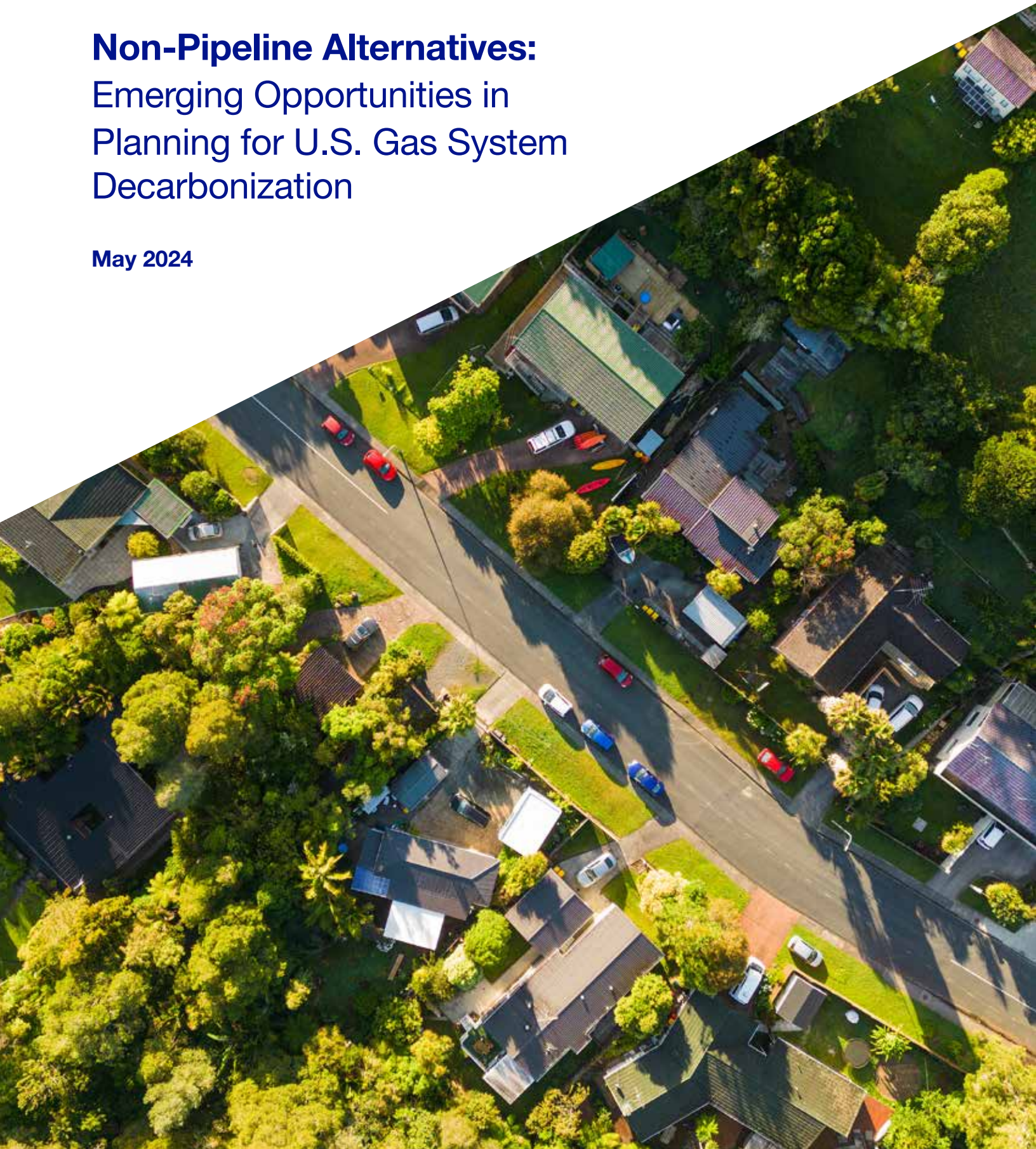
RMI | nationalgrid

Non-Pipeline Alternatives:
Emerging Opportunities in Planning for U.S. Gas System Decarbonization

May 2024



Authors and Acknowledgments

Authors

RMI
Abigail Lalakea Alter
Sherri Billimoria
Mike Henchen

National Grid
Karsten Barde
Courtney Eichhorst
Justin Klingler, formerly from National Grid

Contacts

Mike Henchen, mhenchen@rmi.org
Karsten Barde, karsten.barde@nationalgrid.com
Courtney Eichhorst, courtney.eichhorst@nationalgrid.com

Acknowledgments

We thank the following individuals for sharing their insights and perspectives. Appearing on this list does not indicate endorsement of this paper's findings.

National Grid
Owen Brady-Traczyk
Adrienne Agarwal
Mitchell Campbell
Enrica Galasso LoRusso
Faye Brown
Alec Conte
Behzad Rustemi
James Hughes
Kristina Nikiforova
Michael Amadi
Michael Tupper
Steven Menges
Jennifer Cross
Sara Robarge-Trombley

Agora Energiewende
Mareike Herrndorff

CE Delft
Katja Kruit

Con Edison
Michael Sanchick
Greg Koumoullos

EBP
Sabine Perch-Nielsen

Energie 360
Rainer Schöne

Énergir
Marc-André Goyette
Renault Lortie
Louis-Philippe Laurin

Energy Cities
Julien Joubert

Groundwork Data
Elvis R. Mendez
Conor Lyman
Mike Bloomberg
Michael J. Walsh

Pacific Gas & Electric
Rachel Kuykendall

Regulatory Assistance Project
Megan Anderson
Richard Lowes

Stadtwerk Winterthur
Urs Buchs

Urban Innovation
Michael Cerveny

Xcel Energy
Lauren Quillian

Executive Summary

Multiple states in the U.S. have adopted ambitious climate targets requiring the achievement of net-zero greenhouse gas (GHG) emissions. To meet these climate targets and utility net-zero goals, utilities, regulators, and other stakeholders have begun planning for a future that is less reliant on fossil gas and more dependent on clean energy resources. Progress towards this future can be significantly advanced through integrated energy planning and adoption of non-pipeline alternative solutions.

Integrated energy planning (IEP) is the practice of incorporating critical interactions between gas, electric, and customer energy systems into utility and energy planning processes in the context of long-term climate goals. By recognizing the interdependent nature of today's energy systems, integrated energy planning can aid in assessing the infrastructure and customer impacts of potential transition strategies. This serves to advance net-zero goals most cost-effectively and equitably, while ensuring the safety and reliability of the systems customers rely on.

Non-pipeline alternatives (NPAs) are projects or initiatives intended to simultaneously reduce GHG emissions and defer, reduce, or avoid the need to construct or upgrade components of the natural gas system through customers' installation of all-electric equipment or connection to other lower-carbon infrastructure, including thermal energy networks. NPAs are an emerging area of opportunity for gas system decarbonization in the U.S., with the potential to achieve ratepayer savings across three categories of gas network investment: replacement of existing infrastructure, capacity expansion of existing system, and system extension to new customers.

National Grid U.S. is working to advance its own planning processes in accordance with the goals of the jurisdictions in which it operates, Massachusetts and New York. In order to better understand the landscape of non-pipeline alternatives and integrated energy planning in the gas industry today, National Grid and RMI worked together to identify case studies where NPAs and integrated energy planning have been implemented or developed. This research included interviewing utilities, non-governmental organizations (NGOs), consultants, and others working to deploy NPAs and integrated energy planning in diverse jurisdictions across the U.S. and Europe.

This whitepaper is divided into two parts:

First, we present nine case studies describing the current state of NPA initiatives and integrated energy planning in the U.S. and Europe. These case studies include projects that have moved toward implementation in both the U.S. and Europe, including the decommissioning of specific gas infrastructure.

For example:

- Pacific Gas & Electric (PG&E) in California has completed 88 NPA projects, converting a total of 105 customers from gas. Other U.S. utilities advancing projects include National Grid, Con Edison, Rochester Gas and Electric, and Xcel.
- In Europe, municipal clean heat planning is prevalent or required in multiple countries including the Netherlands and Switzerland. While Zurich is the only example of a city that has completed neighborhood-scale decommissioning to date, other cities in Switzerland and elsewhere are working to follow suit.
- Combination utilities in the U.S. such as National Grid and Xcel are working to integrate internal gas and electric planning teams and develop new tools and processes for integrated energy planning. An early example of cross-utility planning can also be found in Québec, where the gas and electric utilities received regulatory approval for a joint decarbonization strategy that accounts for the benefits each system provides the other.

Then, based on our research and learnings, National Grid and RMI offer the following eight insights for further exploration by U.S. utilities, regulators, policymakers, and other stakeholders to advance the deployment of NPAs and integrated energy planning:

NPA projects underway today reflect diverse energy policy goals and energy system characteristics across different jurisdictions. Clean heat planning is generally motivated by environmental and economic concerns, while some jurisdictions are also motivated by geopolitical and equity concerns. This diversity will necessarily shape the solutions that meet each jurisdiction's goals and needs.

NPA projects can identify value in cost savings on the gas system, emissions reduction, or other societal benefits. Utilities looking to develop cost tests for NPA projects should start by identifying the key costs and benefits, which may vary by jurisdiction and emissions valuation structure.

