Avista – 2020 Natural Gas Integrated Resource Plan

Technical Advisory Committee # 3

September 30, 2020

2020 Natural Gas IRP Schedule

TAC 1: Wednesday, June 17, 2020: TAC meeting expectations, 2020 IRP process and schedule, energy efficiency update, actions from 2018 IRP, and a Winter of 2018-2019 review. Procurement Plan and Resource Optimization benefits. fugitive Emissions, Weather Analysis, Weather Planning Standard

TAC 2 (Dual Meeting with Power side): Thursday, August 6, 2020: Market Analysis, Price Forecasts, Cost Of Carbon, Environmental Policies

- Demand Results and Forecasting – August 18, 2020

TAC 3: Wednesday, September 30, 2020: Distribution, Avista's current supply-side resources overview, supply side resource options, renewable resources, Carbon cost, price elasticity, sensitivities and portfolio selection modeling.

TAC 4: Wednesday, November 18, 2020: CPA results from AEG & ETO, review assumptions and action items, final modeling results, portfolio risk analysis and 2020 Action Plan.

Agenda

	Topic Length	Start Time	–	End Time
• Introductions/Agenda	30 minutes	9:00 AM	–	9:30 AM
• Avista and Carbon Reduction	15 minutes	9:30 AM	–	9:45 AM
• Current Supply Side Resources	30 minutes	9:45 AM	–	10:15 AM
• **BREAK**	**15 minutes**	**10:15 AM**	**–**	**10:30 AM**
• Renewable Natural Gas	60 minutes	10:30 AM	–	11:30 AM
• Hydrogen	30 minutes	11:30 AM	–	12:00 PM
• **LUNCH BREAK**	**60 minutes**	**12:00 PM**	**–**	**1:00 PM**
• Distribution	60 minutes	1:00 PM	–	2:00 PM
• Supply Side Resource Options	30 minutes	2:00 PM	–	2:30 PM
• Carbon Costs/Price Elasticity	30 minutes	2:30 PM	–	3:00 PM
• Sensitivities	30 minutes	3:00 PM	–	3:30 PM

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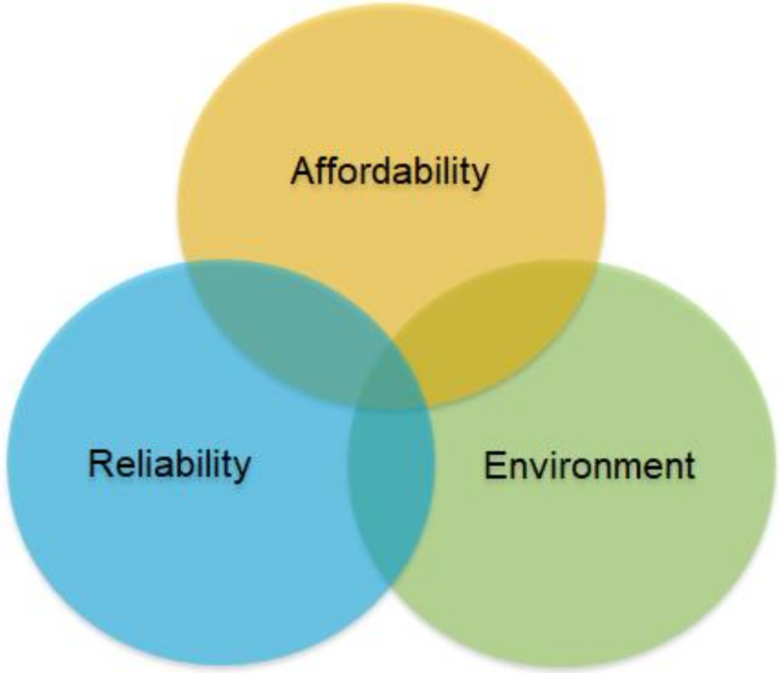
Avista and Carbon Reduction

Jody Morehouse
Director – Natural Gas Supply

Planning for a Deeply Decarbonized Future

Active Energy Policy Environment

- Washington
  - Carbon reduction goal House Bill 2311
  - RNG/EE House Bill 1257
- Oregon:
  - RNG Senate Bill-98
  - Cap and Reduce Executive Order 20-04



Focus on solutions that balance carbon reduction, affordability, and reliability

Avista's Environmental Objectives

- Build further recognition of Avista’s continued commitment to environmental stewardship
- Acquire renewable supplies based on the demand of our customer base and/or policy direction
- Fully account for all costs of natural gas including carbon attributed to upstream emissions
- Continue to engage with state and local governments on all existing and future climate policy
- Increase understanding of how natural gas currently works as part of the energy ecosystem, ensuring that customers have choices for their energy needs that include access to reliable energy at affordable prices
- Demonstrate Avista’s leadership in responsibly managing a transition to a cleaner energy mix while being sensitive to customers’ and other stakeholders’ interests

Natural Gas is an Important Part of a Clean Energy Future

- In the right applications, **direct use of natural gas is best use**
- Natural gas generation provides **critical capacity** as renewables expand until utility-scale storage is cost effective and reliable
- Full electrification can lead to **unintended consequences**:
    - Creates new generation needs that may increase carbon footprint
    - Drives new investment in electric distribution, generation, and transmission infrastructure, causing bill pressure
    - Home and business conversion costs borne by customers
- Customers have paid for a vast pipeline infrastructure that can utilized for a cleaner future by **transitioning the fuel** and keeping the pipe
- A comprehensive view of the energy ecosystem leads to a **diversified approach to energy supply** that includes natural gas

Benefits of Natural Gas

- **For Customers.** Natural gas is affordable, resilient, and reliable.
- **For Society.** Natural gas is an abundant energy resource produced in North America, which helps lessen our dependency on foreign oil.
- **For Innovation.** Natural gas can play a supporting role in expanding the use of renewable energy sources.
- **For Environment.** Natural gas is the cleanest burning fossil fuel, so it helps reduce smog and greenhouse gas emissions.
- **For Economy.** Natural gas provides nearly a fourth of North America's energy today.

Current Supply Side Resources

Justin Dorr
Resource Manager, Natural Gas Supply

Interstate Pipeline Resources

- The Integrated Resource Plan (IRP) brings together the various components necessary to ensure proper resource planning for reliable service to utility customers.

- One of the key components for natural gas service is interstate pipeline transportation. Low prices, firm supply and storage resources are meaningless to a utility customer without the ability to transport the gas reliably during cold weather events.

- Acquiring firm interstate pipeline transportation provides the most reliable delivery of supply.

Pipeline Contracting

Simply stated: The right to move (transport) a specified amount of gas from Point A to Point B

Contract Types

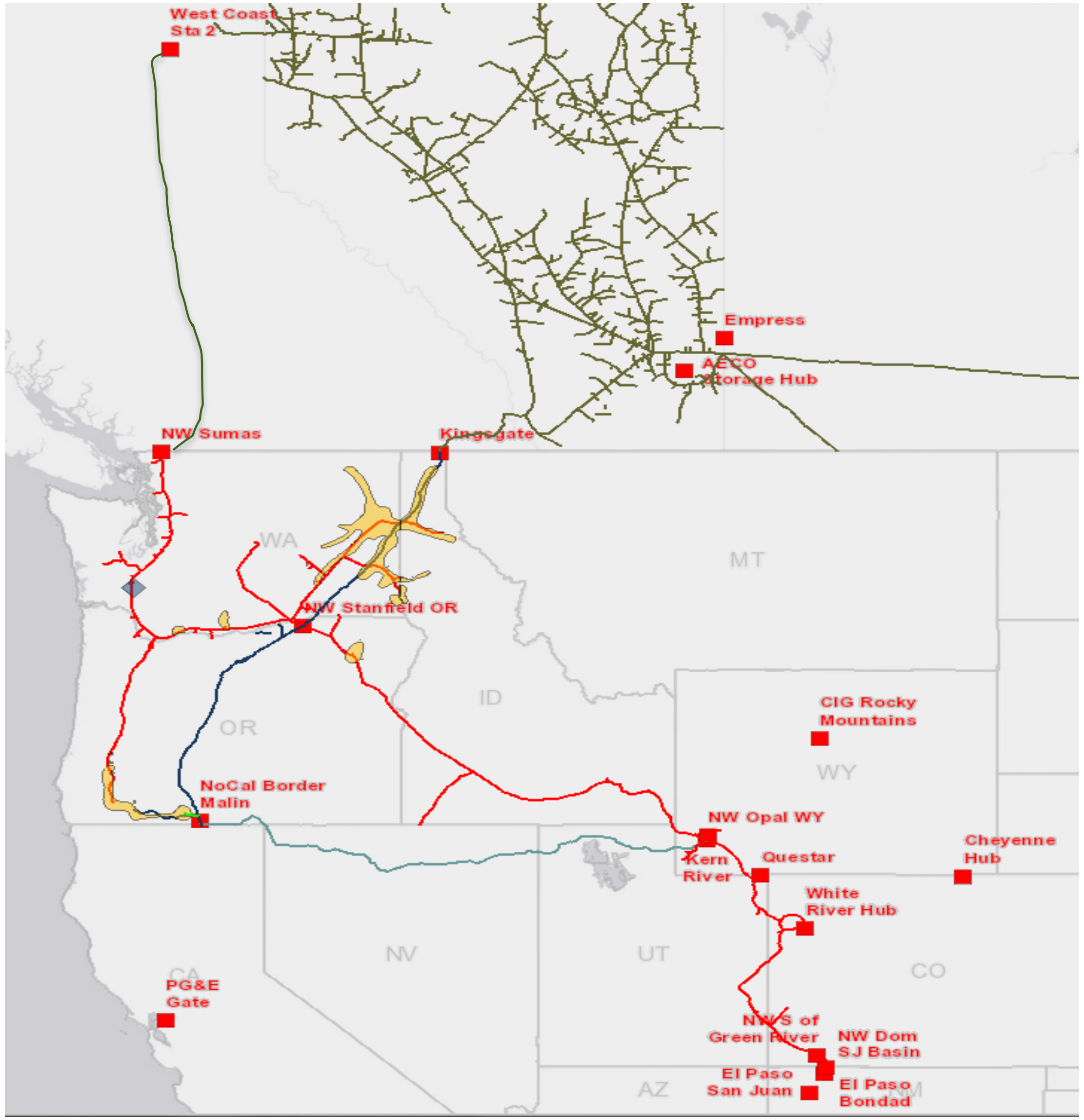
- Firm transport
  - Point A to Point B
- Alternate firm
  - Point C to Point D
- Seasonal firm
  - Point A to Point B but only in winter
- Interruptible
  - Maybe it flows, maybe it doesn’t

Avista's Transportation Contract Portfolio

Avista holds firm transportation capacity on 6 interstate pipelines:

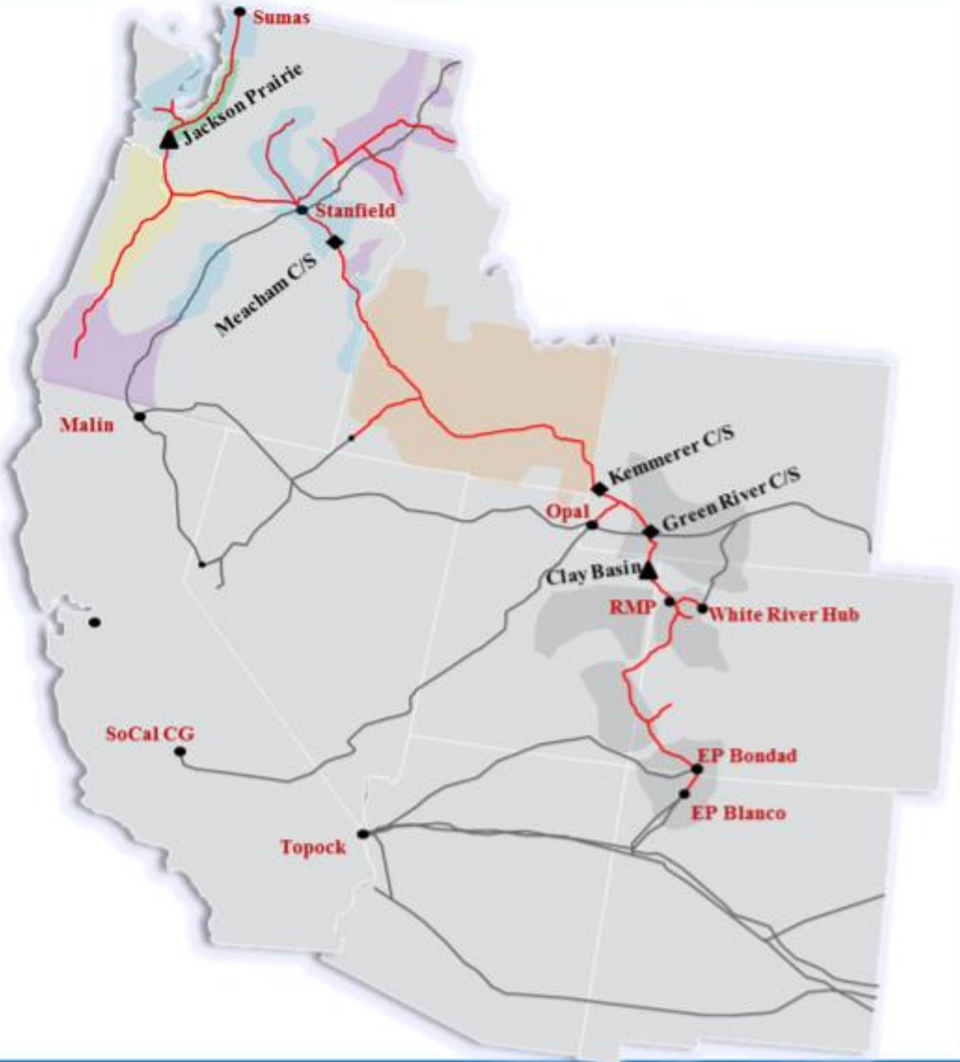
Pipeline	Expirations	Base Capacity Dth
Williams NWP	2025 – 2042 (2035)	290,000
Westcoast (Enbridge)	2026	10,000
TransCanada - NGTL	2024-2046	208,000
TransCanada - Foothills	2024-2046	204,000
TransCanada - GTN	2023-2028	210,000 164,000
TransCanada-Tuscarora	2023	200

Pipeline Overview



Northwest System – Strategically Located

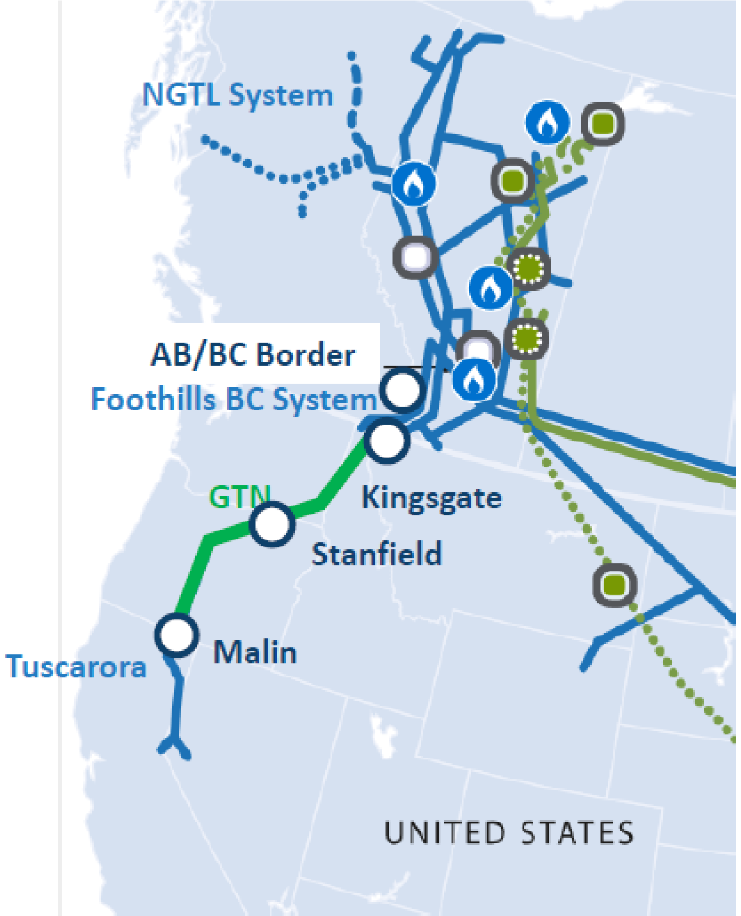
- **Low-cost, primary service provider in the Pacific Northwest**
  - 3,900-mile system with 3.8 Bcf/d peak design capacity
  - ~120 Bcf of access to storage along pipeline, with high injection and deliverability capability in market area
- **Bi-directional design**
  - Provides flexibility (Rockies to market and Sumas to market)
  - Cheapest supply drives flow patterns
  - Provides operational efficiencies through displacement
- **Supply and market flexibility**
  - 65 receipt points totaling 11.6 Bcf/d of supply from Rockies, Sumas, WCSB, San Juan, emerging shales
  - 366 delivery points totaling 9.7 Bcf/d of delivery capacity



Alternate slide for GTN

GTN Overview

- **Transports WCSB and Rockies natural gas to Washington, Oregon and California**
- **Approximately 1,377 miles of pipeline**
- **Kingsgate best efforts receipt capability of approx. 2.87 Bcfd and throughput capacity of approx. 2 Bcfd through Station 14**
- **Deliveries of up to 1.5 Bcfd to non-California Markets**
- **Concurrent transport expansions from NIT to Malin:**
  - Tranche 1
    - 110 TJ/d (NGTL and FHBC), 100 MDth/d (GTN)
    - November 1, 2022 - Targeted in-service
  - Tranche 2
    - 175 TJ/d (NGTL and FHBC), 150 MDth/d (GTN)
    - November 1, 2023 - Targeted in-service



TC Energy

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NGTL to Malin West Path expansion

Connecting WCSB supply to key North American markets

Valued transport path for both Supply and End Use Shippers

Concurrent transport expansions from NIT to Malin:

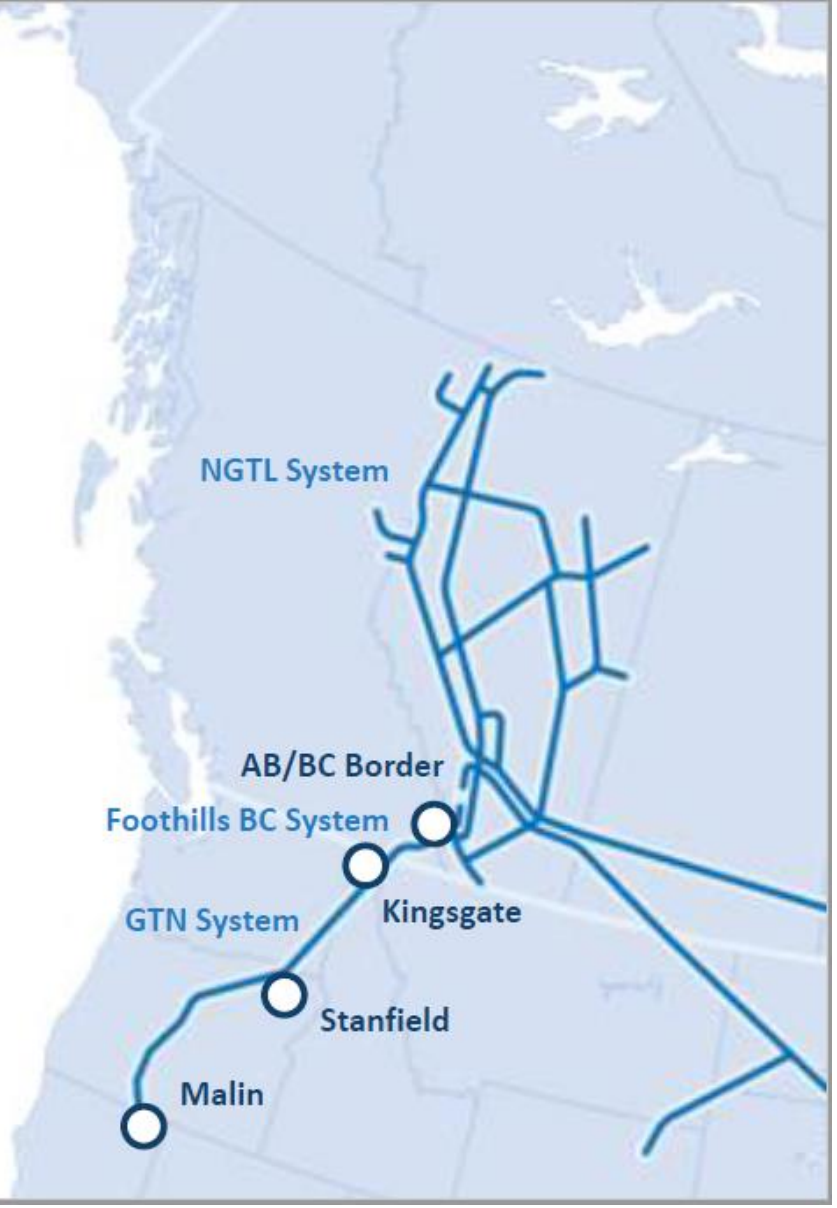
Tranche 1

- 110 TJ/d (NGTL and FHBC), 100 MDth/d (GTN)
- November 1, 2022 - Targeted in-service

Tranche 2

- 175 TJ/d (NGTL and FHBC), 150 MDth/d (GTN)
- November 1, 2023 - Targeted in-service

- **Average** term of awarded capacity:
- **31.3 years** NGTL
- **31.4 years** Foothills BC

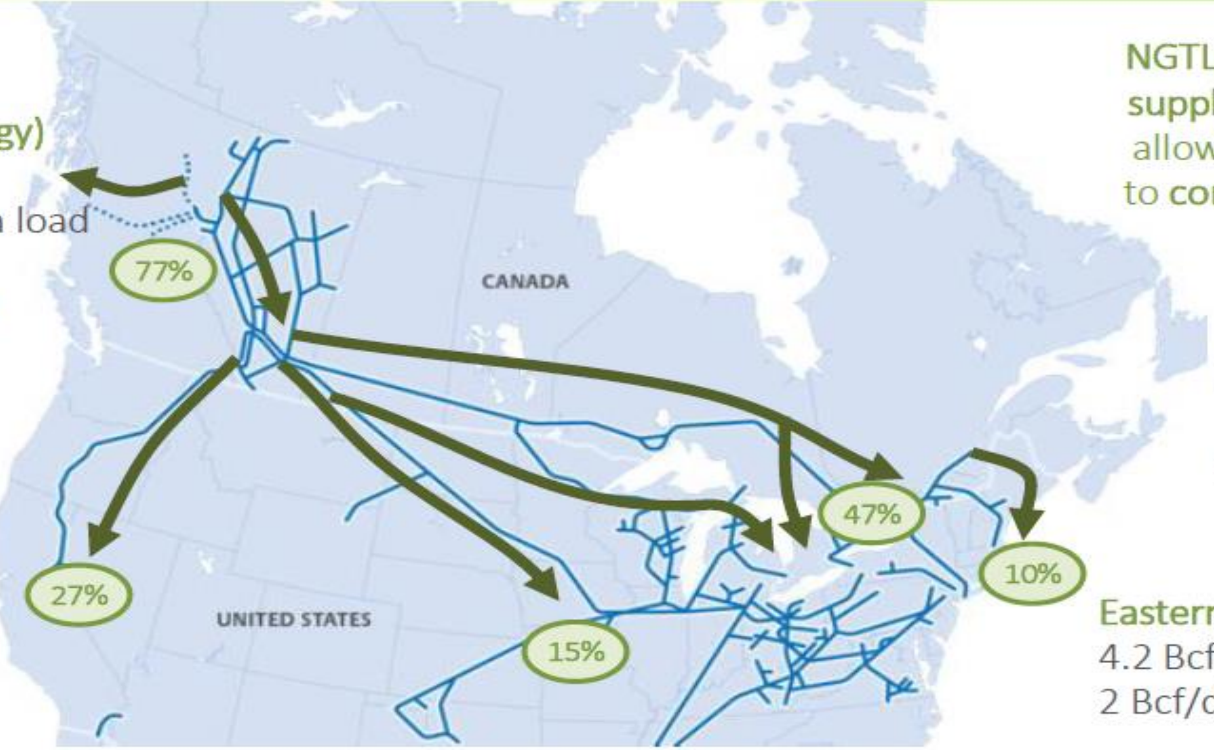


FOR DISCUSSION PURPOSES ONLY | SEPTEMBER 2020

WCSB gas is competitive in key markets, **Safety, Toll Competitiveness & Reliability** is Our Focus

WCSB (77% TC Energy)
15.6 Bcf/d supply
7.1 Bcf/d intra basin load
8.7 Bcf/d export
4 Bcf/d LNG projected

NGTL System provides access to **stable supply source** for WCSB **end users** and allows **unique** opportunity **producers** to **compete** in multiple export markets



Pacific
8.3 Bcf/d market
2.2 Bcf/d via TC

U.S. Northeast
6.9 Bcf/d market
0.7 Bcf/d via TC

Eastern Canada
4.2 Bcf/d market
2 Bcf/d from WCSB via TC

Chicago (Mid-West)
12.7 Bcf/d end use market
1.6 Bcf/d from WCSB via TC

Flow data based on 2019 Calendar year

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TC Energy 1

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Storage – A valuable asset

- Peaking resource
- Improves reliability
- Enables capture of price spreads between time periods
- Enables efficient counter cyclical utilization of transportation (i.e. summer injections)
- May require transportation to service territory
- In-service territory storage offers most flexibility

Avista's Storage Resources

Washington and Idaho
Owned Jackson Prairie

- 7.7 Bcf of Capacity with approximately 346,000 Dth/d of deliverability

Oregon

Owned Jackson Prairie

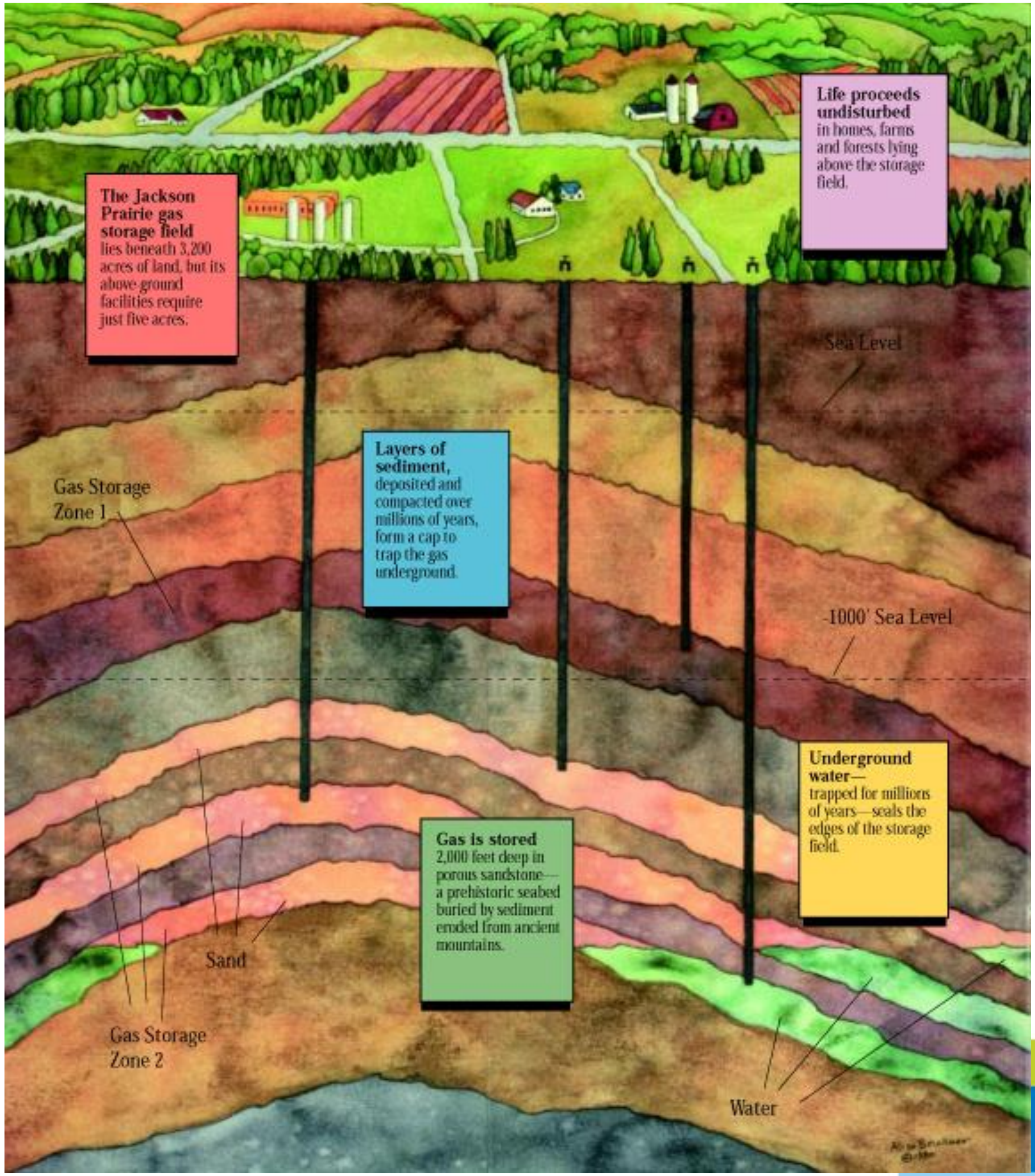
- 823,000 Dth of Capacity with approximately 52,000 Dth/d of deliverability

Leased Jackson Prairie

- 95,565 Dth of Capacity with approximately 2,654 Dth/d of deliverability

The Facility

- Jackson Prairie is a series of deep, underground reservoirs – basically thick, porous sandstone deposits.
- The sand layers lie approximately 1,000 to 3,000 feet below the ground surface.
- Large compressors and pipelines are employed to both inject and withdraw natural gas at 54 wells spread across the 3,200 acre facility.



Renewable Natural Gas (RNG)

Michael Whitby, RNG Manager

Advancing RNG at Avista

Avista has been actively preparing to participate in RNG. The following topics covered in this section of the presentation are as follows:

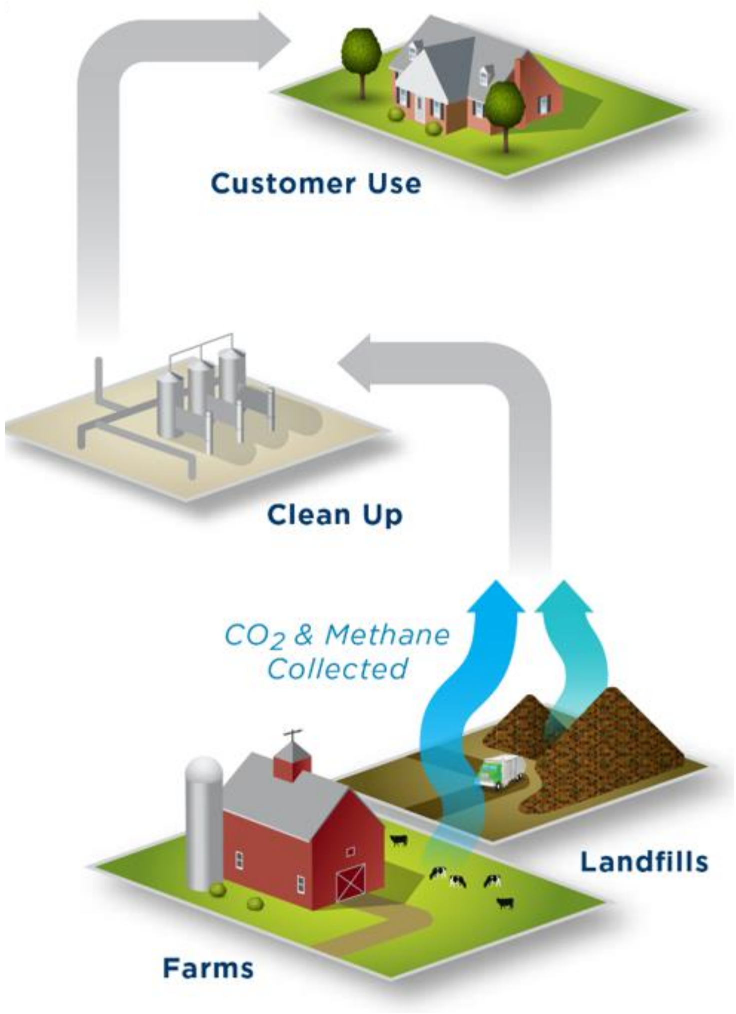
- Renewable Natural Gas (RNG) Explained
- RNG – A Climate Change Solution
- Policy & Regulation
- Industry Reports
- Avista’s Commitment to Carbon Reduction
- Avista’s RNG Program & Team
- Program Considerations
- RNG Market Studies & Voluntary Customer Program
- Pipeline Safety & Interconnection Requirements
- Environmental Attribute Tracking & Banking
- RNG Production Technologies & Project Types
- RNG Opportunities and Challenges
- Cost Effectiveness Evaluation Methodology

Renewable Natural Gas (RNG) Explained

Natural Gas is Critical to a Clean Energy Future

Renewable Natural Gas Explained

Renewable Natural Gas (RNG) is a non-fossil gas resource derived from various renewable waste stream sources including but not limited to landfills, wastewater treatment plants, food waste, and agriculture waste such as dairy farms, and other livestock farms. These feedstocks utilize anaerobic digestion to generate biogas, which in turn can be processed to meet pipeline quality RNG. Forest wood waste can also be converted to biogas via thermal gasification methods and made pipeline ready.



Viable feedstocks that are expected to continually operate and or expand will provide an opportunity for RNG to be produced in perpetuity, and shall serve to displace geologic gas volumes, and capture otherwise fugitive methane. As such, RNG can play an important role in decarbonizing our gas system through RNG customer programs and projects to reduce greenhouse gas (GHG) emissions, and the carbon footprint associated with geologic gas.

RNG is fully interchangeable with conventional natural gas and utilizes the existing natural gas distribution system network to seamlessly serve residential, commercial and industrial end users ***without any*** *additional building improvements, equipment, or special equipment requirements.*

RNG – A Climate Change Solution

Natural gas plays critical role for meeting aggressive green house gas (GHG) reductions goals, RNG even more so!

