A Fluid Concern: San Francisco Must Improve Fuel Resilience

JUNE 2021

City and County of San Francisco

Civil Grand Jury | 2020–2021

About the Civil Grand Jury

The Civil Grand Jury is a government oversight panel of volunteers who serve for one year. It makes findings and recommendations resulting from its investigations.

Reports of the Civil Grand Jury do not identify individuals by name. Disclosure of information about individuals interviewed by the jury is prohibited.

California Penal Code, section 929.

2020–2021 Jurors

Ellie Schafer, *Foreperson*
Allen Cohn, *Foreperson Pro Tem*
Stephanie Jacques, *Recording Secretary*
Donna Hurowitz, *Corresponding Secretary*

Ron Boring
Geoffrey Brown
Mike Fitzgerald
JR Formanek
Nina Huebsch
Evelyn Hunt
Simone Manganelli
James Matthews
Dr. Janet Mohle-Boetani
Kenneth Moses
Judi Sanderlin
Adam J. Thaler
Nicholas Weininger
Bebo White
Thomas Yankowski

To learn more about the Civil Grand Jury, visit: https://civilgrandjury.sfgov.org/

Table of Contents

Executive Summary

The San Francisco Bay Area is vulnerable to many types of disasters, including natural events such as earthquakes and wildfires and technological threats such as cyberattacks. A major disaster could disrupt essential services—electric power, fuel, water, sewage disposal, communications, and transportation—for extended periods of time. These disruptions could pose major safety risks, and preparing to mitigate the damage from such disruptions is critical.

All of these essential services depend on a reliable fuel supply. Fuel shortages, especially in a power outage, will cause many other failures. Vehicles for first responders and service maintainers need gasoline to run. Facilities that run on electricity, such as pumping stations, communications towers, and operations buildings, need diesel fuel for backup generators.

After a region-wide disaster, fuel shortages could last for weeks. If fuel runs out, the resulting failures of other essential services would pose a serious life-safety threat. The City and County of San Francisco (the City) is insufficiently prepared to prevent this failure from happening. The state of California advises counties to plan for a 10-14 day period of self-sufficiency after a disaster, and the City does not meet this standard. Moreover, the City paused work-in-progress on fuel preparedness during the COVID pandemic even though it continued work in other disaster planning areas. Finally, there is no plan for keeping essential services reliable as the City moves away from fossil fuels and toward net-zero emissions by 2050.

The City should invest in a systematic program to address fuel preparedness both technically and organizationally, as it is doing for other comparable disaster preparedness challenges. Key elements of such a program should include:

- Clear organizational ownership of fuel preparedness within City government
- Improved assessment of fuel demand and supply citywide
- Better equipment for managing local fuel reserves in an emergency
- Secure supply chains to ensure the City can receive fuel deliveries
- Comprehensive planning and dedicated funding for fuel preparedness improvements
- Long-term planning for keeping critical infrastructure reliable in a fossil fuel-free future

Background

Lifeline Services Defined

A primary source and inspiration for this report is the Lifelines Restoration Performance Project (the Lifelines Project) produced on behalf of the San Francisco Lifelines Council. The Lifelines Council was formed in 2009 at the behest of then-Mayor Edwin Lee, with the specific charge to:

- Develop and improve collaboration in the City and within the San Francisco Bay Area
- Understand operational interdependencies to enhance planning, restoration, and reconstruction following a disaster
- Share information among affected parties concerning recovery plans, projects, and priorities
- Establish coordination for lifeline restoration and recovery following a disaster
- Issue a report summarizing findings and recommendations

A lifeline is defined as an entity or a process that provides security, relief, and continuity in the face of a difficult situation. Lifeline services, likewise, are those infrastructure services required to sustain life safety and the basic comforts of modern civilization for residents of a given area. The lifelines examined by the Lifelines Project included:

- Energy services, including electric power, natural gas, and fuel
- Water and wastewater service
- Transportation services, including roads and highways, ports, and airports
- Solid waste disposal
- Communications

The Lifelines Project report, released in October 2020, resulted from a sustained research effort to understand the City's likely performance relative to these lifeline services in a disaster. The report summarizes how each lifeline's infrastructure operates, assesses how quickly each lifeline service can be restored in the aftermath of a disaster, and recommends improvements to help restore lifeline services more quickly and reliably.

