Gas Decommissioning in California

An Informational Brief

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Date:

July 3, 2025

Background on Gas Infrastructure

To properly contextualize some of the issues involved with gas infrastructure decommissioning, it is useful to first review the engineered components of the modern system, from the points of primary production to end-use consumption. The vast majority of gas consumed in America is produced from fossilized geological deposits. These subsurface resources are extracted via a network of above-ground wells. For cost reasons, most of this gas production is gathered into high-pressure transmission pipelines and transported to population centers with concentrated gas demand.

While the majority of the wholesale trade in gas is conducted regionally within the United States, gas transmission lines can sometimes cross state and even international boundaries. A minority of fossil gas production is also liquified (via pressurization) so that it can also be transported to international markets by ship using a network of liquified petroleum gas (LPG) port terminals. Much like with the electricity system, gas delivery networks have two different tiers: a transmission network that is involved with "bulk transport" and various local distribution networks that are responsible for delivery to end-users. Figure 1 provides a useful illustration of the gas system's various components.

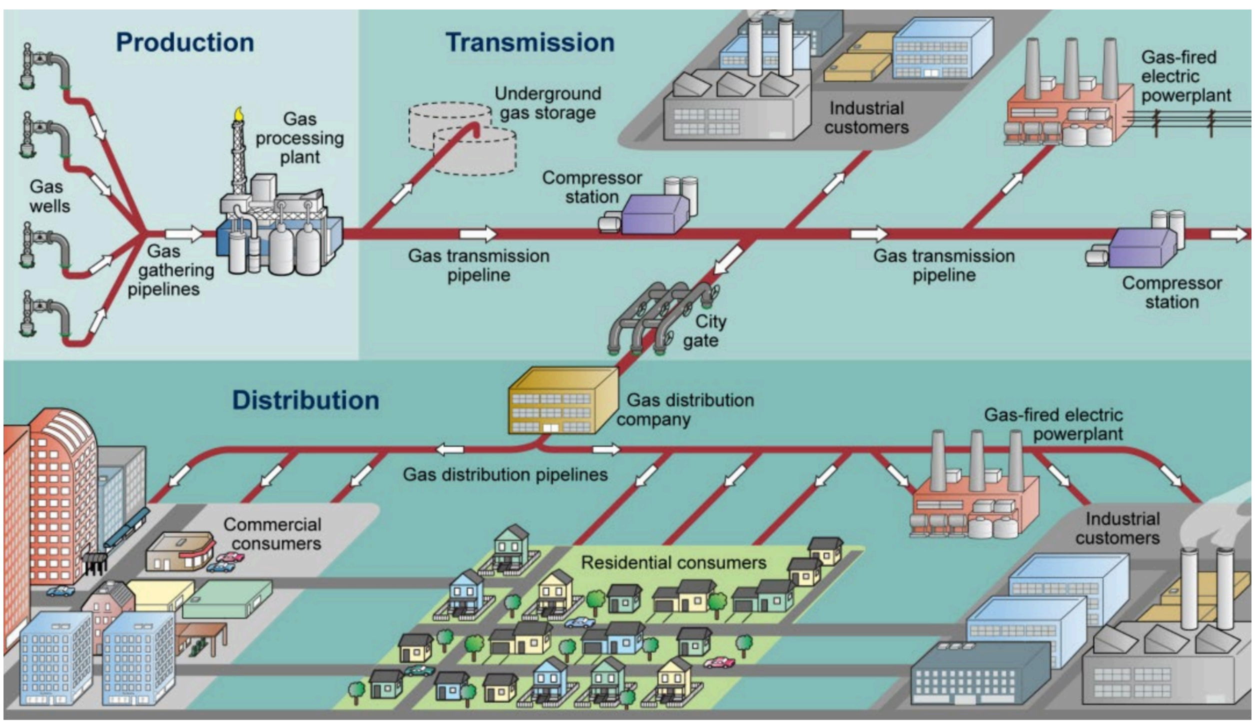

Figure 1. U.S. Energy Information Administration depiction of the gas system's components.[1]

[1]ABS. (2023). *LNG Value Chain.* https://ww2.eagle.org/content/dam/eagle/publications/LNG%20Value%20Chain.pdf

