NW Natural's 2025 IRP- Technical Working Group

TWG #9
Resource Optimization Model
May 29, 2025

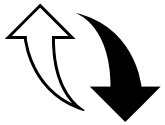
NW Natural®

Today's Agenda

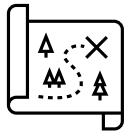
- Logistics
- Recap of TWG 8
- Risk Analysis Overview
- Revisiting TWG #6- Alternative Fuels Assumptions from the ICF Study
- Scenario Deep Dive
- Preferred Resource Strategy
- Lunch Break (12-1pm)
- Monte Carlo Inputs
- Pilot Projects

Facilitator Requests

Engage constructively and courteously towards all participants



Take space and make space



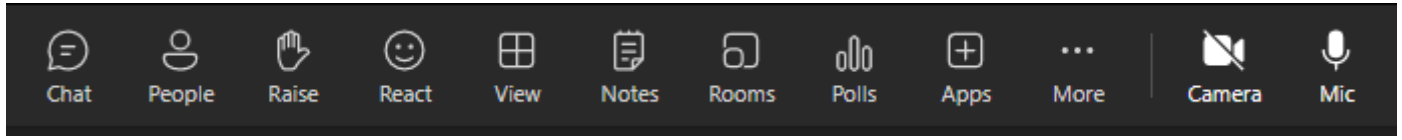
Respect the role of the facilitator to guide the group process

Avoid use of acronyms and help each other understand

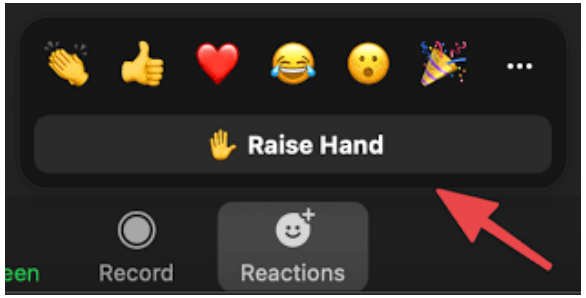
Aim to focus on the meeting topic

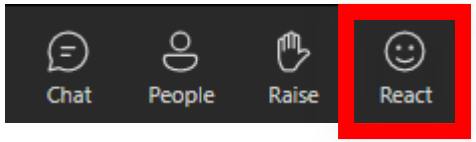
How to Interact in a Teams Meeting

- Participant Controls are at the top or bottom of your screen

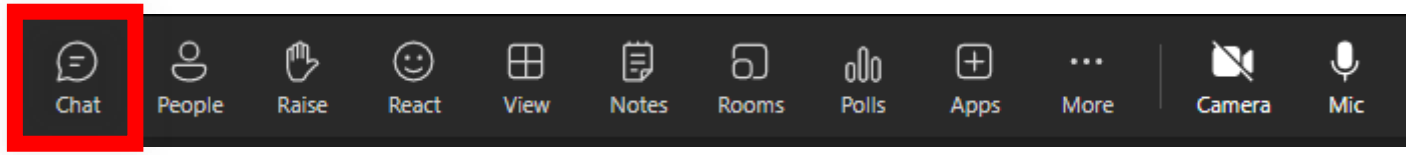


- Ask a question or comment at any time using the “raised hand”





- You may also use the chat box



A member of the IRP team will monitor the chat, and participant list for raised hands during the meeting.

Meeting Best Practices – virtual spaces

To maintain an engaged and productive space, please:

Mute your mic unless asking a question and/or providing comment

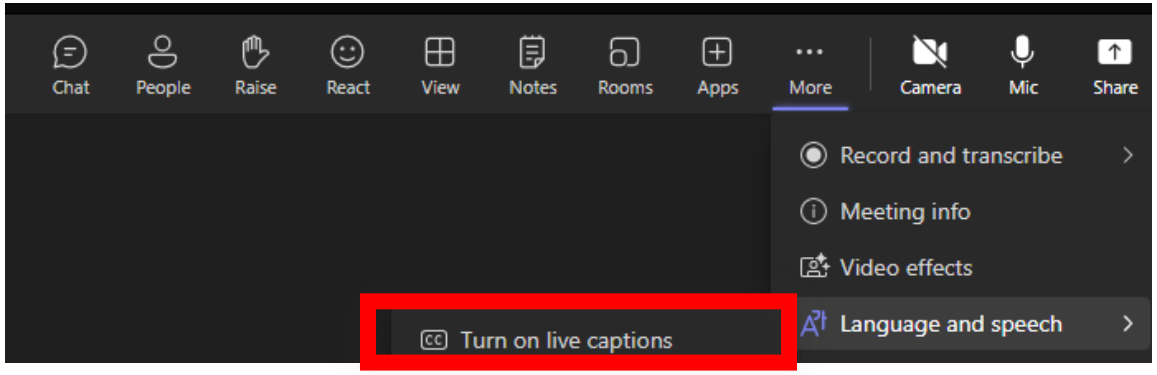
Turn your camera on when speaking (if you are comfortable and your bandwidth allows)

Limit side conversations in the chat

Make efforts to adhere to the meeting schedule

Teams Meeting – Accessibility Functions

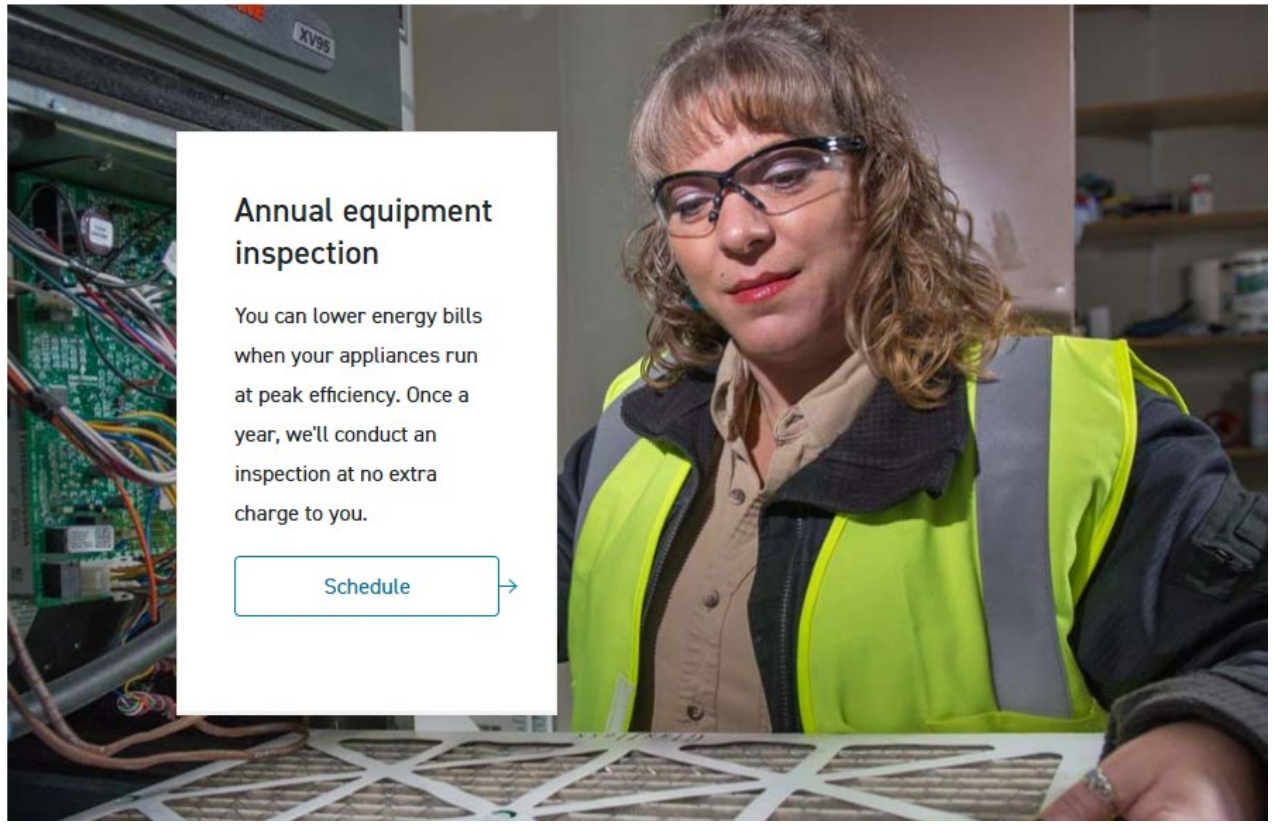
- Live Captions - real-time auto-generated text of what is said in a meeting. They appear a few lines at a time for a user who has turned them on, and aren't saved



- Reducing Distractions and Customizing Views:
  - Microsoft Teams has a variety of features to support different learning styles, please find reference material for:
    - Turn on live captions during meetings
    - Customize your meeting view
    - Change background effects in Teams meetings
    - Reduce background noise in Teams meetings
    - 5 tips for using Teams when you're deaf or hard of hearing
- Meeting Recordings:
  - NW Natural will record IRP virtual meetings and will post them to the NW Natural website on the resource planning webpage

Two Minutes for Safety

Annual Equipment Inspection



- Free inspection offered once per year to residential and business customers
- Assistance and support to ensure gas equipment operates safely & efficiently
  - Help with new equipment
  - Inoperative or broken equipment
  - Evaluation of efficiency
  - Conservation & energy use

Recap April 8 TWG

- Gained a shared understanding distribution planning process, tools, alternatives analysis, and weather planning.
- Reviewed areas that were identified as potentially needing some system reinforcements in the future
- Answered clarifying questions about:
  - Peak hour methodology and finding
  - Range of non-pipeline solutions considered
  - Cost effectiveness of non-pipeline solutions

▷ ▶ Today's objectives

- Gain a shared understanding of resource optimization model
- Review two pilot projects for inclusion in the 2025 IRP
- Answer clarifying questions

Current Technical Working Group Schedule

TWG No.	Date	Type & Purpose of Engagement
TWG#1	Oct 22, 2024	Planning Environment
TWG#2	Nov 1, 2024	Scenarios
TWG#3	Nov 21, 2024	Scenarios Cont. and Climate
TWG#4	Dec 17, 2024	Load Forecast
TWG#5	Jan 21, 2025	Avoided Costs & Demand-Side Resource
TWG#6	Jan 28, 2025	Supply-Side & Compliance Resources
TWG#7	Repurposed	Repurposed for Office Hours
Office Hours	April 1, 2025	Electrification Study – follow up from TWGs
TWG#8	Apr 8, 2025	Distribution System Planning
TWG#9	May 29, 2025	Resource Optimization Planning Model
TWG#10	June 26, 2025	Portfolio Results and Action Plan
File Draft – flight 1	June 13, 2025	Comments due by July 11th
File Draft – flight 2	June 20, 2025	Comments due by July 11th
File 2025 IRP	**Aug 1, 2025**	**Beginning of formal process**

- All TWGs will be facilitated and virtual
- Dates and topics are tentative and subject to change
- Please refer to website for most up to date information: IRP Website
- The Draft IRP will be posted to the website upon release

Other Public Engagement Opportunities

Public Engagement Opportunity & Topic	Date	Type & Purpose of Engagement
Energy Resource (IRP) Fair #1:	November 16, 2024	**In-Person Only. Opportunity to learn and engage on IRPs and Energy Services & Programs. Event to be held in collaboration with community partners.** **Parkrose High School from 11:00am to 2:00pm**
Public Engagement Webinar #1:	March 5, 2025	**Opportunity to learn and engage on an IRP and key topics previously presented and related to resource planning and utility energy services.**
Energy Planning-Events Engagement:	June 7, 2025	**In-Person Only. Opportunity to learn about Energy Planning, Services & Programs. Events to be held in collaboration with community partners.** **1303 NE 136th St Vancouver from 12:00 to 3:00pm**

- Please check our dedicated IRP website for the most current information:

  IRP Website
- Feedback form direct link: Feedback Form
- Email us at IRP@nwnatural.com

Risk Analysis Overview

System Planning in NW Natural's IRP

We use PLEXOS software for our resources planning optimization model.

PLEXOS is a linear program (LP) that selects the least costs resources that meet peak design day capacity, total annual energy, and emissions compliance requirements

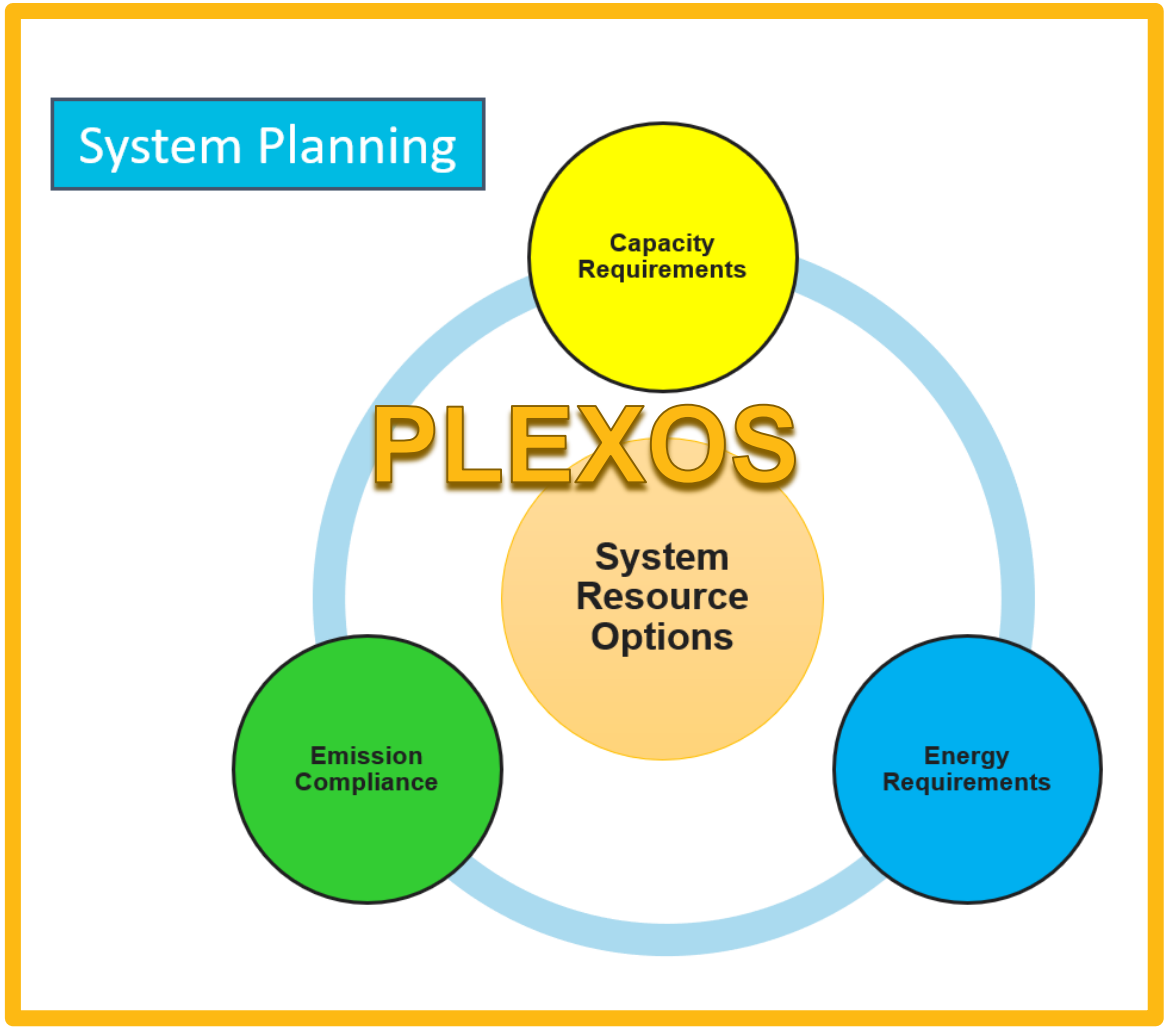
Objective Function of PLEXOS

$$Minimize \sum NPV(Cost_t)$$

We use PLEXOS to evaluate supply-side and compliance resources.

Demand-side resources such as energy efficiency and demand response are evaluated using avoided costs and decremented from the load forecasts.

Electrification is being evaluated through scenario analysis with the work being done by ICF.

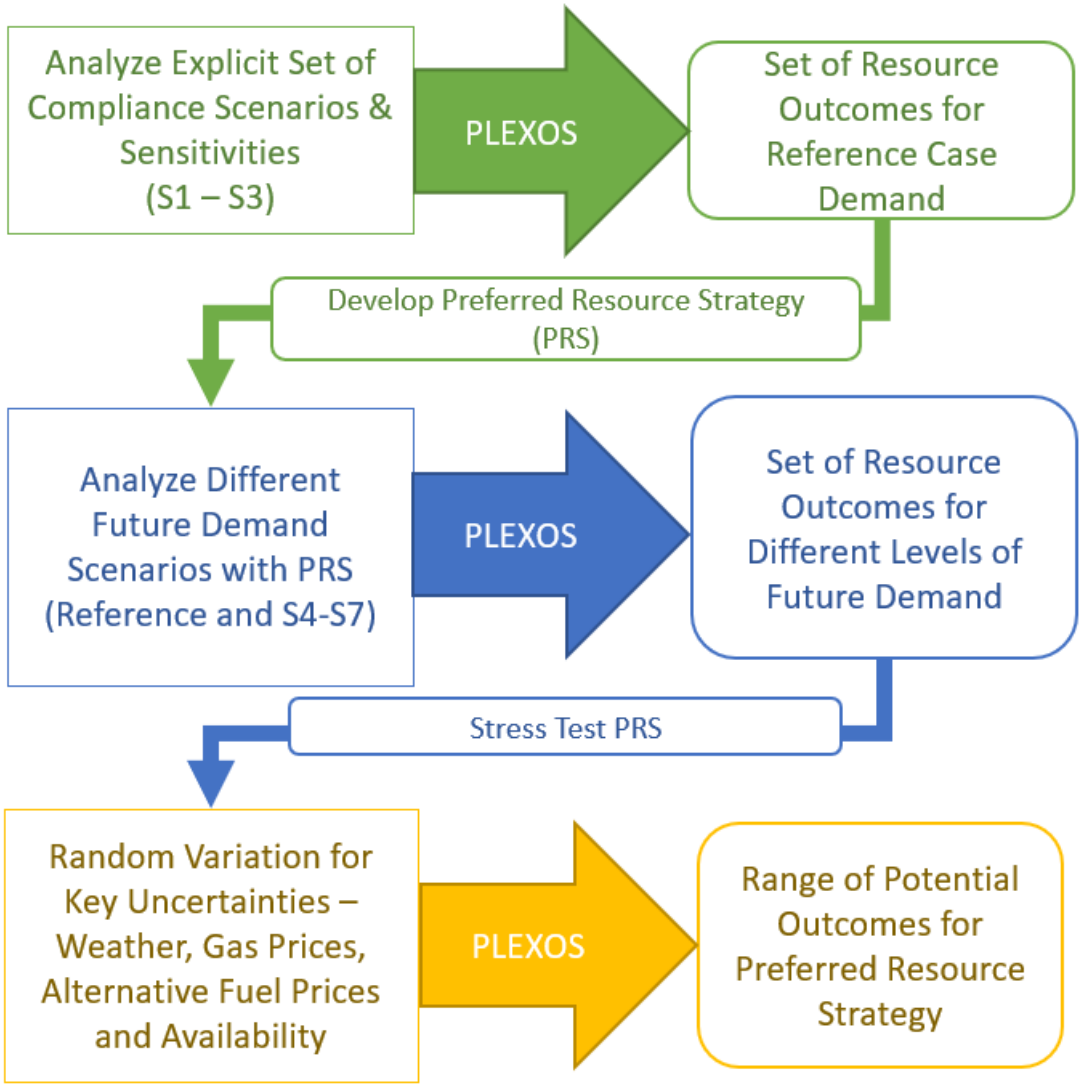


Primary Scenarios

- Scenario numbers S1-S3 (policy variations), S4-S7 (demand variations), and the acronym “PRS” (preferred resource strategy) are used to distinguish the major differences between primary scenarios.
- Lettering (a through e) are used for further distinguishing of additional sensitivities analyzed within a primary scenario for S1, S2, and PRS to gain further insights.
- For example, S1.a is the first sensitivity that examines CPP/CCA compliance.
- Compliance resources vary across all scenarios, however; scenarios with the same levels of demand will have the same system capacity and energy resources.
- Today will only be focusing on compliance resources, capacity and energy resources will be covered in the next TWG

Policy Variations	S1	CPP/CCA Compliance	Eligible resources are acquired to meet CPP and CCA compliance. No SB 98 or HB 1257 targets are considered.
	S2	Voluntary RNG Targets	SB 98 eligible resources are acquired to meet voluntary SB 98 targets. Required by Oregon Administrative Rule 860-150-0100 to be studied in an IRP; Applies to WA for voluntary RNG under HB 1257. This scenario examines meeting SB 98 targets absent CPP or CCA policy.
	S3	No GHG Compliance Policies	Consider current building codes but is absent CPP/CCA or RNG procurement policies; customers are served with the lowest cost resources.
Demand Variations	PRS	Reference Case	Baseline of reference case load forecast and preferred resource strategy constraints.
	S4	Growth Recovery	Population and housing trends experience higher growth patterns than the reference case.
	S5	Modest Customer Electrification	Aims to align with trends from NEEA-RBSA, projections from electric utilities of existing buildings electrifying, and limitations on natural gas in new construction buildings.
	S6	Hybrid System Electrification	Hybrid systems [electric heat pump with gas furnace as back up] are installed in existing buildings and new construction based on stock turn-over.
	S7	All-Electric Buildings	Significant levels of building electrification of existing buildings and new construction based on stock turn-over.

Preferred Resource Strategy (PRS) Risk Analysis



Revisiting TWG #6: ICF Alternative Fuels Assumptions

Category	Resource Name	Location	Count
RNG	LFG 1	National	1
RNG	LFG 2	National	2
RNG	LFG 3	National	3
RNG	LFG 4	National	4
RNG	LFG 5	National	5
RNG	LFG 1	NW	6
RNG	LFG 2	NW	7
RNG	LFG 3	NW	8
RNG	LFG 4	NW	9
RNG	LFG 5	NW	10
RNG	AM 1	National	11
RNG	AM 2	National	12
RNG	AM 3	National	13
RNG	AM 4	National	14
RNG	AM 5	National	15
RNG	AM 1	NW	16
RNG	AM 2	NW	17
RNG	AM 3	NW	18
RNG	AM 4	NW	19
RNG	AM 5	NW	20
RNG	WW 1	National	21
RNG	WW 2	National	22
RNG	WW 3	National	23
RNG	WW 4	National	24
RNG	WW 5	National	25
RNG	WW 1	NW	26
RNG	WW 2	NW	27
RNG	WW 3	NW	28
RNG	WW 4	NW	29
RNG	WW 5	NW	30
RNG	FW 1	National	31
RNG	FW 2	National	32
RNG	FW 3	National	33
RNG	FW 1	NW	34
RNG	FW 2	NW	35
RNG	FW 3	NW	36
Hydrogen	GHW	National	37
Hydrogen	GHW	NW	38
Hydrogen	GHS	National	39
Hydrogen	GHS	NW	40
Hydrogen	BH	National	41
Hydrogen	BH	NW	42
Hydrogen	TH	National	43
Hydrogen	TH	NW	44
Synthetic Methane	Biomass-1	National	45
Synthetic Methane	Biomass-2	National	46
Synthetic Methane	Biomass-3	National	47
Synthetic Methane	Biomass-1	NW	48
Synthetic Methane	Biomass-2	NW	49
Synthetic Methane	Biomass-3	NW	50
Synthetic Methane	GHW-BiogenicCO2	National	51
Synthetic Methane	GHW-CCS1	National	52
Synthetic Methane	GHW-CCS2	National	53
Synthetic Methane	GHW-DAC	National	54
Synthetic Methane	GHS-BiogenicCO2	National	55
Synthetic Methane	GHS-CCS1	National	56
Synthetic Methane	GHS-CCS2	National	57
Synthetic Methane	GHS-DAC	National	58
Synthetic Methane	GHW-BiogenicCO2	NW	59
Synthetic Methane	GHW-CCS1	NW	60
Synthetic Methane	GHW-CCS2	NW	61
Synthetic Methane	GHW-DAC	NW	62
Synthetic Methane	GHS-BiogenicCO2	NW	63
Synthetic Methane	GHS-CCS1	NW	64
Synthetic Methane	GHS-CCS2	NW	65
Synthetic Methane	GHS-DAC	NW	66
CCUS	CCUS-1	NW	67
CCUS	CCUS-2	NW	68
CCUS	CCUS-3	NW	69
CCUS	CCUS-4	NW	70
CCUS	CCUS-5	NW	71
CCUS	CCUS-6	NW	72
CCUS	CCUS-11	NW	73

Alternative Fuels Study To PLEXOS Modeling

ICF Alt Fuels Study to PLEXOS RESOURCES

73 to 24

Category	Type	Costs Differentiation	
Near Term RTC Opportunities	Short Term Contracts	Low Cost	1
		High Cost	2
	Long Term Contracts	Low Cost	3
		High Cost	4
Long Term RTC Opportunities	RTC Purchases	Base Cost	5
Renewable Natural Gas	Land Fill Gas	Low Cost	6
		Mid Cost	7
		High Cost	8
	Animal Manure	Low Cost	9
		High Cost	10
	Wastewater	Low Cost	11
		High Cost	12
	Food Waste	Low Cost	13
		High Cost	14
Hydrogen	Green from Solar	Base Cost	15
	Green from Wind	Base Cost	16
	Blue Hydrogen	Base Cost	17
	Turquoise Hydrogen	Base Cost	18
Synthetic Methane	Biomass	Low Cost	19
		High Cost	20
	Green from Solar	Base Cost	21
	Green from Wind	Base Cost	22
Carbon Capture Utilization and Storage	Industrial Customers	Base Cost	23
	Direct Air Capture	Base Cost	24

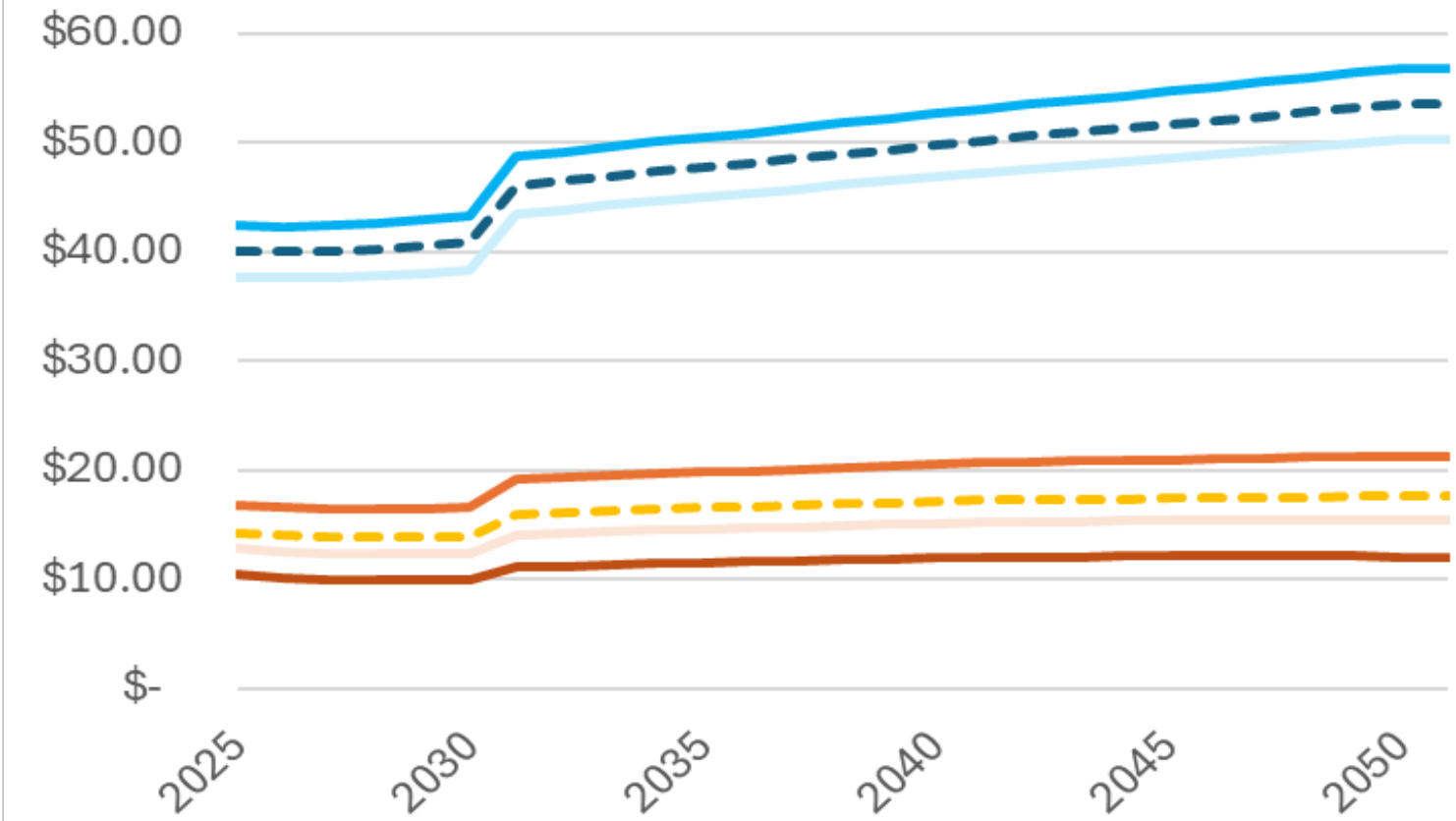
NOTE: We had 4 categories in the last IRP

