

-PACIFIC-GAS-
AND-ELECTRIC
-COMPANY-

NATURAL GAS INNOVATION: PAST, PRESENT, AND FUTURE

A STORY OF ENERGY EVOLUTION, RESILIENCE, AND REINVENTION

August 18, 2025 - Western Regional Gas Conference, Phoenix



Mike Kerans

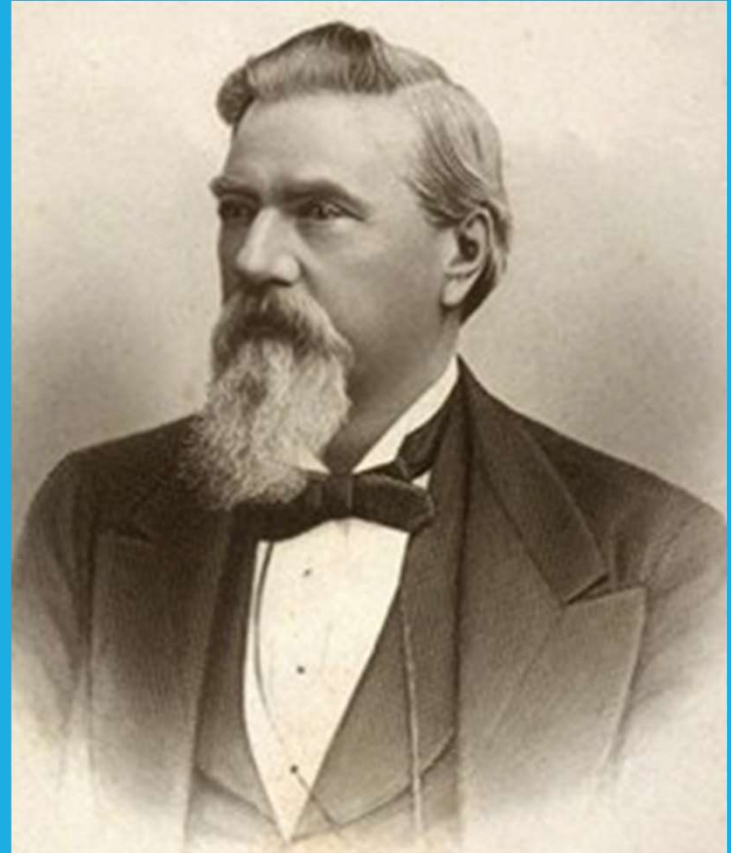
Senior Director

Gas Engineering

Pacific Gas & Electric Company

Natural Gas:

“This is going to be a great city at no distant day; there will have to be a gasworks....”



Peter Donahue

AGENDA



■ History of Western States Gas Innovations

- The origins of gas in the West
- Innovations over time



■ The Present Era of Gas Innovation

- Safety
- Reduce GHG Footprint
- Regulatory
- Decreased Costs



■ Reimagining the Gas System for the Future

- New Molecules
- Customer Impacts
- Back to the Future

PG&E GAS SYSTEM



Service Area

70,000 SQUARE MILES



~6,600 miles of gas transmission pipeline

~43,500 miles of gas distribution pipeline

9 compressor stations with **~175,000** HP

~3.6 million services totaling **~34,000** miles

3 PG&E-owned storage facilities with **51.1 BCF** capacity

~5,200 measurement and control facilities

Service area population

16 million CALIFORNIANS
(That's 1 in 20 Americans!)



