FortisBC Resource Planning Advisory Group

2017 LTGRP – Workshop 3

August 9, 2017

Energy at work FORTIS BC™

Safety Message

- Identify the location of emergency exits
- Determine the muster location in case we have to evacuate the building
- Dial 911 for emergencies
- Earthquake Awareness:

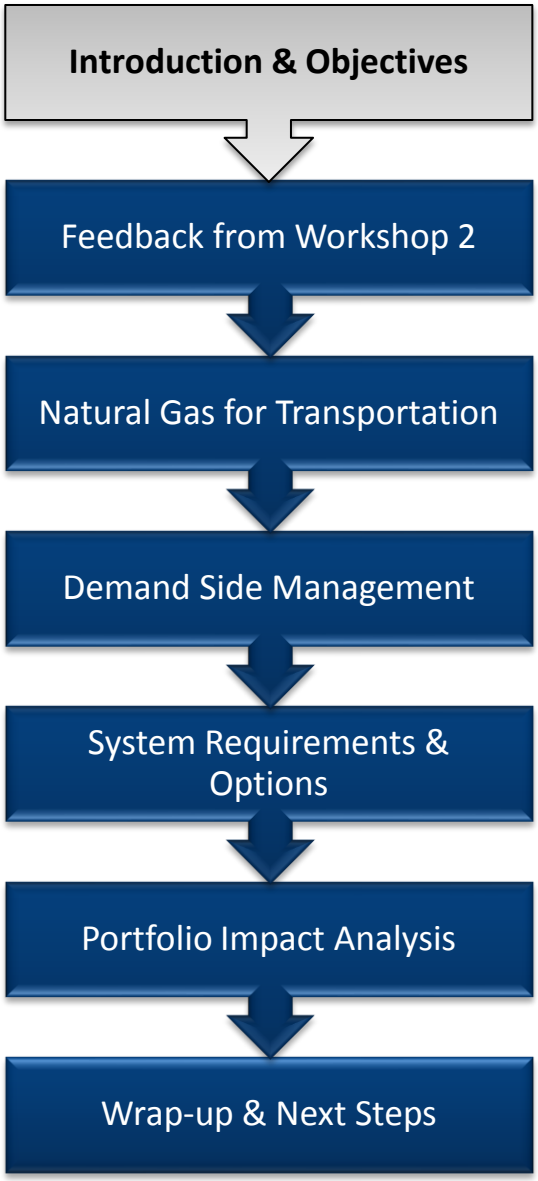
Introductions

RPAG Members:

- Name and Affiliation

FortisBC Staff:

- Name
- Role as it relates to the LTGRP



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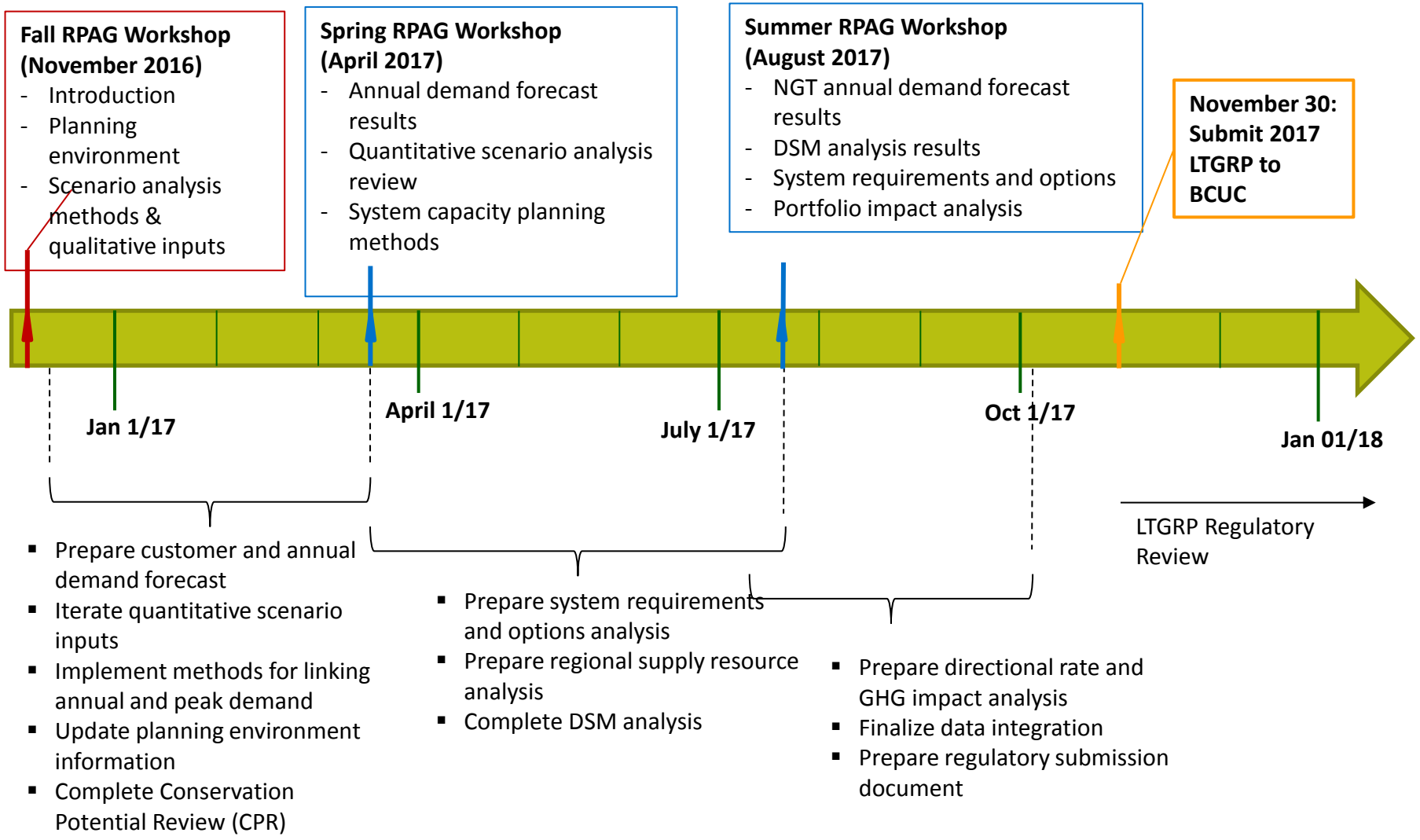
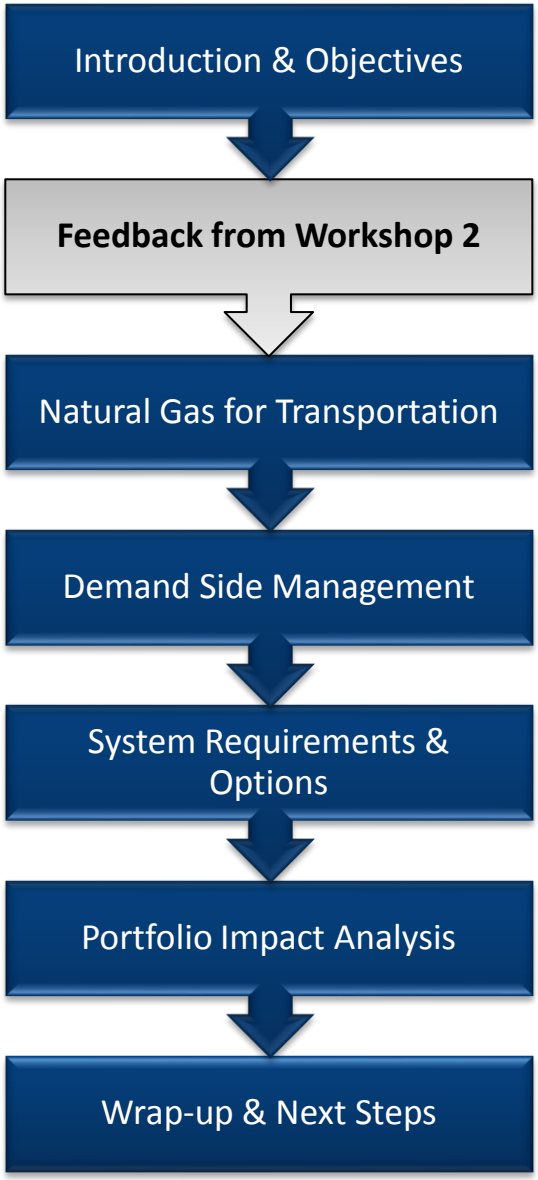
2017 LTGRP Timeline



Please note

- Your contributions may be used for formulating our regulatory submission
- As such, your feedback may become public during the regulatory process
- We will not attribute statements to individual workshop attendees



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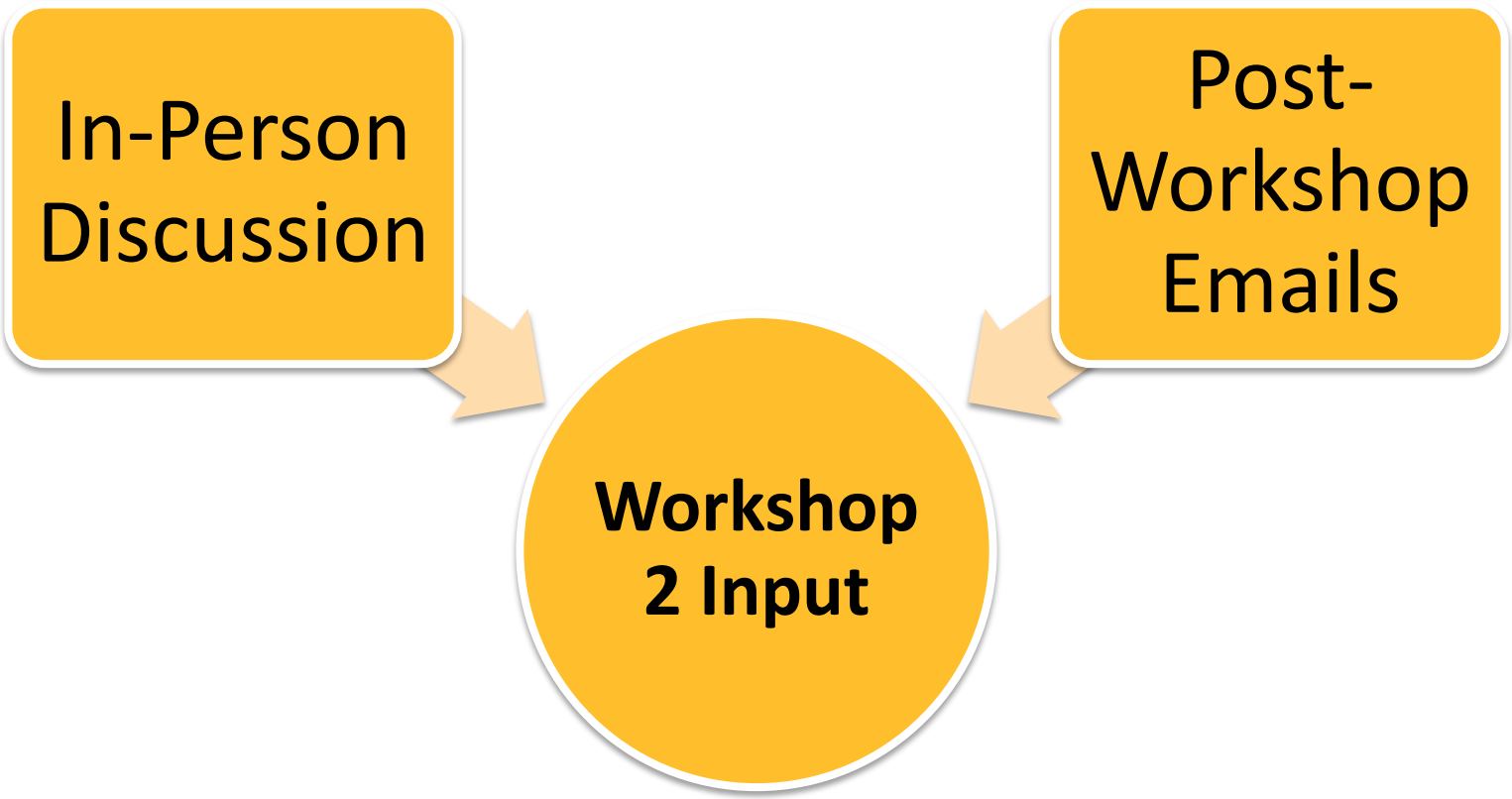
Thank you for your active engagement



FortisBC Innovation to Meet Customer Preferences and Policy Objectives

Jason Wolfe, Director, Energy Solutions

August 9, 2017

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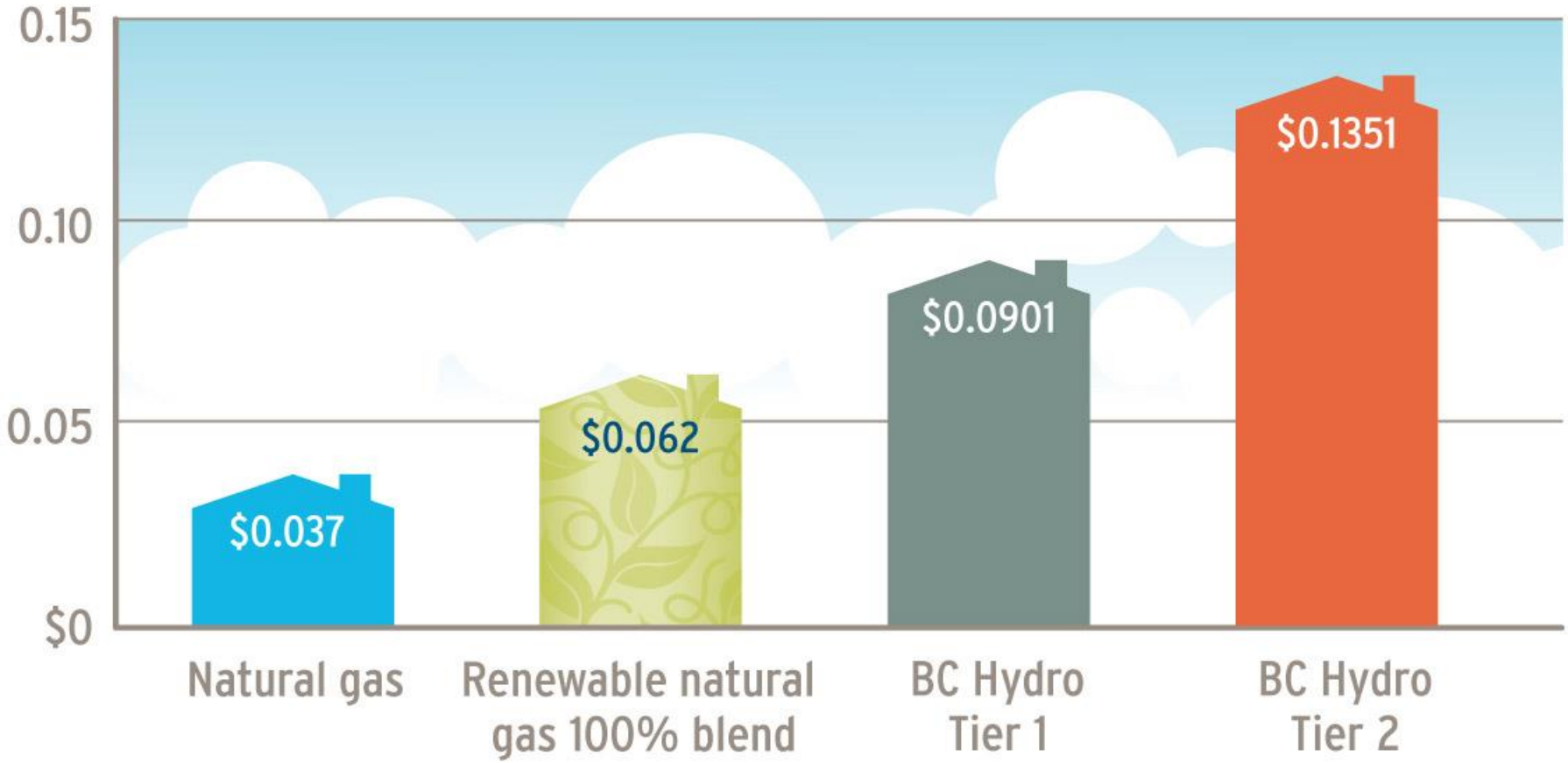
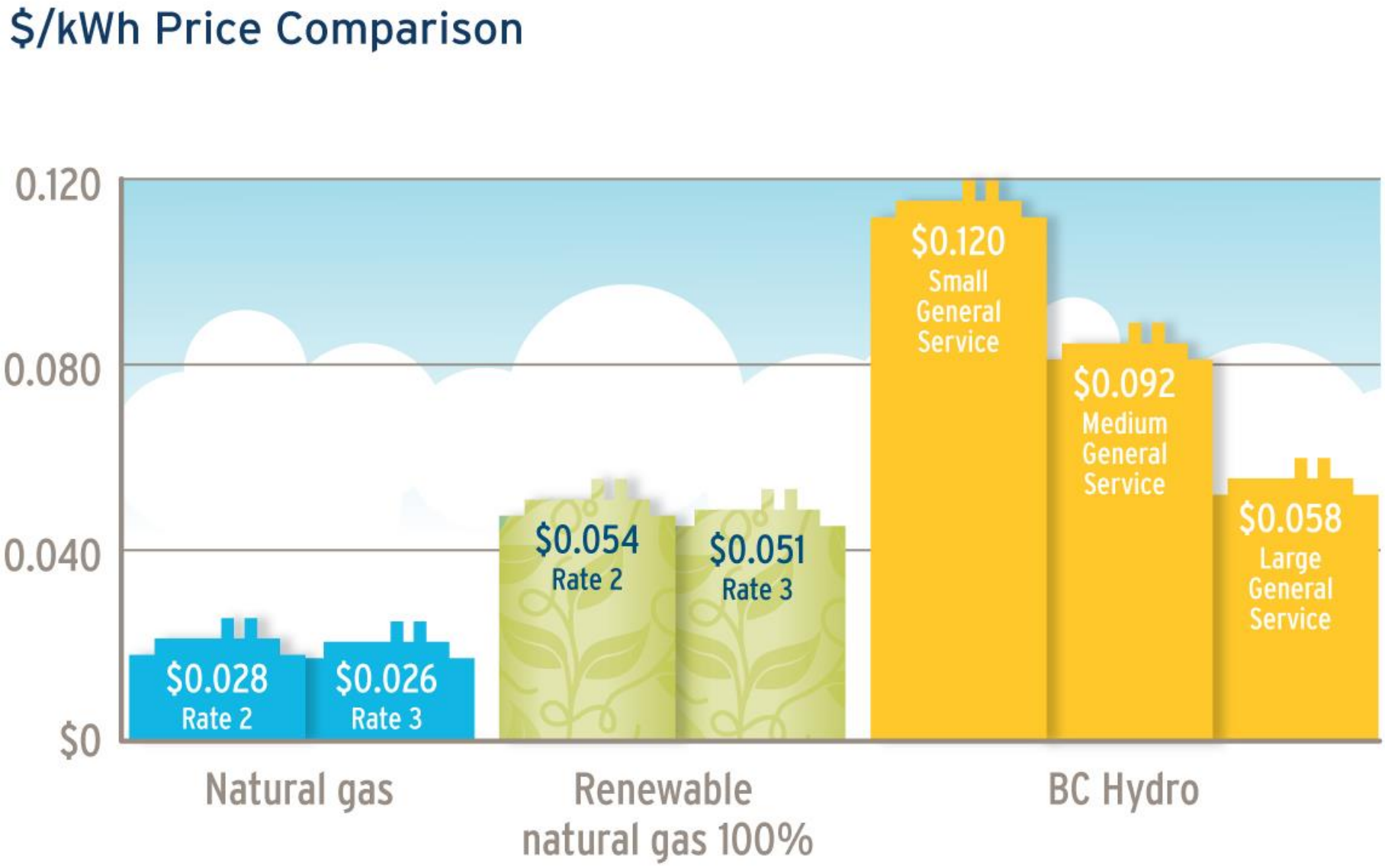
Natural Gas, an Economic Solution

Residential Gas $/kWh Price Comparison



Commercial Price Comparison



Innovation and Customer Demand

Working with builders and developers to bring gas to new developments.

Innovation and Customer Demand Demonstration and New Technology Projects

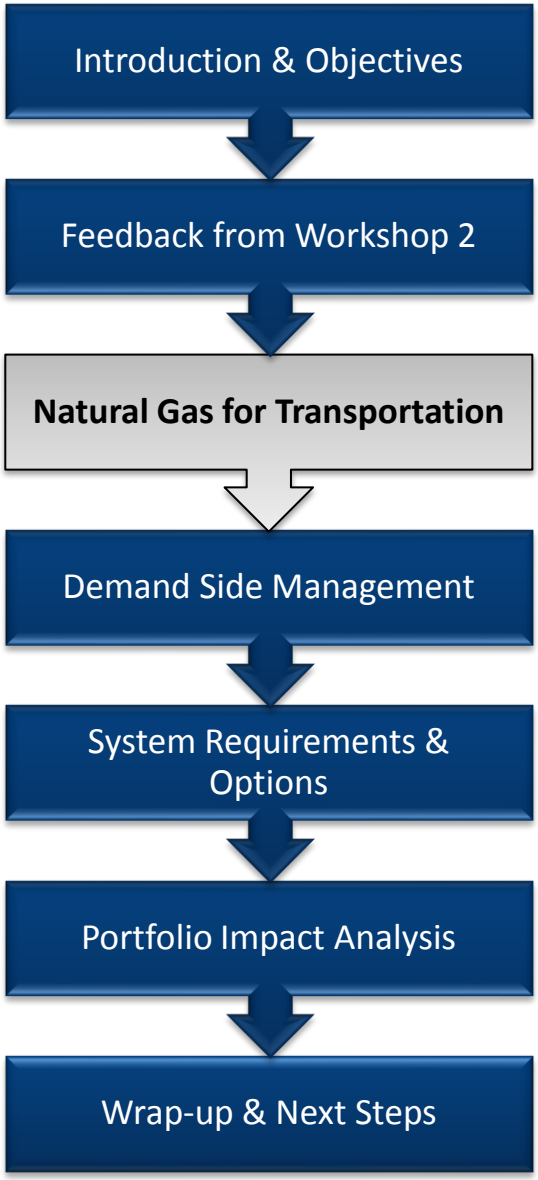
Innovation and Customer Demand Demonstration and New Technology Projects

FortisBC Energy Inc. (FEI) projects (non-DSM)

- Commercial Carbon Capture
- Residential CHP/Fuelcell

We received additional qualitative input

Input Theme	FortisBC Implementation
FEI should provide a graphical reconciliation if it uses multiple data sources to derive specific data points	Logged in 2017 LTGRP lessons learned documentation; this will be considered during planning for the next LTGRP.
FEI should use its Switch 'n' Shrink (SnS) program to validate fuel share changes in its forecast model	Net additions in forecast within range of historical net addition rates. SnS capture rate is low in relation to total market.
Data display and terminology	Considered the duration of historical data in report charts. Background guidelines on terms and formatting for 2017 LTGRP contributors.



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Natural Gas for Transportation: Overview and Annual Demand Forecast

Mike Bains, Manager, Regulatory & Commercial Development

August 9, 2017

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BC Energy Policy – History

2002 — **Energy for Our Future Plan**

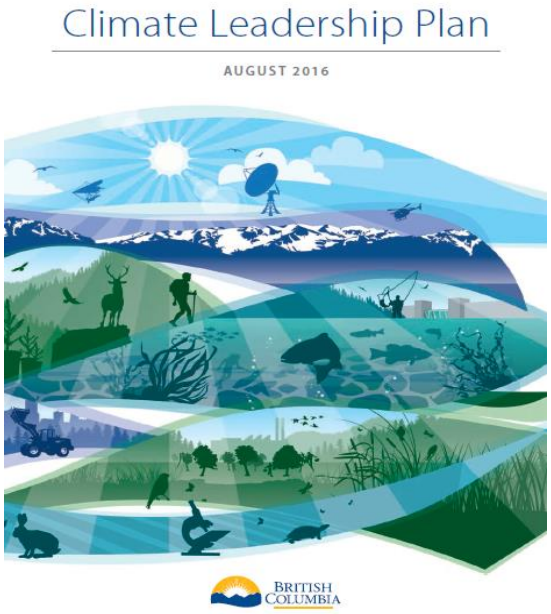
2007/08 — **Climate Action Plan**

2012 — **Natural Gas & LNG Strategies**

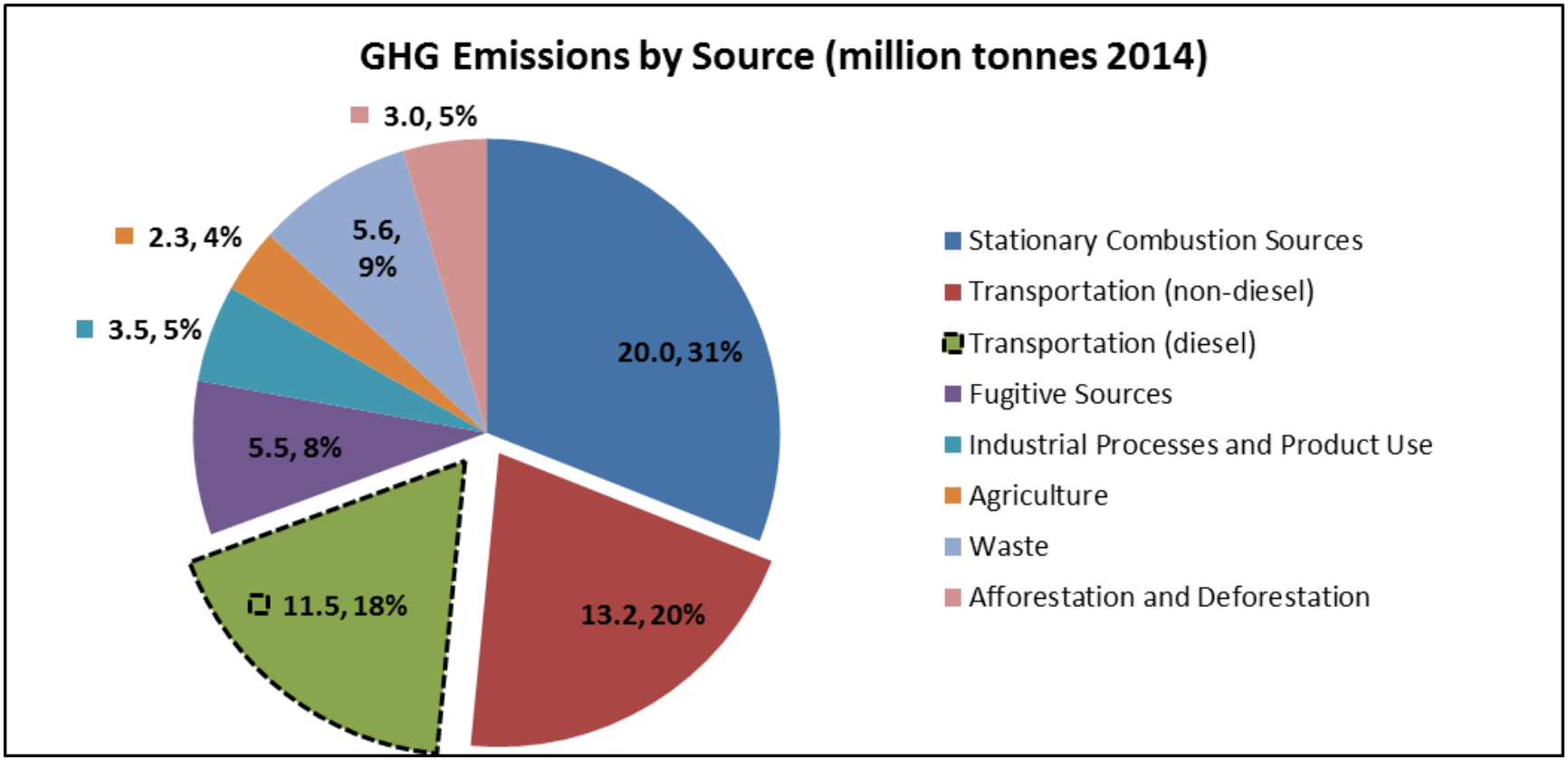
2016 — **Climate Leadership Plan**

Themes of BC Energy Policy:

Balancing interests of environment, economy & energy



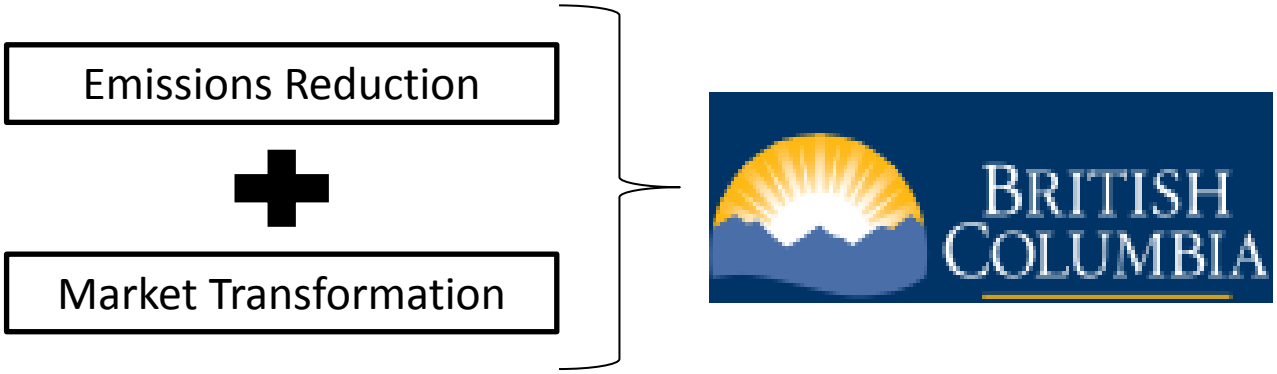
BC Energy Policy – GHG Emissions by Sector



Transportation related emissions:

- diesel-based transportation (~18% of Provincial share emissions) provides best opportunity to displace with natural gas to lower overall CO2e emissions

Greenhouse Gas Reduction (Clean Energy) Regulation



- Incentives enabled for eligible vehicles, maintenance facilities and expenditures for training, admin and marketing
- Gov't focus on refining existing regulations has continued to support the development of Natural Gas for Transportation markets in BC
- Supportive of the commitment and willingness to drive adoption of CNG/LNG and RNG to lower emissions from the Transportation sector

OIC 295 (May 2012) → OIC 556 (Nov 2013) → S.D. No. 5 (Dec 2013) → OIC 297 (Jun. 2015) → OIC 609 (Aug. 2016) → OIC 161 (Mar. 2017)

Natural Gas for Transportation: Stakeholder Approach

- CNG/LNG Customers
- Utility Core Customers
- Climate and Environmental Leadership
- Natural Gas Utilities

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CNG/LNG Business Growth to Date

CNG

Waste Haulers - 206

Buses - 290

Food/Beverage /Parcel Delivery - 94

LNG

Heavy Duty Trucks - 158

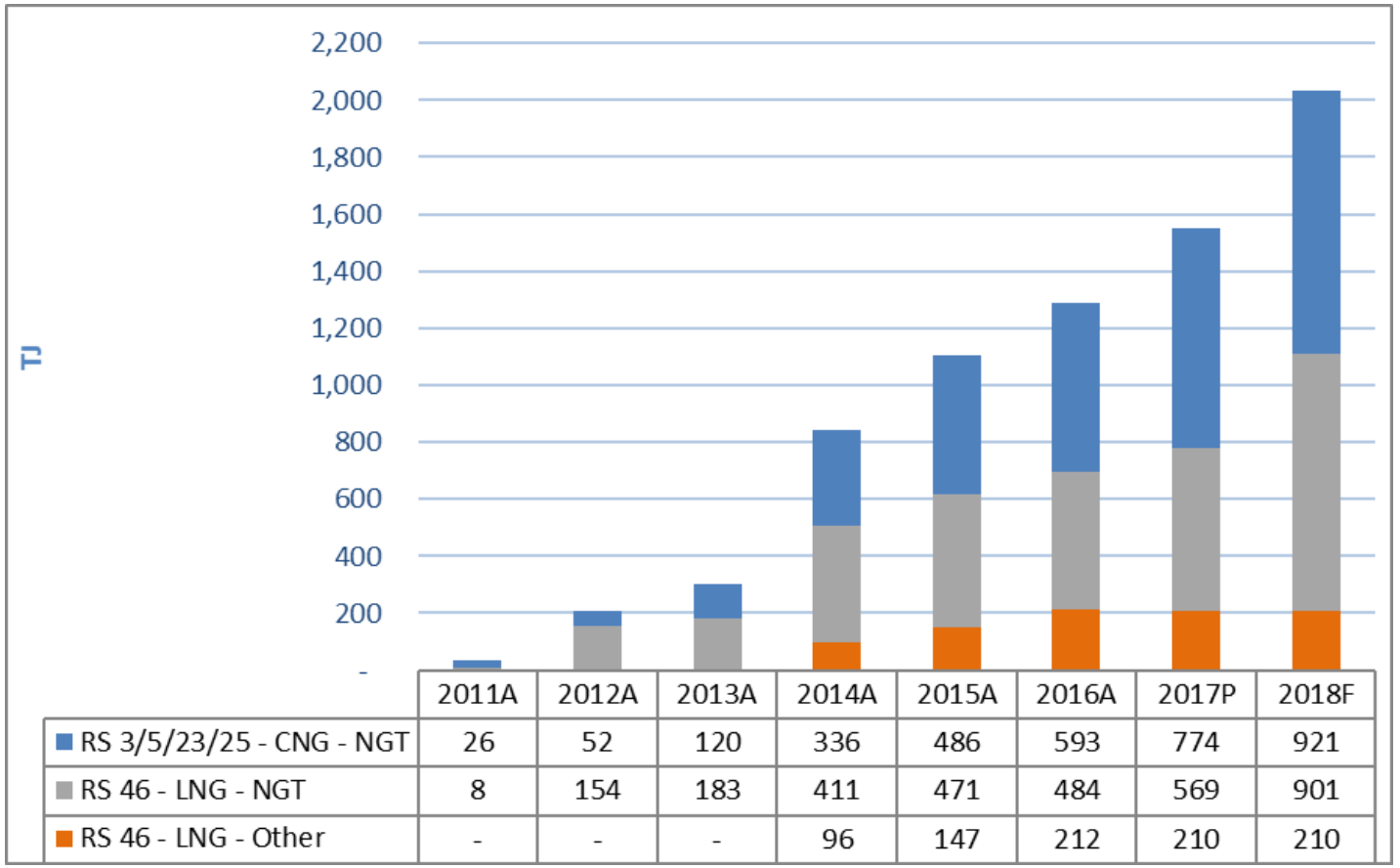
Mine Haul Truck Pilot - 6

Ferries - 5

Cargo Ferries - 2

Remote Power - 3

CNG/LNG Business Growth to Date



	2011A	2012A	2013A	2014A	2015A	2016A	2017P	2018F
RS 3/5/23/25 - CNG - NGT	26	52	120	336	486	593	774	921
RS 46 - LNG - NGT	8	154	183	411	471	484	569	901
RS 46 - LNG - Other	-	-	-	96	147	212	210	210