Prioritization of NPA projects should weigh a broad set of criteria, including gas asset risk and hydraulic feasibility, electric capacity, benefit-cost criteria, customer propensity for new technology adoption, and community factors. Some near-term areas of opportunity for NPAs are high-cost gas asset replacements where there is electric headroom and fewer than five customers on a segment.

NPA projects can be funded from a series of different sources while protecting ratepayers' long-term affordability. To date, NPA projects have been funded by gas ratepayers. However, to help mitigate upward rate pressure for gas customers as gas demand declines, consideration should be given to alternative funding sources, including federal, state or local taxpayer funding, as well as electric ratepayer funding.

Integrated gas and electric network planning offers the opportunity to achieve net-zero goals as cost-effectively and equitably as possible. Regulatory support will be required to enable cross-utility data sharing and decision-making, and to invest in new tools and capabilities.

Utility and municipality partnership may be a key element of NPA projects and localized integrated energy planning. Partnering at the municipal level is a valuable way to ensure alignment, build community support, and incorporate local priorities in project planning.

In presenting this work, we hope the case studies and insights detailed herein will serve as a catalyst for advancing the implementation of NPAs and integrated energy planning across the U.S.

Individual customer persuasion to reach 100% participation is not a scalable NPA approach for avoided replacement projects. Under the current regulatory framework, NPAs that avoid infrastructure replacement require voluntary and coordinated conversion of 100% of customers on the segment from gas to all-electric equipment. To date, no U.S. utility has successfully completed this type of NPA under the existing regulatory framework for projects serving greater than five customers.

Policy change will be needed to evolve the utility business model and obligation to serve, while retaining the opportunity for cost recovery in a transition away from the use of gas. State regulators will have a critical role in overseeing substantial changes to the provision of utility service that enable NPA projects to scale.

In presenting this work, we hope the case studies and insights detailed herein will serve as a catalyst for advancing the implementation of NPAs and integrated energy planning across the U.S.

Introduction

What are non-pipeline alternatives and integrated energy planning?

Non-pipeline alternatives (NPAs) are projects or initiatives intended to simultaneously reduce GHG emissions and defer, reduce, or avoid the need to construct or upgrade components of the natural gas system. NPAs are an emerging tool providing an opportunity to reduce emissions, gas system costs, and customer risk by avoiding unnecessary gas infrastructure spending. This is achieved through the electrification of potential new or existing gas customers or connection to other carbon-free infrastructure, including thermal energy networks such as networked geothermal systems. NPA projects fall under one of three categories of avoided incremental infrastructure investment:

- **Avoided replacement** projects avoid the risk-driven replacement of an asset, including retiring the asset and converting affected customers from gas. Avoided replacement projects require targeted electrification of all gas uses by all customers connected to a given segment of pipe, in order for the investment in new infrastructure to be avoided and the asset disconnected and retired. In practice, avoided replacement projects tend to see greater success under existing regulatory frameworks when the number of customers per project is fewer than five.
- **Avoided capacity expansion** projects avoid investments driven by forecasted load growth. These projects typically do not require 100% of affected customers to participate in demand reduction measures.
- **Avoided system extension** projects avoid the extension of the gas system to new customers. Several jurisdictions address system extensions through avenues other than utility policy.

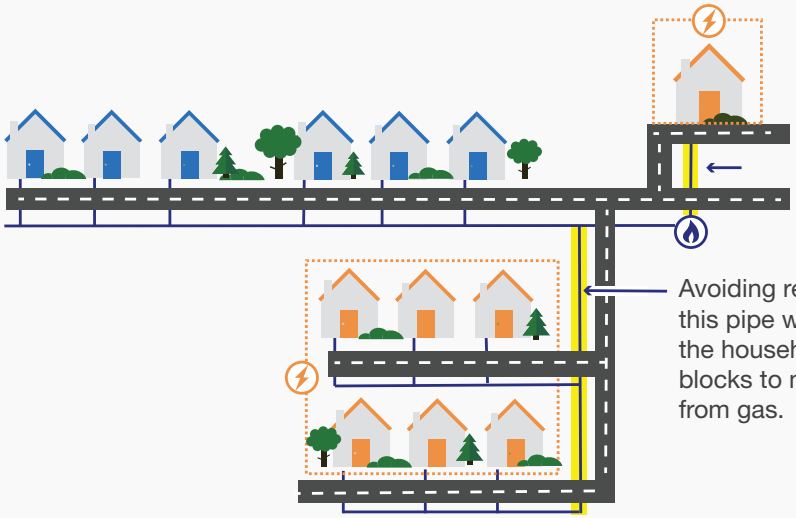
In this paper, our research primarily focuses on deploying NPAs to avoid gas infrastructure replacement or capacity expansion, including projects that involve decommissioning specific gas infrastructure. These three categories can be seen in Exhibit 1.

Integrated energy planning (IEP) is the practice of considering and incorporating critical interactions between gas, electric, and customer energy systems into utility and energy planning processes in the context of long-term climate goals, to achieve net-zero goals most cost-effectively and equitably for customers. While recognizing that IEP can provide broad value beyond NPAs, this paper focuses on the ways IEP can facilitate NPA identification and development.

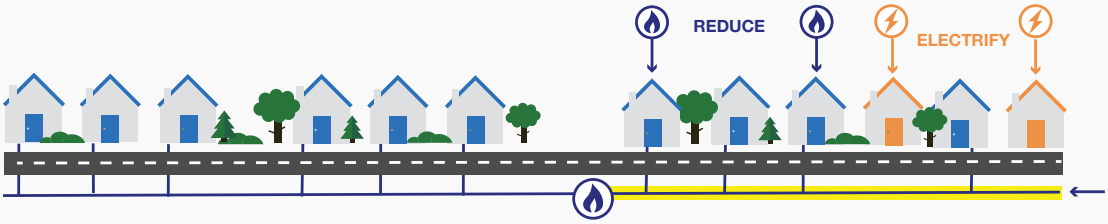
NPAs are an emerging tool providing an opportunity to reduce emissions, gas system costs, and customer risk by avoiding unnecessary gas infrastructure spending.

Exhibit 1: NPA projects fall under one of three categories of avoided incremental infrastructure investment.

Avoided replacement

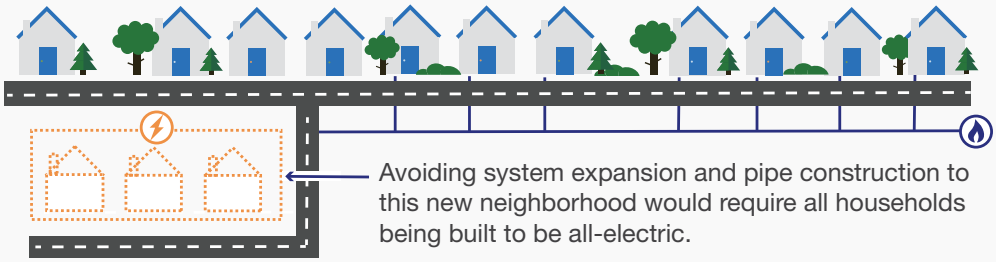


Avoided capacity expansion



To avoid a capacity upgrade for this pipe, buildings beyond this pipe segment would need to reduce their overall gas demand – this could be through incremental reductions across the group, or full electrification of some customers. This reduction would not require 100% participation of all households.

Avoided system extension



Why are these topics important?

Natural gas utilities serve over 77 million customers in the U.S. These utilities maintain and operate more than one million miles of local distribution lines and invest over $20 billion per year in distribution systems.[1] State and federal climate and energy planning processes are increasingly cognizant of significant GHG emissions from the use of natural gas and thus identify a range of strategies aimed at reducing the use of gas over time.[2] In addition, policymakers in several states have begun to grapple with potential policy issues raised by a long-term reduction in the utilization of natural gas infrastructure (referred to in this paper as "gas transition").

State and federal climate and energy planning processes are increasingly cognizant of significant GHG emissions from the use of natural gas and thus identify a range of strategies aimed at reducing the use of gas over time. In addition, policymakers in several states have begun to grapple with potential policy issues raised by a long-term reduction in the utilization of natural gas infrastructure.

Relevant Context for Non-Pipeline Alternatives in MA, NY and other U.S. States

In December 2022, New York and Massachusetts, the states in which National Grid operates, published net-zero plans calling for long-range reductions in the use of gas and new planning for gas transition policy issues. In New York, the Climate Action Council's Final Scoping Plan found that "achievement of the emission limits will entail a substantial reduction of fossil natural gas use and strategic downsizing and decarbonization of the gas system."[3] The Scoping Plan called for the "identification of strategic opportunities to retire existing pipelines as demand declines," including "seeking to move whole streets or neighborhoods at a time from gas infrastructure" to an electrified alternative.[4] The Scoping Plan further recognized the need for "integrated planning with the decarbonization of the power generation sector and buildout of local electric transmission and distribution systems" to meet increased demand and ensure equity and cost-effectiveness for customers.[5]

In Massachusetts, the Clean Energy and Climate Plan for 2050 (CECP) determined that "necessary reductions in natural gas throughput will require changes in how the gas system is operated and regulated and may require decommissioning significant parts of the gas system."[6] The CECP also found that gas distribution utilities may need to "manage customers' departure from the gas system to enable the retirement of some selected parts of the system to save some ongoing avoidable operating and/or capital investment costs."[7]

---

[1] This figure from 2022 (the latest year with available data) represents a four-fold increase in annual spending since 2011. "Gas Utility Construction Expenditures by Type of Facility 1972-2022," American Gas Association, 2023, https://www.aga.org/wp-content/uploads/2023/01/Table12-1.pdf.

