Final Long-Term Plan

National Fuel Gas Distribution Corporation

July 17, 2023

Case 22-G-0610

National Fuel®

CONTENTS

ACRONYMS AND DEFINED TERMS

Acronyms

AC	Air Conditioning
AGREE	Alliance for a Green Economy
AMEEP	Affordable Multifamily Energy Efficiency Program
ASHP	Air Source Heat Pump
BCA	Benefit-Cost Analysis
BRE	Bluebird Renewable Energy
CA LCFS	California Low Carbon Fuel Standard
CH4	Methane
ccASHP	Cold Climate Air Source Heat Pump
CJWG	Climate Justice Working Group
CLCPA	Climate Leadership and Community Protection Act
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CRA	Charles River Associates
DAC	Disadvantaged Community
DEC	NY State Department of Environmental Conservation
DEFR	Dispatchable Emissions-Free Resources
DPS	New York State Department of Public Service
EDF	Environmental Defense Fund
EIA	US Energy Information Administration
EITE	Energy Intensive and Trade Exposed Industries
EJ	Earthjustice
ERAP	Emergency Rental Assistance Program
ESCO	Energy Service Company
GHG	Greenhouse Gas
GSHP	Ground Source Heat Pump
GWP	Global Warming Potential
HDD	Heating Degree Days
HEAP	Home Energy Assistance Program
HFC	Hydrofluorocarbons
HVAC	Heating, Ventilation and Air Conditioning
IHP	Industrial Heat Pump
ISO	Independent System Operator
LDC	Local Distribution Company
LIURP	Low Income Usage Reduction Program
LMI	Low-and Moderate-Income
LNG	Liquified Natural Gas
LPP	Leak Prone Pipe
LTP	National Fuel's Long-Term Plan
MT	Metric Ton
N2O	Nitrous Oxide
NE:NY	New Efficiency New York
NOAA	National Oceanic and Atmospheric Administration
NPA	Non-Pipe Alternative
NPV	Net Present Value
NRDC	Natural Resources Defense Council
NYSERDA	New York State Energy Research & Development Authority
NY-GEO	New York Geothermal Energy Organization
O&M	Operations and Maintenance
RAS	Regular Arrears Supplement
ROFR	Right of First Refusal
RNG	Renewable Natural Gas
SCE	Supply-Constrained Economy
SCT	Societal Cost Test
SC	Sierra Club
SLIP	Statewide Low-Income Program
TEN	Thermal Energy Network
UIU	New York Department of State Utility Intervention Unit
WRRF	Water Resource Recovery Facilities

Defined Terms

Commission or PSC	New York Public Service Commission
Gas Planning Order	May 12, 2022 PSC Order Adopting Gas System Planning Process
Joint Utilities	Joint Utilities of New York
Long-Term Plan	National Fuel's Long-Term Plan
National Fuel or Company	National Fuel Gas Distribution Corporation
National Fuel-Supply	National Fuel Gas Supply Corporation
Scoping Plan	New York Climate Action Council's December 2022 Scoping Plan
Staff	Staff of the New York Department of Public Service
Statewide LMI Portfolio	Statewide Low- and Moderate-Income Portfolio
Strategen	Strategen Consulting
Supply Citygate	National Fuel-Supply Receipt Points
Synapse	Synapse Energy

I. Introduction

I. Introduction

A. Background

National Fuel Gas Distribution Corporation ("National Fuel" or "the Company") presents its Long-Term Plan ("LTP" or "Long-Term Plan") in accordance with the New York Public Service Commission's ("Commission" or "PSC") May 12, 2022, *Order Adopting Gas System Planning Process* ("Gas Planning Order"). The Gas Planning Order establishes a gas system planning process for natural gas local distribution companies ("LDCs") in New York and includes, among other things, a requirement for each LDC to file a long-term plan.

National Fuel's LTP will make substantial contributions toward achieving New York's decarbonization goals. The LTP is projected to reduce GHG emissions by 53% compared to 1990 levels by 2042 with emissions reductions to continue through 2050 and beyond.

Figure I-1
Long-Term Plan Objectives[1]

- Ensure that residents of New York can continue to meet their energy needs in the long term.
- Provide a foundation to ensure that New York continues to reduce Greenhouse Gas ("GHG") emissions in the face of climate change.
- Conduct planning consistent with the Climate Leadership and Community Protection Act ("CLCPA").
- Provide information for customers in a way that promotes effective customer planning, reduces confusion, and avoids inequities or the appearance of inequities.
- Provide information to the Commission, other government entities and agencies, and stakeholders related to the promotion of effective planning and consideration of gas alternatives, thereby reducing costs and emissions while minimizing impacts on economic development.
- Improve the Commission, Staff of the Department of Public Service ("DPS Staff" or "Staff"), and stakeholder's ability to examine LDC long-term plans to ensure those plans are cost-effective for ratepayers and consistent with state policies.

[1] Order Adopting Gas System Planning Process ("Gas Planning Order") issued on May 12, 2022, in Case No. 20-G-0131.

The Gas Planning Order provides context for National Fuel's LTP by expressing the overall objectives for the gas planning process (see Figure I-1), including a robust stakeholder engagement process to inform the development of LDC long-term plans.[2]

The Gas Planning Order also establishes several specific requirements to be addressed in long-term plans:

(1) a demand forecast that estimates the expected sources of growth and/or reduction in peak demand resulting from demand-side investments[3];

(2) a supply forecast that explicitly includes the level of demand-side programs and those that prioritize developing innovative clean demand response programs[4];

(3) the methodology by which reliability will be forecast and measured[5];

(4) solutions to reliability and meeting demand, including a "no infrastructure" scenario and reasonable non-pipe alternatives ("NPAs") to address gaps between demand and supply[6]; and

(5) an estimate of the bill impacts and net present value of costs of each alternative.[7]

As a general matter, the Commission noted that LDCs should provide necessary information to assess the potential impacts of their long-term plans and alternatives, both benefits and burdens, on disadvantaged communities ("DACs").[8] LDCs should further ensure that the Commission, Staff, and stakeholders have the information necessary to appropriately evaluate the potential GHG emissions of the long-term plans and alternatives.[9] The Commission also addresses the methodology to be applied when performing a benefit-cost analysis ("BCA").[10]

The process established in the Gas Planning Order begins a continuing cycle with each LDC filing a long-term plan every three years plus annual updates filed on May 31st in the interim years. The three-year cycle is designed to provide for future comprehensive updates that reflect new information and insights that inform the long-term plans.

National Fuel's LTP and supporting analysis reflect data and assumptions regarding what is feasible in light of current technology and costs, allowing the Company to present a realistic,

---

2 Gas Planning Order, p. 10.

3 Gas Planning Order, p. 28.

4 Gas Planning Order, pp. 30-31.

5 Gas Planning Order, p. 34.

6 Gas Planning Order, pp. 34-39.

7 Gas Planning Order, pp. 45-46.

8 Gas Planning Order, pp. 39-40.

9 Gas Planning Order, p. 47.

10 The Commission directs LDCs to apply the methodology established in the BCA Framework Order, Case 14-M-0101, Reforming the Energy Vision, Order Establishing the Benefit Cost Analysis Framework (issued January 21, 2016).

achievable plan that ensures safe, reliable and resilient service for its customers. The LTP also provides a basis for requests for approval of specific investments and programs, with particular focus on necessary actions during the next three years. In short, the LTP must be technically feasible and provide valid projections of costs, bill impacts, and GHG emission reductions that can inform subsequent utility proposals and decisions. Potential improvements or new challenges related to policy, markets, technology, customer behavior, infrastructure development, and other developments that may evolve over time will be incorporated into future LTP filings.

National Fuel developed a list of "Guiding Principles" that are consistent with Gas Planning Order Objectives and the Company's own mission to ensure energy security and affordability for its customers. The Guiding Principles identify the primary goals of the LTP, and apply a methodology that incorporates the analysis of scenarios and stakeholder feedback to produce insights that have been relied on to construct the LTP. In particular, the methodology (described in Chapter III) is designed to produce insights regarding the tradeoff between environmental and economic objectives. Each of National Fuel's scenarios is designed to be technically feasible while also considering critical safety, reliability, and resilience objectives. The contributions of the LTP to reductions in GHG emissions and costs are estimated by comparing the LTP to a "Reference Case" that is based on pre-LTP business-as-usual activities.

It is important to note that this is the first long-term plan process being executed in New York. The details of several policies will be refined over the next several years as experience is gained regarding energy efficiency, electrification and other decarbonization actions that depend on customer engagement and decisions to participate. Optionality is a key element of the long-term plan to avoid prematurely eliminating options that could be important to ensuring responsible decarbonization in the future.

The National Fuel LTP report is presented in five chapters, plus an Executive Summary. The Executive Summary provides an overview of National Fuel's LTP and a summary of the results of supporting analyses. This Introduction (Chapter I) includes the long-term plan objectives, key requirements established by the Gas Planning Order, and a discussion of the stakeholder engagement process. Chapter II describes National Fuel's service territory characteristics. Chapter III explains the methodology that National Fuel employed to develop the LTP, including the scenario analyses, Chapter IV describes the reliance on the scenarios and stakeholder input to develop the LTP, and Chapter V presents National Fuel's final conclusions and recommendations.

In addition, National Fuel's LTP includes the following appendices:

Appendix A – Decarbonization Action Modeling

Appendix B – Scenario Modeling

Appendix C – Benefit Cost Analyses

Appendix D – Reference Case Detail

Appendix E – "Meeting the Challenge: Scenarios for Decarbonizing New York's Economy," Guidehouse, February 19, 2021.

Appendix F - "Residential Weatherization Potential Study Report," prepared for: National Fuel Gas Distribution Corporation, November 2, 2022, Cadmus

Appendix G – "Residential Home Energy Calculations," prepared for: National Fuel Gas Distribution Corporation, April 2023, CJ Brown Energy, P.C.

Appendix H – "2021 Residential Market Study," National Fuel, August 5, 2021, JRB Insights

Appendix I – "Net-Zero Community Model with Networked Geothermal Heat Pumps Memorandum," National Fuel Gas Company, November 9, 2022, Cadmus

Appendix J – "RNG Potential in NY & NFGDC Territory," April 2020, National Fuel Gas Company

Appendix K – Informational Scenarios Developed at Stakeholder Request

B. Stakeholder Engagement Process

The Gas Planning Order provides for a robust stakeholder engagement process to inform the development of National Fuel's LTP. National Fuel's Revised and Final LTPs were shaped by extensive stakeholder engagement, which includes participation by stakeholders, Staff, and Staff's independent consultant, Charles River Associates ("CRA"). The contribution of the stakeholder engagement process to the development of National Fuel's LTP is addressed throughout this report. A list of participants, filings, and meetings is presented below. The role of the stakeholder engagement process as an integral element of the methodology used to develop the LTP is described in Chapter III. A discussion of specific changes that National Fuel has made to its LTP to reflect stakeholder feedback and input is presented in Chapter IV.

1. Stakeholder Participants

Stakeholders who actively participated in National Fuel's LTP stakeholder engagement process are listed below. All of the stakeholders participated in one or more meetings, and most of the stakeholders also filed written comments.

- Alliance for a Green Economy ("AGREE"), *et al.*
- Couch White for Multiple Intervenors
- Environmental Defense Fund ("EDF")
- Individuals (John Rath, Bob Wyman)

- Natural Resources Defense Council ("NRDC") and their consultant Synapse Energy Economics ("Synapse")
- New York Department of State Utility Intervention Unit ("UIU")
- New York Geothermal Energy Organization ("NY-GEO")
- New York State Energy Research and Development Authority ("NYSERDA")
- PUSH Buffalo
- Ratepayer and Community Intervenors
- Sierra Club ("SC") / Earthjustice ("EJ") and their consultant Strategen Consulting ("Strategen")

2. Filings

Table I-1 lists the major filings made by National Fuel, CRA, and stakeholders in the National Fuel LTP docket (22-G-0610).

Table I-1
National Fuel, CRA, and Stakeholder Filings

Date	Filing	Participant
December 22, 2022	Initial LTP	National Fuel
February 17, 2023	CRA Initial Findings Report	CRA
March 13, 2023	Stakeholder Comments	EDF, SC/EJ,[11] NRDC
April 12, 2023	Stakeholder Comments	UIU
April 18, 2023	Stakeholder Comments	AGREE
April 18, 2023	Reply Comments	National Fuel
May 22, 2023	Revised LTP	National Fuel
May 25, 2023	CRA Preliminary Findings Report	CRA
June 12, 2023	Stakeholder Comments	EDF
June 15, 2023	Stakeholder Comments	AGREE, NY-GEO, NYSERDA, SC/EJ, UIU
June 20, 2023	Stakeholder Comments	NRDC
July 17, 2023	Final LTP	National Fuel

Note: CRA is currently scheduled to file its Final Report on July 25, 2023.

3. Meetings

The stakeholder engagement process began with an informational session one month prior to the filing of National Fuel's Initial LTP. The purpose of this and many additional stakeholder

[11] SC/EJ's comments were subsequently revised on March 14, 2023 and corrected on April 4, 2023.

meetings, responses to data requests, and filing of comments and reply comments was to enhance transparency and enable stakeholders' effective participation in the long-term planning process.

Table I-2 lists the 27 meetings held with stakeholders, Staff and CRA related to the development of National Fuel's LTP. These meetings were held to comply with requirements of the Gas Planning Order and to accommodate requests from Staff, CRA, and stakeholders.

Table I-2
Stakeholder, Staff and CRA Meetings

Date	Topic	Participants
November 16, 2022	Background Information	National Fuel, Staff, CRA, Stakeholders
December 2, 2022	Project Timing	National Fuel, Staff, CRA
January 4, 2023	Technical Session	National Fuel, Staff, CRA
January 11, 2023	CRA Data Requests	National Fuel, Staff, CRA
January 11, 2023	Initial LTP Filing	National Fuel, Staff, CRA, Stakeholders
January 19, 2023	LTP Model Review	National Fuel, Staff, CRA
January 26, 2023	CRA Data Request Follow-up	National Fuel, Staff, CRA
February 6, 2023	CRA's Initial Findings Report	National Fuel, Staff, CRA
February 9, 2023	Hydraulic Model Review	National Fuel, Staff, CRA
February 16, 2023	Technical Session	National Fuel, Staff, CRA, Stakeholders
February 28, 2023	Hydraulic Model Review	National Fuel, Staff, CRA
March 2, 2023	EDF Technical Session	National Fuel, Staff, CRA, EDF, SC
March 3, 2023	SC Technical Session	National Fuel, Staff, CRA, SC, EDF
March 14, 2023	Emissions Technical Session	National Fuel, Staff, CRA, Stakeholders
March 27, 2023	Project Timing	National Fuel, Staff, CRA
March 29, 2023	Stakeholder Comments	National Fuel, Staff, CRA
March 30, 2023	Leak Prone Pipe Methodology	National Fuel, Staff, CRA
March 31, 2023	CJ Brown Study	National Fuel, Staff, CRA, Stakeholders
April 4, 2023	Hydraulic Modeling	National Fuel, Staff, CRA, Stakeholders
April 12, 2023	Stakeholder Scenarios	National Fuel, Staff, CRA
April 19, 2023	Stakeholder Scenarios	National Fuel, Staff, CRA, Stakeholders
April 26, 2023	Stakeholder Scenarios	National Fuel, Staff, CRA, Stakeholders
April 27, 2023	Hydraulic Modeling	National Fuel, Staff, CRA
June 1, 2023	Revised LTP Filing	National Fuel, Staff, CRA, Stakeholders
June 8, 2023	Revised LTP Filing	National Fuel, Staff, CRA
June 14, 2023	Revised LTP Model Review	National Fuel, Staff, CRA
June 22, 2023	Stakeholder Comments	National Fuel, Staff, CRA, Stakeholders

4. Discovery

National Fuel responded to 121 data requests submitted by CRA, EDF, SC, and UIU and maintained a SharePoint site that provided all stakeholders, CRA, and Staff access to all non-confidential data responses as well as stakeholder meeting presentations and meeting notes. Confidential responses were posted to a separate confidential SharePoint site that was accessible to those who executed confidentiality agreements. Highly confidential materials that included customer specific information, project specific information, and the proprietary models were shared only with Staff and CRA. National Fuel also maintained a public website that was updated throughout the process to include the current version of the LTP report, executive summary, and appendices, and copies of presentations from the November 16, 2023 stakeholder information session and the June 1, 2023 technical conference.

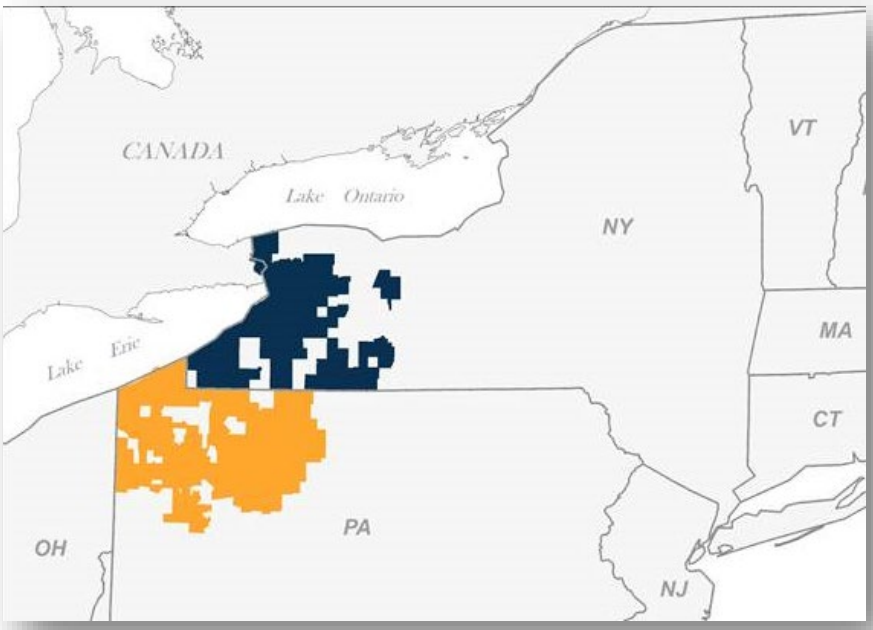
National Fuel appreciates the participation of stakeholders in its LTP process and believes that the number of meetings, responses to data requests, filings in the docket, and many modifications that have been made to the LTP demonstrate that the stakeholder process was inclusive and robust.

II. National Fuel's New York Service Area

II. National Fuel's New York Service Area

National Fuel sells or transports natural gas to over 740,000 customers through its local distribution system in western New York and northwestern Pennsylvania. Its New York service territory spans several counties and includes the cities of Buffalo, Niagara Falls, Batavia, Jamestown, and Wellsville. The Company's New York customer base consists of approximately 540,000 customers among a population of more than 1.6 million people in western New York.[12] Figure II-1 presents a map of the Company's service territory.

Figure II-1
National Fuel Service Territories



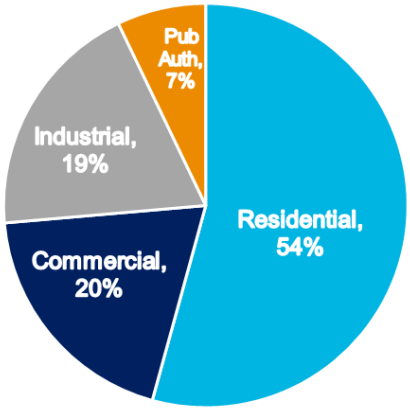
National Fuel operates and maintains 9,818 miles of distribution mains or pipelines in its New York service territory and has maintained an exceptional safety and reliability record, demonstrating continuous improvements. National Fuel's utility service has a 99.999% reliability rating and interruptions in service are exceedingly rare. This is significant because natural gas provides approximately 94% of a typical residential customer's energy use on the coldest days experienced in western New York.

[12] Values obtained from 2020 US Census data for each community within National Fuel's service territory.

A. Customers and Communities

National Fuel's customer base consists of a mix of residential, commercial, industrial, and public authority customers. Residential customers typically use gas to heat their homes and fuel hot water heaters, gas ranges, clothes dryers, fireplaces, grills, and pool heaters. Commercial customers are primarily businesses selling goods or providing services. Industrial customers are larger businesses that manufacture or process goods or materials. Public authority customers are typically towns, cities, public schools & universities, and public housing. Figure II-2 presents National Fuel's throughput by customer type.

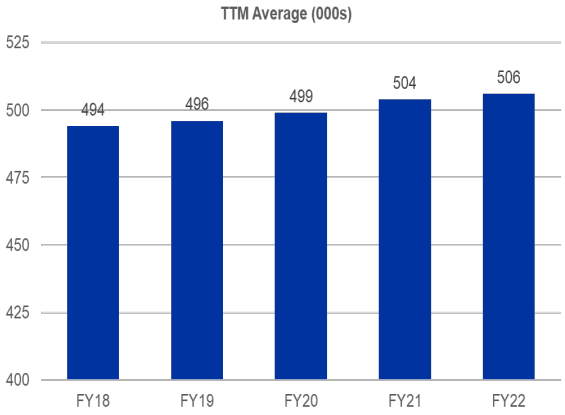
Figure II-2
Percentage of Annual Customer Throughput



1. Residential Customers

Residential customers make up approximately 93% of total National Fuel customers and 54% of total throughput. Over the past five years, residential customer counts have grown at a compound annual growth rate of 0.6%, with a total increase of 2.4% over the period. Figure II-3 presents historical residential customer counts. In 2022, 90% of National Fuel's 506,000 residential customers use gas for heating.

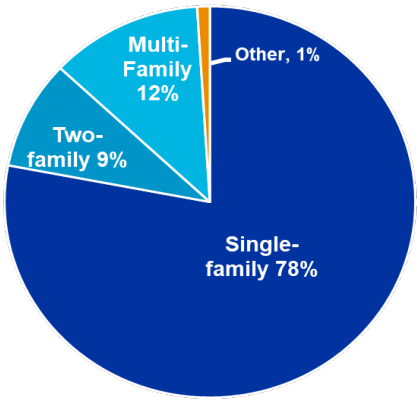
Figure II-3
Number of Residential Customers



TTM is a measure of data over a 12-month period in the past.

The following charts present residential housing demographics. Single-family homes represent 78% of housing in National Fuel's service territory, which contrasts with downstate New York where multi-family homes dominate the housing mix.

Figure II-4
Housing Mix[13]



As shown in Figure II-5, approximately 67% of the housing stock is over 52 years old, with half of that being over 80 years old. It is important to note that these older homes generally possess poor building envelopes with single-pane windows, poor insulation and outdated ampere[14] services, making it more costly for homeowners to convert their homes to electric heat.

[13] 2021 Residential Market Study performed by JRB Insights on National Fuel Residential service territory. Provided in Appendix H.

[14] Ampere is the base unit of electrical current in the international system of units.

Figure II-5
Distribution of Housing by Age[15]

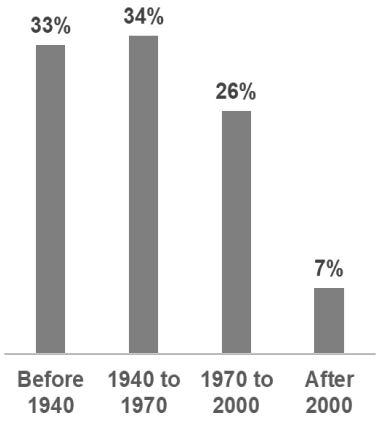
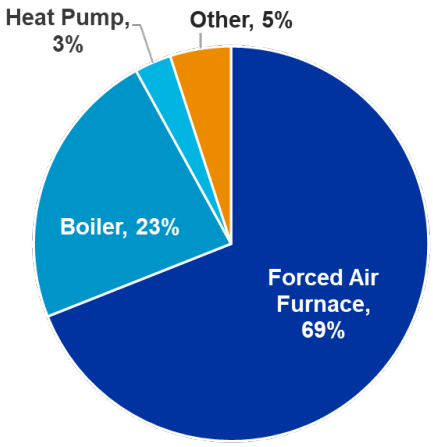


Figure II-6 shows the breakdown of heating systems in residential homes heated by natural gas, with 69% of those being heated with forced air furnaces and 23% with boilers. It is important to note that homes heated with boilers generally lack existing ductwork, making it more difficult and costly to convert to electric heat.

Figure II-6[16]
Type of Heating Systems



The CLCPA established the Climate Justice Working Group ("CJWG") and tasked the group to develop a set of criteria to identify DACs. DACs are to be prioritized with respect to programs and investments that are designed to achieve reductions in air pollution and GHG emissions,

[15] 2021 Residential Market Study performed by JRB Insights on National Fuel Residential service territory. Provided in Appendix H.

[16] 2021 Residential Market Study performed by JRB Insights on National Fuel Residential service territory. Provided in Appendix H.

including clean energy and energy efficiency investments. The criteria to identify DACs were finalized on March 27, 2023, and NYSERDA published a list of qualifying communities.[18] As shown in Figure II-7, several of these communities are located within National Fuel's service territory, many within metropolitan areas (illustrated in the darker purple overlap sections on the map). With the median household income for most of National Fuel's service territory, including in the cities of Niagara Falls, Jamestown, and Buffalo, being below that of the U.S. average, these communities are examples of those within National Fuel's service territory have been identified as "disadvantaged".

Figure II-7
Disadvantaged Communities (Blue) in National Fuel's Service Territory (Orange)

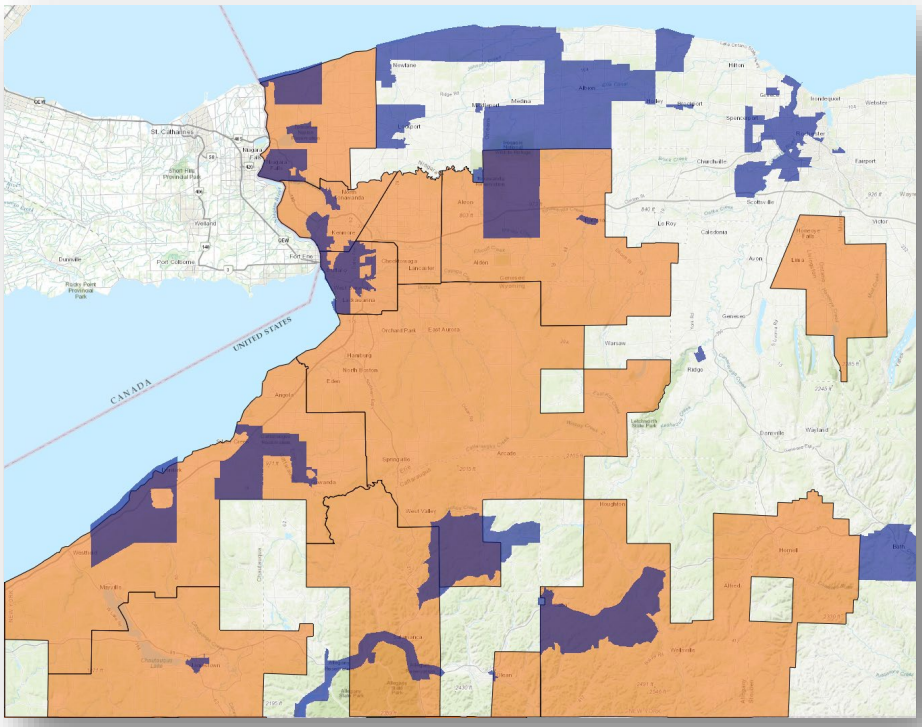


Table II-1 presents income information for National Fuel's service territory, with a comparison to New York State and the country. The cities of Jamestown, Buffalo and Niagara Falls have much higher poverty rates and much lower median household incomes than New York State, National Fuel's entire service region, and the United States.