4.6 million natural gas meters

OUR FIRST CUSTOMER

PRICE: \$15 PER MCF IN 1854



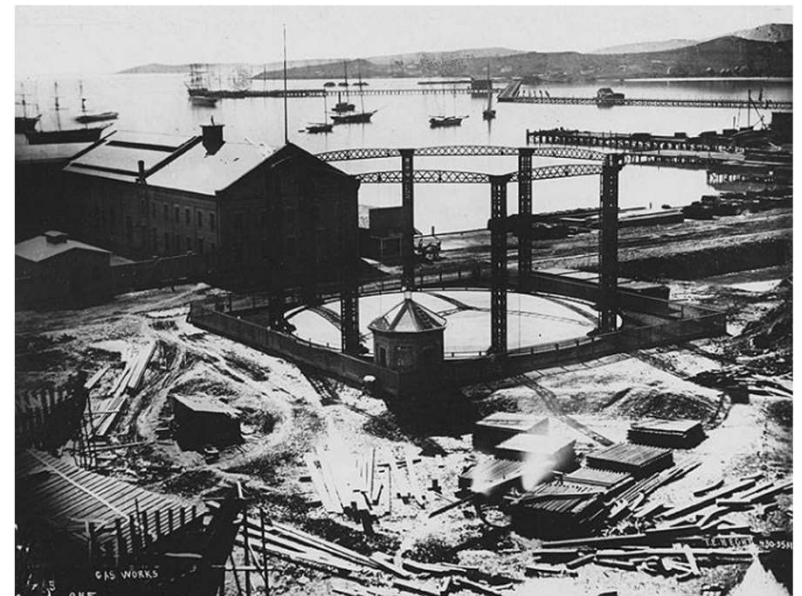
THE ORIENTAL,
CORNER OF BATTERY AND BUSH STREETS,
SAN FRANCISCO.

Caleb Hyatt, - - - - - Proprietor.

THE ORIGINS OF GAS IN CALIFORNIA AND THE WEST (1850S–1870S)

INNOVATION OF MANUFACTURED GAS FOR LIGHTING

- **Peter Donahue**, a machinist turned entrepreneur, envisioned a future for San Francisco lit by gas. In 1852, he and his brothers founded the **San Francisco Gas Company**, the first gas utility in the West.
- Gas was manufactured from coal and used for street lighting and homes. The first gas plant began operation in 1854 providing gas lighting to a gala at the Oriental Hotel.
- By the 1860s, gas lighting was widespread, and competition emerged.
- Cities across the West built Gas Works to meet customers demand for this innovative source of light!



THE ORIGINS OF GAS IN CALIFORNIA AND THE WEST (1850S–1870S)

EXPANSION, COMPETITION, AND PRICE WARS

- The gas industry expanded to inland cities like Sacramento, Stockton, Marysville, and San Jose, and others leading to **continued innovations**.
- 1877 the Oakland Gas Light Co. established the **first high-pressure gas transmission line in the United States**
- In 1879 Oakland Gas Light Co. made history by introduction of the **first gas cooking stoves in California**.
- In 1879 California Electric Light Co. began direct competition with gas lights.



Year	Nominal Price (\$/Mcf)	Inflation-Adjusted Price (2025 \$)	Notes
1854	\$15.00	\$562.50	Initial rate in San Francisco
1860	\$12.50	\$451.81	Early reduction
1870	\$10.00	\$229.01	Pre-rate war
1873	\$4.00	\$91.60	Post-rate war consolidation

Public

THE ORIGINS OF GAS IN CALIFORNIA AND THE WEST (1880S–1940S)

DISCOVERY, TRANSMISSION AND APPLIANCE CONVERSION



“We estimate that natural gas is saving all classes of customers about \$10 million per annum.”

This period marked a major shift from manufactured gas to cleaner, more efficient natural gas. **New fuel was introduced, Gas Plants were retired, New materials practices implemented.**

- In 1910, oil drillers discover natural gas in Kern County and the West side Gas Co is formed, leading to a **107-mile transmission line delivering 24 million cubic feet** to Los Angeles.
- In 1928, PG&E tapped into the Kettleman Hills gas field, bringing natural gas to the Bay Area via a **250-mile transmission pipeline.**
- **Appliance Conversion:** Transitioning from manufactured to natural gas required adjusting millions of appliances to accommodate the higher heat value and different combustion characteristics.
- In June 1949 work began on a 34-inch pipeline delivering gas from the southwest, **it was the largest diameter ever used at the time**