- Advantages of RNG
  - "De-carbonizes" gas stream
  - Gives customers another renewable choice
  - RNG is a strong pathway option for decarbonizing the thermal market
  - RNG utilizes existing infrastructure as it is fully interchangeable with conventional natural gas with no end user equipment modifications or replacement
  - RNG is a more economical solution than electrification which requires the procurement of added renewable electric resources, distribution system upgrades, and has a significant impact to end users due to the necessary replacement of building equipment and systems
  - In the right applications, **direct use of natural gas is best use**
  - Natural gas generation provides **critical capacity** as renewables expand until utility-scale storage is cost effective and reliable

Policy & Regulation:

Washington HB 2580

- RNG study requested by legislature from WA Department of Commerce & WSU Energy Program

Washington HB 1257

- Building efficiency bill that includes RNG
- Requires utilities to offer voluntary RNG programs/products to customers
- Allows utilities to invest in RNG projects and recover the costs

Oregon SB 334

- Directs the Oregon Department of Energy to conduct a biogas and renewable natural gas inventory and prepare a report

Oregon SB 98 & AR 632 Rule Making

- Final rules effective on July 17th 2020
- Allows investment recovery, percent of revenue requirement per year to be determined based on potential project costs & timing, pending petition to participate
- Allows investment in gas conditioning equipment without RFP process

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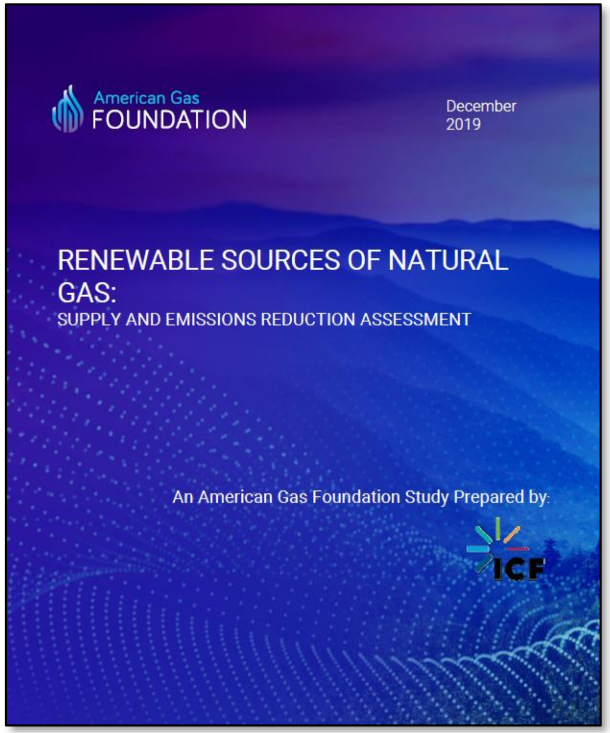
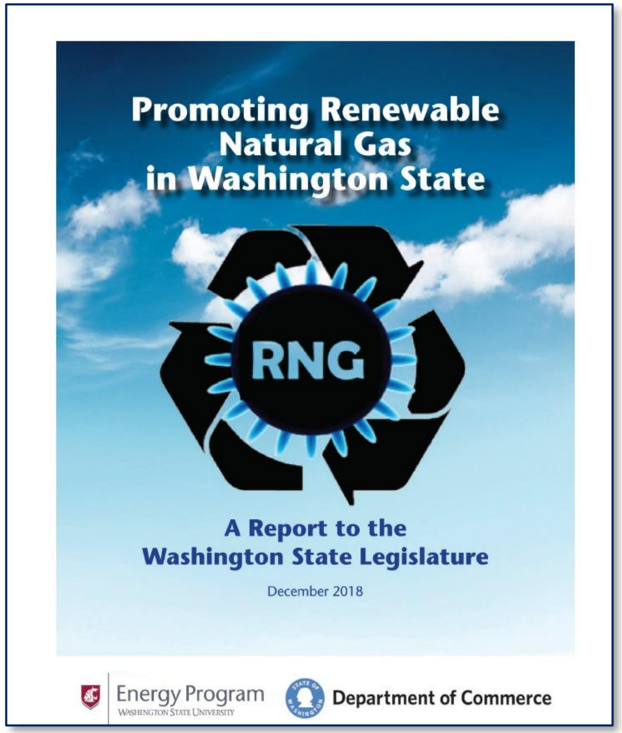
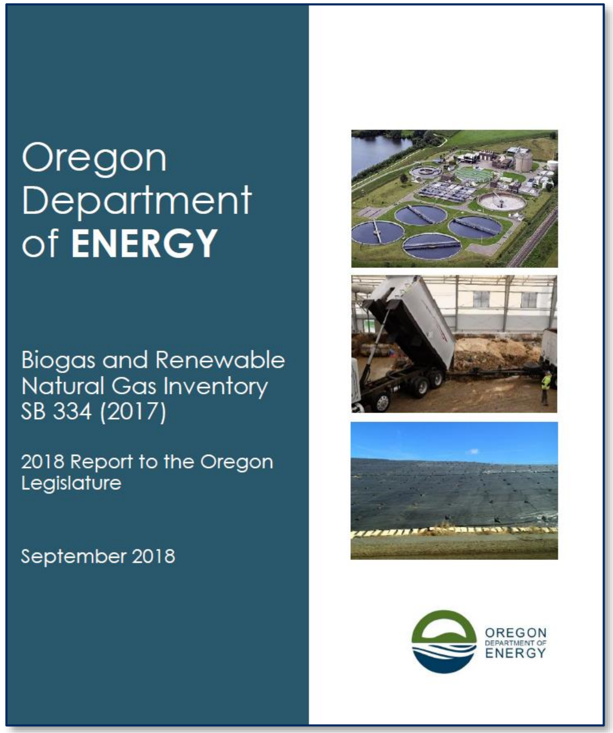
Industry Reports:

Avista is familiar with these relevant industry reports and has utilized them to understand the RNG industry in general as well as the potential in Washington & Oregon







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Avista's Commitment to Carbon Reduction

RNG is a Pathway to Decarbonizing the Natural Gas System

- By utilizing waste streams to create green fuel, RNG can play an important role in supporting Avista's environmental strategy
- RNG provides Avista's customers with a new environmentally friendly, low carbon fuel choice, delivered seamlessly via Avista's existing natural gas system

Avista's RNG Program & Team

Avista has been assessing and planning for RNG

- Program Manager in place
- Program Charter in place
- Program Execution Plan drafted
- Participation in the regulatory and rule making process in OR & WA, informal and formal
- Business Development efforts in pursuit of multiple RNG projects continues
- Business Cases developed for consideration in Avista's five year capital planning cycle
- RNG Project accounting established
- Cross-functional team in place to support RNG:
  - Gas Engineering
  - Gas Supply
  - Legal
  - Governmental Affairs
  - Regulatory Affairs
  - Products & Services

Program Considerations

- Evaluate available RNG procurement options
- Pursue potential RNG development opportunities from local RNG feedstock resources under new legislation (Washington HB 1257 & Oregon SB 98)
- Develop an understanding of RNG development cost, cost recovery impacts to customers, resulting supply volumes and RNG costs
- Evaluate potential RNG customer market demands vs. supply
- Participation in rule making and policy:
  - Participation in HB 1257 Policy development
  - Participation in SB 98 Policy Rulemaking via AR 632 informal and formal
  - Cost recovery proposal led by NWGA with input from all four Washington LDC's
  - Collaborative RNG Gas Quality Framework established across four WA LDC's

RNG Market Studies & Voluntary Customer Program

- RNG Commercial Market Study completed in 2019
- RNG Residential Market Survey concluded in September 2020
  - Customers lack understanding of RNG since it is a new concept
  - Customers like the environmental aspects of RNG
  - Customers like to choose their level of participation to manage costs predictably
- Voluntary customer RNG program design will advance based on the studies above
- Estimate voluntary customer program demands
- RNG to be added to Avista's renewables portfolio

Pipeline Safety & Interconnection Requirements

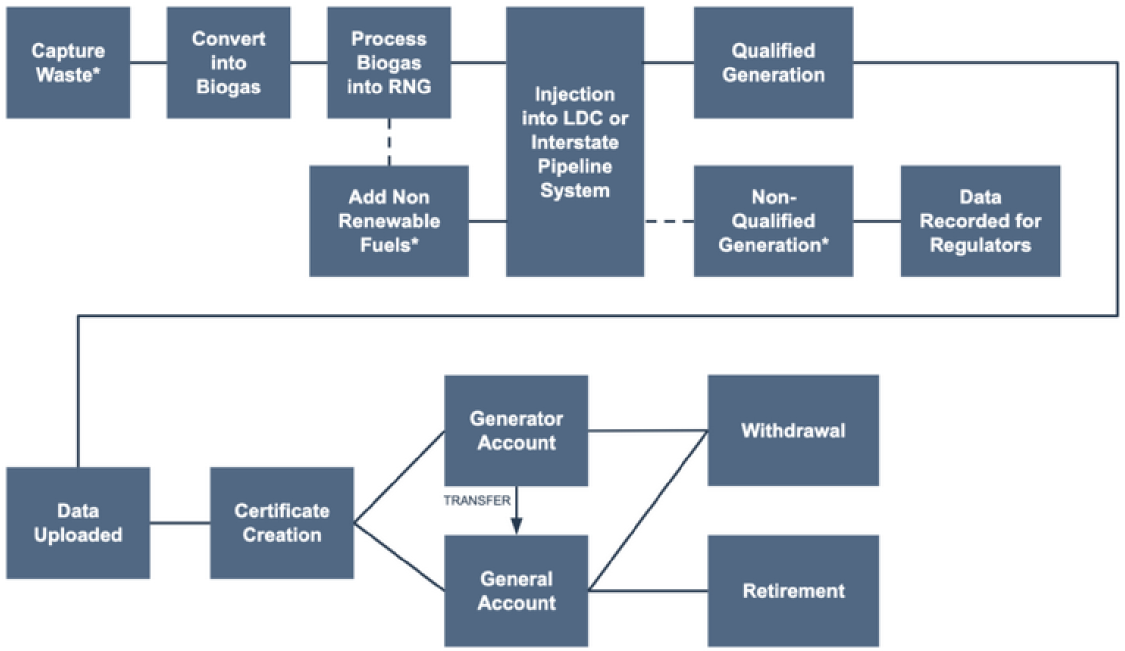
- Avista Gas Quality Specification developed
- Collaborative RNG Gas Quality Framework established across (4) WA LDC's
- Avista Interconnection Agreement template developed
- Avista Study Agreement and RNG Producer review process template developed

Environmental Attribute Tracking & Banking

Under OR SB 98 the M-RETS system has been selected to track RNG environmental attributes. Other jurisdictions including Washington may also select this system

- 1 Renewable Thermal Certificate (RTC) = 1 Dekatherm (Dth) of RNG
- Transparent electronic certificate tracking
- Not a certification entity

RTC Creation Process



What Does an RTC Look Like?

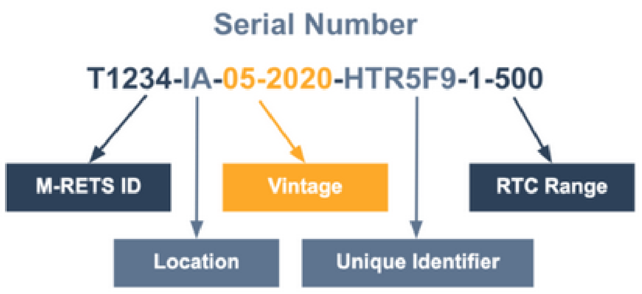
RTC Information

Dekatherm (Dth) Renewable Thermal = 1 Renewable Thermal Certificate

Certificate Details include:

- Serial Number (See Example)
- Account
- Project
- Thermal Resource
- Feedstock
- Vintage
- Location
- Quantity

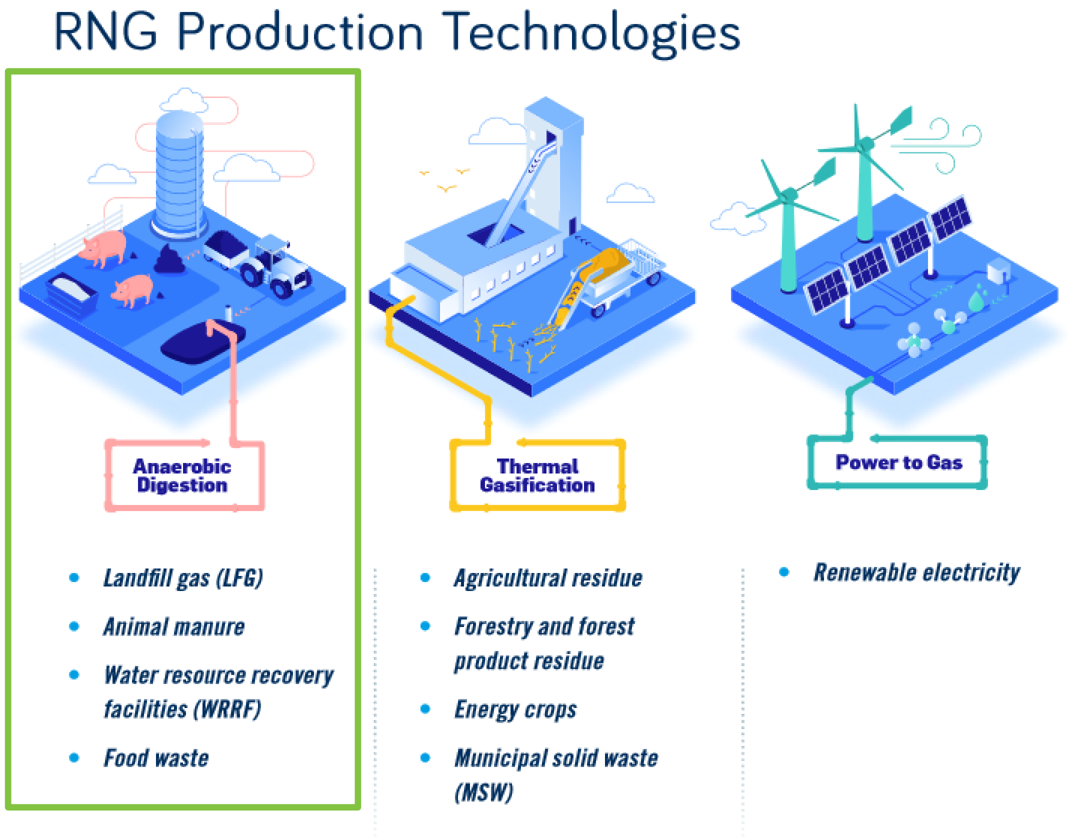
Carbon Pathways (If Applicable)
IRE Verification (If Applicable)



M-RETS Renewable Thermal

RNG Production Technologies & Project Types

Avista is actively evaluating a handful of potential Anaerobic Digestion Projects throughout Washington and Oregon.



RNG Technologies :

- Conventional RNG: Amine scrub, membrane separation, water wash, PSA
- Hydrogen blending

RNG Opportunities & Challenges

California RNG market ($30+/Dth v. $2/Dth)

- Vehicle emission incentives shut-out other potential end users
- Producers see the pot of gold in Federal RIN & California LCFS markets
- RNG supplier cost volatility

Financing for producers

- RIN market is volatile
- No forward pricing for RNG RTC's in carbon market
- Vehicle market may be approaching saturation in CA
- Environmental attribute value for local markets is undefined

RNG Opportunities & Challenges

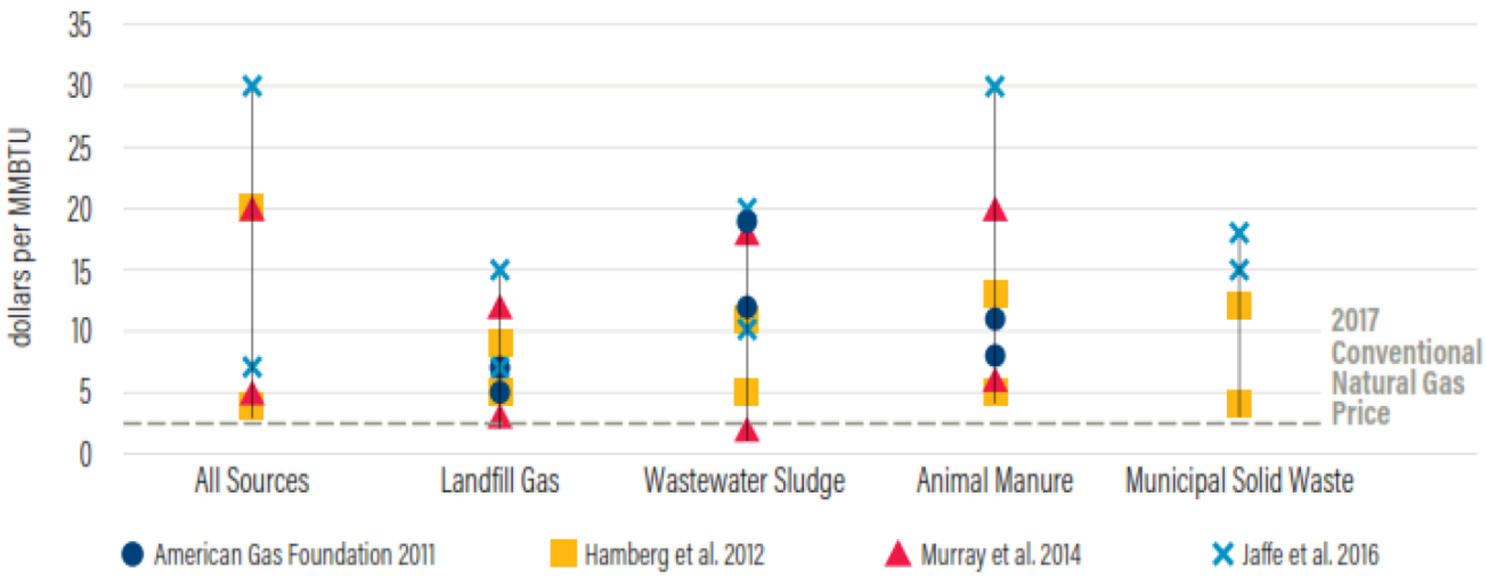
Utility RNG Projects

- Feedstock owners can now partner with LDC’s to cultivate new RNG projects
- Feedstock owners wiliness to partner with the utility’s cost of service model. This is a foreign concept to feedstock owners that seek highest value for their biogas
- LDC’s are credit worthy partners offering long term off-take contracts to feedstock owners
- Each RNG project is unique with respect to capital development costs & resulting RNG costs
- Each RNG project will vary in size, location and distance to interconnection pipeline, feedstock type, gas conditioning equipment and requirements and operating costs
- Economies of scale – Low volume biogas opportunities face economic challenges
- New RNG Projects can take 2-3 years to develop
- Customers have paid for a vast pipeline infrastructure that can be utilized for a cleaner future by **transitioning the fuel** and keeping the pipe

RNG Opportunities & Challenges

RNG $ per Dth/MMBtu

Avista Owned and Operated	ID - WA 2035 Premium Estimate ($ / Dth)
RNG - Landfills	$7 - $10
RNG - Waste Water Treatment Plants (WWTP)	$12 - $22
RNG - Agriculture Manure	$28 - $53
RNG - Food Waste	$29 - $53



Source: Promoting RNG in WA State

RNG Opportunities & Challenges

Carbon Intensity will pay a role in how the environmental attributes / Renewable Thermal Certificate (RTC) values will be determined

Fuel Pathway	Carbon Intensity $\frac{gCO_2e}{MJ}$
Diesel*	102.01
Gasoline*	99.78
Fossil CNG†	78.37
Landfill CNG†	46.42
WWTP CNG*	19.34
MSW CNG*	-22.93
Dairy CNG‡	-276.24

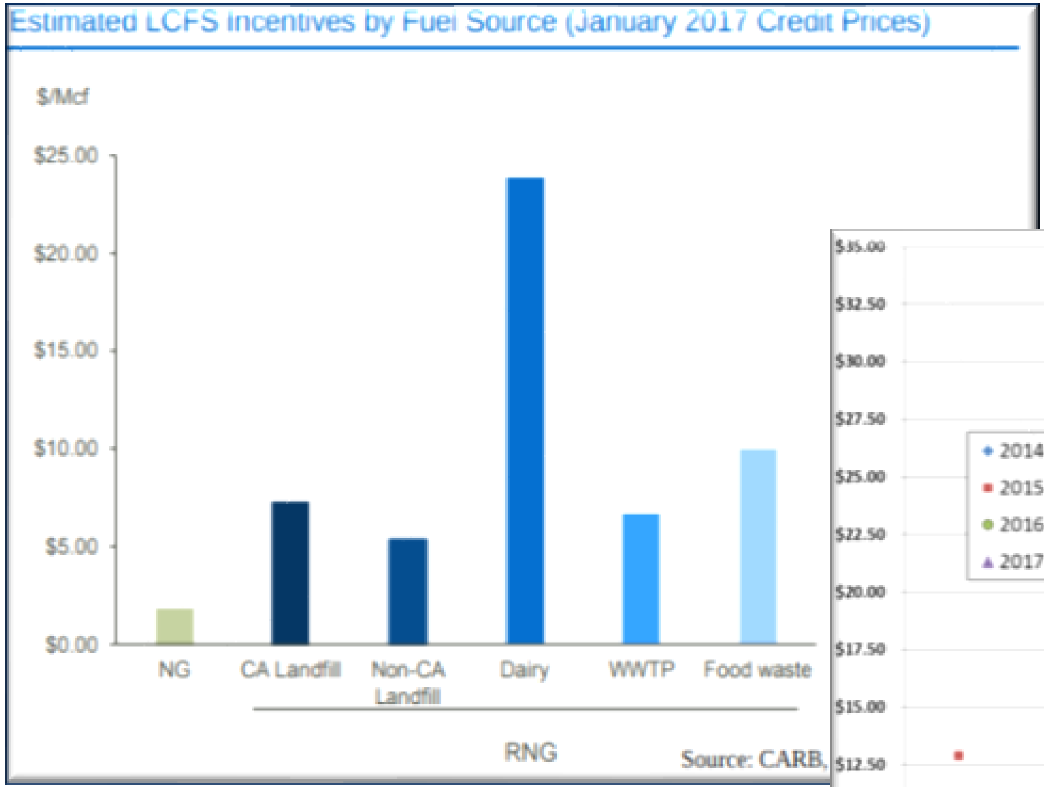
*California Code of Regulation Title 17, §95488, Table 6. Carbon intensity for WWTP is the average of two WWTP pathways.

†California Code of Regulation Title 17, §95488, Table 7.

†Method 2B Application CalBio LLC, Dallas Texas, Dairy Digester Biogas to CNG.

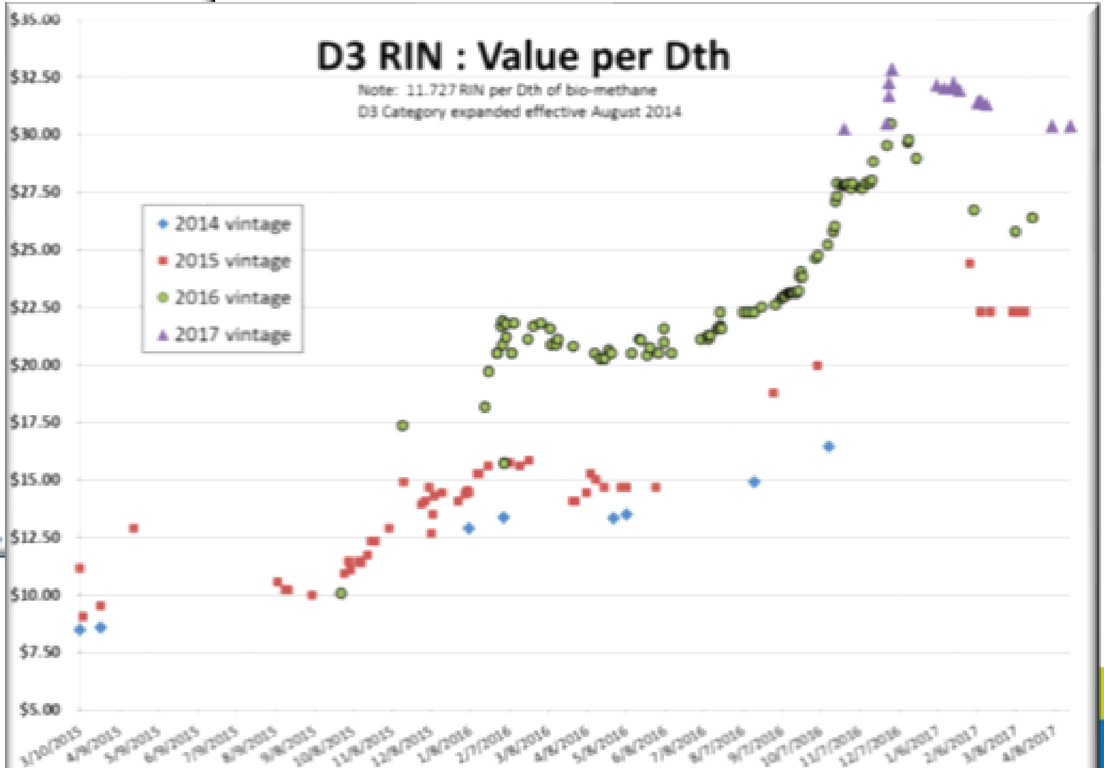
RNG Opportunities & Challenges

RNG RTC values within the utility construct cannot compete with the RNG values driven by the RFS RIN & LCFS markets



Source: CARB

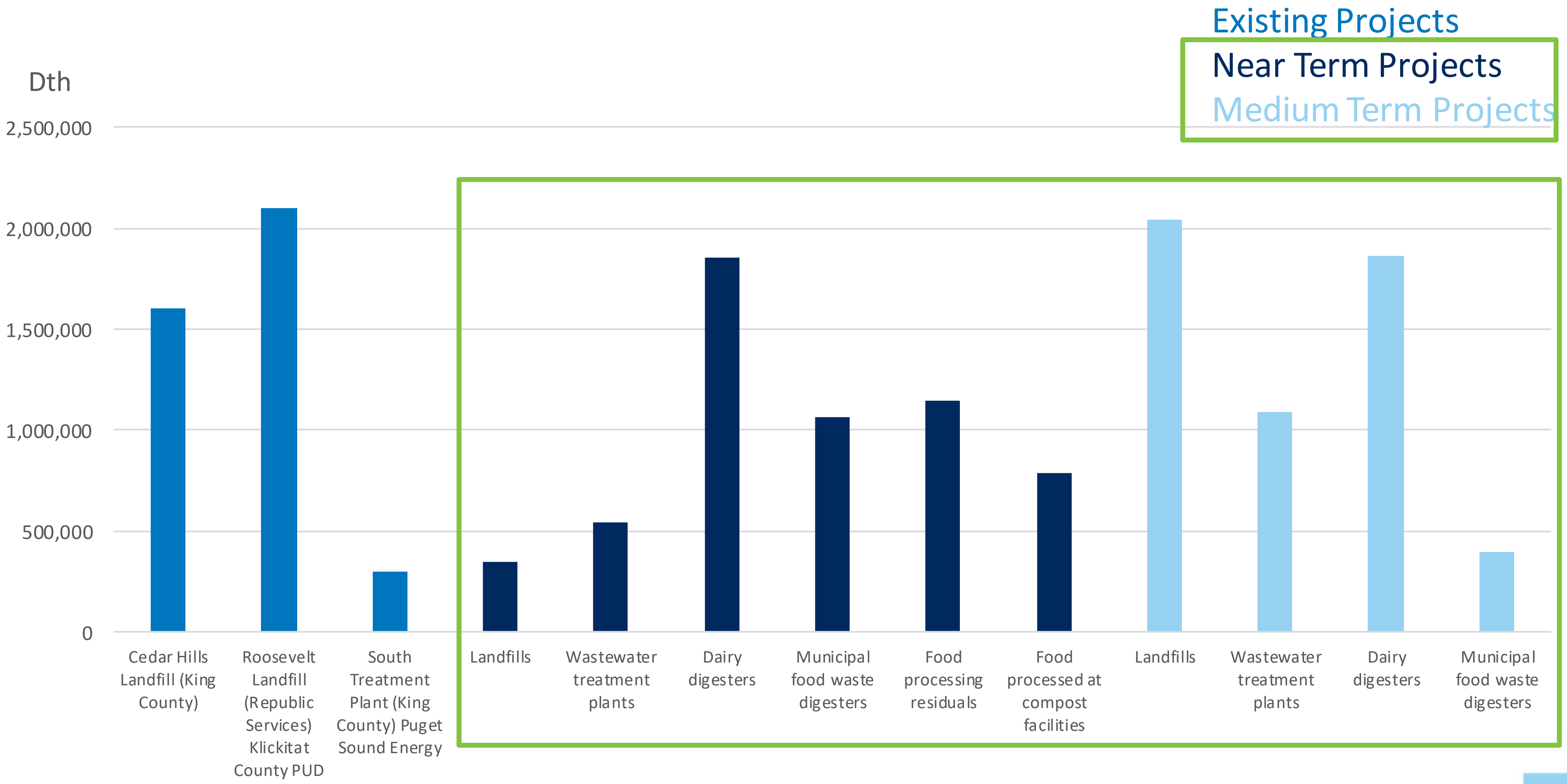
RIN = renewable identification number



Source: EPA

RNG Opportunities & Challenges

WA RNG Report (HB 2580) – Utility's have the opportunity to leverage the remaining RNG opportunities to decarbonize the natural gas system



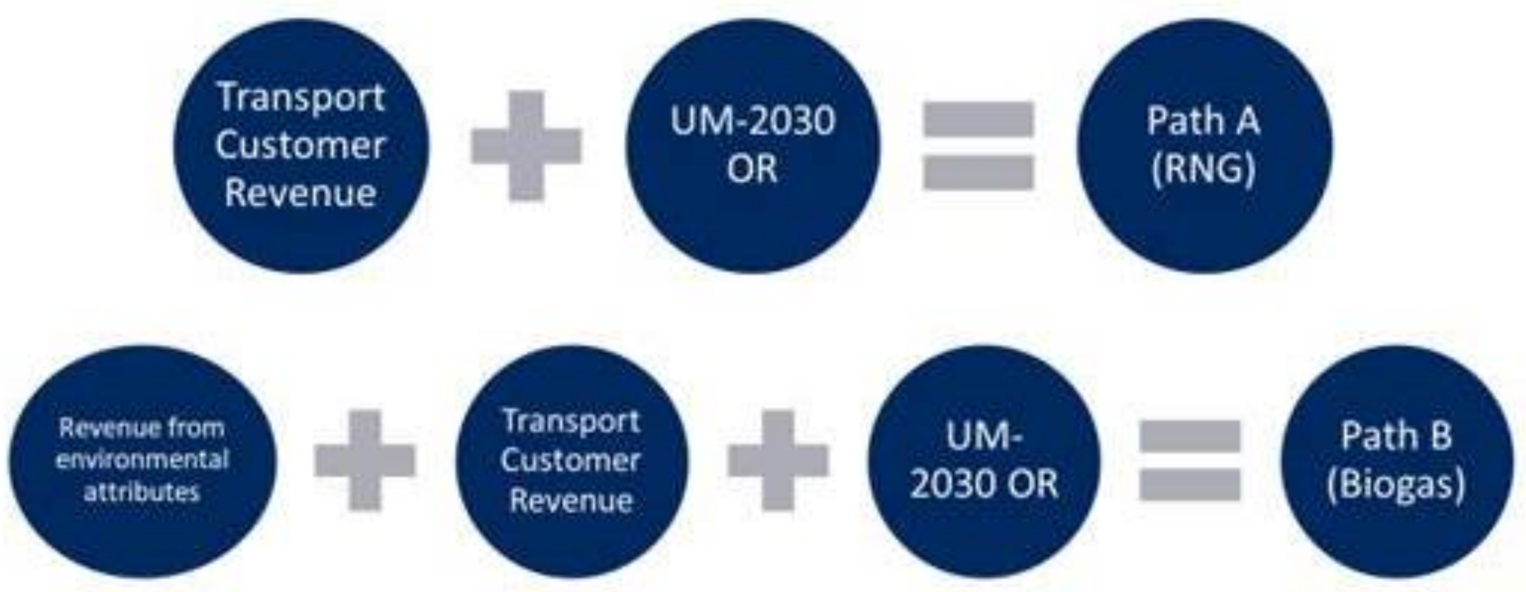
WSU Energy Program, Harnessing Renewable Natural Gas for Low-Carbon Fuel: A Roadmap for Washington State

*Released December 1, 2018

Cost Effectiveness Evaluation Methodology

Developing the Methodology….a work in process

- Avista is creating a cost effectiveness evaluation methodology for evaluating RNG projects. The following slides are a snapshot of Avista's work in progress.
- The methodology shown is derived from OPUC UM2030, also referenced in the OPUC SB 98 AR 632 Rulemaking
- The evaluation method shown herein is subject to input, refinement and reconsideration.



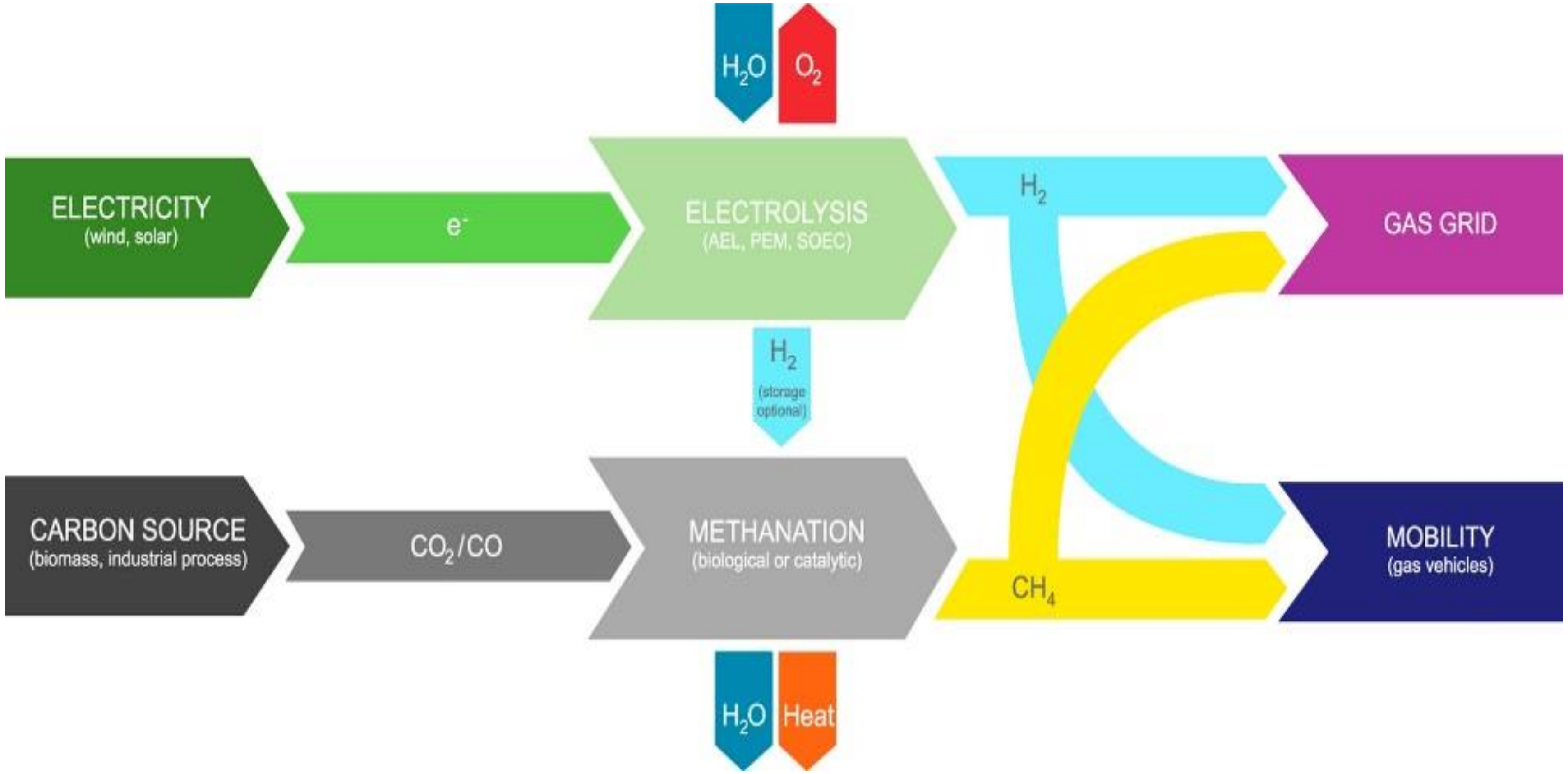
Hydrogen

Tom Pardee
Planning Manager, Natural Gas Supply

Hydrogen

- The energy factor of H2 Low Heating Value (LHV) is roughly equivalent to a gallon of gasoline or 114,000btu
  - This equates to 8.78 kg of H2LHV per Dth
- Most H2 is currently made from reforming natural gas
  - The energy can come from Nuclear (Pink), Renewables (Green) or Fossil fuels (Grey)
- High cost (currently) when compared to energy in a Dth combined with current prices of natural gas
- Hydrogen can only be stored in the pipeline as a % of gas or combined with a carbon source to produce methane.
- Hydrogen is lighter than air and diffuses rapidly (3.8x faster than natural gas) making it more difficult to contain

PtG Process



Source: http://www.europeanpowertogas.com/about/power-to-gas

Power to Gas

- Power to Gas (PtG) is a process using power to separate water into hydrogen and oxygen
- Hydrogen can be stored, as a % of gas, in the existing gas grid or used in the mobility sector (blend up to 20%)
- PtG can help to balance excess power from intermittent sources like wind and solar
- PtG can decarbonize the direct use of natural gas
- PtG economics will advance as more renewables are added and the technology matures
- Short term and seasonal energy storage
- Stored in the existing gas pipeline

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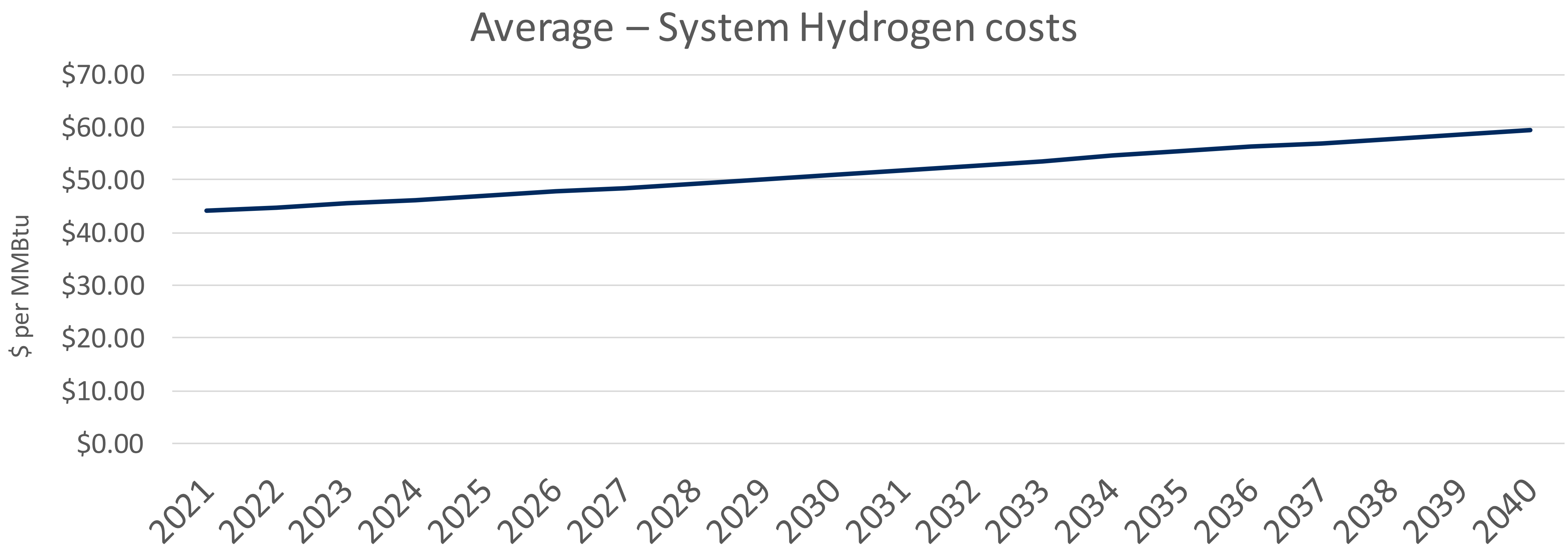
PtG Benefits

Benefits

- Cleans up the grid using excess power
- Stores the energy for future use in the natural gas pipelines/infrastructure utilizing customer owned resources and are currently available
- Hydrogen is relatively safe as if it is released it quickly dilutes into a non-flammable concentration

Current Renewable Hydrogen Price estimates



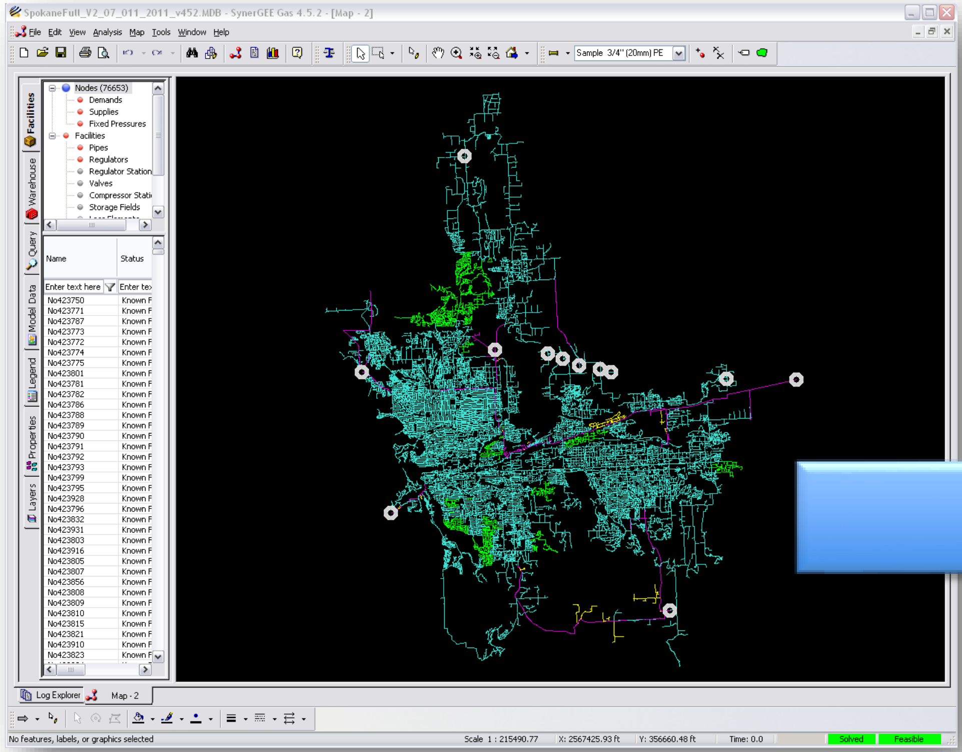
*Assumes Avista owned resources

Distribution Overview

Terrence Browne
Sr. Gas Planning Engineer, Gas Engineering

Mission

- Using technology to plan and design a safe, reliable, and economical distribution system