Table II-1
Demographic Data[17]

	National Fuel's Service Territory				New York State	U.S.
	Overall Territory	City of Buffalo	City of Niagara Falls	City of Jamestown		
Median Household Income	$60,977	$42,186	$43,336	$36,162	$75,157	$69,021
Poverty Rate	13.8%	27.6%	23.8%	28.1%	13.9%	11.6%

Approximately 76,000 National Fuel customers receive bill discounts through the Statewide Low-Income Program ("SLIP"). Those discounts totaled approximately $15.5 million in fiscal year 2022. Many National Fuel customers also receive Home Energy Assistance Program ("HEAP") grants averaging between $400 and $476 per customer per year. In addition to those two programs, National Fuel distributed approximately $3.0 million through the Emergency Rental Assistance Program ("ERAP") in fiscal year 2022. Finally, customers benefited from approximately $22 million in Regular Arrears Supplement ("RAS") grants. These grants were provided to eligible HEAP customers who were behind on their heating bills.

2. Non-Residential Customers

Commercial, industrial, and public authority customers comprise 46% of National Fuel's throughput. National Fuel's commercial customer count has remained consistent over the past five years at approximately 33,000 with total throughput for commercial customers ranging from 18.1 Bcf to 19.4 Bcf. Commercial customers include private hospitals and healthcare facilities, nursing homes, garbage disposal services, colleges and universities, compressed natural gas ("CNG") stations, casinos, hydroponic greenhouses, building materials, and asphalt plants.

The number of industrial customers has risen from 430 to 444 over the last five years. From 2018 through 2022, the total throughput for industrial customers ranged from 17.7 Bcf to 19.9 Bcf. National Fuel's industrial customers generally include iron and steel mills, hazardous waste disposal facilities, flour mills and power generation facilities. Table II-2 identifies the industries that comprise at least 5% of National Fuel's industrial load.

[17] U.S. Census Bureau's July 1, 2022 (V2022) Population Estimate Program, American Community Survey, 5-Year Estimates, and National Fuel Gas's 2022 residential account locations.

Table II-2
Customer Business Types by Percent of Industrial Volume[18]

Food and Kindred Products	25%
Primary Metal Industries and Fabricated Metal Products	19%
Chemicals and Allied Products	14%
Electric, Gas and Sanitary Services	8%
Stone, Clay, Glass, and Concrete Products	6%
Rubber and Miscellaneous Plastic Products	5%
All Other	22%
TOTAL	**100%**

Public authority customers generally include public elementary and secondary schools, public colleges and universities, general medical and surgical hospitals, municipal buildings, correctional facilities and other government buildings.

National Fuel currently has only one interruptible transportation service customer.[19] National Fuel classifies all critical care facilities such as hospitals, and nursing homes, as firm core customers. National Fuel does not require firm customers to have back-up, but other healthcare regulating entities may require back-up capability.

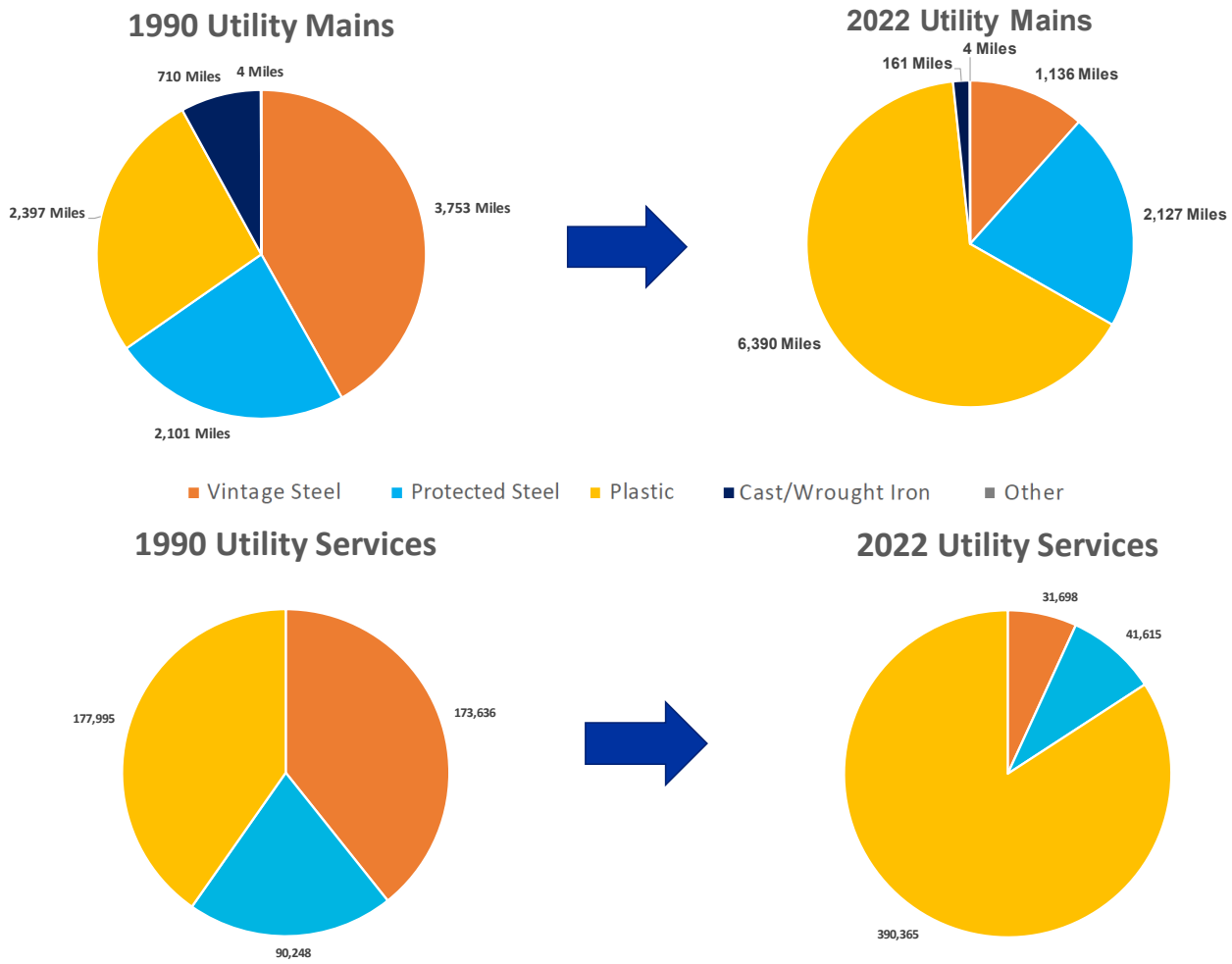
B. Capital Investment Plan

In recent years, National Fuel's capital expenditures have been dominated by its Leak Prone Pipe ("LPP") replacement program. National Fuel has been investing in replacing LPP (mains and services) for several decades, resulting in a significant reduction in cast/wrought iron and vintage steel pipes, as illustrated in Figure II-8. These investments have significantly reduced leaks and enhanced system safety. The Company, pursuant to Commission guidance, is on schedule to replace all leak prone pipe by 2035. This will require continuing the current pace of replacing approximately 110 miles of pipe per year. The modernization effort will continue after 2035 with the replacement of vintage plastic materials, although these replacements are projected at a slower pace.

[18] Provided in response to stakeholder comment.

[19] National Fuel's single interruptible transportation service customer has a load of approximately 566,000 Mcf/year, and an on-site oil tank with annual physical inspections in order to verify the oil tank is full. In addition, National Fuel confirms annually that the customer has entered into a relationship with an oil supplier in the event the natural gas service is interrupted. The Company has not interrupted transportation service to this customer in the past five winter heating seasons.

Figure II-8
Composition of Mains and Services 1990 and 2022



C. Energy Efficiency Programs

National Fuel, with Commission approval, provides energy efficiency programs that offer rebates to customers for replacing specific natural gas appliances with new, energy-efficient models. National Fuel's New Efficiency: New York ("NE:NY") Gas Energy Efficiency Portfolio includes the following three core programs; (1) Residential Rebate Program; (2) Non-Residential Rebate Program; and (3) the Statewide Low- and Moderate-Income Portfolio ("Statewide LMI Portfolio") which includes the Existing 1-4 Unit Family Home Initiative and the Affordable Multifamily Energy Efficiency Program ("AMEEP"). National Fuel has offered the Residential Rebate Program and the Non-Residential Rebate program since 2007. National Fuel phased out its Low-Income Usage Reduction Program ("LIURP") in 2019 and has coordinated with NYSERDA and other parties to support the Statewide LMI Portfolio since 2020. In Q2 2022, National Fuel started contributing to AMEEP under the Statewide LMI Portfolio.

The funding for these programs was established under the Comprehensive Energy Efficiency Initiative in Case 18-M-0084 and continued under Case 15-M-0252. The Joint Utilities of New York ("Joint Utilities"), including National Fuel, work closely with DPS Staff and NYSERDA on all energy efficiency issues. Additional details on National Fuel's energy efficiency portfolio can be found on NYSERDA's Clean Energy Dashboard and the DPS website.

National Fuel files a quarterly scorecard to report on the progress and spending associated with its existing energy efficiency programs. This scorecard provides standardized metrics that include primary end use sector, number of participants per program, spending level by program, and Gross Annual Natural Gas Savings MMBtu Acquired. The Joint Utilities and DPS Staff are currently collaborating on an update to the reporting template to provide additional detail on energy efficiency spending and metrics throughout New York State and between DACs and non-DACs.

D. Capacity and Supply Portfolio

1. Portfolio Overview

National Fuel's gas supply portfolio consists of flowing supplies (contracted upstream pipeline supplies), storage withdrawals, and winter peaking city gate delivered services. Each of these supplies are contracted on a firm basis and must be contracted in advance of the winter to ensure they are available to the Company during cold winter days. Firm pipeline and storage services are typically contracted over a longer term, with terms that range from two to twenty years or longer and provide the Company a right of first refusal ("ROFR") provision. Many of the Company's current contracts are extended for one-to-two-year renewal terms. In contrast, contracts with suppliers for winter peaking citygate delivered services can be as short as one winter season and do not provide ROFR provisions. National Fuel pays fixed demand (or reservation) charges to reserve specific amounts of pipeline, storage, and citygate delivery capacity. In addition, National Fuel pays variable commodity charges based on the amount of these services it uses on a daily basis to serve its customers. The Company does not include any liquified natural gas ("LNG"), CNG, local production, renewable natural gas ("RNG"), or hydrogen in its gas supply portfolio.[20] All gas supply-related costs are passed through to customers on a dollar-for-dollar basis (i.e., National Fuel does not make a profit on the cost of gas supplies).

[20] There are small quantities of local natural gas production (approximately 11,000-12,000 Mcf/day in recent years) as well as some small RNG production (approximately 2,500 Mcf/day) that is purchased by marketers and delivered directly to National Fuel's distribution system on behalf of transportation customers.

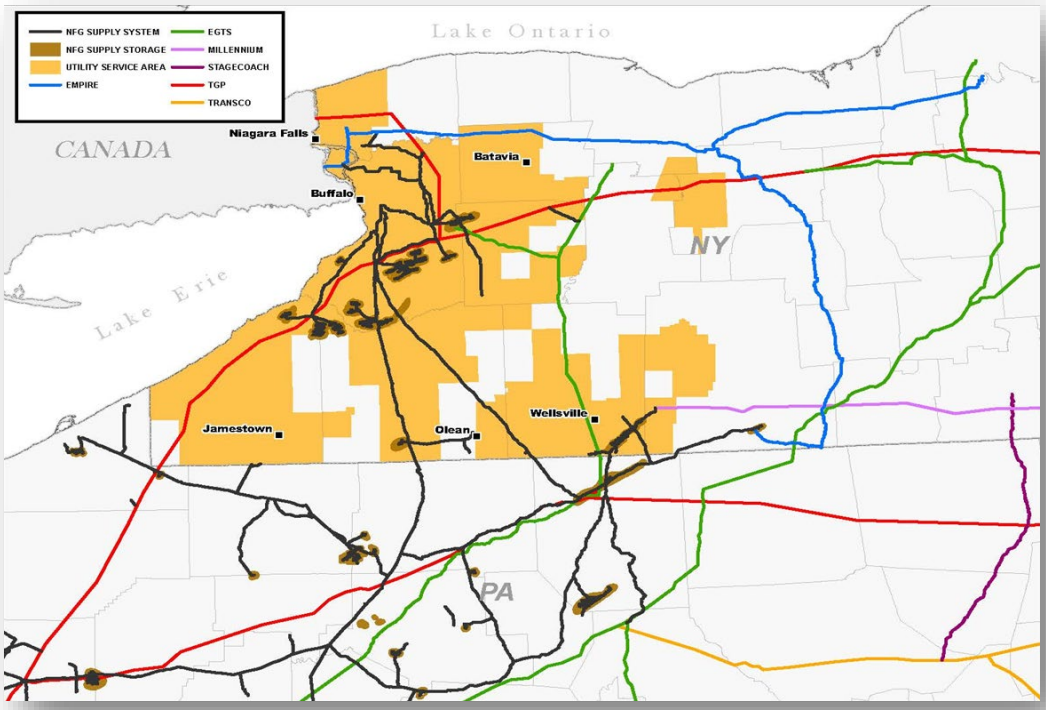
Transportation customers do not purchase gas supply from the Company and National Fuel is not obligated to plan to provide these customers with supply service. Marketing companies, or energy service companies ("ESCOs") purchase natural gas for the delivery to transportation customers via the Company's distribution system. National Fuel receives ESCO gas at its citygate and delivers it to its transportation customers. Some large industrial transportation customers procure their own gas supplies and provide them to National Fuel for ultimate delivery to the industrial plant.

National Fuel maintains contracts for firm transportation and storage capacity on National Fuel Gas Supply Corporation ("National Fuel-Supply")[21] and on several pipelines upstream of National Fuel-Supply, including Eastern Gas Transmission and Storage, Inc, Empire Pipeline, Inc., Honeoye Storage Corp., Millennium Pipeline Co., Stagecoach Pipeline and Storage Co., Tennessee Gas Pipeline, LLC, and Transcontinental Gas Pipeline Co. These pipelines provide access to production and storage throughout New York, Pennsylvania, and Ohio, as well as along Tennessee Gas Pipeline's long-haul path to the Gulf of Mexico through Kentucky, Tennessee, Mississippi, Alabama, Louisiana, and Texas. Approximately 95% of the Company's deliveries originate from gas supplies attached to National Fuel-Supply or pipelines upstream of National Fuel-Supply. The remaining 5% of the Company's annual deliveries are sourced from production attached directly to its system.

Figure II-9 presents National Fuel-Supply's major transmission lines and storage facilities within the Company's service territory. The Company receives gas from National Fuel-Supply at approximately 400 delivery points in New York and Pennsylvania. The Figure also demonstrates how National Fuel-Supply's facilities interconnect the Company's facilities with the network of upstream pipelines and storage facilities. The colored lines indicate the upstream pipelines' major transmission lines that the Company utilizes to serve its western New York customers.

[21] National Fuel-Supply and the Company are both subsidiaries of National Fuel Gas Company. National Fuel-Supply provides interstate natural gas transmission and storage services for a number of customers, including the Company.

Figure II-9
Pipeline and Storage Service



The Company relies on National Fuel-Supply's transmission system as intermediate capacity to receive gas from pipelines upstream of its system and, in turn, to make redeliveries to the Company's many non-contiguous delivery systems. The Company also relies on National Fuel-Supply for the transmission of the Company's gas supplies from National Fuel-Supply's underground storage fields dispersed in and around National Fuel's service territory. The Company relies on National Fuel-Supply's storage and transmission facilities to receive and store gas during periods of low customer demand. This storage gas is redelivered to the Company's distribution system during the winter months when customer demands exceed flowing gas supplies. This use of National Fuel-Supply's storage service allows the Company to maintain a high load factor on its upstream pipeline capacity, resulting in lower pipeline costs and a more favorable purchasing pattern with its suppliers that generally translates to lower costs for National Fuel's customers. These services provide sufficient response to the hourly demand variability of National Fuel's distribution system and National Fuel relies on the firm no-notice enhanced pipeline and storage delivery service provided by National Fuel-Supply for hourly system balancing.

National Fuel and National Fuel-Supply have a shared control room staffed 24 hours a day with resources that perform control room services for both National Fuel and National Fuel-Supply. The centralized control room receives real time pressure and flow data from certain

measurement stations at major feeds into National Fuel's distribution system. Currently National Fuel receives only daily and monthly throughput data from its upstream capacity pipeline and storage service providers. National Fuel will work with National Fuel-Supply to develop procedures to begin receiving reports that contain hourly throughput data collected from measurement stations at major National Fuel citygate locations throughout its service territory. National Fuel anticipates that this hourly data will inform future LTPs and may inform design day[22] planning processes.

2. Winter Peaking Services

The Company satisfies its peaking service requirement solely through traditional pipeline delivered services, specified as "NFGSC Citygate". These citygate supply deliveries include firm supplies purchased by the Company from producers or suppliers directly at various National Fuel-Supply receipt points ("Supply Citygate").

The Company evaluates opportunities to purchase Supply Citygate supplies from reputable, proven suppliers rather than seeking upstream capacity. The Company strives to maintain the appropriate quantity of pipeline delivered peaking services with various business terms. To date, the Company's reliance on Supply Citygate services is limited to the winter period, and accounts for approximately 10% of the Company's design day requirements. The Company's citygate supplies typically include firm gas calls ranging from 30 days to 151 days during the winter period. The Company does not rely on other forms of peaking supplies, such as LNG or trucked CNG delivered services.

Typical winter supply arrangements vary each winter season as the capacity asset portfolio changes. The Company ensures that firm winter seasonal pipeline and citygate supplies are available and connected to the firm capacity, and that such supplies are sufficient to meet the design day requirement.

E. Distinguishing Characteristics

National Fuel is distinct in several respects from other natural gas utilities in New York State, in ways that are important for long-term planning. These distinctions are more pronounced when National Fuel is compared to downstate utilities. Specifically, as discussed in greater detail below, the Company is unique in that it does not operate in a constrained area, has relatively low rates, and operates in a colder climate where customers frequently experience very cold days for prolonged periods of time compared to other New York gas utilities.

[22] Design day is an industry term that refers to the practice of capacity and supply planning based on customers' usage requirements on the coldest winter day expected.

1. Lack of Supply and Delivery Constraints

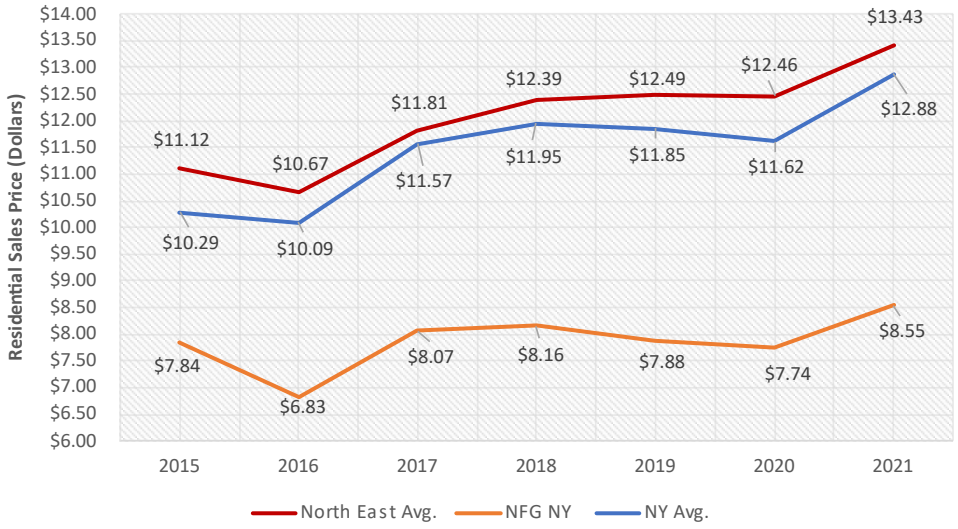
As discussed above, and in the Company's July 31, 2020 supply and demand analysis filed with the Commission as part of the Gas Planning Proceeding, there are no significant areas of concern or vulnerability in the Company's system due to supply or delivery constraints, and ample firm capacity and supplies are available to serve the Company's projected design day, winter season and year-round demand over the next five years.[23] Further, the Company does not currently project any pipeline capacity constraints, distribution system delivery constraints, or a gas moratorium during the 20-year LTP forecast period.[24] This is in contrast to other gas utilities in New York that have supply and/or distribution constraint challenges, and existing gas moratoria.

2. Relatively Low Gas Rates

The Company has the most affordable residential gas bills in the region. Based on utility data reported by the Energy Information Administration ("EIA"), National Fuel has maintained the lowest average all-in residential retail sales rates (residential revenue per Mcf of throughput) among gas utilities in New York State and throughout the Northeast as shown in Figure II-10.

Figure II-10[25]

National Fuel, New York, and Northeast Average Gas Rates ($/Mcf)



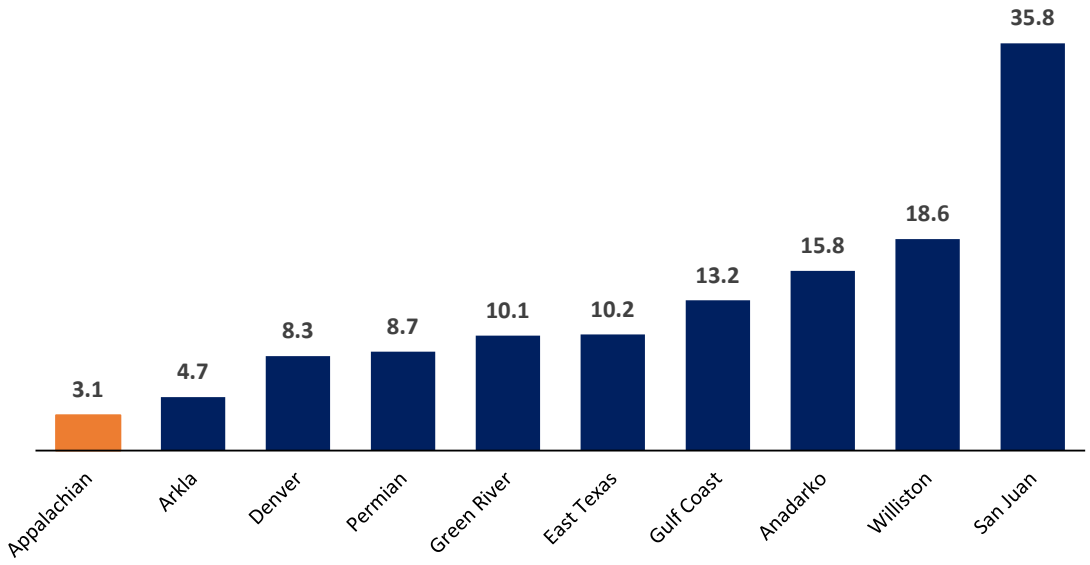
[23] "Supply and Demand Analysis Related to Service Areas with Known Supply Constrain Vulnerabilities", Case 20-G-0131, July 17, 2020 ("July 2020 Filing").

[24] Contingent upon current forecast and an expectation that the existing gas system is maintained and not decommissioned.

[25] Based on analysis of EIA residential natural gas price data from calendar year 2021 (the most recent available data).

The proximity to low-cost natural gas supplies being produced from the Marcellus and Utica shales in the Appalachian basin is a major contributor to the affordability of National Fuel's supplies. Approximately 95% of National Fuel's natural gas supply is produced from the Appalachian supply basin with the remaining 5% sourced from New York. In addition to supplies from the Appalachian basin being relatively low cost, Figure II-11 demonstrates that the GHG emissions intensity of the gas produced in the Appalachian Basin is also the lowest in the country.

Figure II-11
GHG Emissions Intensity (kg of Carbon Dioxide Equivalent/Barrel of Oil Equivalent using 100-year Global Warming Potential)[26]



3. Colder and More Extreme Weather

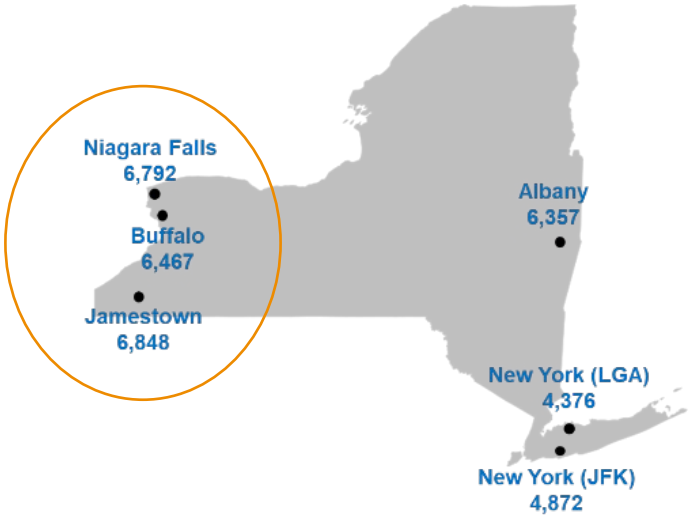
National Fuel's service territory also experiences colder and more extreme weather than many other New York utilities. Figure II-12 demonstrates that National Fuel's largest cities experience annual average heating degree days ("HDD")[27] that are 33%-56% greater than its counterparts in downstate New York.

---

[26] ERM for Ceres, "Benchmarking Methane and Other GHG Emissions of Oil & Natural Gas Production in the United States," July 2022.

[27] A degree day is a quantitative index demonstrated to reflect demand for energy to heat or cool houses and businesses. This index is derived from daily temperature observations at nearly 200 major weather stations in the contiguous United States. A mean daily temperature (average of the daily maximum and minimum temperatures) of 65°F is the base for both heating and cooling degree day computations. Heating degree days are summations of negative differences between the mean daily temperature and the 65°F base. For example, when the temperature is 5 degrees that equates to a 60 HDD (65-5).

