DECARBONIZING MINNESOTA'S NATURAL GAS END USES

Meeting 4

March 13th, 2020

Via Zoom

GREAT PLAINS INSTITUTE

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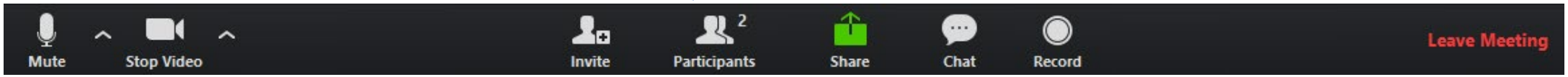
Ground Rules for Virtual Meeting

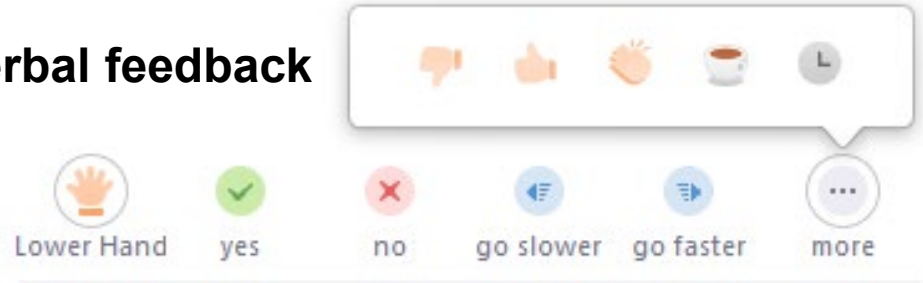
- Respect the commitment that you and others have made to this group by eliminating distractions.
- If you have something to say, please speak up!
- DO link your audio to your visual when prompted so that we can better manage participation.
- Use the “raise hand” feature if you’d like to say something, but aren’t sure when to jump in, so that facilitators can plan to call on you.

Meeting Controls

1. Click "Participants" at bottom of screen



2. Non-verbal feedback buttons



Meeting Goals

1. Build a shared understanding of the how the natural gas system works.
2. Better understand utility perspectives regarding changes to the natural gas system in response to pressures to decarbonize.
3. Discuss the certainties and uncertainties around natural gas end use decarbonization that were drafted at the previous meeting (if time allows).

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Overview of Natural Gas System

John Heer, CenterPoint Energy

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CenterPoint Energy

NATURAL GAS SYSTEMS, AN INTRODUCTION

13 MARCH 2020

John Heer, P.E.
Director of System Operations

NATURAL GAS SYSTEMS

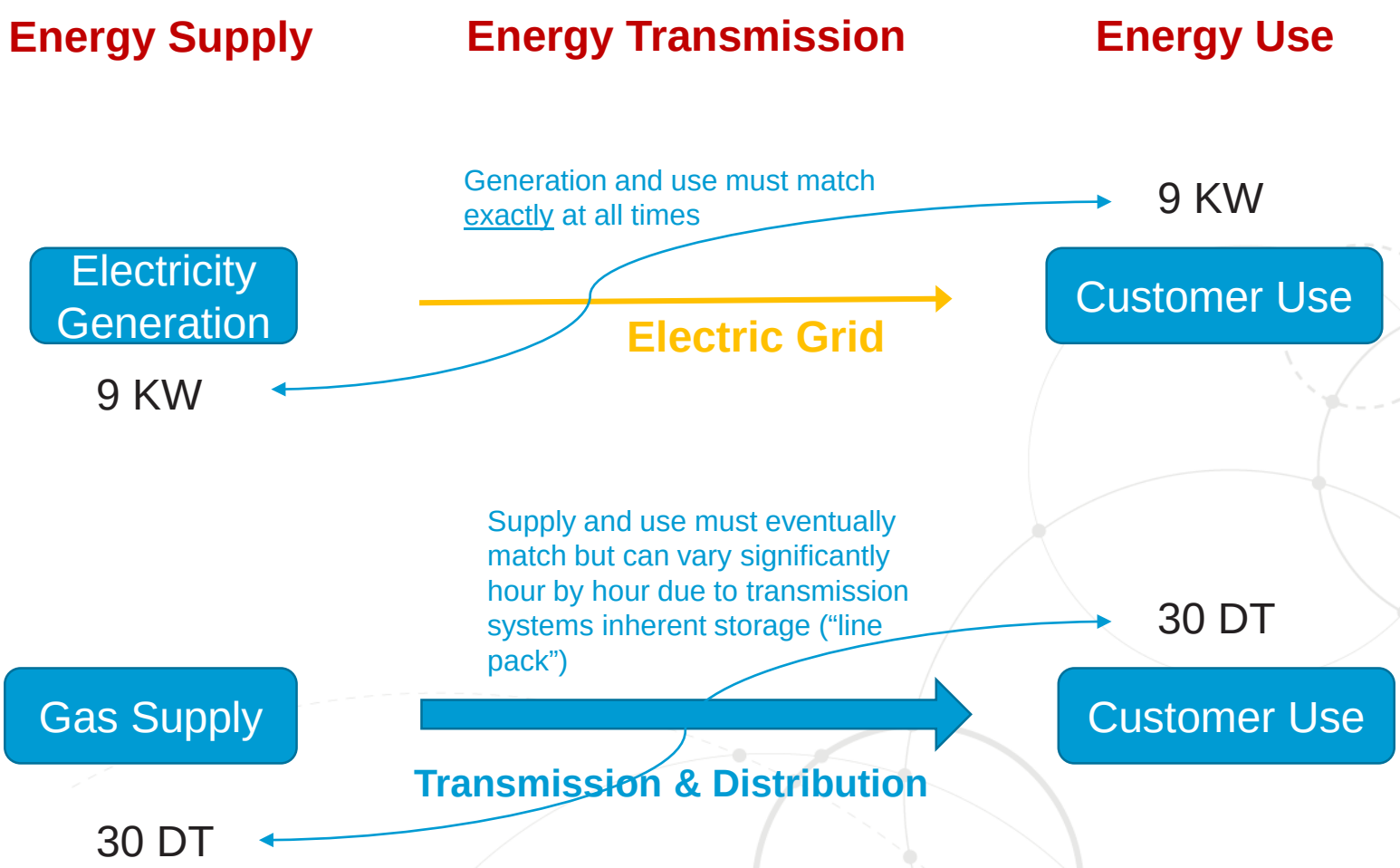
- Delivery of Gas – (Our Business)
- Sources of Supply –
- Transportation to our service areas
- Distribution of Gas
- Measurement, Odorization, Regulation, etc.
- System Control
- Customers
- Local Storage
- Alternative Resources

GAS & ELECTRIC SYSTEM -EQUIVALENCIES

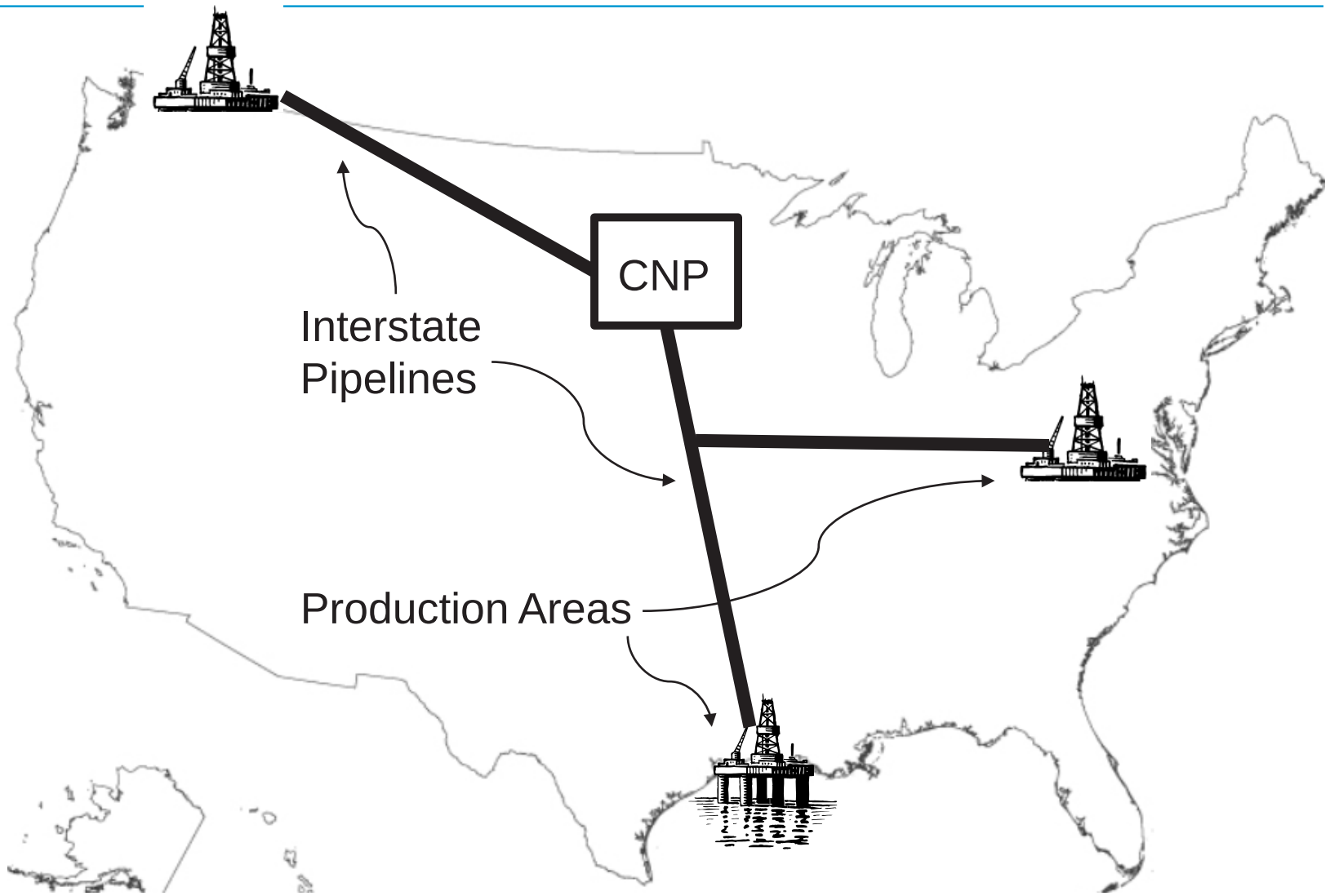
Electric Property	Gas Property
• Voltage (Volt)	Pressure (PSI, Bar)
• Current (Amps)	Flow Rate (FT^3/HR)
• Power (KW)	BTU/HR, DT/HR
• Energy (KWH)	BTU, Dktherm
• Reactive Power (Vars)	No Equivalent [1]