79% compound annual growth rate
in CNG and LNG demand over 2011-2018 period

Benefits to Date from NGT Development

Over 137 million diesel litres displaced to date (~ $20 million in fuel savings since 2011)

Captured Demand of ~2.7 PJ per year (~33,700 homes)

Over 135,000 tonnes of CO2e reduced to date (since 2011)

Investment Opportunity in CNG/LNG Infrastructure

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GGRR Investments To Date

Categories	Commitments to Date	GGRR Allowance
CNG Stations	$9.8 million (7 stations)	$12 million
LNG Stations, LNG Tankers and Truck Load Outs	$22.5 million (5 stations, 6 LNG tankers, and 1 LNG truck load out)	$50.5 million
Vehicle Incentives	$53.1 million	$210 million
Admin, Marketing and Training	$3 million	$8.1 million
Safety Upgrade Incentives	$1.8 million	$6 million

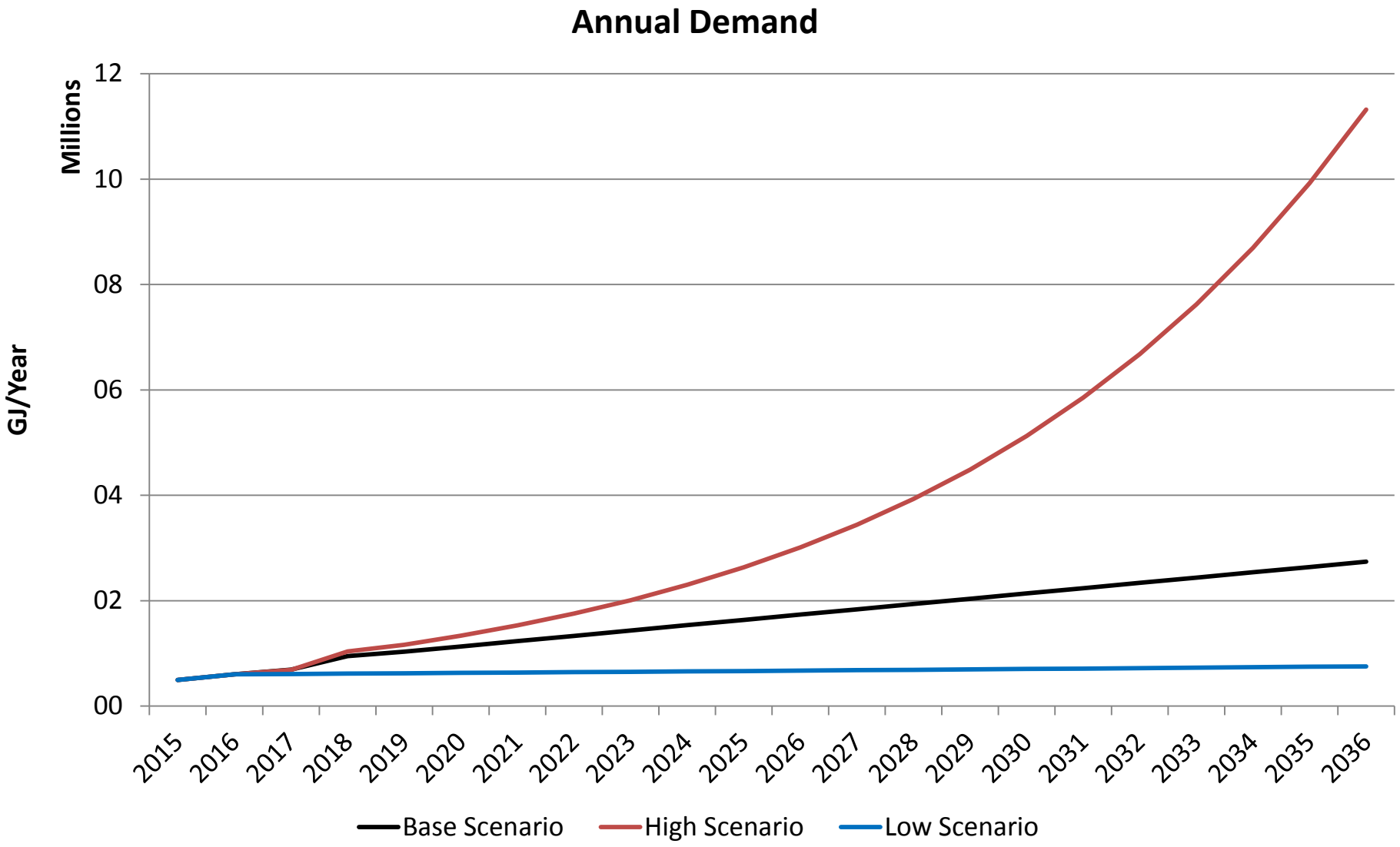
Demand Forecast Methodology

- Separate demand forecasts developed for CNG and LNG applications
  - Different market considerations for each CNG and LNG NGT markets
- Variance in use and characteristics
  - CNG: mainly On-road applications and short haul trucking
  - LNG: high horsepower on-road and off-road applications (i.e. marine, mine haul truck and rail)

CNG: Forecast Assumptions

- Diesel transportation market grows to 75 PJ in 2036 (57 PJ in 2016)
- Factors determining variance in forecast range of scenarios:
  - Natural gas engine availability and efficiencies
  - Diesel and natural gas price spreads
  - Carbon pricing
  - Policies and regulation supportive of CNG adoption

Long Term CNG Forecast



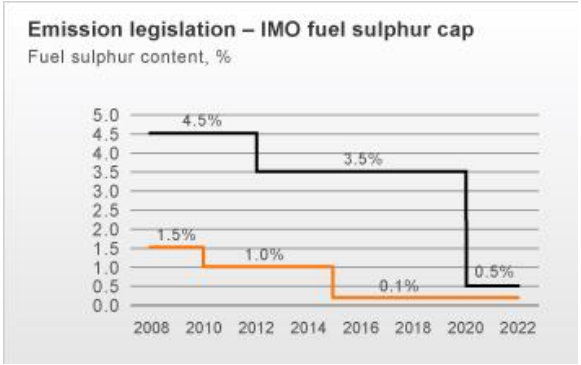
LNG: Adoption Assumptions

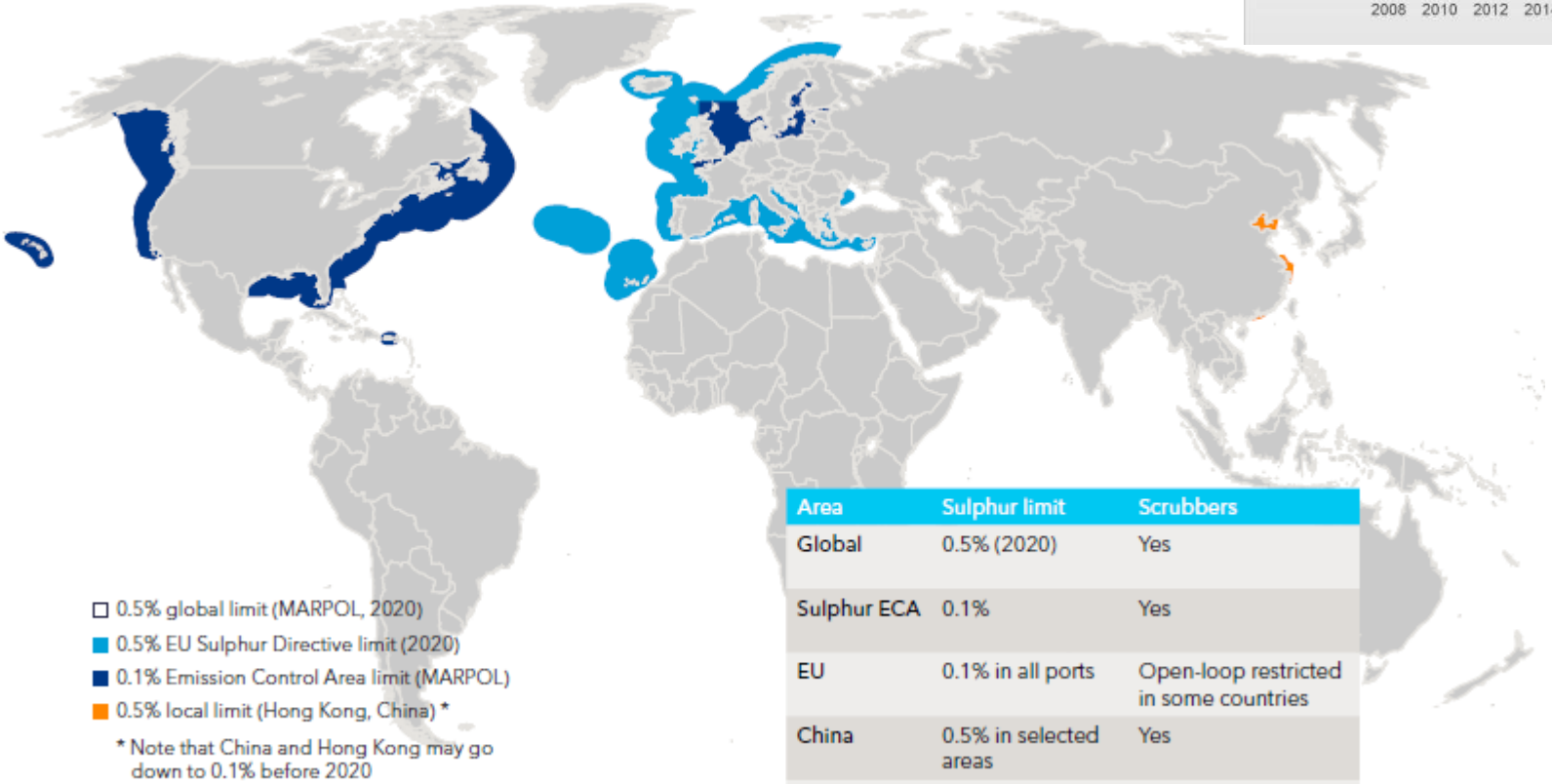
- If LNG gains prominence as a maritime fuel, marine sector (i.e. bunkering demand) expected to be largest share of overall domestic LNG demand in BC
- Policies and regulations supportive of LNG adoption as a transport fuel (i.e. IMO emissions regulations, further supportive regulatory environment limiting other PM and NOx) expected to spur LNG adoption
- Determination of market size of marine vessels regularly calling ports in BC and along West Coast of North America
- Technology (engine) availability to support NG adoption Locomotive engines
    - Marine engines
    - Mine haul truck engines, locomotive engines
- More uncertainty re: long term forecasts for marine LNG bunkering

LNG for Marine Bunkering

- 3 current paths to IMO Sulfur Cap compliance:

  - SOx Scrubbers - Low Sulfur Marine Gas Oil - LNG





Area	Sulphur limit	Scrubbers
Global	0.5% (2020)	Yes
Sulphur ECA	0.1%	Yes
EU	0.1% in all ports	Open-loop restricted in some countries
China	0.5% in selected areas	Yes
California	0.1% within 24 nm	No, only through research exemption

Marine – Target Market Segments

Short Sea Vessels

(BC Ferries / Seaspan)

Coastal Freight Vessels

(container ships, product tankers)

Trans-Pacific Vessels

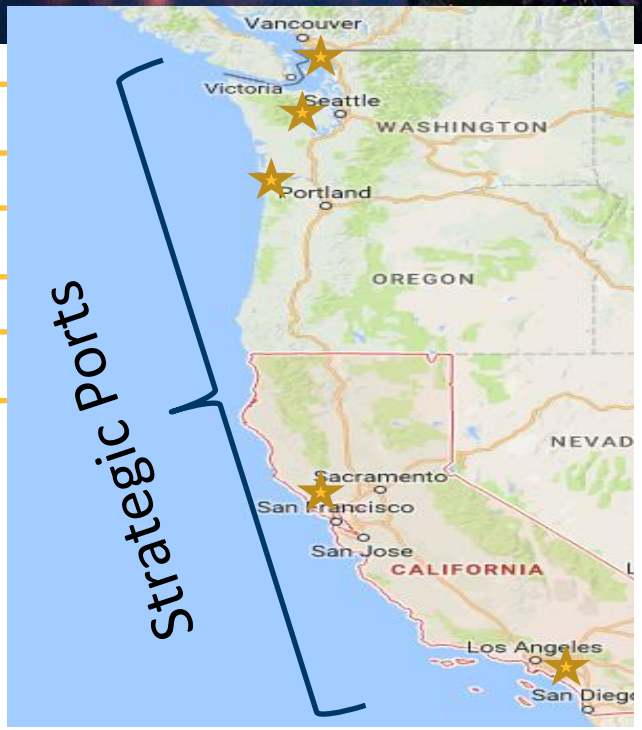
(car carriers, bulk cargo, container ships, cruise ships)

- Each marine market segment operates in distinct ways
  - Different operational requirements (transit routes, vessel design, etc.)
- Each segment also requires fuel (i.e. bunkering) in distinct ways
  - i.e. truck-to-ship vs. ship/vessel-to-ship

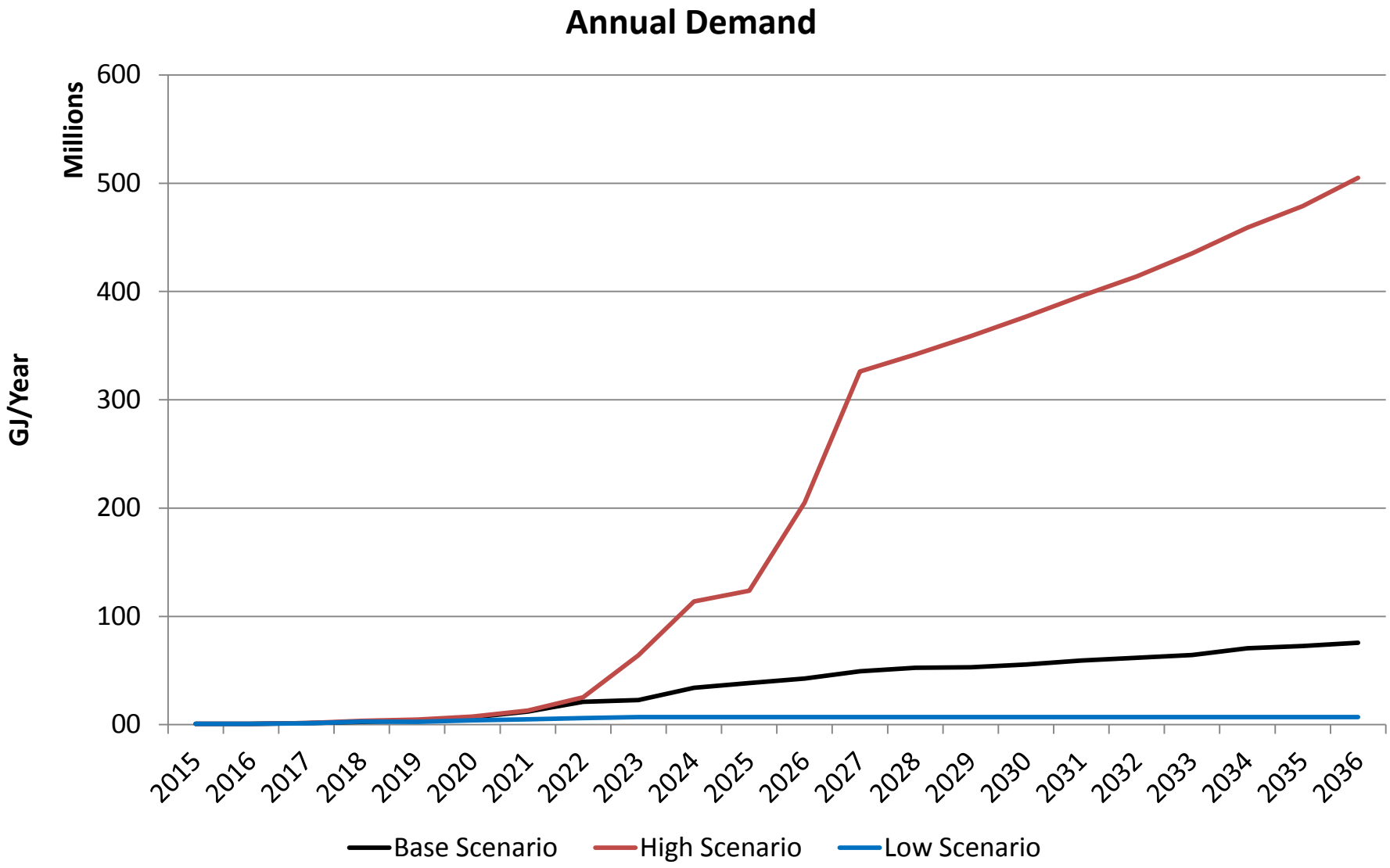
The Opportunity - Vancouver as a LNG Bunkering Hub on the West Coast

Market Advantages

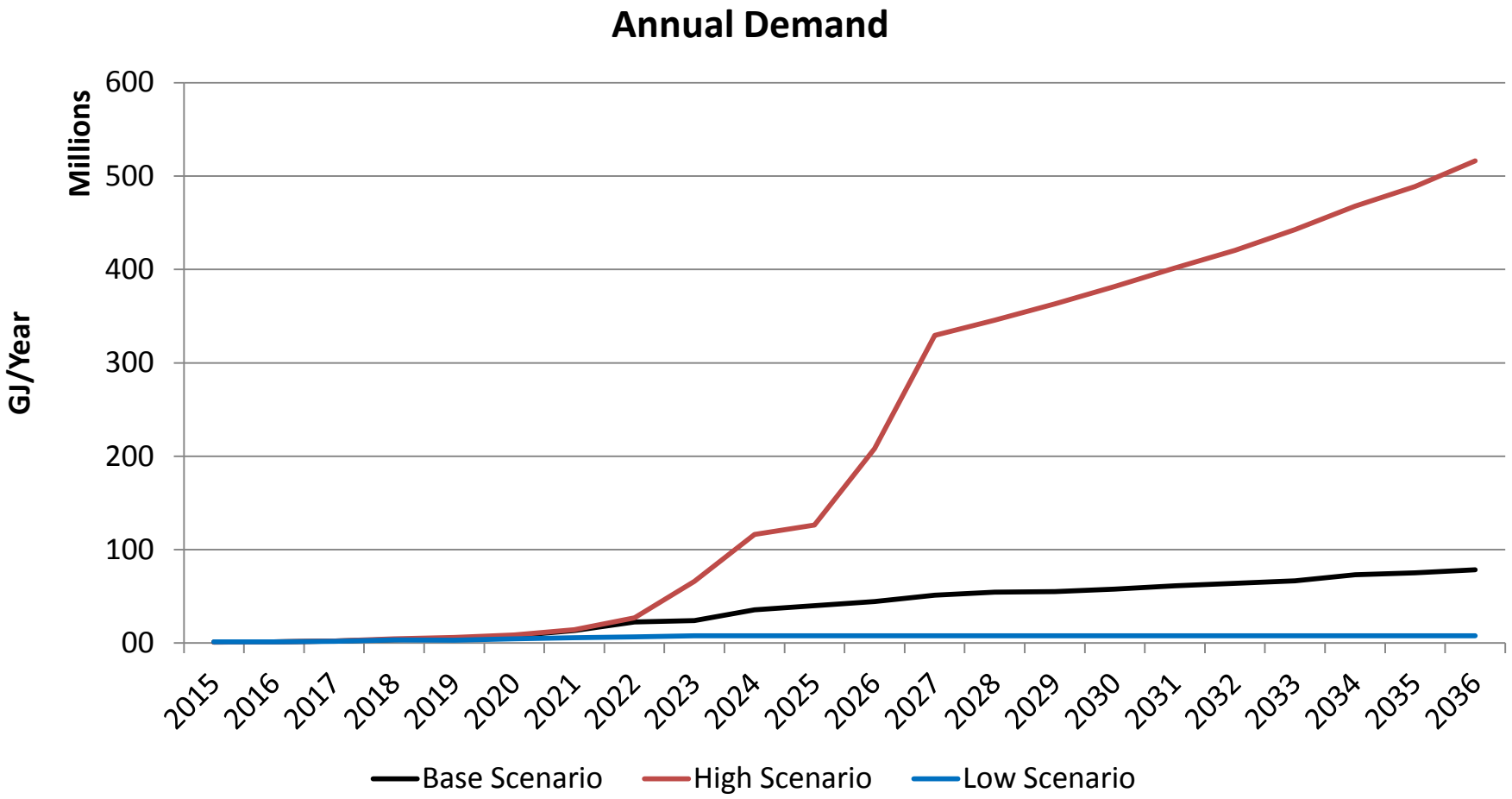
- **LNG supply available today – transparent RS46 LNG tariff**
- **LNG price advantage (Cdn/USD exchange rate)**
- **Jones Act exemption for marine vessels w/ foreign flags**
- **Financial incentives available for eligible vessel operators**



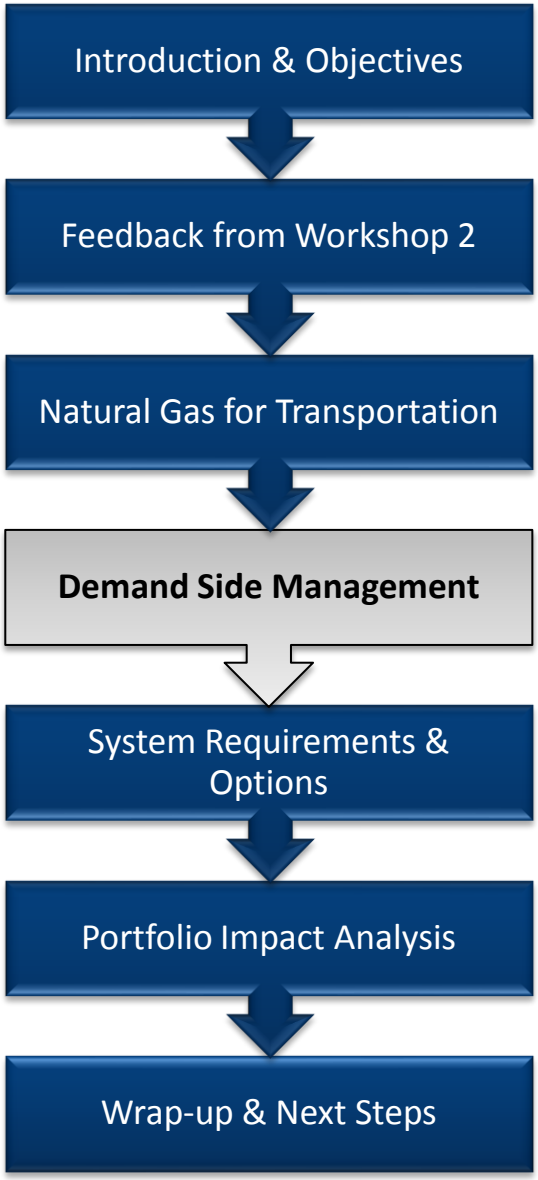
Long Term LNG Adoption Scenarios



Combined CNG and LNG Demand Forecast



- Important for FEI to support the development of both markets over the long run to realize the CO2e reduction potential of the Transportation sector
- *Diverse application of markets is a stronger market rather than developing just one or a few market segments*



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Demand Side Management Analysis Results

Robert Schuster, Integrated Resource Planning Manager

August 9, 2017

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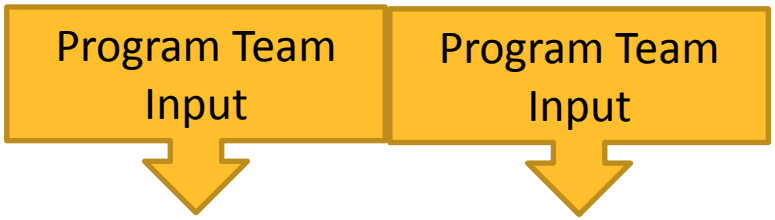
The LTGRP DSM analysis differs from the CPR and the DSM Expenditure Schedule

	CPR	LTGRP – DSM	DSM $ Schedule
Purpose	Forecast	Forecast Scenario analysis	Budget request
Time horizon	Long term	Long term	Near term
Measure inputs	Per measure	Per measure	Per measure
Macroeconomic inputs	Reference case	Reference case Scenarios	Reference case
Historical program uptake and expenditures	Per program area	Per measure	Per program
Program deployment considerations	Not considered	Not considered	Considered



	CPR	LTGRP – DSM	DSM $ Schedule
Purpose	Forecast	Forecast Scenario analysis	Budget request
Time horizon	Long term	Long term	Near term
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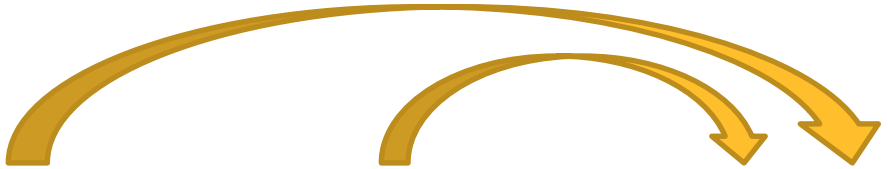

	CPR	LTGRP – DSM	DSM $ Schedule
Purpose	Forecast	Forecast Scenario analysis	Budget request
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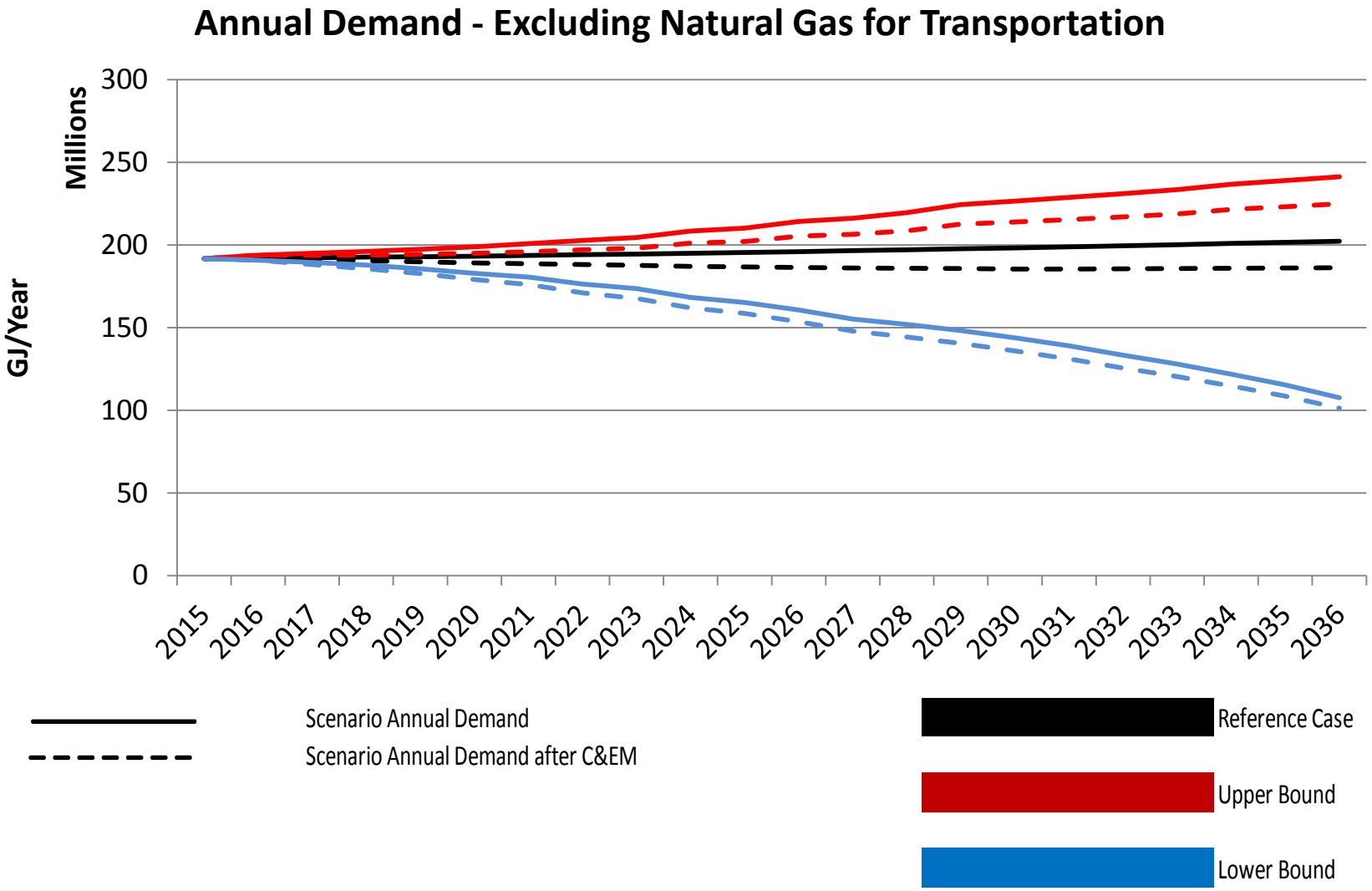
DSM Analysis – Portfolio Results, Annual Demand



DSM Analysis – Portfolio Results, Annual Expenditures

	REFERENCE CASE (MILLIONS)		
Year	Incentive Estimate	Non-Incentive Estimate	Total Estimate
2017	$ 27	$ 5	$ 31
2018	$ 30	$ 5	$ 35
2019	$ 31	$ 5	$ 36
2020	$ 33	$ 5	$ 39
2021	$ 42	$ 7	$ 49
2022	$ 41	$ 6	$ 47
2023	$ 46	$ 7	$ 52
2024	$ 43	$ 7	$ 50
2025	$ 36	$ 6	$ 42
2026	$ 35	$ 6	$ 41
2027	$ 33	$ 6	$ 39
2028	$ 32	$ 6	$ 38
2029	$ 32	$ 6	$ 37
2030	$ 33	$ 6	$ 39
2031	$ 29	$ 5	$ 34
2032	$ 25	$ 5	$ 30
2033	$ 25	$ 4	$ 29
2034	$ 25	$ 4	$ 29
2035	$ 25	$ 4	$ 29
2036	$ 25	$ 4	$ 29

N.B.: 2017 LTGRP DSM results are projections only on a 2015 base year that exclude non-program administrative and enabling expenditures, do not assume efficiencies of scale, do not include operational program delivery considerations, do include measures that do not exist in the current portfolio, and do not account for unforeseen future technologies. Cost test results exclude behavioral and energy management measures.