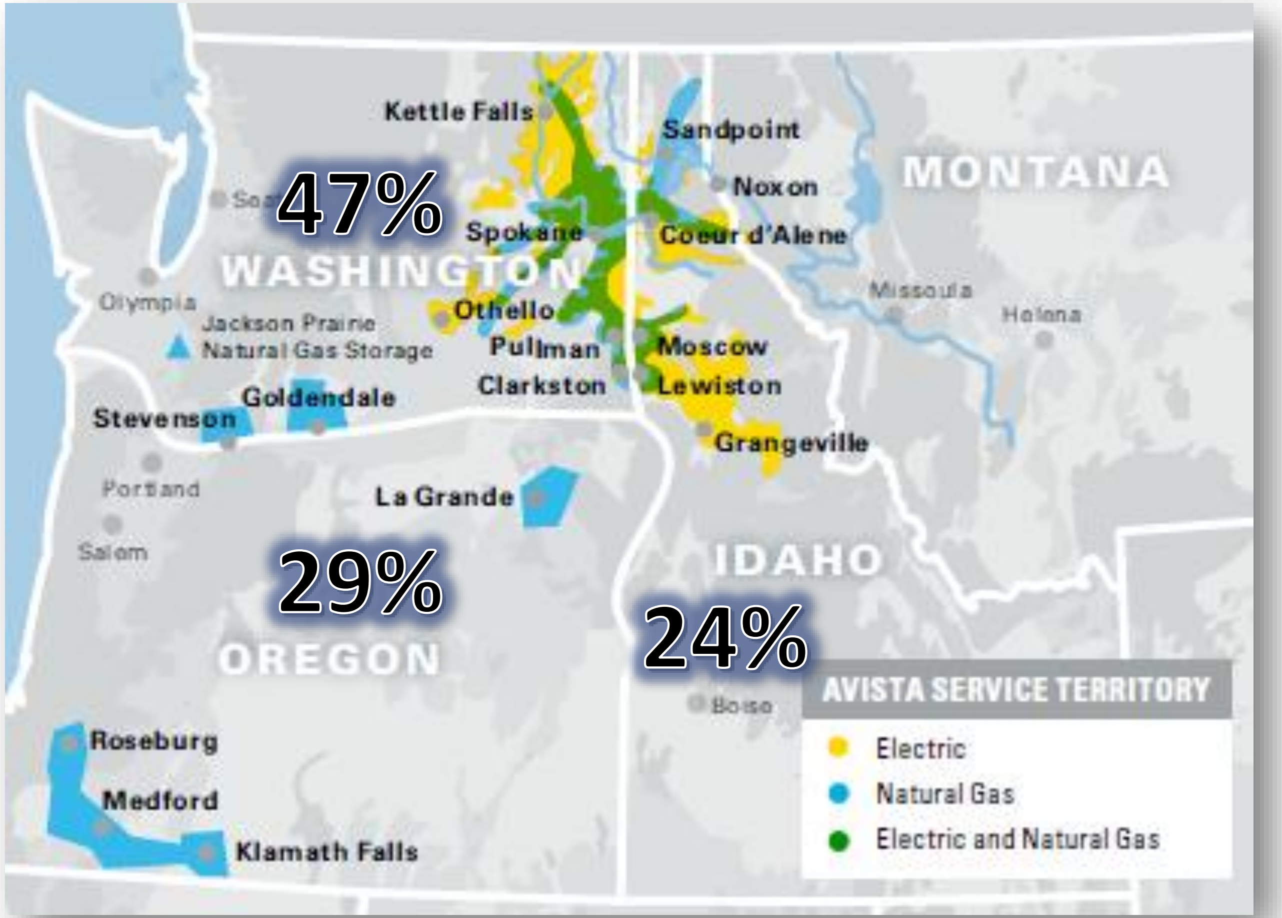


Gas Distribution Planning

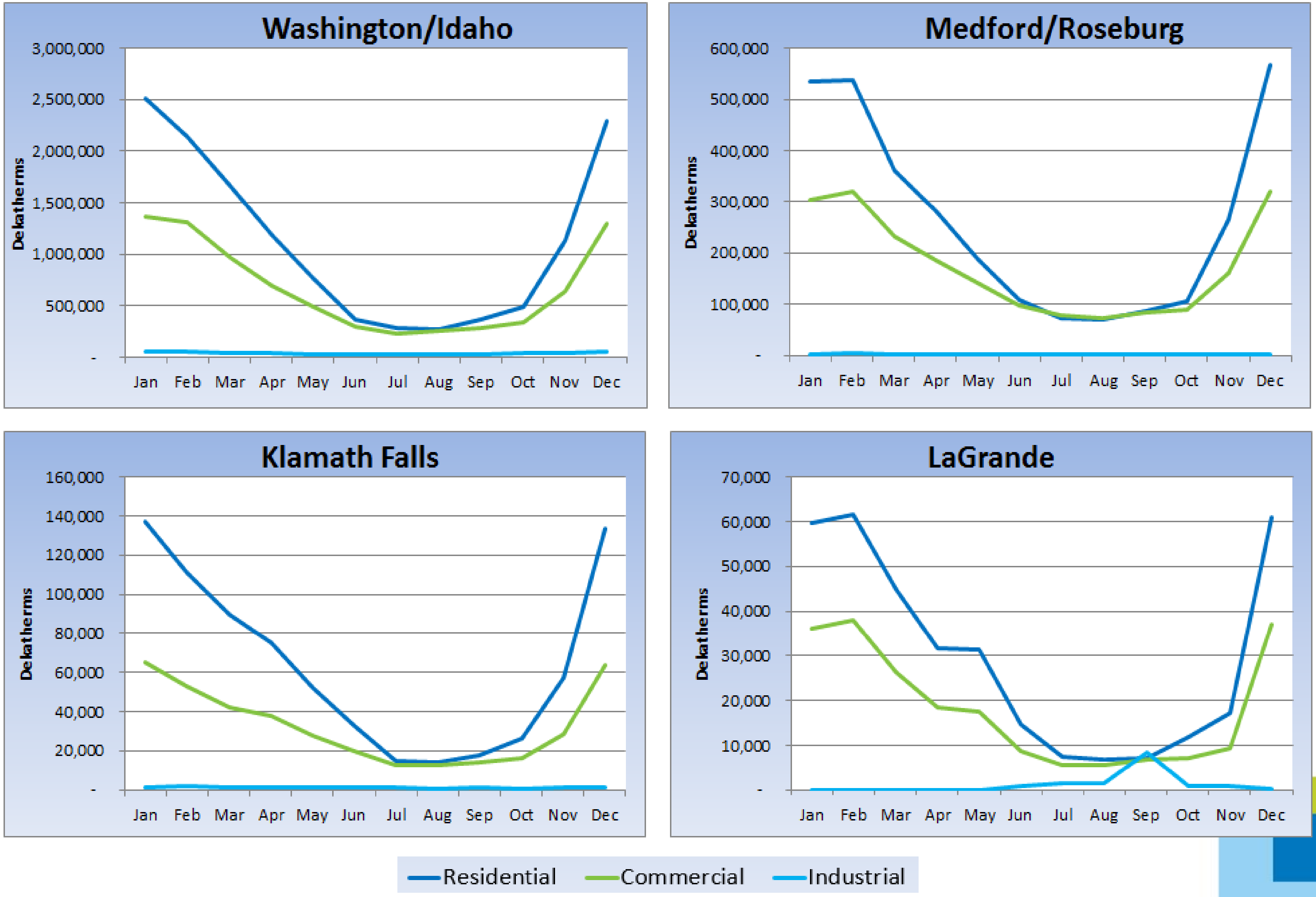
- Service Territory and Customers
- Scope of Gas Distribution Planning
- SynerGi Load Study Tool
- Planning Criteria
- Interpreting Results
- Long-term Planning Objectives
- Monitoring Our System
- Communicating Solutions
- Gate Station Capacity Review
- Project Examples

Service Territory and Customer Overview

- Serves electric and natural gas customers in eastern Washington and northern Idaho, and natural gas customers in southern and eastern Oregon
  - Population of service area 1.5 million
    - 385,000 electric customers
    - 360,000 natural gas customers

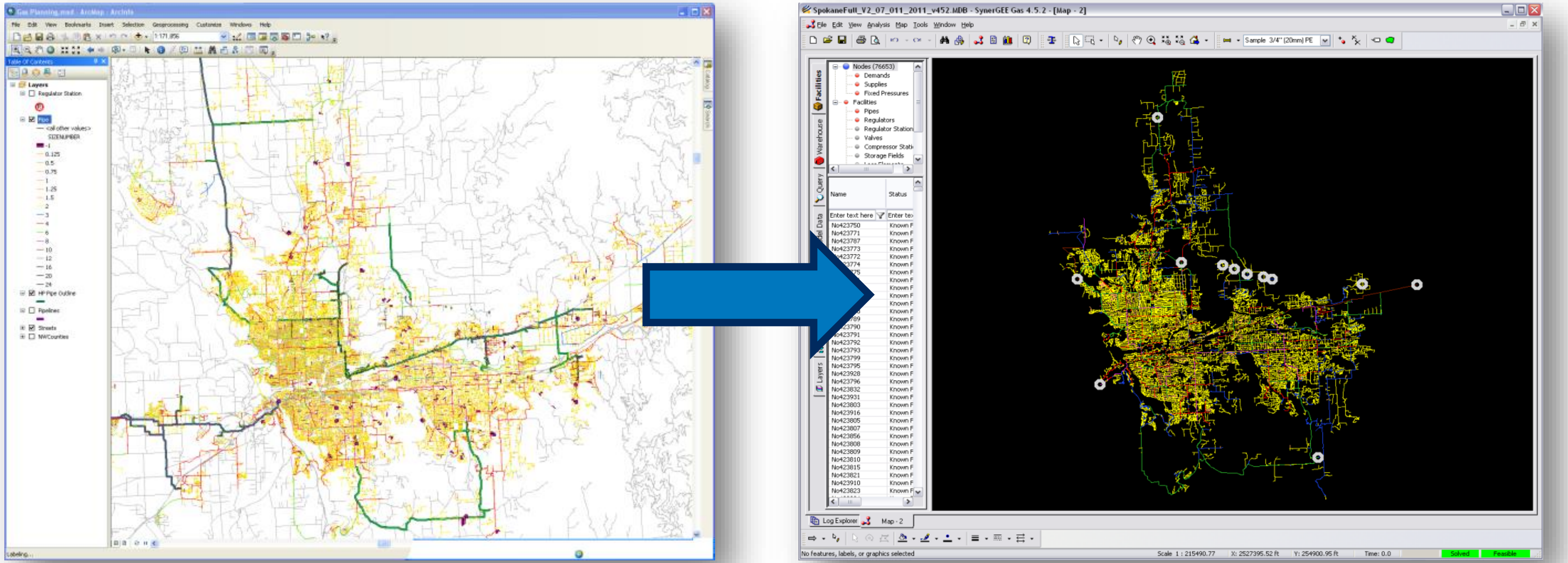


Seasonal Demand Profiles

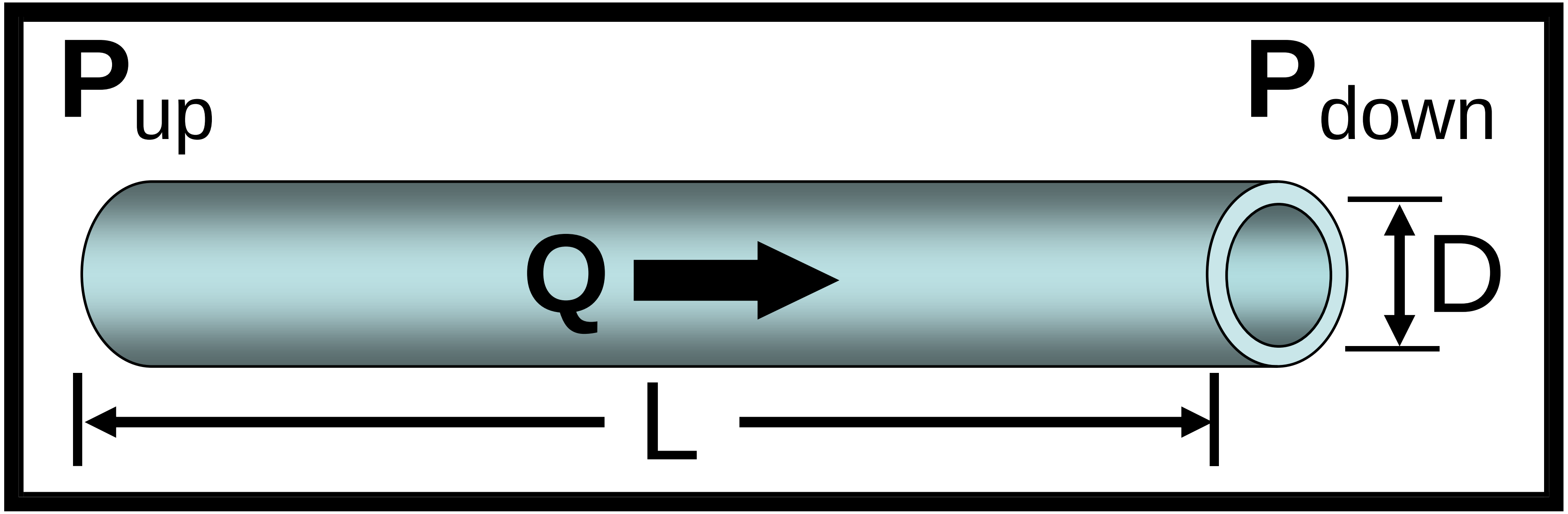


Our Planning Models

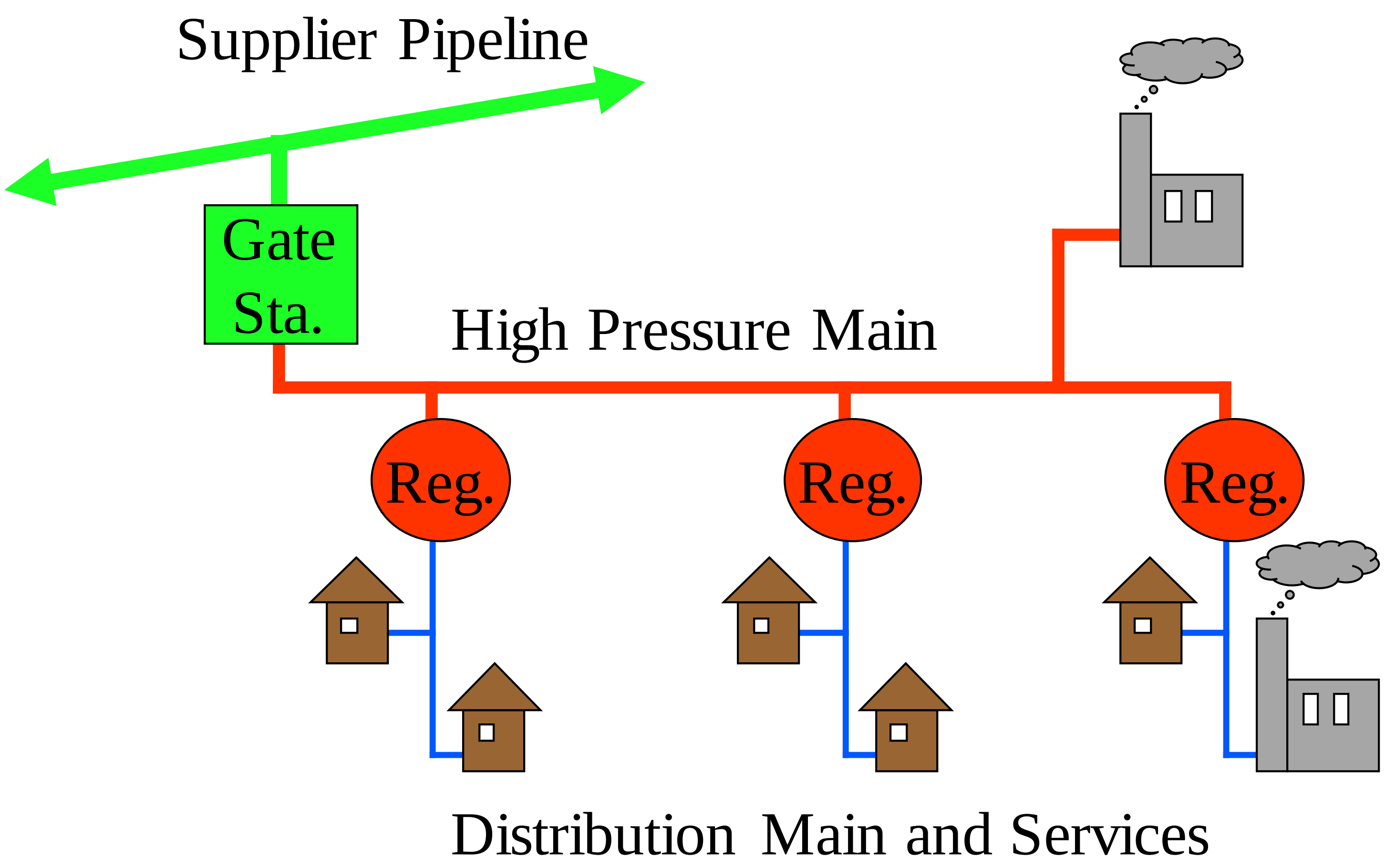
- 120 cities
- 40 load study models



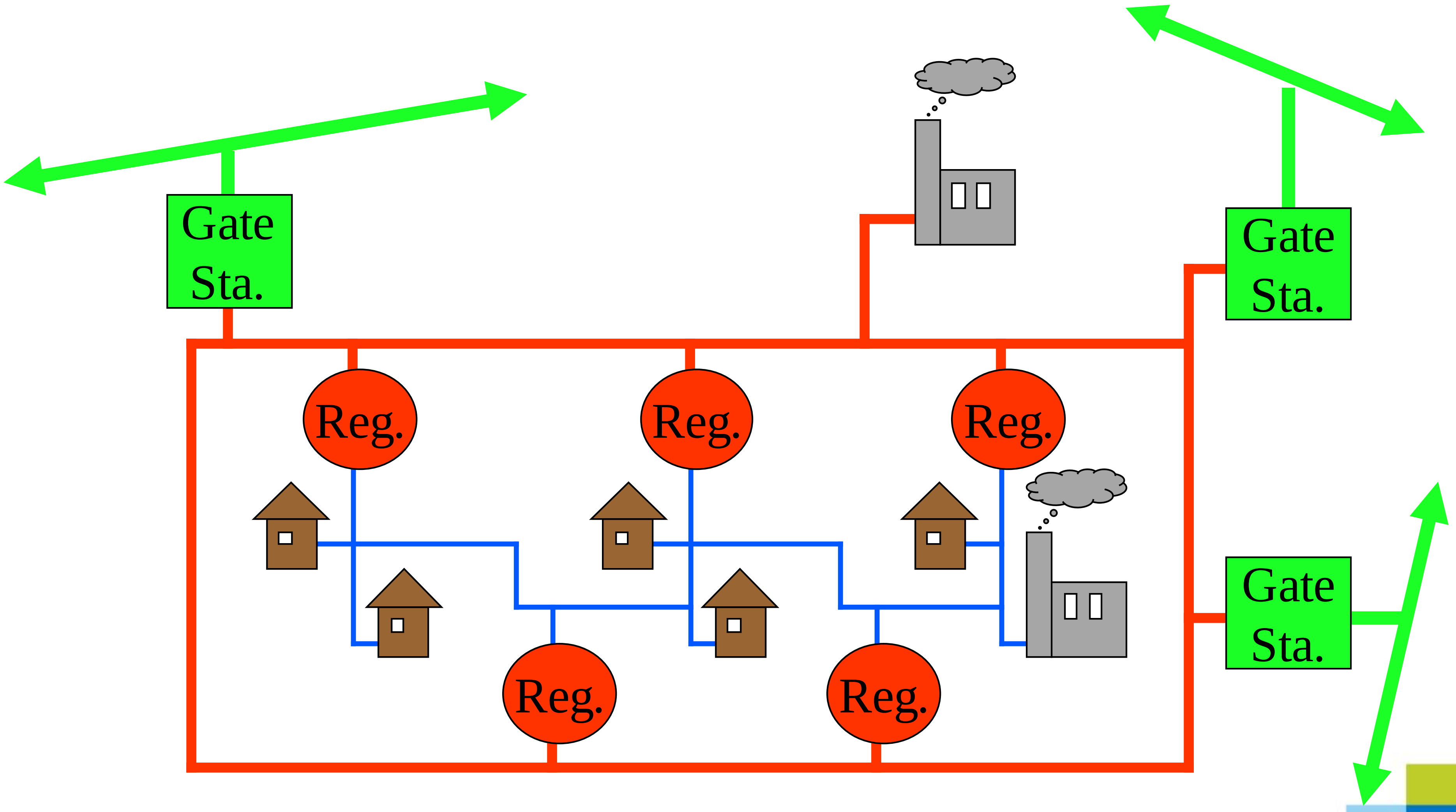
5 Variables for Any Given Pipe



Scope of Gas Distribution Planning

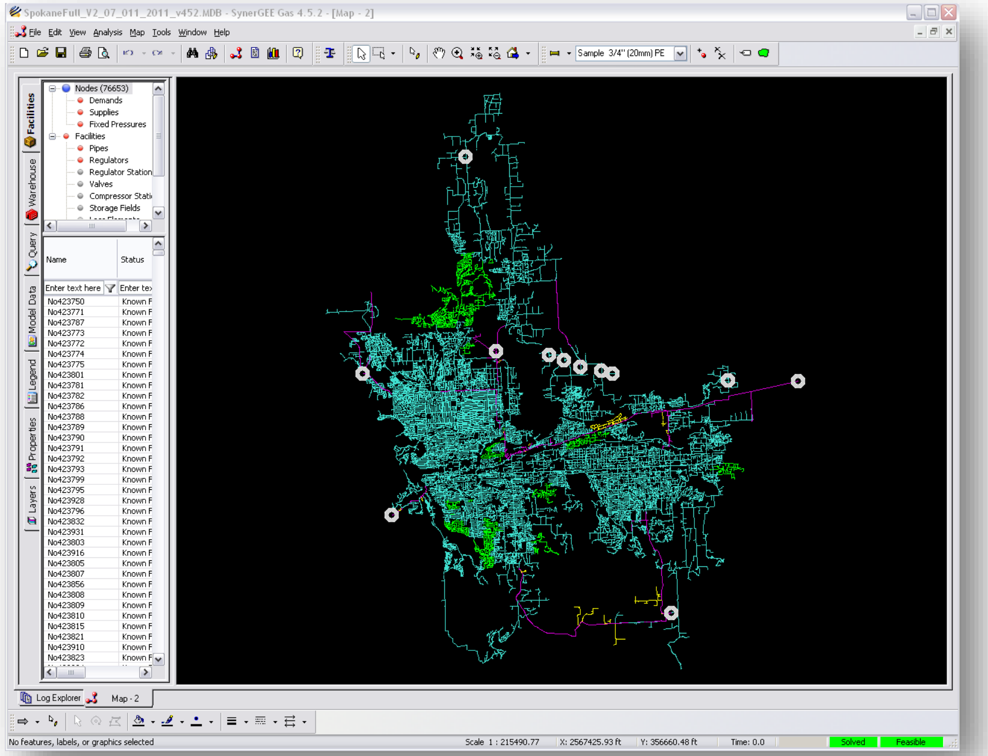


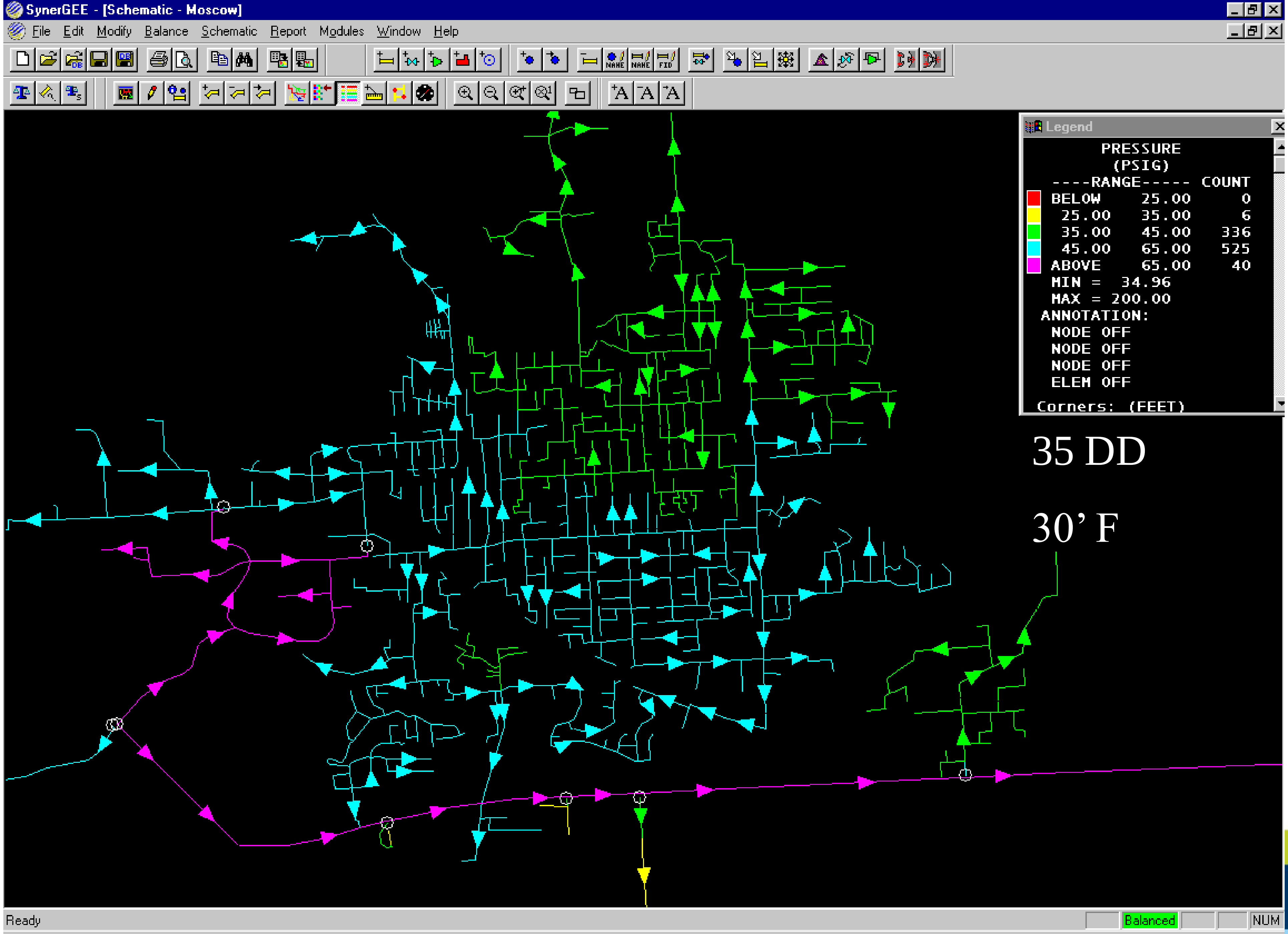
Scope of Gas Distrib. Planning cont.



SynerGi (SynerGEE, Stoner) Load Study

- Simulate distribution behavior
- Identify low pressure areas
- Coordinate reinforcements with expansions
- Measure reliability




SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 25.00 0
25.00 35.00 6
35.00 45.00 336
45.00 65.00 525
ABOVE 65.00 40
MIN = 34.96
MAX = 200.00
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
Ready
Balanced
NUM

35 DD

30’ F

Preparing a Load Study

- Estimating Customer Usage
- Creating a Pipeline Network
- Join Customer Loads to Pipes
- Convert to Load Study

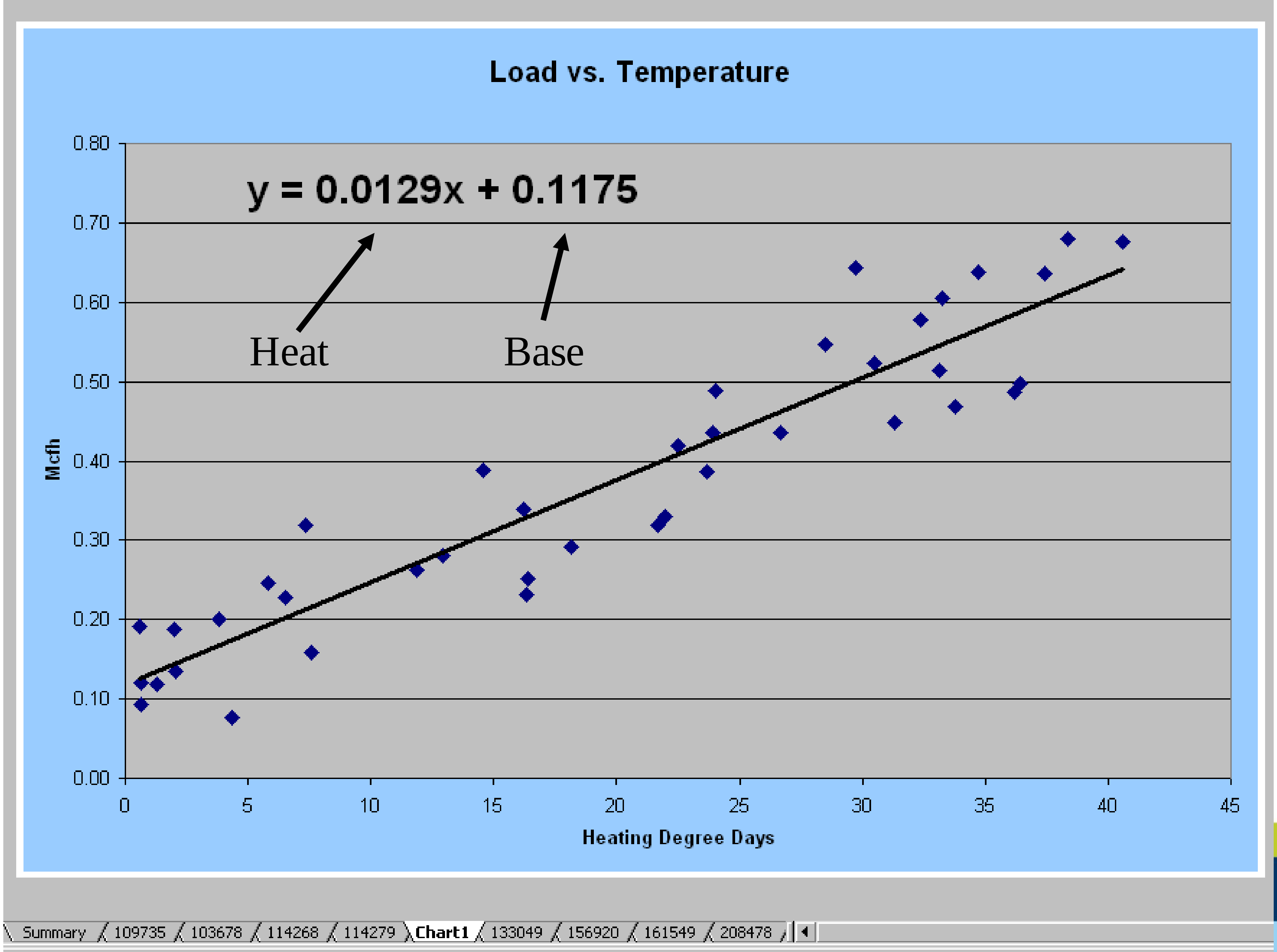
Estimating Customer Usage

- Gathering Data
  - Days of service
  - Degree Days
  - Usage
  - Name, Address, Revenue Class, Rate Schedule…

Estimating Customer Usage cont.

- Degree Days
  - Heating (HDD)
  - Cooling (CDD)
- Temperature - Usage Relationship
  - Load vs. HDD's
  - Base Load (constant)
  - Heat Load (variable)
  - High correlation with residential

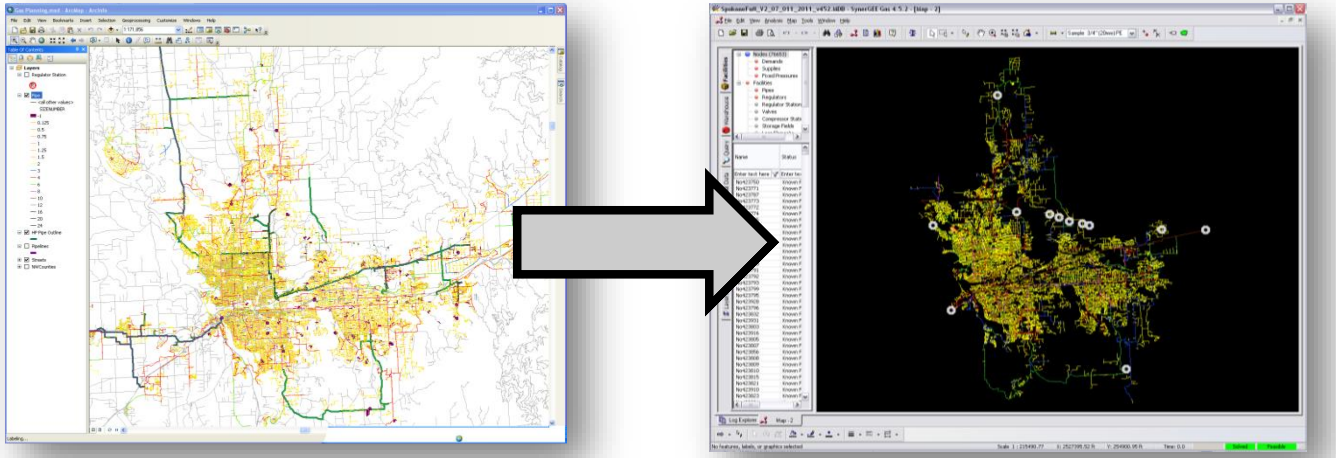
Avg. Daily Temperature ('Fahrenheit)	Heating Degree Days (HDD)	Cooling Degree Days (CDD)
85		20
80		15
75		10
70		5
65	***0***	***0***
60	5	
55	10	
50	15	
45	20	
40	25	
35	30	
30	35	
25	40	
20	45	
15	50	
10	55	
5	60	
4	61	
0	65	
-5	70	
-10	75	
-15	80	

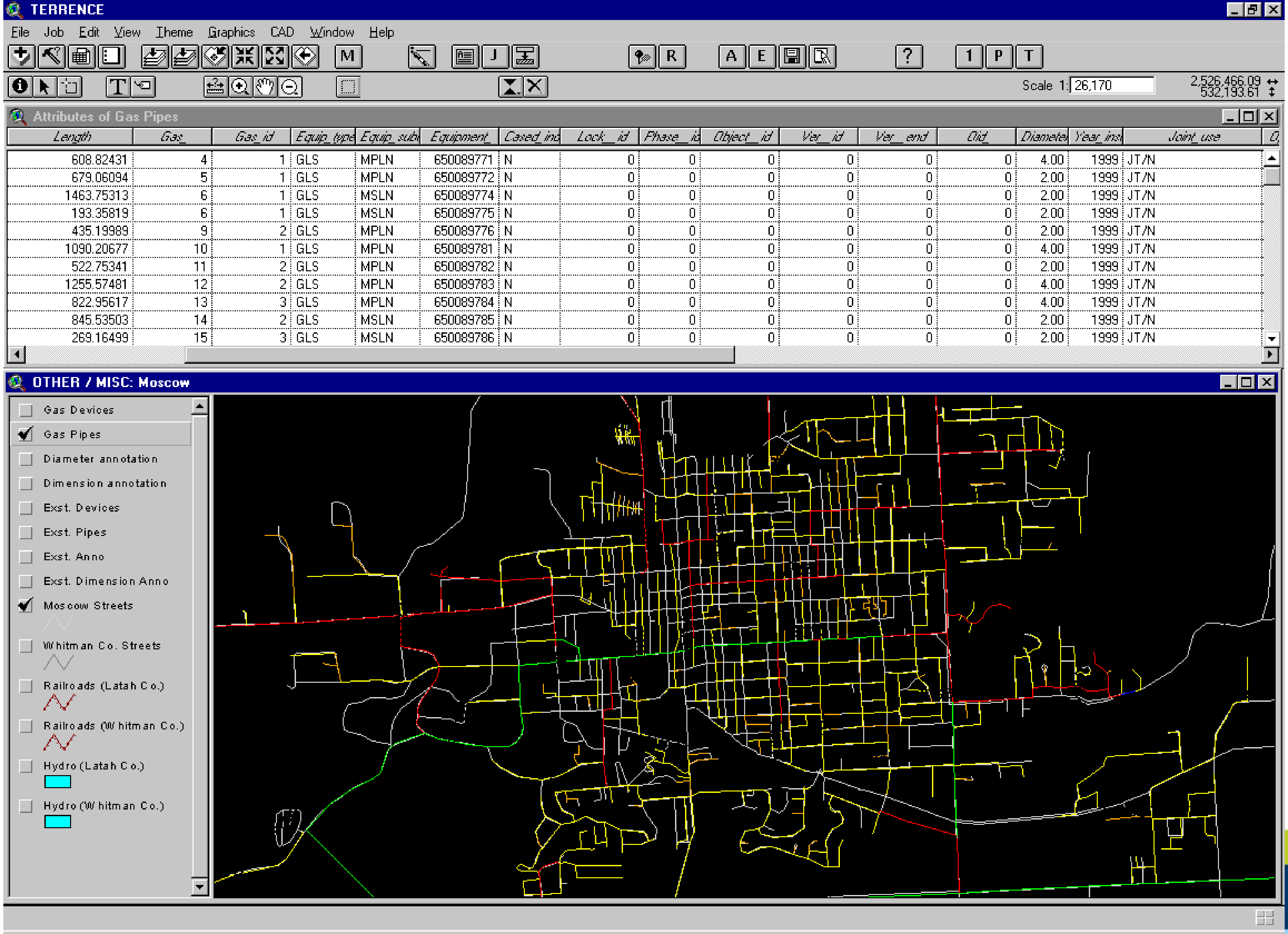


Load vs. Temperature
y = 0.0129x + 0.1175
Heat
Base
Mcfh
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
5
10
15
20
25
30
35
40
45
Heating Degree Days
Summary
109735
103678
114268
114279
Chart1
133049
156920
161549
208478