1/ *the gas business hasn't figured out how to charge for imaginary power yet*

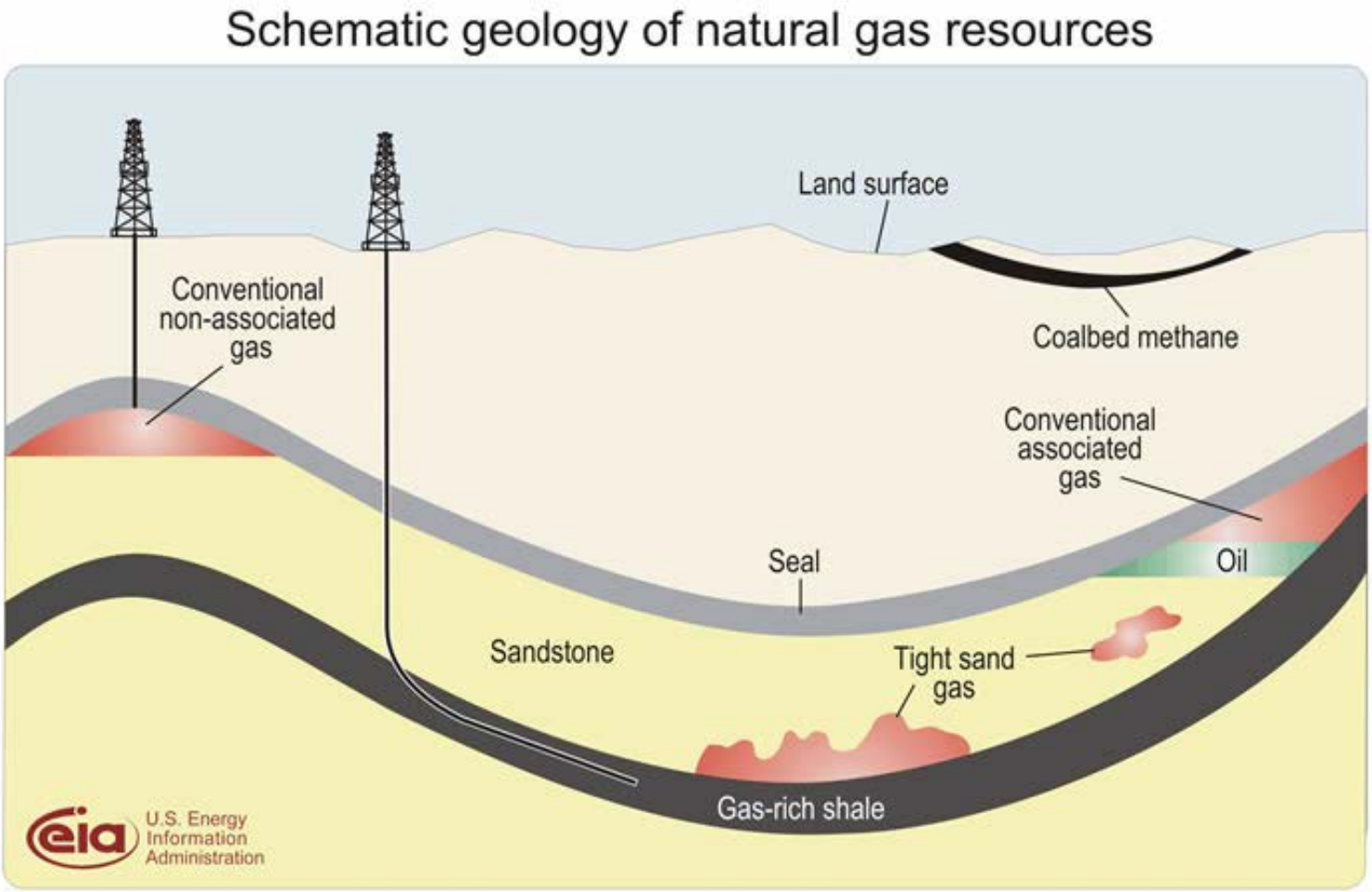
GAS & ELECTRIC SYSTEM - DIFFERENCES



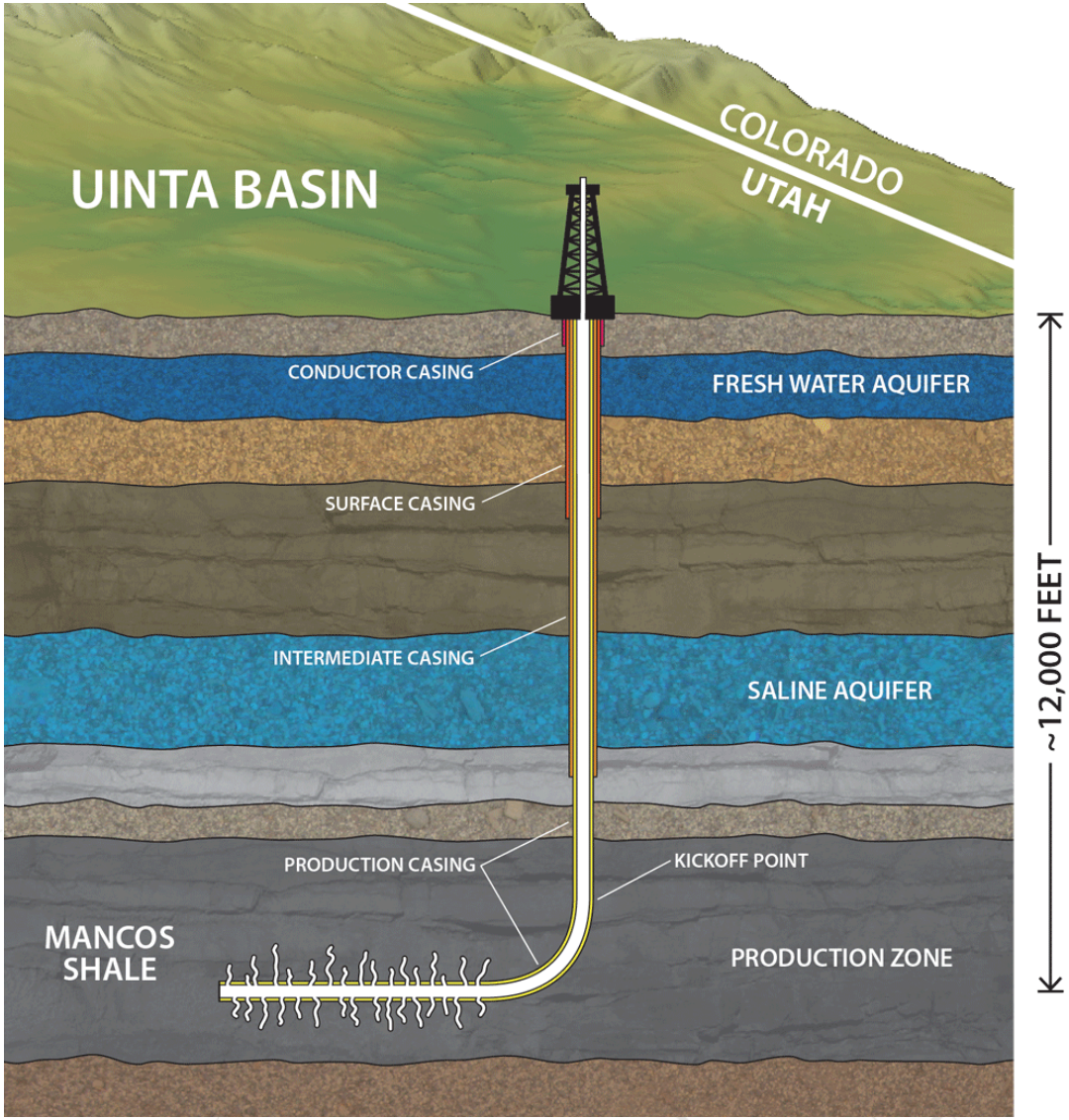
NATURAL GAS SYSTEMS



GAS SUPPLIES

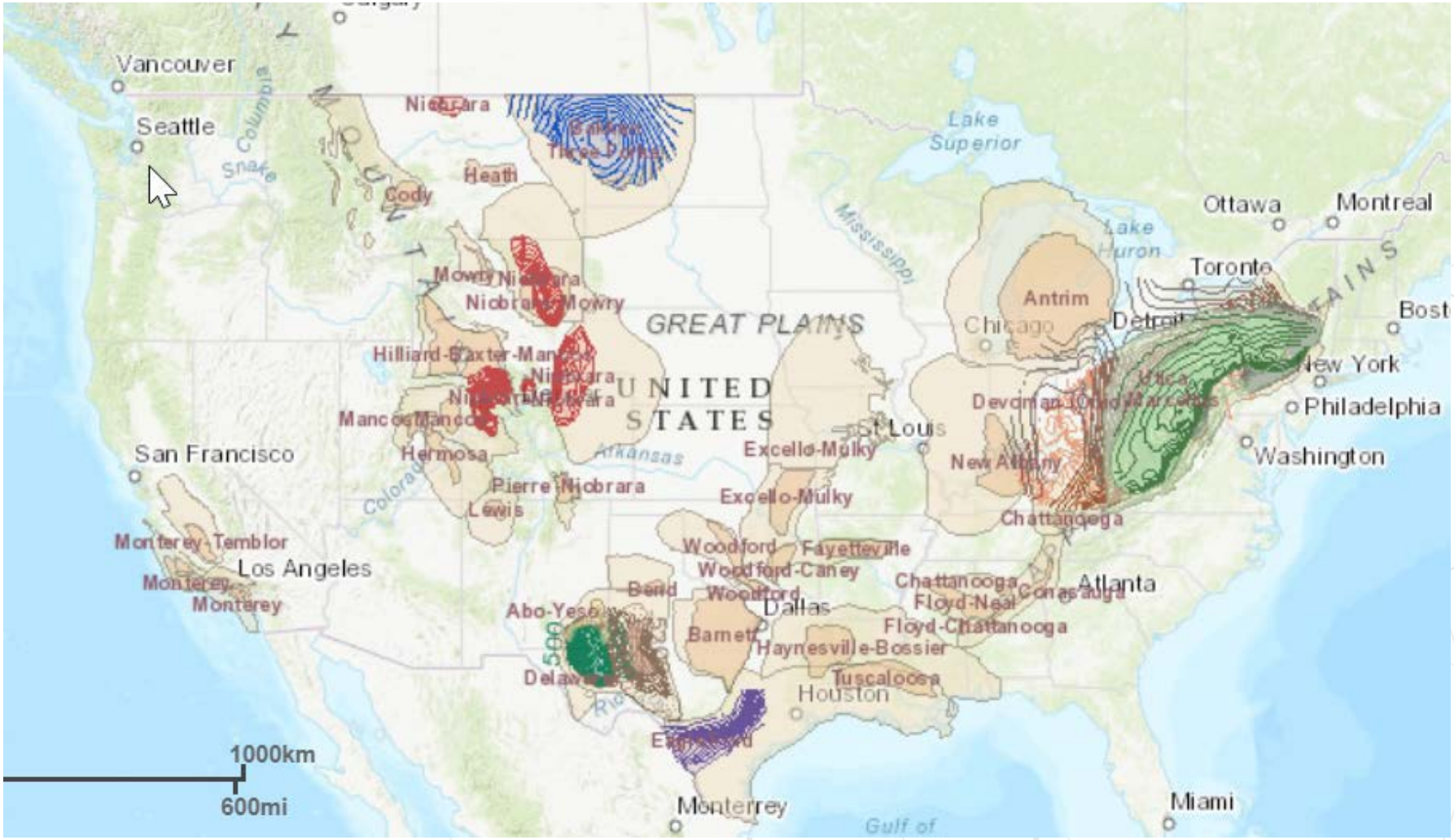


GAS SUPPLIES – SHALE GAS WELL



GAS SUPPLIES

GAS SUPPLY SOURCES

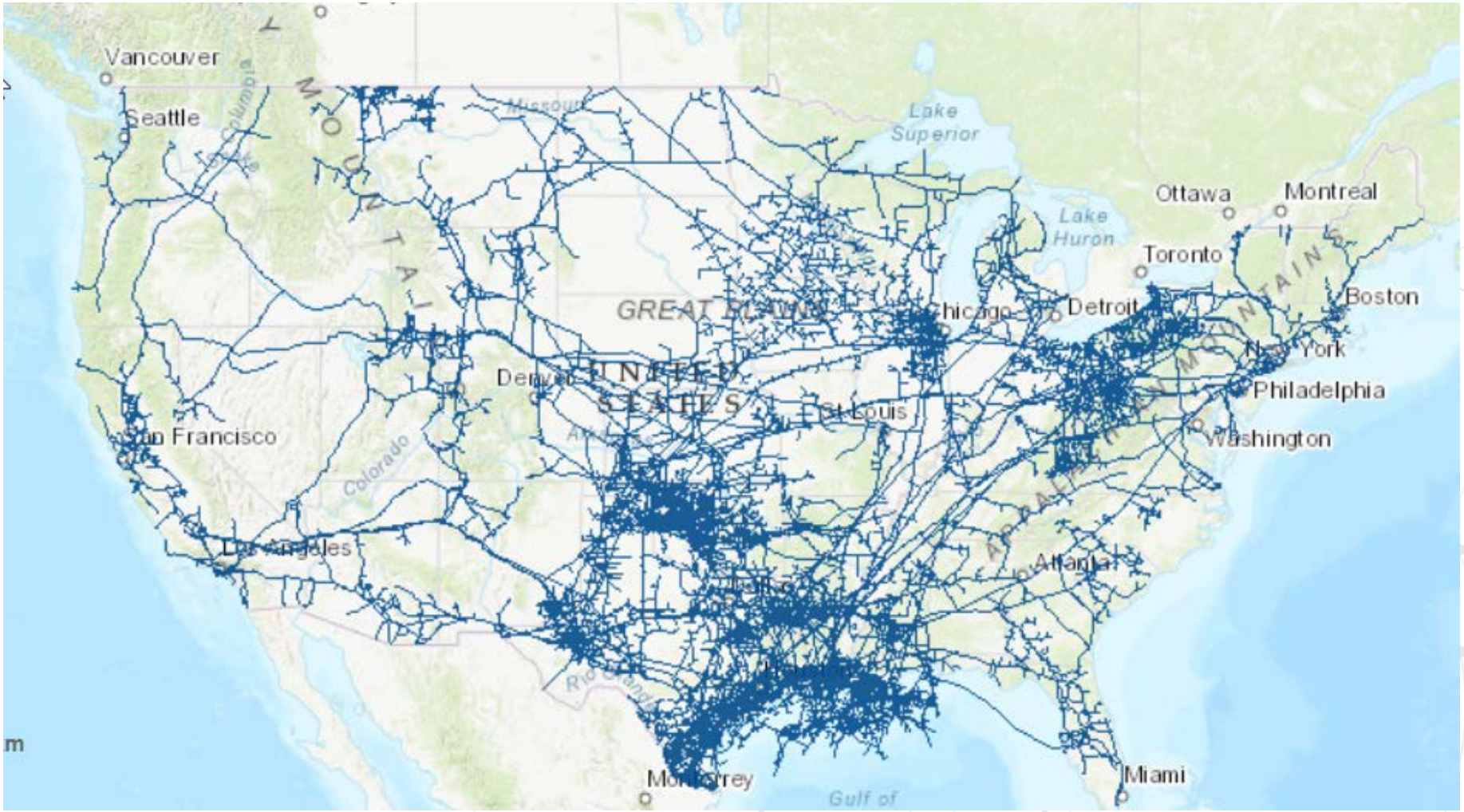


Source: EIA

GAS TRANSMISSION

How does natural gas get to Minnesota?

