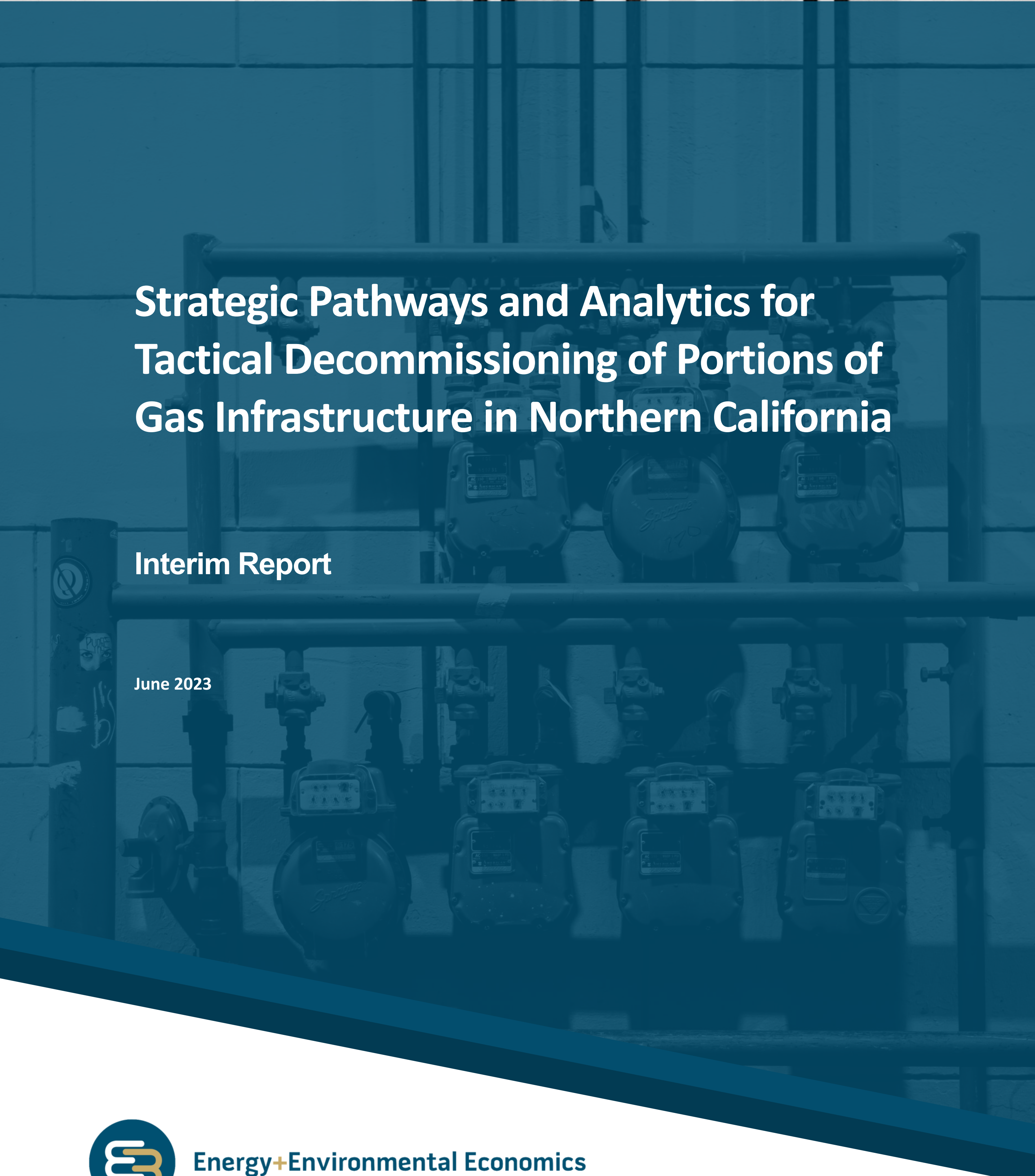

Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Gas Infrastructure in Northern California

Interim Report

June 2023

Energy+Environmental Economics

GRIDWORKS

EAST BAY COMMUNITY ENERGY

Energy and Environmental Economics, Inc.
Gridworks Organization
East Bay Community Energy

Energy and Environmental Economics, Inc. (E3)
44 Montgomery Street, Suite 1500
San Francisco, CA 94104

Project Team

Energy and Environmental Economics (E3)

- Ari Gold-Parker
- Fangxing Liu
- Dan Aas
- Amber Mahone

East Bay Community Energy (EBCE)

- Allison Lopez
- Helen Mejia
- JP Ross
- Beckie Menten (now with the Building Decarbonization Coalition)

Gridworks

- Sarina Soor
- Claire Halbrook
- Matthew Tisdale

Report Updates

This document was updated on 9/27/2023 to reflect two changes:

- Figure 2: “Synergi Gas” was replaced with “hydraulic model” to reflect a more general framework rather than describing the specific tool used by PG&E.
- Table 4: Some characteristics of sites I and J had been mistakenly switched and were corrected.

This document was updated on 1/22/2024 to reflect the following changes:

- Table 7 and Table 9: gas main miles in EBCE territory corrected to 4,108 (was previously 4,300) and PG&E total gas main miles corrected to 43,385 (was previously 45,555)
- Share of “Highest Risk” (Table 7) and customer density (Table 9) were adjusted correspondingly

Acknowledgements

Pacific Gas and Electric Company (PG&E). PG&E has been a valuable project partner throughout this work, providing key gas system data, engineering analysis, and staff expertise to support this project. PG&E staff involved in this project include:

- Rachel Kuykendall
- Rick Brown
- Ben Brown
- Zohair Rizvi
- David Sawaya

Technical Advisory Committee (TAC). Gridworks has assembled a team of technical advisors to provide input on the project and has facilitated five TAC meetings to date. Our advisory committee members are:

- Merrian Borgeson (Natural Resources Defense Council)
- Kiki Velez (Natural Resources Defense Council)
- Michael Colvin (Environmental Defense Fund)
- Ari Eisenstadt (California Environmental Justice Alliance)
- Billi Romain (City of Berkeley)
- Wade Stano (formerly The Greenlining Institute, now with Marin Community Energy)
- Michael Wara (Stanford University)
- Larry Waters (Electrify My Home)

We thank the TAC for their active engagement and input to date.

Policy Advisory Committee (PAC). In addition to the TAC, the following agency staff have provided input on key project questions.

<u>California Energy Commission (CEC)</u>

- Qing Tian (CEC Agreement Manager)
- Reta Ortiz
- Liz Gill
- Le-Quyen Nguyen
- Ken Rider
- Martine Schmidt-Poolman
- Jonah Steinbuck
- Terra Weeks

<u>California Public Utilities Commission (CPUC)</u>

- Kristina Abadjian
- Eileen Hlavka
- Abhilasha Wadhwa

We thank the PAC for the feedback they have provided.

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Acronym Definitions

Acronym	Definition
AEP	(PG&E) Alternative Energy Program
BCA	Benefit Cost Analysis
BTM	Behind-The-Meter
CARB	California Air Resources Board
CARE	California Alternate Rates for Energy
CBO	Community-Based Organization
CCA	Community Choice Aggregator
CEC	California Energy Commission
CPUC	California Public Utilities Commission
DAC	Disadvantaged Community
DIMP	Distribution Integrity Management Program
E3	Energy and Environmental Economics
EBCE	East Bay Community Energy
GIS	Geographic Information System
GHG	Greenhouse Gas
GRC	General Rate Case
HIS	Hydraulically Independent System
ICA	Integration Capacity Analysis
MF	Multi-Family
NDA	Non-Disclosure Agreement
PG&E	Pacific Gas & Electric Company
RFP	Request For Proposals
SF	Single-Family
TAC	Technical Advisory Committee

Executive Summary

Electrification of homes and businesses is an essential component of California's plan to achieve net zero greenhouse gas emissions. However, building electrification will significantly challenge the funding and cost recovery mechanisms for California's gas distribution system. Policymakers and regulators in California are beginning to think strategically about how to pursue a managed transition for the gas system amidst declining gas usage driven by electrification. This managed transition will need to include strategies for reducing gas system spending and for managing rates for gas customers who have not or cannot make the switch to electric building equipment.

This project is funded by a California Energy Commission (CEC) research grant and aims to address the question: *How can targeted building electrification paired with tactical gas decommissioning provide net gas system savings while promoting equity and meeting the needs of local communities?*[1] This research grant does not include funding to implement gas decommissioning projects. After the completion of this research phase, the project team intends to apply for funding to support a separate implementation phase for one or more pilot projects.

Progress and Lessons Learned to Date

Progress

The project team has completed the development of a site selection framework for targeted building electrification and gas decommissioning projects, has applied the framework to East Bay Community Energy's service territory, and has conducted outreach to community members to inform the development of deployment plans for three pilot projects.

The proposed Site Selection Framework includes three key steps:

1. **Candidate Screen:** This step involves identifying candidate sites where a utility could feasibly avoid a gas pipeline repair or replacement project through gas decommissioning.
2. **Engineering Review:** This step assesses the feasibility of decommissioning a portion of the gas system without stranding customers outside of the project's footprint or adversely affecting reliability for remaining gas customers.
3. **Site Prioritization:** The final step in the proposed selection framework entails using more detailed site-specific information to prioritize sites.

[1] Decommissioning a portion of the gas system may involve full or partial removal of the existing system, or the purging and abandonment of that system in place, depending upon legal requirements and other considerations by the utility.

After applying the Site Selection Framework in East Bay Community Energy's service territory, the project team ultimately selected the following three proposed pilot locations:

- **East Oakland site**: Urban Single-Family; Disadvantaged Community (DAC); 70 gas meters
- **Oakland-Allendale site**: Mixed building types (single-family, multi-family, and non-residential); 110 gas meters
- **San Leandro site**: Suburban Single Family; Disadvantaged Community (DAC); 190 gas meters

Community engagement is key to successful planning and implementation of gas decommissioning projects. The project team initially planned a hyper-local approach to community engagement that would be led by local Community-Based Organizations (CBOs). However, despite having funding available to support CBO engagement, we were unable to identify CBOs who were able and willing to provide community outreach and engagement services for this research grant. As a result, the project team developed a revised community engagement strategy that includes public town hall events, tabling at community events, and focus groups led by an expert in community engagement on environmental justice topics, as well as extensive outreach to local community-based organizations and compensated interviews with a number of these groups.

Lessons Learned and Recommendations

The project team has gained key insights over the course of developing the site selection framework and engaging with communities. These preliminary learnings will be further refined as the project team continues our work. In summary, we have found that implementing targeted building electrification and gas decommissioning at a scale that supports California's GHG reduction goals and helps keep gas rates affordable would require a number of policy and regulatory changes. This report includes recommendations for steps that utilities, regulators, state agencies, and the legislature can take to bring about those needed changes.

Table 1 describes recommended policy and regulatory changes across several areas by illustrating the current paradigm, a potential future paradigm, and actions needed. Actions are tentatively ascribed to specific regulatory bodies or to legislators. This table is repeated in the section **Lessons Learned**, which includes more details on each of these recommendations.