[2] More than ten states, including Massachusetts and New York, have opened regulatory proceedings to consider how gas utility planning should evolve in line with state emissions reduction targets.

[3] New York State Climate Action Council, "New York State Climate Action Council Scoping Plan," 2022, https://climate.ny.gov/resources/scoping-plan/, at p.350.

[4] Ibid at p.351.

[5] Ibid at p.350.

[6] Massachusetts Executive Office of Energy and Environmental Affairs, "Clean Energy and Climate Plan for 2050," 2022, https://www.mass.gov/info-details/massachusetts-clean-energy-and-climate-plan-for-2050, at p.62.

[7] Ibid at p.83.

Additionally, the December 6, 2023 order in Massachusetts Department of Public Utilities (DPU) Future of Heat Proceeding 20-80 affirms the value of targeted electrification and integrated energy planning as key strategies for managing the long-term costs of the gas system.[8] The DPU emphasizes the importance of rate recovery for existing, prudently made infrastructure investments and indicates in this order that the DPU will increase its scrutiny of new investments on the gas system, including an expectation that utilities will regularly assess NPAs to projected infrastructure needs. In the Climate Compliance Plan process established by the order, gas utilities must file plans every five years detailing their alignment with emissions reduction targets. The DPU also highlights the need for better integration of gas and electric system planning and requires electric utilities to partner in the development of overlapping gas utilities' Climate Compliance Plans.

Beyond the Northeast, there are other examples of regulators and utilities evolving gas infrastructure planning to manage ratepayer costs while achieving needed emissions reductions. California and Colorado have eliminated gas line extension allowances statewide, an indication that expansion of the gas system is no longer seen as a net benefit to existing gas ratepayers.[9] Both states now also require utilities to seek approval for and evaluate alternatives to certain gas infrastructure investments above a specific cost threshold.[10] Colorado's gas planning rules, similar to the new Massachusetts DPU Climate Compliance Plans, also require utilities to regularly file plans for meeting emissions targets and managing gas system costs.[11]

In this evolving policy landscape, gas utilities should prepare for changes on their systems and find new ways to manage capital investments. Utilities need to balance the imperatives of safe and reliable service, GHG emissions reduction, and long-term customer affordability in a future with reduced gas use. In this context, IEP and NPA solutions to avoid gas system investments present important opportunities to achieve this balance.

This whitepaper aims to describe the current state of NPA solutions and gas transition planning in North America and Europe and identify projects that have moved toward implementation, including decommissioning of gas infrastructure. We further explore the potential for the expanded use of NPAs and integrated energy planning in the U.S., including the potential role of municipalities in helping coordinate planning at the neighborhood or city scale.

Gas utilities should prepare for changes on their systems and find new ways to manage capital investments. Utilities need to balance the imperatives of safe and reliable service, GHG emissions reduction, and long-term customer affordability in a future with reduced gas use.

[8] Massachusetts Department of Public Utilities, "Order on Regulatory Principles and Framework," D.P.U 20-80-B, December 6, 2023, https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/18297602.

[9] California Public Utilities Commission, "Phase III Decision Eliminating Gas Line Extension Allowances, Ten-Year Refundable Payment Option, and Fifty Percent Discount Payment Option under Gas Line Extension Rules, Decision 22-09-026," Rulemaking 19-01-011, September 15, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M496/K987/496987290.PDF. S.B. 23-291, 74th Leg., (CO 2023), https://leg.colorado.gov/sites/default/files/2023a_291_signed.pdf.

[10] California Public Utilities Commission, "Decision Adopting Gas Infrastructure General Order," Rulemaking 20-01-007, November 30, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M499/K396/499396103.PDF.

[11] Colorado Public Utilities Commission, "Commission Decision Adopting Rules," Proceeding No. 21R-0449G, December 1, 2022, https://www.dora.state.co.us/pls/efi/EFI_Search_UI.Show_Decision?p_session_id=&p_dec=29605.

Case Studies

This section provides illustrations of non-pipeline alternatives and integrated energy planning from leading jurisdictions in North America and Europe. This section begins with a description of National Grid's initiatives in this area, then identifies other notable U.S. utilities advancing NPAs and IEP, and then details the most developed European examples.

National Grid US

In April 2022, National Grid published its Clean Energy Vision, which calls for achieving net-zero GHG emissions by 2050 by focusing on four pillars: energy efficiency in buildings; 100% fossil-free gas network; hybrid electric-gas heating systems; and targeted electrification and networked geothermal.[12] This vision recognizes the need for electrification of many existing gas customer end uses to achieve net-zero GHG emissions through full electrification as well as partial or hybrid electrification.

National Grid has been evaluating potential non-pipeline alternative projects in New York for several years and working with peer utilities, regulators, and stakeholders to develop supporting regulatory frameworks.[13]

More recently, in Massachusetts, National Grid has been developing networked geothermal demonstrations which could also have potential as NPAs.[14]

National Grid has been evaluating potential non-pipeline alternative projects in New York for several years, and working with peer utilities, regulators, and stakeholders to develop supporting regulatory frameworks.

NPAs for Avoiding the Replacement of Existing Infrastructure

Over the last two years in New York, National Grid has been working to identify planned gas capital projects that could potentially be avoided through targeted electrification and decommissioning of specific segments of aging gas infrastructure rather than replacement.[15] In that time, National Grid has identified 27 of these projects in its New York territory. Of the 398 customers initially contacted about these 27 potential NPA projects, 149 customers have responded (37%) and 18 have expressed interest (5%).

One of the key barriers to implementing NPA solutions that retire leak-prone pipe is the fact that 100% of affected customers must participate in the program in order to decommission the asset. In communicating with customers about the benefits of NPAs, National Grid has identified a lack of broad customer familiarity with heat pump technologies,

[12] National Grid, "Our Clean Energy Vision," April 2022, https://www.nationalgrid.com/us/fossilfree.

[13] This work has included National Grid's NPA Screening and Suitability Criteria proposal as well as the Joint Local Distribution Companies NPA Incentives and Cost Recovery proposals, filed with NYS Public Service Commission on August 10, 2022. "Joint Local Distribution Companies' Proposals for Non-Pipe Alternative Incentive Mechanism and Cost Recovery Procedures," New York Public Service Commission Case 20-G-0131, August 10, 2022, https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={EBD3BFE2-6AC6-4A28-B98A-09E6A7CB75A4}. National Grid, "National Grid's Proposals for Non-Pipe Alternative Screening and Suitability Criteria," New York Public Service Commission Case 20-G-0131, August 10, 2022, https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={2EC93238-1BA2-4AE6-B390-0436B198391B}.

[14] The company is developing a networked geothermal demonstration project at the Boston Housing Authority's (BHA) Franklin Field in Dorchester, MA. This geothermal project will replace an aging gas boiler loop that currently serves 129 BHA units. Construction is expected to begin in 2025.

[15] These efforts have focused on specific planned gas main replacement projects that are part of ongoing capital programs to replace Leak Prone Pipe, or 'LPP,' a term used in several Northeast states to refer to infrastructure that is assessed as a leak risk, based on vintage, material, or other factors. Utilities in other regions of the U.S. may refer to this type of pipe by its 'DIMP' score, based on the federal Distribution Integrity Management Program administered by the Pipeline and Hazardous Materials Safety Administration ('PHMSA').

customer concerns about the impacts of electrification on their energy bills, customers' preferences for some gas appliances, and challenges aligning the gas infrastructure replacement timelines with timelines for customers' own equipment turnover.[16]

However, National Grid has had three successful NPAs in rural upstate NY, where it identified 19 homes that are each directly served by a connection to gas transmission infrastructure, or "farm tap," that requires replacing gas regulator equipment. National Grid proposed covering the full cost of installing geothermal heating systems for each of these 19 homes, in lieu of investment in new regulators. Of these customers, five have expressed interest and three have moved forward with full electrification, with geothermal heating system installation complete.[17] Their gas service will be terminated, and any gas appliances replaced with electric appliances, paid for by the gas utility's program. Together, the electrification of these three customers will retire 586 feet of gas pipe and avoid the need for three new regulators.

NPAs for Avoiding Capacity Expansion Projects

National Grid has released three requests for proposals to date across six sites in the New York Cityand Long Island gas territories, seeking third-party vendors to offer NPA solutions to permanently reduce peak demand to help avoid future capacity investments planned to meet growing gas demand.[18] [19] The company is currently evaluating requests for proposal responses and considering the cost-effectiveness and deployment feasibility of proposed solutions.

Electrification, weatherization, and energy efficiency are among the solutions that National Grid and the third-party vendors have identified to permanently reduce peak demand. Unlike avoided replacement projects, these projects do not always require 100% of affected customers to participate. The number of participating customers needed to avoid the capacity expansion project will depend on the specific project and how much demand reduction is necessary.