INTERSTATE GAS TRANSMISSION



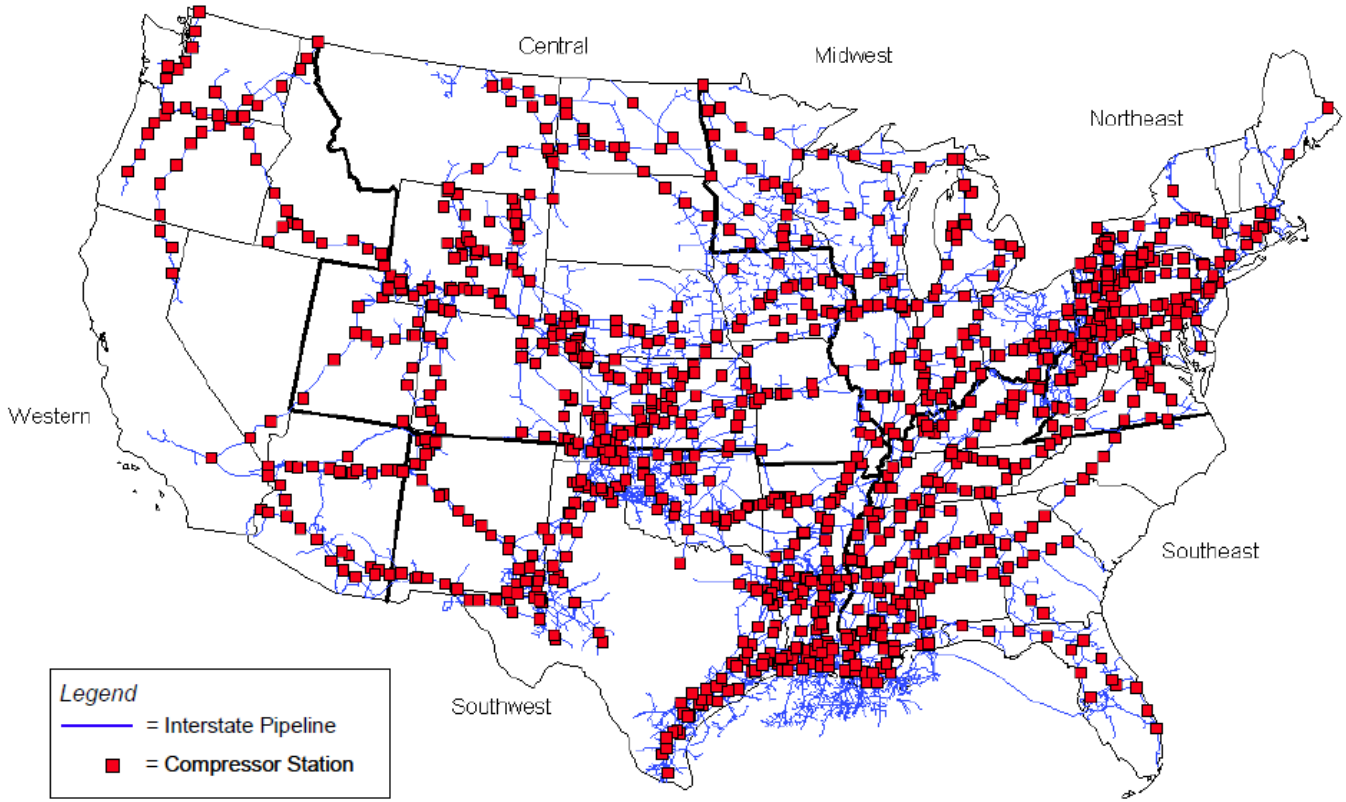
Source: EIA

Interstate Pipelines

CenterPoint Energy

GAS TRANSMISSION – COMPRESSOR STATIONS

Figure 1. Interstate Natural Gas System Mainline Compressor Stations, 2006



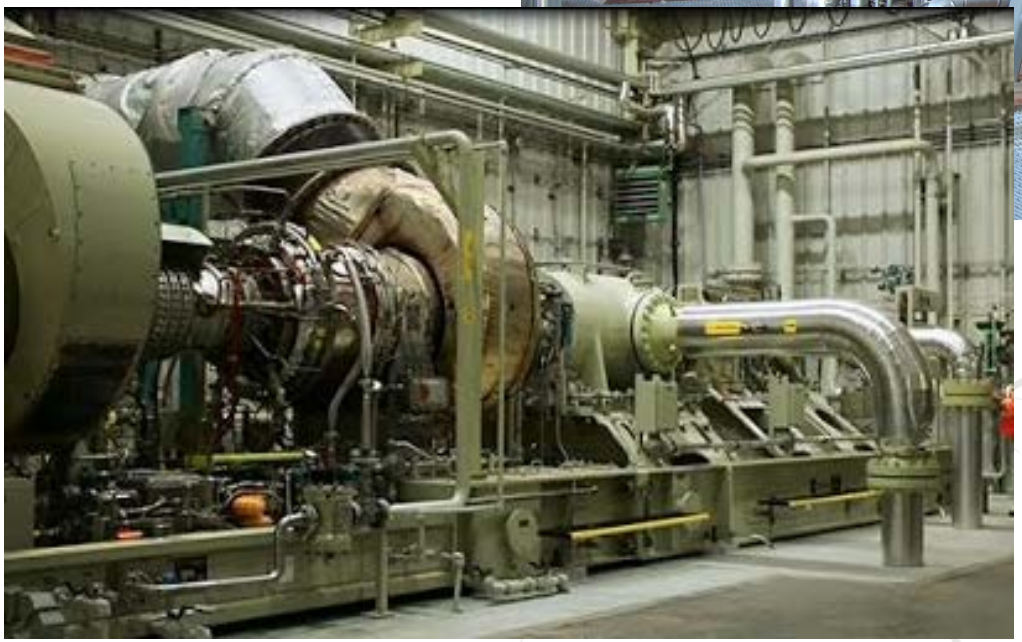
Note: EIA has determined that publication of this figure does not raise security concerns, based on the application of Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.
Source: Energy Information Administration, Natural Gas Division, Natural Gas Transportation Information System, Compressor Station Database.

1,200+ Compressor Stations, 17 million HP

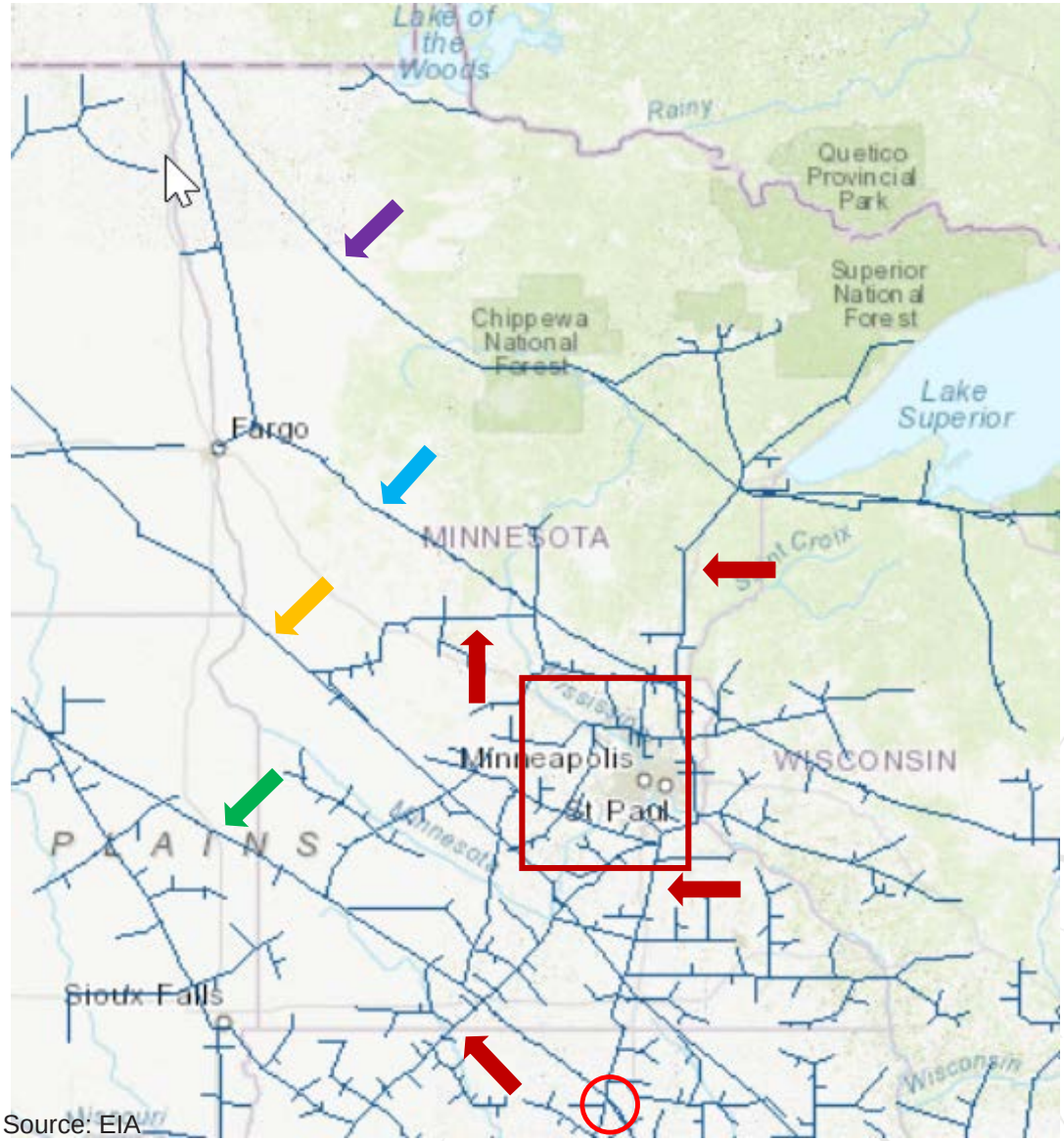
Source: EIA

COMPRESSOR STATION

COMPRESSOR STATION



GAS TRANSMISSION LINES - MINNESOTA



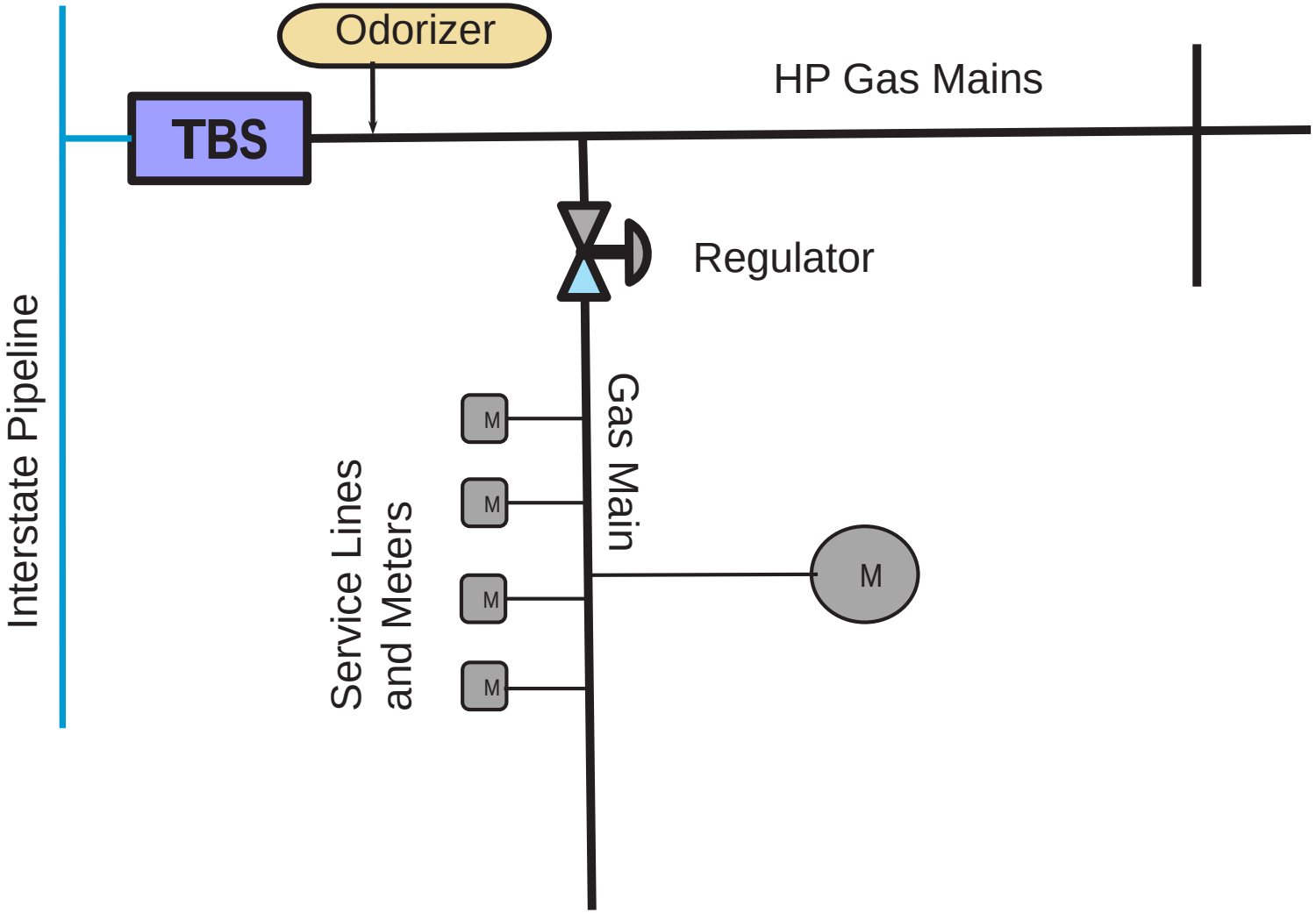
- Great Lakes
- Northern Natural
- Alliance
- Northern Boarder
- Viking

Source: EIA

LOCAL GAS DISTRIBUTION SYSTEMS

How does natural gas get to your home?

