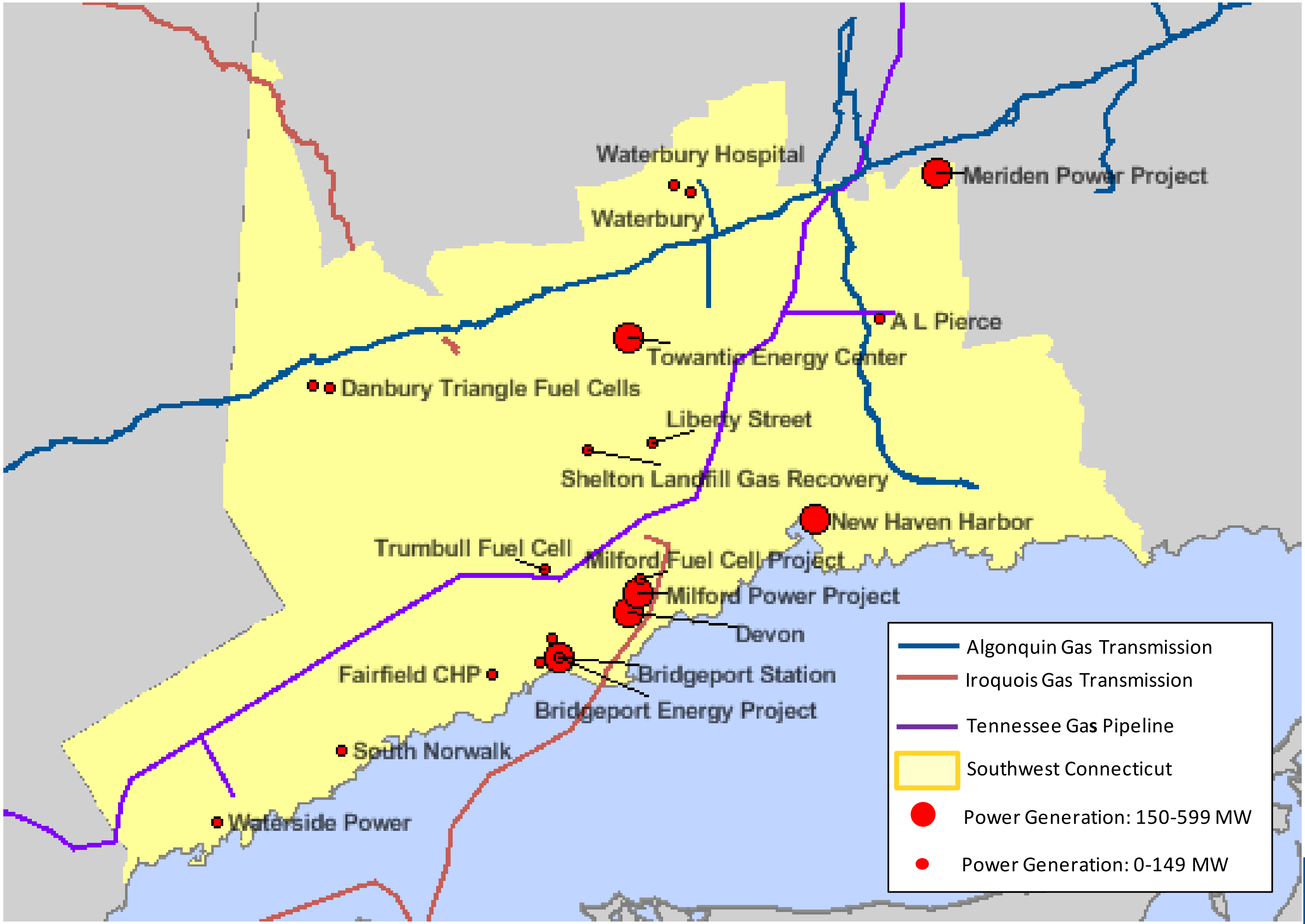


Southeastern Massachusetts Load Duration Curve

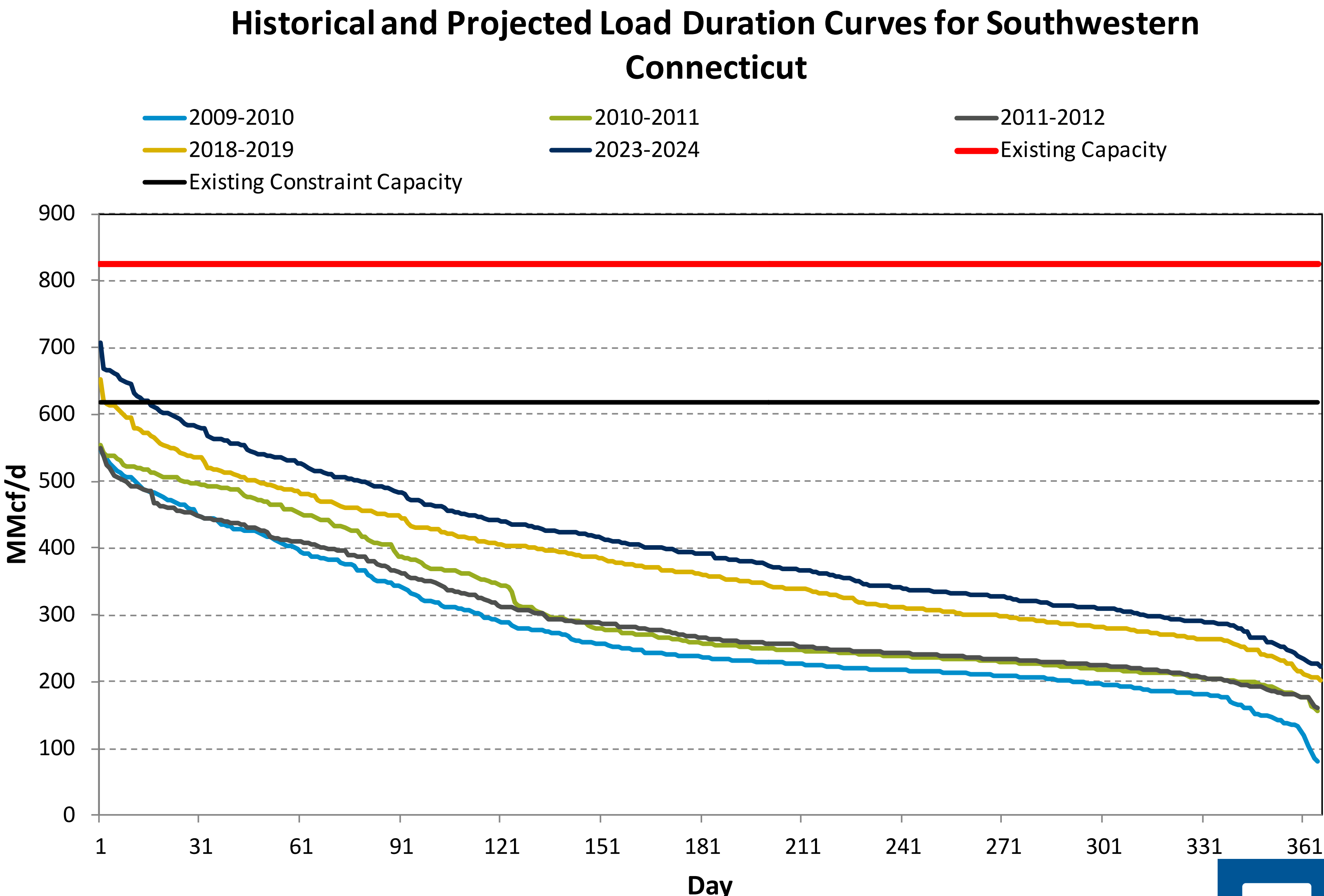


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Southwestern Connecticut

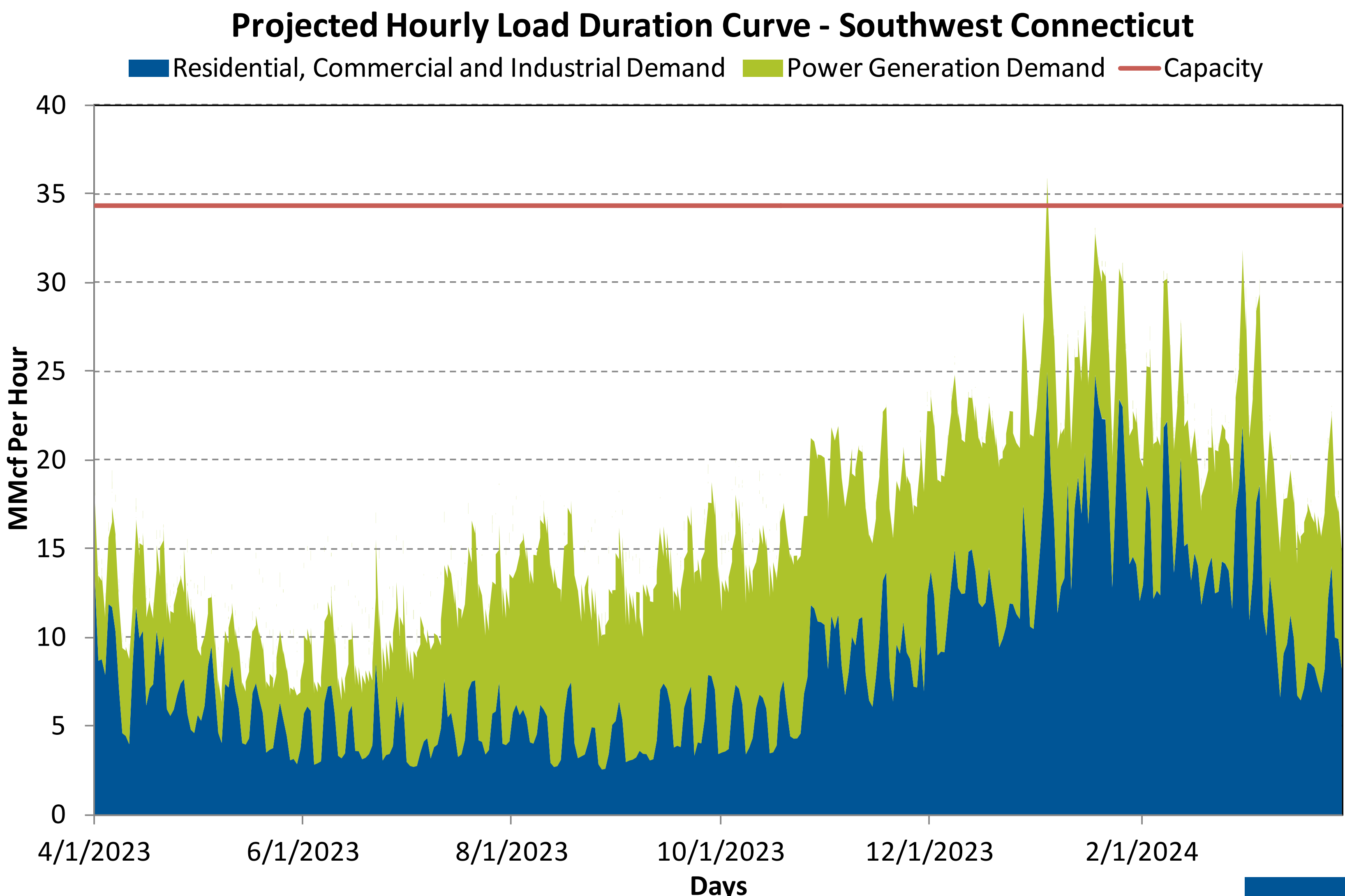


Southwestern Connecticut Load Duration Curve



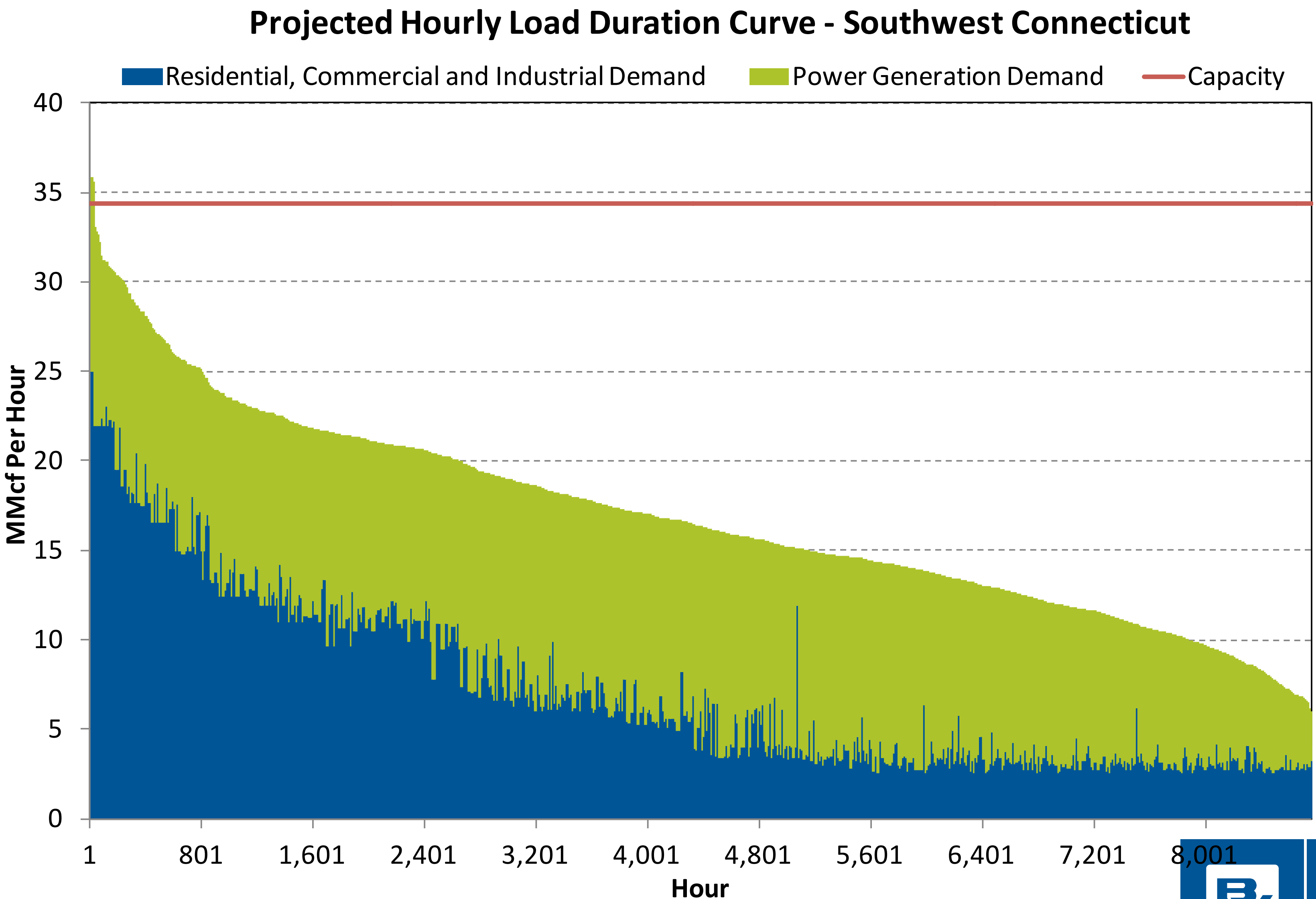
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Projected Hourly Load Duration Curve from April 2023 thru March 2024 - Southwest Connecticut



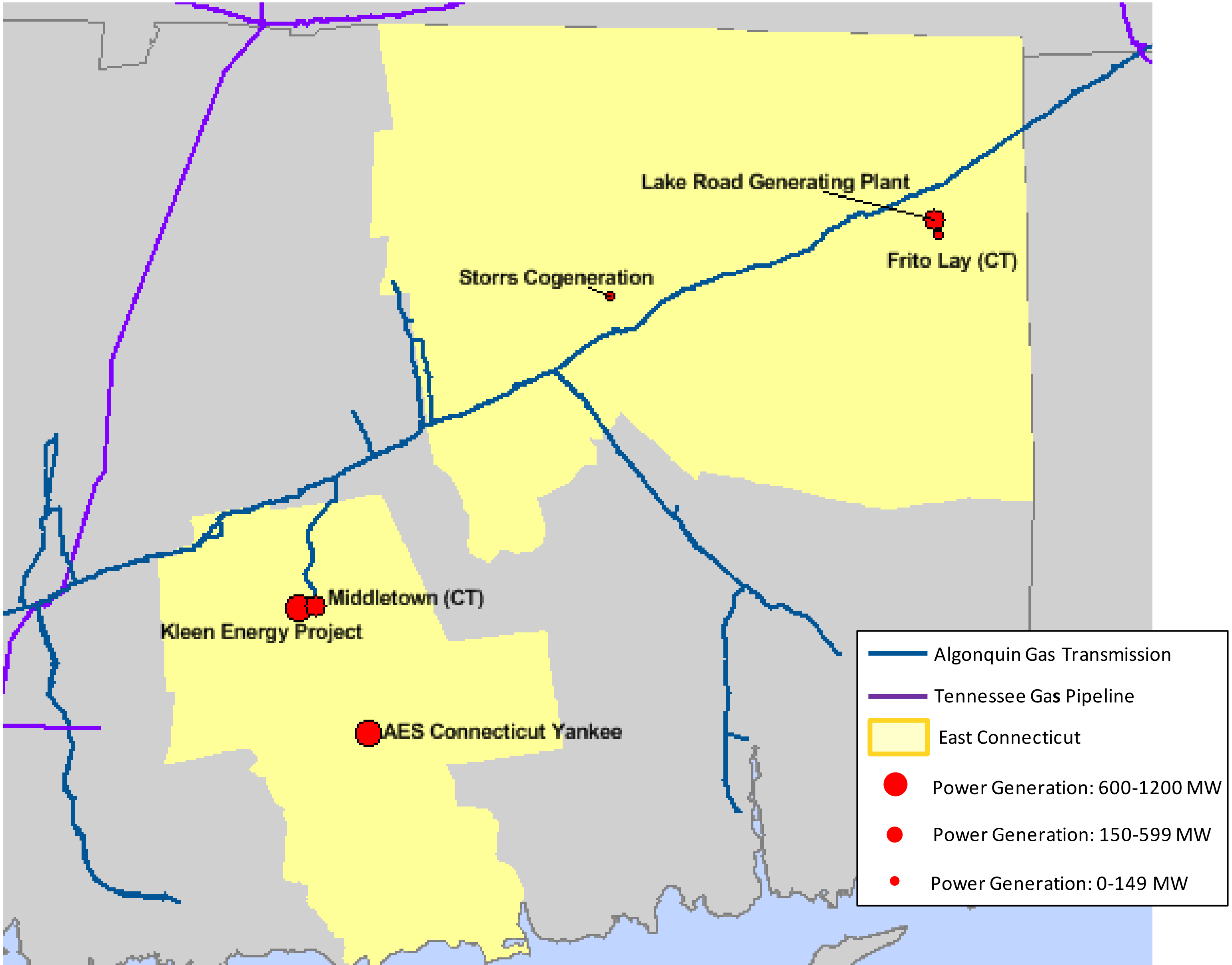
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Projected Hourly Load Duration Curve for 2023 to 2024 Gas Year– Southwest Connecticut