Table 1: Current paradigm, potential long-term paradigm, and actions needed to support the viability of gas decommissioning

	Current Paradigm	Potential Long-term Paradigm	Action Needed
Gas System Data	• Planning tools with gas pipeline-level data are not widely available • Data confidentiality concerns regarding pipeline risk limit use of key data • Hydraulic feasibility requires manual review • Technical complexity limits stakeholder involvement	• Standardized pipeline-level data and models developed • Confidentiality issues addressed • Heuristics available to support screening for hydraulic feasibility • User-friendly tools and processes support stakeholder involvement	• Evaluate concerns regarding making pipeline risk data publicly available (CPUC) • Support development of new tools for gas planning (CPUC, CEC)
Planning Horizon	• Gas capital projects are planned on a 3-year timeline, inadequate to plan and execute gas decommissioning projects • Very large projects require 10-year planning under new "General Order"	• Longer-term planning horizon for all capital projects • Broader strategic long-term planning for gas customers and utilities aligned with California's climate targets	• Develop process for longer-term planning of gas & electric system, considering both large and small projects (CPUC) • Develop long-term vision for California's gas system (CARB + CPUC)
Obligation to Serve	• Current obligation to serve requires 100% customer opt-in, severely limiting gas decommissioning opportunities	• Neighborhoods could be removed from gas service given sufficient advance notice and financial support for electrification	• Electricity could be identified as an acceptable substitute fuel (legislation) • Clear policies for advance notice and financial support needed for gas decommissioning (CPUC)
Community Engagement	• Utilities and local government may not be trusted parties • Local organizations have little awareness of gas decommissioning topics and limited capacity to engage on these issues	• Long-term investments in community engagement could support long-term relationships and staffing for local groups	• Recommendations/actions still under development
Project Funding	• Significant funding needed • Gas system avoided costs may be repurposed to fund electrification, but then would not mitigate gas rate pressures	• Other funding sources made available to support electrification • Gas system avoided costs largely used to mitigate gas rate pressures	• State-funded subsidies (legislation) • Clear guidelines for gas and electric ratepayer funding of gas decommissioning projects (CPUC)
Cost-Effectiveness Metrics	• Cost-effectiveness tests have not yet been established for gas decommissioning • Cost-effectiveness may be better in less dense regions of gas distribution system	• Cost-effectiveness may improve due to changes such as high GHG costs, zero-emissions appliance standards, and others	• Standardized BCA methodology (CPUC)

Introduction

This interim report documents progress and lessons learned to date in the California Energy Commission (CEC)-funded research project "Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Natural Gas Infrastructure in Northern California."

Background

Achieving California's climate goals will require decarbonization of all sectors of the economy. Prior research for the CEC indicates that building electrification is likely to be the lowest cost and lowest risk option for decarbonizing much of California's building sector.[2] Although crucial for achieving California's climate goals, widespread building electrification will significantly challenge the funding and cost recovery mechanisms for California's gas distribution systems.

As homes and buildings depart the gas system, the fixed costs of the gas system will be spread across fewer customers and lower overall gas sales. As a result, remaining customers could face significant increases in their gas rates. Low-income homeowners, who cannot afford electric alternatives, and renters, who cannot elect these alternatives, are particularly vulnerable to these potential gas rate increases. Rate increases may be further compounded by escalation in gas infrastructure costs that exceeds inflation, and/or by growing commodity costs as lower-emitting fuels like biogas and green hydrogen are introduced into the pipeline fuel blend.

Given these challenges, a deliberate "managed transition" will be needed to reduce future gas system spending and manage gas rates for customers. Multiple mitigation strategies will likely be required. Prior work for the Energy Commission has indicated that targeted building electrification coupled with strategic gas system decommissioning could be one approach to help reduce gas system costs and mitigate cost impacts for remaining gas customers.[2]

Project Overview

This project's primary objective is to address the following question: *How can targeted electrification paired with tactical gas decommissioning provide net gas system savings, while promoting equity and meeting the needs of local communities?*

The project team for this endeavor includes Energy and Environmental Economics (E3), East Bay Community Energy (EBCE), Gridworks, and Environmental / Justice Solutions (E/J Solutions). Pacific Gas and Electric Company (PG&E) is assisting the team with technical insights into their gas and electric systems.

This project is divided into four primary tasks, with the following goals for each task:

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[2] https://www.energy.ca.gov/sites/default/files/2021-06/CEC-500-2019-055-F.pdf

1. **Site selection framework**: Develop a replicable framework to identify specific locations where targeted building electrification, combined with tactical gas decommissioning, could support gas system cost savings. Using that framework, propose three sites within EBCE's service territory for gas decommissioning pilot projects, including at least one within a disadvantaged community.
2. **Community engagement**: Engage local communities in sharing their perspectives and priorities related to targeted building electrification and tactical gas decommissioning. This will inform each pilot site's Deployment Plan.
3. **Deployment plans**: Produce Deployment Plans for the recommended pilot sites, taking into account feedback received through community and stakeholder engagement.
4. **Education and outreach**: Conduct education and outreach to stakeholders and policymakers within and beyond California to inform and motivate action regarding the projects' final deliverables, lessons learned, and recommendations for next steps.

Note that this research grant does not include funding to implement gas decommissioning projects. After the completion of this research phase, the project team intends to apply for funding to support a separate implementation phase for one or more of the pilot projects. Funding for implementation could come from state programs such as the CEC's equitable building decarbonization program.[3]

[3] https://www.energy.ca.gov/programs-and-topics/programs/equitable-building-decarbonization-program

Project Context

Current Paradigm vs. Long-term Paradigm

Today, PG&E's Alternative Energy Program (AEP) uses electrification or other measures to avoid large capital investments or operational costs associated with the gas system. Through this program, PG&E has reached agreement with 105 gas customers to discontinue gas service. These projects have focused mainly on the higher-pressure gas transmission system and on reducing costs associated with gas transmission and gas pressure regulators. The number of gas customers in these projects has been small, *i.e.*, less than 5 customers at a time. These projects have resulted in avoiding the rebuild of 88 gas regulator stations and 4.4 miles of distribution main, and in the retirement of 22 miles of transmission pipeline.[4] While PG&E is making strides in exploring projects that reduce gas system expenditure, to date, these efforts have been small relative to the scale of the gas system and the scale that may ultimately be needed to achieve significant cost savings for ratepayers.

For this study, the project team decided to focus on tactical decommissioning opportunities on PG&E's lower-pressure gas *distribution* system. This choice was made for two reasons:

+ **Potential for scale:** Most retail customers are connected to the distribution system, so most of the potential for targeted decommissioning is likely to be on the distribution system.
+ **Potential for mitigating cost impacts:** Anticipated cost challenges for gas customers associated with widespread building electrification largely concern cost recovery for the gas distribution system.

Regarding the size of decommissioning pilots for this project, the project team has decided to situate our project between the status quo of very small projects (less than 5 customers) and a future decommissioning paradigm with much larger projects (hundreds or thousands of customers) that would require significant policy changes to achieve. Pursuing large, complex pilots before a policy and regulatory framework for gas decommissioning is in place and before outstanding questions are addressed would likely compromise the success of these pilots. Even at the scale of 50 – 200 customers, the success of the proposed gas decommission pilots is not guaranteed. Figure 1 illustrates the paradigm shift that may be required to achieve gas system decommissioning at scale. This project will serve as a bridge and opportunity to learn how gas decommissioning can be scaled up in the near term as we set the stage for much larger decommissioning projects that may ultimately be needed in the long term.

[4] https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M502/K757/502757091.PDF

Figure 1: Paradigm shift needed to enable gas system decommissioning at scale

Pilots to be explored through this project → Major regulatory changes regarding obligation to serve and electric-gas cost and incentive sharing →

	Current paradigm	Potential near-term paradigm	Potential long-term paradigm
Time to capital project	1-3 years	3-10 years	3-30 years
Gas system pressure	Mainly transmission	Mainly distribution	Distribution and some transmission
Location on system	Terminal branch	Terminal branch or small part of network	Large portion of HIS or full HIS*
Number of building owners	1-5, primarily residential	1-100	1-1000s
Funding sources	Near-term avoided costs, financing, other funds	Incentives (IRA, CCA, utility programs), bridge funding	Long-term gas system avoided costs, customer $
Priority criteria for site selection	Immediate gas system avoided costs, few customers	Feasibility, long-term avoided costs, community champion	Long-term avoided costs, equity

*Hydraulically Independent System

Key Data Sources

This section describes the primary data sources used to support analytics for this project.

- **PG&E Public Gas Data (CPUC R. 20-01-007)**. A significant amount of gas system data has been made public as part of the CPUC's Long-Term Gas Planning proceeding (R. 20-01-007).[5] This includes census tract-level data regarding gas customers and gas system equipment as well as $/mile estimates of gas main replacement costs. Census tracts range in size and average about 4,000 residents per tract. While census tract-level data are useful for project framing and comparing among regions, they are not sufficient for identifying specific project sites for gas system decommissioning. Identifying sites for gas decommissioning requires pipeline segment-level data that enables evaluation of which customers would be electrified and which specific pipeline segments would be decommissioned as part of a project.
- **PG&E Gas Asset Analysis Tool (GIS-based).** PG&E has developed a gas system planning and analysis tool based in GIS (Geographic Information System). The Gas Asset Analysis Tool is a map of PG&E's service territory that includes data on individual gas pipeline segments and individual gas meters. PG&E maintains an internal version of the tool that includes confidential data, for example related to customer usage. PG&E can also create external-facing versions of the tool that include only specific data elements, and PG&E has produced a number of these for sharing with external partners such as municipalities. A version of the Gas Asset Analysis Tool was made available to E3 via a web application for use in the project. Because some confidential data is

[5] See "Data" section, https://www.cpuc.ca.gov/industries-and-topics/natural-gas/long-term-gas-planning-rulemaking

accessible in this version of the tool, E3 signed a non-disclosure agreement (NDA) with PG&E in order to access the tool.

- **Synergi Gas.** Synergi Gas is a gas system hydraulic modeling and simulation program developed by DNV.[6] PG&E maintains separate Synergi Gas models for different parts of the gas system. These models are used to perform engineering analysis on the impacts associated with physical changes to the gas system, such as gas system decommissioning.

In addition, two other data sources are currently being used to support cost-effectiveness analysis of individual candidate sites for gas decommissioning. This process is ongoing and results will be included in future materials. These data sources are:

- **Gas and electric customer usage data.** EBCE has provided historical gas and electric usage data for customers located in candidate sites identified by the project team. These data are provided to EBCE by PG&E in standardized formats. Customer data are confidential and were provided under NDA, and the project team will ensure that analyses of customer data adhere to confidentiality rules.
- **California 2019 Residential Appliance Saturation Survey (RASS).** The RASS is a study of residential sector energy use in California performed in 2019 by DNV on behalf on the CEC.[7] The RASS contains information on energy usage and appliance saturation for different types of residential customers in California.

Comparing EBCE's Service Territory to the Broader PG&E Gas Service Territory

This project is focused on the intersection of PG&E's gas service territory and EBCE's retail electric service territory. EBCE (East Bay Community Energy) is a community choice aggregator (CCA) based in the East Bay region of the San Francisco Bay Area. CCAs like EBCE are not-for-profit public agencies that provide retail electric service, and EBCE serves customers in 14 municipalities in Alameda and San Joaquin Counties as well as unincorporated Alameda County.[8] PG&E is the gas utility in EBCE's service territory and provides gas service to many EBCE customers. However, PG&E's full gas service territory is much larger and covers much of Northern California.

The public gas data from the CPUC's Long-term Gas Planning Proceeding and PG&E's Gas Asset Analysis Tool provide a wealth of geographic data about PG&E's gas system. These data enable a comparison between PG&E's full gas service territory and the smaller EBCE/PG&E territory that this project is focused on. This comparison offers a sense of how indicative the results of this project may be for Northern California more broadly. Detailed tables comparing the attributes of PG&E's broader gas service territory with the segment of its system that overlaps with EBCE's electric service area are included in **Appendix A.1.**

One interesting finding is that the smaller EBCE territory and the broader PG&E gas service territory have a similar share of mains categorized as "highest risk" (4.4% and 4.8%). However, under a related metric,

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[6] https://www.dnv.com/services/hydraulic-modelling-and-simulation-software-synergi-gas-3894
[7] https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study
[8] https://ebce.org/about/

High "DIMP" operational risk score, the EBCE territory has nearly double the share of miles as PG&E's broader gas territory (2.5% vs. 1.3%). Finally, EBCE has more than double the share of Aldyl-A pipe as the broader PG&E gas territory (22.2% vs. 10.4%), which is a material that has been targeted for near-term replacement.