DSM Analysis – Portfolio Results, Cost Tests, Reference Case

Year	TRC	UCT
Aggregate	**2.2**	**2.2**
2017	4.8	4.4
2018	4.1	3.7
2019	3.5	3.2
2020	3.1	2.9
2021	2.8	2.7
2022	2.6	2.5
2023	2.4	2.4
2024	2.3	2.3
2025	2.3	2.2
2026	2.2	2.2
2027	2.1	2.1
2028	2.1	2.1
2029	2.0	2.1
2030	2.0	2.1
2031	2.0	2.0
2032	2.0	2.0
2033	2.0	2.0
2034	2.0	2.0
2035	2.0	2.0
2036	2.0	2.0

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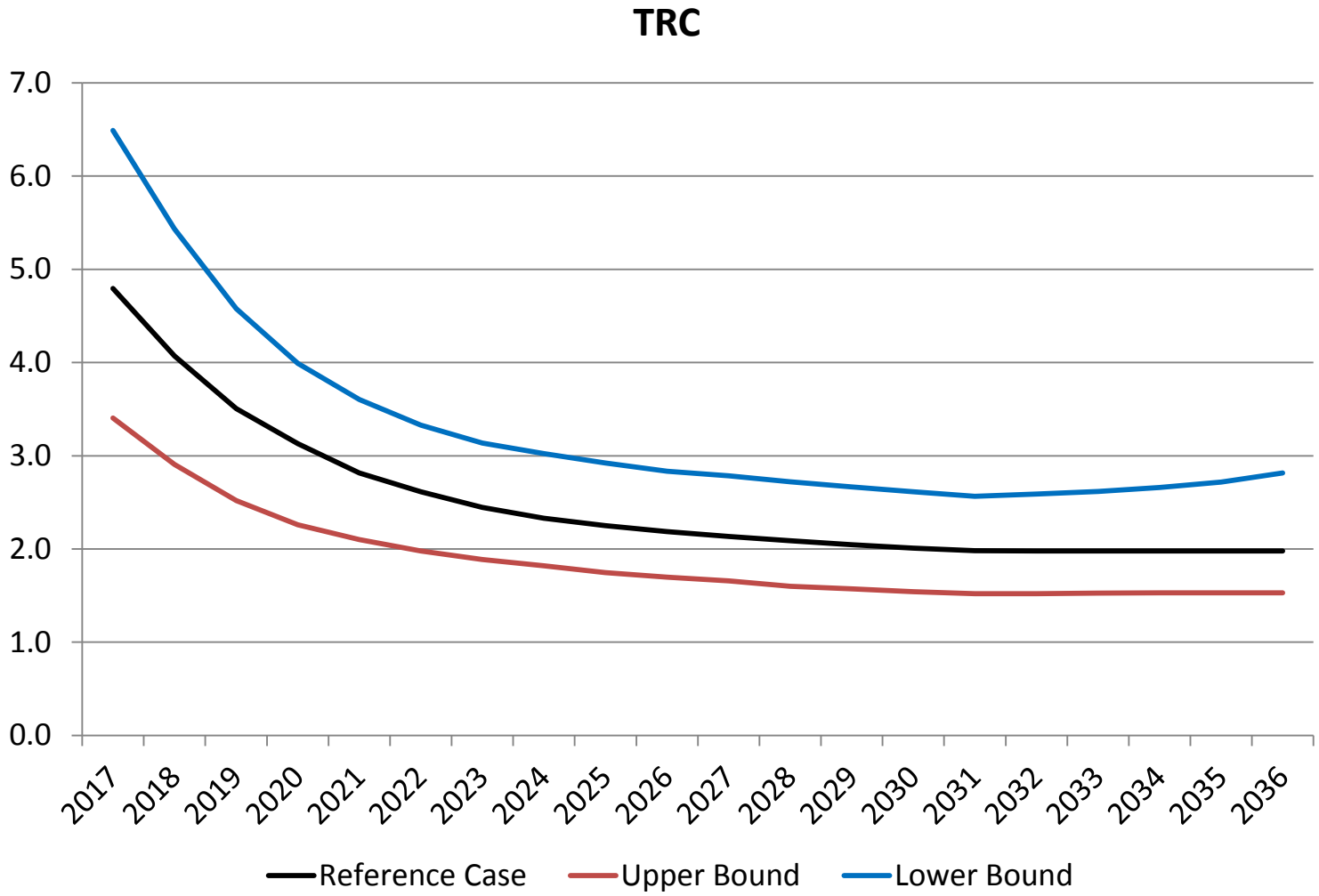
DSM Analysis – Portfolio Results, Key Scenarios



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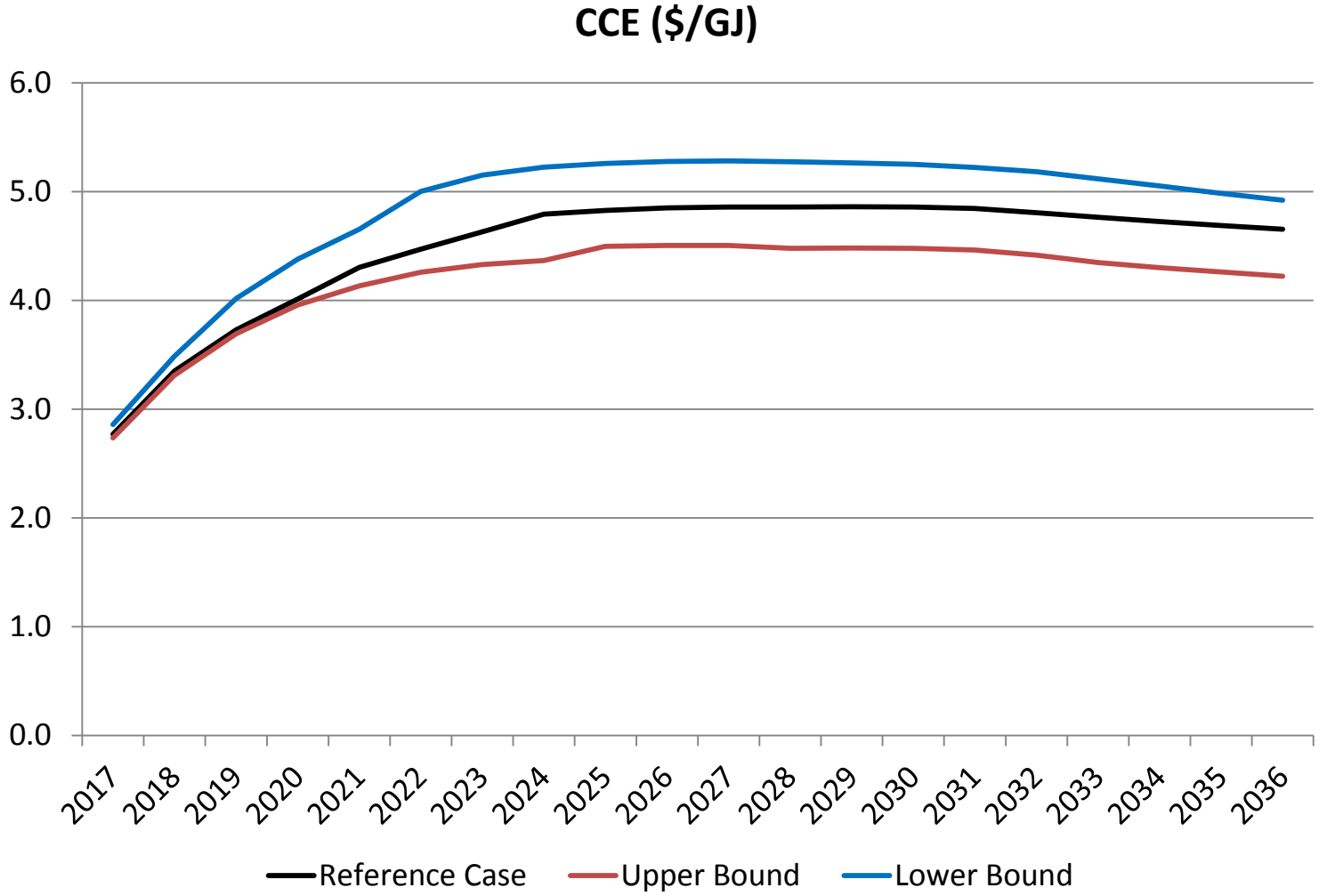

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DSM Analysis – Portfolio Results, Top 10 Measures

Measures	REFERENCE CASE	UPPER BOUND		LOWER BOUND	
	2036 Cumulative Savings (GJ)	2036 Cumulative Savings (GJ)	% Change from Reference Case	2036 Cumulative Savings (GJ)	% Change from Reference Case
Com | NC measure 45 %>code	1,581,337	2,631,732	66%	819,329	-48%
Res | Smart Thermostats	1,364,259	1,433,232	5%	706,260	-48%
Ind | Process Boiler Load Control	1,006,385	0	-100%	247,243	-75%
Res | Efficient Fireplaces	980,244	986,687	1%	974,217	-1%
Res | Home Energy Reports	682,987	711,710	4%	359,450	-47%
Com | HVAC Control Upgrades - Direct Digital Data	672,362	373,675	-44%	128,123	-81%
Res | ENERGY STAR Home	559,221	766,373	37%	35,404	-94%
Ind | Gas Ventilation Optimization	527,271	612,812	16%	209,427	-60%
Ind | Heat Recovery Systems	475,244	619,890	30%	210,595	-56%
Com | Gas Condensing Boiler_ROB	464,484	503,378	8%	102,730	-78%

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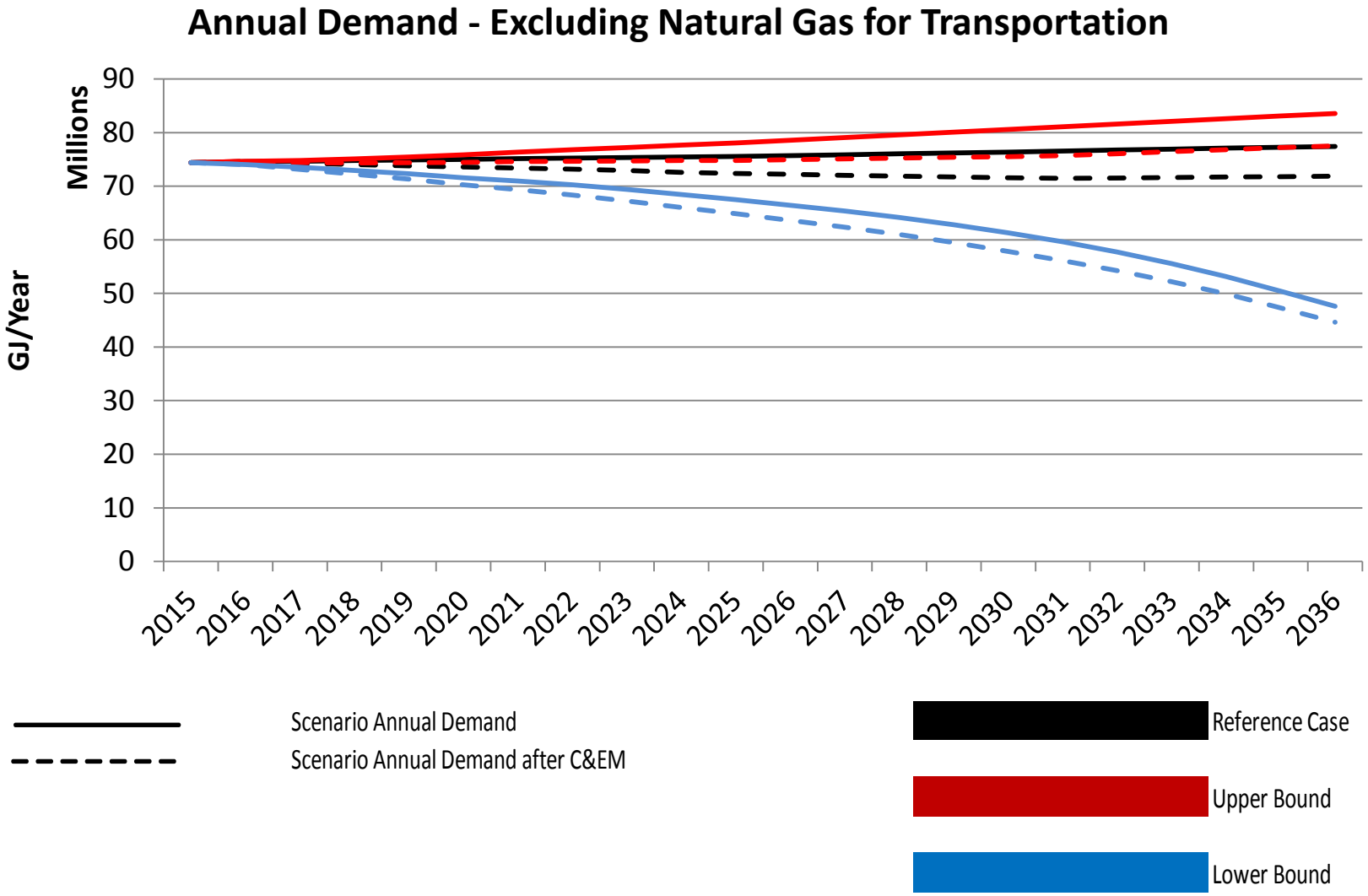
DSM Analysis – Residential Results, Annual Demand



DSM Analysis – Residential Results, Annual Expenditures

	REFERENCE CASE (MILLIONS)		
Year	Incentive Estimate	Non-Incentive Estimate	Total Estimate
2017	$ 16	$ 3	$ 19
2018	$ 17	$ 4	$ 21
2019	$ 16	$ 3	$ 19
2020	$ 16	$ 3	$ 19
2021	$ 19	$ 4	$ 23
2022	$ 17	$ 4	$ 21
2023	$ 17	$ 4	$ 21
2024	$ 22	$ 5	$ 27
2025	$ 17	$ 3	$ 20
2026	$ 16	$ 3	$ 19
2027	$ 15	$ 3	$ 19
2028	$ 15	$ 3	$ 18
2029	$ 15	$ 3	$ 18
2030	$ 16	$ 3	$ 20
2031	$ 13	$ 3	$ 15
2032	$ 10	$ 2	$ 12
2033	$ 10	$ 2	$ 12
2034	$ 10	$ 2	$ 12
2035	$ 10	$ 2	$ 12
2036	$ 10	$ 2	$ 13

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DSM Analysis – Residential Results, Cost Tests, Reference Case

Year	TRC	MTRC	UCT
Aggregate	**1.6**	**7.2**	**2.3**
2017	2.4	9.7	2.9
2018	2.2	9.0	2.8
2019	2.1	8.8	2.7
2020	2.1	8.6	2.7
2021	1.9	8.2	2.6
2022	1.9	7.9	2.5
2023	1.8	7.7	2.4
2024	1.7	7.3	2.3
2025	1.6	7.2	2.3
2026	1.6	7.1	2.3
2027	1.6	7.0	2.3
2028	1.5	6.9	2.2
2029	1.5	6.8	2.2
2030	1.5	6.7	2.2
2031	1.5	6.7	2.2
2032	1.5	6.9	2.2
2033	1.5	7.1	2.3
2034	1.6	7.2	2.3
2035	1.6	7.4	2.4
2036	1.6	7.6	2.4

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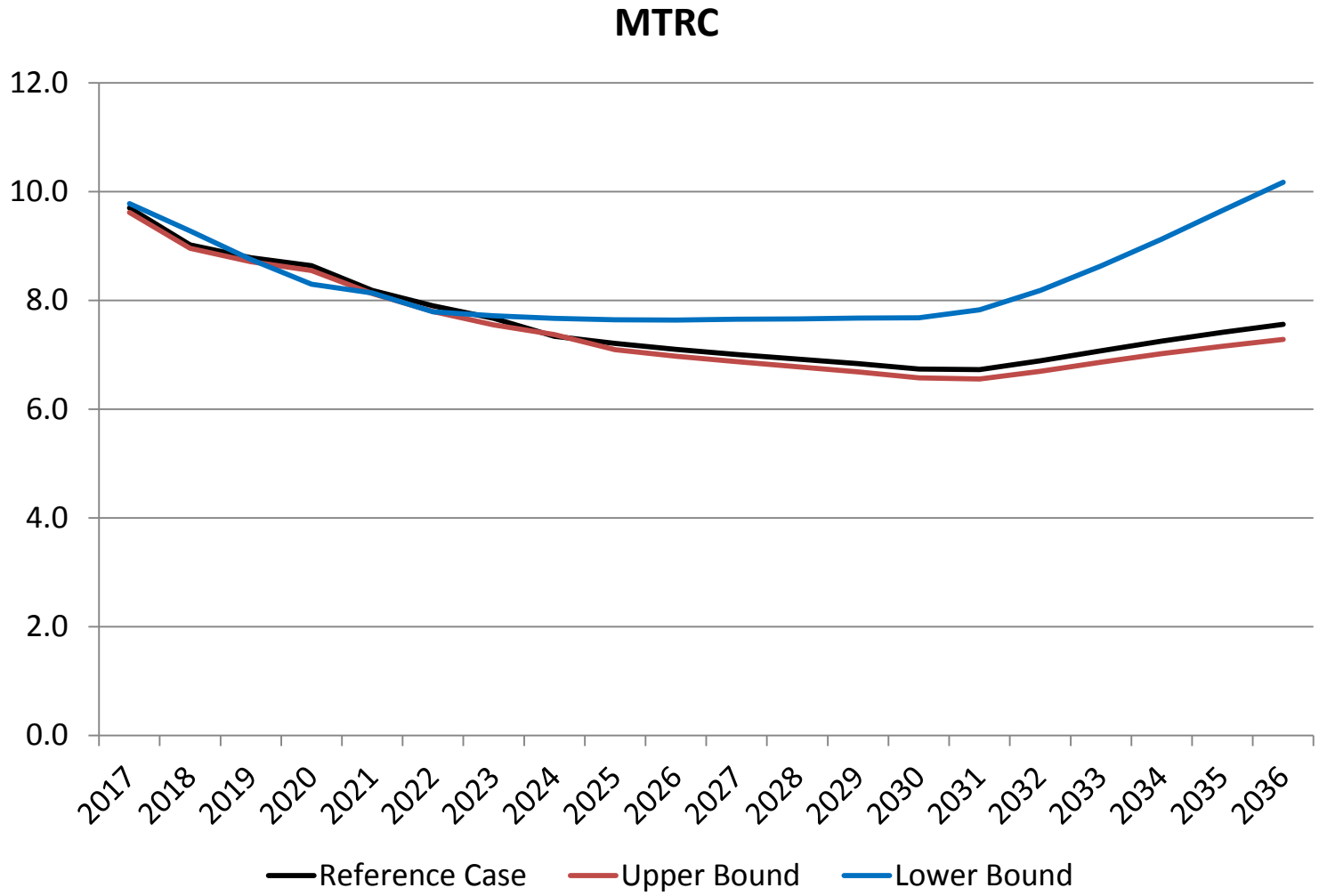
DSM Analysis – Residential Results, Key Scenarios



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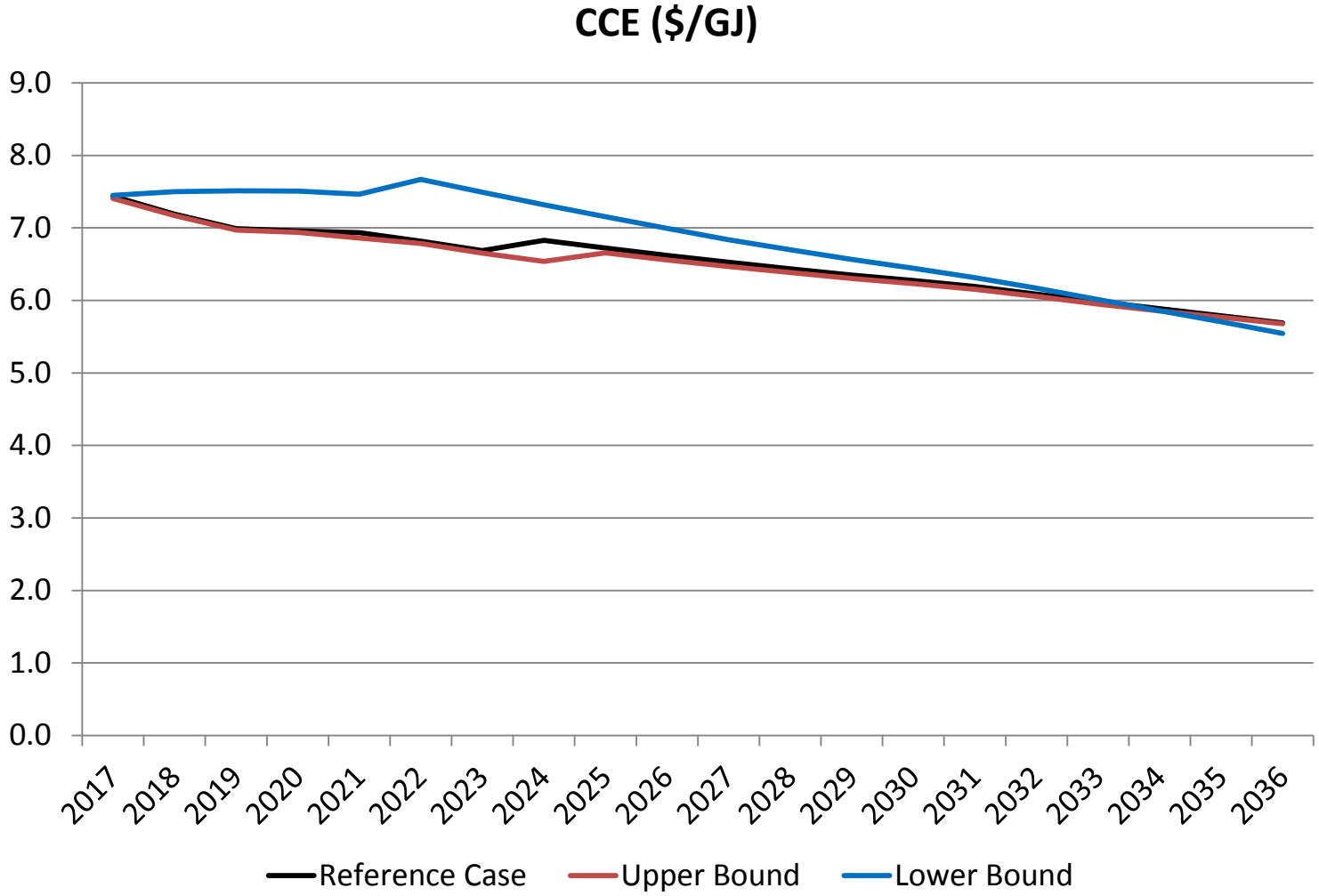
DSM Analysis – Residential Results, Key Scenarios



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DSM Analysis – Residential Results, Top 10 Measures

Measures	REFERENCE CASE	UPPER BOUND		LOWER BOUND	
	2036 Cumulative Savings (GJ)	2036 Cumulative Savings (GJ)	% Change from Reference Case	2036 Cumulative Savings (GJ)	% Change from Reference Case
Res | Smart Thermostats	1,364,259	1,433,232	5%	706,260	-48%
Res | Efficient Fireplaces	980,244	986,687	1%	974,217	-1%
Res | Home Energy Reports	678,661	705,222	4%	358,683	-47%
Res | ENERGY STAR Home	559,221	766,373	37%	35,404	-94%
Res | Condensing Gas Tankless Water Heater	365,968	373,020	2%	266,322	-27%
Res | Crawlspace Duct Ins	279,659	295,545	6%	133,456	-52%
Res | Attic Insulation	230,539	244,145	6%	103,881	-55%
Res | Non-Condensing Gas Storage Water Heater	188,474	200,644	6%	0	-100%
Res | Passive House	162,467	230,622	42%	7,850	-95%
Res | Basement Insulation	131,909	137,616	4%	52,819	-60%

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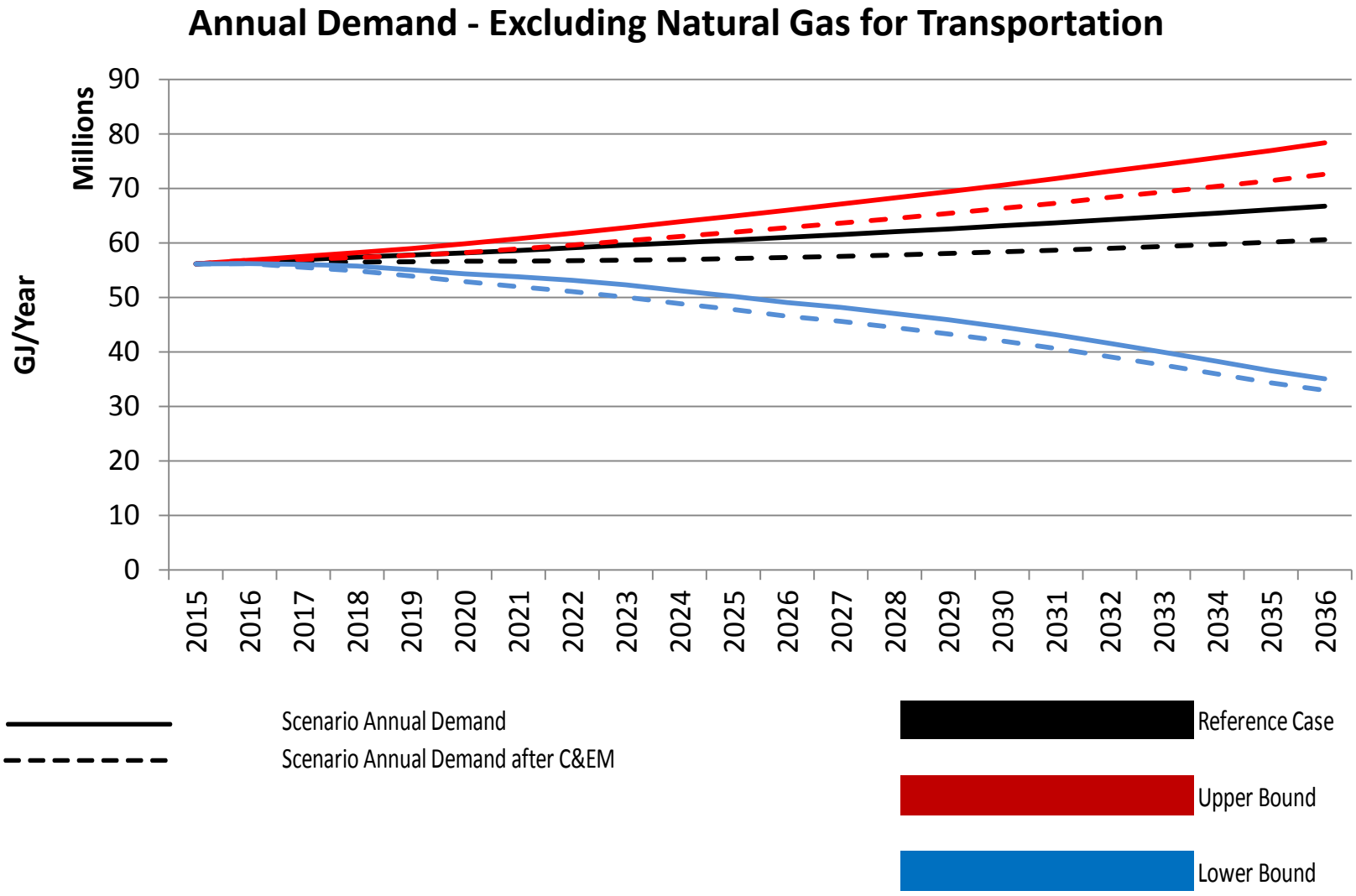
DSM Analysis – Commercial Results, Annual Demand



DSM Analysis – Commercial Results, Annual Expenditures

	REFERENCE CASE (MILLIONS)		
Year	Incentive Estimate	Non-Incentive Estimate	Total Estimate
2017	$ 9	$ 1	$ 10
2018	$ 11	$ 1	$ 12
2019	$ 13	$ 1	$ 14
2020	$ 15	$ 1	$ 16
2021	$ 21	$ 2	$ 22
2022	$ 21	$ 2	$ 23
2023	$ 26	$ 2	$ 28
2024	$ 18	$ 1	$ 19
2025	$ 17	$ 1	$ 18
2026	$ 16	$ 1	$ 17
2027	$ 15	$ 1	$ 16
2028	$ 14	$ 1	$ 15
2029	$ 13	$ 1	$ 14
2030	$ 13	$ 1	$ 14
2031	$ 13	$ 1	$ 14
2032	$ 12	$ 1	$ 13
2033	$ 12	$ 1	$ 13
2034	$ 12	$ 1	$ 13
2035	$ 11	$ 1	$ 12
2036	$ 11	$ 1	$ 12

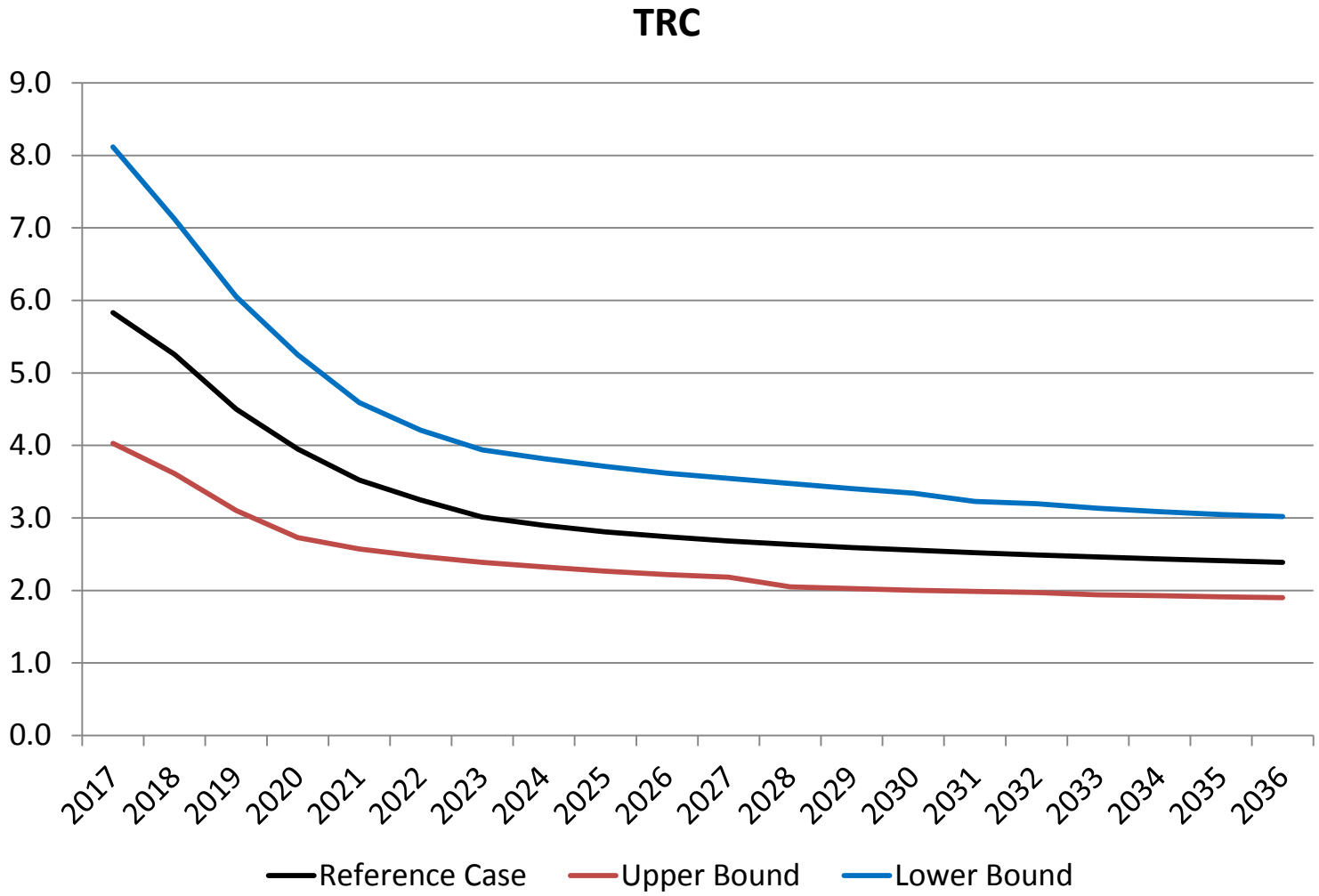
N.B.: 2017 LTGRP DSM results are projections only on a 2015 base year that exclude non-program administrative and enabling expenditures, do not assume efficiencies of scale, do not include operational program delivery considerations, do include measures that do not exist in the current portfolio, and do not account for unforeseen future technologies. Cost test results exclude behavioral and energy management measures.

DSM Analysis – Commercial Results, Cost Tests, Reference Case

Year	TRC	UCT
Aggregate	**2.8**	**2.2**
2017	5.8	5.0
2018	5.3	4.4
2019	4.5	3.7
2020	4.0	3.3
2021	3.5	2.9
2022	3.2	2.6
2023	3.0	2.4
2024	2.9	2.3
2025	2.8	2.3
2026	2.7	2.2
2027	2.7	2.1
2028	2.6	2.1
2029	2.6	2.1
2030	2.6	2.0
2031	2.5	2.0
2032	2.5	2.0
2033	2.5	1.9
2034	2.4	1.9
2035	2.4	1.9
2036	2.4	1.9

N.B.: 2017 LTGRP DSM results are projections only on a 2015 base year that exclude non-program administrative and enabling expenditures, do not assume efficiencies of scale, do not include operational program delivery considerations, do include measures that do not exist in the current portfolio, and do not account for unforeseen future technologies. Cost test results exclude behavioral and energy management measures.