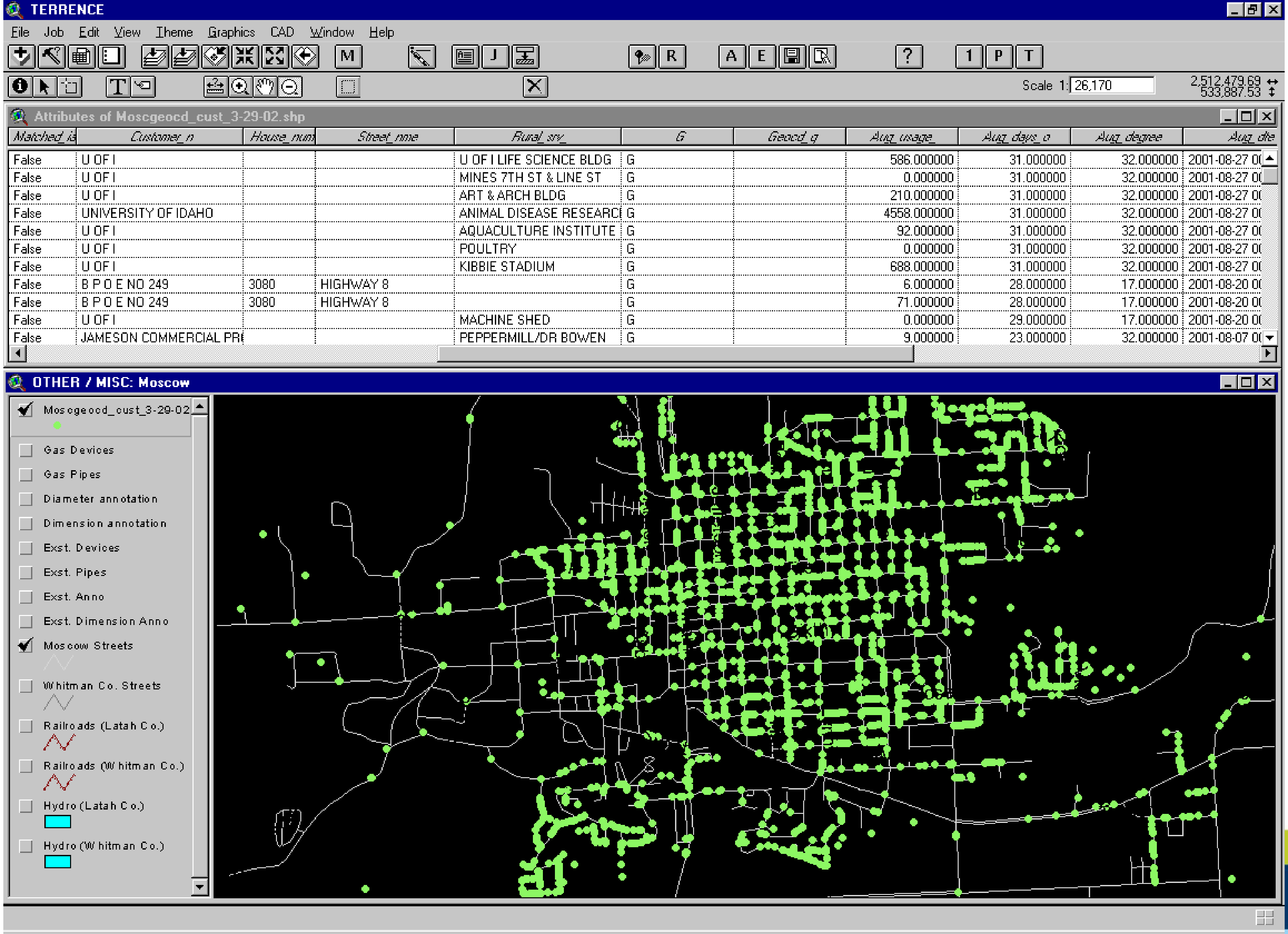
Creating a Pipeline Model

- Elements
  - Pipes, regulators, valves
  - Attributes: Length, internal diameter, roughness
- Nodes
  - Sources, usage points, pipe ends
  - Attributes: Flow, pressure

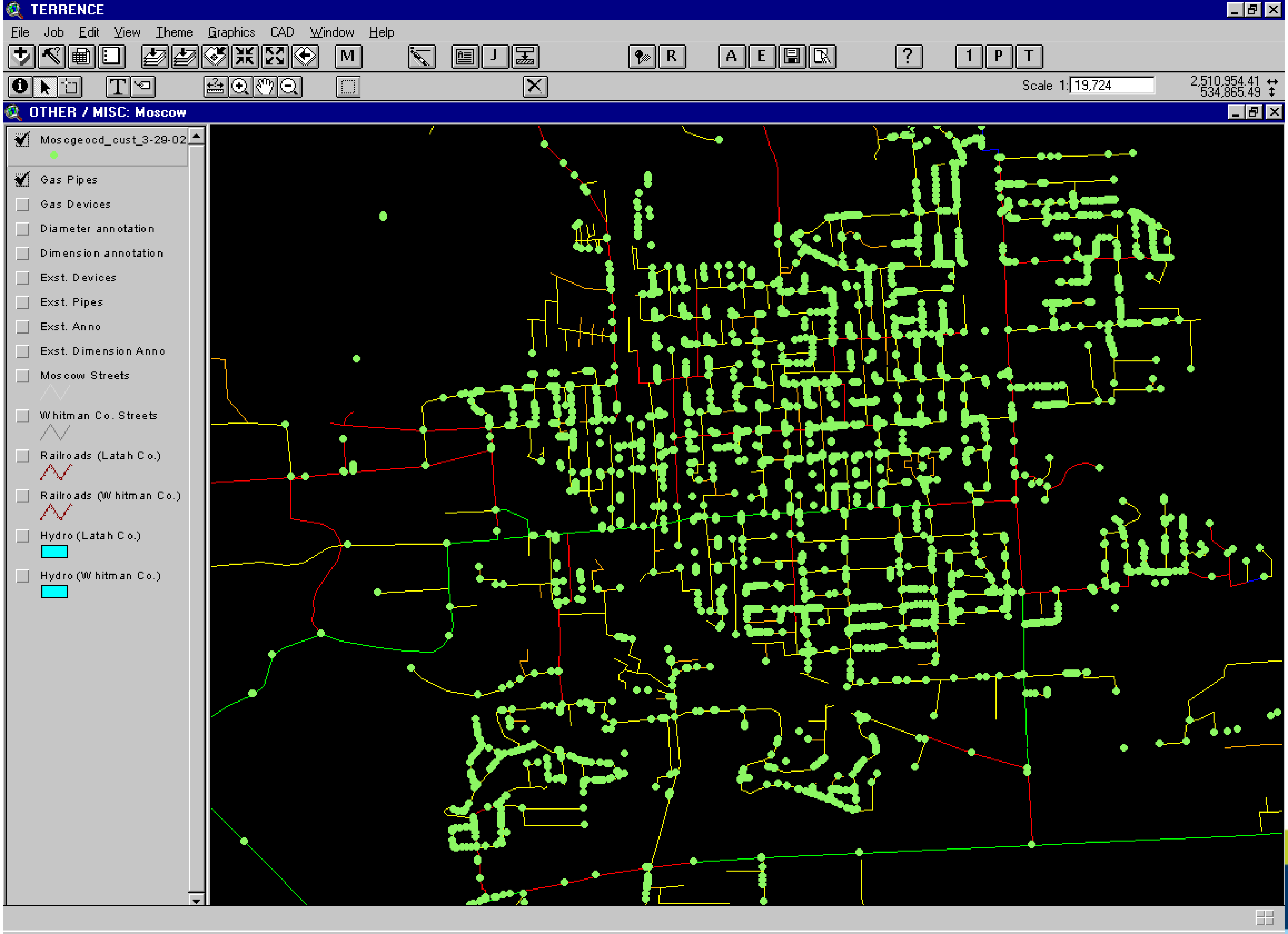


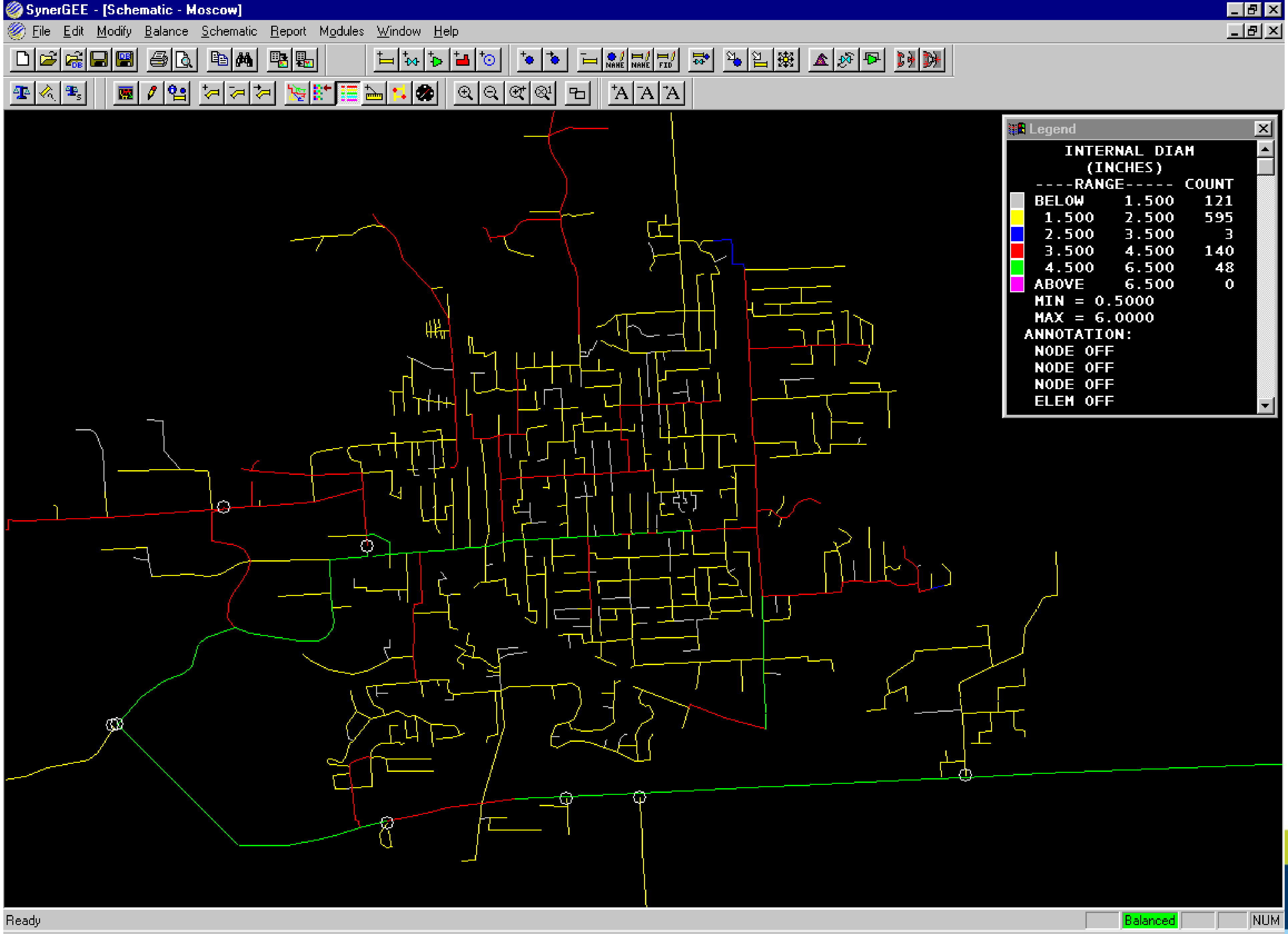


Length	Gas_	Gas_id	Equip_typ	Equip_sub	Equipment_	Cased_ind	Lock_id	Phase_id	Object_id	Ver_id	Ver_end	Oid	Diamete	Year_ins	Joint_use
608.82431	4	1	GLS	MPLN	650089771	N	0	0	0	0	0	0	4.00	1999	JT/N
679.06094	5	1	GLS	MPLN	650089772	N	0	0	0	0	0	0	2.00	1999	JT/N
1463.75313	6	1	GLS	MSLN	650089774	N	0	0	0	0	0	0	2.00	1999	JT/N
193.35819	6	1	GLS	MSLN	650089775	N	0	0	0	0	0	0	2.00	1999	JT/N
435.19989	9	2	GLS	MPLN	650089776	N	0	0	0	0	0	0	2.00	1999	JT/N
1090.20677	10	1	GLS	MPLN	650089781	N	0	0	0	0	0	0	4.00	1999	JT/N
522.75341	11	2	GLS	MPLN	650089782	N	0	0	0	0	0	0	2.00	1999	JT/N
1255.57481	12	2	GLS	MPLN	650089783	N	0	0	0	0	0	0	4.00	1999	JT/N
822.95617	13	3	GLS	MPLN	650089784	N	0	0	0	0	0	0	4.00	1999	JT/N
845.53503	14	2	GLS	MSLN	650089785	N	0	0	0	0	0	0	2.00	1999	JT/N
269.16499	15	3	GLS	MSLN	650089786	N	0	0	0	0	0	0	2.00	1999	JT/N



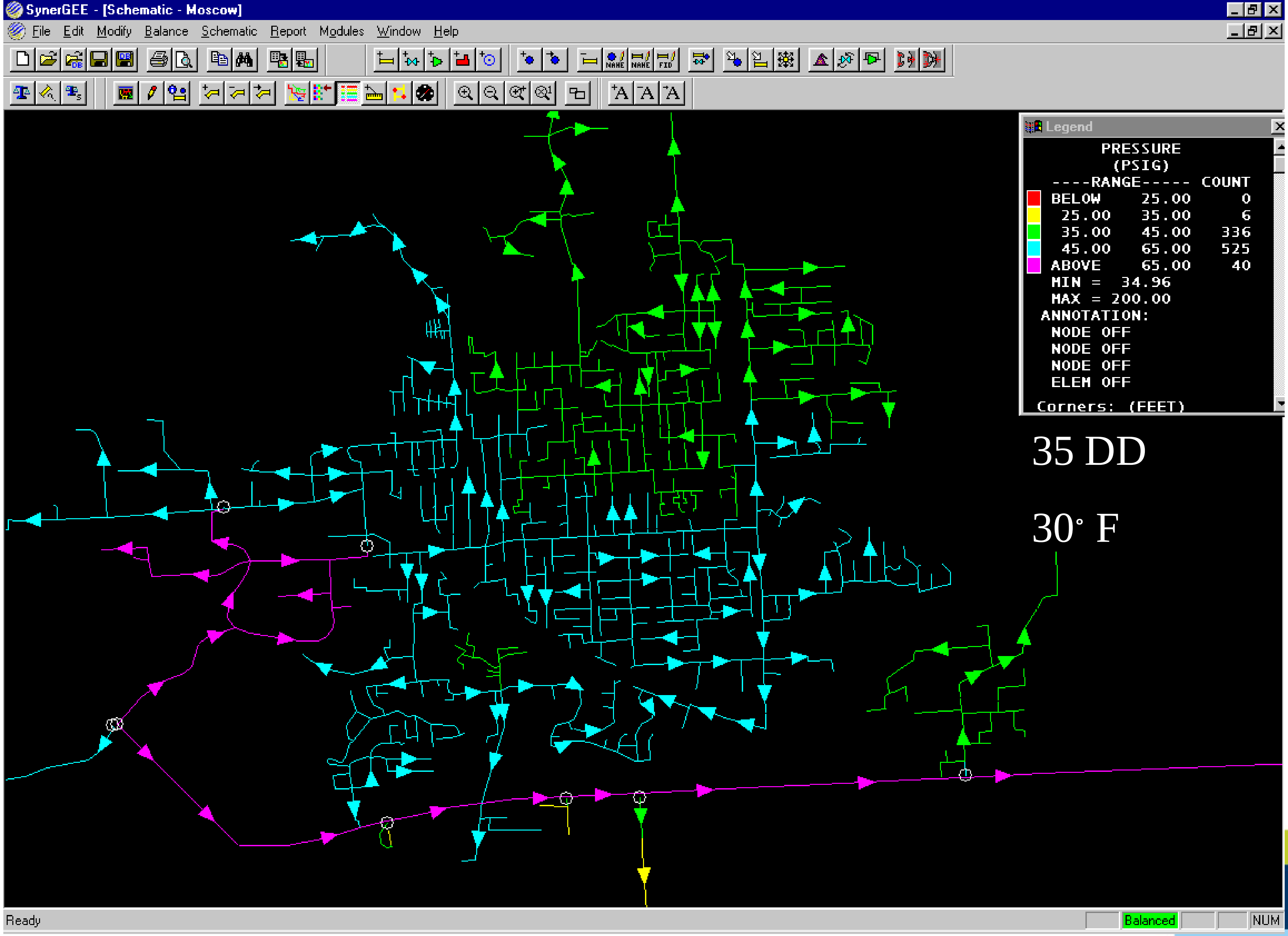
Matched_is	Customer_n	House_num	Street_nme	Rural_srv_	G	Geocd_g	Avg_usage_	Avg_days_o	Avg_degree	Avg_dte
False	U OF I			U OF I LIFE SCIENCE BLDG	G		586.000000	31.000000	32.000000	2001-08-27 00
False	U OF I			MINES 7TH ST & LINE ST	G		0.000000	31.000000	32.000000	2001-08-27 00
False	U OF I			ART & ARCH BLDG	G		210.000000	31.000000	32.000000	2001-08-27 00
False	UNIVERSITY OF IDAHO			ANIMAL DISEASE RESEARC	G		4558.000000	31.000000	32.000000	2001-08-27 00
False	U OF I			AQUACULTURE INSTITUTE	G		92.000000	31.000000	32.000000	2001-08-27 00
False	U OF I			POULTRY	G		0.000000	31.000000	32.000000	2001-08-27 00
False	U OF I			KIBBIE STADIUM	G		688.000000	31.000000	32.000000	2001-08-27 00
False	B P O E NO 249	3080	HIGHWAY 8		G		6.000000	28.000000	17.000000	2001-08-20 00
False	B P O E NO 249	3080	HIGHWAY 8		G		71.000000	28.000000	17.000000	2001-08-20 00
False	U OF I			MACHINE SHED	G		0.000000	29.000000	17.000000	2001-08-20 00
False	JAMESON COMMERCIAL PRI			PEPPERMILL/DR BOWEN	G		9.000000	23.000000	32.000000	2001-08-07 00


TERRENCE
File Job Edit View Theme Graphics CAD Window Help
Scale 1: 19,724
2,510,954.41
534,865.49
OTHER / MISC: Moscow
Moscgeocd_cust_3-29-02
Gas Pipes
Gas Devices
Diameter annotation
Dimension annotation
Exst. Devices
Exst. Pipes
Exst. Anno
Exst. Dimension Anno
Moscow Streets
Whitman Co. Streets
Railroads (Latah Co.)
Railroads (Whitman Co.)
Hydro (Latah Co.)
Hydro (Whitman Co.)


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
INTERNAL DIAM
(INCHES)
----RANGE----- COUNT
BELOW 1.500 121
1.500 2.500 595
2.500 3.500 3
3.500 4.500 140
4.500 6.500 48
ABOVE 6.500 0
MIN = 0.5000
MAX = 6.0000
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Ready
Balanced
NUM

Balancing Model

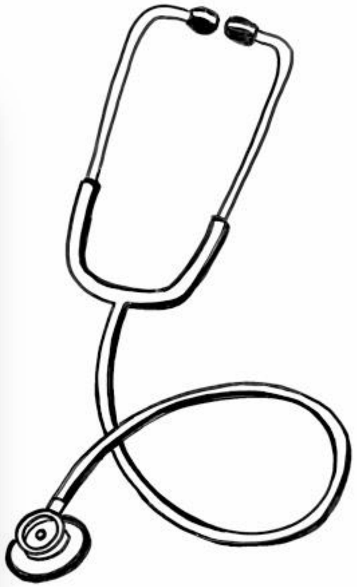
- Simulate system for any temperature
  - HDD's
- Solve for pressure at all nodes


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 25.00 0
25.00 35.00 6
35.00 45.00 336
45.00 65.00 525
ABOVE 65.00 40
MIN = 34.96
MAX = 200.00
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
Ready
Balanced
NUM

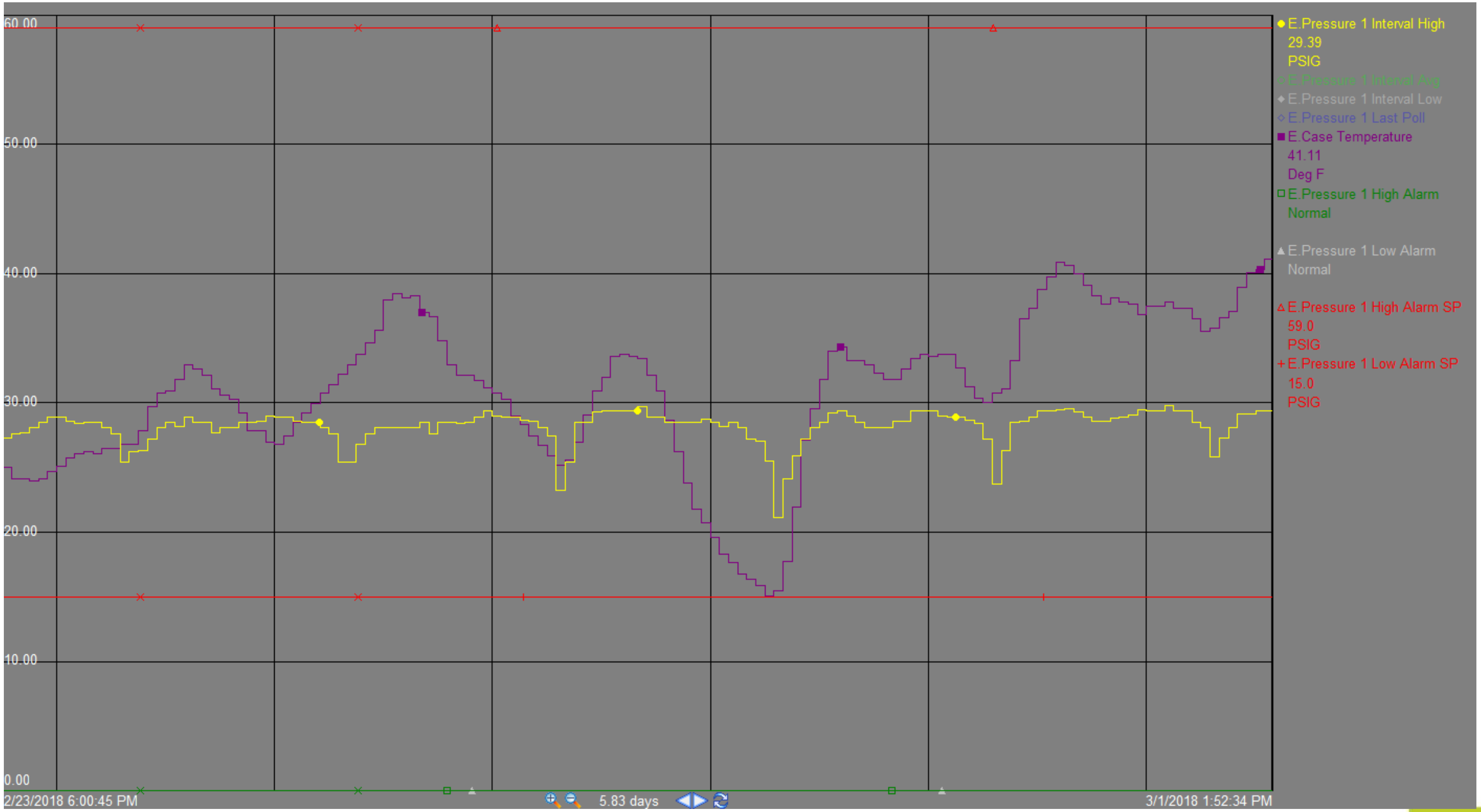
35 DD

30° F

Validating Model



Validating Model cont.



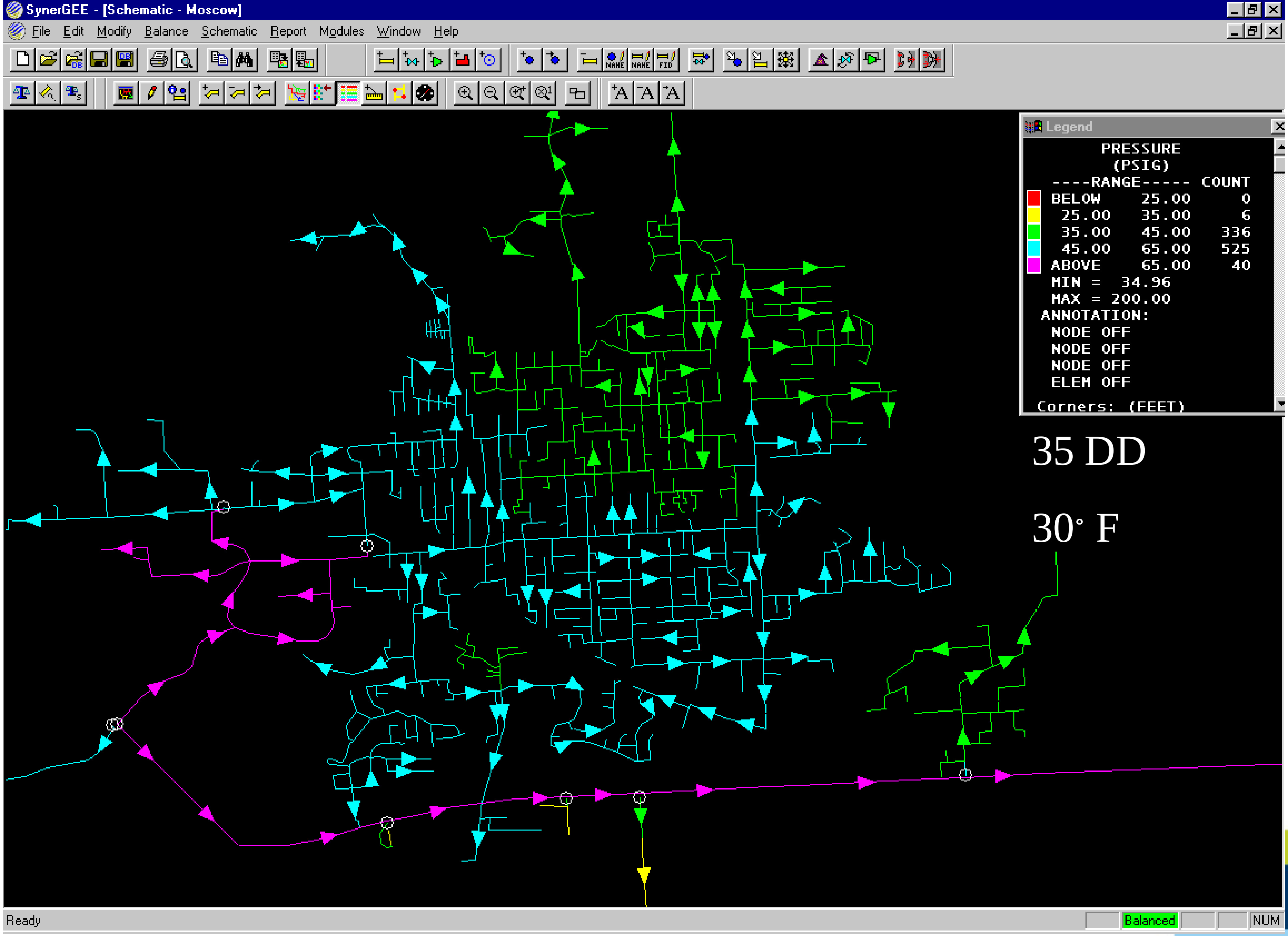
Validating Model cont.

- Simulate recorded condition
- Electronic Pressure Recorders
  - Do calculated results match *field* data?
- Gate Station Telemetry
  - Do calculated results match *source* data?
- Possible Errors
  - Missing pipe
  - Source pressure changed
  - Industrial loads

Planning Criteria

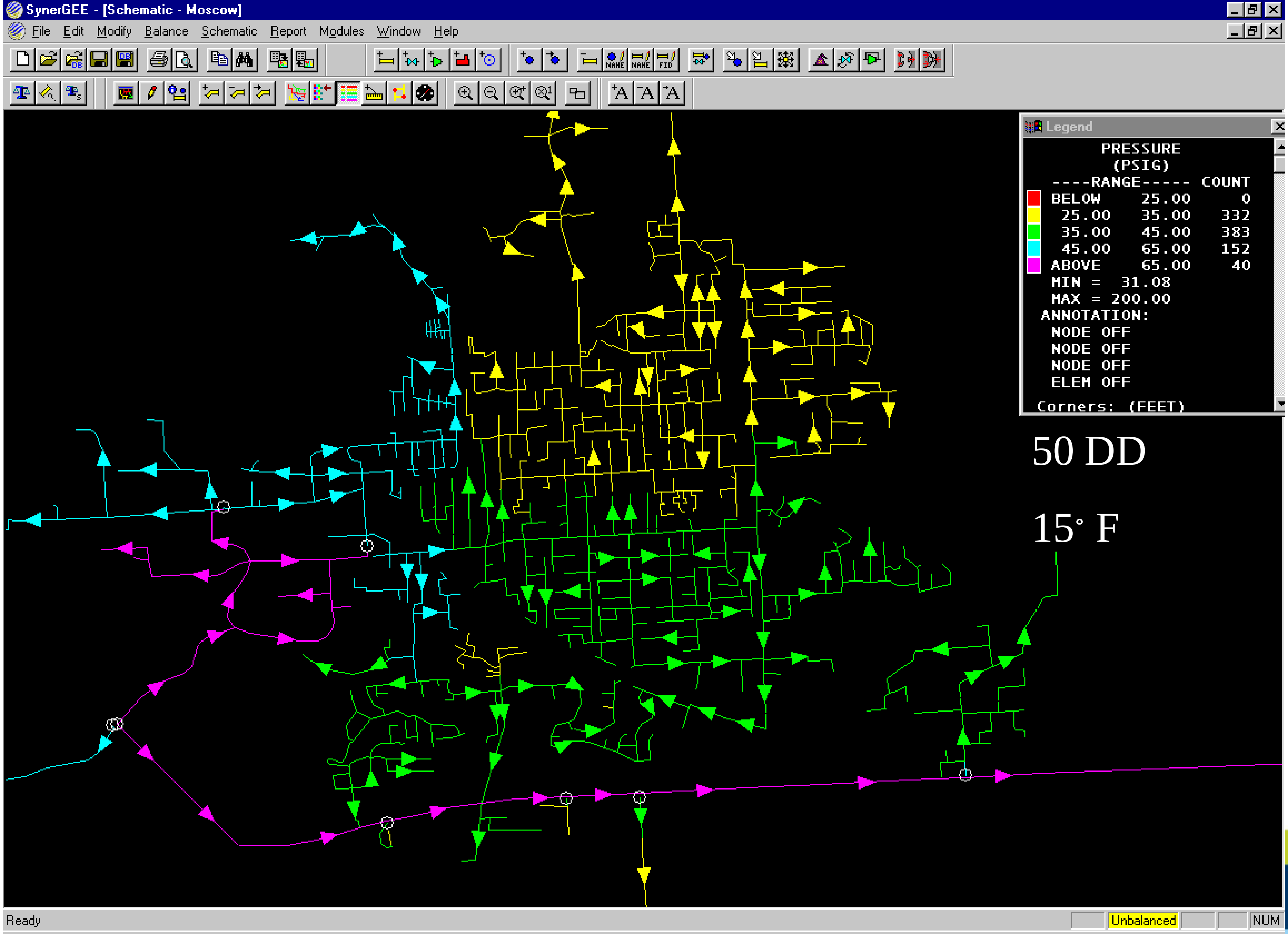
- Reliability during design HDD
  - Spokane **77 HDD** *(avg. daily temp. -12' F)*
  - Medford **54 HDD** *(avg. daily temp. 11' F)*
  - Klamath Falls **74 HDD** *(avg. daily temp. -9' F)*
  - La Grande **76 HDD** *(avg. daily temp. -11' F)*
  - Roseburg **51 HDD** *(avg. daily temp. 14' F)*

- Maintain minimum of 15 psig in system at all times
  - 5 psig in lower MAOP areas


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 25.00 0
25.00 35.00 6
35.00 45.00 336
45.00 65.00 525
ABOVE 65.00 40
MIN = 34.96
MAX = 200.00
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
Ready
Balanced
NUM

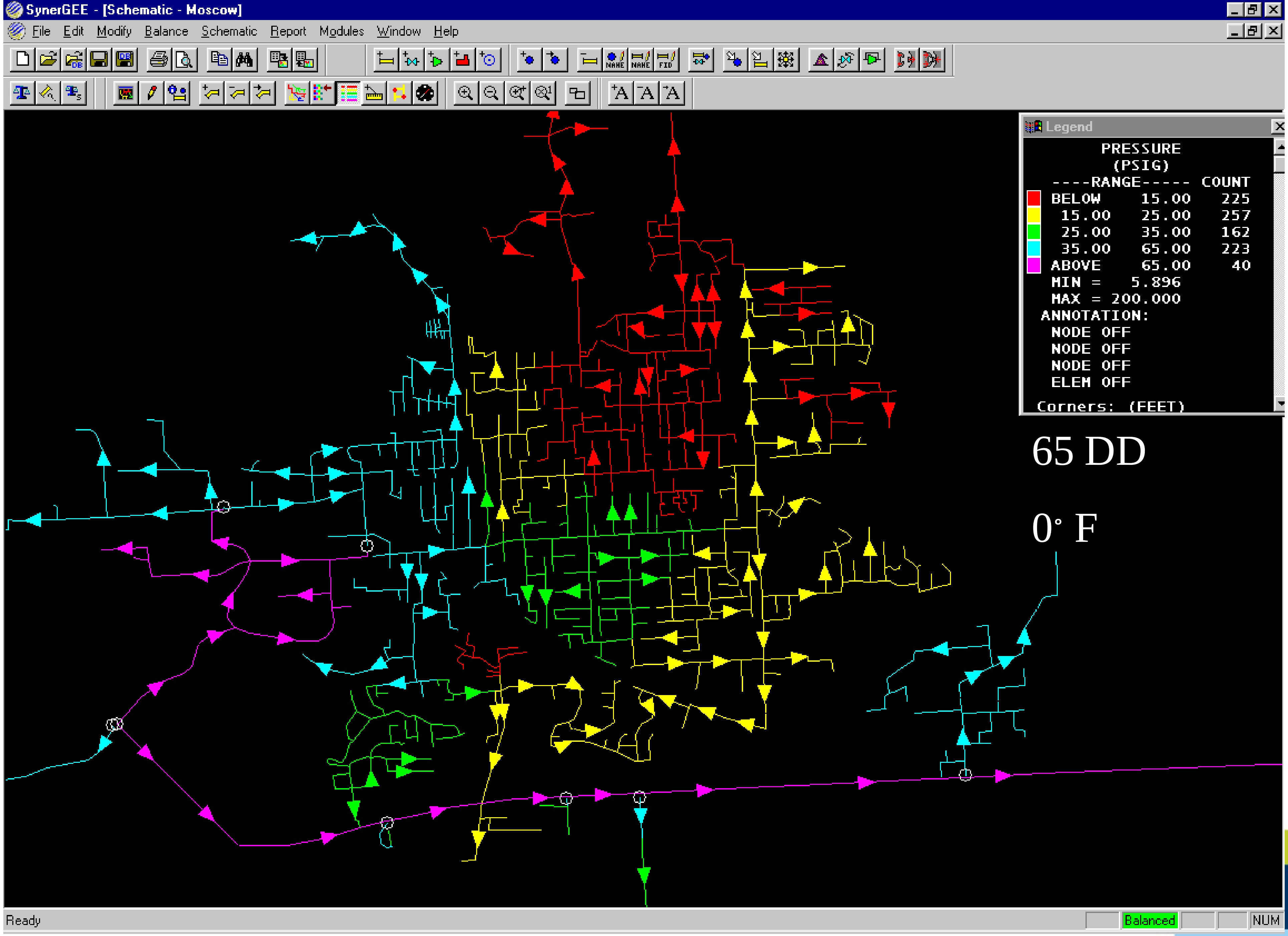
35 DD

30° F


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 25.00 0
25.00 35.00 332
35.00 45.00 383
45.00 65.00 152
ABOVE 65.00 40
MIN = 31.08
MAX = 200.00
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
Ready
Unbalanced
NUM