Figure II-12
HDD Days (30-Year Average)[28]



In addition, National Fuel's service territory frequently experiences frigid temperatures and extreme winter weather events often accompanied by high winds, ice, and/or multiple feet of snow. The most recent examples occurred in November 2022 and December 2022. In the November 2022 event, record-breaking heavy snowfall in portions of the service territory downed powerlines, resulting in power outages to thousands of western New York homes and businesses.[29] During the multi-day 2022 Christmas Blizzard, more than 100,000 electric customers lost power and relied on National Fuel's natural gas deliveries to fuel equipment such as fireplaces, hot water tanks, and back-up generators to maintain life sustaining heat. Despite those power outages, National Fuel's underground natural gas system, again, proved its resilience to such winter events and continued offering uninterrupted service to its customers.

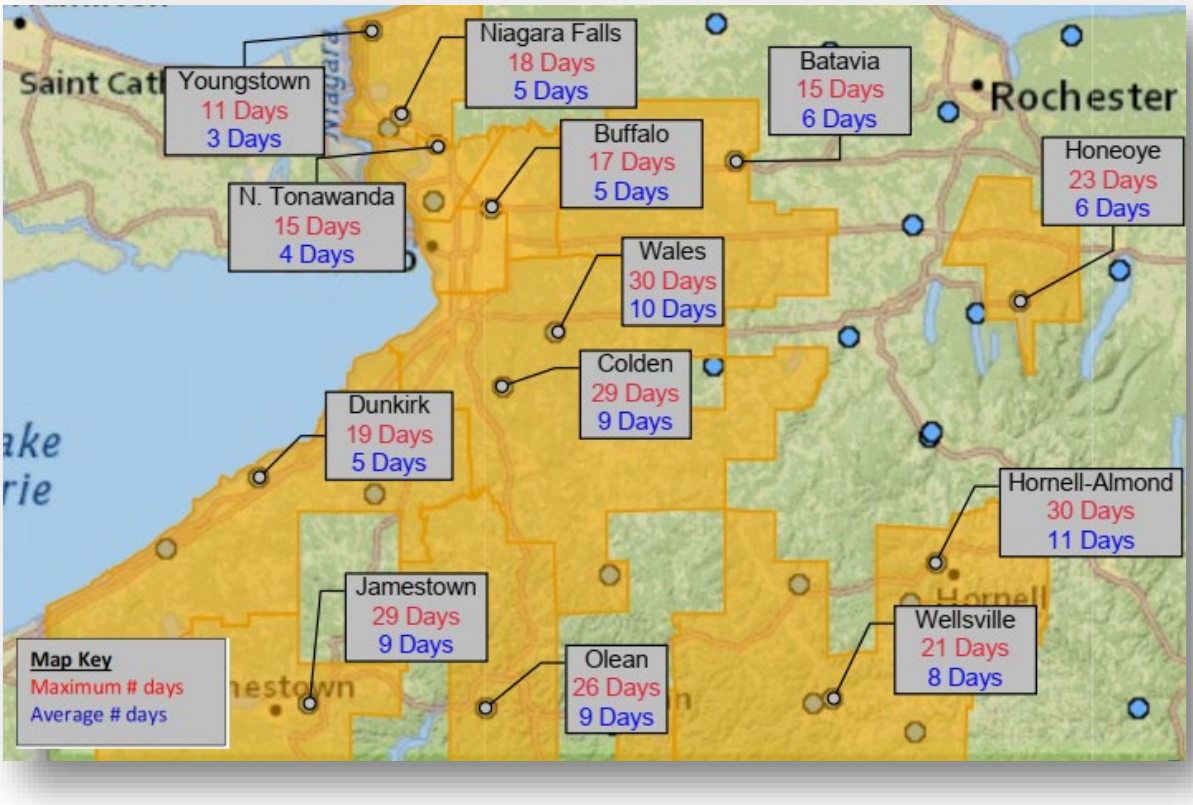
Figure II-13 demonstrates that National Fuel's customers frequently experience very cold days for prolonged periods of time, with some cities experiencing up to 30 days a year with average daily temperatures at or below 10 degrees.

---

28 National Oceanic and Atmospheric Administration ("NOAA").

29 In the November 2022 storm, more than 6.5 feet of snow fell in some areas. Locations with the highest totals experienced heavy snowfall at a rate of six inches per hour. See, https://spectrumlocalnews.com/nys/buffalo/weather/2022/11/28/recapping-the-2022-november-lake-effect-snowstorm

Figure II-13
Annual Winter Days with an Average Temperature at or Below 10°F[30]



Some of the service territory's notable low temperatures are shown in Table II-3.

Table II-3
Notable Low Temperatures

City	Date	Low Temp (ºF)
Olean	January 23, 2022	-22*
Wellsville	January 23, 2022	-19
Wellsville	February 17, 2015	-24*
Jamestown	February 17, 2015	-31*
Batavia	February 14, 2016	-15
N. Tonawanda	February 14, 2016	-15

*Record Low Temperatures

[30] These temperatures represent the 15-year (2006-2020) average for the winter period of November – March as reported by NOAA.

Due to the low temperatures that are experienced over prolonged periods of time in National Fuel's service territory, when making decisions related to building heating equipment it is critical that policy makers and homeowners consider the fact that the efficiency and capacity of heat pumps diminish as temperatures drop. In addition, these challenges require that any alternative sources of energy used to meet the peak winter heating demands of National Fuel's service territory be as reliable as today's natural gas system.

III. Long-Term Plan Methodology

III. Long-Term Plan Methodology

A. Overview and Guiding Principles

The LTP methodology guides the development of National Fuel's LTP, which sets forth specific decarbonization actions that the Company will pursue. The methodology is designed to examine and communicate how alternative "decarbonization actions" contribute to cost-effective GHG reductions and how the most promising and efficient options might be sized and staged to make a significant contribution to New York's statewide environmental objectives in a responsible manner (i.e., maintaining safety, reliability, resilience, affordability, and customer choice throughout the plan period).[31] The LTP provides a basis for requests for approval of specific investments and programs in future regulatory proceedings. Thus, it is important to note that the LTP should not be merely aspirational; it must be technically feasible and provide valid projections of costs, bill impacts, and GHG emission reductions that can inform subsequent utility proposals and decisions.

The methodology involves a multi-dimensional approach that incorporates analyses, quantitative and feasibility assessments, consideration of customer and stakeholder perspectives, and evaluation of risks and uncertainties. The examination starts with the current business circumstances (markets, asset base, customer programs, policies, and regulation) and produces an LTP that achieves desired future outcomes as delineated by a set of Guiding Principles. Guiding Principles are a collection of clear, concise statements that define the overall goal of the LTP.

National Fuel has employed an analytical model to support the development of the LTP. The model has been designed to assess alternative scenarios over a twenty-year period (2023-2042). A scenario consists of a combination of decarbonization actions that can be taken by National Fuel to contribute toward the realization of New York's GHG emissions targets. This quantitative model provides insights into the tradeoffs among objectives - particularly the tradeoff between GHG emissions reductions and the costs to achieve them. The scenarios provide insights regarding the contribution of individual decarbonization actions that are used to develop the LTP.

The model results are driven by assumptions that define the capability of individual decarbonization actions to produce desired results (timing, amount, and cost) as well as global

[31] The LTP focuses on National Fuel's potential contribution to New York's clean energy targets; it does not optimize across all sectors of the economy, including electric generation, transportation and agriculture, for example. However, it does consider the potential contribution of National Fuel to electrify building heating within its service area, even though the execution and cost of this strategy will depend critically on a buildout of electric generation, transmission, and distribution infrastructure.

assumptions that are beyond the control of National Fuel or any stakeholder, including fuel prices and inflation. All assumptions are documented in Appendices A through D with supporting sources provided in Appendices E through J. The model also produces a forecast of the incremental impact of the scenarios and LTP on National Fuel's revenue requirements and customer rates. Rate impacts are estimated based on existing cost recovery ratemaking principles and assume that National Fuel will recover an authorized return on invested capital with a return of investment based on National Fuel's existing depreciation methodology.[32]

The development of any long-term plan begins with establishing a clear vision of the desired outcomes for the Company's customers and communities it serves. Figure III-1 presents the Guiding Principles that National Fuel used to develop and test its LTP. The LTP must carefully balance the overall collection of principles as well as satisfy each principle on its own.

Figure III-1

National Fuel's Guiding Principles

Safe Operations	Meet or exceed all applicable safety regulations, policies and procedures to assure safe operations of the transmission and distribution network, consistent with National Fuel's "Safety-First" Culture.
Reliable Service	Maintain reliable delivery and energy supply service to all customers throughout the year, including on the coldest days.
Energy Resilience	Contribute to realization of overall energy system resilience (including electricity and natural gas service) by anticipating threats posed by climate change and avoid or minimize the impact and duration of major energy outages.
Energy Affordability	Plan and operate the network, acquire energy supplies, and pursue environmental objectives as efficiently as possible in order to maintain affordability for all customers, with particular attention to the needs of low- and moderate-income customers and disadvantaged communities.
GHG Emissions Reductions	Propose, design, and execute climate actions to achieve responsible, meaningful, and sustained GHG emissions reductions while maintaining safe, reliable, resilient and affordable energy service.
Customer Choice	Preserve customer choice, consistent with legislative and regulatory mandates, with respect to customer-sited energy investments and energy usage.

Some principles are "absolute" requirements; "safety" is perhaps the best example for LDCs. Other principles may be expressed to acknowledge that there are inherent tradeoffs among

[32] Gas Planning Order, p. 60.

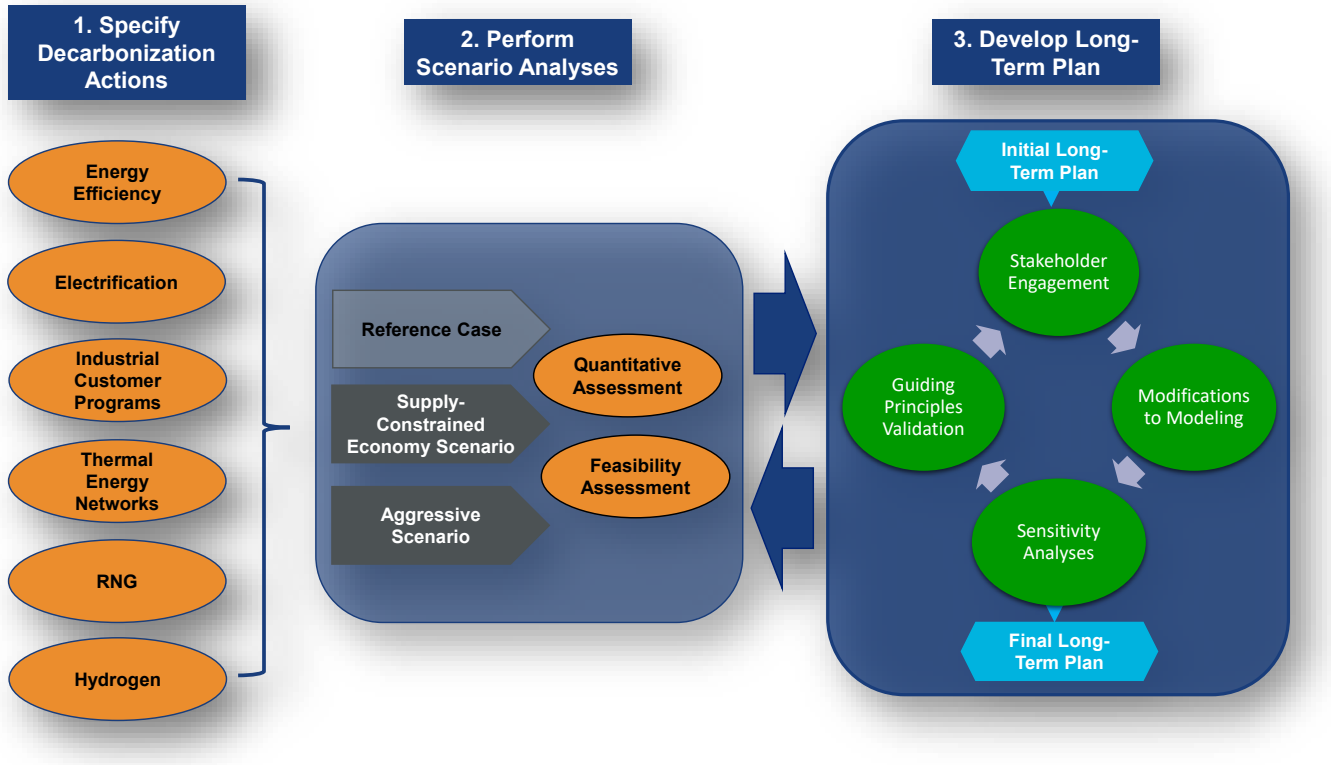
desired outcomes. With respect to National Fuel's LTP, the most important tradeoff is between cost and the goals of achieving GHG emissions reductions, while enhancing energy system resilience, and maintaining safe, reliable, and affordable energy service for all customers.

The "reliability" principle takes on a particularly critical role when considering the electrification of heating due to the potential consequences of an extended electric outage that coincides with extremely cold temperatures. Separate major storms in western New York in November and December 2022 provide recent examples of the weather in National Fuel's service territory that must be addressed in the LTP. For this reason, the "Reliable Service" principle is expressed as "reliable delivery and **energy** supply service", inferring that it also incorporates reliability of electricity rather than focusing exclusively on the reliability of gas service.

B. Long-Term Plan Process

The development of National Fuel's LTP can be summarized as a three-step process, however several aspects are iterative, as presented in Figure III-2.

Figure III-2
Development of National Fuel's Long-Term Plan



C. Specify Decarbonization Actions - Step 1

Decarbonization actions are actions that National Fuel can execute to reduce GHG emissions. The Company identified six decarbonization actions that are sufficiently advanced to enable modeling of estimated costs (capital investments and operations & maintenance ("O&M") expenses) and GHG emissions reductions. Two decarbonization actions, targeted network retirement and demand response, are difficult to project at this time but remain options if it is determined that they are economically superior and do not adversely impact safety and/or reliability. Each of the decarbonization actions that are assessed in the quantitative model are described in more detail below.

The modeling of each decarbonization action follows the same basic approach with assumptions regarding the per unit installation or procurement costs, changes in gas usage, and changes in electric usage as major data inputs. Assumptions are also made regarding the quantity and timing of each decarbonization action. The model also includes global inputs that apply to all decarbonization actions including GHG emissions per unit of gas or electricity consumed, gas prices, and electric prices. The model calculates the annual total reductions in gas use, total increases in electric use, total GHG emissions changes, total up-front costs, and total change in energy costs for each decarbonization action, as applicable.

Each of the modeled decarbonization actions are described in the following paragraphs. Additional details are provided in Appendix A.

1. **Energy Efficiency:** National Fuel is considering two new energy efficiency programs targeted to the residential class (weatherization and home energy reports) and one new energy efficiency program for the small commercial class (weatherization) to supplement the Company's existing energy efficiency programs. The key energy efficiency assumptions include program start date and annual participation rates. The residential weatherization model also includes assumptions that define which measures are included in the program.

   The residential weatherization model reflects assumptions regarding the per unit cost and natural gas usage reduction for each of seven potential measures, and customer participation ramp rates from a recent energy efficiency potential study.[33] The study assumes that 85% of the technical potential is achievable if all cost barriers are removed ("max achievable savings") and presents an associated aggressive ramp rate S-curve that peaks in year 14, which is used as the basis for residential customer participation.

[33] "Residential Weatherization Potential Study Report" prepared for National Fuel November 2, 2022, The Cadmus Group. Also provided in Appendix F.

The residential home energy report model incorporates assumptions regarding per participant cost and natural gas usage reduction that are based on similar programs implemented at other utilities.

The small commercial weatherization program, added in response to stakeholder feedback, is based on high-level assumptions regarding cost per unit of natural gas usage reduction. This class of customers is more diverse than residential customers with respect to building types and the role that energy serves in supporting economic activity, and there is limited data on the cost and savings associated with commercial weatherization programs.

2. **Electrification:** The analytical model incorporates a robust approach to electrification of existing space heating loads for several separate market segments, including residential, small commercial, universities and colleges, and large multi-family customers, as well as electrification of other gas appliances (water heating, dryer, and cooking ranges).

   The approach evaluates several electrification options. In response to stakeholder feedback, the model assumes electrification occurs at the end of expected life of central air conditioning equipment in addition to the end of expected life of heating systems. National Fuel used residential demographic data specific to its service territory to split residential customers into key segments, including (1) older homes (80+ years old) versus newer homes, (2) homes heating with furnaces versus boilers, and (3) homes with central air conditioning versus those without.[34] National Fuel determined the appropriate segments for modeling by cross-referencing demographic data provided by JRB Insights with cost data provided by CJ Brown.[35] In addition, standard air source heat pumps ("ASHP") are typically found in warmer climates such as the southern and southwest U.S. and are not designed or built to operate effectively in colder northern U.S. climates such as National Fuel's. Therefore, standard ASHP are not considered a viable sole heating source in the Company's service territory.

   Key assumptions include the up-front per unit incremental cost to convert to electric equipment and the per unit annual change in natural gas and electric use resulting from electrification for an average-sized home based on a study performed by CJ Brown for

[34] Based on a study by JRB Insights: "2021 Residential Market Study," August 5, 2021, provided as Appendix H.

[35] National Fuel recognizes that each home will have specific characteristics that will impact the costs and savings associated with electrification. For example, some larger homes may have higher installation costs and energy savings and some smaller homes may have lower installation costs and energy savings. For the purposes of estimating overall costs in its model, National Fuel necessarily relied on average cost and savings data. National Fuel will incorporate any additional meaningful segmentation data that becomes available in future LTPs.

National Fuel.[36] Residential energy use associated with electrification is based on an hourly analysis of the gas and electricity required to heat and cool an average home given hourly temperature fluctuations using various heat pump configurations modeled by CJ Brown. For residential heating, National Fuel analyzed the different costs and impacts associated with electrifying (1) older homes (80+ years old) compared to newer homes, (2) furnaces as compared to boilers, and (3) full electrification with cold climate air source heat pumps ("ccASHP") compared to hybrid heating (i.e., pairing an efficient gas furnace with an air-source heat pump).[37] Similarly, National Fuel considered the different costs and impacts associated with electrifying furnaces compared to boilers for small commercial customers, university/colleges and large multi-family customers. The model allows the Company to modify the start date, annual customer participation levels, type of building (i.e., by current heat source or by age of home), and type of heating system to be installed (i.e., ccASHP, hybrid heating system).

Stakeholders suggest that all residential customers will weatherize at the same time as they electrify and note in support that some ASHP incentives require weatherization measures to be installed, including NYSERDA's EmPower Plus program, which offers incentives to low- and moderate-income ("LMI") households in New York. National Fuel believes that it is unrealistic to assume that 100% of residential customers would or could weatherize at the same time as electrifying due to higher initial cost, challenges related to coordinating multiple contractors, and general disruption to home life during the construction. Recognizing that some customers may choose to weatherize at the same time as electrifying and to be responsive to stakeholders, National Fuel revised its LTP, which previously assumed that weatherization and electrification were independent. National Fuel's Final LTP assumes that 50% of residential customers weatherize at the same time as electrifying. This assumption will be revisited in future LTP filings to reflect any new information and insights.

In response to stakeholder feedback, electrification of new customers is modeled separately from the electrification of existing customers. National Fuel has incorporated the prohibition on fossil fuel equipment in new residential and small commercial buildings starting in 2026 consistent with legislation passed in May 2023. For the purposes of

---

[36] Residential per-unit cost and energy use information sourced from CJ Brown Report, provided as Appendix G.

[37] National Fuel did not model hybrid heating systems for existing gas customers that pair an ASHP with propane or oil because it assumes that (1) existing gas customers will likely want to maintain their existing heating fuel as backup rather than incurring additional equipment and installation costs and having to learn about a new system, (2) using gas as a backup fuel has a lower GHG emission profile than propane or oil, so switching to these fuels would result in a net increase in emissions which is contrary to statewide goals, and (3) natural gas is a more convenient backup fuel as the customer does not need to schedule deliveries or store inventory. Given the demonstrable environmental and affordability benefits of natural gas that currently exist, it would have been inappropriate for the Company to consider anything else as a supplemental fuel.

modeling, from 2026 through the end of the forecast period, National Fuel assumes all new residential and small commercial customers are new buildings and therefore will be fully electrified. The model also accounts for the avoided growth-related capital associated with new construction customers, as recommended by stakeholders. Finally, in response to stakeholder feedback, National Fuel assumes that new customers electrify at double the rate assumed for existing customers for the period prior to the prohibition of fossil fuels in new buildings.

3. **Industrial Customer Programs:** There are competitive challenges related to achieving GHG emissions reductions for National Fuel's large industrial customers.[38] The model considers two forms of decarbonization actions related to industrial customers: performing energy efficiency on process loads and electrification of space heating loads. Furnace and boiler-based heating systems are addressed separately to reflect their unique attributes. Key assumptions for both actions include the start date and annual customer participation levels. Energy efficiency of process loads reflects high-level assumptions regarding cost per unit of natural gas usage reduction. Electrification of industrial space heating loads is modeled similar to the modeling of electrification of small commercial space heating loads, reflecting assumptions regarding the up-front per unit incremental cost to convert to electric equipment and the per unit annual change in natural gas and electric use resulting from electrification.

   Many of National Fuel's industrial customers require high temperatures for their process needs. For example, metallurgical processes require temperatures over 650°C and ceramic processes require temperatures over 1,100°C which require an energy-intensive fuel, like gas. Currently, industrial heat pumps ("IHPs") can provide heat up to approximately 160°C, which is significantly lower than what is necessary for the majority of National Fuel's industrial load, thus limiting their application, therefore IHPs were not included in the LTP modeling.

   IHPs that can provide higher temperatures, direct use of hydrogen or RNG, and carbon capture technology may be options for industrial customers in the future. National Fuel will continue to monitor technology developments and will consider whether these options will be suitable for our industrial customers in future LTPs.

4. **Thermal Energy Networks ("TENs"):** National Fuel and other New York investor-owned utilities are proposing TENs pilot programs within their respective service areas. National Fuel is specifically exploring a geothermal TEN project. The economics and feasibility of networked geothermal projects are extremely site-specific. The Company is committed to

[38] "National Fuel Gas Corporate Informational Filing" submitted on June 15, 2022 in Case Nos. 20-G-0131 and 22-M-0149 includes a detailed discussion of the opportunities and challenges facing National Fuel's industrial customers as they explore actions that they can take to reduce emissions.

implementing the geothermal pilot or other pilots that are approved in Case No. 22-M-0429. These pilots, and others that are being planned and implemented in New York, other states, and other countries, will inform the network geothermal assumptions in the Company's future LTP filings. Following a competitive request for proposal process, the Company has engaged an engineering firm to complete a TENs site selection study of its service territory in the fall of 2023, including a focus on opportunities in DAC areas. Following completion of the study, the Company will select one or more sites suitable for further development and ensure that at least one site is located in and will benefit a DAC community.

For the purposes of this LTP, National Fuel has modeled the development of a generic residential TENs project in an existing neighborhood based on estimates of the per home up-front cost, natural gas usage reduction and electric usage increase. Key assumptions include the operational date, the number of homes in the generic residential TENs project, and the number of TENs projects in each year.

5. **RNG:** A report prepared by ICF Resources, L.L.C. on behalf of NYSERDA states:

> Renewable Natural Gas (RNG) is generally derived from biomass or other renewable resources and is a pipeline-quality gas that is fully interchangeable with conventional natural gas. As RNG is a "drop-in" replacement for natural gas, it can be safely employed in any end use typically fueled by natural gas, including electricity production, heating and cooling, industrial applications, and transportation. Today, about 50 trillion Btu year (tBtu/yr.) of RNG from landfills, dairy digesters, and water resource recovery facilities (WRRFs) around the United States are injected into pipelines, with production growing from year to year. … New York State has significant potential RNG feedstock resources from food waste, manure, agricultural residues, landfills, WRRFs as well as woody biomass and municipal solid waste.[39]

One of the benefits of RNG is that it can be easily blended into the gas supply and does not require building-by-building installations of equipment. Supply availability, timing, and per unit production cost assumptions for development of RNG are based on recent New

[39] *Potential of Renewable Natural Gas in New York State*, Final Report, Report Number 21-34, ICF Resources, L.L.C. (April 2022).

York State studies.[40] Availability of RNG from outside New York is based on a study performed for the American Gas Foundation.[41]

Numerous RNG developers have approached National Fuel about opportunities located throughout the Company's New York and Pennsylvania service territories. The Coalition for Renewable Natural Gas reported that there are 757 RNG facilities either operational, under construction or planned in the United States as of March 2023, including 84 facilities located in New York, Pennsylvania and Ohio,[42] the area where National Fuel sources almost all of its natural gas supplies and can rely on existing upstream pipeline capacity to deliver these supplies to customers in New York. RNG producers have access to the National Fuel system pursuant to tariff requirements as well as state-approved RNG interconnection and gas quality specifications to ensure the RNG is merchantable, pipeline quality product that requires no appliance modifications.

Using RNG as a substitute for natural gas captures the GHG emissions from the biogas feed source that would otherwise have been emitted to the atmosphere, resulting in significant GHG emissions reductions and environmental benefits. For example, capturing the methane emissions from animal manure from dairy farms, converting it to pipeline-quality gas, and using it as an energy source removes more GHG emissions from the atmosphere than the process produces. The Commission acknowledged the GHG emissions benefits of RNG in the press release announcing the approval of Bluebird Renewable Energy's ("BRE") RNG project, which states:

> While some opponents of the project felt that it would lead to increased Greenhouse Gas (GHG) emissions, Department of Public Service analysis determined that the project will, on average over its 30-year life, result in a net reduction in CO2 equivalent GHGs, and therefore is compliant with the Climate Leadership and Community Protection Act (CLCPA) requirements. The project will also reduce emissions from the farms themselves. Accordingly, the record before the Commission demonstrates that the project is consistent with the CLCPA and supports allowing the project to proceed.[43]

---

40 "Potential of Renewable Natural Gas in New York State", ICF April 2022. NYSERDA Report Number 21-34, p 44. "RNG Potential in NY & NFGDC Territory", National Fuel Gas Company, April 2020.

41 "Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment," An American Gas Foundation Study Prepared by: ICF, December 2019.

