Renewable Natural Gas

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About Us

M.J. Bradley & Associates ("MJB&A") is a multi-disciplinary team of experts with a long-track record of advising industry, NGOs, and government agencies on energy and environmental policy, technology, and implementation. Our staff have backgrounds in law, engineering, finance, policy, and environmental science.

Key areas of focus and expertise:

- Power Sector
- Natural Gas Sector
- Transportation and Electric Vehicle Technology and Policy
- Engineering and Technical Services

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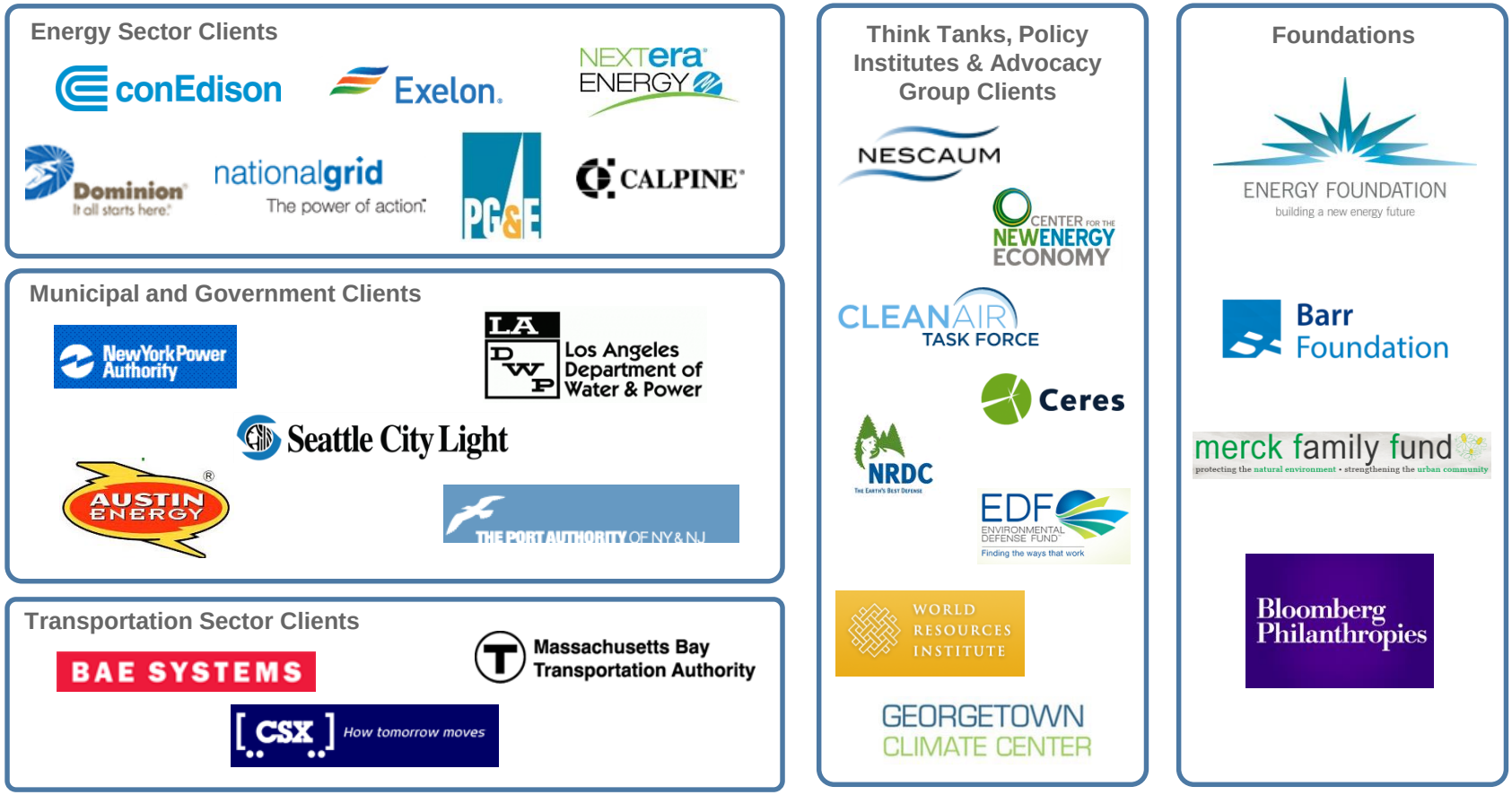
We help our clients:

- Evaluate the market implications of emerging laws and regulations
- Execute on strategic policy initiatives
- Manage sustainability programs
- Develop market entry strategies for emerging technologies
- Evaluate investment opportunities
- Track state, regional, and federal energy and environmental initiatives
- Engage with stakeholders and communities

Sampling of Clients

Our clients are multi-national in scope and include energy and clean technology firms, environmental groups, transportation companies, and government agencies.