Alternative Fuels and Carbon Capture for IRP Analysis

- For IRP Modeling through the Resource Optimization Planning Model, we need to bucket resources to a reasonable number of proxy resources for evaluation
- We have 24 separate buckets of compliance resources
- Summing quantities that would be available to NW Natural
    - 33% of Pacific Northwest Numbers and 33% of downscaled National Numbers
- Pricing is based on weighted averages from the more granular types/project sizes provided by ICF models

Category	Type	Costs Differentiation	
Near Term RTC Opportunities	Short Term Contracts	Low Cost	1
		High Cost	2
	Long Term Contracts	Low Cost	3
		High Cost	4
Long Term RTC Opportunities	RTC Purchases	Base Cost	5
Renewable Natural Gas	Land Fill Gas	Low Cost	6
		Mid Cost	7
		High Cost	8
	Animal Manure	Low Cost	9
		High Cost	10
	Wastewater	Low Cost	11
		High Cost	12
	Food Waste	Low Cost	13
		High Cost	14
Hydrogen	Green from Solar	Base Cost	15
	Green from Wind	Base Cost	16
	Blue Hydrogen	Base Cost	17
	Turquoise Hydrogen	Base Cost	18
Synthetic Methane	Biomass	Low Cost	19
		High Cost	20
	Green from Solar	Base Cost	21
	Green from Wind	Base Cost	22
Carbon Capture Utilization and Storage	Industrial Customers	Base Cost	23
	Direct Air Capture	Base Cost	24

Example: Wastewater RNG Gas (Bundled Product)

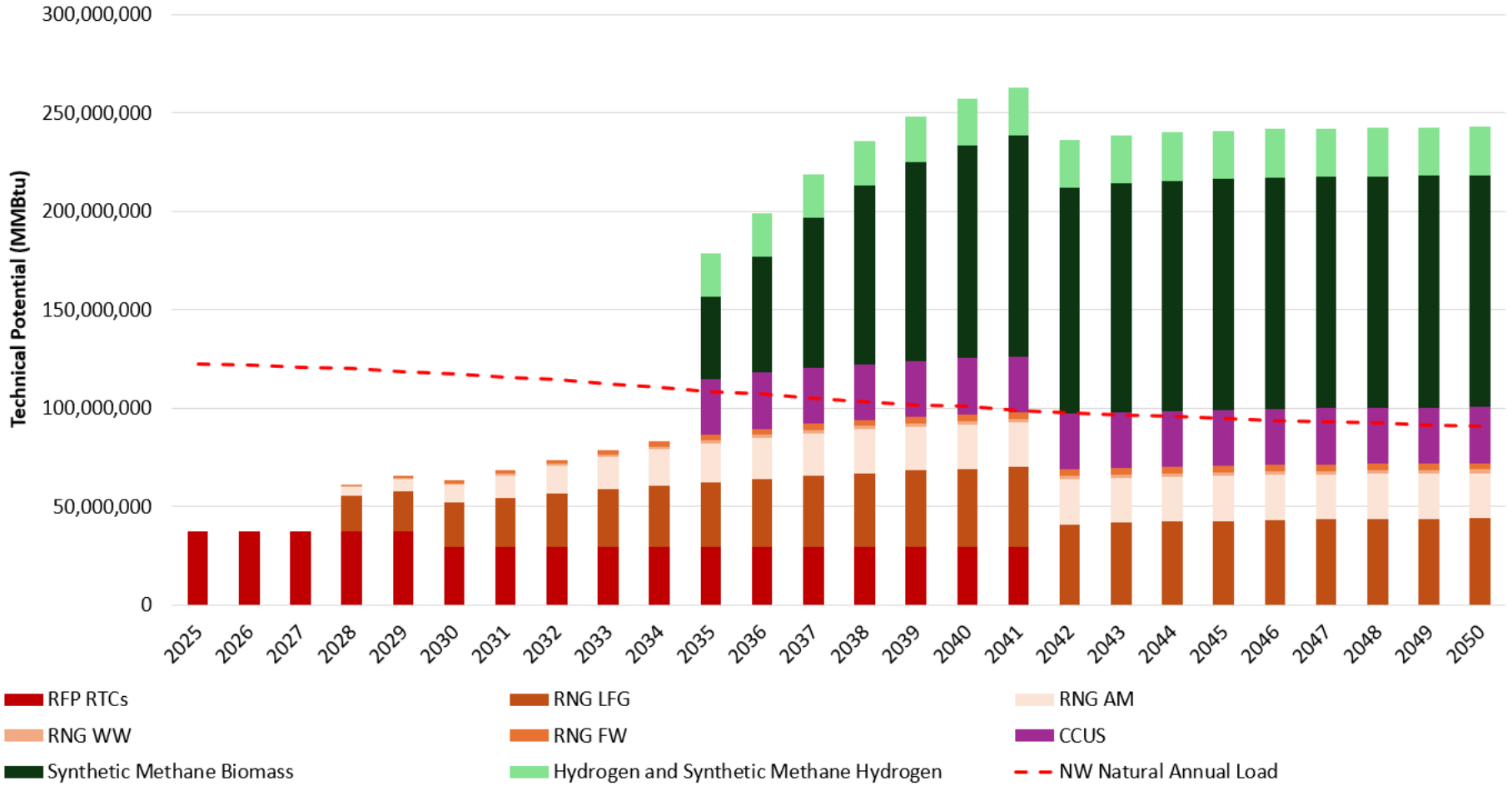


- Prices for alternative fuels are for a bundled product (i.e., environmental attributes plus commodity)
- A forecasted Henry Hub price is subtracted out to get an equivalent unbundled price for comparison with other unbundled compliance instruments

WW1 WW2 WW3 WW4 WW5 ⇨ From ICF's Models

WW_High WW_Low ⇨ Weighted Average for PLEXOS

Alternative Fuel and CCUS Quantities



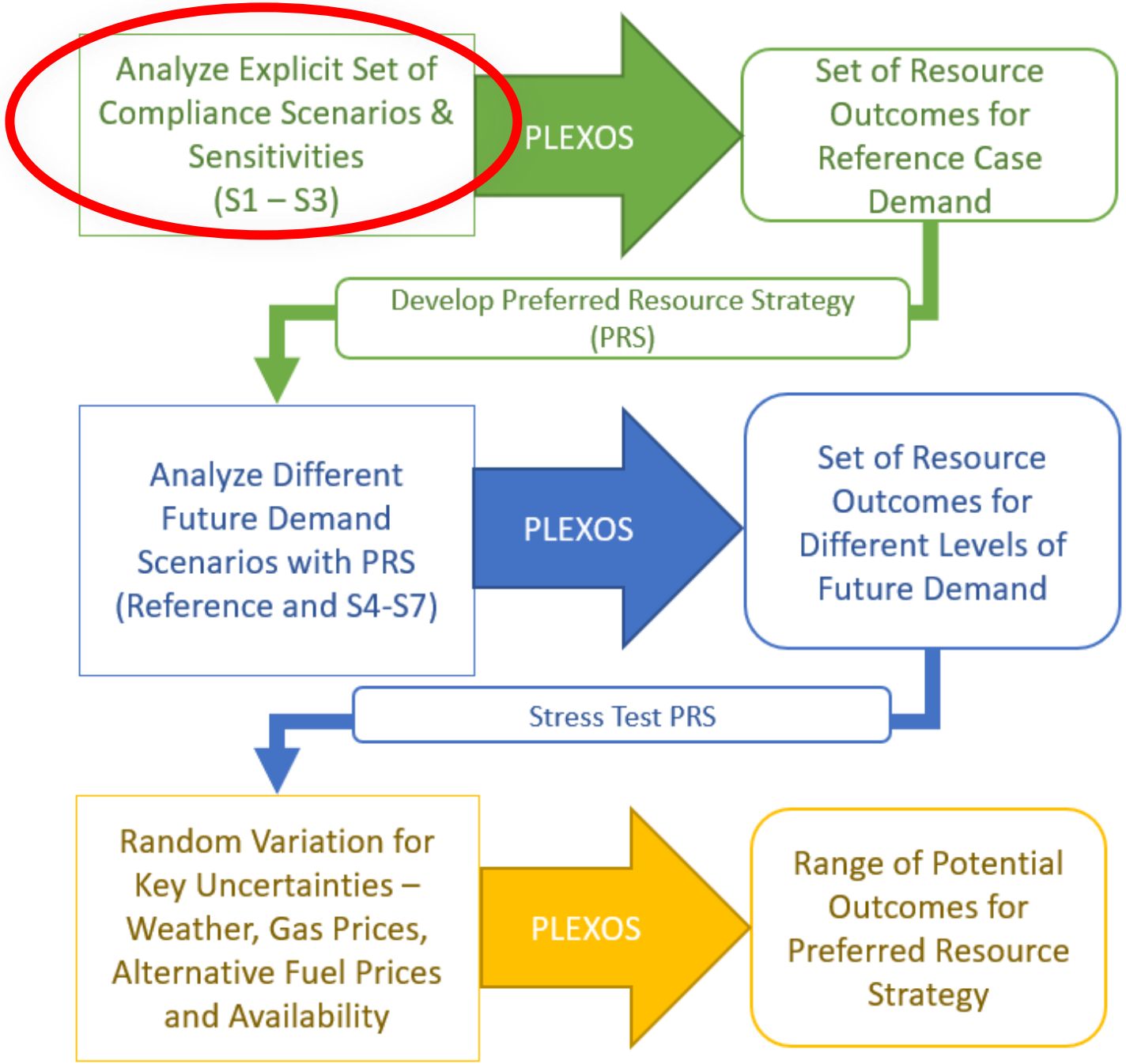
- Quantities have been downscaled to what could be available to NW Natural
- Hydrogen is capped at 20% of load by energy
- This accounts for both blending some hydrogen into the system and industrial customers using 100% hydrogen
- Synthetic Methane from Green Hydrogen is capped at the volumes available for green hydrogen (wind or solar respectively). PLEXOS further constrains the model that the sum of the two (Synthetic Methane and Hydrogen) is also capped at the volumes for Green Hydrogen.

Policy Variations

Scenario 1 (S1)
CPP/CCA Compliance Variations

S1 Sensitivities

S1: CPP/CCA Compliance Sensitivities		
S1.a	Low-cost Compliance	This is the least constrained model and sets the lower bound of CPP/CCA compliance costs.
S1.b	Mid-cost Compliance	This sensitivity sets constraints on key resources that can drive higher compliance costs.
S1.c	High-cost Compliance	This sensitivity sets further constraints on key resources that can drive compliance costs higher and sets an upper-bound of CPP/CCA compliance costs.
S1.d	RTC Dependence	This sensitivity sets constraints on development projects not to be available until 2035. Synthetic Methane from Biomass is not available.
S1.e	No CPP Instrument Banking	This sensitivity does not allow banking of DEQ Distributed Allowances across compliance periods. This restricts purchasing CCIs to meet the CPP compliance within a compliance period and does not allow for purchasing CCIs in advance of need to bank DEQ instruments for later use.


Analyze Explicit Set of Compliance Scenarios & Sensitivities (S1 – S3)
PLEXOS
Set of Resource Outcomes for Reference Case Demand
Develop Preferred Resource Strategy (PRS)
Analyze Different Future Demand Scenarios with PRS (Reference and S4-S7)
PLEXOS
Set of Resource Outcomes for Different Levels of Future Demand
Stress Test PRS
Random Variation for Key Uncertainties – Weather, Gas Prices, Alternative Fuel Prices and Availability
PLEXOS
Range of Potential Outcomes for Preferred Resource Strategy

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S1.a: Low-Cost Compliance

Model Parameters

CCA Compliance

- Low CCA Allowance Price forecast from cCarbon
- Offsets available at full quantity; 8% of the obligation in each year for the first compliance period and 6% starting in 2027 for the rest of the planning horizon

CPP Compliance

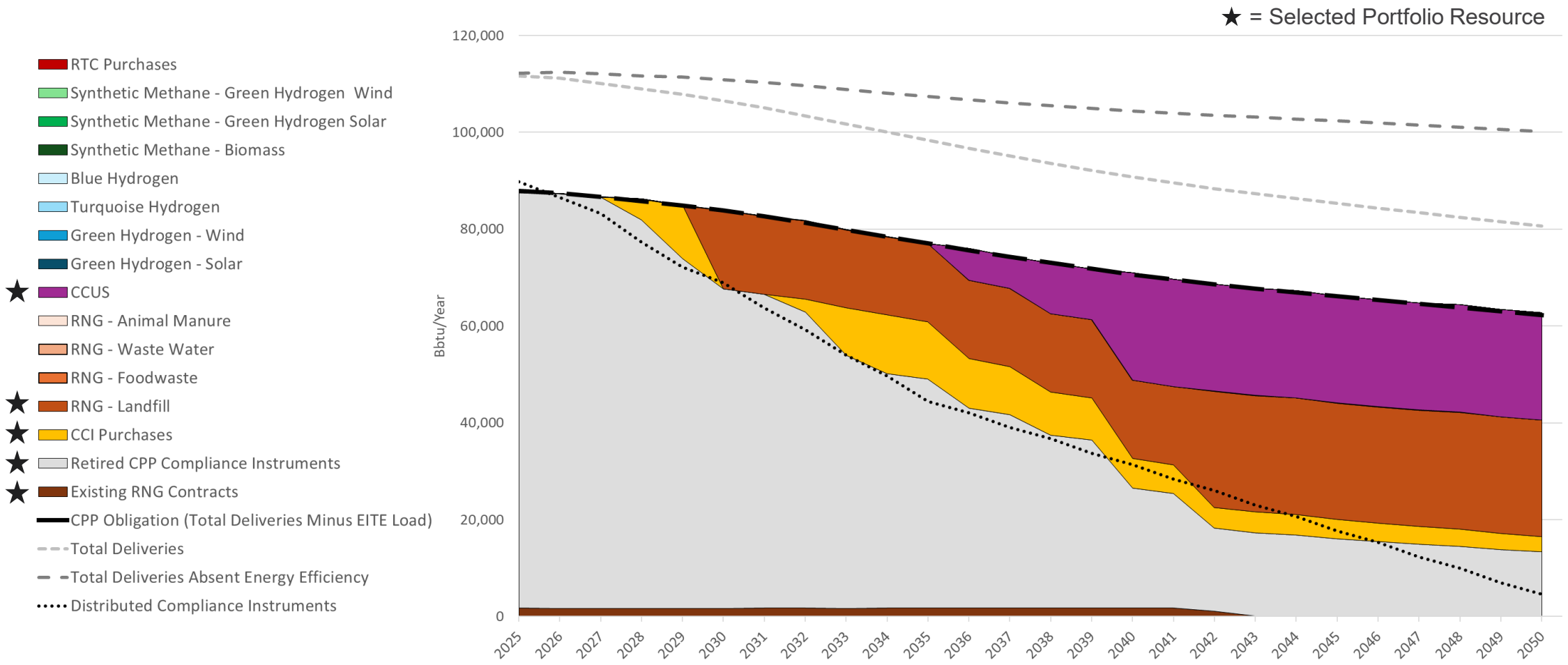
- CCI purchases are available starting in 2026

Alt Fuels/RTCs/CCUS

- Access to all alternative fuels as specified in the alternative fuels work and aggregated to buckets used for PLEXOS modeling; this includes low-cost LFG RNG projects and the full amount of CCUS
- RNG is available in 2028
- Hydrogen, Synthetic Methane, and CCUS are not available until 2035

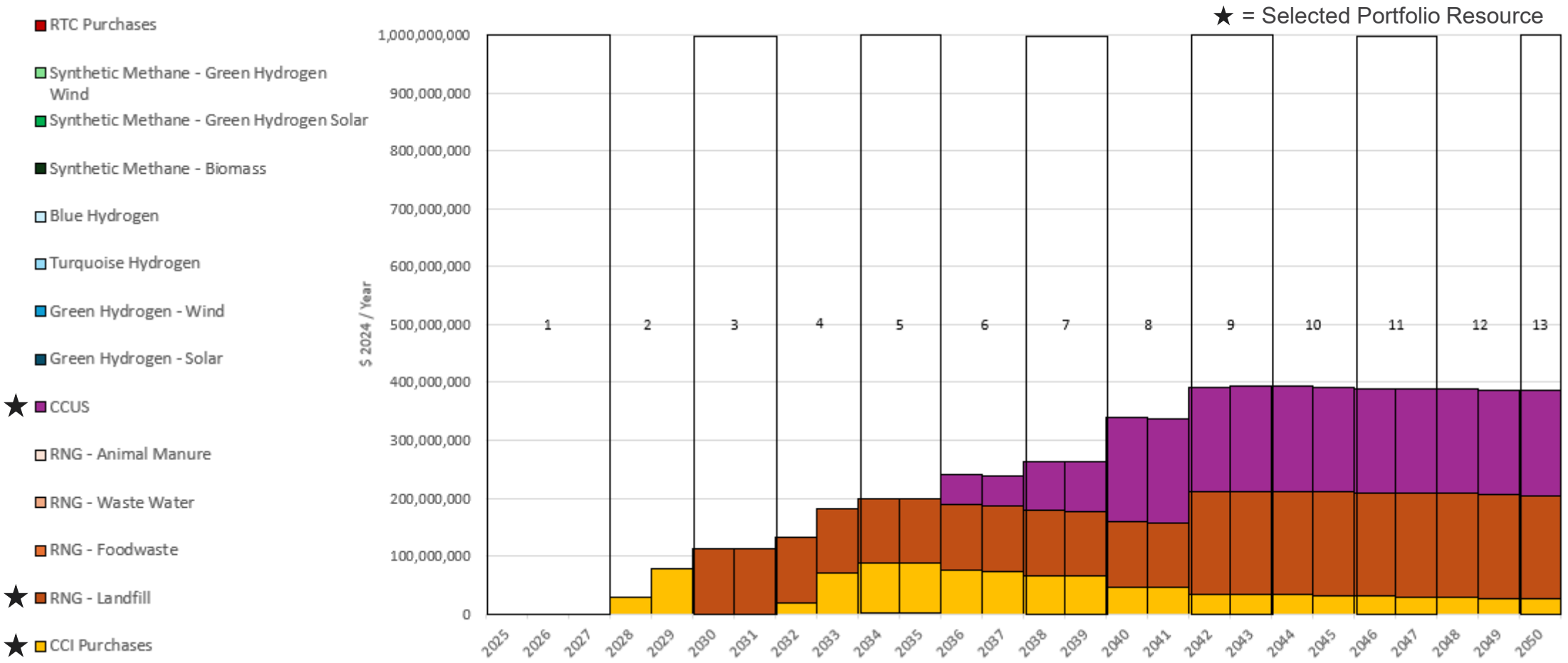
S1.a: Low-Cost Compliance

CPP Compliance



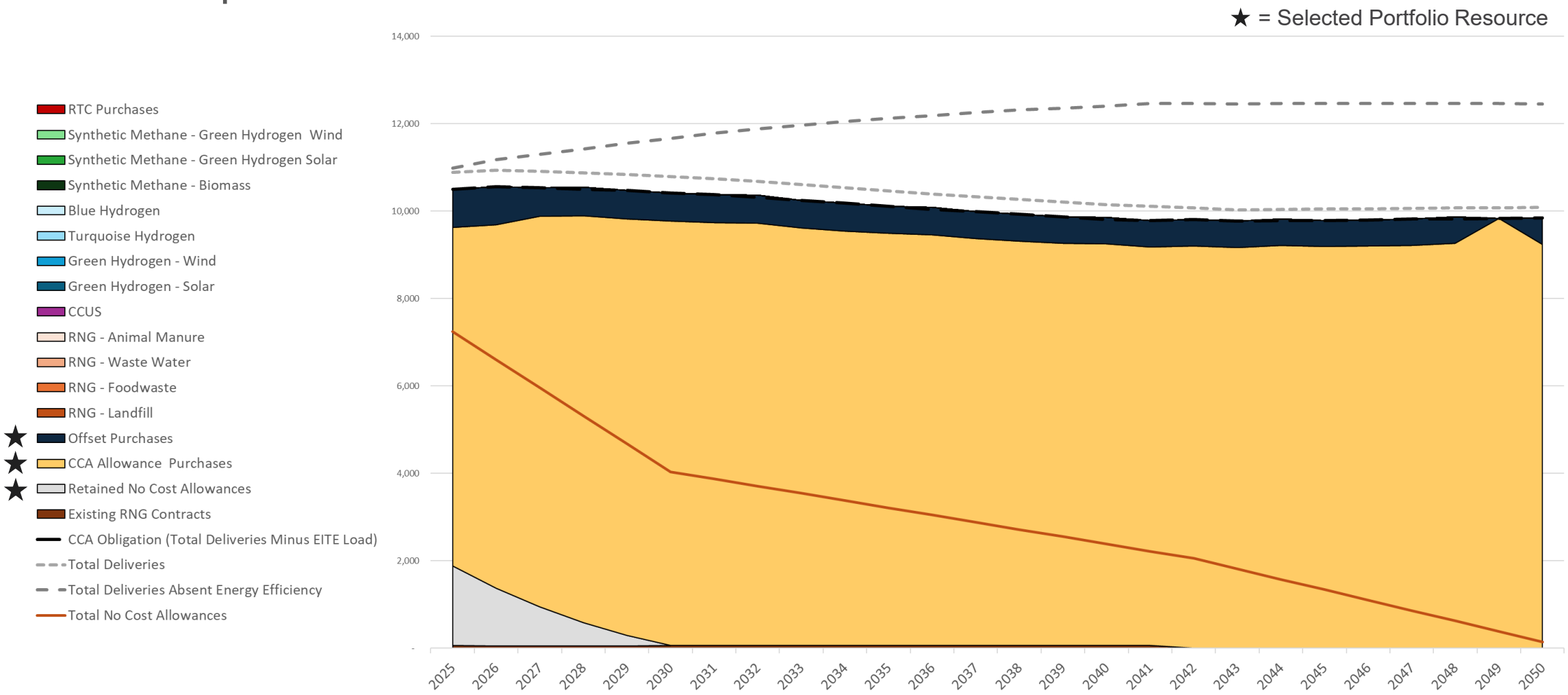
S1.a: Low-Cost Compliance

Annual Compliance Cost By Year and CPP Compliance Period



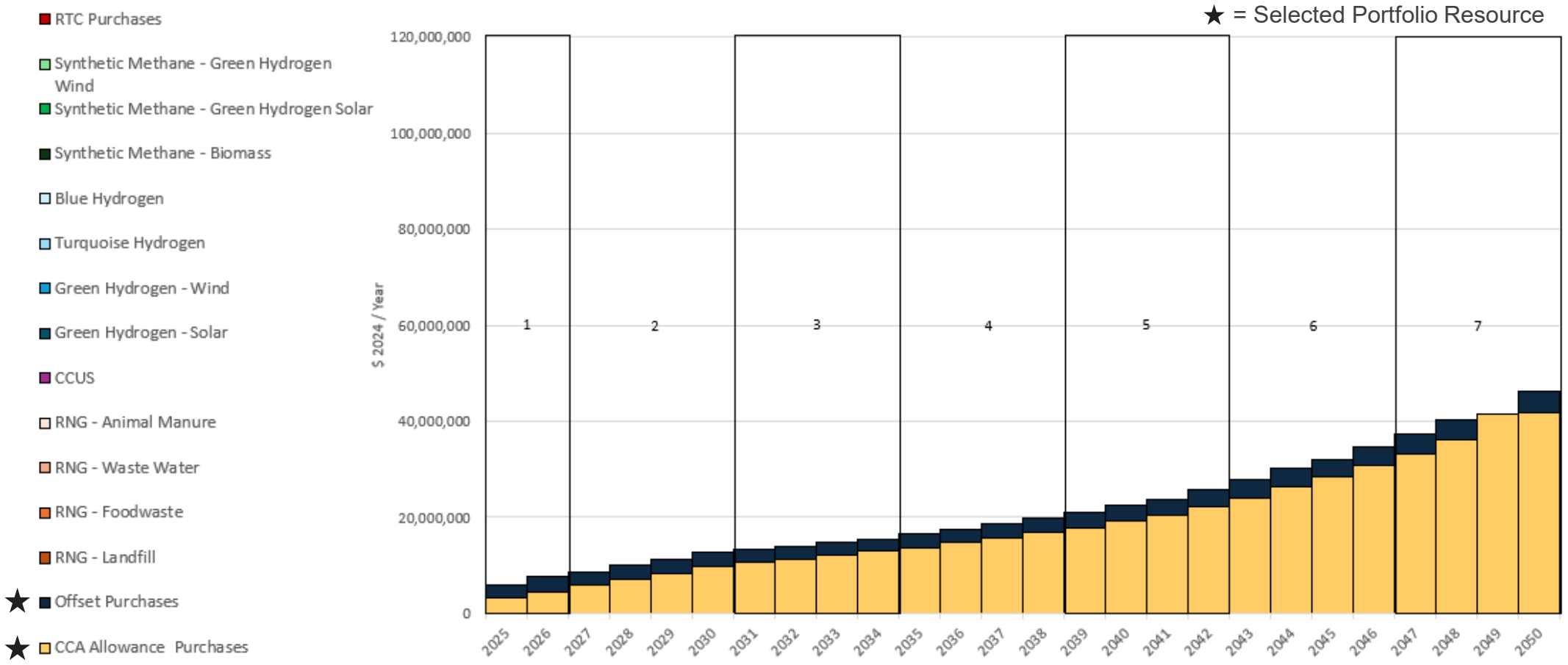
S1.a: Low-Cost Compliance

CCA Compliance



S1.a: Low-Cost Compliance

Annual Compliance Cost By Year and CCA Compliance Period



S1.b: Mid-Cost Compliance

Model Parameters

CCA Compliance

- cCarbon Allowance price forecast for the linked scenario
- Offsets are not available until 2027
- Offsets are limited to 3% of obligation in each year