The distribution portion of the gas system comprises a large number of interconnected infrastructure assets, many of which are buried underground. The function of this system is both to transport and incrementally step down the pressure of gas flows, such that they are appropriate for the end-use requirements of the various customers to whom gas is being delivered. According to the American Gas Association (AGA), the United States possesses 2.3 million miles of local utility distribution lines. This infrastructure is currently responsible for transporting more than one-fourth of the total primary energy consumed in the U.S. annually.[2]

The following sections review the major asset classes within gas distribution systems, beginning from the point of interconnection to the high pressure transmission network (i.e. the city gate) and working down to the final interface with a customer premise (i.e. the meter). The architecture of this distribution system has important implications for the prioritization of sites for gas decommissioning projects.

When discussing gas decommissioning efforts within the context of this document, we will generally be referring to projects affecting portions of the distribution network.

City Gates

The city gate is the point where the high-pressure gas from the interstate or intrastate transmission pipeline system is received by the local distribution company (LDC). The city gate station performs several critical functions, perhaps chief among which is pressure regulation. The pressure in transmission pipelines is extremely high (up to 1,500 psi). At the city gate, regulators reduce this pressure to a manageable level for the local distribution system, typically ranging from 150 to 400 psi. City gates also play host to large meters which measure the volume of gas received from the transmission pipeline, which is essential for billing and tracking.

Other important activities which take place at the city gate include odorization and filtration. Gas is naturally odorless. To make leaks detectable for safety, an odorant (usually a mercaptan compound) is injected into the gas at the city gate. These perform an essential safety function by helping individuals detect gas leaks via smell, as the gas itself is otherwise invisible. In addition to odorization, city gate facilities also contain a series of filters and scrubbers which remove any remaining impurities in the gas, such as dust, dirt, rust, or liquids, which may have accumulated during production and transport.

Supply Mains / Feeder Mains

From the city gate, the gas flows into a network of large-diameter underground pipes called supply mains or feeder mains. These pipes carry the gas at a medium to high pressure through the main service territory. They act as the primary arteries of the distribution system, feeding into smaller mains. These mains are typically made of steel, but newer installations may use durable

[2] American Gas Association. (n.d.). *Delivering Natural Gas.* https://www.aga.org/natural-gas/reliable/delivering-natural-gas/

plastic (polyethylene) pipe, which is corrosion-resistant and flexible. The pressure in these lines is lower than in the transmission pipelines but still high enough to push the gas through the system.

Distribution Mains

These are the most extensive part of the distribution system. They are smaller than feeder mains and run throughout residential, commercial, and industrial areas, often located under streets and sidewalks. These can range from 2 inches to 24 inches in diameter. Their pressure is further reduced from the feeder mains, typically ranging from 1 to 60 psi, depending on the system design and customer type. Finally, distribution mains are often laid out in a grid or looped pattern to ensure that gas can be delivered from multiple directions, improving reliability and allowing for maintenance on certain sections without disrupting service to a wide area.

Service Lines

These are the small-diameter pipes that branch off from the distribution mains to deliver gas to individual homes and businesses. They are much smaller, typically 1/2 to 2 inches in diameter and typically low pressures – generally around 1/4 psi for residential customers, but can be higher for larger commercial or industrial customers. Service lines are often made of plastic or, in older systems, steel or copper and are virtually always buried at least 18 inches below ground

Regulators

Regulators are crucial components used throughout the system to reduce gas pressure from a higher to a lower level. These regulators are located at various points in the distribution network to reduce pressure from the feeder mains to the distribution mains. A small regulator is additionally installed at each customer's meter to reduce the pressure from the service line to the low pressure required for household appliances (e.g., furnace, stove, water heater).

Gas Meters

The gas meter is located at the customer's property, either outside or inside the building. Its function is to measure the volume of gas consumed by the customer. This data is used for billing purposes. The meter is a key point where the utility's responsibility ends and the customer's responsibility for their internal piping (fuel line) begins.