Distribution System



Town Boarder Stations

Odorizers

GAS MAINS

GAS MAINS

GAS MAINS

PRESSURE REGULATION

PRESSURE REGULATION

GAS METERS

CUSTOMERS

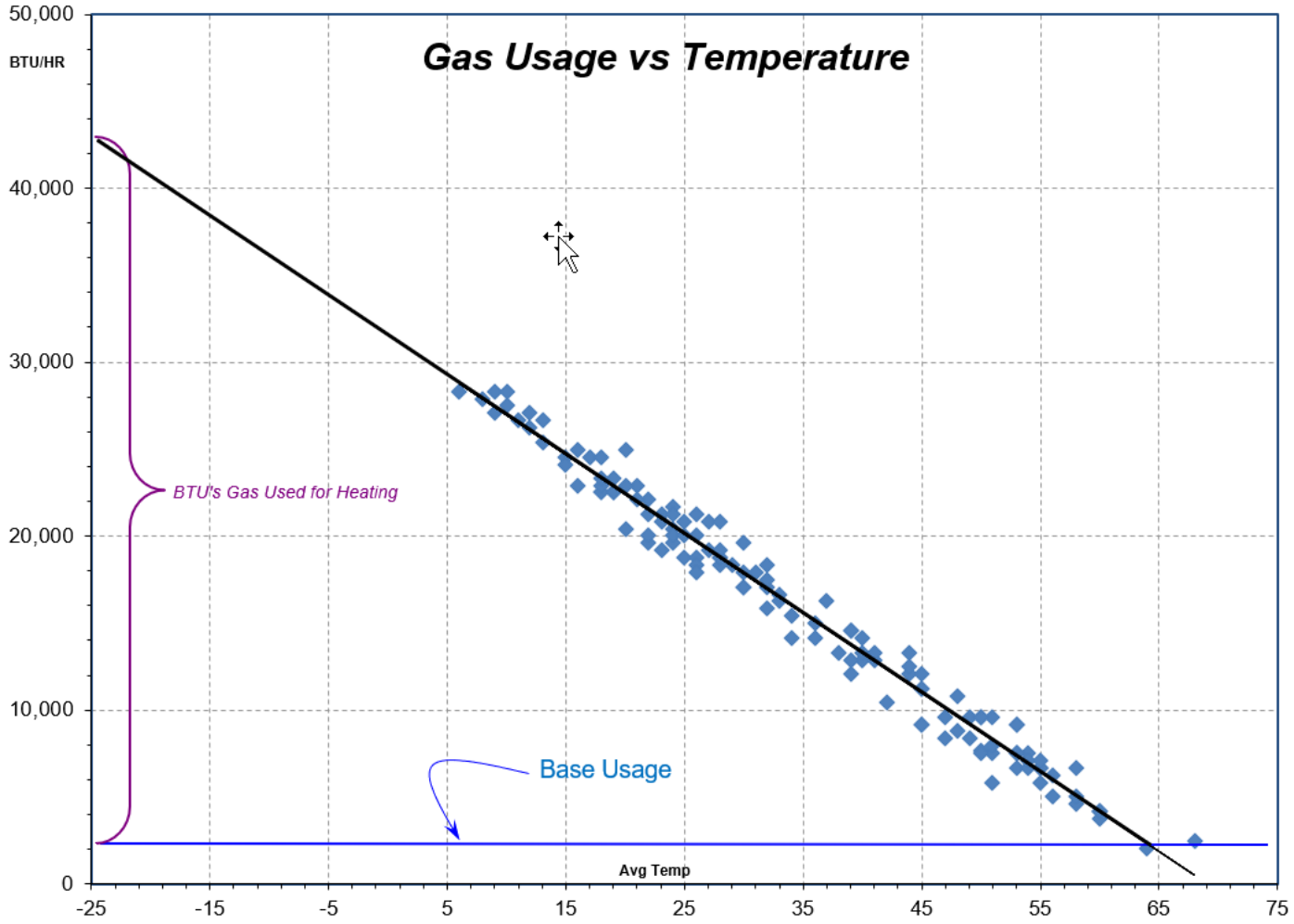
2019 US Consumption	31 Trillion CF [1]	2018 Minnesota 490 BCF[1]
Power Generation	36 %	13%
Industrial	27 %	33%
Residential	16 %	29%
Commercial	11 %	23%
Lease & Plant Fuel	6 %	
Pipeline Fuel	3 %	2.5%
Vehicle Fuel	0.16 %	0.01%

/1 EIA Natural Gas Consumption by End Use

RATE RECOVERY

- Interstate Pipelines have demand based rates.
- Many Utilities, such as CNP have decoupled delivery rates.
- This is important!
- Gas throughput is not as significant to the transportation and delivery businesses.

CUSTOMERS – EXAMPLE RESIDENTIAL HOME



MEETING THE POLAR VORTEX CHALLENGE

What happens at -25F?

LOCAL STORAGE & PRODUCTION

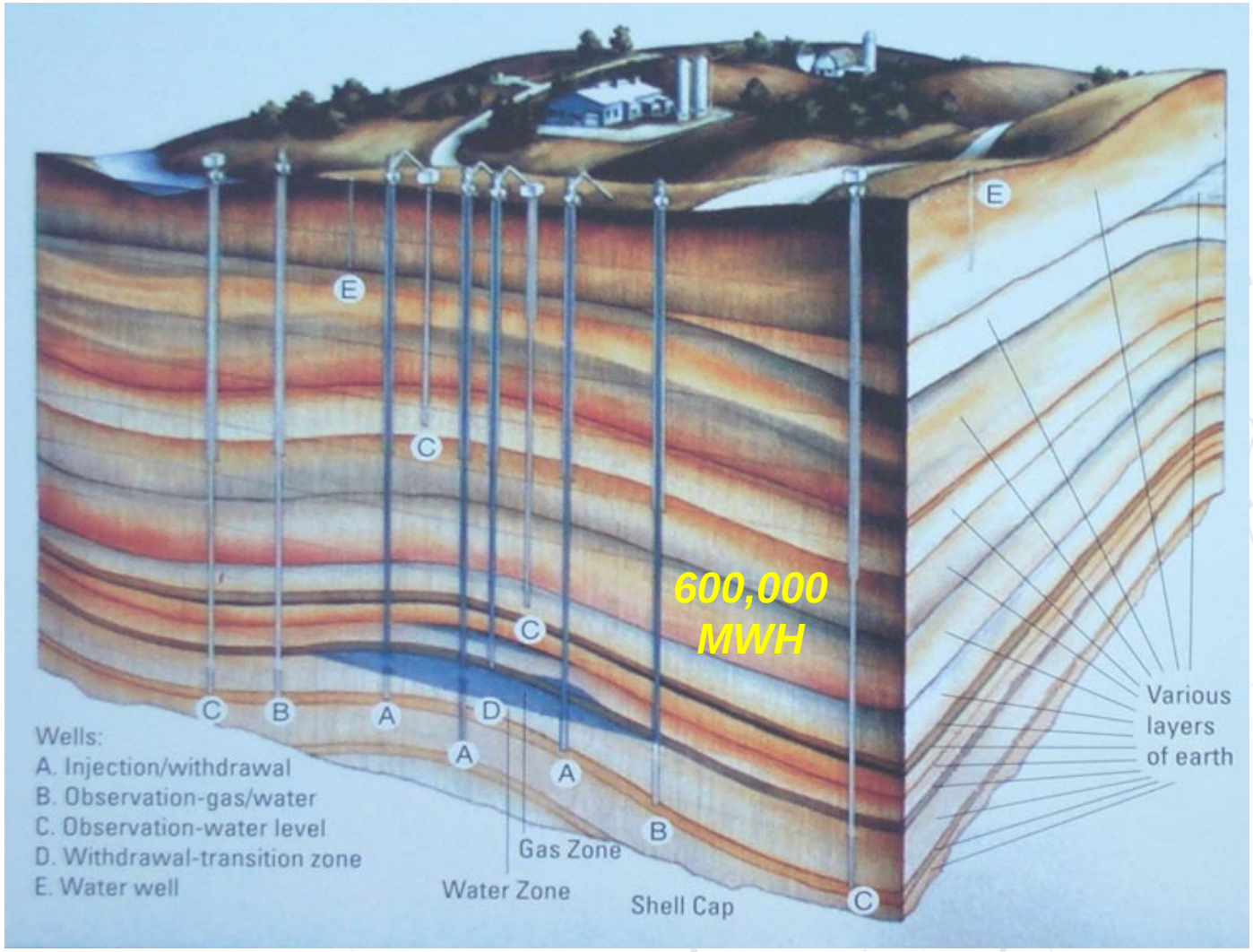
- ~1,450,000 DT needed to meet CNP Minnesota design day requirements (-25F avg).
- Peak power needs of 70,000 DT/hr (20,000 MW)
- Approximately 80% is brought in through interstate pipelines under firm contracts.

- 20% of CNP Minnesota design day requirements can be produced and delivered from local storage facilities in Minnesota

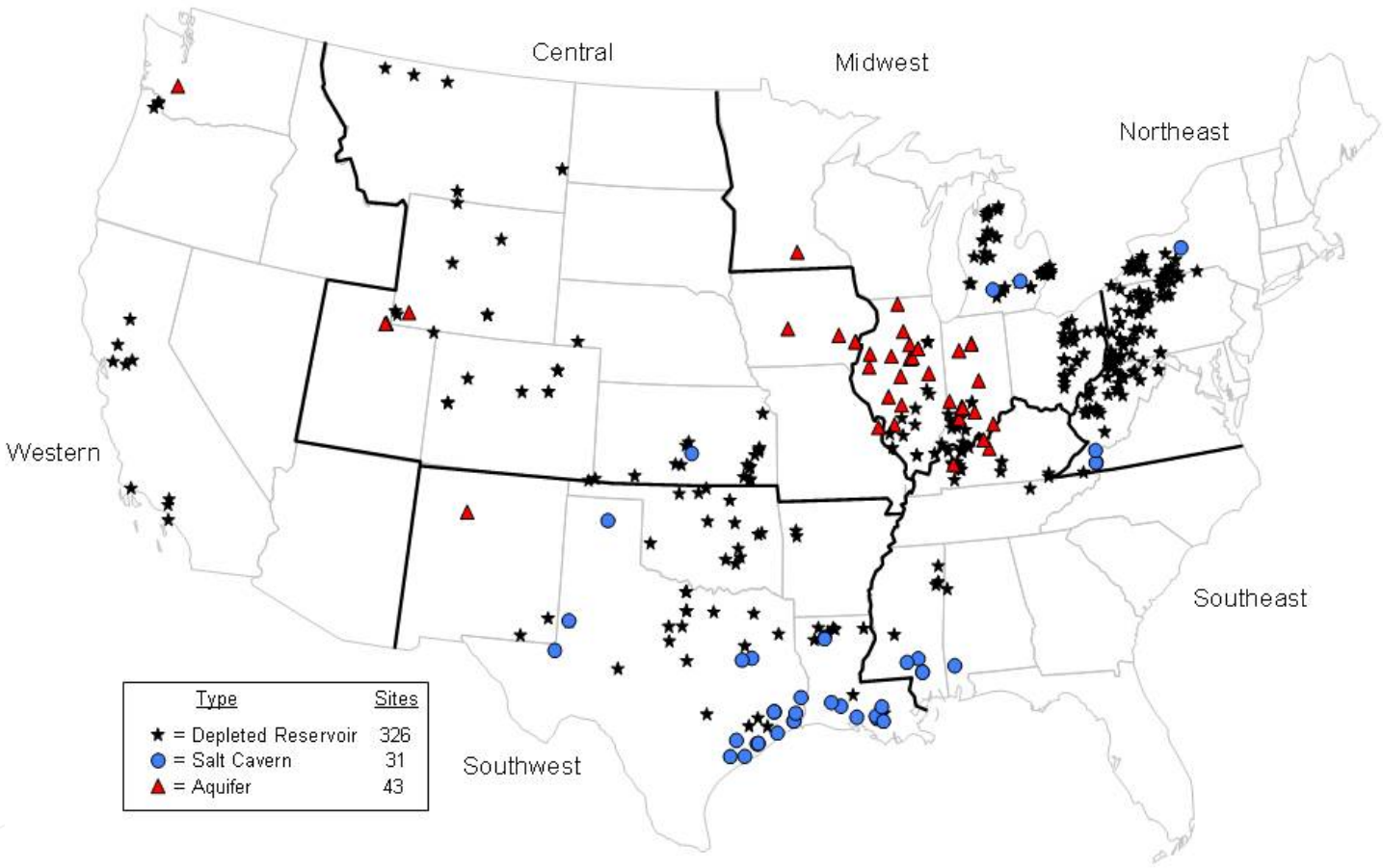
• Liquefied Natural Gas	72,000 DT/Day	(20,000 MWH))
• Underground Storage	50,000 DT/Day	(15,000 MWH)
• Propane Air MN	180,000 DT/Day	(50,000 MWH)

LOCAL STORAGE & PRODUCTION

UNDERGROUND STORAGE



GAS STORAGE



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division Gas, Gas Transportation Information System, December 2008.

PROPANE-AIR PEAK SHAVING STATIONS

RENEWABLE NATURAL GAS

WHAT IS RNG?

- **Renewable Natural Gas (RNG)**
- **Created from a renewable source**
- **Most commonly from a organic material such as ag waste, manure, landfill**
- **Digested by an anaerobic bacteria to produce a gas comprising methane and carbon dioxide (Biogas)**
- **The biogas will also contain other trace constituents that may be of concern.**

BIOGAS

Raw Biogas

60% CH_4, 40% CO_2, H_2S, etc.