CPP Compliance

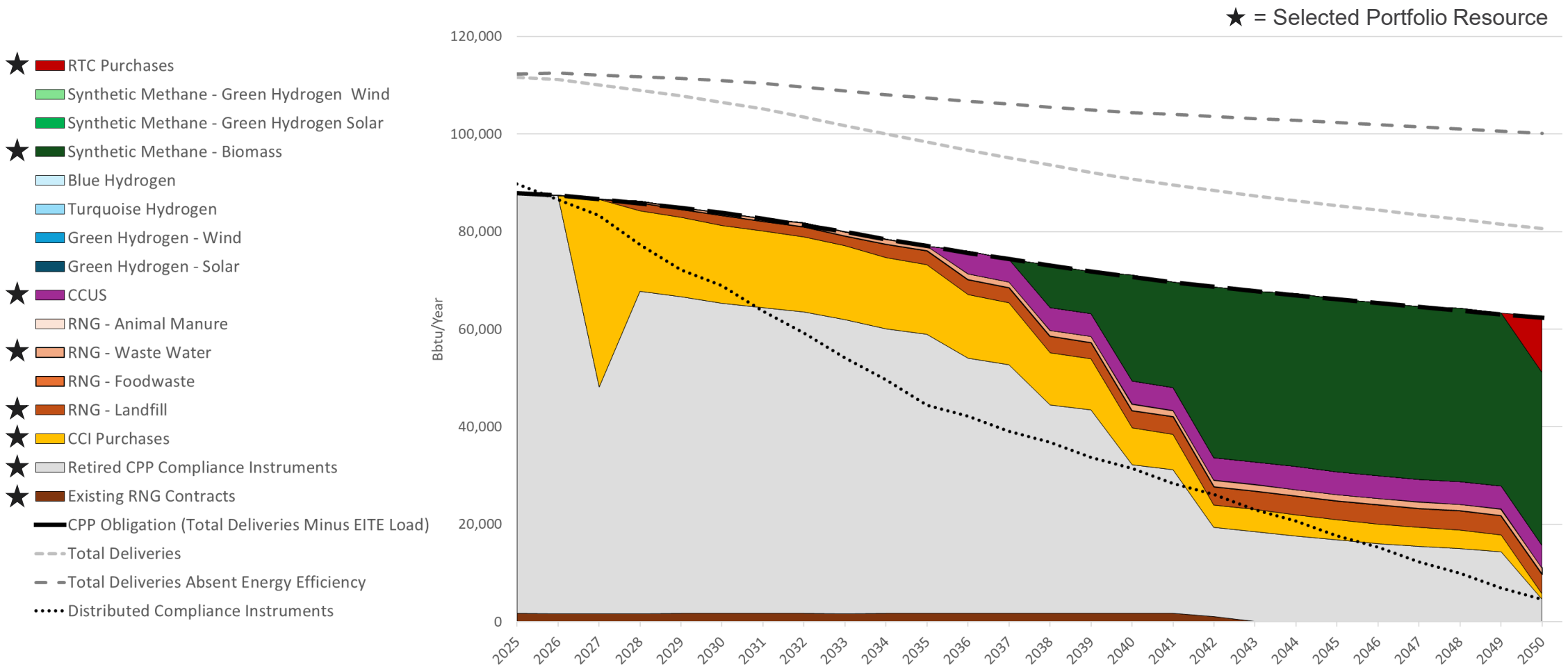
- CCI purchases are available starting in 2026

Alt Fuels/RTCs/CCUS

- There is no access to low-cost LFG RNG projects
- CCUS not available from EITEs
- RNG is available in 2028
- Hydrogen, Synthetic Methane, and CCUS are not available until 2035

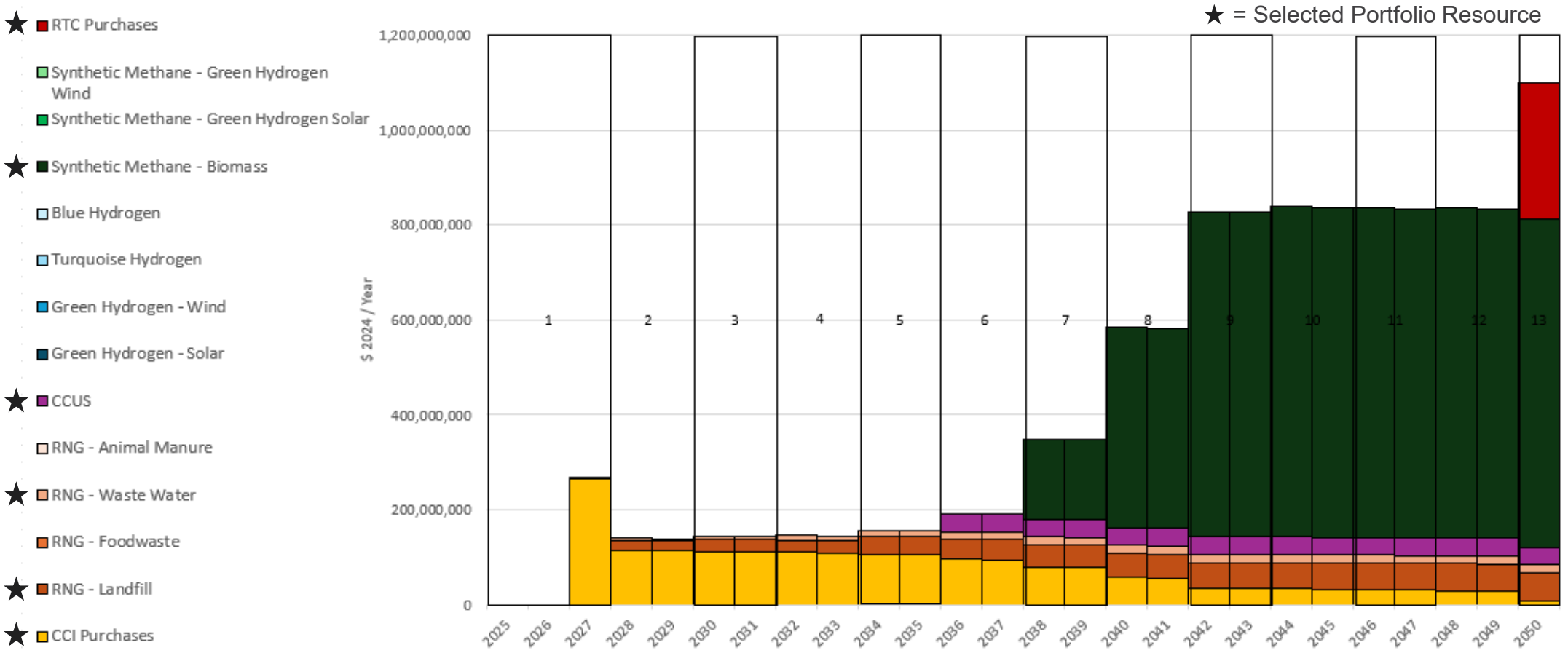
S1.b: Mid-Cost Compliance

CPP Compliance



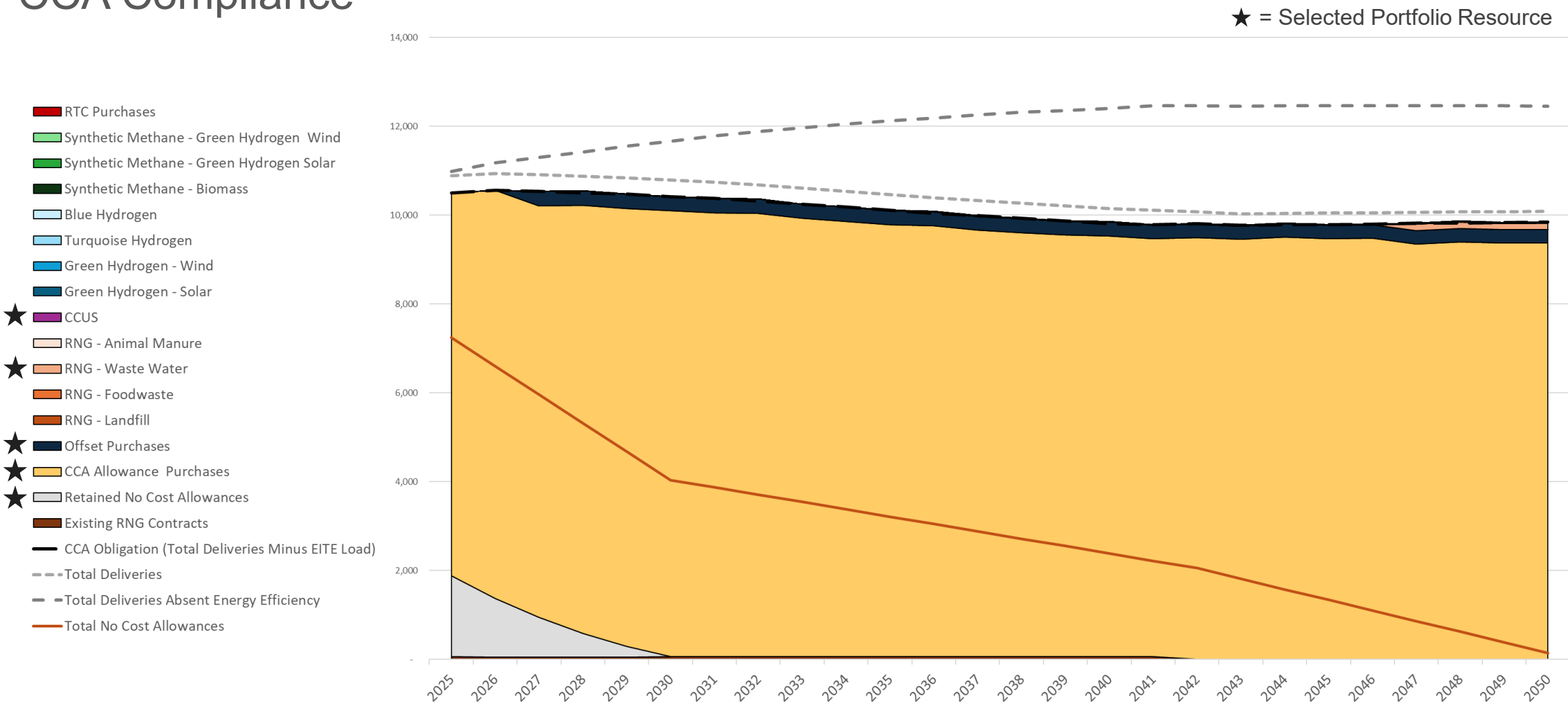
S1.b: Mid-Cost Compliance

Annual Compliance Cost By Year and CCP Compliance Period



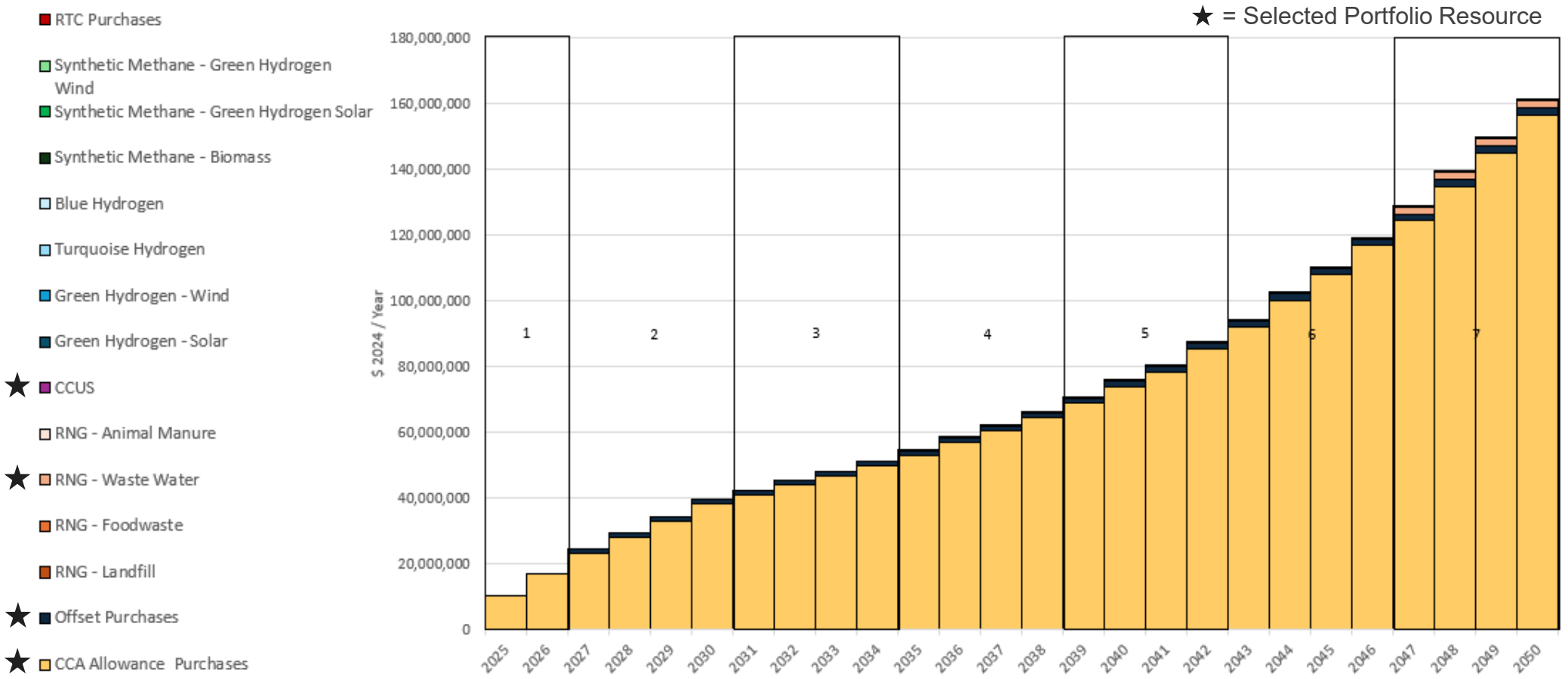
S1.b: Mid-Cost Compliance

CCA Compliance



S1.b: Mid-Cost Compliance

Annual Compliance Cost By Year and CCA Compliance Period



S1.c: High-Cost Compliance

Model Parameters

CCA Compliance

- Allowance prices are at the price ceiling for the entire planning horizon
- Offsets not available at any point in the planning horizon

CPP Compliance

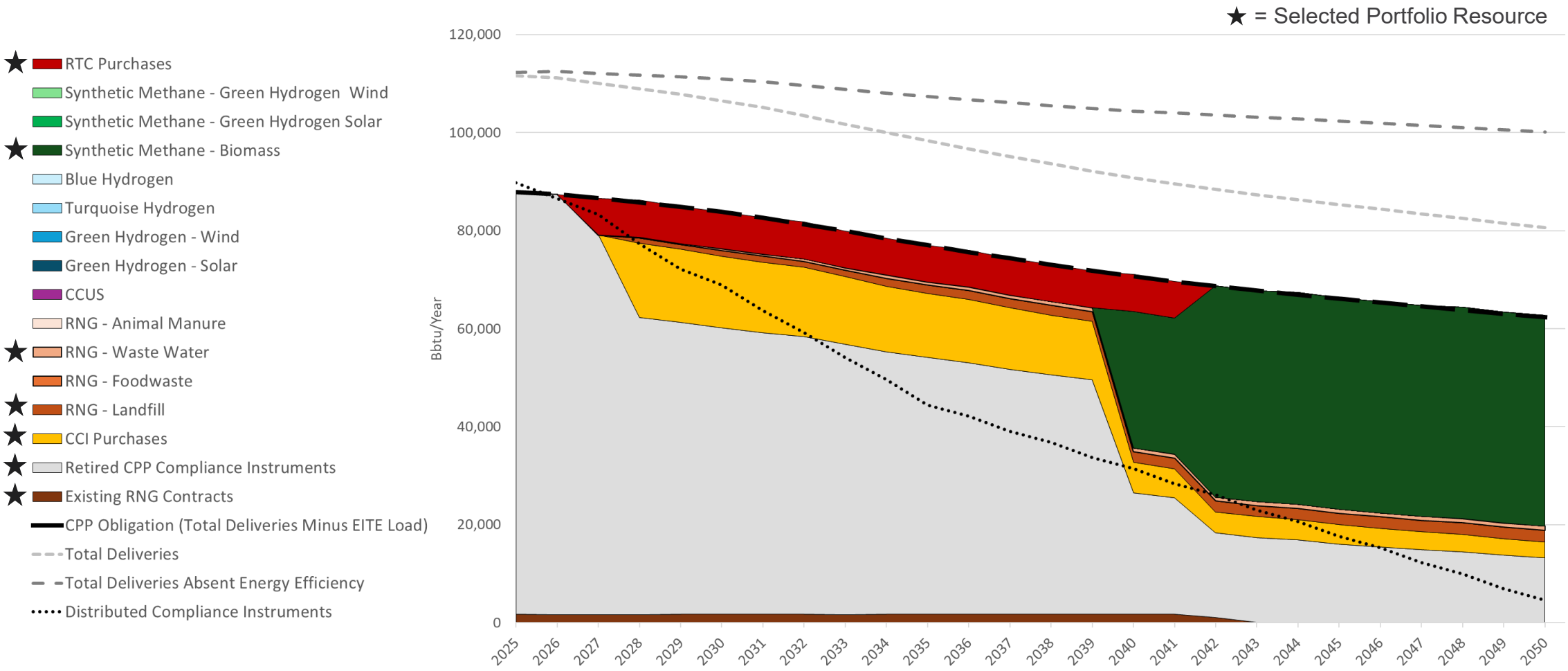
- CCI purchases are not available until the second compliance period starting in 2028

Alt Fuels/RTCs/CCUS

- There is no access to low-cost LFG RNG projects
- Reduced NW Natural share of RNG from 33% to 20%
- Prices are 20% higher for all resources
- CCUS not available
- Blue hydrogen is not available
- RNG is available in 2028
- Hydrogen and Synthetic Methane are not available until 2035

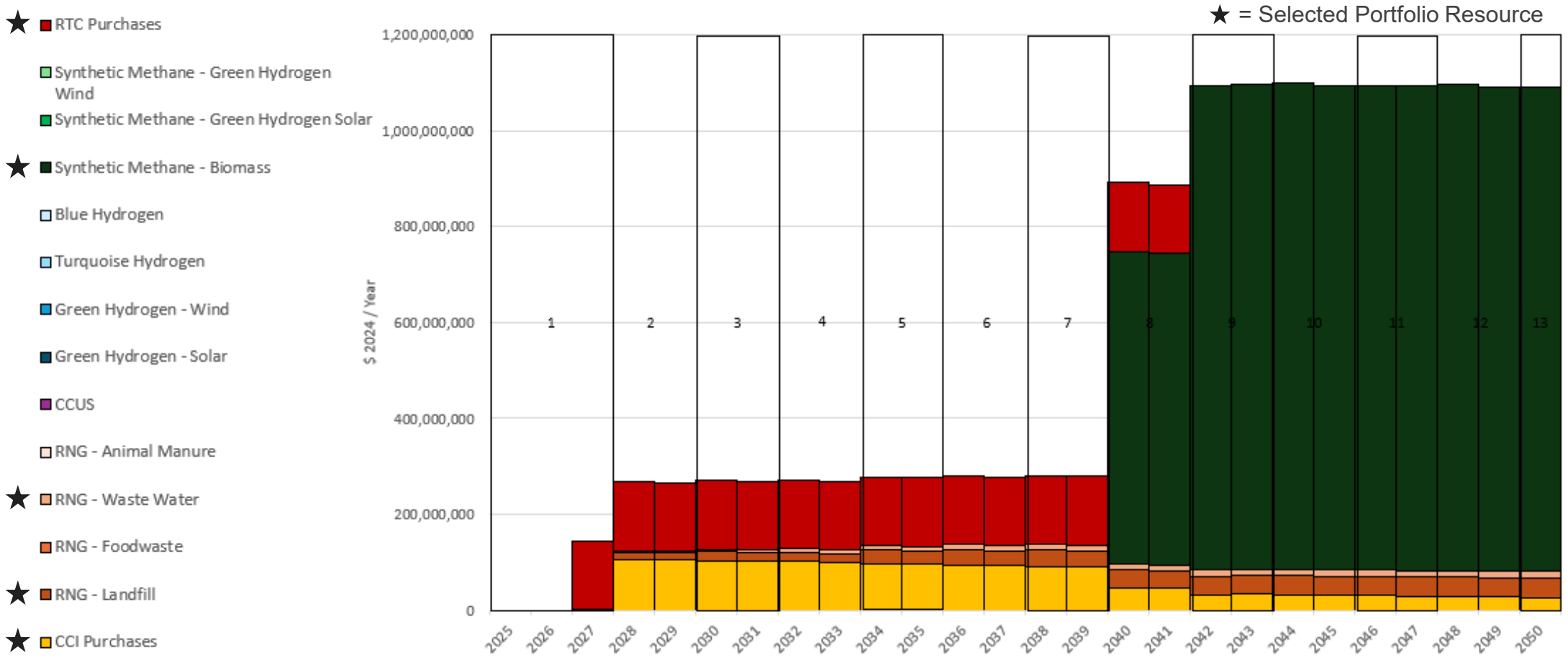
S1.c: High-Cost Compliance

CPP Compliance



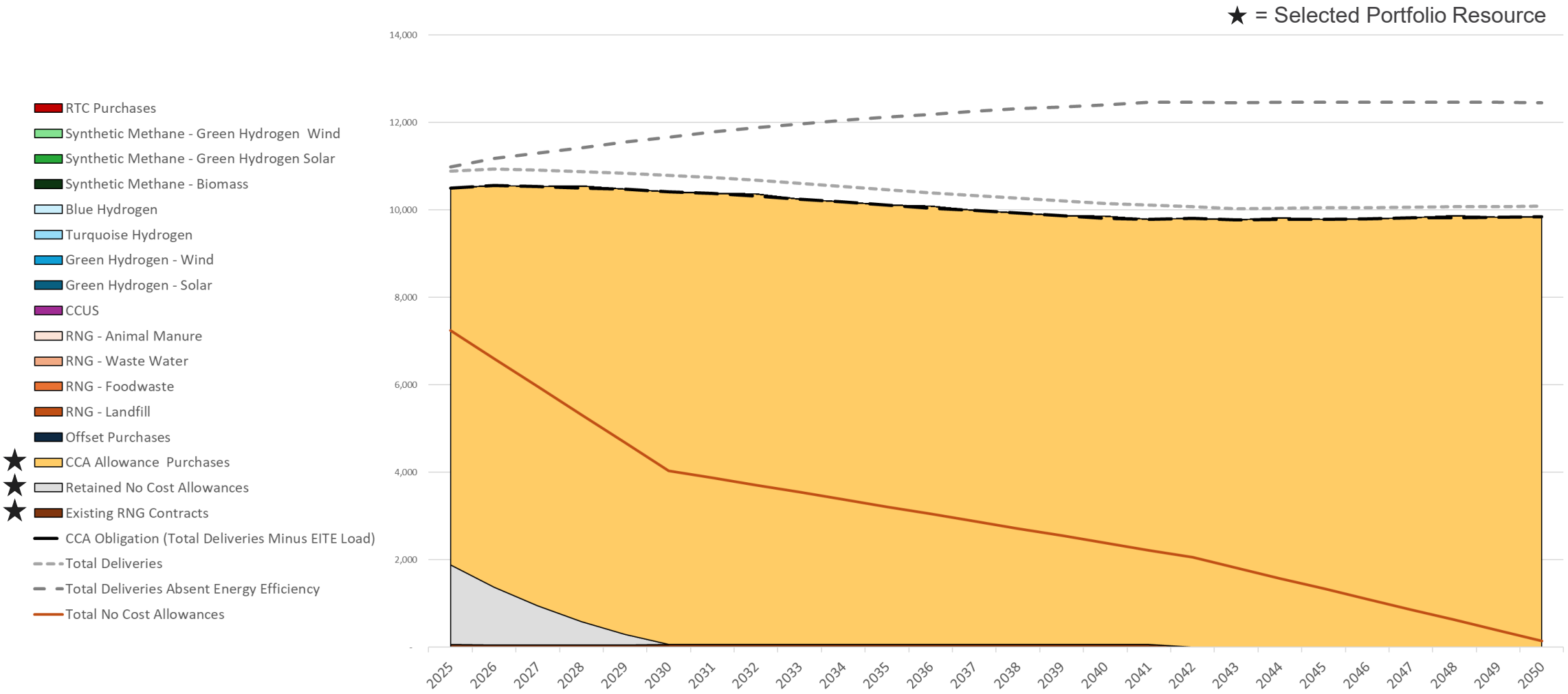
S1.c: High-Cost Compliance

Annual Compliance Cost By Year and CPP Compliance Period



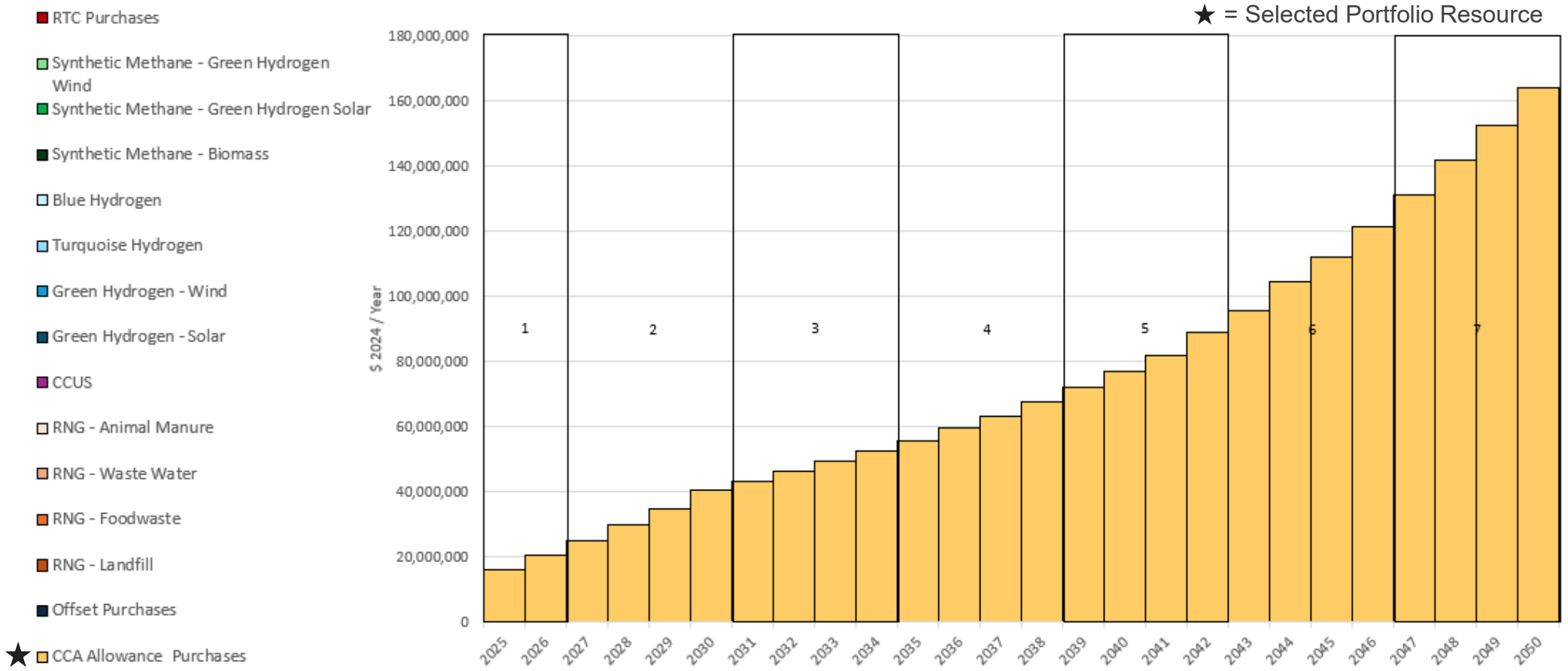
S1.c: High-Cost Compliance

CCA Compliance



S1.c: High-Cost Compliance

Annual Compliance Cost By Year and CCA Compliance Period



S1.d: RTC Dependence

Model Parameters

CCA Compliance

- cCarbon Allowance price forecast for the linked scenario
- Offsets are not available until 2027
- Offsets are limited to 3% of obligation in each year