Valves and Control Systems

A variety of valves must be placed at strategic locations throughout the system to control the flow of gas. These allow the system operator to isolate sections of the pipeline for maintenance, repairs, or in case of an emergency. Many of these valves can often be operated via SCADA (Supervisory Control and Data Acquisition) systems. SCADA systems are used for automating different types of industrial processes and equipment. They are integrated with digital sensors to collect real-time data on pressure, flow, and temperature. This stream of telemetry data allows operators in a central control room to remotely monitor and adjust the system for safety and efficiency.

When discussing gas decommissioning activities within the context of this document, we are generally referring to projects which would involve taking distribution and/or service mains out of commission. This would necessarily include those lines' associated valves, regulators, and other control equipment.

Why Decommission Gas Infrastructure?

The primary purpose of decommissioning gas distribution infrastructure in the context of electrification is to avoid the growing financial and environmental burdens of maintaining a system that is becoming obsolete. As more customers switch from gas appliances to electric ones (e.g., heat pumps, induction stoves, electric water heaters), the number of customers on the gas system and the overall volume of gas sales decline. This creates a serious problem for gas utilities, and decommissioning is a proactive solution to a complex issue.

Gas pipelines, especially older ones, require constant maintenance, repair, and replacement. These are major capital expenditures. When a utility can decommission a main that serves a neighborhood that has fully electrified, they can avoid the significant cost of replacing that pipeline when it reaches the end of its life. This is particularly relevant for pipelines in low-density areas, where the cost of maintenance per customer is higher.

In a future where electric appliances and equipment are increasingly preferred to gas alternatives, as the gas system's customer base shrinks, the fixed costs of maintaining the entire gas distribution network (from mains to service lines and regulators) are spread across fewer and fewer customers. This leads to a steep increase in gas rates for the remaining customers, who are often those who cannot afford to electrify their homes, such as low-income households or renters. Decommissioning targeted segments of the system helps to manage these costs and protect vulnerable customers from exorbitant bills.

There are additional co-benefits to these projects as well. Abandoning or removing old gas lines eliminates the risk of future leaks and explosions, which are significant safety concerns, especially with aging infrastructure. It also prevents methane emissions, a potent greenhouse gas, from pipeline leaks (known as "fugitive emissions"). Furthermore, decommissioning projects can and should be pursued in conjunction with "targeted electrification" programs. This involves electrifying entire neighborhoods or blocks at once, allowing for the opportunity to completely shutdown the gas main serving the associated customers. This approach is seen as more efficient and cost-effective than electrifying homes on a piecemeal basis and dealing with the consequences of incremental declines in gas sales relative to relatively fixed infrastructure revenue requirements.

Avoiding the "Utility Death Spiral"

The "utility death spiral" is a theoretical concept that describes a vicious cycle that can threaten the traditional business model of a utility, particularly a gas utility, in the face of declining demand. The theory invokes the following stages of evolution:

1. *Decline in Demand:* As customers switch to alternative fueled appliances (principally via electrification) they consume less of the utility's product (gas).
2. *Revenue Loss:* The utility's revenue, which is based on sales volume, decreases.
3. *Fixed Costs Remain:* However, the utility's fixed costs for maintaining its infrastructure (pipelines, transmission lines, etc.) remain constant or even increase due to aging equipment.
4. *Rate Hikes:* To cover these fixed costs with a smaller sales volume, the utility must raise its rates for the remaining customers.
5. *Accelerated Exodus:* Higher rates incentivize even more customers to leave the system by adopting more efficient electric appliances or even going "off-grid" with solar and battery storage.
6. *Continuation:* This leads to another round of revenue loss, further rate increases, and an even faster exodus of customers, creating a downward spiral that can eventually lead to the utility's financial collapse.

Figure 2, which was developed by E3 as part of a CEC-funded research project into the future of the retail gas market, neatly summarizes how these different stages of evolution function to create a positive feedback loop with potentially catastrophic consequences for gas utilities.