Pipeline Gas

88% CH_4, 9% C_2H_6, 1% C_3H_8 1% CO_2, 1%N_2

UPGRADING BIOGAS TO RNG

- **Biogas can be processed to remove almost all of the carbon dioxide (CO2)**
- **Many trace constituents must also be removed or significantly reduced**
- **Upgraded and cleaned biogas is RNG (also called biomethane)**

TYPICAL BIOGAS UPGRADING EQUIPMENT

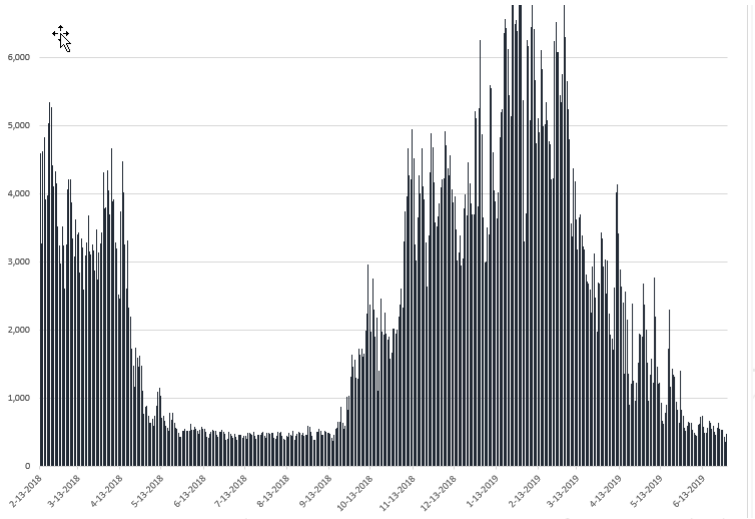
FOCUS ON LDC RENEWABLE NATURAL GAS

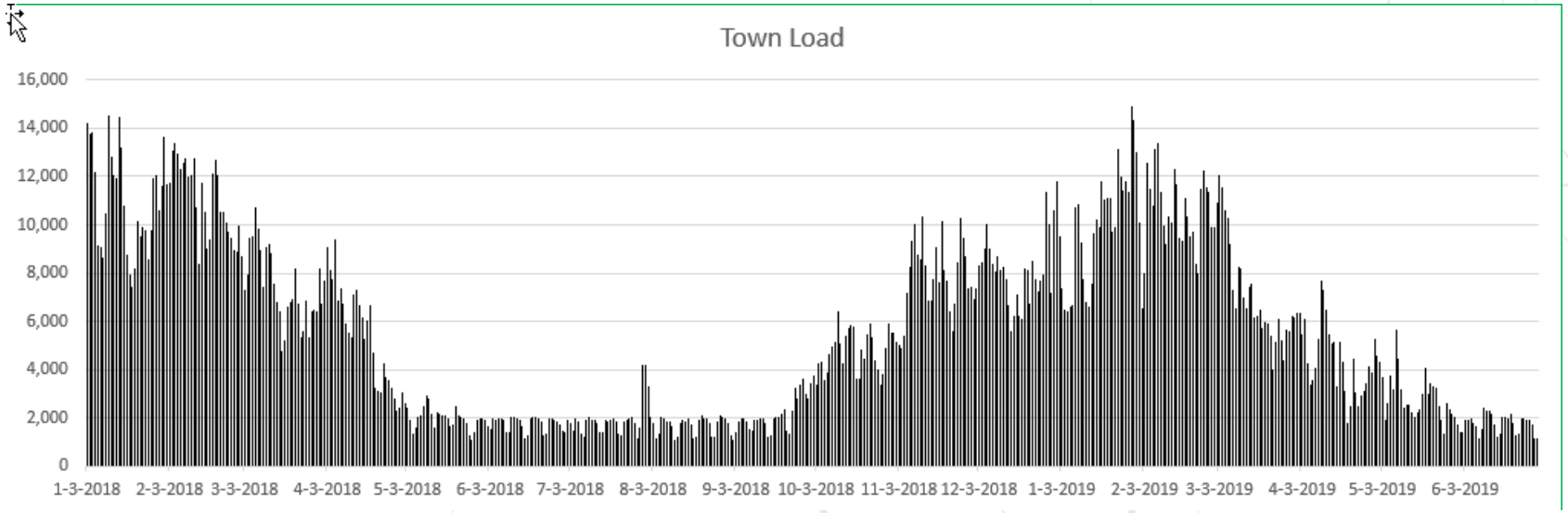
What are pipeline concerns with RNG?

- **Will it burn properly in customer's appliances?**
- **Is it Safe for customers and employees?**
- **Can it be integrated reliably into LDC system?**
- **Is it a reliable supply?**

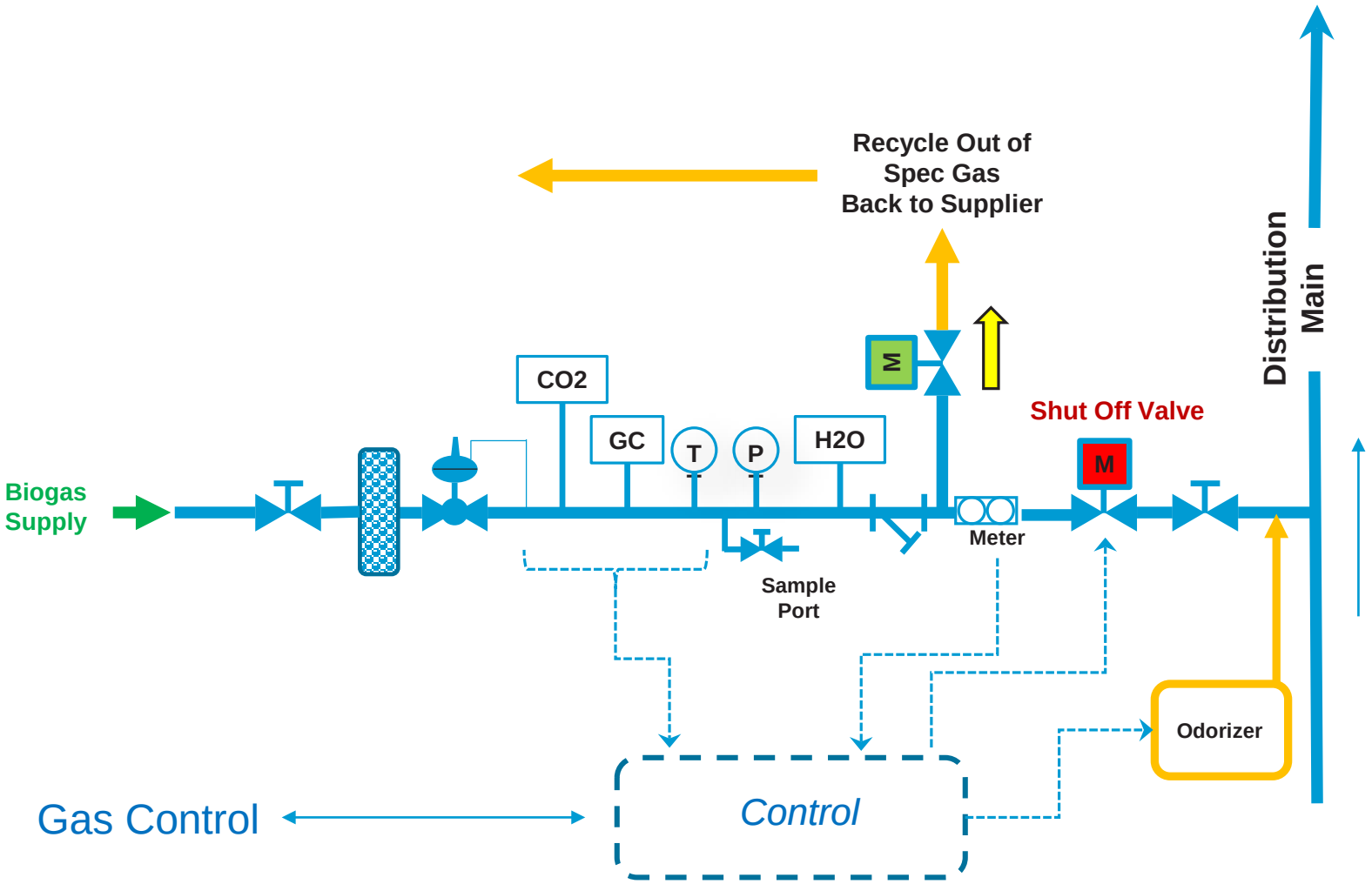
CAN IT BE INTEGRATED INTO THE PIPELINE SYSTEM?

- Where can the gas be used year round?
- Typical rural towns have big summer to winter swings.
- Metro areas have higher loads but limited biomass





Typical RNG Interconnection Schematic



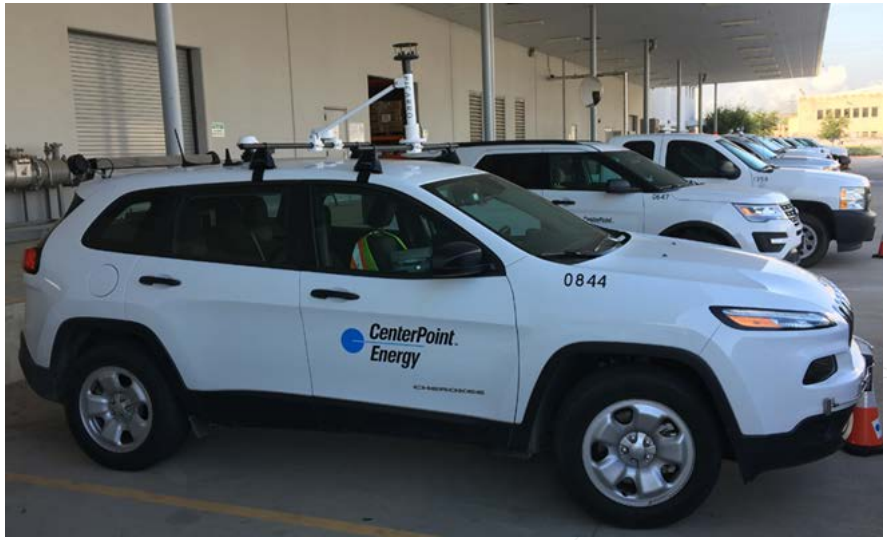
RNG INTERCONNECTION

SAFETY AND RELIABILITY

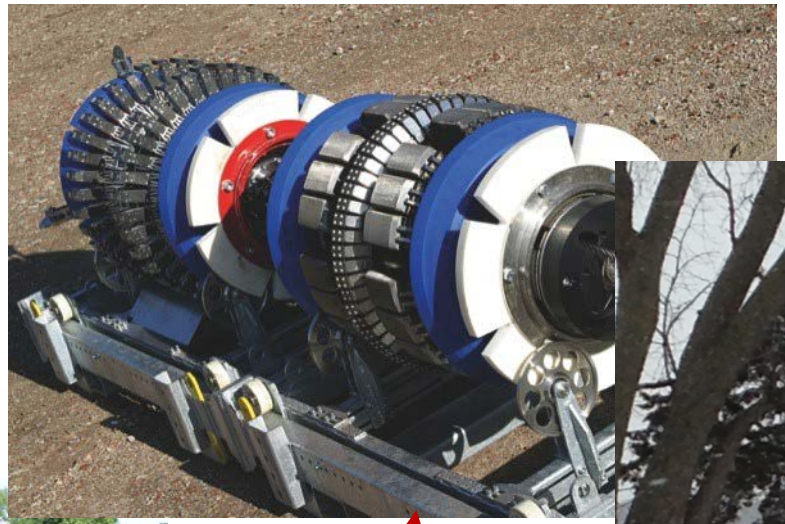
- Engineering and Design
- Pipeline Safety Management Programs
- Leak Detection
- Line Location
- Inspections
- Training and Qualification
- 24 x 7 Monitoring and Control

SAFETY

- Picarro is an innovative technology used for leak detection
- Full deployment of Picarro technology
- Picarro / Cavity Ring-Down Spectroscopy (CRDS) Vehicle
- Anemometer (top) measures wind speed and weather data
- Gas analyzer and computer processor highlight leak indication areas



Pipeline Internal Inspections



Smart Pig

Dumb Pig

Pig Launcher

METHANE LEAKAGE REDUCTIONS

Alternatives to Venting

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What is CenterPoint doing and planning around decarbonization strategies?

Erica Larson, CenterPoint Energy

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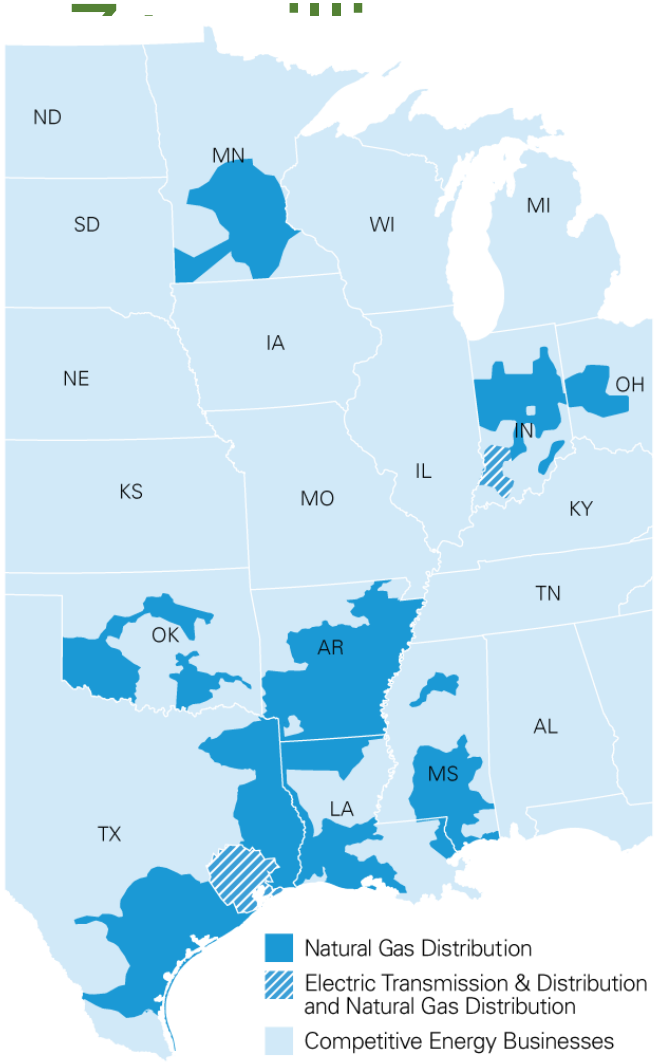
Center for Energy and Environment

CenterPoint Energy

CenterPoint Energy Decarbonization Strategies

- Green tariff, interconnection, renewable hydrogen pilot

- Carbon capture, offsets



Gas Utility Services

Regulated gas distribution jurisdictions in eight states with

~ 4.5 million customers, second largest in the U.S.

~ 119,000 miles of pipe, largest in the U.S.