INNOVATIONS OVER TIME



Timeline	Innovations in Gas Industry	Price of Gas (~2025 dollars)
1840's - 1910's Manufactured Gas Era	• Manufactured gas built in Western states • Gas Lamps for street and home lighting • Gas Appliances for cooking and heating • Early High-Pressure Transmission lines	\$562 - \$120
1910's – 1920's Transition to Natural Gas	• Advances in drilling and steel pipe manufacturing • Discovery of Natural gas in the West • Large Scale Planned Appliance conversions	\$120 - \$28
1920's – 1940's Pipeline Infrastructure	• Improvements in steel allow large diameter, long distance transmission • Compressor Stations • Natural Gas Regulations	\$28 - \$16
1940's – 1970's Post War Expansion	• Invention of polyethylene pipelines • Improvements in metering and regulations • Development of storage fields • Odorization	\$16 - \$8
1970's – 2010's	• Smart Metering, Electrofusion, Risk Management, Fracking, leak detection, advanced welding, LNG/CNG improved safety standards.	\$8 - \$5

OUR CUSTOMERS TODAY

PRICE: \$3 PER MCF IN 2025



THE PRESENT ERA OF GAS INNOVATION

WE CONTINUE TO INNOVATE

- Advanced leak detection
- In line inspection
- Meter technology
- Drones
- Predictive risk modelling
- Changing Molecules



BUT WHY CONTINUE TO INNOVATE SUCH A MATURE INDUSTRY?

THE PRESENT ERA OF GAS INNOVATION

CHANGING CUSTOMER EXPECTATIONS ARE DRIVERS



Safety

Regulatory



Reduce GHG
Footprint

Decrease Cost



SAFETY AND REGULATORY

INNOVATION FROM REGULATORY AGENDA AND REFORM

In the first five months of this Administration, PHMSA has published more final or proposed rulemakings than it has in several years.



SAFETY AND REGULATORY

TODAY WE SEE INNOVATION FROM REGULATORY AGENDA AND REFORM

- Continued **SAFETY** First Focus
- I0 for I policy on regulations
- A focus on improved cost benefit data
- Seeking greater stakeholder engagement
- **Promote technological innovation**

Repair Criteria ANPRM

LNG ANPRM

Pipeline Safety: Integration of Innovative Remote Sensing Technologies

CO2 rule (under review for future action)