DSM Analysis – Commercial Results, Key Scenarios



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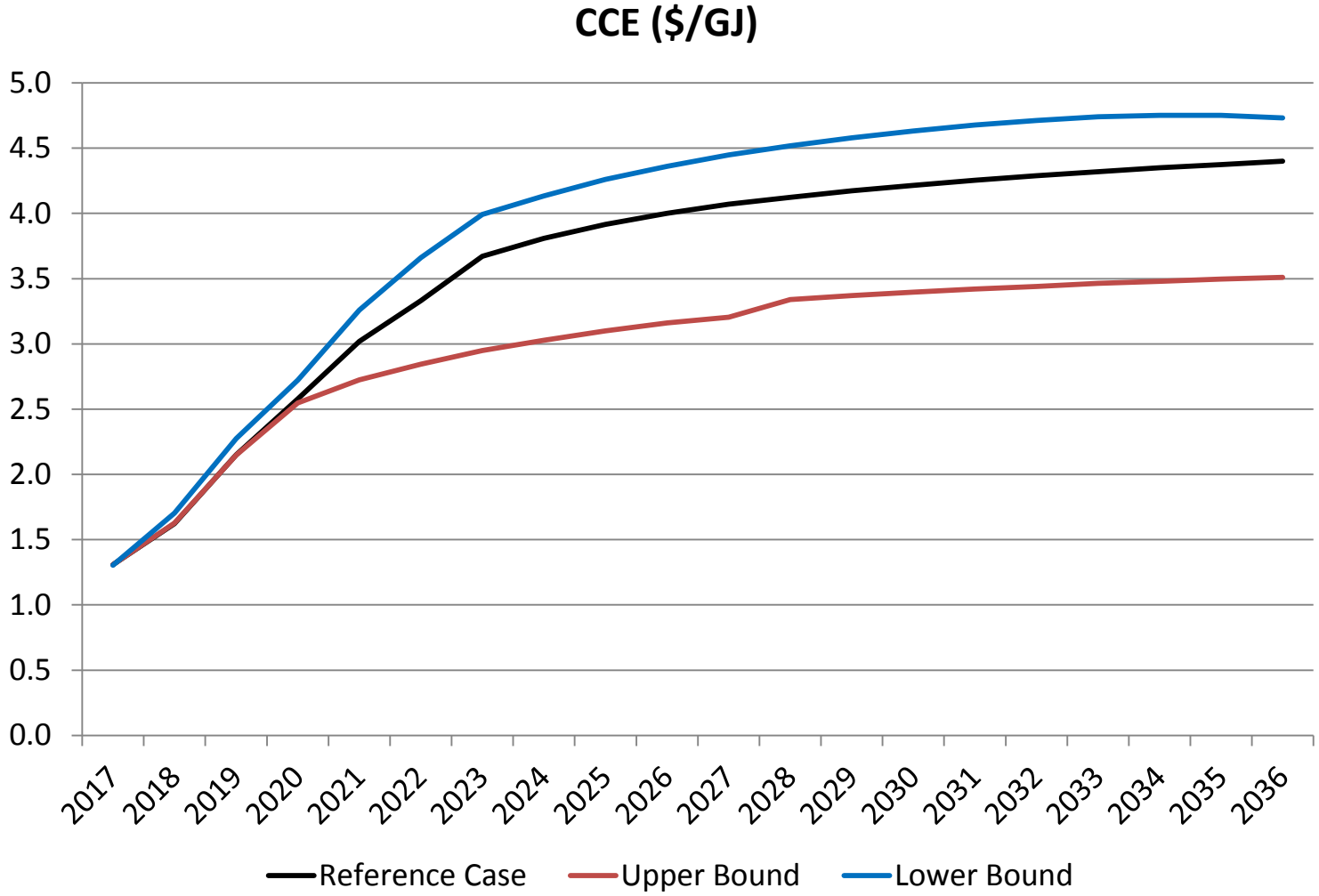
DSM Analysis – Commercial Results, Key Scenarios



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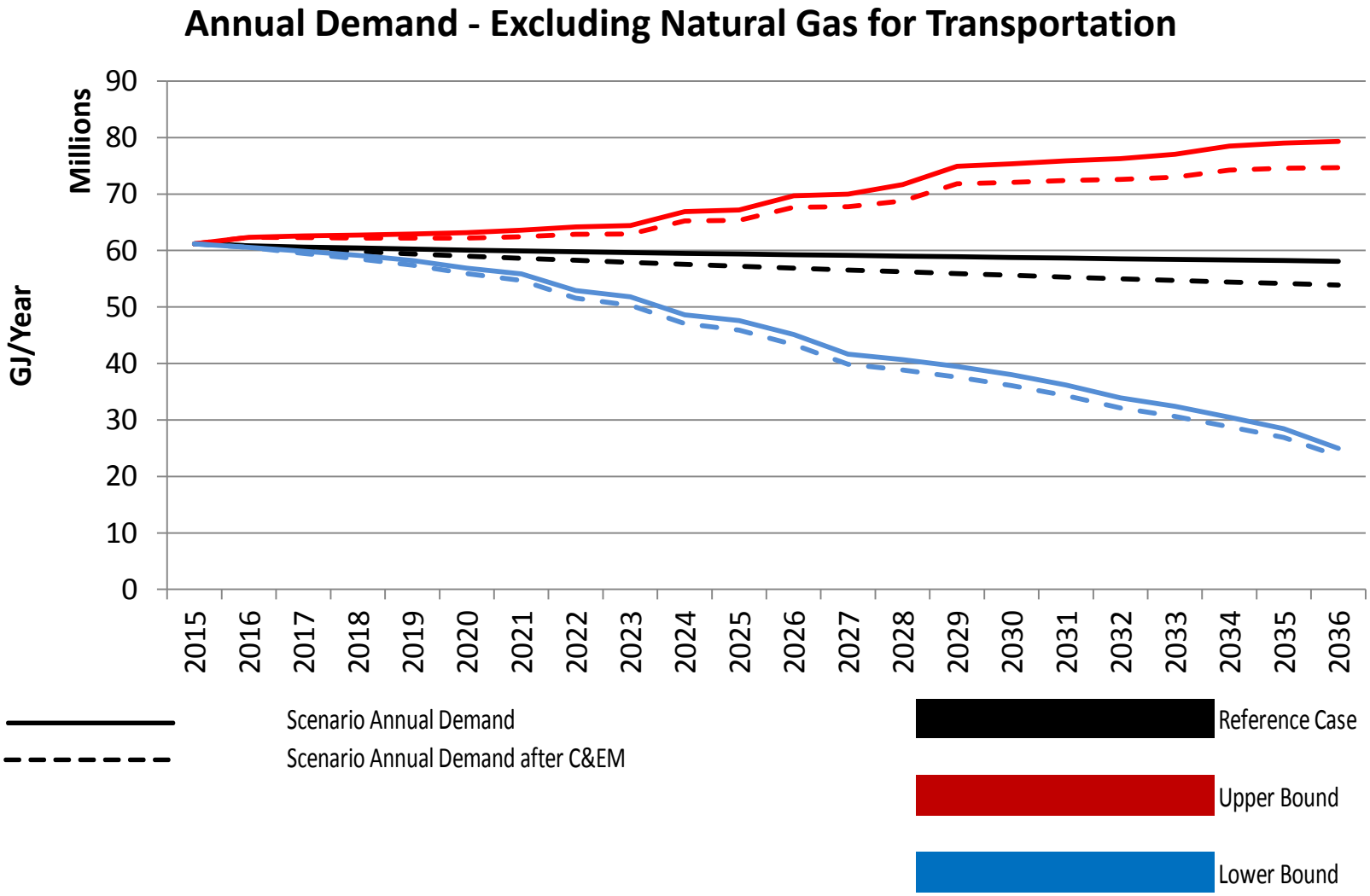
DSM Analysis – Commercial Results, Top 10 Measures

Measures	REFERENCE CASE	UPPER BOUND		LOWER BOUND	
	2036 Cumulative Savings (GJ)	2036 Cumulative Savings (GJ)	% Change from Reference Case	2036 Cumulative Savings (GJ)	% Change from Reference Case
Com | NC measure 45 %>code	1,581,337	2,631,732	66%	819,329	-48%
Com | HVAC Control Upgrades - Direct Digital Data	672,362	373,675	-44%	128,123	-81%
Com | Gas Condensing Boiler_ ROB	464,484	503,378	8%	102,730	-78%
Res | Heat Control System for Boilers	351,360	506,668	44%	0	-100%
Res | Fireplace Timers	310,968	490,350	58%	0	-100%
Com | Condensing Make Up Air Unit_ Gas	304,921	258,153	-15%	69,598	-77%
Com | Comprehensive Retrocomissioning	261,513	292,099	12%	79,929	-69%
Com | Gas Boiler - Mid Efficiency	260,351	0	-100%	59,118	-77%
Com | NC measure 30 %>code	220,115	506,276	130%	3,032	-99%
Res | Central High Eff Boiler Replace	215,482	272,243	26%	271	-100%

N.B.: 2017 LTGRP DSM results are projections only on a 2015 base year that exclude non-program administrative and enabling expenditures, do not assume efficiencies of scale, do not include operational program delivery considerations, do include measures that do not exist in the current portfolio, and do not account for unforeseen future technologies. Cost test results exclude behavioral and energy management measures.

DSM Analysis – Industrial Results, Annual Demand



DSM Analysis – Industrial Results, Annual Expenditures

	REFERENCE CASE (MILLIONS)		
Year	Incentive Estimate	Non-Incentive Estimate	Total Estimate
2017	$ 2	$ 1	$ 3
2018	$ 2	$ 1	$ 3
2019	$ 2	$ 1	$ 3
2020	$ 2	$ 1	$ 3
2021	$ 2	$ 1	$ 3
2022	$ 2	$ 1	$ 4
2023	$ 3	$ 1	$ 4
2024	$ 3	$ 1	$ 4
2025	$ 3	$ 1	$ 4
2026	$ 3	$ 1	$ 5
2027	$ 3	$ 2	$ 5
2028	$ 3	$ 2	$ 5
2029	$ 3	$ 2	$ 5
2030	$ 3	$ 2	$ 5
2031	$ 3	$ 2	$ 5
2032	$ 3	$ 2	$ 5
2033	$ 3	$ 2	$ 5
2034	$ 3	$ 2	$ 5
2035	$ 3	$ 1	$ 4
2036	$ 3	$ 1	$ 4

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DSM Analysis – Industrial Results, Cost Tests, Reference Case

Year	TRC	UCT
Aggregate	**1.7**	**1.8**
2017	1.7	1.8
2018	1.7	1.8
2019	1.7	1.8
2020	1.7	1.8
2021	1.7	1.8
2022	1.7	1.8
2023	1.7	1.8
2024	1.7	1.8
2025	1.7	1.8
2026	1.7	1.8
2027	1.7	1.8
2028	1.7	1.8
2029	1.7	1.8
2030	1.7	1.8
2031	1.7	1.8
2032	1.6	1.8
2033	1.6	1.8
2034	1.6	1.8
2035	1.6	1.8
2036	1.6	1.8

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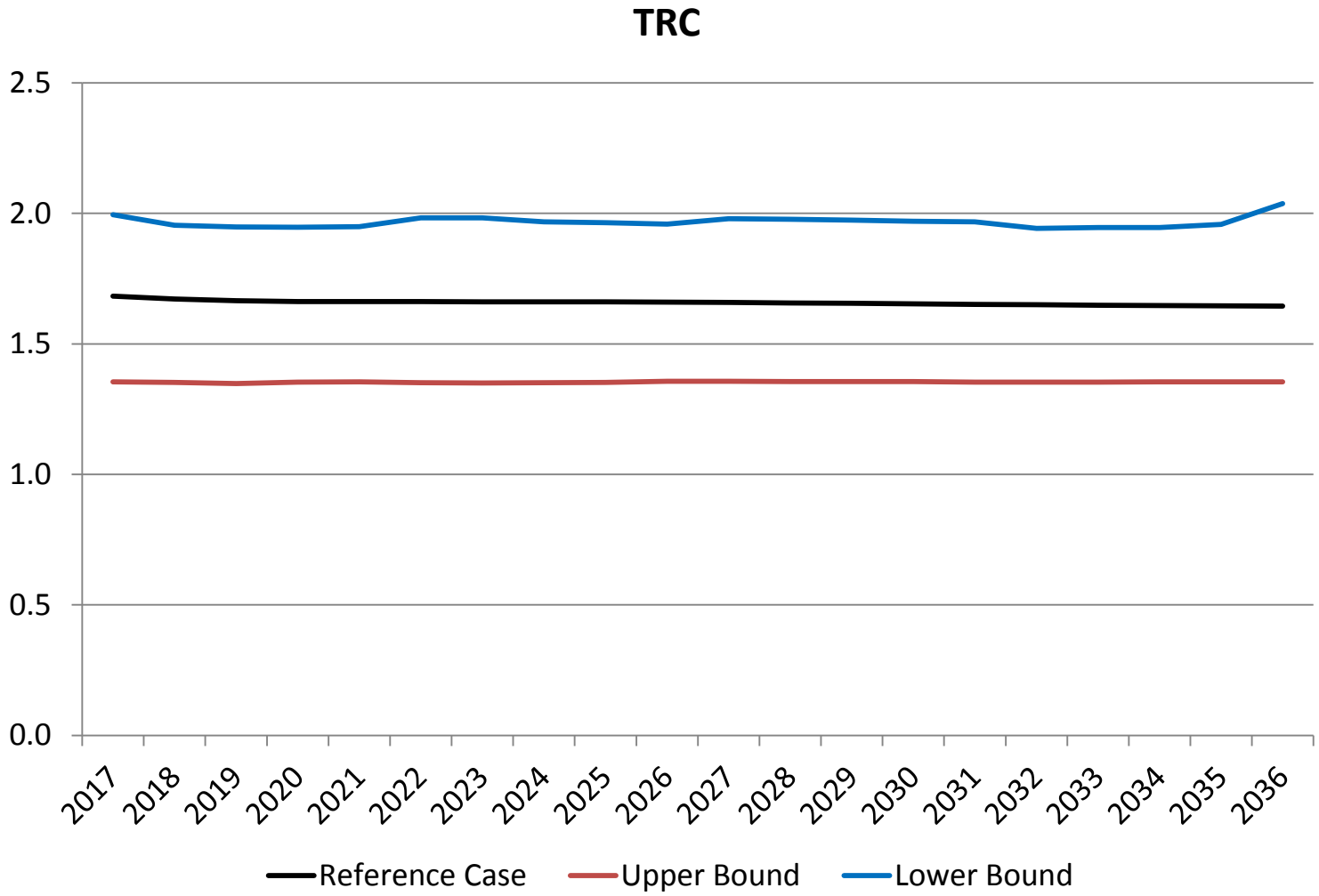
DSM Analysis – Industrial Results, Key Scenarios



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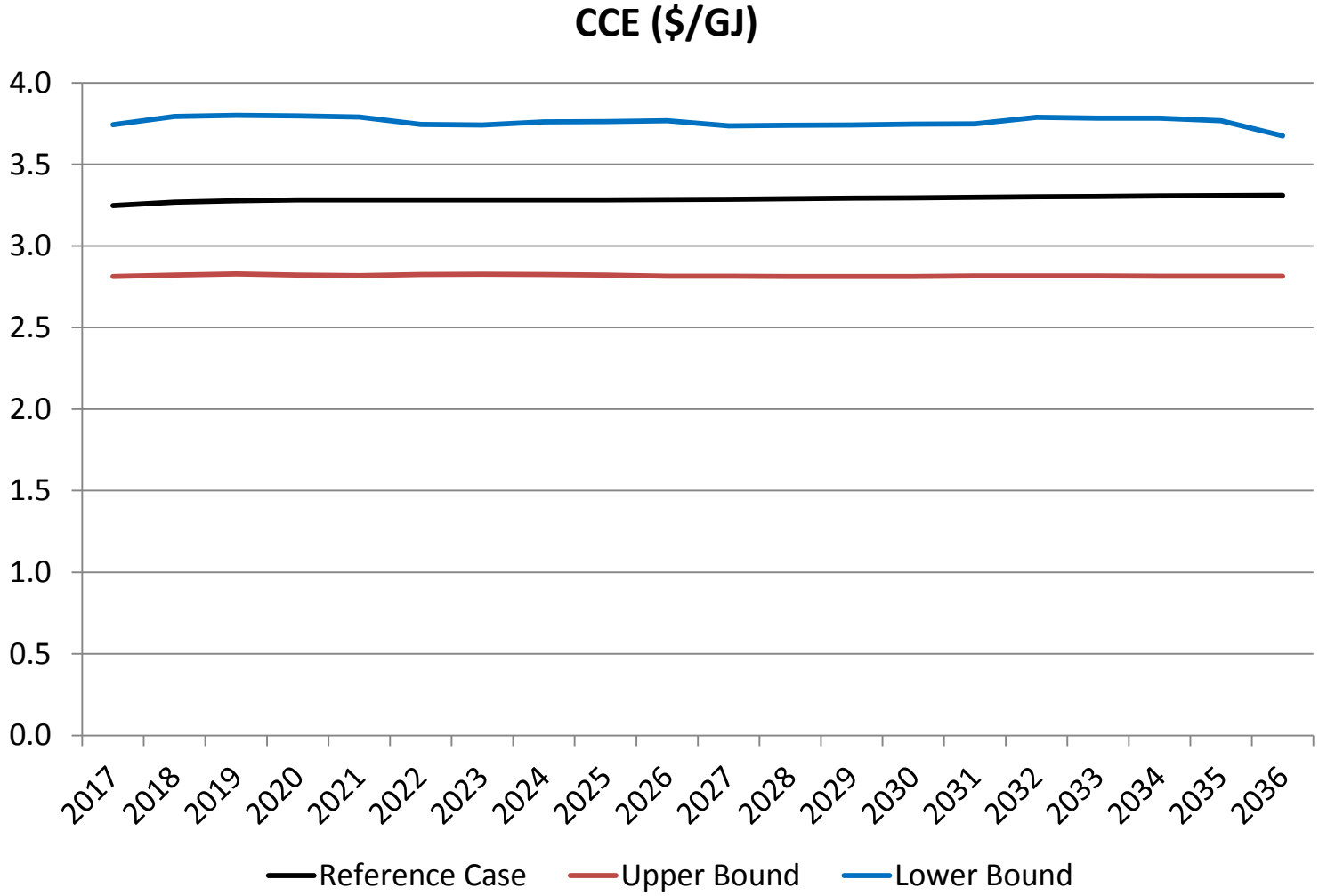
DSM Analysis – Industrial Results, Key Scenarios



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DSM Analysis – Industrial Results, Top 10 Measures

Measures	REFERENCE CASE	UPPER BOUND		LOWER BOUND	
	2036 Cumulative Savings (GJ)	2036 Cumulative Savings (GJ)	% Change from Reference Case	2036 Cumulative Savings (GJ)	% Change from Reference Case
Ind | Process Boiler Load Control	1,006,385	0	-100%	247,243	-75%
Ind | Gas Ventilation Optimization	527,271	612,812	16%	209,427	-60%
Ind | Heat Recovery Systems	475,244	619,890	30%	210,595	-56%
Ind | Energy Management	378,387	237,218	-37%	184,125	-51%
Ind | Process Control	339,593	371,147	9%	108,900	-68%
Ind | Unit Heater	227,530	470,528	107%	75,674	-67%
Ind | Condensing Boiler	184,986	278,421	51%	73,951	-60%
Ind | Insulation	91,732	113,356	24%	34,640	-62%
Ind | Regenerative Catalytic Oxidizer	86,550	100,398	16%	27,913	-68%
Ind | Improved Condensate Return	71,373	0	-100%	28,254	-60%

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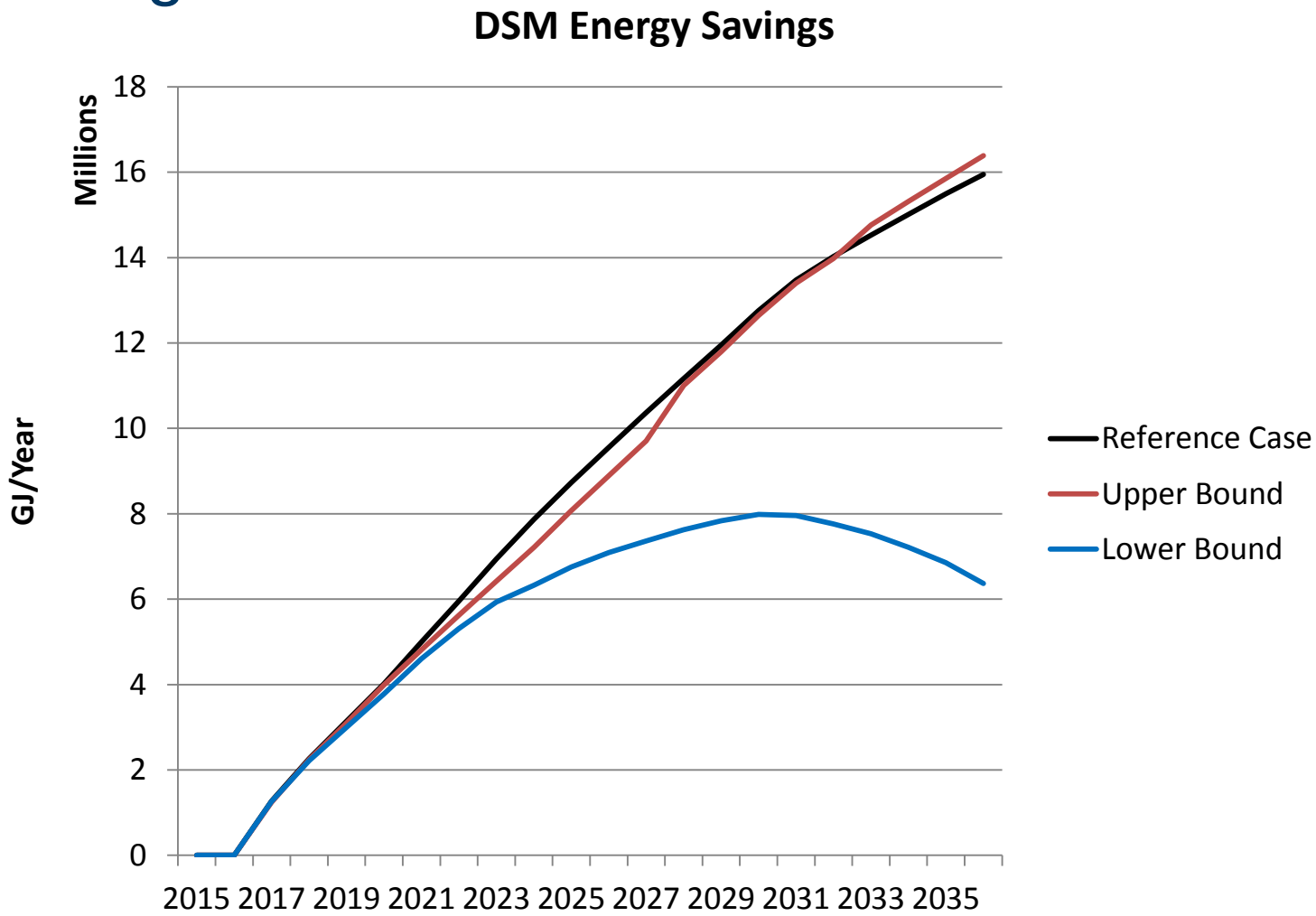
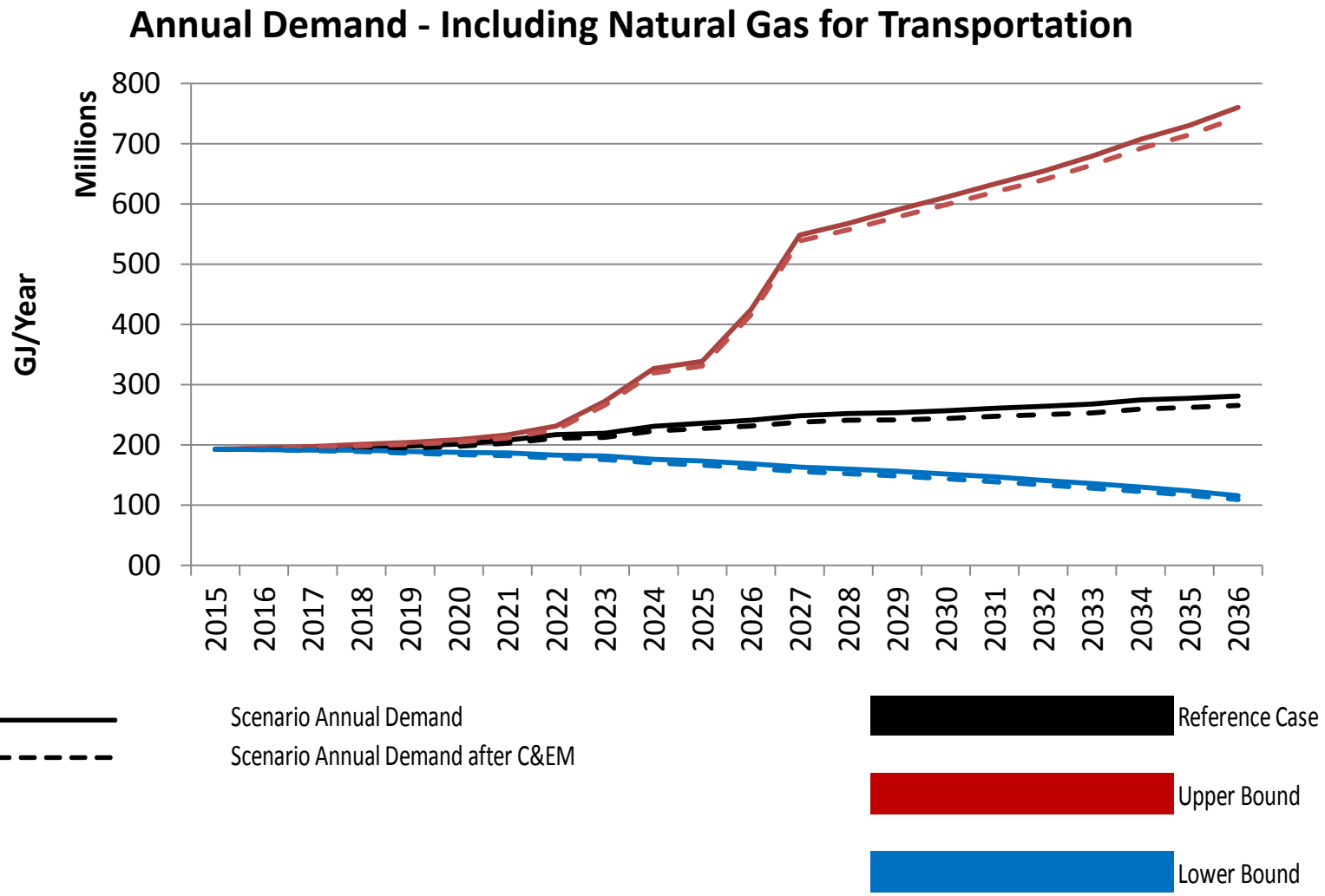
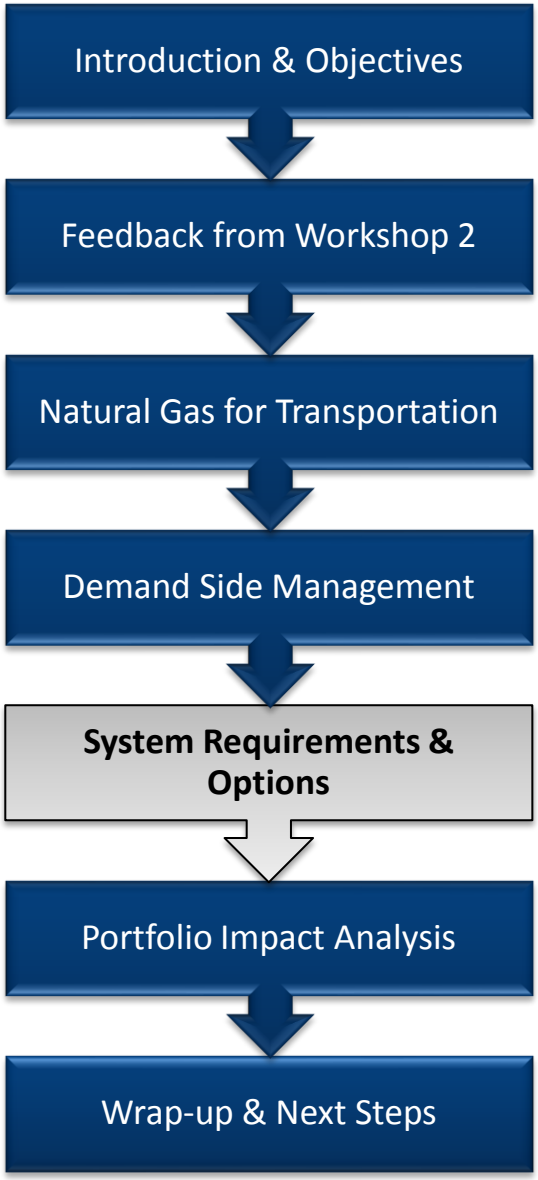
DSM Analysis – Portfolio Results, Energy Savings



DSM Analysis – Portfolio Results, Total Annual Demand





Energy at work

FORTIS BC™

System Requirements and Options Analysis Results

Terry Penner, System Capacity Planning Manager

August 9, 2017

Energy at work FORTIS BC™

System Capacity Planning

This afternoon we will discuss…

Method for determining peak hour demand for End-Use Scenarios.

Results of Traditional, and End-Use Regional Peak Demand Forecasts and proposed infrastructure alternatives

Impact of LNG Forecasts

Impact of DSM

Contingency Plans (timing adjustments) to meet various forecast peak demand

Peak Demand - Recap

Traditionally…

Base year peak demand for UPC_{peak} values derived from currently measured consumption

The UPC_{peak} values remain constant.

Peak demand growth = ∑customer adds x UPC_{peak}

The current industrial accounts are held constant with no increase or decrease in peak consumption over time

An exploratory End-Use alternative to the traditional method…

- Base year peak demand is determined in the traditional manner.
- The UPC_{peak} values for existing and new customers core and industrial customers are varied over the planning period.
- UPC_{peak} variations are derived considering the same end use factors used to determine annual demand in each scenario.
- Industrial accounts will vary in the high and low forecasts.

Peak Demand Forecasts from End-Use Scenarios

In its decision regarding the FEU 2014 LTRP the BCUC asked FEI to:

> …make stronger linkages between the peak demand and the annual demand forecasts
>
> …to understand how “new insights on evolving customer consumption patterns might affect time-of-day demand as well as annual demand
>
> …how changes in… annual demand under different scenarios translate into changes in… peak demand under the same scenario assumptions.”

Peak Demand Forecasts from End-Use Scenarios

Consultant engaged to develop a process linking peak demand forecasts to the end-use scenarios used in the annual forecasting.

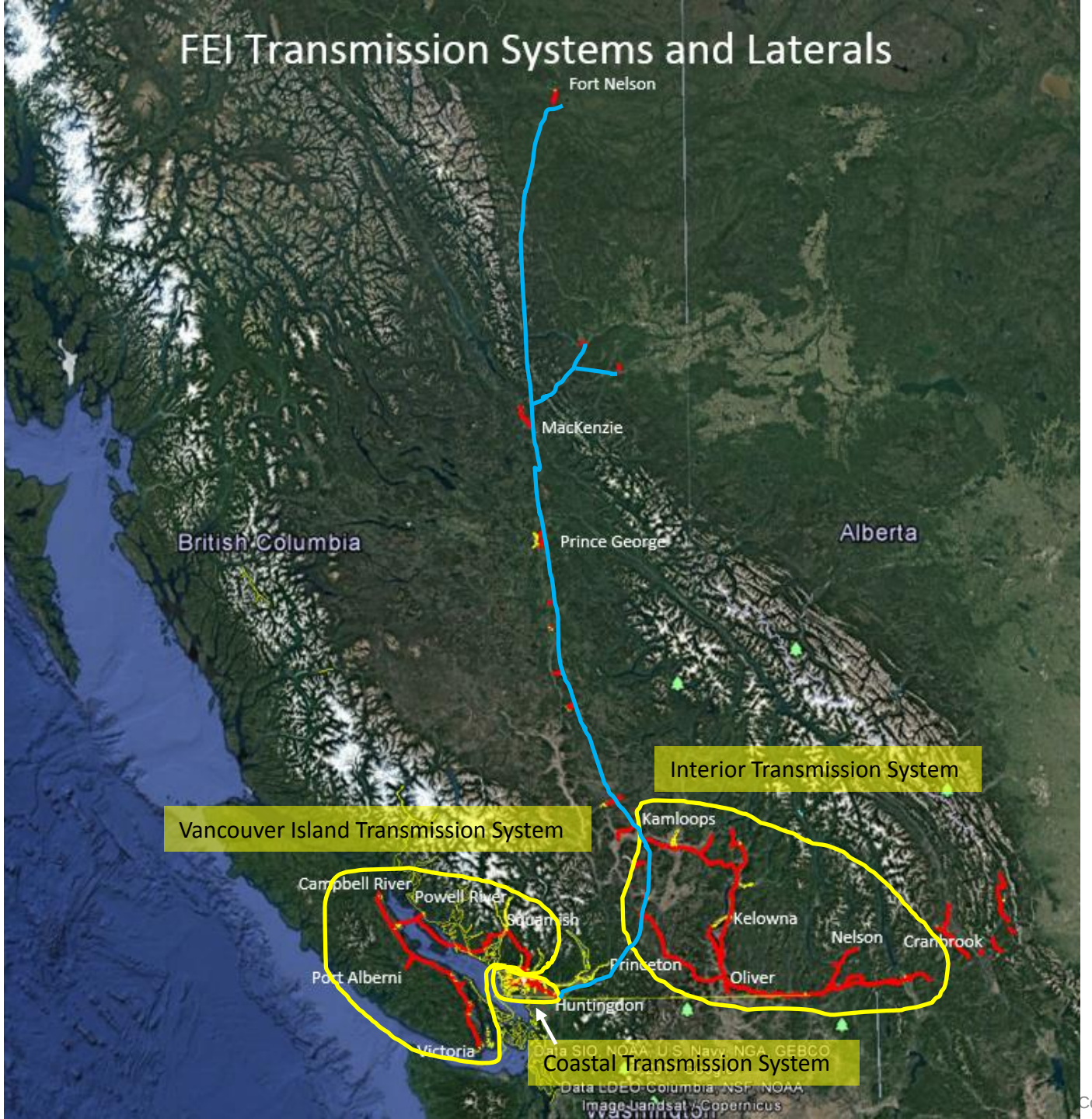
- Method relies on applying hours use factors from end-use load shape profiles
- Load shapes were applied to sequentially break down:
  - Annual → peak monthly consumption
  - Peak monthly → peak daily consumption
  - Peak daily → peak hourly consumption
- End-Use Base Year hourly UPC_{peak} for each rate schedule and region were derived.
- Results corrected to design temperatures for each region
- Calibration factors to match FEI's current values of UPC_{peak} were determined

Infrastructure to Meet Peak Demand Forecasts

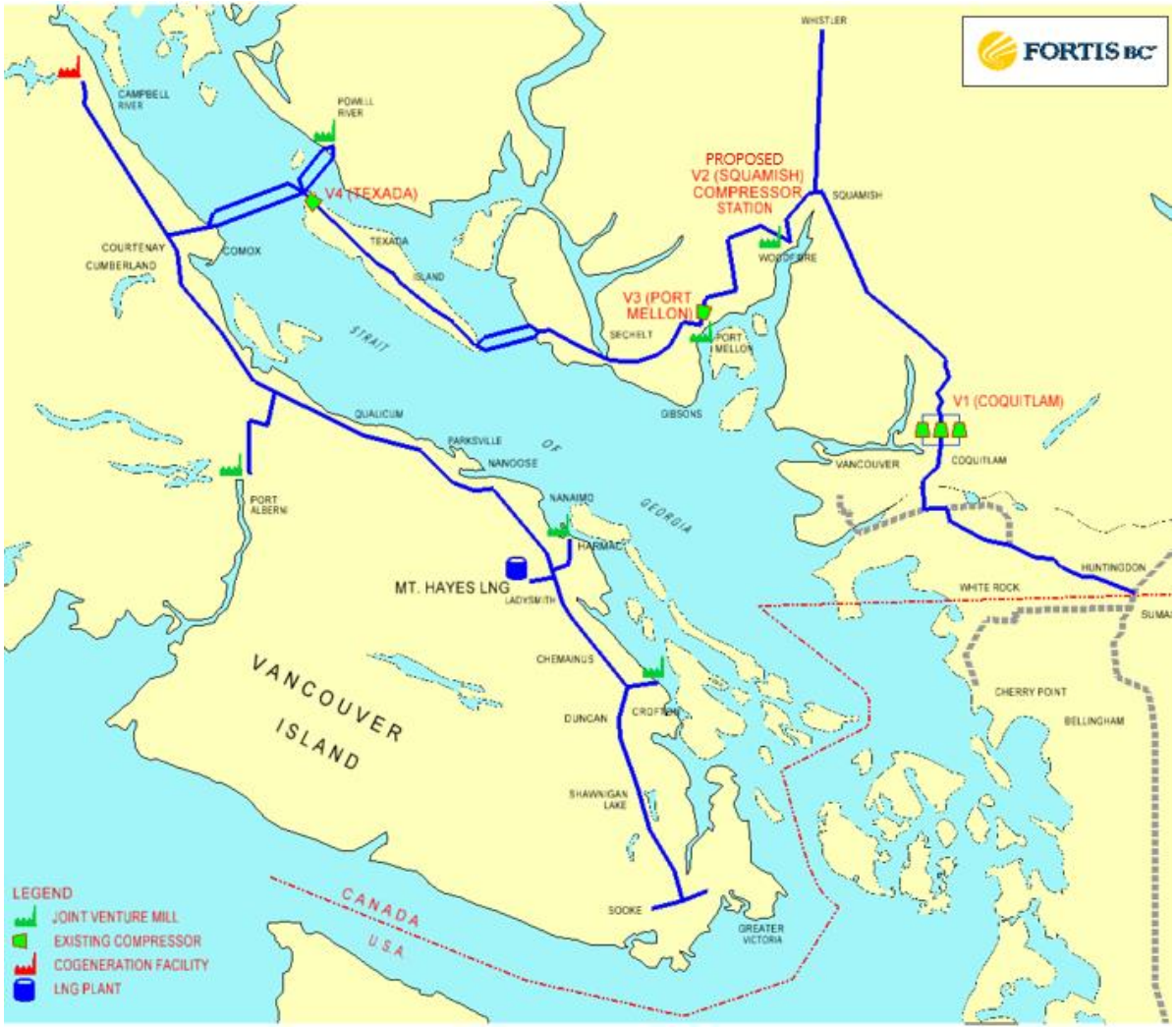
The following slides will present the infrastructure requirements to meet the regional peak demand