These findings indicate that there may be a relatively high concentration of gas pipeline replacement projects in EBCE's territory, which may also mean a greater concentration of candidate sites for gas decommissioning. However, more clarity is needed on why the "highest risk" metric does not reflect a similar finding.

The overall pace of asset replacement can be estimated based on depreciation studies that evaluate the lifetime of capital assets. In the settlement agreement for PG&E's 2020 General Rate Case Phase I, gas distribution mains were determined to have an average service life of 57 years.[9] At face value, this indicates that ~18% of gas mains would be replaced over a ten-year period, although, based on conversations with PG&E, the actual replacement rate is much slower. The service life sets a potential upper bound for the share of capital investments that could be avoided through gas decommissioning. At face value, the 57-year service life indicates that only 35% of gas mains would be scheduled for replacement in the 20-year period from 2025-2045.

The other 65% of mains would not reflect opportunities to avoid capital expenses over this time period. However, that does not necessarily mean they should not be considered for decommissioning projects, as there may be opportunities to reduce operations and maintenance (O&M) costs and/or to implement larger decommissioning projects that include some at least some mains that are scheduled for replacement.

Finally, **Appendix A.1.** examines the total number of gas customers per mile of gas main. As described later in this report, customer density (*i.e.*, the number of customers per mile of gas main) may be a potentially important driver of cost-effectiveness for gas decommissioning projects, with less dense projects seeing better cost-effectiveness. While these numbers are averages over broad regions, they indicate that EBCE's service territory is considerably denser than PG&E's broader gas service territory, which may have significant impacts on the cost-effectiveness of gas decommissioning projects in EBCE's territory.

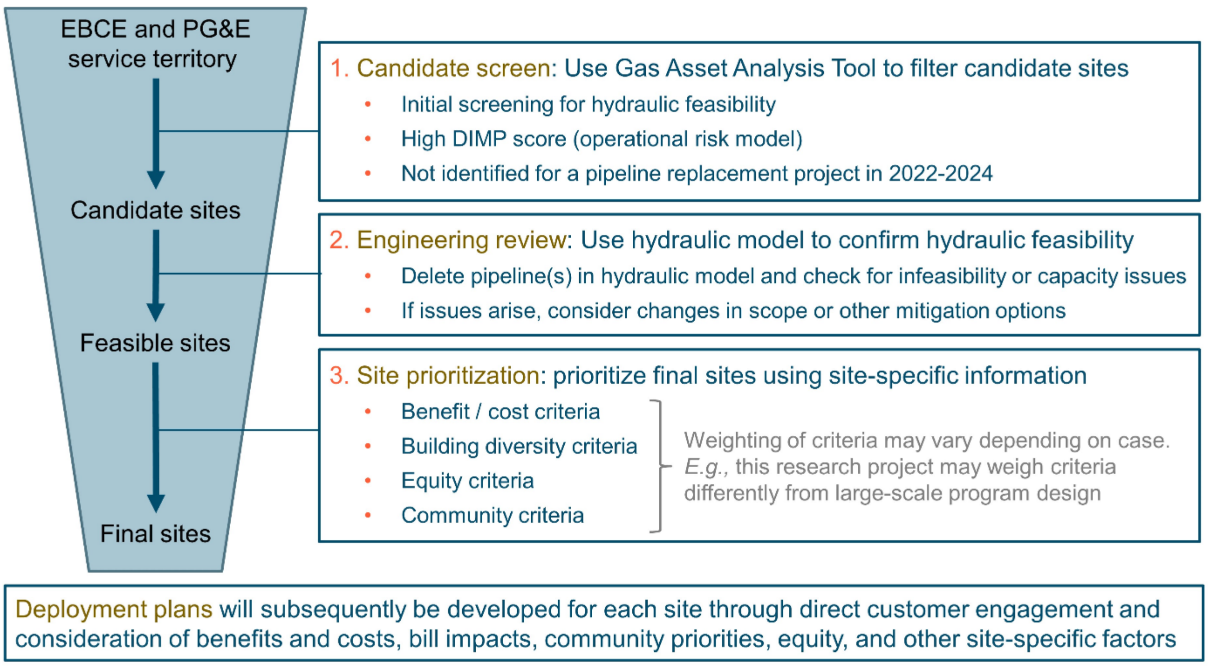
[9] See p142, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M324/K449/324449702.PDF

Proposed Site Selection Framework

The concept of targeted building electrification and gas decommissioning requires that the approach be geographically targeted. Thus, implementing this strategy first requires identifying locations where it would potentially be beneficial. The project team developed a framework for identifying and prioritizing sites for targeted electrification and tactical gas decommissioning projects within PG&E's gas distribution system. This framework has subsequently been applied to evaluate the shared service territory of PG&E and EBCE and to identify three proposed pilot sites for which deployment plans will be developed.

Figure 2 shows the proposed three-step framework for identifying sites for targeted building electrification and gas decommissioning projects. Each step is described in detail below.

Figure 2: Draft framework for identifying candidate sites for targeted building electrification and gas decommissioning



Step 1: Candidate Screen

The first step of the proposed pilot selection framework involves identifying candidate sites where a utility could feasibly avoid a gas pipeline replacement project through gas decommissioning. This screen includes three components, which are explained in greater detail below. This screen was implemented using PG&E's GIS-based Gas Asset Analysis Tool. The application of this screen to EBCE's service territory is described below in the section **Results: Applying the Site Selection Framework**.

a. Hydraulic Feasibility

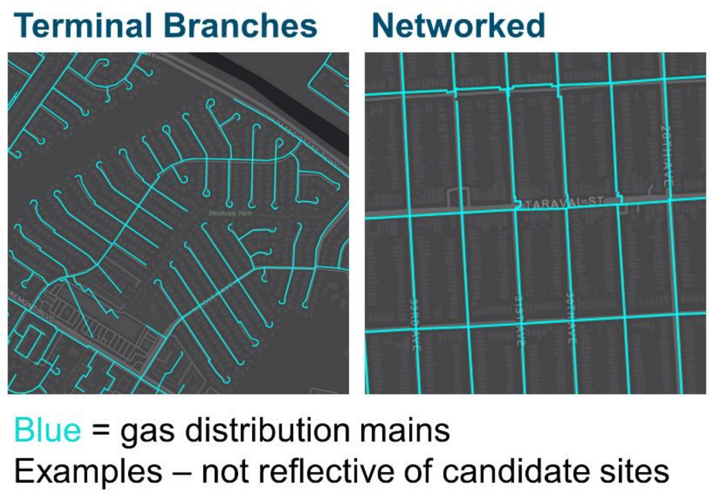
In a gas decommissioning project, PG&E must be able to remove the targeted gas pipelines from service without impacting gas system safety and reliability. Decommissioning projects that can be implemented without negative impacts on the gas system are described as “hydraulically feasible” for decommissioning. The hydraulic feasibility of a given project cannot be conclusively determined until PG&E completes a gas engineering review of the proposed site. However, based on prior experience evaluating hydraulic feasibility of decommissioning for different pipeline segments, PG&E has recognized that “terminal branches” of the system are extremely likely to be hydraulically feasible, *i.e.*, sites that lie at the end of radial portions of the distribution system and have no downstream customers. To provide PG&E with a relatively small number of potential locations to review, the project team preferentially selected for “terminal branches” of the gas distribution system. As detailed in **Appendix A.1.** , initial analysis indicates that approximately 20% of pipeline miles in PG&E’s gas service territory are on terminal branches, with a slightly lower percentage in EBCE’s territory (18%).

Working inward from the end of a radial portion of the system, “terminal branches” of different sizes can be identified. At large enough scale, entire neighborhoods could be considered “terminal branches” if they are hydraulically independent from other parts of the distribution system, meaning those neighborhoods may connect to gas transmission but not directly connect to one another. For the purposes of this project, sites of up to a few hundred customers were identified, with the potential to narrow the site to fewer customers in a future step.

Through application of the initial “terminal branches” screening step, the project team observed that no sites with non-residential buildings passed the candidate screen. This finding is somewhat intuitive, as non-residential customers are relatively more likely to be located in downtown cores or along major arteries rather than in dead-end streets or cul-de-sacs, which may be the radial ends of the gas distribution system. More research will be needed, for example in PG&E’s Gas Asset Analysis Tool, in order to understand whether selecting for terminal branches would predominantly reflect residential buildings across the rest of PG&E’s service territory.

The project team had a goal of evaluating a diverse mix of buildings for potential gas decommissioning pilots, including some sites with non-residential buildings. Thus, the project team subsequently relaxed our approach and advanced sites in “networked” portions of the system that include non-residential buildings. A “networked” site is defined here as a site that appears to have multiple paths to the rest of the distribution system. Decommissioning may be feasible in networked sites without stranding downstream customers, although engineering review may raise other issues. Figure 3 provides examples of terminal branches and networked portions of the gas distribution system.

Figure 3: Examples of terminal branches and networked portions of the gas distribution system



b. High Pipeline Risk (DIMP Score)

The second part of the candidate screen involved identifying pipeline segments with a high likelihood of near-term capital projects, as these would likely provide the greatest opportunity to avoid investment in gas infrastructure and generate gas system cost savings. Based on estimated timelines to execute full electrification of a pilot site, the project team intended to target pipeline segments that would need to be replaced in approximately the next ten years. However, PG&E does not currently plan pipeline replacement projects beyond the 3-year General Rate Case (GRC) cycle.[10] Thus, there are not perfect data available to evaluate which pipeline segments may need replacement beyond the immediate near-term.

For this project, the team has used a PG&E-developed GIS data layer that identifies pipeline segments with high scores in the DIMP (Distribution Integrity Management Program) operational risk model. As PG&E explained in comments in the CPUC's long-term gas planning proceeding R.20-01-007, "PG&E uses the DIMP operational risk model to evaluate all distribution pipe and to identify the highest priority pipe for decommissioning consideration."[11] The DIMP model reflects characteristics including pipeline age, pipeline material, previous leak detection surveys, and other factors.[12]

The "High DIMP score" data layer represents a very small part of the gas system and thus may be a very conservative screen for our interests; i.e., it may reflect only a portion of the pipelines that would be replaced in the next 10 years. As shown in Table 7, this category only reflects 1.3% of gas distribution main miles across the service territory and 2.5% of gas distribution main miles in EBCE's territory.

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[10] PG&E and Sempra recently proposed extending the CRG cycle to every four years.

[11] https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M503/K824/503824397.PDF

[12] https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/natural-gas/long-term-gas-planning-oir/pge/riskmethodsphmsagasdistdatapgne.pdf

For the purposes of this project, the project team was able to identify a set of candidate sites using the existing data layer in the GIS tool. However, a key finding from this analysis is that the site selection framework would benefit from data layers that indicate likely capital projects over a 10-year period. In the near term, this could be based on modeling or forecasting of which pipeline segments may be replaced over the next decade, for example based on the DIMP model or similar risk models. In the longer term, project planning processes could be updated such that gas capital projects are identified and planned over a 10-year or longer period.

c. Not Identified for a Gas Pipeline Replacement Project in 2022-2024

PG&E has already planned a number of pipeline replacement projects through 2026, corresponding to the three-year planning cycle and the 2020 and 2023 GRCs. The project team recognizes that achieving full electrification of a pilot site will potentially take multiple years. For this reason, the proposed selection framework *excludes* sites where the pipelines are likely to be replaced *before* a gas decommissioning alternative project could proceed. A number of candidate sites from the prior screening step were found to have pipeline replacement projects planned in the next few years, and these sites were removed in this step. Because gas main replacement is often driven by safety considerations, PG&E may be unable to postpone a replacement project proposed for the next few years.

Step 2: Engineering Review

This step assesses the feasibility of decommissioning a portion of pipe without stranding customers outside of the project's footprint or having a negative impact on reliability for remaining customers. As described above, PG&E gas engineers use DNV's Synergi Gas model for engineering analysis of the gas distribution system. This tool is also used to evaluate hydraulic feasibility of specific pipeline segments for gas decommissioning. The project team interviewed PG&E gas planning experts to learn how the Synergi Gas model is used in the context of gas decommissioning.