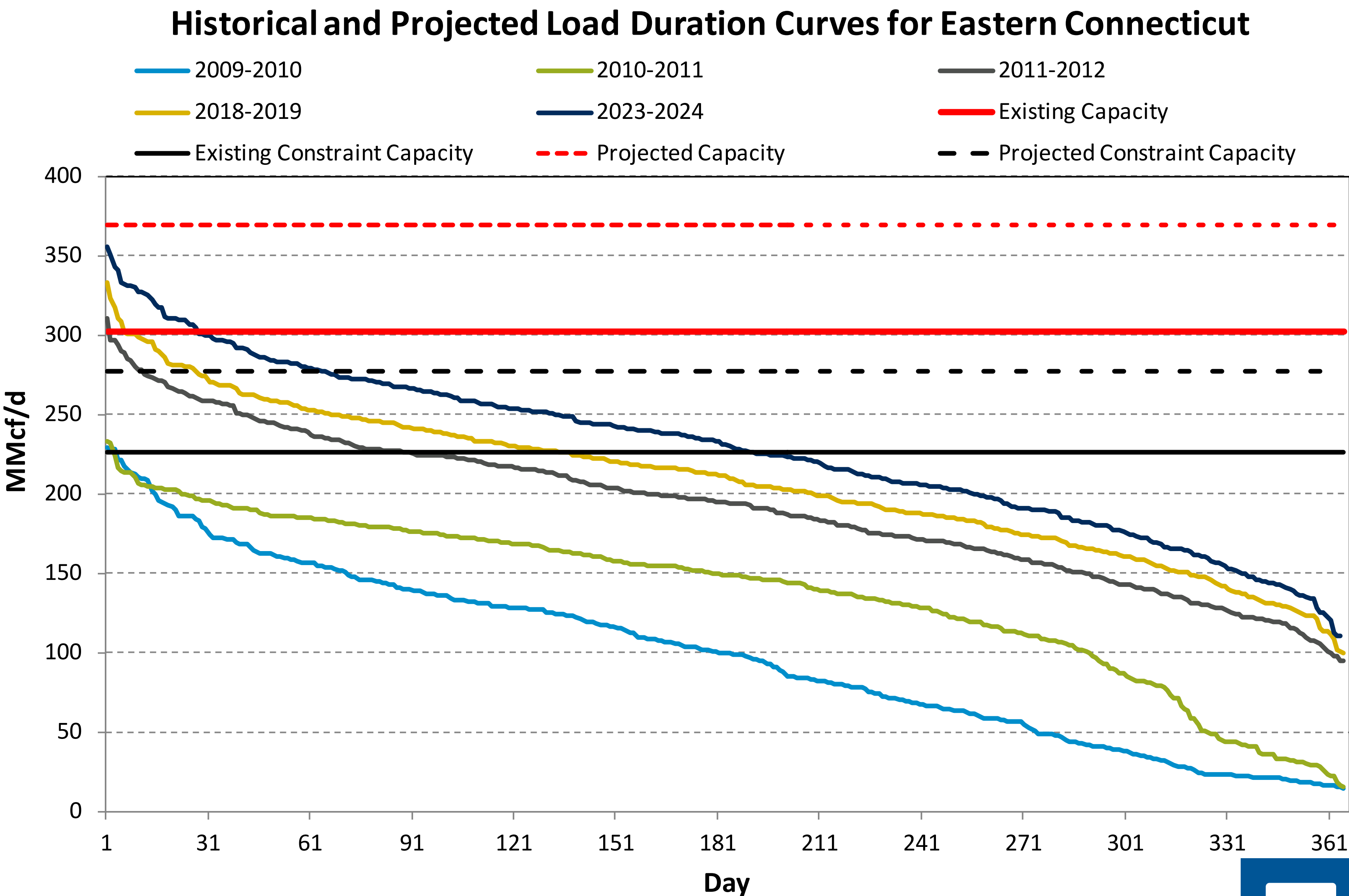


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Eastern Connecticut

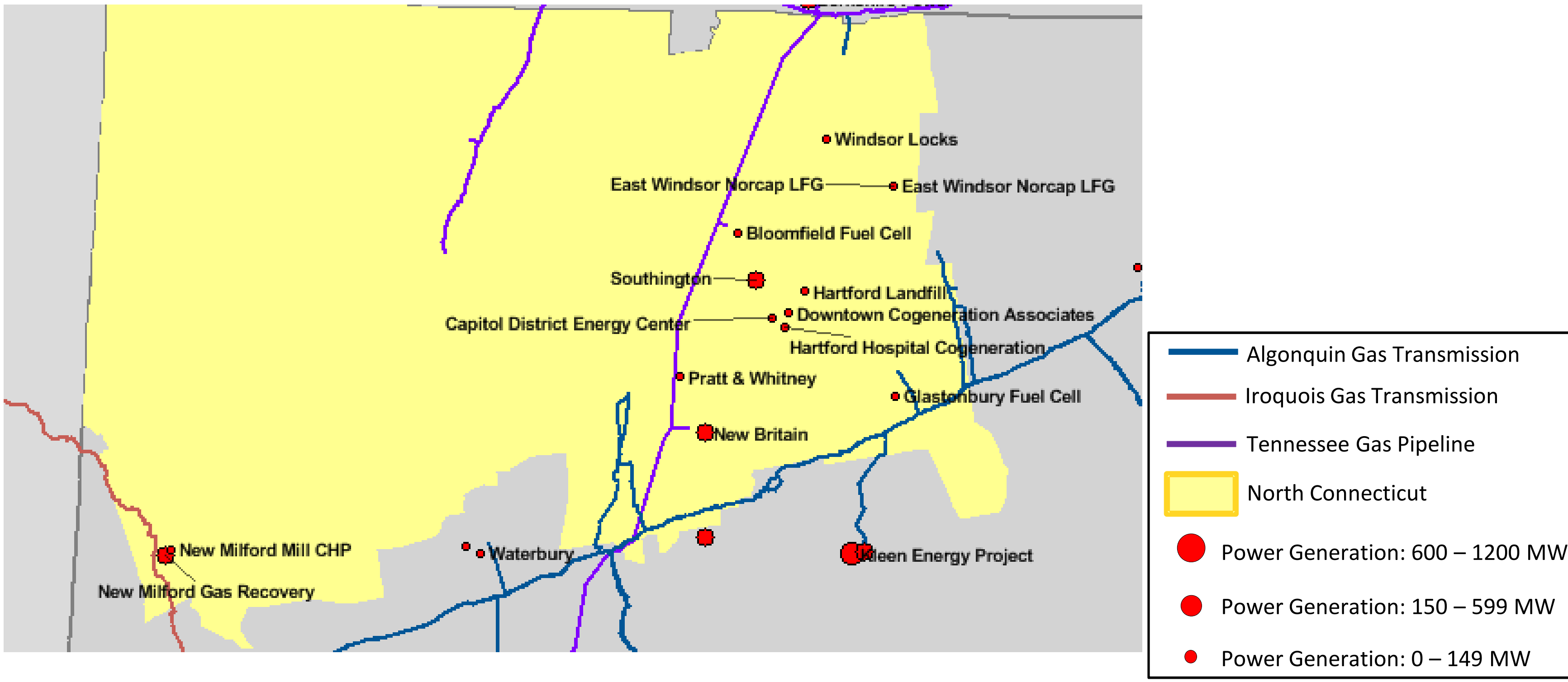


Eastern Connecticut Load Duration Curve

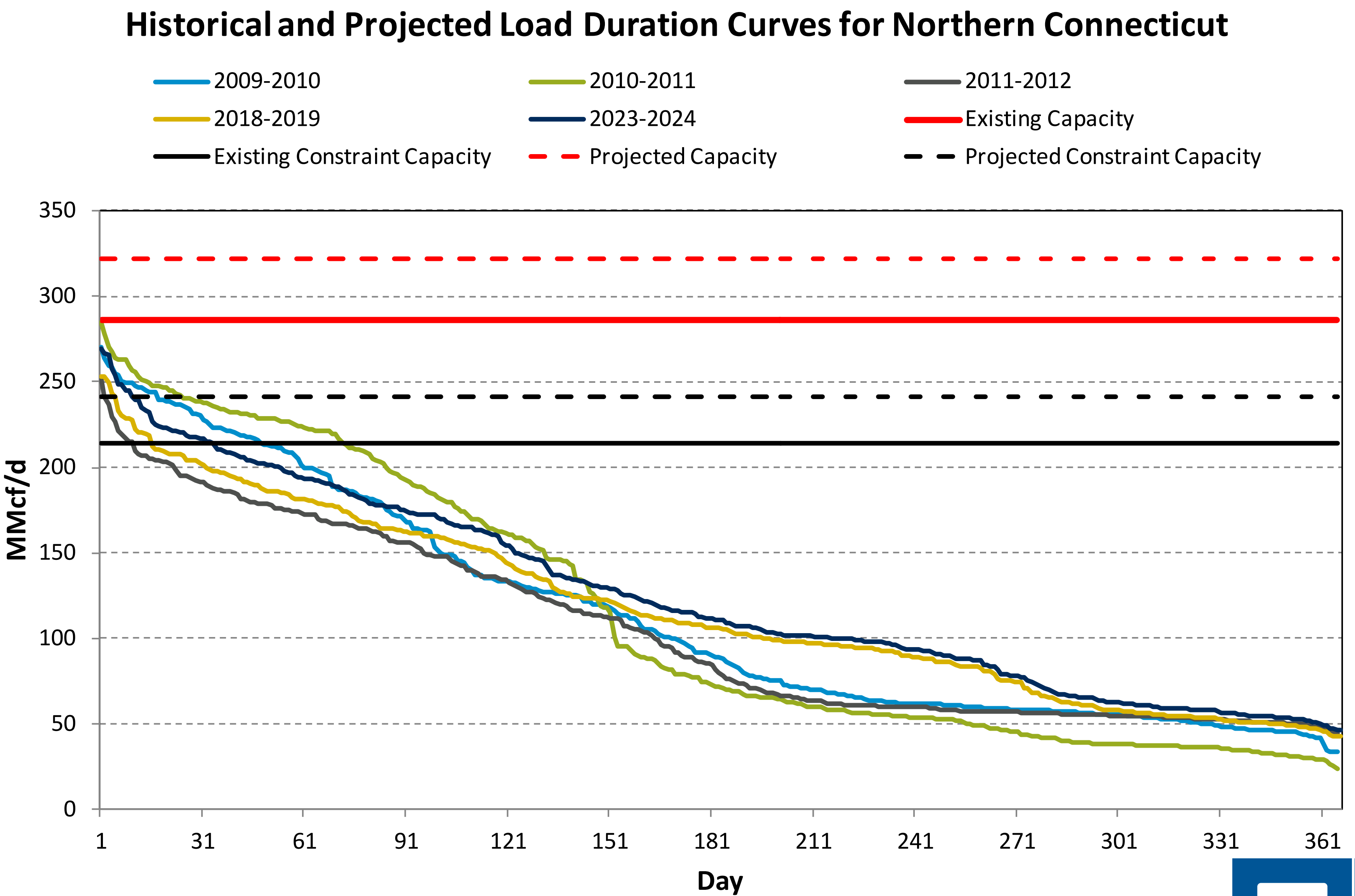


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Northern Connecticut

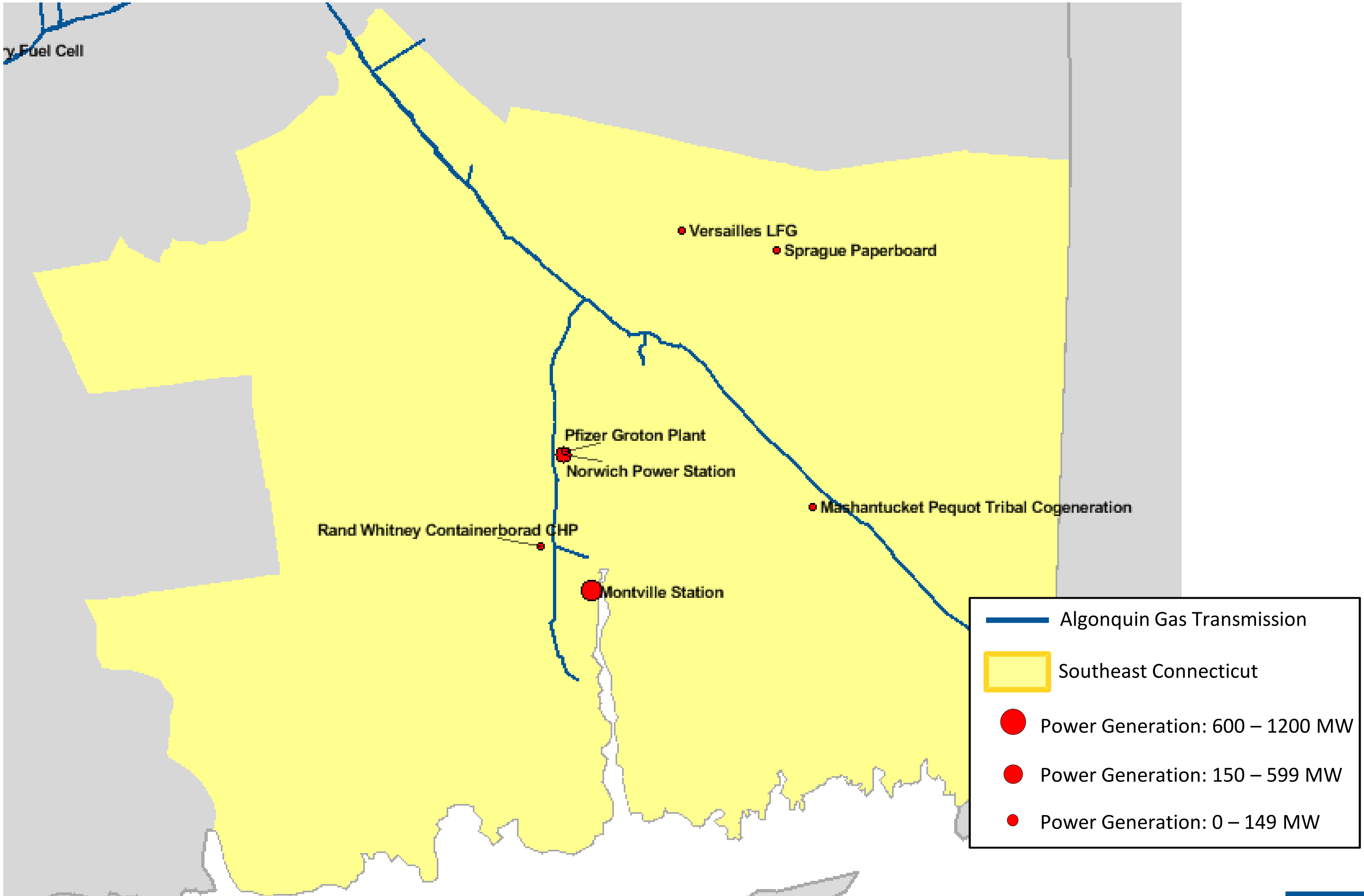


Northern Connecticut Load Duration Curve

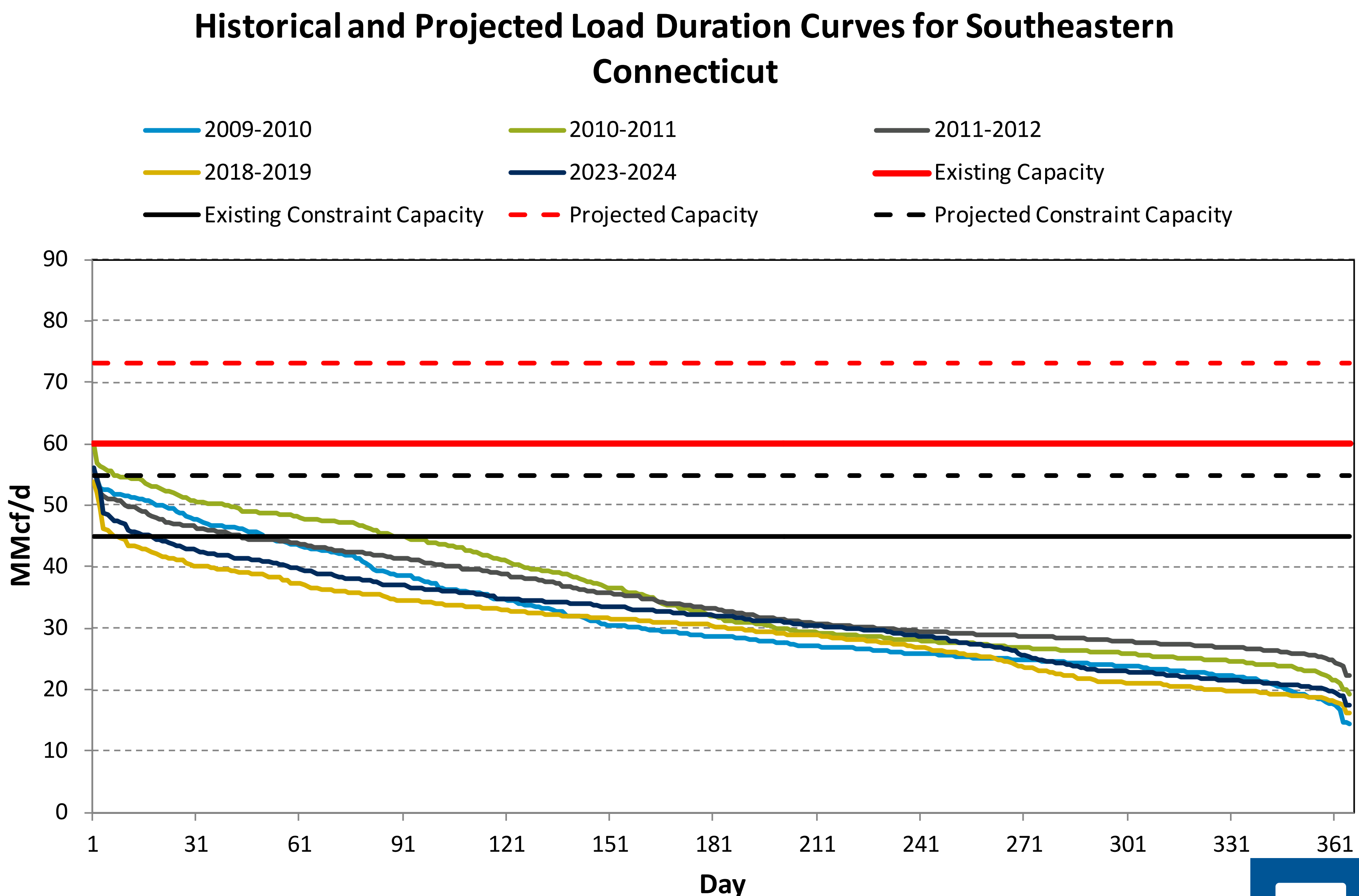


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Southeast Connecticut

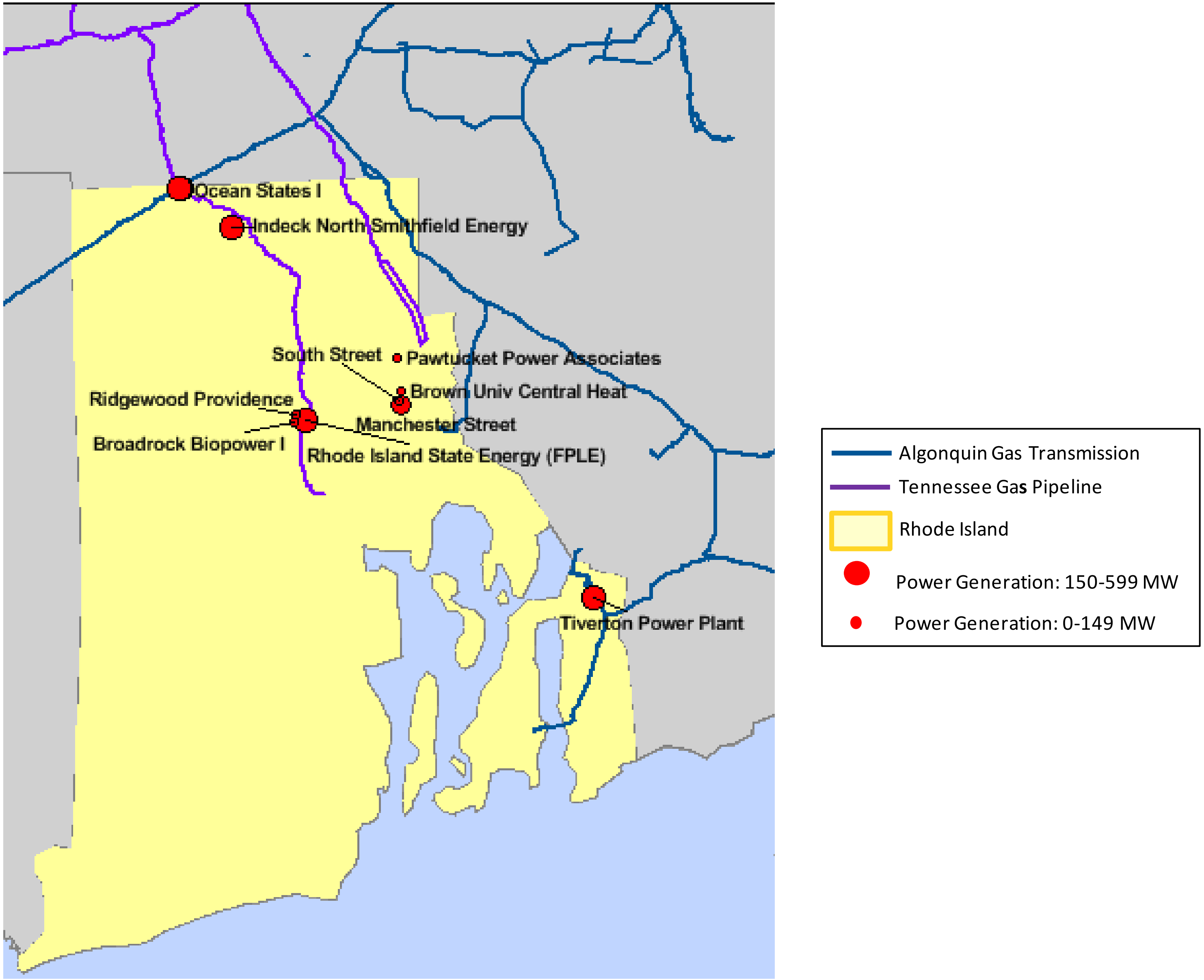