NPAs for Avoiding New Customer Connections

When five or more potential new customers request to connect to National Grid's New York gas system, requiring the addition of more than 500 feet of gas main, National Grid has begun reaching out to these customers with information about NPA incentives for electrification in lieu of connection to the gas system. In these cases, the NPA incentives offered are equivalent to the value of the avoided pipeline installation. National Grid is considering expanding this offering to all potential new customers seeking to add more than 100 feet of gas main.

[16] To date, National Grid has reached customers via phone calls to inform them about NPA incentive opportunities for their property. In 2024, National Grid plans to expand its customer outreach to include email, postcards, and a website for customers to learn and engage further about NPA programs. National Grid is also considering resource requirements for door-to-door outreach.

[17] Of the five customers that initially expressed interest, one project didn't move forward as it was disqualified by the contractor and one customer opted out.

[18] KeySpan Energy Delivery New York (KEDNY) service territory.

[19] KeySpan Energy Delivery Long Island (KEDLI) service territory.

Integrated Energy Planning Analyses

In response to stakeholder and utility commission interest, National Grid electric and gas planning and asset management teams began in 2022 to jointly explore how to conduct IEP.

To better understand the methodology, assumptions, data and capabilities required to enable IEP, a team conducted an analysis that evaluated the electric network impacts of fully electrifying residential gas heating load in two Massachusetts towns with both National Grid electric and gas service. The team also identified segments of leak prone pipe that could be candidates for targeted electrification if customers could be fully electrified and the leak prone pipe segment decommissioned in lieu of replacement.

The preliminary analysis found that the cost of electric grid upgrades to support community-wide heating electrification for all residential customers in the two cities outweighed the costs of avoided gas infrastructure replacement. However, the analysis found some segments of leak-prone pipe that could be good NPA candidates, where the benefits of avoided gas infrastructure replacement outweighed the costs of electric grid upgrades to support the incremental electric demand.

The analysis also identified additional learnings. First, there is a wide range of potential peak load impacts from the electrification of heat depending on many factors, including the type, size and efficiency of the heat pump adopted, the energy efficiency of the premise, and whether electric resistance back-up heating is used. In addition, further analysis and sensitivities are needed to understand the implications of the electrification of transport, which could lead to higher cost of electric upgrades, as well as potential opportunities for load optimization or demand response that could help mitigate peak impacts.

The team also identified segments of leak prone pipe that could be candidates for targeted electrification if customers could be fully electrified and the leak prone pipe segment decommissioned in lieu of replacement.

The exercise also made it clear that new tools and resources would be needed to scale the analysis and to consider multiple scenarios and sensitivities, such as collaborative modeling between gas and electric planning systems and locational forecasting of customer propensity in heating technologies. Since that preliminary analysis, National Grid has explored and begun piloting new software tools that could enable more sophisticated and scalable IEP.

Other U.S. Case Studies: Utilities Advancing NPA Projects

Highlighted below are notable NPA efforts from three utilities in the U.S.: Pacific Gas & Electric, Con Edison, and Xcel Energy. As of early 2024, National Grid and RMI are also aware of ongoing NPA efforts at other New York utilities such as Rochester Gas and Electric and New York State Electric and Gas.[20]

Pacific Gas & Electric

Pacific Gas & Electric (PG&E) has successfully completed 88 targeted electrification projects, including decommissioning 22 miles of transmission pipe and converting 105 customers from gas. Each project has required high-touch customer outreach and in most cases, PG&E has offered to pay the full cost of customer conversion from gas service. PG&E has so far successfully executed projects affecting fewer than five customers at a time, reflecting the challenge of persuading larger clusters of customers to reach unanimous agreement on electrification. PG&E has also proposed a much larger project at California State University Monterey, where the university is the sole decision-maker for campus facilities.[21]

The requirement for voluntary participation from 100% of affected customers is an identified barrier to PG&E's pursuit of larger projects at scale. This requirement derives from the statutory 'obligation to serve,' which broadly obliges utilities to provide utility service upon request. In practice, this obligation prevents utilities from permanently ceasing service to a customer as part of a targeted electrification project so long as that customer wishes to continue to receive gas.[22] PG&E is considering support for legislative changes which could enable larger-scale targeted electrification initiatives.[23]

Pacific Gas & Electric (PG&E) has successfully:

completed
88
targeted electrification projects, including decommissioning

22
miles of transmission pipe and converting

105
customers from gas

PG&E has developed a Geospatial Electrification tool which the utility uses to identify candidate sites for NPAs across its system. PG&E has also provided a version of this gas asset analysis tool under NDA to some cities in its service territory to aid in their decarbonization planning. Additionally, the California Energy Commission has funded a "Targeted Building Electrification and Gas System Decommissioning Pilot Project" in Northern California which leverages PG&E's gas asset analysis tool to develop a framework to identify high-potential NPA projects. The project's interim report, "Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Gas Infrastructure in Northern California," highlights questions essential to integrated energy planning, including what information about energy

[20] "Avangrid Subsidiaries NYSEG and RG&E Advance Their First Whole Home Electrification Project in New York," AP News, February 2024, https://apnews.com/press-release/business-wire/avangrid-inc-new-york-construction-and-engineering-government-programs-246e3fbad6da4b0aaca71e79aa82ace9.

[21] Pacific Gas and Electric, "Application of Pacific Gas and Electric Company (U 39 G) for Approval of Zonal Electrification Pilot Project and Request for Expedited Schedule," California Public Utilities Commission Application No. 22-08-003, August 10, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M496/K451/496451495.PDF.

[22] While exact language can vary, statute in most states includes a definition of utilities' obligation to serve customers as part of the public utilities code.

[23] For example, CA Senate Bill 527 did not pass in 2023 but would have allowed a limited number of pilot targeted electrification projects to proceed with less than 100% customer opt-in, subject to PUC oversight and approval. S.B. 23-527, (CA 2023), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202320240SB527.

infrastructure and population demographics is needed to make near-term investment decisions that advance long-term utility, customer, and state policy goals.[24]

Con Edison

In November 2023, Con Edison released a Non-Pipes Alternatives Implementation Plan, detailing their NPA efforts to date. Con Edison operates two NPA programs: the Area Load Relief Program, which works to address capacity constraints across a broad area, and the Electric Advantage Program, which aims to avoid gas main replacements, such as those removing leak-prone pipe.

The Area Load Relief Program has one active project with expected efficiency investments beginning in 2024, which aims to achieve the necessary demand reduction by November 2025. Since its launch in 2023, the Electric Advantage Program has identified over 300 candidate projects, conducted customer outreach for 65 projects, and confirmed implementation plans for 3 projects that will convert a total of 5 customers from gas. Additional projects are anticipated to progress in 2024. The Electric Advantage Program has so far targeted only pipe segments serving fewer than 5 customers each. Con Edison's early experience emphasizes the importance of high-touch customer contact and face-to-face engagement for these projects.

Con Edison's early experience emphasizes the importance of high-touch customer contact and face-to-face engagement for these projects.

Con Edison's Electric Advantage Program has:

identified over **300** candidate projects and conducted customer outreach for **65** projects and confirmed implementation plans for **3** projects that will convert a total of **5** customers from gas

Xcel Energy

Under new gas planning rules established by the Colorado Public Utilities Commission in 2022, Xcel Colorado assessed NPA portfolios as potential alternatives to seven anticipated infrastructure investment projects. Of these, two NPA projects have been proposed for Commission approval.[25] One project impacts over 25,000 customers and aims to reduce peak gas demand by aggregating customer electrification to avoid the need for a gas capacity expansion project. The second project aims to avoid the replacement of high-risk mains and services, and thus requires full electrification of the 66 primarily commercial customers served by this infrastructure.

[24] Energy and Environmental Economics, Inc., Gridworks Organization, and East Bay Community Energy, "Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Gas Infrastructure in Northern California," June 2023, https://gridworks.org/wp-content/uploads/2023/06/Evaluation-Framework-for-Strategic-Gas-Decommissioning-in-Northern-California-Interim-Report-for-CEC-PIR-20-009.pdf.

[25] Of the remaining five projects assessed, two were too far in the future (five years from filing, approximately six years from initial identification) to perform effective cost estimates and cost-benefit analyses, though these will continue to be assessed for NPAs in future filings. The remaining three projects will proceed with the gas infrastructure option, as the net economic benefit for the NPA option was less than the infrastructure option for one project, and the last two were required in-service by the 2024-2025 heating season. Public Service Company of Colorado, "PSCo Initial 2023-2028 Gas Infrastructure Plan, Attachments B.1-B.4 and B.6-B.8," Colorado Public Utilities Commission Proceeding No. 23M-0234G, May 18, 2023, https://www.dora.state.co.us/pls/efi/EFI.Show_Filing?p_fil=G_804257&p_session_id=.

European Case Studies: Examples of Targeted Electrification and Clean Heat Planning

As of early 2024, National Grid and RMI are aware of several European countries actively advancing targeted electrification and clean heat planning. These examples focus on planned solutions at the municipal and neighborhood level.