Gas engineers reviewing a site for gas decommissioning perform the following steps:

1. The pipelines under consideration for decommissioning are deleted in the Synergi Gas model
2. The Synergi Gas model is re-run
3. Engineers check for two concerns:
    (A) Infeasibility (*i.e.,* stranded customers outside of the decommissioning project) or
    (B) Capacity issues (*i.e.,* pipelines falling below minimum pressure ratings)

If neither (A) nor (B) occurs, the project is considered hydraulically feasible. If (A) or (B) occurs, two approaches may be taken. The first approach is that the decommissioning scope may be changed, meaning that more or less gas pipeline segments (and customers) would be included in the proposed gas decommissioning project. For example, if a proposed project would lead to infeasibility due to stranding some customers downstream, the project could be expanded to include those customers and may then be feasible. The second approach is that mitigation strategies could be considered. In general, this reflects the installation of new infrastructure to maintain system capacity, such as new gas mains and/or new pressure regulators.

PG&E gas engineers indicated that running the Synergi Gas model to evaluate a potential decommissioning project for hydraulic feasibility generally takes only a few minutes. However, if mitigation strategies are needed, developing and testing those strategies in the model can take considerably longer.

An example case study of gas engineering review is provided below in the section **Results: Applying the Site Selection Framework**.

Step 3: Site Prioritization

The final step in the proposed selection framework entails using more detailed site-specific information to prioritize three sites for the development of deployment plans. Given unlimited funding and planning capacity, it is possible that all of the sites that reach this step should be pursued. However, the project team recognizes that budgets and planning capacity for gas decommissioning projects are likely to be limited, at least in the near-term. Thus, the need for formal processes to prioritize projects will likely remain for the near future.

For site prioritization, the project team initially considered four categories of criteria:

1. **Benefit/cost criteria**: gas system avoided costs and electric distribution system costs
2. **Building diversity criteria:** diverse building types (e.g., single-family homes, multi-family dwellings, and non-residential buildings)
3. **Equity criteria:** location in a disadvantaged community (DAC)
4. **Community criteria:** community priorities, presence of community champion(s), local government feedback

Based on preliminary findings, the project team ultimately chose to limit the final selection criteria to numbers 2-4 for this research project. More details on each category, and the rationale for excluding category 1, are described below in the section **Results: Applying the Site Selection Framework**.

Results: Applying the Site Selection Framework

Results of Step 1 – Candidate Screen

Table 2 describes the results of applying Step 1 of the pilot selection framework. Step 1 is the candidate screen and is described in detailed in the above section **Proposed Site Selection Framework**.

In applying the candidate screen, the project team first filtered sites for a) hydraulic feasibility and b) high likelihood of a near-term capital project, resulting in the "Initial Candidate Sites" shown in Column 1 below. Using these criteria, no non-residential sites emerged as potential candidates. This finding was inconsistent with the project team's goal of evaluating a diverse mix of buildings for potential gas decommissioning pilots, including some sites with non-residential buildings. To address this conflict, the project team relaxed the screening for hydraulic feasibility from only considering "terminal branches" to also include "networked" segments of the system with non-residential buildings. This adjustment resulted in the "Updated Candidate Sites" shown in Column 2. Finally, sites with a planned pipeline replacement project in the next few years were excluded, resulting in the "Final Candidate Sites" shown in Column 3. Columns 4 and 5 provide additional details about the sites listed in Column 2.

Table 2: Results of Step 1 - Candidate Screen

City	1 **Initial candidate sites** *Terminal branch + high DIMP operational risk score*	2 **Updated candidate sites** *Also includes "networked" non-residential sites with high DIMP score*	3 **Final Candidate Sites** *Excludes sites where a pipeline replacement project is planned through 2026*	4 **Building Types**	5 **Buildings per Site**
Oakland	8	12	**11**	SF, MF, Non-Res	5-300
San Leandro	2	2	**2**	SF	5-200
Hayward	2	2	**1**	SF	5-100
Berkeley	2	2	1	SF, MF	≤5
Union City	2	2	-	SF, MF	10-400
Tracy	2	2	-	SF, Mobile Home	10-200
Livermore	1	1	1	SF	≤5
Fremont	1	1	-	SF, Non-res	10-20

Green sites progressed to PG&E engineering review.
No candidate sites were identified in Albany, Dublin, Newark, Piedmont, Pleasanton, or unincorporated Alameda County.

After application of the candidate screen to communities in EBCE and PG&E's shared service territory, 16 candidate sites emerged as suitable for further consideration (Column 3). The list of eligible sites is relatively small, constrained by the overlap between hydraulic feasibility, likelihood of near-term infrastructure replacement, and a lack of pipeline replacement projects planned for 2022-24. As described in the section **Proposed Site Selection Framework**, the DIMP data layer used to reflect capital project likelihood is likely very conservative in that it reflects a very small portion of the gas system. This is a probable explanation for why so few candidate sites were identified. If the project team had foresight of all gas system projects that would be planned over the next 10 years, the number of candidate sites may be considerably larger.

The project team hesitated to advance sites with fewer than 5 customers. As mentioned in the project context, the majority of PG&E's historical decommissioning projects have been under 5 customers. Focusing on projects with more buildings will allow the team to identify pilots that may be more representative of future, larger-scale decommissioning projects. For this reason, the project team ultimately excluded the small site in Berkeley and the small site in Livermore, which each had fewer than 5 customers.

In addition to diversity of building types, our project's Technical Advisory Committee (TAC) encouraged consideration of geographic and climate diversity in site selection. This recommendation stems from the possibility that the cost-effectiveness of building electrification may look very different in hot climates with high air conditioning demand. Communities outside of the Bay Area may also require different community engagement strategies. Tracy is the one municipality in PG&E and EBCE's shared service territory that is located outside of the Bay Area. However, the two sites initially identified in Tracy both have gas pipeline replacements planned in the near term. The project team followed up with PG&E to discuss the likelihood of delays for the proposed projects or the potential to defer the projects to allow time for development of gas decommissioning pilots. However, PG&E informed the project team that the identified projects in Tracy are likely to move forward as planned due to safety and reliability needs. For this reason, no gas decommissioning opportunities in Tracy made it through the first screening step.

Ultimately, the 14 candidate sites in Oakland, San Leandro, and Hayward were advanced to Step 2. These sites are labeled in green in column 3.

Results of Step 2 – Engineering Review

Table 3: Results of gas engineering review

		# of sites	Notes
Total	All candidate sites evaluated	14	
Viable	No changes to scope	9	
	Minor changes to scope	2	Small amounts of gas main added to or removed from scope
Not recommended	Major changes to scope needed	1	Would require decommissioning significant additional pipeline segments with low replacement likelihood
	Mitigations needed	1	Would require installing new pipelines to maintain gas capacity for surrounding areas
	Other	1	This site is on a 16" distribution "rib." Though technically feasible in this case, PG&E does not recommend decommissioning distribution ribs.

In Step 2, PG&E gas engineers reviewed the candidate sites that were the result of Step 1. Table 3 shows the results of PG&E's engineering review conducted for the 14 final candidate sites in Oakland, San Leandro, and Hayward. 11 out of the 14 sites were deemed viable with either no change to scope or minor changes in scope (*i.e.,* adding or removing small amounts of gas main from the proposed decommissioning project).

Three sites, all located in Oakland, were not recommended for gas decommissioning, each for a different reason:

- One site would require significantly expanding the decommissioning project's scope to avoid stranding some gas customers without gas service. This would entail electrifying more customers and decommissioning significant additional pipeline. However, this additional pipeline has a low likelihood of near-term replacement, making the site much less appealing in terms of overall potential for cost savings. For this reason, the site is not recommended.
- A second site was found to result in capacity shortfalls upon decommissioning. In other words, after deleting the pipeline segments in the Synergi Gas model, other areas of the gas system were modeled to fall below minimum gas pressure requirements. PG&E gas engineers determined that a significant amount of new distribution pipeline would be needed to meet capacity needs in the surrounding areas. Adding a significant amount of new pipe, with corresponding costs, runs counter to the goals of targeted gas decommissioning. For this reason, this site is not recommended.
- A third site was determined to be on a 16-inch diameter gas distribution "rib." These ribs are the largest gas mains in the distribution system and support gas reliability across a broad geographic region. PG&E engineers advised that decommissioning this distribution rib may lead to reliability challenges. While capacity describes the ability of the system to maintain minimum pressures, reliability describes the ability to provide service and avoid outages during planned system maintenance or unplanned reliability events. Even if Synergi does not show any capacity shortfalls resulting from removing the rib, the system would become much more reliant on a network of nearby smaller pipeline segments. This could result in reliability challenges in the future and may also make it difficult to decommission surrounding pipeline segments in future projects. As the ribs represent a small share of distribution pipeline miles, PG&E recommended to leave the rib in place and focus decommissioning efforts on other pipeline segments.

Ultimately, 11 of the 14 candidate sites were deemed feasible for decommissioning.

Results of Step 3 – Site Prioritization

To support site prioritization, the project team gathered data on the 11 sites that remained after application of the candidate screen and gas engineering review. The following characteristics were explored for each site:

- **Location**: general location of the site
- **DAC**: location in a disadvantaged community (DAC) based on CalEnviroScreen[13]
- **Building Types**: types of buildings in the site including Single-Family homes (SF), Multi-Family dwellings (MF), and non-residential buildings (Non-Res)
- **Non-residential buildings**: specific types of non-residential buildings
- **Number of gas meters**: the total number of gas customers included in the site, based on PG&E's Gas Asset Analysis Tool
- **Length of gas mains**: total feet of gas distribution mains that would be decommissioned in a targeted electrification and gas decommissioning project, based on PG&E's Gas Asset Analysis Tool

[13] https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40

- **Customers per mile of main:** this metric is the number of gas customers in the site divided by miles of gas main
- **Gas main avoided costs**: estimated cost of gas main replacement that would be avoided through a gas decommissioning project (see below for more details)
- **Electric distribution upgrade**: evaluation of whether electric distribution upgrades would be needed based on hosting capacity data (see below for more details)

Table 4 provides these characteristics for each of the 11 candidate sites, identified as sites A through K.

Table 4: Key characteristics of 11 candidate sites

Site Code	A	B	C	D	E	F	G	H	I	J	K
Location	West Oakland	West Oakland	East Oakland	East Oakland	Oakland - Temescal	Oakland - Allendale	Oakland - Castlemont	Oakland - Meadow Brook	San Leandro	San Leandro	Hayward
DAC?	Yes	Yes	Yes	Yes					Yes		
Building Types	SF, MF, Non-Res	SF, MF	SF	SF, MF, Non-Res	SF, MF, Non-Res	SF, MF, Non-Res	SF, MF, Non-Res	SF, MF	SF	SF	SF
Non-Res Buildings	2 Churches, 1 Store			Senior Center	Co-working, office; Priv. School	2 Restaurants, 2 Stores	Public School				
Gas Meters	40	65	69	337	80	106	288	90	187	175	96
Length of Gas Mains (ft)	1065	1551	2108	5189	1600	2927	6234	2845	5782	6829	3822
Customers per Mile of Main	198	221	173	343	264	191	244	167	171	135	133
Max Gas Avoided Costs ($)	$0.9 M	$1.4 M	$1.9 M	$4.6 M	$1.4 M	$2.6 M	$5.6 M	$2.5 M	$5.2 M	$6.1 M	$3.4 M
Gas Avoided Costs per Customer ($)	$24 k	$21 k	$27 k	$14 k	$18 k	$25 k	$19 k	$28 k	$28 k	$35 k	$36 k
Electric Upgrade?	No	Yes	No / Unclear	Yes	No	Unclear	No / Unclear	No	Unclear	No / Unclear	No / Unclear

Under the scope of the CEC research grant, the project team will develop three pilot deployment plans for implementing targeted electrification and eventual gas decommissioning. To support prioritization of potential pilot locations, the project team initially considered four categories of criteria:

1. **Benefit/cost criteria**: gas system avoided costs and electric distribution system costs
2. **Building diversity criteria:** diverse building types (e.g., single-family homes, multi-family dwellings, and non-residential buildings)
3. **Equity criteria:** location in a disadvantaged community (DAC)
4. **Community criteria:** community priorities, presence of community champion(s)

Based on preliminary findings, the project team ultimately chose to limit the final selection criteria to criteria 2-4. This rationale is unique to the research and pilot aspects of this project and is explained in further detail below.