42 Coalition for Renewable Natural Gas website.

43 New York Public Service Commission, "PSC Approves Renewable Gas Project in Cayuga County," November 17, 2022.

Certain stakeholders have asserted that RNG should be deemed to have no emissions reduction benefits due to the unique GHG accounting methodology adopted in the CLCPA. New York's novel GHG accounting methodology is at odds with federal standards and most other jurisdictions. This may have broader negative implications for the state (e.g., as it develops its cap-and-invest program) that may render it impossible for New York to sync its decarbonization efforts with other jurisdictions, prohibit taking advantage of federal programmatic funding sources, and may otherwise disadvantage residents of the state. Despite these GHG accounting irregularities, the Climate Action Council is clear throughout its December 2022 Scoping Plan ("Scoping Plan") that from a policy perspective New York may evaluate adoption of alternative fuel decarbonization strategies utilizing the full life cycle analysis adopted at the federal level.[44] For example, the Waste chapter of the Scoping Plan recognizes that "[s]ignificant GHG impacts from this sector include the uncaptured emissions of methane from landfills, specifically from organic materials."[45] In light of these impacts, among the strategies recommended to mitigate GHG emissions generated by waste in the Scoping Plan is to "[o]ptimize and expand anaerobic digestion" as follows:

> The State should support energy production and methane mitigation *following a full life cycle analysis, including measurement and abatement of methane leakage, consideration for avoided emissions*, and supporting co-digestion programs at anaerobic digesters with existing capacity and include organics generated off site, such as food processing waste, food scraps and fats, oils, and grease. Programs that incentivize anerobic digestion should require systems be built (or retrofit) for maximum methane mitigation to ensure development of well-managed, low emissions biogas or RNG production such as utilizing emissions minimizing technologies and techniques, minimizing fossil fuel use in biogas or RNG production, minimizing emissions from biosolids/digestate, and consideration of a regulatory framework to ensure best practices.[46]

The Commission was confronted with similar arguments regarding GHG accounting issues when considering BRE's petition for a certificate of public convenience and necessity and rejected those arguments stating:

---

44 The Climate Action Council Scoping Plan references utilization of full lifecycle analysis in connection with alternate fuels in multiple chapters including Transportation (p. 174), Buildings (pp. 213, 216), Electricity (pp. 227, 255), Industry (p. 268), Agriculture and Forestry (pp. 290, 312), Waste (pp. 323, 330) and Gas System Transition (p. 351).

45 Climate Action Council, Scoping Plan, p. 323.

46 Climate Action Council, Scoping Plan, pp. 330-331 (emphasis added).

> While some commenters including Sierra Club argue that BRE's participation in the Federal and California programs would not advance the State's decarbonization goals or could have adverse environmental impacts in New York from an "accounting perspective," the Commission finds such claims unpersuasive. BRE's participation in such programs will provide a financial incentive to replace natural gas with RNG, and in turn allow the Farms to continue to digest the farm waste into a useable fuel that can be combusted, rather than releasing methane directly into the atmosphere.[47]

As it did in connection with BRE's petition, the Commission should from a policy perspective recognize the significant GHG emissions reductions benefits of RNG as modeled in this LTP, despite any "accounting" arguments raised by stakeholders. The GHG emissions benefits of RNG are factually indisputable and will be necessary to decarbonize the state in a responsible manner. This is particularly true in the western region of the state where electrification would require even greater expanded electric capacity than other parts of the state and where severe winter weather events render the electric system vulnerable to disruption when heat is critical.

In National Fuel's LTP, GHG emissions impacts related to RNG sourced both in-state and out-of-state are captured on a life-cycle basis, consistent with both the Scoping Plan[48] and the California Low Carbon Fuel Standard ("CA LCFS"), as well as consistent with the life-cycle emissions accounting National Fuel is using for natural gas. The specific GHG emissions factors used in the LTP modeling are consistent with GHG emissions factors associated with CA LCFS projects. Separate emissions factors are used to capture the emissions impacts associated with different RNG feedstocks, including landfill gas, animal manure, food waste, and wastewater. Using separate GHG emissions factors for different RNG feedstocks allows National Fuel to reflect the changing GHG emissions impacts over time as various RNG feedstocks will likely develop at different rates. RNG sourced from out-of-state is assumed to have higher emissions than RNG sourced from within National Fuel's service territory to reflect the added use of upstream transportation to deliver the out-of-state RNG. Thermal gasification is not market-ready, therefore only RNG from anaerobic digestion-based feed stocks is included in this LTP. Thermal gasification will be re-evaluated in future LTPs. The start date and annual quantities of RNG blended into the system are key assumptions for each anaerobic digestion-based feedstock.

---

47 *Order Granting Certificate of Public Convenience and Necessity and Providing for Lightened Regulation*, Petition of Bluebird Renewable Energy, LLC for an Original Certificate of Public Convenience and Necessity and Establishing a Lightened Regulatory Regime (Case 21-G-0576), p. 27 (November 18, 2022).

48 Climate Action Council, Scoping Plan, p. 213.

6. **Hydrogen:** Blending green hydrogen into natural gas for redelivery to customers reduces GHG emissions associated with combustion. There are several examples of hydrogen blending projects that are successfully delivering hydrogen enriched natural gas to customers. National Fuel is actively studying the impact of hydrogen on facilities and equipment and believes that its distribution system will be able to accept low levels of hydrogen blending without significant modification because its LPP replacement program has replaced much of the system with modern materials that are believed to be hydrogen-ready. One of the benefits of hydrogen is that it can be blended into the gas supply and does not require building-by-building installations of equipment at low blending levels. Recent federal legislation contains several incentives to spur development and reduce the cost of clean hydrogen including the Inflation Reduction Act and the Bipartisan Infrastructure Law.

   Key model assumptions include the start date and annual proportion of natural gas that is replaced by hydrogen.[49] Per-unit costs of hydrogen are sourced from a 2021 ICF study that contains annual projections that are higher than U.S. Department of Energy clean hydrogen price goals, but lower than some other sources.

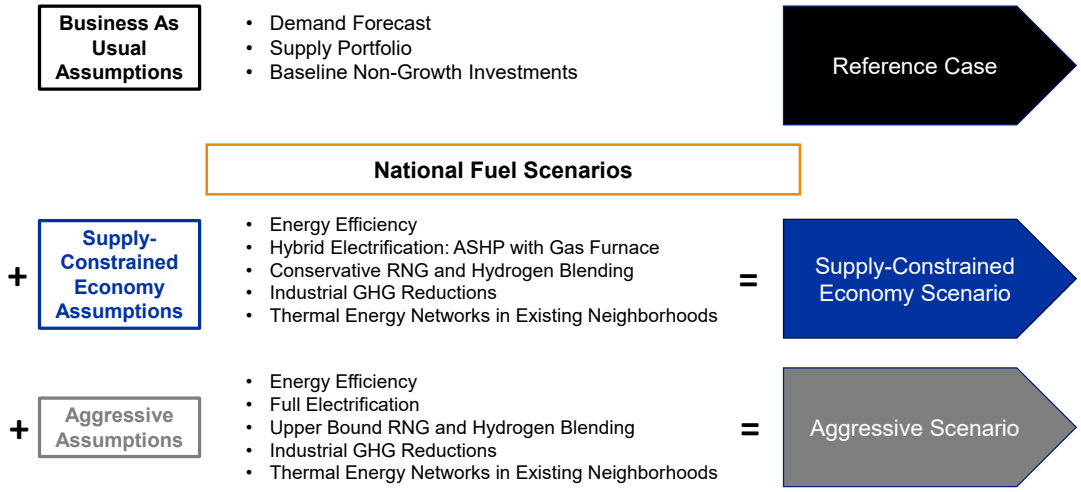
D. Perform Scenario Analyses – Step 2

Scenario analyses inform the LTP by assessing potential actions that National Fuel can take that will have an impact on GHG emissions, including carbon dioxide ("CO2"), methane ("CH4"), and nitrous oxide ("N2O") emissions. National Fuel developed a Reference Case and evaluated two scenarios that inform its LTP.[50] The two scenarios are a "Supply-Constrained Economy ("SCE") Scenario" and an "Aggressive Scenario." Each scenario is comprised of specified levels of each of the six decarbonization actions that are modeled and are designed to be feasible from a technology and development perspective. The development of the Reference Case and two scenarios is depicted in Figure III-3.

[49] The total amount of hydrogen that can be safely blended into a specific gas distribution system will require significant system-specific analysis to determine the make-up and condition of the existing pipelines and other equipment that may be affected by the introduction of hydrogen.

[50] National Fuel also performed three "Informational Scenarios" requested by stakeholders, CRA, and Staff during the stakeholder engagement process. The three informational scenarios are described in Appendix K.

Figure III-3
Reference Case and National Fuel Scenarios



- The **Reference Case** is a 20-year (2023-2042) representation of National Fuel's current market and business profile as described in Chapter II along with a forecast of supply and demand that reflects National Fuel's existing customer programs and outlook for key drivers that are external to National Fuel. These drivers include a demographic and economic outlook, natural gas and electricity prices, and assumptions regarding the availability of end-use technologies. Most importantly for the purposes of evaluating potential incremental decarbonization actions, the Reference Case does not include the impact of CLCPA actions that have not yet been planned or implemented and it assumes that none of the identified National Fuel decarbonization actions have been implemented.[51] As the name implies, the Reference Case is a baseline from which to measure the incremental GHG emissions reductions and associated costs that result from implementing the specific decarbonization actions that comprise each scenario. The Reference Case methodology and results are described in Appendix D.
- The **SCE Scenario** reflects labor and resource constraints that are experienced under normal economic conditions that limit energy equipment manufacturing, building construction and utility infrastructure development.
- The **Aggressive Scenario** reflects an optimistic view with respect to customer interest in electrification options and the ability of the national, regional, and local economy to deliver labor, technologies, customer equipment and infrastructure to enable decarbonization of New York's economy.

[51] The Reference Case forecast addresses total distribution system demand, supply and GHG emissions (i.e., that associated with retail sales customers plus transportation customers) since National Fuel's distribution system is built and used to deliver gas to both retail sales and transportation customers, regardless of what entity is responsible for procuring the natural gas.

Both scenarios are assumed to be technically feasible, safe, and reliable over the 20-year study period. They differ with respect to the impact of labor and resource constraints on the ability of unregulated entities to develop energy infrastructure and install building heating and cooling systems. National Fuel's scenarios are comprised of varying levels of the six decarbonization actions without regard to the total cost impacts of the scenario. The alternative scenarios are intended to provide insights with respect to the contribution of individual decarbonization actions and a collection of actions on key outcomes and thereby inform the development of the LTP. The Aggressive Scenario is comprised of relatively optimistic assumptions regarding the ability of unregulated entities to build electric infrastructure and convert customers to cold-climate heat pumps, while the SCE Scenario assumes that constraints limit the type and amount of decarbonization actions that can be implemented. Table III-1 defines how each decarbonization action is applied to develop the SCE and Aggressive Scenarios.

Table III-1

Decarbonization Actions Modeling Assumptions for National Fuel's Scenarios

	Action	Supply-Constrained Economy Scenario	Aggressive Scenario
1	**Energy Efficiency**	• Continue Reference Case EE • Residential Weatherization: 75% of max achievable savings; all measures • Residential home energy reports: 50% customer participation • Small Commercial Weatherization: ramps up from 0.5% incremental load reduction/year to a cumulative 5% load reduction by 2042	• Continue Reference Case EE • Residential Weatherization: 100% of max achievable savings; all measures • Residential home energy reports: 100% customer participation • Small Commercial Weatherization: ramps up from 0.5% incremental load reduction/year to a cumulative 9% load reduction by 2042.
2	**Electrification**	Electrify furnaces (not boilers) at a pace that ramps up and reaches 50% of customers choosing to electrify at end-of-equipment-life. **Residential** • Existing Homes: conversions to hybrid heating system at furnace or central air-conditioning ("AC") system end-of-life; electrify other appliances at appliance end-of-life; exclude old homes.	Electrify furnaces and boilers at a pace that ramps up and reaches 90% of customers choosing to electrify at end-of-equipment-life. **Residential** • Existing Homes: Customers leave the gas system when heating, ventilating, and air-conditioning ("HVAC") is converted; conversions ccASHP at heating system or central AC end-of-life; electrify other appliances at appliance end-of-life; include old homes.

	Action	Supply-Constrained Economy Scenario	Aggressive Scenario
	Electrification (cont.)	• New Homes: 100% of new homes are all-electric starting in 2026 consistent with recent legislation[52] **Small Commercial** • Existing Buildings: conversions to ASHP at furnace or central AC end-of-life. • New Buildings: 100% of new buildings are all-electric starting in 2026 consistent with recent legislation. **University, College, and Large Multi-Family** • Furnace/heater[53] conversions to ASHP at end-of-life	• New Homes: 100% of new homes are all-electric starting in 2026 consistent with recent legislation. **Small Commercial** • Existing Buildings: conversions to ASHP at furnace, boiler or central AC end-of-life. • New Buildings: 100% of new buildings are all-electric starting in 2026 consistent with recent legislation. **University, College, and Large Multi-Family** • Furnace/heater and boiler conversions to ASHP at end-of-life.
3	**Industrial Customer Programs**	• Energy Efficiency of Process Load: ramps up from 0.5% incremental process load reduction/year to cumulative 5% process load reduction by 2042. • Electrify Space Heating: furnace/heater conversions to ASHP at end-of-life ramping up to max of 50%.	• Energy Efficiency of Process Load: ramps up from 0.5% incremental process load reduction/year to cumulative 9% process load reduction by 2042. • Electrify Space Heating: furnace/heater and boiler space heating (non-processing) conversions to ASHP at end-of-life ramping up to max of 90%.
4	**TENs**	• One existing 50-home neighborhood network geothermal project a year starting in 2027	• Two existing 50-home neighborhood network geothermal projects a year starting in 2027
5	**RNG**	• ICF's Achievable Deployment Scenario, excludes thermal gasification; 100% of RNG produced in National Fuel territory; 2% of RNG produced in PA and OH[54]	• ICF's Optimistic Growth Scenario, excludes thermal gasification; 100% of RNG produced in National Fuel territory; 4% of RNG produced in PA and OH
6	**Hydrogen**	• 2030 start, blend incremental 0.5%/year, max at 5% (Btu content)	• 2028 start, blend incremental 0.5%/year, increasing to incremental 1%/yr in 2038, max at 7% (Btu content)

[52] Consistent with recent amendments to New York Energy Law §11-104 and New York Executive Law §378, National Fuel has assumed for modeling purposes that all new residential and small commercial customers are all-electric starting in 2026 (i.e., National Fuel did not model exceptions for new customers that convert to gas service from existing buildings, or new restaurants or any other specific small commercial customers).

[53] Includes unit heaters, infra-red heaters, make-up air heaters and rooftop heaters.

[54] National Fuel could use its upstream pipeline capacity to access RNG from other states including Kentucky, Tennessee, Alabama, Mississippi, Louisiana, and Texas, but for the purposes of this analysis National Fuel is limiting the RNG potential to that available in New York, Pennsylvania, and Ohio.

All decarbonization actions are assumed to start producing savings in 2025 unless otherwise noted (hydrogen and TENs are assumed to start later). Global assumptions are the same for both scenarios, except the Aggressive Scenario is assumed to have higher electric prices because additional electric capacity will be necessary to accommodate full electrification of heating during winter peak periods compared to the hybrid heating systems assumed in the SCE Scenario.

Each scenario produces results from quantitative metrics as well as an assessment of feasibility considerations that are difficult to quantify but are important factors in the development of the LTP.

Quantitative Assessment: the primary focus of the quantitative assessment is evaluating the trade-off between reductions in GHG emissions and cost impacts. The quantitative outcomes produced by the model include:

- Annual changes in total natural gas throughput, design day demand, and customer counts;
- Annual reductions in GHG emissions;
- Annual natural gas bill impacts for residential customers that do not participate in electrification options;
- Annual and net present value ("NPV") Decarbonization Policy Costs; and
- BCA relative to the Reference Case by quantifying incremental benefits and costs and applying the Societal Cost Test ("SCT").[55]

The calculation of gas prices, electric prices, Decarbonization Policy Costs and other metrics are described in Appendix B.

Feasibility Assessment: The feasibility analysis evaluates the practical ability to implement the set of decarbonization actions safely and reliably during the 20-year timeframe. The economy-wide transformation from fossil fuels to electricity will face resource and development challenges related to the ability to build new electric infrastructure, design, and produce commercially viable enabling energy technologies, and convert heating and cooling systems in existing buildings. The electric infrastructure investments include customer-side investments as well as electric generation, transmission and distribution investments, smart grid investments, and investments in resilience. Each of these challenges will create a strain on the ability to attract and develop a trained workforce to work in manufacturing, building trades, and utility O&M. Transformation of the industrial sector must consider the additional pressure of operating in a competitive business environment. Most large industrial

[55] As confirmed in the Gas Planning Order, the BCA should comply with the Commission's BCA Framework Order, Case 14-M-0101, Reforming the Energy Vision, Order Establishing the Benefit Cost Analysis Framework (issued January 21, 2016).

customers face intense competition for capital from other plants in the same corporation and competition from businesses located in other states and around the globe.

E. Develop the Long-Term Plan – Step 3

National Fuel's LTP is informed by the scenario analyses and input from Staff, CRA, and stakeholders, relying on these insights to develop a plan that is feasible with particular attention paid to costs, bill impacts, and GHG emissions reductions as well as the Guiding Principles. This reflects a consistent approach to the uncertainties associated with specifying individual decarbonization actions as well as global assumptions such as electricity prices.

1. Obtain Insights from National Fuel Scenario Analyses

Scenario analyses provide the insights necessary to develop a technically feasible LTP that achieves a reasonable balance between GHG emissions reductions and the cost of achieving them. National Fuel's scenarios were designed with this principal criterion in mind by defining the Aggressive Scenario to be an upper bound of implementation feasibility. The SCE Scenario also reflects the need to take actions in the near-term that make meaningful progress toward New York's climate goals but takes a more practical view with respect to the ability to address implementation challenges.

The scenario analyses and LTP were developed using a bottom-up approach where per unit costs (e.g., incremental equipment cost and incremental energy bills per participating customer or incremental cost per unit of RNG or hydrogen) and benefits (e.g., decreased emissions per participating customer, decreased emissions per unit of RNG or hydrogen) were estimated for each decarbonization action. It was then determined how much of each decarbonization action was included in the Initial LTP based on its feasibility, relative cost, impact on reliability and resilience, overall LTP cost impacts, and the specific characteristics of National Fuel's system, service territory, customer base, and market.

2. Stakeholder, Staff, and CRA Input

National Fuel's Final LTP has been shaped by extensive stakeholder engagement, which included participation by stakeholders, Staff, and CRA. As described in Chapter I, stakeholders and CRA have had many opportunities to provide feedback and input that helped National Fuel develop its LTP, including two rounds of written comments after Initial and Revised LTP reports were filed and multiple technical sessions organized by Staff. In addition, National Fuel modeled three "Informational Scenarios" that were defined by stakeholders working with CRA and has incorporated several assumptions from the Informational Scenarios into its LTP (e.g., revising

electric distribution prices to reflect rate making principles and electric demand growth, and pushing back the start years for energy efficiency and RNG).[56]

National Fuel carefully considered the recommendations received by all participants. Proposals that improve National Fuel's LTP and are consistent with its Guiding Principles have been adopted by National Fuel and incorporated into its LTP analysis, including modifications to the modeling of individual decarbonization actions (e.g., timing, implementation strategies, and costs) and modifications to assumptions that impact the overall evaluation of the plan (e.g., electricity prices). In certain other instances, where stakeholders or CRA proposed assumptions that were inconsistent with its Guiding Principles or not adequately supported by research, the Company performed sensitivity analyses to isolate the impact of the assumption on the LTP metrics. Chapter IV, Section D provides a comprehensive list of stakeholder and CRA recommendations that were incorporated into the LTP.

3. Addressing Uncertainty

National Fuel's LTP addresses the potential tension between "aspiration" and "plan" by leveraging the Commission's three-year LTP cycle and annual reports, relying on the Guiding Principles, and performing scenario and sensitivity analyses. The tension reveals itself most prominently with respect to important assumptions that must be made to address major unknowns in order to develop a "snapshot" LTP. The frequent updates convert a potentially static plan into a living process that will evolve over time to reflect the latest information and insights.

There are five categories of major unknowns that necessarily require assumptions to produce an LTP. Each category is discussed below, with an explanation of how National Fuel is addressing it for purposes of this LTP. All of these categories will be revisited in future LTPs.

- **Policy Developments:** There are numerous new laws, regulations, directives, and other policies as well as changes to existing laws, regulations, directives, and other policies that will shape decarbonization approaches for gas utilities in the years to come. These developments could originate from any one of several branches and departments of the federal, state, and local government. Topics could include, among others, GHG emissions targets, least cost gas procurement, cap-and-invest programs, non-pipe-alternative suitability criteria, and customer incentive levels and budgets. Any long-term plan must acknowledge the impact of potential future legal

[56] The results of the Informational Scenarios are presented in Appendix K; however, the Company has generally determined that these scenarios are not comparable to the LTP because the Informational Scenarios tend to be more "aspirational" and are not consistent with the Company's goal to develop an LTP that is achievable based on current information.

and policy developments. For the purposes of developing this LTP, National Fuel has relied on a few key concepts related to policy developments. First, the big picture goal is to develop a responsible, technically feasible plan to meaningfully reduce GHG emissions over a 20-year period while considering safety, reliability, affordability, and customer choice. Second, there is a difference between a "mandate" where the mandating body can control compliance and a "target" that is dependent upon choices made by third party entities upon which there is little control. Third, existing policies will change, but no one can accurately predict when and how. Therefore, National Fuel has not attempted to predict future policy direction or restrict its LTP based on potential policy limitations. Instead, National Fuel's LTP is designed to maintain optionality and be flexible enough to evolve with future legal and policy direction. While the LTP necessarily incorporates a 20-year forecast of many data inputs and assumptions, the focus should be on whether National Fuel's three-year action plan is reasonable given current information.

- **Technology Development:** The impact and cost effectiveness of all types of decarbonization actions will be significantly influenced by future technology development. The technical capabilities of heat pumps, hydrogen production and blending, dispatchable emissions-free electric generation resources, and thermal energy networks may improve over time, however no one can accurately predict when and to what extent. As a result, for this LTP, National Fuel has based its assumptions regarding technical capabilities for all decarbonization actions on information for current commercially available technology and does not attempt to predict future improvements. Therefore, National Fuel generally did not base its LTP on the promise of improved technology in the future, but rather technology with evidence of success today. National Fuel will incorporate technological improvements as they develop in future LTPs.

- **Customer Behavior:** There is considerable uncertainty with respect to customer behavior related to decarbonization. Many decarbonization actions will require individual customers to choose to make a change. It is difficult to predict specific customer adoption rates for any decarbonization action as there are potential barriers that must be addressed. For example, what level of economic incentive will be necessary to overcome the disruption associated with electrifying a heating system? How will customers react to the inevitable increased energy costs from decarbonization? For this LTP, customer behavior is modeled to reflect slower adoption rates in the early years, with adoption increasing over time as customer awareness grows. Peak adoption for residential customers is modeled to be reached in 2038 based on the ramp rate curve from a Cadmus study of residential weatherization installations. Adoption rates are not modeled to achieve 100% unless

a mandate is assumed to be in place. It is assumed that customer adoption is not hindered by insufficient incentive levels or incentive budgets. National Fuel is not aware of any relevant studies that would inform assumptions related to customer behavior associated with incentive levels for specific decarbonization actions and acknowledges that there is a need for studies and insights regarding customer behavior that can be incorporated in future LTPs.

- **Electric Infrastructure Development:** Although the CLCPA established targets for electric sector emissions and economy-wide decarbonization levels, achieving these targets is uncertain and depends on unprecedented levels of development of electric generation, transmission, and distribution infrastructure. Progress on each of these fronts will significantly impact the ability of the economy to decarbonize, which depends on electric capacity being developed in time to accommodate electricity demand growth attributed to decarbonization. National Fuel's LTP recognizes this uncertainty by considering the views of various industry experts regarding the timing of electric infrastructure buildout. The LTP reflects increases electric load at a reasonable pace over time to acknowledge the real-world challenges of major infrastructure build-out. For example, National Fuel's LTP uses the EIA's Annual Energy Outlook projections of generation fuel mix for upstate New York, which implies that electric emissions will decline over time, but do not attain the CLCPA goal of 100% clean electricity by 2040. Several entities have raised concerns that reaching this target will require new technology. For example, the New York Independent System Operator ("ISO") assumes that 10% of winter energy in 2040 must be served by yet-to-be-defined "dispatchable emissions-free resources" ("DEFRs") to meet CLCPA's clean energy goal. According to the New York ISO, DEFR "technologies are not yet commercially available at the scale necessary to fill in reliability gaps of retiring fossil fuel resources."[57] In addition, the Commission recently issued an order to initiate a process to identify how the electric emissions goals from the CLCPA can be met. This order states "several studies indicate that renewable energy resources may not be capable of meeting the full range of electric system reliability needs that will arise as fossil generation is replaced. These studies suggest that there is a gap between the capabilities of existing renewable energy technology and expected future system reliability requirements."[58] Therefore, for purposes of the LTP, National Fuel does not assume that the CLCPA goal of 100% clean electricity by 2040 is met, reflecting the fact that the technology to achieve this goal does not yet exist. Future developments

[57] New York ISO, "Power Trends 2022: The Path to a Reliable, Greener Grid for New York, Key Takeaways," June 8, 2022, p. 2.

[58] "Order Initiating Process Regarding Zero Emissions Target," Case 15-E-0302, May 18, 2023.

related to achieving the goal of 100% clean electricity by 2040 will be incorporated into future LTPs.

- **Cost:** Achieving the State's decarbonization goals will be incredibly expensive and it is important that policy decisions be based on realistic cost assessments. However, there is significant uncertainty regarding costs to implement and operate various decarbonization actions. Costs for all decarbonization actions will change over time as supply and demand balances change, as technology develops, and as labor markets develop. Costs that will have a significant impact on future LTPs include costs associated with heat pump equipment and installation, electricity, natural gas, hydrogen, and RNG. National Fuel's cost assumptions are based on the best information available from reliable industry resources, and generally do not attempt to anticipate how markets, technology, and resulting costs will evolve over time. National Fuel recognizes that costs will change and will incorporate updated cost information into future LTPs.

IV. National Fuel's Long-Term Plan

IV. National Fuel's Long-Term Plan

A. Objectives

The goal of the Company's LTP is to realize meaningful GHG emissions reductions at a reasonable overall plan cost while maintaining safety, reliability, resilience, and affordability of energy throughout the plan period. The key metrics are GHG emissions reductions and two measures of costs (gas bill impacts and Decarbonization Policy Costs). In general, the Company strove to be as aggressive as possible with respect to achieving GHG emissions reductions, subject to affordability concerns. National Fuel also considered feasibility implications, which include practical constraints that might restrict the number and type of household heating conversions per year or the buildout of electric infrastructure, for example.

The Company's LTP was developed using a bottom-up approach where per unit costs (e.g., incremental equipment cost and incremental energy bills per participating customer or incremental cost per unit of RNG or hydrogen) and benefits (e.g., decreased emissions per participating customer, decreased emissions per unit of RNG or hydrogen) were estimated for each decarbonization action. National Fuel assessed the relative efficiency of individual decarbonization actions in contributing to GHG emissions reductions (i.e., cost required per unit of GHG emissions reductions), as there is meaningful variation among the decarbonization actions with respect to their economic efficiency in reducing GHG emissions. These efficiencies are expressed as $/metric ton ("MT") GHG emissions reduction, with both numerator and denominator expressed as NPV values. The total costs are the sum of the incremental impact on National Fuel's revenue requirements (relative to the Reference Case) plus the Decarbonization Policy Costs.