Southeast Connecticut Load Duration Curve

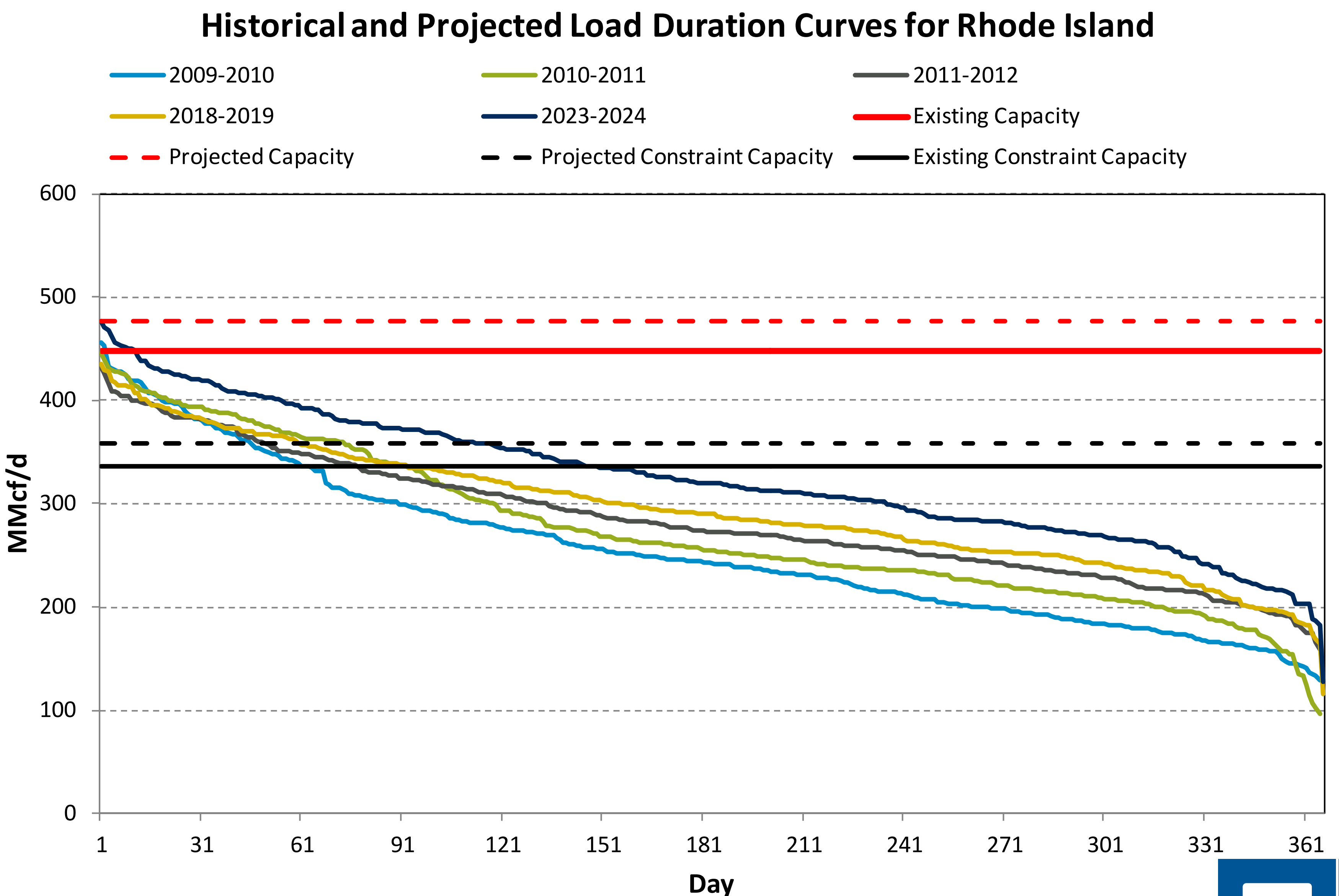


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Rhode Island

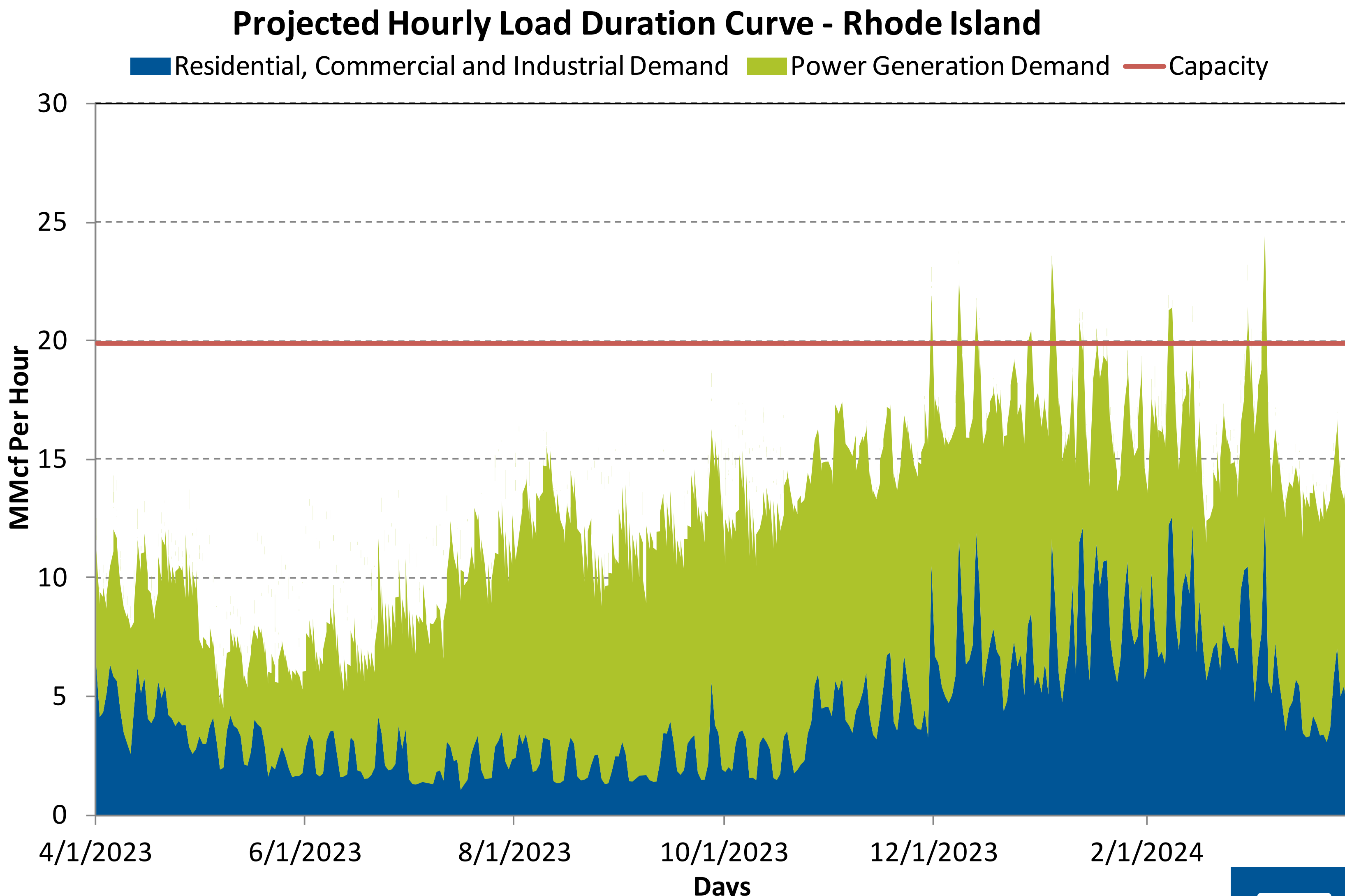


Rhode Island Load Duration Curve



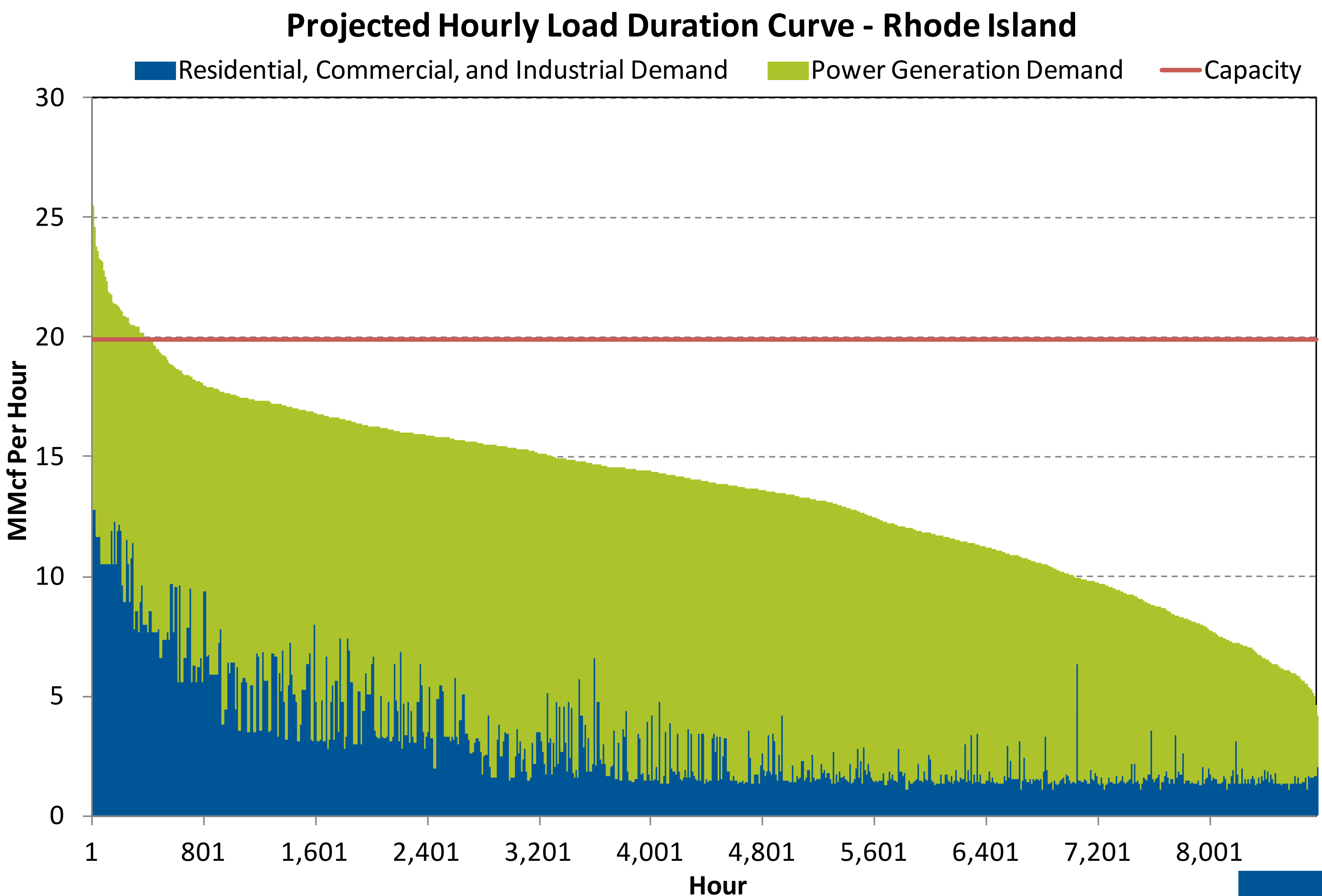
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Projected Hourly Load Duration Curve from April 2023 thru March 2024 – Rhode Island



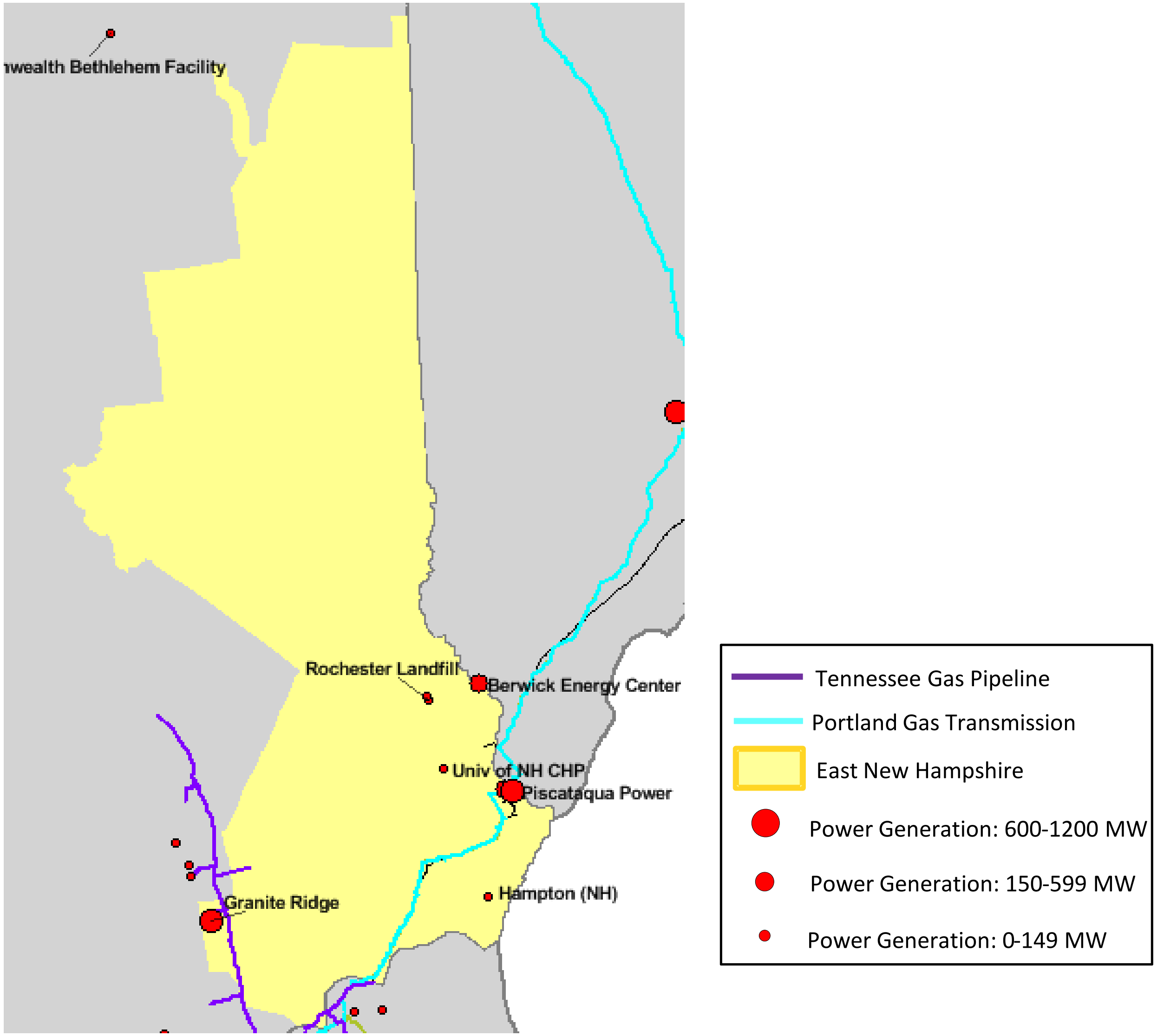
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Projected Hourly Load Duration Curve for the 2023 to 2024 Gas Year – Rhode Island

