FortisBC Resource Planning Advisory Group

Natural gas long term resource planning

November 30, 2016

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

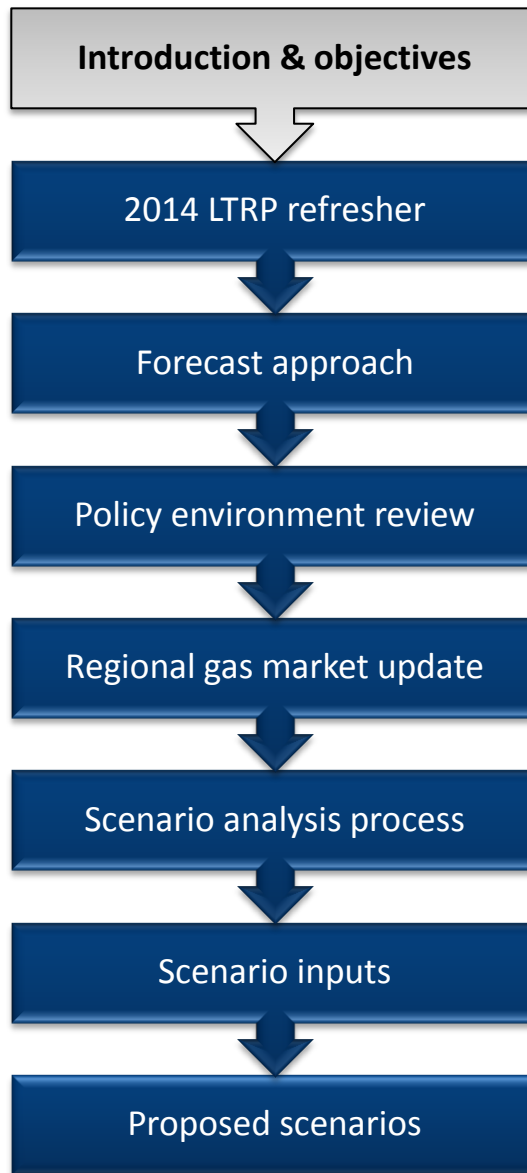- Top opportunity as it relates to energy planning

FortisBC Staff:

- Name

- Role as it relates to the LTGRP

Welcome Message

Dennis Swanson
Vice President of Energy Supply
FortisBC

Resource Planning Advisory Group (RPAG)

Terms of Reference:

- Provide advice and feedback

- Intended to represent a broad range of interests

- A forum for open and frank discussion

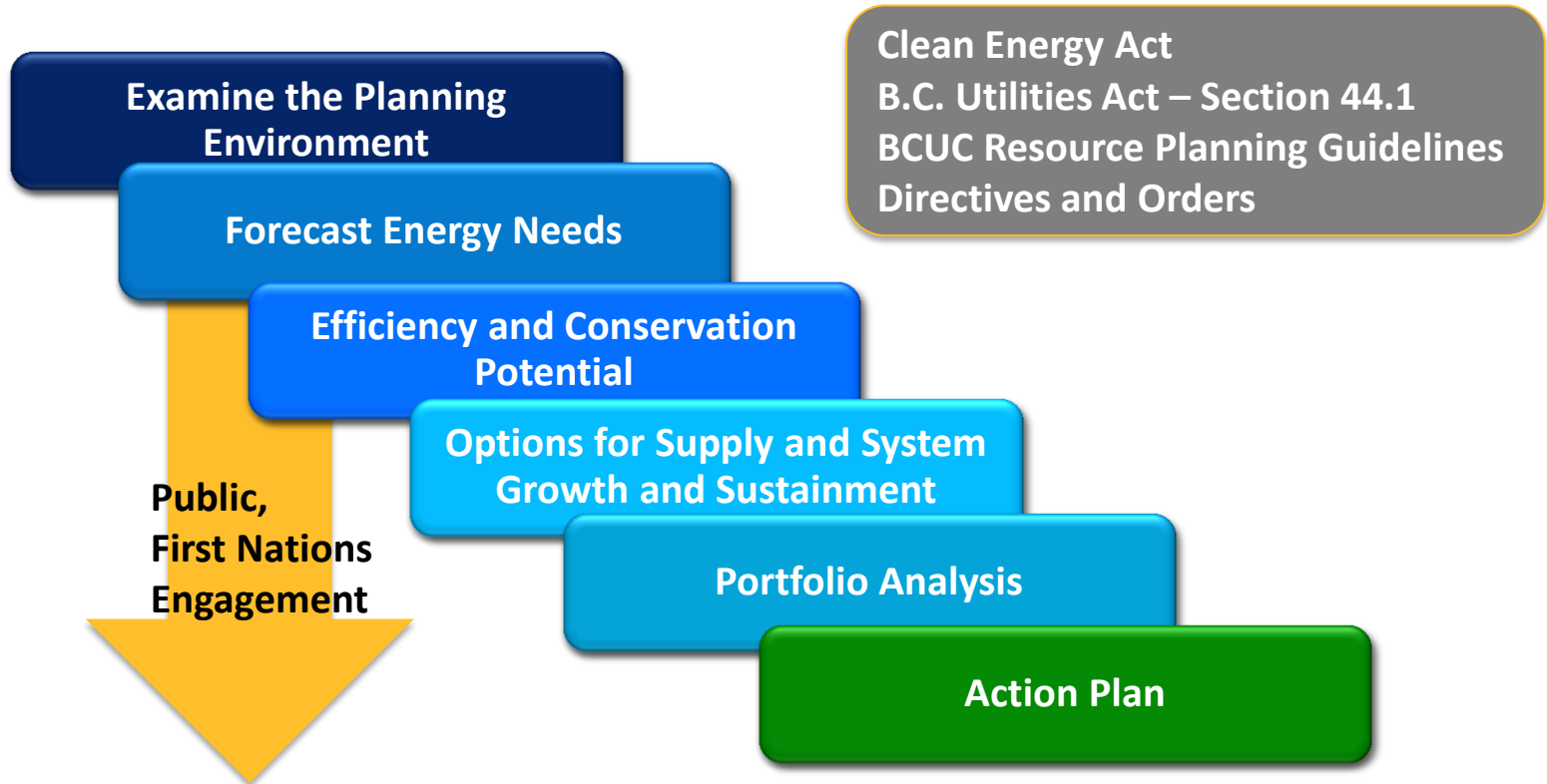- Provide unique perspectives and expertise

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

What we hope to achieve today

1. Provide background on resource planning, issues and outcomes from the 2014 Long Term Gas Resource Plan (LTGRP)

2. Explain our understanding of the planning environment and gather your feedback to ensure that our interpretations are comprehensive and reasonable

3. Explain our approach and qualitative work on the scenario analysis to gather your feedback on whether we are on track before we conduct our quantitative work over the winter

4. Orient you about next steps and gather information about suitable time periods for our second meeting

The Resource Planning Process

What resources must FortisBC have in place to supply customers' energy needs safely, reliably and cost-effectively over the next 20 years?
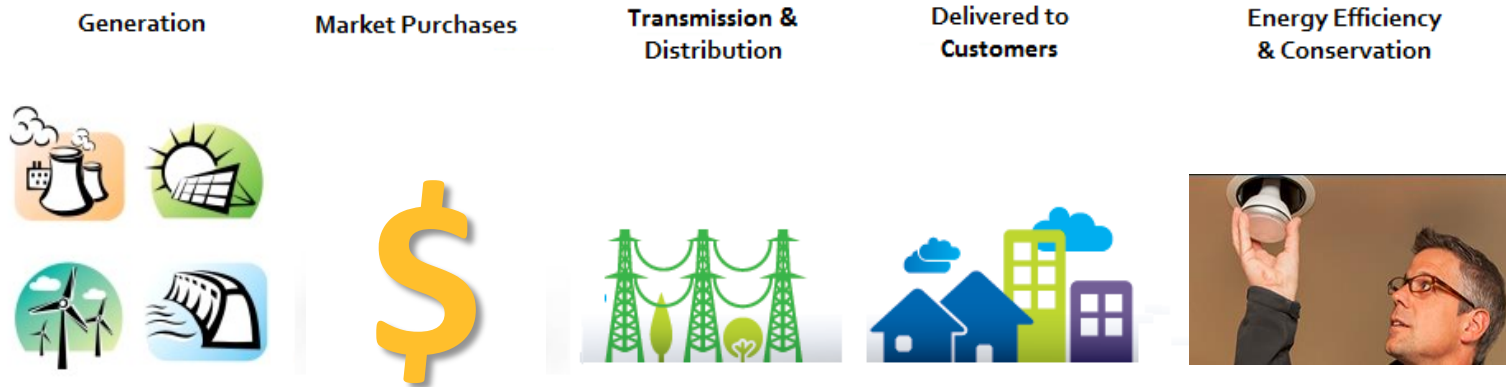
Examine the Planning Environment

Forecast Energy Needs

Efficiency and Conservation Potential

Options for Supply and System Growth and Sustainment

Portfolio Analysis

Action Plan

Public, First Nations Engagement

Clean Energy Act
B.C. Utilities Act – Section 44.1
BCUC Resource Planning Guidelines
Directives and Orders

Resource Planning Objectives

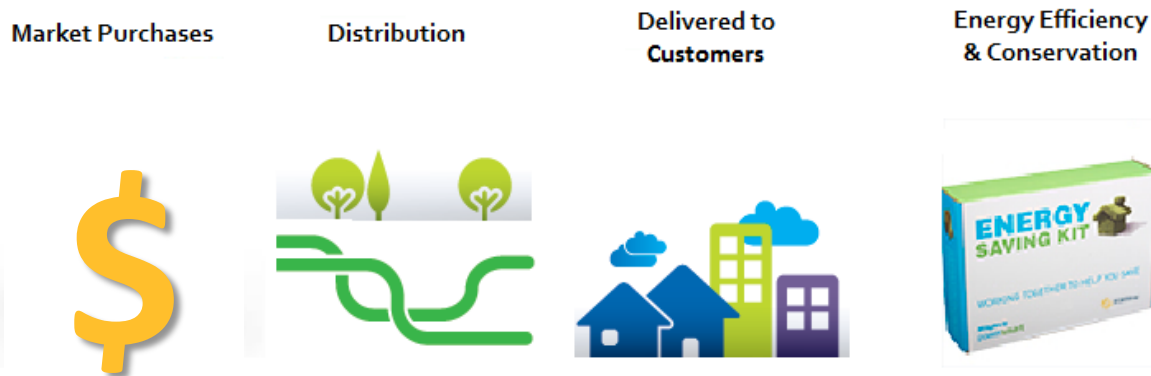**2017 Long Term Gas Resource Plan:**

- Ensure cost effective, secure and reliable energy for customers

- Provide cost-effective energy efficiency and conservation initiatives

- Ensure consistency with provincial energy objectives (e.g. applicable *Clean Energy Act* objectives, Climate Leadership Plan)

# Natural gas vs. electric resource planning

Electricity

Generation	Market Purchases	Transmission & Distribution	Delivered to Customers	Energy Efficiency & Conservation

Natural Gas

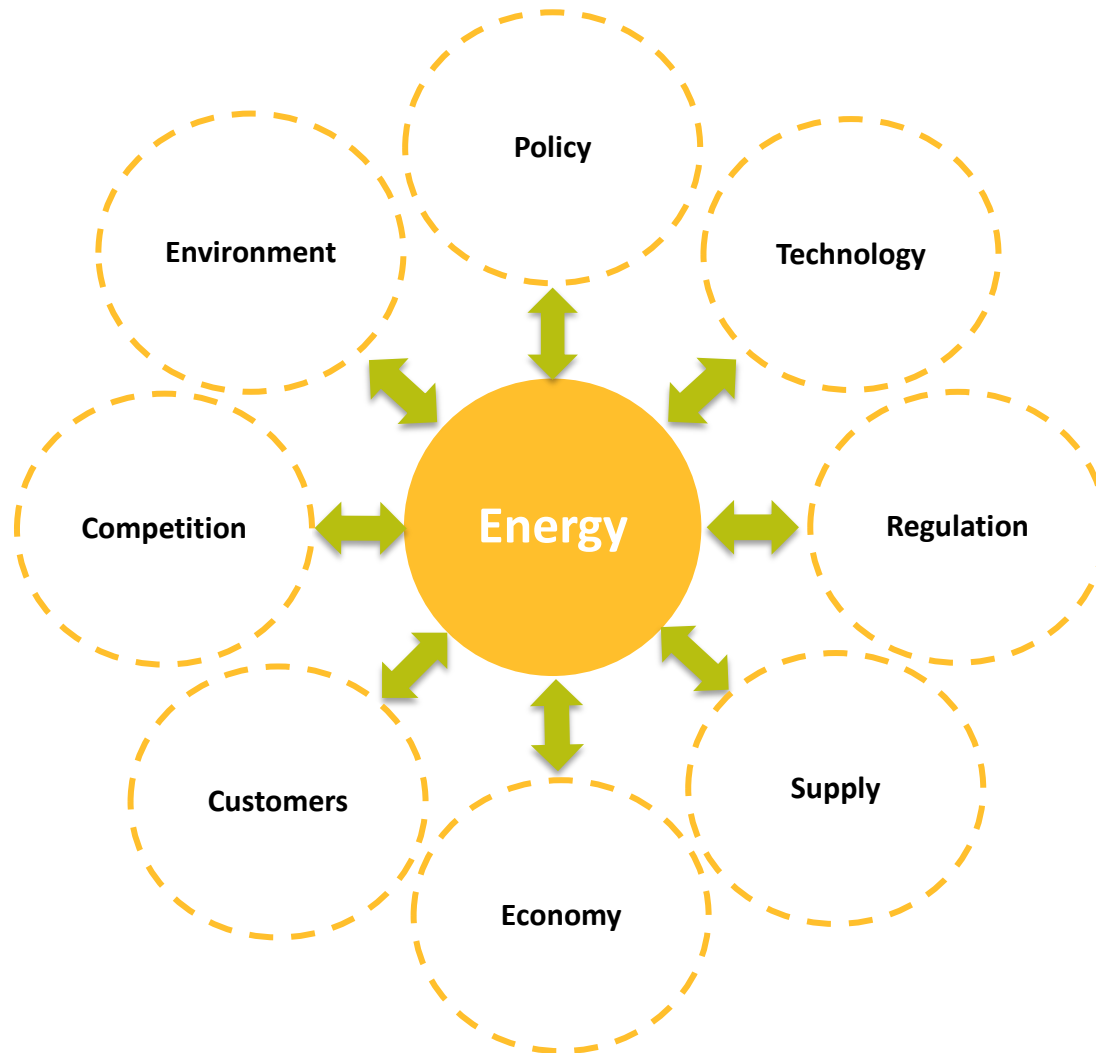|	Market Purchases	Distribution	Delivered to Customers	Energy Efficiency & Conservation

FortisBC: delivering natural gas, electricity and piped propane
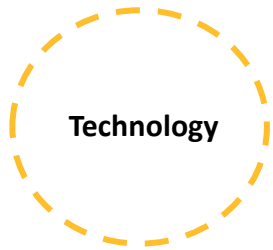
Major transmission pipelines in BC
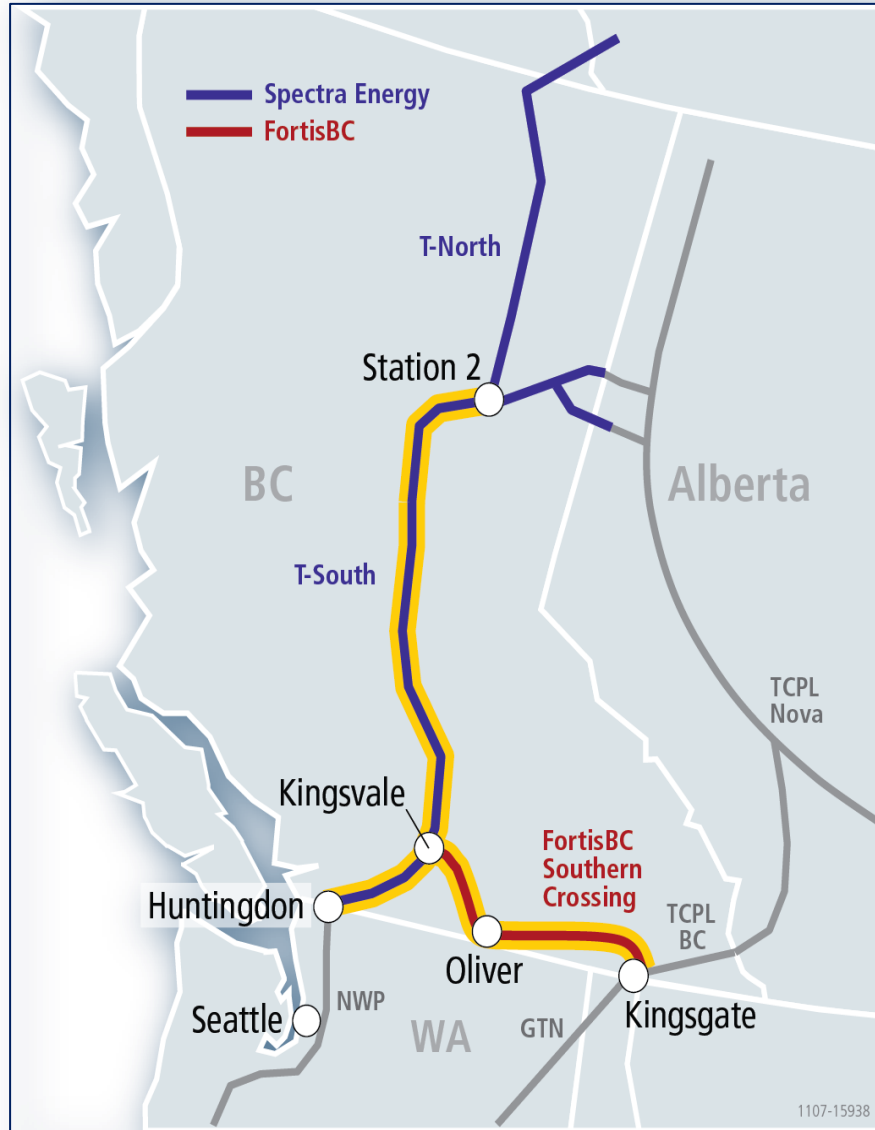
Planning environment: the factors that influence the analysis

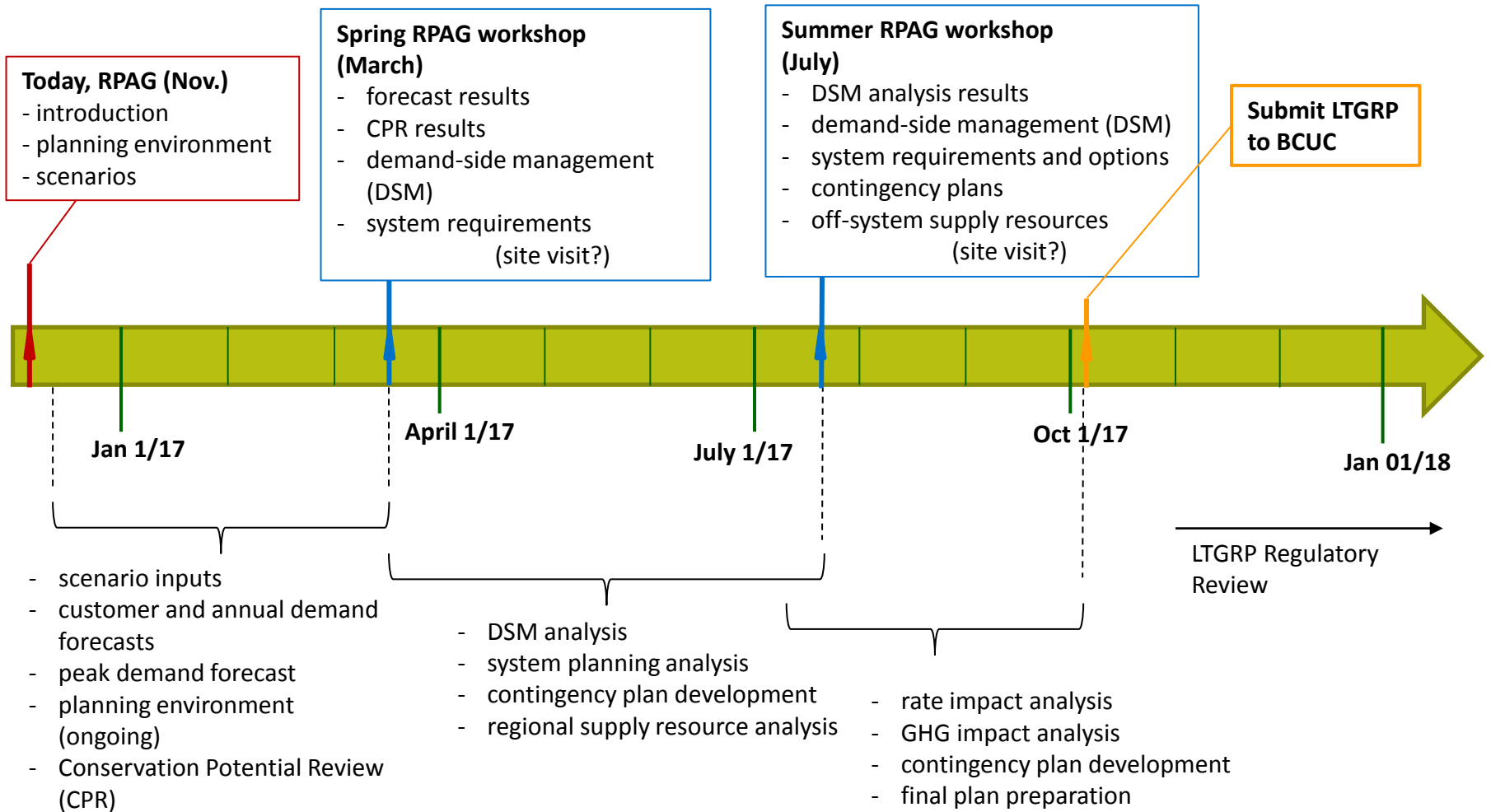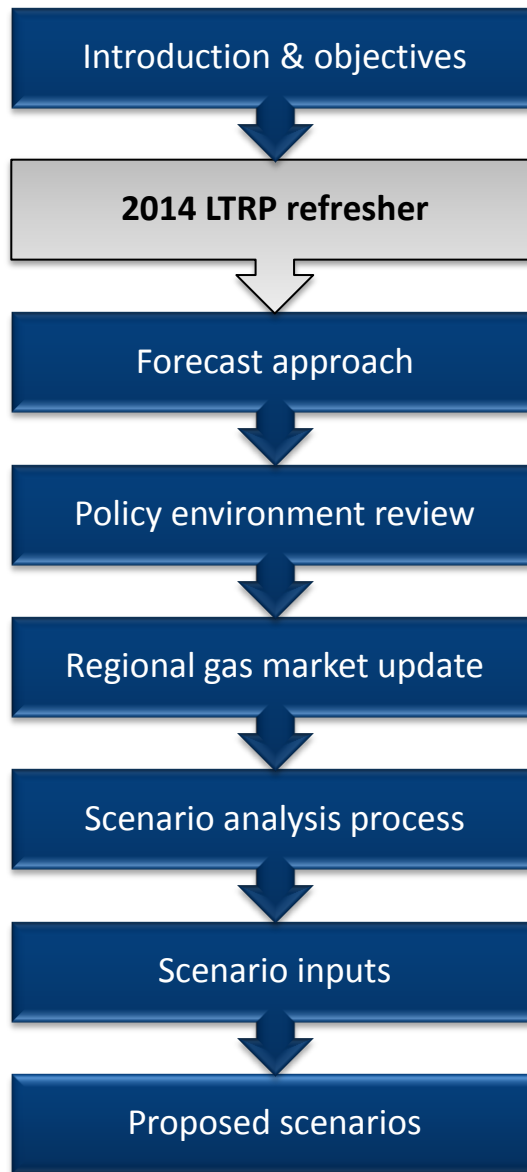# Examples of uncertainty across the planning horizon

Technology

New end-use technologies

Policy

Shifting policy environment

Customers

Customers interacting differently with the energy grid

2017 LTGRP Timeline

Today, RPAG (Nov.)
- introduction
- planning environment
- scenarios

Spring RPAG workshop (March)
- forecast results
- CPR results
- demand-side management (DSM)
- system requirements
  (site visit?)

Summer RPAG workshop (July)
- DSM analysis results
- demand-side management (DSM)
- system requirements and options
- contingency plans
- off-system supply resources
  (site visit?)