CPP Compliance

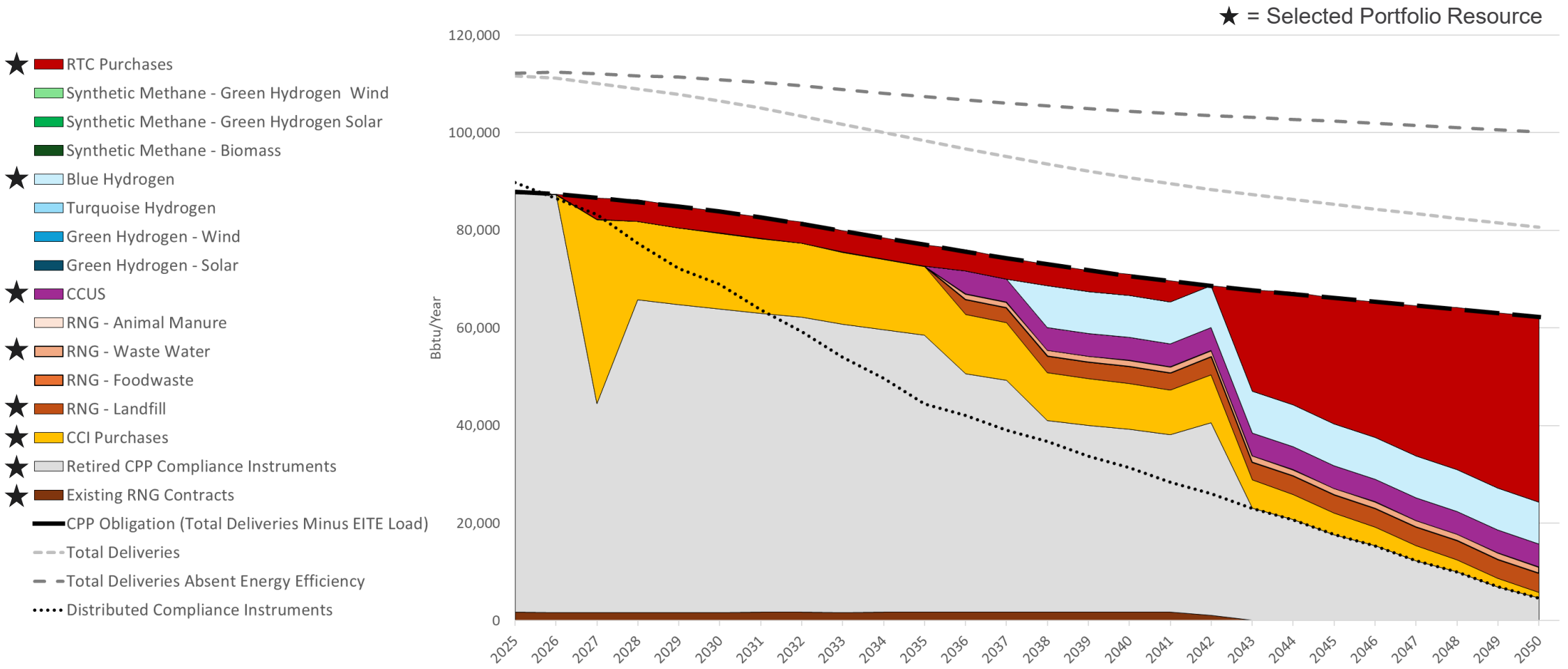
- CCI purchases are available starting in 2026

Alt Fuels/RTCs/CCUS

- There is no access to low-cost LFG RNG projects
- CCUS not available from EITEs
- RNG is available in 2035
- Hydrogen, Synthetic Methane, and CCUS are not available until 2035
- Synthetic Methane from Biomass is not available

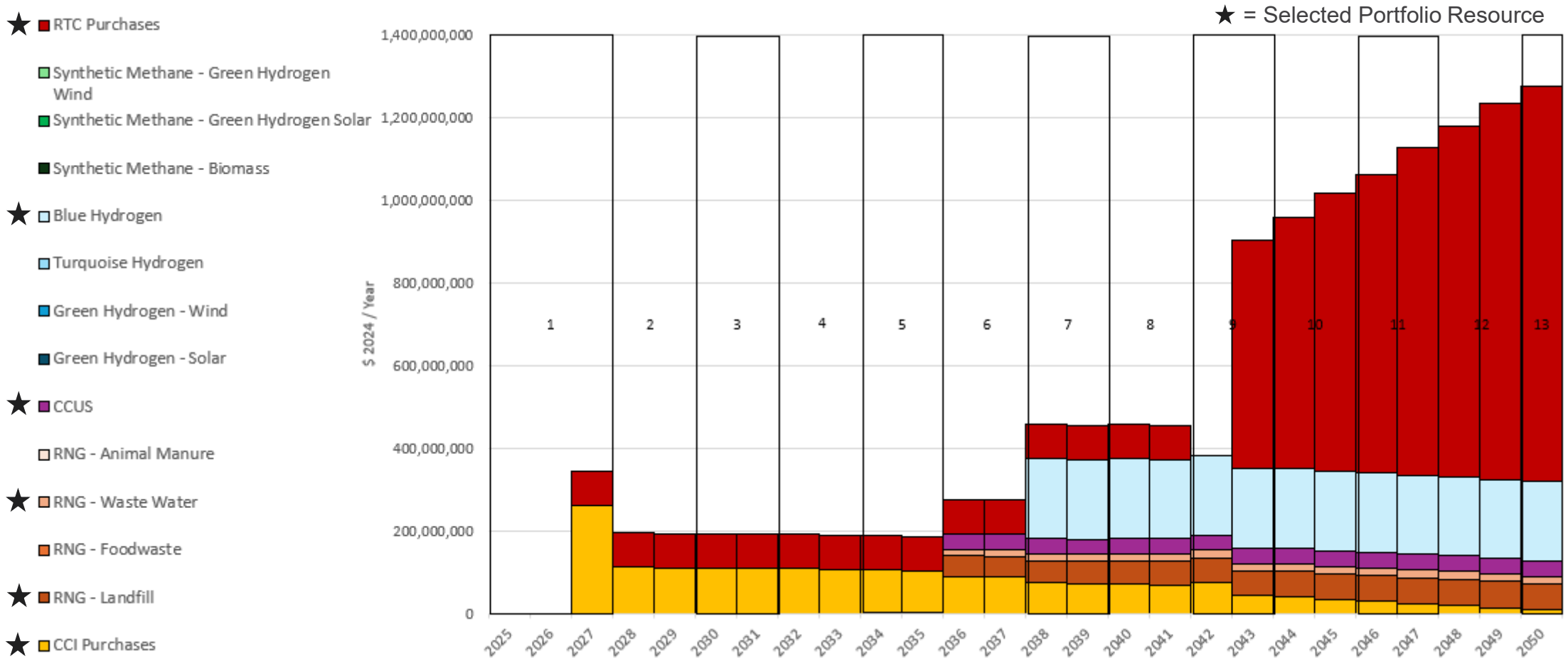
S1.d: RTC Dependence

CPP Compliance



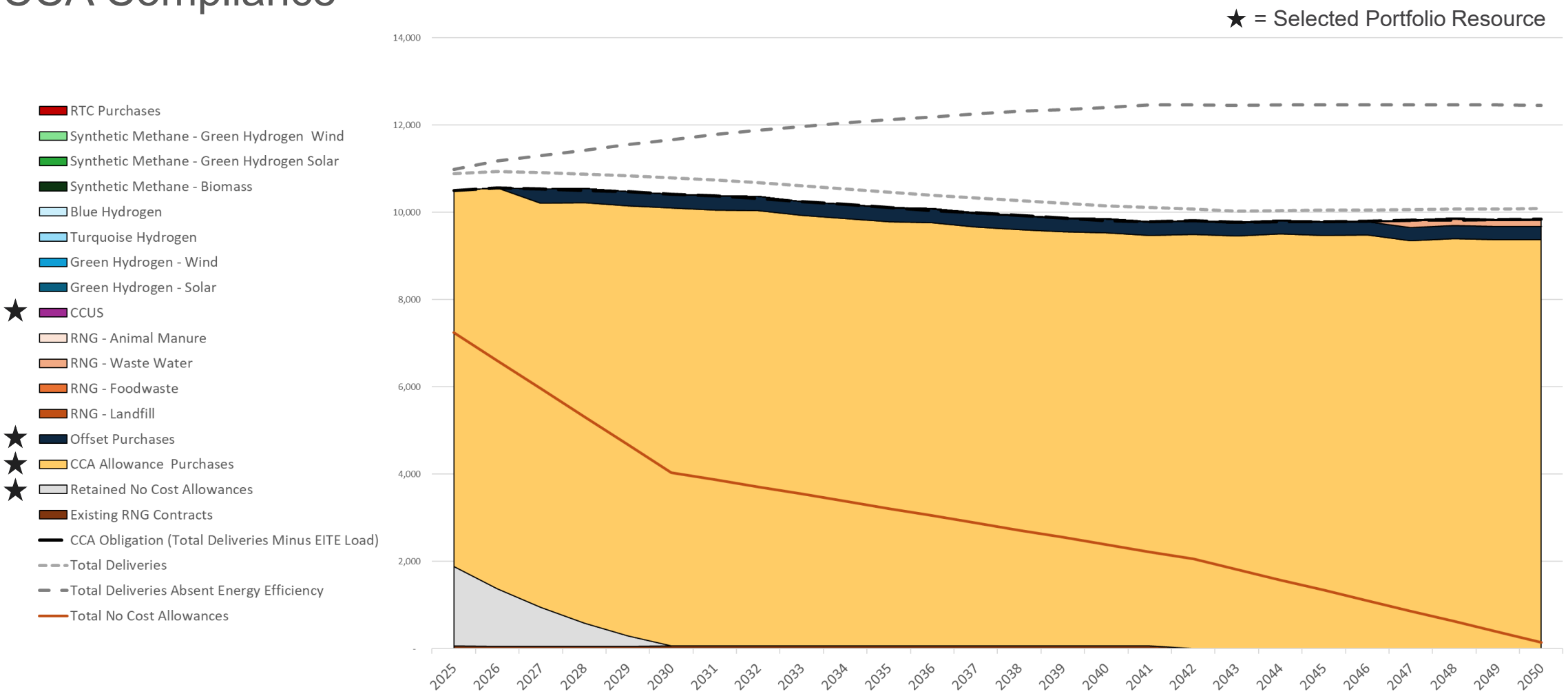
S1.d: RTC Dependence

Annual Compliance Cost By Year and CPP Compliance Period



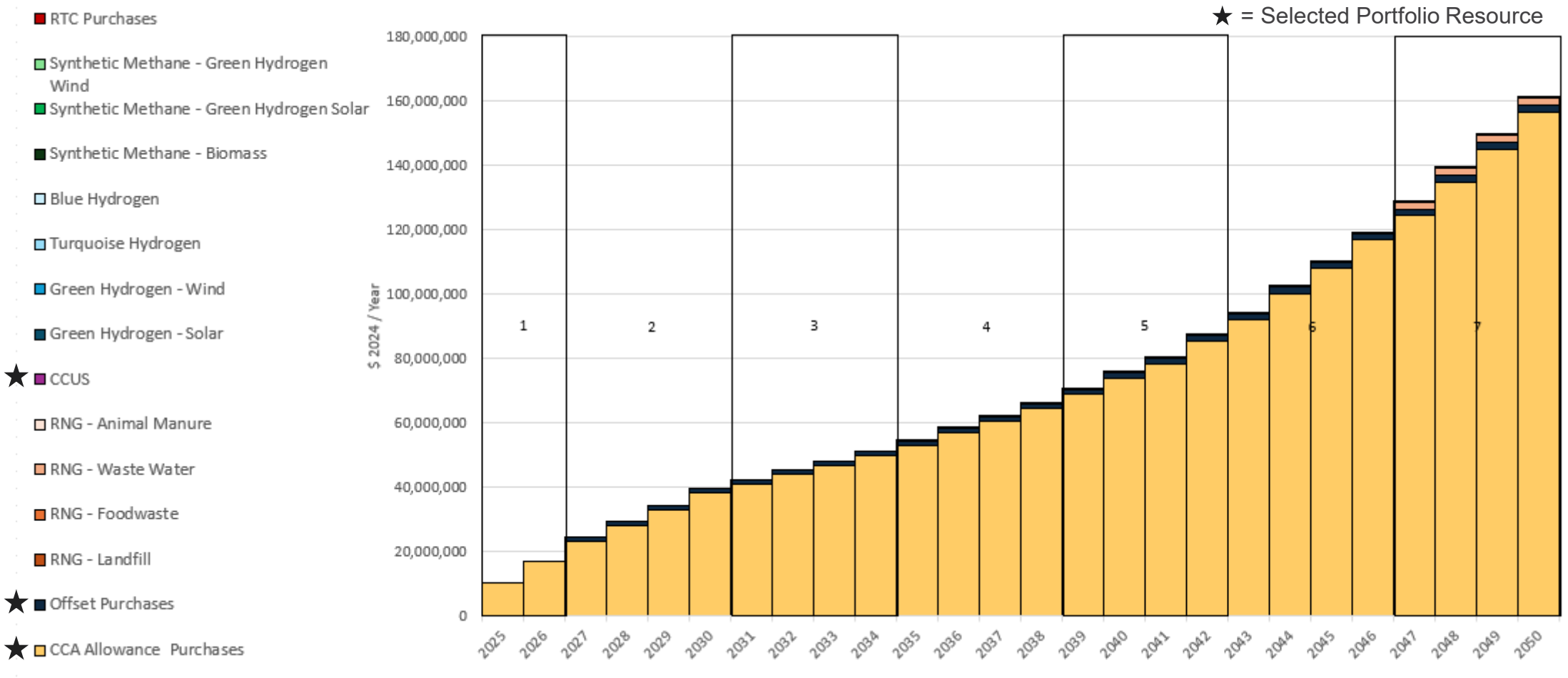
S1.d: RTC Dependence

CCA Compliance



S1.d: RTC Dependence

Annual Compliance Cost By Year and CCA Compliance Period



S1.e: No CPP Instrument Banking

Model Parameters

CCA Compliance

- cCarbon Allowance price forecast for the linked scenario
- Offsets are not available until 2027
- Offsets are limited to 3% of obligation in each year

CPP Compliance

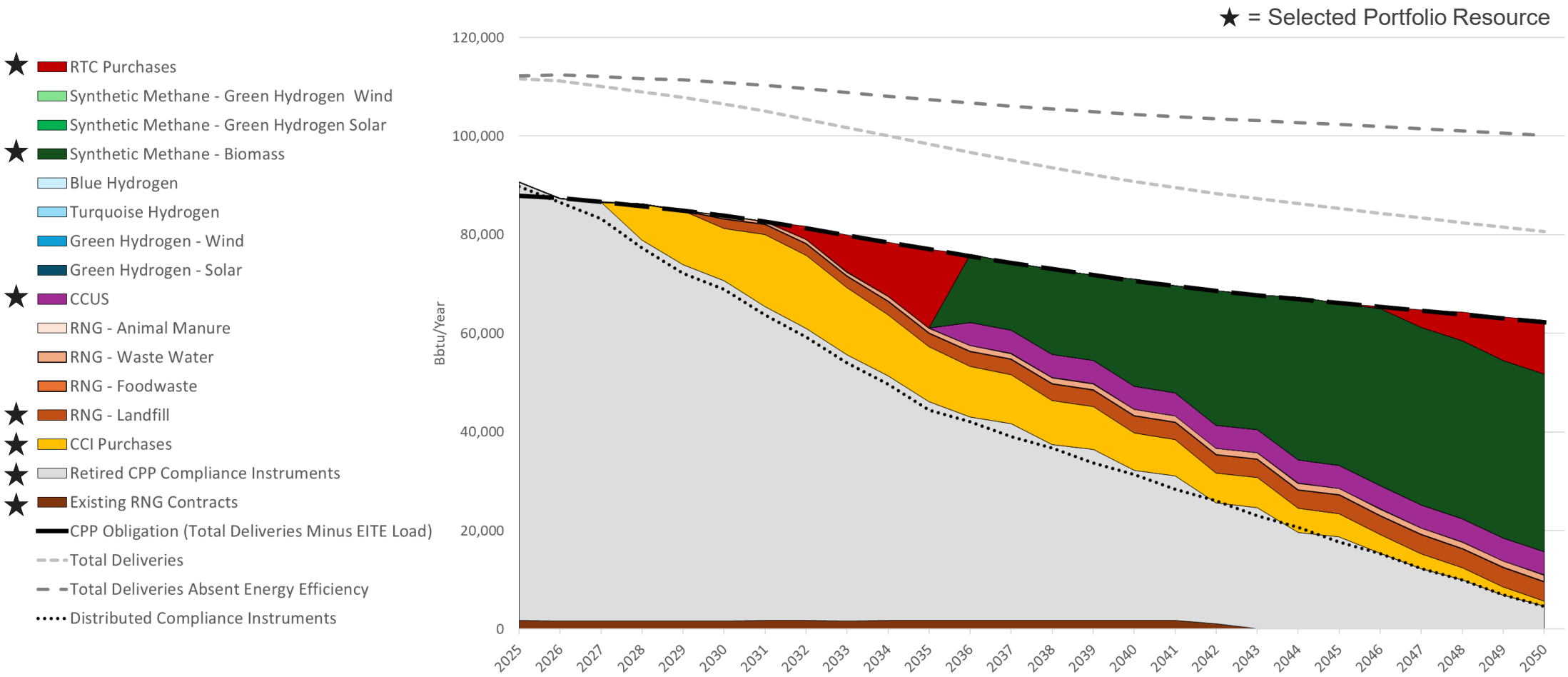
- CCI purchases are available starting in 2026
- Compliance Instruments are not able to be banked across compliance periods

Alt Fuels/RTCs/CCUS

- There is no access to low-cost LFG RNG projects
- CCUS not available from EITEs
- RNG is available in 2028
- Hydrogen, Synthetic Methane, and CCUS are not available until 2035