Downstream Natural Gas Initiative ("DSI")

The Downstream Natural Gas Initiative (DSI) is a group of leading natural gas utilities collaborating to address the role of natural gas in a low-carbon future. The Initiative is focused on opportunities for expanding natural gas end-use markets and leveraging existing infrastructure to support near-term and long-term environmental and economic goals.

Key Issues

- Best practices to reduce methane emissions from natural gas distribution infrastructure and operations
- Ongoing leak detection technology research, development, and deployment
- Methane Challenge Program
- Decarbonization pathway analysis and discussions
- Policy, regulatory, and market barriers to development of the growth of renewable natural gas (RNG)

Member Companies

Consolidated Edison

Énergir

National Grid

NiSource

Pacific Gas & Electric

Vermont Gas

Xcel Energy

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Drivers for a Low-Carbon Future

Non-federal U.S. climate pledges to achieve Paris climate goals[1]:

- U.S. Climate Alliance. 14 states and Puerto Rico representing 36 percent of U.S. population.
- We Are Still In. 2,320 states, cities, businesses, and universities representing 40 percent of U.S. population.
- U.S. Climate Mayors. Mayors of 383 mayors representing 23 percent of U.S. population.

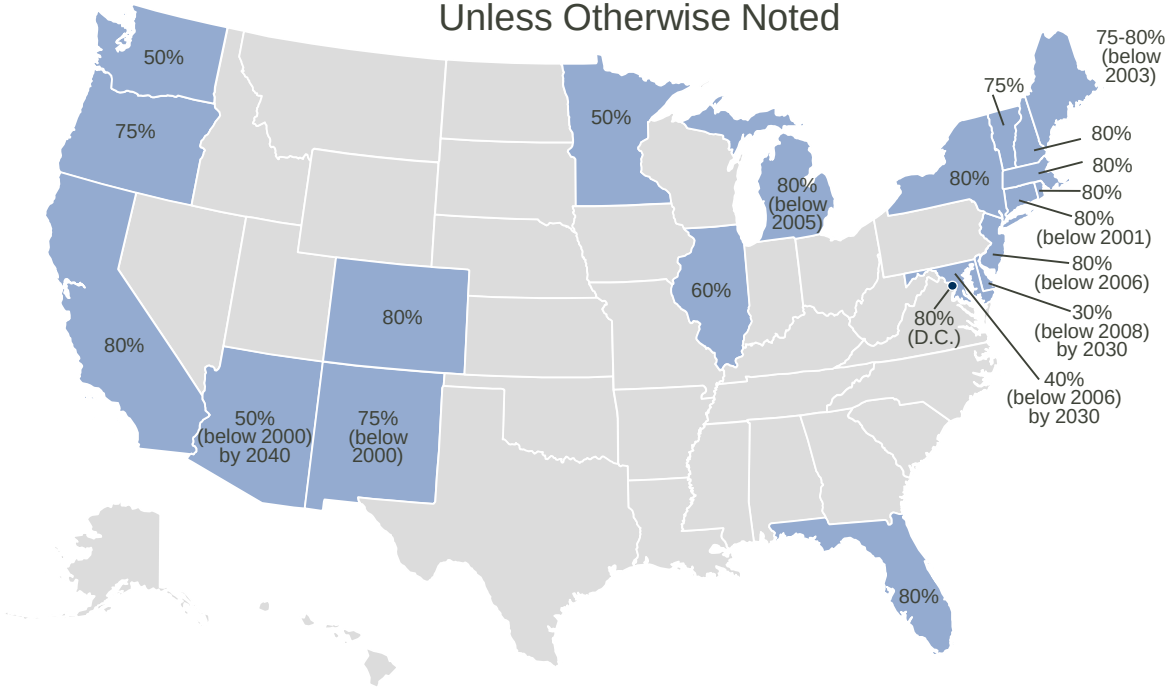
Investor Action:

- Task Force on Climate-related Financial Disclosures
- Climate Action 100+

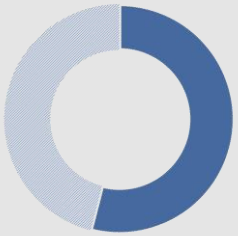
[1] there is overlap of population percentages across each group