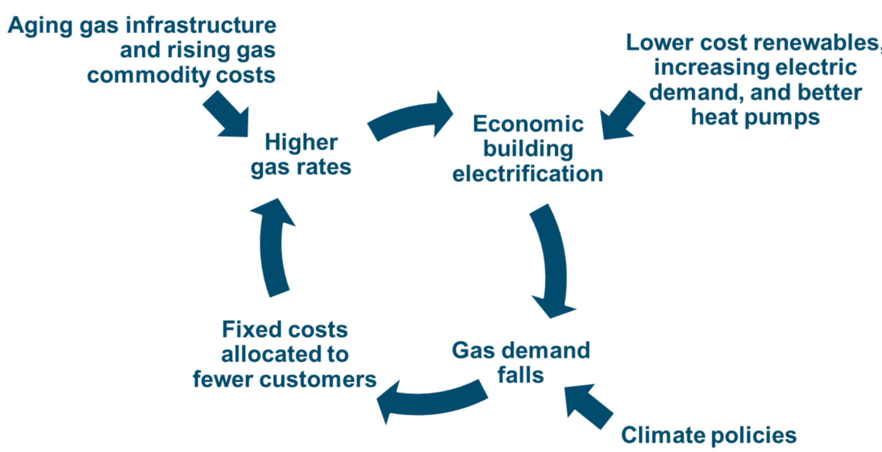

Figure 2. E3 depiction of structural drivers of the gas Utility Death Spiral.[3]

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[3] Aas et al. (2020). *The Challenge of Retail Gas in California's LowCarbon Future.* https://www.energy.ca.gov/sites/default/files/2021-06/CEC-500-2019-055-F.pdf

The possibility of such a death spiral occurring is a serious concern for gas utilities as electrification gains momentum. To avoid it, utilities are exploring various different strategies. Some utilities are investing in alternative fuels, such as "renewable natural gas" (RNG) or hydrogen. While others are also considering changing their business models by shifting from sales-based to service-based models where they are compensated for maintaining the infrastructure, not just selling gas. Finally, many dual fuel utility providers, such as PG&E and SMUD, are taking a proactive approach to the pursuit of combined electrification and decommissioning efforts. The rationale here is that instead of fighting electrification, working simultaneously to execute targeted electrification and decommissioning projects will help manage the transition and provide a least total cost approach to avoiding stranded assets.

Executing Decommissioning Projects

The decommissioning or abandonment of a piece of gas distribution system infrastructure is a highly regulated process that must be carefully planned and executed to ensure safety and prevent environmental hazards.

Planning and Regulatory Approval

Before any physical work begins, the gas utility or pipeline operator must develop a detailed decommissioning plan. For pipe segments that are larger in capacity or operating at high pressures, such as those involved with interstate gas transmission, a decommissioning plan must be submitted to the relevant regulatory authority, such as the National Pipeline and Hazardous Material Safety Administration (PHMSA) for review and approval. For smaller, more localized projects, involving lower capacity/pressure distribution or service lines, the relevant planning authority may be a municipal government or regulatory commission. These decommissioning plans will typically include:

- *Reason for Decommissioning:* This could be due to the end of the pipeline's service life, a shift to other energy sources, or the exhaustion of the gas reserves it serves.
- *Proposed Procedures:* Detailed steps for how the decommissioning will be carried out.
- *Environmental Assessment:* A review of potential environmental impacts and plans to mitigate them.
- *Stakeholder Engagement:* Communication with landowners, communities, and Indigenous groups to inform them of the work.
- *Schedule and Resources:* A timeline for the work and the equipment and personnel required.

Physical Disconnection and Isolation

In terms of the actual decommissioning project work, the first critical step is to physically disconnect the main from all sources and supplies of gas, such as a gas reservoir, another main, or a city gate station. This prevents any further gas from entering the line. The disconnection is done by closing and locking valves and/or installing a physical barrier or fitting to prevent gas flow.

Purging and Cleaning

Once disconnected, the main must be purged to remove all residual gas. This is a crucial safety step to eliminate the risk of fire or explosion. Common methods include:

- *Inert Gas Purging*: An inert gas, typically nitrogen, is pumped through the main to force out any remaining gas. This creates a non-combustible atmosphere inside the pipe.
- *Pigging:* "Pigs" are devices sent through the pipeline to clean the interior walls and remove any hydrocarbon residue.
- *Flushing:* The main may also be flushed with water to remove any remaining materials.