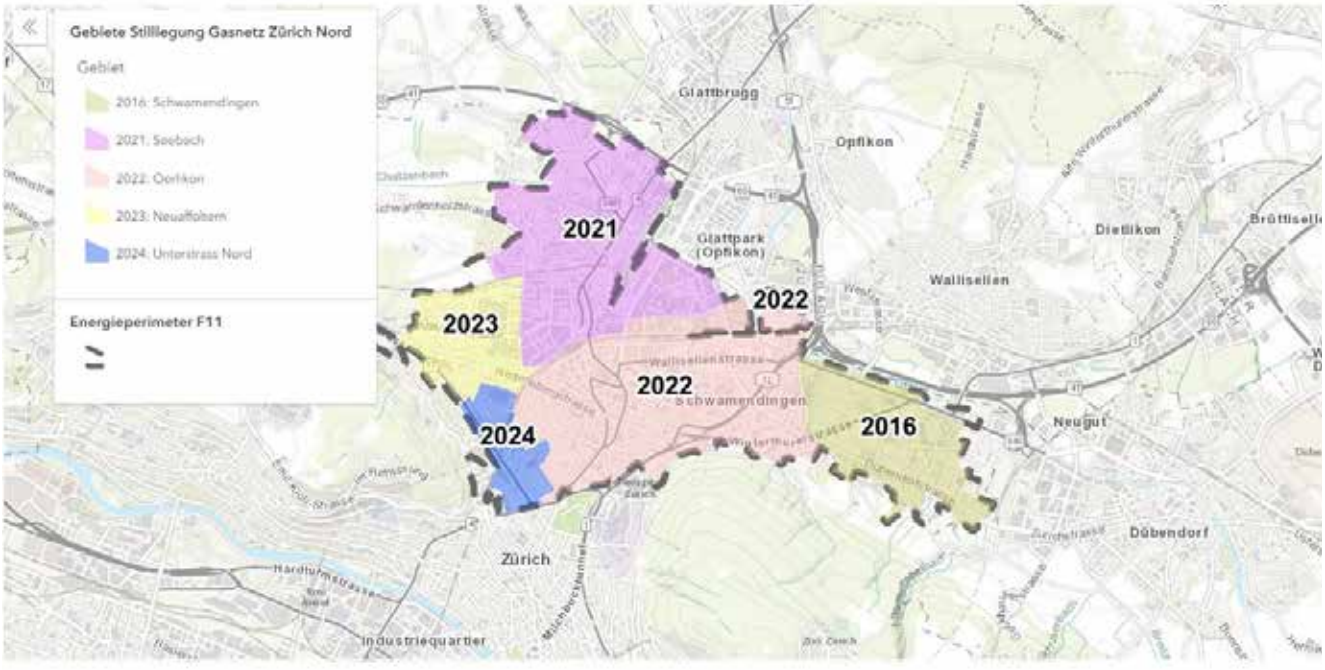
Switzerland

Two cities in Switzerland – Zurich and Winterthur – have initiated plans to decommission some or all of their cities' natural gas distribution infrastructure. In both cases, utilities have informed residents in specific neighborhoods that gas service will be discontinued on a set timeline, typically 10 years in advance. The city of Basel is also planning neighborhood scale decommissioning for the whole city, with a targeted end date of 2037. To date, Zurich is the only city that has completed the decommissioning of segments of the gas system.

Zurich's gas utility, Energie360, initially pursued decommissioning in the North Zurich district based on the poor economics of maintaining the gas system in parallel with a district heating system, given that many customers had already converted from gas to district heat, and gas system utilization was low. Customer communications began in the early 2010s, and many of the affected customers have now seen gas service discontinued. Planning for additional decommissioning by neighborhood is currently underway, led by the City of Zurich in pursuit of GHG reduction goals. The city and utility are discussing plans for the city to compensate the utility for lost future earnings from gas sales, stemming from the next round of decommissioning projects.

Two cities in Switzerland – Zurich and Winterthur – have initiated plans to decommission some or all of their cities' natural gas distribution infrastructure. In both cases, utilities have informed residents in specific neighborhoods that gas service will be discontinued on a set timeline, typically 10 years in advance.

North Zurich neighborhood gas system decommissioning by year.[26]



[26] Energie 360, "Gas network closure in Zurich North," https://www.energie360.ch/de/kundenservice/gas-stilllegung

As part of the gas decommissioning process, the utility offers customers compensation based on the estimated remaining life of their gas equipment and the timeline between notification and gas shutoff. After first communicating a 5-year timeline for early projects, the utility extended the timeline to 10 years based on customer feedback.

In some cases, utilities have informed customers that district heating systems are being expanded to their neighborhoods as alternatives to gas. One identified challenge emerges when a customer's equipment reaches end-of-life before the district heating system is available. Parallels in the U.S. might include streets or neighborhoods where avoiding the gas infrastructure replacement requires additional electric investment that cannot be completed before the new heating systems are needed. This scenario will require special attention from implementers to ensure customers' energy needs continue to be met throughout the conversion.

Denmark

Denmark has a high penetration of district heating — 56% — whereas only 20% of households rely on gas for space heating.[27] The number of gas customers across Denmark is in decline, falling roughly 2% in 2021 and 8% in 2022 as both gas economics and European efforts to reduce reliance on Russian gas imports took hold. The state has a goal that no households are heated by gas after 2035. Industry and district heating are expected to continue receiving gas service but convert from fossil gas to biogas. As of fall 2023, there have been no examples yet of decommissioned gas pipe segments in Denmark.

The national gas distribution system operator, Evida, recently published a study of their system that screens for areas where decommissioning is feasible and would support the economic viability of the system.[28] Evida points to the fact that they must reduce their asset base to avoid significant rate increases as customer count falls. By their estimate, 28% of the subnetworks on the Danish gas system are not recovering revenue equal to their costs. Evida recommends these subnetworks as priorities for decommissioning but notes that shutting down a subnetwork currently requires gas customers to choose a different form of energy on their own initiative. Accordingly, the study highlights the need for legal changes to allow the utility to proactively designate gas subnetworks for decommissioning, with adequate customer notification and support.

Netherlands

The Netherlands has established a target that no households are heated with natural gas by 2050. Currently, 90% of buildings use gas for primary heating. Since 2018, most new construction has been prohibited from connecting to the gas distribution system. Measures to encourage electrification of existing buildings include a gradual reduction of taxes on electricity use and a corresponding increase in taxes on gas use, in addition to heat pump incentives.[29] Depreciation of existing gas infrastructure has been accelerated. In the past, customers disconnecting from the gas system were required to pay an "exit fee," but this cost is now socialized among all gas customers.

Currently, 90% of buildings in the Netherlands use gas for primary heating. Since 2018, most new construction has been prohibited from connecting to the gas distribution system.

[27] Katinka Johansen, Sven Werner, "Something is sustainable in the state of Denmark: A review of the Danish district heating sector," Renewable and Sustainable Energy Reviews, Volume 158, 2022, 112117, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2022.112117.

[27] Evida, "Smart Conversion of Gas Consumption Must Transform the Gas System," June 27, 2023, https://evida.dk/media/4w2b1xdx/evidas-kortl%C3%A6gning-af-gasdistributionssystemet.pdf.

[29] Emma Koster, Katja Kruit, Marianne Teng, and Florian Hesselink, "The Natural Gas Phase-Out in the Netherlands," CE Delft, February 2022, https://cedelft.eu/wp-content/uploads/sites/2/2022/03/CE_Delft_210381_The_natural_gas_phase-out_in_the_Netherlands_DEF.pdf

Currently, municipalities are required to conduct local heat planning in consultation with utilities. However, when this planning process has identified neighborhoods for electrification and discontinued gas service, neither the municipality nor the utility has had a practical pathway to implement this plan.[30] Pending legislation would authorize municipalities to designate specific areas where gas service will be discontinued, with a minimum of eight years' notice.[31]

Germany

In Germany, municipalities are required to develop clean heat plans. Gas distribution systems in Germany are already "largely depreciated"—that is, the remaining net book value of existing assets is less than 20% of their initial cost. This is due in part to the advanced age of many gas assets currently in service.[32] A study by Agora Energiewende, a non-profit think tank, found that efficient planning of gas infrastructure could halve the total increase in gas bills through 2044, relative to the bill increases incurred in an unplanned scenario. While there are not yet specific policies or programs to plan and execute targeted electrification in Germany, there is an increasing focus on questions around gas transition, including emerging research and thought leadership on how to address new gas connections, decommissioning plans, and the potential role of accelerated depreciation.[33]

Austria

The City of Vienna published a climate neutral heating and cooling strategy statement on the building sector implications of the state's 2040 climate neutrality goal.[34] The policy explicitly centers on phasing out gas use. A current barrier to both utility gas system planning and municipal regulation of heating systems in existing buildings is the lack of policy clarity at the federal level. A potential federal law that would authorize municipalities to regulate existing buildings recently failed to reach consensus, and uncertainty about what level of government will hold the decision-making authority for decarbonizing the buildings sector has stalled action on this front.

[30] Ibid.

[31] Municipal Instruments Heat Transition Act, Dutch Parliament, 2023, https://www-tweedekamer-nl.translate.goog/kamerstukken/wetsvoorstellen/detail?cfg=wetsvoorsteldetails&qry=wetsvoorstel:36387&_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp.