2050 GHG Reduction Targets From 1990 Baseline

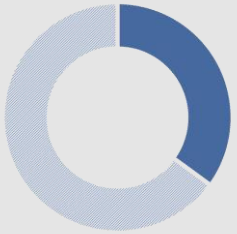
Unless Otherwise Noted



GDP and GHG emissions of states and cities supporting the Paris Agreement



Gross Domestic Product (2016)
$10.1 Trillion
54% of U.S. GDP



GHG Emissions (2016)
2.3 GT
35% of U.S. GHG Emissions

Source: America's Pledge

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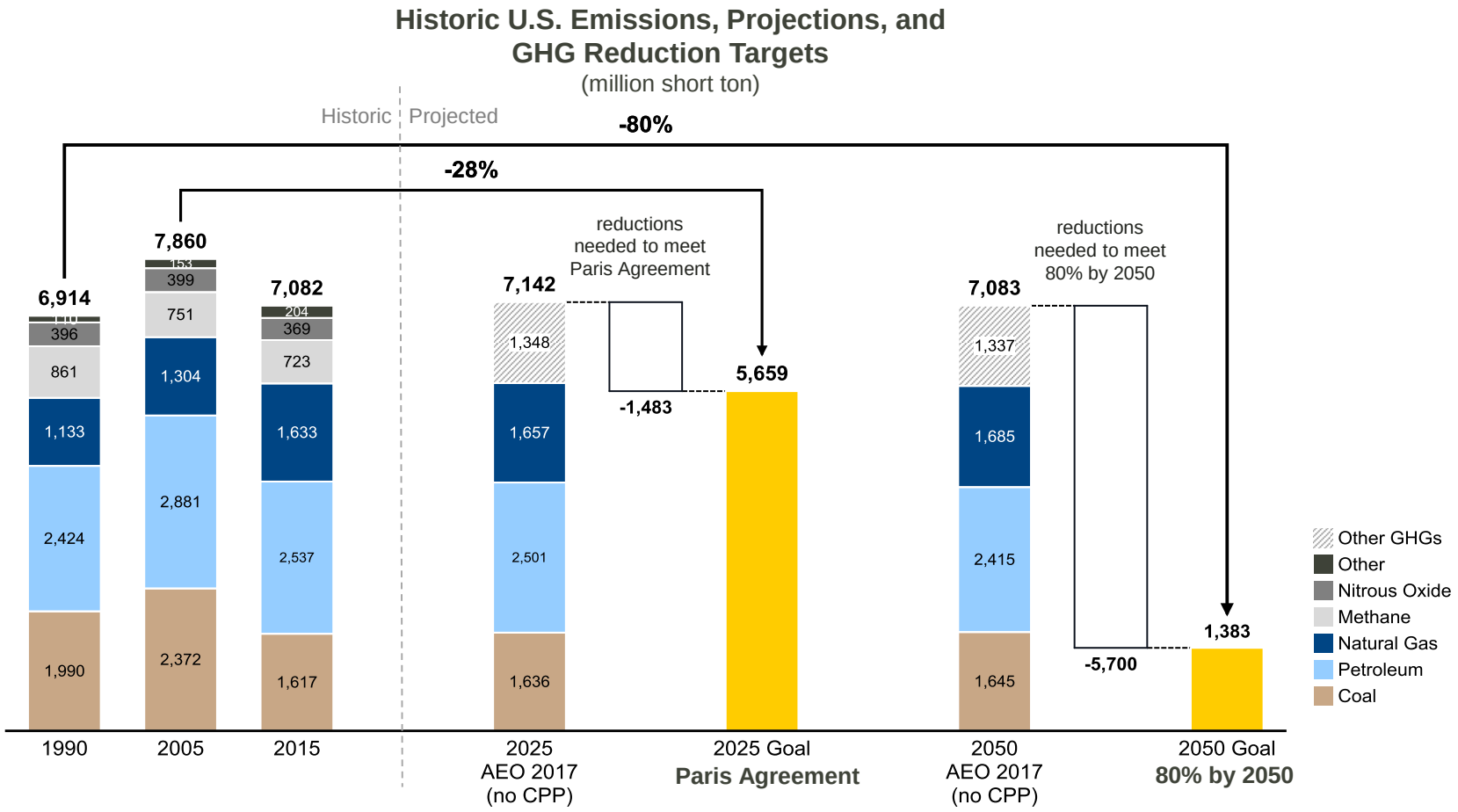
Emissions Sources and Goals

GHG reduction goals require near elimination of fossil fuel emissions



Sources: EIA historic CO_2 emissions from fossil fuel consumption; EPA GHG Inventory; MJB&A analysis

Notes:

1. Emissions by fuel type account for CO_2 emissions from fossil fuel consumption, which represents roughly 82% of total emissions
2. "Other" includes emissions from HFCs, PFCs, SF_6, NF_3
3. "Other GHGs" estimated using EPA GHG Inventory historic 2015 non-CO_2 emissions' share of total GHG emissions