Submit LTGRP to BCUC

Jan 1/17

April 1/17

July 1/17

Oct 1/17

Jan 01/18

LTGRP Regulatory Review

- scenario inputs
- customer and annual demand forecasts
- peak demand forecast
- planning environment (ongoing)
- Conservation Potential Review (CPR)

- DSM analysis
- system planning analysis
- contingency plan development
- regional supply resource analysis

- rate impact analysis
- GHG impact analysis
- contingency plan development
- final plan preparation

Brief recap – highlights from the 2014 Long Term Resource Plan (LTRP)

Annual Demand Forecast

Traditional/End-Use	Industrial Load	Rate Impacts

System Capacity Planning

Coastal System	Interior System

Action Plan

Monitor Environment	NGT & DSM	Tilbury LNG
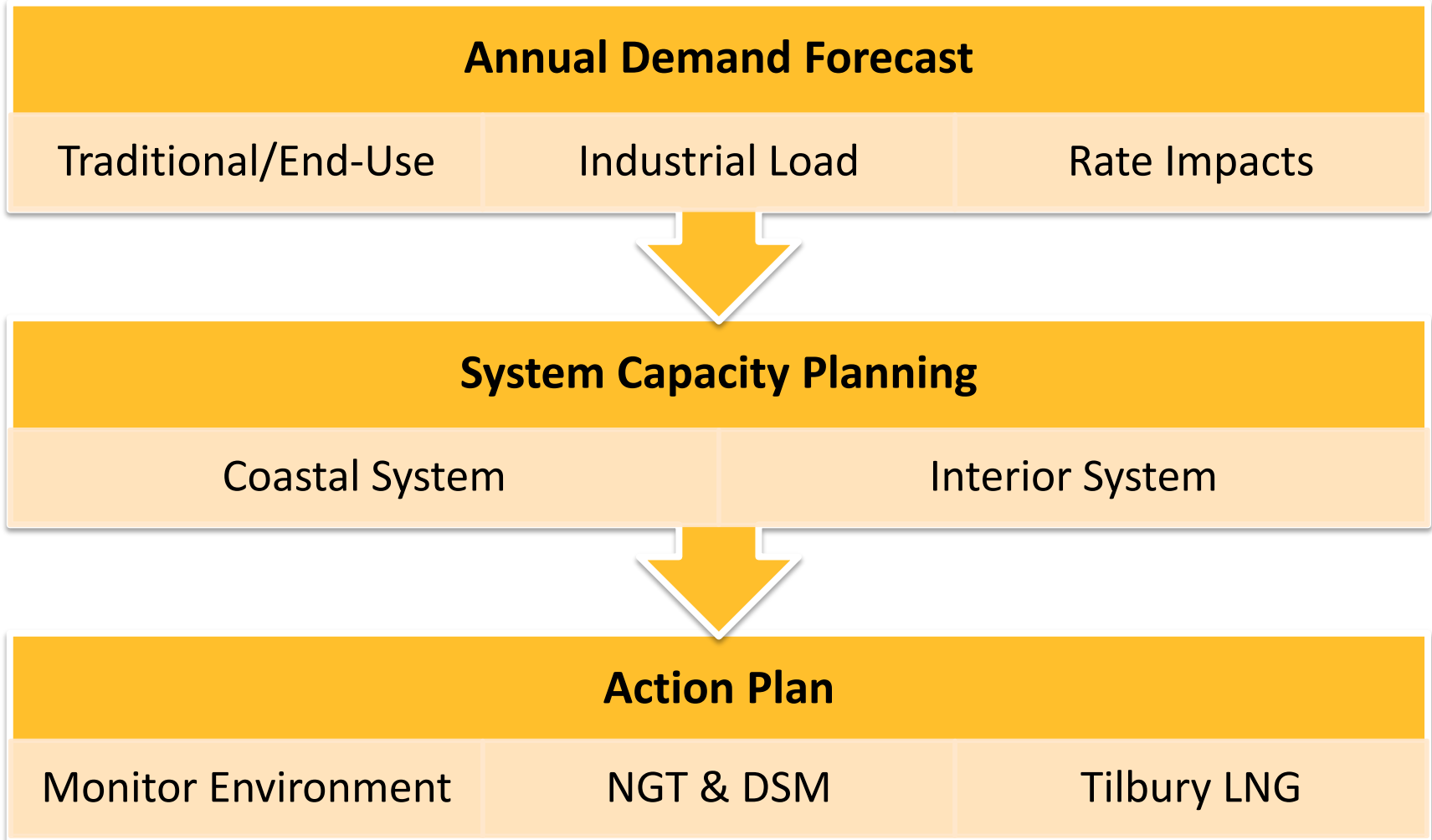
Improvements for the 2017 LTGRP – forecast approach, methods and tools

Forecast Methods
- Traditional Method
- End-Use Review

Model Complexity
- Architecture
- Output Features

Scenario Analysis
- Customer Additions
- Industrial demand

DSM Analysis
- Funding Scenarios
- Results Granularity

Improvements for 2017 LTGRP – additional elements
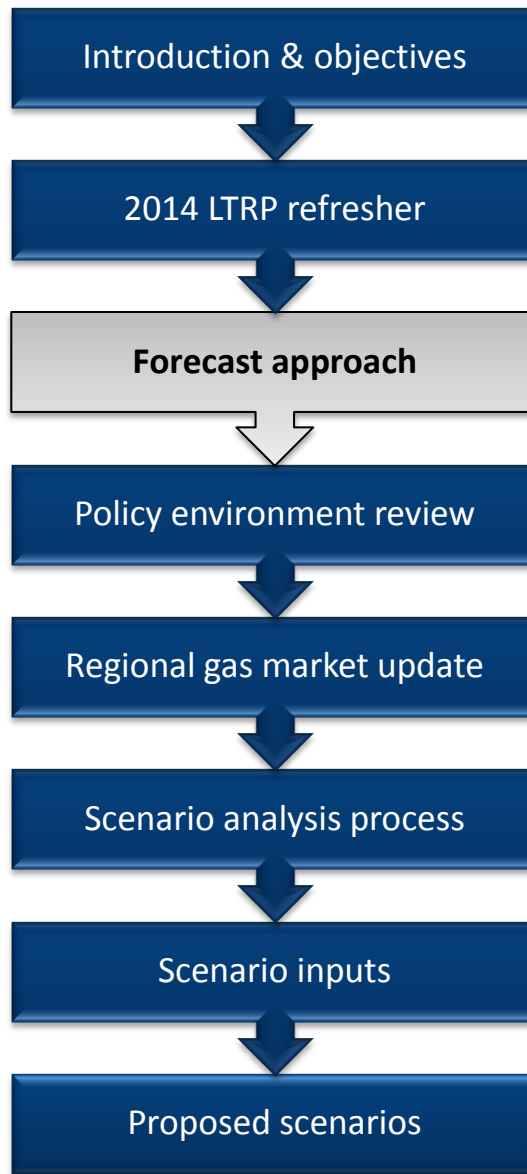
System Resource Needs

- Link to Annual Demand (Contingencies)
- Terminology
- Link to Upgrade Plans

System Sustainment Analysis

- Interior Transmission System

Energy Supply Analysis
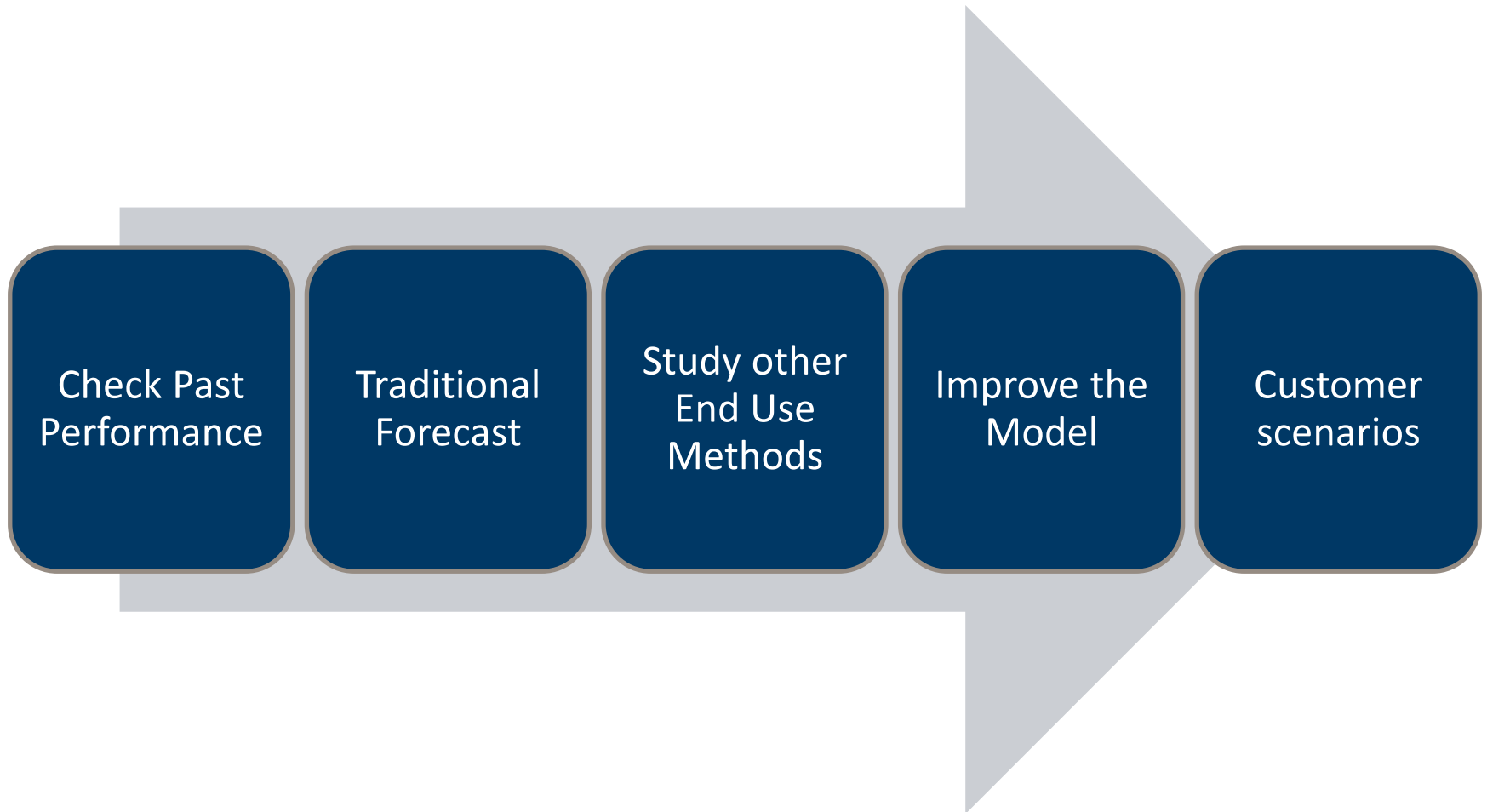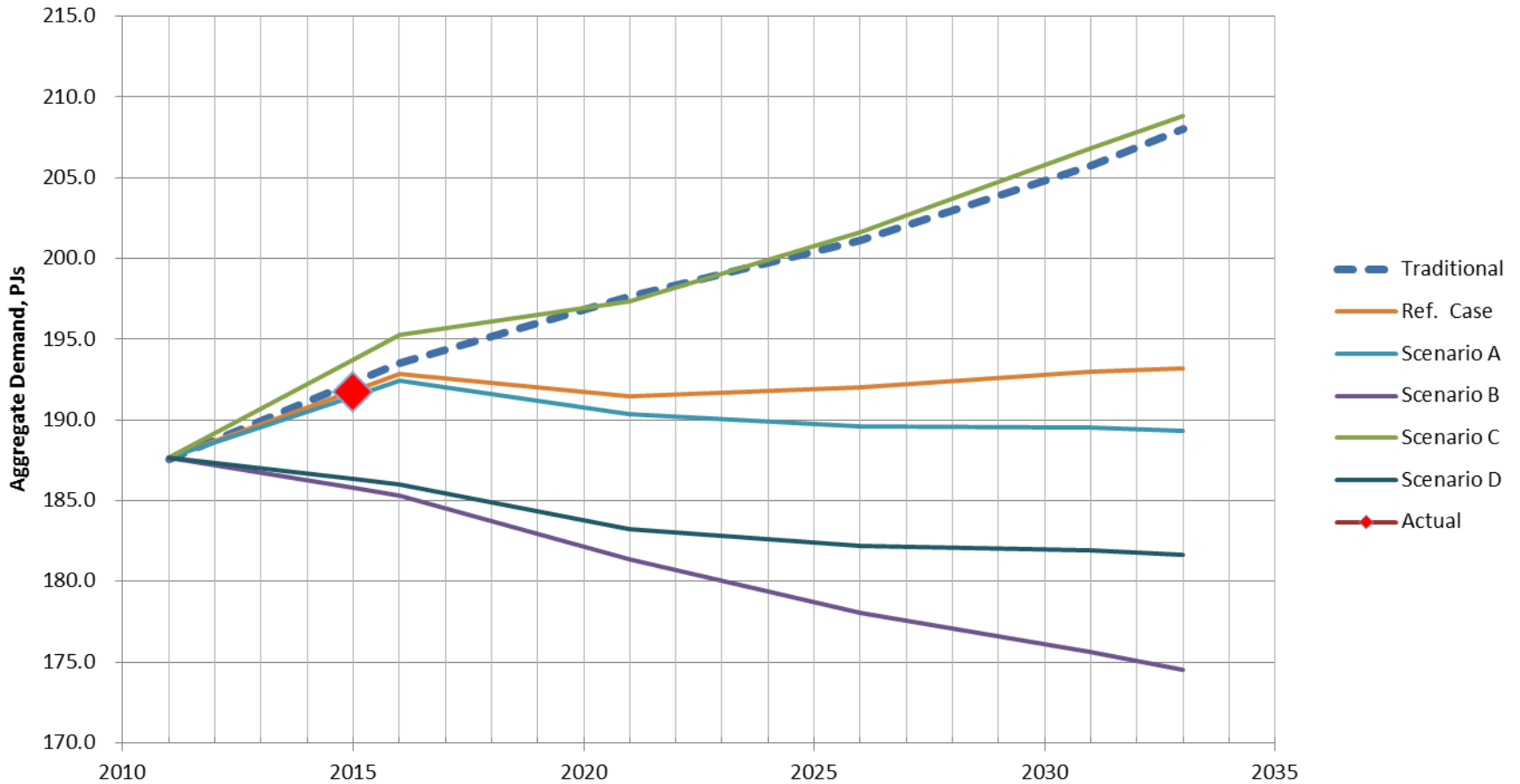
- Price Risk Management Guiding Principles

Forecasting Approach

Check Past Performance → **Traditional Forecast** → **Study other End Use Methods** → **Improve the Model** → **Customer scenarios**

Check Past Performance

2014 LTRP vs Actual

Traditional Forecast

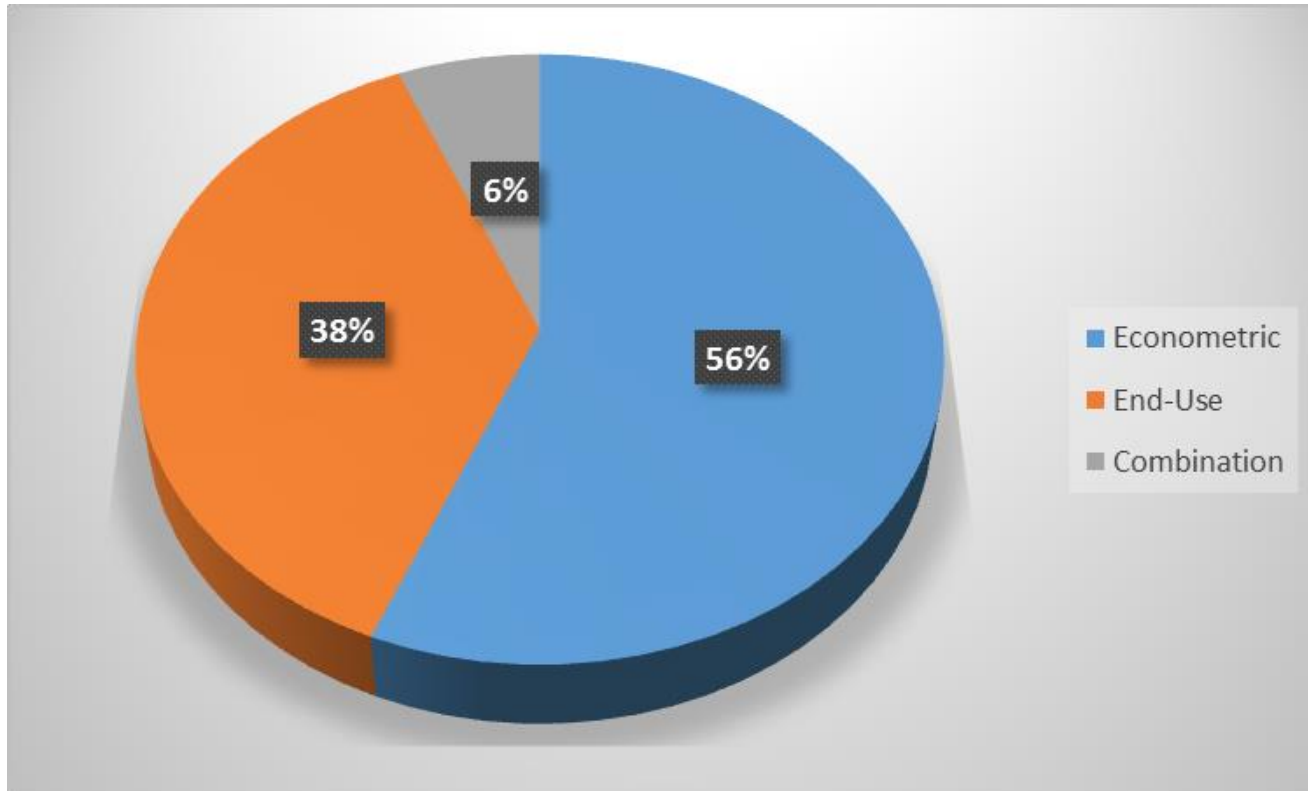| What?	• The **2017 PBR Update** forecast (5 years) • Extend the trends an additional 15 years
Why?	• Check the **End Use Model** results
Is it valid?	• Short Term forecast error < 2%

Other End Use Forecasts

- FEI contracted a survey of the methods used by other utilities

- Once complete, the full report will be included in the filing

Pie chart showing: Econometric 56%, End-Use 38%, Combination 6%

Planned End Use Model Improvements

- More accessible

- Supports fine tuning scenarios

- Improved Peak Forecast

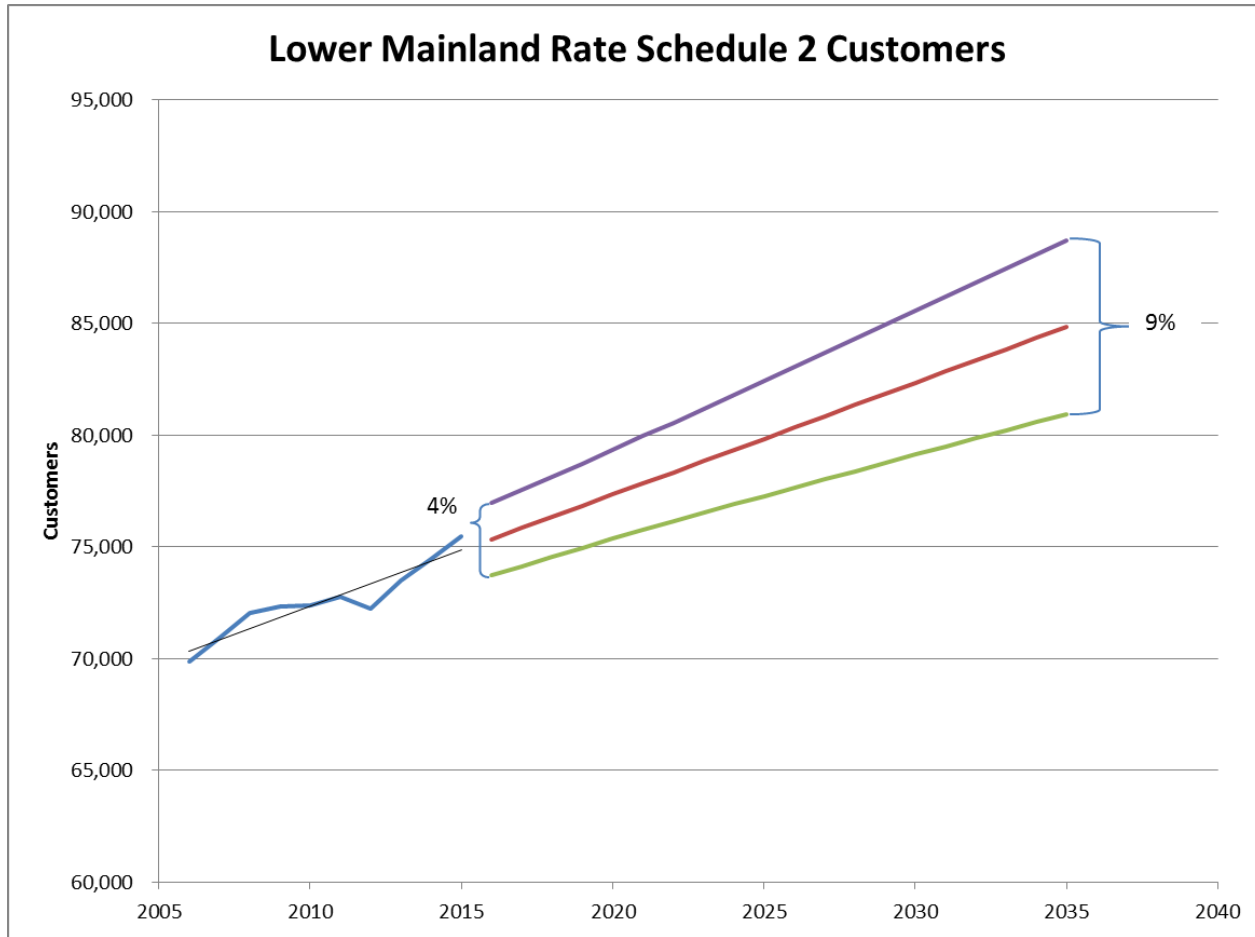- Work is starting now…

- Slider-style model?
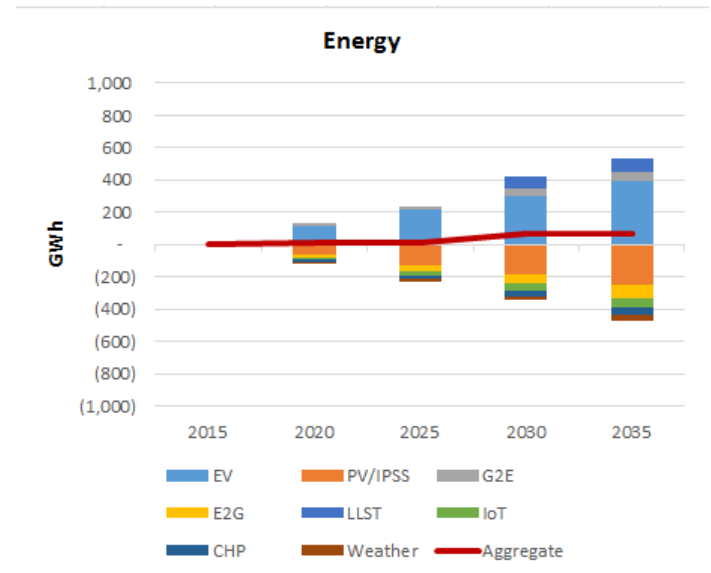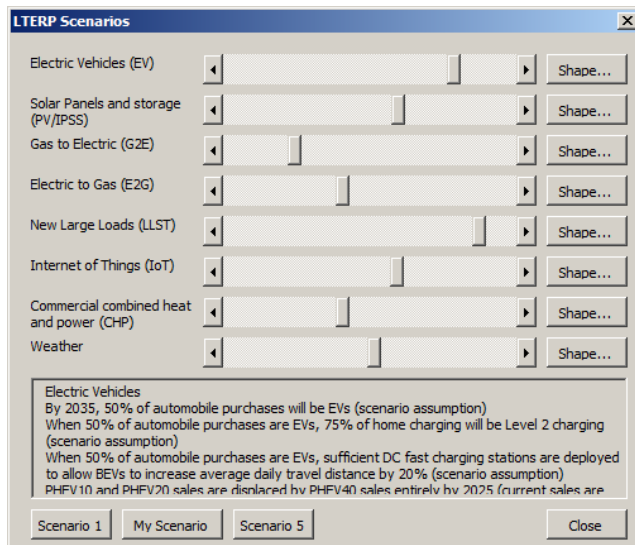
Demonstrate the End Use Model

Once the **End Use Model** software update is complete we will:
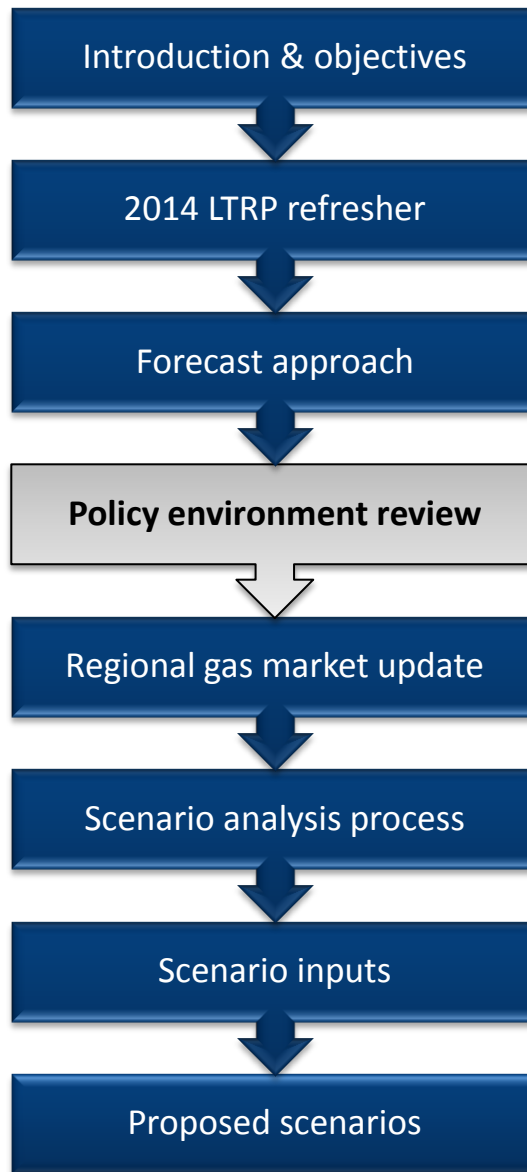
- Do a <u>mini model</u> walk through at a future RPAG meeting

- Verify the results are as expected

- Demonstrate scenarios

Population Growth Outcomes

Lower Mainland Rate Schedule 2 Customers

Start with our 20 year account forecast

Prediction Intervals will be used

# B.C.'s Energy & Climate Policy Environment

Agenda

- Why Does it Matter?