[32] Mareike Herrndorff, et. al., "A New Regulatory Framework for Natural Gas Distribution Networks," April 18, 2023, https://www-agora--energiewende-de.translate.goog/publikationen/ein-neuer-ordnungsrahmen-fuer-erdgasverteilnetze?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp.

[33] Bundesministerium für WIrstchaft und Klimaschutz. "Green Paper Transformation Gags-/Wasserstoff-Verteilernetze," 2024, https://www.bmwk.de/Redaktion/DE/Downloads/G/green-paper-transformation-gas-wasserstoff-verteilernetze.pdf?__blob=publicationFile&v=4

[34] City of Vienna, "Phasing Out Gas: Heating and Cooling Vienna 2040," 2023, https://www.wien.gv.at/stadtentwicklung/energie/pdf/phasing-out-gas.pdf.

Insights for Exploration in the U.S. Context

Across multiple jurisdictions with varied approaches to gas transition planning, these case studies encompass a significant body of experience. While examples of completed NPA projects in the U.S. are still limited, we develop several key insights below worth exploring further in the U.S. context.

1) NPA projects underway today reflect diverse energy policy goals and energy system characteristics across different jurisdictions.

In the U.S., low-cost domestic natural gas supply has led to widespread adoption of natural gas for heating and other purposes over many decades, with the associated expansion of gas distribution networks. Many stakeholders have recognized that continued gas system expansion is no longer consistent with climate policy; however, related policy and planning processes are still in their early stages. As described in the earlier sections, a handful of U.S. gas utilities have begun evaluating and pursuing NPAs as part of their gas planning processes.

In Europe, many jurisdictions have sought to reduce reliance on gas for some time, motivated by economic, geopolitical, and environmental concerns. As discussed earlier, recent developments such as the Russian invasion of Ukraine and related increases in the price of gas, put additional weight behind Europe's policy shift away from gas. At the national level, several jurisdictions have established policies to fully transition away from the use of natural gas. There are also a number of municipal planning processes underway in European cities to support more localized planning of future customer heating technologies and enable long-term infrastructure transitions.

Additional European jurisdictions, such as Germany, have further recognized the value of planning for the management of infrastructure transition costs. For jurisdictions or gas systems in the U.S. with significant undepreciated balances, there is an even higher incentive to act now to find ways to lower the overall costs of the transition to clean energy.

While it is important to recognize the successful and ongoing examples of NPAs and targeted electrification that have been explored in North America and Europe, it is also important to understand the distinctions among the jurisdictions where these projects are proceeding. Jurisdictions can vary significantly in geography, climate, customer composition, policy and regulatory preferences, the availability of other energy infrastructure, supply capacity, and the role that gas systems play in meeting today's energy demand. This diversity will necessarily shape the solutions that meet each jurisdiction's goals and needs.

2) NPA projects can identify value in cost savings on the gas system, emissions reduction, or other societal benefits.

Different jurisdictions and utilities have used varied terms and frameworks to distinguish among specific types of targeted electrification. For example, PG&E's efforts to date differentiate between 'targeted electrification', indicating projects motivated by cost savings on the gas system, and 'zonal electrification', indicating projects motivated by societal benefits, such as providing clean energy to disadvantaged communities or achieving significant greenhouse gas emissions reductions. In Europe, a common distinction is between heat planning, focused on the solutions that will provide clean heat to customers, and gas infrastructure planning, focused on the costs and timelines associated with maintaining, repairing, or retiring gas infrastructure. Broadly, these distinctions reflect the unique considerations for projects that are driven by infrastructure cost savings relative to those driven by other societal benefits.

Infrastructure-driven planning is characterized by a focus on economically driven projects that have a specific timeline – that is, where there is a quantifiable gas investment to be avoided. Common examples in the U.S. include areas of leak-prone pipe or pipe otherwise in need of safety remediation, gas assets at the end of their useful life, or infrastructure in need of capacity expansion to meet increased demand. Attractive NPA projects in lieu of such investments could accrue net savings to gas ratepayers, and early experience from the U.S. demonstrates that utilities have been able to identify such projects where the avoided cost is substantial and investments in NPA projects would be cost-effective.

Notably, certain types of infrastructure-driven projects allow for and require different approaches in order to avoid the anticipated gas system investment. For example, as discussed in the earlier case studies, solutions for capacity expansion projects can be targeted to a broad area and do not usually require 100% customer participation within that area, whereas leak-prone pipe in need of replacement would require all affected customers to adopt alternatives to natural gas service.

While capacity-related projects avoid this specific challenge, they face uncertainty in the permanence of the demand reduction as they cannot guarantee new loads won't appear in the future. Similar to replacement projects, capacity projects still require a minimum threshold of customer participation to ensure the gas investment can be avoided. This complicates the process of funding increased incentives for participating customers, as this funding is premised on avoiding the gas investment, which in turn is premised on a certain number of customers opting in, as well as the location and usage pattern of those customers relative to the capacity project.

Factors other than cost might motivate a utility, regulator, or municipality to prioritize an NPA even if the avoided gas investment alone is not sufficient to fully fund the project. 'Societally' driven projects thus comprise a broad category of projects not solely motivated by infrastructure costs. These could include projects motivated by their impact on reducing greenhouse gas emissions or projects motivated by providing benefits to disadvantaged communities. This category could also include specific communities that seek to exit the gas system regardless of the age of infrastructure serving them, such as through a municipal heat planning process driven by emissions reduction or other concerns. In the Swiss examples, the earliest projects were motivated primarily by cost savings for underutilized infrastructure, but more recent municipally driven projects are motivated by GHG reduction goals.

These categories can and do overlap. Some projects may have a quantifiable infrastructure investment to be avoided in a disadvantaged community, while other projects' avoided investment only covers a portion of the cost, with the remainder covered by funding intended for climate mitigation. The implications of these distinct categories impact how decision-makers might consider how to allocate costs for different projects, as well as how projects might be identified through energy or community planning processes.

3) Prioritization of NPA projects should weigh a broad set of criteria.

For utilities seeking to identify and pursue NPA opportunities within their existing capital or system planning processes (or via newer integrated energy planning processes), there are several key criteria to consider, many of which impact the overall economics of a given NPA project. These criteria include:

- **Gas asset risk and investment timeline:** For many projects, if the investment is needed urgently for safety or reliability, for instance in less than two years, it may not be feasible to implement an NPA before the need must be addressed. One notable exception is the success PG&E has found in executing small-scale (e.g., fewer than five impacted customers) projects in the range of 18-24 months. As illustrated in early experience in Zurich, longer

timelines are more important for larger, neighborhood-scale projects. Longer timelines of five or more years give stakeholders more time to design and implement appropriate solutions, particularly where NPAs and targeted electrification are nascent concepts. Timelines of up to five years may be workable but could be challenging for first-of-a-kind efforts impacting larger groups of customers.

- **Hydraulic feasibility:** Segments with a one-way flow or terminal branches can typically be removed without impacting the remaining system. Meanwhile, assets that provide reliability to other parts of the system may be difficult to retire. In some cases, the hydraulic impact of removing a segment of pipe can be mitigated through limited reinforcement elsewhere.
- **The outlook for local electric capacity, or headroom:** The simplest NPA projects will have ample local electric capacity that can accommodate added load from targeted electrification without costly electric upgrades. Other attractive projects could maintain peak demand below the local capacity threshold through demand-side measures such as load shifting or energy efficiency. Some NPA projects will require upgrades in electric capacity that could be costly. Even in these instances, it may be the case that organic load growth would have required capacity upgrades regardless of the NPA project, and it might not necessarily be appropriate to allocate all electric upgrade costs to the NPA project itself.
- **The types of customers:** Different customer types (residential, commercial, or industrial) or building types (single-family homes vs. large apartment buildings) may involve different levels of cost, difficulty, or NPA project scope.
- **The number of customers:** If each impacted customer must agree to participate for an NPA to proceed, projects with 1-5 customers may be more feasible than projects impacting a larger group, under current regulatory frameworks. Additionally, if the avoided infrastructure cost is divided across the impacted customers, each customer can receive a larger NPA incentive when the project affects fewer customers.
- **The presence of community support:** Partnership with community-based organizations, local governments, or interested individuals can facilitate productive customer engagement. A local government with high climate ambition or additional motivations to reduce the presence of gas infrastructure in their community may be able to provide additional support through data sharing and staff capacity.
- **Customer propensity:** The likelihood of customers to adopt electric technologies and opt to participate in an NPA project could be an indicator of project success, as NPA projects are dependent on voluntary participation under the current regulatory framework. Indicators of customer propensity could include building stock and energy usage data (such as the age and energy intensity of buildings), customer participation in utility programs, awareness and adoption of heat pumps, and other demographic data.
- **Equity:** Equity criteria, such as location in a disadvantaged community and enrollment in bill discount rates, are also important to consider in site prioritization. Cost effectiveness and customer propensity criteria may be at odds with equity criteria, so it is important to assess these criteria holistically to balance a utility's cost and equity goals.

The relative weight of each criterion may vary depending on the goals and authority of the decision-maker, whether the utility, the state utility commission, or a municipality.