The LTP was informed by insights from the scenario analyses and feedback and input from Staff, CRA, and stakeholders (Sections C and D, below).

B. Key Metrics

National Fuel's objective is to develop an LTP that satisfies the overall collection of Guiding Principles as well as each Guiding Principle on its own, recognizing that there are tradeoffs among desired outcomes. The most important tradeoff is between achieving GHG emissions reductions and maintaining safe, reliable, resilient and affordable energy for all customers and competitive energy prices for industrial customers. Three key model outputs enable consideration of these tradeoffs: reduction in GHG emissions, National Fuel gas bill impacts, and decarbonization policy costs. The measurement of each is described in more detail below:

1. **Reduction in GHG Emissions -** Annual GHG emissions are estimated for the entire supply and delivery chain from gas production through gas consumption for all National

Fuel customers to provide a comprehensive representation of the emissions associated with National Fuel's supply and demand. The model calculates and reports direct (Scope 1) and indirect (Scope 2 and Scope 3) GHG emissions.

- **Scope 1** emissions include emissions that are created by sources that are owned and controlled by National Fuel. This includes emissions associated with the Company's mains, services, customer meters as well as those from National Fuel's vehicle fleets and buildings.
- Indirect, **Scope 2** emissions include emissions associated with electricity purchased to operate National Fuel's business.
- Indirect, **Scope 3** emissions include those related to producing and transporting gas to National Fuel's distribution system, as well as emissions associated with the combustion of natural gas by National Fuel's end-use customers.[59]

Reference Case GHG emissions are projected by applying appropriate emission factors to National Fuel's Reference Case forecasted system characteristics, number of accounts, supply, and demand. Annual emissions are calculated for CO2, CH4, and N2O. Total CO2 equivalent ("CO2e") emissions are calculated by converting CH4 and N2O emissions to CO2e assuming a 20-year global warming potential ("GWP").[60] As shown in Figure IV-1, National Fuel's Reference Case CO2e emissions are primarily comprised of emissions created from end user combustion of natural gas, followed by emissions associated with production and transportation of gas, both Scope 3 emissions, and both expected to increase over time as Reference Case demand increases due to anticipated customer growth.[61] End user combustion accounts for 66% of CO2e emissions in FY 2023 and 68% in FY 2042. Over time, Scope 1 emissions are projected to decline as National Fuel continues to replace its LPP. Similarly, Scope 2 emissions

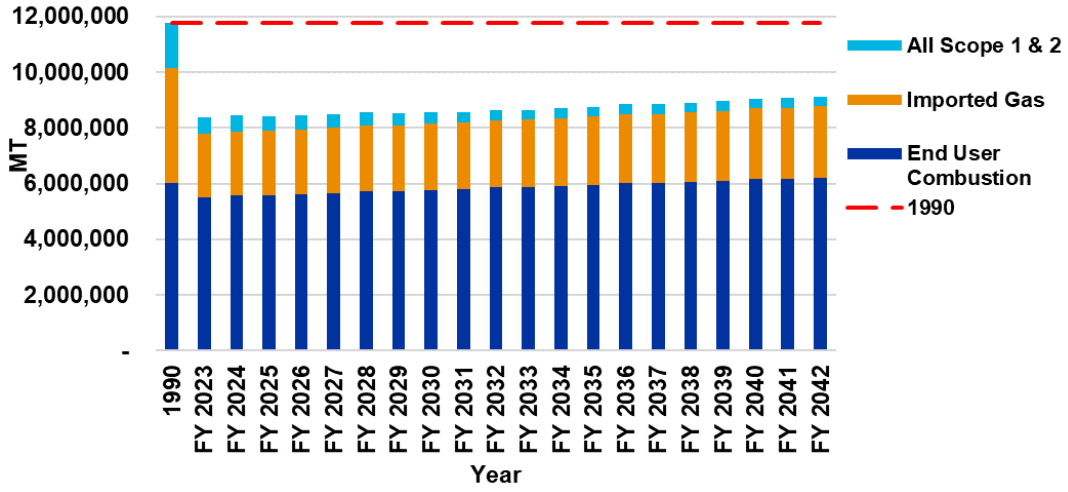
[59] There is some discussion about whether gas utilities must account for Scope 3 emissions associated with gas purchased for and used by transportation customers. National Fuel has included all Scope 3 emissions for transportation customers, which results in significantly increasing the GHG emissions included in this report.

[60] The GWP allows comparisons of the global warming impacts of different gases that have different effects on the Earth's warming (e.g., CO2, CH4, and N2O). Two factors include the ability to absorb energy ("radiative efficiency"), and how long they stay in the atmosphere ("lifetime"). Specifically, GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb relative to the emissions of 1 ton of CO2 over a specific period of time. Most sources report CO2e using a 100-year GWP, so care should be used when comparing the GHG emissions numbers in this report with other sources. National Fuel reported CO2e emissions using the 20-year GWP as defined in the CLCPA. (ECL § 75-0101(2)) The 20-year GWP AR5 values are 1 for CO2, 84 for CH4 and 265 for N20. As an illustrative example, a measure with GHG emissions of 1 Metric Ton ("MT") of CO2, 1 MT of CH4, and 1 MT of N20, would result in an C02e value of 350 MT, which is equal to 1 x 1 MT CO2 + 84 x 1 MT CH4 + 265 x 1 MT N20.

[61] The Reference Case customer and demand forecast were developed prior to the new legislation prohibiting fossil fuels in new buildings, and therefore include growth from new buildings. Impacts of the new legislation are accounted for in the electrification decarbonization action.

are projected to decline over time due to changes in the electric generation mix. Figure IV-1 presents the Reference Case forecast of GHG emissions reductions in relation to the 1990 level of CO2e emissions which serves as the baseline for emission reductions reporting. The approximate 30% decline from 1990 to FY 2023 is primarily attributable to reductions in methane emissions driven by the Company's pipeline replacement and system modernization programs and a substantial shift to procuring gas supplies from the Gulf of Mexico to the nearby Marcellus and Utica shales.

Figure IV-1
Reference Case Annual CO2e Emissions by Major Emissions Category



Annual GHG emissions reductions compared to the Reference Case are calculated for each decarbonization action, converted to CO2e using the same methodology as the Reference Case and summed to derive total emissions reductions for each scenario and the LTP. The GHG emissions reductions are primarily a result of reduced natural gas use (offset by emissions associated with increased electric use) and from blending RNG and hydrogen into gas supplies.

2. **National Fuel Gas Bill Impacts** – Gas bill impacts reflect incremental costs that are likely to be recovered through the gas rates paid by National Fuel's customers and will increase National Fuel's revenue requirement and/or cost of gas. These costs are primarily comprised of incremental supply costs from the blending of RNG and hydrogen. Gas rate impacts also reflect effects on billing determinants (positive or negative) from changes in throughput attributable to decarbonization actions (e.g., energy efficiency or electrification). The impacts to National Fuel's residential gas rates reflect the impact of each decarbonization action on both revenue requirements (numerator) and throughput (denominator). It is assumed that the existing ratemaking principles continue through the forecast period (i.e., National Fuel has not postulated any changes to cost allocation principles or rate design). Bill impacts are calculated for a typical residential heating customer that has not participated in electrification (a "non-participant"), who is assumed to use 106 Mcf/year.

3. **Decarbonization Policy Costs** – Decarbonization Policy Costs are costs that are incurred as a result of National Fuel's decarbonization actions but subject to recovery that will be determined by policy makers. For an existing gas customer that chooses to fully electrify, Decarbonization Policy Costs include the cost to install new electric equipment, minus the replacement cost of retired gas equipment, minus gas cost savings enabled by the investments,[62] plus increases in electricity bills attributable to newly electrified end-uses. National Fuel assumes that 25% of incremental equipment costs will be covered by customer contributions, and the remaining 75% will be covered by some combination of tax credits, rebates, utility program incentives, or other sources. Furthermore, the contribution of electric costs to the estimate of Decarbonization Policy Costs reflects only the increased costs of heating and cooling by participating customers. They do not reflect the impact of higher electric prices on other electric loads by participating or non-participating customers (e.g., refrigerators and lights). Electric prices reflect costs that may be incurred by electric utilities that overlap with National Fuel's service area to accommodate increases in electric load from electrification. As described in Appendix B, the electric prices are based on projected investments by electric utilities to maintain their networks, serve incremental loads, and integrate renewable and distributed resources. Electric prices may be higher after electric utilities perform the necessary detailed planning studies that consider localized impacts of electrification on their systems.

Decarbonization Policy Costs may be funded through a combination of tax policies, natural gas or electric utility rates, utility program incentives, rate subsidies, transfer payments, and other mechanisms that supplement funds contributed by participants and other private sources.

The Inflation Reduction Act offers meaningful incentives for heat pumps and eligible home improvements that meet certain criteria. New York, through its Clean Heat and other programs, offers several heat pump installation incentives that customers across the state may take advantage of. An April 2023 report by NYSERDA describes these programs and reports on the experience to date and areas that require further study. Incentives are a contributor to heat pump adoption. The ability of incentives to affect adoption rates depends on many factors including (1) the level of incentives offered, (2) the size of budgets approved for incentives, and (3) an understanding of free ridership. While National Fuel agrees that incentives are an important consideration, there is not yet sufficient insight to develop an algorithm that reliably depicts the relationship between incentives and adoption rates and to specify the source of funding for the incentives. In the absence of guidance regarding how costs will be recovered and insights that can be relied on to develop participation rates that are a function of incentive

[62] Gas cost reductions associated with reduced customer demand is limited to decreased commodity purchases of pipeline or delivered peaking services. The analysis does not reflect reduction to pipeline and storage service reservation and variable charges because it is assumed that pipelines will attempt to preserve revenues through tariff rate adjustment to address decreased system throughput.

levels, National Fuel has assumed that participation rates are limited only by practical constraints and not by the amount of funds made available for incentives. These practical constraints include the market's ability to implement the decarbonization actions (e.g., ability to provide sufficient labor, materials, and electric infrastructure). The implicit assumption being made is that policy makers will provide all incentives that are necessary to attract customers, and that these incentives will likely come from a variety of sources. If adequate incentives are not provided or if the total amount of ratepayer funded incentives are subject to a cap, participation could be lower than what is included in the LTP.[63]

C. Insights from National Fuel's Scenario Analyses

Insights gained from the two scenarios regarding cost impacts, overall GHG emissions reductions, the relative efficiency of the decarbonization actions in achieving GHG emissions reductions, and the risk to the reliability of the energy system are considered in developing National Fuel's LTP. The results indicate that there will be upward pressure on National Fuel's rates and the Decarbonization Policy Costs under any likely scenario that achieves material GHG emissions reductions. This is consistent with an expectation that achieving New York's climate goals will require significant investments in the energy sector. National Fuel, for its part, proposes to pursue decarbonization actions in a responsible manner, while striving to maintain the most affordable outcomes possible while retaining customer choice throughout the twenty-year LTP period and beyond. The tradeoff between costs and GHG emissions reductions will help National Fuel, Staff, the Commission and other stakeholders evaluate the consequences of adjusting the timing or level of commitment of individual decarbonization actions and the overall portfolio of such actions. Table IV-1 contains summary results for National Fuel's two scenarios.

[63] While some utilities have anecdotal evidence that sometimes incentives that cover 100% of the incremental equipment installation costs are not enough to convince customers to participate, the calculation of Decarbonization Policy Costs assumes that incentives would not exceed 100%.

Table IV-1
Incremental GHG Emissions and Cost Impacts

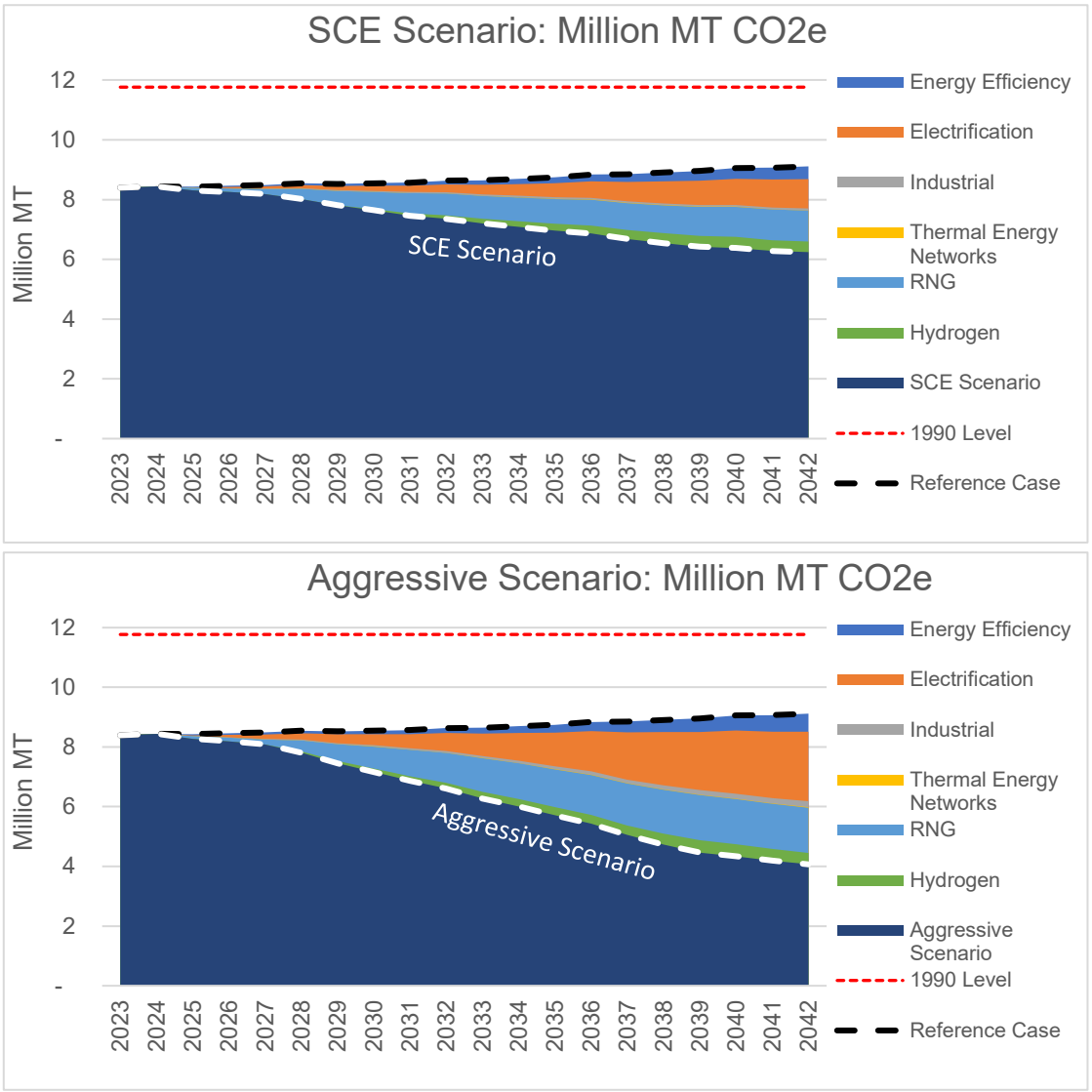
	2042 Annual GHG	2042 Non-Participant Gas Bill	Incentive Costs NPV	Non-Incentive Installation Costs NPV	Gas Costs NPV	Elec. Costs NPV	Total Decarb Policy Costs NPV	Total Cost NPV
Reference Case: Baseline (*)	**9,112**	**$135**	$0	$0	$0	$0	**$0**	**$0**
Increment Relative to the Reference Case								
SCE Scenario	**-32%**	**44%**	$1,352	$451	($935)	$1,069	**$1,937**	**$3,281**
Aggressive Scenario	**-55%**	**138%**	$3,036	$1,012	($2,868)	$3,406	**$4,586**	**$6,494**

(*) Reference Case Units: GHG in Thousand MT CO2e; Gas Bill – Typical Monthly Residential Heating Customer Bill using 106 Mcf per year; NPV Costs in $Millions

The Aggressive Scenario produces approximately 75% more GHG emissions reductions as compared to the SCE Scenario by 2042 (55% reduction compared to 32% reduction versus Reference Case levels) due to higher levels of activity in all decarbonization actions. However, the NPV of Decarbonization Policy Costs is much greater for the Aggressive Scenario than for the SCE Scenario ($4.6 billion vs. $1.9 billion), the Aggressive Scenario results in 2042 bill impacts that were over three times higher (138% vs. 44%), and total NPV costs are nearly twice as high for the Aggressive Scenario ($6.5 billion) as compared to the SCE Scenario ($3.3 billion), as shown in Table IV-1. The higher total costs in the Aggressive Scenario are primarily due to higher upfront and operating costs associated with full electrification compared to hybrid heating systems for residential customers and comparatively more residential conversions.

Figure IV-2 presents the contributions to GHG emission reductions by decarbonization action for the SCE and Aggressive Scenarios, respectively. The red dashed line at the top represents GHG emissions levels for 1990. The dashed black line represents the projected GHG emissions under the Reference Case, and the dashed white line represents the projected total GHG emissions under the scenario. Each colored wedge between the black and white dashed lines represents the GHG emissions decrease associated with a particular decarbonization action.

Figure IV-2
Scenario Contributions to GHG Emissions Reductions



As shown in Figure IV-2, both the SCE Scenario and the Aggressive Scenario have modest impacts on GHG emissions in the early years, with increased impacts in the later years as programs ramp up and impacts accumulate over time. The largest difference in GHG emissions reductions between the two scenarios is related to building electrification (orange wedge). While the all-electrification option in the Aggressive Scenario results in greater contributions to GHG emission reductions as compared to the use of hybrid heating systems for residential customers in the SCE Scenario, this distinction also drives the increase in costs between the two scenarios.

Table IV-2 details the relative cost efficiency, 2042 GHG emissions reduction, and total NPV (NPV impact on National Fuel's revenue requirement, plus, NPV Decarbonization Policy Costs) for each decarbonization action in National Fuel's two scenarios.

Table IV-2
Decarbonization Actions and GHG Emission Reduction Efficiency by Scenario

	SCE Scenario			Aggressive Scenario		
	$/MT CO2e	2042 Annual CO2e (000's MT)	Total Cost NPV ($M)	$/MT CO2e	2042 Annual CO2e (000's MT)	Total Cost NPV ($M)
Energy Efficiency						
Home Energy Reports	$ (108)	(20)	$ (19)	$ (151)	(40)	$ (52)
Weatherization Standard Income	$ 1,284	(121)	$ 376	$ 1,187	(161)	$ 464
Weatherization LMI	$ 673	(242)	$ 396	$ 576	(323)	$ 451
Weatherization Small Commercial	$ 129	(40)	$ 30	$ 164	(72)	$ 45
Electrification						
Residential	$ 420	(800)	$ 949	$ 586	(1,896)	$ 3,192
Small Commercial	$ 215	(189)	$ 117	$ 222	(411)	$ 263
University & College	$ 372	(1)	$ 0	$ 497	(24)	$ 28
Large Multi-Family	$ 482	(1)	$ 1	$ 565	(7)	$ 9
Industrial Sector						
Heating Electrification	$ 99	(13)	$ 3	$ 295	(107)	$ 74
Process Energy Efficiency	$ 150	(50)	$ 43	$ 174	(91)	$ 60
TENs	$ 1,140	(6)	$ 24	$ 1,074	(13)	$ 45
RNG						
RNG (NFG NY)	$ 212	(901)	$ 904	$ 211	(1,183)	$ 1,159
RNG (OH, PA)	$ 239	(127)	$ 205	$ 245	(331)	$ 424
Hydrogen	$ 221	(362)	$ 251	$ 226	(382)	$ 332
Scenario Total	$ 307	6,238		$ 364	4,070	
Reference Case		9,112			9,112	
Change from Ref Case		(2,874)	$ 3,281		(5,042)	$ 6,494
% Change from Ref Case		-32%			-55%	

The SCE Scenario has lower cost per GHG emissions reduction than the Aggressive Scenario ($307 compared to $364/MT CO2e). In both scenarios, weatherization for standard income customers and TENs have the highest cost per GHG emissions reduction, while home energy reports have the lowest cost per GHG emissions reduction. In both scenarios, residential electrification represents the highest total cost, and either the highest or second highest 2042 GHG emissions reductions.

D. Incorporating Stakeholder and CRA Input

National Fuel received considerable feedback and input from Staff, CRA and stakeholders after filing the Initial LTP in December 2022. This feedback was provided in written comments and several technical conferences that are listed in Chapter I. National Fuel has thoroughly considered all proposals, reviewing any support that was provided and performing supplemental research and analysis to assess whether the recommendations would improve the LTP in a way

that is consistent with the Guiding Principles. Numerous Staff, CRA and stakeholder recommendations have been incorporated into National Fuel's Final LTP modeling, including the following:

Customer Decision Points and Adoption Rates:

- Electrification: assume that customers will consider converting to a heat pump when central air conditioning reaches an end of life (not only when the heating system fails);
- Electrification: reflect new legislation that prohibits fossil fuel equipment in new buildings;[64]
- Electrification: increase electrification adoption rates for new customers; and
- Weatherization: assume that a meaningful proportion (50%) of residential customers will elect to weatherize their homes when they are installing a heat pump.

Specification of Decarbonization Actions:

- ASHP: revise estimated up-front installation cost for ccASHP downward by over 20%;
- ASHP: incorporate hourly load data in the operating profile;
- Weatherization: expand weatherization for residential and commercial customers;
- RNG: expand sourcing to neighboring states (Ohio and Pennsylvania);
- RNG: account for emissions attributable to transportation to New York for out-of-state RNG;
- Hydrogen: reduce hydrogen maximum in the Aggressive Scenario;
- Energy Efficiency: defer initiation of new energy efficiency programs by one year (from 2024 to 2025); and
- RNG: Defer blending start by one year (from 2024 to 2025).

Calculation of Benefits and Costs:

- Electricity Distribution Utility Rates: add detail that reflects traditional revenue requirements ratemaking principles;
- Electricity Distribution Utility Rates: reflect the projected increase in electricity sales in the calculation of electric distribution rates;
- Electricity Wholesale Prices: incorporate changes to seasonal shaping of prices over time; and
- Gas Rates: incorporate the avoided cost of new meters/services as an element of costs associated with electrification of new customers.

[64] Stakeholders recommended that National Fuel increase electrification adoption rates to reflect anticipated legislation that would prohibit fossil fuel equipment in new buildings. Subsequently, in May 2023, this type of legislation was enacted, therefore National Fuel incorporated the impacts of the new legislation.

Reporting of Additional Model Outputs

- GHG emissions reduction detail for 2030 for all scenarios;
- Design day demand forecast over the 20-year forecast period for all scenarios;
- BCA results for all scenarios, not just the LTP
- Annual throughput forecast by customer type over the 20-year forecast period for all scenarios;
- Annual throughput forecast by fuel type over the 20-year forecast period for all scenarios; and
- Annual customer count forecast over the 20-year forecast period for all scenarios.

Insights on how these proposals contribute to the Final LTP are presented in the following section.

However, not all proposals suggested by stakeholders and CRA are reflected in the Final LTP modeling. Following a thorough analysis, the Company refrained from adopting some assumptions because they are subject to considerable uncertainty, present feasibility concerns, and/or are not consistent with the Guiding Principles. Nonetheless, as outlined below, the impact of many of these assumptions have been evaluated as sensitivity analyses, are reflected in the Stakeholder Informational Scenarios, and/or are discussed in more detail in this report.

Evaluated as Sensitivities (see Section I below) and reflected in Stakeholder Informational Scenarios (see Appendix K):

- Decreasing ASHP costs over time;
- Improving ASHP technology over time;
- 100% residential customers weatherizing at the same time as electrifying;
- Reaching 100% clean electricity by 2040 and associated electric supply price impacts;
- Redefining hybrid heating to pair a gas furnace with a ccASHP instead of a standard ASHP;[65]

Reflected in Stakeholder Informational Scenarios (see Appendix K):

- Increasing electrification adoption rates as would be required for National Fuel to reach 40% GHG emissions reductions from 1990 levels by 2030;
- Assuming legislation is enacted that prohibits installation of fossil fuel equipment in existing buildings in 2031 (residential and small commercial) and 2036 (multi-family and university)

[65] This item is evaluated as a sensitivity, but not reflected in Stakeholder Informational Scenarios.

Expanded Discussion (see Sections E and J below):

- Using ground source heat pumps ("GSHP") for individual customer electrification;
- Including IHPs for industrial customer process load as a decarbonization action;
- Modeling demand response as a decarbonization action;
- Incorporating the impacts of New York's Cap-and-Invest Program;
- Modeling NPAs as a decarbonization action;
- Accounting for the impact of accelerated depreciation on future gas bills;
- Quantifying impacts on disadvantaged communities

Other:

- CRA has proposed that heat pump adoption rates should be modeled as a function of incentive levels. National Fuel agrees that incentives will influence behavior related to heat pump adoption but concluded that it could not reliably specify this relationship based on the current state of industry evidence. For purposes of this LTP, National Fuel has captured the costs of incentives and remaining customer costs in the calculation of Decarbonization Policy Costs, implicitly assuming that policy makers will establish and fund incentives that achieve the assumed decarbonization adoption rates. The ability to reflect this enhancement to the LTP methodology will be revisited in future LTPs based on evidence and insights that are available at that time.

E. National Fuel's Long-Term Plan

Insights from the scenario analyses, along with overall cost considerations and stakeholder input were used to determine the specific levels, types, and timing of each decarbonization action included in National Fuel's LTP based on feasibility, relative cost efficiencies, and the specific characteristics of National Fuel's system, service territory, customer base, and market. In general, the Company strove to be as aggressive as possible with respect to achieving GHG emissions reductions, subject to affordability concerns as well as confidence that the Plan could feasibly be executed.

1. Energy Efficiency

Overall Approach: Same as Aggressive Scenario but eliminate the least efficient weatherization measures to reduce costs. Also, focus weatherization investments on LMI customers. More specifically:

- Continue Reference Case energy efficiency programs.
- Assume 100% of residential customers receive home energy reports.
- Design residential weatherization program for standard income customers that excludes replacing windows and achieves 100% of max achievable savings.

- Design residential weatherization program for LMI customers that includes all measures and achieves 100% of max achievable savings.
- Design small commercial weatherization program that achieves savings that ramp up at a rate of 0.5% incremental load reduction/year to a cumulative 9% load reduction by 2042.

Reasoning:

- As shown in Table IV-2, home energy reports for residential customers are the only action with cost savings that are expected to exceed the costs to implement the program (i.e., total NPV cost is negative) in both the SCE and Aggressive Scenarios. Therefore, National Fuel included residential home energy reports in its LTP at the maximum possible level (i.e., 100% customer participation).