- B.C. Climate Action Priorities

- 2016 Climate Leadership Plan

- Federal Energy & Climate Action

- Municipal Initiatives

- Summary: Planning Impacts

Why Does it Matter?

- Planning impacts

- Context for scenarios
  - Key uncertainties drive scenario development

- **We need your feedback**
  - Are we missing anything?

  - Are we misinterpreting anything?

  - Evolution of the policy environment

B.C. Climate Action Priorities
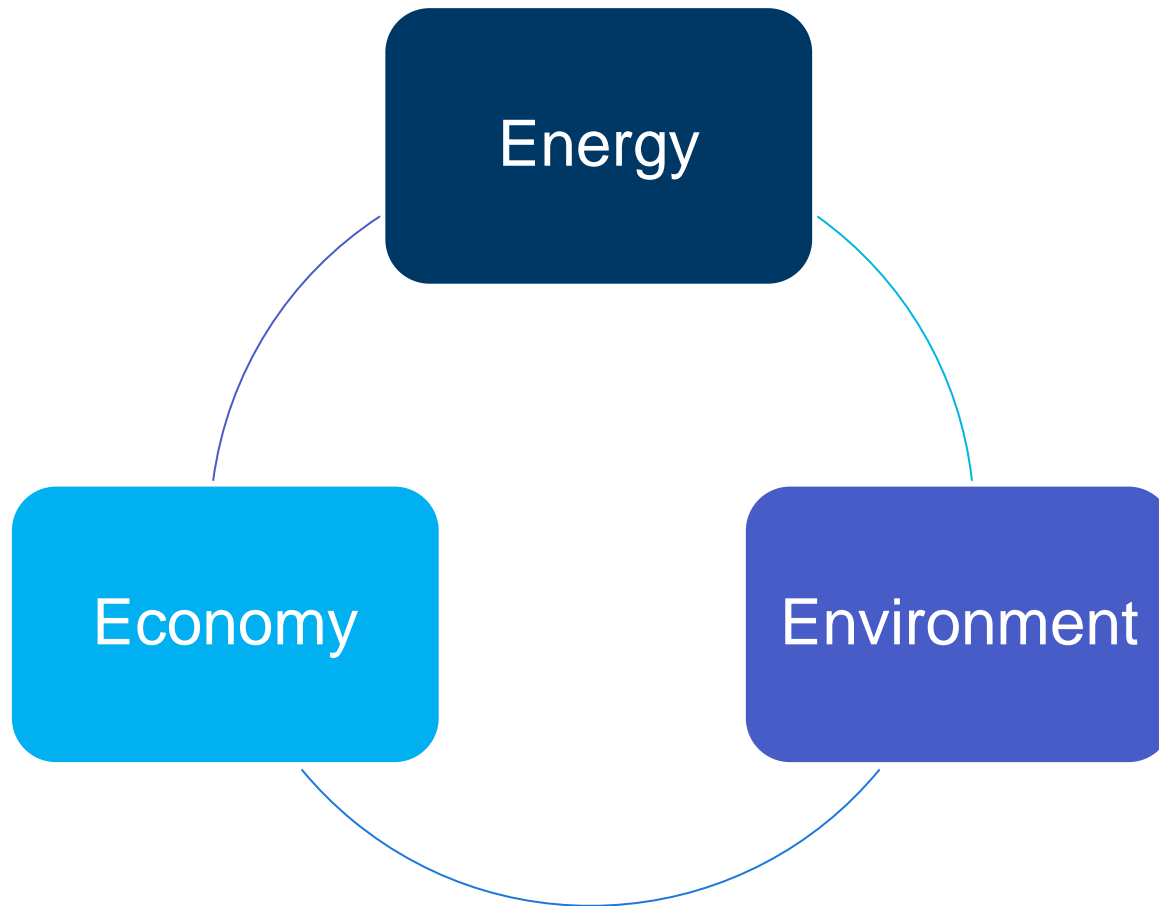
B.C. GHG Emissions Landscape: Global Context

Canada (excluding B.C.) 1.45%
B.C. 0.14%

U.S.A. 14%

Rest of the world 60%

China 25%
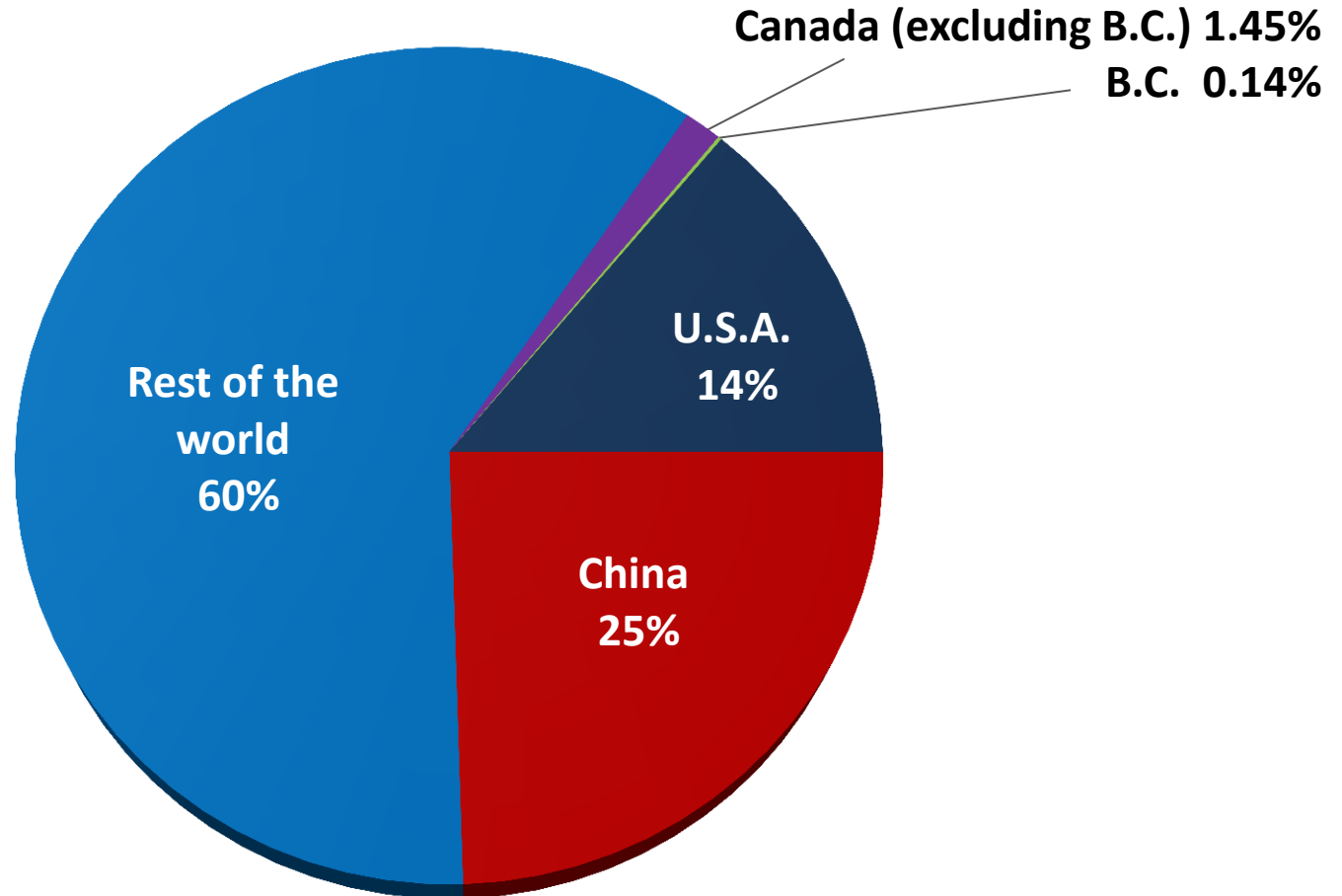
Source: Environment & Climate Change Canada (2014) and City of Vancouver Greenest City 2020 Action Plan (2014)

B.C. GHG Emissions Landscape: Provincial Context

Afforestation & Deforestation 5%

Agriculture 4%

Industrial Processes & Products Use 5%

Fugitive Sources (Energy) 8%

Waste 9%

Transport (Energy) 38%

Stationary Combustion (Energy) 31%
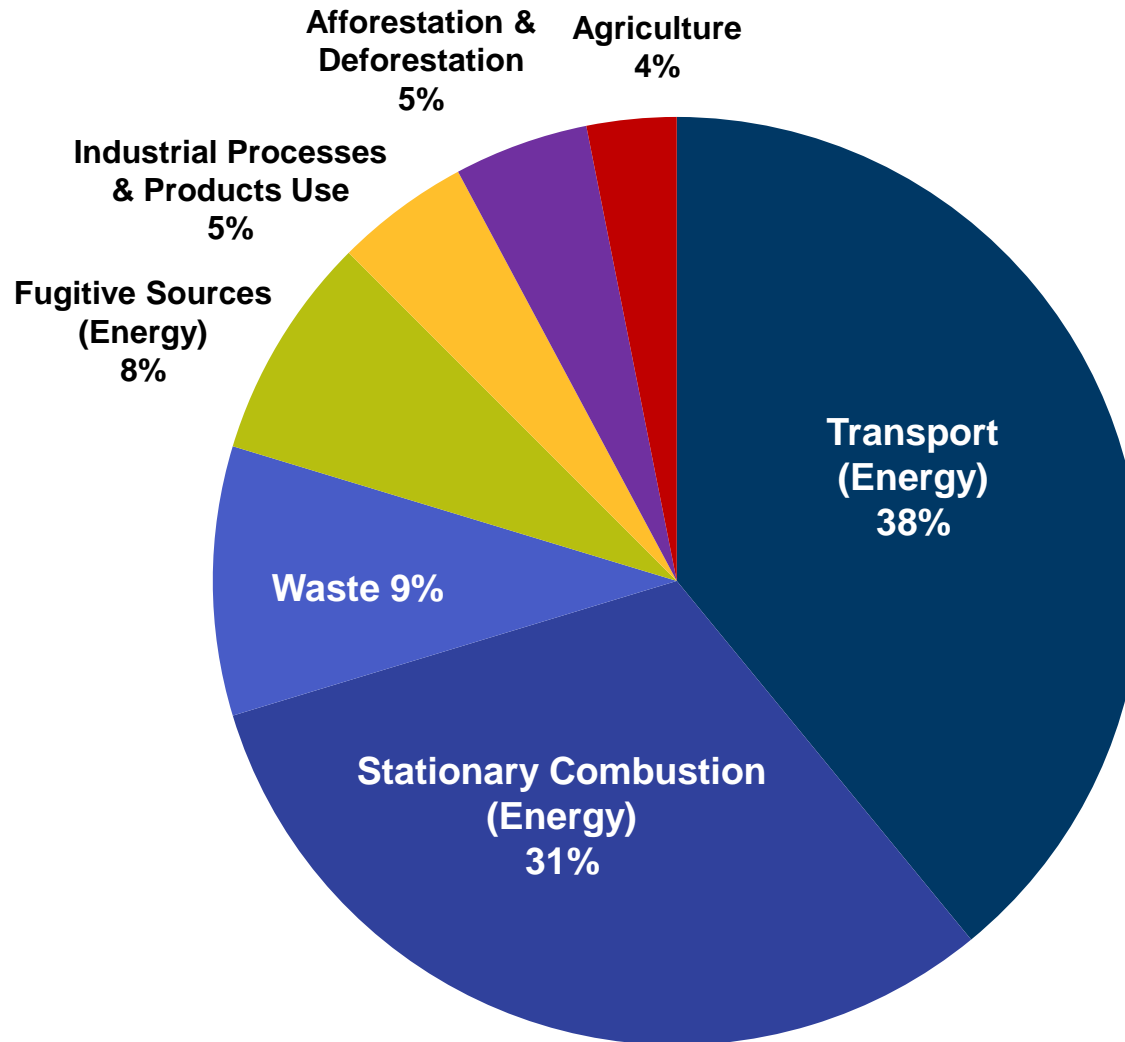
2016 Climate Leadership Plan

Natural Gas

Transportation

- Low Carbon Fuel Standard
- Incentives for RNG, EVs, hydrogen vehicles
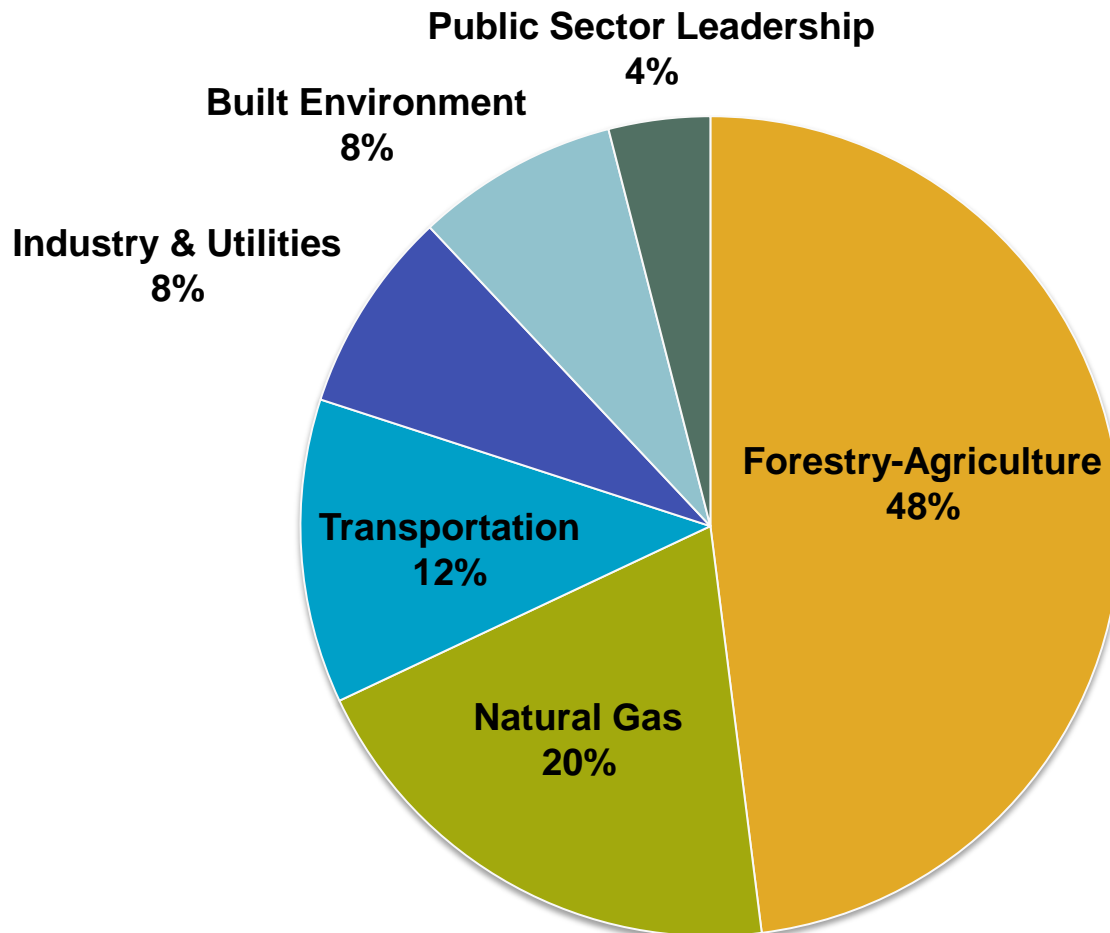- Charging stations for zero emission vehicles

Industry & Utilities

- 100% clean or renewable electricity
- Efficient electrification
- LNG bunkering
- New efficiency standards for gas-fired boilers
- Expanding incentives for efficient gas equipment

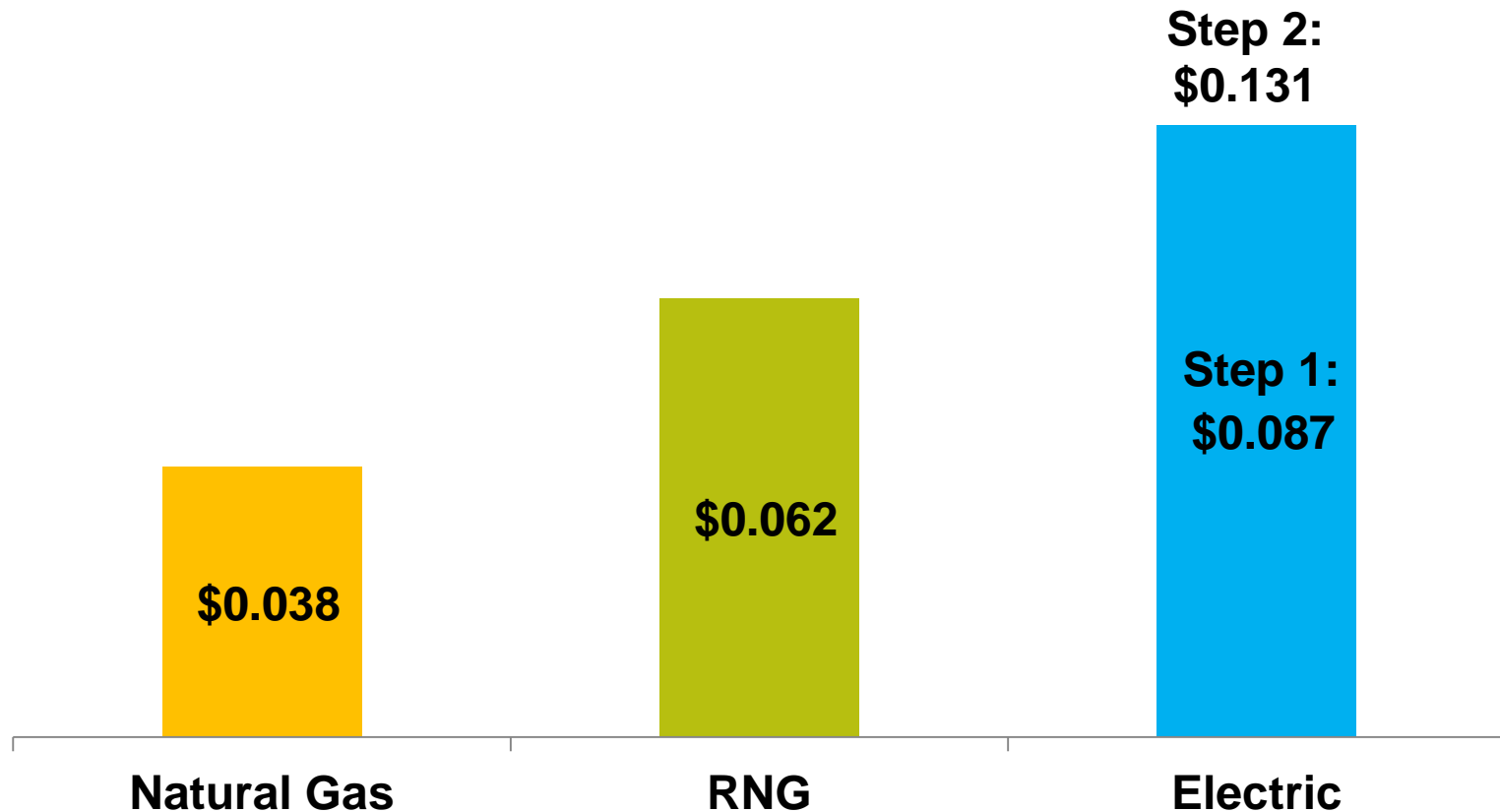## Built Environment

- Net zero-ready buildings
- Waste-to-resource strategy

2016 Climate Leadership Plan: GHG Emissions Reductions by Sector, 2050

B.C. Energy Landscape: Affordable Residential Choices

Bar chart showing residential rates:
- **Natural Gas**: $0.038
- **RNG**: $0.062
- **Electric**: Step 1: $0.087, Step 2: $0.131

*$/kWh residential rates. Electric rate excludes basic charge

B.C. Energy Landscape: Low Consumption of New Residential Customers

Lower Mainland

Legend:
- FEI Residential Customer Base, 2011
- FEI Residential Customers, 2011-2014

~45 GJ **~85 GJ**   **GJ/Year**
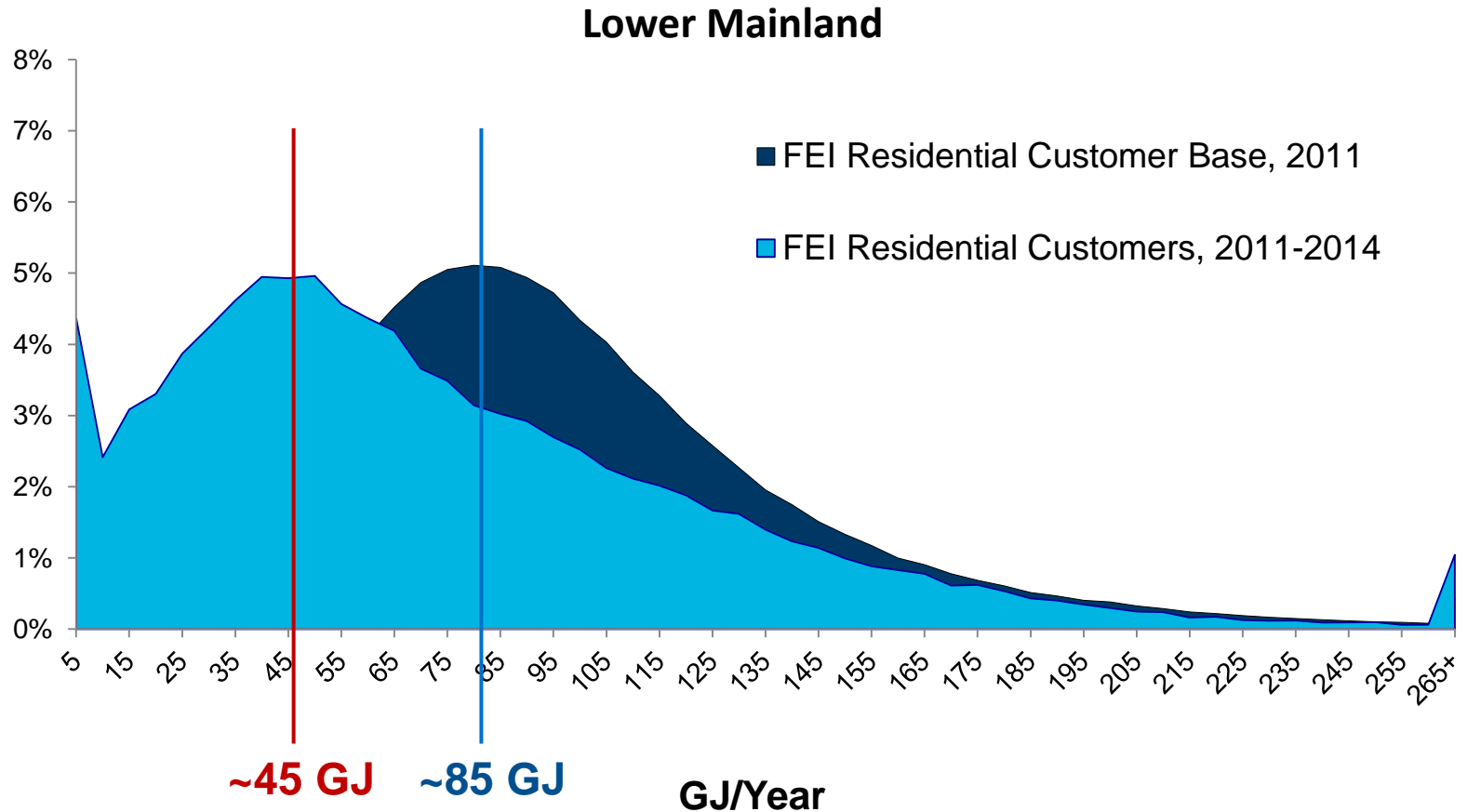
Federal Energy & Climate Action

- ## Three Amigos North American **clean energy target**
  - 50% clean power generation by 2035

- ## Ratified the **Paris Accord**
  - Canada's target 30% below 2005 levels by 2030

- ## Signaled a federal **carbon price**
  - $10/tCO$_2$e in 2018
  - Rising $10/year to $50/tCO$_2$e in 2022

- ## Mid-Century Strategy
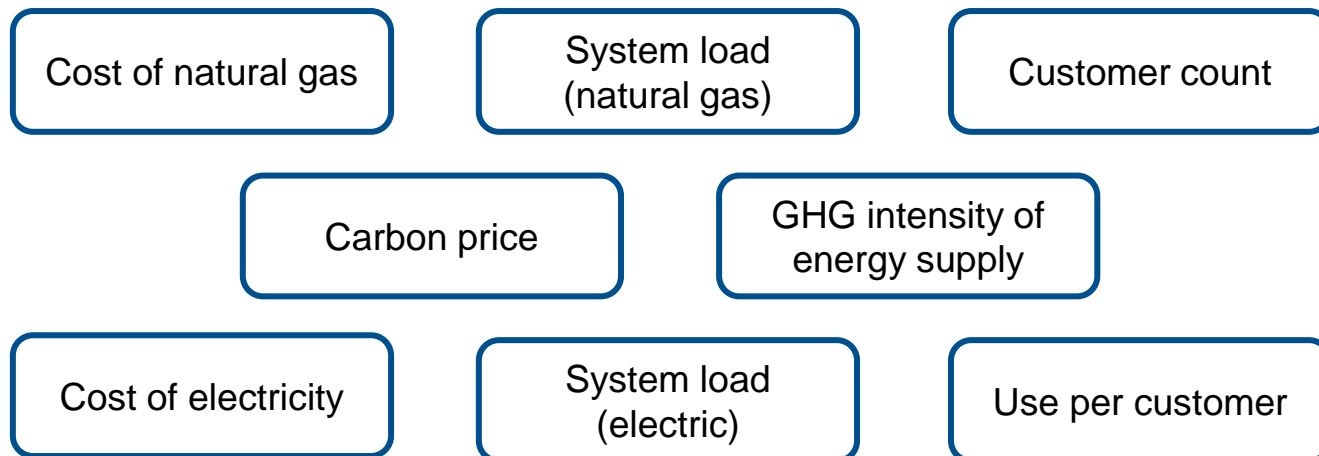 - Vision for **deep decarbonisation**