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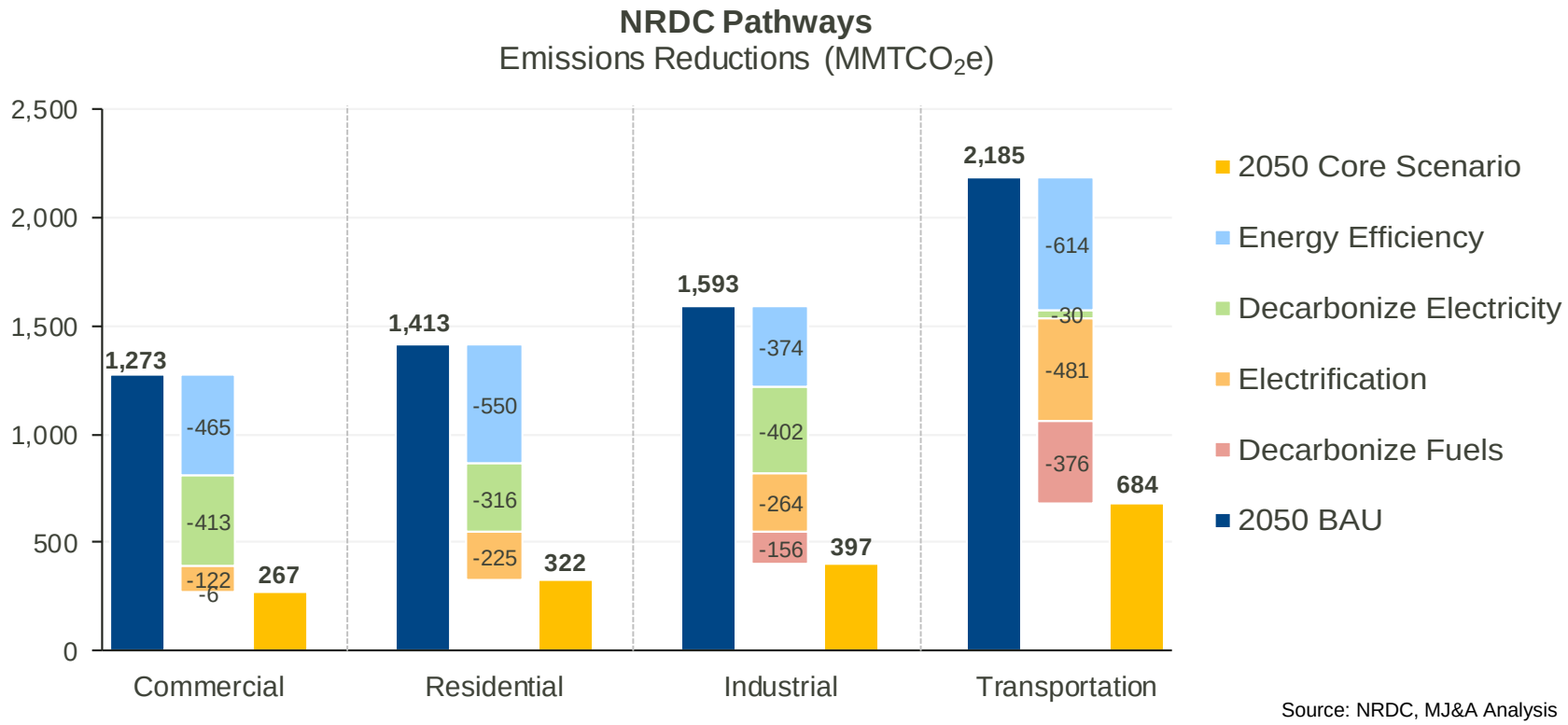
Pathways Analyses Illustrate Impact on Fossil Fuels



Source: NRDC, MJ&A Analysis

LDC Impact-Related Findings

- Energy demand decreases primarily through improvements in appliance, heating, and facility efficiency
- Residential/commercial energy demand is almost completely electrified by 2050
- Industrial process limitations require decarbonized fuel sources and feedstock
- Industrial CHP capacity increases substantially

Renewable Natural Gas LDC Actions…Picking Up

Voluntary Customer Program	FORTIS BC™, Vermont Gas, DTE Energy, CenterPoint Energy
Private-Public Partnerships	nationalgrid HERE WITH YOU. HERE FOR YOU., NW Natural®
Direct Purchase-Thermal REC Policies	Liberty Utilities
RNG Upgrading Tariffs	TECO PEOPLES GAS AN EMERA COMPANY, SoCalGas A Sempra Energy utility®
Power to Gas Pilots	SoCalGas A Sempra Energy utility®

RNG Barriers

Regulatory

LDCs are subject to least-cost requirements. Costs for RNG investments can be challenging to approve. The vast majority of regulators currently do not consider state climate targets in their least cost analyses.

Financial

A biogas collection system, RNG processing facility, and gas pipeline interconnection and lateral can cost tens of millions of dollars. Projects are not economically viable if developers must cover all of these costs.