Benefit/Cost Criteria

At present, there are not clearly established cost-effectiveness tests to support prioritization of gas decommissioning projects. The project team is working to develop a proposed set of cost-effectiveness evaluations that will be further detailed in the pilot deployment plans.

For site prioritization, the project team initially considered specific benefit and cost criteria that may vary among project sites and could be evaluated at this stage in our research. However, as explained below, it was determined that these criteria conflicted with our goal to include disadvantaged communities in our study.

Disadvantaged communities have historically seen underinvestment. However, cost-effectiveness metrics may be at odds with the goal of prioritizing equity and investment in disadvantaged communities. For example, in these communities, it may be more expensive to bring buildings up to code to ready them for energy efficiency and electrification measures. Our findings illustrate an additional factor that may materialize when comparing gas system decommissioning projects in urban environments to those in suburban or rural communities, with potential impacts on project funding in disadvantaged communities.

The preliminary cost criteria considered for prioritization were:

1. **Avoided gas main and service replacement costs**
2. **Incremental electric distribution system costs**

Additional benefits and costs will be considered in cost-effectiveness evaluation as part of the deployment plans as the relevant data becomes available. These additional costs and benefits may include:

- **Behind-the-meter (BTM) electrification costs (device costs, labor, panel upgrade).** Although not directly estimated here, these are likely to be the largest costs associated with electrification.
- **Incremental electric system costs (non-distribution)**
- **Costs associated with gas system decommissioning**
- **Gas commodity savings**

- **Other gas revenue requirement savings associated with avoiding capital investments** (net salvage accruals, taxes, O&M costs)
- **GHG impacts**
- **Air quality impacts**
- **Customer comfort impacts associated with the electrification project** (*e.g.*, gaining space cooling service)
- **Incremental electric revenues** (these may partially offset marginal electric system costs or could provide net electric ratepayer benefit if they exceed those costs)

Gas System Avoided Costs

Although gas system avoided costs will be explored in more detail in the deployment plans, the project team proposes not to prioritize pilot sites based on gas system avoided costs in this research project. This decision centers around one of the research goals of this project: exploring targeted electrification paired with gas system decommissioning across different types of building and communities. The project team is *not* specifically recommending that future endeavors to deploy gas decommissioning omit gas system avoided costs in project prioritization.

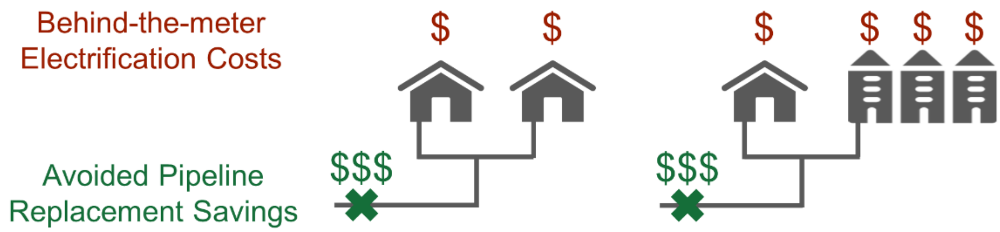
The key financial benefit associated with gas distribution system decommissioning is expected to be the avoided cost of gas main and service replacement. To calculate gas system avoided costs, the project team used PG&E's Gas Asset Analysis Tool to gather technical details on each site, including the length of gas mains to be decommissioned. The project team also utilized $/mile gas pipeline replacement cost estimates filed in the CPUC's long-term gas planning proceeding.[14] Unit costs for gas main and service replacement vary by gas planning division. In the East Bay planning division, the costs of gas main and service replacement are reported to be $4.72 million per mile of gas main.[15]

In evaluating gas system avoided costs, a key finding is that the cost-effectiveness of gas system decommissioning may be more favorable in sites with a lower customer density, *i.e.*, fewer customers per mile of gas main. This is because the primary financial benefit of gas decommissioning, avoided pipeline replacement, scales by miles of main; however, the primary cost of gas decommissioning is expected to be behind-the-meter (BTM) customer electrification costs, which scale by number of customers. Thus, while two gas decommissioning projects with the same length of gas mains may have the same gas pipeline savings, the costs of implementing a gas decommissioning project would be lower in the site with less dense development (*i.e.*, with fewer customers to electrify).

Figure 4 describes the primary financial cost and benefit of gas decommissioning for two illustrative pilot sites, one with two customers and one with four customers, but both with the same length of gas mains to be decommissioned. While both sites have the same total financial benefit (avoided gas main replacement), the less dense site would have only half of the costs (customer electrification costs).

[14] https://www.cpuc.ca.gov/industries-and-topics/natural-gas/long-term-gas-planning-rulemaking
[15] Ibid., see PG&E "Gas System Census Tract Data" csv file.

Figure 4: Illustrative costs and benefits for gas system decommissioning in two sites



	Less Dense Community	More Dense Community
Financial Costs (Behind-the-meter Electrification) Costs scale as $/customer	($$)	($$$$)
Financial Benefits (Avoided Pipeline Replacement) Benefits scale as $/mile	$$$	$$$
Financial Impact Financial Costs vs. Financial Benefits	Net Benefits	Net Costs

A more holistic framework may include other cost and benefit components such as electric system costs, cost of gas decommissioning, avoided gas commodity costs, other gas revenue requirement savings, GHG impacts, air quality impacts, comfort benefits, and others.

Note that this simple illustration does not include other components that would factor into benefit cost-analysis. However, initial calculations indicate that these two benefit/cost components are larger than other components by a significant margin. However, there may be sites or instances where this is not true. In addition, if a high $/tonne GHG cost were assumed (*e.g.*, an order of magnitude higher than cap and trade prices of ~$30/tonne), then the finding here may not hold.

Average customer density across EBCE's service territory is 129 customer per mile of main, while PG&E's broader gas service territory is less dense, with 105 customers per mile of main (Table 9). Across the 11 candidate sites identified in this project, customer density ranges from 133 to 343 gas customers per mile of gas main (Table 4). Thus, while there is a very wide range in density among the 11 candidate sites, even the least dense site has a higher customer density than the EBCE average.

The project team and our Technical Advisory Committee (TAC) reviewed the finding that gas decommissioning projects are likely to see better cost-effectiveness in less dense sites. A key goal of this project is to explore decommissioning in diverse locations and the TAC encouraged the project team not to pass on urban sites, especially in Disadvantaged Communities, based on this finding. Customers in urban DACs are at risk for being left behind in a decarbonization transition because renters and low-income customers are less likely to be able to electrify their homes.

For this reason, the project team recommends that gas system avoided costs should not be a key factor in prioritization of pilot sites as part of this research grant, where these cost criteria could lead to the de-prioritization of sites in urban disadvantaged communities. However, the finding that decommissioning projects may see better cost effectiveness in less dense parts of the gas system is a key result for planners to consider in evaluating future projects.

Policymakers and regulators generally consider other factors in addition to cost-effectiveness and may determine that equity considerations support prioritization of urban DAC communities, even if high customer density leads to relatively worse cost-effectiveness compared to suburban or rural communities. Targeted electrification and gas decommissioning investments in dense project sites may bring important benefits to local communities. However, our findings indicate these investments may result in relatively lower gas system savings than dollars invested to support gas decommissioning in less dense regions.

Electric Distribution System Costs

As noted above, the greatest cost associated with gas decommissioning is expected to be behind-the-meter customer electrification costs, including device costs, installation costs, and behind-the-meter electric panel upgrades. However, customer-level electrification cost data were not available at the pilot screening phase of this project. These data are being developed and estimates of customer-specific electrification costs will be explored in the pilot deployment plans.

To support site prioritization, the project team considered the cost of electric distribution system upgrades and where these upgrades may be driven by a gas decommissioning project. The project team utilized PG&E's Integration Capacity Analysis (ICA) data that describes available capacity for adding new loads on the electric distribution system.[16] The ICA data provide information at the levels of distribution feeder and line segment, but do not include information on which customers would require electric service upgrades to support electrification.

As part of this CEC research grant, the project team recommends that electric distribution upgrade costs should not be a key factor in prioritizing pilot sites. There are three reasons for this conclusion:

- First: In this preliminary analysis, we find that public ICA data enable the evaluation of some candidate sites but not others. ICA data reflect hosting capacity by line segment. This is adequate to evaluate whether a single electrification project on a single line segment would trigger an upgrade. However, the capacities for connected line segments are not actually independent. As a result, it is not always clear whether there is adequate capacity across multiple connected line segments to accommodate a large number of newly electrified buildings. In addition, ICA data are missing for a number of segments. Due to incomplete ICA data, only half of the project sites were conclusively evaluated regarding the need for a distribution system upgrade, as shown in Table 4 in the row "Electric Upgrade." The project team is working with PG&E to evaluate electric distribution system needs as part of the deployment plans. Other data sources could be used to support evaluation of distribution system needs in future work. These sources may include internal PG&E data or models and data that are developed as part of the CPUC's High DER Future Grid Proceeding.[17]
- Second: we find that electric distribution upgrade costs may be relatively small compared to the behind-the-meter costs of building electrification costs. PG&E's 2021 Distribution Deferral Opportunity Report provides details on 70 planned distribution investments across the Bay

[16] PG&E Integration Capacity Analysis and Distribution Investment Deferral Framework maps (pge.com)
[17] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/distribution-planning

Area. The costs of these investments vary widely, but have a mean of $2,200 per customer and median of $1,000 per customer served by these projects,[18] while BTM electrification costs are likely to be on the order of $30,000 per residential customer.[19]

- Third: it is not clear that electric distribution upgrade costs should be fully attributed to gas decommissioning projects. Sites with low headroom for new loads may require electric distribution upgrades to support electric vehicle charging or air conditioning adoption, regardless of whether significant building electrification occurs.

For these reasons, we recommend not to include electric upgrade costs in site prioritization for this project.

Selecting the Final 3 Proposed Pilot Locations

For site prioritization, the project team has focused on criteria 2-4: building diversity criteria, equity criteria, and community criteria.

Building Diversity Criteria: To support prioritization, the project team first grouped sites into three categories that reflect diverse building stock, location, and building density. The project team then proposed to advance one site from each of the three groups.

- Group 1 (Sites A-D) are located in urban DAC neighborhoods in West Oakland and East Oakland.
- Group 2 (Sites D-G) are mixed-use sites including non-residential buildings that may be difficult to electrify. Note that site D appears in two groups due to overlapping criteria.
- Group 3 (Sites I-K) are suburban single-family neighborhoods in San Leandro and Hayward. Note that site I is also in a DAC.

Equity Criteria: In choosing among the candidate sites in each group, the project team prioritized sites located in a DAC. This was also aligned with community feedback (below) and a goal of this CEC project.

Community Criteria: The project team solicited feedback from city staff involved in building electrification and other sustainability efforts, conducted compensated interviews with two Community-Based Organizations (CBOs) based in the East Bay but not in these specific communities, and had preliminary conversations with a large customer located in one of the candidate sites.