Abandonment In-Place or Removal

After purging, the operator must decide whether to abandon the pipeline in place or physically remove it. Abandonment In-Place is the most common method, especially for buried pipelines. It minimizes environmental disruption and reduces the risk of soil instability and damage to surrounding infrastructure. The process typically involves:

- *Sealing the ends:* The disconnected ends of the main are permanently sealed with caps or plugs.
- *Filling:* In some cases, the main may be filled with an inert material like sand, rotary mud, or a special concrete material to prevent collapse or the entry of fluids and gases.
- *Maintaining cathodic protection:* For buried steel mains, cathodic protection may be maintained to prevent corrosion and ensure the structural integrity of the pipeline, especially at road, canal, and rail crossings.
- *Monitoring:* The abandoned line remains the responsibility of the operator, who continues to monitor it through regular patrols and surveys.

The alternative to abandonment in-place is removal. In certain situations, particularly if the main is shallow (e.g., less than two feet below the surface) or interferes with other construction projects, it may need to be physically removed. This is a more costly and disruptive process that involves excavation, cutting the pipe into sections, and transporting the material for disposal or recycling.

Site Restoration

Once the decommissioning work is complete, the disturbed area is restored to match the surrounding landscape. This includes backfilling trenches, cleaning up the site, and restoring soil and vegetation.

Reporting

Finally, the operator must submit a post-decommissioning report to the regulatory agency, certifying that the work was completed according to the approved plan and all regulations. This report includes details about the location, size, date, and method of abandonment.

Identifying Decommissioning Sites

How to identify the most promising candidate sites for the decommissioning of gas infrastructure is a complex problem. This is because it requires the simultaneous consideration of multiple, and potentially competing, criteria. Different stakeholders in gas decommissioning activities are likely to have different priority issues of concern when evaluating the relative suitability of different sites for decommissioning. Here, we introduce some common stakeholder groups and discuss some of their differences in perspective.

Utility Concerns

From the perspective of gas utilities, the primary objectives are to decommission infrastructure assets which are:

- Most costly to maintain/replace
- Generate the smallest amount of revenue from customer gas sales
- Would require the smallest number/size of remediation measures in order to maintain the hydraulic integrity of the remaining portions of the network should they be taken out of service.

In this way, nearly all the concerns that are most relevant to the utility can be articulated in strictly financial terms. Figure 3 below, which was produced by a joint GridWorks and PG&E research study into gas decommissioning site prioritization, neatly summarizes the prevailing utility perspective on the rank prioritization of concerns when it comes to determining site suitability for decommissioning projects.

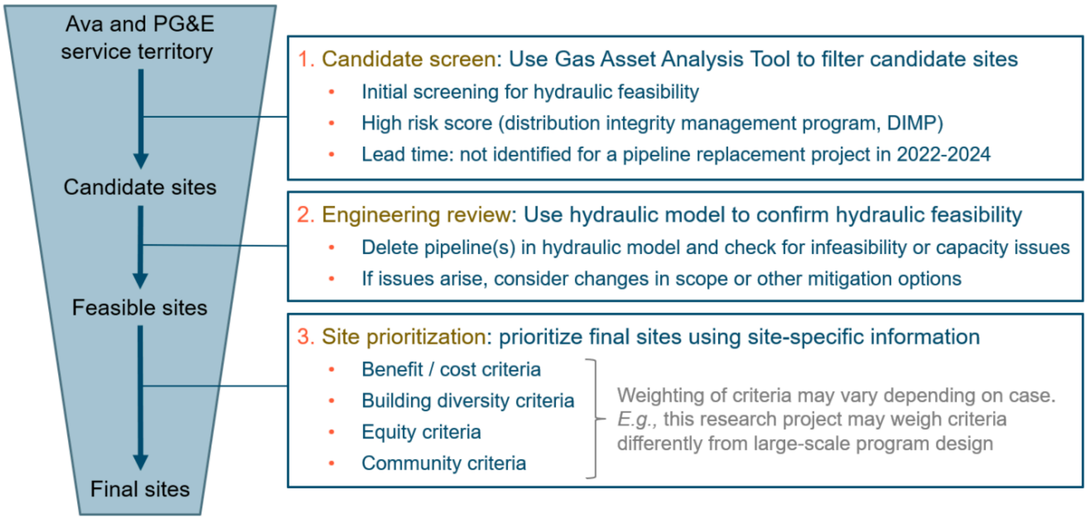

Figure 3. Depiction of a PG&E, GridWorks, E3, and Ava Community Energy framework for identifying candidate sites for targeted building electrification and gas decommissioning. [4]

For other stakeholders with interests in gas decommissioning projects, however, the relevant costs and benefits of pursuing a decommissioning project in a particular location can be more varied and difficult to quantify. In the following we discuss some of these disparate concerns relative to gas customers, including those whose service would be terminated by a decommissioning project and those who wouldn't, as well as the priorities for regulators.