In each region we will:

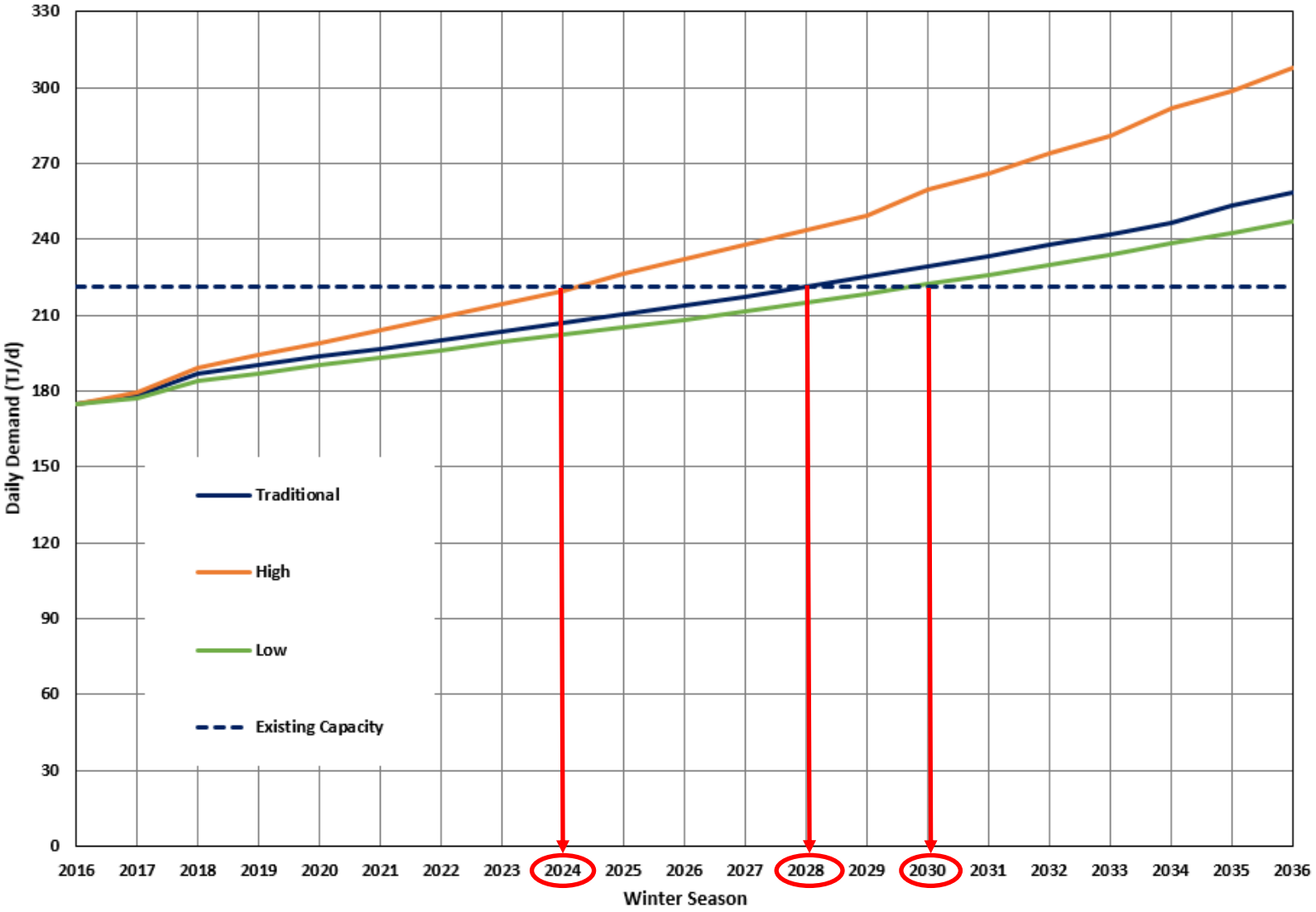
- Briefly review current infrastructure (schematics)
- Review the system capacity constraint using our current traditional peak forecast with high and low forecast variations in project timing(including CNG peak impacts)
- Review system expansion options
- Review the capacity constraint timing variation with the End-Use forecasts
- Review the impacts of DSM on the capacity constraint timing


FEI Transmission Systems and Laterals
Fort Nelson
MacKenzie
British Columbia
Prince George
Alberta
Interior Transmission System
Vancouver Island Transmission System
Kamloops
Campbell River
Powell River
Squamish
Kelowna
Nelson
Cranbrook
Princeton
Oliver
Port Alberni
Huntingdon
Victoria
Coastal Transmission System
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Image Landsat / Copernicus

VI Transmission System



VI Capacity Constraint Under Traditional Peak Forecasts



VI Infrastructure to meet Traditional Peak Forecasts

System Expansion Alternatives:

Option 1 – Additional Compression

- Construct a new Compressor facility (V2) in the Squamish area in 2028

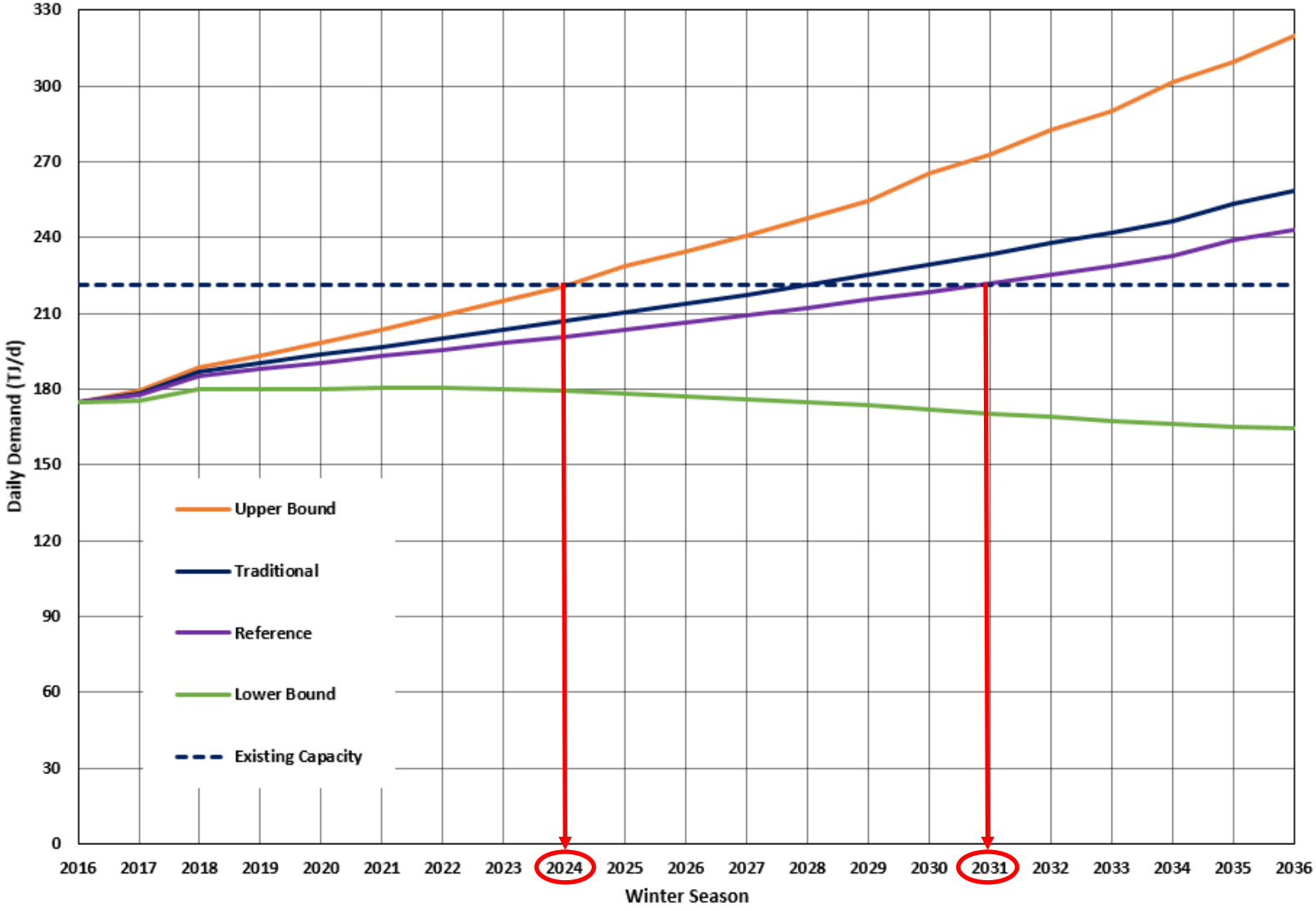
Option 2 – Increase Mt Hayes Send Out

- Increase Send Out above the current 50 MMscfd in 2028.
- Mt Hayes vapourizer capacity is sufficient beyond the 20 year planning horizon
- In 2030 additional compression at Squamish is required due to LNG inventory constraints

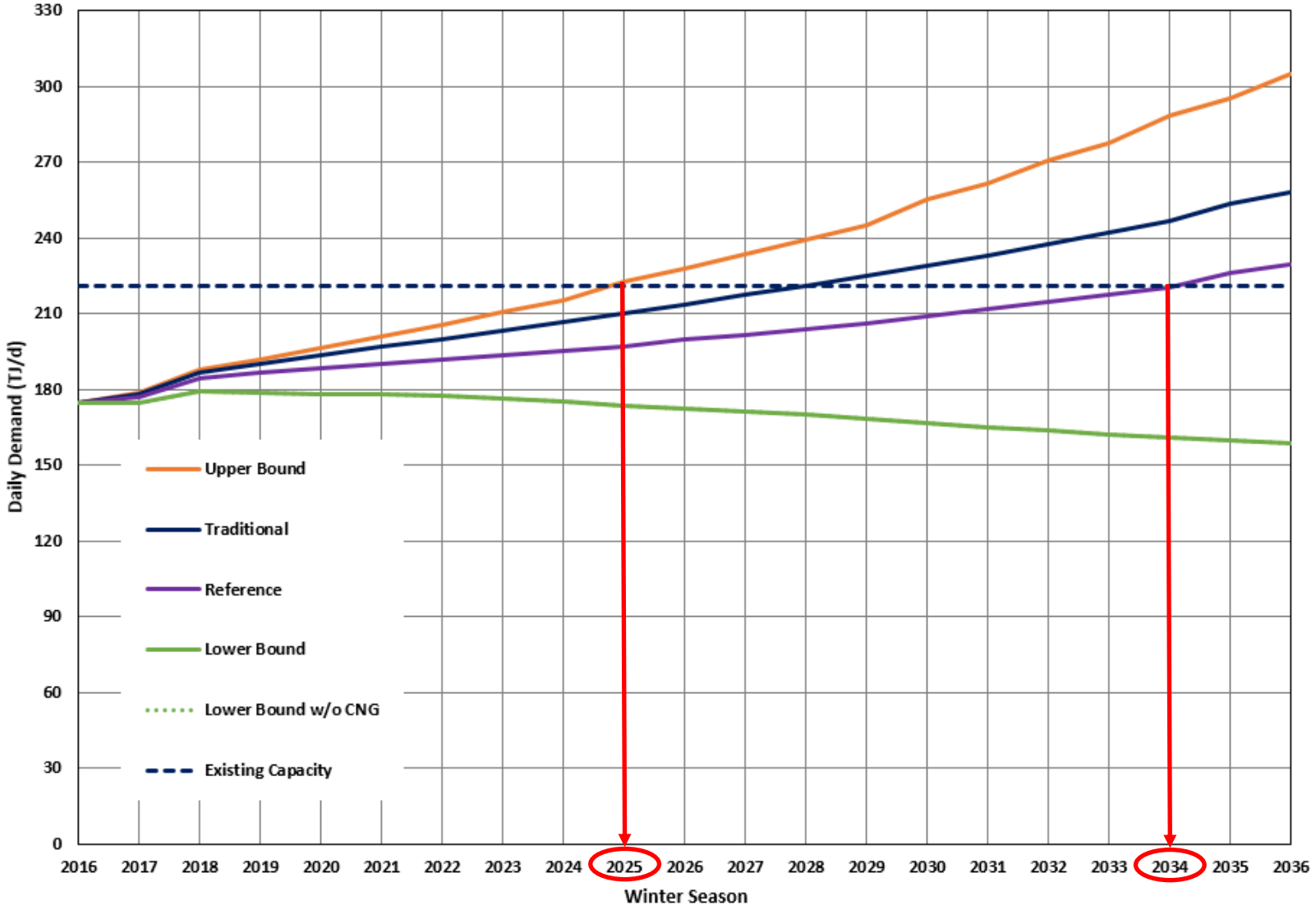
Key Input – BC Hydro Island Generation peak supply (50 TJ)

- Agreement expires in 2022 - six years before the expected capacity constraint
- The final form of this agreement could defer the capacity constraint to later in or beyond the 20 year planning horizon
- a key input into determining the preferred option

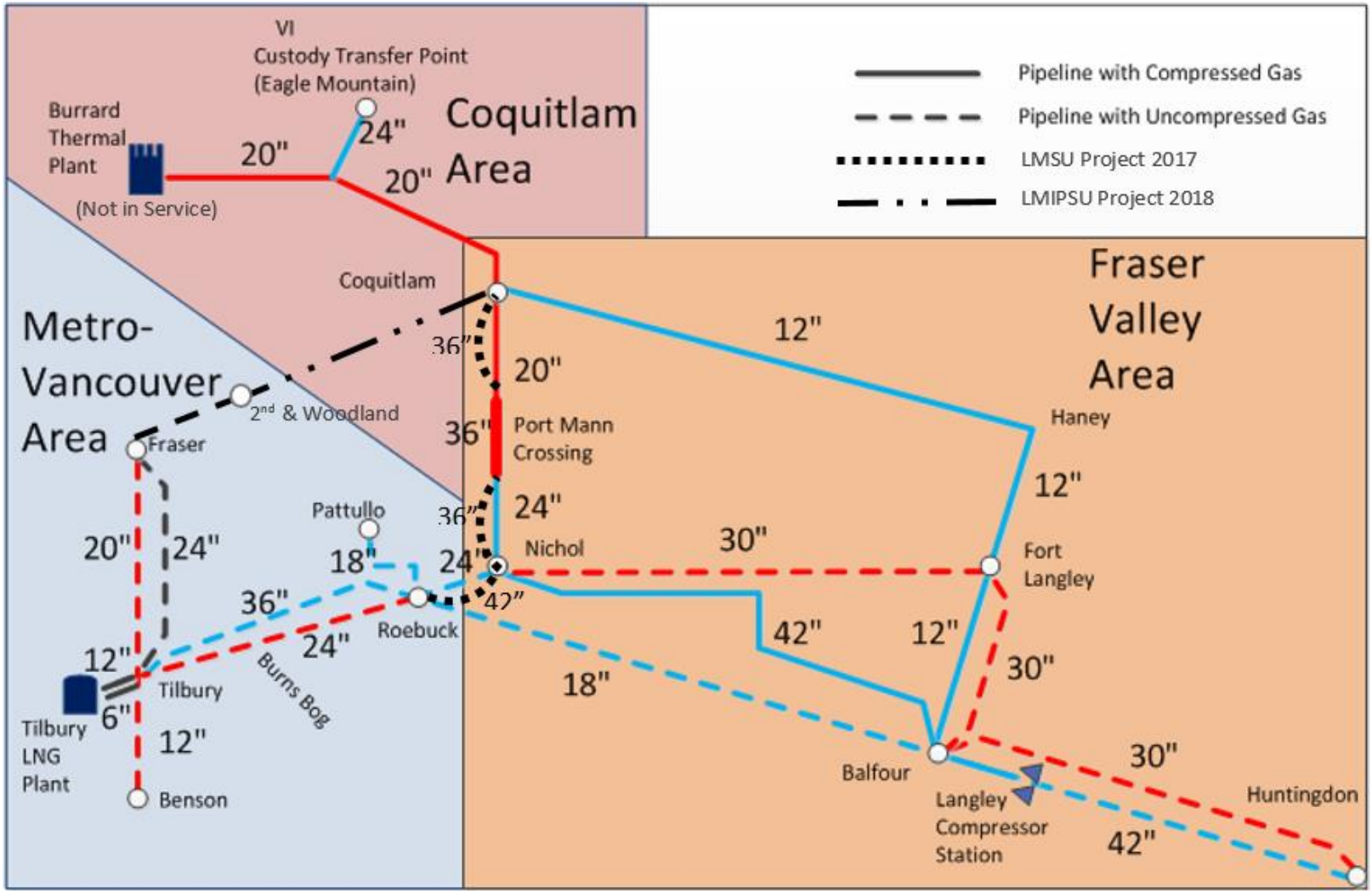
VI Capacity Constraint Under End-Use Forecasts



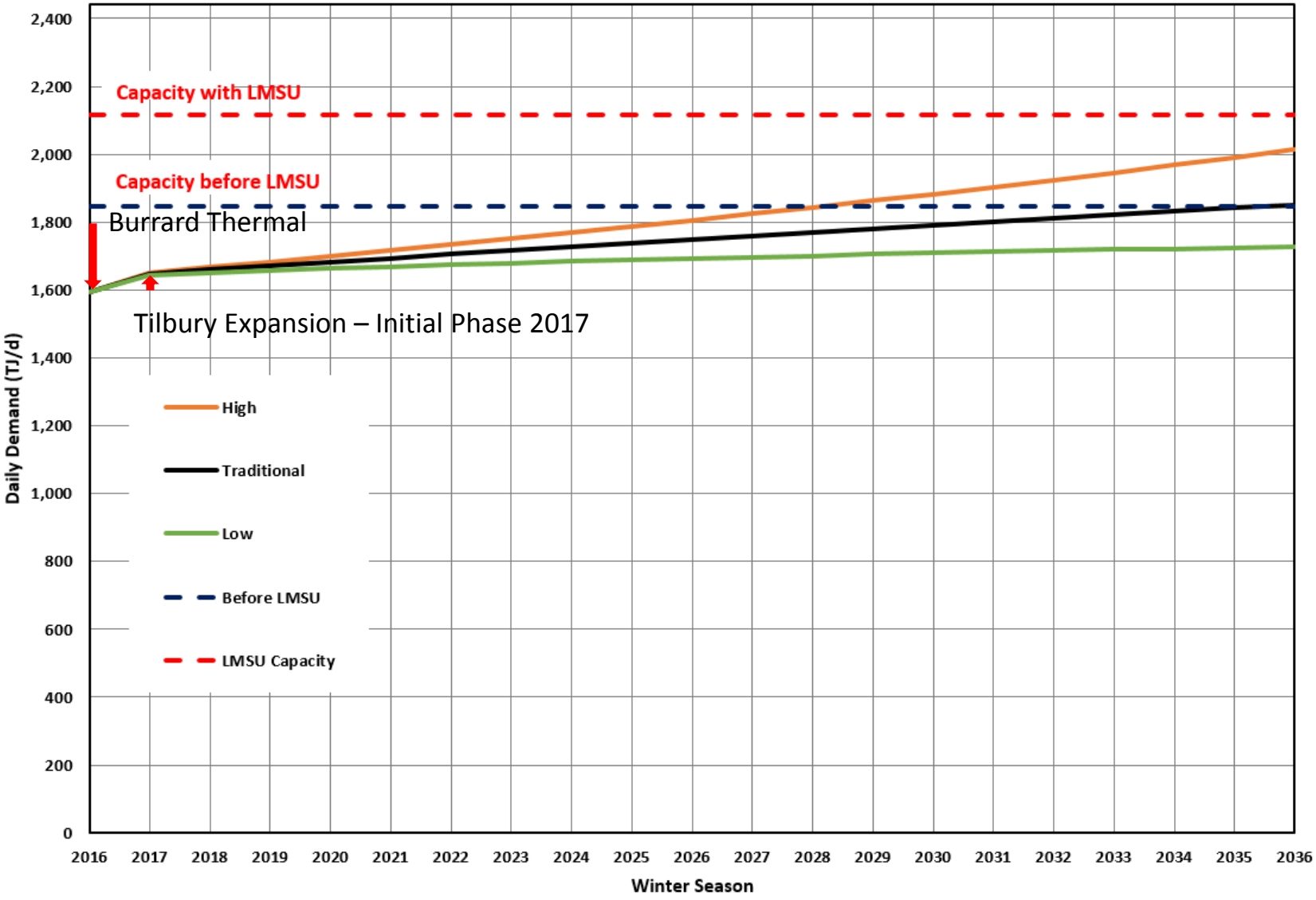
VI Capacity Constraint Under End-Use Forecasts (DSM Impacts)



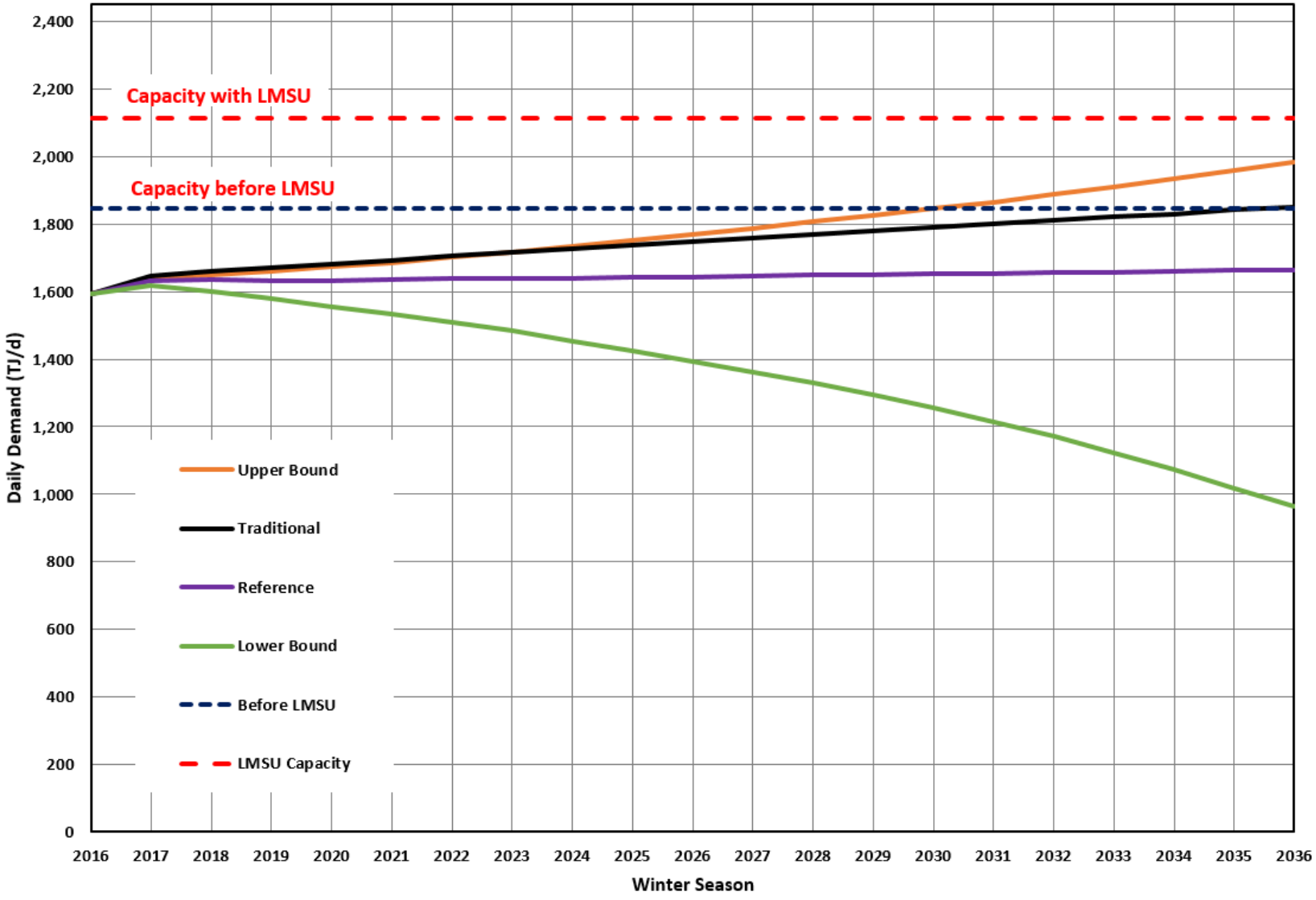
Coastal Transmission System



CTS Capacity Constraint Under Traditional Peak Forecasts

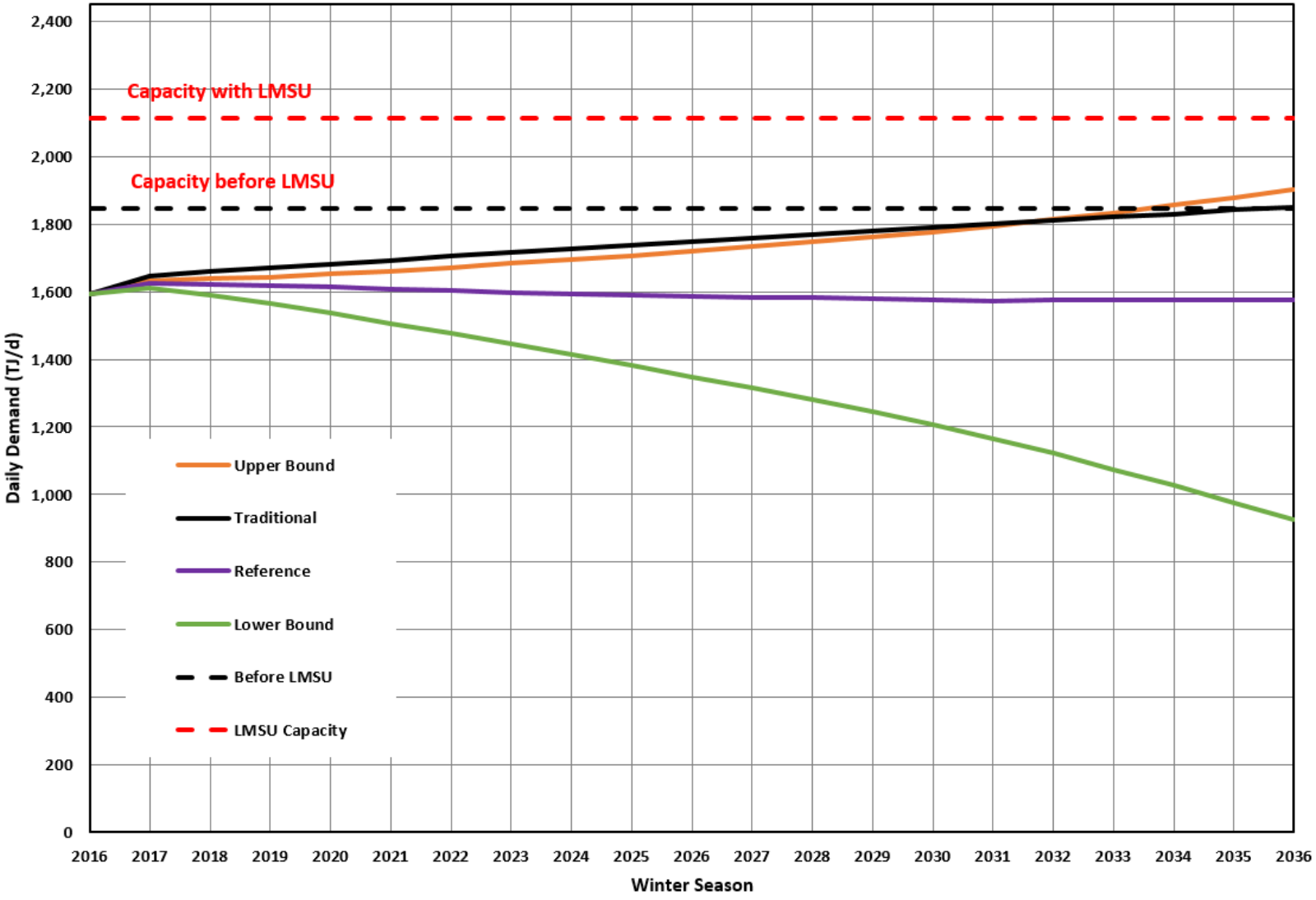


CTS Capacity Constraint Under End-Use Forecasts

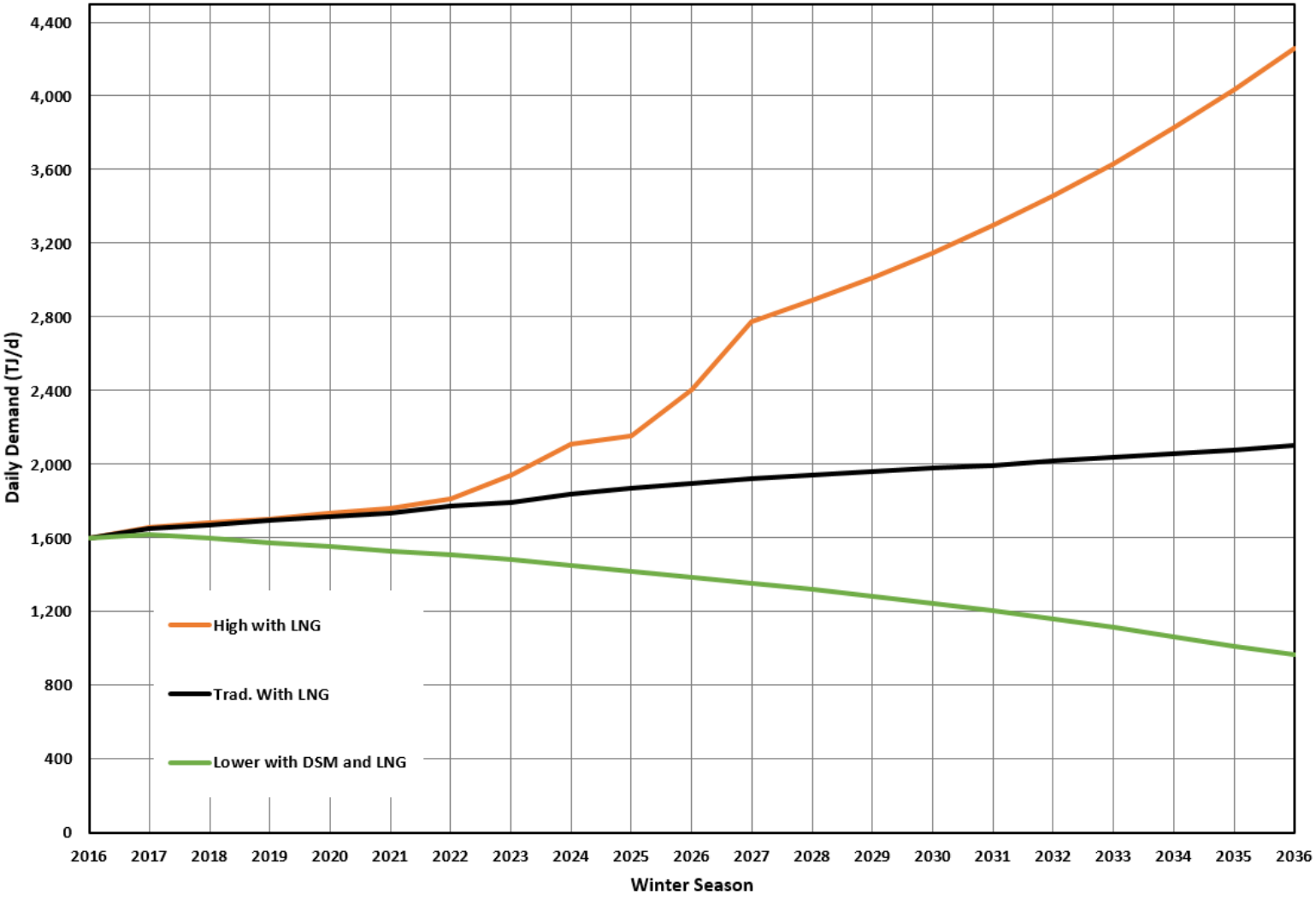


CTS Capacity Constraint Under End-Use Forecasts

(DSM Impacts)