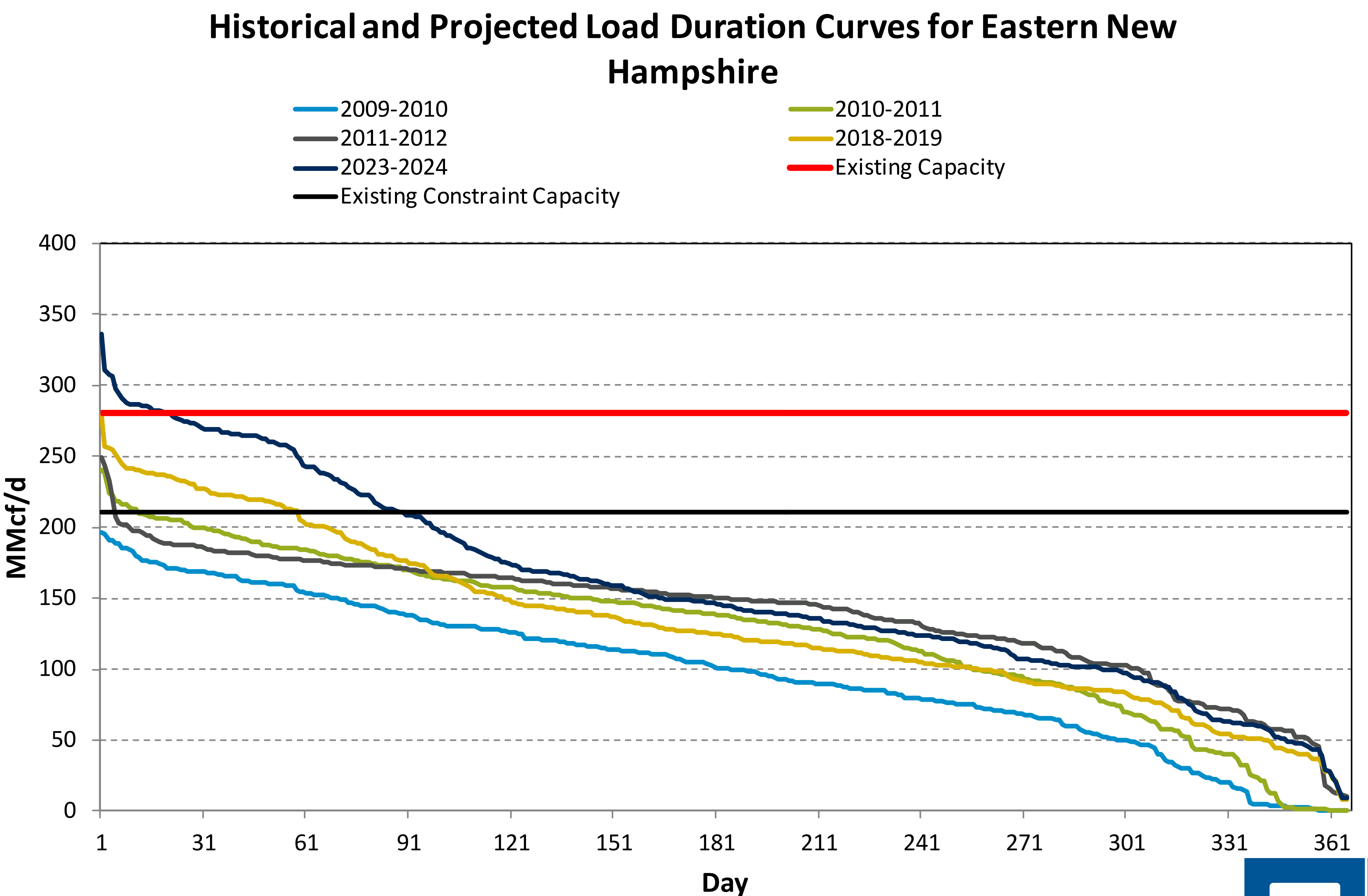


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Eastern New Hampshire

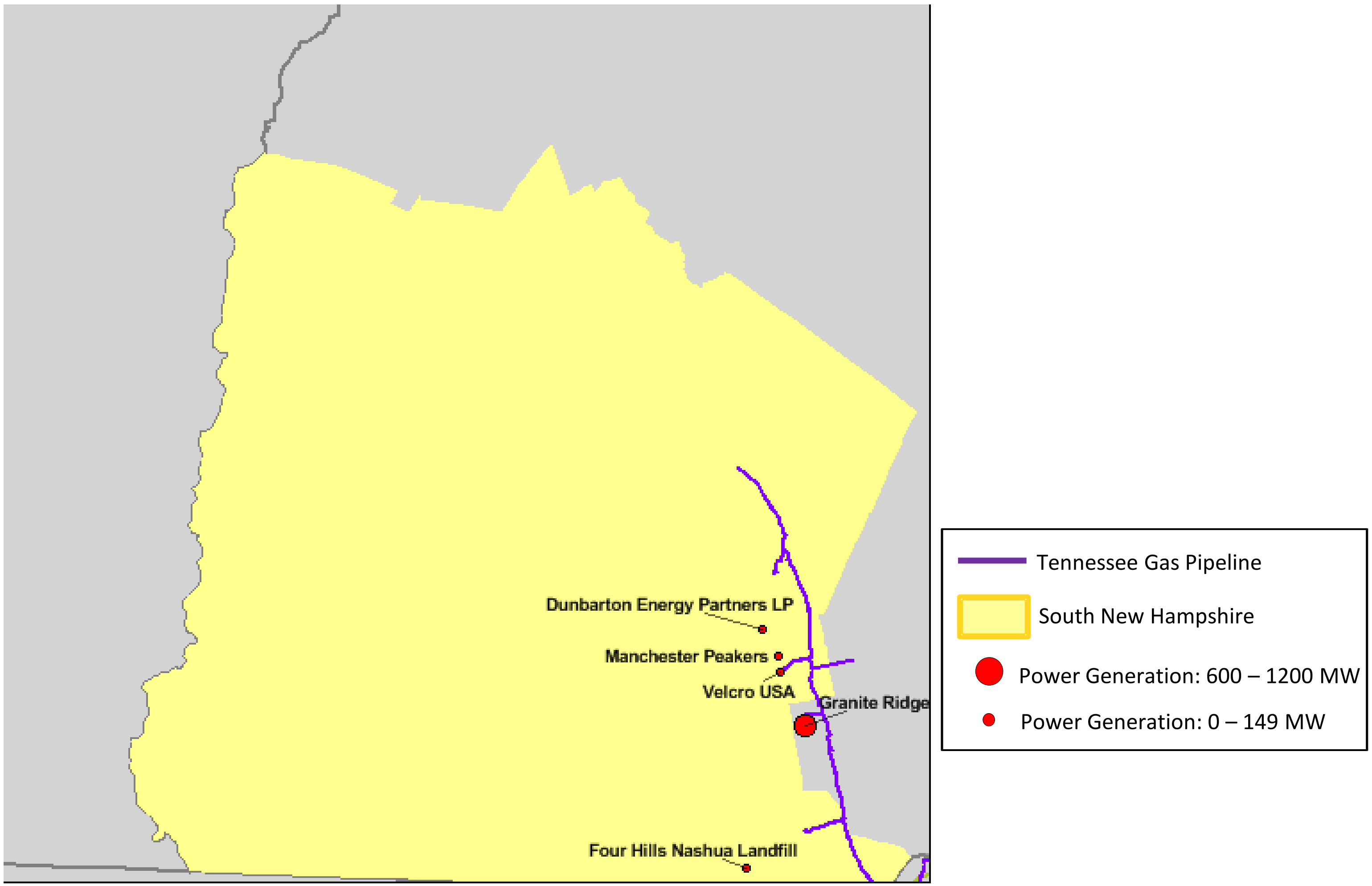


Eastern New Hampshire Load Duration Curve

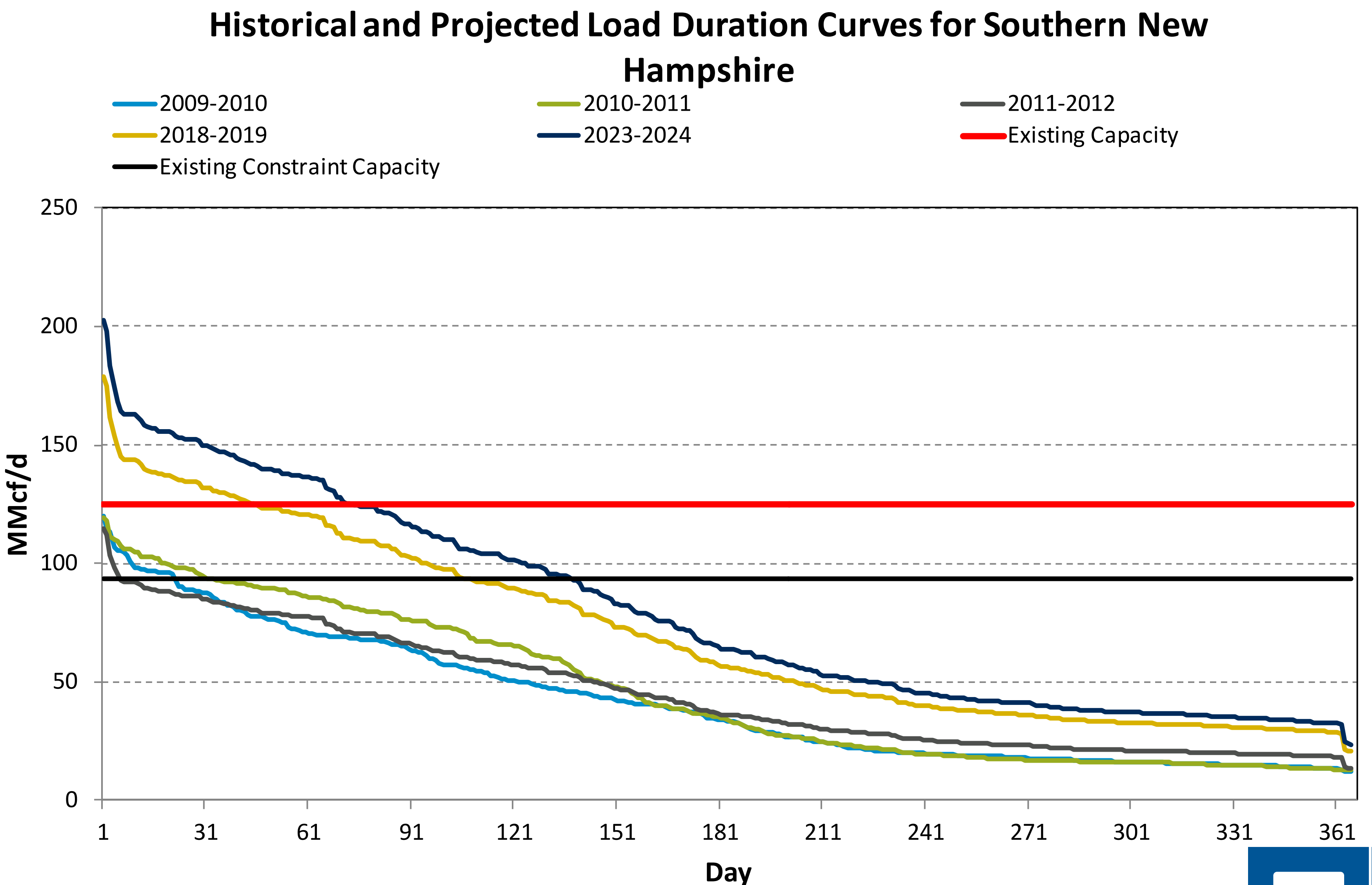


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Southern New Hampshire

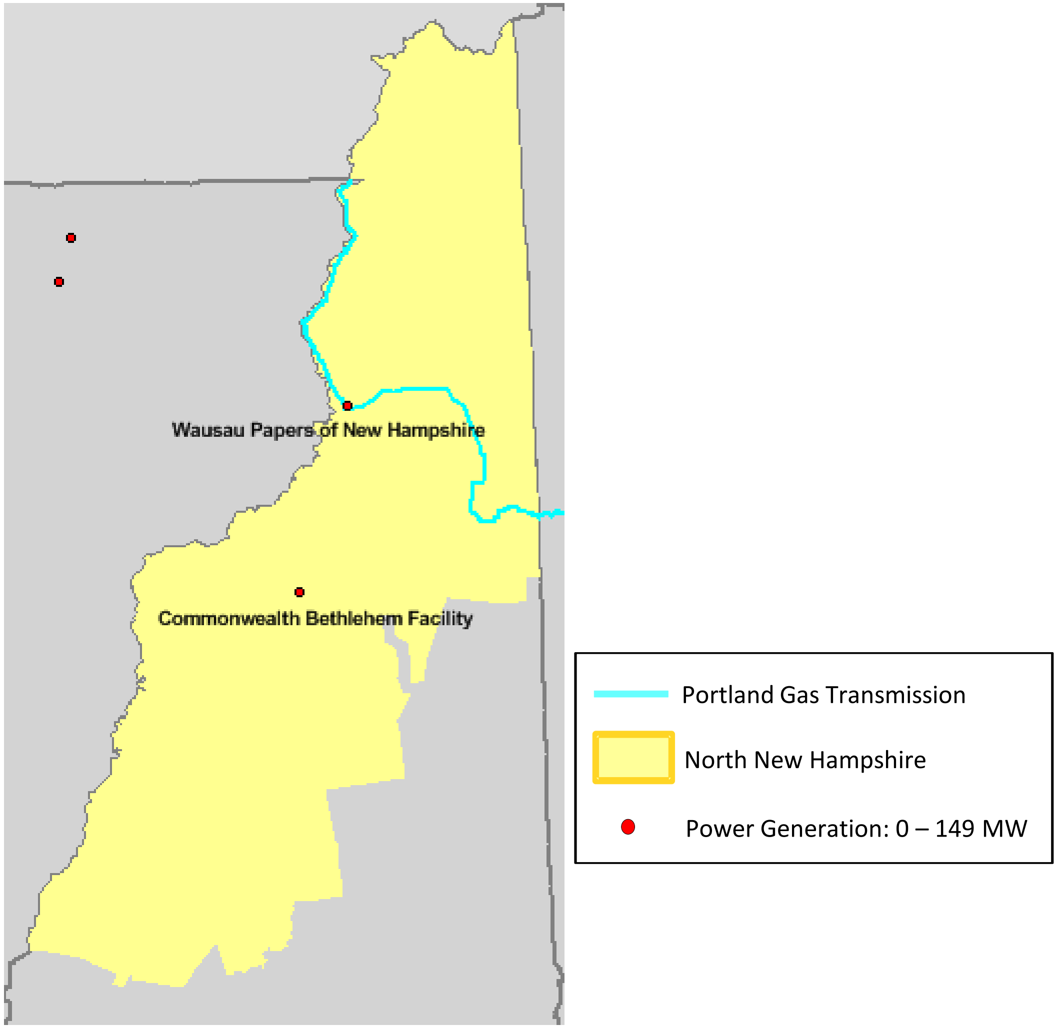


Southern New Hampshire Load Duration Curve

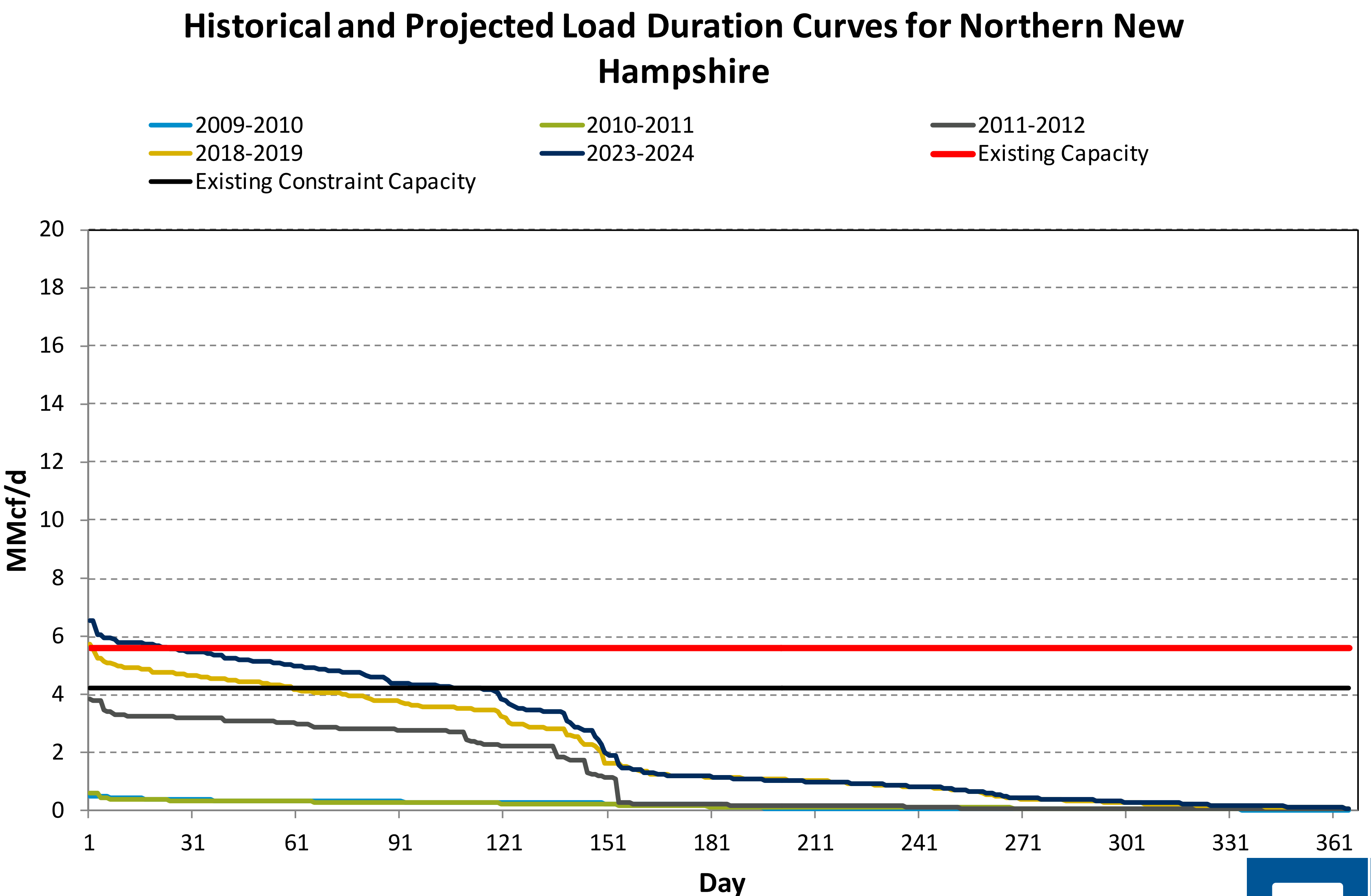


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Northern New Hampshire

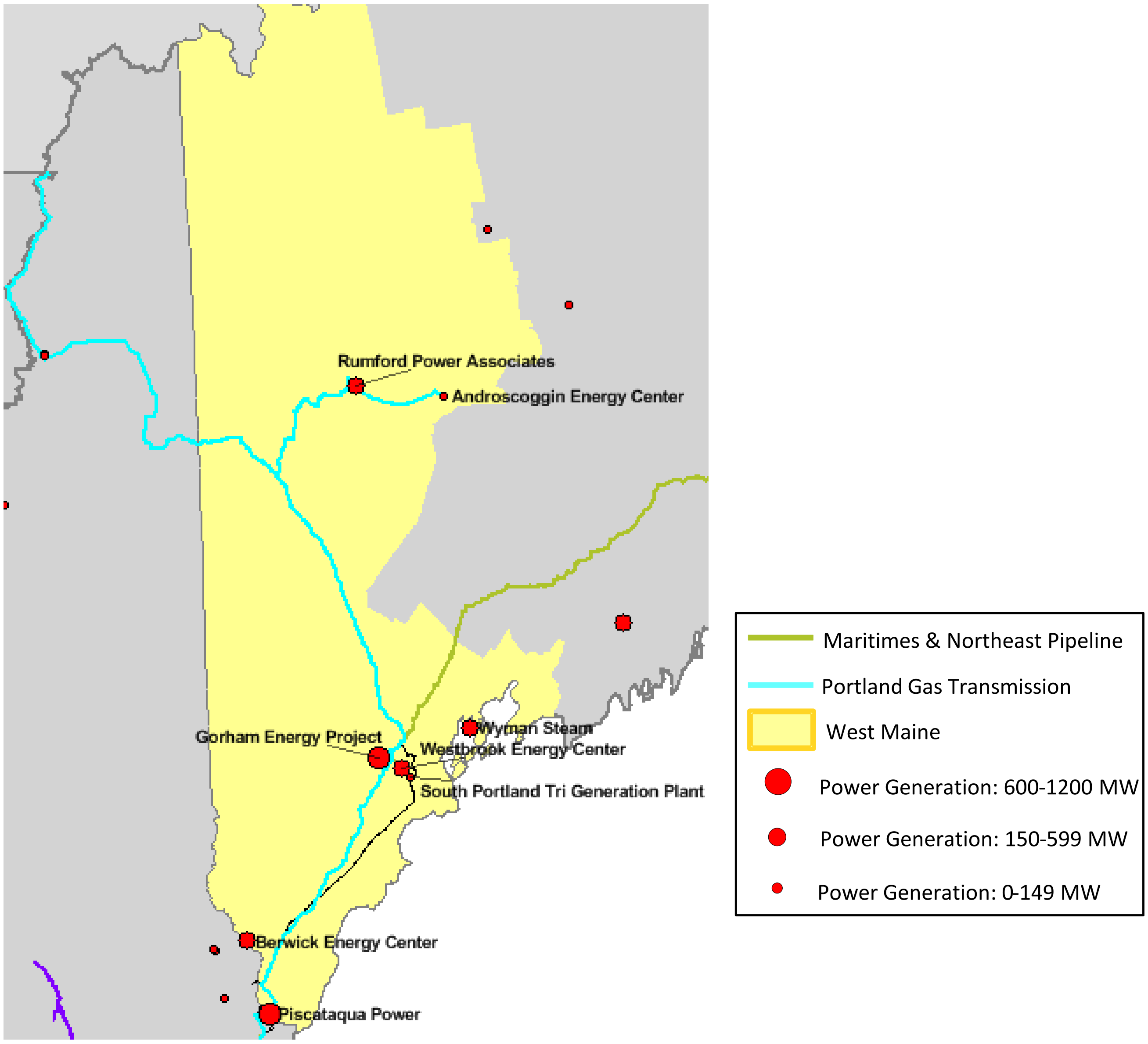