Customer Concerns

For customers whose gas service would be impacted by a decommissioning project for example, there is the fundamental question of how to substitute existing gas equipment with alternatives. Today, for many domestic and small commercial end-uses of gas, most of the commercially viable substitute equipment offerings are powered by electricity. These can have different performance characteristics, siting constraints, and power requirements that must be negotiated to facilitate their adoption. This is because they make use of fundamentally different physical principles to render energy services (i.e. they are not combustion based).

Substituting gas equipment with electric alternatives can sometimes necessitate additional investments to ensure that there is sufficient capacity to transmit the required electrical power, both on the utility distribution system, which serves the customer's premise, as well as within the premise's buildings. Capacity expansion projects on the electricity provider's distribution system can invoke a number of different rules which require different cost-sharing agreements between the utility and customer to cover the expenses associated with different elements of a project (i.e. line extensions, undergrounding, etc.).

[4] Gold-Parker, et al. (2024). *An Analytical Framework for Targeted Electrification and Strategic Gas Decommissioning: Identifying Potential Pilot Sites in Northern California's East Bay Region*. https://www.energy.ca.gov/sites/default/files/2024-06/CEC-500-2024-073.pdf

Regulator Concerns

For regulators interested in advancing decommissioning projects as part of the state's broader decarbonization initiatives, there are several important criteria which must be considered when evaluating candidate sites for gas decommissioning projects. Among these include:

- Maintaining energy affordability for all customers, not just for those participating in decommissioning projects and not only relative to gas retail rates.
- Ensuring the safety and integrity of both the gas and electricity distribution systems.
- Maximizing avoided greenhouse gas emissions, both from gas combustion as well as leakages.
- Improving local indoor and ambient air quality through the avoidance of criteria air pollutant emissions.
- Developing transparent and consistent criteria for decommissioning, including definitions of cost-effectiveness. Decommissioning may not be guided by the same goals in each case, but they should be made clear and understandable with explicit nexus to the policy.
- Advancing objectives related to principles of energy equity and energy justice.

Additional important considerations for regulators is how the net-present value of decommissioning projects, both for gas utilities and their affected customers, can be impacted by the cost of substitute fuels, especially electricity. Customers participating in decommissioning projects may be able to find financial assistance (in the form of program incentives) to defray some of the upfront cost of fuel-substitution projects. However, once these substitute equipment are installed, those customers will be solely responsible for the operational costs of their energy consumption going forwards. If these operational costs continue to increase, due to continued electricity rate increases for example, customers may require additional structural incentives for their participation in decommissioning projects to make financial sense, and thus be a logical voluntary choice.

Recent Developments

SB 1221

California's Senate Bill 1221 (SB 1221), also known as the "Neighborhood Decarbonization Act," was signed into law in September 2024. The bill was authored by Senator Dave Min and supported by a coalition of environmental justice advocates, climate organizations, and even some energy providers like Pacific Gas & Electric (PG&E), which recognized the potential for cost savings and decarbonization. Its genesis stems from a growing recognition of several interconnected issues. Perhaps chief among these is that California faces an estimated $20 billion in costs over the next decade to repair and replace aging gas pipelines.[5] These costs are ultimately passed on to ratepayers, leading to concerns about increasing energy bills, especially for low-income households. Additionally, there is a growing recognition that continued investment in fossil gas infrastructure runs counter to California's aggressive climate goals, including the elimination of net emissions from the power sector by 2045. Shifting away from fossil gas is seen as crucial for reducing greenhouse gas emissions and improving air quality.