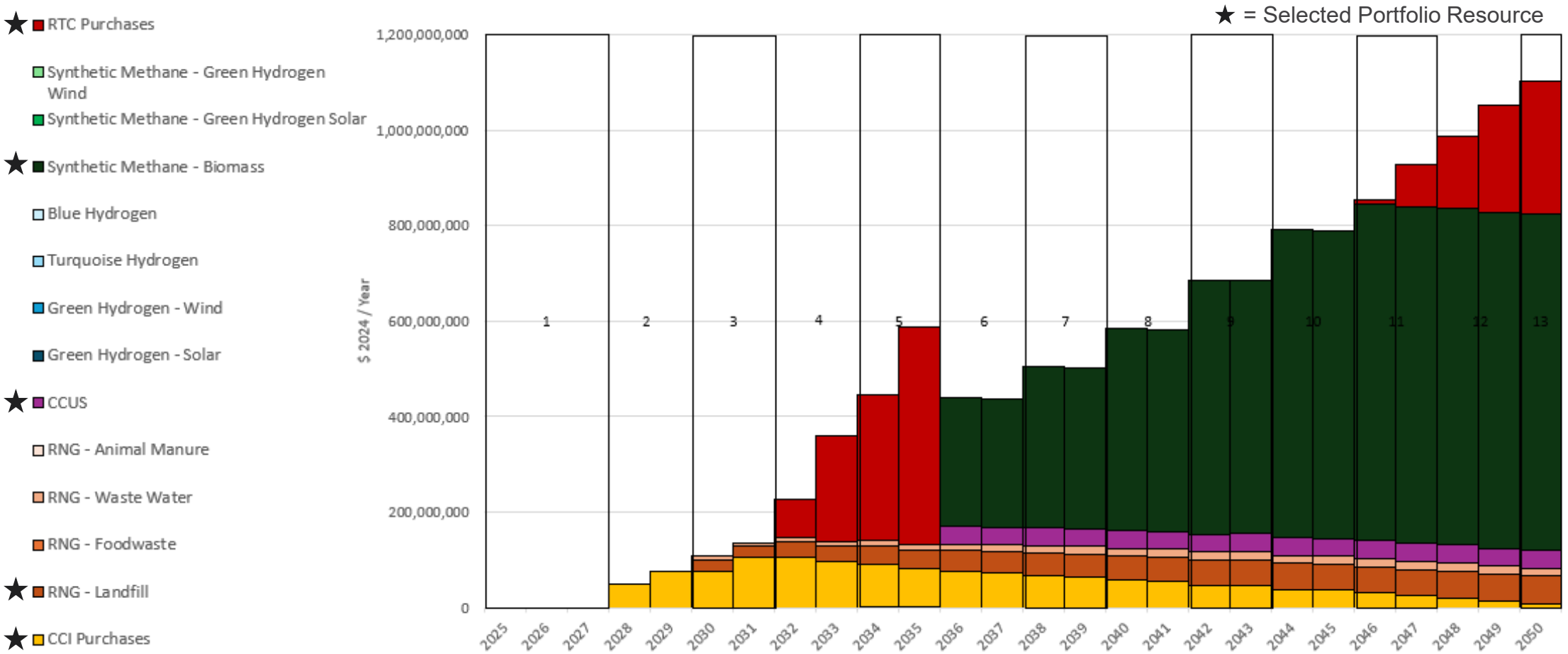
S1.e: No CPP Instrument Banking

CPP Compliance

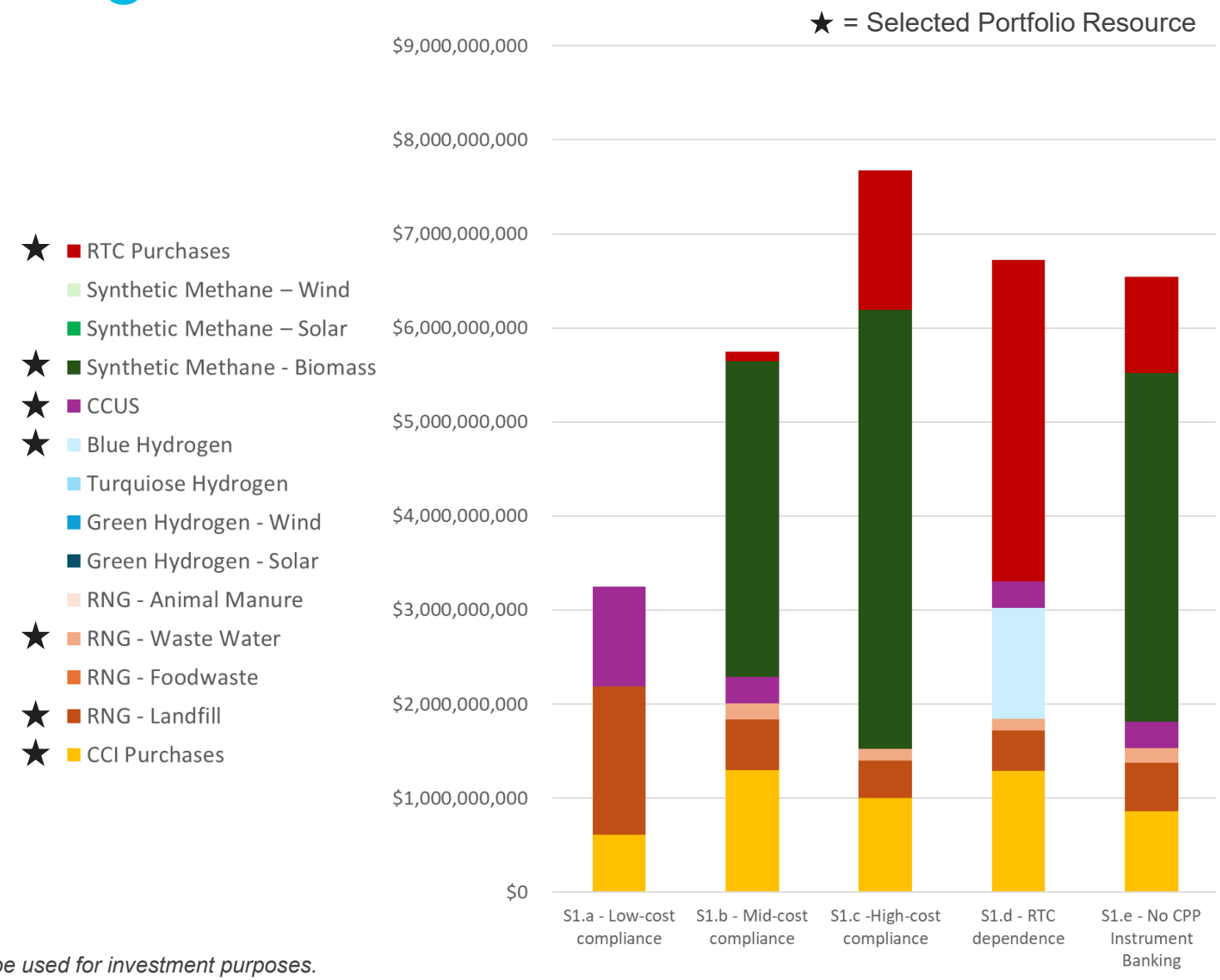


S1.e: No CPP Instrument Banking

Annual Compliance Cost By Year and CCP Compliance Period

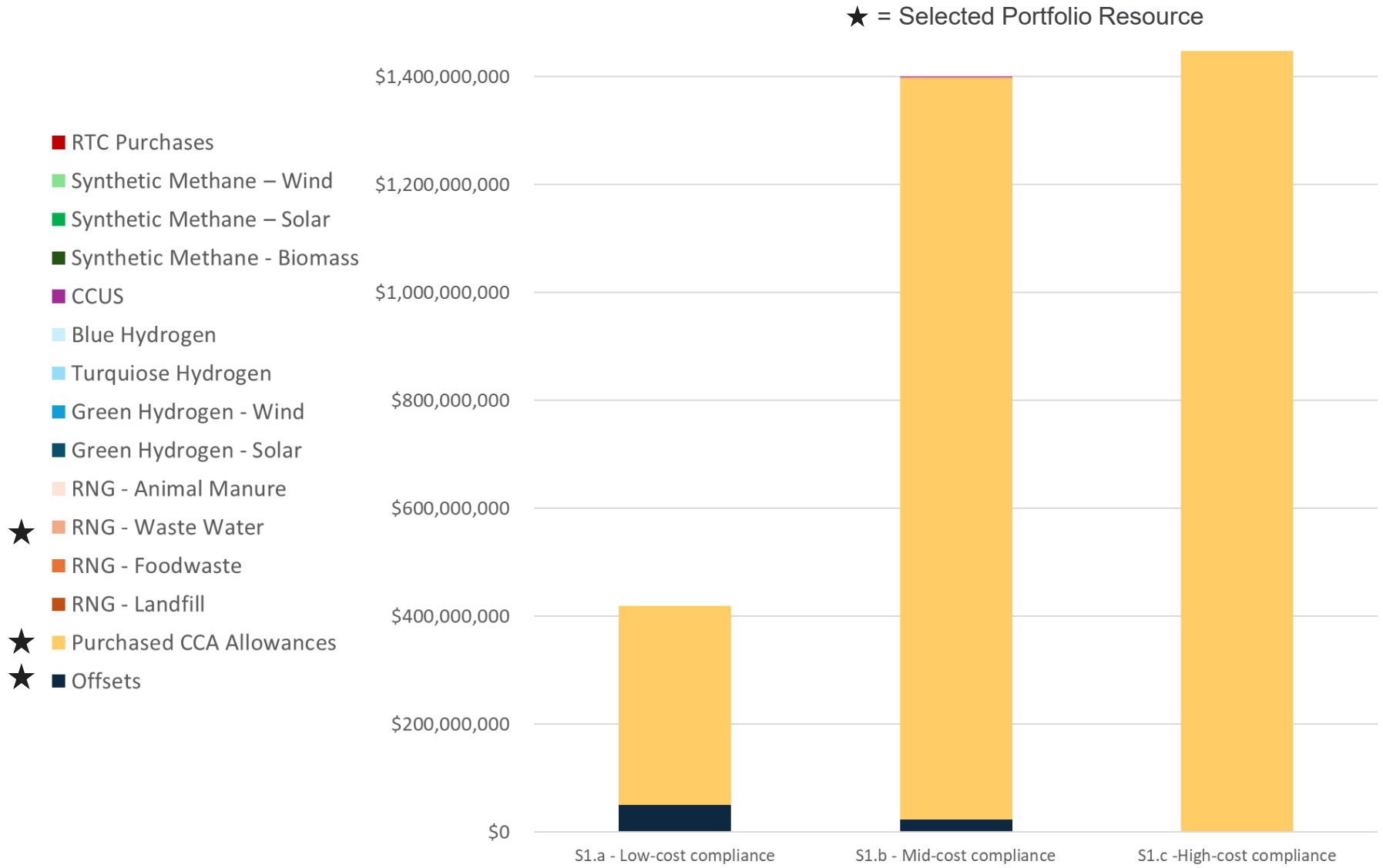


Comparing S1 Results – OR



- net present value (NPV) compliance cost from 2025-2050

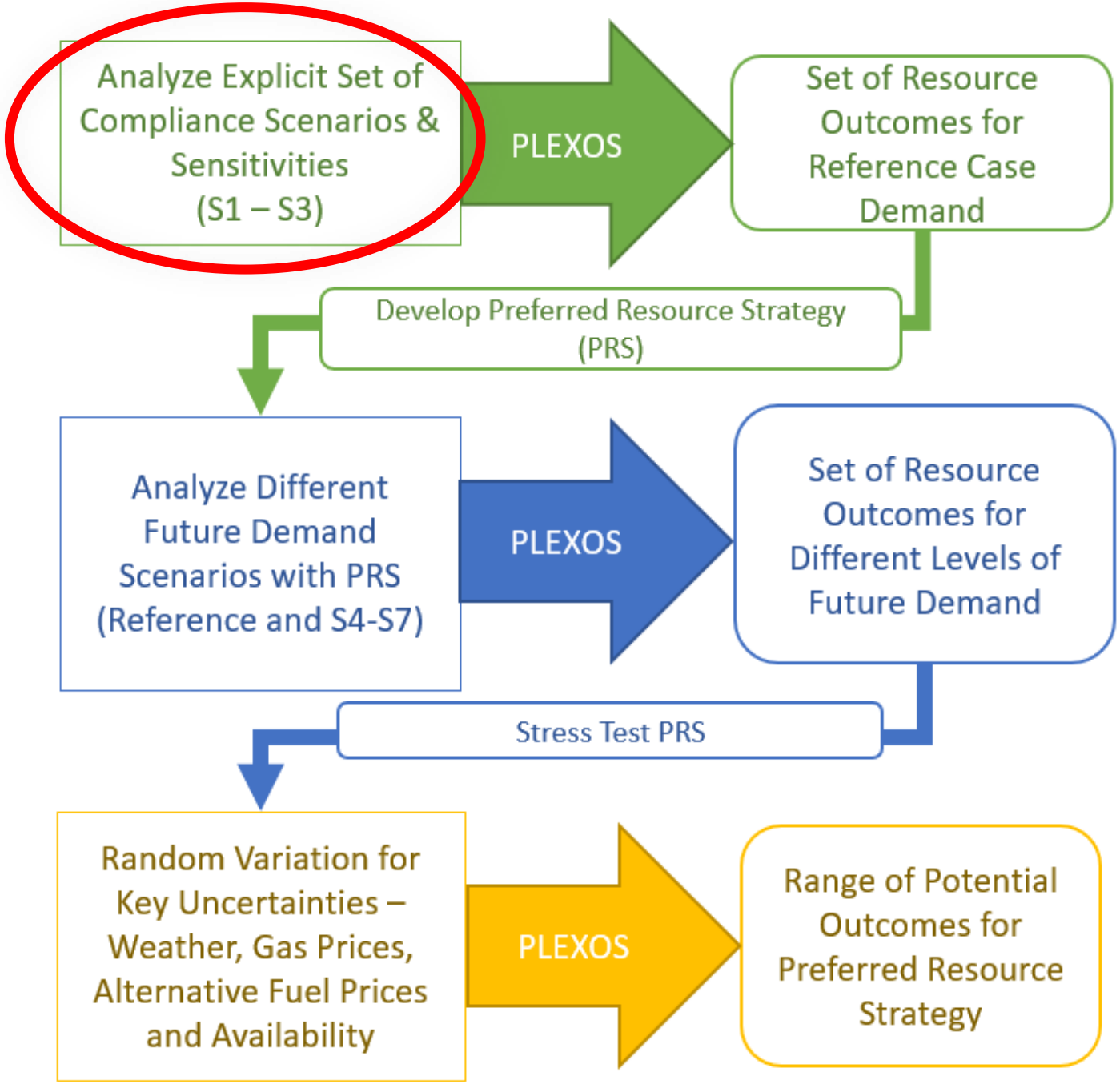
Comparing S1 Results - WA



- net present value (NPV) compliance cost from 2025-2050

5 Minute Break

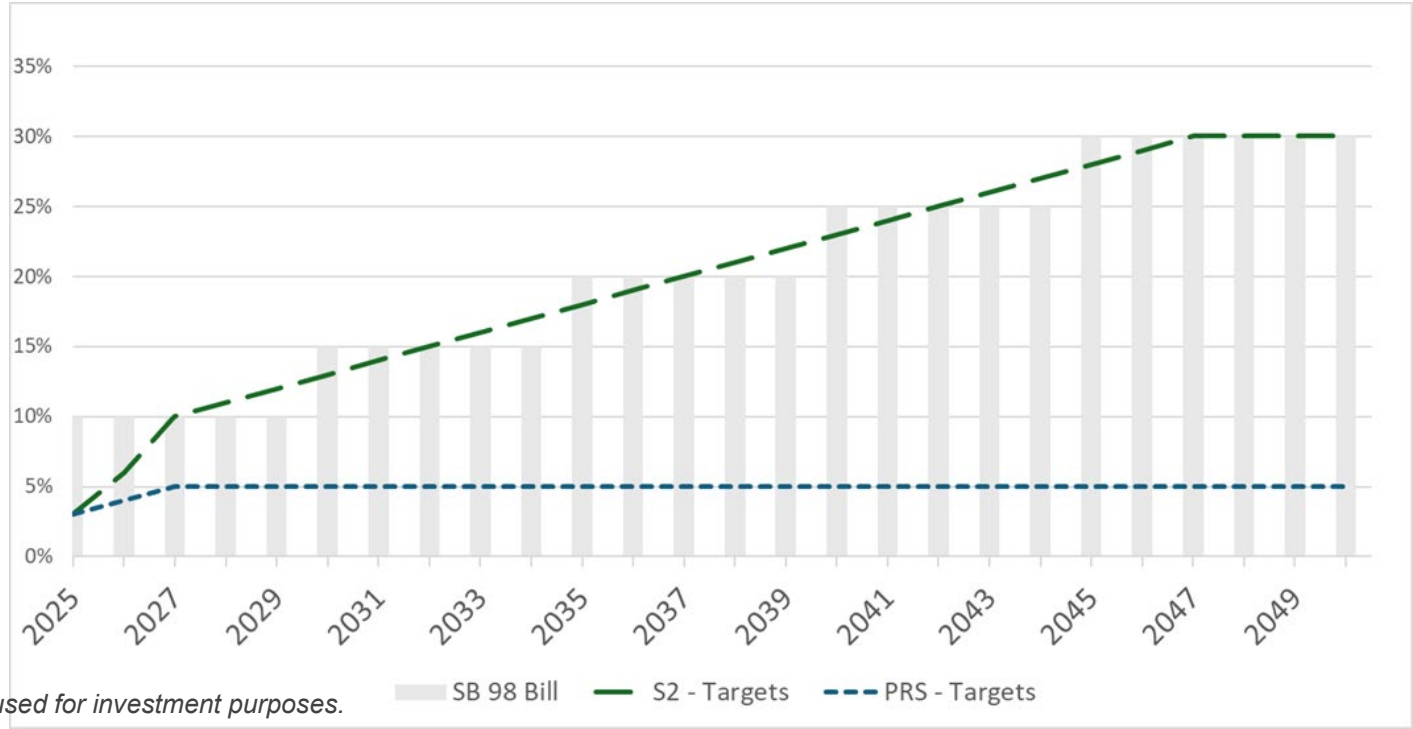
Scenario 2 (S2)
Voluntary RNG Targets


Analyze Explicit Set of Compliance Scenarios & Sensitivities (S1 – S3)
PLEXOS
Set of Resource Outcomes for Reference Case Demand
Develop Preferred Resource Strategy (PRS)
Analyze Different Future Demand Scenarios with PRS (Reference and S4-S7)
PLEXOS
Set of Resource Outcomes for Different Levels of Future Demand
Stress Test PRS
Random Variation for Key Uncertainties – Weather, Gas Prices, Alternative Fuel Prices and Availability
PLEXOS
Range of Potential Outcomes for Preferred Resource Strategy

NW Natural®

S2 Sensitivities

S2: Voluntary RNG Target Sensitivities		
S2.a	Low-cost Compliance	This is the least constrained model and sets the lower bound of compliance costs for achieving voluntary targets.
S2.b	Mid-cost Compliance	This sensitivity sets constraints on key resources that can drive higher compliance costs for achieving voluntary targets.



S2.b: Mid-Cost Compliance

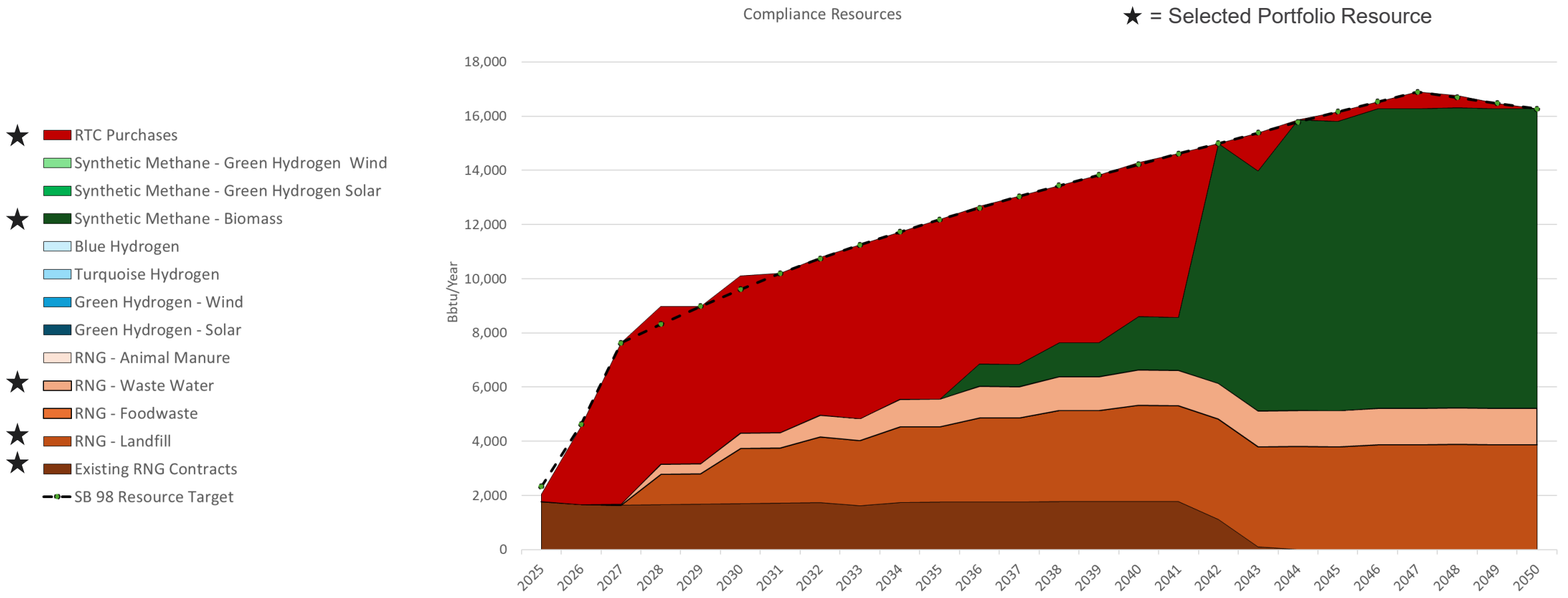
Model Parameters

Alt Fuels/CCUS

- There is no access to low-cost LFG RNG projects

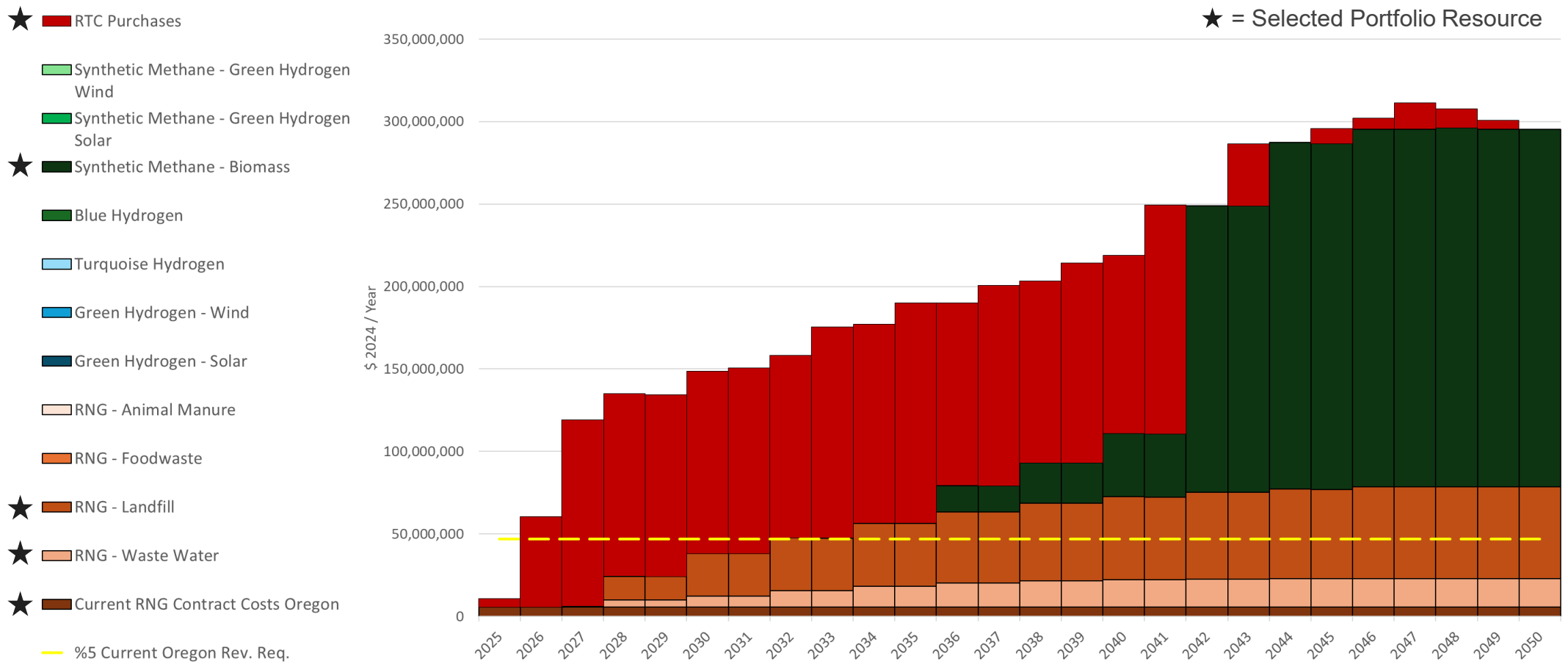
S2.b: Mid-Cost Compliance

Oregon - SB 98 Resources



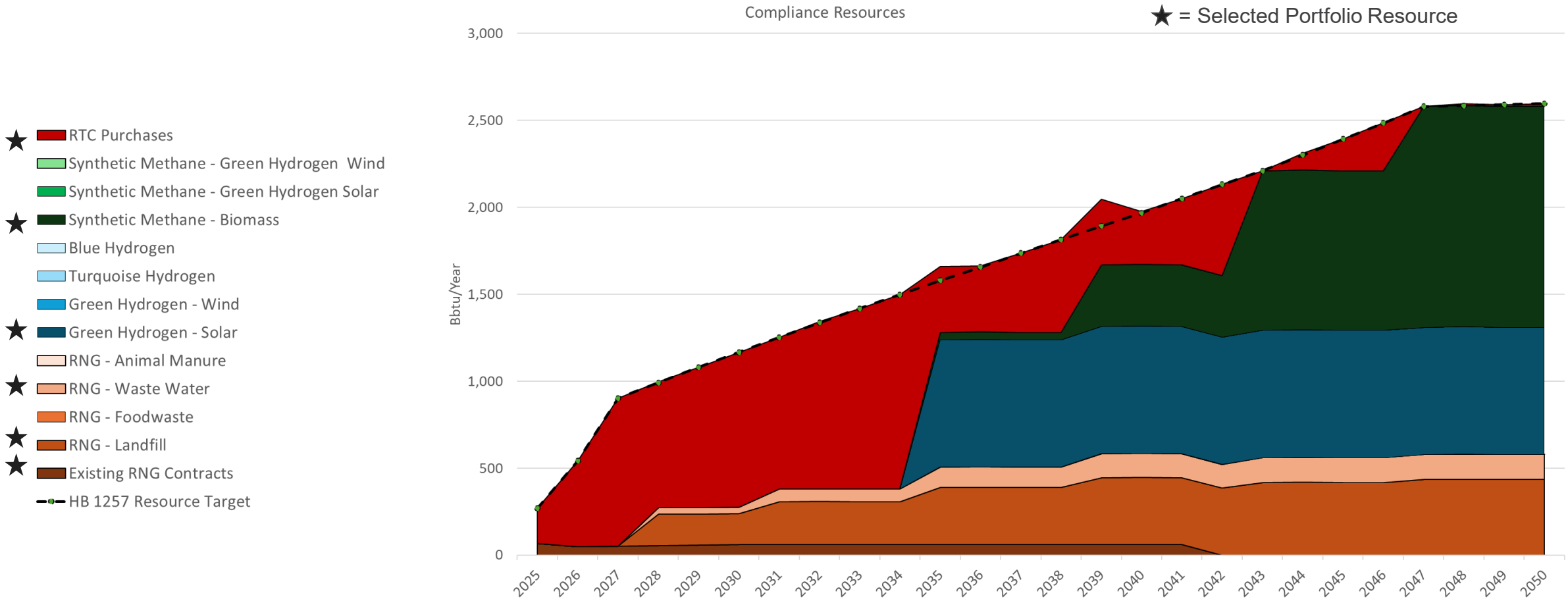
S2.b: Mid-Cost Compliance

Oregon - SB 98 Costs



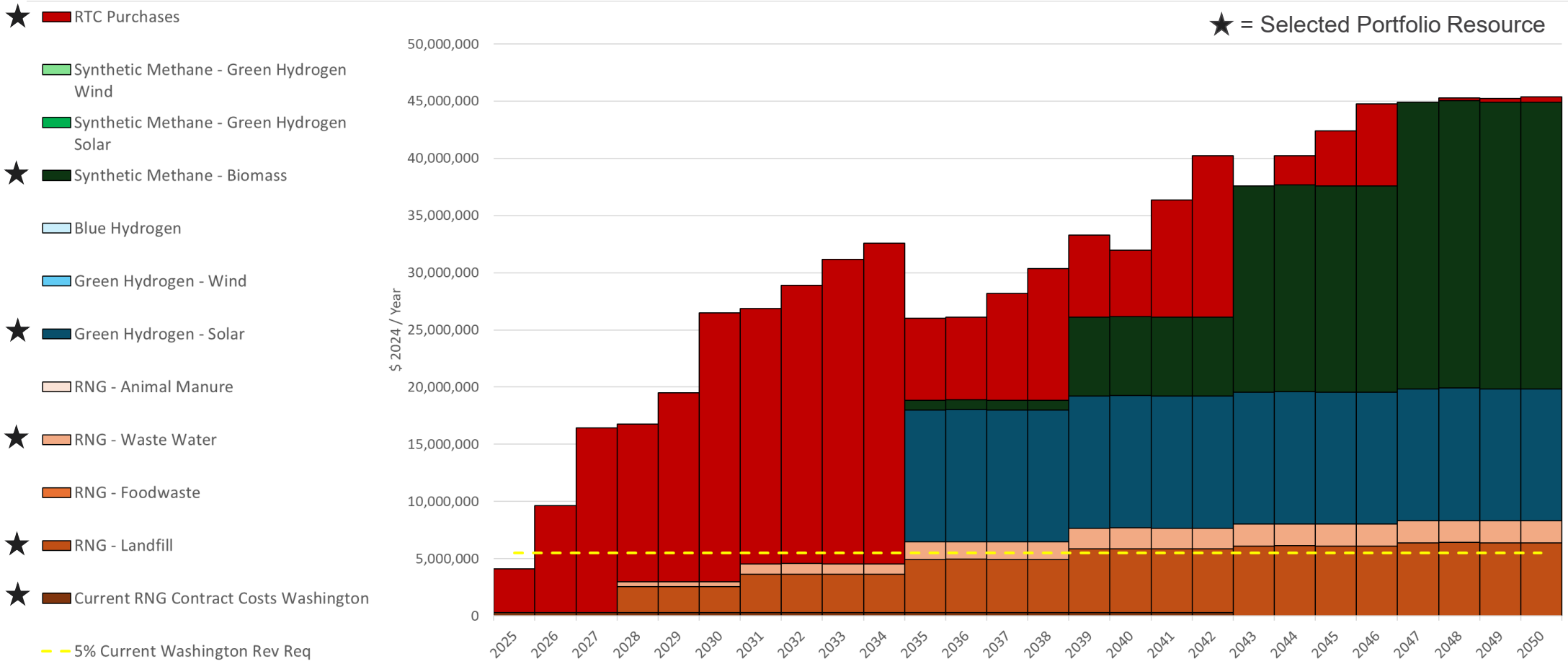
S2.b: Mid-Cost Compliance

Washington - HB 1257 Resources



S2.b: Mid-Cost Compliance

Washington - HB 1257 Costs

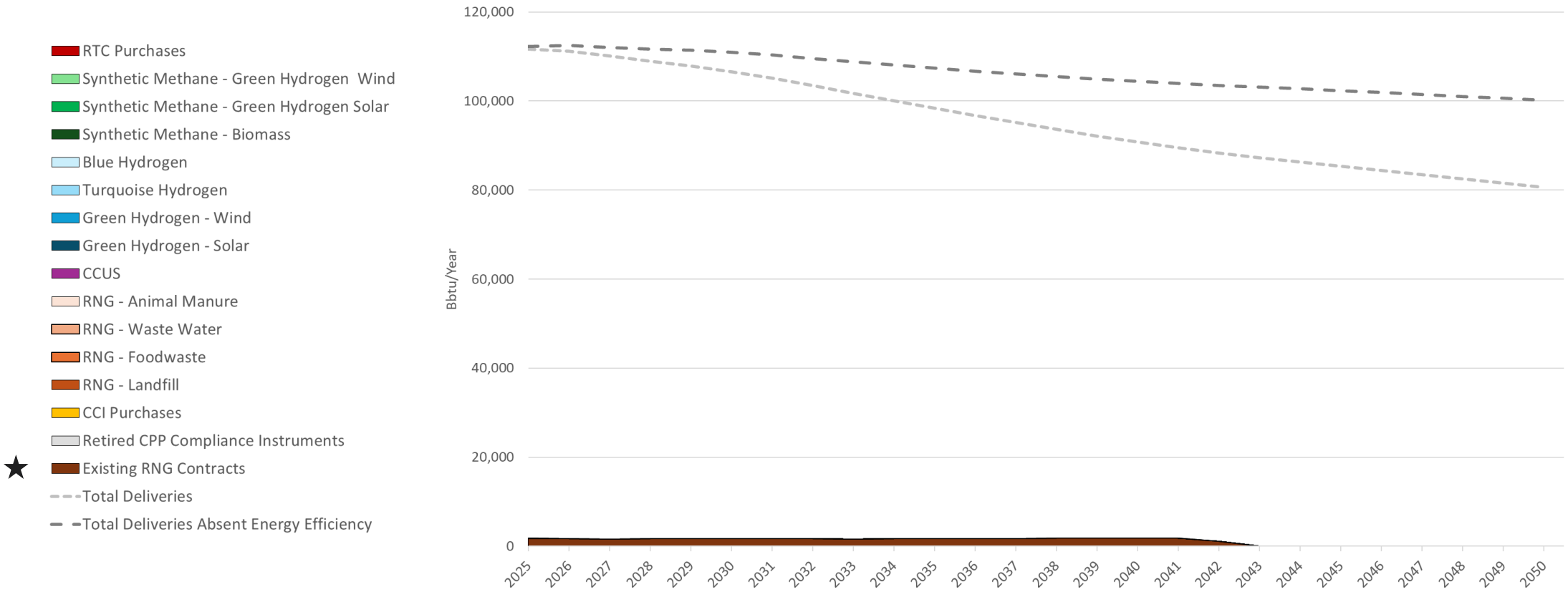


Scenario 3 (S3)
No GHG compliance policies

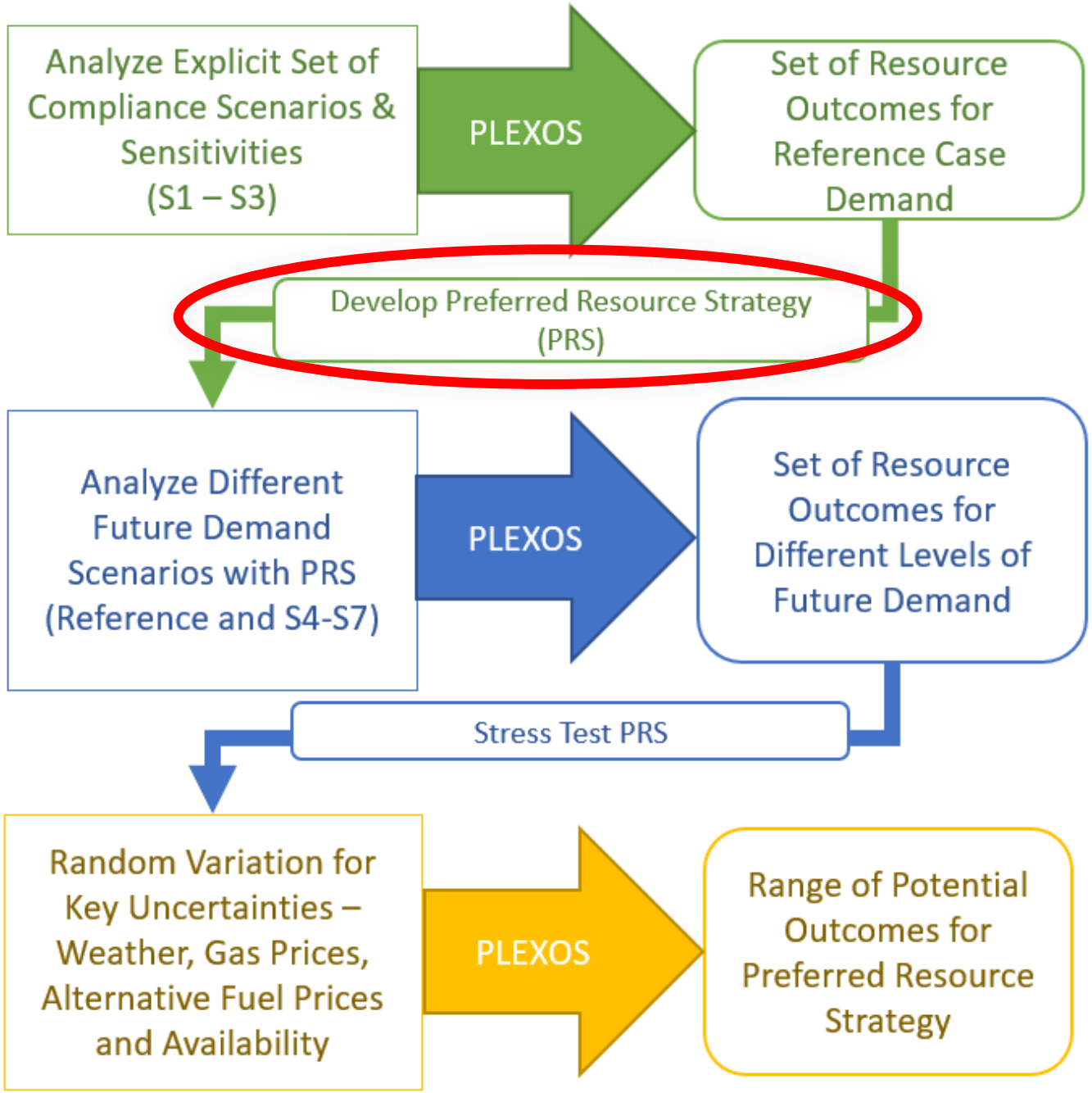
S3 - No GHG compliance policies

CPP Compliance

★ = Selected Portfolio Resource



Preferred Resource Strategy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Set of Resource Outcomes for Different Levels of Future Demand
Stress Test PRS
Random Variation for Key Uncertainties – Weather, Gas Prices, Alternative Fuel Prices and Availability
PLEXOS
Range of Potential Outcomes for Preferred Resource Strategy