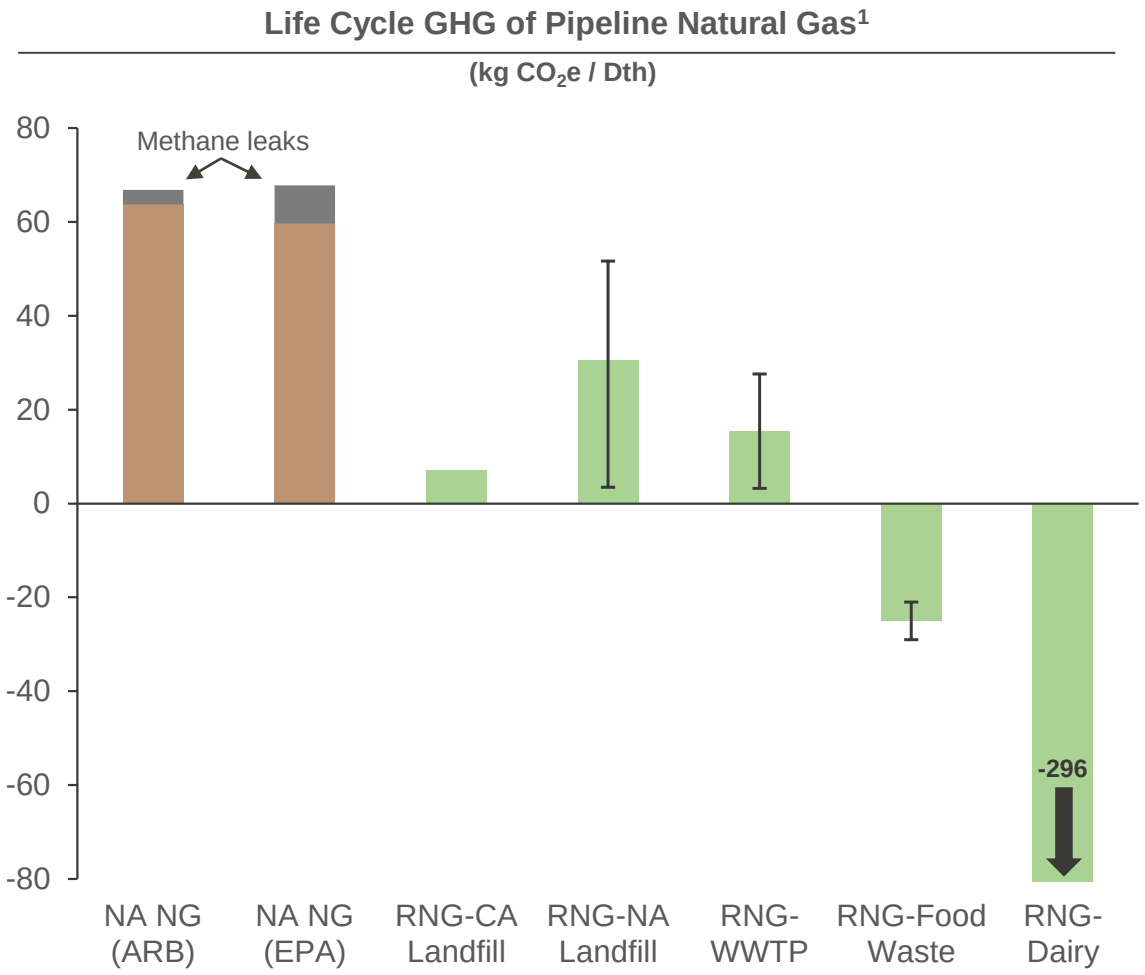
Market

Current primary demand drivers are the transportation (RFS, LCFS) and electric power (state RPS) sectors. LDCs need RNG customers who are willing to pay higher prices to justify investments.

Technical

Uniform gas quality and interconnection standards are key to providing certainty to both RNG producers and the LDCs accepting RNG into their systems.

GHG Benefits of Renewable Natural Gas



[1]Based on California LCFS. Error bars show range of approved pathways for commercial fuels. EPA values for North American natural gas based on EPA GHG Inventory.

Other RNG Benefits

- Generates local economic activity and job creation
- Local gas supply enhances fuel diversity
- Local air quality improvements (elimination of flaring and onsite combustion of biogas)
- Uses existing infrastructure to deliver renewable energy
- Beneficial use of a waste stream
- More efficient use of energy (compared to onsite electric generation)