Electric Utility Services

Electric transmission and distribution operations with ~2.4 million metered customers across ~5,000 sq. miles in and around Houston, Texas

Electric generation, transmission, and distribution to ~145,000 metered customers in southwestern Indiana

(1) Operational data based on information as of December 31, 2017
(2) Does not include approximately 72,000 natural gas customers as of December 31, 2017 that are under residential and small commercial choice programs invoiced by their host utility

CENTERPOINT ENERGY MINNESOTA GAS
AT A GLANCE

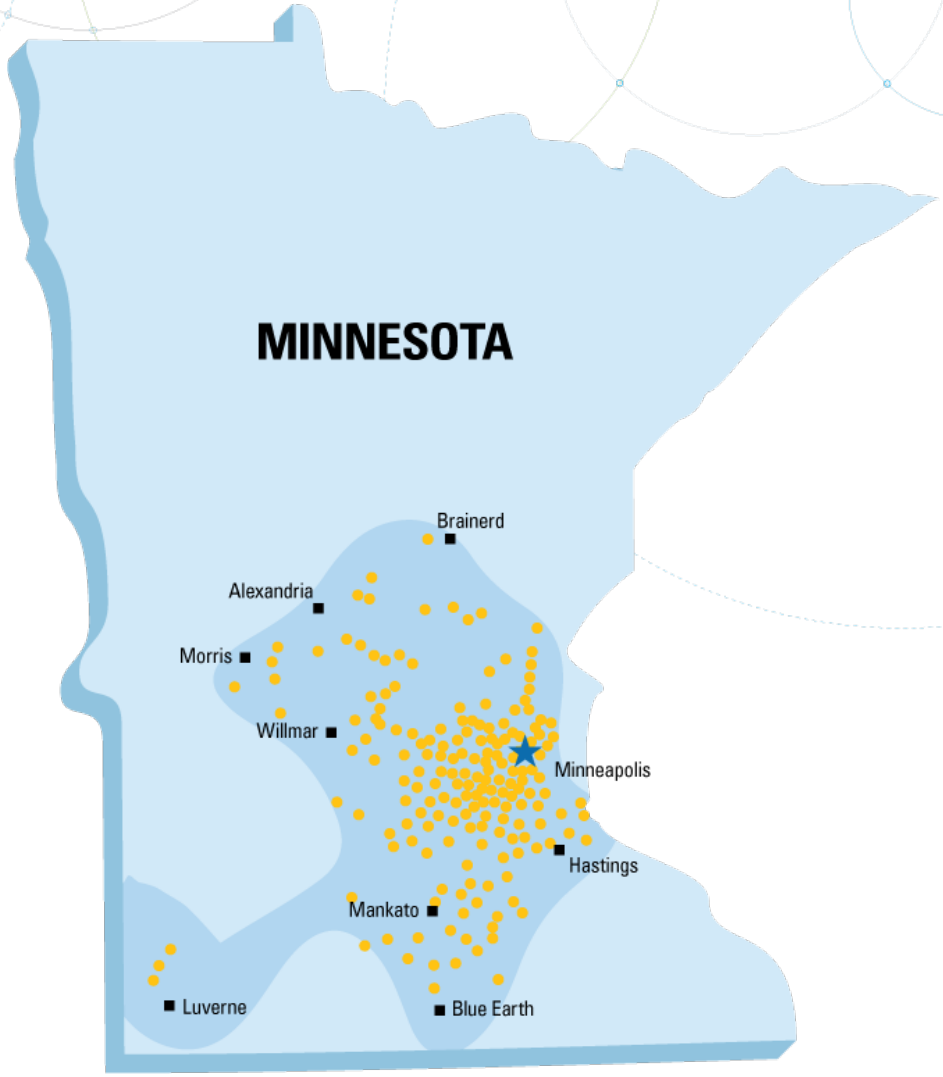
Largest natural gas distribution business in Minnesota:

Serving

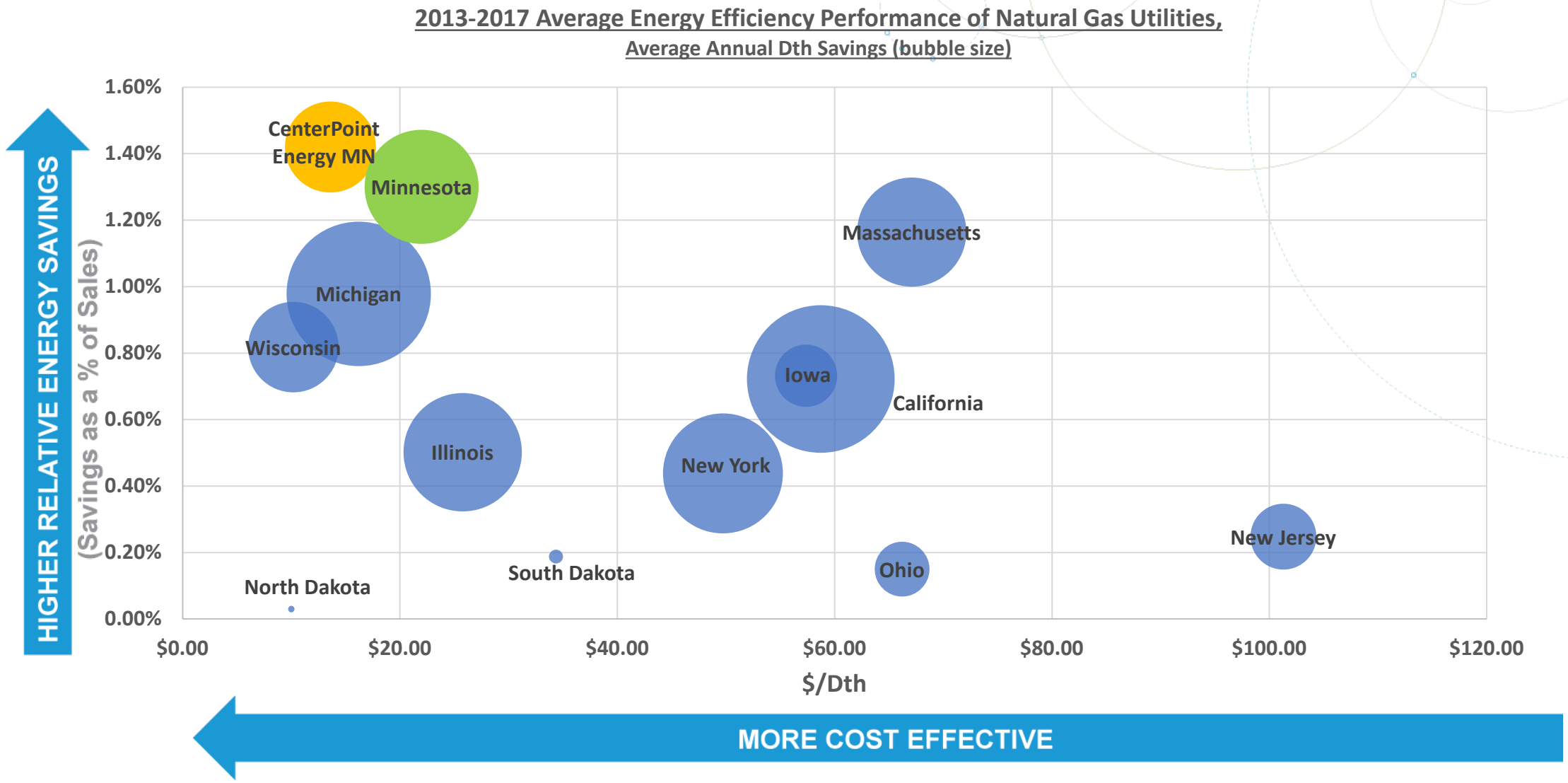
- 860,000 customers
- 260 communities

Employing

- 1,200 employees

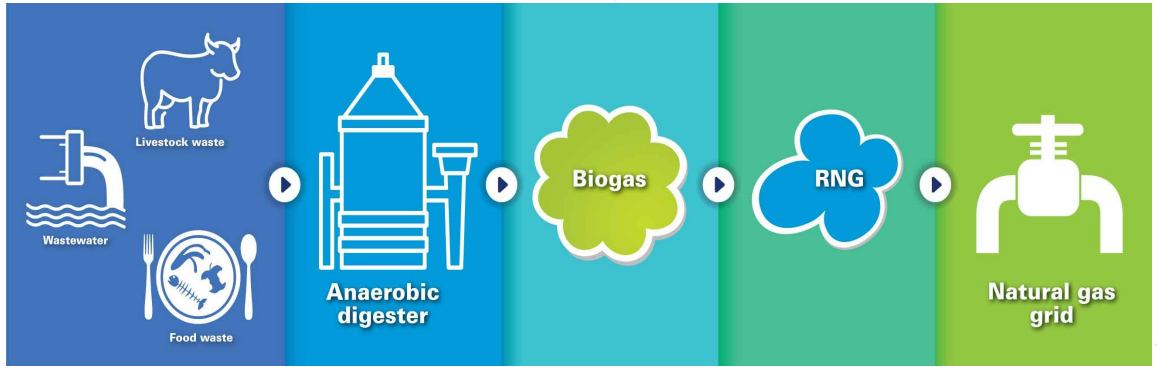


CONSERVATION IMPROVEMENT PROGRAM



Source: ACEE's State Energy Efficiency Scorecard. Editions 2014-2018. http://aceee.org/state-policy/scorecard. CenterPoint Energy Data from the 2019 Decoupling Report.

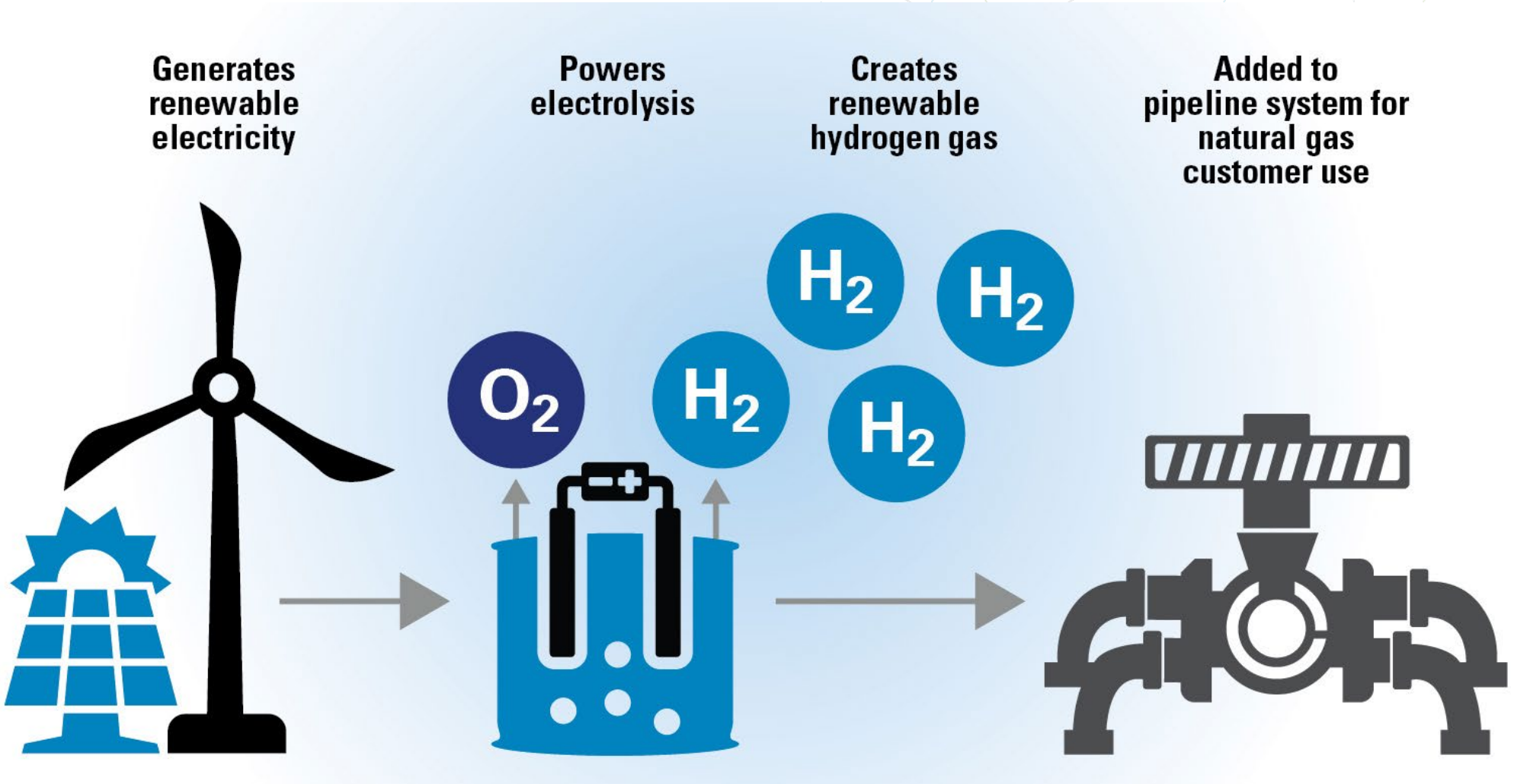
- Wanted more detail on tracking and verification systems
- Wanted local supply
- Wanted a demonstration of scalability
- Encouraged the Company to resubmit a revised program proposal