In prioritizing projects and crafting implementation plans, utilities will need to weigh gas system, electric system, and customers' system considerations and economics together. One approach seen in Winterthur mapped the city according to the type of clean heating solution each neighborhood would transition to; these maps index predominantly on customer density to determine suitability for extension of existing network heating or construction of new heat networks. While district heating is much less prevalent in the U.S., thermal energy networks are increasingly of interest to utilities, regulators, and stakeholders, particularly in urban areas with colder climates. Where appropriate, NPA planning could

assess feasibility for thermal energy networks, as these provide an opportunity for utility business model evolution and can mitigate peak electric network infrastructure requirements and costs, if deployed at scale.

4) NPA projects can be funded from a series of different sources while protecting ratepayers' long-term affordability.

NPA projects can involve multiple distinct categories of cost, including:

- front-of meter gas system costs, including the cost of decommissioning the gas asset,
- front-of-meter electric system costs (e.g., distribution capacity upgrades),
- behind-the-meter costs (e.g., the cost of electrification retrofits), and
- programmatic or administrative costs.

In the context of long-term declining gas demand, NPA projects should aim to mitigate upward rate pressure on customers remaining on the gas system. Not only will managing system costs improve customer equity and long-term affordability, but it will also contribute to utilities' long-term cost recovery and financial health via reasonable rates.

Some existing regulatory mechanisms, such as accelerated depreciation, are available to aid with financially sustainable and equitable cost recovery. However, additional policy mechanisms may be needed to help manage gas transition costs, including the potential flow of funding across the electric and gas customer bases, as demonstrated by the Québec gas and electric utilities discussed on page 23.

Cost-effectiveness evaluations are a key method of determining the amount of funding appropriate for ratepayers to pay into a targeted electrification or NPA program. Due to the broad set of benefits these projects provide, these tests may include societal costs and benefits, including carbon reduction benefits. Appropriately accounting for the societal and customer value of the investment efficiencies enabled through IEP and NPAs will require updating cost-effectiveness tests as these solutions scale.

Below we lay out the major potential sources of funding for NPA projects, with the rationale for using each.

Federal and state funding (taxpayers)

Where federal or state funding is available, these sources should be pursued to maximize ratepayer savings whenever possible. For example, the Infrastructure Investment and Jobs Act and the Inflation Reduction Act make available significant funding for programs that help to reduce the costs of NPA projects. Many states including Massachusetts and New York also offer rebates and incentives for energy efficiency upgrades, heat pumps, and more efficient appliances. To the extent targeted electrification initiatives are a priority for a given jurisdiction, legislators may appropriate funds specifically to support these projects.

Gas ratepayers

NPA projects present an opportunity to avoid costs on the gas system, thereby achieving savings for gas ratepayers. This forms the primary rationale for recovering NPA funding from gas ratepayers. These projects also provide a direct opportunity to reduce GHG emissions. Because NPAs are premised on the ability to avoid a future investment in gas infrastructure, there is a strong justification for gas ratepayers to provide funding for these projects. At the same time, it may be appropriate to limit gas ratepayer funding to some threshold below the full avoided cost, so that some avoided spending can be returned as savings for gas ratepayers.

In certain cases, paying more than the avoided infrastructure cost may be justified based on project benefits, though the allocation of these costs between gas and electric customers should be determined by regulators. These benefits could include the innovation value of early project demonstrations, quantified GHG benefits, or support for income-qualified customers' participation in targeted electrification and NPA projects. In the long term, particularly as rate pressures on a declining gas customer base increase, decision-makers may wish to reconsider whether it continues to make sense to seek NPA funding from gas ratepayers.

Electric ratepayers

Funding from electric customers is premised on the benefits that NPA projects provide via load growth and additional future revenue on the electric system. Electric ratepayers could also be responsible for incentives for equipment upgrades that may be needed, after any state and federal energy efficiency incentives are exhausted. One model of funding could draw a "bright line" between the two rate bases, allocating electric ratepayer funding only to associated costs on the electric system, and gas ratepayer funding only to costs on the gas system. This model's simplicity may be particularly attractive for early or pilot projects. Alternately, regulators could determine what amount of funding is justified on either side of the "bright line," while allowing for the potential combination of funding for any remaining costs.

Local taxpayer funding

Local funding from a county, city, or town may be a particularly relevant resource where the municipality is conducting clean heat planning that might pursue more NPA projects than could be funded through traditional pathways.

Individual customers

Most customers will bear some costs within the home, as they would during normal equipment replacement. Offering a sufficient timeline from initial notice to gas decommissioning could allow a reasonable period for homeowners and building owners to plan for proactive equipment replacement in lieu of short term or emergency replacements.

In the Swiss case studies identified above, customers are typically given 10 years' notice and offered supportive incentives and programming but are responsible for costs in excess of the incentives they receive. For low- and moderate-income customers, additional support for equipment replacement and supplemental upgrades such as energy efficiency will be needed.

5) Integrated gas and electric network planning offers an opportunity to achieve net-zero goals as cost-effectively and equitably as possible.

An orderly transition to net-zero emissions requires gas and electric coordination and collaboration on system planning, as well as involvement of customers and communities in decision-making. Coordinated planning offers several opportunities to ensure affordability and reliability, including:

An orderly transition to net-zero emissions requires gas and electric coordination and collaboration on system planning, as well as involvement of customers and communities in decision-making.

- Prudently building out the electric system in the right locations at the right time to prepare for conversion of fossil fuel-based heating (including delivered fuels as well as natural gas) to electric heating;
- Making calculated decisions about where on the gas system to prioritize investment (e.g. leak-prone pipe repair or replacement) and/or planning to decommission sections of the gas network in favor of electric heating or thermal networks; and
- Leveraging energy efficiency and load control to help optimize demand and avoid the highest-cost infrastructure scenarios.

Coordination between and within utilities to optimize long-range investment plans is critical to ensure a cost-effective energy transition for all customers.

Optimized investment of this kind requires a significant, long-term exchange of geographically specific data between planning teams within or across utilities. For example, coordinated planning could ensure electric capacity is available or built out in time to support NPA projects. However, a process for information exchange between utilities at this level of specificity does not yet exist. While some utilities serving both gas and electricity have voluntarily embarked on intra-utility integration of their gas and electric teams, the scalability of these efforts is constrained by limited levels of territorial overlap, especially in the Northeast U.S. Regulatory action is thus needed to enable data sharing and decision making between utilities in a more comprehensive way. Absent regulatory support, it is unlikely that integrated energy planning will achieve the scale needed to realize cross-system savings.

Regulatory support is needed to invest in new tools and capabilities that enable integrated energy planning to achieve a cost-optimized transition.

Key tools could include software that translates geographic gas demand scenarios into impacts on electric system load, and vice versa. These gas and electric load scenarios would then inform geographically specific distribution planning for both systems, and aid in the identification of high priority, or most cost-effective, NPA projects. These tools should also be used to generate versions of distribution system maps that could be shared with municipal or local government planners to support local clean heat planning.

PG&E has already developed an asset screening tool, featuring an integrated mapping of gas and electric systems with customer data. This tool has aided in early research on potential NPA frameworks for California. Indeed, such an integrated system mapping and planning tool empowers the utility and partners to identify potential projects along multiple prioritization criteria. PG&E's mapping tool has also helped cities gain insight for localized decarbonization planning.

Targeted electrification and NPA pilots should leverage integrated planning to inform the development of regulatory frameworks for deploying these solutions at scale.

Regulators should encourage pilots to test innovative approaches to scaling NPAs, including through novel cost recovery and allocation structures. Pilots could also be used to test deployment under alternate structures of the utilities' obligation to serve, though this model may require legislative authorization. Where customers' gas and electric providers differ, pilots should also seek to inform new protocols for cross-utility coordination. Development of these pilots will enable testing of new data-sharing, planning, and cost-recovery structures across utilities.

Québec Example of Cross-Utility Funding

Énergir and Hydro-Québec, respectively the primary gas and electric utilities serving Québec, have signed an agreement for a joint decarbonization strategy. This strategy, approved by the regulatory authority, centers on partial (70%) electrification of building heating systems with gas backup. The strategy includes compensation payments from the electric utility to the gas utility based on avoided electric peak capacity investments enabled by maintaining gas backup. Participating gas customers are estimated to see modest annual bill savings, while the gas utility anticipates preserving a substantial share of distribution revenues despite a significant reduction in gas throughout.

This approach provides an early example of integrated energy planning, including the concept of funding flowing between gas and electric rate bases contingent on the value that each system contributes through decarbonization-focused programs. In the near term, funding across rate bases could be applicable to thermal energy networks where capital investments cannot be reasonably recovered from thermal network customers alone. In the longer term, regulators may consider models of cross-rate base funding that account for the value each system provides the other, in service of broader policy goals such as the reduction of GHG emissions.

6) Utility and municipality partnership may be a key element of NPA projects and localized integrated energy planning.