State lawmakers and energy system regulators have expressed a strong desire to ensure that the transition away from fossil fuels is equitable and doesn't disproportionately burden vulnerable communities. Low-income and disadvantaged communities often bear the brunt of pollution and extreme heat, and SB 1221 aims to prioritize these areas for decarbonization efforts. This focus on equity reflects concerns that relying solely on individual consumers to electrify their homes will likely result in piecemeal adoption biased towards wealthier communities where there is greater access to the financial resources necessary to cover the upfront capital costs of fuel-substitution measures. Pursuing neighborhood-scale decarbonization projects, where entire areas transition off gas at once, is seen as a more efficient and impactful approach.

Among the most important precedents established by SB 1221 is establishment of a legal pathway for overcoming gas investor-owned utilities' (IOUs) "Obligation to Serve." This is a legal requirement that IOUs must provide service to all customers who request it within their territories. The existence of the Obligation to Serve has previously implied that even a single dissenting customer could block a neighborhood-wide gas line decommissioning project. SB 1221 seeks to address this by lowering the approval threshold for pilot projects such that so long as at least 2/3rds of the customers affected by a decommissioning project approve, then the obligation can be waived.

Decommissioning Pilot Project Status

With SB 1221 now law, the California Public Utilities Commission (CPUC) is tasked with establishing a voluntary program for up to 30 neighborhood decarbonization pilot projects across the state. Though it is important to appreciate that this is an upper limit and the statute does not require that any or all of these projects actually be implemented.

So far as the timeline for SB 1221's implementation:

- *July 1, 2025:* Each gas corporation must submit maps to the CPUC detailing potential gas distribution line replacement projects.
- *January 1, 2026:* The CPUC is required to designate "priority neighborhood decarbonization zones," considering factors like the concentration of identified pipeline replacement projects.
- *July 1, 2026:* The CPUC must establish a voluntary program for the pilot projects.

[5] Smillie et al. (2024). *Avoiding Gas Distribution Pipeline Replacement Through Targeted Electrification in California.* https://www.ethree.com/wp-content/uploads/2024/06/Gas-Decommissioning-Fact-Sheet-2024-06-18.pdf

- No pilot projects can be established after *January 1, 2030*.

The pilot projects will focus on areas where utilities would normally replace aging gas pipelines. Instead of new gas infrastructure, these areas will transition to fully electric service, often through the installation of heat pumps and other all-electric appliances. The legislation details a number of requirements for pilot project planning and implementation processes – though not all of which are prescriptively defined. These include:

- *Consent Threshold:* As discussed previously, for a pilot project to proceed, at least two-thirds (67%) of affected property owners in a given area must consent to the change, a reduction from the previous 100% "Obligation to Serve" requirement.
- *Cost and Benefits*: The goal is for these projects to be more cost-effective than continued gas pipeline replacements. Customers in pilot project areas are not expected to pay for the gas line shut-off or for the retrofitting and equipment of their homes with electric appliances. The bill aims to unlock new funding for energy efficiency upgrades, accelerate the transition to clean energy, and reduce long-term energy costs for utility customers.
- *Prioritization:* The legislation emphasizes prioritizing benefits to disadvantaged and low-income communities and including tenant protections.
- *Reporting:* The CPUC is required to submit various reports to the Legislature regarding the progress of these pilot projects.

Even prior to the passage of SB 1221, some communities and utilities were exploring neighborhood-scale decarbonization. For example, the Bay Area City of Albany secured a grant from the U.S. Department of Energy to pursue a gas line decommissioning pilot program. Additionally, the Southern California City of Santa Monica is developing a framework to identify decommissioning pilots, focusing on areas with high CalEnviroScreen scores – which indicate the relative degree of exposure to various environmental burdens within different communities. PG&E has already undertaken smaller-scale electrification efforts where it's more cost-effective than repairing gas infrastructure, and has completed over 100 such projects. PG&E was also planning a targeted electrification project at CSU Monterey Bay to replace an aging gas pipe with fully electrified service for student, staff, and faculty housing. However, recent regulatory filings indicate that this project is likely going to be abandoned due to anticipated cost and schedule overruns. Finally, ACCE Action, a non-governmental community based organization based in Richmond, is working on a neighborhood-scale project that aims to electrify homes and add solar panels and batteries for up to 80 homes. They are hoping this project will be included in the SB 1221 pilot program.