50 DD

15° F

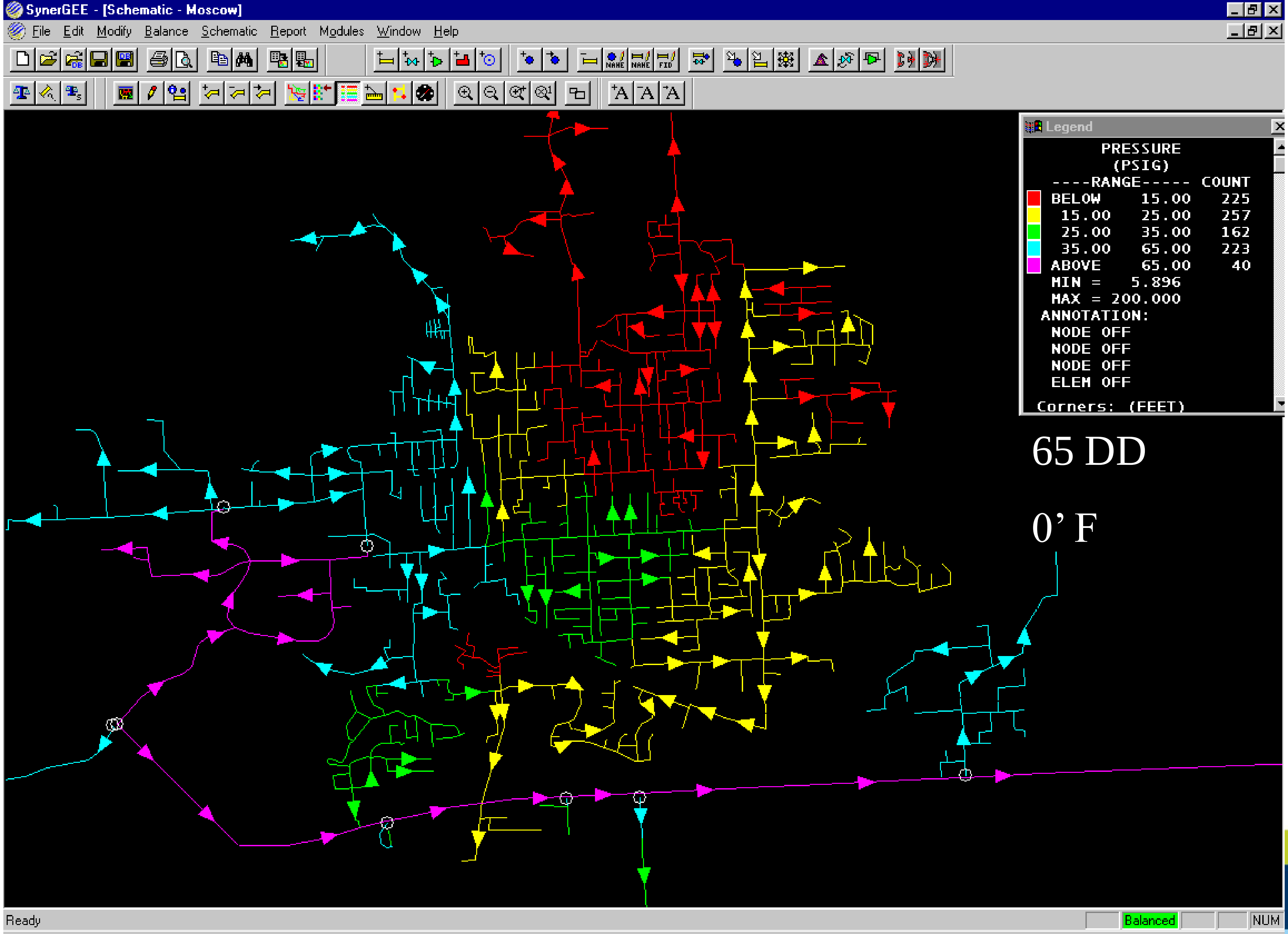

SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 15.00 225
15.00 25.00 257
25.00 35.00 162
35.00 65.00 223
ABOVE 65.00 40
MIN = 5.896
MAX = 200.000
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
Ready
Balanced
NUM

65 DD

0° F

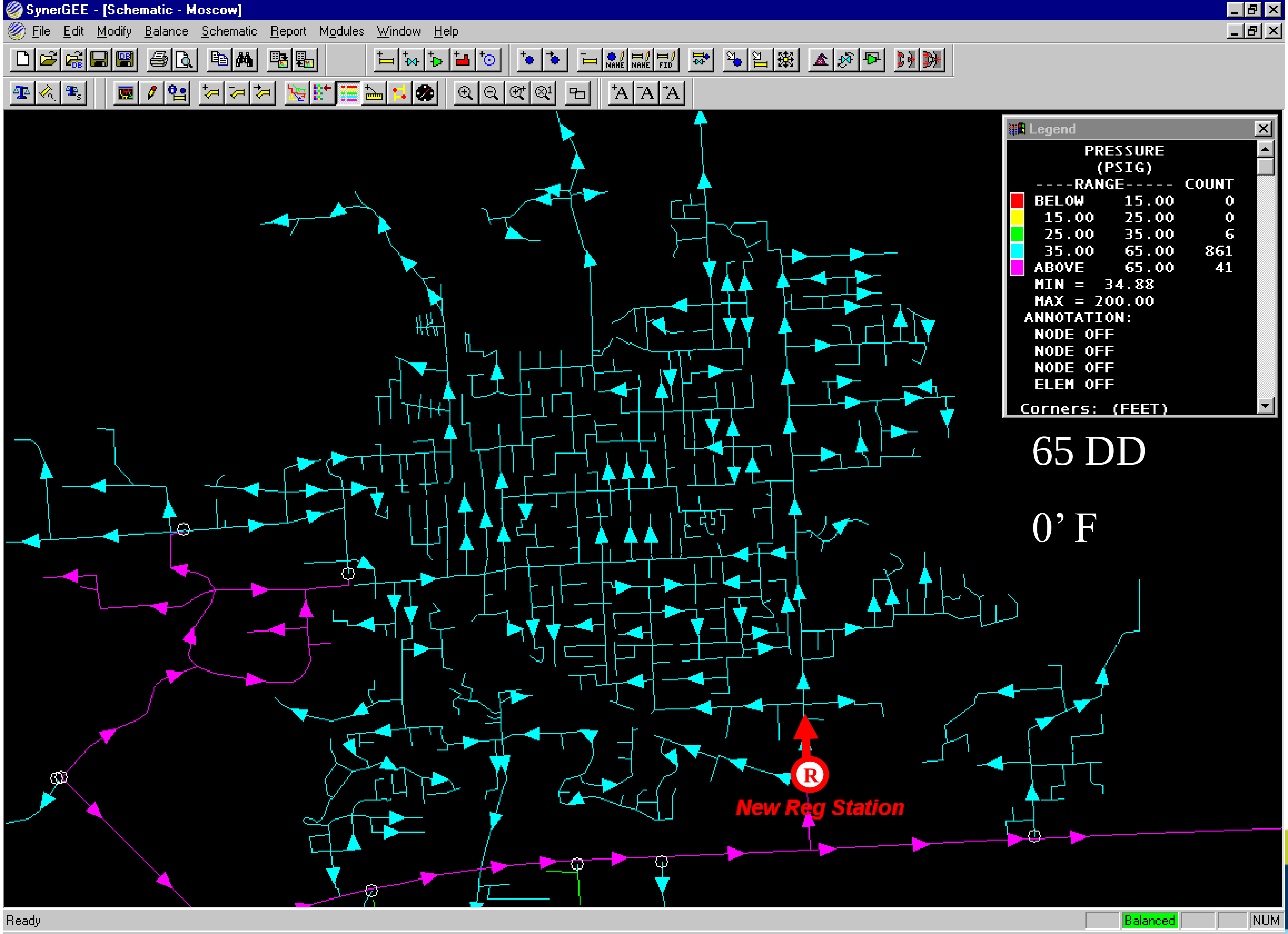
Interpreting Results

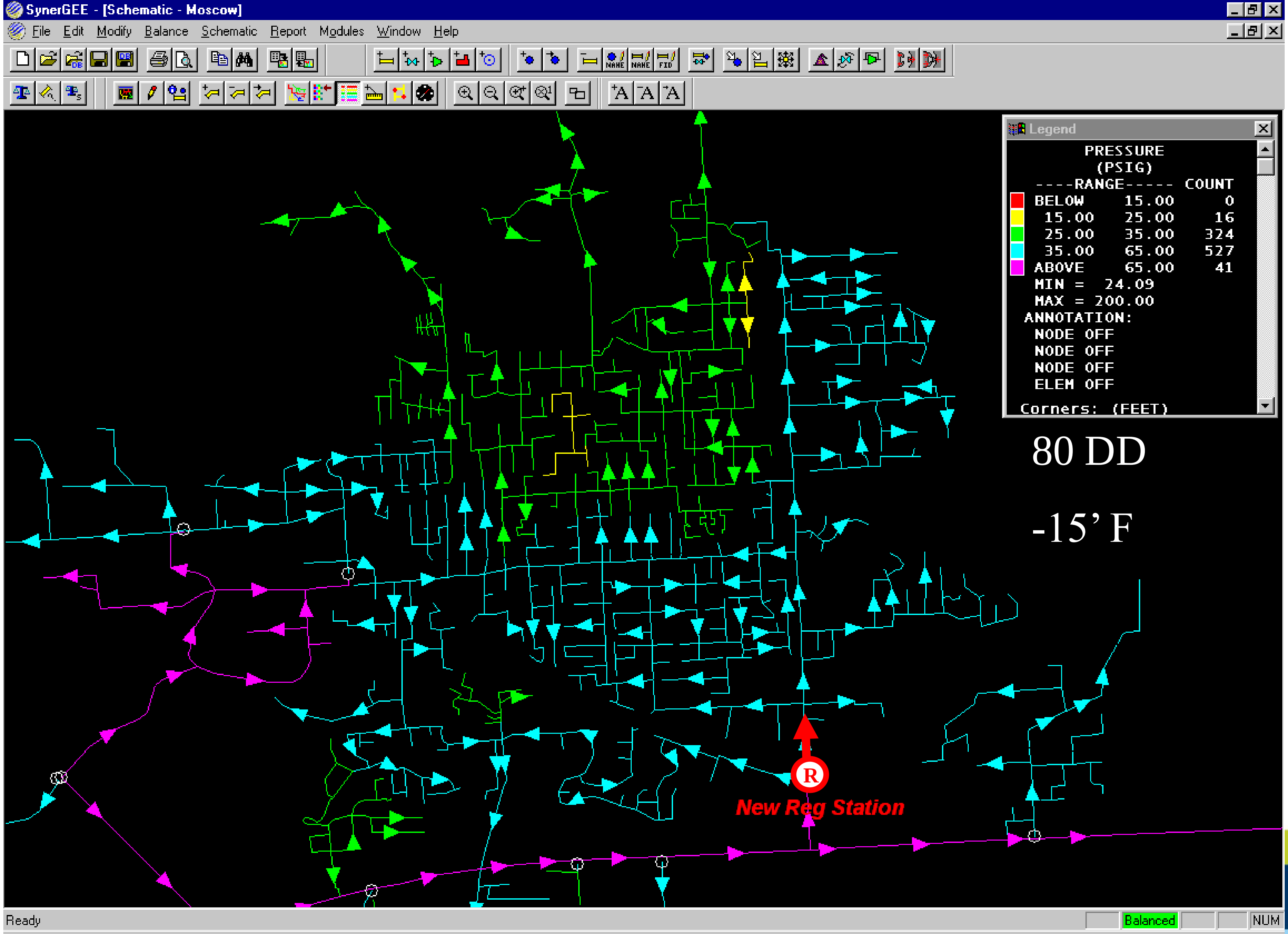
- Identify Low Pressure Areas
  - Number of feeds
  - Proximity to source
- Looking for Most Economical Solution
  - Length (minimize)
  - Construction obstacles (minimize)
  - Customer growth (maximize)


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 15.00 225
15.00 25.00 257
25.00 35.00 162
35.00 65.00 223
ABOVE 65.00 40
MIN = 5.896
MAX = 200.000
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
Ready
Balanced
NUM

65 DD

0' F


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 15.00 0
15.00 25.00 0
25.00 35.00 6
35.00 65.00 861
ABOVE 65.00 41
MIN = 34.88
MAX = 200.00
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
65 DD
0' F
R
New Reg Station
Ready
Balanced
NUM


SynerGEE - [Schematic - Moscow]
File Edit Modify Balance Schematic Report Modules Window Help
Legend
PRESSURE
(PSIG)
----RANGE----- COUNT
BELOW 15.00 0
15.00 25.00 16
25.00 35.00 324
35.00 65.00 527
ABOVE 65.00 41
MIN = 24.09
MAX = 200.00
ANNOTATION:
NODE OFF
NODE OFF
NODE OFF
ELEM OFF
Corners: (FEET)
80 DD
-15' F
R
New Reg Station
Ready
Balanced
NUM

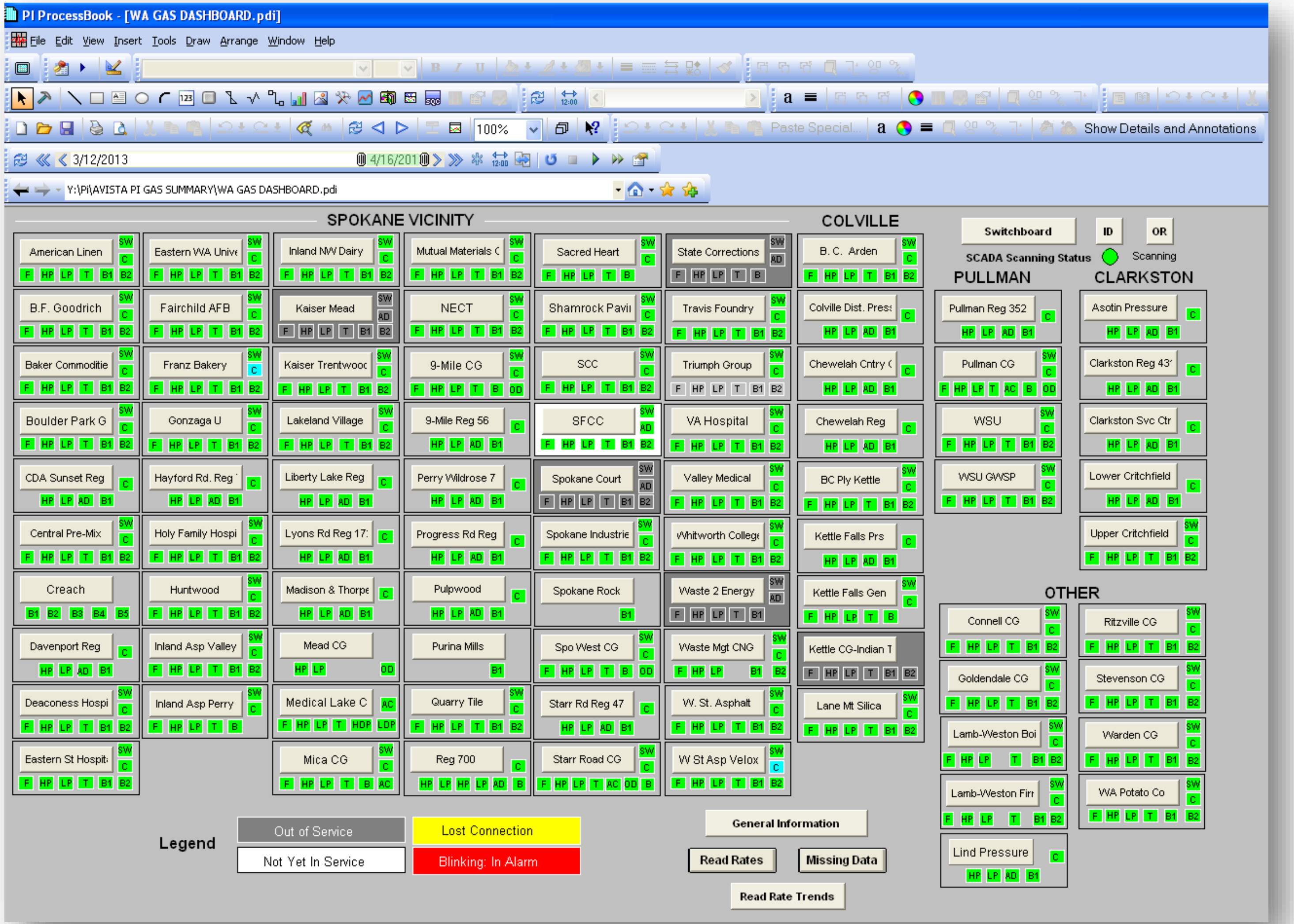
Long-term Planning Objectives

- Future Growth/Expansion
- Design Day Conditions
- Facilitate Customer Installation Targets

Monitoring Our System

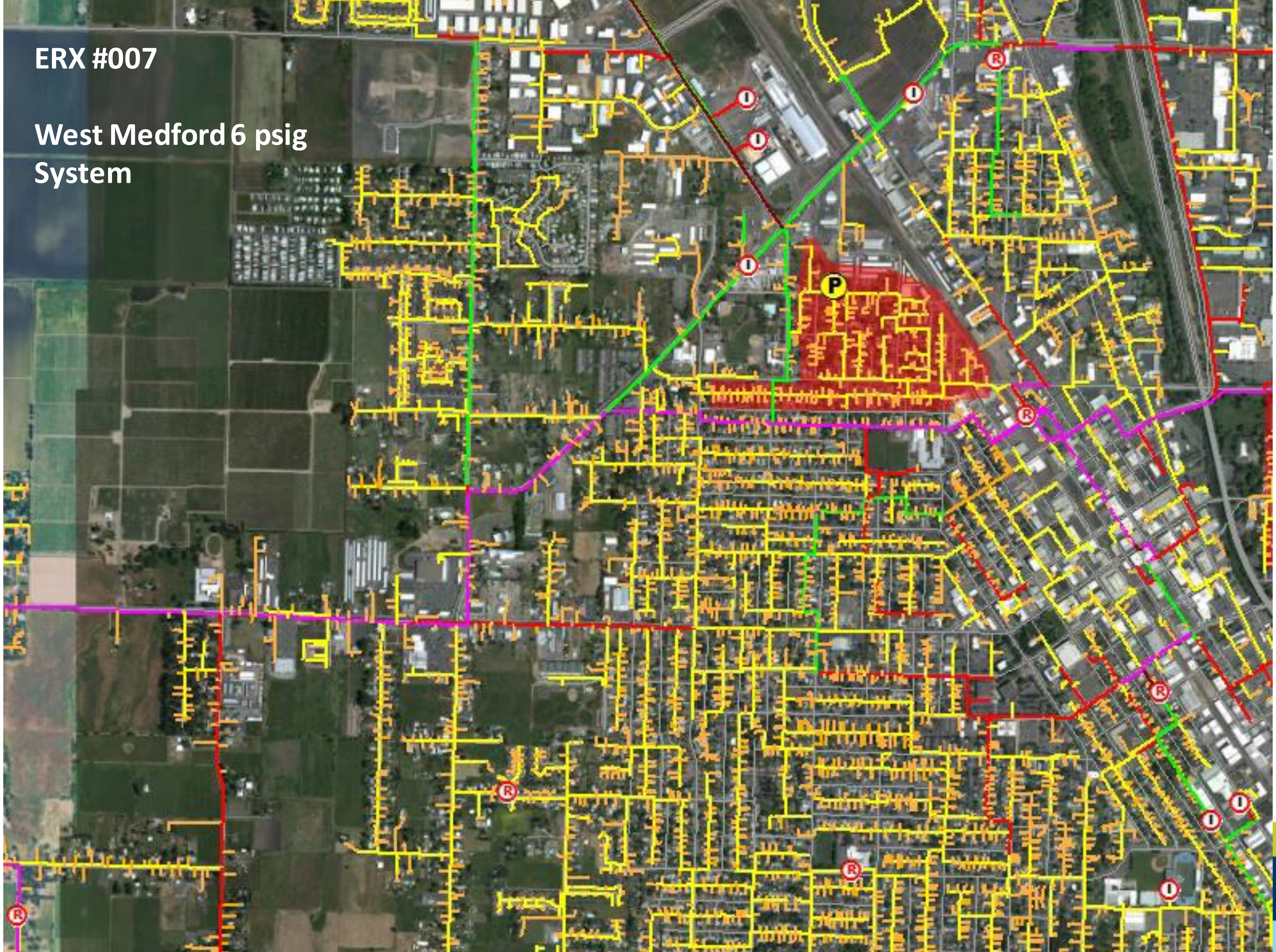
- Electronic Pressure Recorders
  - Daily Feedback
  - Real time if necessary
- Validates our Load Studies

Real-time Pressure & Flow Monitoring

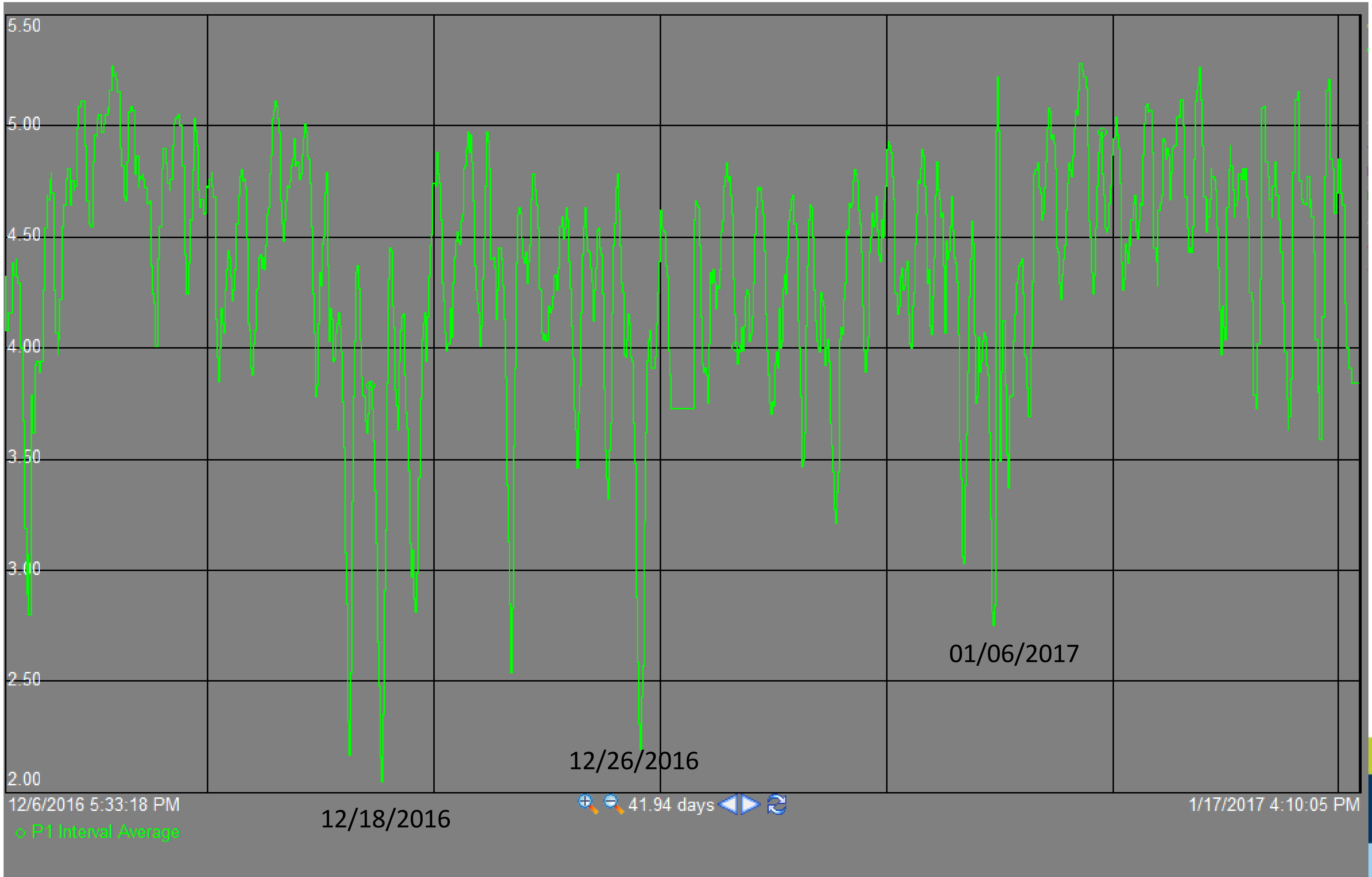


ERX #007

West Medford 6 psig System



ERX #007: West Medford 6 psig System, OR



2019-2020 Winter

AVISTA

Gas Load And Weather Forecast Report

Page: 1
Date: 01/08/20 01:00 PM
Database: NUCPRD
gs_fore_temp

Date: 01/08/2020

Area: LAGRANDE

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	39	29	30	3,827
MON	01/06/20	39	32	29	3,984
TUE	01/07/20	44	37	24	3,474
WED	01/08/20	41	30	30	3,636
THU	01/09/20	35	23	35	4,284
FRI	01/10/20	35	27	33	4,220
SAT	01/11/20	39	31	30	3,812
SUN	01/12/20	39	31	30	3,788
MON	01/13/20	33	26	34	4,241
TUE	01/14/20	27	15	43	5,177
		Average:			4,044

Area: KLAMATH FALLS

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	38	28	33	8,302
MON	01/06/20	45	20	35	7,822
TUE	01/07/20	47	21	29	7,345
WED	01/08/20	38	28	32	7,872
THU	01/09/20	36	21	37	8,027
FRI	01/10/20	39	24	31	7,783
SAT	01/11/20	38	28	32	7,650
SUN	01/12/20	38	30	31	7,617
MON	01/13/20	38	24	34	7,923
TUE	01/14/20	30	20	40	8,786
		Average:			7,913

Area: MEDFORD

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	47	34	25	27,581
MON	01/06/20	49	30	27	30,760
TUE	01/07/20	40	31	28	32,807
WED	01/08/20	45	38	25	30,458
THU	01/09/20	43	32	28	31,174
FRI	01/10/20	43	33	26	30,409
SAT	01/11/20	42	37	25	27,942
SUN	01/12/20	43	38	26	27,696
MON	01/13/20	40	33	28	31,906
TUE	01/14/20	37	30	31	34,882
		Average:			30,562

Area: ROSEBURG

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	49	41	20	7,334
MON	01/06/20	53	41	17	7,574
TUE	01/07/20	55	40	18	6,956
WED	01/08/20	48	41	21	7,363
THU	01/09/20	47	35	25	7,888
FRI	01/10/20	48	36	21	7,649
SAT	01/11/20	49	41	20	6,840
SUN	01/12/20	48	42	21	7,201
MON	01/13/20	46	37	23	7,942
TUE	01/14/20	46	35	26	8,553
		Average:			7,530

Area: SPOKANE

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	40	31	31	119,295
MON	01/06/20	44	33	24	108,349
TUE	01/07/20	45	36	24	99,618
WED	01/08/20	40	27	31	113,614
THU	01/09/20	33	26	36	130,326
FRI	01/10/20	34	27	33	127,052
SAT	01/11/20	35	31	32	120,468
SUN	01/12/20	32	23	38	132,989
MON	01/13/20	24	14	46	163,049
TUE	01/14/20	17	1	55	190,891
		Average:			130,565

Area: LEWISTON

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	46	34	24	15,796
MON	01/06/20	49	41	18	14,631
TUE	01/07/20	52	38	20	12,168
WED	01/08/20	47	36	24	14,115
THU	01/09/20	39	29	30	17,991
FRI	01/10/20	40	32	28	17,517
SAT	01/11/20	44	37	25	15,788
SUN	01/12/20	42	36	26	16,308
MON	01/13/20	38	31	30	18,342
TUE	01/14/20	31	18	40	22,165
		Average:			16,482

Area: OTHER

	Date:	Hi	Lo	HDD	Load
SUN	01/05/20	0	0	0	210
MON	01/06/20	0	0	0	207
TUE	01/07/20	0	0	0	207
		Average:			208

AVISTA

2013-2014 Winter

Area:	LaGrande				
	Date	Hi	Lo	HDD	Load
SAT	12/7/2013	18	-4	58	6,615
SUN	12/8/2013	9	-9	65	6,695
MON	12/9/2013	21	-4	56	5,389
TUE	12/10/2013	29	16	42	4,897
WED	12/11/2013	30	15	42	4,689
THU	12/12/2013	35	20	37	4,131
FRI	12/13/2013	41	27	31	3,398
SAT	12/14/2013	38	22	35	3,618
SUN	12/15/2013	41	23	33	3,491
MON	12/16/2013	40	22	34	3,642

Area:	Klamath Falls				
	Date	Hi	Lo	HDD	Load
SAT	12/7/2013	21	-16	63	11,170
SUN	12/8/2013	6	-20	72	12,002
MON	12/9/2013	14	-17	66	11,474
TUE	12/10/2013	31	-6	52	9,299
WED	12/11/2013	36	7	43	8,799
THU	12/12/2013	39	9	41	8,191
FRI	12/13/2013	42	17	35	7,206
SAT	12/14/2013	45	15	35	6,887
SUN	12/15/2013	47	16	33	6,681
MON	12/16/2013	47	16	33	6,812

Area:	Medford				
	Date	Hi	Lo	HDD	Load
SAT	12/7/2013	32	11	44	40,462
SUN	12/8/2013	25	2	52	47,855
MON	12/9/2013	27	4	50	48,999
TUE	12/10/2013	38	9	41	44,095
WED	12/11/2013	42	17	35	35,943
THU	12/12/2013	42	20	34	35,273
FRI	12/13/2013	44	29	28	29,966
SAT	12/14/2013	48	26	28	27,507
SUN	12/15/2013	50	25	27	26,954
MON	12/16/2013	49	27	27	27,580

Area:	Roseburg				
	Date	Hi	Lo	HDD	Load
SAT	12/7/2013	27	18	43	11,843
SUN	12/8/2013	26	15	44	13,011
MON	12/9/2013	31	17	41	9,984
TUE	12/10/2013	34	19	38	10,867
WED	12/11/2013	40	28	31	9,197
THU	12/12/2013	40	30	30	8,730
FRI	12/13/2013	42	33	27	8,112
SAT	12/14/2013	43	30	28	7,686
SUN	12/15/2013	45	32	26	7,418
MON	12/16/2013	44	34	26	7,682

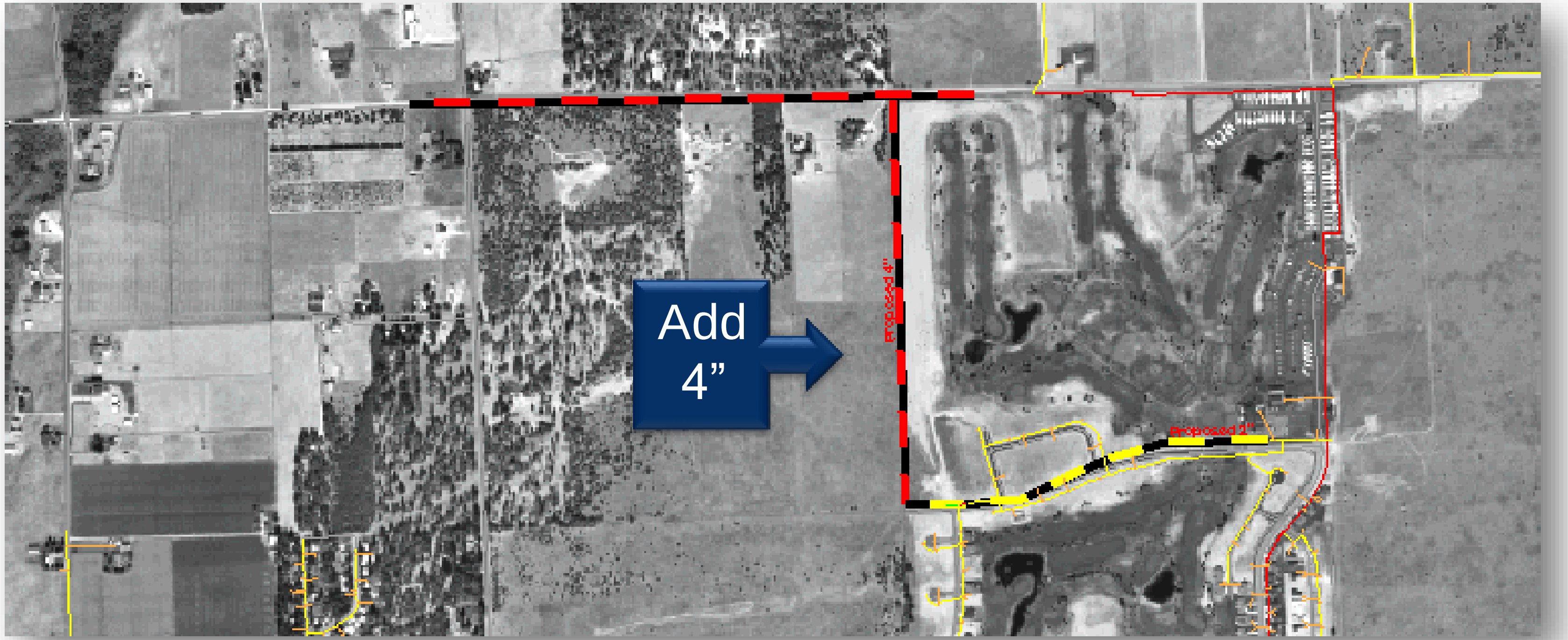
Area:	Spokane				
	Date	Hi	Lo	HDD	Load
SAT	12/7/2013	15	0	57	195,583
SUN	12/8/2013	15	-2	58	183,544
MON	12/9/2013	20	9	51	166,628
TUE	12/10/2013	25	12	46	156,433
WED	12/11/2013	29	15	43	145,441
THU	12/12/2013	31	20	39	134,506
FRI	12/13/2013	33	26	35	120,774
SAT	12/14/2013	35	27	34	114,257
SUN	12/15/2013	36	27	33	114,089
MON	12/16/2013	34	26	35	120,924

Area:	Lewiston				
	Date	Hi	Lo	HDD	Load
SAT	12/7/2013	18	2	55	31,016
SUN	12/8/2013	13	0	59	31,386
MON	12/9/2013	26	8	48	25,901
TUE	12/10/2013	28	22	40	21,715
WED	12/11/2013	31	17	41	22,022
THU	12/12/2013	34	21	37	19,886
FRI	12/13/2013	38	29	31	17,448
SAT	12/14/2013	36	27	33	17,579
SUN	12/15/2013	38	27	32	17,570
MON	12/16/2013	36	27	33	18,079

What I do when "things" look bad?

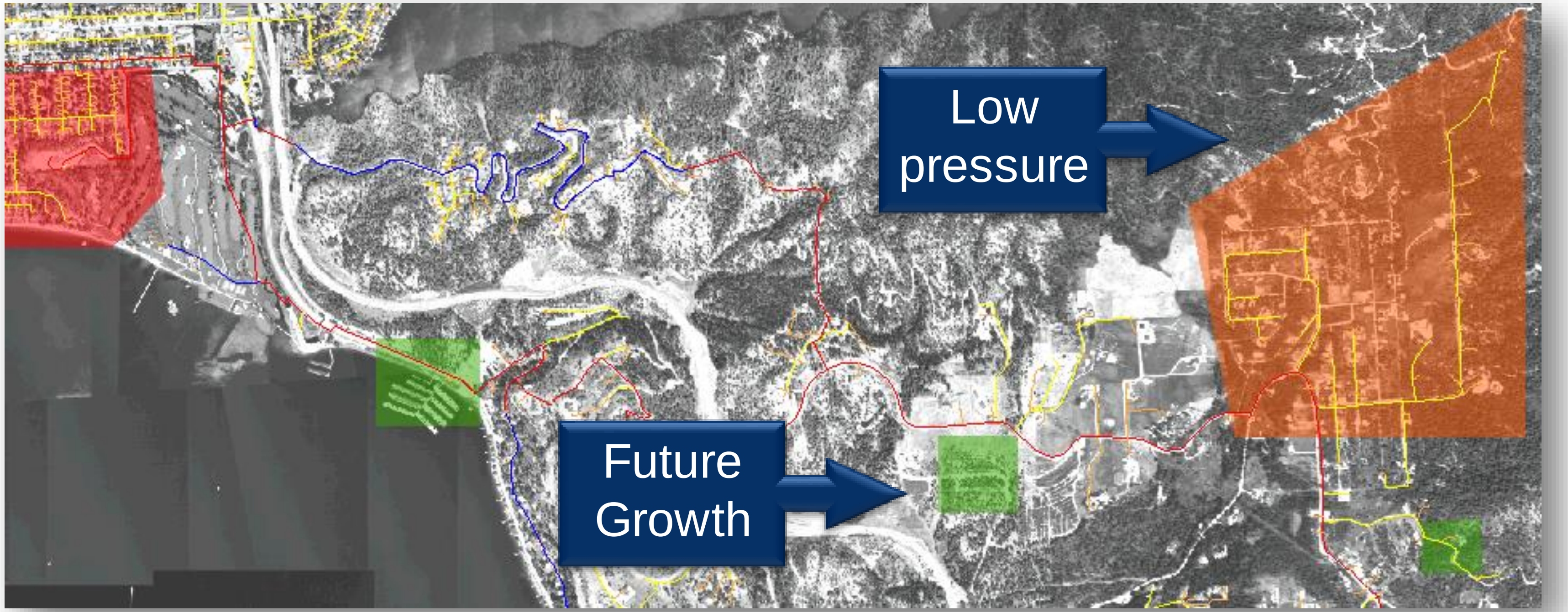
1) Notify service area manager
2) Show where and at what temperature we think we'll have low pressure
3) Identify possible solutions like:
   - Curtailing interruptible customers
   - Ask schools & businesses to voluntarily lower thermostats
   - Bring out CNG trailers
4) Continue to monitor forecast to see if temperatures improve or get worse
5) Share plan with Gas Controllers
6) *Pray for warmer weather…*

Communicating Solutions



Gas Planning Proposals
SIZENUMBER
- 2"
- 4"
- 6"
- >6"

Gas Planning AOI



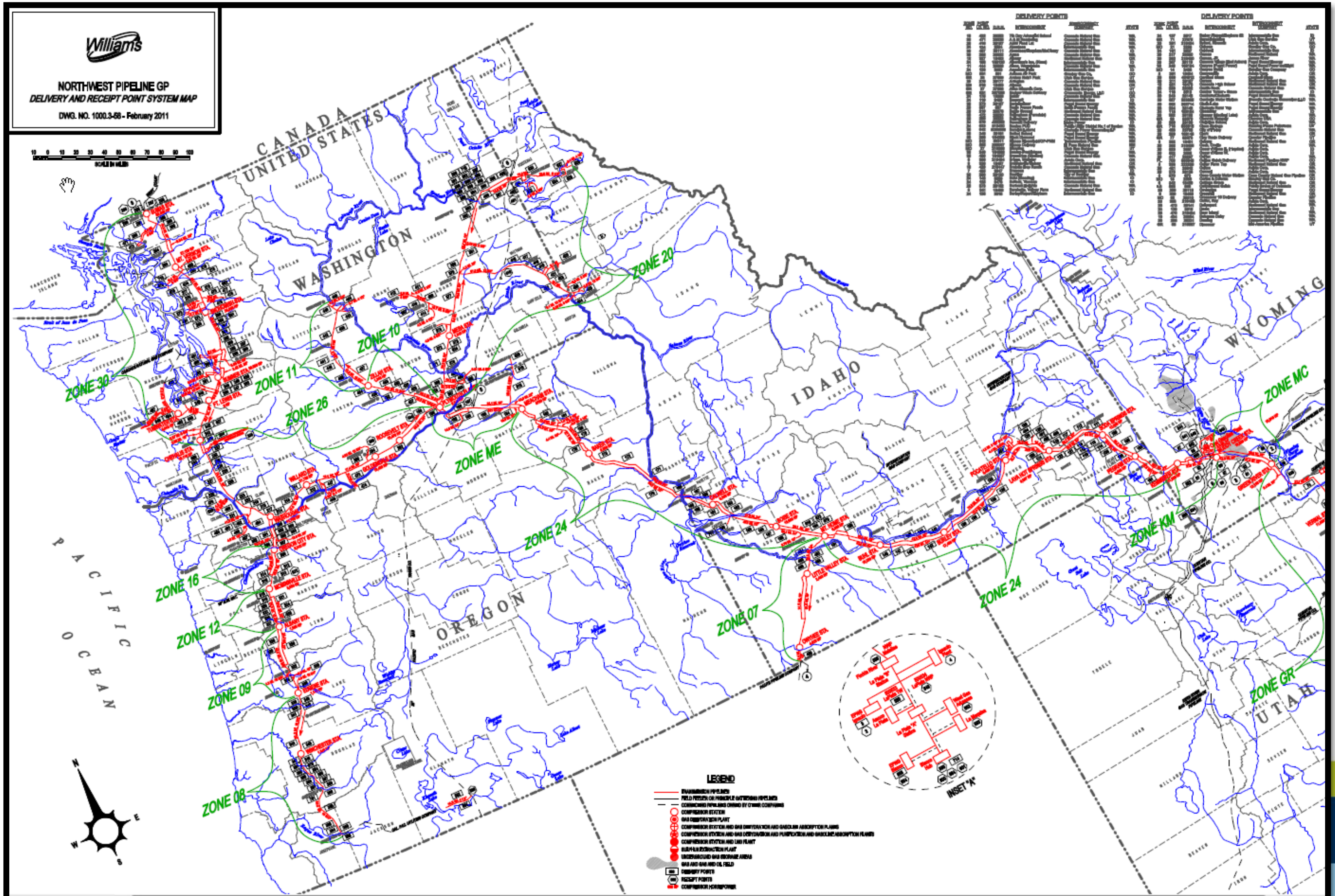
Gas Planning AOI
Area Type
Critical Pressure
Low Pressure
Miscellaneous
New Developments