NW Natural®

Preferred Resource Strategy

Model Parameters

CCA Compliance

- cCarbon Allowance price forecast for the linked scenario
- Offsets are not available until 2027
- Offsets are limited to 3% of obligation in year

CPP Compliance

- CCI purchases are available starting in 2026

Alt Fuels/RTCs/CCUS

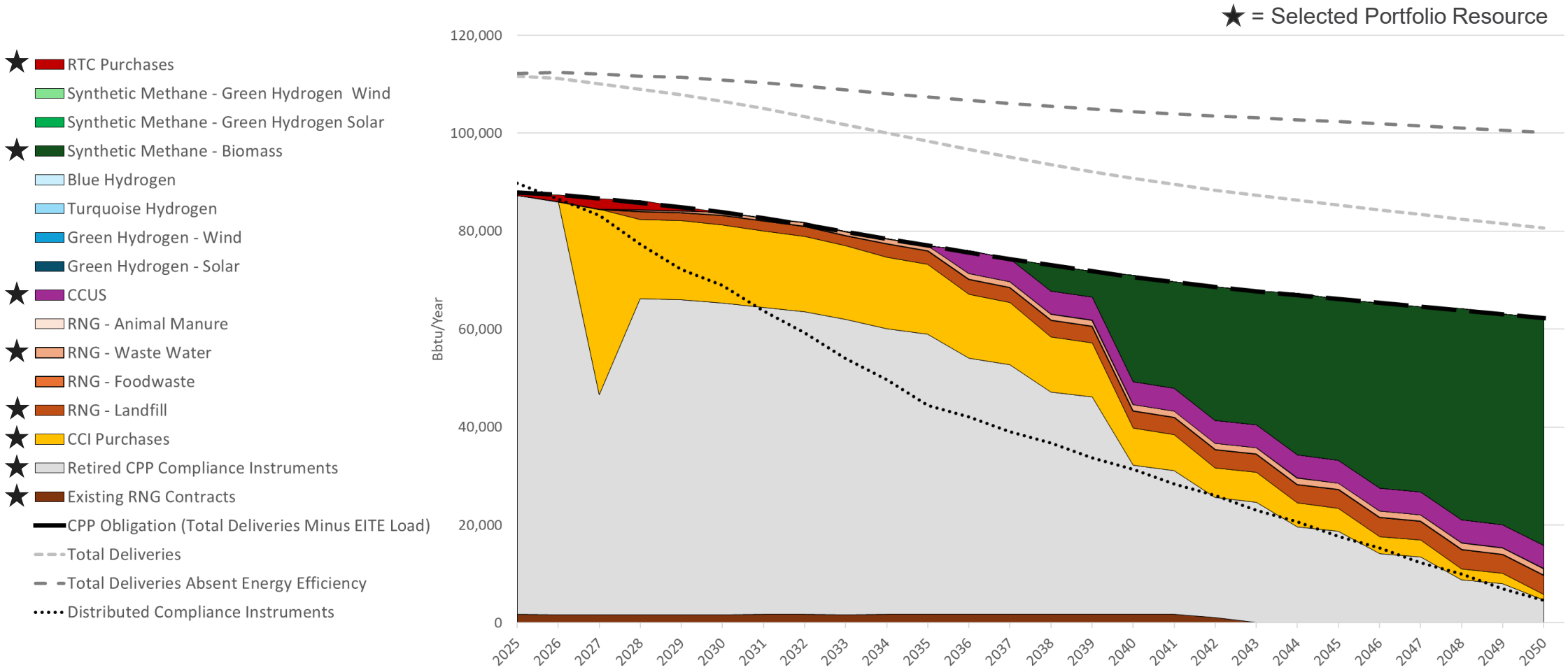
- There is no access to low-cost LFG RNG projects
- CCUS not available from EITEs
- RNG development projects are available in 2028
- Hydrogen, Synthetic Methane, and CCUS are not available until 2035

Voluntary RNG Targets

- Voluntary RNG Targets are set to 3% for 2025; 4% for 2026; and 5% for 2027-2050

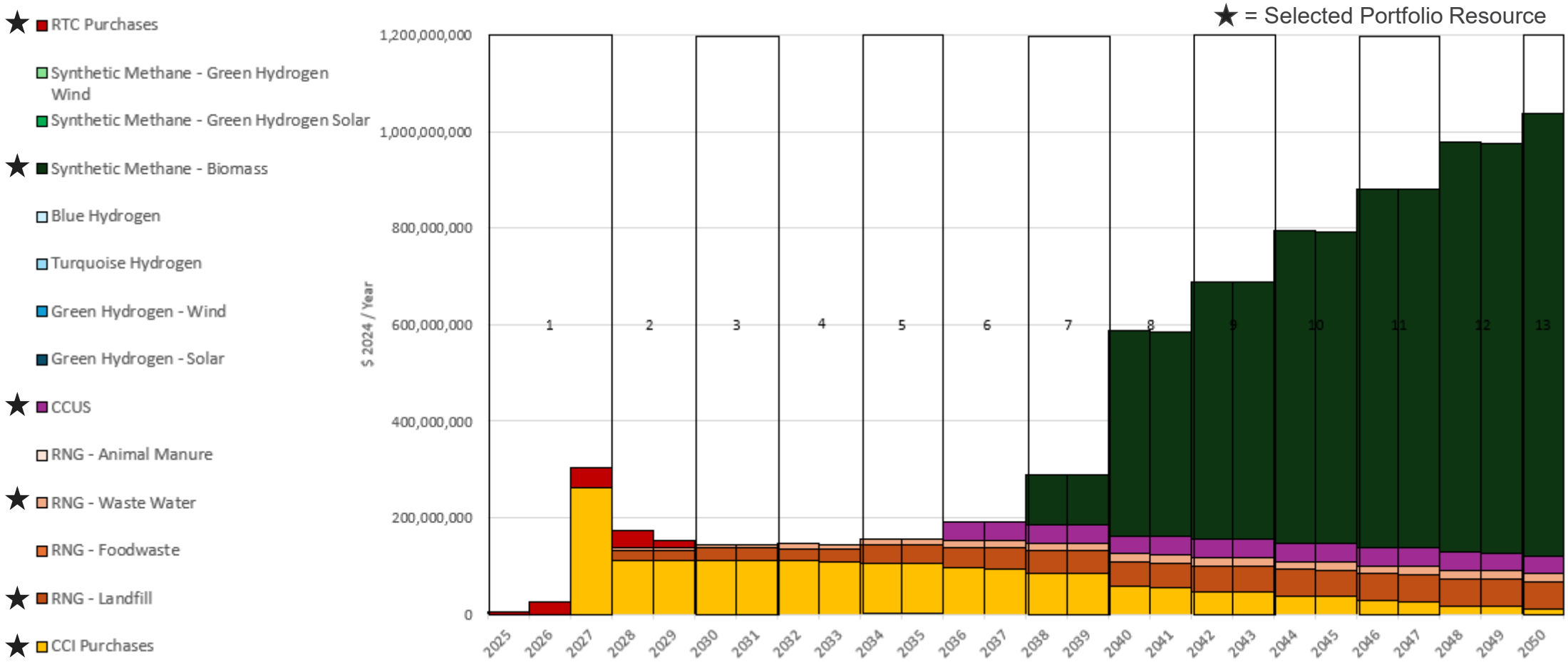
Preferred Resource Strategy

Oregon Resource Selection



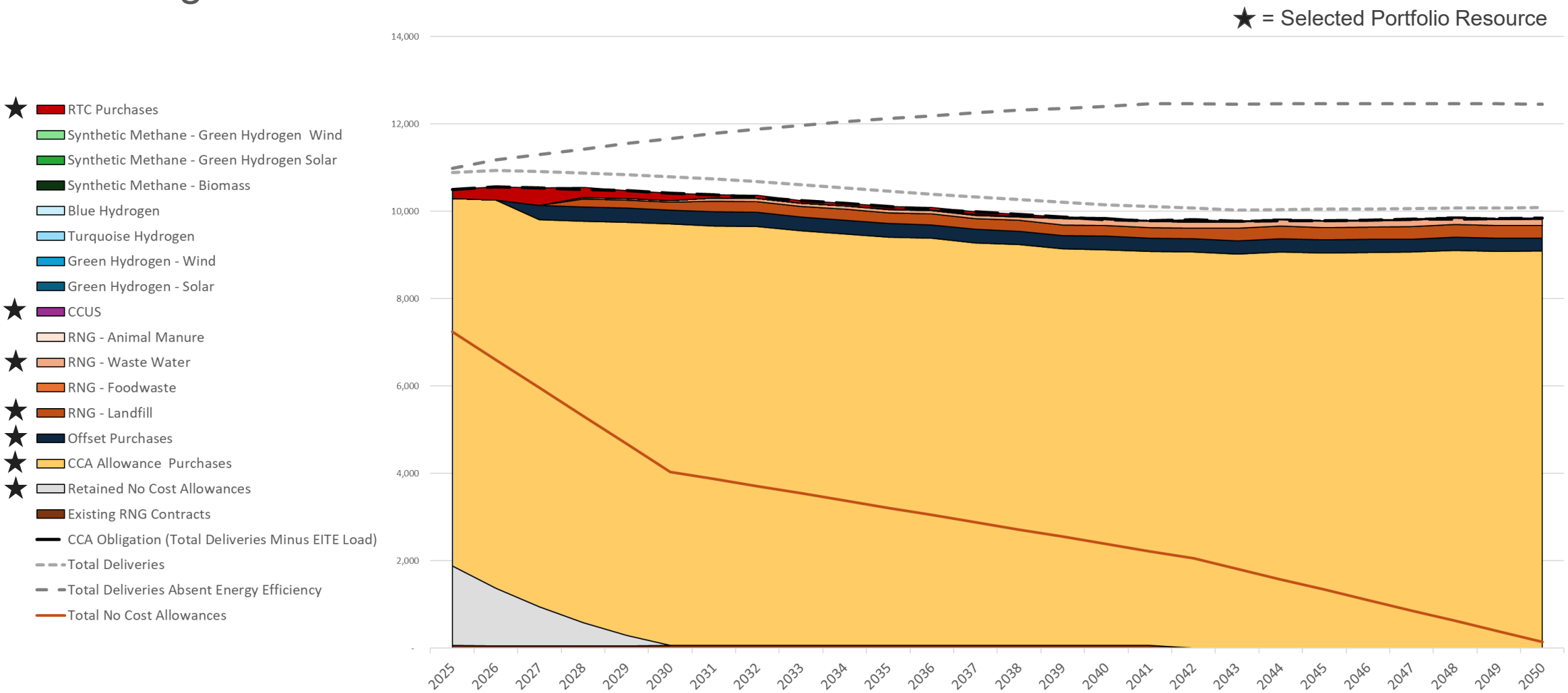
Preferred Resource Strategy

Oregon Resource Selection Costs



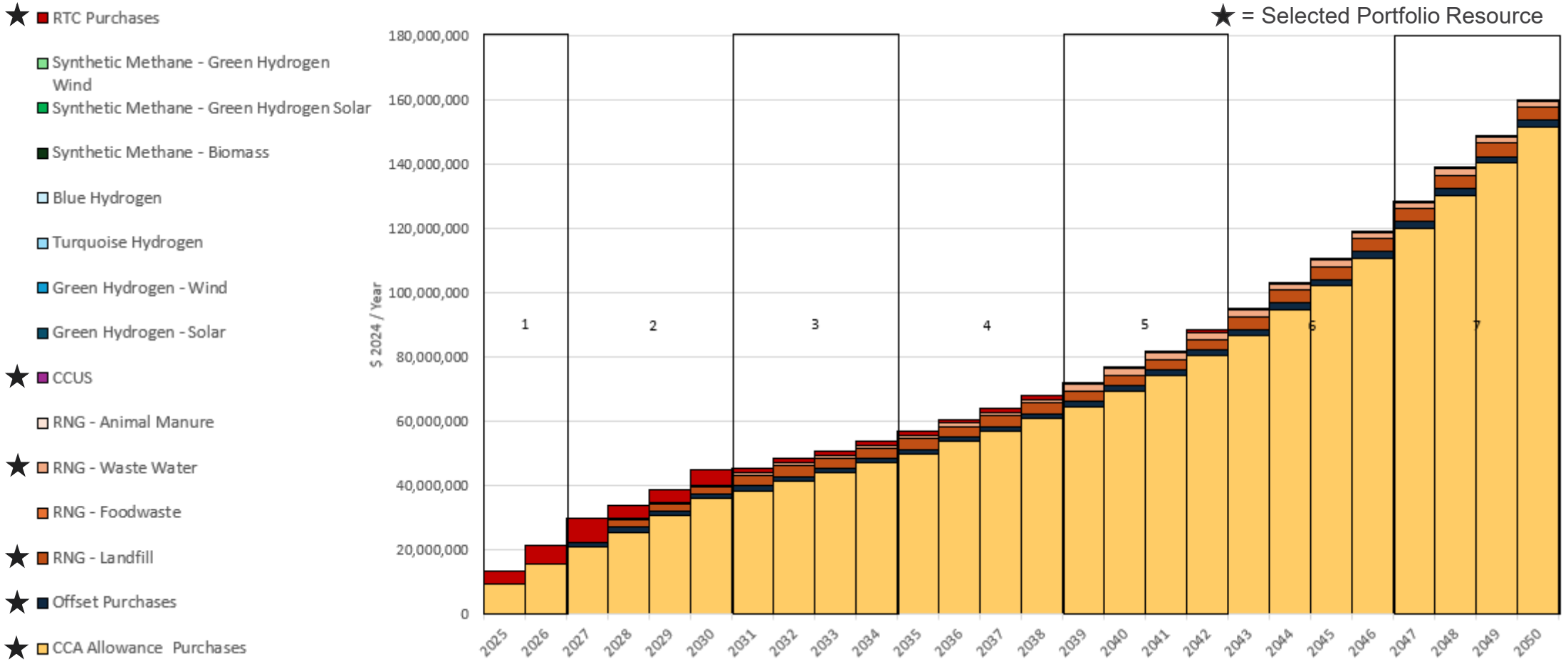
Preferred Resource Strategy

Washington Resource Selection



Preferred Resource Strategy

Washington Resource Selection Costs



Scenario Analysis Insight and Implications

- **CCI Purchase Strategy**:
  - Maximize CCI purchases unless low-cost RNG (e.g., LFG RNG) is available.
  - Excess DEQ compliance instruments can be banked to avoid costlier future alternatives.
  - Not banking instruments leads to higher future customer costs.
- **CCI Cap Mechanics**:
  - CCI cap (20% in later periods) applies to remaining obligation after other resources.
  - Each unit of alternative fuel used reduces the CCI cap by 1/20th.
  - Absolute CCI limit shrinks over time.
- **Modeling Insights**:
  - In 2027, CCIs are bought for the full first compliance period.
  - Initial models show buying CCIs at the end of each subsequent compliance period would minimize NPV cost
  - Year-based compliance modeling (vs. compliance period-based) avoids rate volatility.
  - Delayed CCI availability will be costly to customers.
- **CCUS Role**:
  - Critical for CPP and CCA compliance.
  - Availability depends on partnerships with industrial customers and CPP rule treatment.
  - Early modeling didn't enforce a 10-year lead time; some projects may be faster.

Scenario Analysis Insight and Implications

- **Cost Implications**:
  - CPP compliance costs rise significantly after CCI caps are hit (e.g., by 2038 in PRS.a), whereas CCA costs are expected to rise gradually.
  - Alternative fuels like synthetic methane become necessary post-cap.
  - Specific project costs will vary by location, tax credits, tech, and timing and therefore the mix of compliance resources will vary from deterministic modeling results.
- **Alternative Resources**:
  - Landfill RNG, Wastewater RNG, and Synthetic Methane from Biomass are cheaper than RTCs, but RTC are more flexible.
  - If Synthetic Methane from Biomass is unavailable, hydrogen and RTCs can ensure compliance.
- **Voluntary RNG Limits**:
  - 1% RNG acquisition ≈ 1% revenue requirement.
  - Voluntary RNG capped at 5% of sales volume due to cost containment laws in OR and WA.

Lunch Break – we will return at 12:40pm

Monte Carlo Inputs

Monte Carlo Analysis

NW Natural®

Stochastic Variables

Weather
(Reference Case Only)

Gas Prices

Alternative Fuel Availability

Alternative Fuel Prices

Full PRS All 4 Stochastic Variables

200-500 Draws of PRS Results

Across Demand Variation Scenario Stochastics

50 Draws for Reference Demand

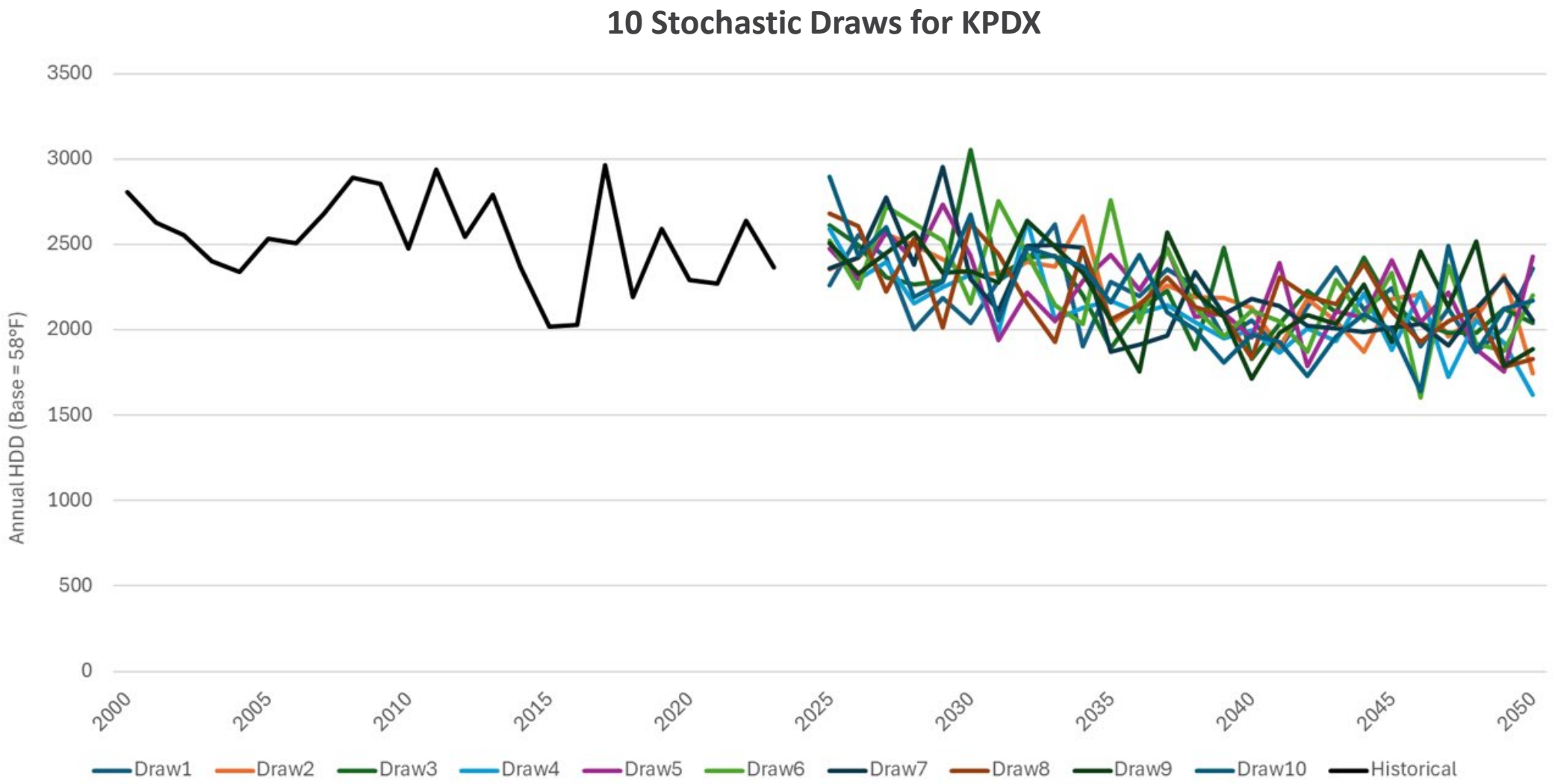
50 Draws for S6

50 Draws for S7

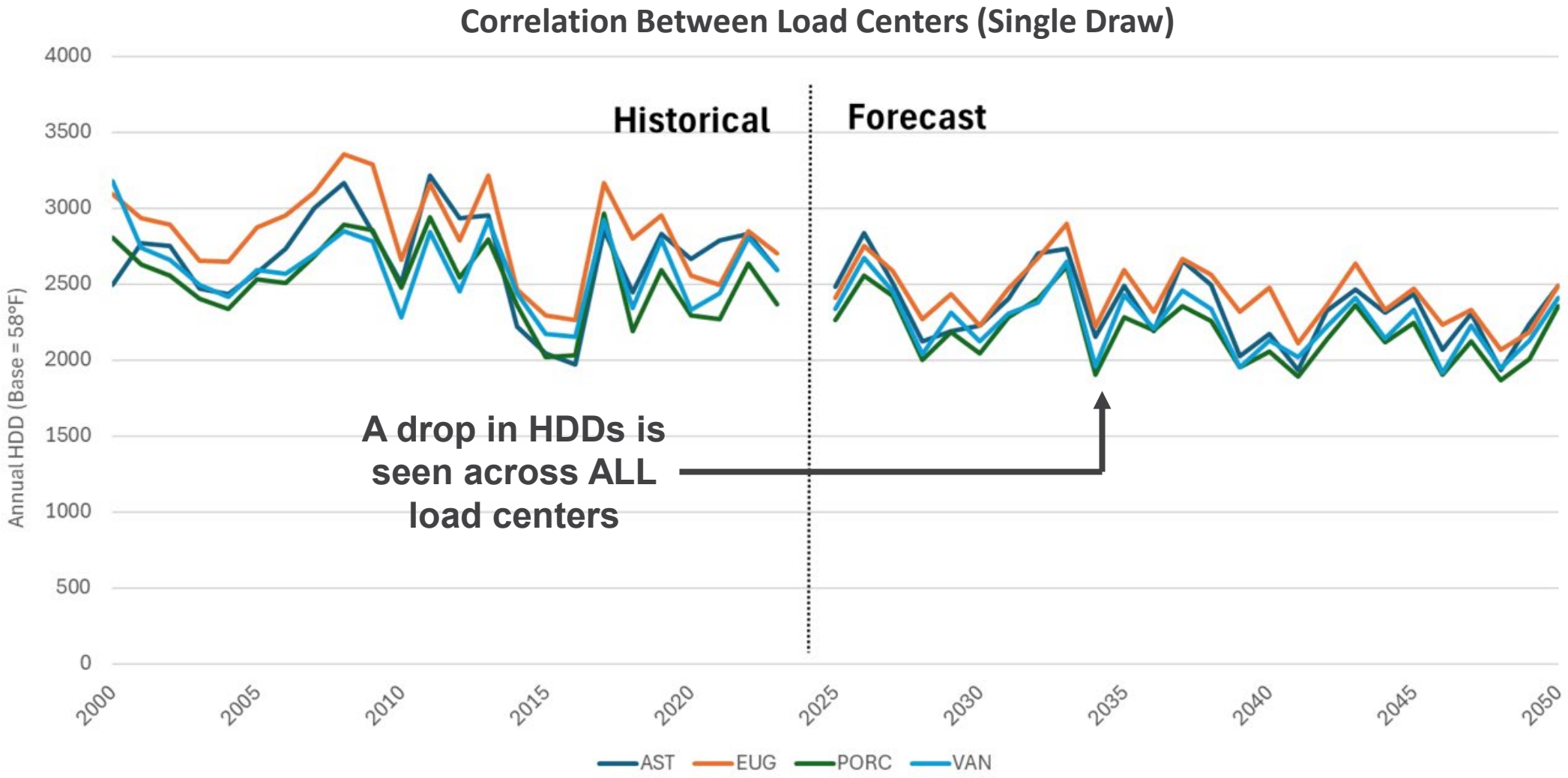
Weather Simulation

- Simulate Annual HDDs for each load center
  - Builds in correlation across load centers
  - Builds in year of year correlation inclusive of impact from climate change
  - Utilizes the variation produced from 22 IPCC models
- Simulate Intra-year daily temperatures
  - Uses historical daily temperature patterns to create intra-year daily temperatures
  - Daily temperatures are shifted up or down until simulated HDD are matched
- Use daily simulated temperatures by load center through the reference case UPC model coefficients to produce stochastic daily demand
  - We do not have how those coefficients change over time due to varying levels of electrification, so we cannot run stochastic weather through demand variation scenarios
  - Although industrial and large commercial demand is less sensitive to weather, we do incorporate the weather simulation into a stochastic impact to these sectors as well.