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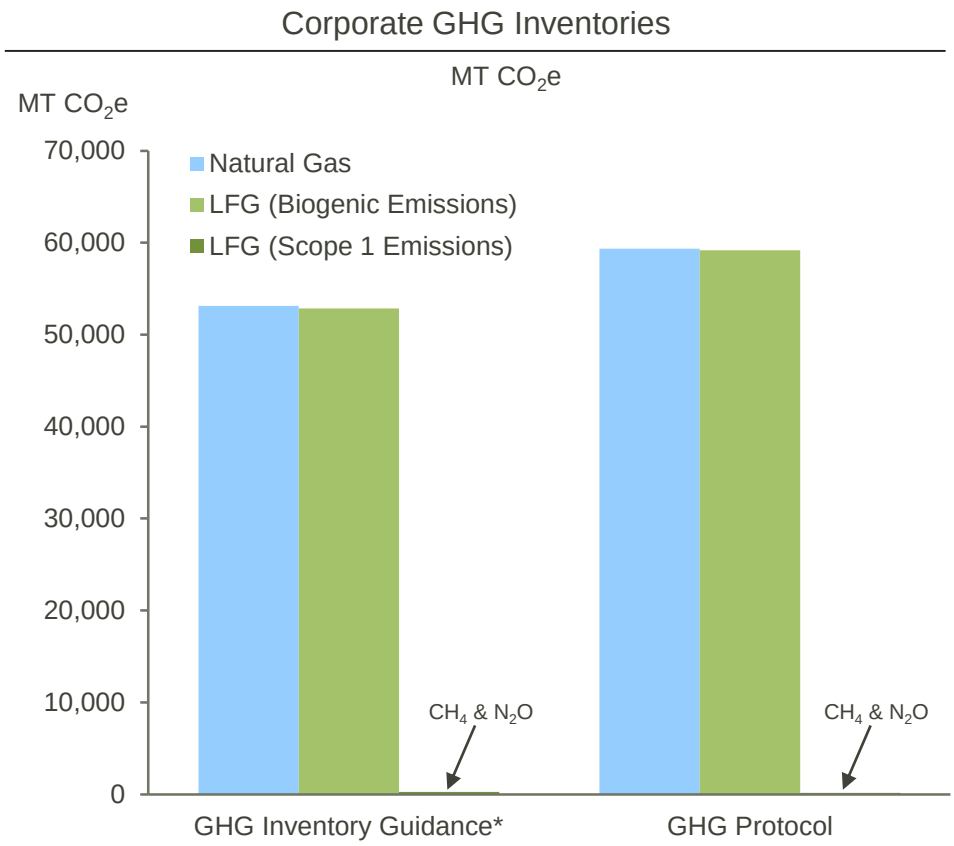
GHG Emissions Quantification: Corporate GHG Inventories (MT CO_2e)

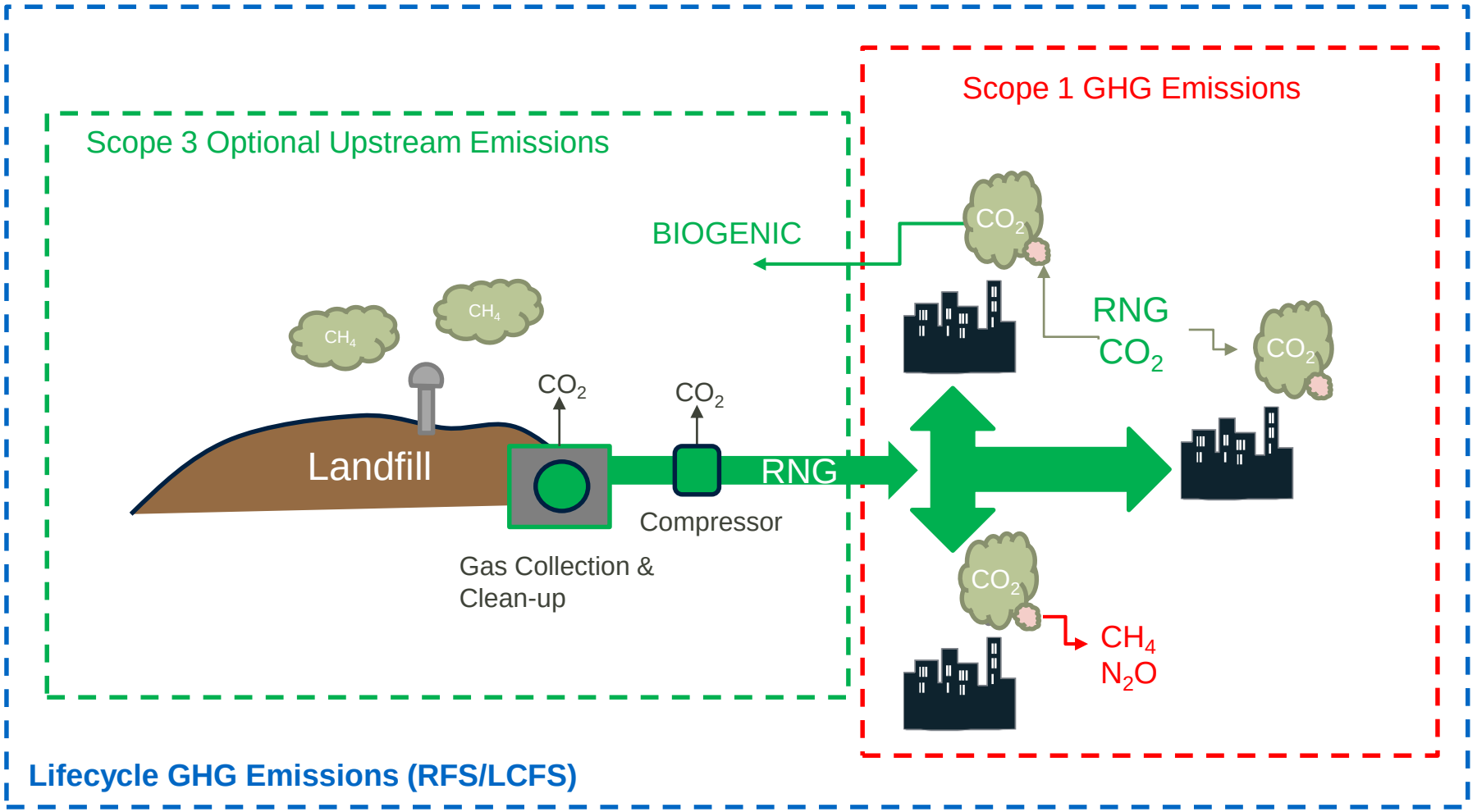
- Emission inventory guidance is based on fuel combustion GHG emission factors only
- Does not include lifecycle emissions
- CO_2 emissions from LFG combustion are considered biogenic and can be removed from Scope 1 emission estimate
- Emission Factors for LFG are comparatively similar to North American Natural Gas