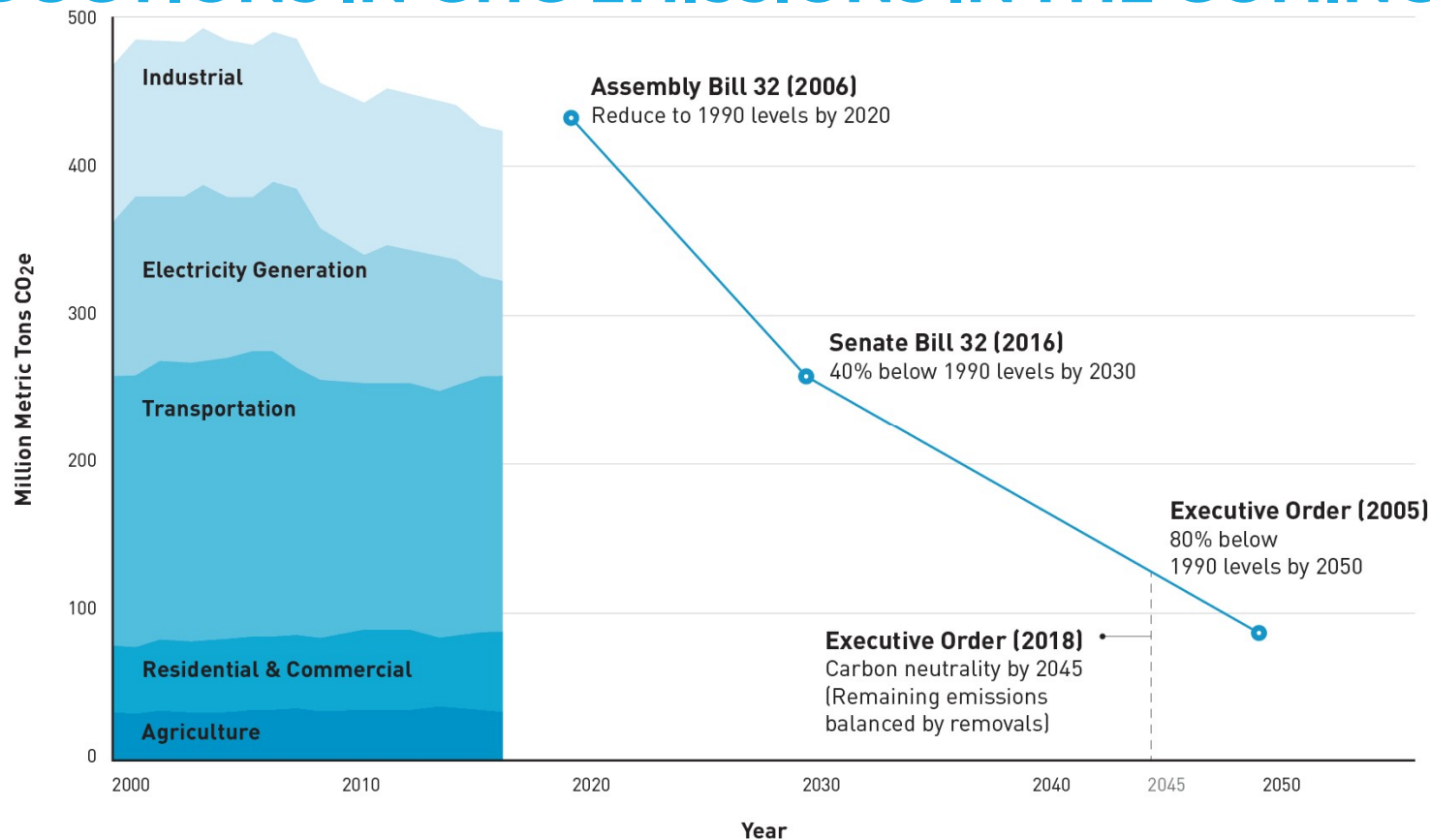
SAFETY AND REGULATORY

WHAT'S NEXT...

- **Pipeline Safety:** Keeping pipeline safety a priority. Leverage each other to continue to innovate and improve pipeline safety.
- **Reauthorization:** The 2024-2025 Reauthorization efforts have been stalled a in Congress.
 - Unclear when the House will come out with a bill or if they will go with the bill they had in 2024 or a new one.
 - The Senate has suggested a few items, but we have not seen much although there is a new draft that simply asks that the LDAR rule be moved forward. Industry is watching and waiting..." or something like that.
- **Regulations:** Delayed for for now, but some areas that may move forward include LDAR, Class Location, CO2, and the Gas Distribution NPRM.

CALIFORNIA'S GHG POLICY GOALS

THE STATE'S POLICY GOALS TARGET SUBSTANTIAL REDUCTIONS IN GHG EMISSIONS IN THE COMING DECADES



DECARBONIZATION IS AN EQUATION TO NET ZERO

As a society we need to reduce emissions and sequester carbon to have a cleaner environment and address climate change