Northern New Hampshire Load Duration Curve

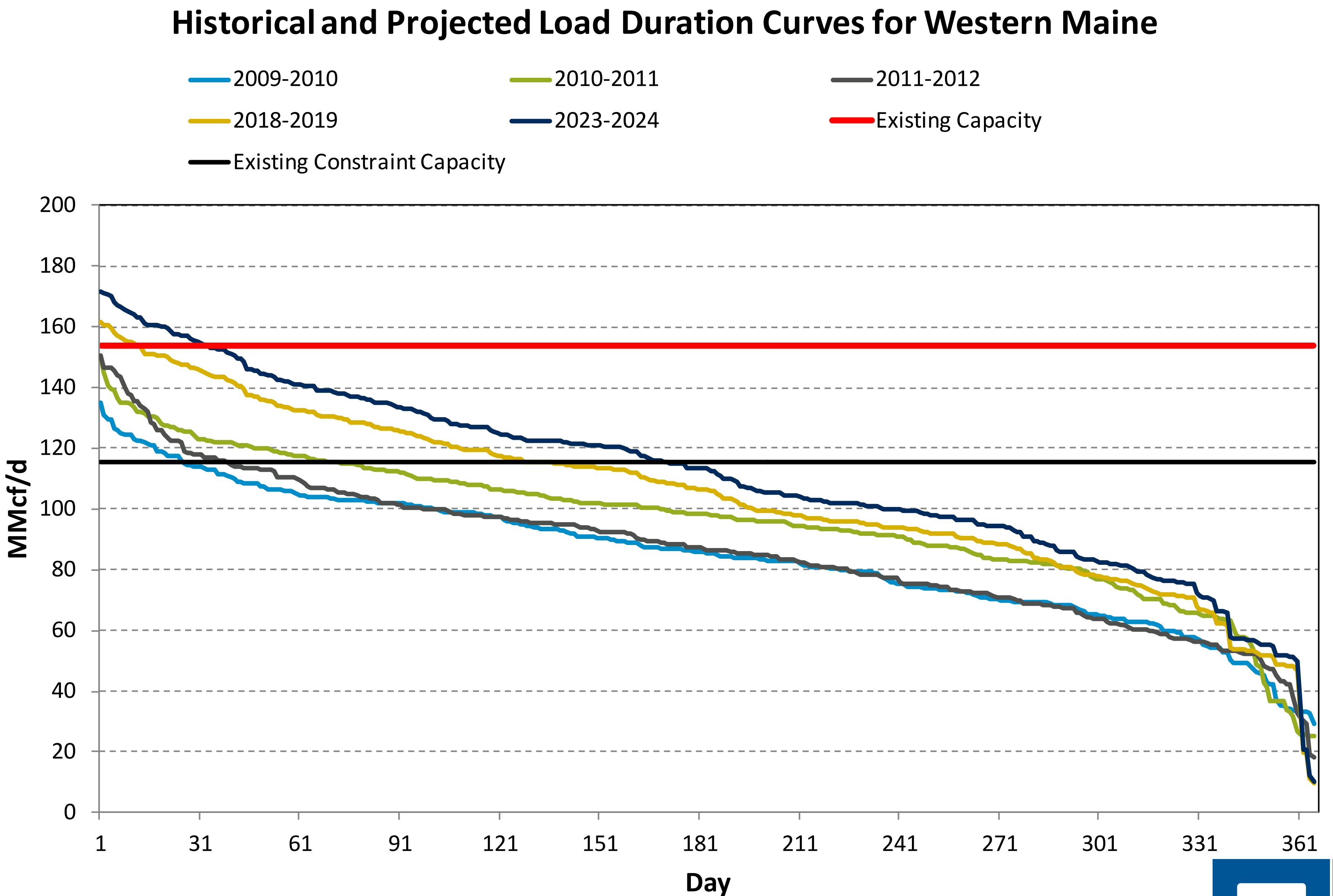


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Western Maine

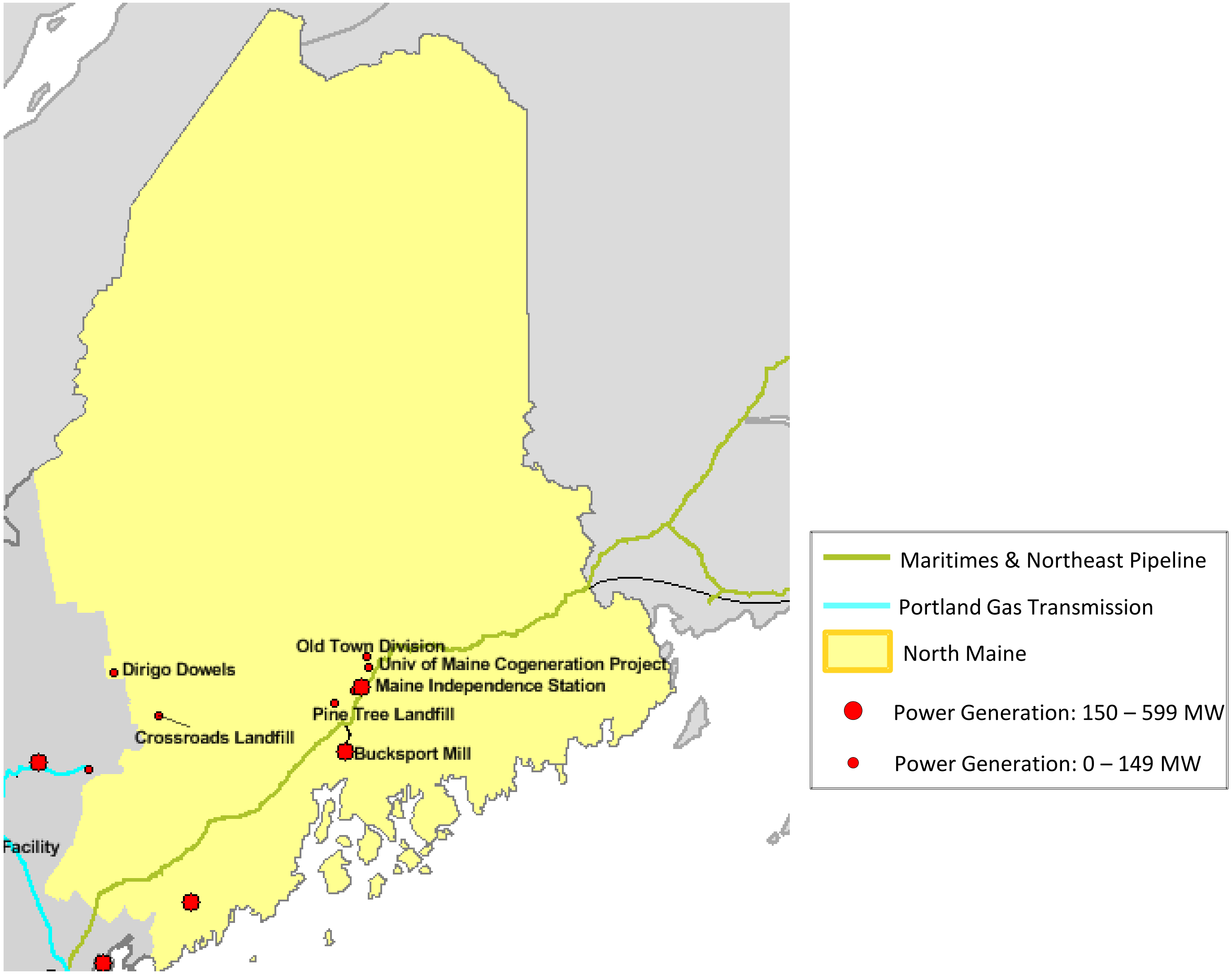


Western Maine Load Duration Curve

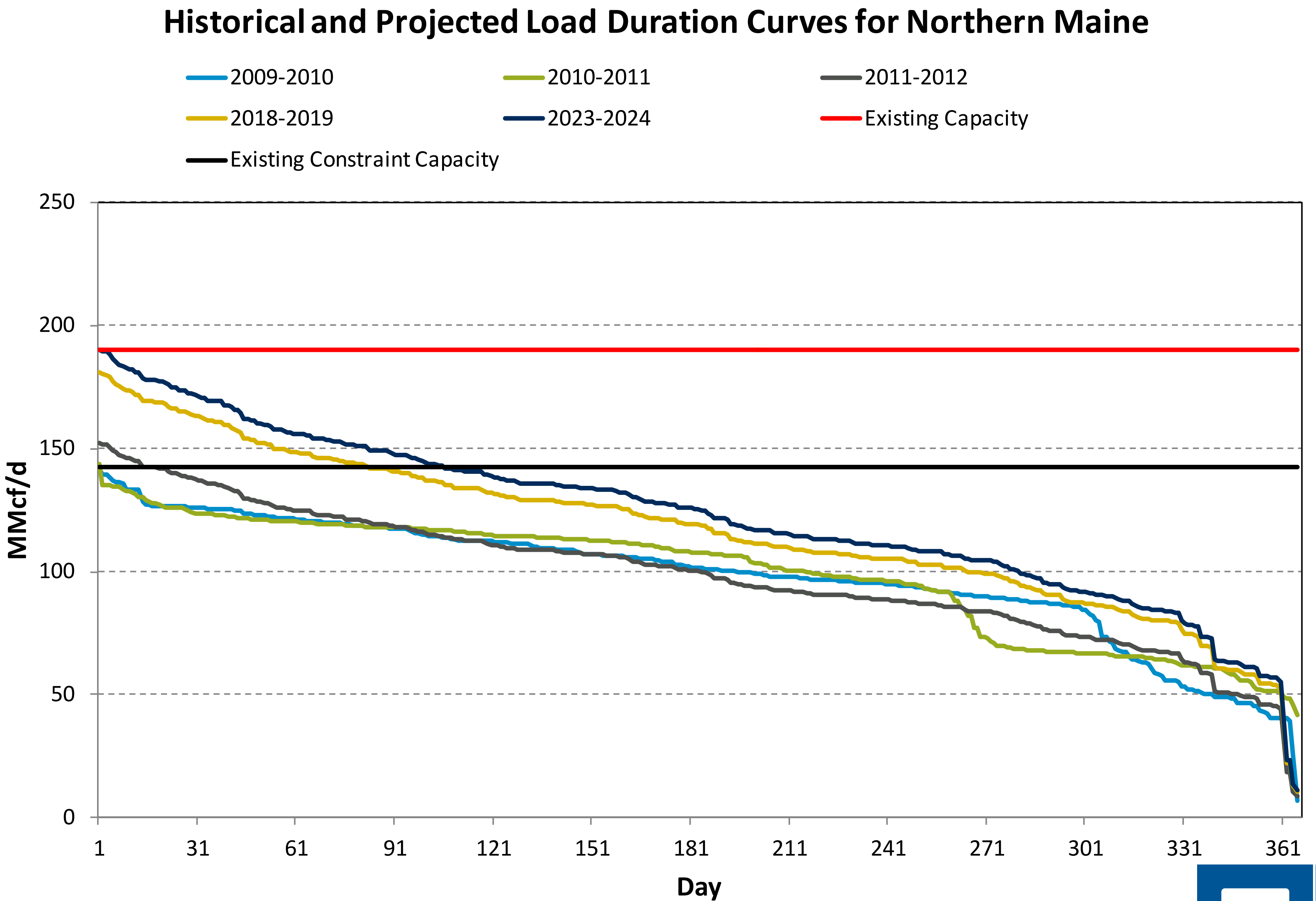


Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Pipelines & Natural Gas Power Generation Northern Maine

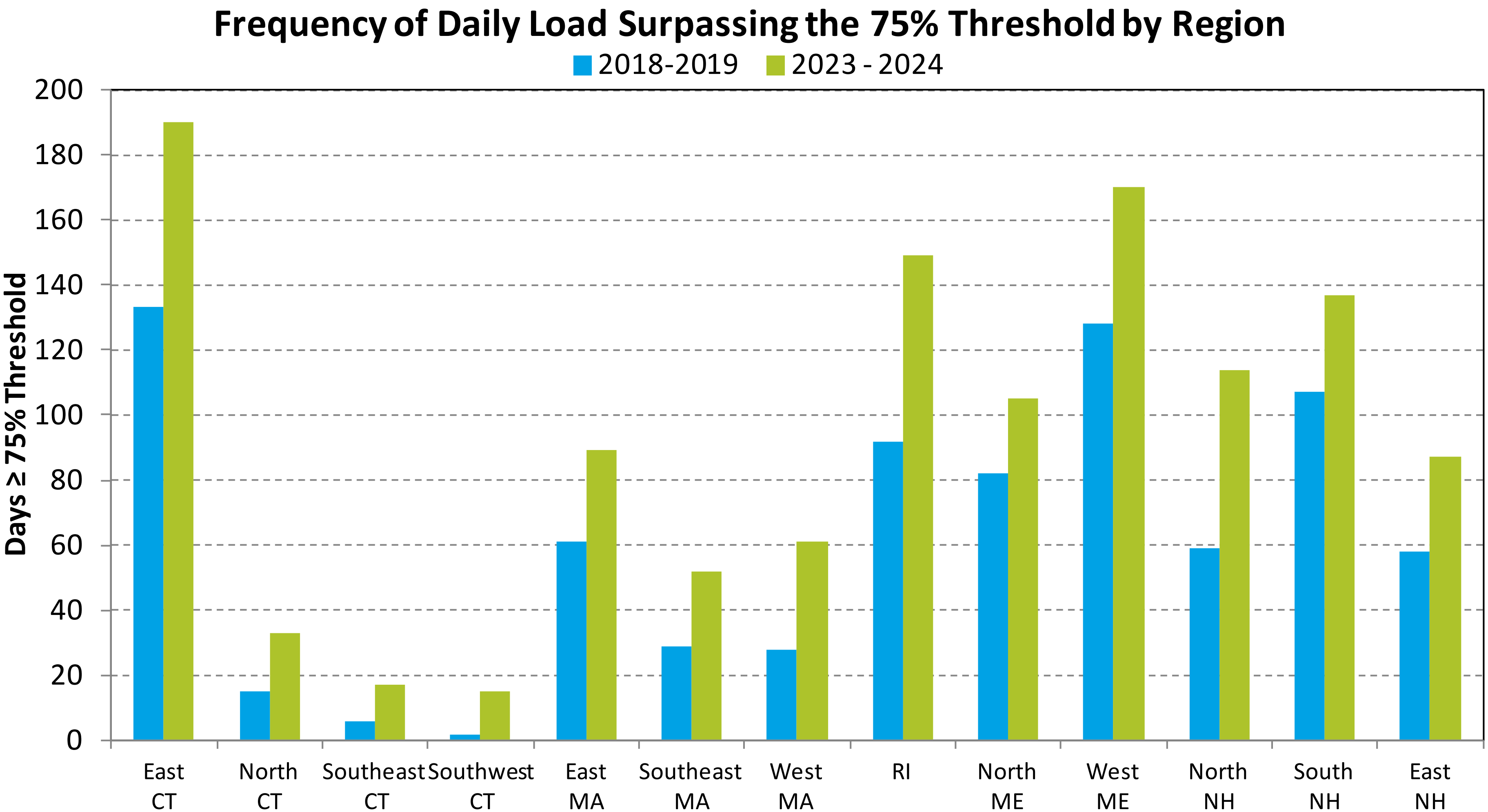


Northern Maine Load Duration Curve



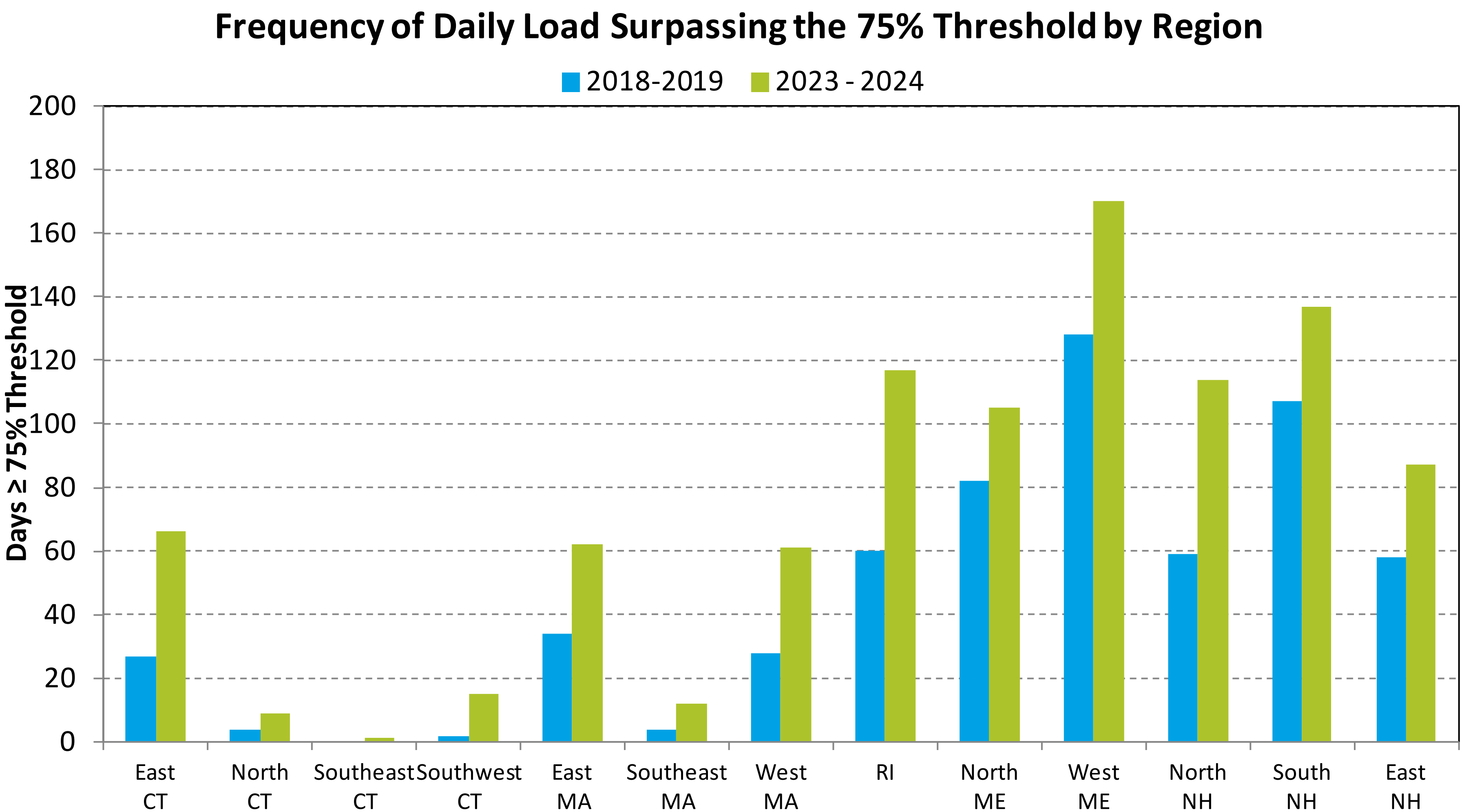
Source: Black & Veatch Analysis, Electronic Pipeline Bulletin Board