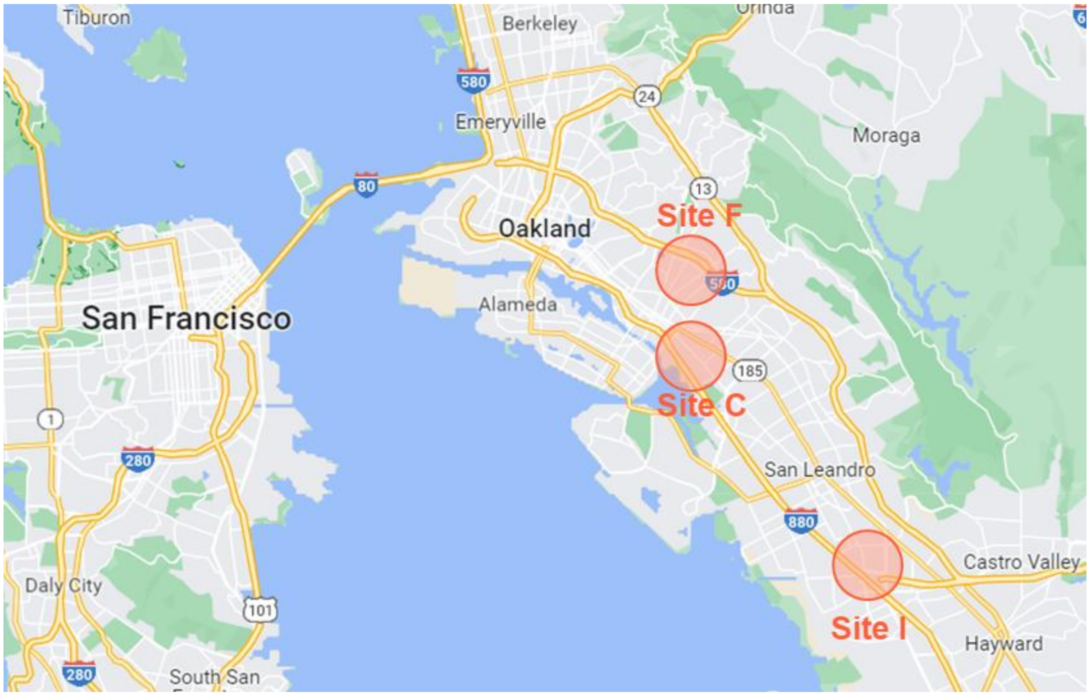
Based on all three criteria, the project team selected the following final three pilot locations for the development of deployment plans. Figure 3 indicates the approximate locations of these sites.

- Site C: East Oakland: Urban Single Family; DAC
- Site F: Oakland – Allendale: Mixed building types (single-family, multi-family, and non-residential)
- Site I: San Leandro: Suburban Single Family; DAC

[18] PG&E's 2021 Distribution Deferral Opportunity Report, available at [400593924.PDF (ca.gov)](400593924.PDF (ca.gov))

[19] https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

Figure 5: Approximate locations of three proposed pilot sites for development of deployment plans



Comparison to CPUC Staff Proposal

In December 2022, CPUC staff published the "Staff Proposal on Gas Distribution Infrastructure Decommissioning Framework in Support of Climate Goals."[20] The Staff Proposal offers a framework for prioritizing sites for gas decommissioning distinct from the framework developed in this CEC research project.

The framework developed in the CPUC Staff Proposal is based on classifying census tracts into five tranches, with the first tranche representing the highest-priority zones for decommissioning. The Staff Proposal suggests that "non-emergency repair or replacement of distribution infrastructure should be minimized unless mandated by other programs."

The project team has compared the Staff Proposal to our own proposed site selection framework and identified the following similarities and differences:

- The site identification and prioritization criteria for both proposals have significant overlap, including criteria such as: pipeline risk, equity considerations, scale of gas system avoided costs, and presence of a community champion.
- The proposals differ on where decommissioning feasibility should be included in the framework; *i.e.*, before other site prioritization considerations, or as part of a second phase of site selection.
- The proposals also differ on how costs of gas decommissioning should be included in site prioritization (in addition to benefits). The staff proposal suggests that certain components related to cost savings should be considered, but does not suggest estimating the upfront costs of electrification or considering how they would be geographically differentiated. Our project team notes that, as a simple estimate, electrification costs are likely to scale with the number of customers. Therefore, we conclude that lower site density (*i.e.,* the number of customers per mile of gas main) is likely to be correlated with better overall cost-effectiveness for gas decommissioning projects. The project team will aim to discuss this further with the CPUC team.

A more detailed comparison of the two proposals is included in the section **Appendix A.2.**

[20] https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M500/K158/500158371.PDF

Community Engagement

Community engagement will be key to successful planning and implementation of gas decommissioning projects. Under the current regulatory paradigm, utilities face an obligation to continue providing gas service to existing gas customers who want to keep their gas service. Implementing a gas decommissioning project will require 100% of potentially affected customers in a project site to agree to no longer receive gas service. The project team is currently monitoring progress of Senate Bill 527 (Min) which would reduce the required opt-in rate from 100% to two-thirds of customers in a targeted area.[21]

When projects occur in disadvantaged communities, the need for community engagement is amplified. Many disadvantaged communities are characterized by a diversity of languages and socioeconomic pressures, and frequently these locations come with a history of environmental injustices. Because of this history, disadvantaged communities may not have a high degree of trust in institutions that may lead gas decommissioning projects, such as government bodies and utilities.

Preliminary Community Engagement Plan

During the preliminary stages of this project, EBCE submitted a high-level community engagement plan to the CEC. This plan laid out a hyper-local approach to community engagement that would be led by local Community-Based Organizations (CBOs). This strategy was based on best practices EBCE developed through work with community groups on several program offerings and was further informed by feedback from our project's TAC members, environmental justice organizations, and local governments. The plan was based on the premise that local organizations would best understand the unique needs of local communities and the unique circumstances and conditions for specific pilot sites.

EBCE envisioned collaborating with local community organizations or community champions to inform their overall outreach strategy and to connect directly with the community members. The project team set aside financial resources for contracting with up to three CBO partners or community champions, seeking to ensure that local organizations were compensated for their efforts.

EBCE conducted compensated interviews with two CBOs to gather feedback on the team's initial community engagement strategy. EBCE supplemented this effort with interviews with members of the project's TAC who have experience working with local communities on environmental initiatives. Taking feedback from these interviews, the project team developed and released a public Request for Proposals (RFP) to formally engage CBOs and/or individual community organizers in supporting the project.

The project team designed an RFP that would require relatively little effort to respond and would offer interested parties a high degree of flexibility in their proposals. CBOs and local organizers could apply to support between one and three pilot locations. The scope of work in the RFP included tasks with 190 hours of projected work per pilot site taking place from January to June 2023. The primary role for CBOs or local organizers would be to help develop a site-specific community outreach strategy for the

[21] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202320240SB527

community being served, help implement that strategy, and summarize the results of outreach. In addition, the RFP offered the ability to propose modifications to the scope as needed to align with a CBO or individual's needs and capabilities.

The RFP offered up to $40,000 in funding to support each of the three pilot sites, up to $120,000 total if a single applicant proposed to support all three sites. The RFP was open for approximately one month via E3's website. EBCE promoted this solicitation by directly communicating with CBOs through meetings and email lists, reaching over 100 organizations. Additional follow-up emails highlighting the RFP and an informational webinar were shared with a smaller group of CBOs identified as potential partners.

Ultimately, no organizations attended the informational webinar and the solicitation received zero responses.

Revised Community Engagement Plan

Following the solicitation, the project team decided to pursue an alternative community engagement approach for reaching residents, drawing on lessons learned through developing the initial engagement plan and the RFP. Our revised community engagement plan follows a two-pronged approach that focuses on existing partnerships, events, and opportunities in the cities of Oakland and San Leandro. The team is now working with city government staff and an environmental justice consultant based in the region to gather feedback from community members. This new approach begins with a series of public community events and then transitions to focus groups to dive into deeper discussions.

Educational Community Events

The first part of the revised engagement plan entails partnering with city governments to host community events that provide public-facing education on building electrification. The primary intention of participating in these larger community events is to provide educational materials on building electrification, gas decommissioning, and related topics while answering community members' questions. It is also an opportunity for the project team to understand attendees' interest in implementing building electrification in their communities and homes.

In implementing the revised plan, the project team has worked closely with the City of Oakland to participate in and promote five of their Building Electrification Clinics (later renamed to Home Energy Resource Fairs) from May through early June 2023. These resource fairs were conducted at various community centers throughout Oakland, including the Better Neighborhoods Same Neighbors Resource Center, Cypress Mandela Training Center, and the West Oakland Senior Center. The community events included relevant topics across existing climate initiatives, had a variety of service providers and community organizations available to answer questions about their programs, and were an opportunity for our team to learn about community perspectives on decarbonization efforts in the area.

The project team supported these resource fairs by having an EBCE staff member at each event who provided information and answered questions about building electrification, programs available to customers, and information on this research project. In addition, the project team provided $15 gift cards to participants who took an exit survey developed by the City of Oakland after each event. The results from this survey, the broader City of Oakland's Building Electrification survey,[22] and the anecdotal feedback that EBCE staff gathered through direct conversations will all provide critical insight into the home improvement needs of the community and their perceptions and concerns about all-electric homes and buildings.

The project team also met with staff from the City of San Leandro to explore joining an existing community event to share general educational materials with the community on EBCE's energy saving and electrification programs. Based on the city staff's recommendation and calendar of events, EBCE staff hosted a table at the San Leandro Cherry Festival in June 2023 to share information, answer questions, and gather direct feedback from community members.

The project team is currently compiling key findings from our participation in these local government events. More detailed results including participant feedback will be included in future materials.

Focus Groups on All-Electric Buildings

The project team partnered with Environmental / Justice Solutions, a Bay Area-based consulting firm specializing in community engagement on environmental and environmental justice topics. E/J Solutions conducted focus groups consisting of residents and business owners from the three selected pilot sites in May 2023.

The project team worked with E/J Solutions to conduct three focus groups which saw a turnout of 45 attendees across all groups. Direct in-language outreach in the immediate area of each site was performed both digitally (email) and physically (paper flyers in neighborhood locations) to ensure that community members involved in the pilot site had an opportunity learn about the project and provide input.

The project team provided the following services and incentives to encourage participation:

- $150 gift card stipend for participation
- Translated materials and live interpretation services in several languages
- Food and beverages from local vendors
- Held outside of working hours (9am-5pm), with one event hosted on a weekend.
- Childcare services
- COVID-19 testing before entering.

The focus groups were scheduled for an hour and a half, with an additional 45 minutes before the event for COVID-19 testing and dining. The focus groups centered around a conversation about all-electric buildings and integrated many discussion questions and educational materials throughout. The focus groups explored participants' perceptions about challenges and opportunities around building electrification, specifically in the pilot locations. These conversations presented an opportunity for community members who would be directly impacted by these projects to hear each other's opinions, concerns, and needs while considering what all-electric homes and businesses mean to them. Providing a facilitated discussion at well-known community resource centers provided a safe space for residents to

[22] City of Oakland Building Electrification Survey: https://us.openforms.com/Form/4952aa67-f6a2-401f-adf3-081f6509151c

raise their concerns, ask questions, and receive information. Ultimately, these spaces provided a sense of the local community's interest in electrifying their homes or businesses and potential challenges to electrification.

The project team is currently evaluating results of the focus groups. More detailed results including outreach strategies, sample materials, and participant feedback will be included in future materials.

Lessons Learned

The project team has identified key insights over the course of developing the draft gas decommissioning site selection framework and early community engagement work. These preliminary learnings will be further refined as the project team continues its research.

In summary, we found that without structural changes across a range of areas, the strategy of targeted electrification and gas decommissioning is unlikely to achieve meaningful scale needed to reduce gas system costs. Table 5 describes how changes are needed in these areas by illustrating the current paradigm, a potential future paradigm, and actions needed. Actions are tentatively ascribed to specific regulatory bodies or to legislators. The following sections describe these findings in more detail.