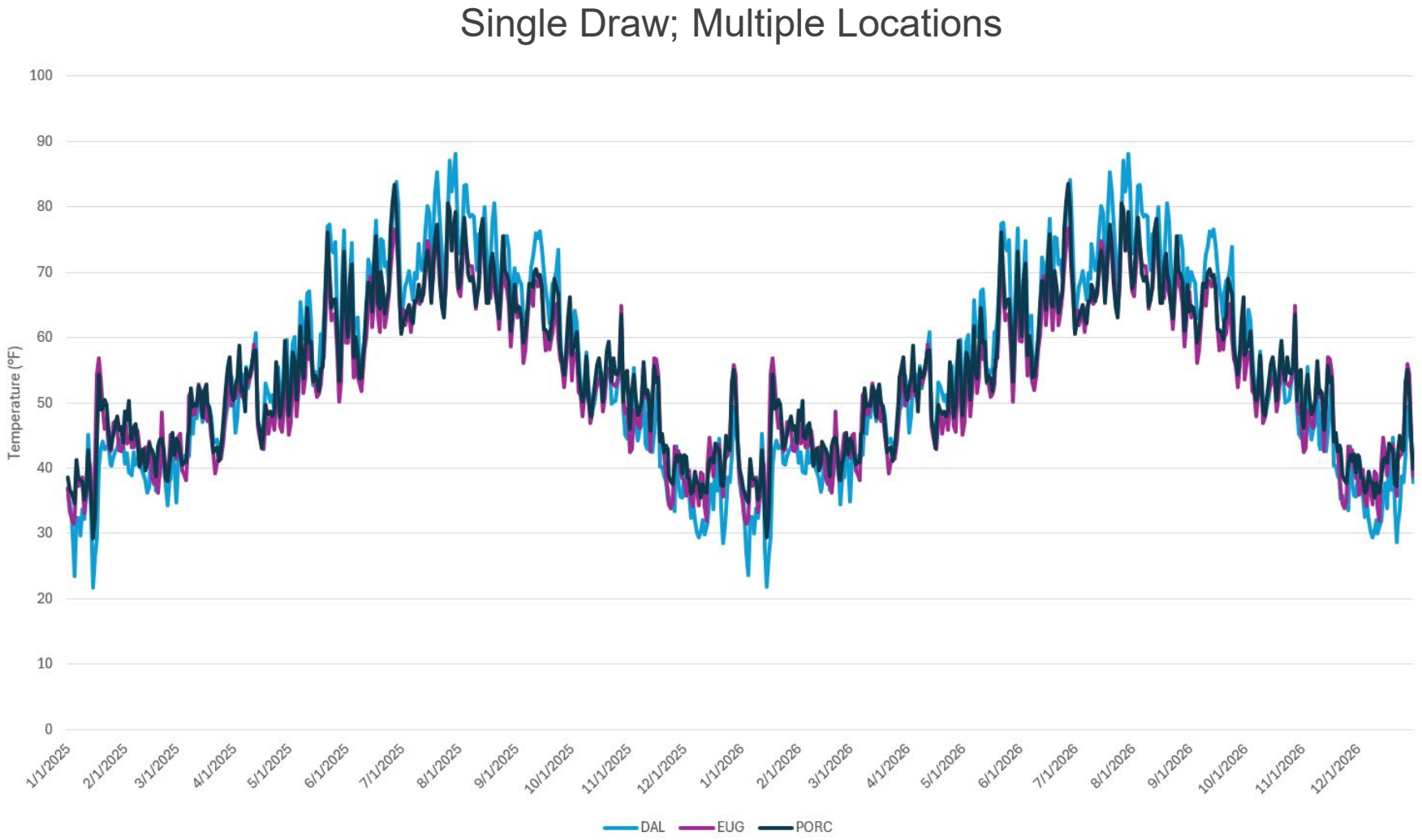
Weather


10 Stochastic Draws for KPDX
Annual HDD (Base = 58°F)
3500
3000
2500
2000
1500
1000
500
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Draw1
Draw2
Draw3
Draw4
Draw5
Draw6
Draw7
Draw8
Draw9
Draw10
Historical

Weather

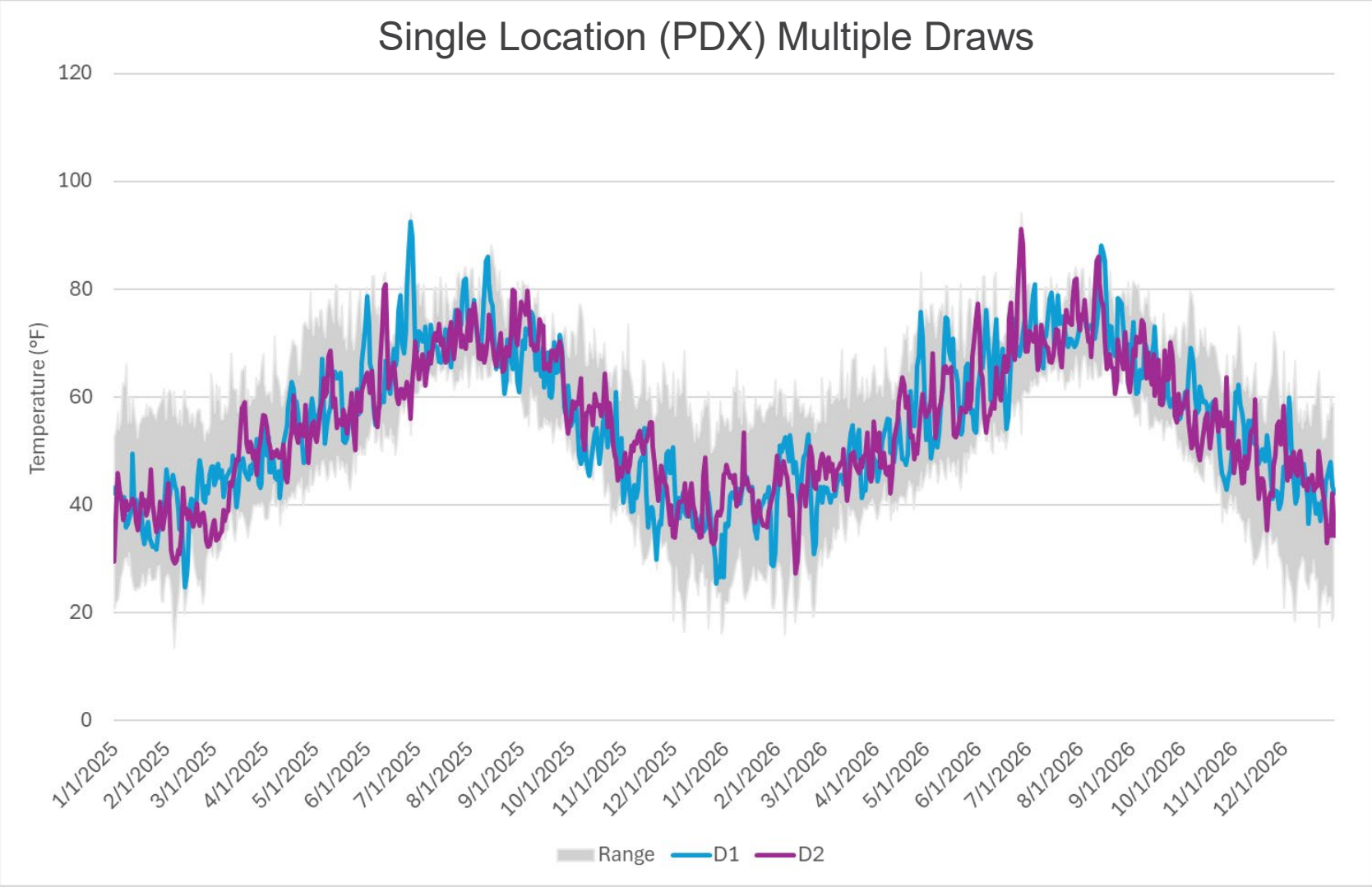

Correlation Between Load Centers (Single Draw)
Historical
Forecast
A drop in HDDs is seen across ALL load centers
Annual HDD (Base = 58°F)
4000
3500
3000
2500
2000
1500
1000
500
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
AST
EUG
PORC
VAN

Daily Temperatures



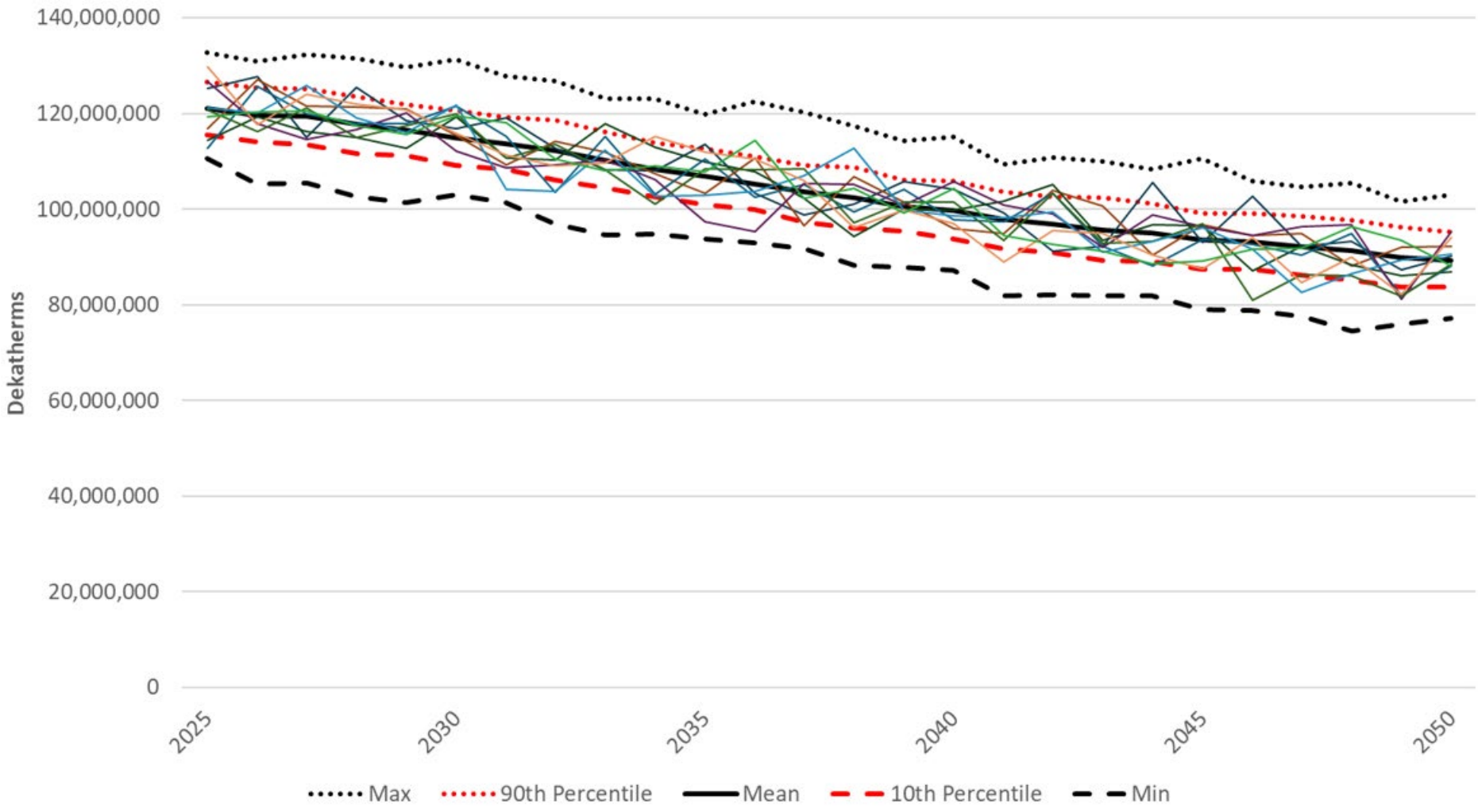
- Our residential and small commercial load forecasting models are a function of daily temperatures
- We use a representative year to shape monthly HDDs into daily temperatures
- Daily volatility is necessary to realistically model resource requirements (i.e., on cold days we need to rely on our storage facilities)

Daily Temperatures



- Model long term HDD uncertainty from climate change using the IPCC modeling
- Simulate monthly and daily uncertainty using historical shapes
- We use these temperature simulations to define the range

Demand


140,000,000
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
Dekatherms
2025
2030
2035
2040
2045
2050
Max
90th Percentile
Mean
10th Percentile
Min

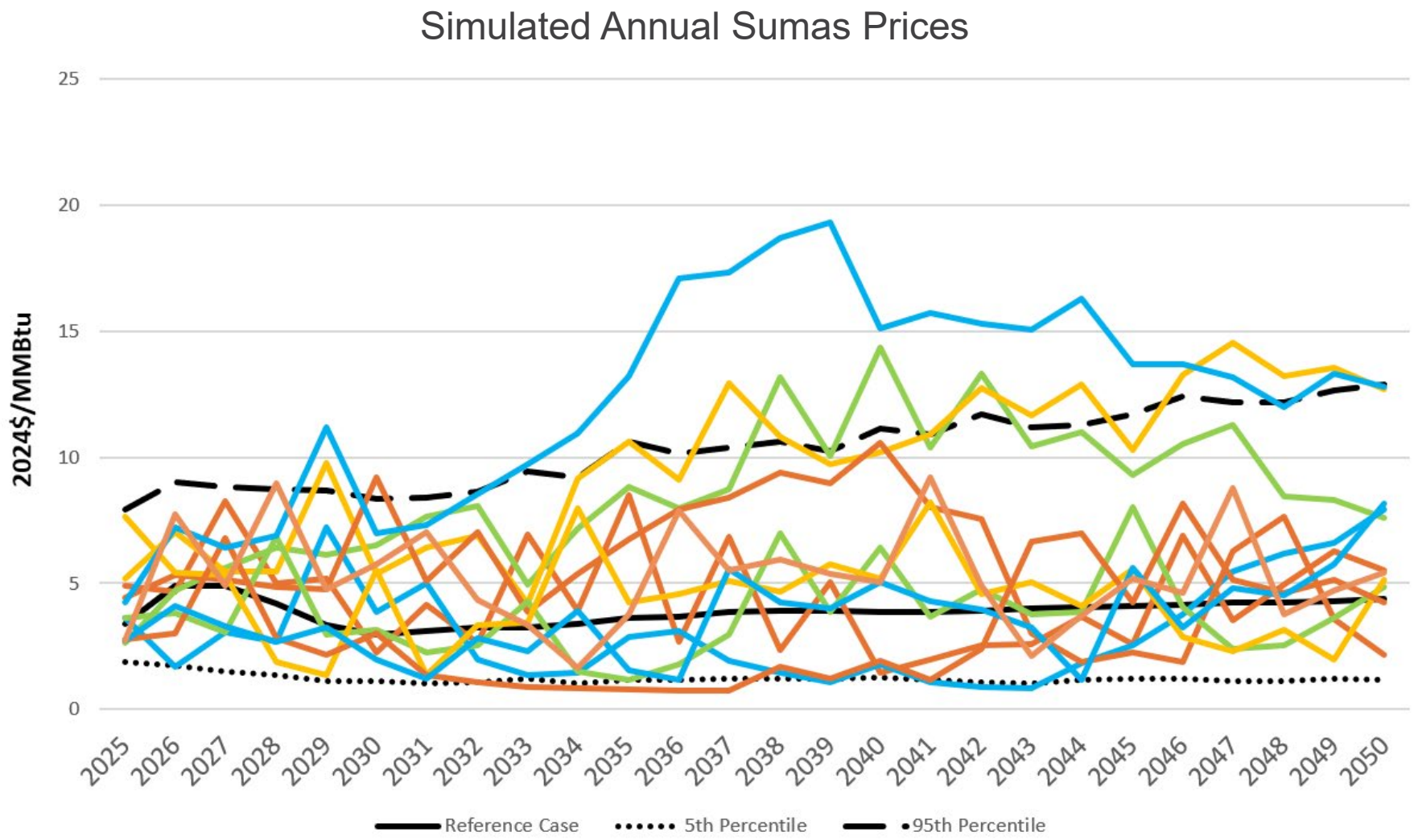
Stochastic Gas Prices

- Captures correlation across basins
- Captures correlation across time

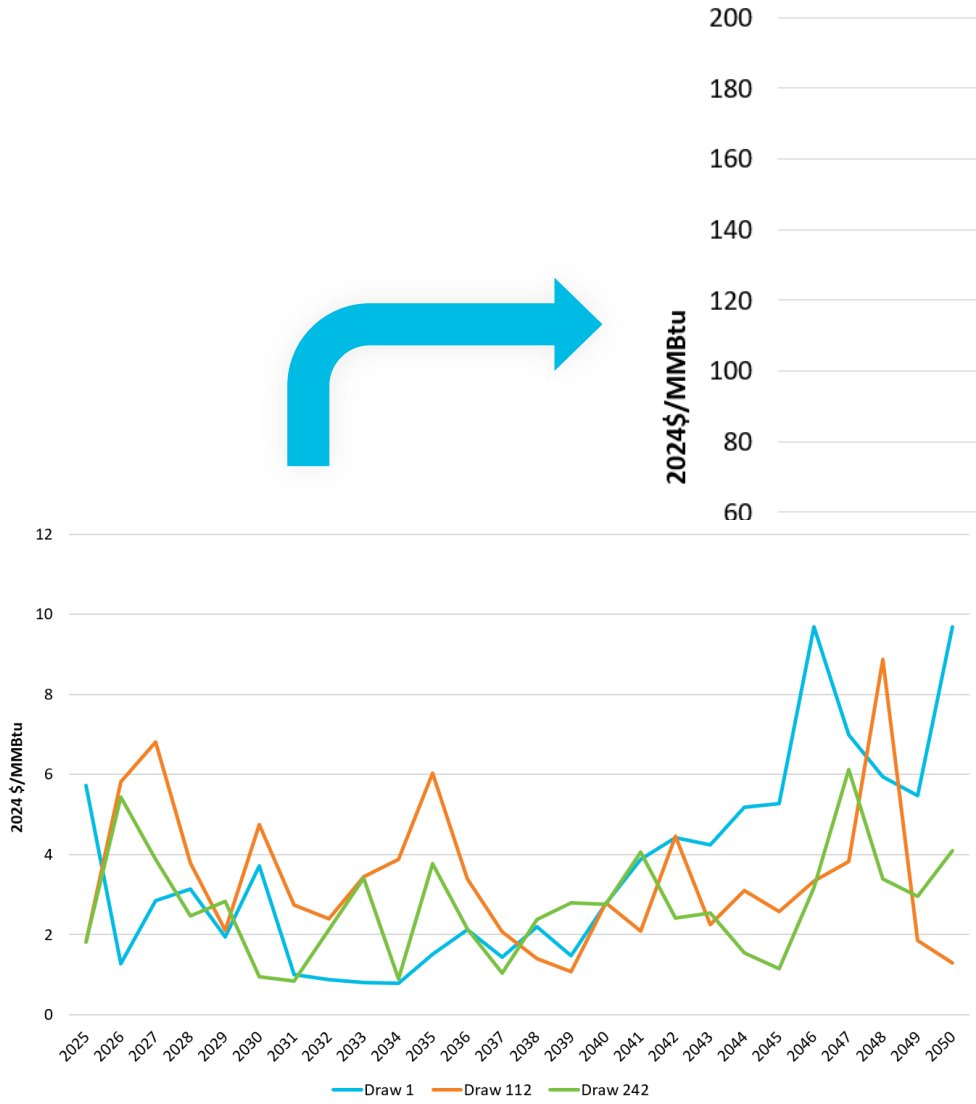
New to this IRP

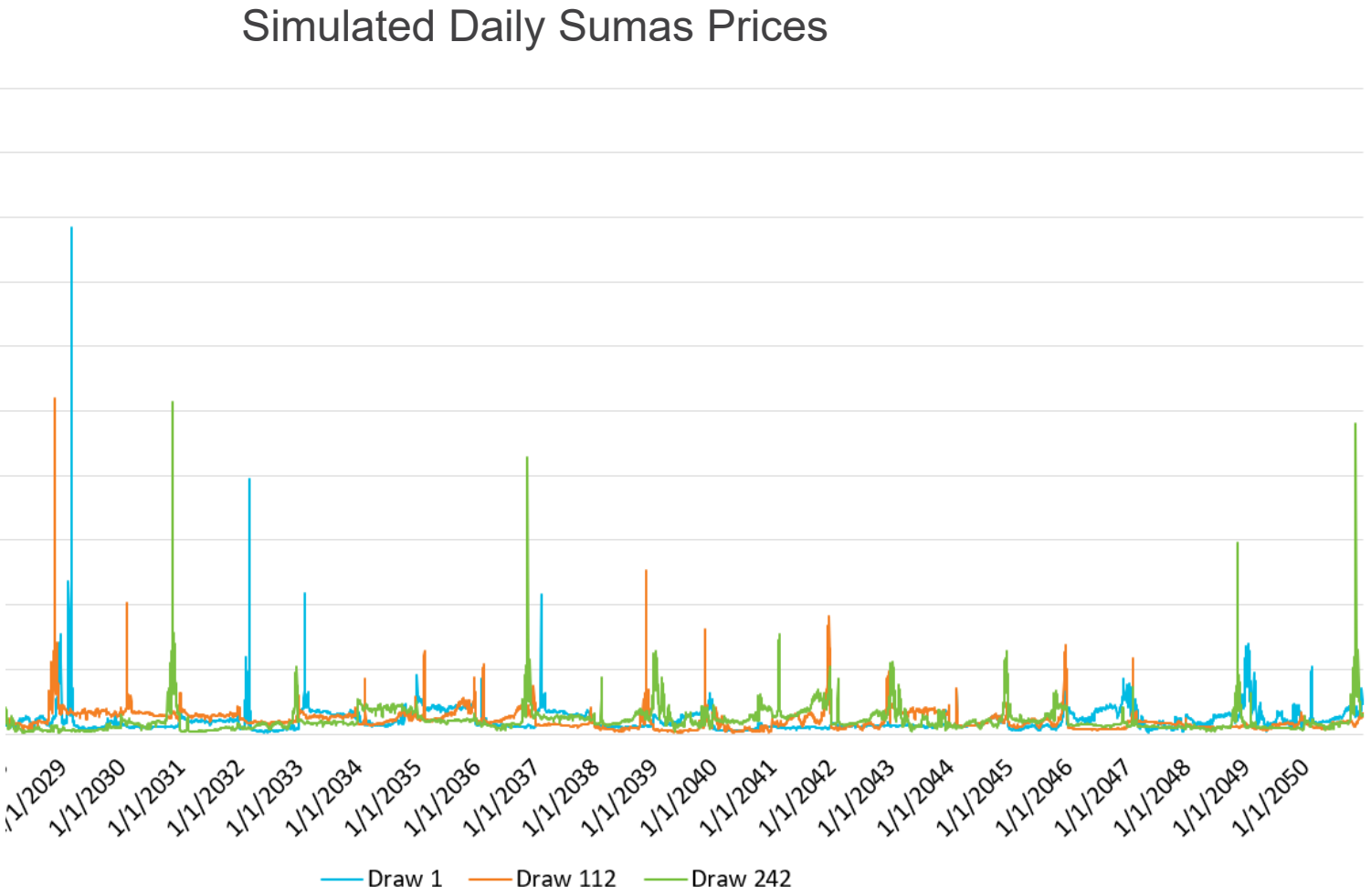
- Stochastic modeling brought gas prices to the daily level
  - Previous IRPs had stochastic monthly prices
- Correlate daily price shocks with daily temperature simulation

Gas Prices


Simulated Annual Sumas Prices
2024$/MMBtu
25
20
15
10
5
0
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
Reference Case
5th Percentile
95th Percentile

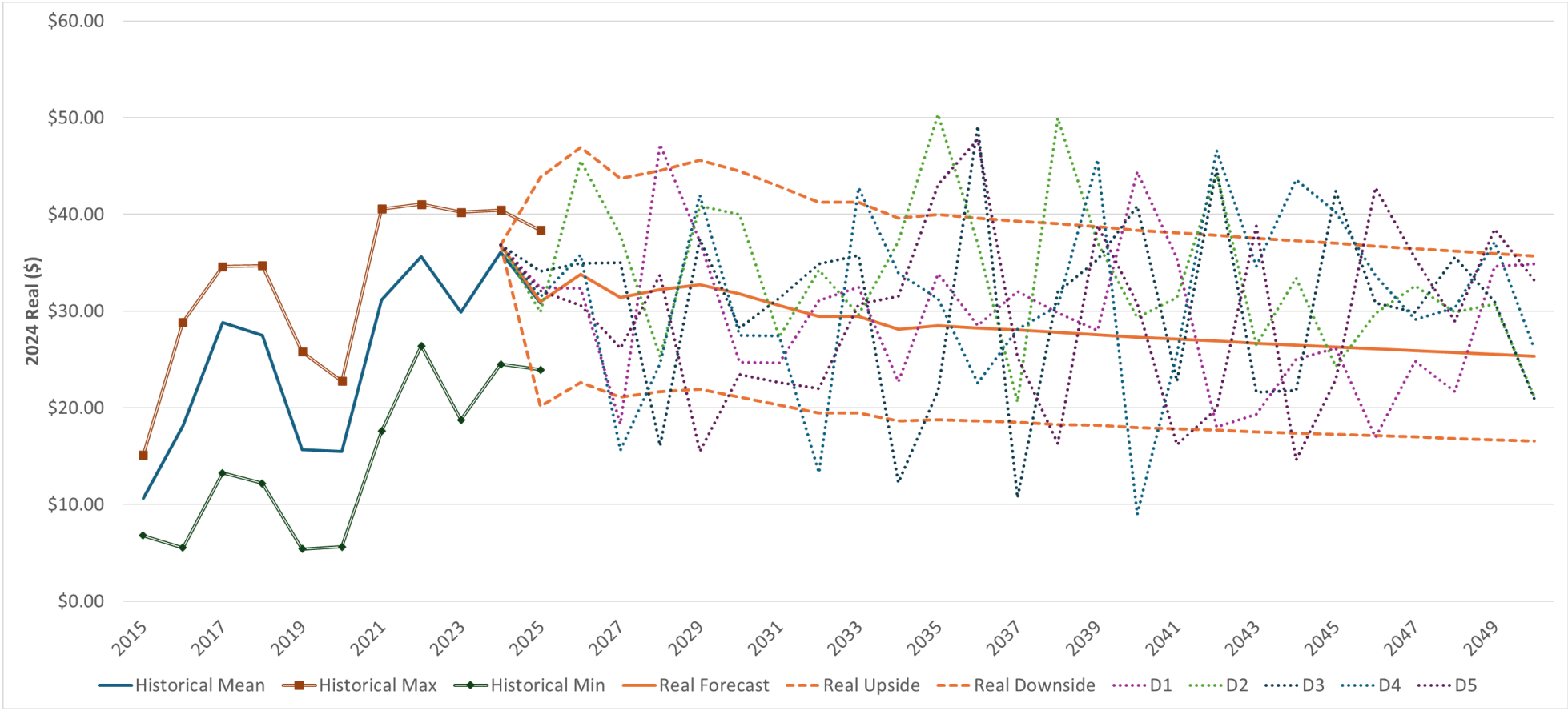
Gas Prices





Alternative Fuel Prices and Availability

- Simulate RTC prices, which are tied to D3 RIN prices
  - We do have historical D3 RIN prices that we use to create a simulation



Alternative Fuel Prices

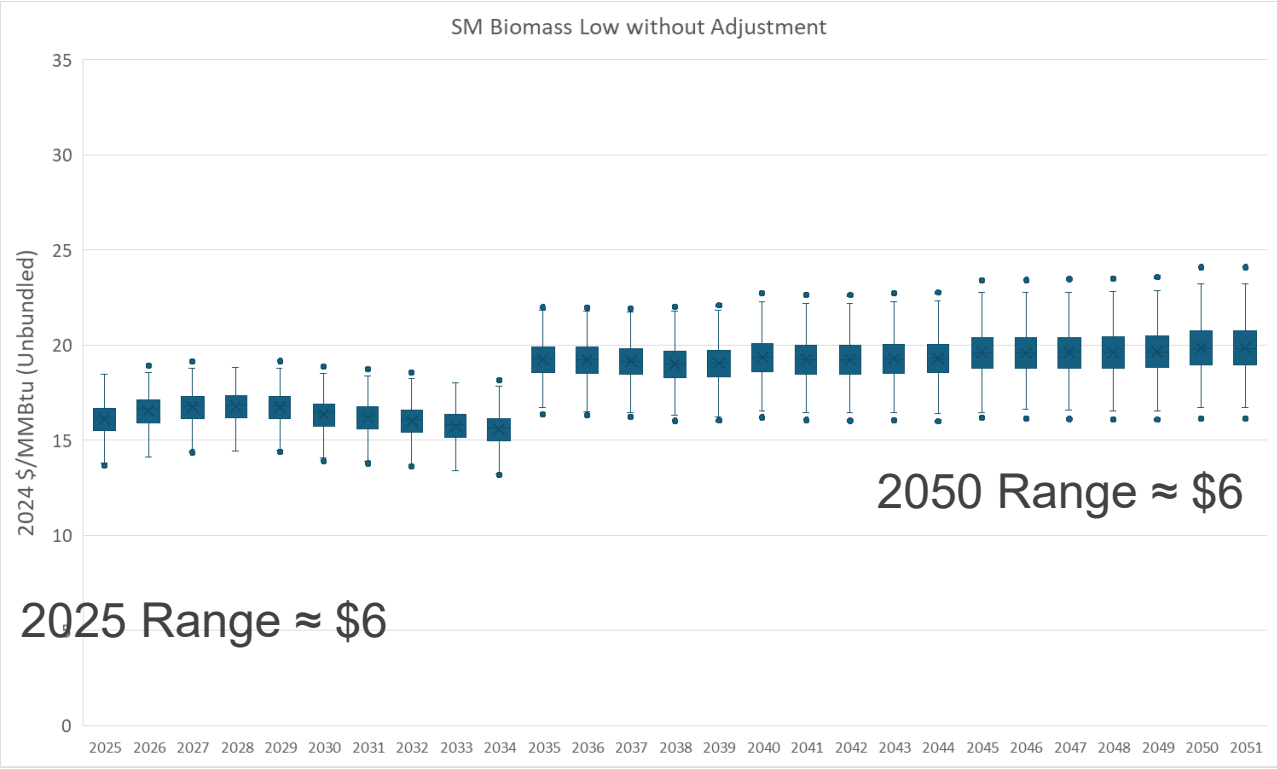
- For other alternative fuel prices, we do not have historical market data
- We rely on the production cost results from the Alternative Fuels study
  - These results conducted Monte Carlo analysis on primary cost drivers in the production cost models to generate stochastic draws
  - This process created stochastic costs levels, but ultimately did not create increased variation through time
- NW Natural modified the costs to reflect increased cost uncertainty through time
  - The modified costs focus on the percentage difference between the cost for each draw and the reference case
  - The modified cost are equal to:

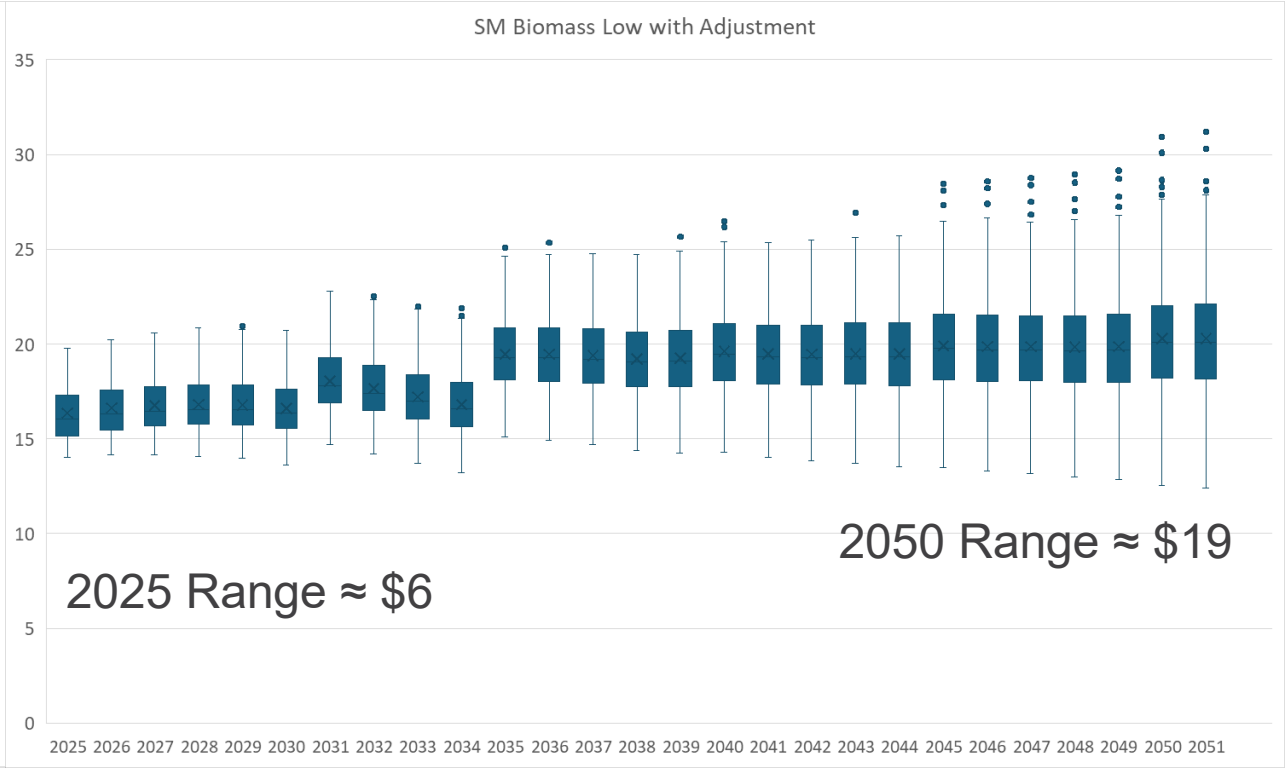
[Reference case cost] * (1 + { [2] * [# of forecast years / total years in planning horizon] * [Percentage Difference]}

Modifier

  - Using this method the cost in 2050 could be 2x the percentage difference as the original stochastic modeling, but never less than the original percentage difference

Alternative Fuel Prices





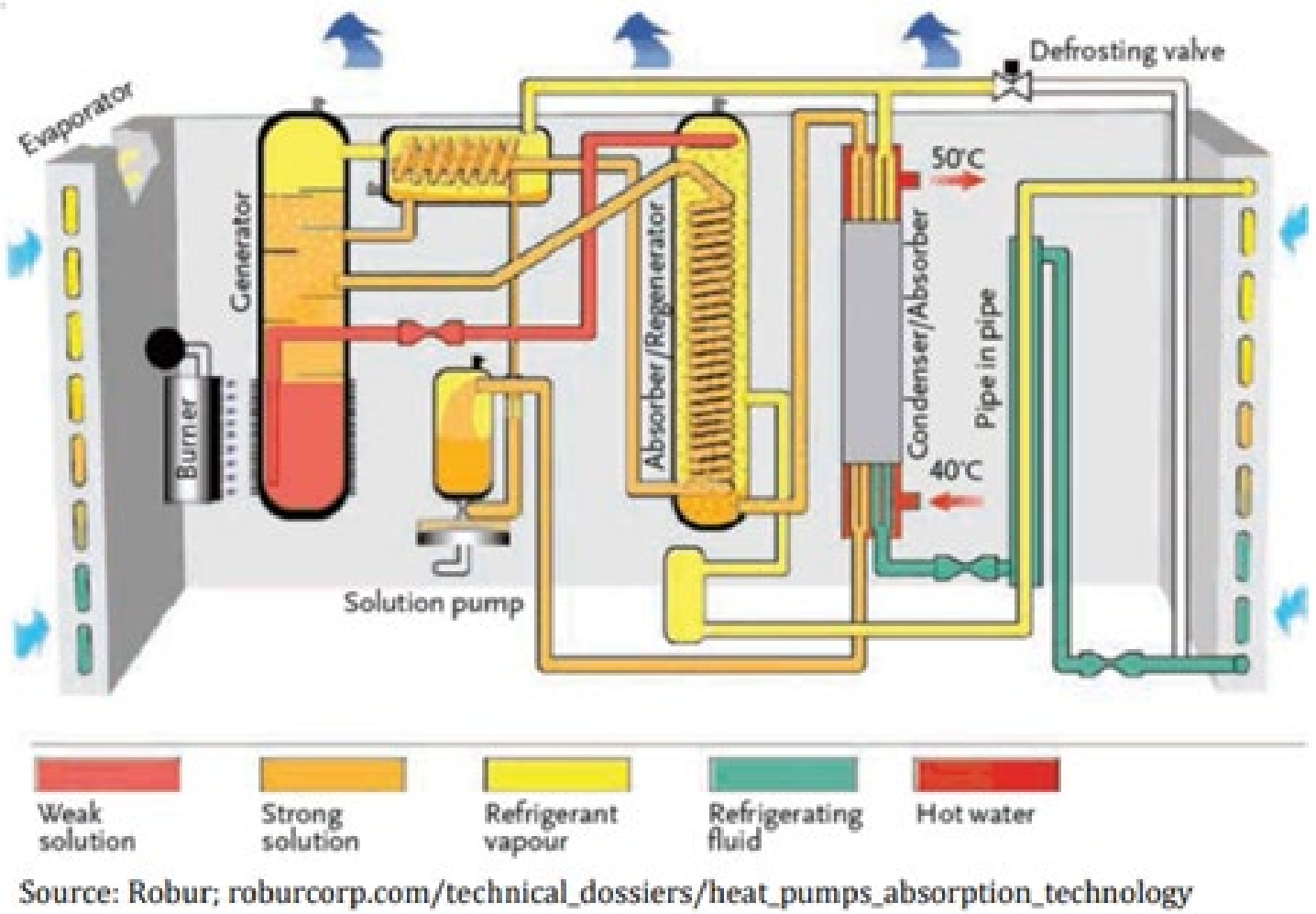
Alternative Fuel Availability

- We rely on the Monte Carlo quantity results from the Alternative Fuels study for availability
- NW Natural modifies the quantity with an additional 33% probability of resource for development projects simply not being available
  - This is done at the most granular alternative fuels buckets
  - Resulting quantities that include draws where resource is not available are used to create weighted prices for PLEXOS buckets

Pilot Projects

Commercial Gas Heat Pumps

What is a Commercial Gas Heat Pump?



Source: Robur; roburcorp.com/technical_dossiers/heat_pumps_absorption_technology

- Like an electric heat pump, it extracts heat from outdoor air for use indoors
- Greater than 100% efficiency
- Utilizes combustion onsite which allows for high efficiency and higher capacity at lower temperatures
- GHPs can be utilized in a variety of applications.
  - Boilers
  - Domestic Hot Water (up to 140°F)
  - Variable Refrigerant Flow
  - Hydronic heating

Availability of Commercial GHP

Although viewed as emerging technology, full production and commercialized GHP units with necessary approvals have been available in North America since 2006. Uptake has been low in this market due to lack of awareness.

Over 100,000 water-ammonia absorption chillers and heat pump installations have been performed world-wide.

Robur brand equipment is in stock in the U.S. (Evansville, IN) and distributed throughout the U.S. and Canada.

Fortis BC currently offers an incentive rebate of 75% of total project costs up to $200,000 (C$). The program covers up to $20,000 in feasibility study funding. Measure is based on pilot tests of 14 units in 7 installation sites in B.C. with up to 21% energy savings.

https://www.fortisbc.com/rebates/business/gas-absorption-heat-pump-rebates

Why Gas HP and not Electric HP?

While Gas HPs are typically less efficient than electric air-to-water heat pumps, which often have an annual COP above 2.0 in Northwest climates, Gas HPs provide several unique advantages over their electric counterparts:

- **Gas HPs typically use an ammonia-water solution as the refrigerant, which has a global warming potential (GWP) of zero. By contrast, electric heat pumps commonly use Hydrofluorocarbons (HFC) refrigerants with GWPs between 450 to 2100.**
- Gas HPs can deliver hot water at a lower cost, depending on the application.
- Due to their performance and reliability, gas boilers are the predominant commercial water heating equipment type in the market.

Commercial Gas Heat Pump Pilot Objectives

The primary objectives are to evaluate the performance of GHPs under different commercial scenarios, inform a broader strategy to reduce gas use as well as greenhouse gas (GHG) emissions, and demonstrate cost-effectiveness and proof of concept to the commercial market.

1. **Performance Evaluation:**
   - Assess the efficiency and reliability of GHPs in diverse commercial settings, including but not limited to office buildings, laundry, retail spaces, and healthcare facilities.
   - Monitor performance metrics such as energy consumption, heating capacity, and maintenance requirements.

2. **Scenario Analysis:**
   - Implement GHPs in various climatic conditions and building types to understand their adaptability and effectiveness.
   - Compare GHP performance with traditional heating systems in terms of energy savings and operational costs.

3. **GHG Emissions Reduction:**
   - Quantify the reduction in GHG emissions achieved by using GHPs compared to conventional gas heating systems.
   - Evaluate the environmental benefits of GHPs, including their impact on carbon footprint.

4. **Cost-Effectiveness:**
   - Analyze the economic viability of GHPs by comparing installation, operational, and maintenance costs with those of traditional systems.
   - Provide a detailed cost-benefit analysis to demonstrate the financial advantages of adopting GHP technology.
   - Data from pilots can be used to validate Energy Trust incentive measures.

5. **Proof of Concept:**
   - Showcase successful pilot projects to the commercial market, highlighting the practical benefits and scalability of GHPs.
   - Gather feedback from stakeholders to refine and optimize GHP deployment strategies.

Scope of pilot project

- **Target:** Large commercial loads.
- **Pilot**: Tests up to five commercial gas heat pumps in different commercial installations to gather information and inform a broader strategy to scale a cost effective GHP deployment schedule and improved facilitate market transformation.
- **Sizing:** Units are modular and can be connected to achieve desired capacity.
- **Potential sites**: Commercial laundry, restaurant, hospitality, residential living facility, commercial pool, food processing.
- **Cost**: $550,000 or about $110,000 per installation. At scale, the cost of the equipment is expected to be about a 12% increase over more conventional equipment before installation and incentives costs. Pilot would help inform this comparison.

Pilot Project Cost Elements	% of overall project cost
Installation, electrical, permits	50.25%
Equipment (two-unit assumption)	29.56%
Dealer Mark up	10.34%
Controls and data loggers	9.85%

Commercial laundry

Commercial food processing

2020 NEEA Pilot - Salem

- This leverages a pilot that was performed by NEEA in 2020*. That pilot recommended future pilots look at applications for large commercial loads. Savings from the NEEA pilot were **5,134 therms annually**.

- Capital Manor Retirement Community in Salem is comprised of the Manor Care building and Main Tower building, each of which has separate mechanical systems. For this demonstration, the Main Tower building was selected, which is a 10-story, 185,000 square foot building.

- **“In summary, the Robur gas absorption heat pumps have a positive outlook. Its reasonable first cost, ease of installation, efficient operation, reliability, and low maintenance operation result in a viable solution for achieving natural gas savings.”**

- Conclusion was that more pilot tests were recommended.

*Tierney, Jennifer, P.E., et al, Robur Heat Pump Field Trial, NEEA report #E20-309, March 11, 2020.
HHW- Heating Hot Water, DHW – Domestic Hot Water

Collaboration

NW Natural would collaborate with NEEA, ETO, and GTI Energy to leverage their experience and expertise in pilot project design and, in the case of ETO, understand their data needs in creating an updated incentive measure for the market.

Proof of concept and validation of the technology in this market is an important objective. Contractors, developers and building owners would need to see demonstration of the energy savings (operating cost) that offsets the expected 12% cost delta of the installed equipment.

When validated with acceptable incentive measures, commercial building owners/operators will hope to see a favorable return on investment with low risk.

Commercial GHP - Energy Trust Custom Incentive

Energy Trust offers cash incentives to customers planning a custom energy-efficiency project. Incentives are calculated based on operating hours and usage.

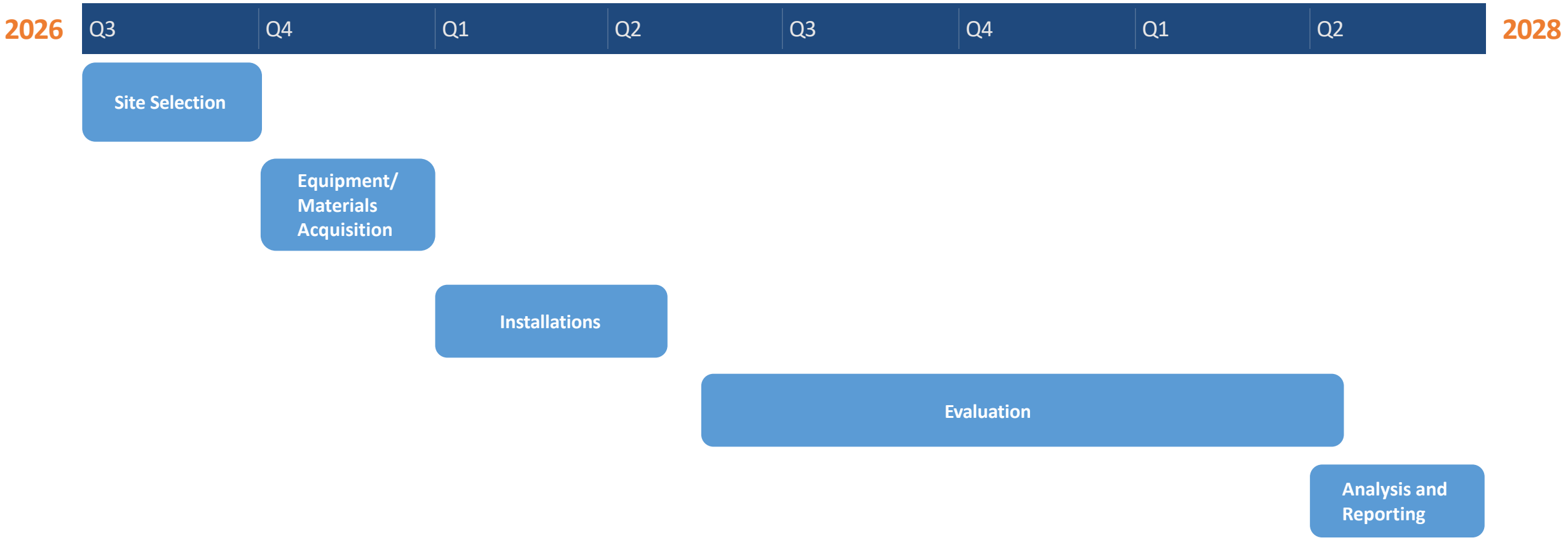
Custom Capital Gas & Electric	Incentive
Custom gas	$5/therm, up to 90% of eligible project cost

In addition to cash incentives, Energy Trust provides the following technical services:

- **Scoping Studies**: Energy Trust can conduct a technology-specific or facility-wide scoping study to help you identify energy and cost-saving opportunities.
- **Technical Energy Studies**: Once a custom project has been identified, Energy Trust can conduct a technical study to identify the most cost-effective and energy-saving solution. These studies are valued at up to $20,000; Energy Trust can conduct these studies at no cost to your company.

Incentives are subject to funding availability and may change.

Indicative Commercial Gas Heat Pump Timeline



The schedule covers a period of eighteen to twenty-four months and should include at least one full heating season. Successful pilot will see a detailed summary report delivered in time to inform decisions for the following heating season.

Carbon Capture Utilization and Storage/ Sequestration (CCUS)

Strategic CCUS piloting for decarbonization :

- NW Natural must reduce emissions 50% by 2035 and up to 95% by 2050, under the CPP and CCA.*
- Commercial and industrial customers represent 38% of gas sales— a key decarbonization target.
- NW Natural is exploring scalable reliable and affordable on-site emissions reduction options.
- This pilot will help assess cost-effective solutions and build knowledge to inform future scalability.

∗ Oregon Climate Protection Program (CPP) Reduce emissions – 50% by 2035 and 90% by 2050 from 2017-2019 average baseline emissions.
Washington Climate Commitment Act (CCA) Reduce emissions – 45% by 2030, 70% by 2040, and 95% by 2050 under1990 levels.

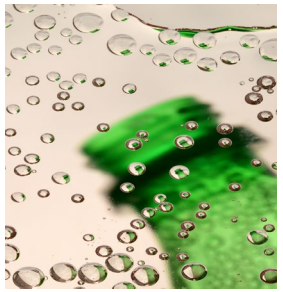
Carbon Capture Utilization and Storage (CCUS)

Capture

Catch the CO2 It before it goes into the air.

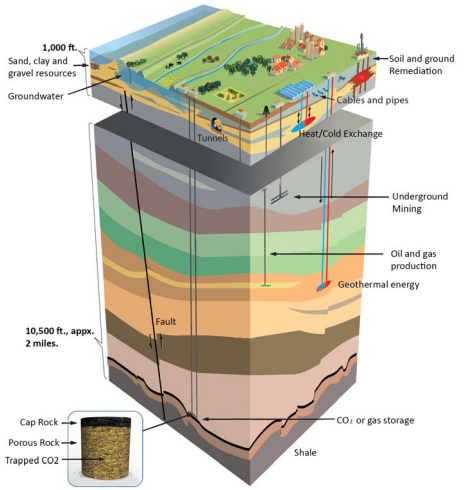
Utilization

Reuse it by turning it into something useful



Storage/Sequestration

Safely inject it underground so it does not contribute to climate change.

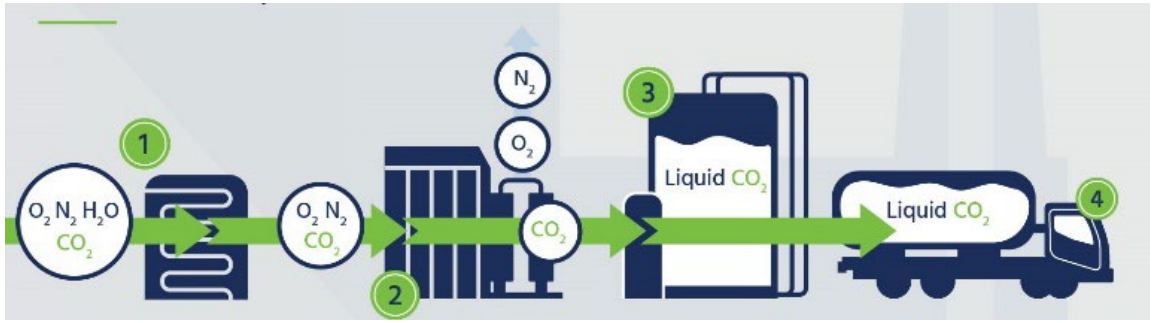


Pacific Northwest has strong CO_2 sequestration potential—Western Oregon and Washington basins can store 14,000 megatons, enough to hold Oregon's emissions for over 200 years.

Proposed CCUS Pilot

Research question: *Can post-combustion carbon capture provide a reliable, scalable, and cost-effective solution for reducing emissions while maintaining operational feasibility and economic viability?*

The Approach: install and operate a commercially ready carbon capture solution at a commercial facility to capture, liquefy, store, and transport CO_2 for sequestration or mineralization



Example of Carbon Capture process (Source: CarbonQuest: How it works)

Partners and Roles:

Technology provider: Turnkey solution, owns and operates equipment provides performance data

Host site: Provides site access, coordinates on-site operations, provides feedback for evaluation.

Key activities:

- Test Performance: Validate capture efficiency and system reliability.
- Evaluate Integration: Ensure seamless fit with existing infrastructure.
- Evaluate Costs: Analyze cost drivers and identify opportunities to lower them.
- Enable Scale-Up: Inform broader deployment strategies.
- Support Policy: Provide data to inform and support emissions regulations.

Site selection and scalability potential

Host site Partner:
Oregon Health and Science University (OHSU) uses natural gas for steam heat in a centralized system supplying multiple buildings. OHSU requires reliable energy to support its critical healthcare and research operations and are committed to reducing emissions and achieving net-zero by 2050.

Why this site?

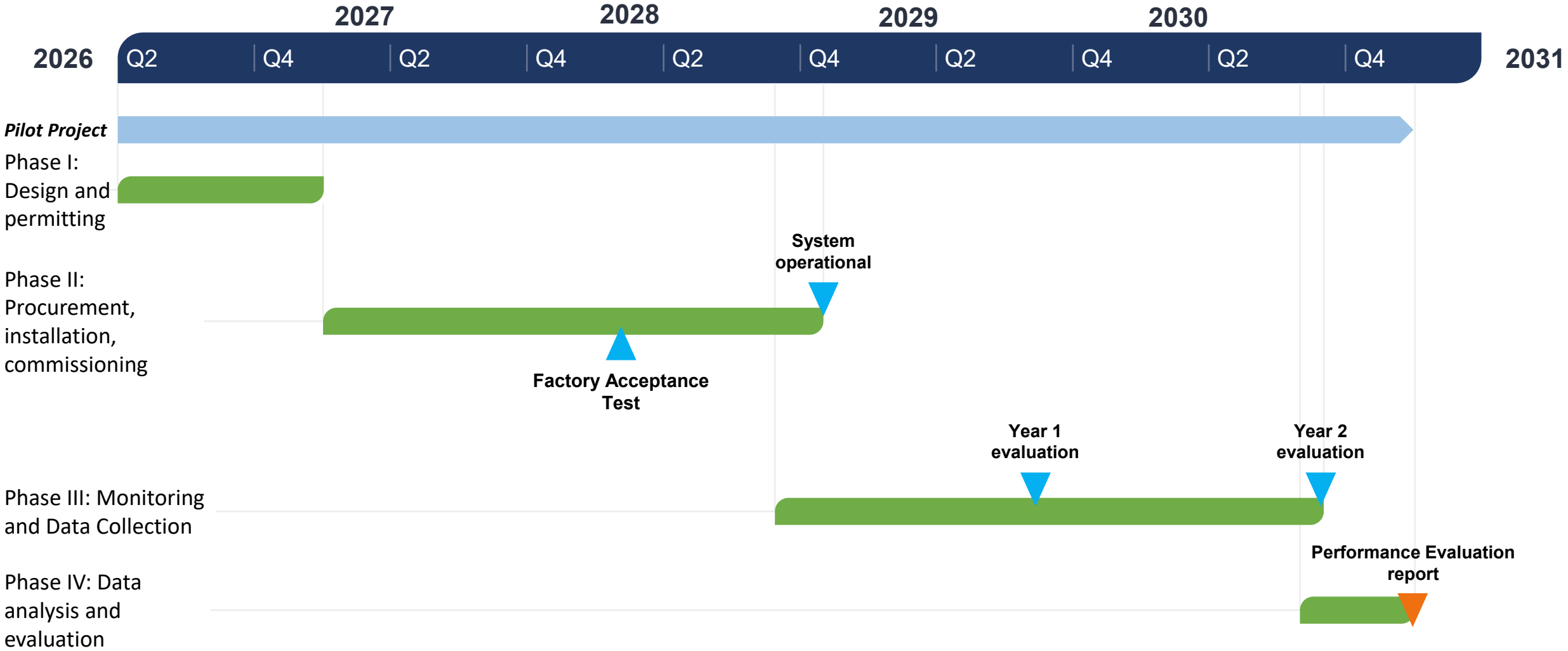
- Representative of sector
- Centralized heating, natural gas use profile, year-round demand.
- Physical space available for equipment.
- Strong alignment with decarbonization goals.

Scalability potential
The pilot could enable broader deployment across large energy commercial and industrial users.

Long-term viability depends on:

- Adequate CO_2 concentrations and volumes
- Available space for CCUS system
- Competitive cost vs. alternatives

Schedule and milestones



Expected CO_2 Capture and Storage

Emissions Baseline:

Based on Oregon DEQ data, OHSU average emissions were approximately **26,000 metric tons of CO_2 per year** in the last 5 years (2019-2023).

Expected Carbon Capture:

The system will integrate with existing infrastructure, preliminarily expected to capture 65-75% of CO_2 from flue gas **(average 17,400 tons of CO_2 per year)**, depending on space and service availability.

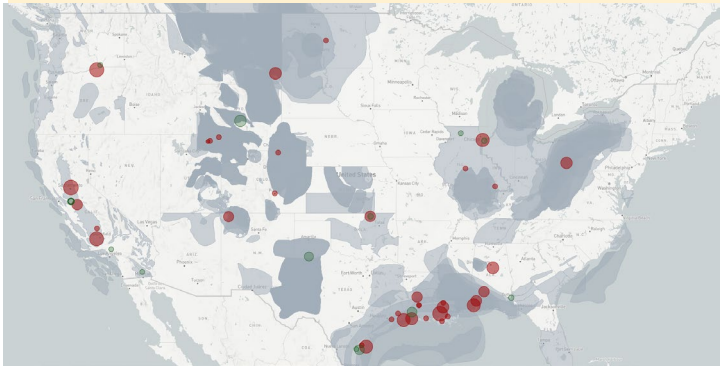
17,400 tons of CO2 per year

=  3,800 cars

What Happens to the CO_2?

Captured carbon may be:

- Injected into concrete for permanent mineralization during curing
- Sequestered at emerging or future storage sites



Carbon sequestration project map, CATF. https://www.catf.us/ccsmapus/

Estimated costs

Business model:

All Capital, Operation and Maintenance (O&M) expenses will be covered by the tech provider.

NW Natural will pay a performance-based fee per ton of CO_2 removed.

Costs:

Capital Cost	~$25 MM
Annual O&M	~$2.5-3 MM
Annual Cost of CO2 removed	$4.5-5 MM
Cost per tonCO_2e	**~$315**

Preliminary cost estimated by technology provider based on system capacity, site conditions and expected CO_2 removal.

Expected cost decline over time with scale, shared infrastructure, local sequestration sites. target price $150-200 per ton CO_2

Minimizes capital exposure and limits risks

Cost-effective compared to other decarbonization resources identified in the ICF alternative fuel study

Why Carbon Capture?

- ✓ Potential to be low-cost, scalable decarbonization option (target price $150-200 per ton CO_2).
- ✓ Targets emissions from systems that are difficult or costly to convert.
- ✓ Compatible with existing infrastructure—minimal customer disruption.
- ✓ Enables deep emissions reductions, integrates with other decarbonization strategies.
- ✓ Could be deployed across commercial and industrial sites.

Feedback Form

Feedback preferred by June 12, 2025

https://www.surveymonkey.com/r/NWNaturalIRP

Forward Looking Statement

This presentation contains forward-looking statements within the meaning of the U.S. Private Securities Litigation Reform Act of 1995. Forward-looking statements can be identified by words such as "anticipates," "assumes," “continues,” “could,” "intends," "plans," "seeks," "believes," "estimates," "expects," "will" and similar references to future periods. See "Risk Factors” in our most recent Annual Report on Form 10-K and our subsequent quarterly reports for examples of forward-looking statements and for important factors that could cause actual results to differ materially from those in the forward-looking statements, including legal, regulatory and legislative risks, financial, macroeconomic and geopolitical risks, and business, environmental and technology risks.

You are cautioned against relying on any forward-looking statements. Any forward-looking statement speaks only as of the date on which such statement is made, and we undertake no obligation to publicly update any forward-looking statement, whether as a result of new information, future developments or otherwise, except as may be required by law. New factors emerge from time to time and it is not possible to predict all such factors, nor can we assess the impact of each such factor or the extent to which any factor, or combination of factors, may cause results to differ materially from those contained in any forward-looking statements.

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We value your feedback.

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