Municipal Initiatives

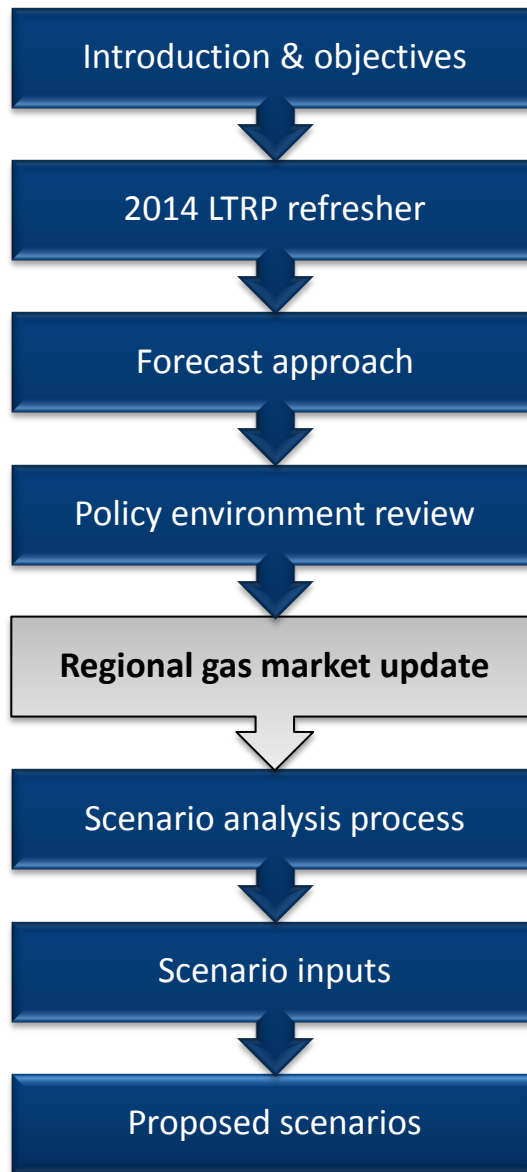- **Climate Action Charter**
  - Set GHG reduction targets and create more efficient communities
  - Carbon neutral government operations

- Community **Energy & Emissions Plans** (CEEPs)
  - Energy efficiency
  - Behavioural change
  - District energy & renewable energy
  - Fleet conversions to CNG and LNG

- **Energy Step Code**
  - Opt-in, high-performing buildings
  - Transition to net-zero buildings

Summary: Planning Impacts

- Foundation for scenario development

  - E.g. GGRR driving demand for natural gas & RNG in transport sector

- Planning impacts

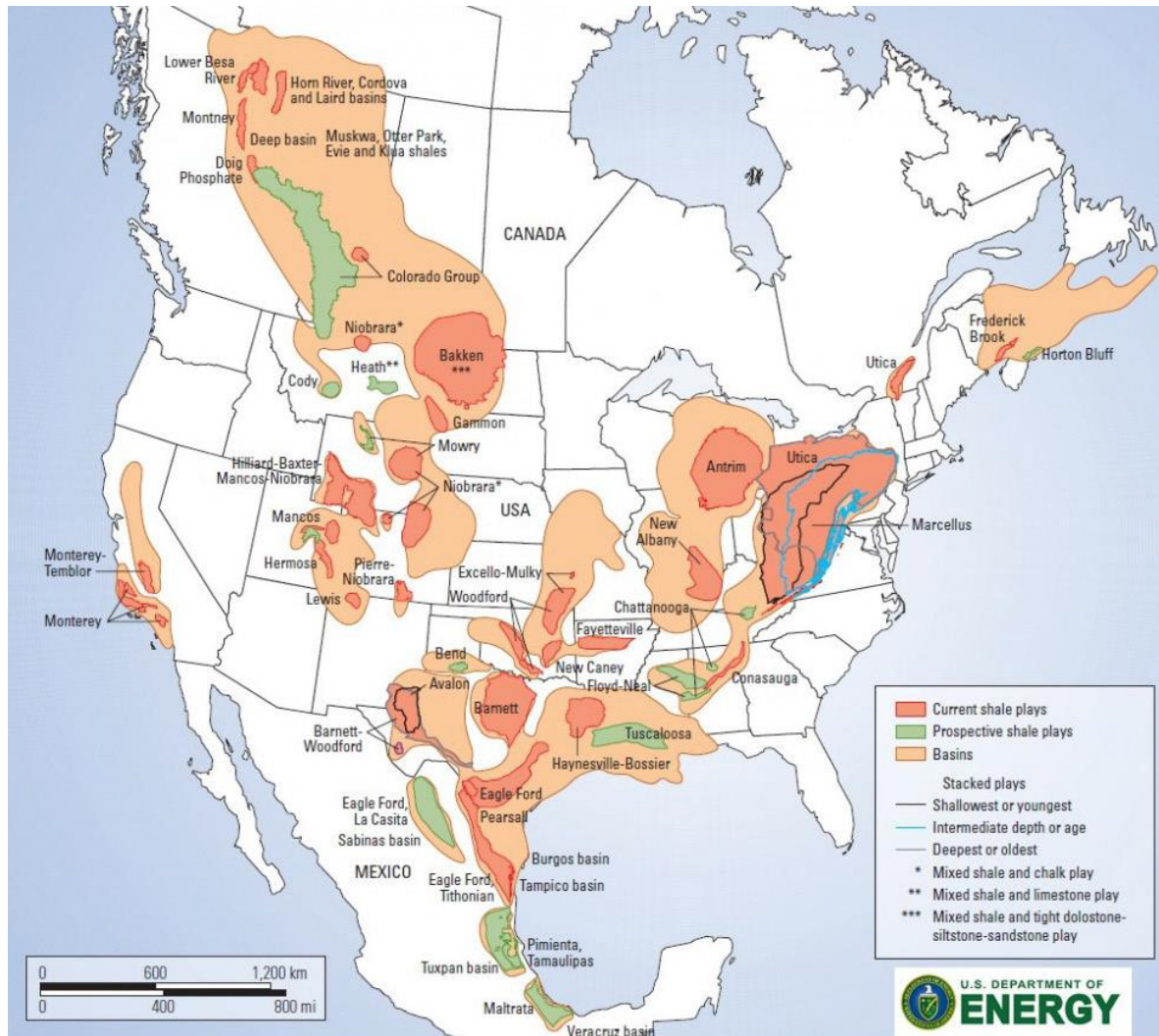| Cost of natural gas	System load (natural gas)	Customer count
	Carbon price	GHG intensity of energy supply	
Cost of electricity	System load (electric)	Use per customer

Shale Production remains resilient

Shale gas production has remained resilient in the current low price environment for natural gas. Producers have reduced costs and increased well efficiency.

Forecasted US Gas Supply Growth

US Production by Type

Source: Wood Mackenzie
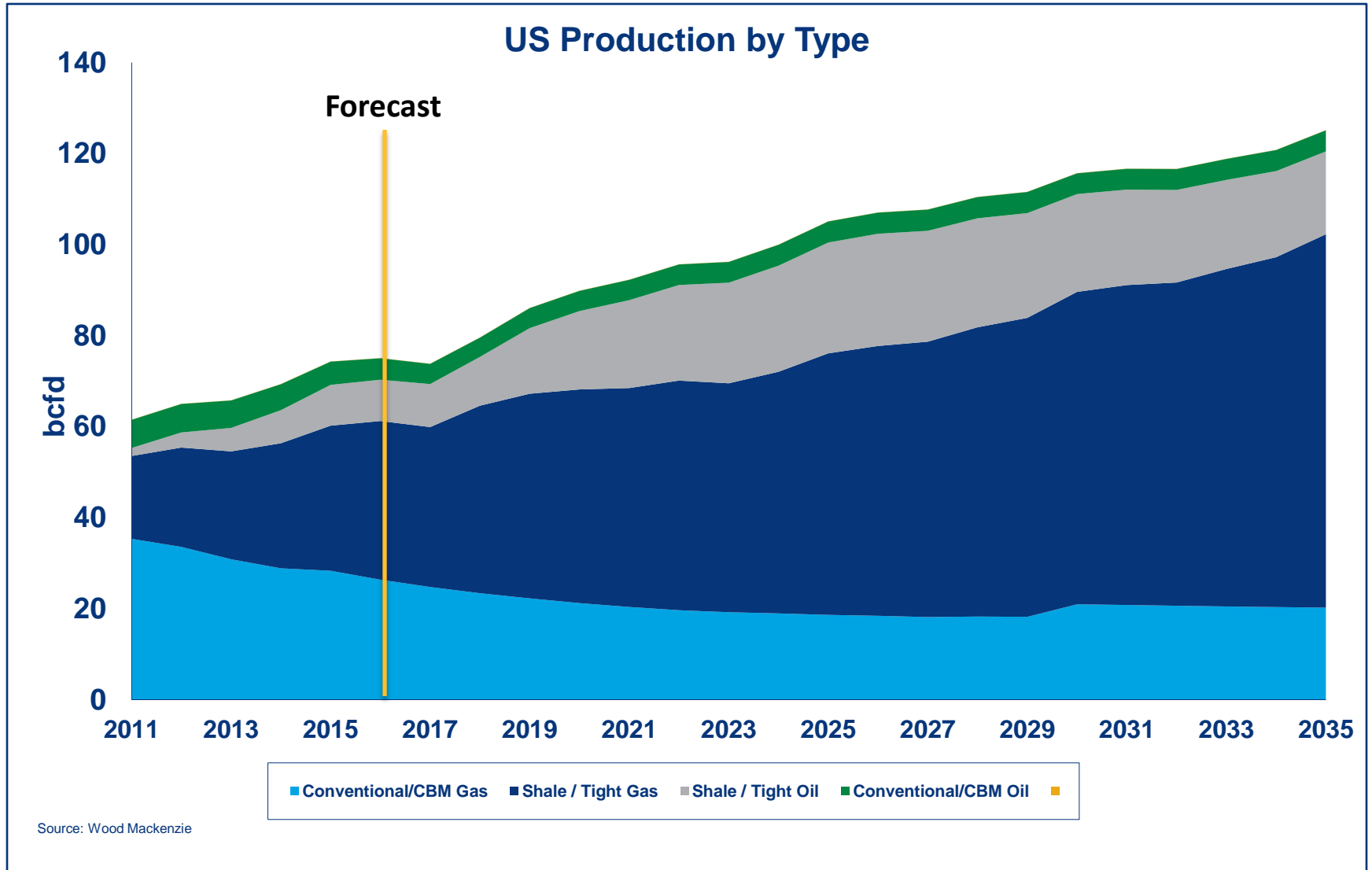
Increasing shale supply offsets declining conventional supply

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Forecasted Canadian Gas Supply Growth

Canada Production by Type
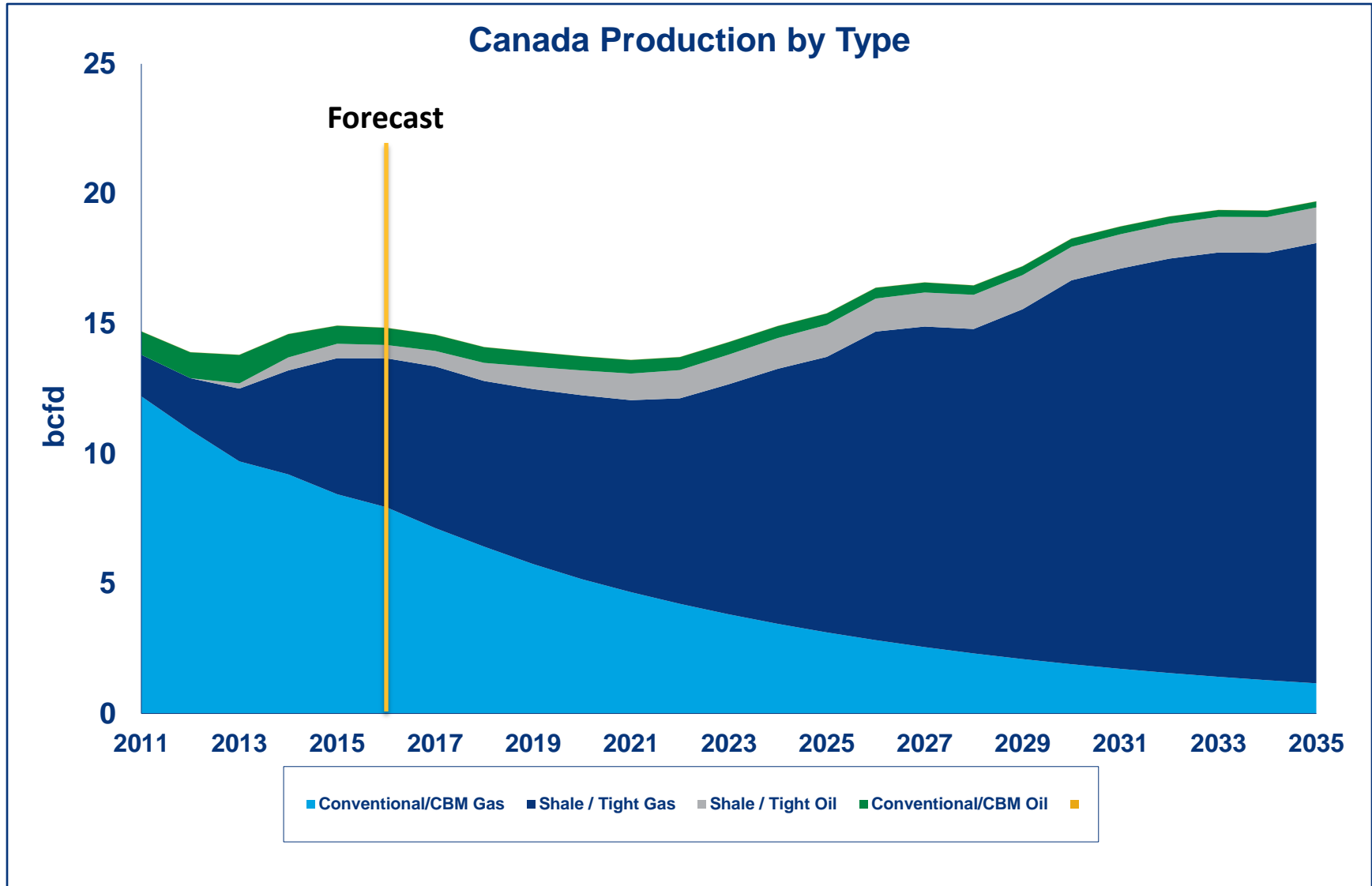
- Increasing shale supply offsets declining conventional Alberta production

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Natural Gas Terminology

Henry Hub

- Pricing point for NYMEX natural gas futures.

- The Henry Hub prices are used as benchmarks for the entire North American natural gas market

AECO

- Alberta natural gas pricing hub

- AECO has traditionally traded at a discount relative to Henry Hub

Low Pricing Environment for Natural Gas

NYMEX Historical Natural Gas Prices
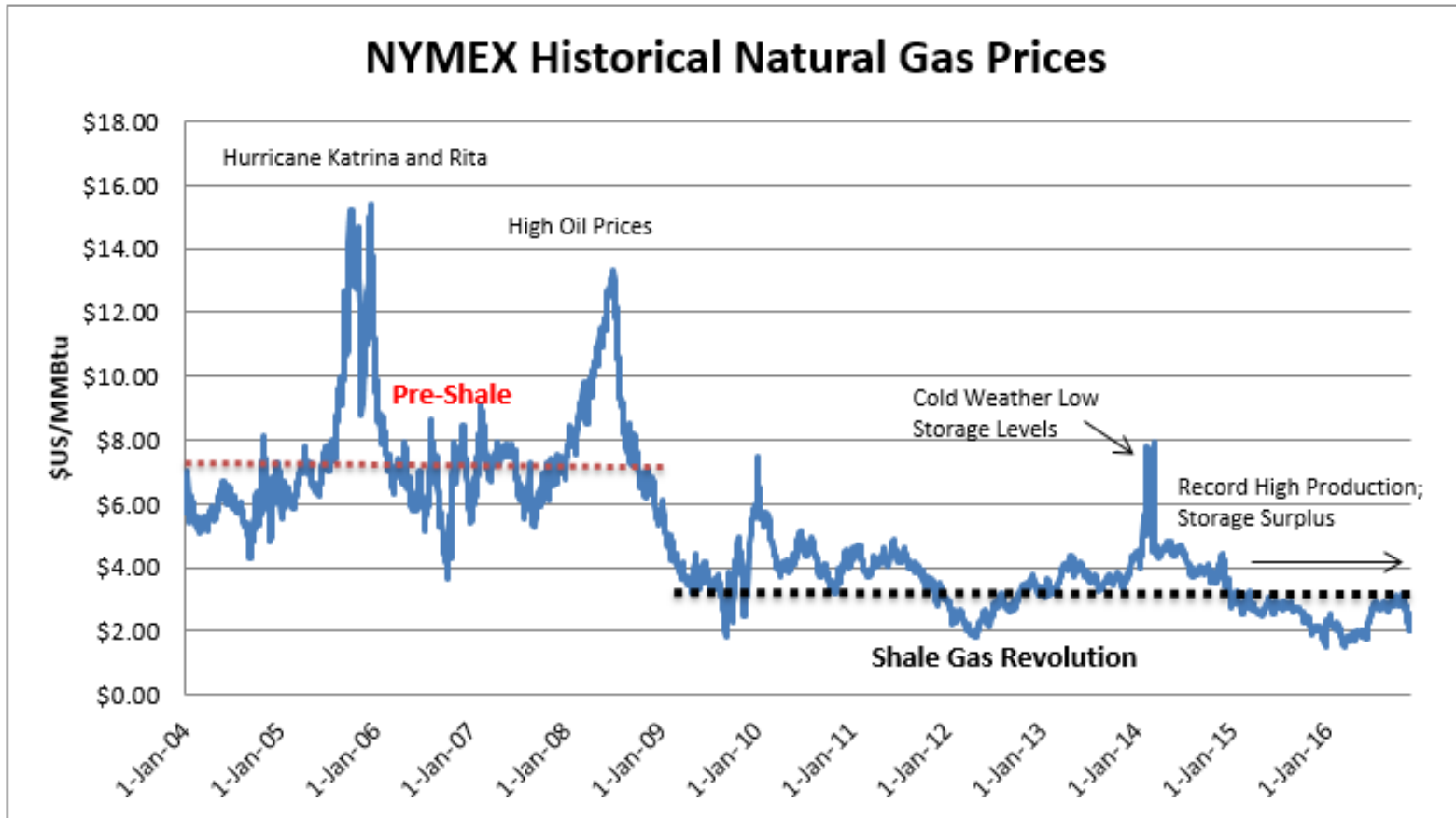
- Shale gas changed the range of gas prices which should continue until demand catches the scale of the resource

- North America is now a net exporter of natural gas (Pre-shale North America was a net importer)

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Low Price Environment for Energy

Competing Fuel Prices

Forward Prices as of Nov. 21, 2016

ULSD (Diesel)
Crude
JKM LNG
Natural Gas
CAPP Coal
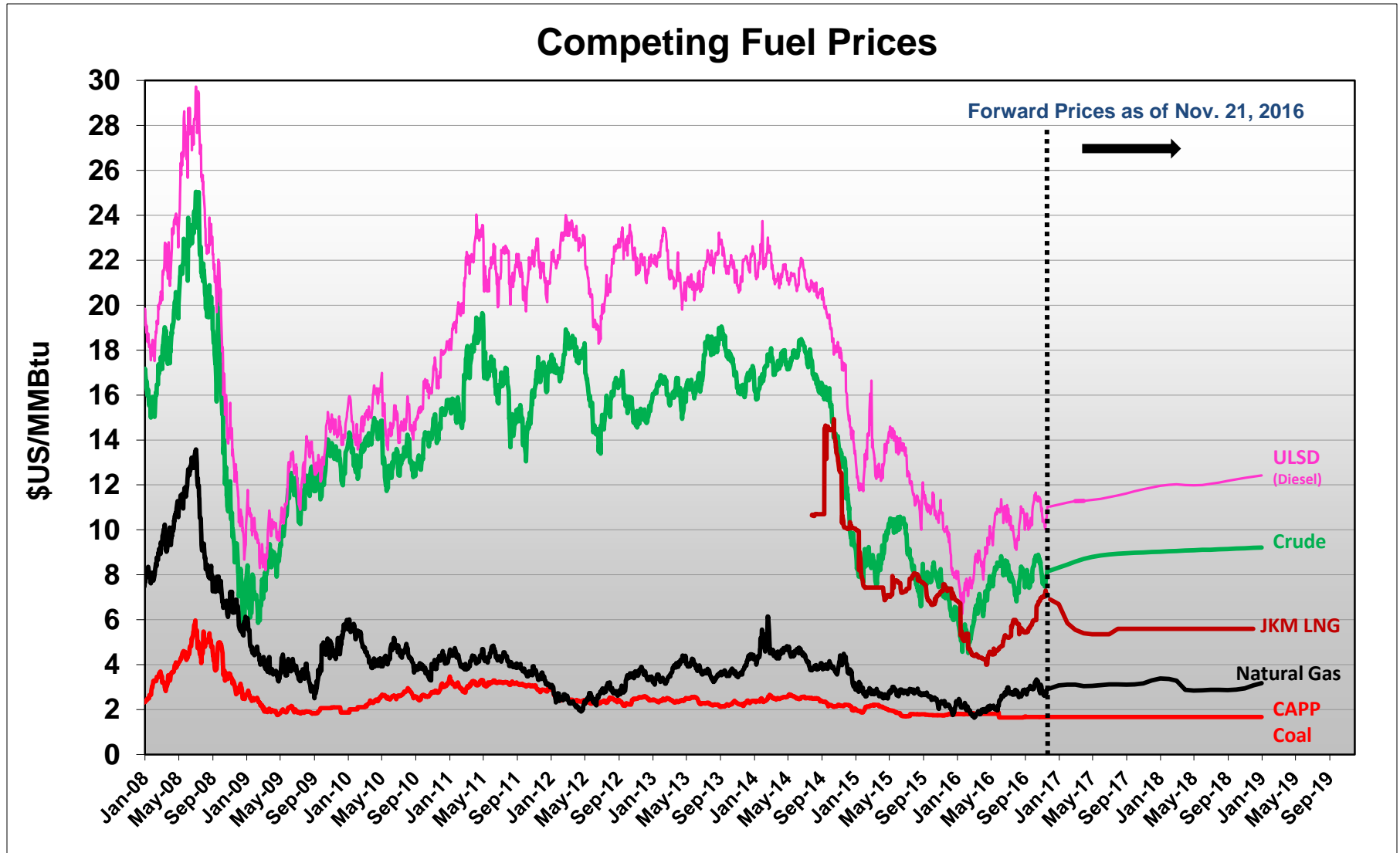
$US/MMBtu

- NYMEX gas prices remain disconnected from other competing fuels

- NYMEX gas prices remain close to 10-year lows

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Shale Gas Basin Economics
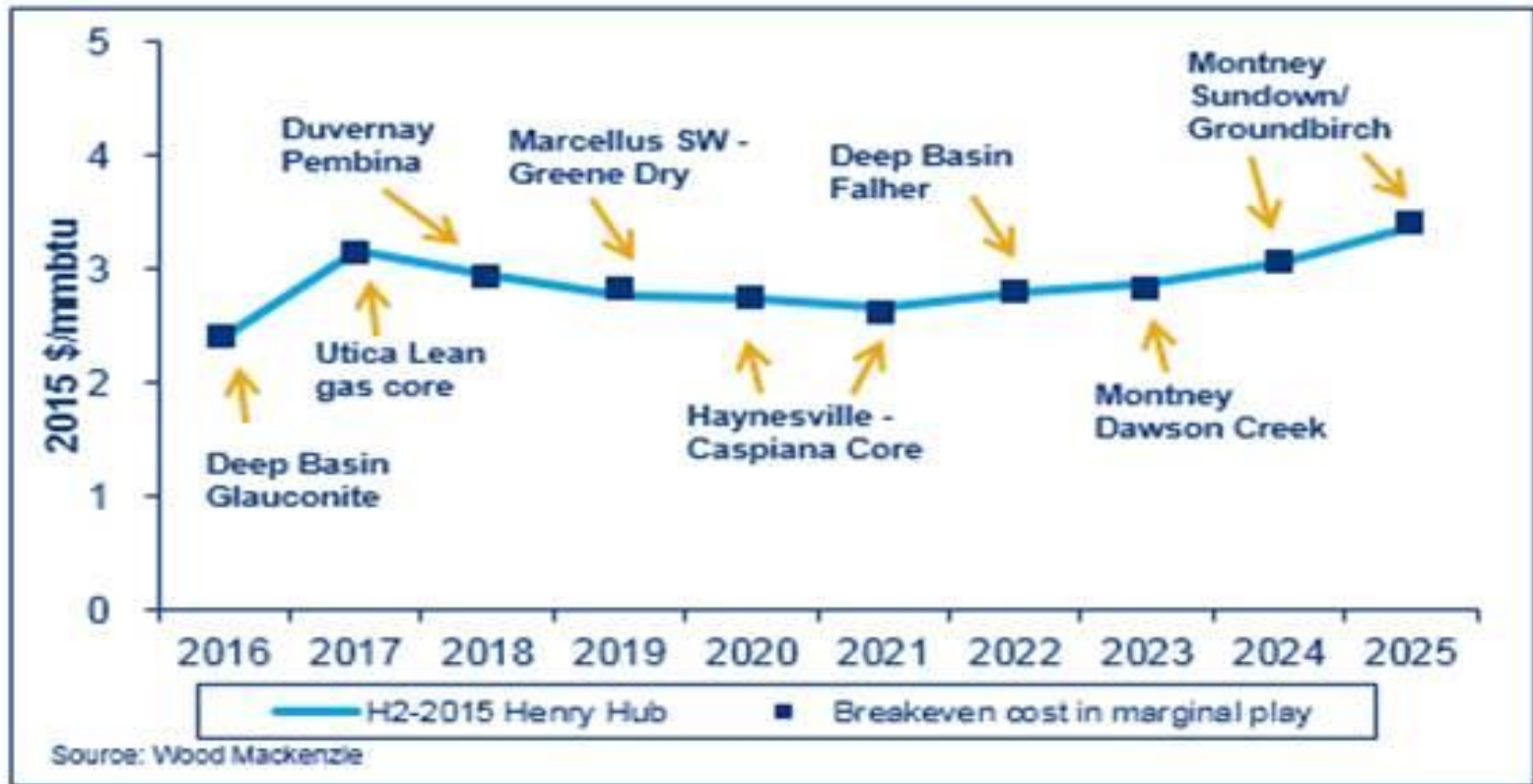
- Lots of Natural Gas economical between $3-$4 US/MMBtu