Solutions: long-term reinforcements

State	Feet of pipe*	Estimated Cost $*
Idaho	8,000	500,000
Oregon	22,000	1,600,000
Washington	70,000	4,900,000

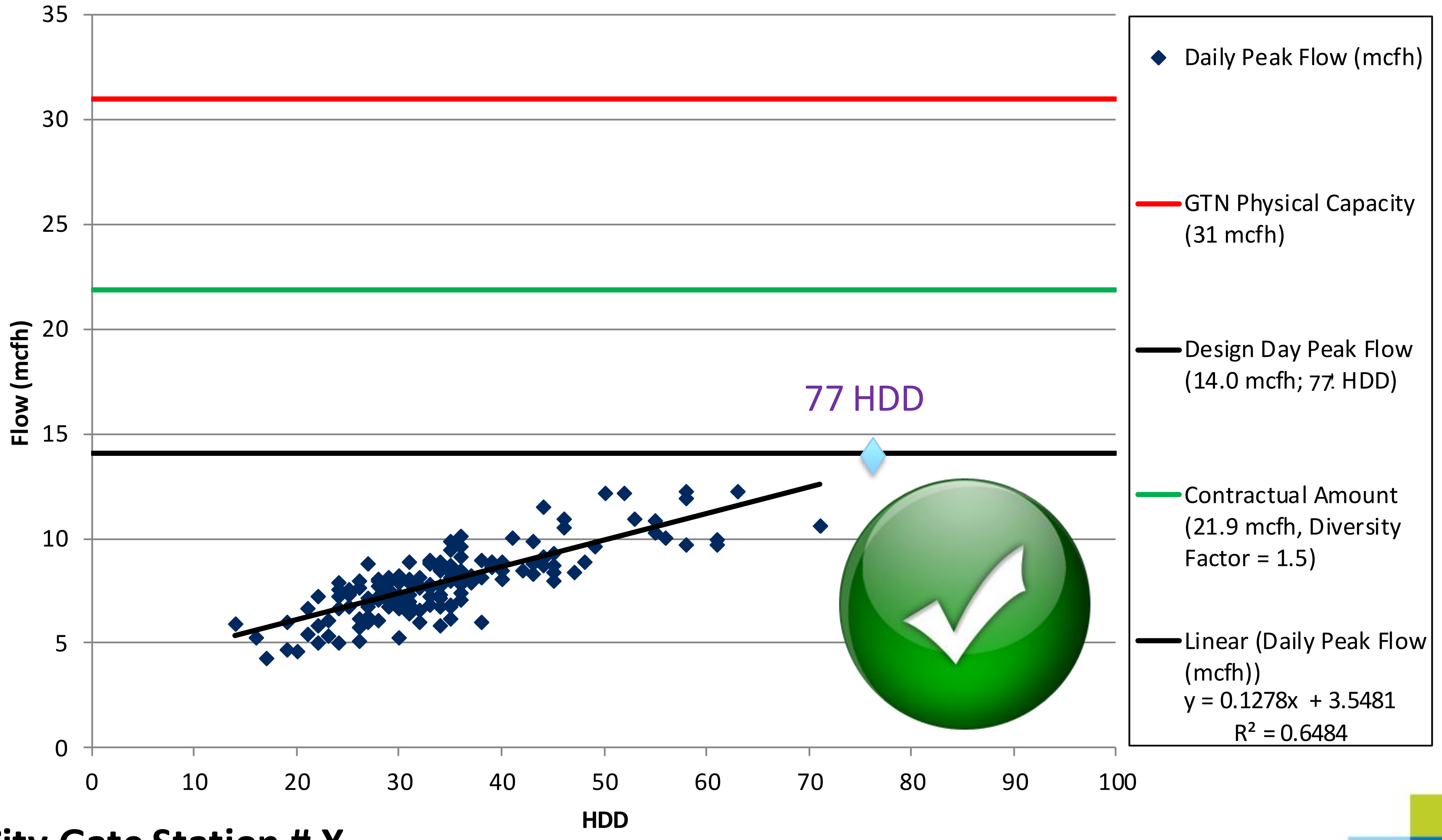
*projects are subject to change and will be reviewed on a regular basis

Gate Station Capacity Review



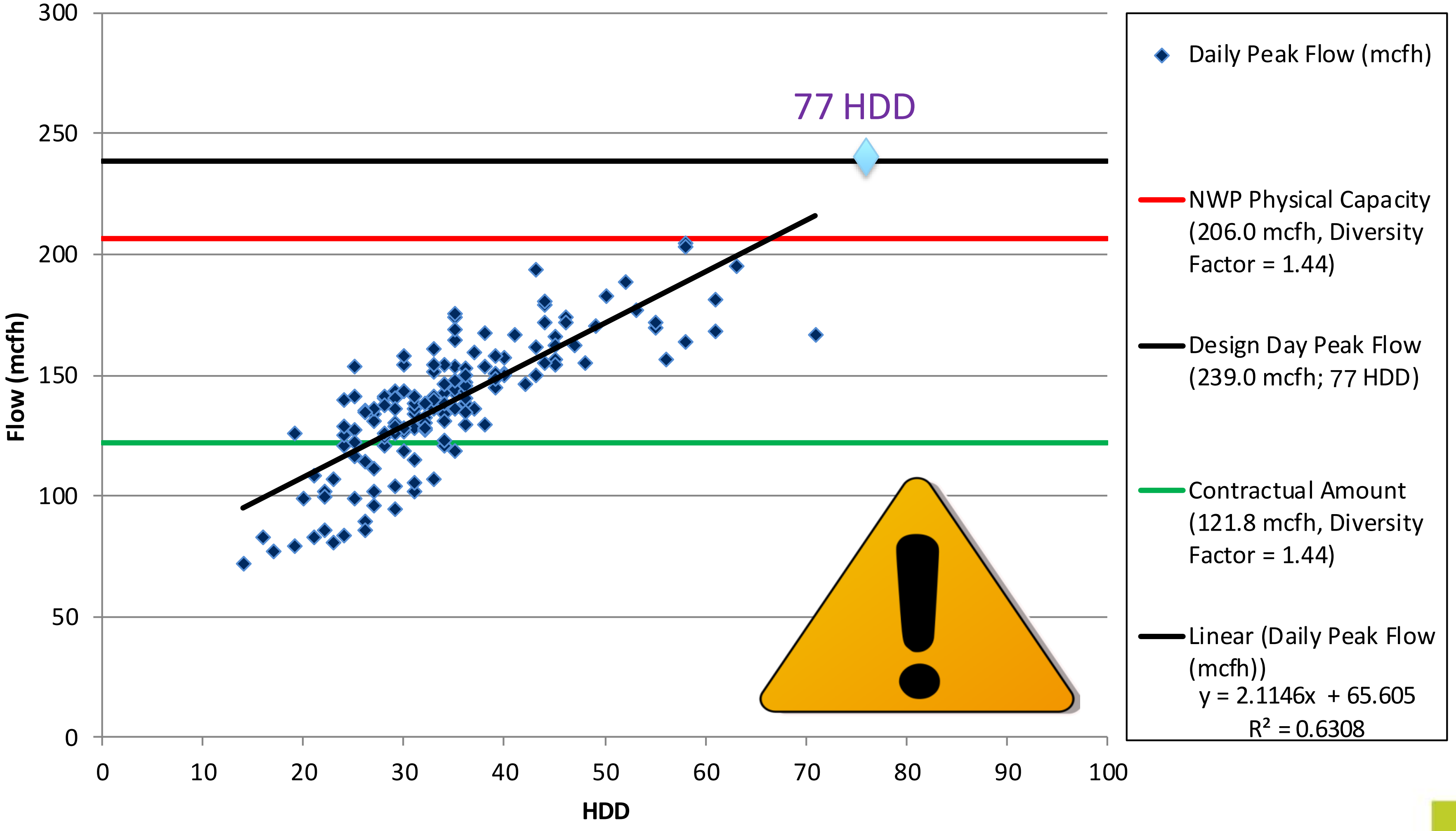
AVISTA

Gate Station Capacity Review (example)



City Gate Station # X

Gate Station Capacity Review (example)



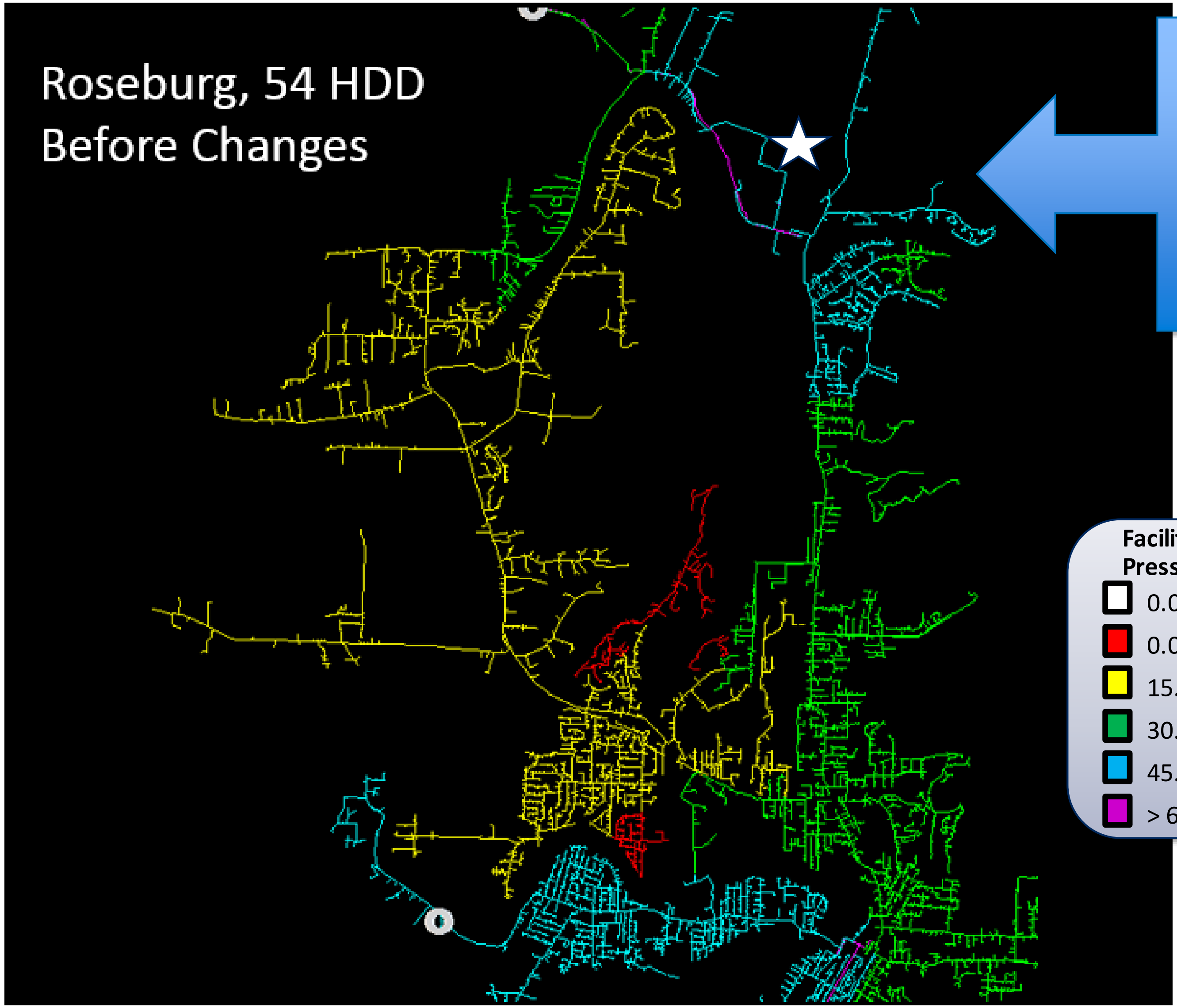
City Gate Station # Y

Recent Projects and Examples

New Agri-Industrial Customer Service Request

Roseburg, OR

Agri-Industrial Customer Service Request



Conditions:

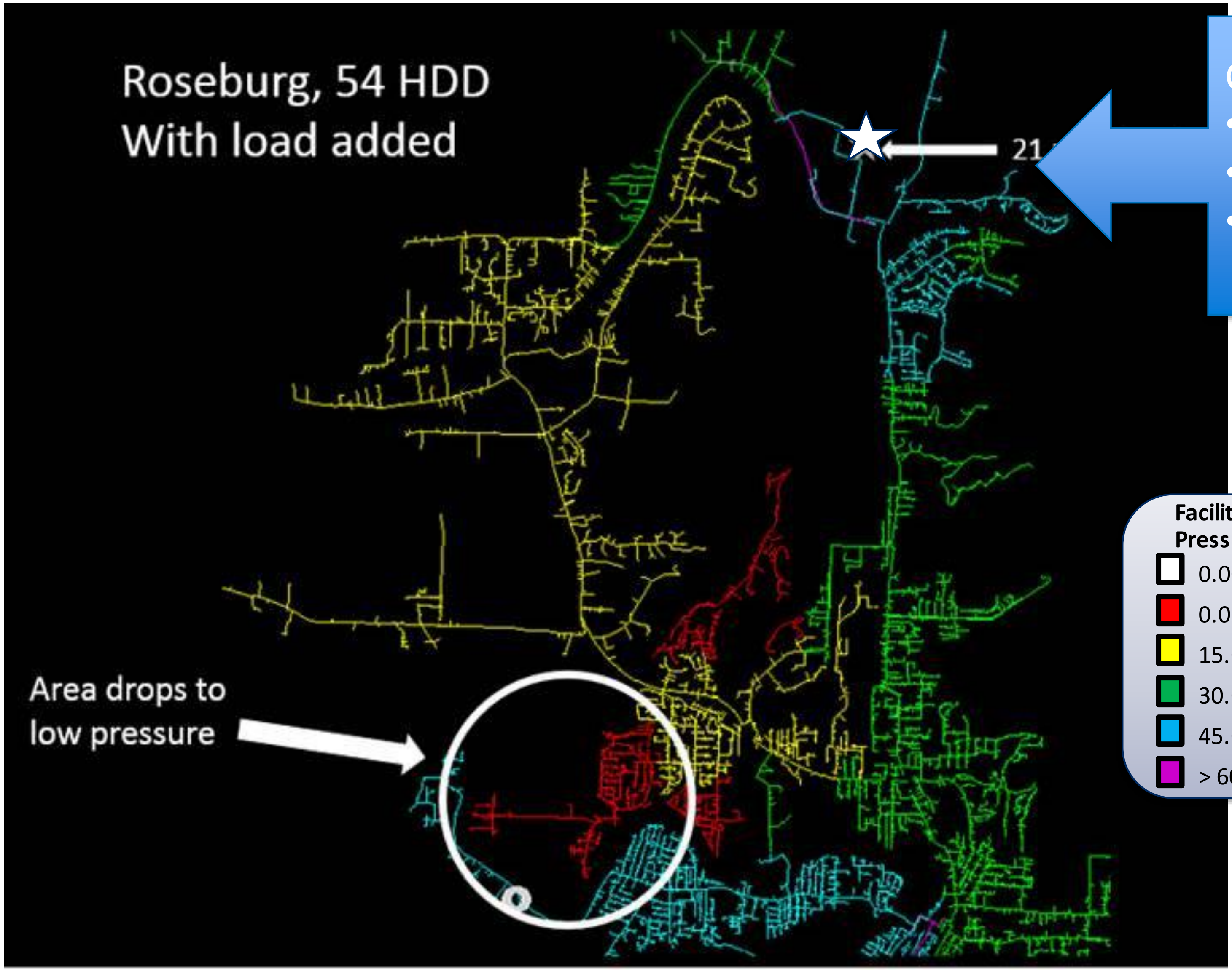
- 21 Mcfh
- 15 psig
- year-round
  - 51 HDD

Facilities Color By: Pressure (psig)

- 0.00
- 0.01 – 15.00
- 15.01 – 30.00
- 30.01 – 45.00
- 45.01 – 60.00
- > 60.01

AVISTA

Agri-Industrial Customer Service Request



Conditions:
- ~~21 Mcfh~~ 18 Mcfh
- 15 psig
- year-round
  - ~~51 HDD~~
  47 HDD

Facilities Color By:
Pressure (psig)
- 0.00
- 0.01 – 15.00
- 15.01 – 30.00
- 30.01 – 45.00
- 45.01 – 60.00
- > 60.01

Residential Development Service Request

Deer Park, WA

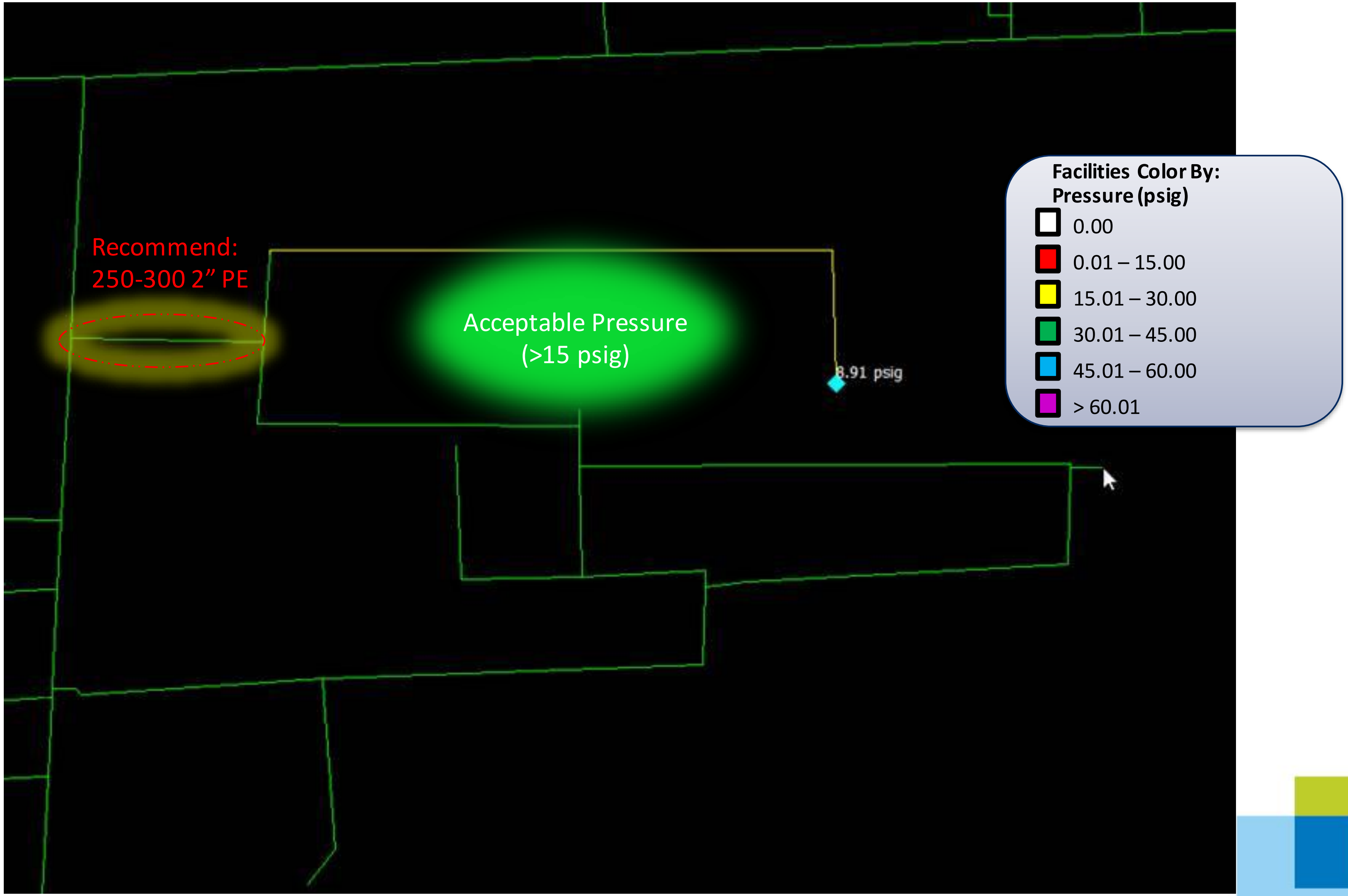
Residential Development Study

Residential Development Study

Facilities Color By:
Pressure (psig)

- 0.00
- 0.01 – 15.00
- 15.01 – 30.00
- 30.01 – 45.00
- 45.01 – 60.00
- > 60.01

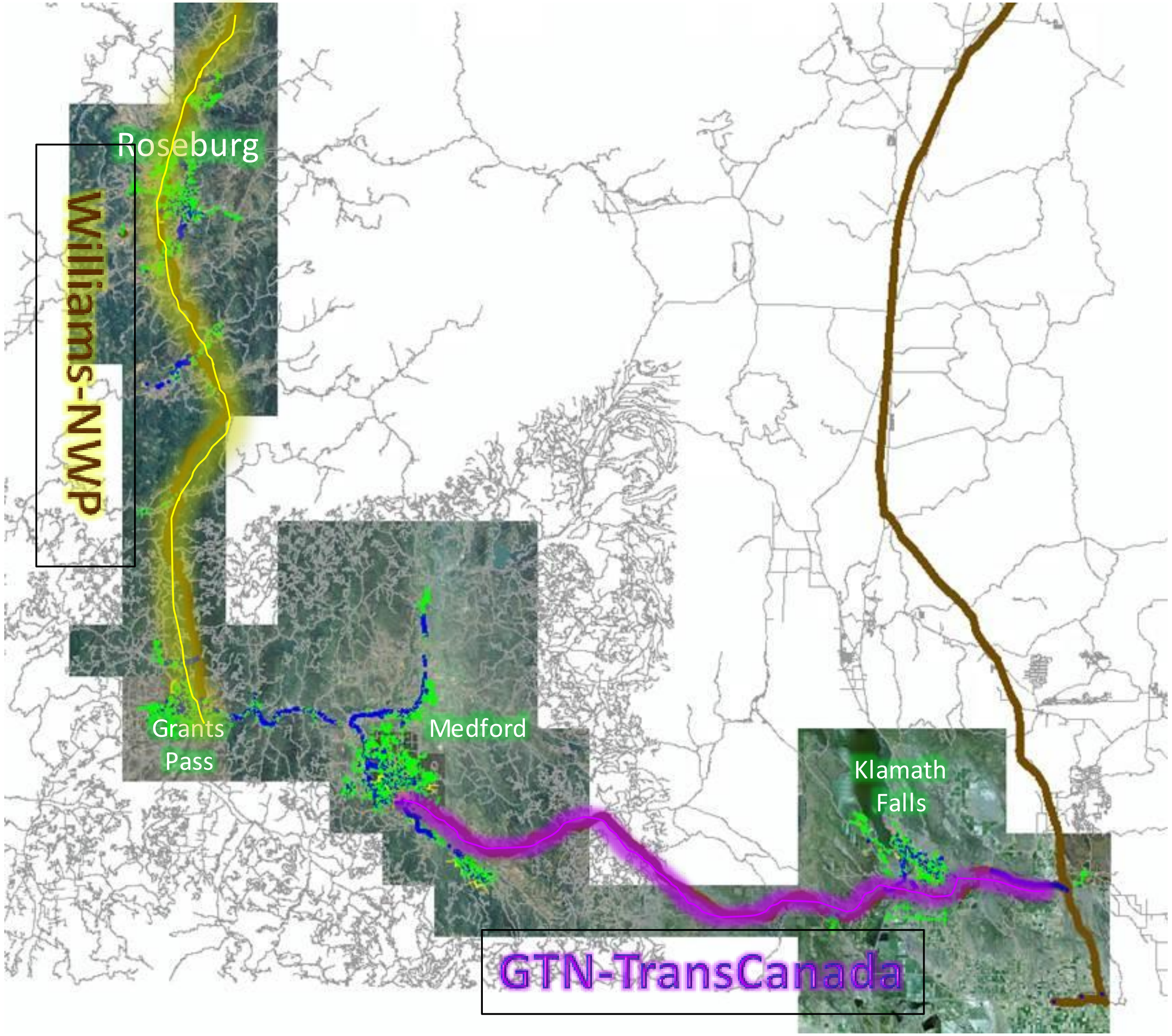
Residential Development Study



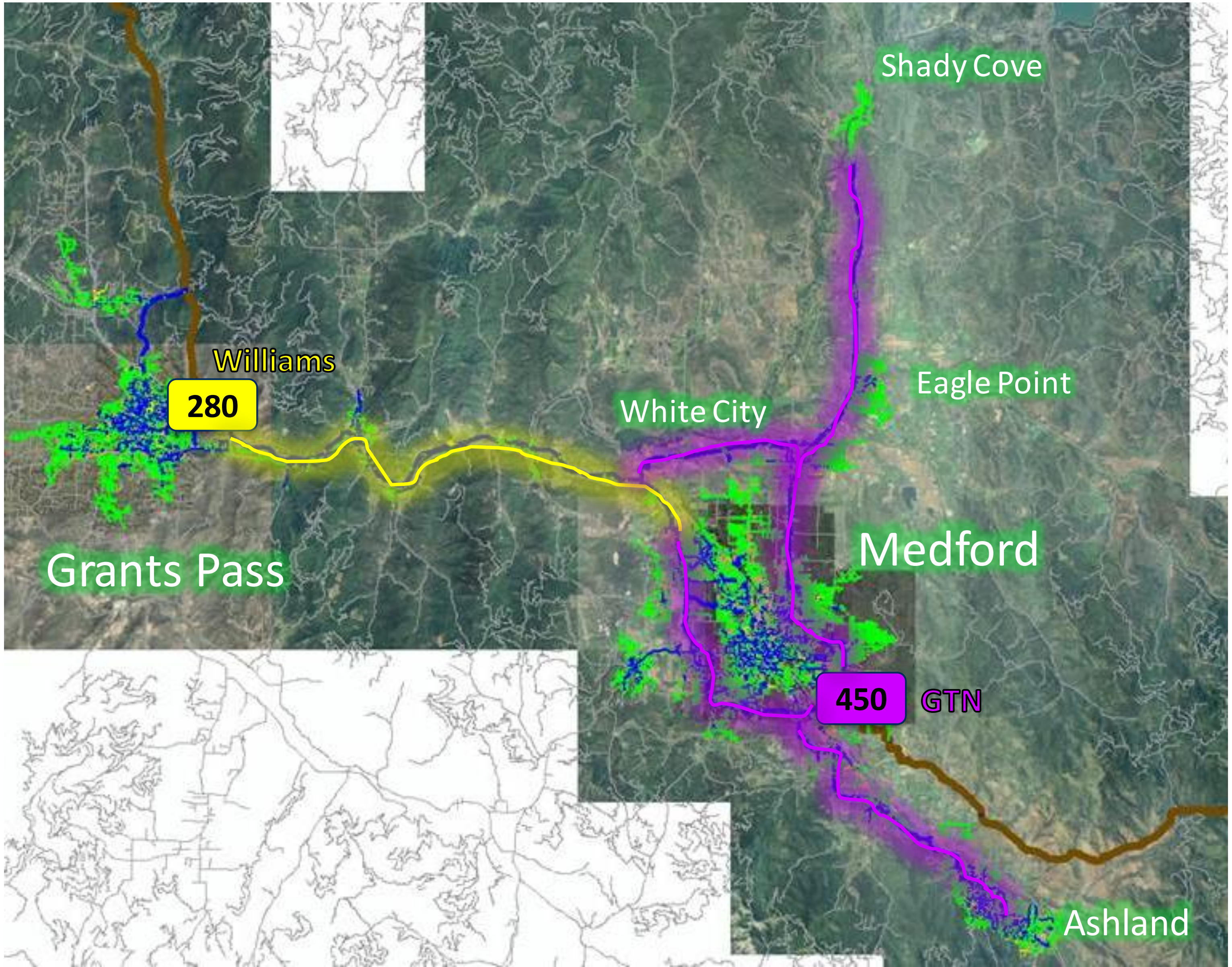
Enbridge Pipeline Rupture Effect on distribution

Medford, OR

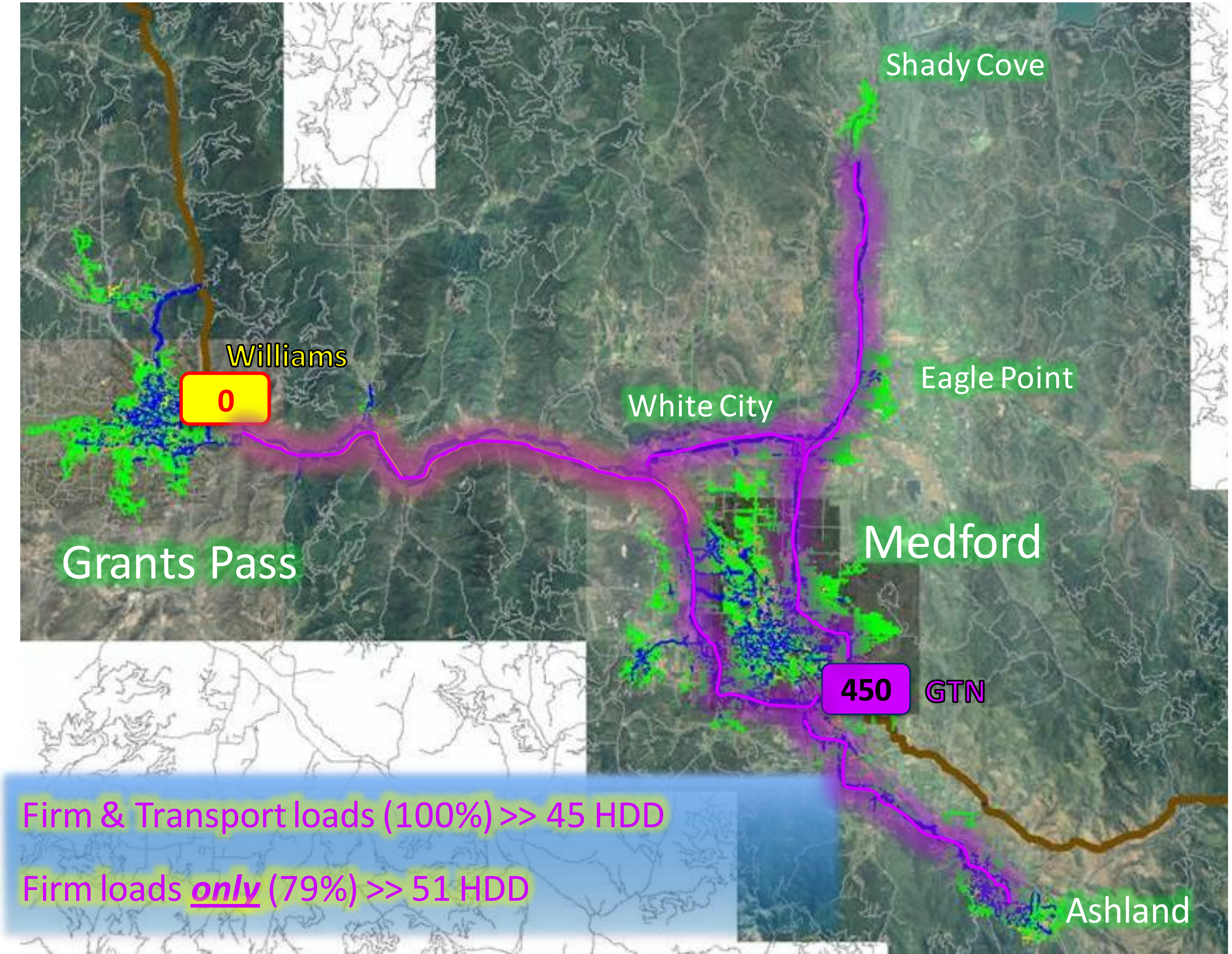
Enbridge Pipeline Rupture effect



Enbridge Pipeline Rupture effect



Enbridge Pipeline Rupture effect



Questions and Discussion

Mission

Using technology to plan and design a safe, reliable, and economical distribution system

Unserved Demand and Supply Side Resource Options

Tom Pardee
Planning Manager, Natural Gas Supply

When unserved demand does show up……

There are a few questions we need to ask:

1. Why is the demand unserved?
2. What is the magnitude of the short? (i.e Are we 1 Dth or 1000 Dth's short?)
3. What are my options to meet it?

When current resources don’t meet demand what could we consider?

- Transport capacity release recalls
- “Firm” backhauls
- Contract for existing available transportation
- Expansions of current pipelines
- Peaking arrangements with other utilities (swaps/mutual assistance agreements) or marketers
- In-service territory storage
- Satellite/Micro LNG (storage inside service territory)
- Large scale LNG with corresponding pipeline build into our service territory
- Structured products/exchange agreements delivered to city gates
- Biogas (assume it’s inside Avista’s distribution)
- Hydrogen blend (assume it’s inside Avista’s distribution)
- Avista distribution system enhancements
- Demand side management

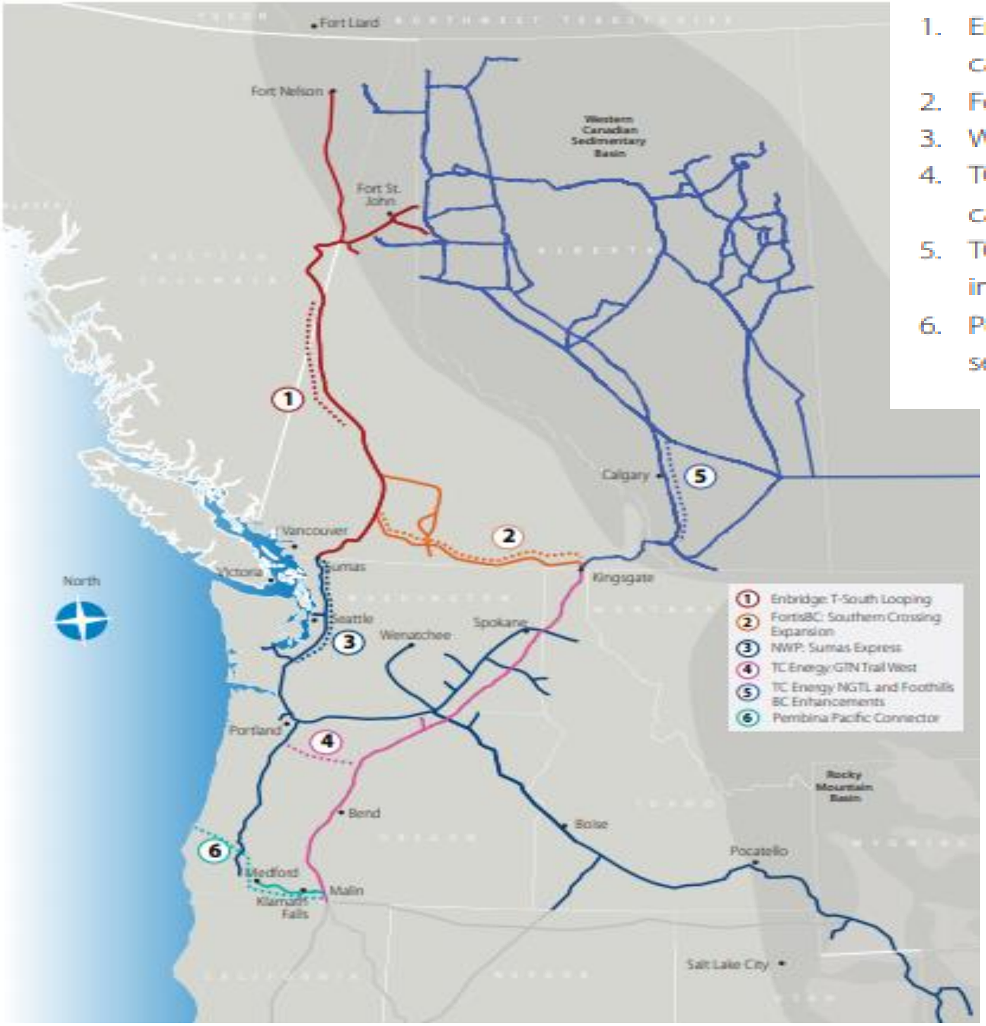
New Resource Risk Considerations

- Does is get supply to the gate?
- Is it reliable/firm?
- Does it have a long lead time?
- How much does it cost?
  - New build vs. depreciated cost
  - The rate pancake
- Is it a base load resource or peaking?
- How many dekatherms do I need?
- What is the “shape” of resource?
- Is it tried and true technology, new technology, or yet to be discovered?
- Who else will be competing for the resource?

Potential New Supply Resources Considerations

- Availability
  - By Region – which region(s) can the resource be utilized?
  - Lead time considerations – when will it be available?
- Type of Resource
  - Peak vs. Base load
  - Firm or Non-Firm
  - “Lumpiness”
- Usefulness
  - Does it get the gas where we need it to be?
  - Last mile issues
- Cost

Regional Infrastructure – Potential Projects



1. Enbridge T-South expansion: addition of 190 million cubic feet per day (MMcf/d) of firm capacity.
2. FortisBC Southern Crossing expansion: addition of 300-400 MMcf/d of bidirectional capacity.
3. Williams Northwest Pipeline (NWP) Sumas Express: still under assessment.
4. TC Energy Gas Transmission Northwest (GTN) Trail West/N-Max: addition of 500 MMcf/d capacity, expandable to 1,000 MMcf/d.
5. TC Energy other system enhancements: two projects to add a combined 525 MMcf/d of incremental firm transportation to the Alberta/BC export delivery point.
6. Pembina Pacific Connector Gas Pipeline (PCGP) Project: Addition of 1,000 MMcf/d capacity to serve proposed Coos Bay LNG export facility.