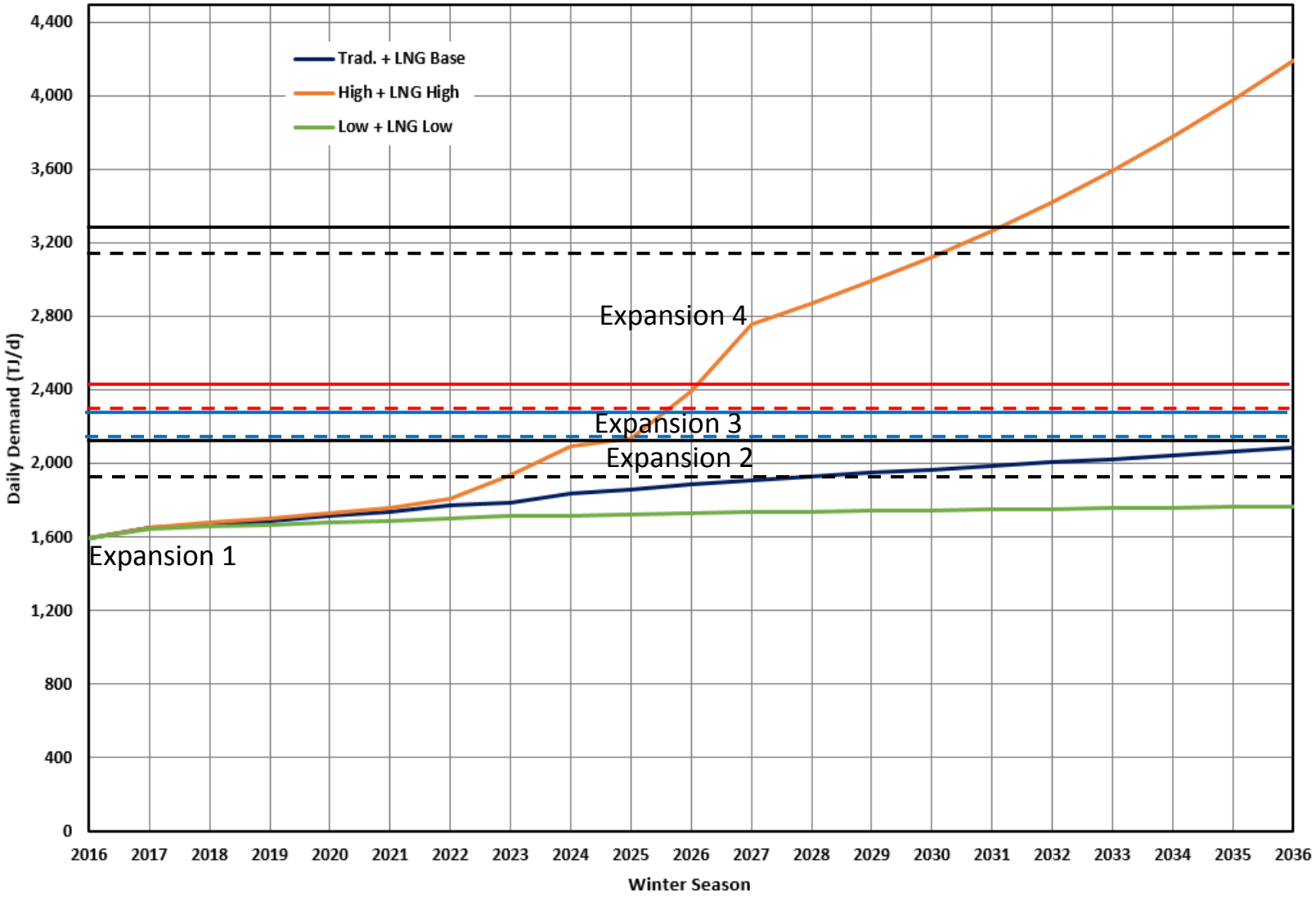
CTS Traditional Peak Forecasts with CNG & LNG Impacts



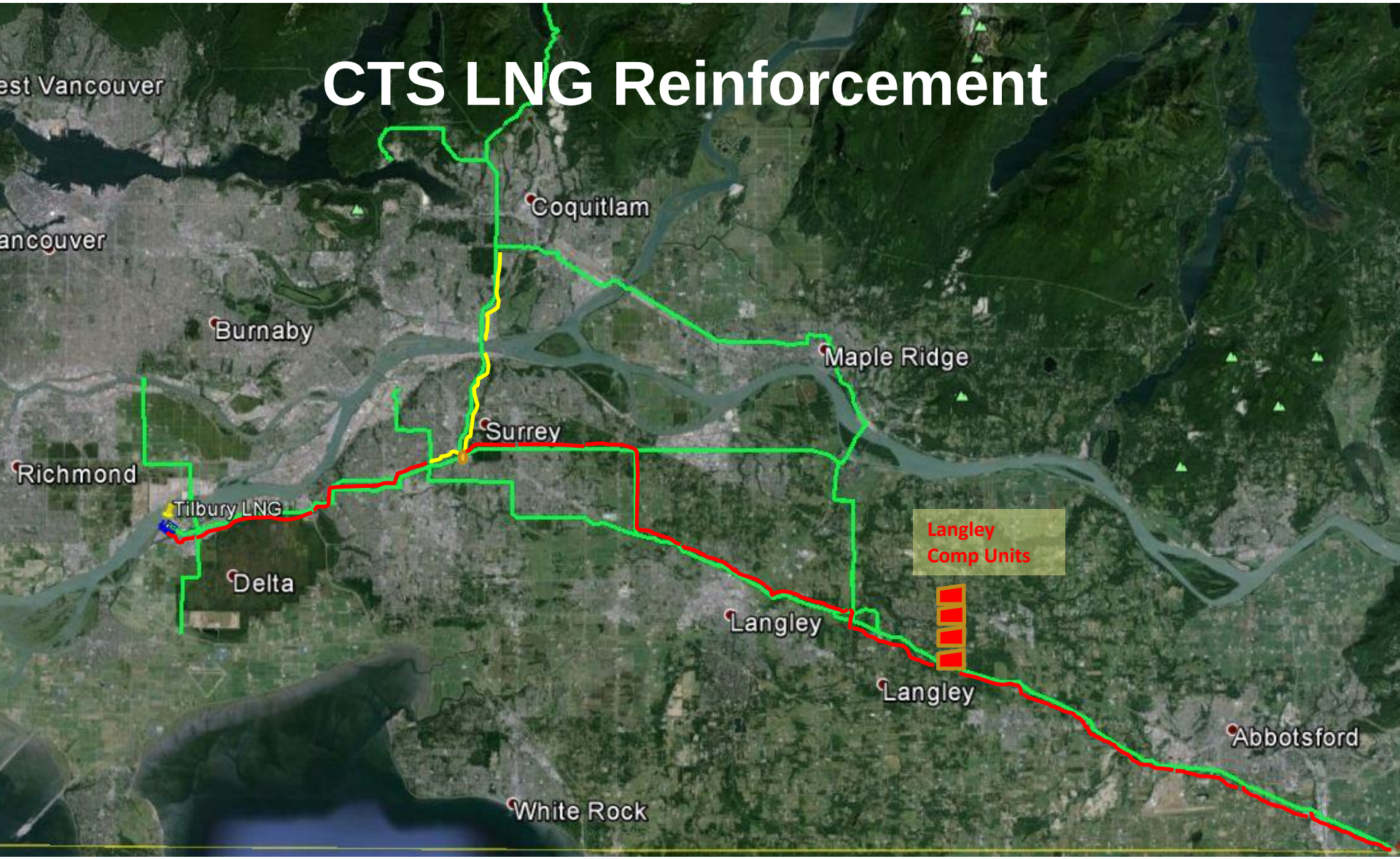
CTS Expansion Possibilities to meet LNG Forecasts

		Max CTS Delivery to South Delta/Richmond	
Expansion Scenario	**CTS Expansion Description**	**With Export LNG on VI System (260 TJ/d)**	**Without Export LNG on VI System**
1	LMSU Project	98 TJ/d	264 TJ/d
2	- Add Replacement of 1.9 Km NPS 6 feed to Tilbury Plant - Add 2 T70 compressor units at Langley Compressor Stn	276 TJ/d	436 TJ/d
3	- Add 14.8 km NPS42 Loop from Langley Compressor to Clayton Valve Stn - Add 2 T70 compressor units at Langley Compressor Stn	448 TJ/d	577 TJ/d
4	- Add 28.1 Km NPS42 Loop from Clayton Valve Stn to Tilbury Area. - Add 25 Km NPS42 Loop from Huntingdon to Langley Compressor Stn - Add 2 T70 compressor units at Langley Compressor	1306 TJ/d	1414 TJ/d

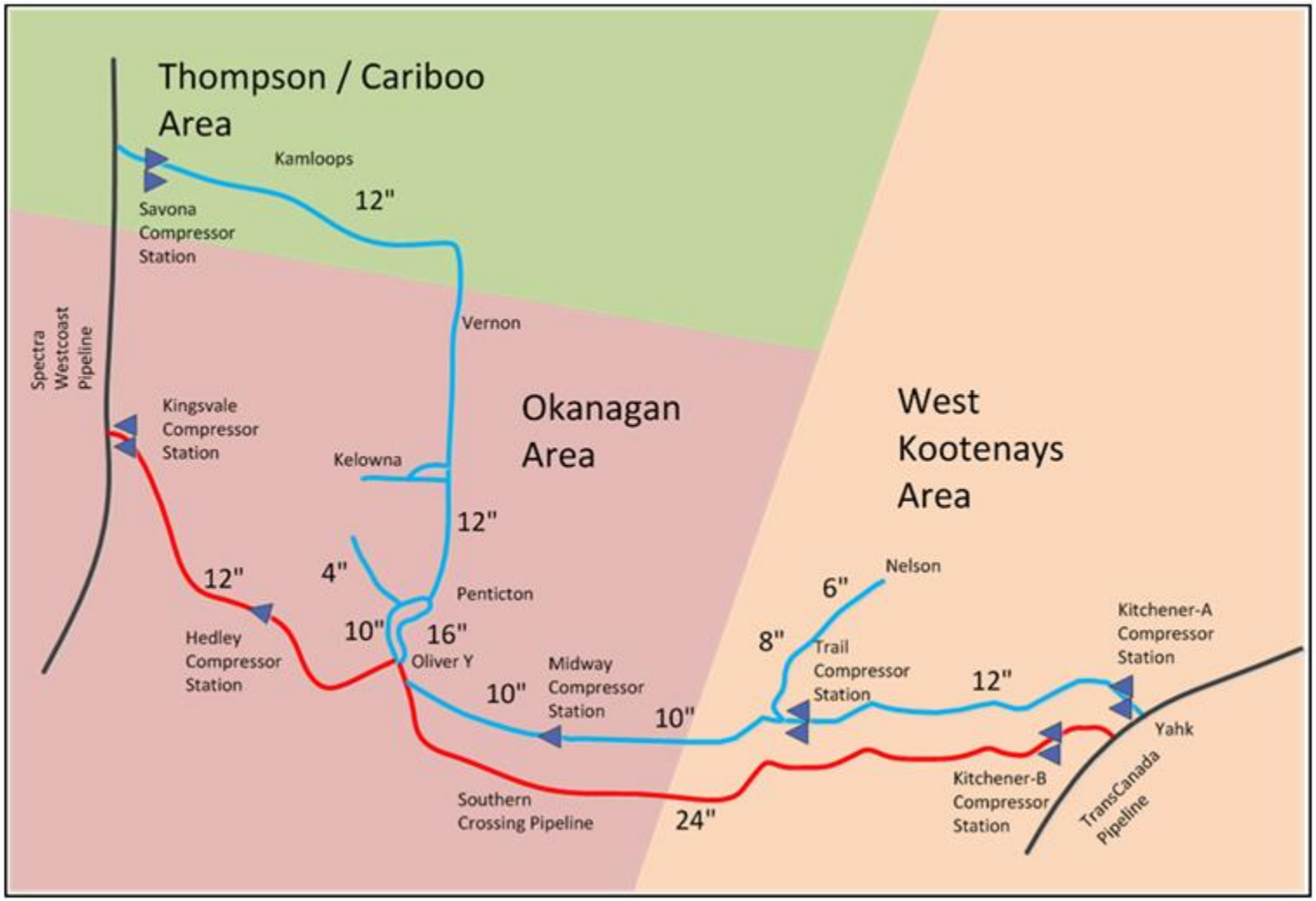
CTS Expansion Possibilities to meet LNG Forecast



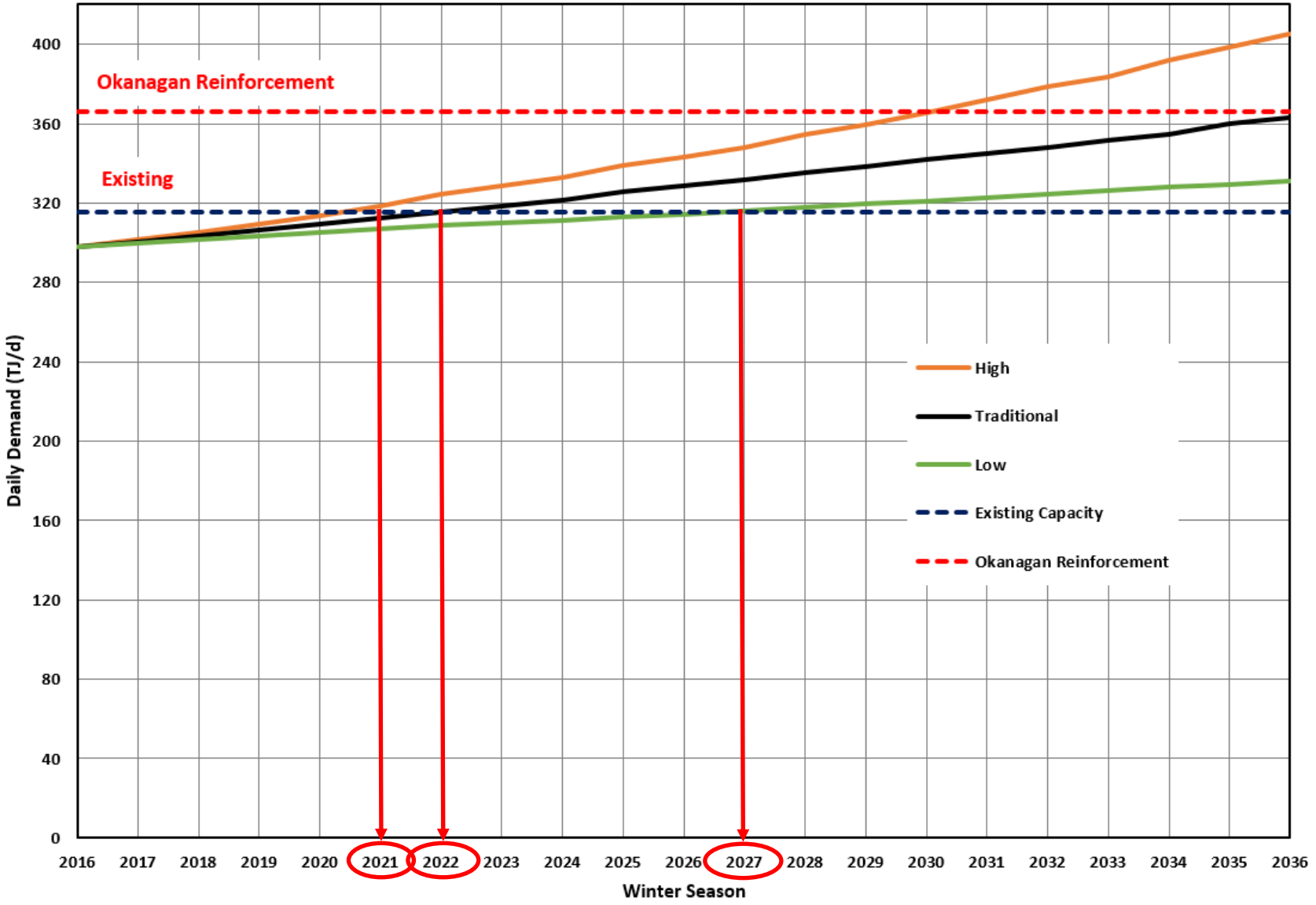
CTS LNG Reinforcement



Interior Transmission System



ITS Capacity Constraint Under Traditional Peak Forecasts



ITS Infrastructure to meet Traditional Peak Forecast

System Expansion Alternatives:

Option 1 – Okanagan Reinforcement - South Loop

- Loop approximately 28 Km of existing NPS12 pipeline with NPS20 pipeline
- Upgrade inlet to Kelowna Gate #1
- Add Compression at Kitchener B Compressor Station

Option 2 – Okanagan Reinforcement -North Loop

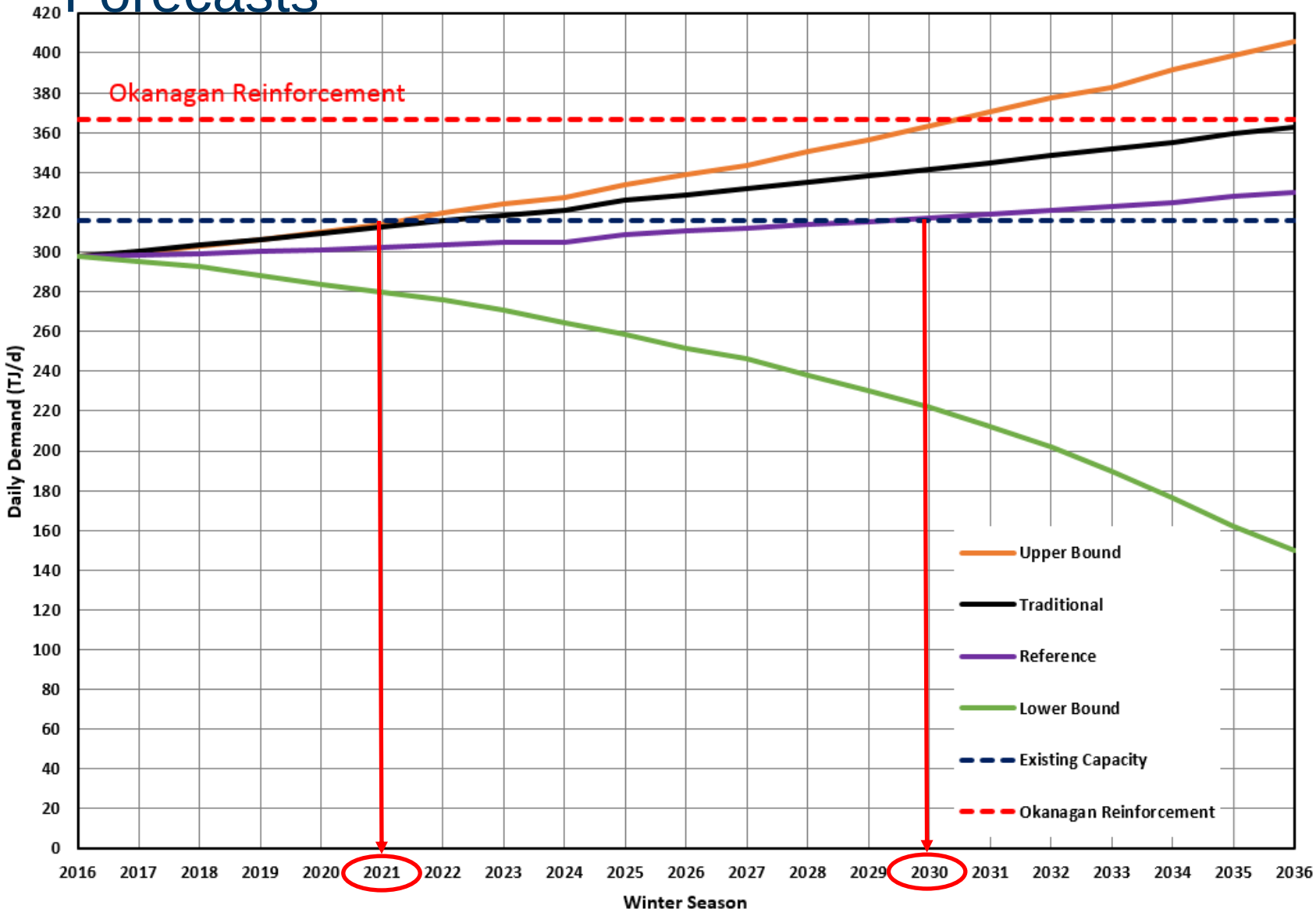
- Loop approximately 52 Km of existing NPS12 pipeline with NPS 20
- Upgrade Kelowna Gate #1

Option 3 – LNG Peak Shaving Facility

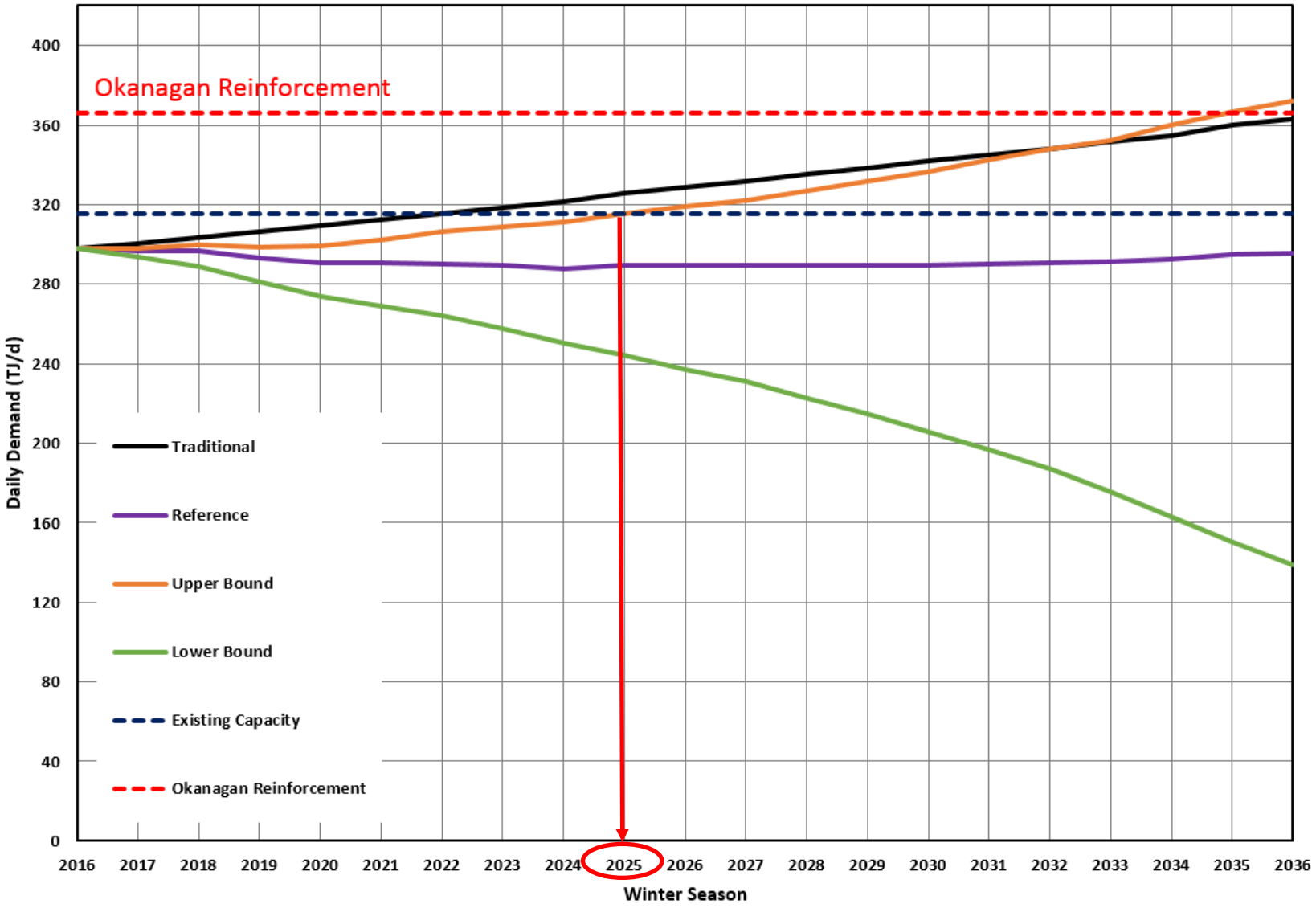
- Approximately 30+ TJ/d LNG peak Shaving
- Optimum location is near ITS no flow point near Vernon

Okanagan Reinforcement

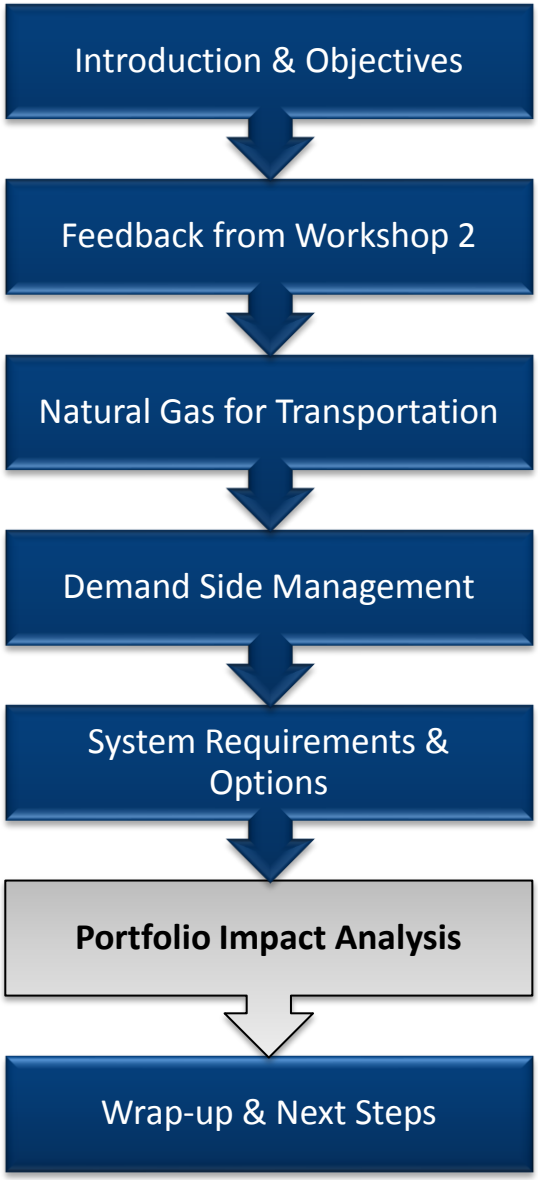
ITS Capacity Constraint Under End-Use Forecasts



ITS Capacity Constraint Under End-Use Forecasts (DSM Impacts)



Questions?



Energy at work

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Delivery Rate Impact Projections

Gerald Chan, Cost of Service Manager

August 9, 2017

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High-level method

- Energy projections
- Delivery cost high-level long term projections

- Not a detailed rate forecast
- Does not consider future rate design changes

Key assumptions and caveats

Delivery Cost Components:

- Earned return on assets in service (pipelines, compressor stations, LNG, etc.)
- Operations & Maintenance
- Income taxes
- Property taxes

Delivery costs excludes:

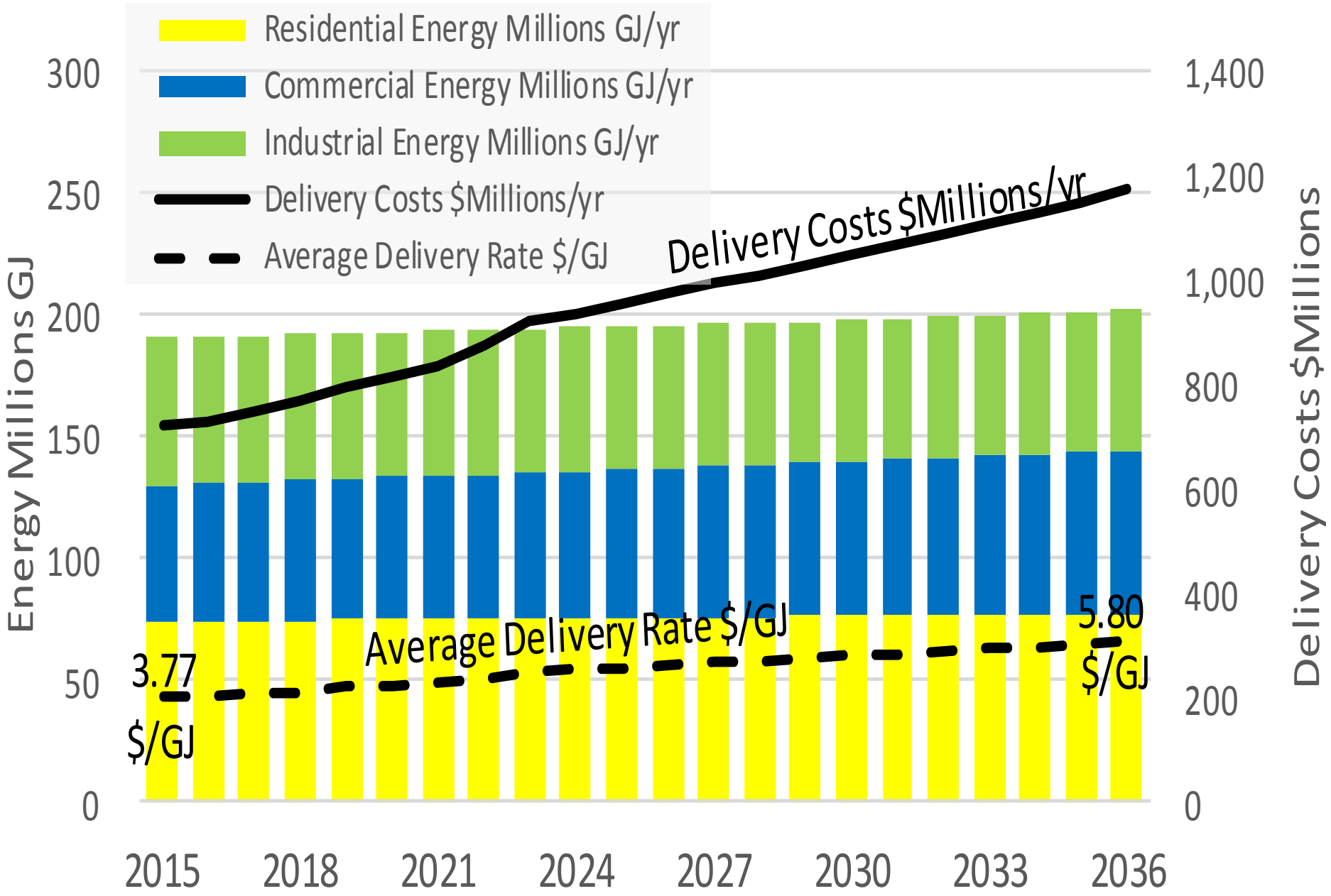
- Gas commodity & midstream costs
- PST / GST
- Carbon tax

Delivery cost projections:

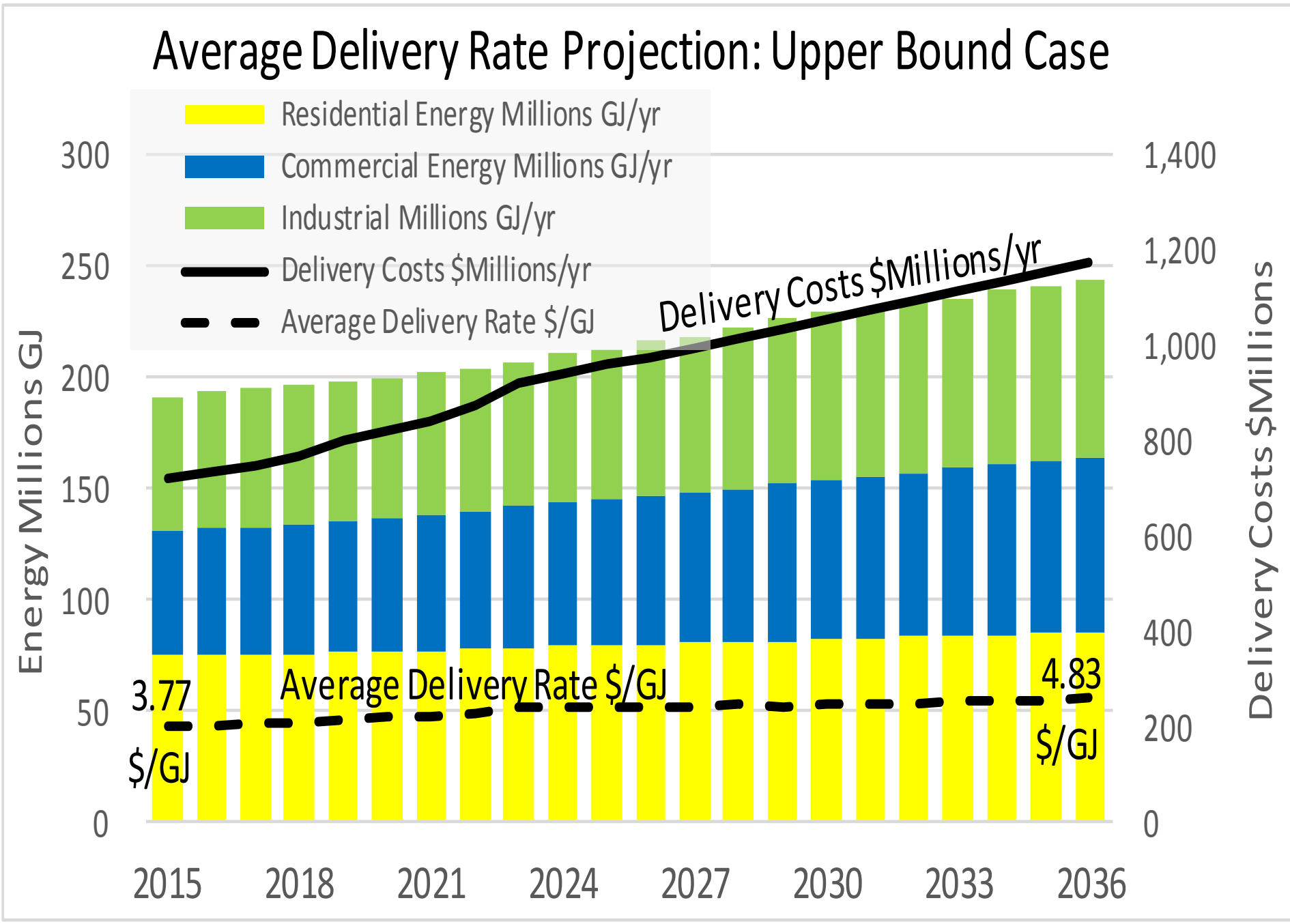
- Current delivery cost increased at 2% per year across planning horizon
- Added cost for major projects