Without Spectra's AIM Project, days with pipeline constraints range reach as high as 180 days



Source: Black & Veatch Analysis

With Spectra's AIM Project, days with pipeline constraints are reduced for Connecticut, Massachusetts and Rhode Island Sub-Regions



Source: Black & Veatch Analysis

Frequency of Daily Load Surpassing the 75% Threshold – Existing Capacity vs. With AIM Capacity

Existing Capacity

		Connecticut				Massachusetts			Rhode Island	Maine		New Hampshire		
		East	North	Southeast	Southwest	East	Southeast	West	RI	North	West	North	South	East
Total Load as % of New England Total	2018-2019	7.6%	4.3%	0.1%	13.7%	32.5%	6.9%	5.1%	10.8%	4.2%	3.8%	0.2%	2.9%	4.8%
	2023 - 2024	7.7%	4.2%	0.1%	13.7%	31.9%	6.7%	5.0%	11.0%	4.2%	3.7%	0.2%	3.1%	5.3%
Days Exceeding 75% Capacity	2018-2019	133	15	6	2	61	29	28	92	82	128	59	107	58
	2023 - 2024	190	33	17	15	89	52	61	149	105	170	114	137	87

With AIM Capacity

		Connecticut				Massachusetts			Rhode Island	Maine		New Hampshire		
		East	North	Southeast	Southwest	East	Southeast	West	RI	North	West	North	South	East
Total Load as % of New England Total	2018-2019	7.6%	4.3%	0.1%	13.7%	32.5%	6.9%	5.1%	10.8%	4.2%	3.8%	0.2%	2.9%	4.8%
	2023 - 2024	7.7%	4.2%	0.1%	13.7%	31.9%	6.7%	5.0%	11.0%	4.2%	3.7%	0.2%	3.1%	5.3%
Days Exceeding 75% Capacity	2018-2019	27	4	0	2	34	4	28	60	82	128	59	107	58
	2023 - 2024	66	9	1	15	62	12	61	117	105	170	114	137	87

Source: Black & Veatch Analysis

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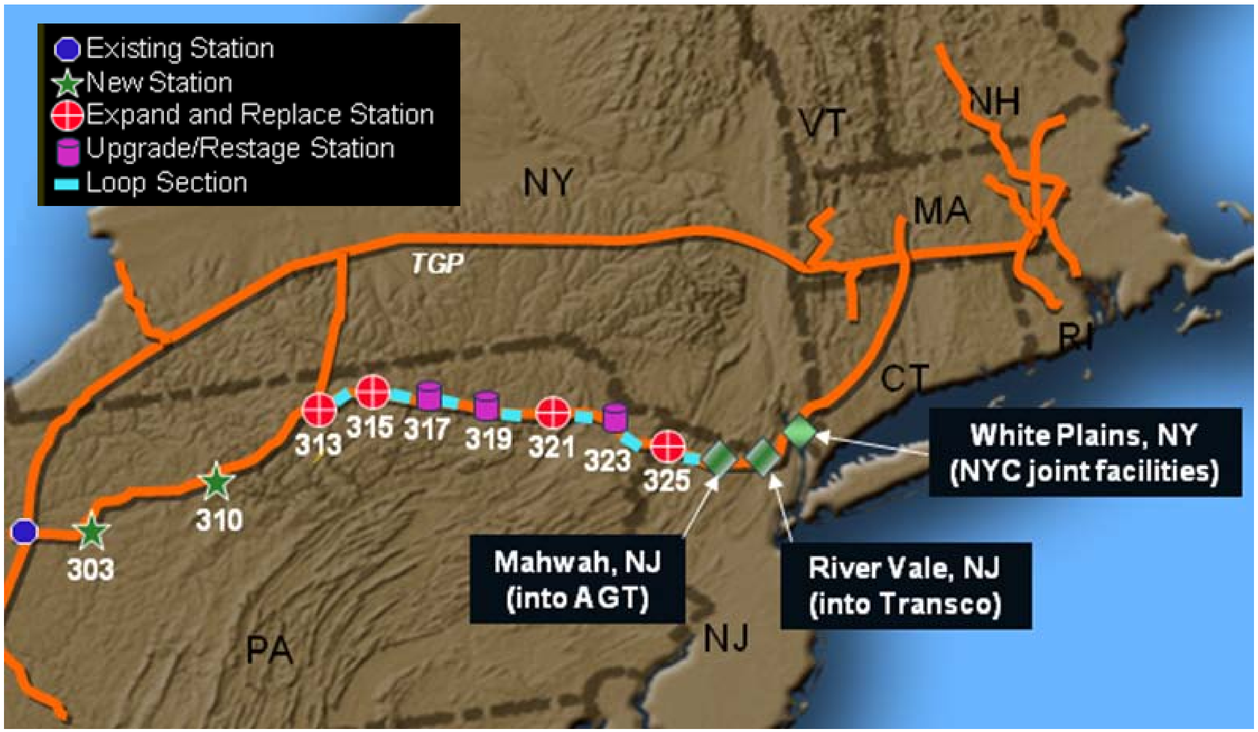
New England Infrastructure Construction Cost Estimates Looping and Lift and Replace

- **The following proposed projects into New England would involve looping (laying a parallel segment of new pipe and rejoin with the existing pipe at the end) of existing mainlines within or adjacent to existing rights of way**
  - TGP Northeast Expansion: 200 Line Looping
  - TGP Connecticut Expansion
- **Estimated project capital costs for these projects assume $3.5 million/mile, using 30” diameter pipe**
  - Estimates are based on pipeline construction costs (excluding compression) for Tennessee Gas Pipeline’s recently completed 300 Line Project (~130 miles of 30” pipeline for ~$450 million)
  - Cost estimate assumes looping rather than lift-and-lay replacement of older, smaller diameter pipe with the 30” pipe
  - Cost assumption also includes additional compression at existing compressor stations
- **Lift and Replace**
  - Algonquin Incremental Market (AIM) Expansion
  - The cost of lift and replace is estimated to be more expensive than looping but less expensive than greenfield construction

Looping Cost Estimate Benchmark - TGP 300 Line Project



- **Placed in Service in Nov. 2012**
- **Utilized as a benchmark for proposed expansions involving pipeline looping**
- **<u>Capacity: </u>350,000 Dth/day**
- **~130 miles of 30" looped pipeline**
- **Capex: : $634 million**
  - $585 million for incremental capacity
  - $49 million for replacement of facilities
- **Involved construction of 8 looping segments across PA and NJ**

Source: Black & Veatch Analysis, Kinder Morgan Investor Presentations

New England Infrastructure Construction Cost Estimates Greenfield Construction

- **New England greenfield pipeline alternatives include:**
  - TGP's Northeast Expansion – Bullet Line (proposed in-svc 2017-2018)
    - 30", 150 miles, 1.2 Bcf/day pipeline from Wright, NY to Dracut, MA
  - Cabot Inc.'s Constitution Pipeline joint venture (proposed in-svc 2015)
    - 30", 121 mile, 650,000 dth/d line from PA to Wright, NY interconnections with TGP and Iroquois
- **Capital cost estimates of $6 to $8 million/mile for greenfield construction are derived from information publish by the Constitution Pipeline sponsors:**
  - Recourse rate of $0.76/Dth
  - Assumes a 30-year levelization
  - Capital cost is estimated at $730 million to $1 billion
- **Cost per mile estimate includes compression**
  - Construction costs premiums for mountainous terrain, rock subsurface, regional permitting and fragmented land ownership along ROWs
  - Each project was estimated to include 5 meter stations, each constructed for $3 million

Pipeline Cost Estimates

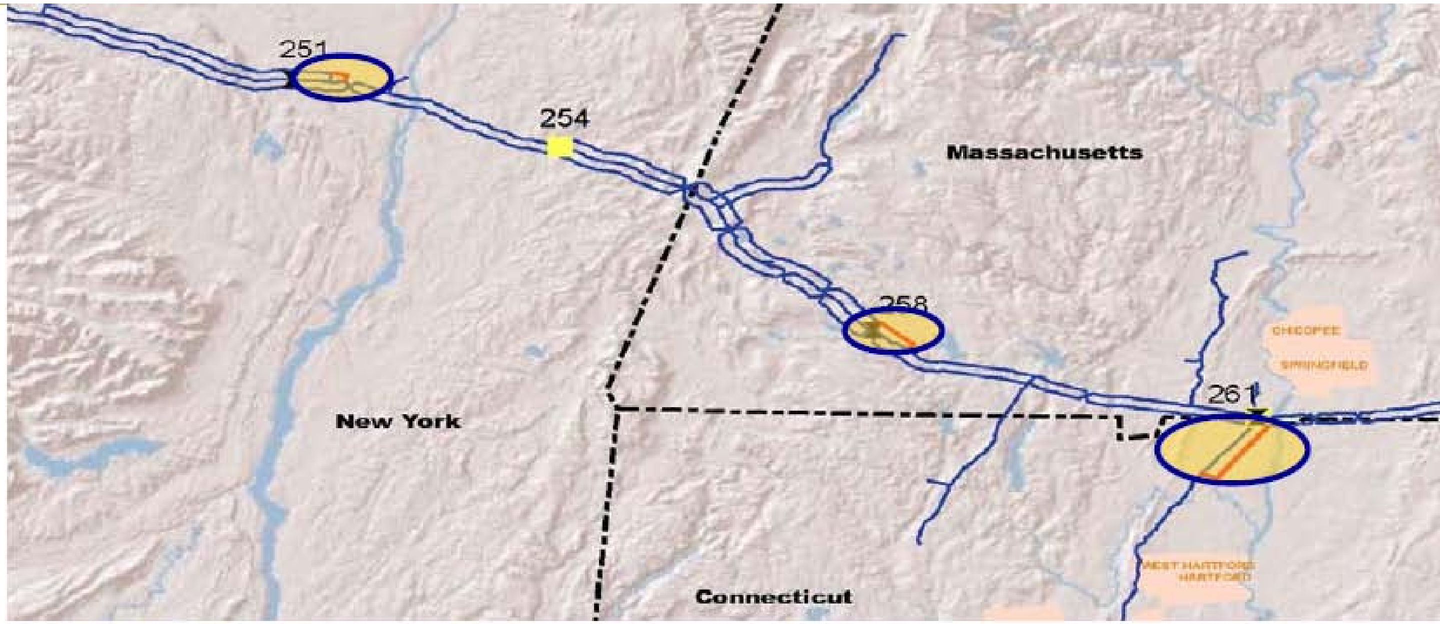
Construction Type	Project	Capacity (Dth/day)	Estimated Cost (millions)
Looped	Tennessee Gas Pipeline Northeast Expansion 200 Line Looping	500,000 to 1,000,000	$508 to $653
	Tennessee Gas Pipeline Connecticut Expansion[1]	72,100	$47 to $60
Lift and Replace	Algonquin Incremental Market Expansion	400,000	$861 to $1,017
Greenfield	Constitution Pipeline	650,000	$729 to $971
	Tennessee Gas Pipeline Northeast Expansion Bullet Line	1,200,000	$900 to $1,200

[1]Pipeline construction cost only. Excludes estimated cost of Thompsonville Lateral.

Note - The costs of recently completed projects cannot predict the construction costs of proposed projects with absolute certainty. With the exception of AIM, Black & Veatch did not verify the accuracy of these cost estimates with project sponsors.

Source: Black & Veatch Analysis

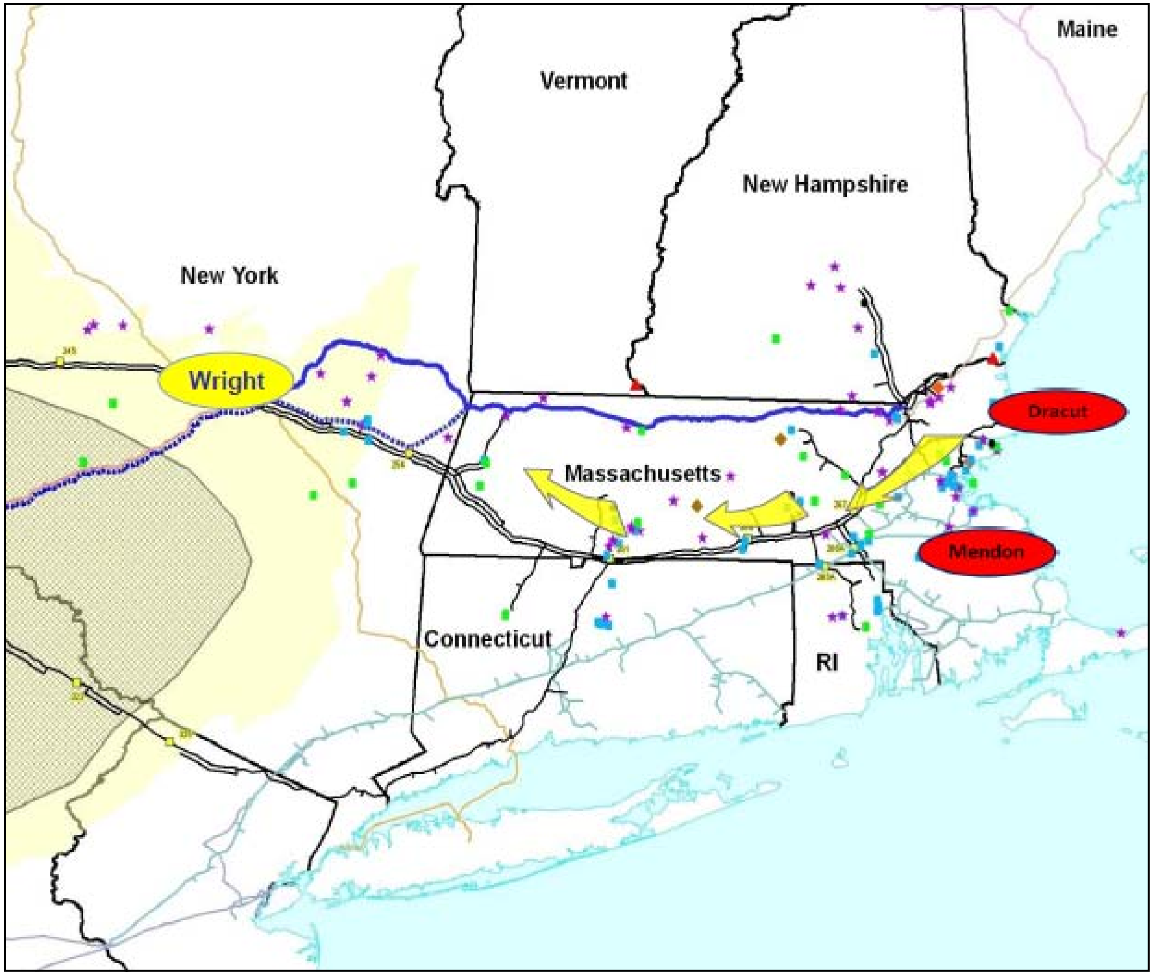
Proposed Pipeline Expansion Overview
TGP Connecticut Expansion Project



- **Capacity:** 72,100 Dth/d
- **Capital:** $81.2 MM
- **Estimated In-Service:** November 1, 2016
- **Project Scope:**
  - 13.3 miles of pipeline loop
  - Acquisition of Thompsonville Lateral
- **Commercial Benefit:** Additional capacity to serve New England market
- **Rate:** Negotiated
- **Current Status:** Shipper negotiations underway
- **Major Milestones:**
  - 1st Quarter 2013: Execute PAs

Source: Black & Veatch Analysis, Kinder Morgan Presentation

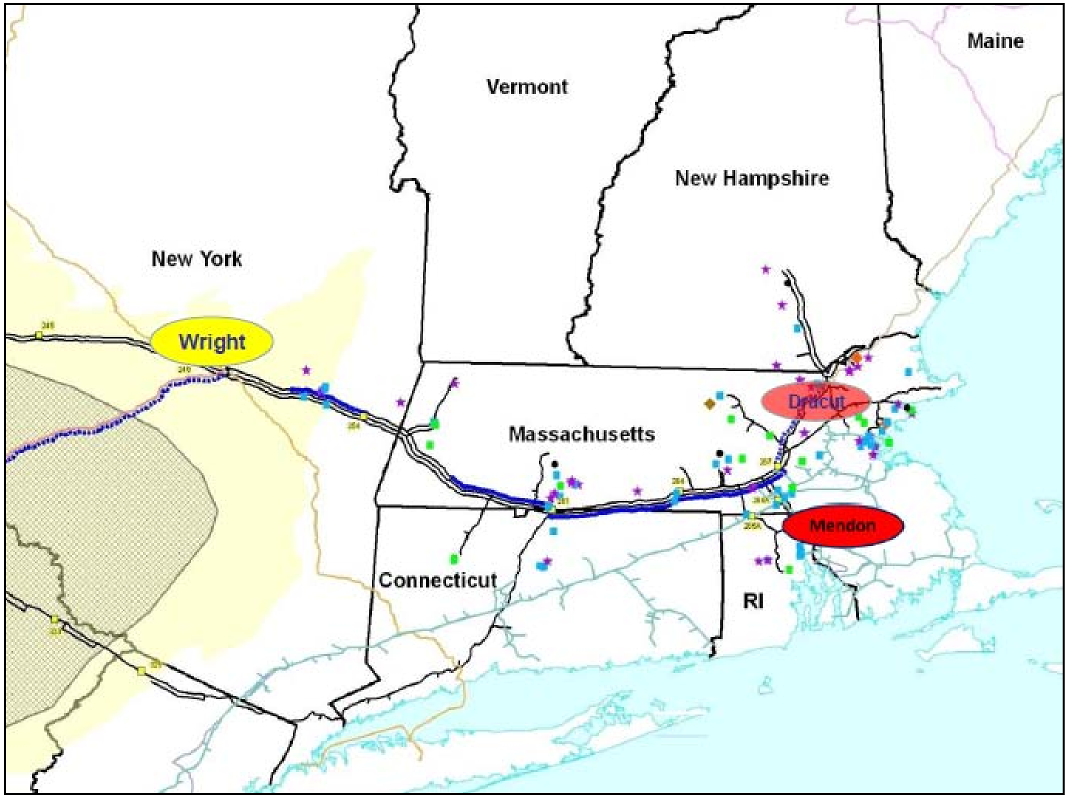
Proposed Pipeline Expansion Overview
TGP Northeast Expansion- Bullet Line