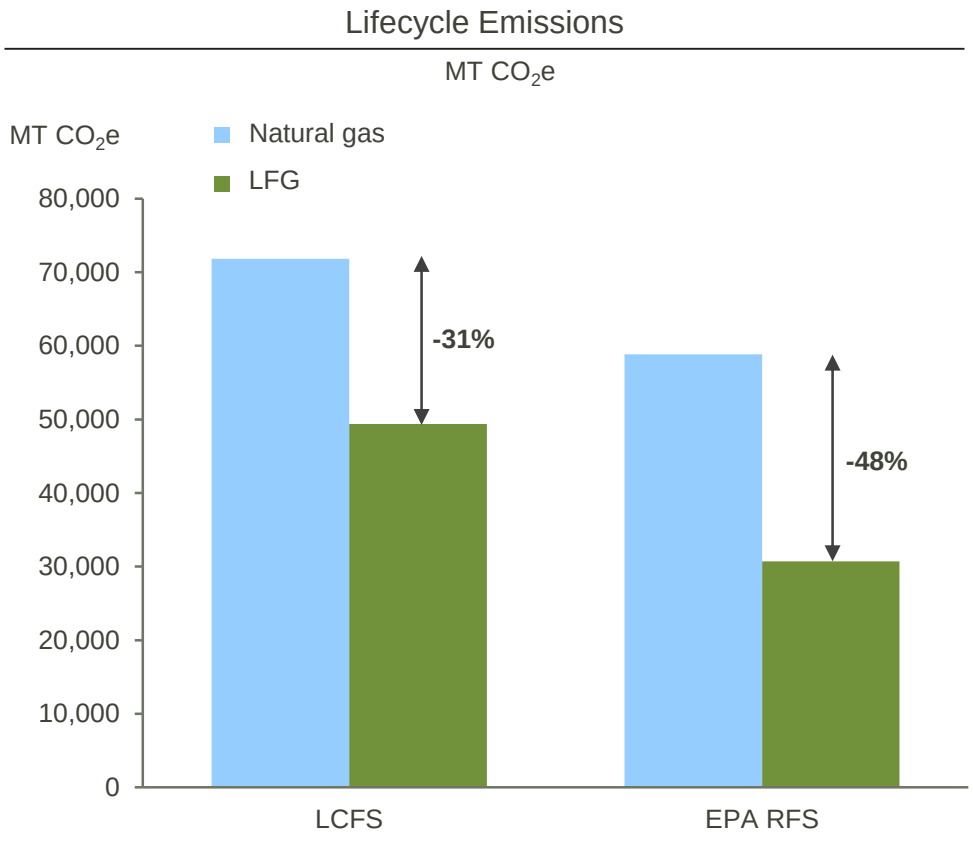
**Includes The Climate Registry, EPA Climate Leaders and EPA GHG Reporting Program*

Note: Illustrative example using 10 million therms of natural gas/LFG

Corporate GHG Emission Quantification Boundaries



GHG Emissions Quantification: Lifecycle Emissions (MT CO_2e)