- Weatherization for standard income residential customers has the highest cost per unit of emissions reduction in both the SCE and Aggressive Scenarios compared to the other actions modeled, meriting an examination of individual measures. As shown in Table IV-3, the cost of windows per unit of gas savings is significantly higher than other weatherization measures for standard income customers. Therefore, National Fuel's LTP excludes window replacements from the residential weatherization program for standard income customers, lowering the overall cost per emissions reduction.

Table IV-3
Residential Weatherization Measure Cost and Gas Use Reduction

Measure	Gas Savings (Mcf)		Per Unit Installation Cost ($)	Cost per Gas Savings ($/Mcf)	
	Standard Income	LMI		Standard Income	LMI
Air Leakage Sealing	7.56	7.56	$ 680	$90	$ 90
Attic Insulation	4.53	9.39	$ 2,558	$565	$272
Rim and Band Joist Insulation	1.42	1.51	$ 63	$44	$ 42
Wall Insulation	8.29	16.55	$ 1,404	$169	$ 85
Floor Insulation	10.72	11.35	$ 1,423	$133	$125
Window	5.65	18.42	$ 13,753	$2,436	$747
Duct Sealing and Insulation	0.72	0.88	$ 1,442	$2,010	$ 1,640

For similar reasons, National Fuel had excluded attic insulation and duct sealing from the residential weatherization program for standard income customers in its Initial LTP. National Fuel agrees with stakeholder concerns that energy efficiency is a foundational decarbonization strategy. Therefore, in response to stakeholder feedback, the Final LTP includes attic insulation and duct sealing, and only excludes windows from the residential weatherization program for standard income customers.

- As shown in Table IV-2, weatherization for LMI residential customers has a relatively high cost per unit of emissions reduction in both the SCE and Aggressive Scenarios compared to the other actions. National Fuel had excluded duct sealing from the LMI residential weatherization program in its Initial LTP. Again, based on feedback from stakeholders

National Fuel has included all weatherization measures for residential LMI customers in its Final LTP, resulting in an increase in the total cost per unit of emissions reductions for LMI weatherization programs.

- Weatherization for small commercial customers was not included in the modeling for National Fuel's Initial LTP but has been added to the Final LTP in response to stakeholder feedback. As discussed in Chapter III, there is limited experience and insights regarding small commercial weatherization programs, at least partially due to diversity among customers. Since the program has a relatively low cost per emissions reduction, National Fuel has included small commercial weatherization at the higher level in the Final LTP, consistent with the Aggressive Scenario.

2. Electrification

Overall Approach: Electrify non-boiler-based heating systems at a pace that ramps up and reaches a peak of 70% of customers choosing to electrify at end-of-equipment-life. Electrification of homes with boilers was included in the Aggressive Scenario but is not reflected in the Final LTP due to the significant increased cost of electrifying systems heated by boilers. Residential customers convert to hybrid heating system (rather than an all-electric system) due to the reliability, cost premium, and comfort challenges in National Fuel's service territory associated with electrifying heating without natural gas backup. More specifically:

- Existing Residential Homes: Conversions to hybrid heating systems for existing residential homes occur at furnace or central AC system end-of-life. Other appliances are electrified at appliance end-of-life. Electrification excludes old homes.
- Existing Small Commercial: Conversions to ASHP for existing small commercial customers occur at furnace or central AC end-of-life.
- New Residential and Small Commercial Construction: Consistent with recent legislation, assume that 100% of new buildings are all-electric starting in 2026.
- University/Multi-Family: Conversions to ASHP for existing university and multi-family buildings occur at furnace/heater end-of-life.

Reasoning:

- Residential electrification is the largest contributor to overall decarbonization costs in both scenarios, as shown in Table IV-2. National Fuel examined two full electrification and four hybrid heating options for residential customers, relying on an analysis performed by CJ Brown using hourly temperatures and energy use. Table IV-4 presents the key assumptions, with a more detailed analysis presented in Appendix G.

Table IV-4
Per-Home Electrification Costs[66]

Option	1	2	3	4a	4b	4c
	Full Electrification Options		Hybrid Heating Options			
Heat Pump Technology	ccASHP	GSHP	Standard ASHP	ccASHP	ccASHP	ccASHP
Size of Heat Pump	4 ton	4 ton	3 ton	3 ton	4 ton	4 ton
Change Over Temperature (^{o}F)	n/a	n/a	30	20	15	10
First Cost	$ 17,500	$ 41,000	$11,000	$21,000	$22,500	$22,500
Annual Cost	$1,499	$ 813	$975	$1,178	$1,354	$1,436
Gas Use (ccf)	-	-	393	210	101	40
Electric Use (kwh)	11,990	6,507	5,329	8,102	10,201	11,235

Both ccASHP and GSHP were considered as full electrification options. With the significantly higher up-front cost for GSHP ($41,000) compared to ccASHP ($17,500) and expected annual energy cost savings of approximately $686, it would take approximately 30-35 years for a GSHP to be equivalent to the cost of a ccASHP. In addition, GSHPs have significant land requirements and can be much more difficult to site, especially in urban areas and areas located on bedrock. Based on these factors, National Fuel eliminated GSHP as an option in the Final LTP.

For hybrid heating, gas furnaces could be either paired with a standard ASHP or with a ccASHP. As shown in Table IV-4, all hybrid heating with ccASHP options have more than double the up-front costs plus higher annual operating costs compared to hybrid heating with a standard ASHP. As a result, National Fuel eliminated hybrid heating with a ccASHP as an option to be included in the Final LTP, but as presented in Section I below, hybrid heating with a ccASHP was included as a sensitivity analysis.

The scenario analyses indicate that a hybrid system with a standard ASHP is preferred to a full electrification option with a ccASHP from a total cost, and cost per emissions reduction perspective. Several other non-cost factors including comfort and reliability also support this preference, which are influenced by the extreme weather conditions experienced in National Fuel's service area.

National Fuel has been studying the cost and performance of full electrification and hybrid heating systems in real-world situations within its service territory through demonstration projects. While ccASHPs can operate during cold weather, the efficiency and heating

[66] CJ Brown Report, provided as Appendix G.

capacity diminishes as the outdoor air temperature drops. At very low outdoor temperatures, supplemental electric resistance heating is required to maintain adequate indoor temperatures, which causes electric consumption to drastically increase resulting in high electric costs.[67]

There are also reliability and associated public safety concerns with reliance on full electrification with ccASHPs. It is possible to maintain heat during power outages with hybrid heating system by installing a small, gasoline or natural gas partial home generator (approximately 1kW) that provides electricity to operate the gas furnace blower fan.[68] In contrast, a ccASHP will require substantially more power to operate during a power outage. Running a ccASHP with electric resistance supplemental heating during a power outage will require a large generator (approximately 20kW), which is likely too large to operate on gasoline and typically runs on natural gas.

Full electrification using ccASHPs will also place additional strain on the regional and local electric system and likely add significantly to customer energy bills, as more electric system build-out will be required to meet peak heating demand on cold days. National Grid estimates that a hybrid heating approach will require an additional 6 GW of electric capacity in western New York by 2050, while full electrification will require an additional 11 GW of electric capacity compared to current levels. This same report estimated that managing winter peaks through hybrid heating could avoid almost $75 billion of electric capital expenditures across New York through 2050.[69] Similar concerns have been noted in Quebec where the electric utility is supporting hybrid heating as a benefit to the electric system.[70]

Therefore, for the purposes of developing the LTP, National Fuel relies on hybrid heating with a standard ASHP for residential customers that heat with furnaces and do not live in old homes (i.e., over 80-years old). Homes currently heating with boilers and older homes are assumed to incur additional costs associated with electrification, implying that electrification programs should focus on younger homes that currently heat with furnaces

---

67 Anecdotally, customers are unhappy with the quality of the heat the ccASHP provides, especially during cold weather since ccASHPs have lower discharge air temperatures than a gas furnace. Participants in the Company's pilot program have complained that the house does not feel as warm during cold weather and the ccASHPs cannot recover from overnight setback temperatures (e.g., warming the house up in the morning to 70 degrees after the setback to 62 degrees overnight). In addition, National Fuel has received feedback that the electric bills are excessively high when using a ccASHP. As a result, one participant in the study has already indicated that they want the ccASHP removed and to return to using a gas furnace when the study period is over. National Fuel acknowledges that the anecdotal evidence represents a small sample size, but it provides real-world insight into customer feedback on the performance of ccASHPs.

68 In addition, gas appliances with a pilot light can operate without power, such as some storage tank water heaters, stoves, and fireplaces.

69 "Achieving a Low-Carbon Future in Western New York," National Fuel/National Grid, February 2022.

70 "Dual Energy for Sustainable Decarbonization", Hydro-Québec.

as an initial priority.[71] However, consistent with the Guiding Principle that values customer choice, National Fuel will support customer support other electrification choices by customers as well.

Finally, the LTP reflects assumptions regarding the number of conversions and timing of customer decisions to electrify. Conversion rates for existing homes are assumed to ramp up until they level off at 70% of customers with equipment failures converting in 2038, representing a balance between the SCE and Aggressive Scenario assumptions. The LTP also assumes that new customers electrify at twice the rate of existing customers until 2026, when fossil fuel is prohibited in most new homes under the recent legislation.

- The remaining sectors: small commercial, college/university, and large-multifamily customers are assumed to fully electrify in both the SCE and Aggressive Scenarios, with two distinctions between the scenarios. First, the Aggressive Scenario assumes systems heated by both furnaces and boilers electrify whereas the SCE Scenario assumes only furnace-based systems electrify. Second, the Aggressive Scenario assumes a maximum conversion rate of 90% starting in 2038 whereas the SCE Scenario assumes a maximum conversion rate of 50% starting in 2038. For all three non-residential subsectors, the cost per emissions reduction is lower in the SCE Scenario due to eliminating the more expensive boiler conversions. Therefore, electrification for these three segments is modeled after the SCE Scenario and does not include electrification of boilers. In addition, similar to residential electrification, the LTP assumes a middle-ground where 70% of customers with equipment failures will electrify starting in 2038.

3. Industrial Customer Clean Actions

Overall Approach: Electrify non-boiler-based heating systems at a pace that ramps up and reaches 70% of customers choosing to electrify at end-of-equipment-life due to the significant increased cost of electrifying systems heated by boilers. Include energy efficiency at Aggressive Scenario level. More specifically:

- Assume energy savings from energy efficiency of process load ramps up from 0.5% incremental process load/year to cumulative 9% process load reduction by 2042.
- Conversions to ASHP for industrial space heating load occur at furnace/heater end-of-life.

---

[71] It is assumed that homes with boilers would not be good candidates for hybrid heating systems as the controls do not yet exist to switch to using the gas boiler on cold winter days. Mini-splits are an option but they are projected to have an incremental up-front cost of $1,500 compared to an ASHP ($19,000 vs. $17,500). In addition, old homes are assumed to incur an additional $21,200 in electrical upgrades (mostly for upgrades to 200 Amp service and replacing knob and tub wiring) to allow for full electrification.

Reasoning:

- Industrial customers are extremely cost-sensitive for competitive reasons (often requiring paybacks of 1-3 years) and many corporations have options to move production to existing plants in other states or to another country in the mid- to long-term. For these reasons, and consistent with the Guiding Principles, National Fuel's LTP incorporates electrification of furnace heating, but not boiler heating. As shown in Table IV-2, Electrification of industrial space heating has a relatively low cost per emissions reduction in the SCE Scenario which focuses on electrifying furnace/heater load. The cost per emissions reduction is notably higher in the Aggressive Scenario, which includes electrifying heating load from boilers. The Aggressive Scenario assumes a maximum conversion rate of 90% starting in 2038 whereas the SCE Scenario assumes a maximum conversion rate of 50% starting in 2038. Similar to other electrification modeling, the LTP assumes a middle-ground where 70% of customers with equipment failures will electrify starting in 2038.

- Energy efficiency of industrial process loads also has relatively low cost per emissions reduction. Since the cost per emissions savings and the total cost of the programs are relatively low, National Fuel included energy efficiency of process loads at the Aggressive Scenario level in its LTP. As discussed previously, IHPs are not included in the LTP for process loads because current IHP technology cannot not provide the level of heat necessary for the majority National Fuel's industrial load and local electric requirements for IHPs add to the challenges of finding suitable candidates. However, consistent with the Guiding Principle that values customer choice, National Fuel will support industrial customers who choose to convert to IHPs for their process loads.

4. Thermal Energy Networks

Overall Approach:

- Complete one 50-home neighborhood network geothermal project a year starting in 2027. (As reflected in the SCE Scenario)

Reasoning:

- As shown in Table IV-2, TENs (modeled as networked geothermal projects) have the second highest cost per unit of emissions reduction (over $1,000/MT CO2e) in both the SCE and Aggressive Scenarios compared to the other actions modeled. The only difference between the SCE Scenario and the Aggressive Scenario is the number of TENs projects assumed each year (one existing neighborhood project in the SCE Scenario and two existing neighborhood projects in the Aggressive Scenario). To minimize impacts on costs consistent with the affordability Guiding Principle, while acknowledging New York State's desire to promote TENs, the Final LTP includes only one existing neighborhood TENs project per year. National Fuel is pursuing a TEN pilot

project in compliance with the Utility Thermal Energy Network and Jobs Act[72] and Commission's order in Case 22-M-0429 and is currently working with a consultant to identify appropriate projects in its service territory. Following completion of the study, which is anticipated in the fall of 2023, the Company will select a site or sites suitable for further development and ensure that at least one site is located within a DAC community.

5. RNG

Overall Approach:

- Assume RNG availability consistent with ICF's Optimistic Growth Scenario for anerobic digestion (i.e., excluding ICF's thermal gasification). Assume National Fuel can access 100% of the RNG produced in National Fuel territory and 2% of the RNG produced in PA and OH.

Reasoning:

- RNG has a relatively low cost per emissions reduction, can be easily scaled based on existing technology, and allows for material decarbonization without having to implement changes at individual customer premises. The LTP assumes National Fuel will have access to RNG produced in its territory. National Fuel assumed that it will be able to blend RNG sourced from within its service territory at levels consistent with the Aggressive Scenario (i.e., ICF's Optimistic Growth Scenario, excluding thermal gasification). Based on input received during the stakeholder process, these supplies will be supplemented by a relatively small percentage of RNG supplies from neighboring states (Pennsylvania and Ohio) that can be delivered by National Fuel-Supply. National Fuel's LTP relies on agricultural and landfill biogas feedstocks (anerobic digestion) and excludes RNG potential associated with thermal gasification as it is not as market-ready as anaerobic digestion-based feed stocks.

- National Fuel is well positioned geographically as it can rely on the existing pipeline network to interconnect and transport blended RNG. National Fuel's service territory includes significant rural agricultural communities with approximately 400,000 cows and cattle. Wyoming County alone, located within National Fuel's territory, is the largest dairy farming community in New York State with over 100,000 cows and cattle with significant RNG potential from dairy farms/animal manure. Several large landfills also operate within National Fuel's service territory.

- Some jurisdictions have recognized the potential benefits of these no- and low- carbon fuels and have created policies that encourage gas utilities to pursue their development.

[72] See, Laws of 2022, Chapter 375 (enacted July 5, 2022).

For example, Minnesota passed the Natural Gas Innovation Act In 2021, which allows gas utilities to pursue and recover prudently incurred costs related to innovative resources aimed at reducing GHG emissions and meeting renewable energy goals, which include biogas, RNG, and power-to-hydrogen, among others.[73] Florida also passed legislation in 2021 that provides for the cost recovery of RNG procurement by a gas utility.[74] These and other market mechanisms, like the renewable gas standards developed in California and Oregon and the clean heat standard recently adopted in Vermont, should be considered In New York to stimulate alternative fuels development in the state.

6. Hydrogen

Overall Approach: Consistent with federal, regional and New York initiatives, responsibly pursue a hydrogen option, test blend within National Fuel's service area, and monitor national and global progress that will inform the future contribution of hydrogen as a decarbonization action.

- 2030 start, blend incremental 0.5%/year, max at 5% (Btu content)

Reasoning:

- Hydrogen has a relatively low cost per emissions reduction, as shown in Table IV-2. National Fuel's LTP includes conservative levels of hydrogen blending with a later start date, consistent with the SCE Scenario (i.e., start in 2030 at incremental levels of 0.5%/year, up to a maximum of 5% by btu content (approximately 15% by volume)).

- Significant research is underway to determine appropriate levels of hydrogen that can be blended into natural gas systems. The Scoping Plan recommends that New York State follow "technological and research developments on the use of hydrogen as a tool to reduce greenhouse gas emissions." New York is currently evaluating the potential role hydrogen can play in decarbonization. To further advance the Hydrogen economy, NYSERDA is leading a multi-state effort to compete for federal hydrogen hub funding available as part of the Infrastructure Investment and Jobs Act. In line with the Climate Action Council recommendation, and as a member of the Northeast Regional Clean Hydrogen Hub, National Fuel will continue to explore the role hydrogen can have in lowering CO2 emissions in a safe and reliable manner. In addition, the 2022 Inflation Reduction Act contains subsidies for clean hydrogen production, which should facilitate additional hydrogen development. Current technology and the current composition of the U.S. gas distribution system suggests that approximately 5-10% (by Btu) hydrogen can be blended into natural gas systems.

---

73 H.F. No. 164 June 2021 - Natural Gas Innovation Act, Article 8 Sec.20.

74 SB 896 approved June 29, 2021. Page 4. Chapter No. 2021-178.

- There is a need to perform specific engineering and safety studies to identify the amount of hydrogen that can safely be blended into National Fuel's distribution system without creating operational issues. National Fuel notes that there are several examples of hydrogen blending projects that are successfully delivering hydrogen enriched natural gas to customers. Hydrogen blending ratios of up to 20% are being tested around the world including Germany, UK, and France with limited impact to infrastructure and end-use appliances. Scotland is conducting a demonstration of delivering 100% hydrogen to some homes. Hawaii Gas' existing pipeline network currently accommodates a mix of synthetic natural gas, RNG, liquid natural gas, and up to 15% hydrogen. Closer to home, Enbridge Gas, the LDC serving the greater Toronto, Canada area whose service territory is adjacent to National Fuel's territory is currently conducting a pilot program under the supervision of the Ontario Energy Board. Enbridge's pilot project stores hydrogen produced via electrolysis process from excess grid power and blends up to 2% by volume with natural gas for delivery through the existing natural gas distribution network to approximately 3,600 residential customers, located in the City of Markham, Ontario.[75]

- Although certain stakeholders expressed concern regarding the inclusion of hydrogen in the LTP, in light of these positive results and the amount of public and private resources being dedicated to the pursuit of hydrogen as a decarbonization tool, it is premature to eliminate hydrogen blending as a viable, cost effective decarbonization action that could contribute to the LTP. Introduction of hydrogen into National Fuel's system will be carried out in a technical and systematic approach that considers safety, O&M, the impact of hydrogen's properties, material compatibility, system capacity analysis, end-user equipment, and other factors. National Fuel is continually evaluating hydrogen and how it may impact the distribution system and our end-users. As hydrogen research advances and demonstration projects are being undertaken globally, the knowledge and information available on the subject will continue to evolve. National Fuel will utilize all available information to assess where and at what concentrations hydrogen can be safely blended into the existing system. National Fuel anticipates filing at least two additional full LTP studies prior to starting to blend hydrogen into its system, based on the LTP assumption that hydrogen blending starts in 2030. National Fuel will also continue to monitor developments associated with direct use of hydrogen by industrial customers.

A summary of the resulting LTP, organized by each decarbonization action, is presented in Table IV-5. All decarbonization actions are assumed to start producing savings in 2025 unless otherwise noted.

[75] Enbridge Energy, Inc., "Clean Hydrogen Enters the Markham Energy Mix," https://www.enbridge.com/stories/2022/january/hydrogen-blending-project-enbridge-gas-cummins-operational-markham-ontario, January 13, 2022.

Table IV-5
Summary of National Fuel's LTP – Decarbonization Actions

	Action	National Fuel's Long-Term Plan
1	Energy Efficiency	**Overall Approach: Same as Aggressive Scenario but eliminate the least efficient weatherization measures to reduce costs. Focus weatherization investments on LMI customers.** • Continue Reference Case EE • Residential home energy reports: 100% customer participation • Residential Weatherization, Standard Income: 100% of max achievable savings; excludes windows • Residential Weatherization, LMI: 100% of max achievable savings; all measures • Small Commercial Weatherization: ramps up from 0.5% incremental load reduction/year to a cumulative 9% load reduction by 2042.
2	Electrification	**Overall Approach: Focus on electrifying non-boiler based heating systems** at **a pace that ramps up and reaches 70% of customers choosing to electrify at end-of-equipment-life due to the significant increased cost of electrifying systems heated by boilers. Residential customers convert to hybrid heating system due to the reliability, cost premium, and comfort challenges associated with electrifying heating without natural gas backup.** • Existing Residential Homes: conversions to hybrid heating system at furnace or central AC system end-of-life; exclude old homes • Existing Small Commercial: conversions to ASHP at furnace or central AC end-of-life • New Residential and Small Commercial Construction: 100% of new buildings are all-electric starting in 2026 consistent with recent legislation • University/Multi-Family: Furnace/heater conversions to ASHP at end-of-life
3	Industrial Customer Clean Actions	**Overall Approach: Electrify non-boiler-based heating systems** at **a pace that ramps up and reaches 70% of customers choosing to electrify at end-of-equipment-life due to the significant increased cost of electrifying systems heated by boilers. Include energy efficiency at Aggressive Scenario level.** • Energy Efficiency of Process Load: ramps up from 0.5% incremental process load reduction/year to cumulative 9% process load reduction by 2042 • Electrify space heating: furnace/heater conversions to ASHP at end-of-life
4	TENs	**Overall Approach: Same as SCE Scenario** • 50-home neighborhood network geothermal project a year starting in 2027
5	RNG	**Overall Approach: Same as Aggressive Scenario for in state feed stocks and 50% of Aggressive Scenario for neighboring Pennsylvania and Ohio feed stocks** • ICF's Optimistic Growth Scenario, excludes thermal gasification; 100% of RNG produced in National Fuel territory; 50% of National Fuel's pro-rata share of RNG produced in PA and OH
6	Hydrogen	**Overall Approach: Same as SCE Scenario.** • 2030 start, blend incremental 0.5%/year, max at 5% (Btu content)

Taken together, the decarbonization actions included in National Fuel's LTP will make substantial contributions toward achieving New York's decarbonization goals.[76] The LTP is projected to reduce emissions by 40% by the end of the 20-year horizon (2042) compared to Reference Case levels, and by 53% from 1990 levels as shown In Figure IV-3. The emissions reductions start modestly and increase over time as constraints on deploying technology are resolved. Emissions reductions are expected to continue after 2042, through 2050 and beyond. Where necessary, the Company will seek appropriate regulatory approval(s) for implementation of these initiatives. The start dates for the decarbonization actions are all 2025 or later based on the likely time necessary to obtain regulatory approvals, and design and implement programs or projects.

The largest emissions reductions in 2042 result from adding RNG to the gas supply mix and from electrification primarily with hybrid heating systems.

Figure IV-3
LTP Contributions to GHG Emissions Reductions

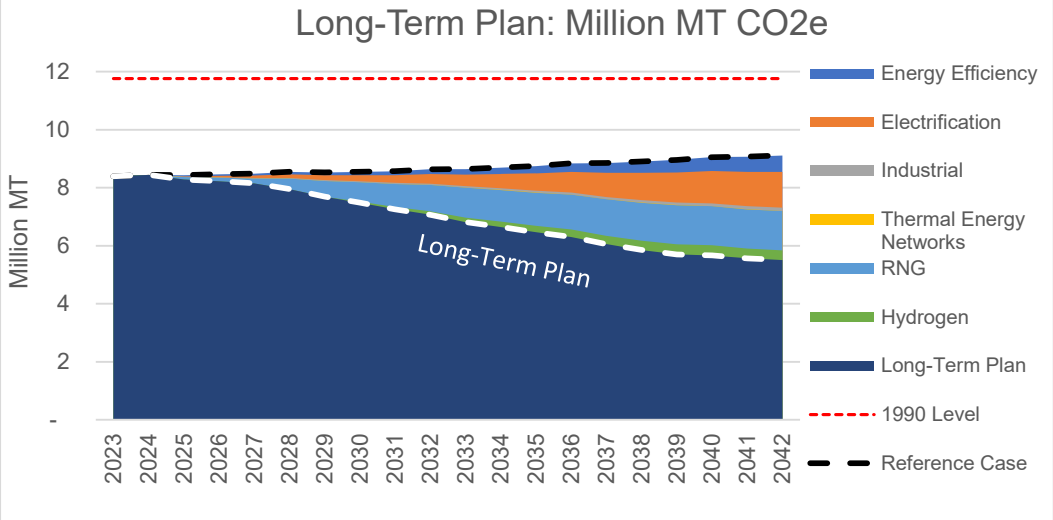


Table IV-6 details the relative cost efficiency, 2042 GHG emissions reduction, and total NPV (NPV impact on National Fuel's revenue requirement, plus, NPV Decarbonization Policy Costs) for each decarbonization action in National Fuel's LTP. The incremental cost of equipment at the customer premises (including incentives), incremental gas supply costs for RNG and hydrogen, and incremental energy bills for participating customers associated with the LTP as a

[76] The CLCPA specifies economy-wide goals but does not specify sector-specific or LDC-specific goals. The Climate Action Council's Scoping Plan recommends potential actions to achieve these goals, many of which require further action by local governments, the New York State Legislature, and/or state agencies. National Fuel's LTP is consistent with the CLCPA, the Gas Planning Order, and New York State's climate goals generally.

whole are estimated to total approximately $3.7 billion on a net present value basis over the next 20 years.

Table IV-6
LTP Decarbonization Actions and GHG Emission Reduction Efficiency

	National Fuel's LTP		
	$/MT CO2e	2042 Annual CO2e (000's MT)	Total Cost NPV ($M)
Energy Efficiency			
Home Energy Reports	$ (118)	(40)	$ (41)
Weatherization Standard Income	$ 388	(131)	$ 123
Weatherization LMI	$ 653	(323)	$ 512
Weatherization Small Commercial	$ 194	(72)	$ 53
Electrification			
Residential	$ 388	(1,000)	$ 1,107
Small Commercial	$ 197	(234)	$ 138
University & College	$ 354	(1)	$ 1
Large Multi-Family	$ 465	(2)	$ 2
Industrial Sector			
Heating Electrification	$ 81	(18)	$ 3
Process Energy Efficiency	$ 201	(91)	$ 69
TENs	$ 1,121	(6)	$ 23
RNG			
RNG (NFG NY)	$ 214	(1,183)	$ 1,175
RNG (OH, PA)	$ 241	(166)	$ 256
Hydrogen	$ 221	(339)	$ 241
Scenario Total	$ 275	5,506	
Reference Case		9,112	
Change from Ref Case		(3,606)	$ 3,663
% Change from Ref Case		-40%	

As shown in Table IV-6, home energy reports (with a green font) is the most efficient decarbonization action included in National Fuel's LTP at a cost of -$118/MT CO2e reduced, however total GHG reductions are limited. Installing thermal energy networks (geothermal) is the least efficient decarbonization action (meriting a red font) included in National Fuels LTP at a cost of $1,121/MT CO2e reduced, and energy efficiency (LMI weatherization) is the second least efficient decarbonization action at $653/MT CO2e reduced. National Fuel believes that including less efficient measures in the LMI weatherization program in the LTP is warranted given the need to pay particular attention to the effects that decarbonization will have on LMI customers. National Fuel will update the level of various decarbonization actions in future LTPs to reflect the evolution of decarbonization action costs, technology enhancements, and their relative efficiencies as measured by $/MT CO2e. For example, should National Fuel determine

through its TEN pilot projects that TENs become more cost competitive with other decarbonization actions, the Company would then look to increase the number of TENs installed per year.