Natural Gas Potential Price Range

Henry hub natural gas price
dollars per million Btu
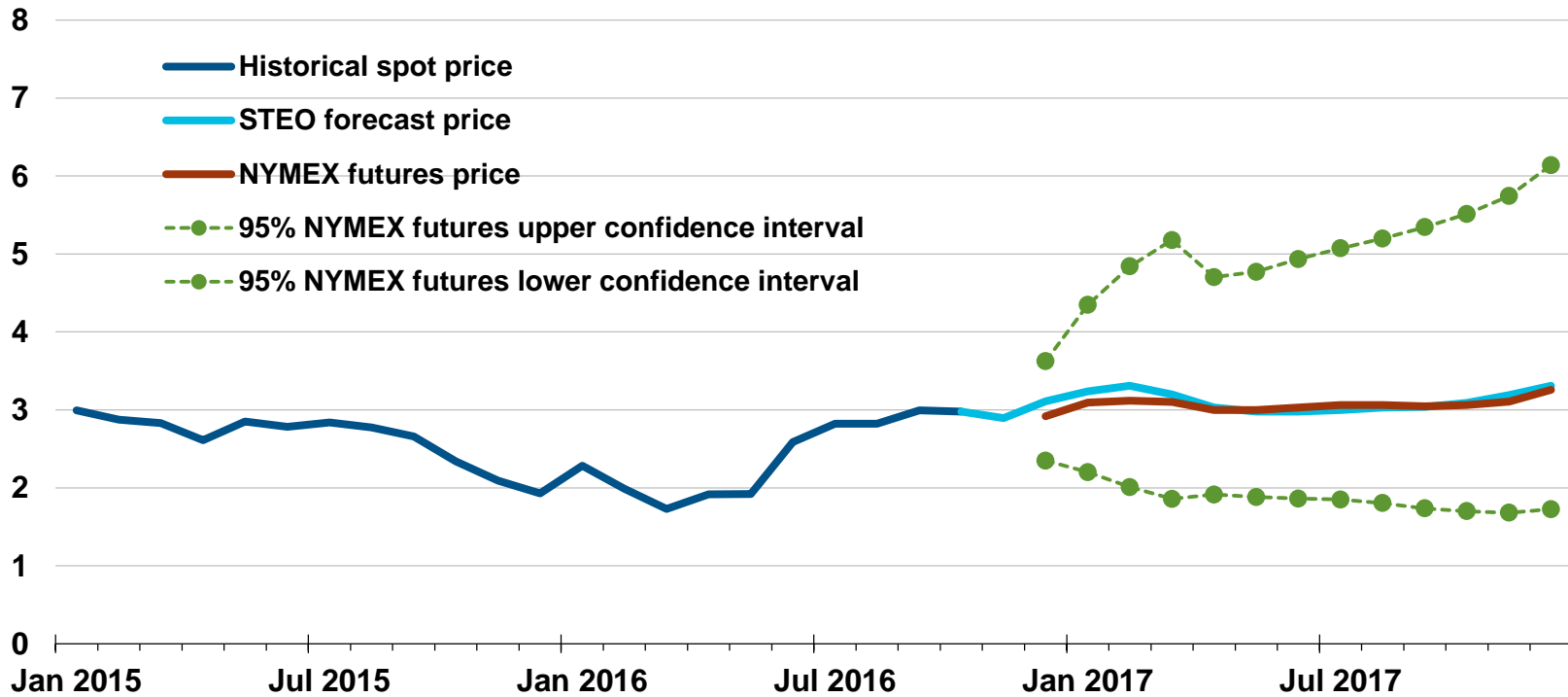
Note: Confidence interval derived from options market information for the 5 trading days ending Nov 3, 2016. Intervals not calculated for months with sparse trading in near-the-money options contracts.

Source: Short-Term Energy Outlook, November 2016.

Natural Gas Price Forecasts

Henry Hub Natural Gas Forecast
Nominal USD dollars per MMBtu
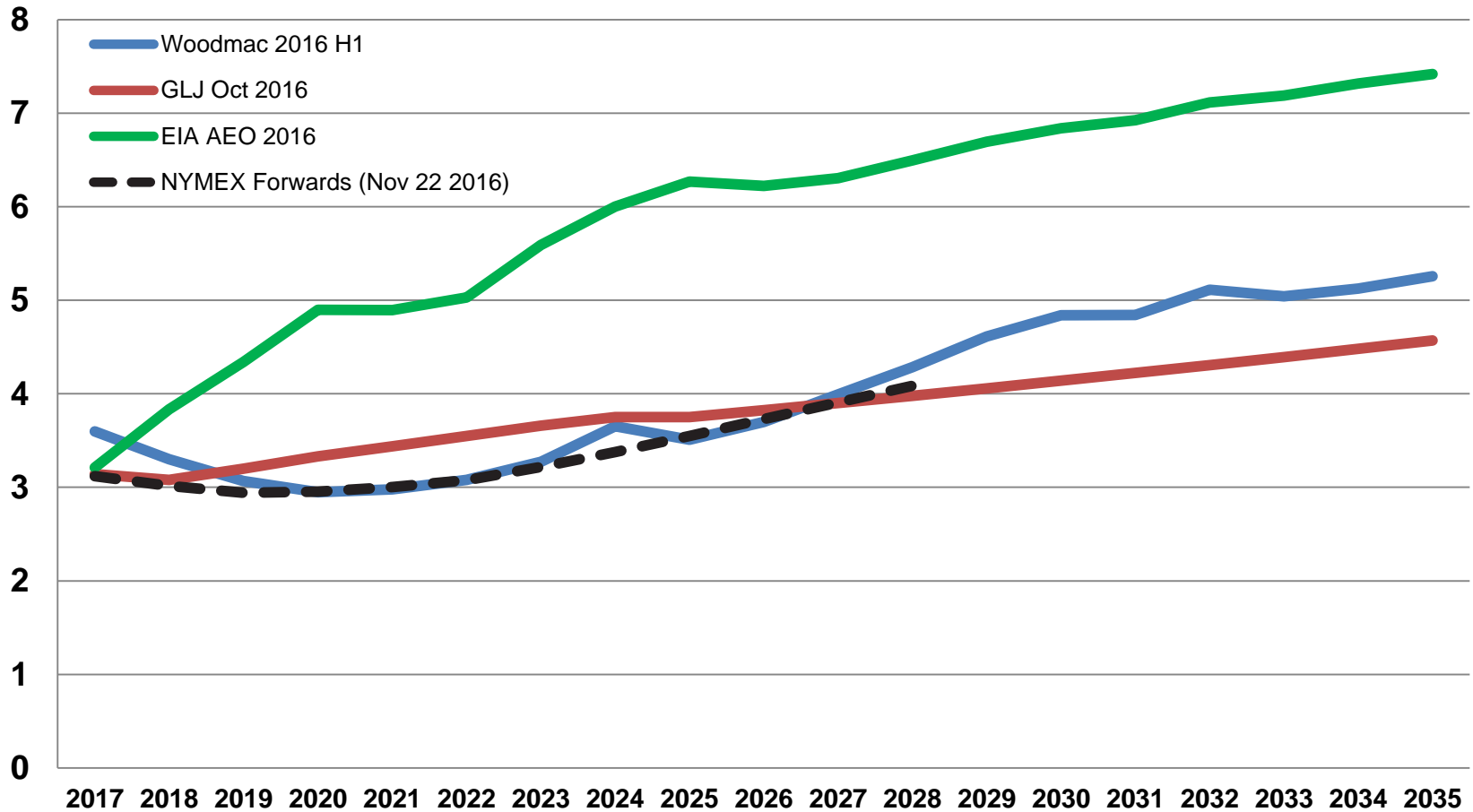
- Increases in production costs and demand cause prices to rise over time

Why higher gas prices in the future ?

- Producers cutting back on gas drilling & focusing on liquids producing wells

- LNG exports

- Increased demand for power generation

- Mexican Exports

- Increased industrial demand

- Growth in natural gas vehicles (NGV's) & transport

Forecast US Gas Demand Growth

Growth in US gas demand by sector from 2016
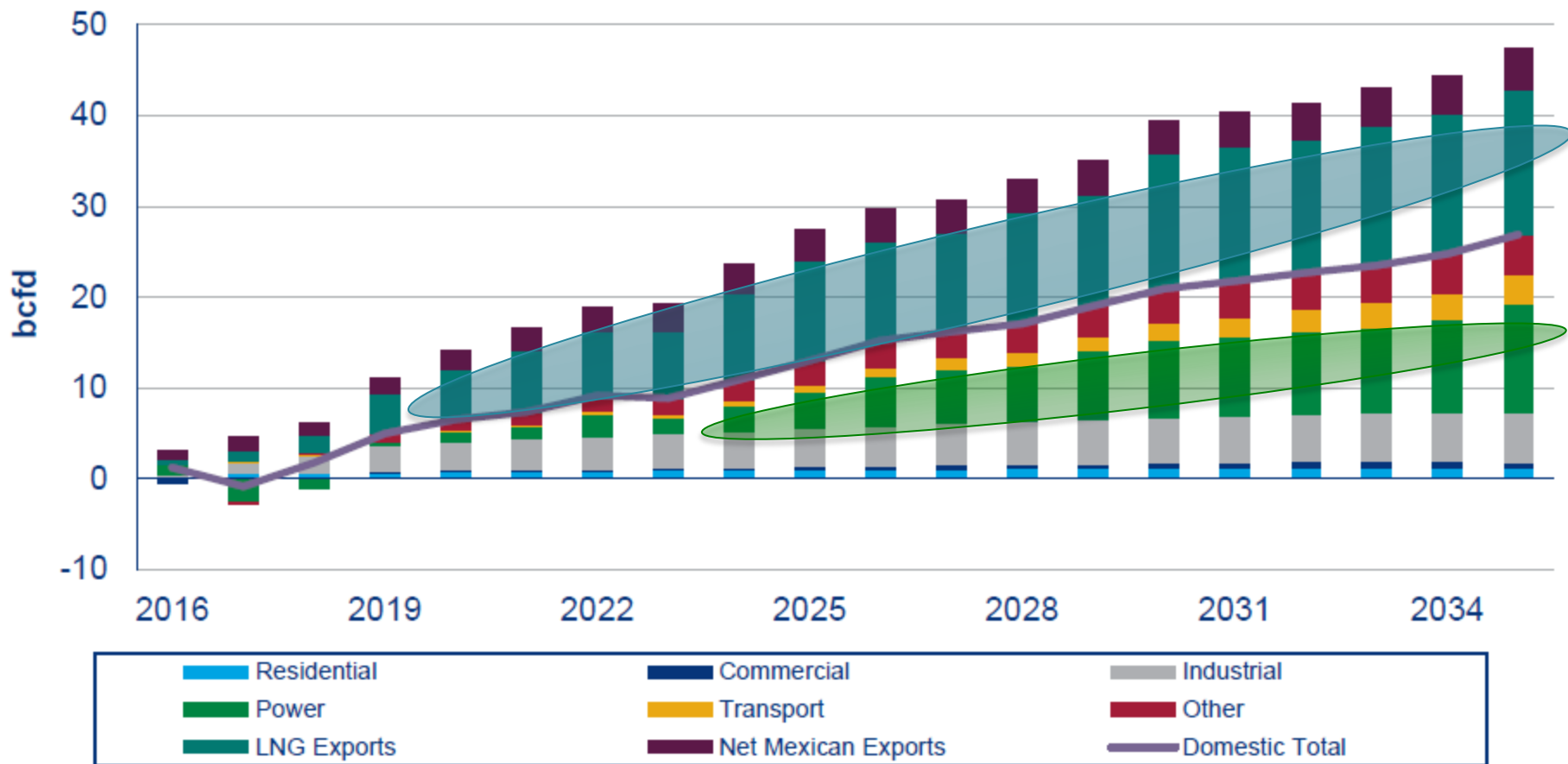
Source: Wood Mackenzie

Committed pipeline projects

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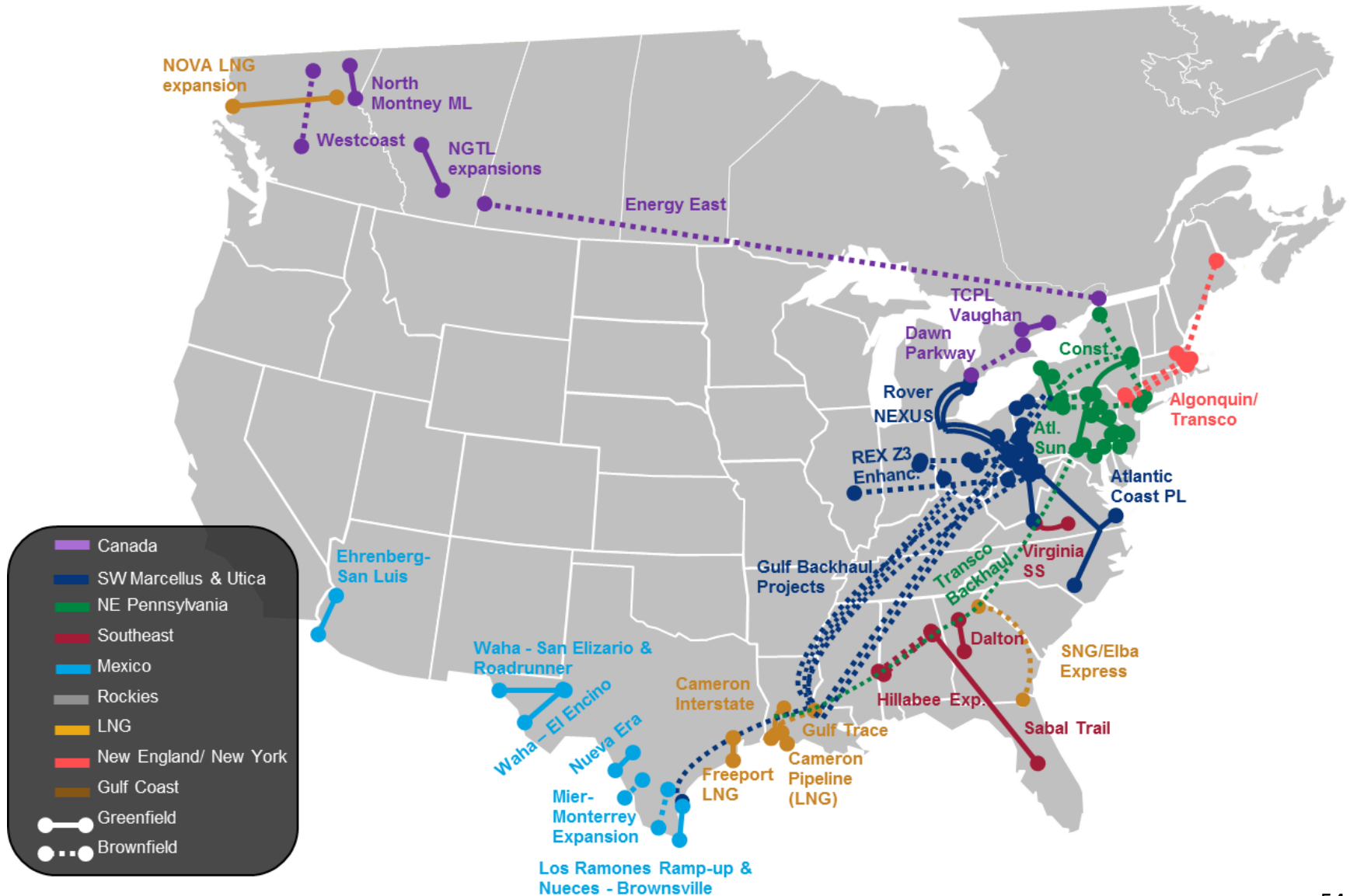
Widened NYMEX-AECO/NIT Basis

NYMEX/AECO Basis (US$/MMBtu)
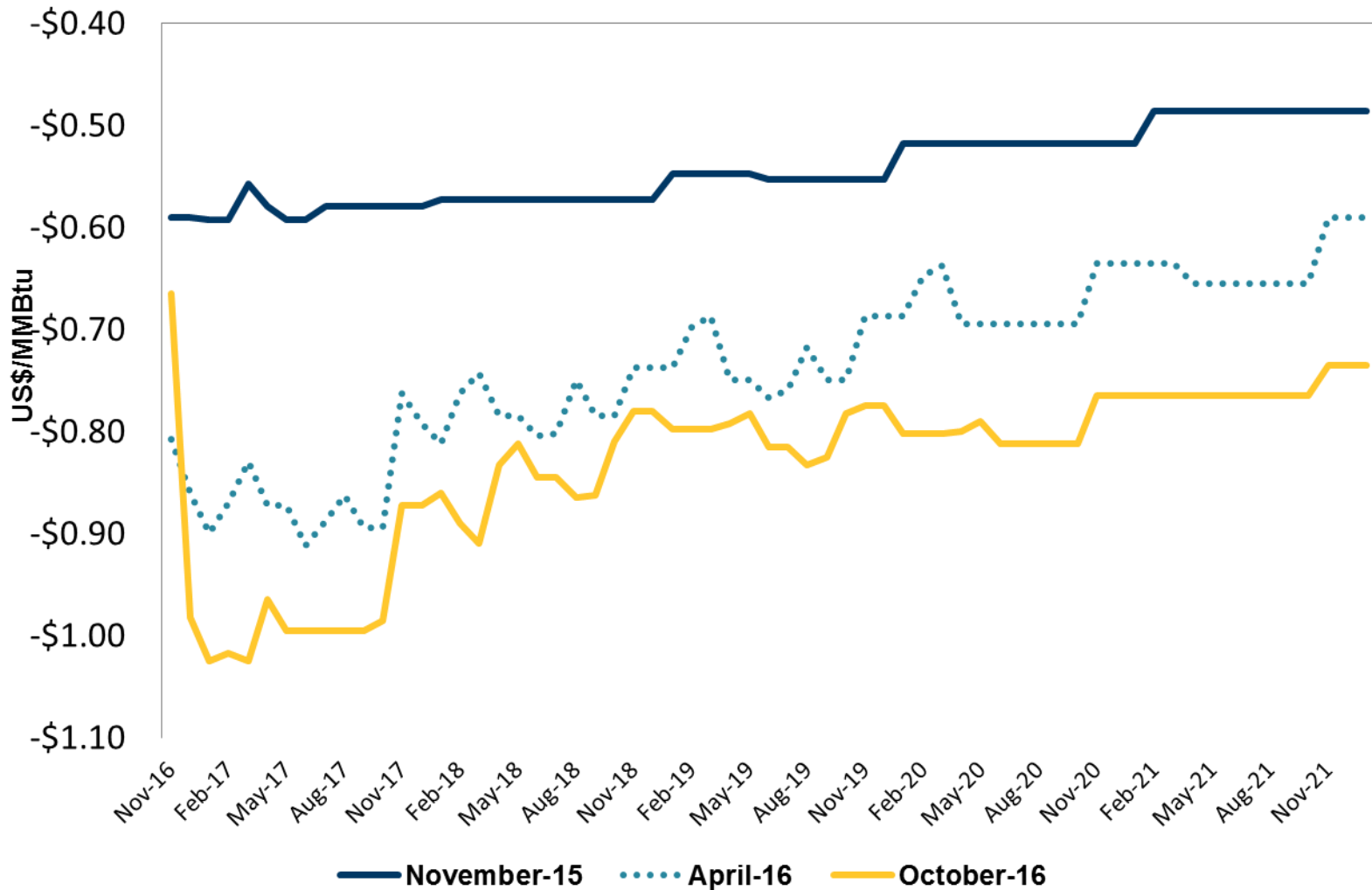
Forecast Canadian Gas Demand Growth

Canadian demand growth relative to 2015
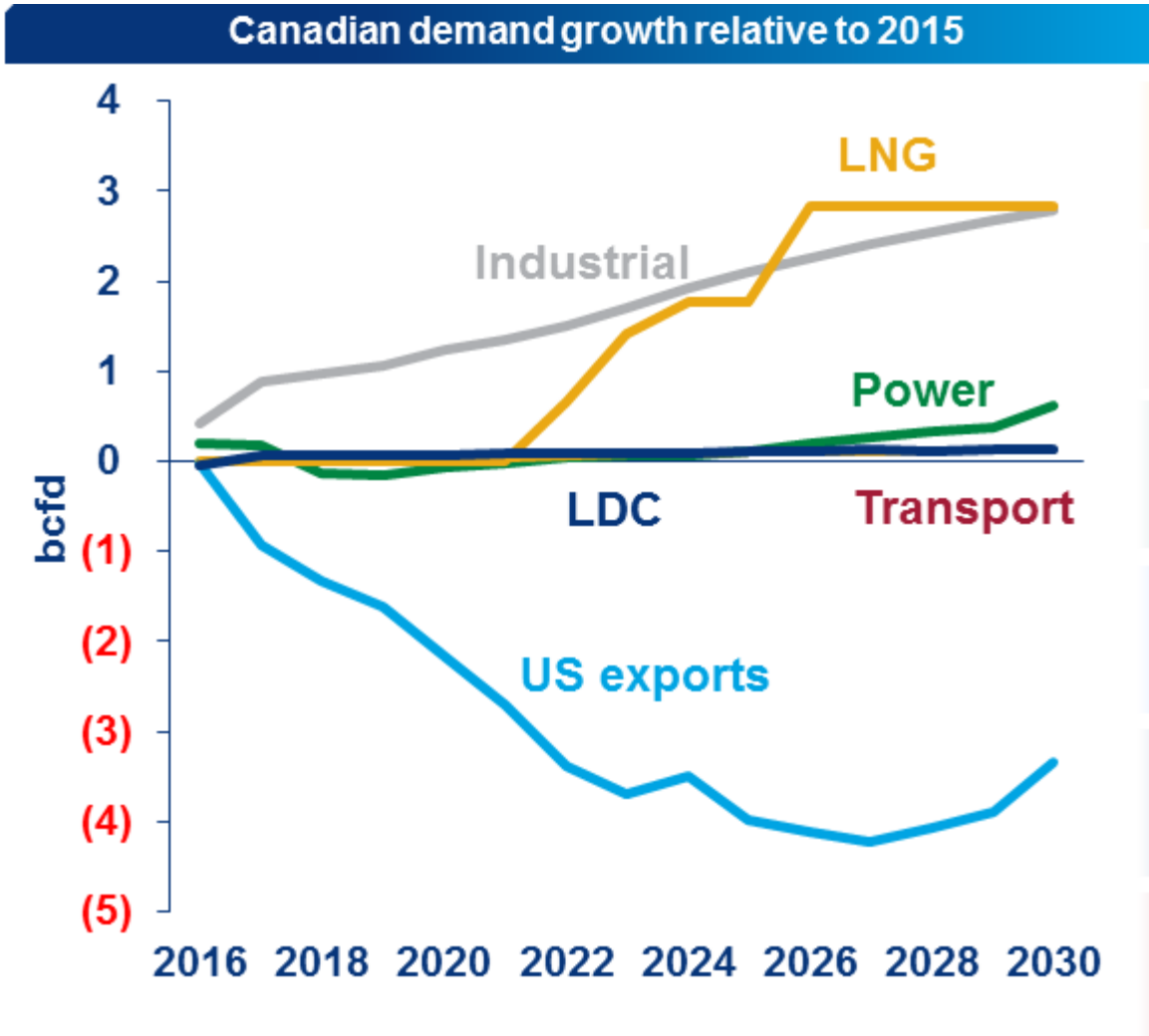
- US exports (east) expected to decrease as Marcellus production pushes Canadian Gas out of the Market

- LNG exports are expected to make up difference

- Oil sands production still drives gas demand

- Power plays a less significant role compared to U.S.