Supply Resources - Modeled

Additional Resource	Size	Cost/Rates			Availability	Notes
		WA	ID	OR		
Unsubscribed GTN Capacity	Up to 50,000 Dth	GTN Rate			Now	Currently available unsubscribed capacity from Kingsgate to Spokane
Medford Lateral Exp	50,000 Dth / Day	$35M capital + GTN Rate			2022	Additional compression to facilitate more gas to flow from mainline GTN to Medford
Hydrogen	166 Dth / Day	$48 / Dth	$40 / Dth	$46 / Dth	Varies	Cost estimates obtained from a consultant; levelized cost includes revenue requirements, expected carbon adder and assumed retail power rate
Renewable Natural Gas – Distributed Landfill	635 Dth / Day	$13 / Dth	$13 / Dth	$13 / Dth	Varies	Costs estimates obtained from a consultant for each specific type of RNG; levelized costs include revenue requirements, distribution costs, and projected carbon intensity adder/(savings). This cost also includes any incentives from bills such as Washington House Bill 2580 or Oregon Senate Bill 334
Renewable Natural Gas – Centralized Landfill	1,814 Dth / Day	$11 / Dth	$11 / Dth	$12 / Dth	Varies	
Renewable Natural Gas – Dairy	635 Dth / Day	$34 / Dth	$39 / Dth	$33 / Dth	Varies	
Renewable Natural Gas – Waste Water	513 Dth / Day	$19 / Dth	$18 / Dth	$19 / Dth	Varies	
Renewable Natural Gas – Food Waste to (RNG)	298 Dth / Day	$38 / Dth	$39 / Dth	$38 / Dth	Varies	
Plymouth LNG	241,700 Dth w/70,500 Dth deliverability	NWP Rate			Now	Provides for peaking services and alleviates the need for costly pipeline expansions Pair with excess pipeline MDDO's to create firm transport

Future Supply Resources – Not Modeled

Other Resources to Consider

Additional Resource	Size	Cost/Rates	Availability	Notes
Co. Owned LNG	600,000 Dth w/ 150,000 of deliverability	$75 Million plus $2 Million annual O&M	2024	On site, in service territory liquefaction and vaporization facility
Various pipelines – Pacific Connector, Trails West, NWP Expansion, GTN Expansion, etc.	Varies	Precedent Agreement Rates	2022	Requires additional mainline capacity on NWPL or GTN to get to service territory
Large Scale LNG	Varies	Commodity less Fuel	2024	Speculative, needs pipeline transport
In Ground Storage	Varies	Varies	Varies	Requires additional mainline transport to get to service territory

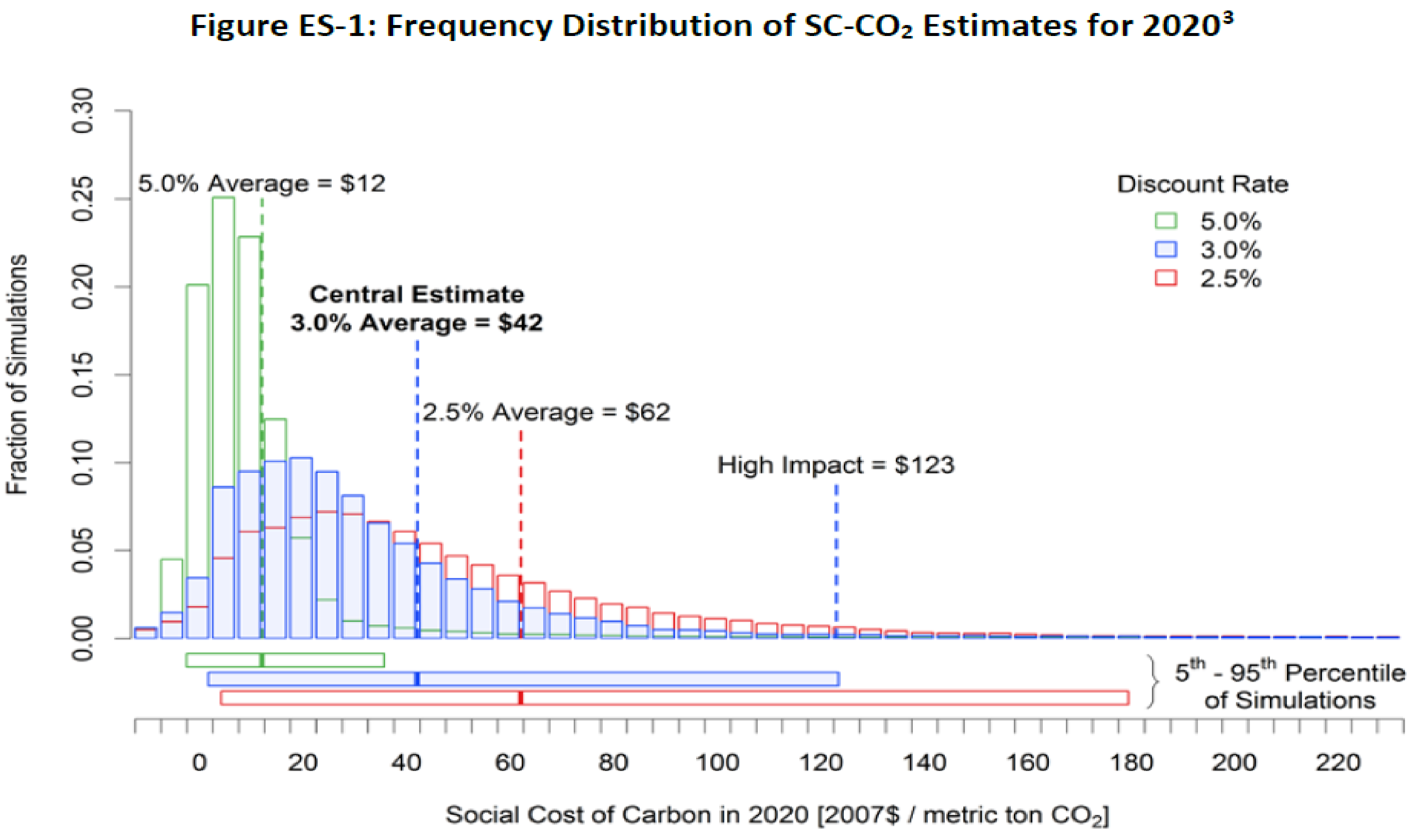
Carbon Costs

Tom Pardee
Planning Manager, Natural Gas Supply

Cost of Carbon and Sendout

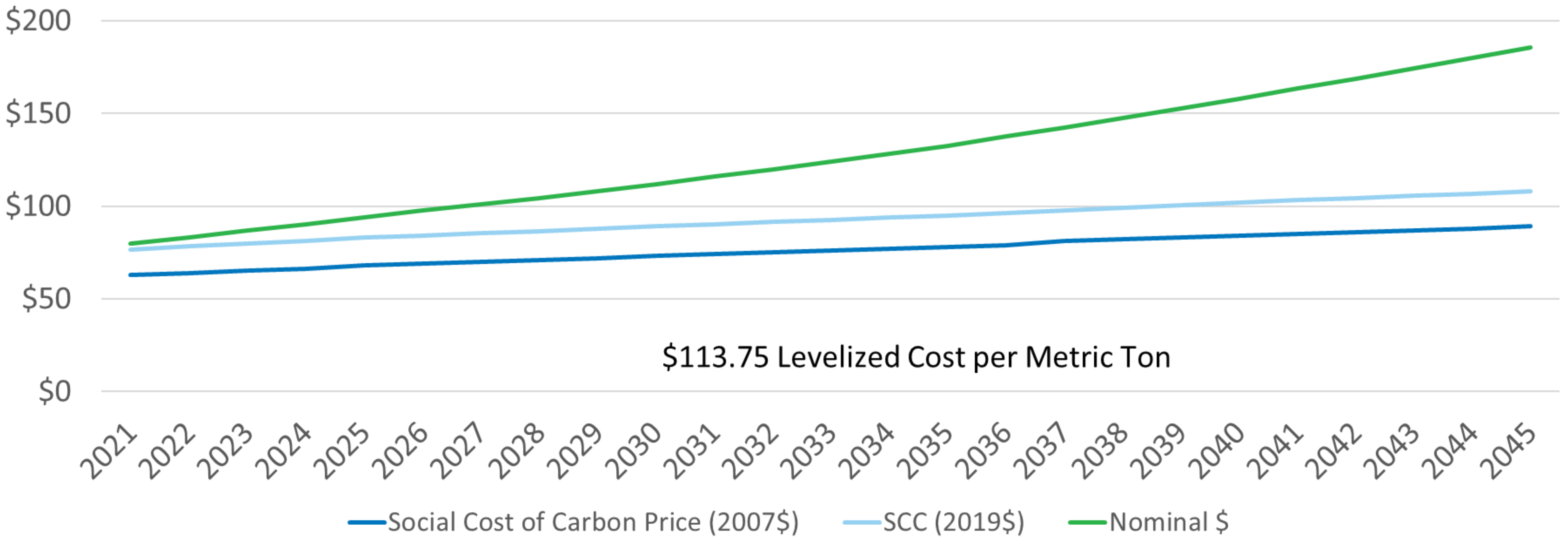
- Monthly costs are loaded into SENDOUT
- These costs will differ based on the requirements or an expected program type by state
- These costs are input at the transportation level in order to correctly account for the cost of carbon in each area regardless of supply basin

Social Cost of Carbon



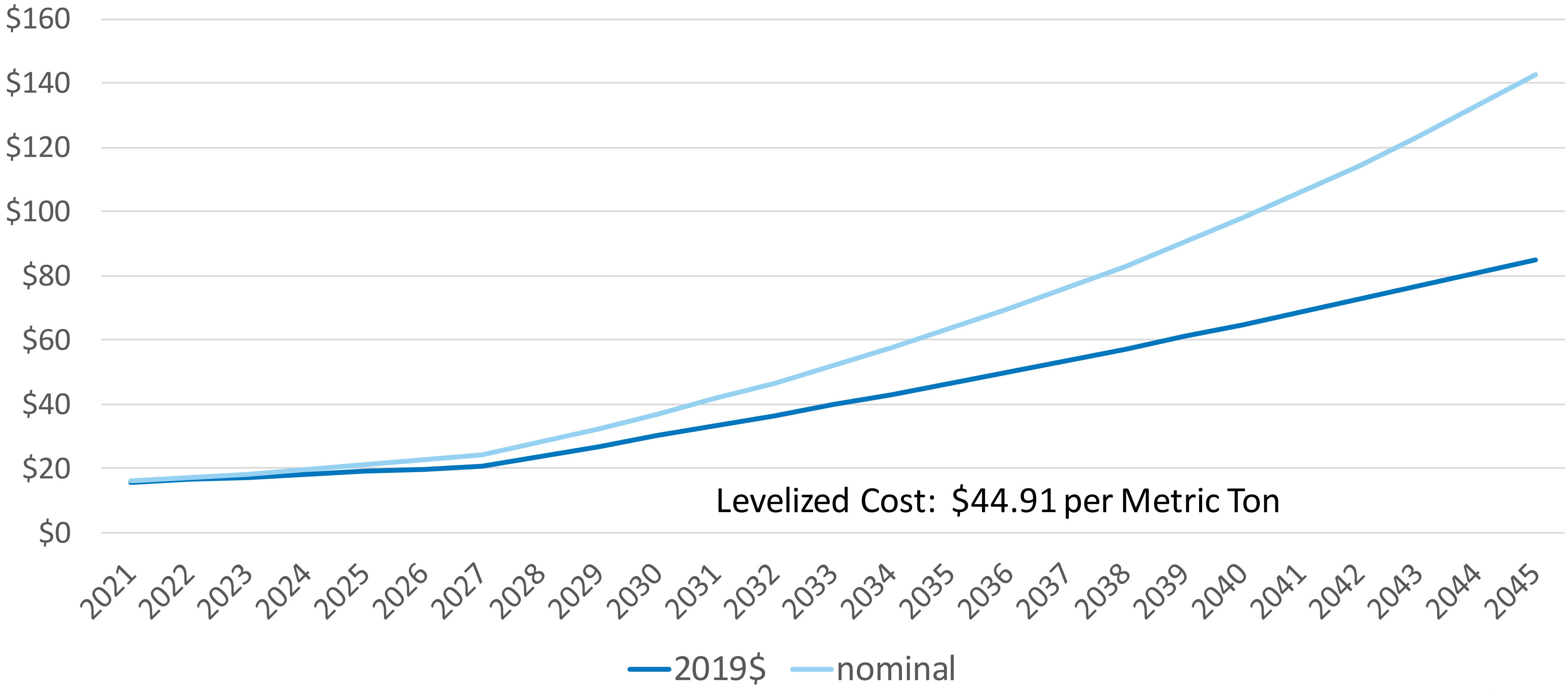
- Social cost of carbon dioxide in 2007 dollars using the 2.5% discount rate, listed in table 2, technical support document: Technical update of the social cost of carbon for regulatory impact analysis under Executive Order No. 12866, published by the interagency working group on social cost of greenhouse gases of the United States government, August 2016.

Washington – Carbon adder



- Social cost of carbon dioxide in 2007 dollars using the 2.5% discount rate, listed in table 2, technical support document: Technical update of the social cost of carbon for regulatory impact analysis under Executive Order No. 12866, published by the interagency working group on social cost of greenhouse gases of the United States government, August 2016.
- Adjust to 2019$ using Bureau of Economics GDP
- Adjust to Nominal $ using 2.11% annual inflation rate

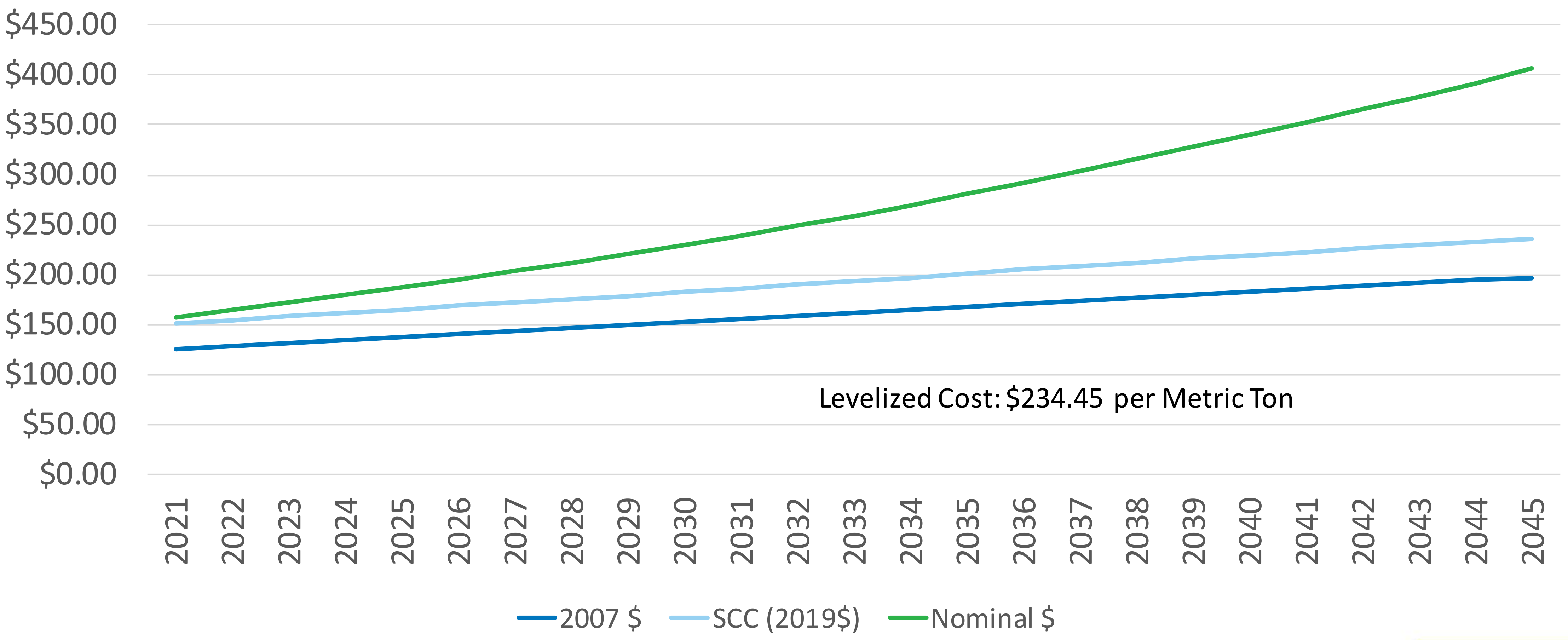
Oregon – Carbon adder



Source: Wood Mackenzie North America gas markets long-term outlook – H1 2020

***Modeled as an expected cost of California's cap and trade program**

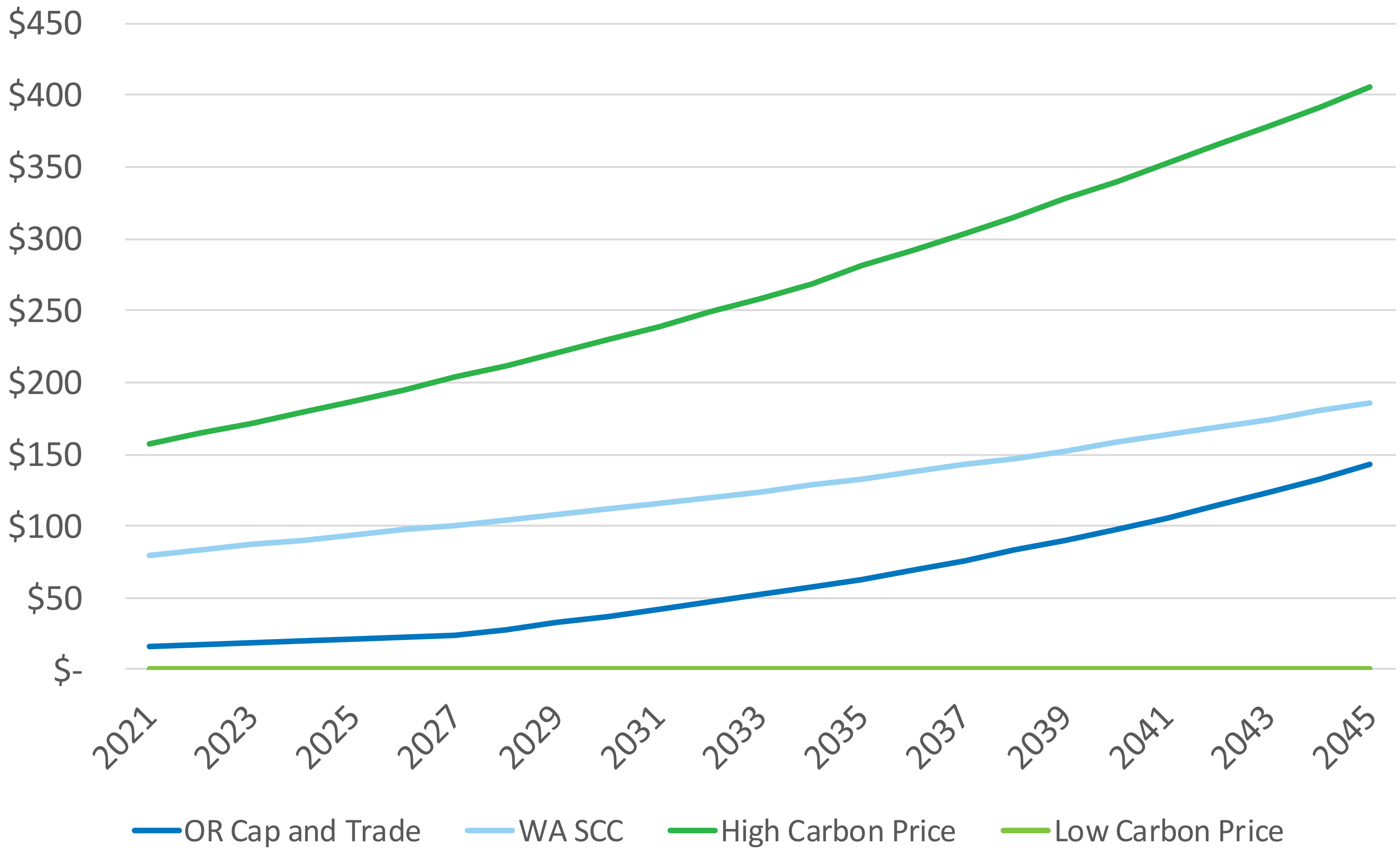
All jurisdictions - Carbon adder
High sensitivity



- EPA – Social Cost of Carbon
- Adjust to 2019$ using Bureau of Economics GDP
- Adjust to Nominal $ using 2.11% annual inflation rate

High Carbon Scenario - SCC @ 95% @ 3%

Carbon Costs



Levelized Cost per MTCO2e	$44.92	$113.75	$234.45	$0

Expected Case
Cost of Carbon by State - Summary

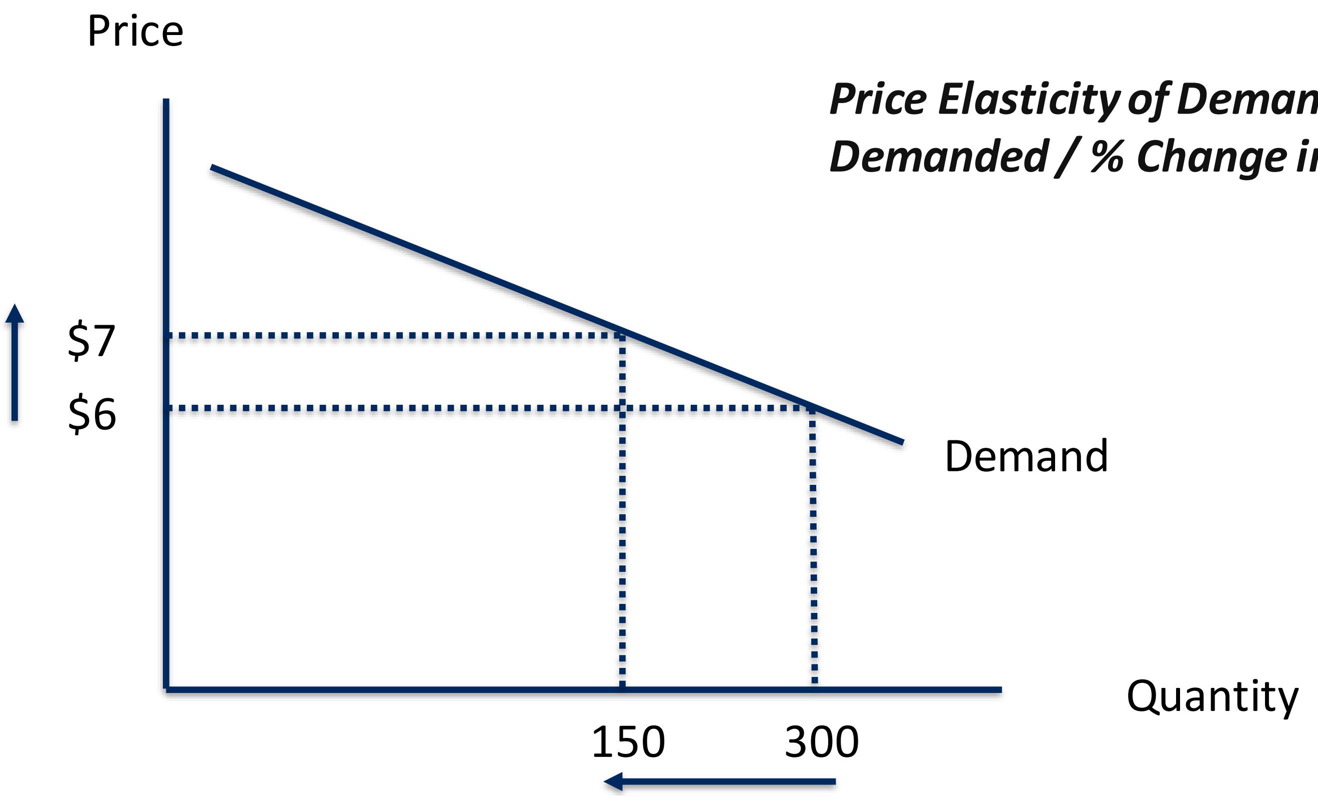
- Washington - Social cost of carbon @ 2.5% discount rate;
  - upstream emissions associated with natural gas drilling and transportation of natural gas to its end use.
- Oregon is based off a Wood Mackenzie estimate for Cap and Trade
- Idaho - carbon prices will not be included

Price Elasticity

Tom Pardee
Planning Manager, Natural Gas Supply

Price Elasticity

Price elasticity is a method used by economists to measure how supply or demand changes based on changes in price.



Price Elasticity of Demand = % Change in Quantity Demanded / % Change in Price

Price Elasticity Factors Defined

- Price elasticity is usually expressed as a numerical factor that defines the relationship of a consumer’s consumption change in response to price change.

- Typically, the factor is a **negative** number as consumers normally **reduce** their consumption in response to **higher** prices or will **increase** their consumption in response to **lower** prices.
  - For example, a price elasticity factor of -0.081 means:
    - A 10% price **increase** will prompt a 0.81% consumption **decrease**
    - A 10% price **decrease** will prompt a 0.81%
    - consumption **increase**

Summary

- The elasticity as measured in the Medford and Roseburg areas will be used for the entire system as estimated elasticity.
- 0.81% decrease only for each price rise of 10%
- This elasticity is measured through heat coefficients and annual price changes

Sensitivities

Michael Brutocao
Analyst, Natural Gas Supply

Sensitivities Summary

Influence Type	Sensitivity	Customer Growth Rate	Use per Customer	Weather	Demand Side Management	Prices	Elasticity	First Year System Unserved	Location Unserved
DEMAND INFLUENCING - DIRECT	Reference	Reference	3 Year Historical	20 Year Average	None	Expected	None	-	-
	Reference Plus Peak			Planning Standard				2035	Washington
	Low Cust	Low Growth						-	-
	High Cust	High Growth						2029	Washington
	Alternate Weather Standard	Reference		Coldest in 20yrs				2035	Washington
	DSM			20 Year Average	Expected			-	-
	Peak plus DSM			Planning Standard				2039	Idaho
	80% below 1990 emissions – OR/WA only				None			-	-
	2 Year use per customer Alternate		2 Year Historical					2035	Washington
	5 Year use per customer Alternate		5 Year Historical					2035	Washington
	JP Outage Only (0% capacity)		3 Year Historical					2021	Washington
	AECO Outage Only (0% capacity)							2020	WA, ID
	Sumas Outage Only (0% capacity)							2020	Medford
	Rockies Outage Only (0% capacity)							2020	La Grande
	JP Outage Only (50% capacity)							2021	Washington
	AECO Outage Only (50% capacity)							2026	Washington
	Sumas Outage Only (50% capacity)							2025	Washington
	Rockies Outage Only (50% capacity)							2025	La Grande
	NWP Outage (0% capacity)							2020	WA, ID, La Grande
	GTN Outage (0% capacity)							2020	WA, ID, Klamath Falls
	NWP Outage (50% capacity)							2020	WA, La Grande
	GTN Outage (50% capacity)							2026	Washington

Sensitivities Summary (Continued)

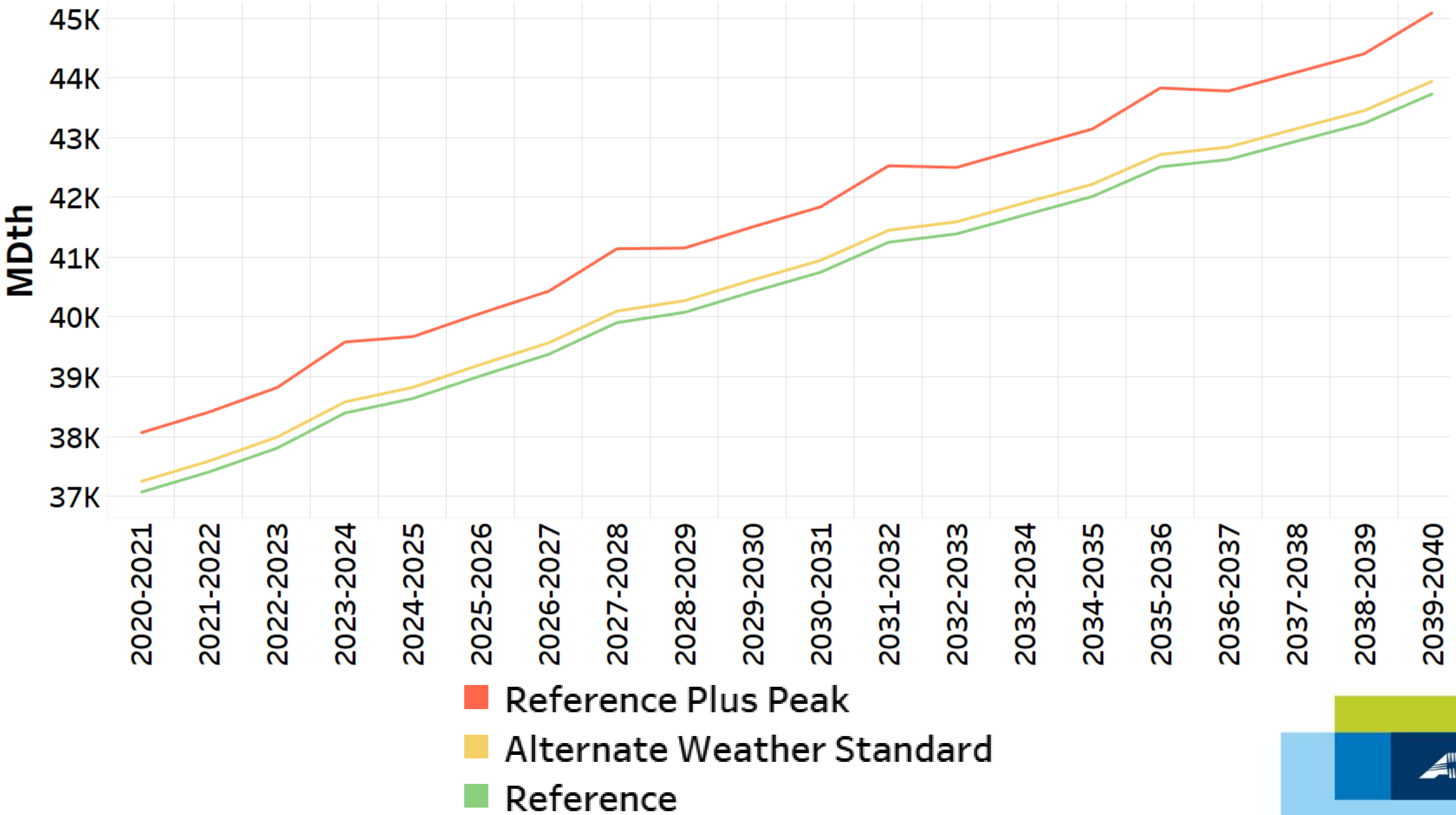
Influence Type	Sensitivity	Customer Growth Rate	Use per Customer	Weather	Demand Side Management	Prices	Elasticity	First Year System Unserved	Location Unserved
PRICE INFLUENCING - INDIRECT	Expected Prices	Reference	3 Year Historical	Planning Standard	None	Expected	Expected	-	-
	Low Prices					Low		-	-
	High Prices					High		-	-
	Carbon Cost - High (SCC 95% at 3%)					Expected		-	-
	Carbon Cost - Expected (SCC 2.5% (WA) & Cap&Red (OR))							-	-
	Carbon Cost - Low $0							-	-
EMISSIONS INFLUENCING	High Upstream Emissions 2.47% leakage (EDF study)							-	-
	Expected Upstream Emissions (0.79% leakage)							-	-
	No Upstream Emissions							-	-
	Expected Global Warming Potential (20 Years)							-	-
	Expected Global Warming Potential (100 Years)							-	-

First Year Peak Demand Unserved (11/1/2020 – 10/31/2040)

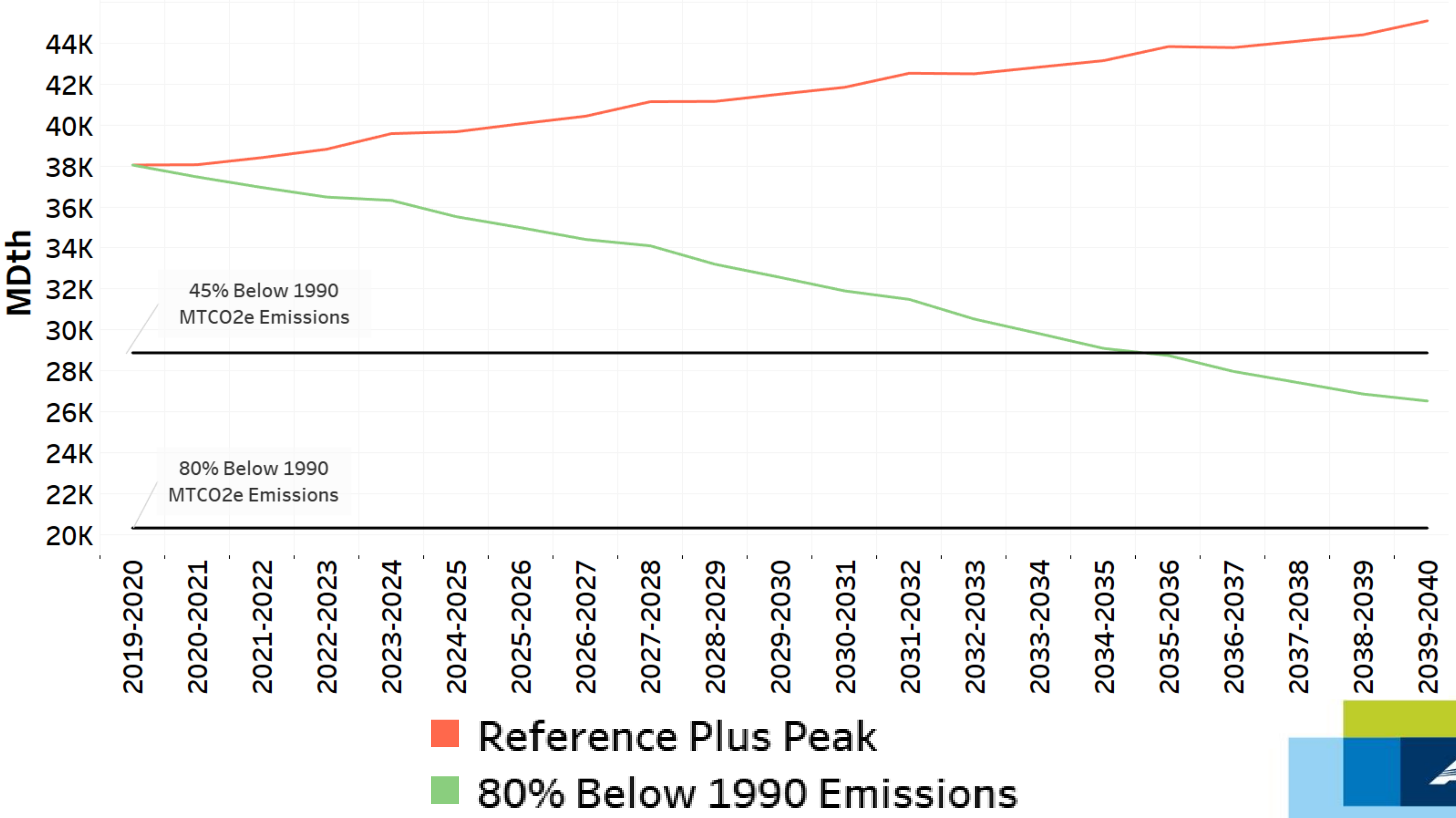
	Washington	Idaho	La Grande	Medford	Klam Falls	Roseburg
Reference Plus Peak	2035	2039				
High Customer Growth	2029	2038	2035			
Alternate Weather Standard	2035					
Reference Plus Peak Plus DSM		2039				
2-yr Use Per Customer	2035	2039				
5-yr Use Per Customer	2035					
Outage (JP - 0%)	2021	2022		2028		
Outage (JP - 50%)	2021					
Outage (AECO - 0%)	2020	2020				
Outage (AECO - 50%)	2026	2028				
Outage (Sumas - 0%)	2026	2021		2020		2032
Outage (Sumas - 50%)	2025	2038		2035		
Outage (Rockies - 0%)	2021	2023	2020	2031		2033
Outage (Rockies - 50%)	2028	2039	2025			
Outage (NWP - 0%)	2020	2020	2020	2021		2028
Outage (NWP - 50%)	2020	2023	2020	2029		
Outage (GTN - 0%)	2020	2020		2026	2020	2028
Outage (GTN - 50%)	2026	2028				