F. Comparison of the LTP to National Fuel's Scenarios

The LTP performs well with regard to total cost, reliability, resiliency, and affordability when compared against the outcomes of the Aggressive Scenario. The primary difference between the LTP and the Aggressive Scenario is that the Aggressive Scenario assumes residential customers convert to full electrification of all major home appliances whereas the LTP assumes existing residential customers convert to a hybrid heating system, which pairs an efficient gas furnace with an ASHP, along with the electrification of all other non-heating appliances. While the reliability of National Fuel's natural gas system is largely unchanged under the LTP and the Aggressive Scenario due to its lack of constraints and vulnerable locations, the reliability and resilience of energy required for heat is likely to be substantially lower under the Aggressive Scenario as compared to the LTP due to the reliance on full electrification of heat without alternate fuel backup on all days of the year.

As illustrated in Figure IV-4, the LTP is substantially more cost-effective compared to the Aggressive Scenario. The LTP produces significant reductions in GHG emissions (3.61 million metric ton reduction of CO2e emissions in 2042) at a total NPV cost of $3.7 billion. The Aggressive Scenario produces somewhat higher reductions in GHG emissions (5.04 million metric ton reduction of CO2e emissions in 2042), but at a cost that is almost 80% higher than the LTP at $6.5 billion. This is primarily due to the relatively lower upfront and ongoing operating costs of converting residential customers to hybrid heating in the LTP compared to conversion to a full electric ccASHP in the Aggressive Scenario. The residential natural gas bill for non-participants in 2042 is also substantially lower in the LTP than in the Aggressive Scenario ($217 per month compared to $335 per month).

Figure IV-4
GHG Emission Reductions and Cost Impacts

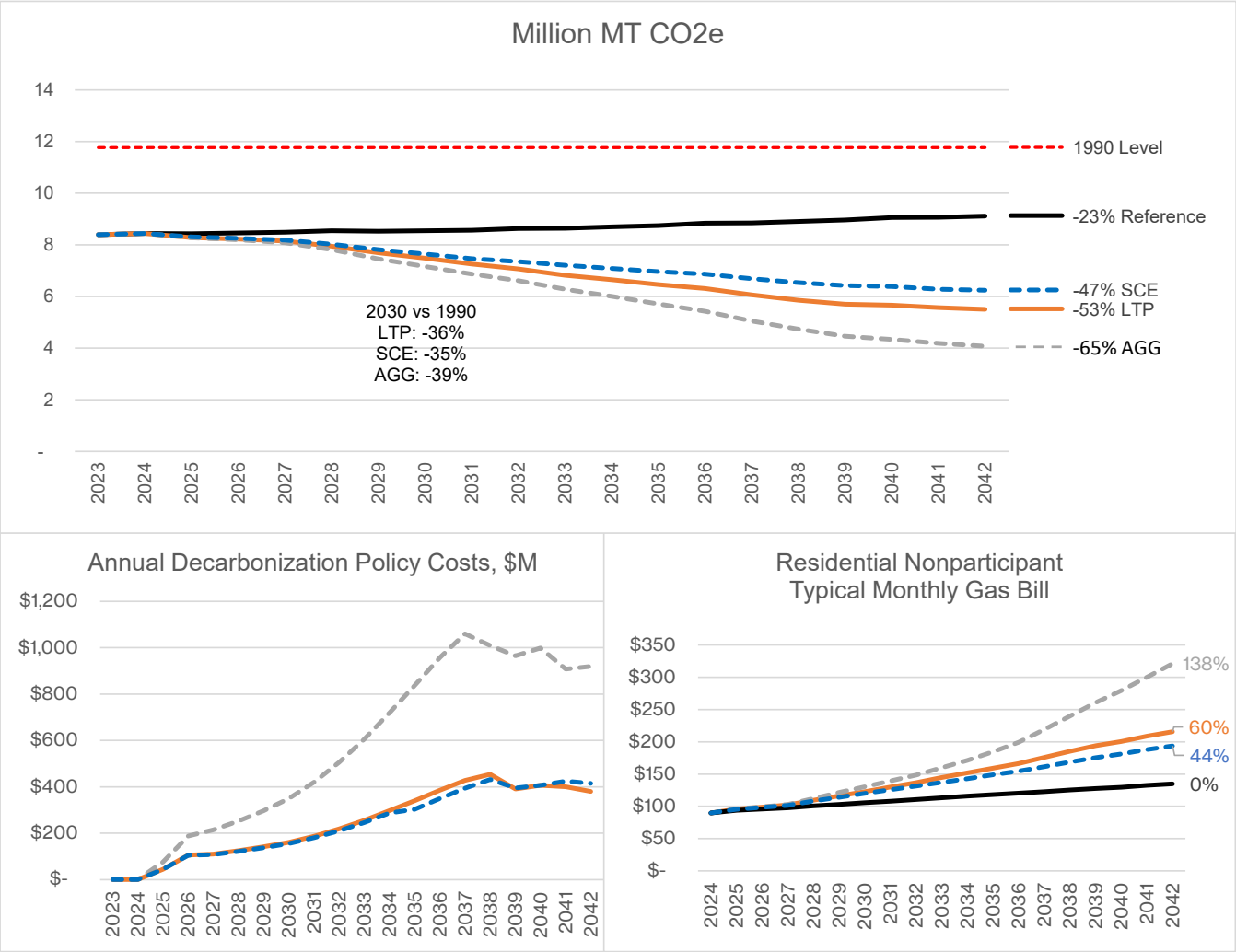
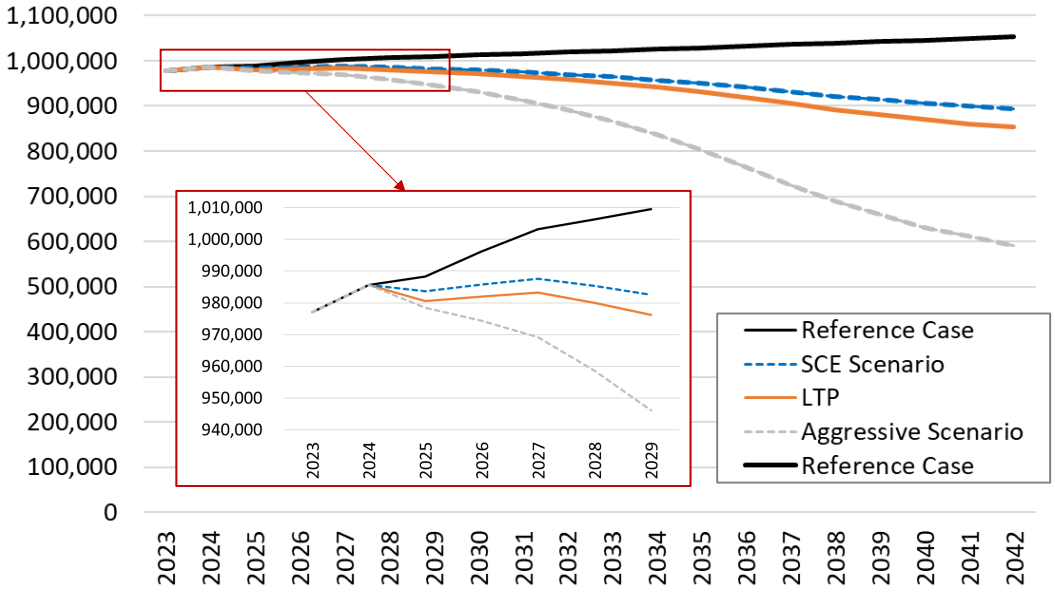


Figure IV-5 shows National Fuel's design day demand for the Reference Case, SCE Scenario, Aggressive Scenario, and the LTP through 2042, with a more detailed view of the early years of the analysis. While the Reference Case shows continued growth in design day demand throughout the 20-year period, the LTP and both scenarios show an overall decline in design day demand. Some of this decline is due to the new legislation prohibiting the installation of fossil fuel equipment in certain new buildings after December 31, 2025. Another material factor in the decline in design day demand is the ongoing weatherization and electrification of existing buildings. Design day demand in the SCE Scenario peaks in 2027 and is followed by a steady

decline. Design day demand in both the Aggressive Scenario and the LTP peaks in 2024, just before the decarbonization actions are implemented.[77]

Figure IV-5
Design Day Demand (Mcf) (excludes shrinkage)



The graphs in Figure IV-6 show annual gas throughput by sector and by fuel for the LTP, SCE and Aggressive Scenarios, as requested by stakeholders. The LTP results in 23% reduced gas throughput in 2042 compared to Reference Case levels, while the SCE Scenario results in 18% reduced gas throughput and the Aggressive Scenario results in 38% reduced gas throughput in 2042 compared to Reference Case levels.

[77] The Gas Planning Order states in relevant part that, "We require that LDCs shall be expected to include a "no infrastructure" scenario in their long-term plans. However, we will allow an LDC to assert that a no infrastructure scenario is not feasible for a particular project, or portion of its long-term plan. We expect Staff, the selected consultant, and stakeholders to vigorously test such assertions and the entirety of the LDCs' long-term plans." [p. 35-36]. While stakeholders have assumed that "no infrastructure" is synonymous with no design day demand growth, technically National Fuel does not require any infrastructure investments to meet modest levels of anticipated demand growth or address moratoria concerns due to having sufficient reserve capacity on its system to meet design day demand growth forecasted in the Reference Case (and every scenario analyzed).

Figure IV-6

Annual Throughput by Sector (excludes shrinkage) **Annual Throughput by Fuel**

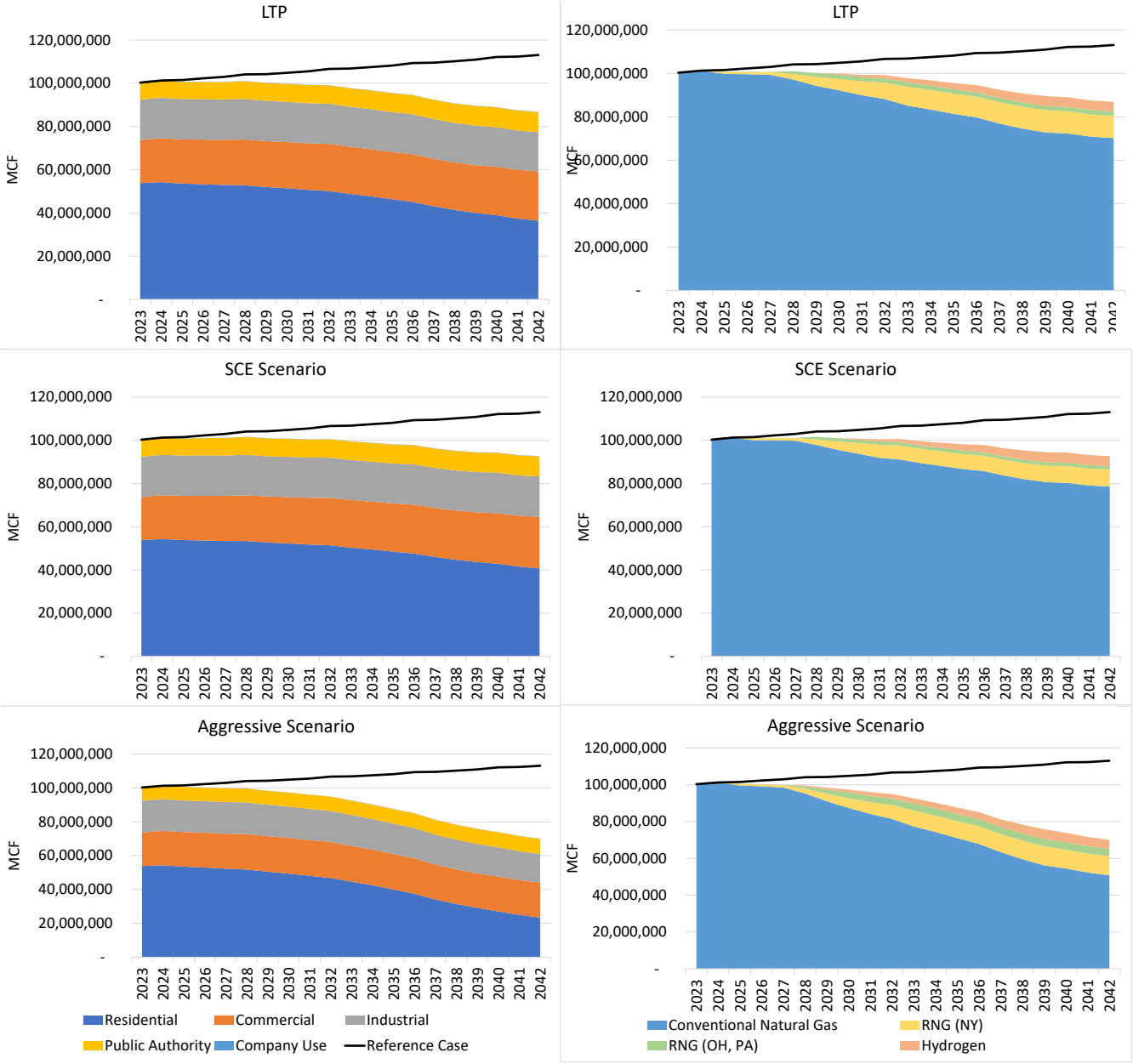
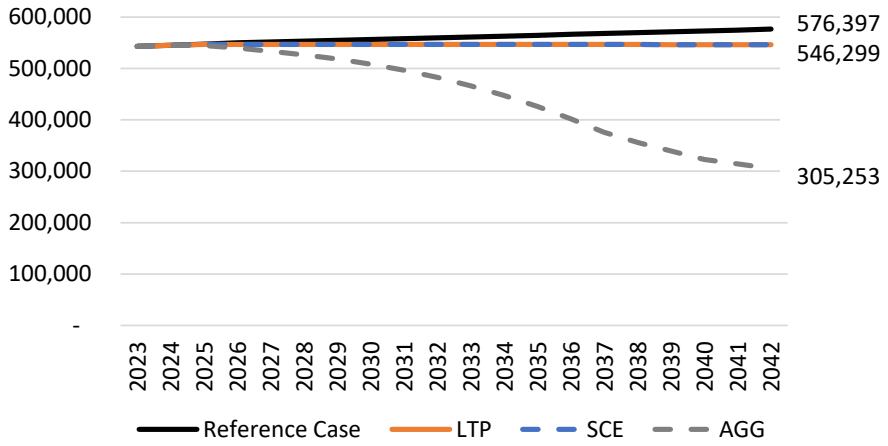


Figure IV-7 illustrates annual customer counts for the LTP, SCE and Aggressive Scenarios, as requested by stakeholders. The LTP and SCE Scenario result in 5% fewer customers in 2042 compared to Reference Case levels, while the Aggressive Scenario results in 47% fewer customers in 2042 compared to Reference Case Levels.

Figure IV-7
Annual Customer Count



NATIONAL FUEL'S LTP DELIVERS ESSENTIAL FEATURES AND BENEFITS TO ITS CUSTOMERS AND COMMUNITIES:

1) The LTP prioritizes safety and reliability by diversifying energy sources and continuing the Company's LPP replacement program;
2) The LTP preserves customer choice and provides a more affordable option while relying on the gas system to ensure effective heating during the coldest days and nights of the year;
3) The LTP addresses affordability and reduces energy cost burdens for LMI and other customers, including those that reside in disadvantaged communities;
4) The LTP achieves meaningful reductions in GHG emissions by 2042, prioritizing emissions reductions for LMI customers, including those that reside in disadvantaged communities;
5) The LTP is not merely aspirational; it is technically feasible and contemplates technology advances during the 20-year period;
6) The LTP is also feasible from an infrastructure standpoint. It reflects resource and timing constraints related to the conversion of heating and cooling to electricity and the buildout of electric infrastructure to reliably serve incremental demand;
7) The LTP contributes to a resilient energy system that involves coordination between the natural gas and electricity industries; and
8) The LTP is flexible and can adapt as energy technology and policy evolve in the future.

G. Consistency with the Guiding Principles

The final step in the development of National Fuel's LTP is to validate its compliance with the overall set of Guiding Principles and with each principle. This assessment is presented in Figure IV-8.

Figure IV-8
Compliance with Guiding Principles

	GUIDING PRINCIPLES	LONG-TERM PLAN
Safe Operations	Meet or exceed all applicable safety regulations, policies and procedures to assure safe operations of the transmission and distribution network, consistent with National Fuel's "Safety-First" Culture.	• LTP meets or exceeds safe operations.
Reliable Service	Maintain reliable delivery and energy supply service to all customers throughout the year, including on the coldest days.	• LTP maintains reliable service from both a network operations and supply portfolio perspective.
Energy Resilience	Contribute to realization of overall energy system resilience (including electricity and natural gas service) by anticipating threats posed by climate change and avoid or minimize the impact and duration of major energy outages.	• LTP will enhance overall energy system resilience by including hybrid heat pumps in the electrification decarbonization actions.
Energy Affordability	Plan and operate the network, acquire energy supplies, and pursue environmental objectives as efficiently as possible in order to maintain affordability for all customers, with particular attention to the needs of low- and moderate-income customers and disadvantaged communities.	• LTP materially increases National Fuel typical bills and imposes significant costs that will need to be addressed by policy makers. However, it reflects substantial efficiencies by tailoring decarbonization actions, thus achieving GHG emissions efficiently, and is significantly less expensive than the Aggressive Scenario which relies on full electrification for residential customers.
GHG Emissions Reductions	Propose, design, and execute climate actions to achieve responsible, meaningful, and sustained GHG emissions reductions while maintaining safe, reliable, resilient and affordable energy service.	
Customer Choice	Preserve customer choice, consistent with legislative and regulatory mandates, with respect to customer-sited energy investments and energy usage.	• LTP allows customers to make energy choices that are appropriate for their circumstances, while focusing efforts on more affordable options.

Despite the efforts to tailor decarbonization actions to achieve GHG emissions reductions efficiently, National Fuel is concerned that the costs to achieve the reductions will be unacceptably high as rates are reviewed and as policy makers address the recovery of Decarbonization Policy Costs. These concerns are consistent with the results of the BCA.

H. Benefit-Cost Analysis

The Gas Planning Order requires gas utilities to include a BCA in their long-term plan filings. The Commission's BCA Framework Order[78] designated the SCT as the primary BCA method. The SCT was performed for the LTP by comparing the NPV of the LTP's incremental benefits and costs relative to the Reference Case over the 20-year planning horizon. The Benefit Cost Ratio must exceed 1.0 to "pass". The LTP did not pass the SCT test with a Benefit Cost Ratio of 0.55. Assumptions used in the BCA are described in Appendix C. BCA results for the LTP are shown in Table IV-7.[79]

Table IV-7
BCA Results

Benefit Cost Analysis **Societal Cost Test**	**Discount Rate** 6.92% **NPV**
Benefit: Avoided Electrical Costs ($)	$ (39,017,670)
Benefit: Avoided Gas Costs ($)	$ (1,721,363,403)
Benefit: Avoided Gas Appliances ($)	$ (2,154,160)
Benefit: Avoided Services and Meters Revenue Requiren	$ (25,271,513)
Benefit: Avoided Emissions, Societal Cost ($)	$ (1,226,430,370)
Benefit: Avoided ICAP for Peak kW, Summer ($)	$ (12,299,771)
Total Benefit ($)	$ (3,026,536,887)
Cost: Incremental Electricity Cost ($)	$ 1,306,472,126
Cost: HER Program ($)	$ 18,219,053
Cost: Weatherization Cost ($)	$ 1,019,276,720
Cost: Weatherization Cost ($) - Incentive	$ 764,457,540
Cost: Weatherization Cost ($) - Non-Incentive	$ 254,819,180
Cost: Net Installed Cost ($)	$ 953,696,987
Cost: Net Installed Cost ($) - Incentive	$ 715,272,740
Cost: Net Installed Cost ($) - Non-Incentive	$ 238,424,247
Cost: Hydrogen Cost ($)	$ 313,647,787
Cost: RNG Production Cost ($)	$ 1,780,874,694
Cost: Implementation Costs ($)	$ 4,085,715,240
Cost: Increased Emissions, Societal Cost ($)	$ 36,392,847
Cost: Incremental ICAP for Peak kW, Winter ($)	$ 38,058,160
Cost: Incremental ICAP for Peak kW, Summer ($)	$ 11,483,143
Cost: Incremental ICAP($)	$ 49,541,303
Total Cost($)	**$ 5,478,121,515**

Benefit/Cost Ratio	0.55

[78] Case 14-M-0101, Reforming the Energy Vision, Order Establishing the Benefit Cost Analysis Framework, issued January 21, 2016.

[79] As requested by the stakeholders, BCA results for National Fuel's scenarios are presented in Appendix C.

The majority of the benefits accrue from avoided gas costs as well as avoided emissions, while the majority of the costs accrue from incremental electric costs and implementation costs.

The BCA Framework Order referenced in the Gas Planning Order was developed for the purposes of calculating BCAs for electric utilities. A corresponding BCA framework for gas utilities that addresses gas-specific issues, including treatment of RNG, has not been established. National Fuel applied the BCA Framework Order when calculating the SCT but acknowledges that some items do not have clear guidelines, including the accounting of GHG emissions impacts associated with RNG. National Fuel accounted for the GHG emissions impacts of RNG in the SCT using the same emissions factors and life-cycle accounting methodology it used to account for the GHG emissions impacts of RNG in its LTP modeling because it makes intuitive sense that the GHG emissions accounting would be consistent. However, stakeholders have indicated that for the purposes of calculating the BCA, the GHG emissions impacts of RNG should be calculated on a net basis instead of on a gross basis.[80] National Fuel understands that net GHG emissions impacts are calculated by removing the CO2 impact from the GHG emissions calculations but retaining the methane and nitrous oxide impacts. To accommodate stakeholders' views on this topic, and to understand the magnitude of the impact, National Fuel also calculated the SCT using net GHG accounting for RNG. The impact on the result is negligible. The SCT using the net GHG accounting for RNG is 0.548, compared to the SCT result above of 0.552, which uses gross GHG accounting for RNG.

Implementation Costs related to up-front costs for weatherization and electrification are split into costs covered by incentives versus costs not covered by incentives for the BCA. As discussed, National Fuel has not attempted to quantify the value of potential federal incentives, state incentives, utility incentives, rate subsidies, transfer payments or other mechanisms that may reduce costs to participating customers. In addition, a BCA framework applicable to gas utility LTPs has not been developed. Therefore, for the purposes of calculating the BCA for its LTP, National Fuel has grouped all potential sources of incentives into one "incentive" category and included these incentives as part of implementation costs in the calculation of the SCT.

There are several items in the SCT that were not included as they are difficult to quantify, including reliability/resiliency improvements, non-energy benefits, and non-energy costs. In addition, the increased electric costs included in the SCT were limited to those directly related to converting gas equipment to electric. Increases in electric costs due to electric rates increasing for all customers for other electric use (e.g., to run existing electric equipment such as refrigerators) were not quantified or included in the SCT.

[80] Energy and Environmental Economics, Inc., "Fossil and Biogenic Fuel Greenhouse Gas Emission Factors Final Report," Prepared for NYSERDA, Revised May 2023.

The BCA ratio is 0.55 despite the effort to achieve GHG emissions reductions at a low cost. Given the high costs associated with most of the decarbonization actions, it is unlikely that most decarbonization actions would pass a SCT. National Fuel believes that the combination of decarbonization actions included in its LTP represents a responsible plan to reduce GHG emissions, enhance the resilience of the energy supply system, and deliver safe, reliable and affordable energy service while preserving customer choice. National Fuel notes that other New York LDC's have received Commission approval to proceed with certain non-pipe alternative projects with similar BCA ratios.[81]

I. Key Uncertainties and Sensitivity Analyses

The LTP represents a 20-year perspective, a challenging future that will be characterized by continued evolution of policies, customer behavior, economic and market trends, electric infrastructure development, and technological innovation. As such, each of its key drivers is subject to some level of uncertainty, including:

- Customer perspective and acceptance with respect to building heating and cooling system modernization as they apply to fuel sources, equipment technologies, and conservation;
- Regulatory actions related to the CLCPA legislation and emission reduction targets that may be imposed on the gas distribution system over the next 20 years;
- Continued evolution of New York energy policy and Commission regulatory requirements (e.g., allowing the cost of RNG and hydrogen to be recovered by utilities, policies to mitigate up-front cost barriers associated with installing equipment at customer premises to enable decarbonization);
- The ability for the unprecedented electric infrastructure buildout to occur at a pace faster than the rate of electric demand growth;
- Technology advancement including the viability and scalability of several different technologies related to: (1) heat pumps; (2) RNG; (3) hydrogen; (4) TENS (including district geothermal); and (5) carbon capture and storage; and
- Market conditions including workforce training and availability, supply-chain issues, inflationary pressures, investor initiatives, and global energy instability.

National Fuel has quantified the impact of some of these uncertainties through sensitivity analyses. Each of the sensitivity analyses represents recommendations from stakeholders. Six sensitivities were performed, each reflecting a single change to the LTP to isolate the impact of

[81] PSC Case 17-G-0432: Order Approving Petition for Non-Pipe Alternative Projects, with Modifications.

the particular input. The six sensitivity analyses and associated results are summarized in the following table and discussed in more detail below:

Table IV-8
Results of Sensitivity Analyses

	$/MT CO2e	2042 CO2e Reduction vs Reference Case (000s MT)	Total Cost NPV ($M)
LTP	**$ 275**	**(3,606)**	**$ 3,663**
Decrease ASHP cost 1%/year	$ 266	(3,606)	$ 3,546
Increase ASHP cost 1%/year	$ 284	(3,606)	$ 3,795
Increase ASHP efficiency 1%/year	$ 265	(3,620)	$ 3,549
100% of residential customers weatherize while electrifying	$ 276	(3,572)	$ 3,657
100% clean electricity by 2040 with higher electric supply price	$ 278	(3,748)	$ 3,779
Hybrid heating = ccASHP + gas furnace (15-degree switchover)	$ 361	(3,849)	$ 5,081

- **ASHP Cost and Efficiency:** Stakeholders suggest that technology improvements are likely to result in decreased costs and/or increased efficiency of ASHPs over time and incorporated this assumption into the Stakeholder Informational Scenarios. National Fuel agrees that efficiencies may improve but believes that ASHP costs are as likely to increase as they are to decrease particularly given the forecasted growth in the ASHP market and potential constraints on production and the number of qualified installers, creating an opportunity for vendors to demand higher prices and increase profits. The LTP incorporates current cost and performance information for ASHP and, consistent with the EIA,[82] does not assume that there will be any changes in costs or efficiency over time. The first three sensitivity analyses reflect varying assumptions on the costs and efficiency of ASHP over time and demonstrate that changes in costs or efficiencies of 1% per year could change the total cost, emissions impacts, and cost per emissions reduction of the LTP up to 4%. As discussed, National Fuel's LTP must be feasible, and therefore must rely on costs and technology that is commercially available today. National Fuel will continue to monitor the evolution of cost and efficiencies of ASHP and will incorporate updates in future LTPs.