Source: Wood Mackenzie

Proposed LNG Export Facilities

North American LNG Import/Export Terminals
Approved

As of October 13, 2016

US Jurisdiction
- 🔴 FERC
- ⚫ MARAD/USCG
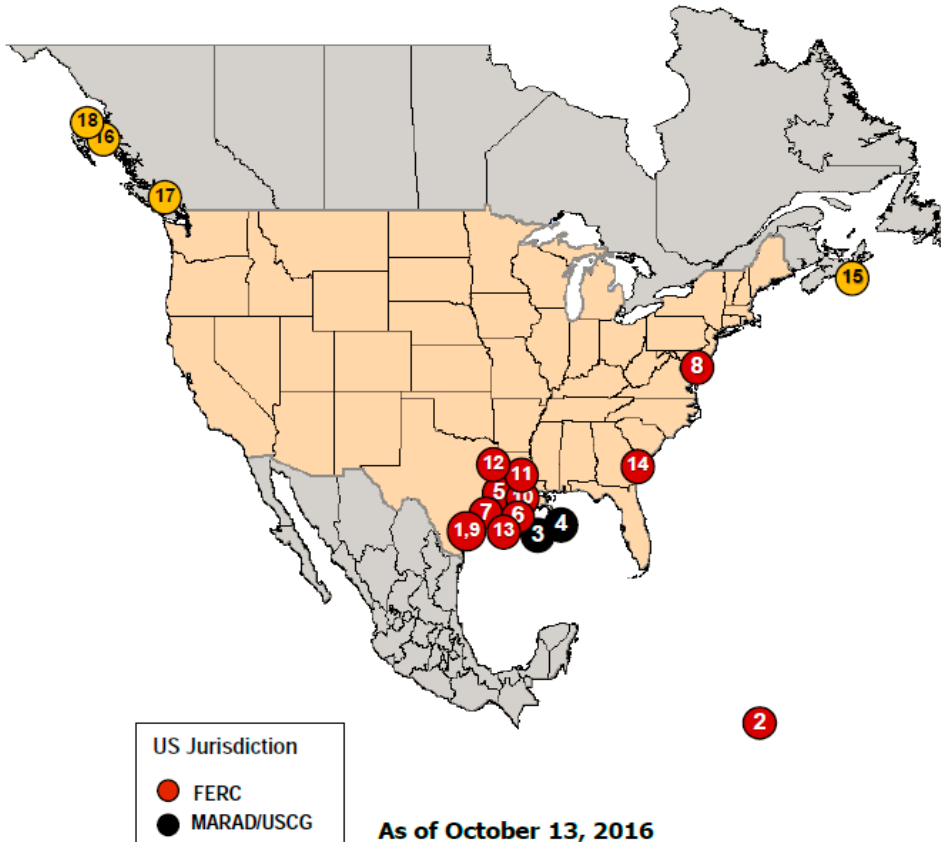
Import Terminals

U.S.
APPROVED - UNDER CONSTRUCTION - FERC
1. Corpus Christi, TX: 0.4 Bcfd (Cheniere – Corpus Christi LNG) (CP12-507)

APPROVED – NOT UNDER CONSTRUCTION - FERC
2. Salinas, PR: 0.6 Bcfd (Aguirre Offshore GasPort, LLC) (CP13-193)

APPROVED - NOT UNDER CONSTRUCTION - MARAD/Coast Guard
3. Gulf of Mexico: 1.0 Bcfd (Main Pass McMoRan Exp.)
4. Gulf of Mexico: 1.4 Bcfd (TORP Technology-Bienville LNG)

Export Terminals

U.S.
APPROVED - UNDER CONSTRUCTION - FERC
5. Sabine, LA: 1.4 Bcfd (Cheniere/Sabine Pass LNG) (CP11-72 & CP14-12)
6. Hackberry, LA: 2.1 Bcfd (Sempra–Cameron LNG) (CP13-25)
7. Freeport, TX: 2.14 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction) (CP12-509) (CP15-518)
8. Cove Point, MD: 0.82 Bcfd (Dominion–Cove Point LNG) (CP13-113)
9. Corpus Christi, TX: 2.14 Bcfd (Cheniere – Corpus Christi LNG) (CP12-507)
10. Sabine Pass, LA: 1.40 Bcfd (Sabine Pass Liquefaction) (CP13-552) ★

APPROVED – NOT UNDER CONSTRUCTION - FERC
11. Lake Charles, LA: 2.2 Bcfd (Southern Union – Lake Charles LNG) (CP14-120)
12. Lake Charles, LA: 1.08 Bcfd (Magnolia LNG) (CP14-347)
13. Hackberry, LA: 1.41 Bcfd (Sempra - Cameron LNG) (CP15-560)
14. Elba Island, GA: 0.35 Bcfd (Southern LNG Company) (CP14-103)

Canada
APPROVED – NOT UNDER CONSTRUCTION
15. Port Hawkesbury, NS: 0.5 Bcfd (Bear Head LNG)
16. Kitimat, BC: 3.23 Bcfd (LNG Canada)
17. Squamish, BC: 0.29 Bcfd (Woodfibre LNG Ltd)
18. Prince Rupert Island, BC: 2.74 Bcfd (Pacific Northwest LNG)

- Multiple LNG export terminals proposed in the US
- Several facilities proposed for northern BC

Global LNG Spot Prices -2013 ($US/MMBtu)

World LNG Estimated May 2013 Landed Prices

UK $10.17

Belgium $10.08

Korea $14.95

Cove Point $4.16

Spain $11.78

Japan $14.95

China $14.55

Altamira $4.42

Lake Charles $3.79

India $14.40

Rio de Janeiro $15.11

Bahia Blanca $16.41

Global LNG Spot Prices -2016 ($US/MMBtu)

World LNG Estimated Landed Prices: Oct-16

- UK $5.81
- Canaport $ 4.35
- Cove Point $3.29
- Belgium $5.59
- Korea $ 6.41
- Japan $ 6.41
- Lake Charles $3.06
- Spain $ 6.05
- China $ 6.26
- Altamira $ 6.19
- India $ 6.44
- Rio de Janeiro $ 6.26
- Bahia Blanca $ 6.30

- LNG Spreads have collapsed >50%

- $3-4 Gas + $2-3 liquefaction + $1 Shipping = **$6-8 LNG**

- Previous LNG contracts linked to price of Oil – changing to Henry Hub Linked

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Canadian LNG projects post-2020

Map of select liquefaction plants

Legend:
- Proposed Gas Pipelines (dashed red line)
- Existing Gas Pipelines (solid red line)
- Liquefaction (green hexagon)
- Liquefaction (Floating) (blue hexagon)
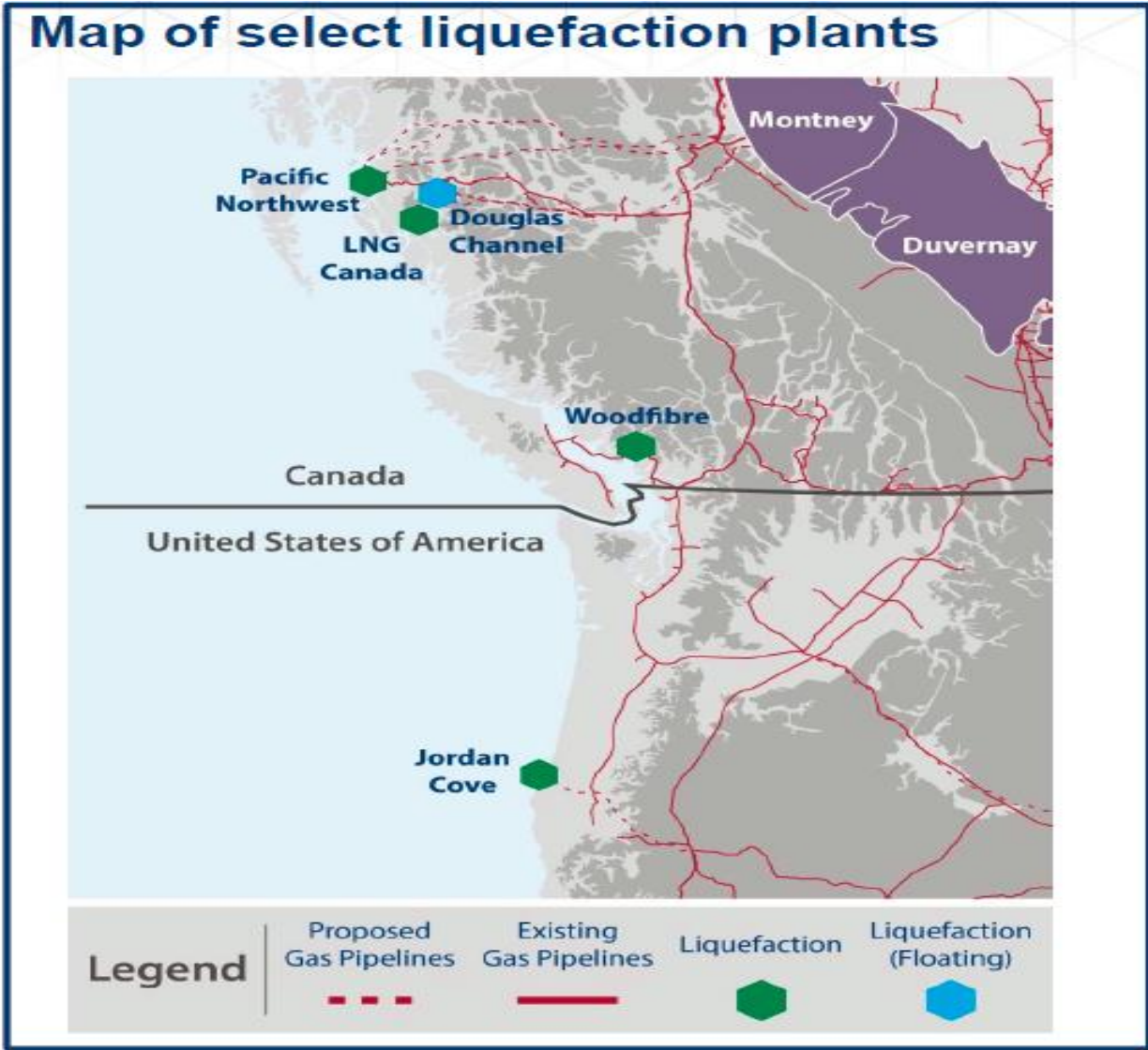
Canada LNG Pr...

- Projects are stalling

Momentum into 2H 2016	Project (Sponsor)
↓ (red)	Douglas Channel (AltaGas, Idemitsu, Exmar & EDF)
→ (yellow)	Woodfibre (Pacific Oil and Gas)
→ (yellow)	Pacific Northwest (PETRONAS)
→ (yellow)	LNG Canada (Shell)
→ (yellow)	Jordan Cove* (Veresen)

Source: Wood Mackenzie LNG To
advanced projects. Amongst the p
Aurora LNG (CNOOC), Cedar LNG
(Woodside), Kitimat LNG (Chevro
LNG, Orca LNG, Prince Rupert LN
Tilbury, Triton LNG, and WCC LNG

- Multiple LNG export terminals proposed in the US
- Several facilities proposed for northern BC

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Woodfibre becomes the first Canadian LNG project to receive FID
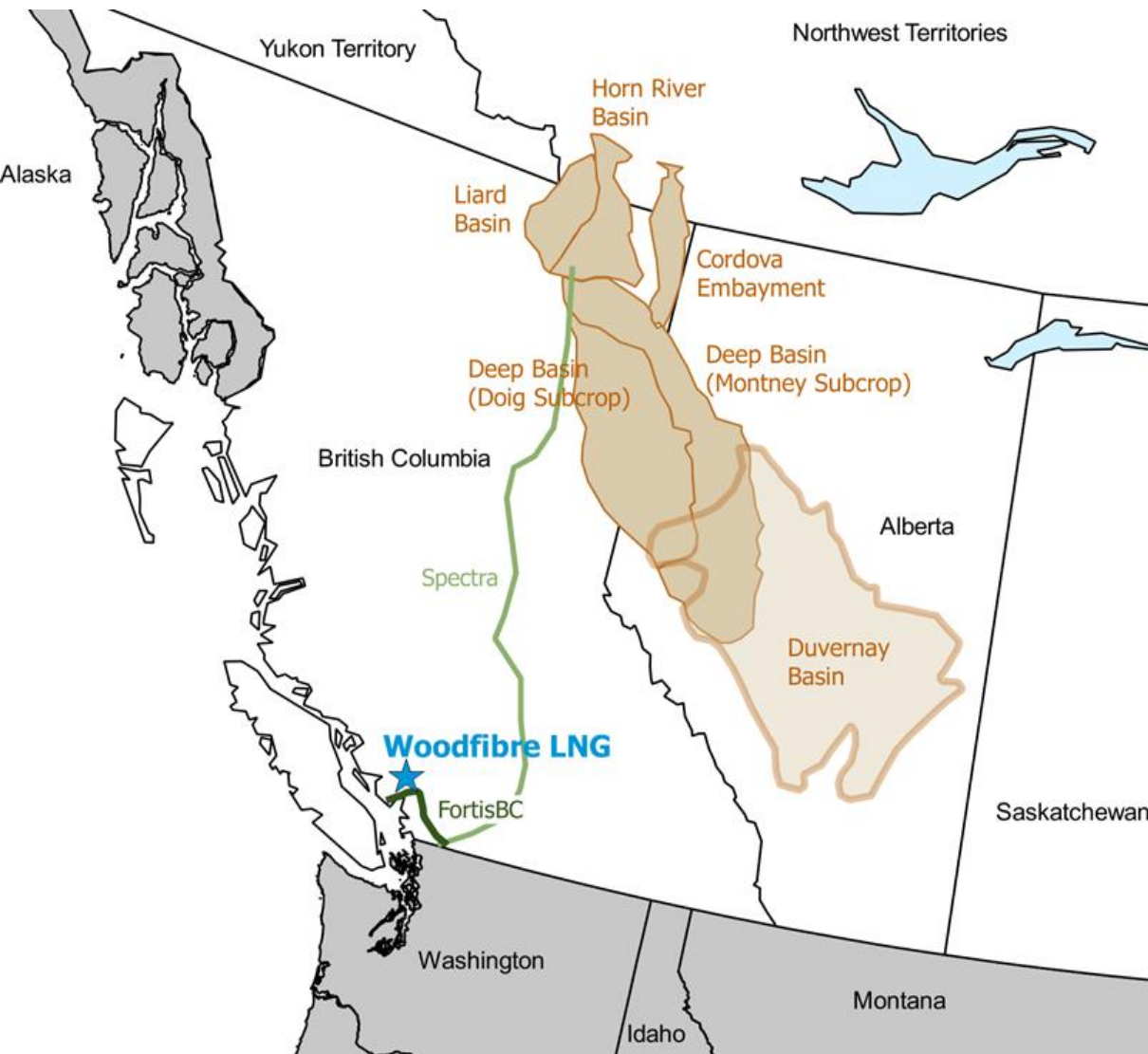
- Owned by Pacific Oil & Gas - Singapore based Energy/Utility Company

- Relatively Small – 0.3 bcf/day vs. Sabine Pass (Gulf Coast) – 2bcf/day

- Unlike Other proposed LNG projects, Woodfibre does not own production

FortisBC Regional Gas Market
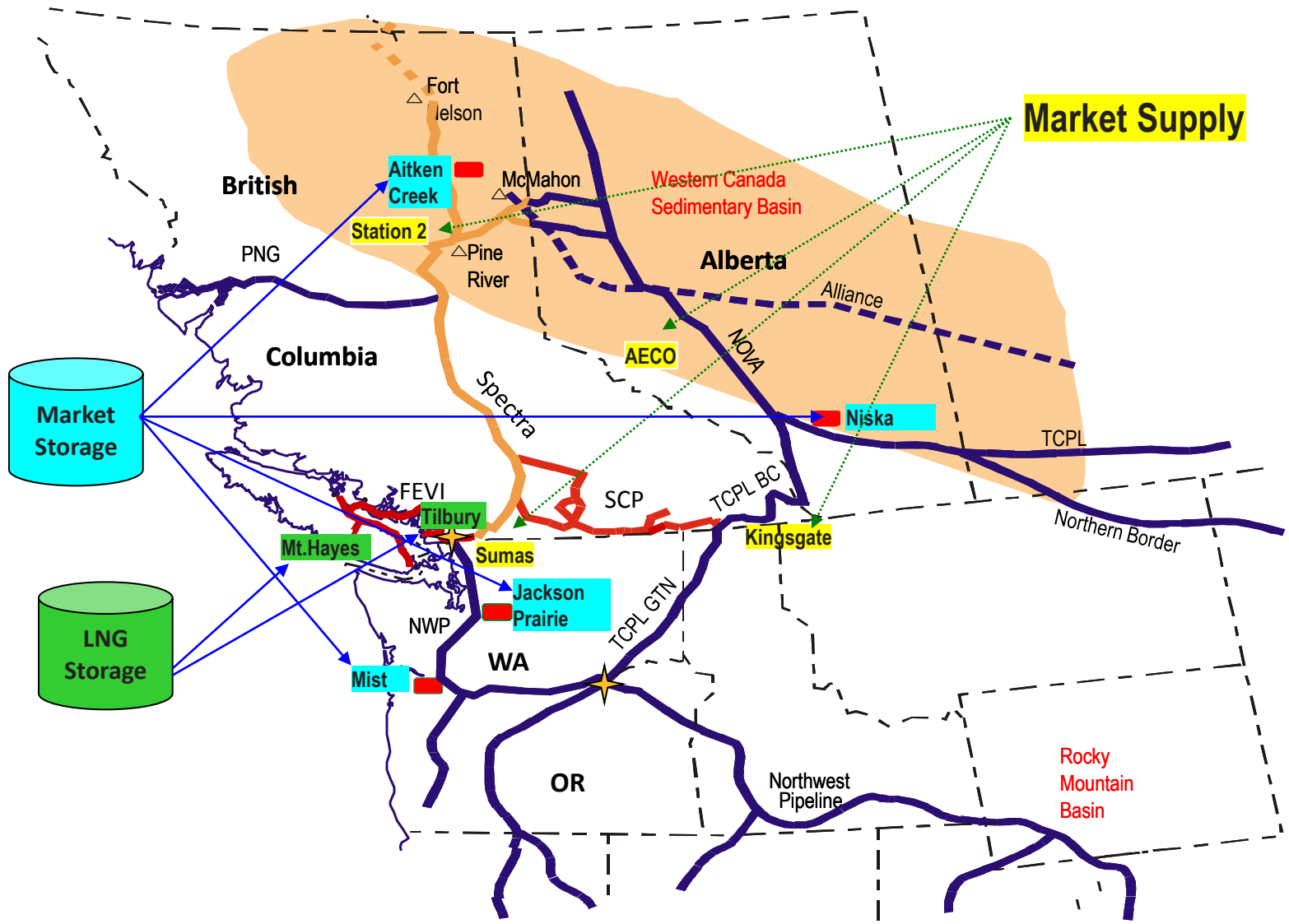
Regional Peak Day Demand vs. Capacity

FIGURE C3. I-5 Peak Day Resource/Demand Balance[17]

Legend: Low Case | Expected | High Case | Pipeline | Underground Storage | Peak LNG

Y-axis: Million Dth/day

X-axis: Gas Year (Nov-Oct) — 2016/17, 2017/18, 2018/19, 2019/20, 2020/21, 2021/22, 2022/23, 2023/24, 2024/25, 2025/26
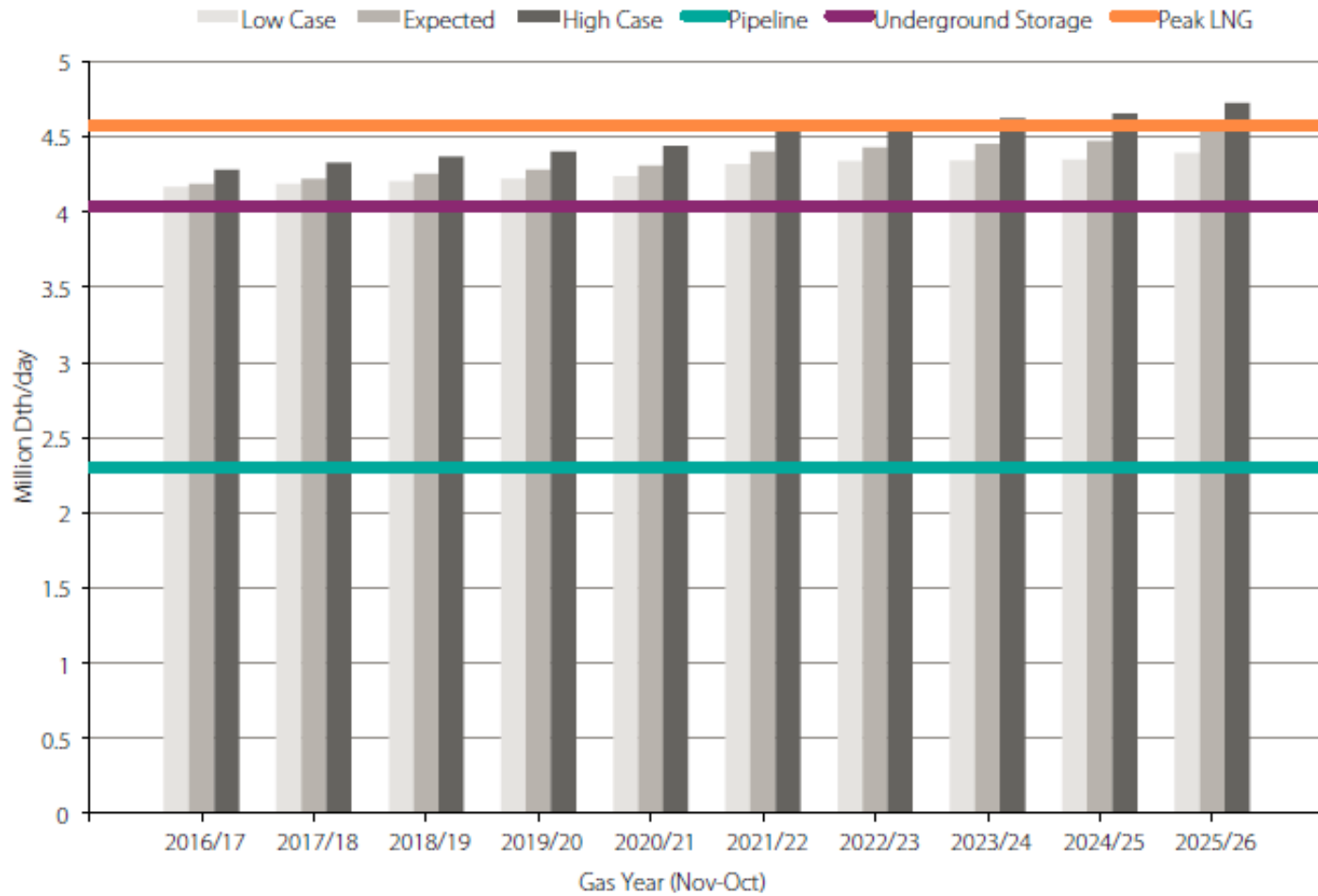
Winter peak day capacity is constrained in the I-5 region over the long term

Other Regional Developments
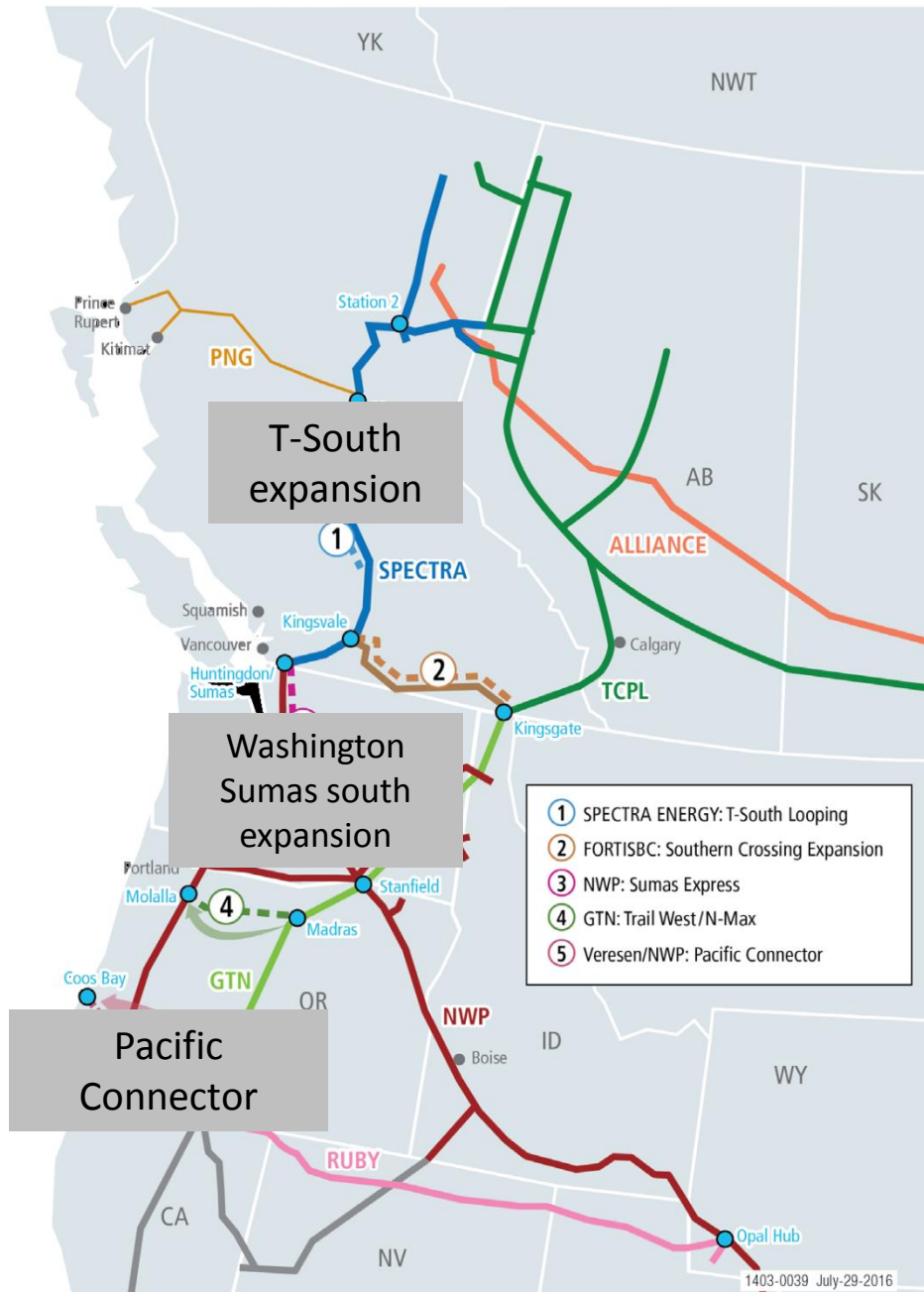
- Pipeline transportation capacity expansions are required

- 4-5 year lead time to bring new pipeline infrastructure into service

- Firm long-term contracts are required to initiate an expansion

- BC production moving to Alberta

Summary

- Low gas prices – due to strong supply, high storage and weak demand

- BC supply growth - helping offset declines in Alberta

- Demand expected to increase in the future

- Pacific Northwest - future expansion required in the region to meet demand growth

- Threat – Potential that BC producers may elect to send future production to the higher priced Alberta market
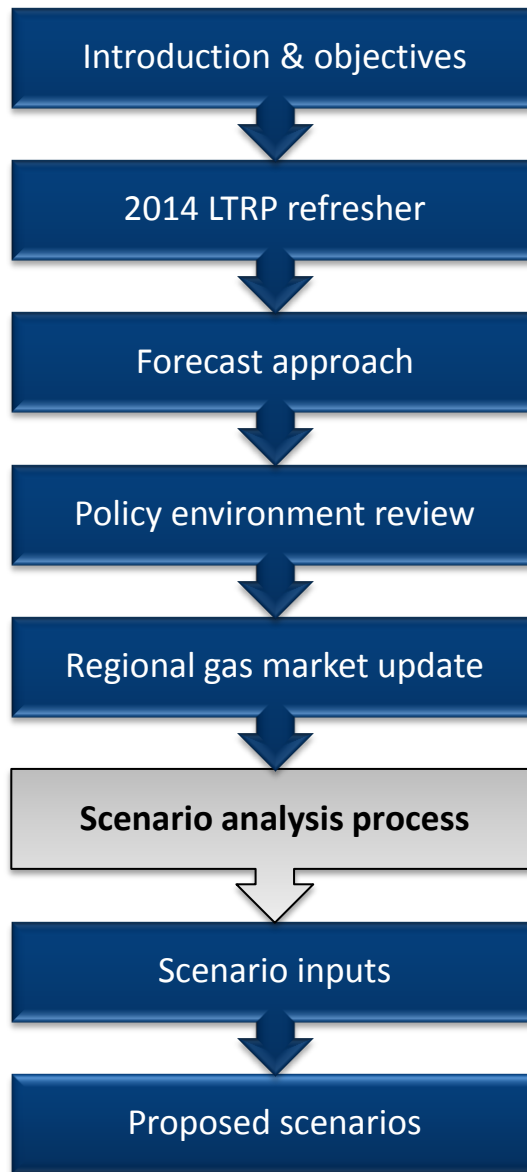
Why do we prepare a scenario analysis?