***Sensitivities not listed above have no unserved demand.**

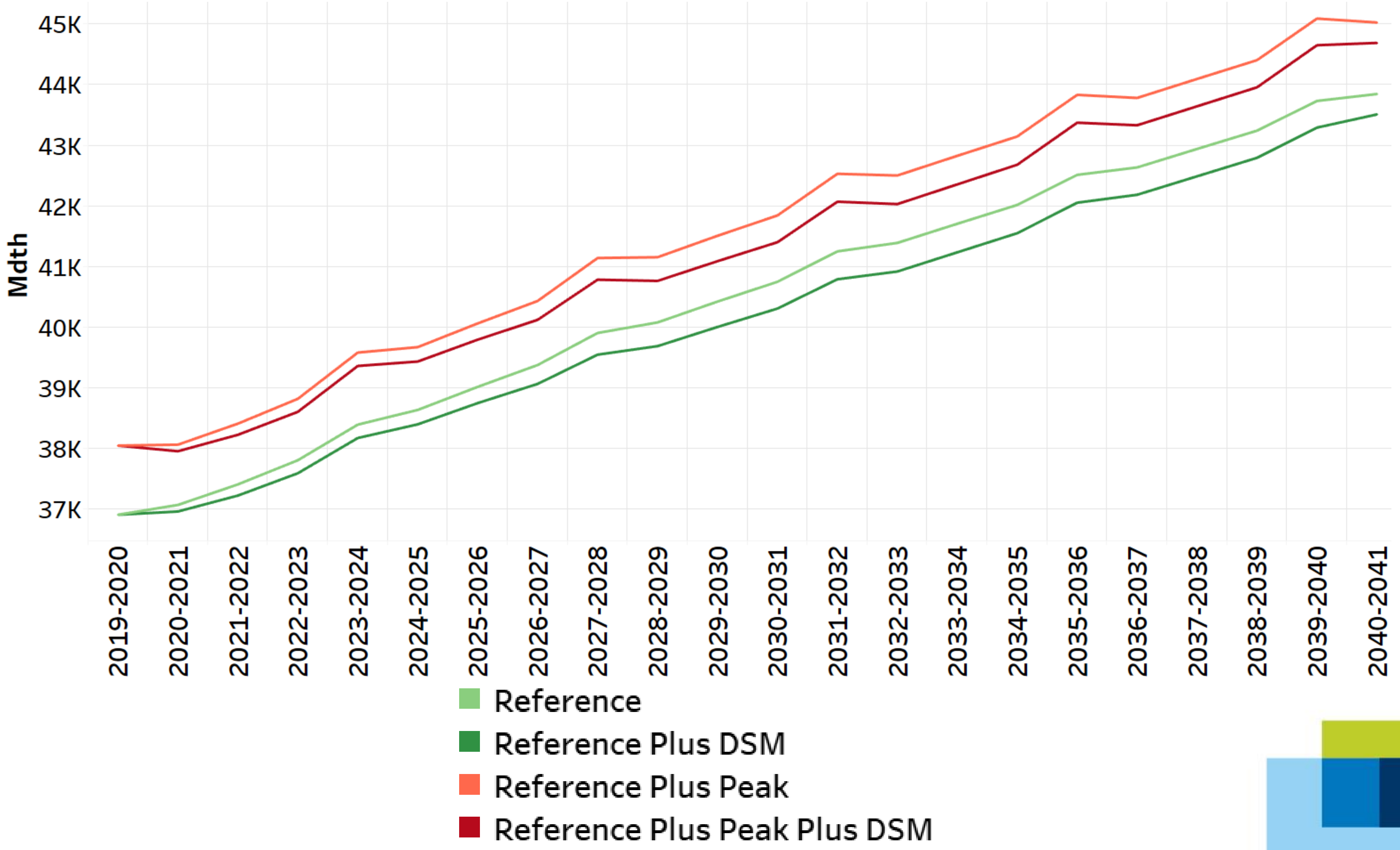
Demand Sensitivities: Weather



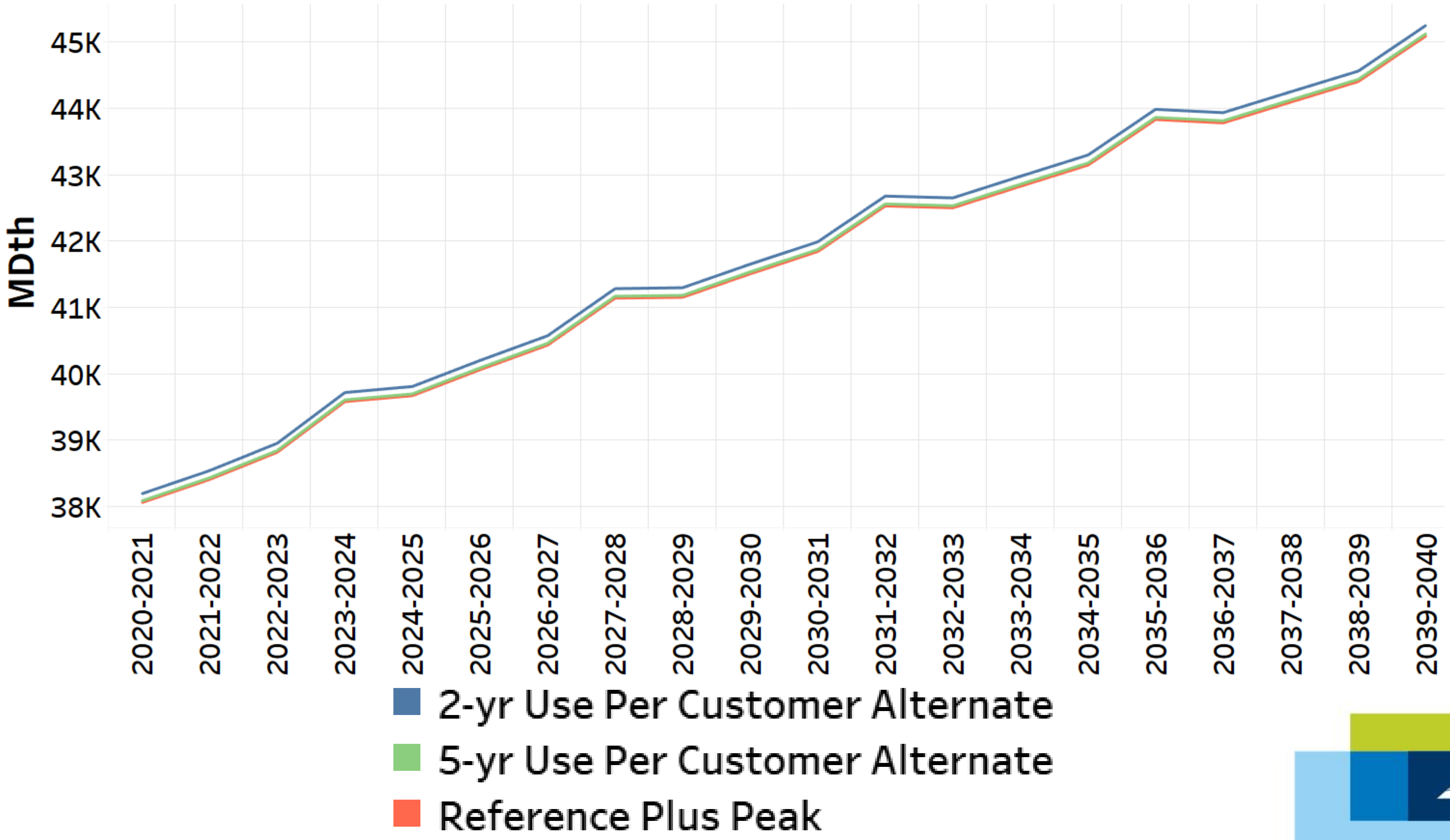
Demand Sensitivities: 80% Below 1990 Emissions



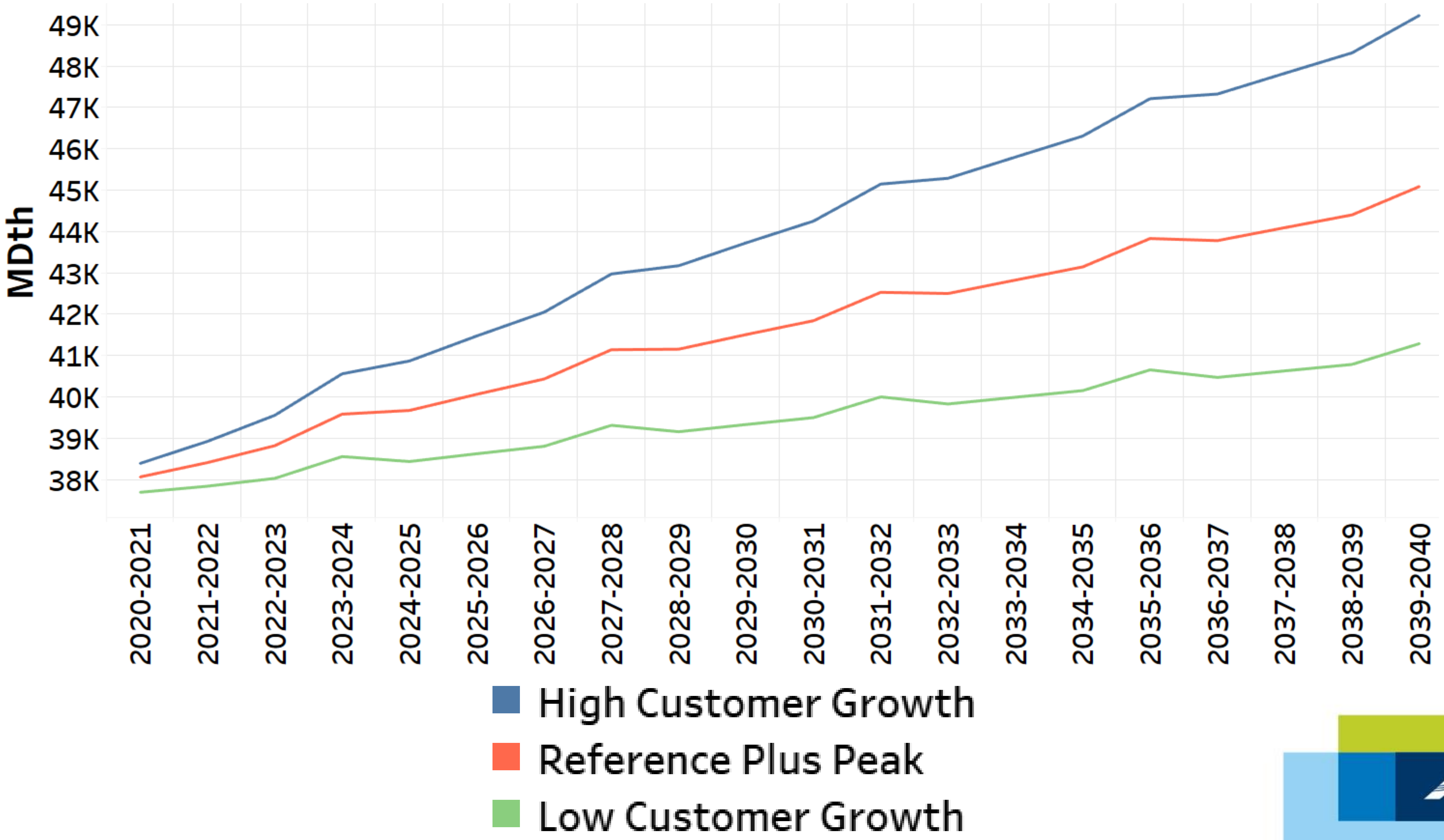
Demand Sensitivities: Demand Side Management



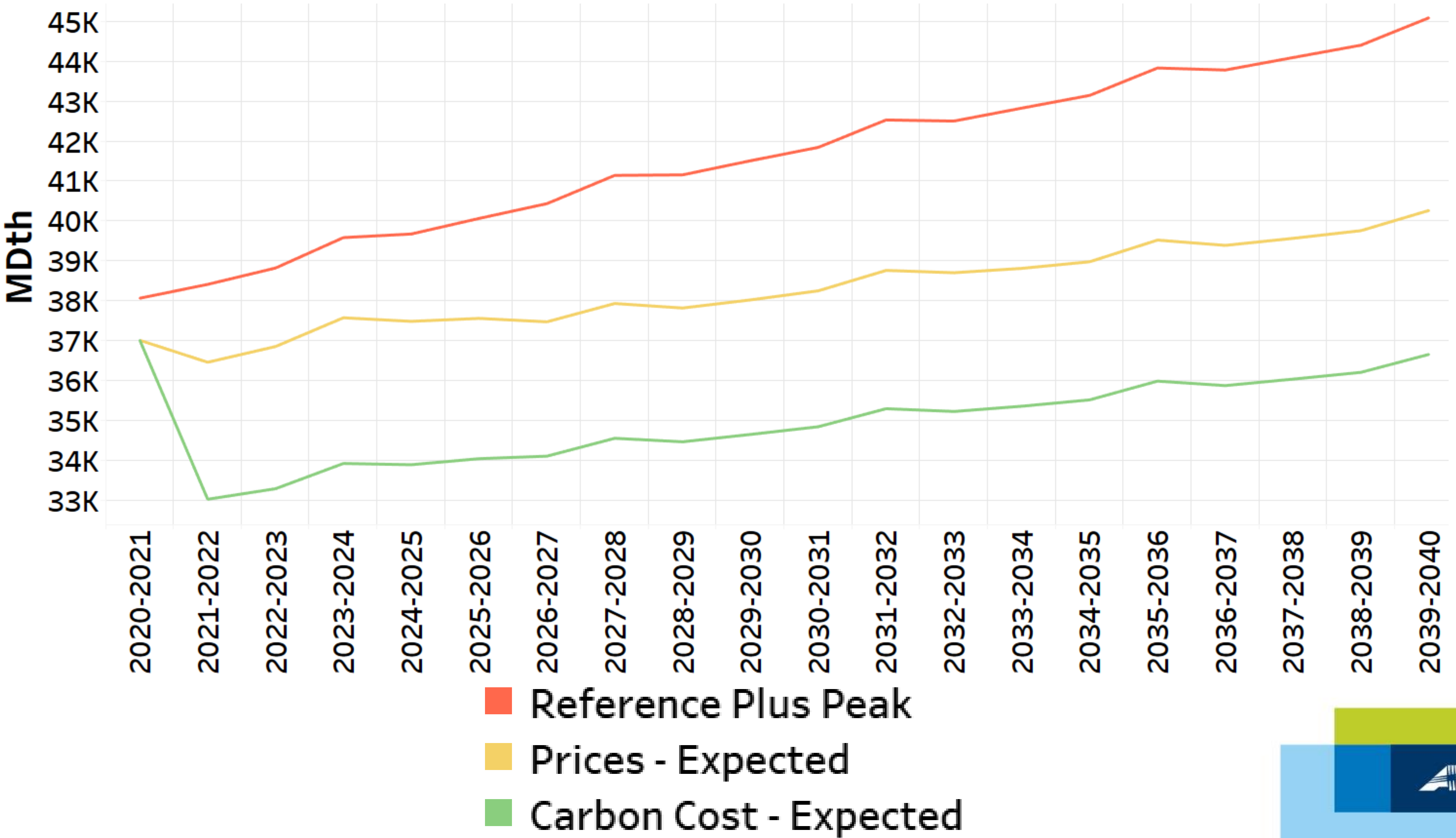
Demand Sensitivities: Use Per Customer



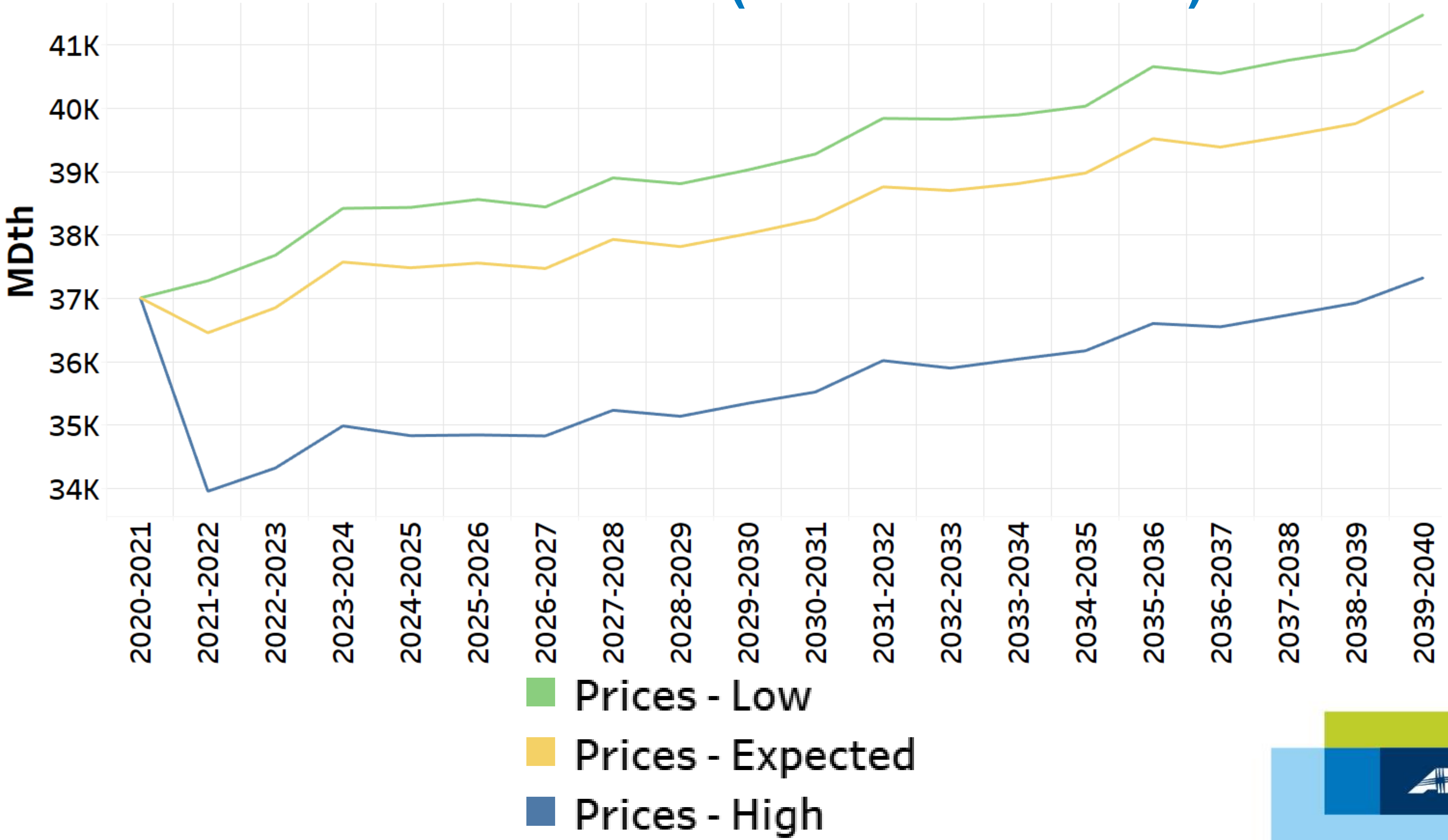
Demand Sensitivities: Customer Growth



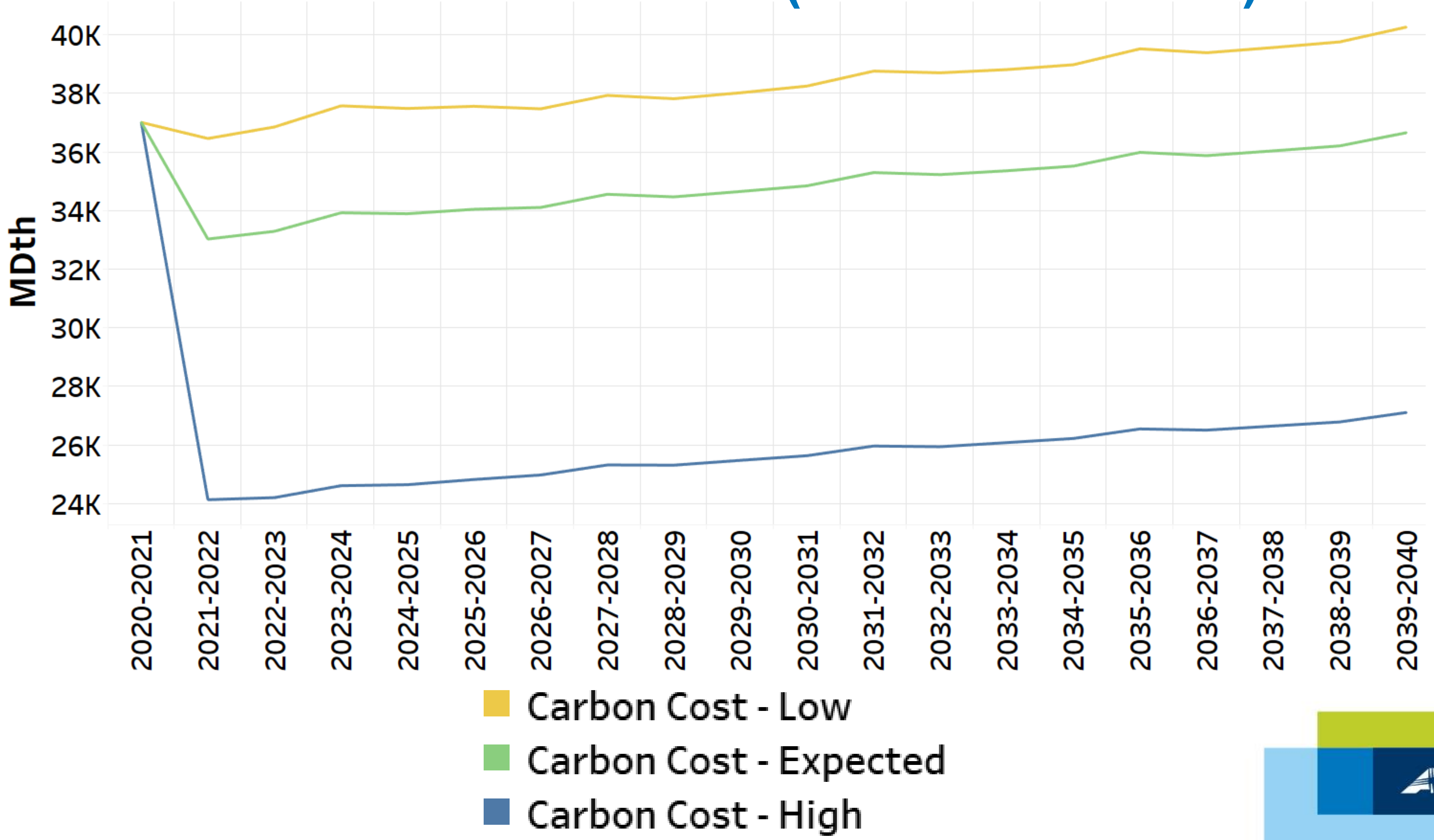
Demand Sensitivities: Price and Carbon Elasticities



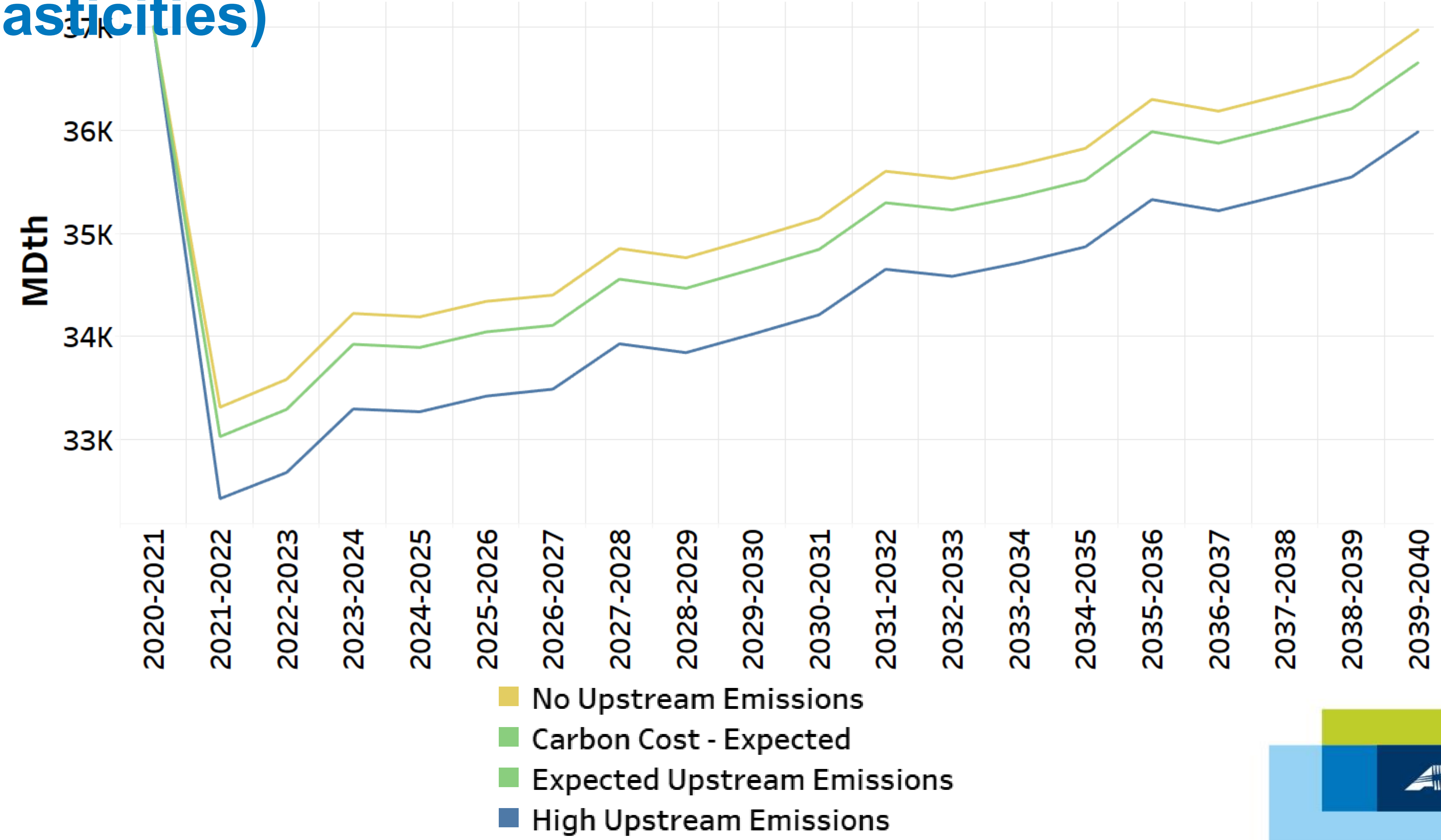
Demand Sensitivities: Price (with Elasticities)



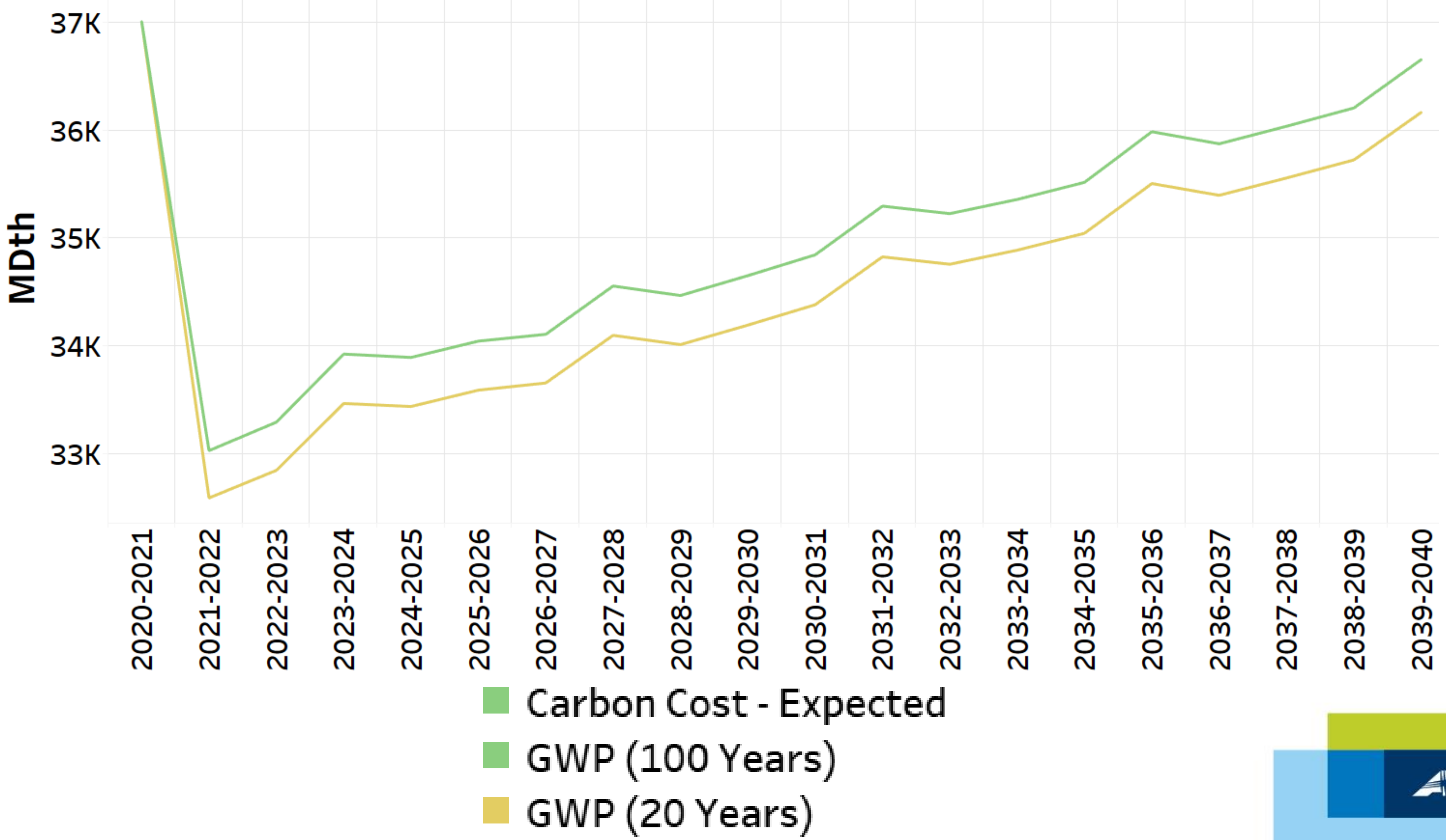
Demand Sensitivities: Carbon (with Elasticities)



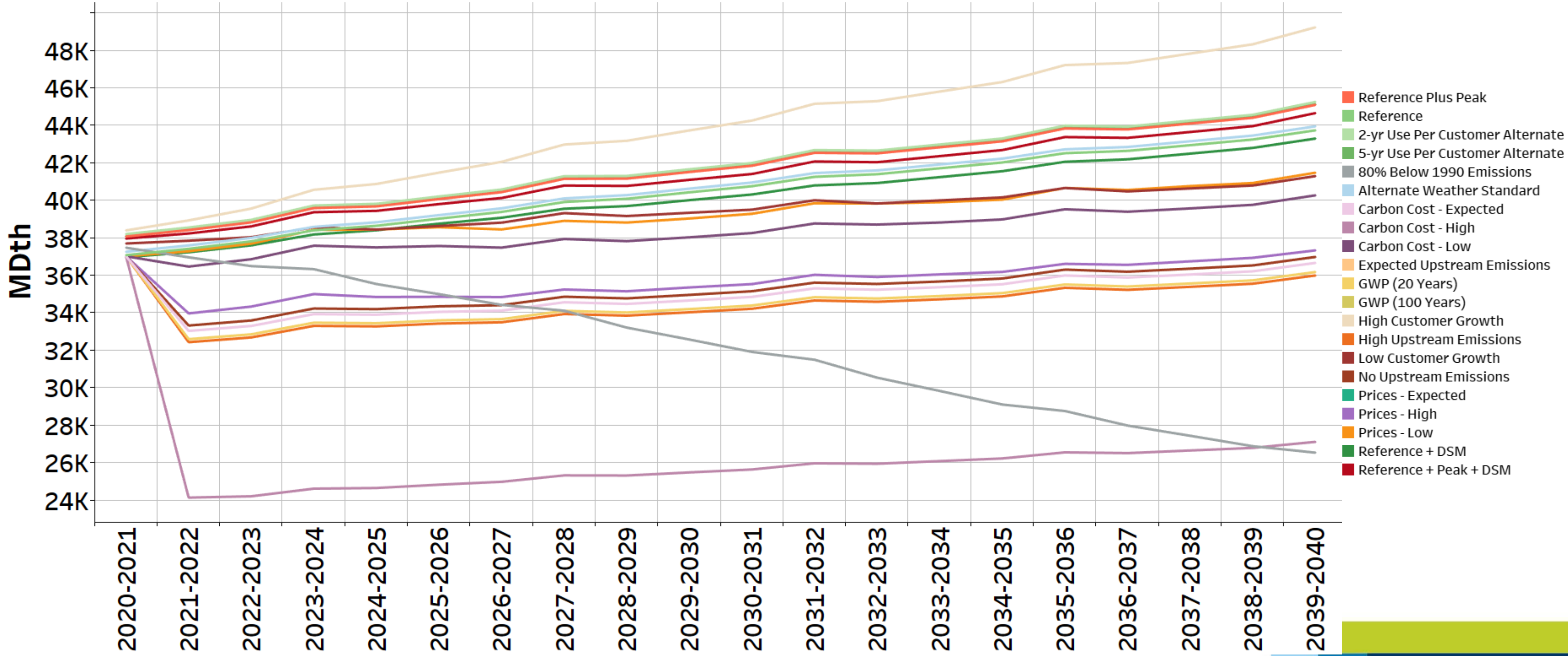
Demand Sensitivities: Upstream Emissions (with Elasticities)



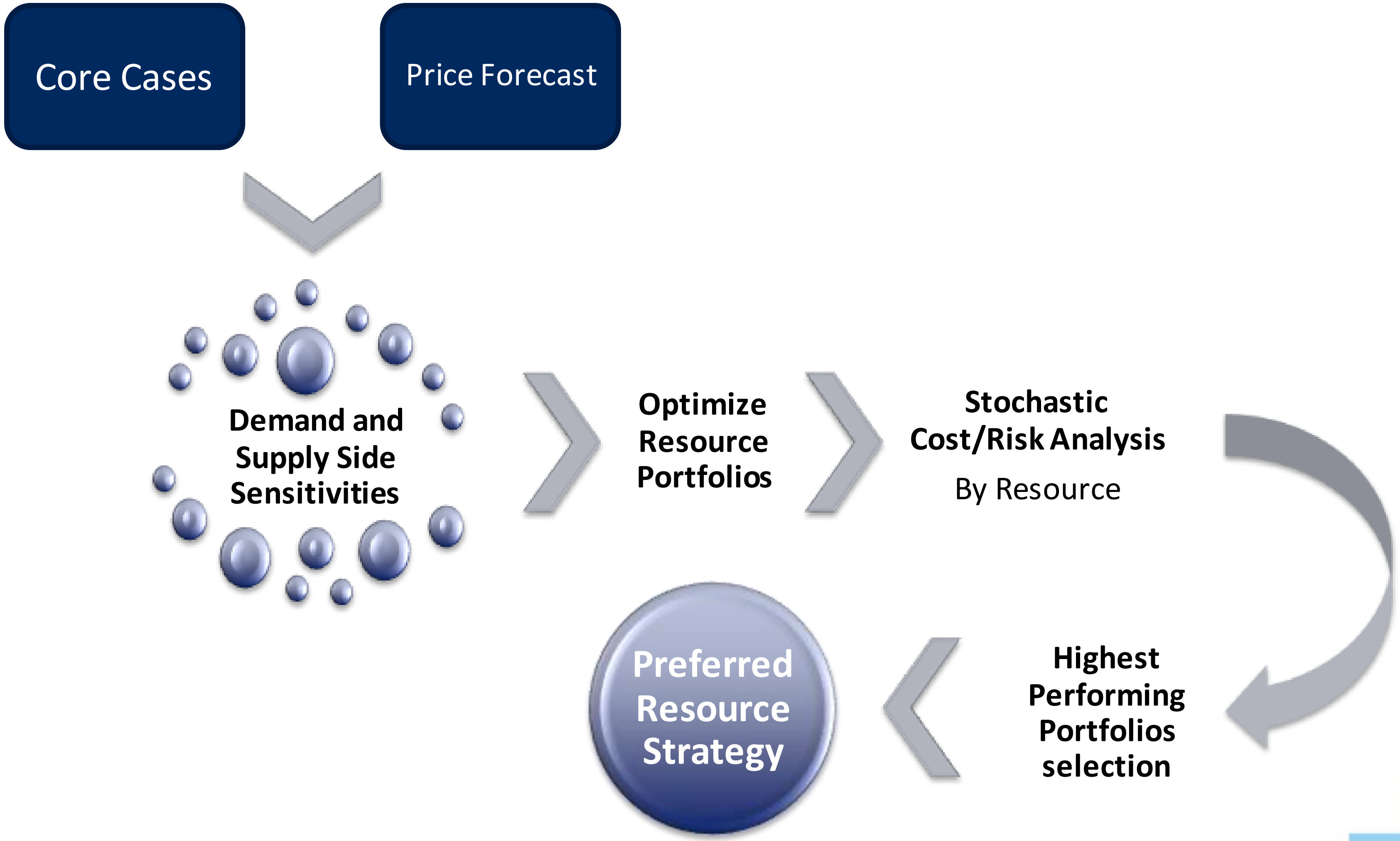
Demand Sensitivities: GWP (with Elasticities)



Demand (11/1/2020 – 10/31/2040)



Sensitivities, Scenarios, Portfolios



Proposed Scenarios

Proposed Scenarios INPUT ASSUMPTIONS	Expected Case	Average Case	Low Growth & High Prices	Carbon Reduction	High Growth & Low Prices
Customer Growth Rate	Reference Case Cust Growth Rates		Low Growth Rate	Reference Case Cust Growth Rates	High Growth Rate
Use per Customer	3 yr + Price Elasticity				
Demand Side Management	Expected Case CPA		High Prices DSM	Low Prices DSM	
Weather Planning Standard	99% probability of coldest in 30 years	20 year average	99% probability of coldest in 30 years		
GWP	100-Year GWP				
Prices Price curve	Expected		High	Low	
Carbon Legislation ($/Metric Ton)	SCC @ 2.5% WA; Cap and Trade forecast - OR; NO Carbon adder in ID		Carbon Cost - High (SCC 95% at 3%)	SCC @ 2.5% WA; Cap and Trade forecast - OR; NO Carbon adder in ID	$0
RESULTS					
First Gas Year Unserved					
Washington					
Idaho					
Medford					
Roseburg					
Klamath					
La Grande					
Scenario Summary					
	Most aggressive peak planning case utilizing Average Case assumptions as a starting point and layering in peak day 99% probability. The likelihood of occurrence is low.	Case most representative of our average (budget, PGA, rate case) planning criteria.	Stagnant growth assumptions in order to evaluate if a shortage does occur. Not likely to occur.	Reduction of the use of natural gas to 80% below 1990 targets in OR and WA by 2050. The case assumes the overall reduction is an average goal before applying figures like elasticity and DSM.	Aggressive growth assumptions in order to evaluate when our earliest resource shortage could occur. Not likely to occur.

*1,000 Draws per scenario will be run stochastically

2020 Natural Gas IRP Schedule

TAC 1: Wednesday, June 17, 2020: TAC meeting expectations, 2020 IRP process and schedule, energy efficiency update, actions from 2018 IRP, and a Winter of 2018-2019 review. Procurement Plan and Resource Optimization benefits. fugitive Emissions, Weather Analysis, Weather Planning Standard

TAC 2 (Dual Meeting with Power side): Thursday, August 6, 2020: Market Analysis, Price Forecasts, Cost Of Carbon, Environmental Policies

- Demand Results and Forecasting – August 18, 2020

TAC 3: Wednesday, September 30, 2020: Distribution, Avista's current supply-side resources overview, supply side resource options, renewable resources, Carbon cost, price elasticity, sensitivities and portfolio selection modeling.

TAC 4: Wednesday, November 18, 2020: CPA results from AEG & ETO, review assumptions and action items, final modeling results, portfolio risk analysis and 2020 Action Plan.