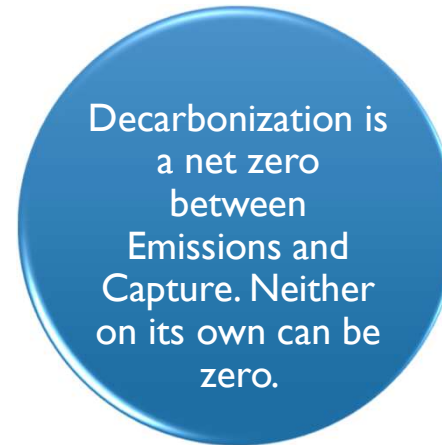
*Reduce CO2
Emissions*

+



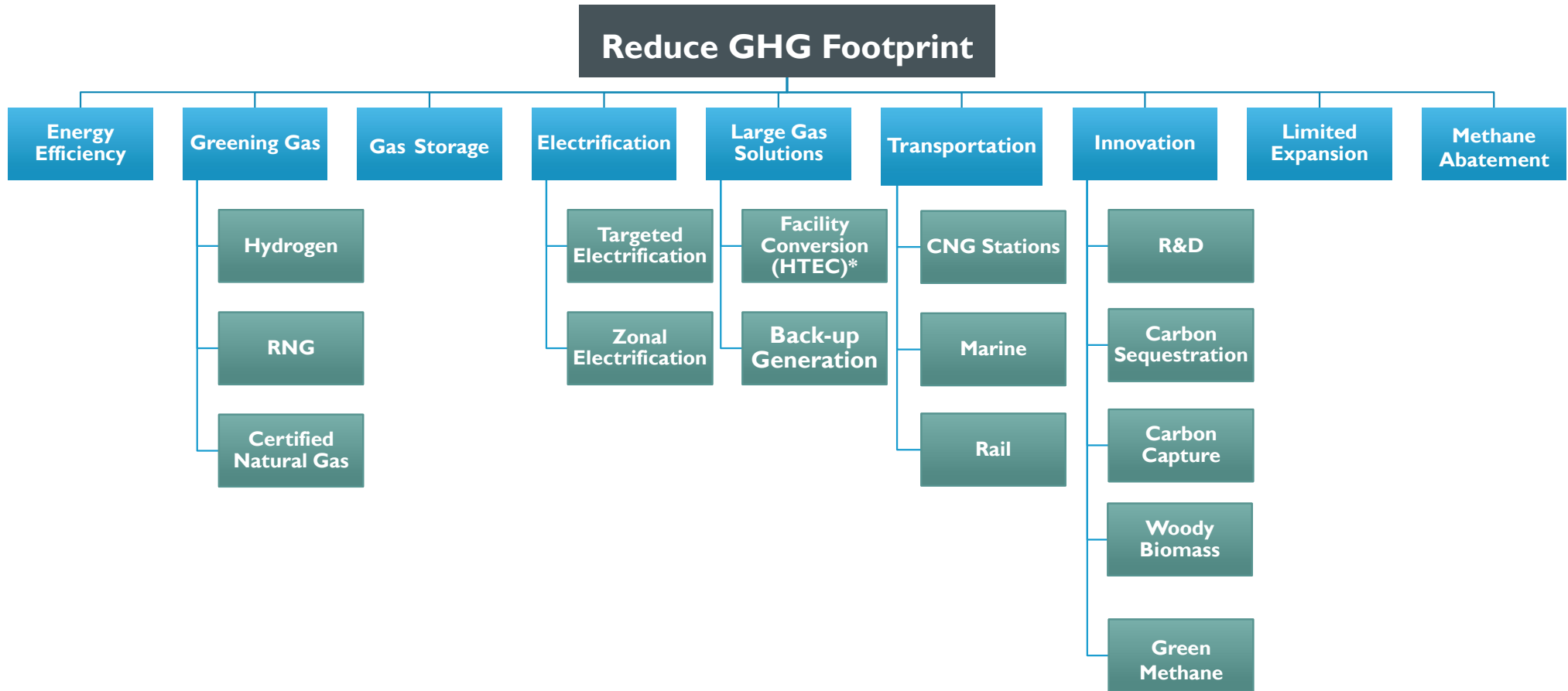
*Balanced by CO2
Capture and Removal of
Residual Emissions*

=



Decarbonization is
a net zero
between
Emissions and
Capture. Neither
on its own can be
zero.

TODAY'S FOCUS ON GHG INNOVATIONS



*Hard To Electrify Customers

PG&E'S GHG REDUCTION SECTORS

Sector	Associated PG&E Program
Industrial	Hydrogen, RNG, Certified Natural Gas, Energy Storage, Back-up Gen, Facility Conversion, R&D, Carbon Sequestration, Carbon Capture, Woody Biomass, Green Methane, Methane Abatement
Electric Generation	Hydrogen, RNG, Certified Natural Gas, Energy Storage, R&D, Carbon Sequestration, Carbon Capture, Woody Biomass, Green Methane, Methane Abatement
Transportation	Hydrogen, RNG, Certified Natural Gas, Energy Storage, CNG Stations, Marine, Rail, R&D, Carbon Sequestration, Carbon Capture, Woody Biomass, Green Methane, Methane Abatement
Residential/Commercial	Hydrogen, RNG, Certified Natural Gas, Energy Storage, Targeted Electrification, Zonal Electrification, Limited Expansion, R&D, Carbon Sequestration, Carbon Capture, Woody Biomass, Green Methane, Methane Abatement
Agricultural	RNG, CNG Stations, Woody Biomass

From slowing down GHG growth to net-zero carbon: an innovative transition

Public



DECREASE COSTS MODIFICATIONS TO THE GAS SYSTEM



Technology

Leverage today's technology to eliminate waste in processes.