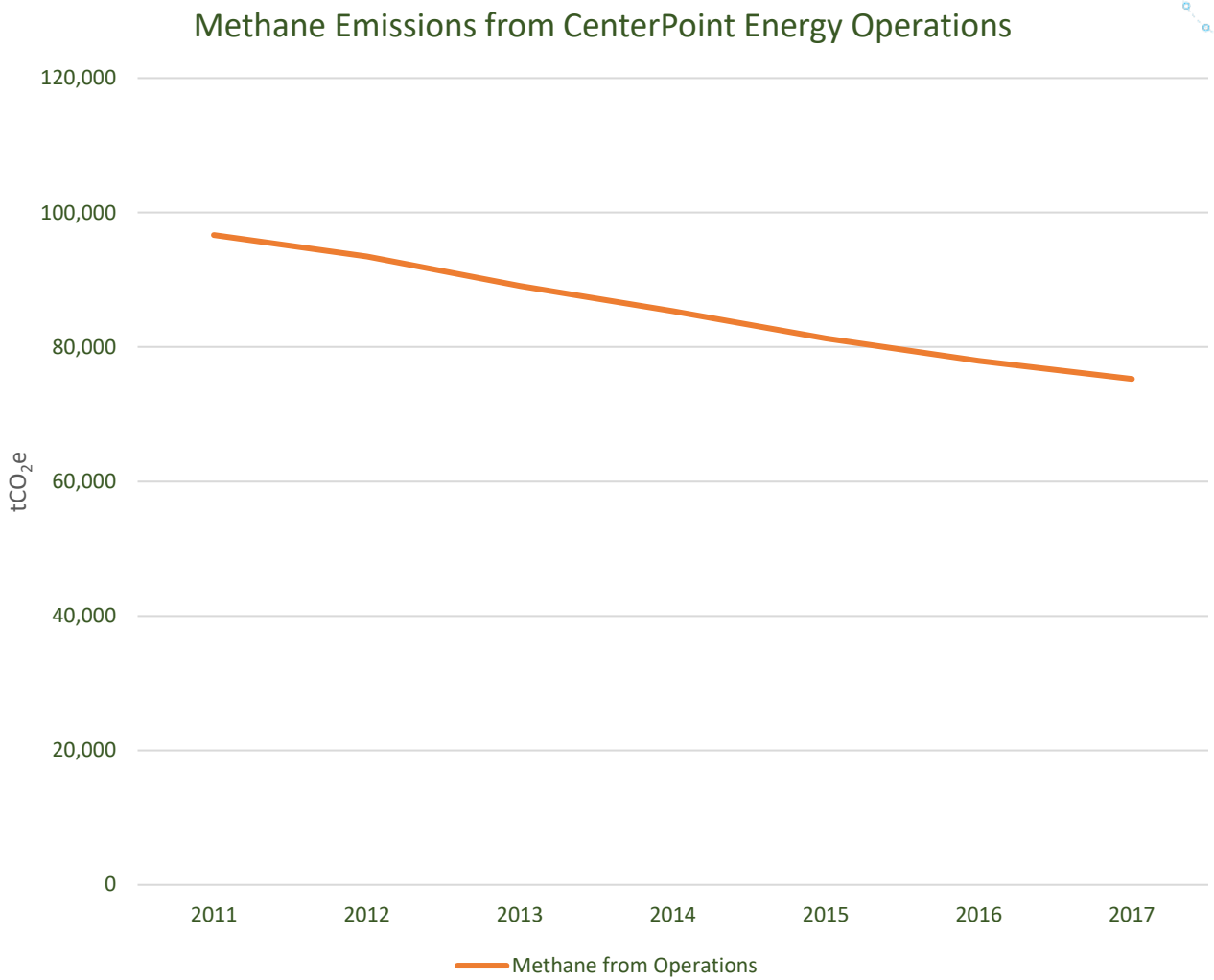


- Proposes a process for producers seeking interconnection
- Proposes quality standards for injection

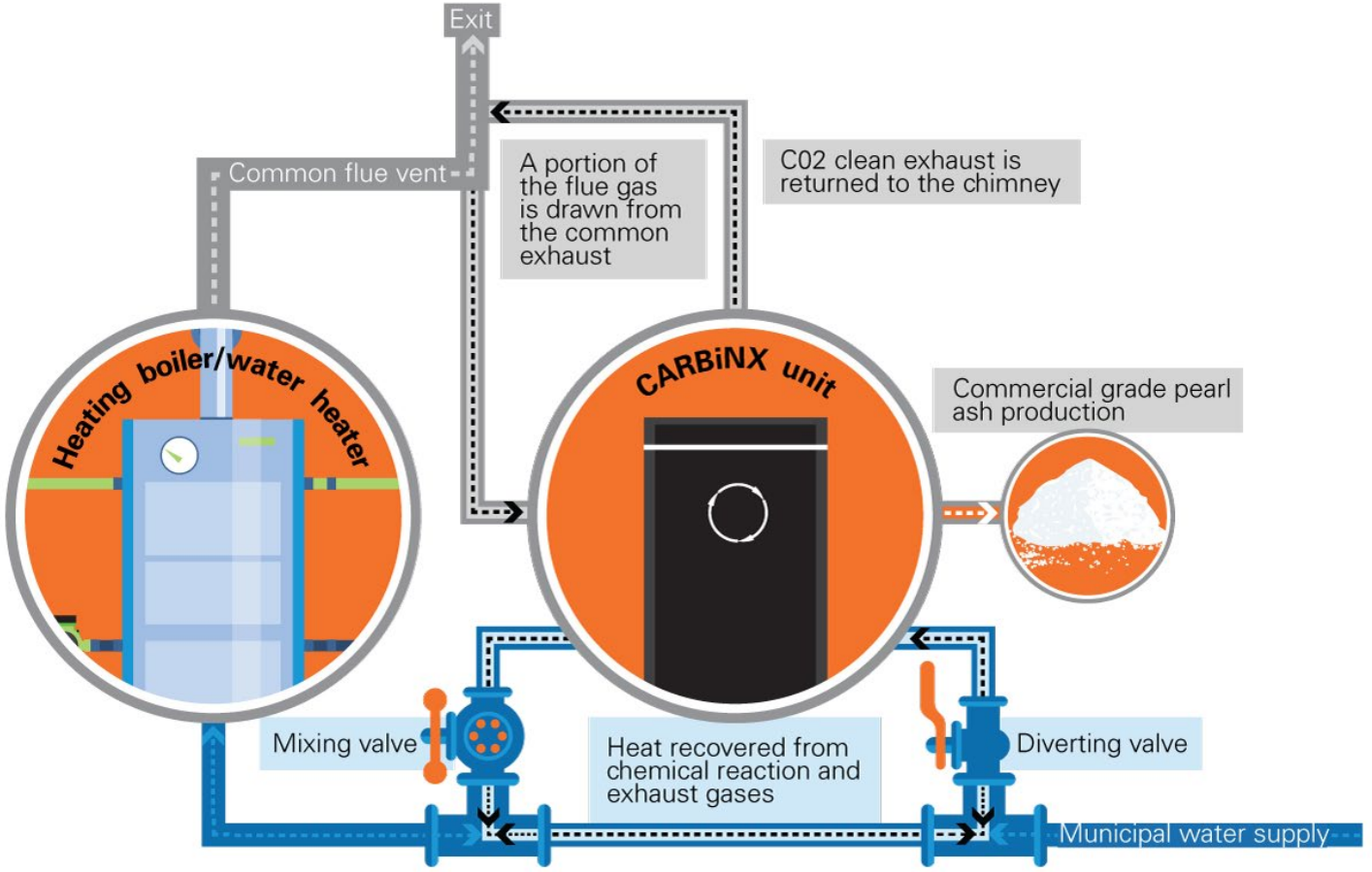
- CenterPoint Energy will not (necessarily) buy the RNG – will transport to interstate system for producer
- Will charge similar to existing transport tariff – a monthly basic charge, a volumetric “receipt” charge
- CenterPoint Energy will seek a return on investments to serve RNG developers similar to return for transport customers
  - Reduces the need for upfront payment by developer

CenterPoint Energy



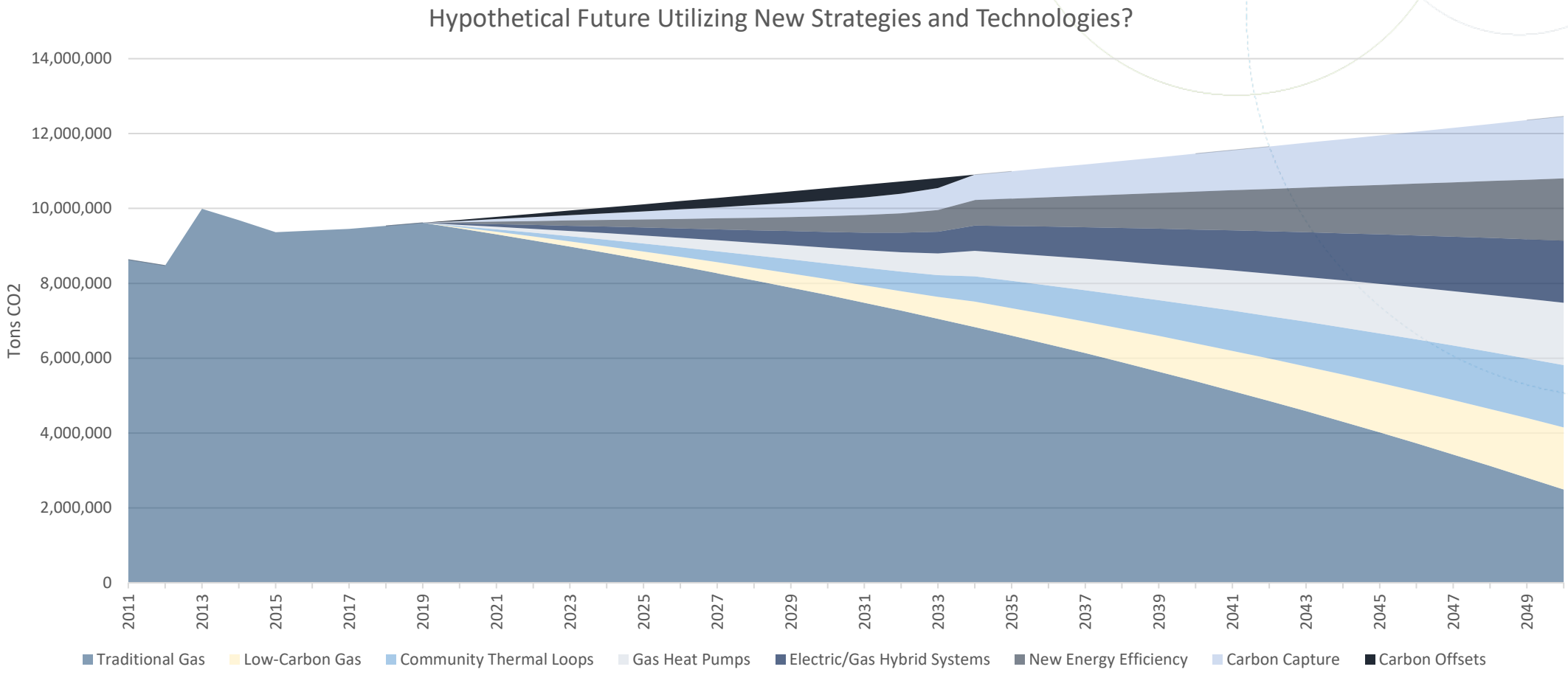


Source: United States Environmental Protection Agency, Facility Level Information on Greenhouse gases Tool, https://ghgdata.epa.gov/ghgp/main.do.


Exit
Common flue vent
A portion of the flue gas is drawn from the common exhaust
C02 clean exhaust is returned to the chimney
Heating boiler/water heater
CARBiNX unit
Commercial grade pearl ash production
Mixing valve
Heat recovered from chemical reaction and exhaust gases
Diverting valve
Municipal water supply

- Definitions
- Clarifies legislative intent that natural gas utilities can assist the state in meeting existing renewable energy and greenhouse gas reduction goals
- Alternative resource plans
- Renewable natural gas inventory


Natural gas plays a pivotal role in:
Providing consumers with a safe, clean and affordable source of direct heating
Supporting transition of the nation's generation fleet to meet lower carbon-emission goals
NEW GOALS TO REDUCE CARBON EMISSIONS
from 2005 levels
70%
reduction from our operations
by 2035
20-30%
reduction from customer usage
by 2040
by
1. Partnering with customers to offer affordable conservation and energy-efficiency programs
2. Continuing to develop alternative fuels programs
3. Partnering with suppliers to lower their methane emissions
4. Piloting and supporting research and development


Hypothetical Future Utilizing New Strategies and Technologies?
Tons CO2
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
2011
2013
2015
2017
2019
2021
2023
2025
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2031
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2039
2041
2043
2045
2047
2049
Traditional Gas
Low-Carbon Gas
Community Thermal Loops
Gas Heat Pumps
Electric/Gas Hybrid Systems
New Energy Efficiency
Carbon Capture
Carbon Offsets

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What is Xcel doing and planning around decarbonization strategies?