1. All energy, **excluding** DSM and NGT

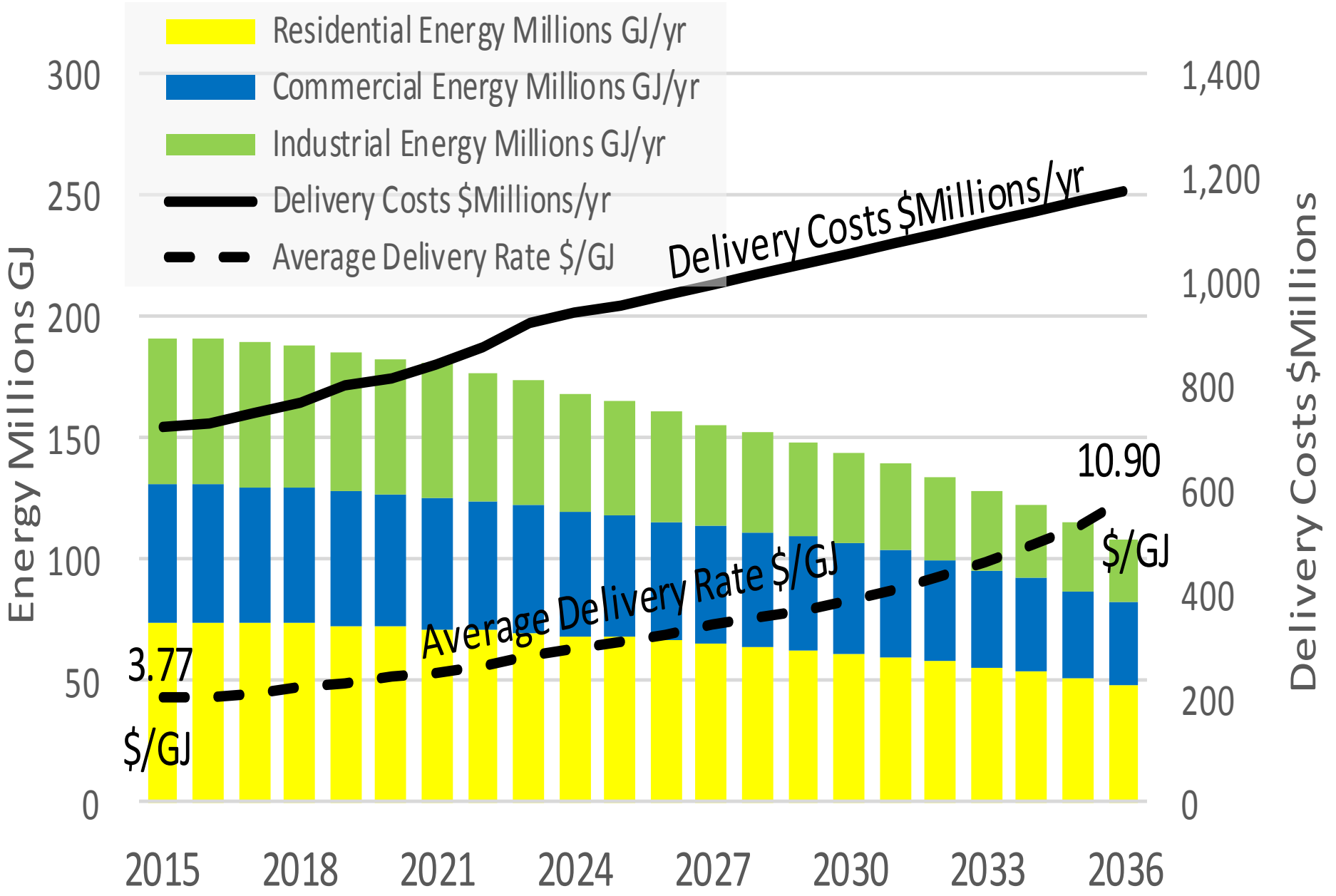
Average Delivery Rate Projection: Reference Case



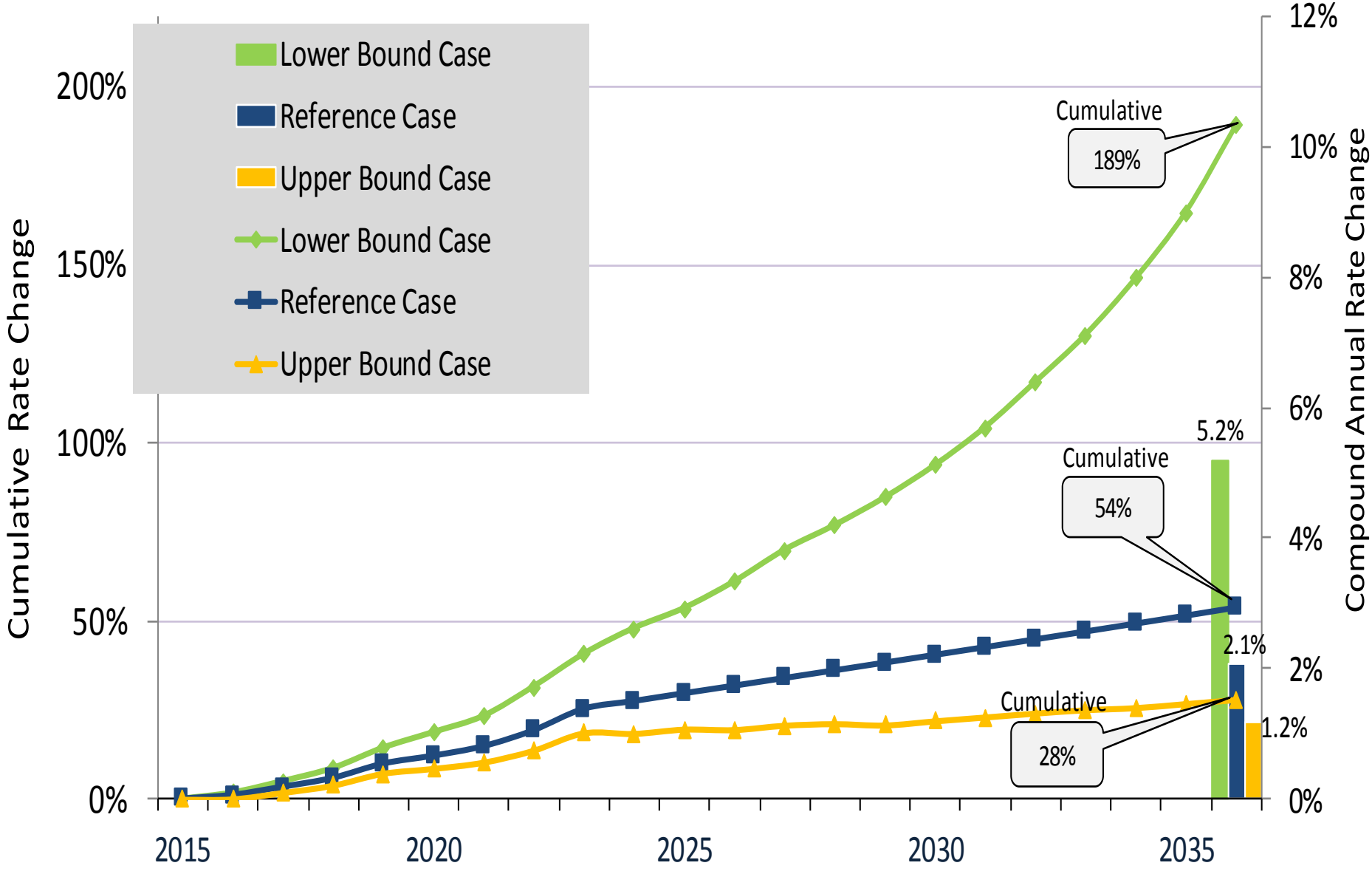
Average Delivery Rate Projection: Upper Bound Case



Average Delivery Rate Projection: Lower Bound Case

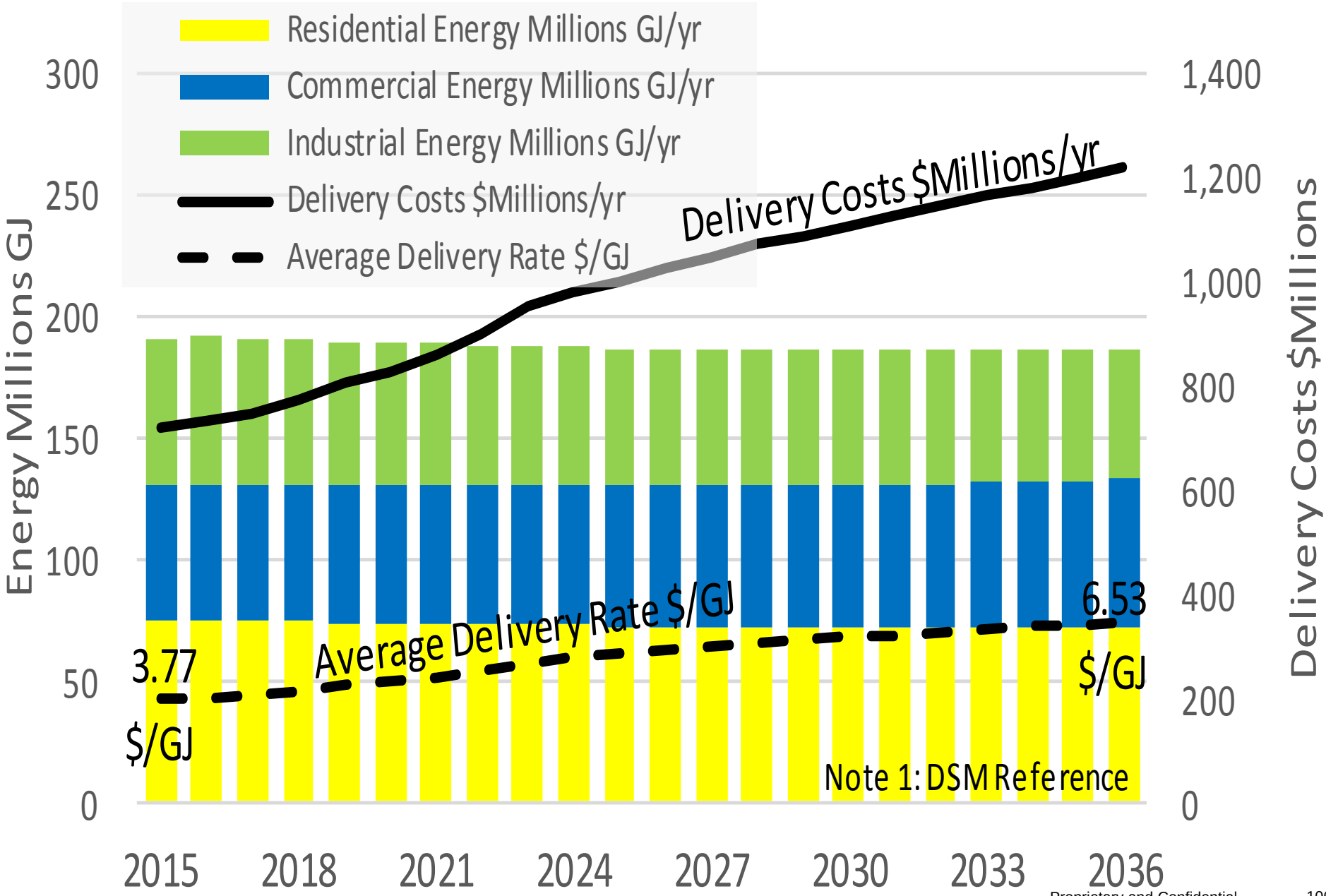


Average Delivery Rate Direction: Reference / Upper Bound / Lower Bound

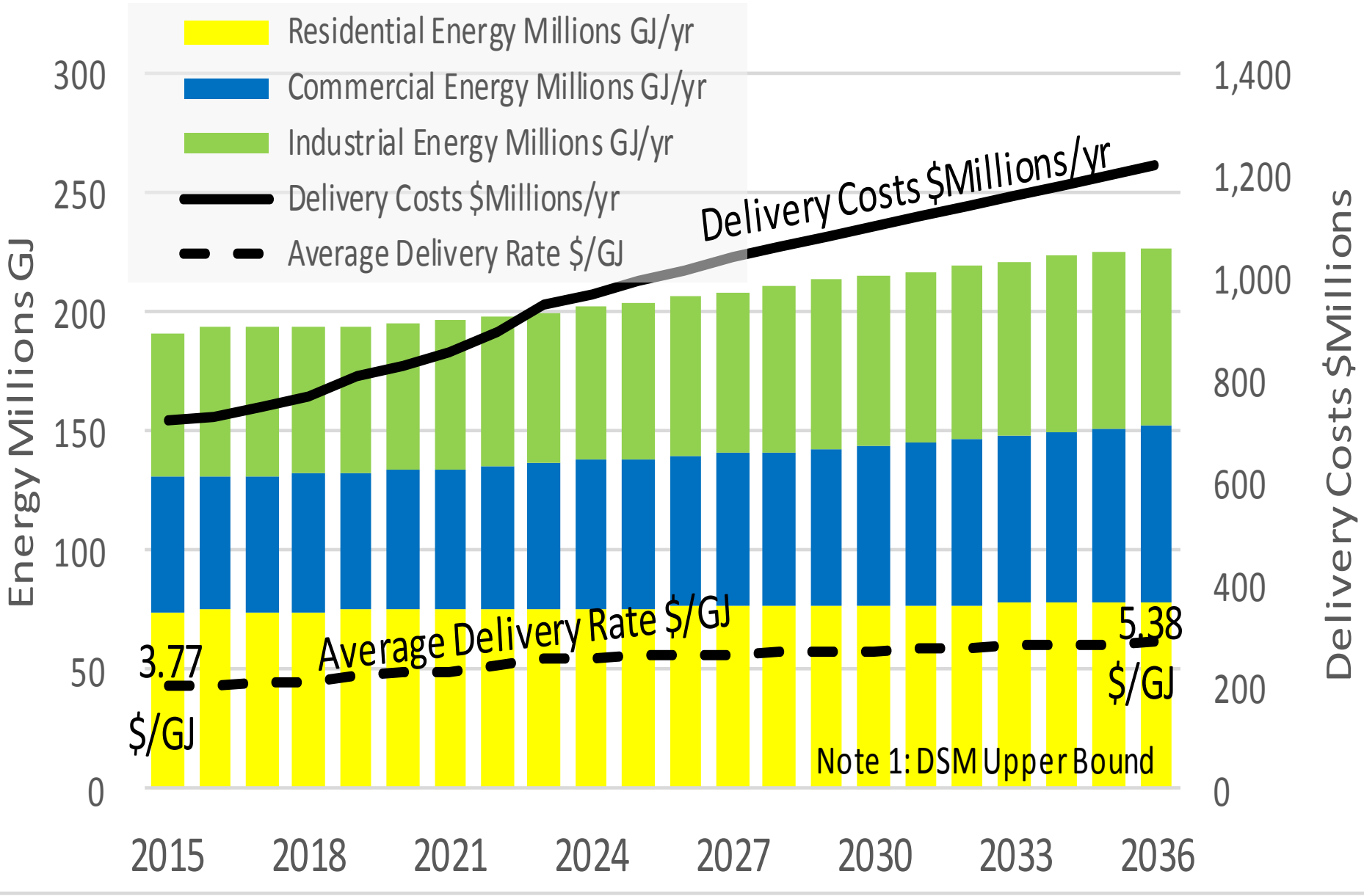


2. All energy, including DSM **but** excluding NGT

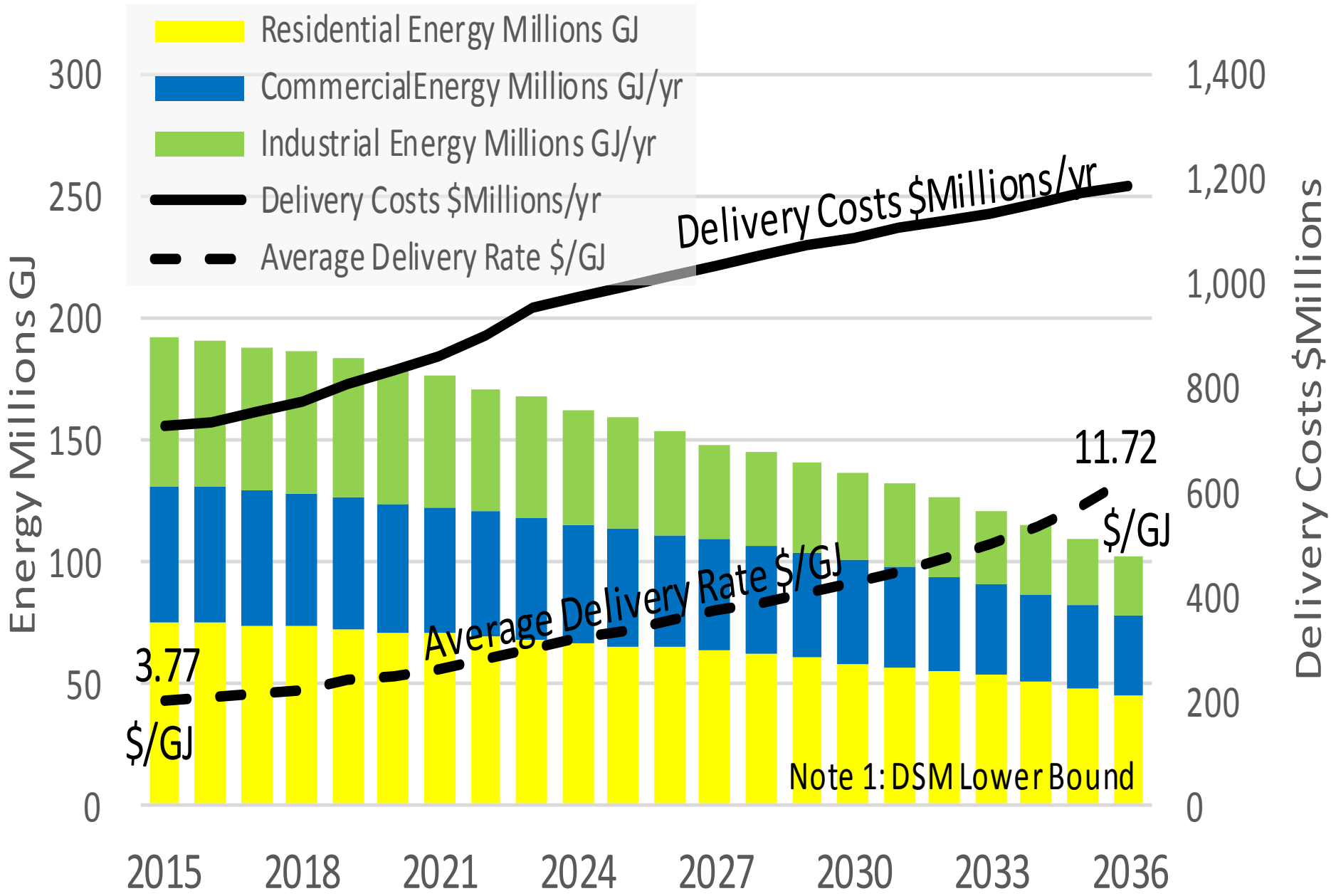
Average Delivery Rate Projection: Reference Case + DSM[1]



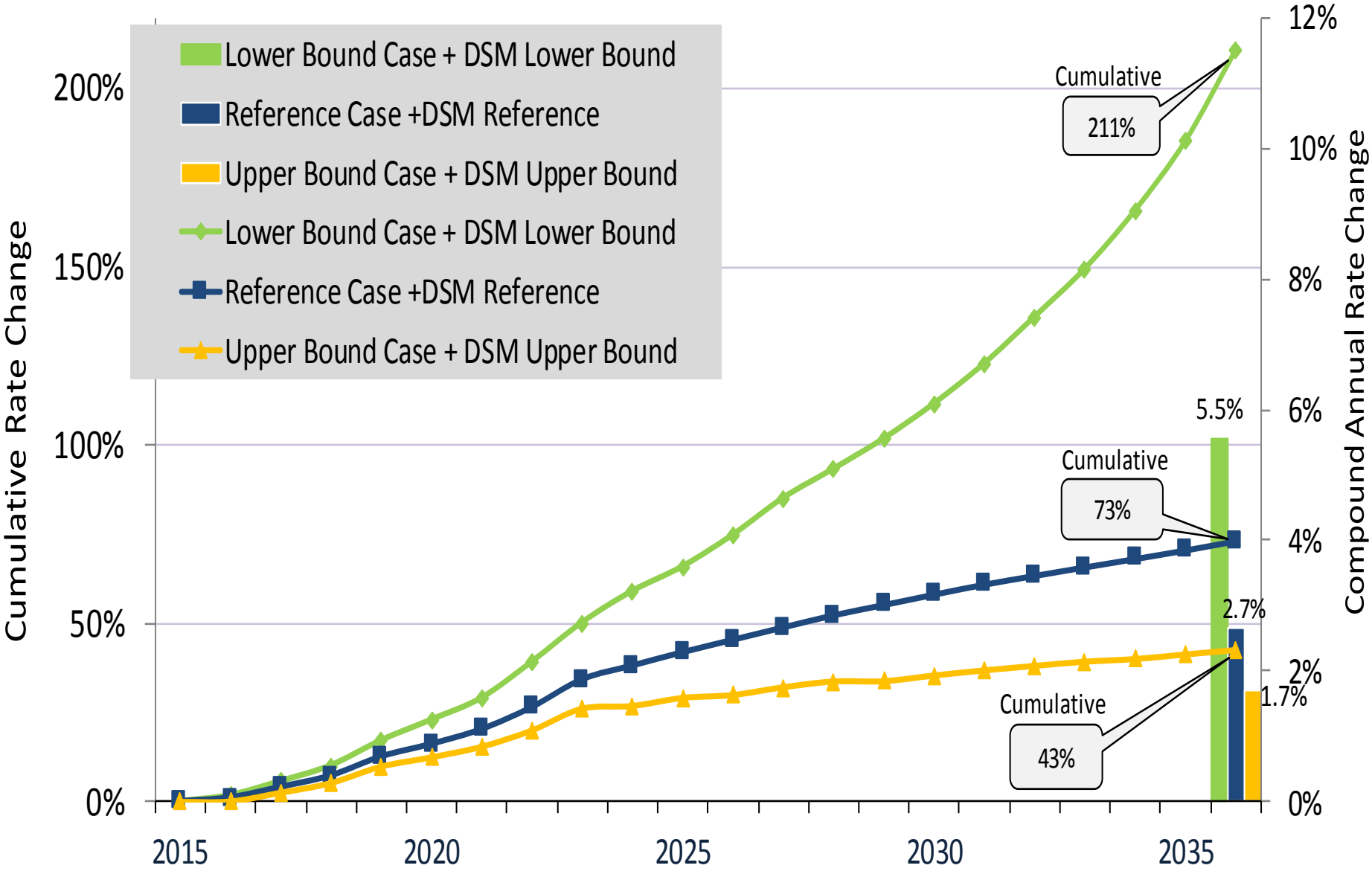
Average Delivery Rate Projection: Upper Bound Case + DSM[1]



Average Delivery Rate Projection: Lower Bound Case + DSM[1]

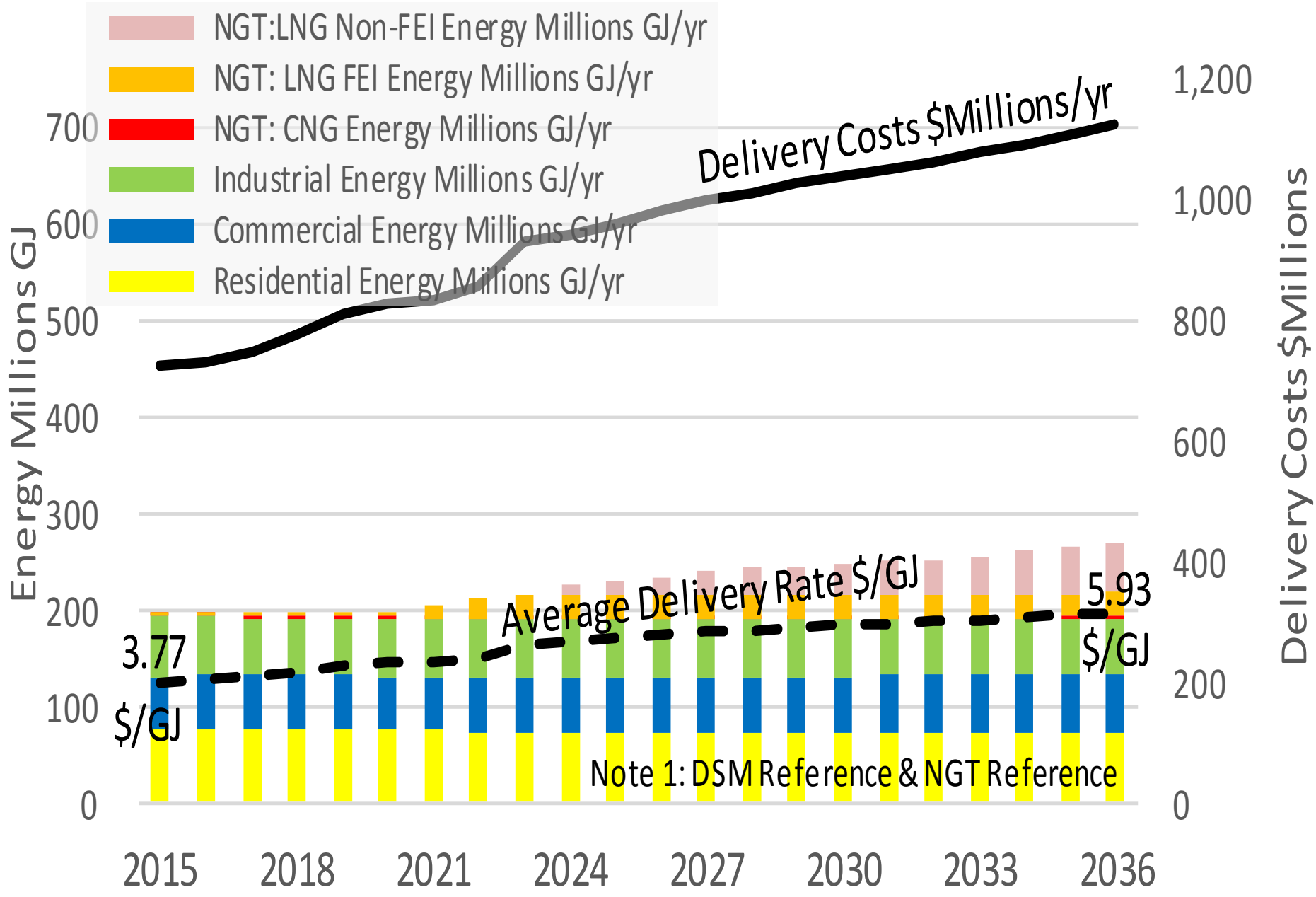


Average Delivery Rate Direction: Reference / Upper Bound / Lower Bound + DSM

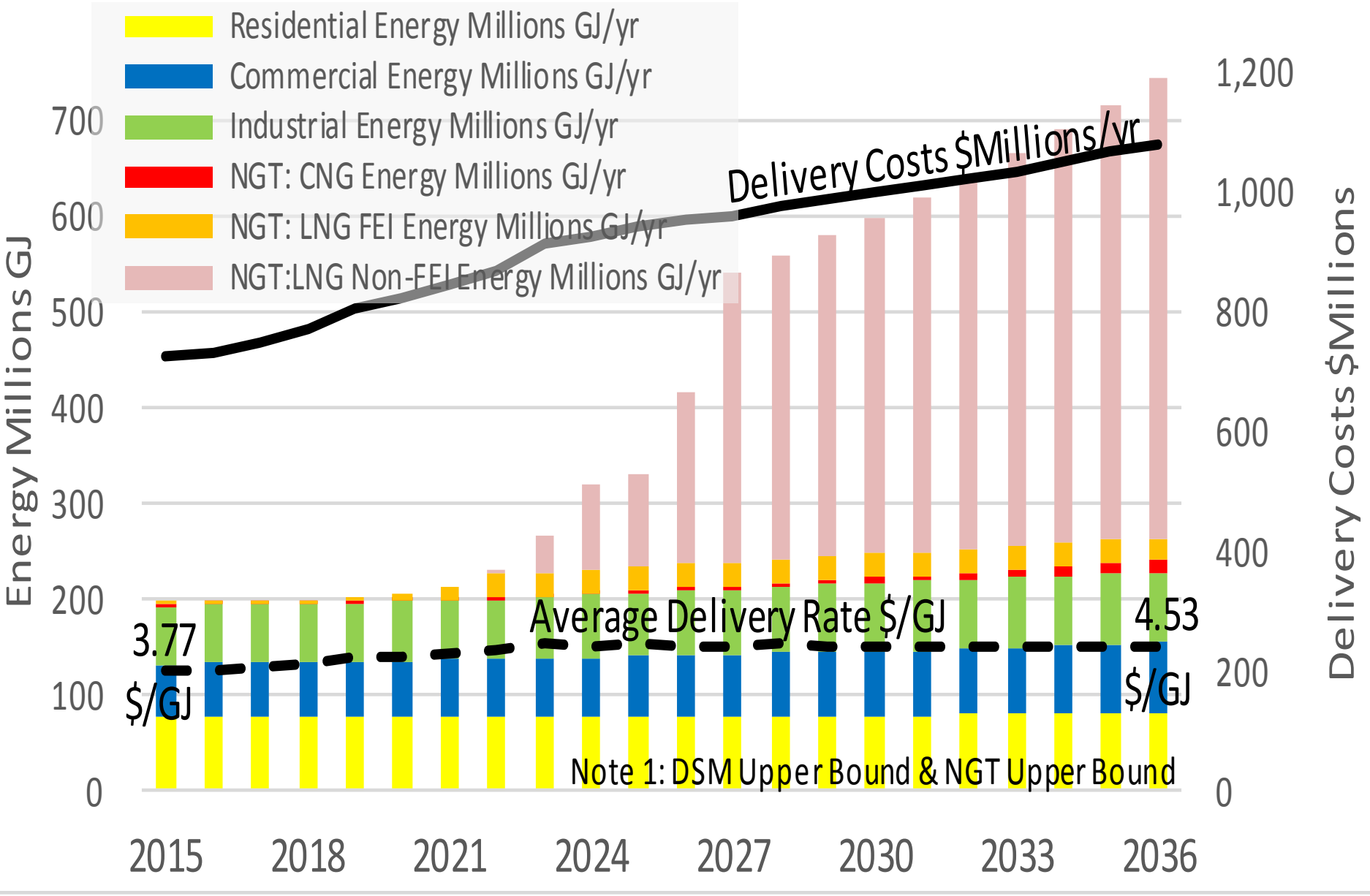


3. All energy, including DSM **and** NGT

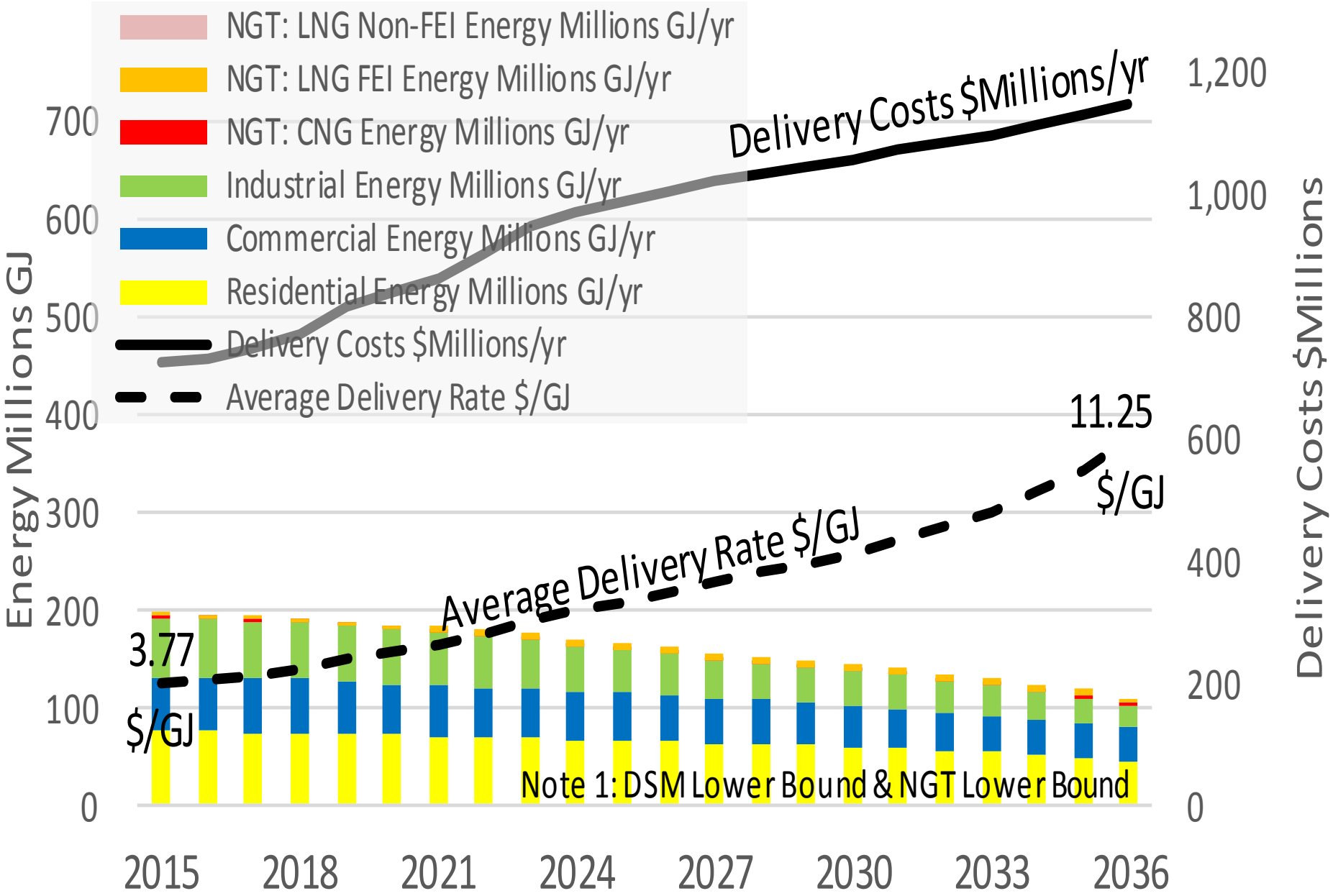
Average Delivery Rate Projection: Reference Case + DSM[1] + NGT[1]