As seen in the European case studies highlighted above, local energy planning achieves the level of granularity needed to plan for and meet local needs. Policymakers and regulators should find ways to empower local energy planning that identifies a long-term portfolio of heat solutions for a community or municipality. It will be important for utilities to partner with municipal governments conducting local energy planning, both to share system maps and to provide technical partnership in municipal decision-making based on system data. Potential benefits of local energy planning include the opportunity for residents and local leaders to design and champion locally tailored solutions.

The early examples of successful European targeted electrification projects come from the Swiss cities in which municipal government has become more involved in making community-specific heating transition decisions. Pending new legislation, communities in the Netherlands are poised for similar progress, having already coordinated between municipal governments and utilities on community-wide heating plans.

Applying a similar model in the U.S. could entail supporting municipalities to partner with the utilities that serve them to conduct clean heat planning, including identifying segments of the gas network for NPA and thermal heating projects. This approach could allow municipalities with ambitious climate policies to pursue NPAs at a faster pace than others, and to reflect local priorities in identifying projects.

This kind of partnership can be effective if it produces proposed NPA projects rooted both in utility analysis and community priorities. To make it effective in the U.S., utilities, municipalities, regulators, and policymakers will need to take several new actions:

- Utilities will need to develop improved tools and capabilities for evaluating NPA opportunities at the local level, building on data across the gas system, electric system, and their customer base, as described above.
- Utilities and municipal staff will need to learn how to conduct this collaborative planning most effectively. Utilities generally have little precedent for such detailed planning with local government, and cities may lack the staff capacity or expertise to partner fully.
- Regulators may need to provide guidance to streamline such planning and make it consistent across their state. Regulators can also set clear expectations for how the outputs of this planning will be evaluated – for instance, how they will evaluate proposed NPA projects resulting from utility-municipal joint planning.
- Regulators must provide clear guidance on cost allocation and cost recovery, recognizing the need for a clear framework to advance proposed NPA projects, while also protecting ratepayers outside first mover communities and ensuring less well-resourced communities are not burdened by early NPA projects.
- Policymakers will need to give clear direction regarding how the utility's obligation to serve will be treated for projects resulting from joint utility-municipal planning, to ensure promising projects can advance, as described further below.
- In cases where a community is served by separate gas and electric utilities, this planning will be more complex. In this case, new guidance will be needed regarding how data will be shared across both systems and the responsibilities of each utility. New policy direction may be needed, including for the case in which an investor-owned utility provides one service, and a municipal or cooperative utility provides another.

7) Individual customer persuasion to reach 100% participation is not a scalable NPA approach for avoided replacement projects.

Several U.S. utilities are currently pursuing individual customer persuasion to implement NPAs, with notable but limited success. In order for avoided replacement NPA projects to be successful, 100% of affected customers need to transition all gas heating equipment and appliances, including water heaters and stoves, to electric and transition off of the gas

system. As discussed, it is very difficult to get all customers to participate and disconnect from the gas system in projects with more than 5 customers.

Early experience makes clear that, under a voluntary model, any one customer can derail a potential project that is otherwise economically attractive and well-received by other customers, thereby limiting the prospects for this approach.

These approaches continue to have value, and new customer engagement strategies may expand success. However, it is unlikely they will readily scale to be a substantial portion of projects that could be attractive on economic and climate terms. There may be more scalable success in the near term pursuing this approach in projects not requiring 100% participation, such as capacity expansion projects.

8) Policy change will be needed to evolve the utility business model and obligation to serve, while still retaining the opportunity for cost recovery in a transition away from the use of gas.

In many jurisdictions, gas utilities are obligated by statute or regulation to connect new customers upon request and/or to continue providing service to existing customers (i.e. indefinitely). Such obligations have implications for targeted electrification projects. Utilities' obligation to connect new gas customers upon request will require the construction of new gas infrastructure regardless of whether the expansion is economically viable. Utilities' obligation to continue serving gas to existing customers poses a different challenge – that even where an NPA solution is economically attractive, if even one customer wishes to continue receiving gas service, the utility may still be required to install new infrastructure to maintain service.

This policy challenge requires designing a new process to enable projects driven by community needs or system economics rather than individual customer opt-in. Addressing this challenge will entail new and substantial policy shifts that also ensure reliable and affordable energy for customers.

This policy challenge requires designing a new process to enable projects driven by community needs or system economics rather than individual customer opt-in. Addressing this challenge will entail new and substantial policy shifts that also ensure reliable and affordable energy for customers.

In many cases in the U.S., legislative change is needed at the state level to enable regulators to work with stakeholders to develop a new paradigm for equitable access to essential energy services. The simplest change would remove the statutory obligation for utilities to continue serving gas to existing customers and empower regulators to enable or establish alternative plans or programs whereby customers are still provided with affordable and equitable access to energy.

Another model, as illustrated by the Swiss and Dutch case studies, would empower motivated municipalities to conduct heat planning that includes the retirement of gas infrastructure. In the Swiss case, community willingness to be an 'early adopter' of clean heat and infrastructure planning enabled cities like Zurich and Winterthur to proactively designate which neighborhoods would transition from the gas system on specific timelines. This approach also enabled these cities to plan the expansion of existing and construction of new district heating systems to align with geographically specific heat infrastructure plans. Such an approach would similarly require utility regulators to play an active role in project approval and the establishment of guardrails to ensure that reliability is maintained, excessive costs are not put onto ratepayers, and utilities have the opportunity to recover prudent investments in gas infrastructure even as NPA projects scale.

State regulators have a critical role in overseeing changes to the provision of utility service.

In the U.S., relevant authorities for infrastructure investment and service provision are provided by statute to public utility commissions. These commissions are charged with setting utility rates and policy in accordance with the regulatory compact that provides utilities with an opportunity to earn a reasonable return on investment in exchange for providing safe and reliable service at reasonable cost to all customers who request it.

Utility regulators have a critical role to play in implementing any changes to the utilities' obligation to serve and advancing NPAs.

As such, state regulators have a critical role to play in overseeing infrastructure planning and changes to the provision of utility service. The regulatory process to establish guardrails in any model of a reformed obligation to serve could include determinations of the minimum years of notice given to customers who would no longer receive gas, guidance on incentives and customer compensation, design of programs to support customers in transitioning behind-the-meter equipment, and preconditions tying the termination of service to municipal heat plans or other forms of municipal support. Regardless of the method of reform, utility regulators have a critical role to play in implementing any changes to the utilities' obligation to serve and advancing NPAs. Regulatory guidance is necessary to require the identification and analysis of NPAs, shape cost-effectiveness assessments, direct deeper analyses of utilities' investments, update rate mechanisms and depreciation methodologies that provide the opportunity to recover prudent investments, create data-sharing protocols across utilities with overlapping territory and with interested municipalities, conduct robust stakeholder processes, and set requirements for both broad and targeted customer education.

Conclusion

The insights laid out in this paper are a starting point for further exploration in the U.S. context. Our hope in presenting this work is for the findings to serve as a jumping-off point for future work across the country.

Below are some suggested starting points for decision-makers and stakeholders seeking to advance this work.

- Regulators should develop specific guidance to clarify the path to identify, propose, receive approval for, implement, and recover costs for NPAs in their state.
- Utilities should advance efforts to pursue the most achievable NPAs under existing frameworks (e.g., projects serving 1-5 customers, under the 100% persuasion model, and projects to avoid capacity expansions).
- Decision-makers should find ways to encourage increased utility-municipal engagement, data sharing, and cooperation for integrated energy planning in support of jurisdictional climate policy goals.
- Regulators should also support utilities' development of integrated system mapping tools to facilitate cross-utility coordinated planning and cooperation with interested municipalities.
- Stakeholders should develop an understanding of the ways utilities' obligation to serve may need to evolve, and what guardrails are necessary, in their state.
- Regulators should update rate mechanisms and depreciation methodologies that address the opportunity to recover prudent investments and protect future ratepayers, in light of anticipated changes in long-run gas system utilization.

Additional References

The following are links to additional resources that informed this paper.

Energie 360, "Gas network closure in Zurich North," https://www.energie360.ch/de/kundenservice/gas-stilllegung/.

Energy and Environmental Economics, Inc., Gridworks Organization, and East Bay Community Energy, "Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Gas Infrastructure in Northern California," June 2023, https://gridworks.org/wp-content/uploads/2023/06/Evaluation-Framework-for-Strategic-Gas-Decommissioning-in-Northern-California-Interim-Report-for-CEC-PIR-20-009.pdf.

Energy Moves Winterthur, "New energy plan now in the city map," December 2022, https://ebw-ch.translate.goog/energieplan-winterthur?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp.

Evida,"Smart Conversion of Gas Consumption Must Transform the Gas System," June 27, 2023, https://evida.dk/media/4w2b1xdx/evidas-kortl %C3%A6gning-af-gasdistributionssystemet.pdf. English translation available upon request from RMI

Municipal Instruments Heat Transition Act, Dutch Parliament, 2023, https://www-tweedekamer-nl.translate.goog/kamerstukken/wetsvoorstellen/detail?cfg=wetsvoorsteldetails&qry=wetsvoorstel:36387&_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp.

Walsh, Michael, "Local Energy Asset Planning," Groundwork Data, October 2022, https://www.groundworkdata.org/s/Local-Energy-Asset-Planning-v20221014-4.pdf

RMI | nationalgrid

CM9904 (4/24)