Advance Leak Survey

Drones

Automation

Integrated Planning



Retirement

Cost savings when no customers are served by the pipeline.

Reduce Risk

Reduced O&M



Downrating

Downrate pipeline from Transmission to Distribution service to reduce costs.

Modify System pressure

Evaluate System loads

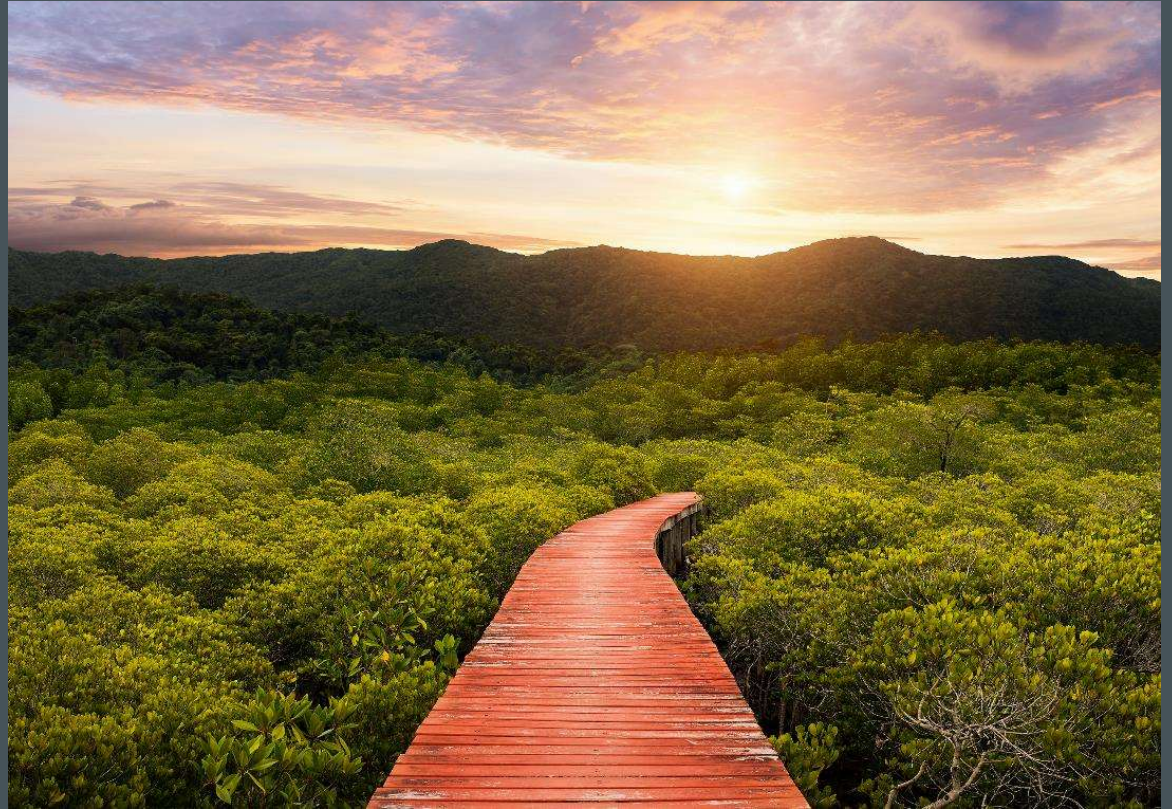


Customer Conversion

Convert end-use customers to alternative energy supply.

REIMAGING THE GAS SYSTEM FOR THE FUTURE

PRICE: \$3 PER MCF IN 2045?