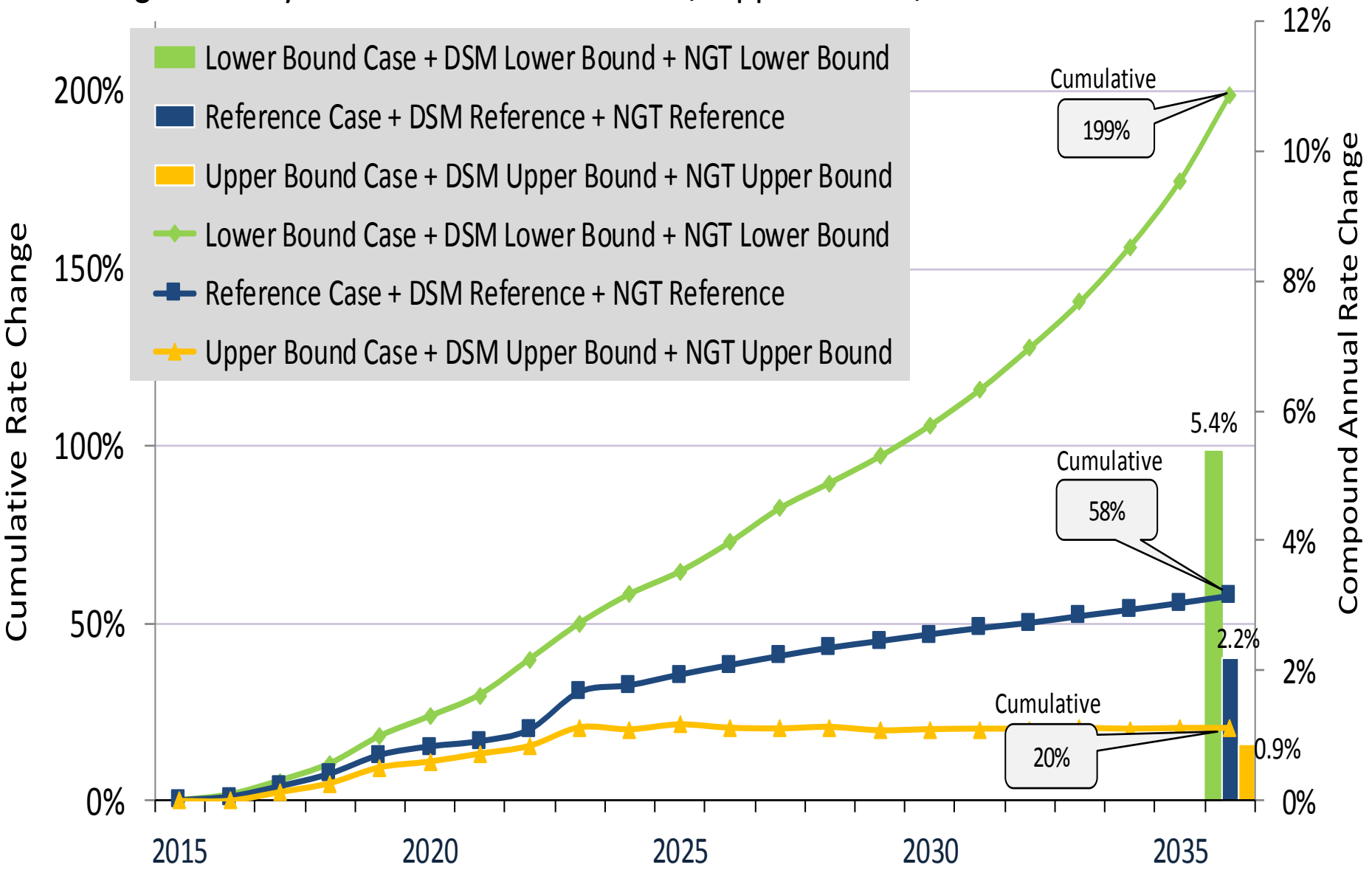
Average Delivery Rate Projection: Upper Bound Case+DSM[1]+NGT[1]



Average Delivery Rate Projection: Lower Bound Case+DSM[1]+NGT[1]



Average Delivery Rate Direction: Reference / Upper Bound / Lower Bound + DSM + NGT



Summary of average delivery rate changes

	Base		Base + DSM		Base + DSM + NGT	
	Rate Change (2015-36, %)		Rate Change (2015-36, %)		Rate Change (2015-36, %)	
	Cumulative	Compound Annual	Cumulative	Compound Annual	Cumulative	Compound Annual
Reference Case	54	2.1	73	2.7	58	2.2
Upper Bound	28	1.2	43	1.7	20	0.9
Lower Bound	189	5.2	211	5.5	199	5.4

Greenhouse Gas Emissions Impact Projections

Robert Schuster, Integrated Resource Planning Manager

August 9, 2017

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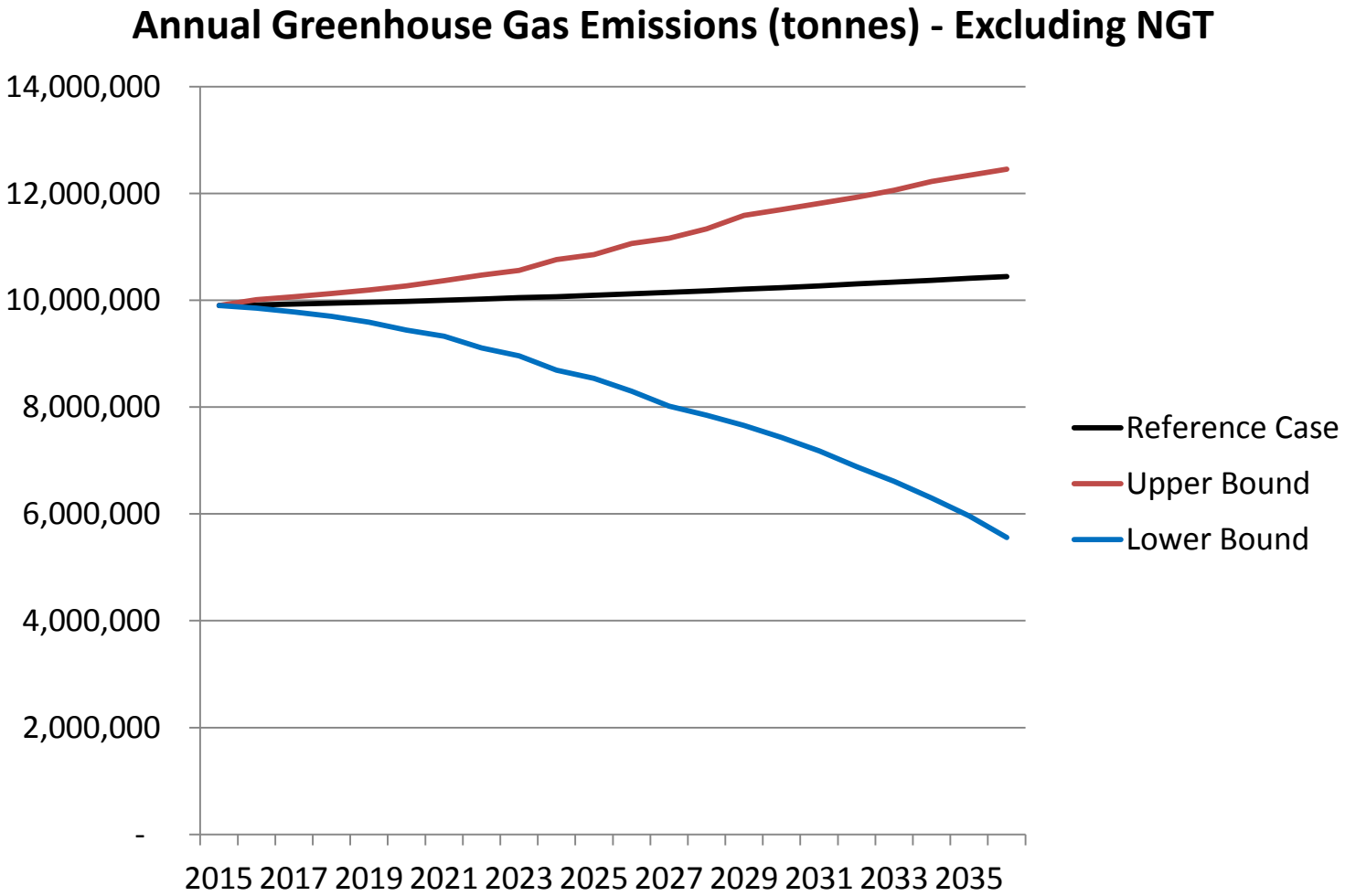
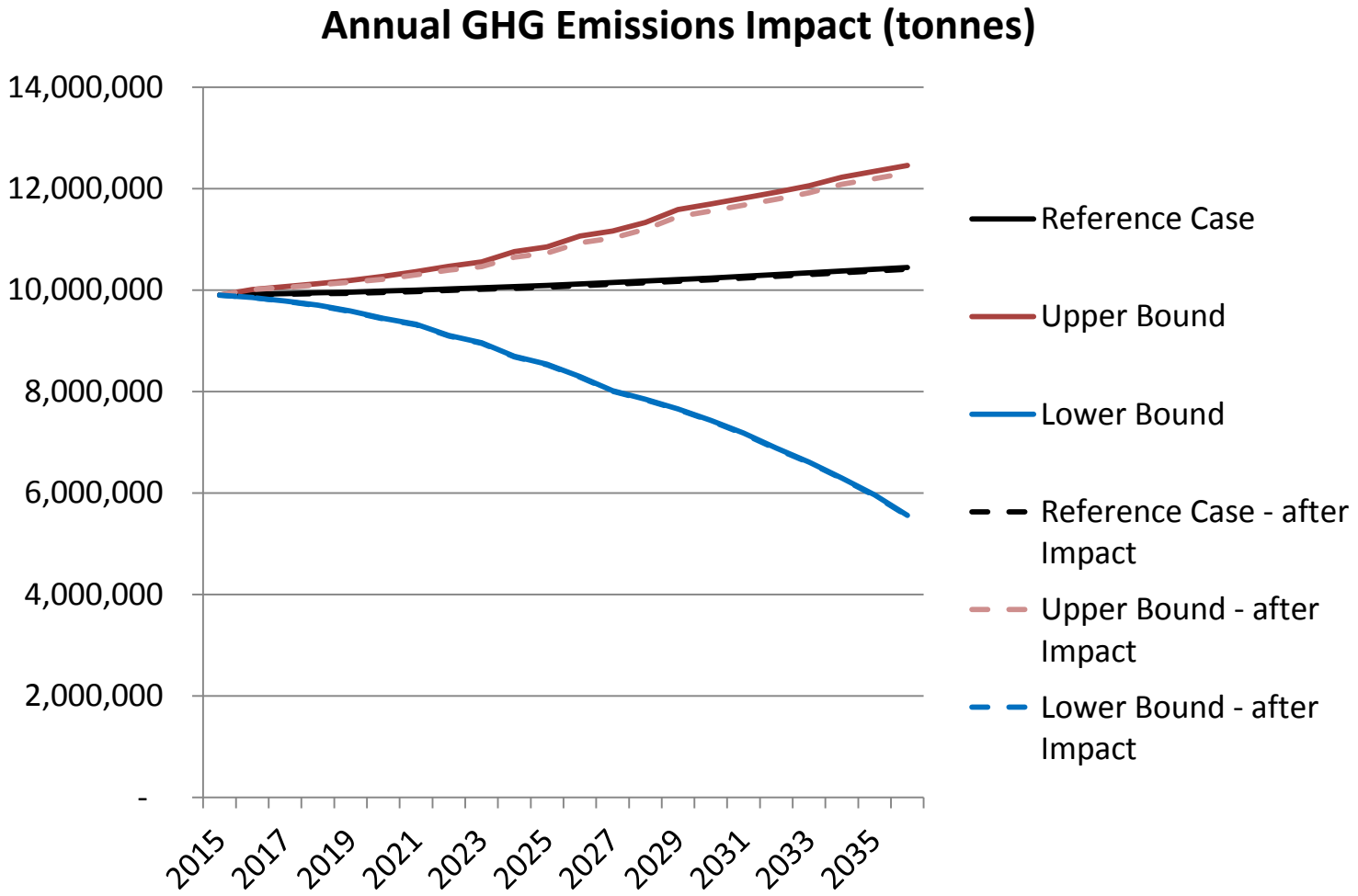
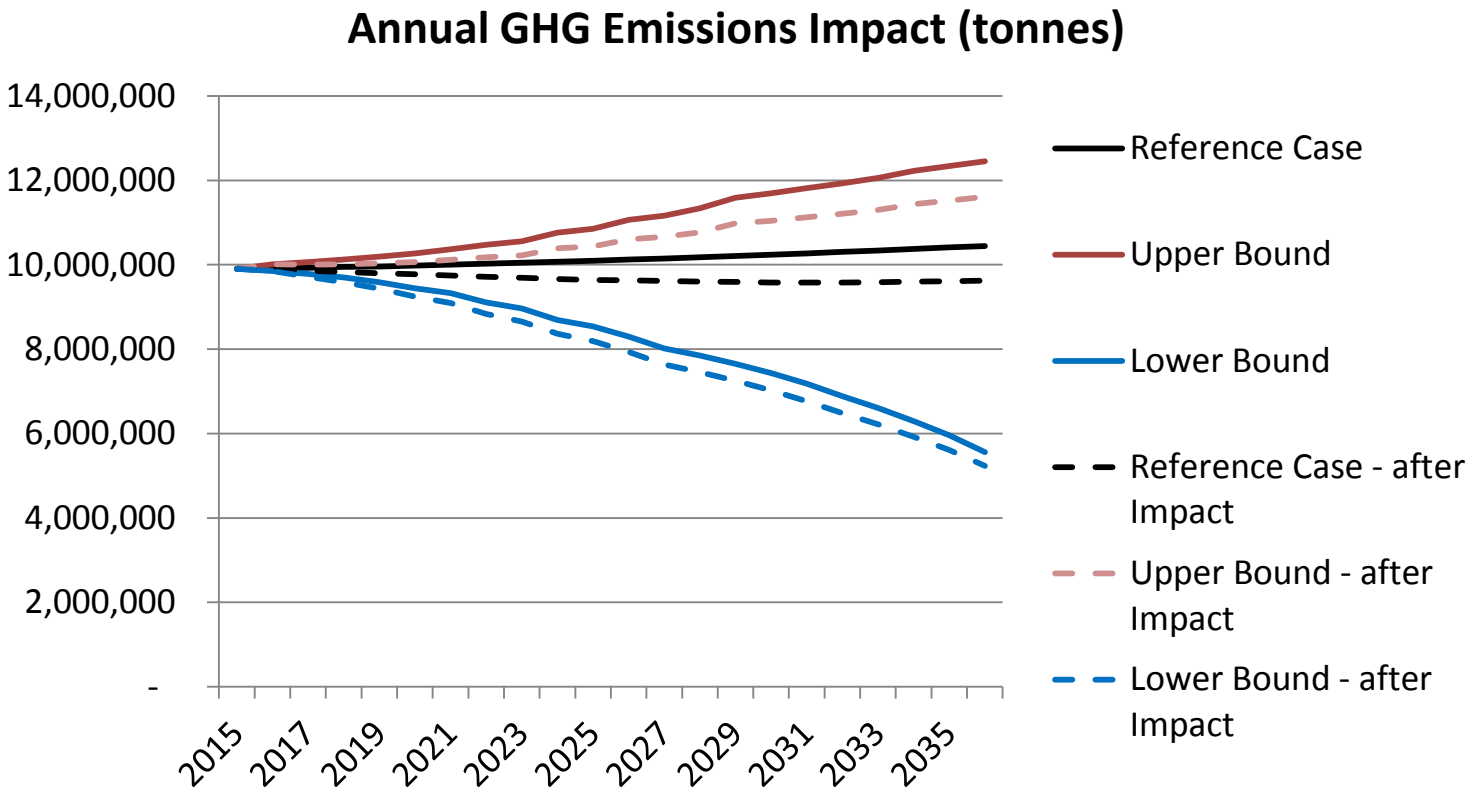
Emissions from combusting natural gas from FEI's system depend on the scenario



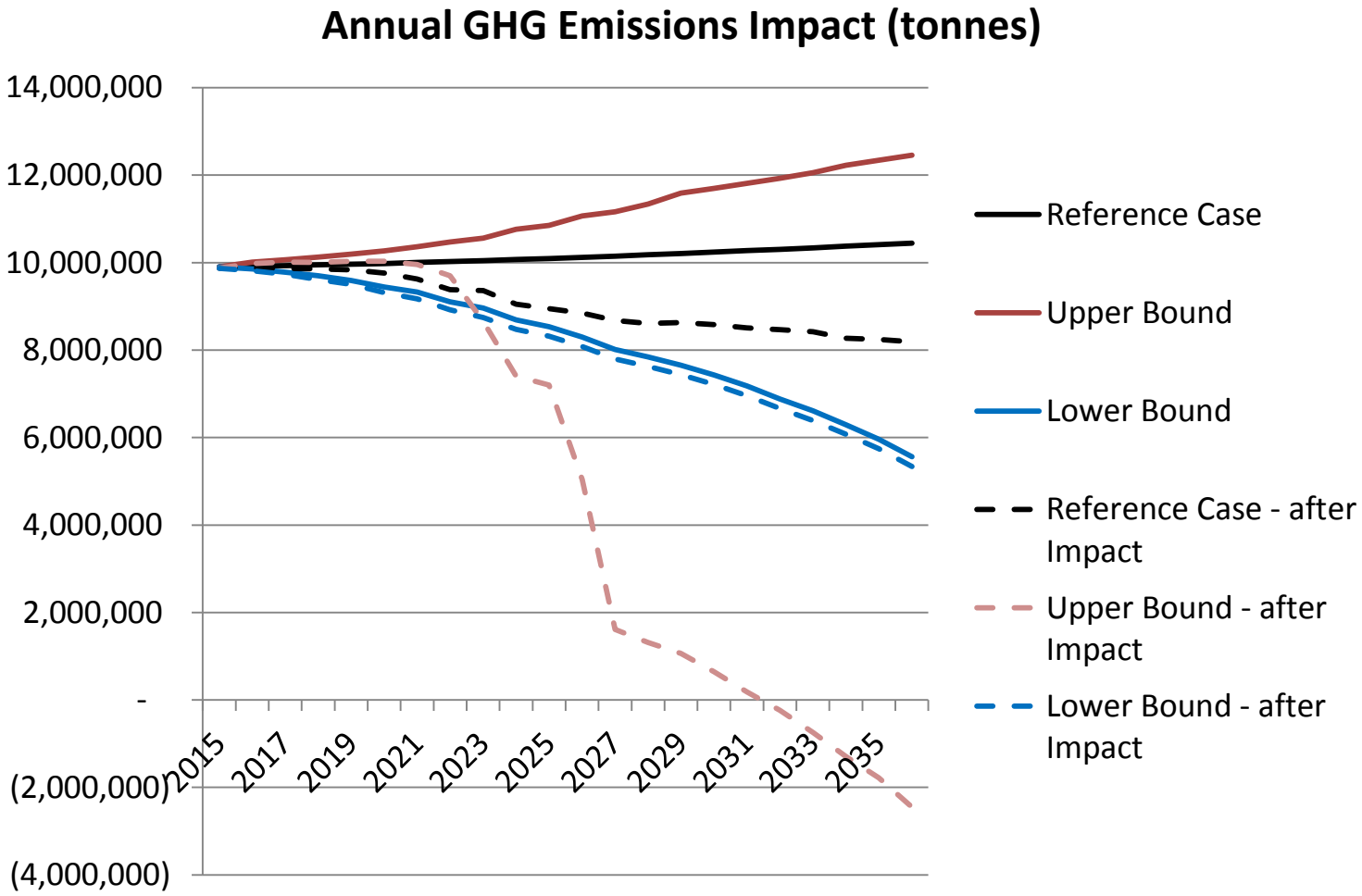
Emissions impact of Renewable Natural Gas **without** Natural Gas for Transportation



Emissions impact of DSM only (Conservation & Energy Management Programs) **without** Natural Gas for Transportation

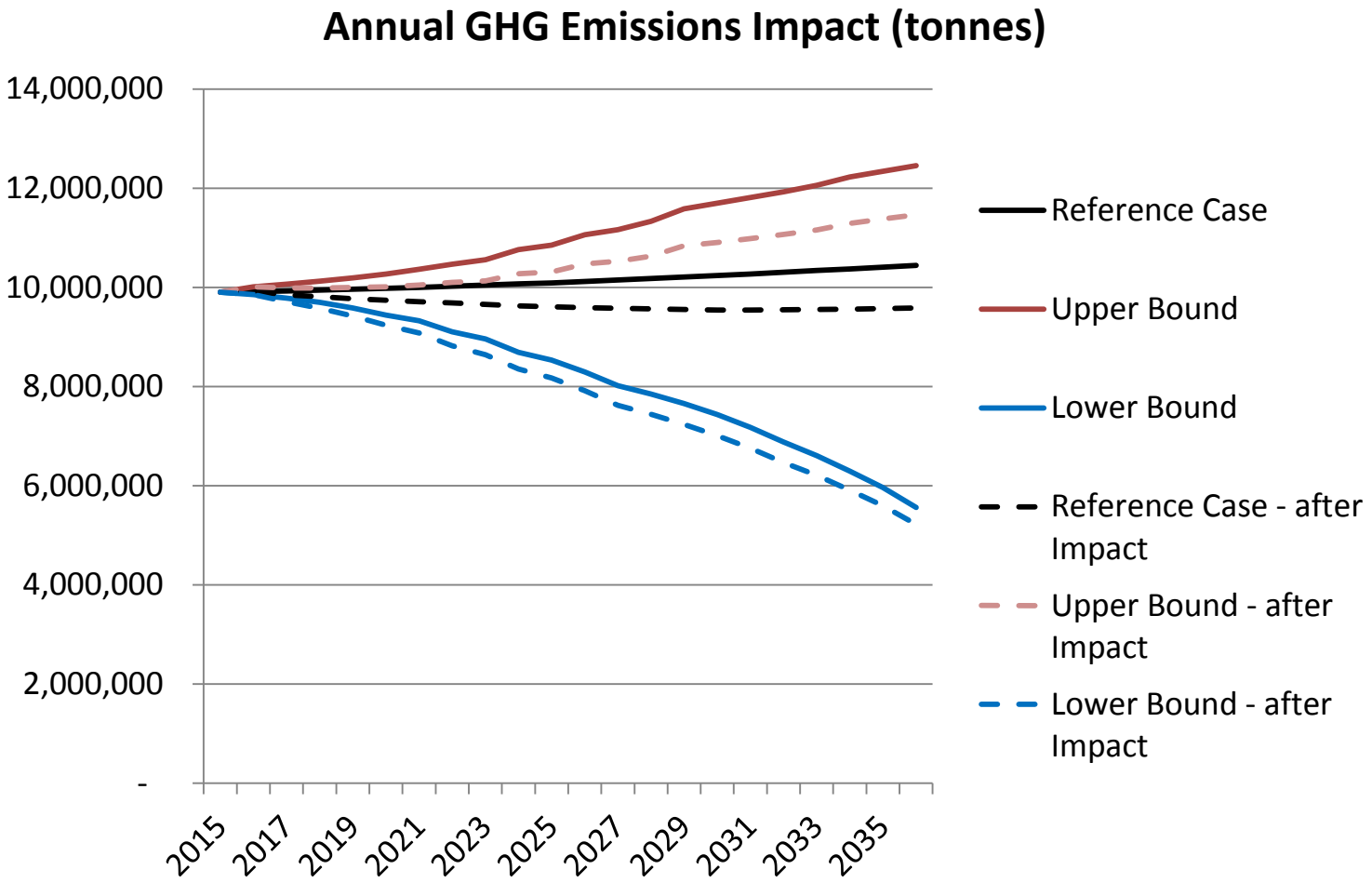


Emissions impact of Natural Gas for Transportation only

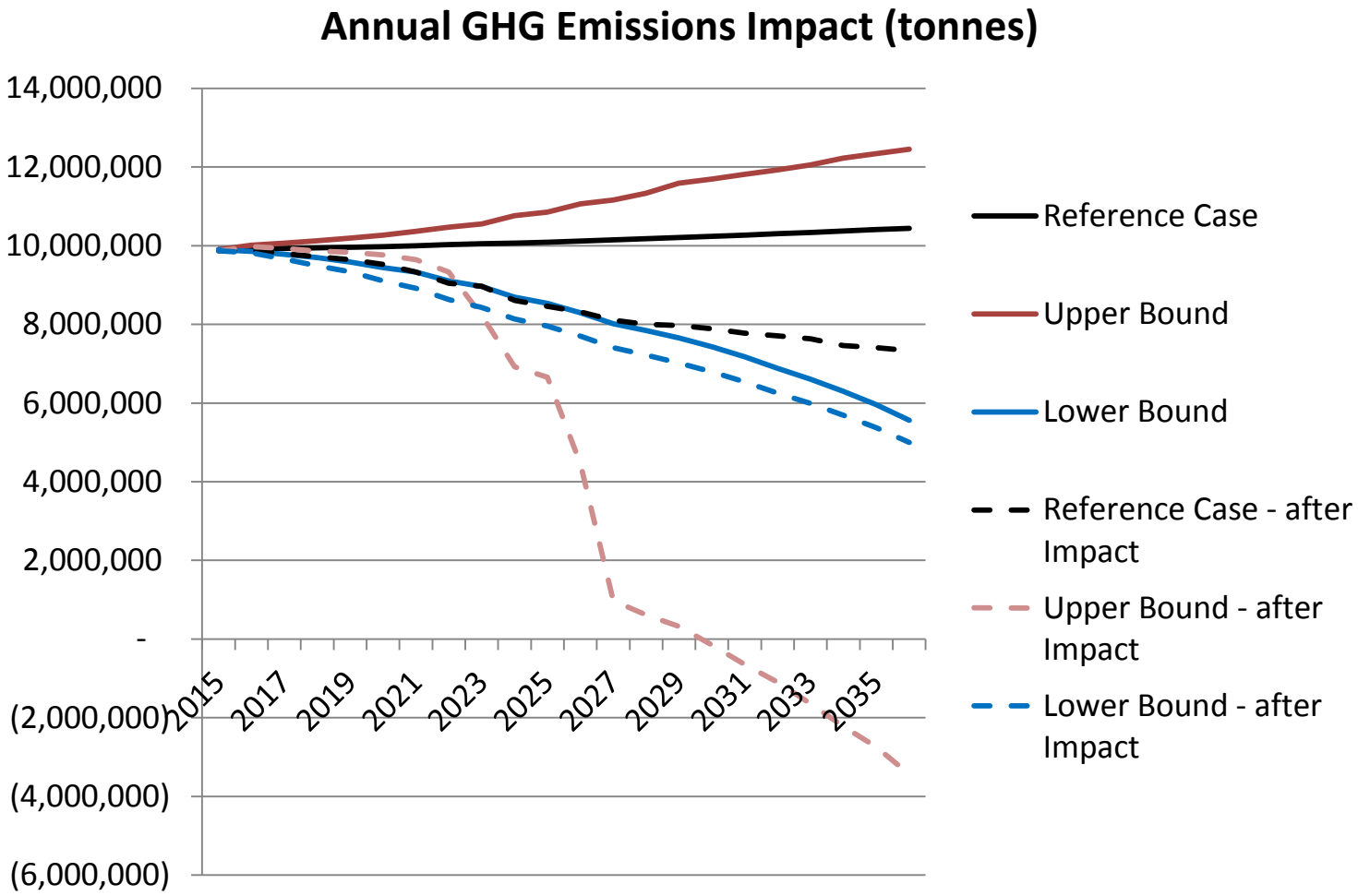


N.B.: This chart displays emissions reductions from FEI customers using natural gas; only a portion of projected Natural Gas for Transportation emissions reductions accrue to the current boundaries of the BC emissions inventory.

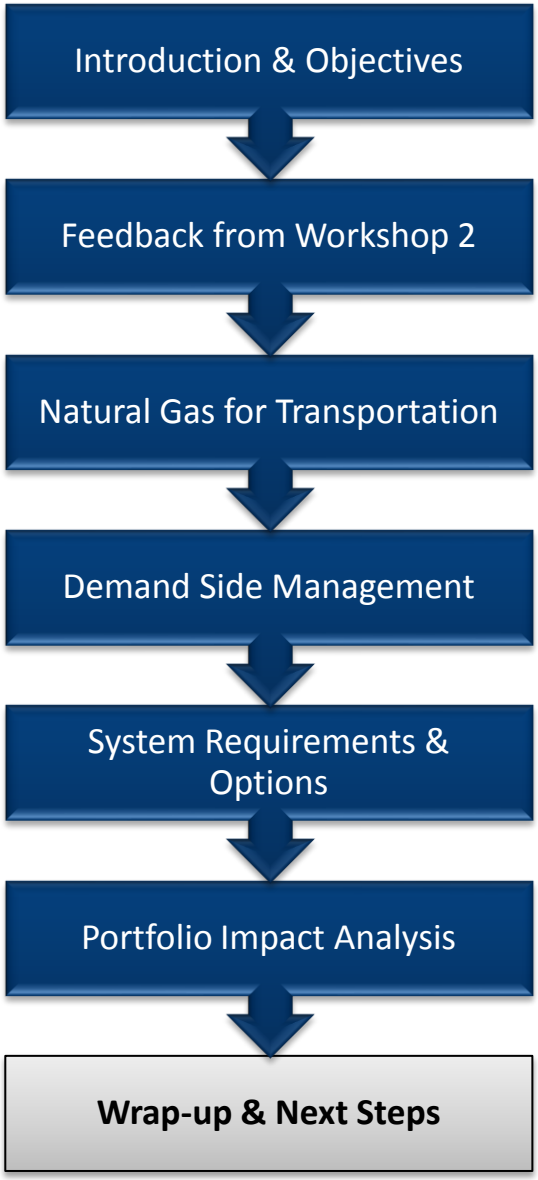
Cumulative emissions impact **without** Natural Gas for Transportation



Cumulative emissions impact **with** Natural Gas for Transportation



N.B.: This chart displays emissions reductions from FEI customers using natural gas; only a portion of projected Natural Gas for Transportation emissions reductions accrue to the current boundaries of the BC emissions inventory.



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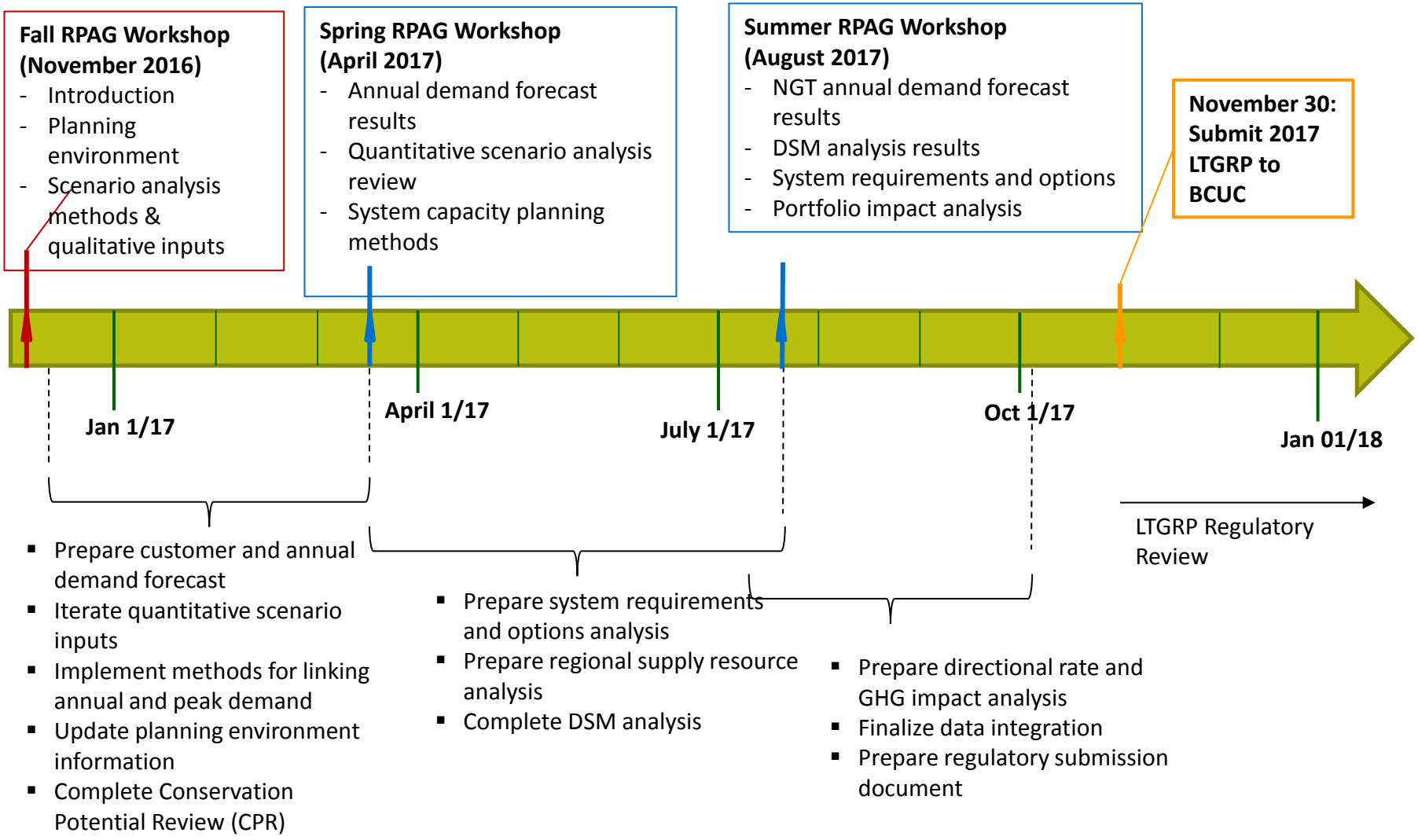
Next steps


Fall RPAG Workshop (November 2016)
- Introduction
- Planning environment
- Scenario analysis methods & qualitative inputs
Spring RPAG Workshop (April 2017)
- Annual demand forecast results
- Quantitative scenario analysis review
- System capacity planning methods
Summer RPAG Workshop (August 2017)
- NGT annual demand forecast results
- DSM analysis results
- System requirements and options
- Portfolio impact analysis
November 30: Submit 2017 LTGRP to BCUC
Jan 1/17
April 1/17
July 1/17
Oct 1/17
Jan 01/18
LTGRP Regulatory Review
Prepare customer and annual demand forecast
Iterate quantitative scenario inputs
Implement methods for linking annual and peak demand
Update planning environment information
Complete Conservation Potential Review (CPR)
Prepare system requirements and options analysis
Prepare regional supply resource analysis
Complete DSM analysis
Prepare directional rate and GHG impact analysis
Finalize data integration
Prepare regulatory submission document

The 2017 LTGRP

- Introduction
- Planning Environment
- Demand Forecasts
- Demand-side Management
- Gas Supply
- System Resource Needs
- Engagement and Feedback
- 20-Year Vision
- Action Plan

Thank you

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For further information, please contact:

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