- **1.2 Bcf/d pipeline**
- **From Wright to Dracut, MA**
- **Backhaul existing markets**
- **3rd pipeline into region**
  - Benefits all existing markets
  - Enhances existing system
  - Development of new markets
- **High pressure line**
- **Expandable**
- **In service 2017-2018**

Source: Northeast Gas Association Pre-Winter Briefing 2012/2013 Tennessee Pipeline

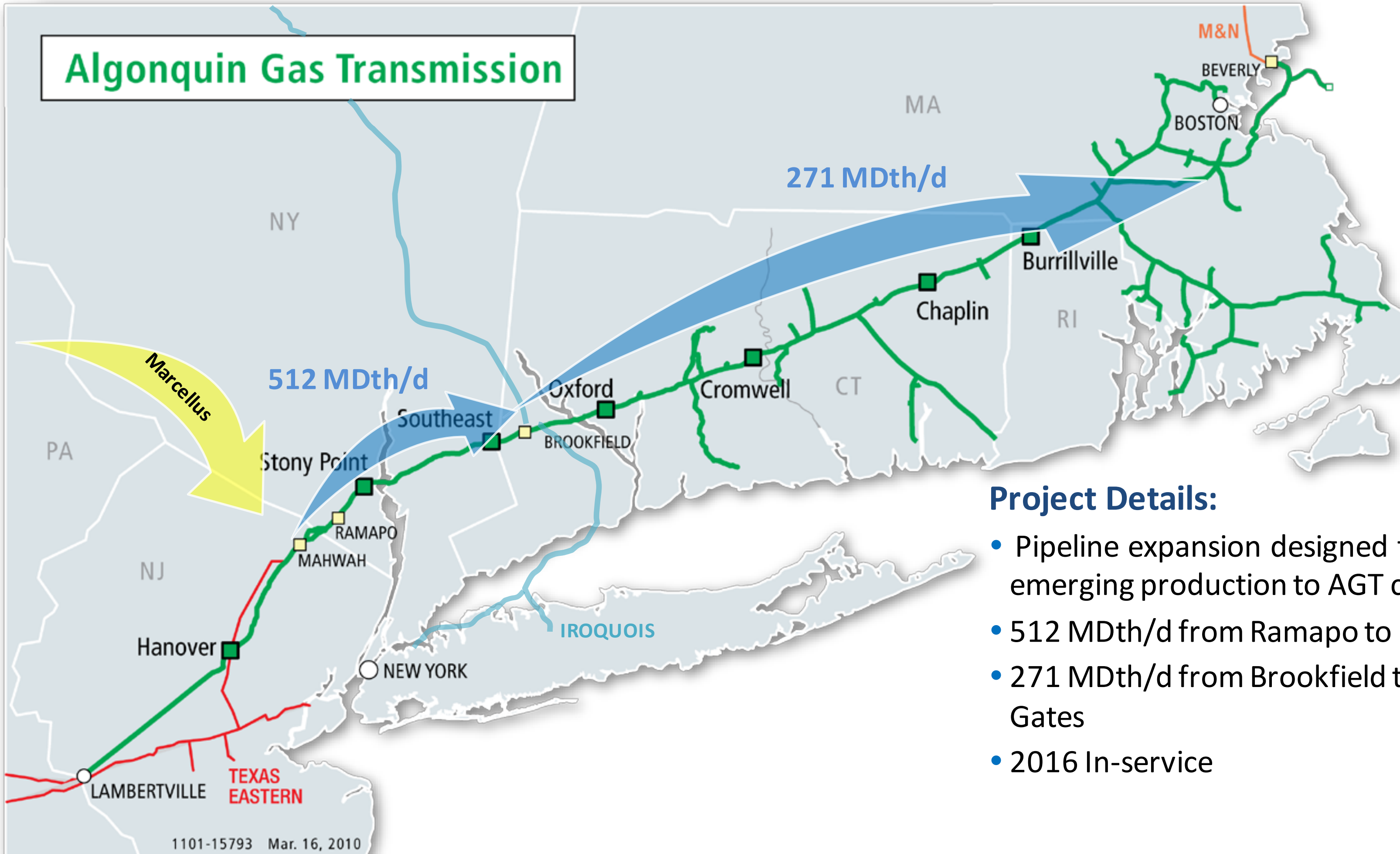
Proposed Pipeline Expansion Overview
TGP Northeast Expansion- 200 Line Looping



- Lower volume scale
  - 0.5 to 1.0 Bcf/d
- Current gas infrastructure located in TGP corridor
- Increases deliverability
- Flexibility in design
- In service 2016-2018

Source: Northeast Gas Association Pre-Winter Briefing 2012/2013 Tennessee Pipeline

Proposed Pipeline Expansion Overview
Algonquin Incremental Market Expansion

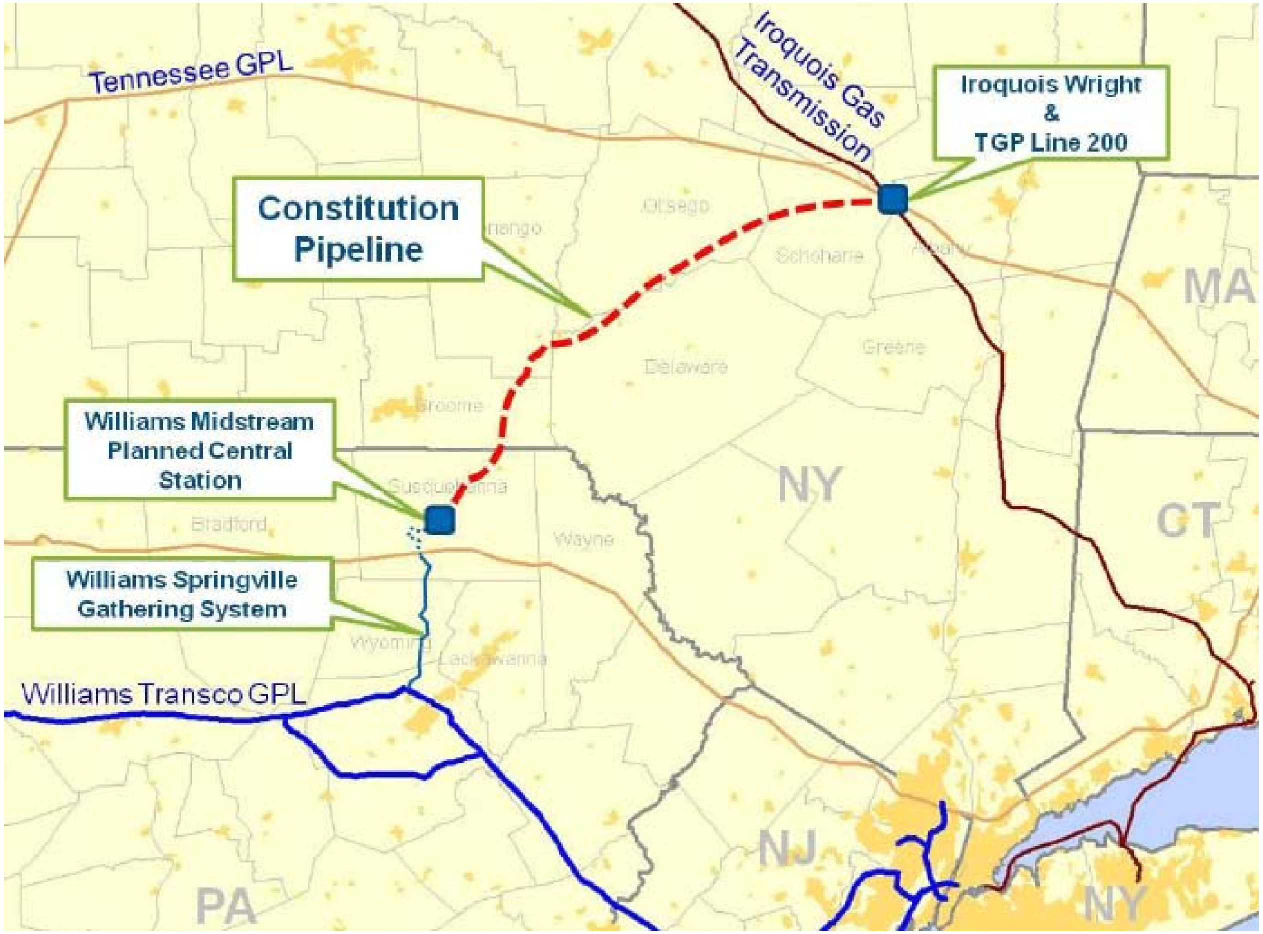


Project Details:

- Pipeline expansion designed to move emerging production to AGT city gates
- 512 MDth/d from Ramapo to Brookfield
- 271 MDth/d from Brookfield to AGT City Gates
- 2016 In-service

Source: Spectra Website

Proposed Pipeline Expansion Overview
Constitution Pipeline



- **<u>Joint Venture</u>:**
  - <u>Williams (51%)</u>
  - <u>Cabot (25%)</u>
  - <u>Piedmont (24%)</u>
- **<u>Capacity</u>: 650,000 Dth/day**
- **<u>Expected In-Service Date</u>: 2015**
- **Greenfield project to stretch from Susquehanna County, PA to Schoharie County, NY**
- **Iroquois Gas Transmission and Constitution will develop the Wright Interconnect Project to deliver up to 650 MMcf/d from Constitution to Iroquois and Tennessee Gas Pipeline in Schoharie County, NY under a 15 year agreement**

Source: Constitution Pipeline Website

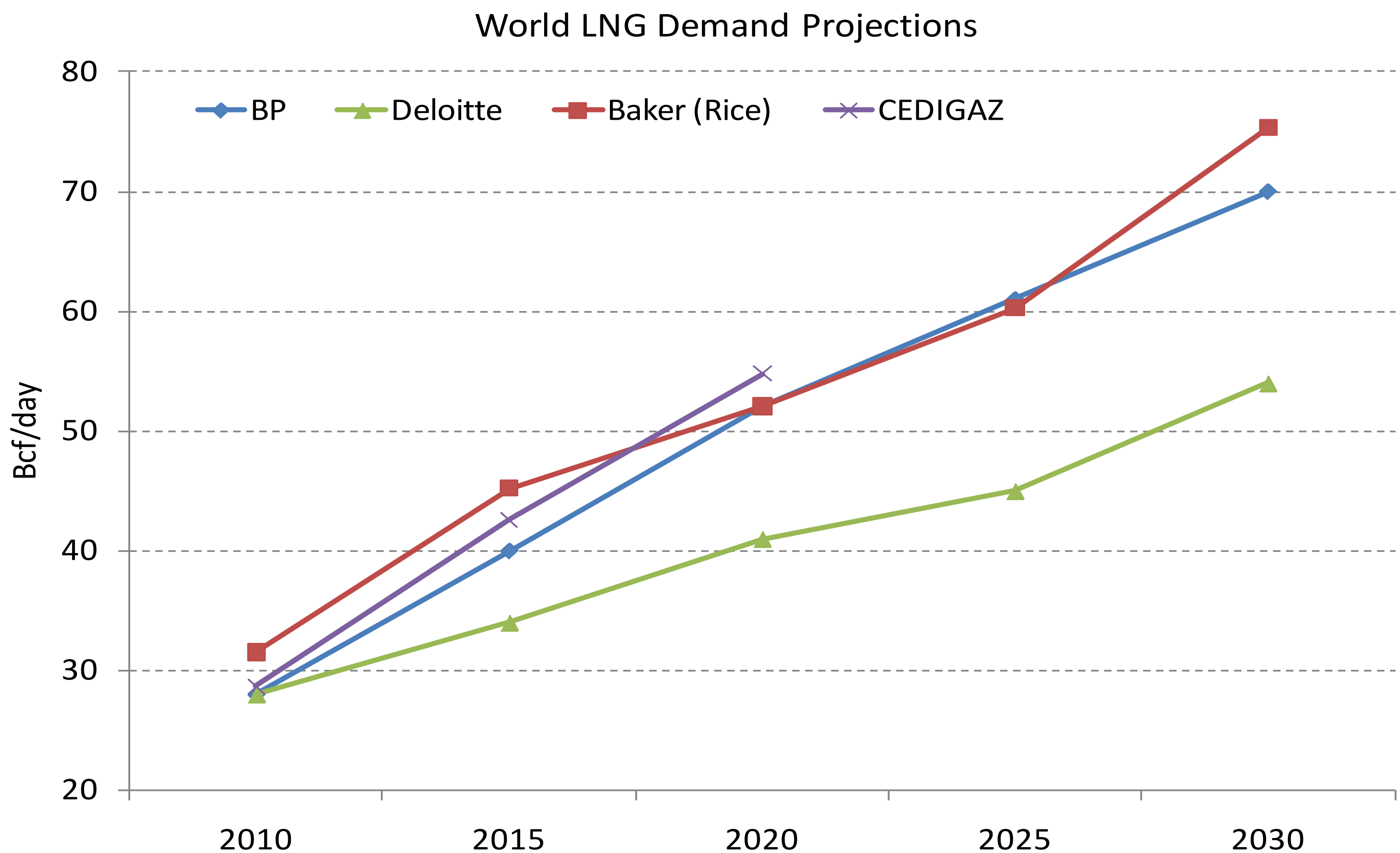
LNG Peak Shaving Facility Cost Estimates

	New England LNG Peakshaving Facility[1]	Black & Veatch Estimate[2]
Storage Tank Size (Barrels/Bcf)	348,000 Barrels* 1.2 Bcf	300,000 Barrels 1.0-1.1 Bcf
Liquefaction Capacity (MMBtu/d)	6,000	8,600
Vaporization Capacity (MMBtu/d)	60,000	60,000
Total Capital Cost	$108M	$120M

1 Reflects the Yankee Gas, Waterbury Connecticut facility configuration when the facility was completed in 2005. Does not reflect the 2011 Waterbury to Wallingford Line Project (WWL) expansion of vaporization capacity from 60,000 to 105,000 MMBtu/d

2 Based on B&V EPC experience in North America

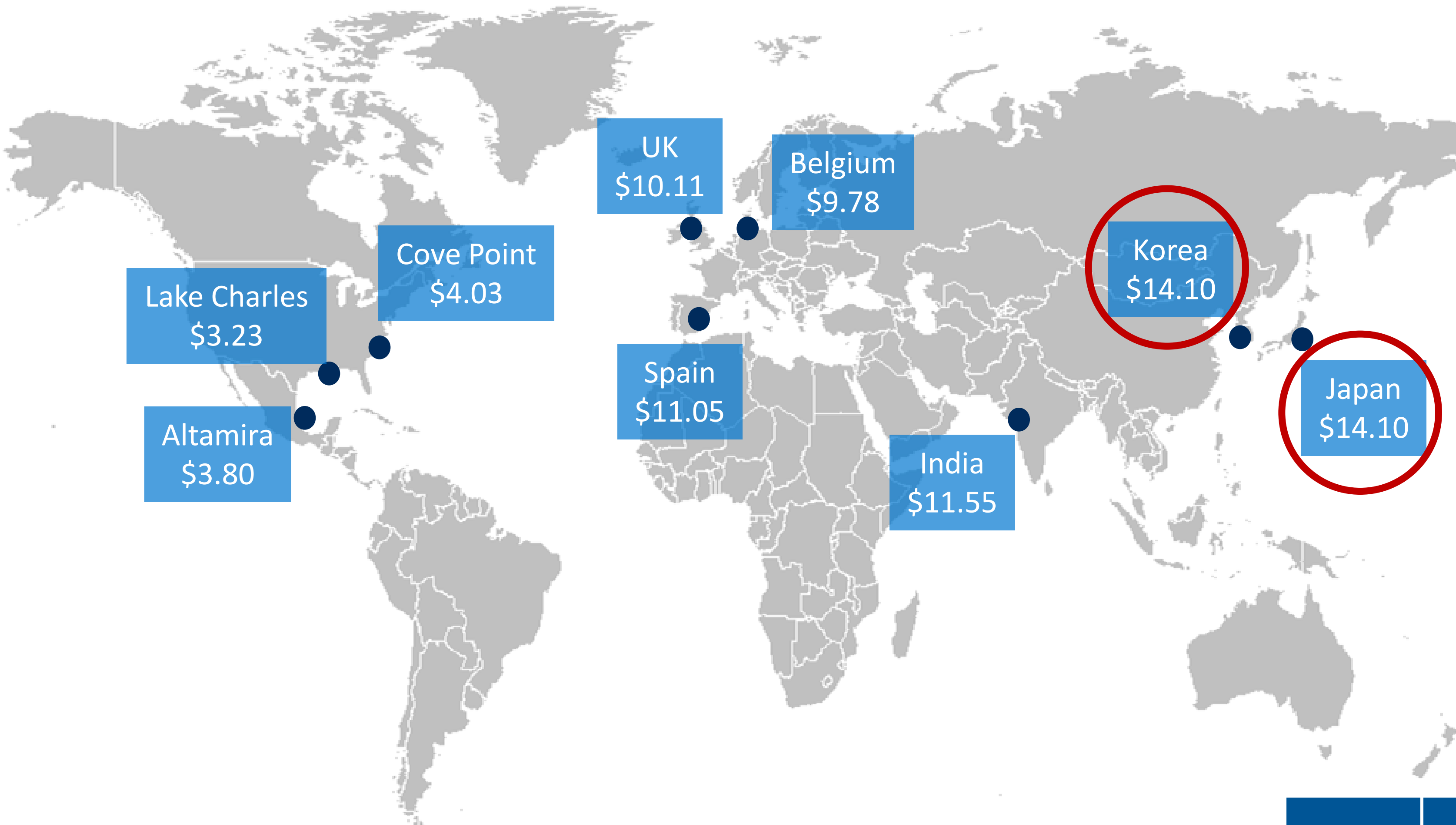
World LNG demand growth projections reflect aggressive growth of 5-7% annually to 2020



Sources:
BP - Statistical Review 2011 and Energy Outlook 2030
CEDIGAZ - World LNG Market: Current Developments and Prospects, CEDIGAZ General Meeting (June 24, 2011)
Deloitte – Navigating a Fractured Future, Deloitte Center for Energy Solutions and Deloitte MarketPoint
Baker (Rice) - James A Baker Institute Energy Forum (Rice University), Shale Gas and U.S. National Security (July 2011)