Table 5: Current paradigm, potential long-term paradigm, and actions needed to support the viability of gas decommissioning

	Current Paradigm	Potential Long-term Paradigm	Action Needed
Gas System Data	• Planning tools with gas pipeline-level data are not widely available • Data confidentiality concerns regarding pipeline risk limit use of key data • Hydraulic feasibility requires manual review • Technical complexity limits stakeholder involvement	• Standardized pipeline-level data and models developed • Confidentiality issues addressed • Heuristics available to support screening for hydraulic feasibility • User-friendly tools and processes support stakeholder involvement	• Evaluate concerns regarding making pipeline risk data publicly available (CPUC) • Support development of new tools for gas planning (CPUC, CEC)
Planning Horizon	• Gas capital projects are planned on a 3-year timeline, inadequate to plan and execute gas decommissioning projects • Very large projects require 10-year planning under new "General Order"	• Longer-term planning horizon for all capital projects • Broader strategic long-term planning for gas customers and utilities aligned with California's climate targets	• Develop process for longer-term planning of gas & electric system, considering both large and small projects (CPUC) • Develop long-term vision for California's gas system (CARB + CPUC)
Obligation to Serve	• Current obligation to serve requires 100% customer opt-in, severely limiting gas decommissioning opportunities	• Neighborhoods could be removed from gas service given sufficient advance notice and financial support for electrification	• Electricity could be identified as an acceptable substitute fuel (legislation) • Clear policies for advance notice and financial support needed for gas decommissioning (CPUC)
Community Engagement	• Utilities and local government may not be trusted parties • Local organizations have little awareness of gas decommissioning topics and limited capacity to engage on these issues	• Long-term investments in community engagement could support long-term relationships and staffing for local groups	• Recommendations/actions still under development
Project Funding	• Significant funding needed • Gas system avoided costs may be repurposed to fund electrification, but then would not mitigate gas rate pressures	• Other funding sources made available to support electrification • Gas system avoided costs largely used to mitigate gas rate pressures	• State-funded subsidies (legislation) • Clear guidelines for gas and electric ratepayer funding of gas decommissioning projects (CPUC)
Cost-Effectiveness Metrics	• Cost-effectiveness tests have not yet been established for gas decommissioning • Cost-effectiveness may be better in less dense regions of gas distribution system	• Cost-effectiveness may improve due to changes such as high GHG costs, zero-emissions appliance standards, and others	• Standardized BCA methodology (CPUC)

Gas System Data

The project team had access to pipeline-level gas system data in PG&E's GIS-based Gas Asset Analysis Tool, which proved invaluable for identifying candidate sites at the level of individual gas main segments and specific gas customers. We also had the support of PG&E gas engineers using the Synergi Gas model, which was required to determine hydraulic feasibility for decommissioning.

We are grateful to have had access to these data sources and models. However, challenges remain for third parties such as local governments to identify, design, and implement pilots. These challenges were highlighted by reviewing the CPUC Staff Proposal on gas decommissioning, which does not pre-suppose that pipeline-level data would be available to support prioritization of sites for gas decommissioning.

Challenges identified include:

- **Need for planning tools.** PG&E's Gas Asset Analysis tool is GIS-based and offers a clear visualization of gas system infrastructure at the level of individual pipeline segments. Key layers in the GIS tool, such as the DIMP operational risk score, enabled the project team to conduct the initial screening and identify specific candidate sites. While we laud PG&E for having developed this useful planning tool, we note that many utilities may not have a similar tool available. The development of similar planning tools by other utilities will be a necessary step in planning gas decommissioning projects outside of PG&E's service territory. In addition, future data improvements to PG&E's tool and other tools could include a representation of electric distribution headroom and upgrade costs, longer-term forecasts of gas pipeline replacement projects, and more granular estimates of gas pipeline replacement costs.
- **Data confidentiality.** We have also identified key issues with data confidentiality, specifically regarding pipeline risk. To identify sites for gas decommissioning, it is crucial to know which pipeline segments are likely to be replaced in the near term. It is evident that the risk of leakage or failure would likely be a key metric in determining which pipeline segments are slated for pipeline replacement projects. However, there are important considerations regarding making pipeline risk data public, as customers may be upset to learn that that pipelines in their neighborhood are deemed high-risk. Concerned residents may even petition the utility to quickly replace the pipelines, eliminating the potential for a gas decommissioning project to avoid gas system costs. Utilities, regulators, and other stakeholders should consider these issues as they work to balance the need for pipeline replacement schedules to be available to support site identification for gas decommissioning against sensitivities regarding making pipeline risk data public.
- **Manual review of hydraulic feasibility**. The next issue we identified is that manual engineering review by gas utility engineers is needed to evaluate hydraulic feasibility for decommissioning. In the current process, gas engineers must open the Synergi Gas model corresponding to the area where candidate sites are located, manually remove pipes proposed to be decommissioned, and re-run the model. This process also requires close coordination between the project team and gas engineers to discuss mitigation plans if the initial scope of decommissioning is deemed infeasible. While some level of manual review may always be needed prior to implementing a gas decommissioning project, a potential improvement would

be to have a layer in the GIS-based Gas Asset Analysis Tool that reflects whether specific projects or areas are likely to be hydraulically feasible. A simple option could be to develop a robust characterization of terminal branches to use as proxy for hydraulic feasibility. A more complex option could be to evaluate thousands of potential sites in Synergi through batch processing, and then provide the feasibility results as a layer in the GIS Tool. Other strategies may be developed in the CEC's ongoing research project to develop a "Data-Driven Tool" to support gas decommissioning, led by DNV and their project partners.[23]

+ **Level of technical complexity**. Finally, even if key data are accessible, stakeholders such as local governments could face challenges interpreting all the data elements across various models. Targeted electrification and gas decommissioning is a highly complex topic and, even though our project team has a significant amount of technical experience, we have still required extensive support from PG&E throughout the process. Ultimately, user-friendly tools and well-defined procedures should be available that enable stakeholders to make informed evaluations regarding site identification and prioritization for gas decommissioning.

To address these challenges, the state could review concerns regarding data availability and make a final determination of what should be made public and what should remain confidential. The state could also work to support the development of tools for gas planning that enable the evaluation of targeted electrification and gas decommissioning. As one option, the CPUC could direct the utilities to develop such tools. Alternatively, the state could work to develop these tools, and one such process is currently underway at the CEC.[23]

Planning Horizon

The three-year timeline for planning gas infrastructure investments through the GRC is insufficient for identifying and implementing targeted building electrification and strategic gas system decommissioning projects at-scale. Two major changes to the planning process could help address this issue:

+ A longer-term planning process could be developed where gas pipeline replacement projects are identified and planned on a longer timeframe, such as 10-15 years in advance. This would provide time to evaluate alternatives, perform robust community engagement, and allow for implementation of alternatives like targeted electrification and gas decommissioning. Although the 2022 Gas Planning Order requires advance planning of very large projects, it does not change the timeframe for planning the smaller gas pipeline replacement projects that reflect the majority of utility capital projects.
+ The consideration of non-pipeline alternatives such as gas decommissioning could be required for sites where existing gas pipelines are in need of replacement or other major repair, or for the subset of these projects that would be hydraulically feasible for decommissioning. This alternatives analysis would need to be performed several years in advance to provide the time needed to implement alternatives like targeted electrification.

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[23] GFO-21-504 - Development of a Data-Driven Tool to Support Strategic and Equitable Decommissioning of Gas Infrastructure

Another key concern is that there is not yet a strategic long-term plan for gas customers and gas utilities that is aligned with California's climate targets, nor are there emissions reduction targets for the buildings sector or for gas utilities. Long-term planning and target-setting could provide helpful regulatory context to support greater advance planning for specific capital projects.

Obligation to Serve

In the current regulatory paradigm, utilities contend that 100% customer opt-in is required to decommission gas infrastructure. This requirement means that large sites with many customers may prove difficult or impossible to implement gas decommissioning and even small sites may require substantial financial incentives to achieve 100% opt-in. Any gas system decommissioning projects pursued in the next few years will need to consider ways to work within the obligation to serve. In the longer term, California will need to evolve the obligation to serve to ensure it does not become a barrier to the state's decarbonization goals. Particular care will need to be taken to ensure that customers have the time, resources, knowledge, and funding needed to transition to electricity or other energy sources.

The project team will consider the obligation to serve in more detail as we develop deployment plans for the three proposed pilot sites.

Community Engagement

Implementing gas decommissioning and targeted electrification projects at scale will require buy-in and participation from individuals within selected communities. However, identifying the appropriate parties to interface with community members may prove difficult. For example, utilities and local governments may not be viewed as trusted parties and local organizations may not have the bandwidth to engage on these issues when faced with other more urgent priorities.

Long-term investments in community engagement are needed to ensure that targeted electrification and gas system decommissioning projects reflect the interests and needs of local communities while delivering financial savings and other benefits. Below are some key observations from our work, including conversations with CBOs and TAC members, and recommendations for others looking to lead projects in this space.

- Communities should be given an opportunity to define what successful community engagement looks like. Reporting back to the community on how their input shaped outcomes demonstrates respect for their time and effort and helps maintain trust.
- Strong facilitation is essential for difficult or complex conversations with community members to ensure that all voices are heard and knowledge is transferred successfully in both directions. Community engagement efforts should leverage trusted messengers who work in communities, offer in-language support, and compensate community members for their time.
- Both TAC members and municipal partners communicated that meaningful community engagement takes time and "moves at the speed of trust." Project timelines imposed by grant funding or customer programs should be developed to support long-term engagement. However, there may be hard deadlines for gas decommissioning projects to successfully avoid

pipeline replacement. Allocating sufficient time in the beginning stages of a project to reach consensus on the scope and purpose of the proposed work can go a long way.

- Even with sufficient funding available and mutually aligned priorities, bandwidth and capacity constraints may limit local organizations' ability to engage in a project, especially within a limited timeframe. CBOs and other community champions should be offered administratively simple funding and should have the opportunity to shape scope, timing, and budget based on their capacity.
- Time should be taken to explore the local community's current priorities and identify how proposed work can support those efforts.
- Time should be taken to understand cultural norms and perspectives to ensure the project is communicated effectively with community members.

Project Funding

California will need to identify significant funding streams to achieve widespread building electrification in the coming decades. This funding will be needed regardless of whether electrification can be targeted to specific neighborhoods that would support gas system decommissioning. Electrification funding will need to cover some or all of the costs associated with building electrification, especially in low-income communities. These costs may include behind-the-meter electrification costs, building energy efficiency improvements, and potentially remediation to bring housing units up to code. In addition, bill guarantees may be needed to support bill savings in the near term. Importantly, increases in electric revenue from higher system usage due to building electrification could potentially offset some of these costs.

It may be appealing to use gas system avoided costs to provide funding for building electrification. However, if all gas avoided costs are repurposed in this manner, it would fail at the key objective of returning funds to gas ratepayers to reduce long-term gas cost pressures. In the near term, decisionmakers will need to consider the tradeoffs between using gas avoided costs to support building electrification in the absence of other funding sources vs. using gas avoided costs to reduce gas cost pressures. In the long term, it may be preferable to prioritize other funding sources to support building electrification so that gas system avoided costs can be returned to gas ratepayers and help offset the gas rate impacts associated with declining gas demand, escalating gas infrastructure costs, and rising commodity costs for low-carbon fuels. A substantial amount of local, state, and federal funding sources will likely be needed to support the levels of building electrification aligned with state decarbonization goals.

Cost-Effectiveness

Development of benefit-cost analyses for gas decommissioning projects is an important area for further research, as cost-effectiveness tests and metrics have not yet been established for these projects. In future materials, the project team will propose sets of benefits and costs and will perform benefit cost analysis for our proposed pilot sites. The project team will also explore how cost-effectiveness evaluation may change over time if building electrification becomes the expectation or norm for California's buildings, regardless of whether a site is being pursued for gas decommissioning.