Lauren Wilson, Xcel Energy

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Center for Energy and Environment

BUILDING A CLEAN ENERGY FUTURE

March 2020

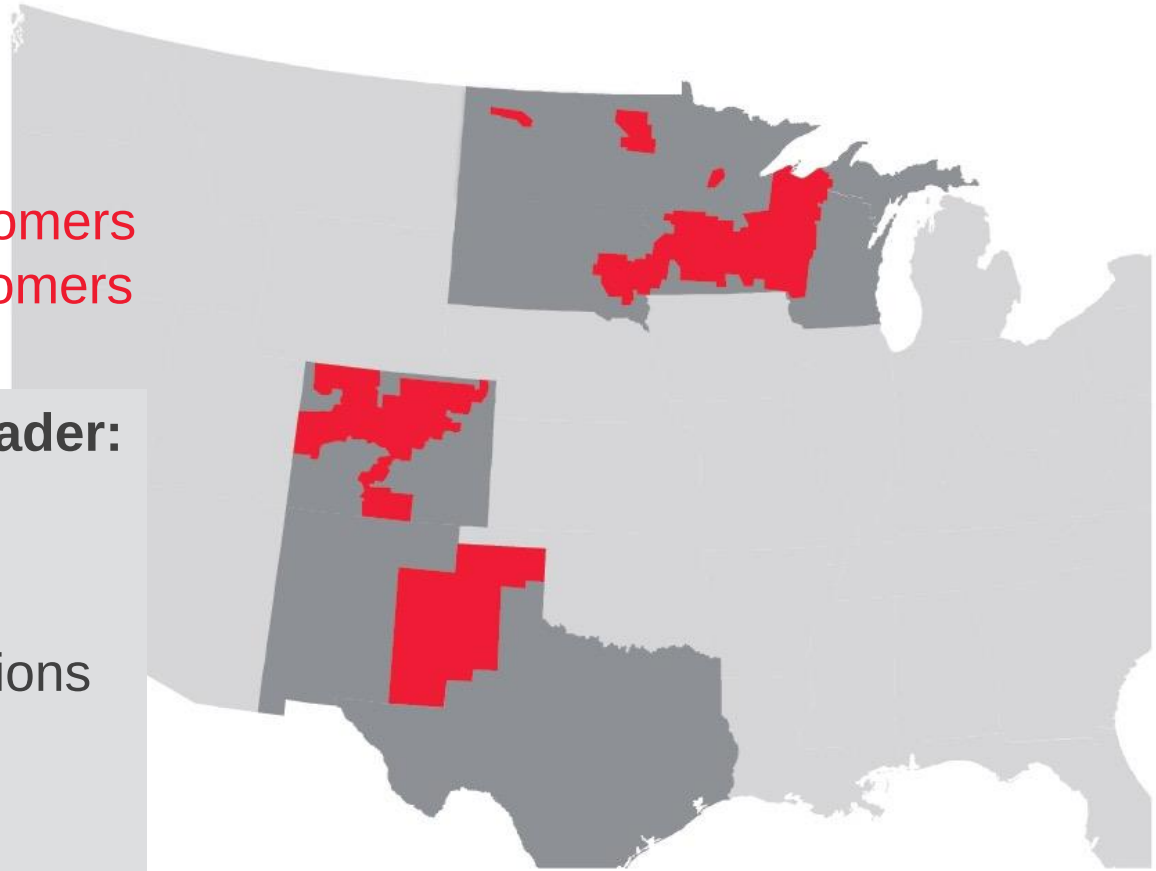
Xcel Energy

Serving eight states

- 3.6 million electricity customers
- 2 million natural gas customers

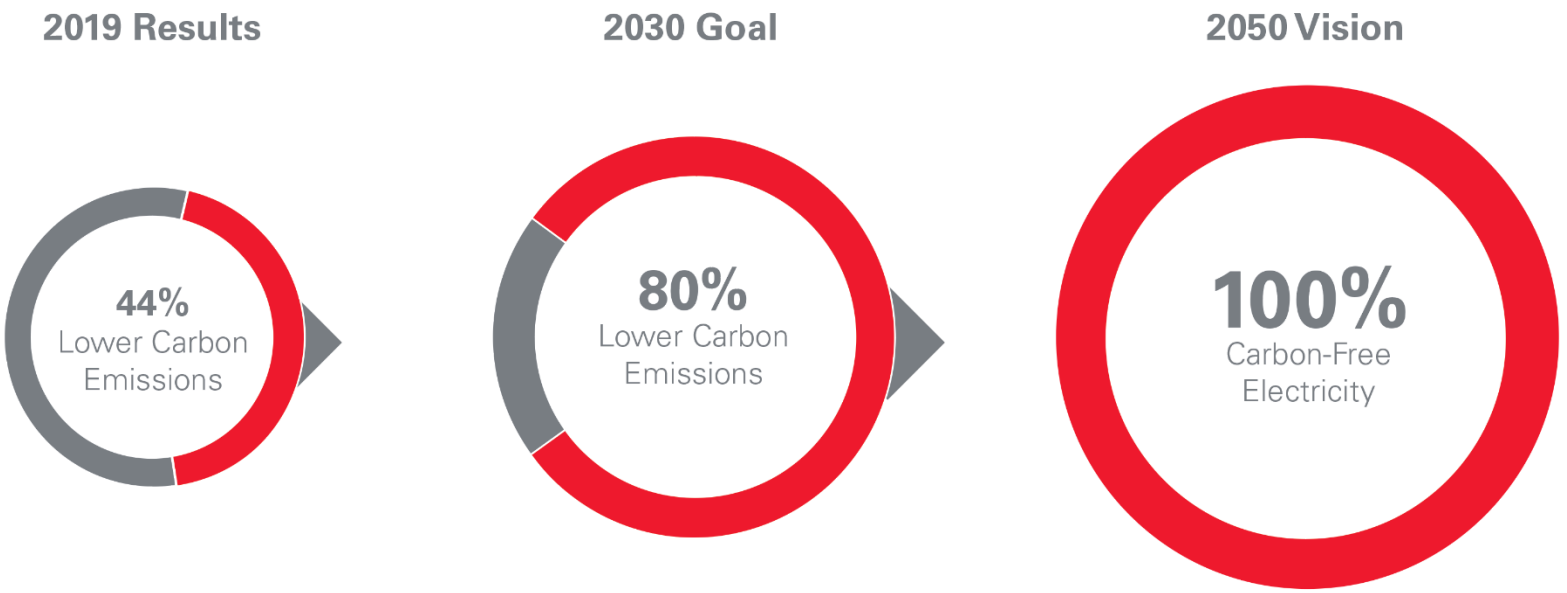
Nationally recognized leader:

- Wind energy
- Energy efficiency
- Carbon emission reductions and reporting
- Innovative technology



Leading the Clean Energy Transition

A bold vision for a carbon-free future

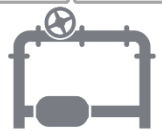


Company-wide emissions reductions from the electricity serving our customers, compared to 2005

Reducing Emissions from the Natural Gas System

Producers and Suppliers

Xcel Energy System



Customer

Collaborative Natural Gas Sustainability Initiatives

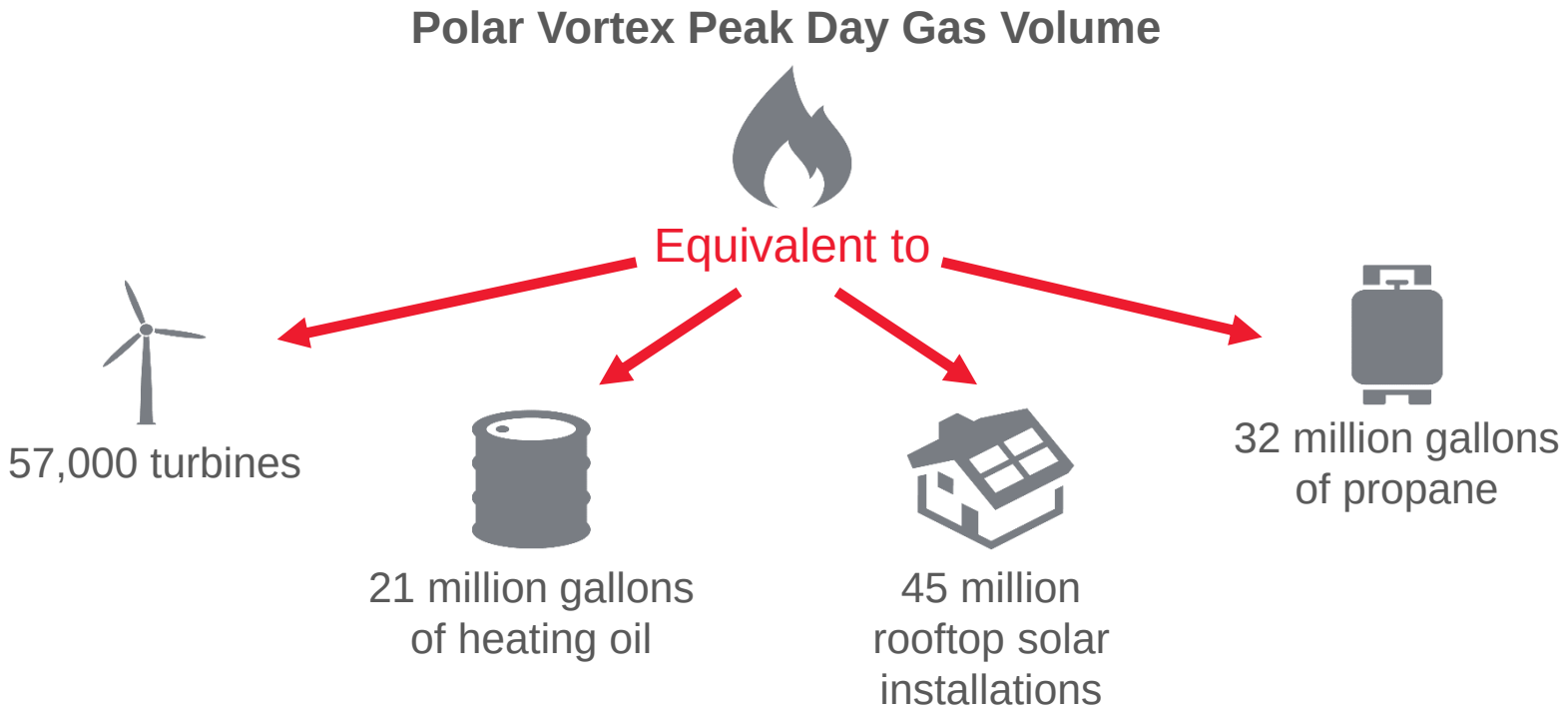
- Partnering to encourage transparency and disclosure
- Exploring opportunities to drive best practices among our suppliers

- Replacing pipelines
- Participating in EPA Natural Gas STAR, Methane Challenge
- Participating in ONE Future
- Connecting RNG, hydrogen and power to gas

- Increasing conservation
- Developing voluntary electrification programs
- Offering customers low-carbon supply options

The natural gas system is an energy workhorse

Customers depend on natural gas on cold winter days



Challenges to Replacing Natural Gas

Technology

Impacts to Low-income Customers

Electricity Dependence

Unintended Environmental Impacts

Customer Choice

Safety and Comfort

Our System: Environmental Leadership

- EPA Natural Gas Star and Methane Challenge
- 50+ customer conservation programs

Our System: ONE Future Commitment

- Industry partnership started in 2014
- 20 members across the supply chain
- Goal is to limit emissions rate of entire supply chain below 1%
- Distribution must limit emissions rate below 0.2% (emissions divided throughput, normalized)

Our Customers: Voluntary Offerings

We are pursuing a portfolio of programs to address customer emissions with the technology available today.

Strategy	Recommendation
Managing Load	Expand gas energy efficiency
Beneficial Electrification	Gas to electric water heater programs
	All electric community offering
Lower Carbon Supply	Renewable Natural Gas customer product
	Hydrogen demonstration

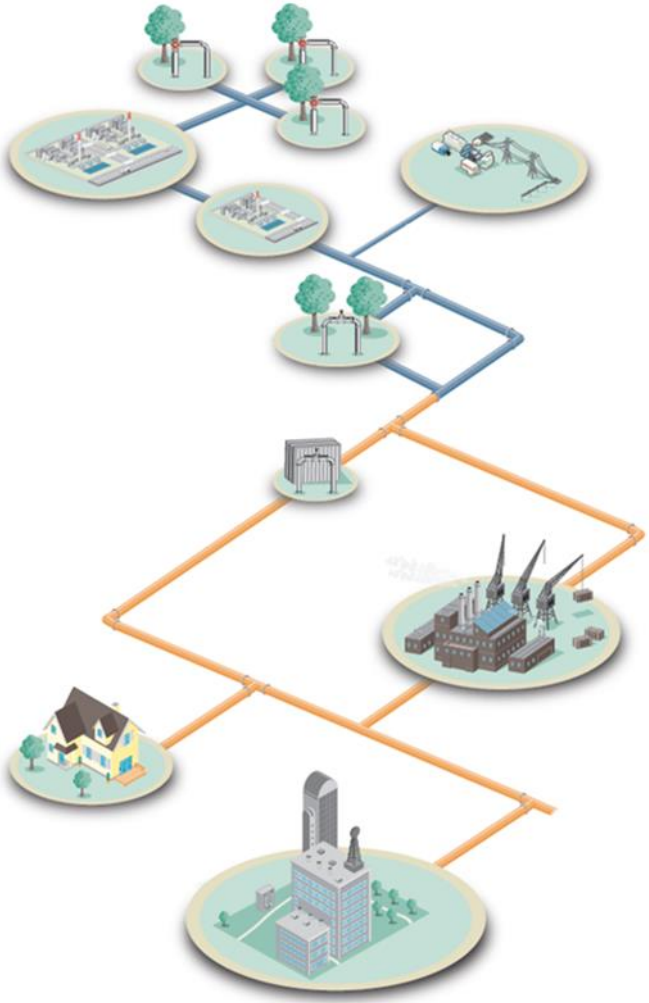
Our Suppliers: Upstream Strategy

Disclosure

Best Practices

Performance

- Participating in initiatives that encourage increased disclosure and emissions reporting among suppliers
  - MJ Bradley Natural Gas Supply Collaborative
  - EEI's Natural Gas Sustainability Initiative
- Evaluating ways to further exert our buying power as an individual company



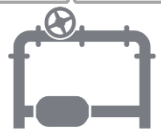
Reduce and repurpose: future innovation

- Renewable natural gas
- Hydrogen and power to gas
- Long-duration storage
- Hybrid appliances

Reducing Emissions from the Natural Gas System

Producers and Suppliers

Xcel Energy System



Customer

Collaborative Natural Gas Sustainability Initiatives

- Partnering to encourage transparency and disclosure
- Exploring opportunities to drive best practices among our suppliers
- Replacing pipelines
- Participating in EPA Natural Gas STAR, Methane Challenge
- Participating in ONE Future
- Connecting RNG, hydrogen and power to gas
- Increasing conservation
- Developing voluntary electrification programs
- Offering customers low-carbon supply options


Xcel Energy®

Discussion:

- Challenges and opportunities with regard to utility perspectives on decarbonizing natural gas.
- Certainties and uncertainties (revisit from last meeting if time allows)

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DECARBONIZING MINNESOTA'S NATURAL GAS END USES

Meeting 4

March 13th, 2020

Via Zoom

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