Note: Illustrative example using 10 million therms of natural gas/LFG

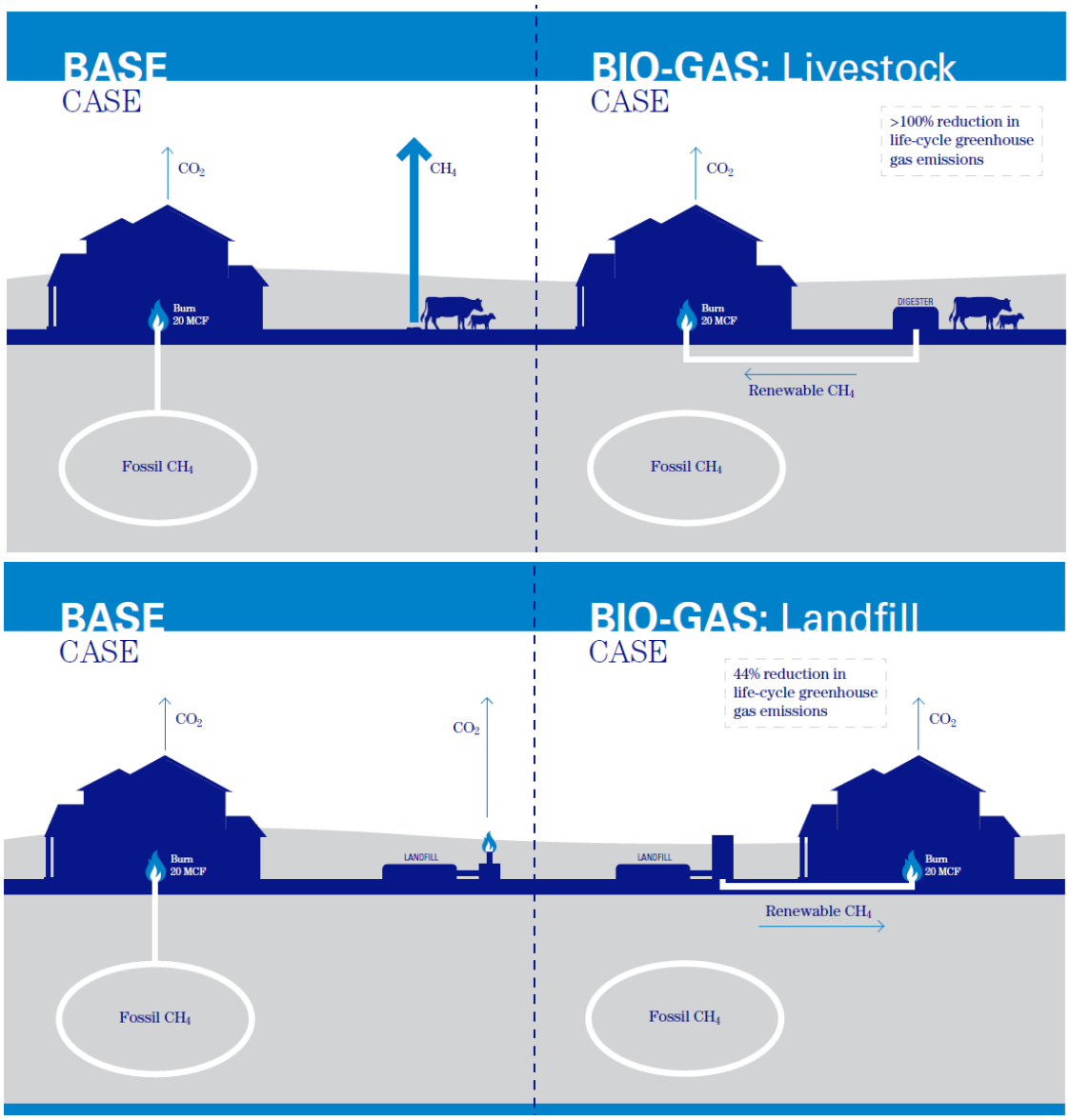
- Includes lifecycle (Well-to-pump) emissions from production & use
  - Exploration/development
  - Processing
  - Transport
  - End use
- Carbon Intensity (CI), of "pathway" from production to end use calculated using GREET model
  - CI's differ by project location and activity
  - LFG has net GHG reduction due to "credit" for avoided CO_2 from flaring at landfill
- CI's range from 32 to 85 kg CO_2 per MMBtu for LFG
- Natural gas CI approximately 72 kg CO_2 per MMBtu

RNG Infographic

This infographic by CenterPoint illustrates the lifecycle GHG benefits of RNG.

CenterPoint literature states:

"Using RNG, instead of conventional natural gas, results in a 40 to 100 percent or more decrease in GHG emissions, depending on the source of the RNG."



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Policies are Key

California and Connecticut proposed legislation setting RNG procurement requirements for gas companies.

Connecticut SB 337

- Proposes an RPS requiring gas companies to have RNG comprise at least 5 percent of output by 2033
- Sets RNG quality standards
- Requires electric distribution companies to procure additional electricity from biomass power plants

California SB 1440

- As initially intended, would authorize the PUC to adopt a biomethane procurement program
- In its current form, requires the PUC to consider adopting specific biomethane procurement targets
- Signed by Governor Brown

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