[82] EIA Updated Buildings Sector Appliance and Equipment Costs and Efficiencies, Appendix A and B, Residential Air-Source Heat Pumps, "EIA – Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case (and Advanced Case)," prepared by Guidehouse and Leidos (March 2, 2023).

- **Residential Customer Weatherization While Electrifying:** Stakeholders note that certain ASHP incentives require residential customers to weatherize, and therefore incorporated the assumption that all residential customers weatherize while electrifying in the Stakeholder Informational Scenarios. As discussed above, National Fuel believes that practical and economic considerations may limit residential weatherization while electrifying, and therefore assumes in the LTP that 50% of residential customers weatherize while electrifying. The fourth sensitivity analysis demonstrates that assuming 100% of residential customers weatherize while electrifying affects the overall results of the LTP by less than 1%. National Fuel will gather information about residential electrification projects and will incorporate updates in future LTPs.

- **100% Clean Electricity by 2040 with Higher Electric Supply Price:** Stakeholders requested that the Informational Scenarios assume that New York achieves zero-emission electricity by 2040, consistent with the CLCPA, and reflect NREL's All Options Clean Energy Scenario in the assumption for wholesale electricity prices. As discussed above, the New York ISO has indicated that new technology will need to be developed to achieve 100% clean electricity by 2040. The LTP relies on the EIA Annual Energy Outlook regarding electric emissions, which reflects EIA's forecast of the timing of a transition to clean generation, which does not assume clean electricity by 2040. The LTP electricity price forecast is aligned with EIA's emissions forecast. The fifth sensitivity analysis indicates that if electric emissions are reduced such that the 100% clean electricity by 2040 target is met, and if electric supply prices are reflective up NREL's All Options Clean Energy Scenario, overall LTP emissions reductions and costs would each increase by approximately 3%-4%. Updates to the status of achieving 100% clean electricity and the associated electric supply costs will be incorporated into future LTPs.

- **Hybrid Heating Redefined as ccASHP plus Gas Furnace (with 15-degree Switchover Point):** Stakeholders have questioned National Fuel's use of a standard ASHP in its hybrid heating configuration and have indicated that using a ccASHP with a gas furnace back-up would produce greater emissions reductions. National Fuel does not dispute that a ccASHP in a hybrid heating configuration would produce greater emissions reductions. However, National Fuel chose not to include ccASHP in a hybrid heating configuration in its LTP because it will significantly increase costs. As demonstrated in the sixth sensitivity analysis, using a ccASHP in a hybrid heating configuration would increase the total cost of the LTP by almost 40% and produce only 7% more emissions reductions, resulting in over a 30% increase in cost per emissions reduction. This extreme increase in cost per emissions reduction contradicts the Guiding Principles associated with achieving GHG emissions reductions as cost efficiently as possible. As discussed above, customers will be able to choose to electrify using a ccASHP in a hybrid heating configuration, but due to affordability concerns, it is not featured in National Fuel's LTP.

J. Other Considerations

1. Demand Response

Demand response programs attempt to shift customer usage patterns to reduce the impact on the system during constrained peak periods.

In a gas demand response program, the goal would be to reduce gas usage on the coldest days or hours of the year. These programs typically focus on residential and commercial usage because these customers' usage varies significantly over time, and the goal is usually to shift customer usage to a different, less-constrained period. Participating customers are provided incentives to reduce their typical energy use during "events" that are announced by the utility. These programs require special devices to either control customer equipment to reduce energy use or measure customer voluntary response during events. Demand response programs can be effective at reducing the strain on the electric system during peak conditions, and gas utilities are exploring whether similar programs could have material benefits on the gas system. Gas demand response programs have been implemented at other gas utilities in New York and have been reported to be an effective tool in lowering peak system load requirements on the coldest of days. Peak load reductions can help ensure safe and reliable service for all customers, particularly for utility systems that are experiencing high firm demand growth, vulnerable areas, and/or upstream gas supply constraints.

It is premature to include demand response as a modeled decarbonization action due to limited information regarding the potential magnitude of the impact on peak day demand, but National Fuel will propose a demand response pilot program to gather the necessary information to determine the cost and effectiveness of demand response programs. The pilot program may be aimed at reducing gas consumption during select peak winter days with extreme cold temperatures (i.e., event days). National Fuel observes that it does not have the same demand growth and gas supply constraint concerns as other downstate utilities, and currently holds or has access to more than adequate levels of upstream pipeline capacity to meet peak demands. In response to CRA's comments, the Company has reviewed National Grid's recent rate case for demand response program options, conducted initial outreach with National Grid, and will consider additional inquiries as development of the demand response pilot commences. After additional study, the Company intends to engage with Staff to seek feedback on the program design, costs, and potential benefits.

2. No-Infrastructure Scenarios, NPAs and Leak Prone Pipe Replacement

As noted above, National Fuel is distinct in several respects from other natural gas utilities in New York State and does not currently project any pipeline capacity constraints or distribution system delivery constraints during the LTP forecast period. As a result, none of the scenarios

presented in the LTP require new infrastructure to meet projected demand, and NPAs and/or demand response or similar initiatives are not necessary to close a gap between demand and supply. Thus, all scenarios in the LTP are appropriately considered "no-infrastructure" scenarios and the LTP meets the Gas Planning Order's requirement that "LDCs shall be expected to include a 'no-infrastructure scenario' in their long-term plans."[83]

Outside of the context of a no-infrastructure scenario evaluation, the Gas Planning Order includes a number of requirements related to NPAs, including that each of the utilities subject to the order file within 90 days of the date of the order proposals for NPA (a) screening and suitability criteria, (b) cost recovery procedures and (c) an incentive mechanism.[84] The Gas Planning Order also requires that LDCs, in the annual reports required by the order, "identify … the locations of specific segments of LPP that could be abandoned in favor of NPAs and where infrastructure projects may be needed in the near future to maintain reliability."[85]

In accordance with the Gas Planning Order, on August 10, 2022 the Company filed jointly with the other LDCs *Proposals for Non-Pipe Alternative Incentive Mechanism and Cost Recovery Procedures*. Also on that date, National Fuel individually filed its *Proposals for Non-Pipe Alternative Screening and Suitability Criteria*. Both the jointly filed and Company proposals remain pending with the Commission.

In its Initial LTP the Company referenced its NPA proposal and indicated that it would apply the suitability criteria and other aspects as directed by the Commission in its anticipated order on the filing. As part of the stakeholder review process that occurred after issuance of the Initial LTP certain stakeholders indicated that they would like a more fulsome discussion of NPAs in the LTP. In response to that request, the Company incorporated in the Revised LTP a number of the details included in its pending NPA Proposal.

National Fuel's NPA Proposal

In its NPA proposal, National Fuel indicated that it will evaluate gas capital projects to determine whether they qualify for NPA solutions that can reliably meet customer needs, including electrification, geothermal energy networks, compressed natural gas, or liquified natural gas. Examples of projects that may be suitable for NPA consideration include gas distribution projects associated with load growth and main or service replacements. Capital projects associated with immediate system needs related to safety, reliability, and service obligations, where construction is expected to commence in less than 12 months, would be excluded from NPA consideration, as would any non-distribution projects where NPAs are not applicable.

---

83 Gas Planning Order, pp. 36-37.

84 Gas Planning Order, pp. 65-66.

85 Gas Planning Order, p. 39.

National Fuel will use a two-prong approach for evaluating NPAs. Smaller capital projects with a cost of $2 million or less and an implementation timeline of 24-36 months will undergo an expedited standardized review that involves a streamlined economic and technical analysis to determine the feasibility of an NPA.[86] Large capital projects that exceed a cost threshold of $2 million and have an implementation timeline 36-60 months will undergo a comprehensive review, including a full-scale market request for proposal of NPAs and a BCA of potential solutions.[87] The BCA will be completed before any detailed engineering, permitting, or construction activities have commenced, and before more than 5% of the total project cost has been spent. Following the completion of the applicable review process, if an NPA solution is determined to be technically and economically feasible, it will be selected and implemented. If no acceptable NPAs are available, the traditional solution may be implemented.[88]

The timeline and costs of a proposed capital project will inform the approaches National Fuel may take to develop and implement an NPA. In the sourcing and development phase, data needed for accurate evaluation, effective communication, and planning will be compiled to help inform the best path for determining feasibility of implementing an NPA. This phase will augment the review process described above to allow National Fuel to determine whether to use increased incentives and outreach through existing programs to meet the system need, to conduct a market solicitation, or to develop a portfolio that includes a combination of both approaches. In addition to the suitability criteria, factors that determine the market approach will include the customer type, geographic area, and current programs and measures in place. As such, National Fuel intends to maintain flexibility on releasing market solicitations for suitable projects.[89]

Following issuance of the Company's Revised LTP certain stakeholders noted that, in addition to the detail noted above regarding the Company's proposed screening and suitability criteria,

---

86 Projects that involve a single street or only a few streets will be classified as a small project.

87 Large projects will typically cover larger geographic areas and may potentially be associated with significant regulator station upgrades or larger mains. Projects that involve several streets or a small neighborhood could qualify as either a large or small project, depending on the size and timeline.

88 In reliance on capital project data that National Fuel supplied in response to data requests issued as part of this LTP development process, EDF indicated in its comments on the Revised LTP a concern that the timelines in National Fuel's NPA proposal will inappropriately exclude certain projects from NPA consideration. The Company thoroughly reviewed EDF's concern and explained at the June 22, 2023 technical conference that the Company's current processes include clear project identification timelines such that projects will not be artificially excluded from the NPA process. To further address EDF's comment, the Company will ensure that these timelines are clearly documented in its NPA process.

89 Though National Fuel anticipates releasing market solicitations for large projects, there may be instances, such as large projects limited to a specific geographic area and/or targeting a specific customer that require consideration of an alternative procurement approach to maintain customer confidentiality.

they would like the Company to specifically identify segments of LPP that will be abandoned in favor of NPAs. On this issue, the Commission noted as follows in the Gas Planning Order:

> The Commission agrees with Staff's proposal and requires that LDCs identify *in the annual reports required by this Order* the locations of specific segments of LPP that could be abandoned in favor of NPAs and where infrastructure projects may be needed in the near future to maintain reliability. The commission encourages LDCs to take a "neighborhood approach" and work with local groups and State agencies on a comprehensive program that simultaneously removes leaking or leak-prone infrastructure and employs programs such as weatherization and demand response along with electrification. We further encourage the LDCs to combine this effort with special programs for LMI customers or disadvantaged communities. We agree that LDCs should be strategic when planning the removal of LPP and plan in a cost-effective manner that reduces unnecessary investments.[90]

Consistent with the Commission's clear direction in the Gas Planning Order, the Company intends to include in its annual reports – the first of which will issue on or before May 31, 2024[91] – an approach whereby it will implement the NPA screening and suitability criteria[92] articulated in its NPA proposal to identify segments of LPP that can be abandoned in favor of NPAs and where infrastructure projects may be needed in the near future to maintain reliability (which is currently not anticipated, as noted above). The Company will include in this approach special consideration of LMI customers and disadvantaged communities, as well as the needs and desires of individual customers affected by proposed NPA options and the impact on energy reliability generally.

3. LMI Customers and Disadvantaged Communities

The Gas Planning Order in its subsection identified as "Impacts on LMI Customers[93] and Disadvantaged Communities" requires that:

---

90 Gas Planning Order, p. 39 (emphasis added).

91 Gas Planning Order, pp. 21-22.

92 To the extent that the Commission directs the Company to modify its criteria in its anticipated order on the Company's NPA proposal, National Fuel will amend and implement the criteria as directed by the Commission.

93 As part of the stakeholder engagement process some commenters have characterized the Company's statements about programs that benefit LMI customers as "misleading" because LMI customers are not DAC customers. In response to these assertions the Company has clarified that, although there is undoubtedly significant overlap between these groups, the Company is not equating LMI and DAC customers. Rather, it is able to acknowledge challenges faced by *both* groups while simultaneously ensuring that it meets CLCPA

> [I]n their long-term plans, LDCs shall identify the disadvantaged communities in their service territories, explain the impacts to disadvantaged communities of any proposed projects, and explain how the LDC will ensure that an appropriate portion of the benefits of any proposed NPAs such as energy efficiency, demand response, and electrification accrue to disadvantaged communities.[94]

In accordance with the Gas Planning Order, the Company has identified the disadvantaged communities in its service territory, as shown in detail above, and is aware that under the final methodology adopted by the CJWG the percentage of census tracts that now identify as disadvantaged communities in Western New York has increased from 32% to 34%. With this increase in mind, National Fuel notes that it does not currently have any proposed projects that will disproportionately negatively impact its disadvantaged communities. It does, however, have pipeline replacement projects that will occur within disadvantaged communities. As the Company develops these and other potential projects and evaluates proposed NPAs such as demand response, geothermal, electrification, energy efficiency, etc. it will include in that analysis how disadvantaged communities may be impacted and consider "special programs for LMI customers or disadvantaged communities" as the Commission encourages in its Gas Planning Order.[95] With respect to clean energy and energy efficiency projects the Company will determine how the associated benefits will accrue to the disadvantaged communities with a focus on achieving no less than thirty-five percent of the overall benefits as directed by the CLCPA. The Company notes that disadvantaged communities will see emissions benefits from RNG and hydrogen blended into the system to serve customers as well as other clean energy initiatives such as geothermal and hybrid heating that will be developed, with the associated benefits tracked by the Company as the projects are implemented. The Company will track the benefits of energy efficiency projects in accordance with the Disadvantaged Communities Benefits Framework currently being developed in coordination with Commission Staff, NYSERDA, and other New York utilities.

4. Cap-and-Invest and Accelerated Depreciation

In June 2023, New York kicked off the initial stage of pre-proposal outreach in connection with the development of its cap-and-invest program. A series of seven webinars addressing different

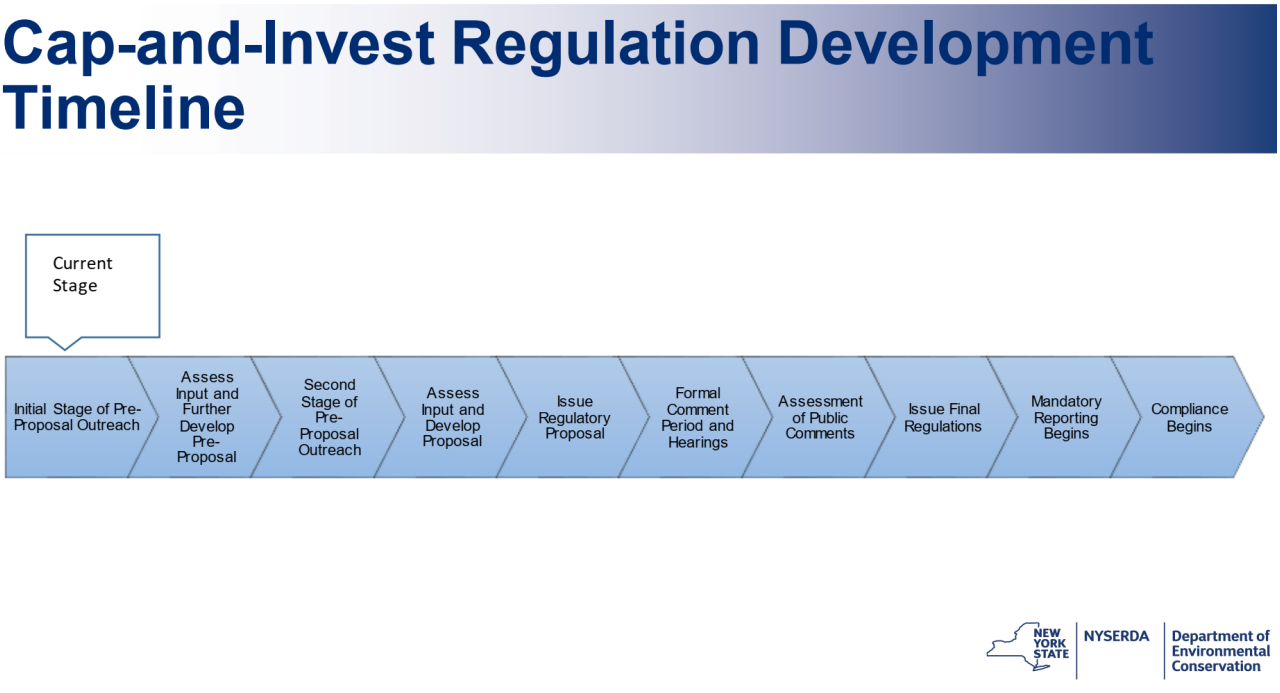
---

requirements to separately quantify clean energy and energy efficiency benefits that accrue to DACs specifically. Indeed, like the Company, the Commission in the Gas Planning Order refers to both LMI and DAC customers and in recent proceedings has recognized the need to address financial and other concerns faced by customers beyond those who are characterized as low income or as residing in disadvantaged communities (see, e.g., Case 23-M-0298, *In the Matter of Budget Appropriations to Enhance Energy Affordability Programs*; Case 20-M-0266, *Proceeding on Motion of the Commission Regarding the Effects of COVID-19 on Utility Service*).

94 Gas Planning Order, p. 40.

95 Gas Planning Order, p. 39.

topics associated with the program – cap-and-invest overview, natural gas, liquid fuels, energy intensive and trade exposed industries ("EITE"), waste, cap-and-invest analysis inputs, and electricity - recently concluded. The stated purpose of the webinar series was to gather feedback as the New York State Department of Environmental Conservation ("DEC") and NYSERDA begin the process of developing regulations to implement three separate rules that will constitute the program. The "Cap-and-Invest Rule" and "Mandatory Reporting Rule" will be promulgated by DEC, and the "Auction Rule" will be promulgated by NYSERDA. Throughout the webinar series DEC and NYSERDA presented numerous questions associated with each of these rules, on topics such as obligated and non-obligated sources, applicability and thresholds for various sectors (electricity, EITE, other stationary sources, waste, hydrofluorocarbons ("HFC"), and fuels), allowance allocation, program ambition, allowance budget, program stability mechanisms, compliance process enforcement and compliance mechanisms, auction rules, market rules, reporting and verification, EITEs, emissions reporting for various sectors (electricity, solid waste, wastewater, HFCs, fuel suppliers, natural gas infrastructure) and California's reporting rule.[96] The graphic below was shared at each of the webinars and shows the lengthy development process that will be followed by DEC and NYSERDA:



In connection with the stakeholder outreach process for National Fuel's LTP some stakeholders have asked that New York's cap-and-invest program be incorporated into the LTP. As is evident from the timeline and information shared by DEC and NYSERDA during the webinar series, New

[96] DEC and NYSERDA presented nineteen pages of question on these topics (https://capandinvest.ny.gov/Meetings-and-Events).

York is in the beginning stages of a long process to develop a complex economy wide program that will result in significant impacts on the state's residents, businesses and industries. Although DEC and NYSERDA have not specified when they expect the program to be implemented, they have indicated that it will not take effect prior to 2025. Given this timeline and the lack of any specificity around New York's cap-and-invest program at this time, it would be speculative to model it in the Company's current LTP. National Fuel is following the cap-and-invest development process carefully and will incorporate the resulting program into future LTPs.

Relatedly, certain stakeholders have also asked that the effects of accelerated depreciation and stranded costs that may allegedly result from a transition away from the use of natural gas be incorporated into the LTP. Like cap-and-invest, it would be speculative to include any such costs in the LTP at this time. The Commission has opined on the issue in recent rate proceedings. For example, in its May 19, 2021 *Order Establishing Rates and Rate Plan* for Corning Natural Gas Corporation, the Commission rejected the idea that the CLCPA-mandated reduction of statewide GHG emissions will necessarily require the shortening of asset lives.

> Logically, the shortening of depreciable lives to a 2050 end-point amounts to a forecast that the Company will cease utility operations by 2050 and that none of its assets at that time will have any value . . . It simply does not follow that a target of 85% statewide greenhouse gas reductions by 2050 means that the Company will close up shop by 2050 and that none of its assets will remain in service. It is impossible to make a precise forecast at this time of what the Company's business will look like in 2050, but it is clear that the assumption that the Company will be out of business at that time is at the extreme end of many possibilities.[97]

Additionally, in accordance with the Gas Planning Order, the LDCs have filed depreciation studies with multiple scenarios that examine both the structure of accelerated depreciation and its potential impacts on ratepayers. In its order, the Commission noted that "[t]hese studies will be able to inform future discussions of how best to recover the costs of assets and reduce potential stranded costs in the LDCs' respective rate proceedings."[98] It would be premature to address these issues prior to receiving the Commission's determination on the pending studies.

---

[97] Order Establishing Rates and Rate Plan, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Corning Natural Gas Corporation for Gas Service, Case 20-G-0101 (May 19, 2021)

[98] Gas Planning Order, pp. 61-62

V. Conclusions

V. Conclusions

In preparing this LTP, National Fuel has complied with requirements of the Gas Planning Order and the CLCPA while striving to maximize its contribution to achievement of the statewide emissions goals over the next 20-years. The Gas Planning Order identifies costs, bill impacts, and emissions impacts as the principal metrics for evaluating utility long-term plans. It identifies other important objectives as well, including maintaining safety, reliability, and resilience and delivering benefits to DACs. The LTP was informed by extensive stakeholder engagement that included several technical conferences and more formal feedback on an Initial and Revised LTP. The Company has incorporated numerous adjustments to the LTP to reflect this feedback. The result is a Final LTP that maintains safety and reliability, while enhancing overall energy system resilience. It strikes an appropriate balance between GHG emissions reductions and costs, as measured by the impact on gas customer bills and the Decarbonization Policy Costs. National Fuel's LTP achieves this balance by prioritizing efficient and effective individual decarbonization actions and derating less effective and more expensive actions while also considering the implementation and technological feasibility constraints.

In certain instances, the Company and stakeholders expressed different perspectives with respect to assumptions about future drivers including resource and technology availability, capability, and costs. National Fuel modeled scenarios that were developed pursuant to discussions with stakeholders and CRA, and supplemented these with sensitivity analyses that reveal the impacts of alternative assumptions suggested by stakeholders. This approach is consistent with a gas planning process that calls for new long-term plans to be prepared every three years to update assumptions along with annual reports to be filed in the intervening years.

Energy policy and decarbonization of New York's economy will likely continue to be the subject of legislation. In addition, regulatory policies will continue to evolve as New York's natural gas and electric utilities design plans to contribute to achievement of the state's GHG reduction goals. National Fuel will continue to monitor these developments and promote responsible GHG emission reduction policies and regulations that support safe, reliable, and affordable energy choices for its customers throughout western New York.

A. National Fuel's LTP Implementation Actions

National Fuel will pursue numerous activities that are designed to develop capabilities and take specific implementation actions related to its LTP.[99] These include:

[99] Some implementation actions may be subject to regulatory approval.

1) Research:
   - Gather insights from residential and commercial customers to inform the design of programs that contribute to decarbonization of the New York economy;
   - Gather intelligence from industrial customers on decarbonization plans, options, and competitive concerns;
   - Monitor evolution of the RNG and hydrogen markets; and
   - Monitor advances in technology related to heat pumps.

2) Design, Propose, and Implement Pilots and Related Programs:
   - Thermal energy network pilots once the site selection processes are completed;
   - ccASHP pilot;
   - Hybrid heating system pilot; and
   - Hydrogen blending pilot.

3) Design, Propose, and Implement Customer and Supply Programs:
   - Energy efficiency and other clean energy programs that deliver benefits to DACs and LMI customers;
   - Gas demand response program;
   - Residential and small commercial weatherization program;
   - Behavioral energy efficiency program; and
   - RNG procurement and cost recovery program.

4) Invest:
   - LPP program in compliance with Commission directives; and
   - Systems and processes necessary to fulfill the Company's commitments to decarbonization, including processes to implement NPAs and obtain hourly information from National Fuel-Supply.

5) Engage, Communicate, and Collaborate With:
   - Stakeholders in the ongoing gas planning process;
   - Customers regarding National Fuel's Final LTP;
   - Industrial customers to understand decarbonization opportunities, plans, and unique challenges; and
   - Electric utilities in National Fuel's service territory regarding opportunities for coordination of planning activities.

B. National Fuel's Next LTP

National Fuel's next LTP provides an opportunity for a comprehensive refresh of the assumptions, analyses, and recommended plan. The next LTP will include:

- Updates to reflect relevant legislative mandates and final Commission orders;
- Updates to the natural gas demand forecast and gas supply portfolio, including the potential impact of ESCO activities on the supply portfolio;
- Updates on the status of work with National Fuel-Supply to develop procedures to begin to gather and provide hourly throughput data from measurement stations at major National Fuel citygate locations throughout its service territory and how that hourly data will inform the LTP;
- Evaluation of the cap-and-invest policy impacts to the LTP methodology and updates to assumptions based on market evidence;
- Review of decarbonization action policy assumptions, including technology capabilities, costs to install and operate, and low-carbon fuel prices;
- Updates to all decarbonization action adoption rates to reflect experience over the next three years;
- Updates to electric buildout assumptions to reflect progress toward achievement of CLCPA electric sector emissions targets; an update to the electricity price forecast to reflect the latest information and insights regarding electric distribution and supply costs;
- Enhancements to the electrification adoption methodology and assumptions to reflect study results, NY Clean Heat progress/lessons learned, and other insights;
- Updates to the outlook and potential contribution of alternative sources of RNG;
- Updates to the outlook and potential role of hydrogen; and
- Incorporation of Commission determinations and/or policy decisions that address accelerated depreciation, the recovery of capital costs and/or the allocation of Decarbonization Policy Costs among funding sources.

National Fuel looks forward to implementing the decarbonization actions articulated in this LTP and is hopeful that the state will view the plan as a model that can be utilized in other regions of the state with similar economic, geographic and other characteristics as the Company's service territory. The priorities that have guided the development of this LTP - ensuring safe, reliable, resilient and affordable energy for consumers while preserving emissions reduction options and customer choice - should be reflected in the state's overall decarbonization efforts as well.