For this interim report, the project team identified that site density (*i.e.,* the number of customers per mile of gas main) is likely to be a key driver of cost-effectiveness for gas decommissioning projects. Unless very high GHG costs are assumed, the most significant benefit and cost components for gas decommissioning are likely to be gas system avoided costs (benefit) and behind-the-meter electrification costs (cost). Because these scale in different ways, sites with fewer customers per mile of gas main are likely to see better overall cost-effectiveness.

In addition to cost-effectiveness, planners and regulators may consider other factors such as equity in prioritizing sites for gas decommissioning, recognizing that electrification can bring important benefits to low-income and disadvantaged communities. However, this finding indicates that less dense project sites will likely see greater gas system cost savings per dollar spent on electrification.

In the future, cost-effectiveness of gas decommissioning may improve due to a number of factors. For example, higher costs for GHG emissions would increase cost-effectiveness. In addition, zero-emission appliance standards, such as those under consideration by CARB,[24] would likely improve cost-effectiveness of gas decommissioning by increasing upfront equipment costs in the counterfactual scenario where gas decommissioning is not implemented. Future materials will explore this in more detail.

[24] https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-appliance-standards/meetings-workshops

Next Steps

The project team plans to continue building upon the progress and learnings demonstrated in this report. This will be accomplished through completion of the following deliverables over the coming months:

+ **Pilot Site Deployment Plans:** The Deployment Plans will provide a high-level framework for the three selected pilot sites to pursue full building electrification and eventual gas decommissioning. These plans will describe the specific requirements to implement the pilots, the roles and responsibilities for various parties, and key pilot design elements informed by feedback gathered during the research phase of this project.
+ **Benefit-Cost Analysis Report:** This report will detail the benefits and costs of gas decommissioning in the 11 candidate sites that passed through the first two steps in the Site Selection Framework, including the final three proposed pilot locations. This report will be provided directly to the CEC. It will also inform portions of the project team's Final Report, which will be made publicly available.
+ **Public Workshop on Results from Community Engagement:** The project team plans to host a workshop in Oakland to share results from our Community Engagement work with the community. This will include progress updates and key findings from the community events and focus groups.
+ **Outreach Strategies Report:** This report will include a summary of stakeholder input and key findings from community engagement events. It will also identify community priorities and perspectives vis-a-vis energy equity, affordability, and climate goals. This report will be provided directly to the CEC. It will also inform portions of the project team's Final Report, which will be made publicly available.
+ **Final Report:** This final report will summarize the entirety of the project, including information contained in more detailed reports provided directly to the CEC.

To stay updated on our progress, sign up for our newsletters here. To read our publications, visit our initiative website here.

Appendix

A.1. EBCE's Service Territory vs. Broader PG&E Gas Service Territory

The public gas data from the Long-term Gas Planning Proceeding and the Gas Asset Analysis Tool both provide a wealth of geographic data about PG&E's gas system. The tables below provide some metrics comparing PG&E's full gas service territory with the narrower EBCE territory, which is a subset of PG&E's gas territory and is the focus of this CEC research project. Some data are taken from the CPUC Long-term Gas Planning proceeding (labeled "CPUC") – for these rows, EBCE-specific metrics were calculated based on the census tracts whose center is located within EBCE's territory. Other data come from the GIS-based Gas Assent Analysis Tool (labeled "GIS") – for these data, metrics were directly filtered to a GIS shapefile representing EBCE's territory.

Table 6 provides counts of gas customers by customer segment. This table is based on public data from the CPUC Long-term Gas Planning Proceeding. Residential customers are differentiated based on whether they are enrolled in the CARE bill discount program (California Alternate Rates for Energy). Core commercial customers are non-residential customers who receive firm (i.e., non-interruptible) gas service. Non-Core customers reflect customers on interruptible tariffs and may include industrial customers, electric generators, and others. Finally, natural gas vehicle customers and uncategorized customers are combined.

Table 6: Gas customers by customer segment

Gas Customers	EBCE Territory	Full PG&E Gas Territory	Source
Residential Customers (Non-CARE)	390,755	3,163,300	CPUC
Residential Customers (CARE)	114,285	1,183,440	CPUC
Core Commercial Customers	26,290	227,198	CPUC
Non-Core	138	1,402	CPUC
Vehicles and other	105	1,006	CPUC
Total	**531,573**	**4,576,346**	CPUC

Table 7 describes some key features of gas distribution mains. First, the total miles of gas distribution mains are provided, based on public data from the Long-term Gas Planning Proceeding. Next, the table shows the share of main miles identified as "highest risk" based on filings in that proceeding. Risk may be correlated with pipeline replacement programs. Next, the table describes two metrics that were used to filter candidate sites for gas decommissioning, as explained in more detail in the section **Proposed Site Selection Framework**. These metrics are the share of main miles categorized as High in the DIMP operational risk model (Distribution Integrity Management Program), and the share of miles that are on terminal branches of the gas distribution system. Both of these metrics are based on data in the GIS-based Gas Asset Analysis Tool. Terminal branch miles are based on initial analysis performed by PG&E and may be revised as PG&E improves techniques used to identify these pipeline segments in the Asset Analysis Tool.

Table 7: Key features of gas distribution mains

Gas Distribution Mains	EBCE Territory	Full PG&E Gas Territory	Source
Total Miles	**4,108**	**43,385**	CPUC
Share of “Highest Risk”	4.7%	5.0%	CPUC
Share of High “DIMP” operational risk score	2.5%	1.3%	GIS
Share of Terminal Branches	18.1%	20.3%	GIS

Table 8 describes metrics related to three pipeline materials that have been targeted for replacement: Aldyl-A (a polymer material), non-cathodic protection steel, and copper. These data come from the Long-term Gas Planning Proceeding and reflect both gas mains and gas services, which are the smaller pipes that connect individual buildings to gas distribution mains.

Table 8: Gas pipeline materials targeted for replacement (mains + services)

Gas Distribution Mains and Services	EBCE Territory	Full PG&E Gas Territory	Source
Total Miles	**7,834**	**78,128**	CPUC
Share Aldyl-A	22.2%	10.4%	CPUC
Share non-cathodic protection steel	0.4%	0.4%	CPUC
Share copper	0.0%	0.0%	CPUC

One interesting finding is that EBCE and PG&E territories have a similar share of mains categorized as “highest risk” (4.4% and 5.0%). However, under a different metric, “Share of High “DIMP” operational risk score,” the EBCE territory has nearly double the share of miles as PG&E’s broader gas territory (2.5% vs. 1.3%). Finally, EBCE has more than double the share of Aldyl-A pipe as the broader PG&E gas territory (22.2% vs. 10.4%).

These findings indicate that there may be a relatively high concentration of gas pipeline replacement projects in EBCE’s territory, which may also mean a greater concentration of candidate sites for gas decommissioning. However, more clarity is needed on why the “highest risk” metric does not reflect a similar finding.

Finally, Table 9 shows the total number of gas customers per mile of gas main. As described earlier in this report, customer density may be a potentially important driver of cost-effectiveness for gas decommissioning projects, with less dense projects seeing better cost-effectiveness. While these numbers are averages over broad regions, they indicate that EBCE’s service territory is considerably denser than PG&E’s broader gas service territory.

Table 9: Average customer density (customers per mile of main)

Feature	EBCE Territory	Full PG&E Gas Territory	Source
Total Gas Customers	531,573	4,576,346	CPUC
Total Miles of Main	4,108	43,385	CPUC
Average Customers per Mile	**129**	**105**	CPUC

A.2. Detailed Comparison to CPUC Staff Proposal

There are several key similarities and distinctions between the CPUC Staff Proposal and our project team's proposed site selection framework.

Site Identification and Prioritization Criteria: The primary point of alignment between the two proposals is that both identify a core set of characteristics for site identification and prioritization. Similar criteria included for site prioritization in both proposals are:

- High pipeline risk, which is correlated with near-term pipeline replacement
- Equity considerations such as designation as a DAC
- Scale of gas system avoided costs
- Presence of a community champion

Feasibility: Both proposals note the importance of feasibility, although they differ in where feasibility would be evaluated in the process. The CPUC Staff Proposal suggests first prioritizing census tracts for gas decommissioning and then evaluating site feasibility in a later step prior to actual implementation of a gas decommissioning project. Conversely, this CEC research project team has proposed that feasibility be considered in an initial screening step (Step 1) and evaluated in detail in engineering review (Step 2) *before* sites advance to prioritization (Step 3).

The distinct treatment of feasibility in the two proposals may be related to the data available to each team in developing our proposals. The CPUC Staff Proposal was developed using census tract-level data that would not enable screening project sites for feasibility. Feasibility of a project will also be affected by decisions regarding how many and which customers to include in a given project, and the CPUC Staff Proposal does not suggest specific projects or project sizes. For the CEC research project, the project team had access to PG&E's GIS-based Gas Asset Analysis Tool, which enables screening of candidate sites that lie on terminal branches, as well as support from PG&E gas engineers for performing engineering analyses of feasibility.

Costs of Gas System Decommissioning: Another important distinction between the proposals is whether they directly consider the upfront costs associated with building electrification as part of site identification or prioritization. The CPUC Staff Proposal includes some variables that relate to cost, such as gas vs. electric operating cost estimates and measures related to gas demand, and the Staff Proposal asks if other technology considerations should be included, such as weather variables that affect heat pump operation in cold weather. The CPUC Staff Proposal does not say explicitly that benefit-cost analysis would be required prior to implementing a gas decommissioning project, although it implies this in a question to utilities (emphasis added): "How can electric and gas utilities best perform their respective roles to support **cost-effective** gas decommissioning?"

However, the CPUC Staff Proposal does not explicitly include the costs associated with implementing a gas decommissioning project, such as upfront costs associated with electrification, in the prioritization of census tracts into the five tranches. In contrast, our project team's proposal includes cost and benefit categories for site prioritization and notes that upfront electrification costs are likely to be the greatest cost category associated with gas decommissioning projects. (Note, however, that the project team ultimately de-emphasized benefit/cost criteria in the context of this research project, as discussed in the section **Results of Step 3 – Site Prioritization**).

It may be challenging to differentiate costs of electrification or other alternatives to gas across census tracts. However, the CPUC Staff Proposal suggests including representative *benefits* of gas decommissioning at the census tract level. Our recommendation would be to also consider costs associated with gas decommissioning, to the extent that they can be estimated or compared at the census tract level. Even if costs cannot be differentiated among census tracts, recognizing that electrification costs are likely to scale with the number of customers leads to the finding that site density (*i.e.,* the number of customers per mile of gas main) may have an impact on project cost-effectiveness. The project team will aim to discuss this further with CPUC staff.

<u>Additional Criteria:</u> The CPUC Staff Proposal includes some criteria that are not included in our proposed framework. First, the Staff Proposal suggests prioritizing census tracts with higher gas demand to support reducing gas infrastructure needs that are driven by peak demand. This is aligned with PG&E's historical approach to gas decommissioning, which in some instances has targeted areas where gas load reductions could lead gas transmission assets to be derated to lower pressures, reducing costly operations and maintenance requirements for high-pressure transmission pipelines. Based on PG&E's experience, the proposal to consider gas demand could be particularly valuable if combined with information on where demand reductions could reduce costs on the gas system.

The second set of criteria included in the CPUC Staff Proposal but not in our proposed framework are metrics directly related to affordability. Although affordability factors into CalEnviroScreen and the designation of some census tracts as DACs, the Staff Proposal suggests that affordability should be considered as a distinct criterion using dedicated metrics. The staff proposal also notes that customers may not necessarily see near-term bill savings from electrification, and that subsidies and rate reform will be critical to address this. For this project, we only had 11 candidate sites for prioritization and were able to work with local governments to better understand wealth and affordability in these sites. For a service territory-wide screening, we support the use of additional affordability metrics as suggested in the Staff Proposal.