REIMAGINING GAS IN CALIFORNIA AND THE WEST (2025–2040S)

INNOVATION OF NEW MOLECULES FOR GAS

- **Peter Piper**, a rancher turned entrepreneur, envisioned a future powered by **Renewable Natural Gas**. In 2027, he and his brothers founded the **Western Regional Gas Company**, the first RNG utility in the West.
- **Hydrogen Gas** was manufactured from Natural Gas Pyrolysis and used to blend into systems used for home, commercial, along with 100% hydrogen for industry. The first H₂ plant began operation in 2030 providing energy to ports.
- By the 2040s, the adoption of new molecules was widespread, and competition emerged in new markets.
- Cities across the West built **H₂** and **RNG** Works to meet international demand for this innovative fuel!



RNG SUPPLY POTENTIAL
FROM BIOGENIC
RESOURCES RANGE
FROM 1,628 TO 7,061
TBTU/YEAR

— A LEVEL THAT
EXCEEDS THE 10-
YEAR AVERAGE
RESIDENTIAL
NATURAL GAS
CONSUMPTION OF 4,840
TBTU/YEAR IN THE U.S.



REIMAGINING GAS IN CALIFORNIA AND THE WEST (2025–2040S)

CUSTOMER IMPACTS - APPLIANCE CONVERSION, TRANSMISSION, COST

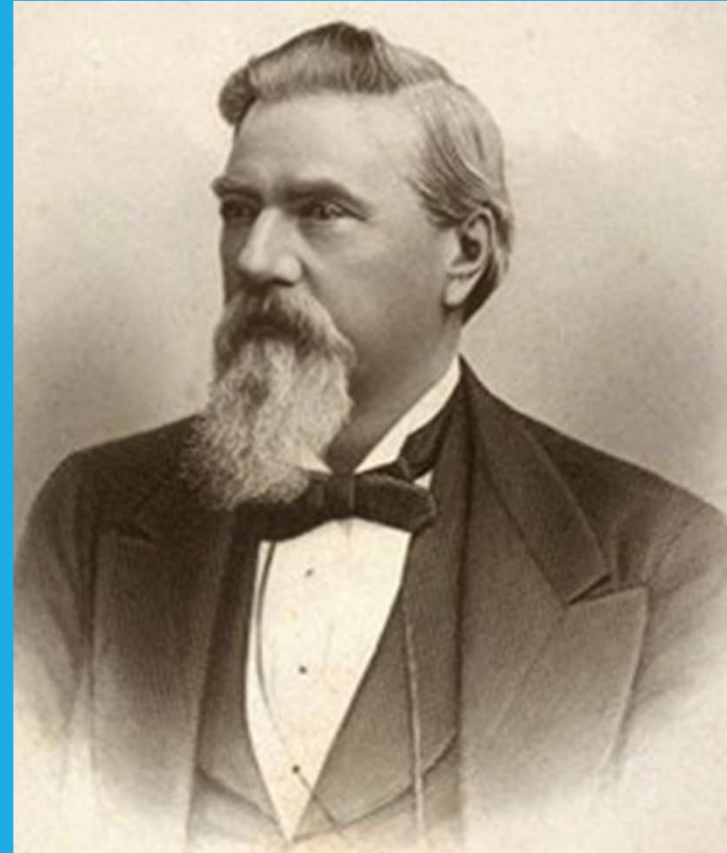
This period may mark a major shift from natural gas to cleaner, more renewable gases. **New fuels introduced, gas assets being modified, and new materials/practices implemented.**

- **Appliance Conversion:** Transitioning from manufactured to new molecules may require adjusting appliances to accommodate the higher heat value and different combustion characteristics.
- **Dedicated transmission** lines along with existing lines will accommodate new fuels, along with the Carbon Dioxide.
- New innovations and regulations will spur **increased safety, reduced emissions, expanded markets.**
- **Costs** in this period may follow a similar trend as seen in the 1850's



Natural Gas:

“This is going to be a great city at no distant day; there will have to be a gasworks.... And whoever has faith of these enterprises will make money ”



Peter Donahue



Thank You

Mike Kerans

Mike.Kerans@pge.com

Pacific Gas & Electric Company