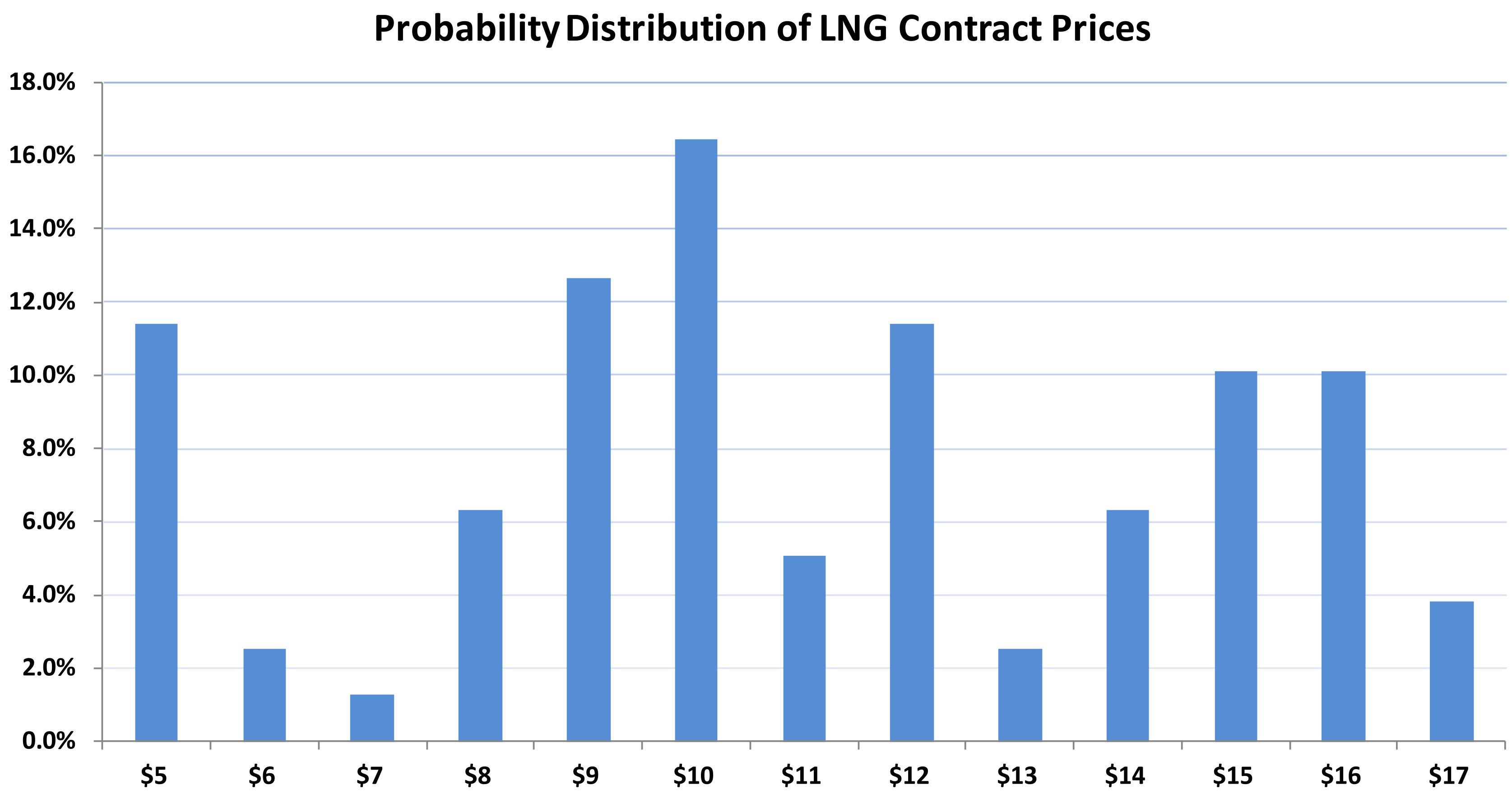
Any LNG Imports must compete with Asian and European LNG Prices

World LNG Estimated December 2012 Landed Prices



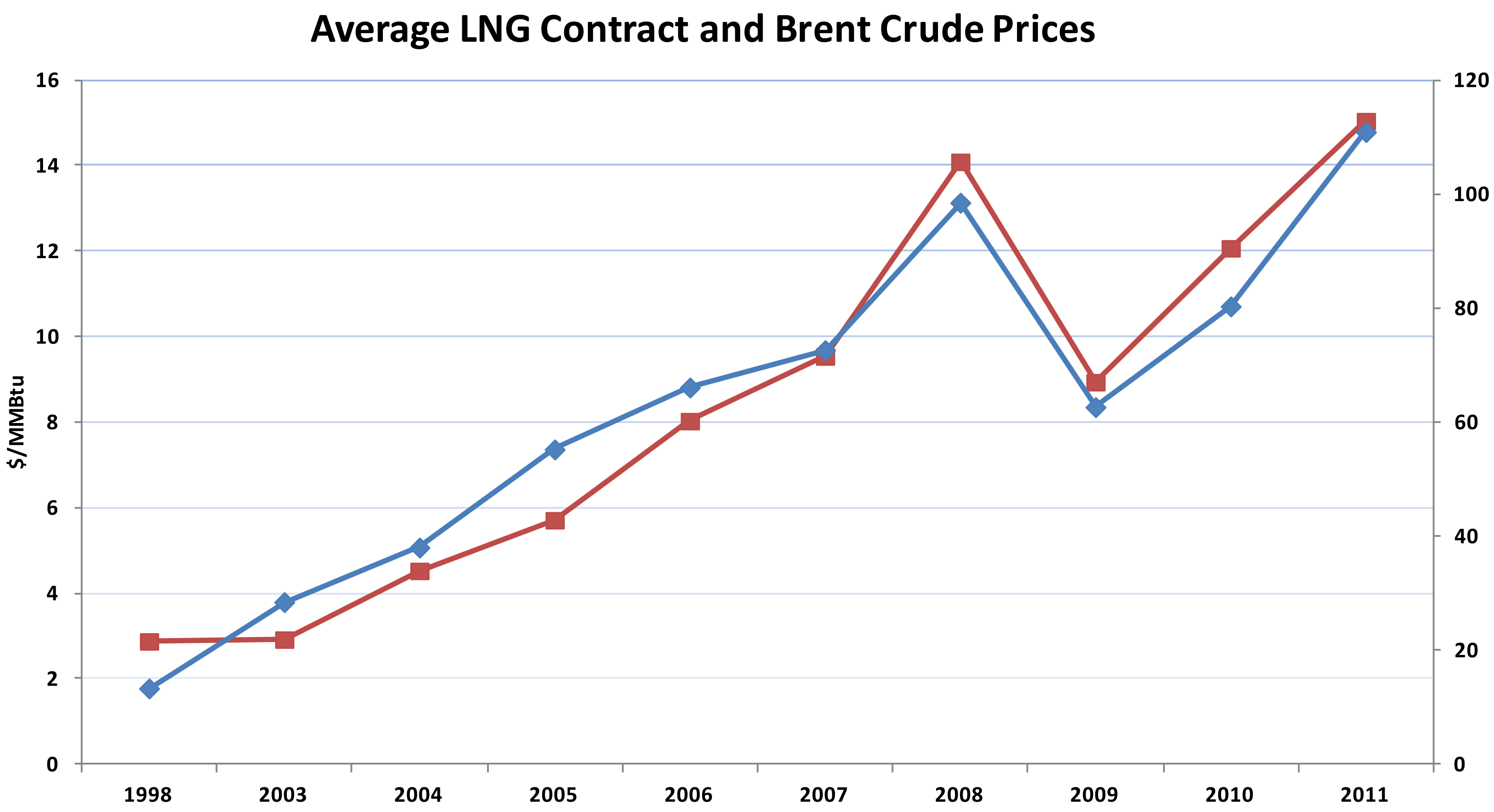
Source: FERC, Waterborne Energy, Inc

LNG Import Contract Prices reflects a sufficient range of prices to bid away European/Asian LNG Cargoes



Source: Black & Veatch Analysis

LNG Import Contract Prices still closely tied to Brent Crude Prices



Source: Black & Veatch Analysis

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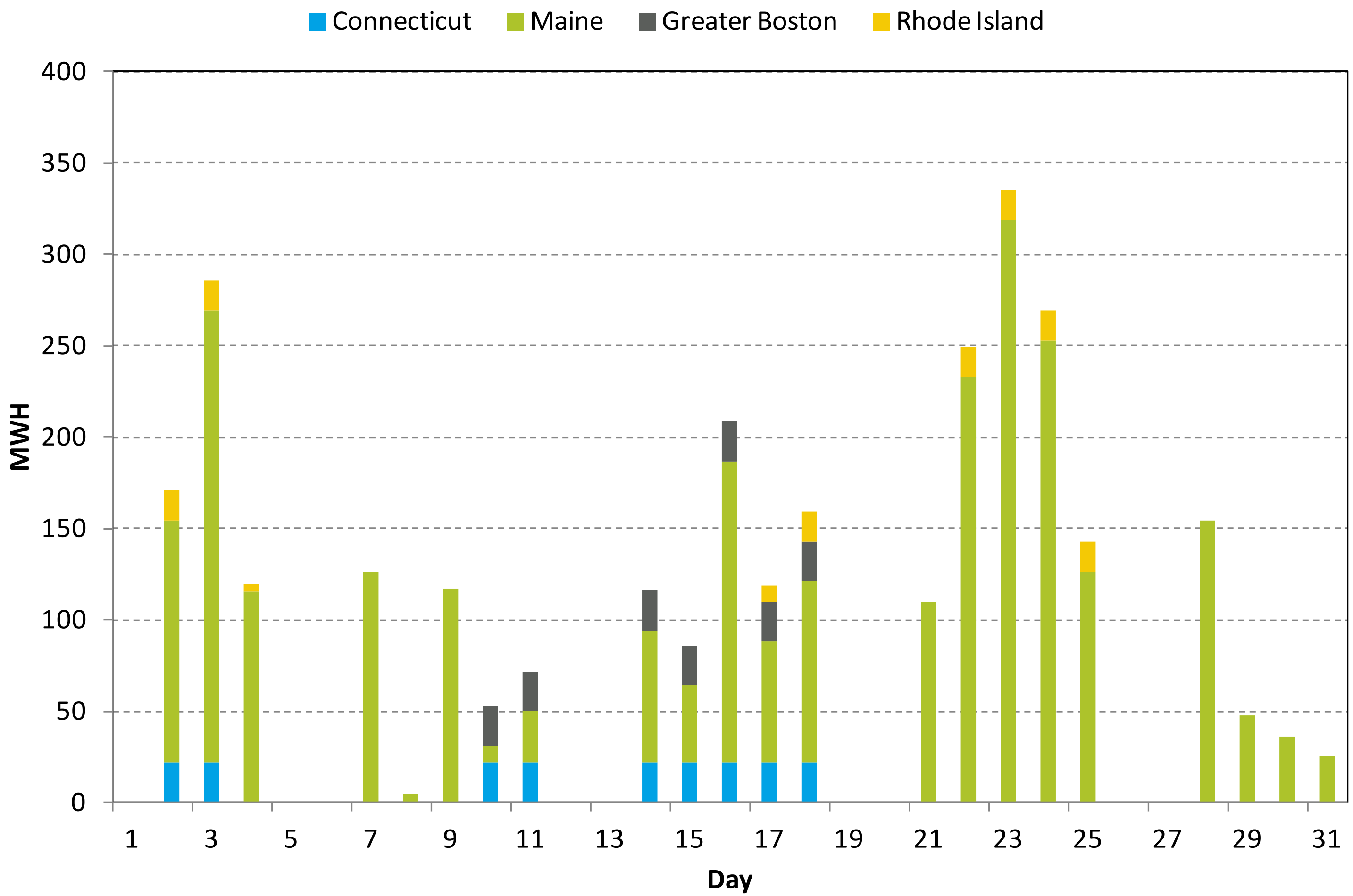
Demand Response – Total Capacity and Payments

	Active Demand Resources			Passive Demand Resources			
	Real-Time Demand Response Resource	Real-Time Emergency Generation Resource	Total Active Demand Resources	On-Peak Demand Resource	Seasonal Peak Demand Resource	Total Passive Demand Resources	Total All Demand Resources
2010 Year End	669	522	1191	406	118	524	1716
2011 Year End	649	436	1085	617	259	876	1960

	Capacity Payments	% of Total	DALRP Payments	% of Total	RTPR Payments	% of Total	Total Payments
2010	$134,456,420	93.9%	$7,763,220	5.4%	$942,307	0.7%	$143,161,947
2011	$97,591,566	93.5%	$6,296,955	6.0%	$455,462	0.4%	$104,343,983

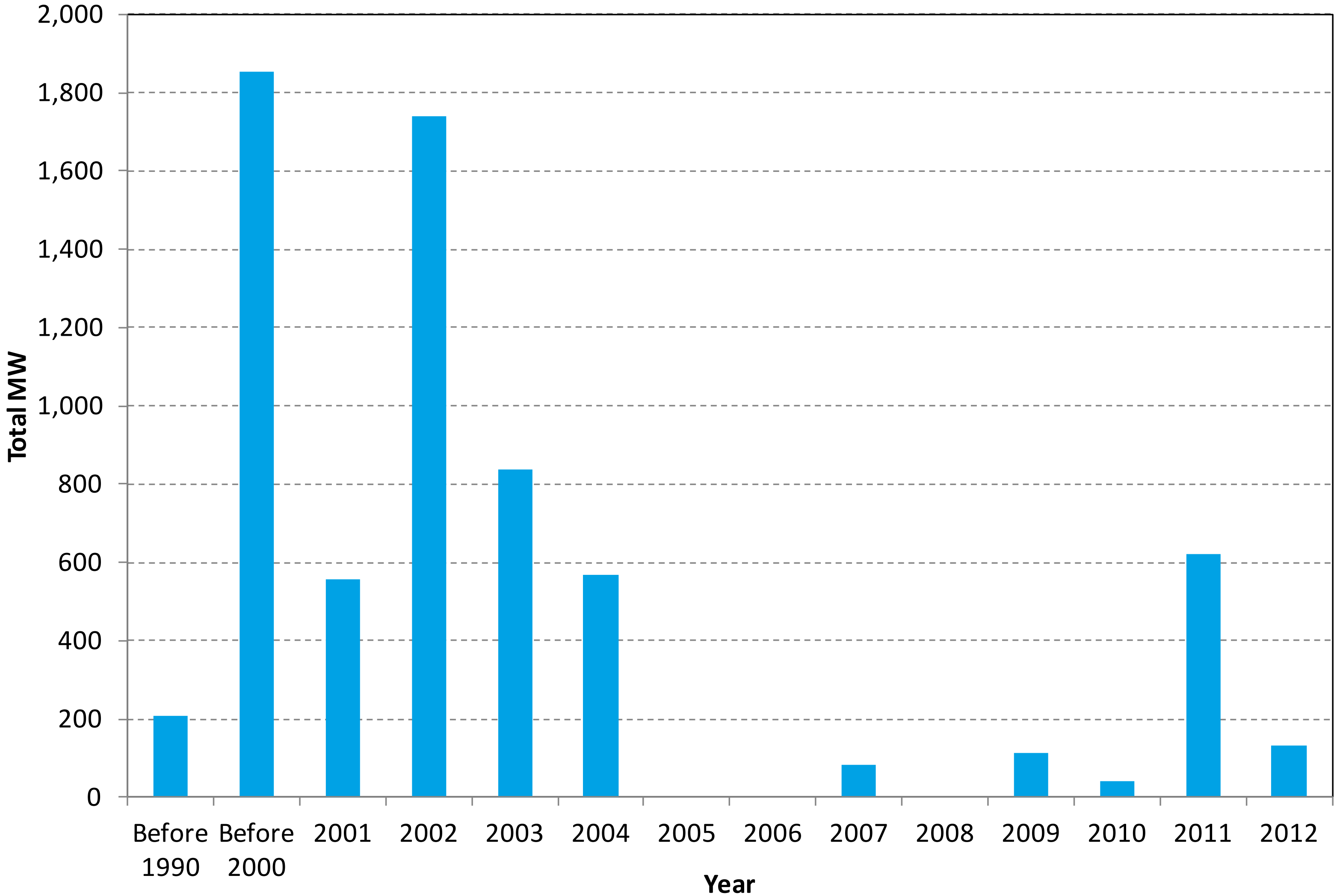
Source: ISO New England and Black & Veatch Analysis

Demand Response – Cleared Demand Response Resources in January 2013



Source: ISO New England and Black & Veatch Analysis

ISO-NE's Duel Fuel Capacity Addition Schedule



Source: Ventyx and Black & Veatch Analysis

Costs of Combined Cycle Conversion to Duel – Fuel Capacity

Components	Cost Estimates (million $)
Conversion Material	$21
Conversion Labor	$4
Indirect Costs (such as Contingency or Construction Management)	$9
Other Costs (Plant Site Upgrade and Ancillary Construction)	$5
Total	$39

Source: Black & Veatch Analysis

Discussion Outline

- Phase II Objectives
- Black & Veatch Methodology Overview
- New England Demand Growth
- Geographic Load Distribution and Infrastructure
- Load Duration and Constraint Assessment
- Natural Gas Infrastructure Costs
- Power Side Solutions
- Recommended Scenarios and Sensitivities

Base Case Assumptions

Power

1. Moderate load growth at around 1% per year
2. Efficiency gains grow significantly until 2020 with an ever decreasing growth rate
3. Environmental policies triggers retirements of coal and oil capacity
4. A federal emissions program in 2022
5. Each New England state to meet its RPS standards;
6. Later period capacity additions exclusively gas based

Natural Gas

1. Base Case Residential/Commercial and Industrial demand growth
2. LNG Export at Gulf Coast and West Coast
3. No regulation on hydraulic fracturing
4. No stricter control on usage and treatment for water used in hydraulic fracturing
5. No collapse in natural gas liquids price
6. Eastern Canadian supply decline

New England Electricity Price

Run 1: No Incremental Infrastructure
Run 2: Pipeline Infrastructure
Run 3: LNG Imports
Run 4: Demand Response and Dual-Fuel Capacity
Run 5: Canadian Electric Imports

New England Natural Gas Price

High Demand Case Assumptions

Power

1. Moderate load growth at around 1% per year
2. Energy efficiency does not grow
3. Some New England states do not meet 2012 RPS standards
4. Nuclear retirement earlier than expected

Natural Gas

1. High case residential/commercial and industrial demand growth with policy incentives
2. Higher LNG export at Gulf Coast and west Coast; multiple terminals
3. No regulation on hydraulic fracturing
4. No stricter control on usage and treatment for water used in hydraulic fracturing
5. No collapse in natural gas liquids price
6. MN&P pipeline reversal

New England Electricity Price

Run 1: No Incremental Infrastructure
Run 2: Design Day Weather Sensitivity
Run 3: Pipeline Infrastructure
Run 4: LNG Imports
Run 5: Canadian Electric Imports

New England Natural Gas Price

Low Demand Case Assumptions

Power

Limited Demand Growth from the Power Sector

Natural Gas

No Demand Growth from the Gas Sector

New England Electricity Price

Run 1: No Incremental Infrastructure
Run 2: Negative Electric Sector Demand Growth
Run 3: Dual-Fuel Capacity
Run 4: Canadian Electric Imports
Run 5: LNG Peak Shaving

New England Natural Gas Price

Recommended Sensitivities for Phase III

Scenario	Sensitivities
Base Case	-No Incremental Solutions Incremental Solutions: -Pipeline Infrastructure -LNG Imports -Demand Response and Dual Fuel Capacity -Canadian Electricity Imports
High Demand Case	-No Incremental Solutions -Design Day Weather Sensitivity Incremental Solutions: -Pipeline Infrastructure -LNG Imports -Canadian Electricity Imports
Low Demand Case	-No Incremental Solutions -Negative Electric Sector Demand Growth Incremental Solutions: -Dual Fuel Capacity -Canadian Electricity Imports -LNG Peak Shaving

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