Hypothetical example:
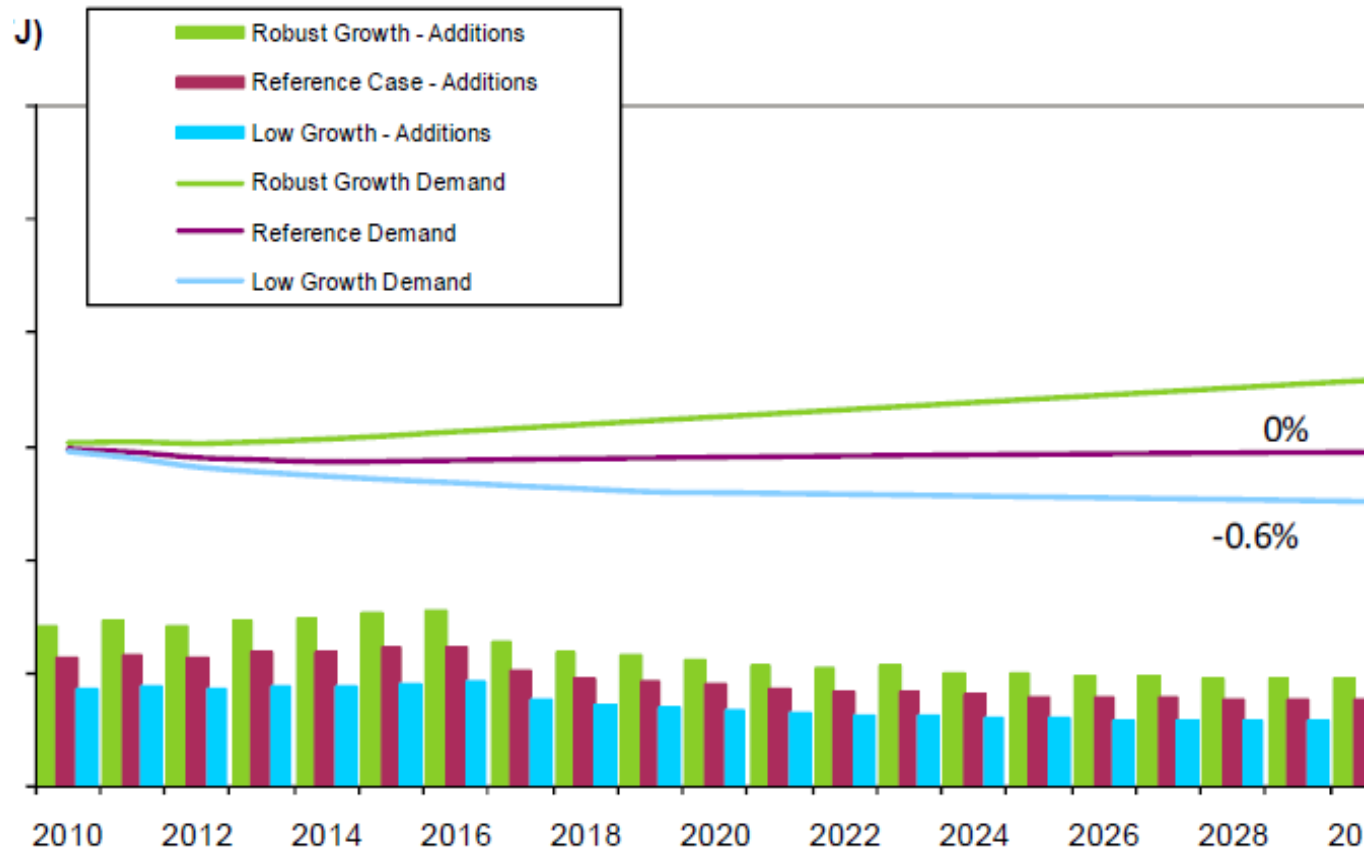
Why do we prepare a scenario analysis?

Illustration: 2014 Long Term Gas Resource Plan
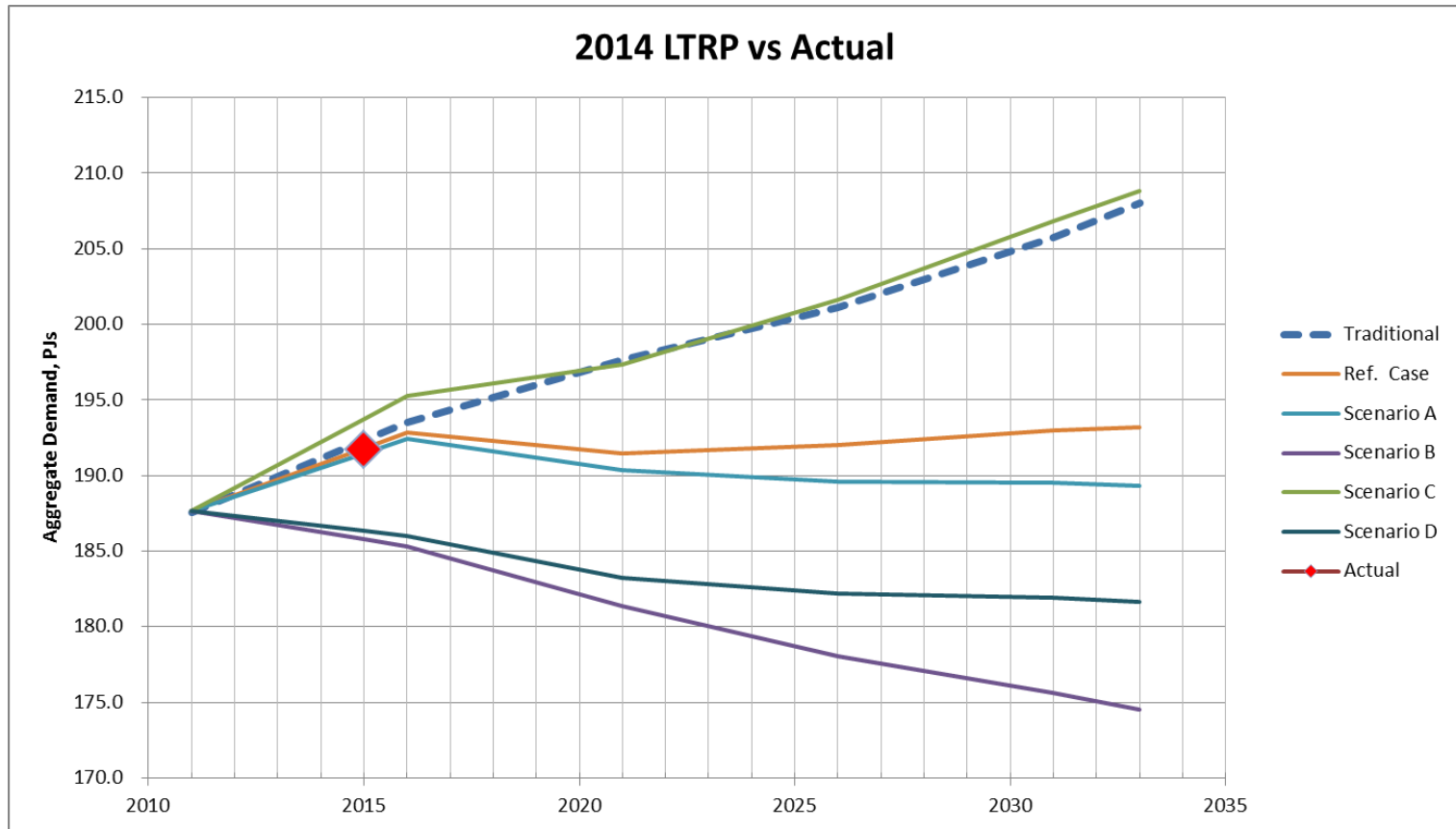
How do we assess scenario factors?

Impactful

Critical Determined Variables	Critical Uncertainties

Determined ←→ **Uncertain**

Minor Determined Variables	Minor Uncertainties

Not Impactful
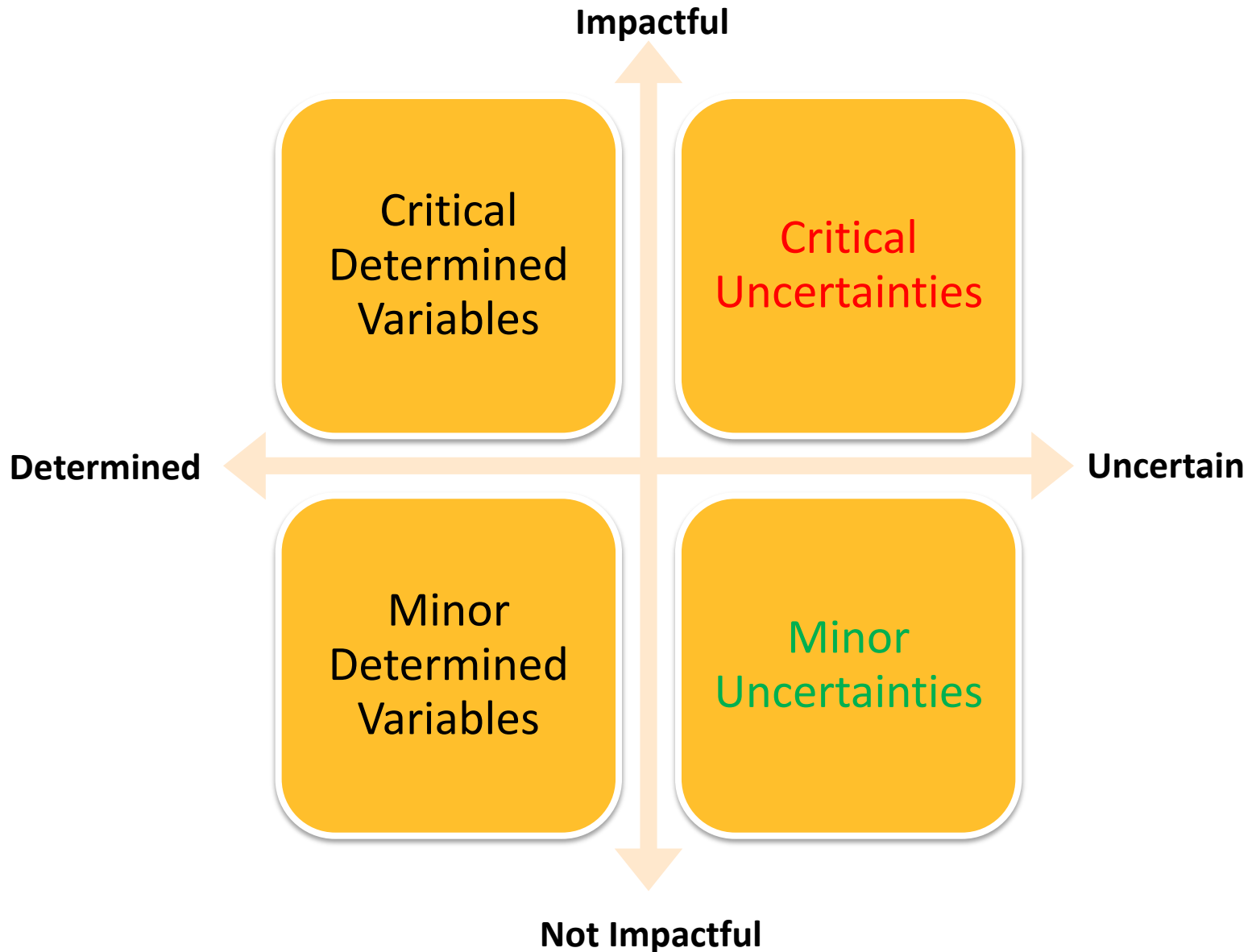
Mapping uncertainties – an illustration
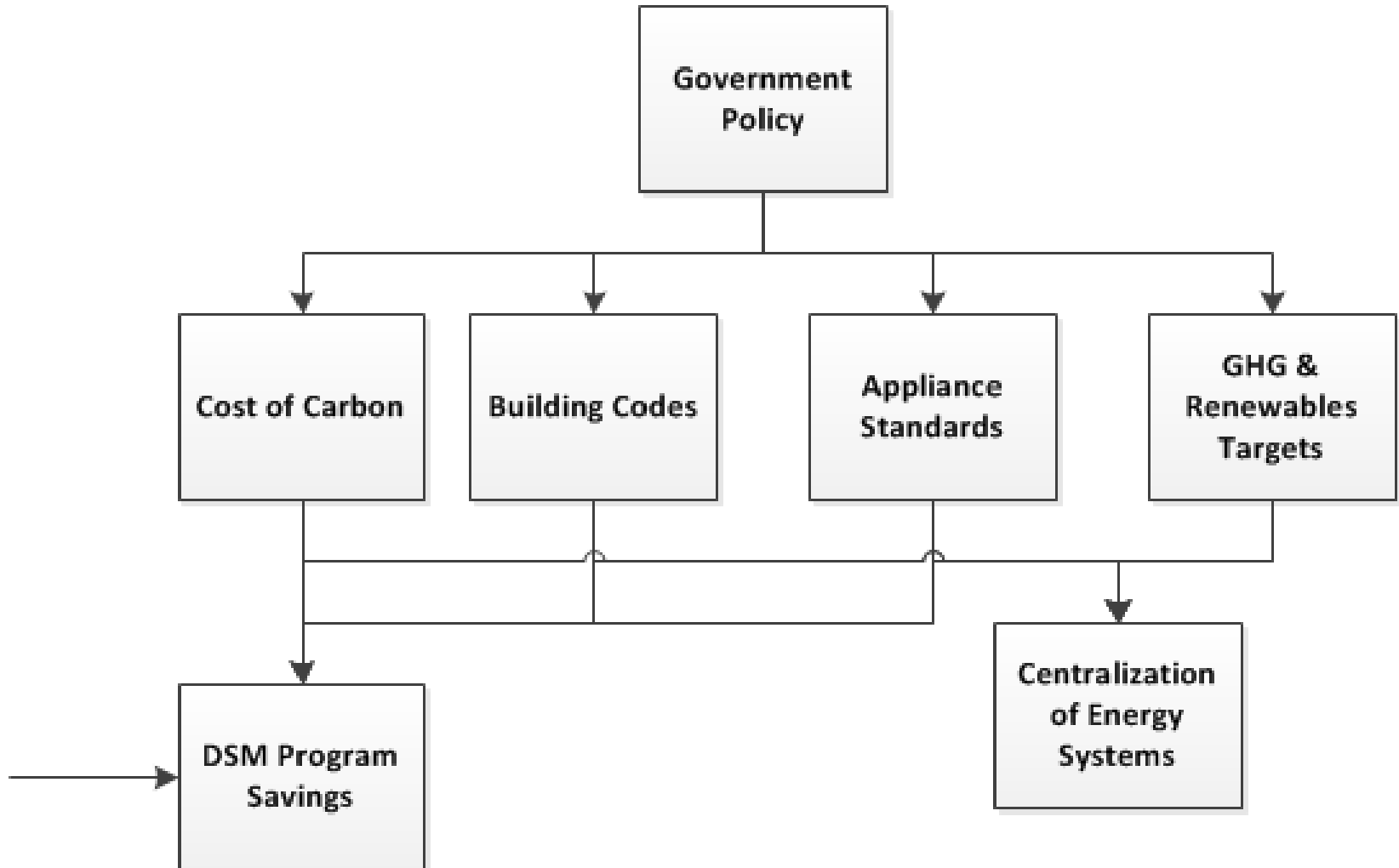
Building scenarios from the critical uncertainties

1. Describe Critical Uncertainties	
# of outcomes for each uncertainty	Qualitative description of each outcome

Building scenarios from the critical uncertainties

1. Describe Critical Uncertainties	
# of outcomes for each uncertainty	Qualitative description of each outcome

2. Combine Critical Uncertainties into Scenarios	
Reasonable plotlines	Extremes

Building scenarios from the critical uncertainties

1. Describe Critical Uncertainties

| # of outcomes for each uncertainty | Qualitative description of each outcome |

2. Combine Critical Uncertainties into Scenarios

| Reasonable plotlines | Extremes |

3. Create Quantitative Model Inputs & Iterate
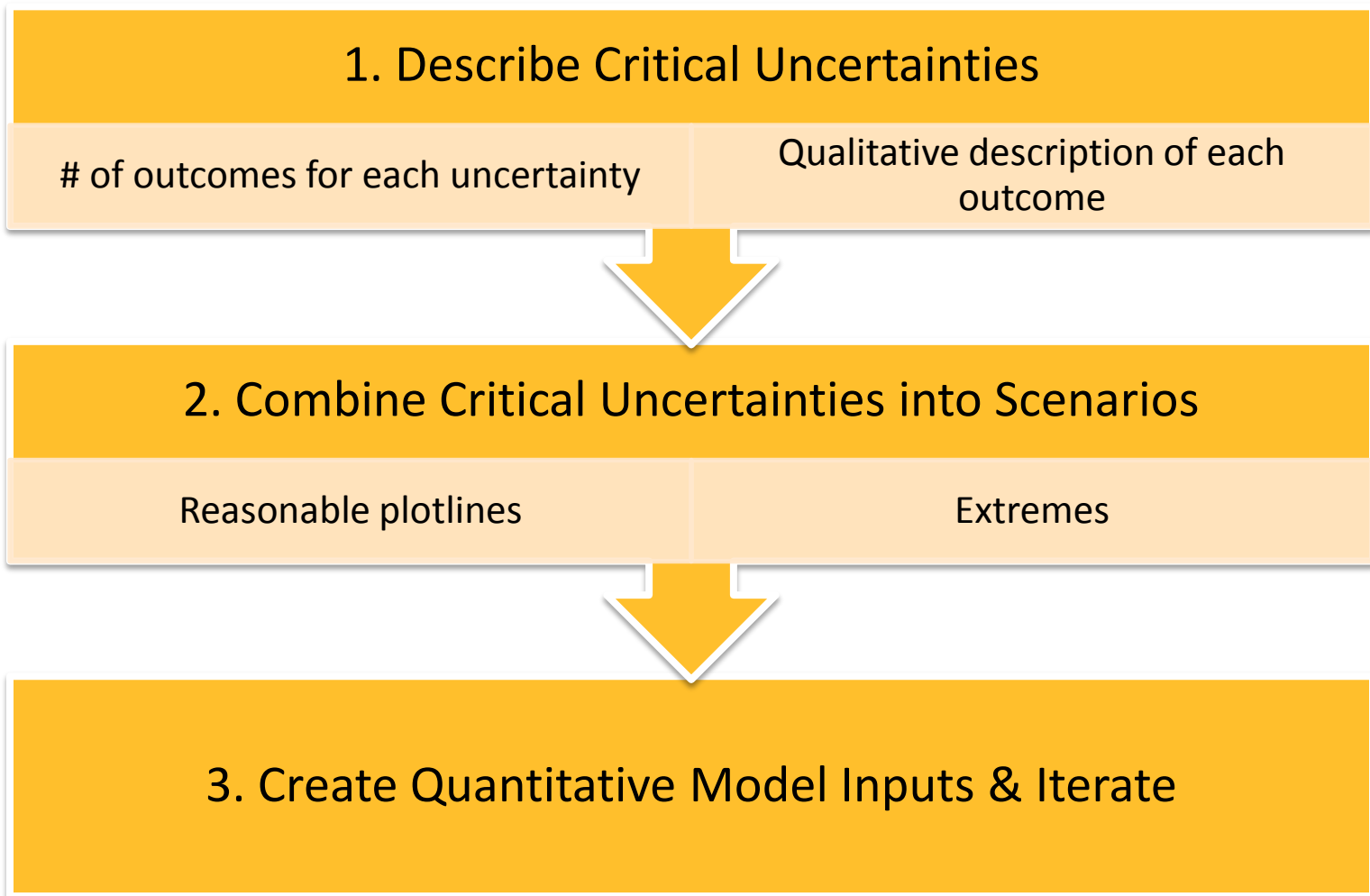
Why your input matters – a sample critical uncertainty
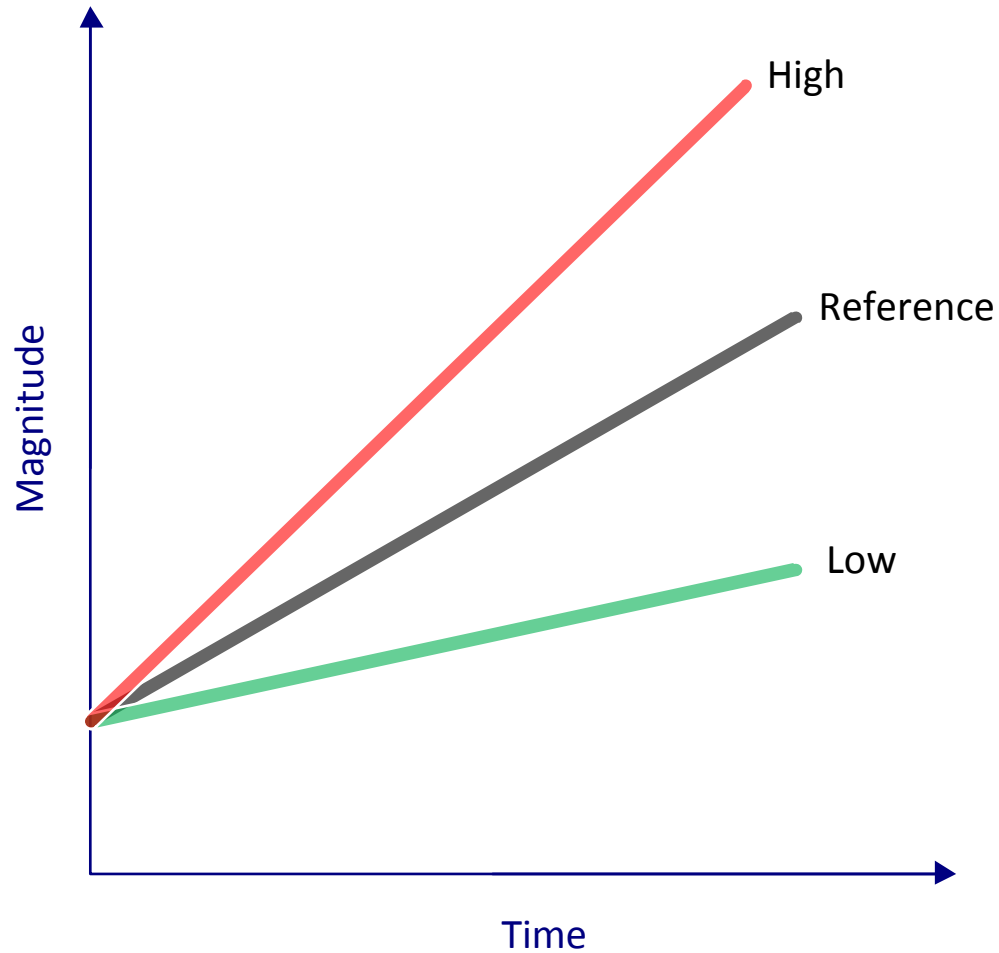
Your qualitative input before our quantitative work

1. Describe Critical Uncertainties

# of outcomes for each uncertainty	Qualitative description of each outcome

2. Combine Critical Uncertainties into Scenarios

Reasonable plotlines	Extremes

3. Create Quantitative Model Inputs & Iterate
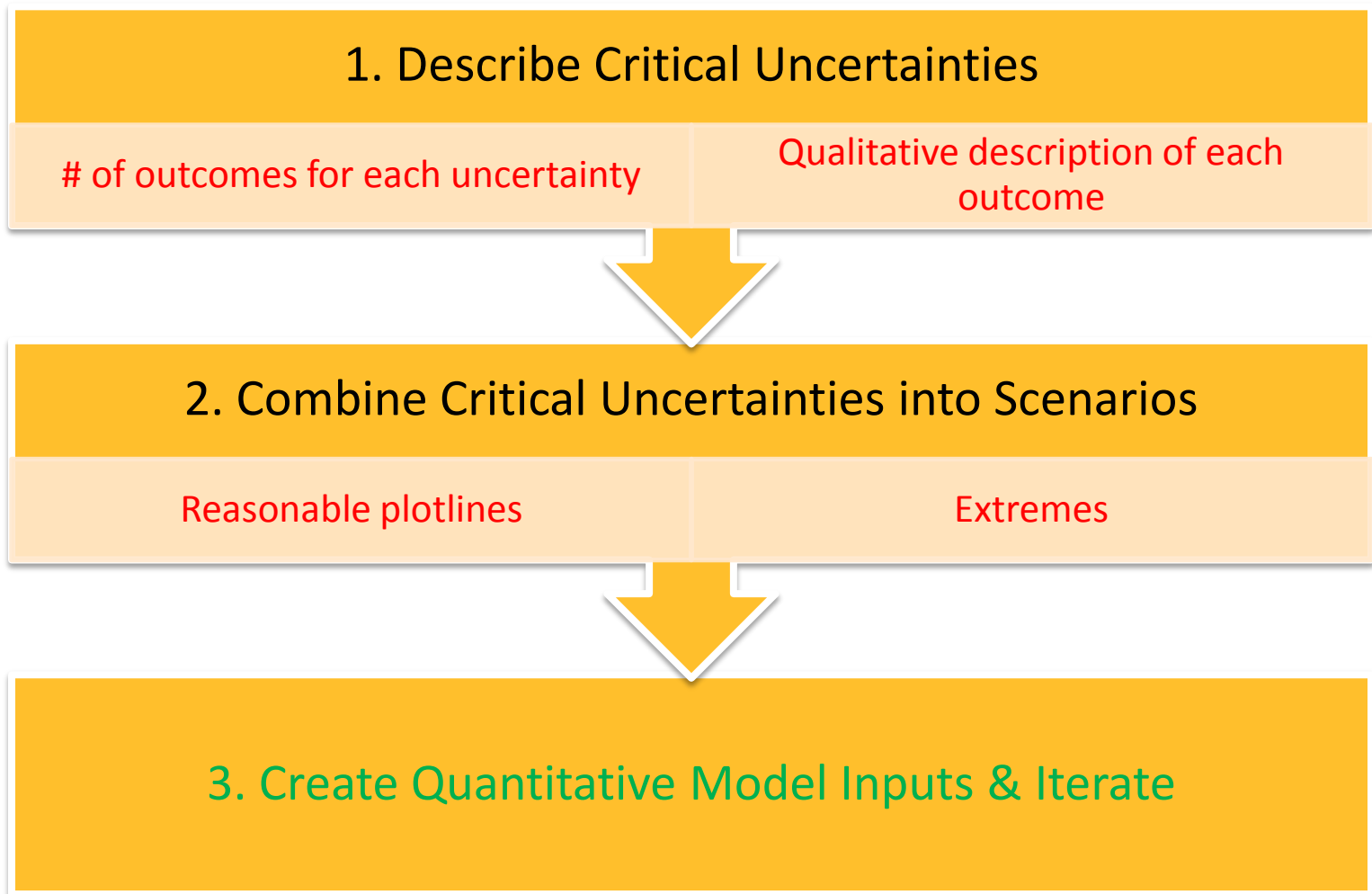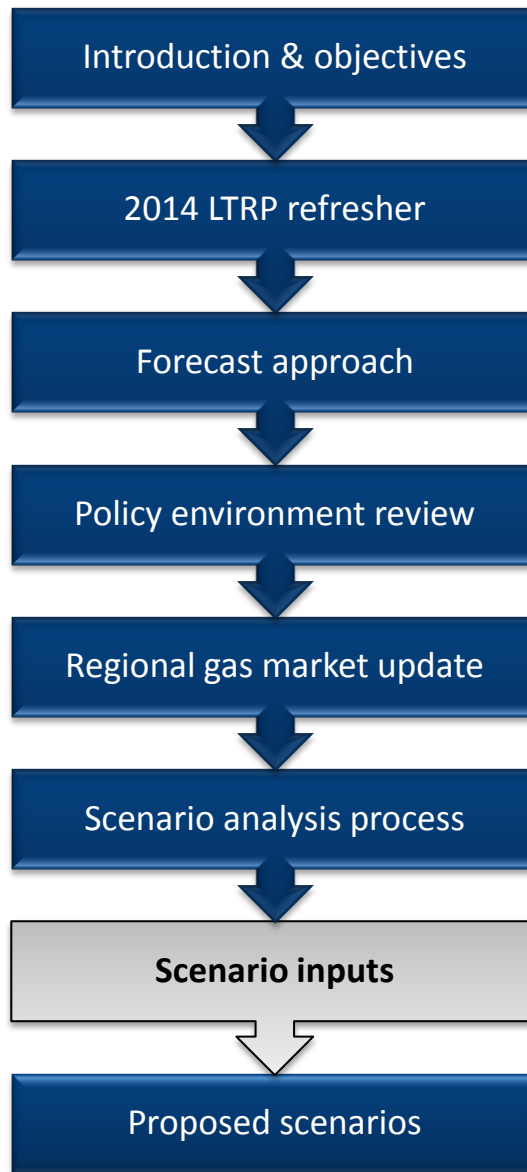
We will include the following critical uncertainties in our scenario analysis

Population Growth

Prices
- Natural gas
- Carbon (driven by policy)

Policy
- Building codes
- Appliance standards

NGT & Regional LNG Demand

LNG Export Demand

RNG Supply & Demand

Critical Uncertainty	Population Growth
Impact on Model	Residential Building Stock
	Commercial Floor Area
	Industrial Floor Area/Consumption
Outcomes	High
	Reference
	Low
Questions to this Group	Alternatives?

Critical Uncertainty	Cost of natural gas
	Cost of carbon
Impact on Model	Building & appliance fuel shares
	UPC
	DSM funding scenarios
	NGT adoption
Outcomes	High
	Reference
	Low
Questions to this Group	Any major concerns?

Critical Uncertainty	Building codes
	Appliance standards
Impact on Model	Building & appliance fuel shares
	Building performance
	Appliance performance
	DSM savings
Outcomes	Accelerated – annual demand ⬇
	Reference
	Delayed – annual demand ⬆
Questions to this Group	Mechanics?
	More delayed scenario?
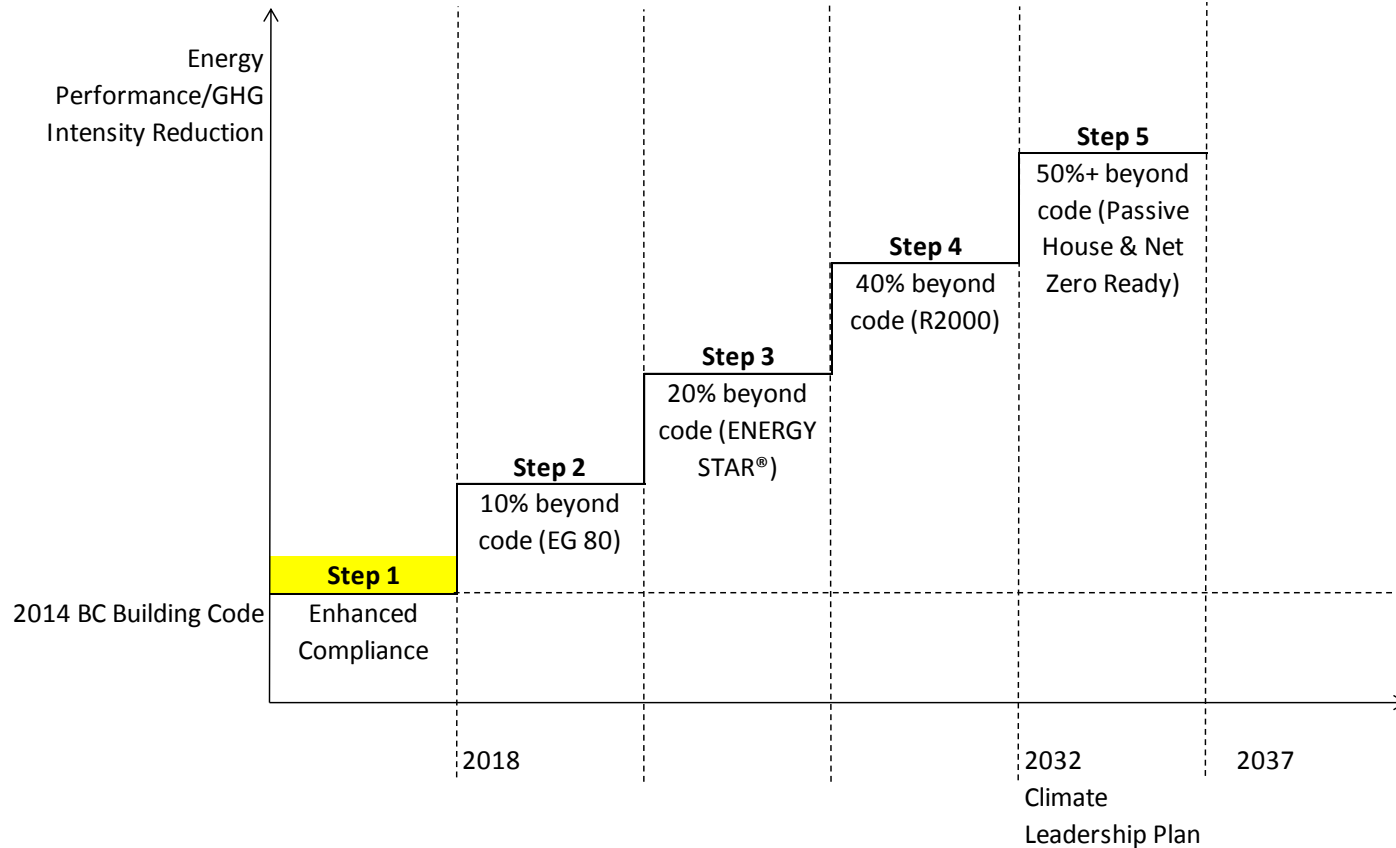
Illustration – Accelerated policy impacts on new buildings

Illustration – Accelerated policy impacts on new buildings

Energy Performance/GHG Intensity Reduction

Step 1 — Enhanced Compliance (2014 BC Building Code)

Step 2 — 10% beyond code (EG 80)

Step 3 — 20% beyond code (ENERGY STAR®)

Step 4 — 40% beyond code (R2000)

Step 5 — 50%+ beyond code (Passive House & Net Zero Ready)

2018

2032 Climate Leadership Plan

2037

Illustration – Accelerated policy impacts on new buildings

Energy Performance/GHG Intensity Reduction

Step 5 — 50%+ beyond code (Passive House & Net Zero Ready)

Step 4 — 40% beyond code (R2000)

Step 3 — 20% beyond code (ENERGY STAR®)

Step 2 — 10% beyond code (EG 80)

Step 1 — Enhanced Compliance

2014 BC Building Code

2018   2032   2037

Climate Leadership Plan

Illustration – Accelerated policy impacts on new buildings

Energy Performance/GHG Intensity Reduction

Step 1 — Enhanced Compliance

2014 BC Building Code

Step 2 — 10% beyond code (EG 80)

Step 3 — 20% beyond code (ENERGY STAR®)

Step 4 — 40% beyond code (R2000)

Step 5 — 50%+ beyond code (Passive House & Net Zero Ready)

2018

2032 — Climate Leadership Plan

2037

Illustration – Accelerated policy impacts on new buildings (<u>commercial</u>)

Energy Performance/GHG Intensity Reduction

MURB only

Step 1
Enhanced Compliance

Step 2
Best Practices (heating 45 kWh/m^2/yr)

Step 3
High Efficiency Building (heating 30 kWh/m^2/yr)

Step 4
Passive House-like performance (heating 15 kWh/m^2/yr)

2014 BC Building Code

2018   2032   2037

Climate Leadership Plan
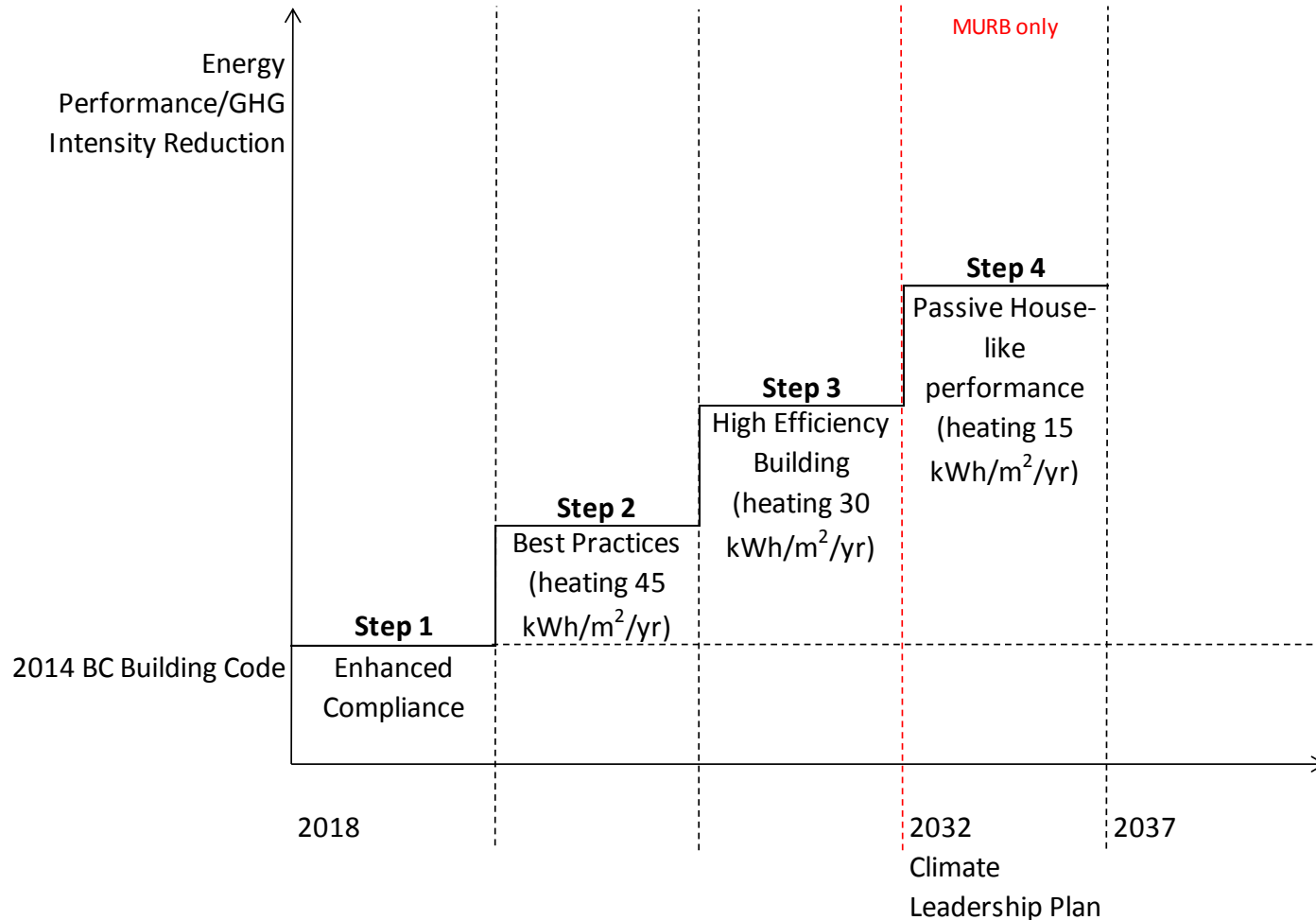
Feedback so far?

Critical Uncertainty	RNG supply and demand	
Impact on Model	GHG intensity	
Outcomes	High	
	Reference	
	Low	
Questions to this Group	Reasons for inclusion?	
	Load loss offset scenarios?	
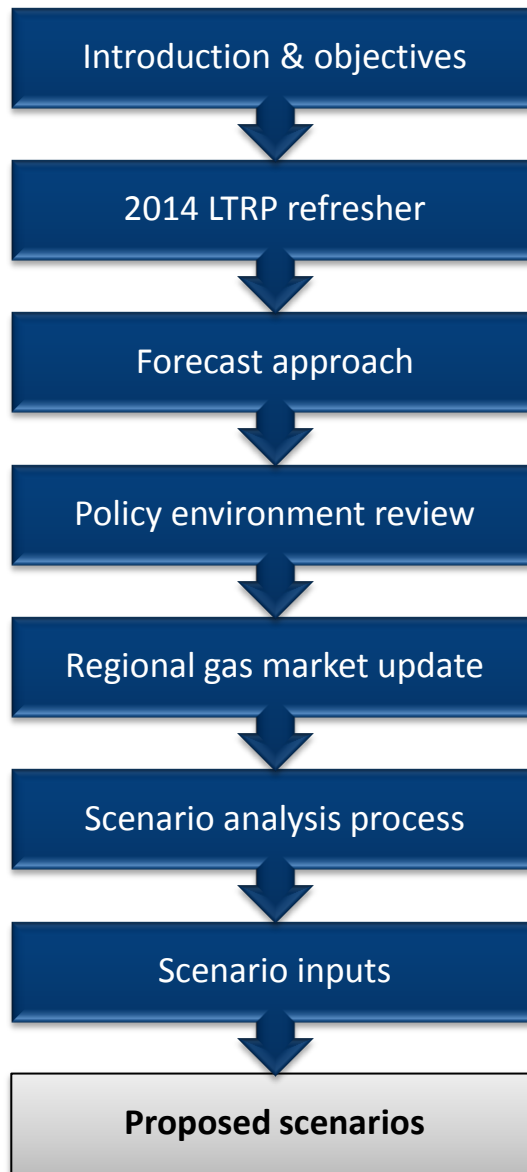
Are the plotlines logical & are any critical scenarios missing?

A	B	C	D	E
Max. Demand	Strong economy	Strong economy	Weak economy	Min. Demand
Strong economy	Constricted supply	Ample supply	Ample supply	Weak economy
Ample supply	Accelerated policy	Accelerated policy	Delayed policy	Constricted supply
Delayed policy				Accelerated policy
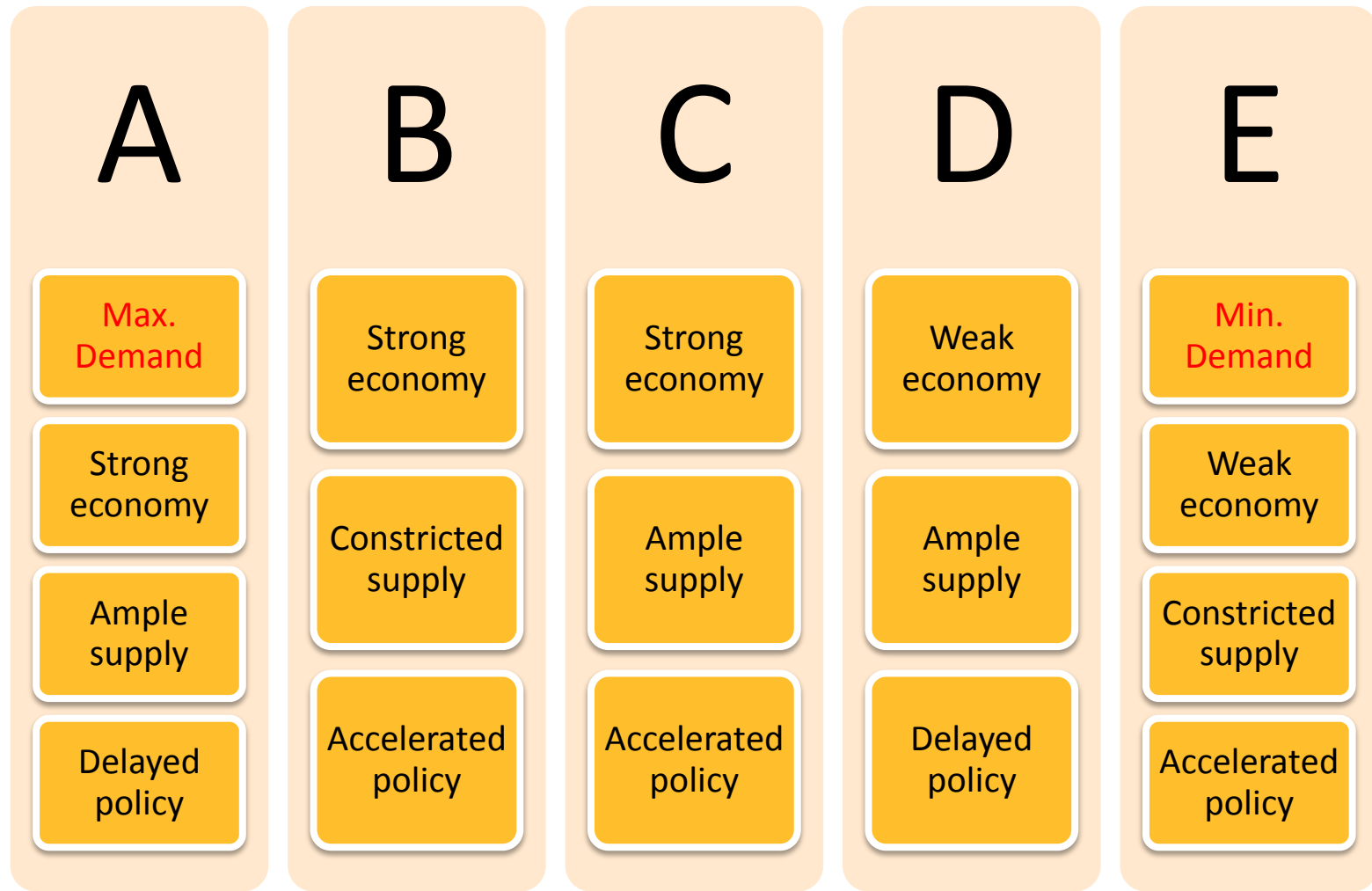
Reference case – enshrined information

Critical Uncertainty	Impact on Demand	Selected Outcome
Population growth	+	Reference
Gas price	-	Reference
Carbon price	-	Reference
Policy	-	Reference
NGT & regional LNG demand	+	Reference
RNG demand & supply	N/A	Reference

Scenario A – max. demand, strong economy, ample supply, delayed policy

Critical Uncertainty	Impact on Demand	Selected Outcome
Population growth	+	High
Gas price	-	Low
Carbon price	-	Reference
Policy	-	Delayed
NGT & regional LNG demand	+	High
RNG demand & supply	N/A	High

Scenario B – strong economy, constricted supply, accelerated policy

Critical Uncertainty	Impact on Demand	Selected Outcome
Population growth	+	High
Gas price	-	High
Carbon price	-	Low
Policy	-	Accelerated
NGT & regional LNG demand	+	High
RNG demand & supply	N/A	High

Scenario C – strong economy, ample supply, accelerated policy

Critical Uncertainty	Impact on Demand	Selected Outcome
Population growth	+	High
Gas price	-	Low
Carbon price	-	High
Policy	-	Accelerated
NGT & regional LNG demand	+	High
RNG demand & supply	N/A	High

Scenario D – weak economy, ample supply, delayed policy

Critical Uncertainty	Impact on Demand	Selected Outcome
Population growth	+	Low
Gas price	-	Low
Carbon price	-	Reference
Policy	-	Delayed
NGT & regional LNG demand	+	Low
RNG demand & supply	N/A	Low

Scenario E – min. demand, weak economy, constricted supply, accelerated policy

Critical Uncertainty	Impact on Demand	Selected Outcome
Population growth	+	Low
Gas price	-	High
Carbon price	-	High
Policy	-	Accelerated
NGT & regional LNG demand	+	Low
RNG demand & supply	N/A	Low

Any scenario questions before we conclude?

Wrap-up & next steps

- Do you have any questions or concerns before we conclude?

- Quantitative forecast work over the winter, will contact you for next meeting

- Preferences on follow-up survey?

- Any preferred dates for next meeting?

Thank you

Energy at work **FORTIS** BC™

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