The Scope of this Report

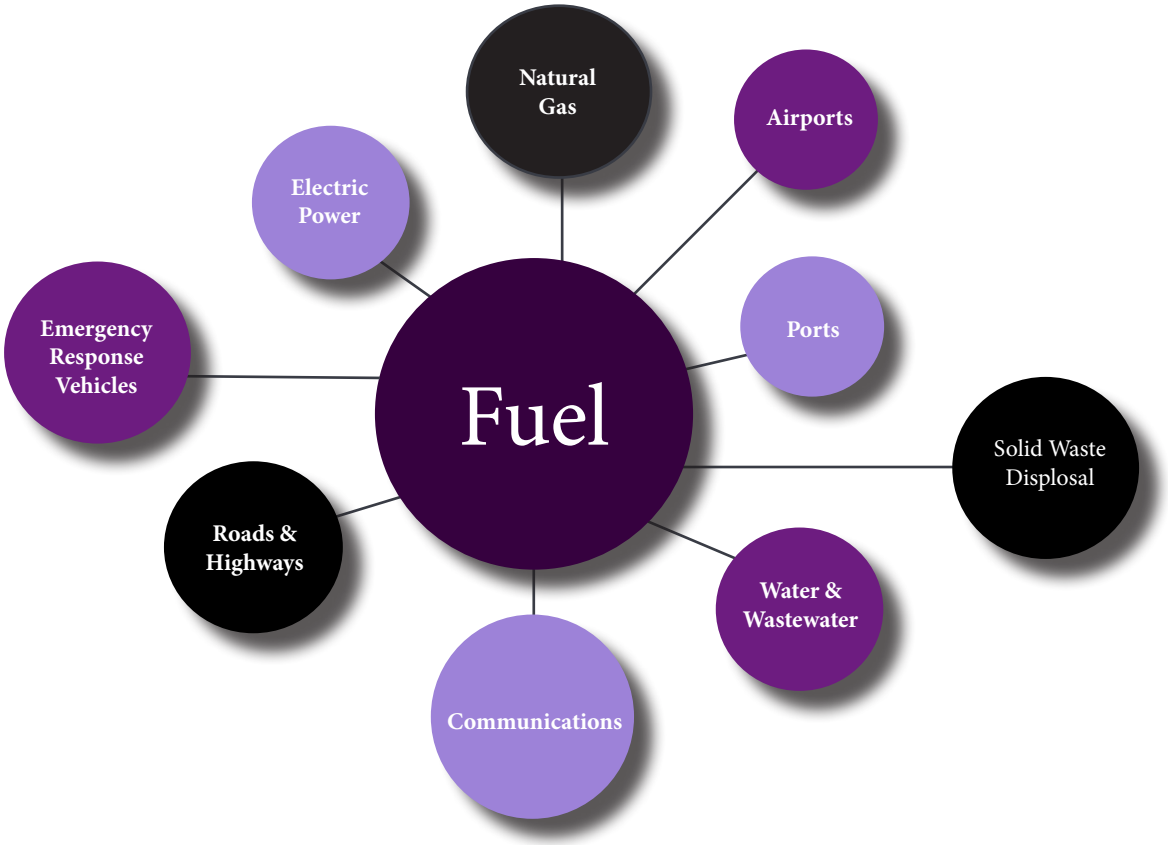
As the Lifelines Project report points out, "The complexity of lifeline systems—their differing purposes, physical structures, ownerships, and regulations—pose a challenge for local leaders setting expectations for restoration plans and timeframes."[1] Because of this complexity, the Civil Grand Jury (the Jury) could not feasibly investigate all aspects of lifelines' performance. The Jury chose to focus on fuel after completing high-level surveys of the condition of several lifelines. There are two primary reasons for this focus:

1. All other lifeline services depend on fuel. Improved fuel supply in a disaster increases the reliability of all other lifeline services.
2. The City has given less attention to fuel compared to the other lifeline services, and as a result, more effort is needed to improve its resilience. In the Jury's initial broad-ranging interviews with lifeline experts, fuel was most commonly mentioned as the weakest point. This is likely due to a lack of clear ownership over this area.

Lifeline Interdependencies: Why Fuel is Critical

Lifeline interdependency simply means that to sustain the operation of one lifeline service, it may be necessary for another one to be at least partially operational. The following figure summarizes the various lifelines that depend on fuel:

Figure 1. Summary of Lifeline Dependencies on Fuel



[1] City and County of San Francisco, *Lifelines Restoration Performance Project*. PDF file. https://onesanfrancisco.org/sites/default/files/inline-files/Lifelines%20Restoration%20Performance%20Project%20Report_Oct%202020.pdf.

Figure 1 demonstrates the importance of fuel as a critical lifeline: literally, everything else depends substantially on fuel to operate. In summary:

- Lifeline transportation vehicles need fuel, as do first responder vehicles such as ambulances and fire trucks.
- Most lifelines have service vehicles that are essential to maintaining key portions of their service infrastructure, and those need fuel too.
- If grid power is disrupted, lifeline infrastructure facilities need backup power to continue running. This backup power typically comes from fuel-based generators.

The City has known about this issue since at least since 2014 when the Lifelines Council released a report focused on evaluating interdependencies.[2] This makes the relative lack of attention to fuel preparedness more concerning.

Types of Disasters that Could Cause Fuel Shortages

The most common example of a potential disaster for the City is a major earthquake of magnitude 7.0 or greater. Earthquakes are an important focus not only because of the likelihood of damage across the region but also because the possible damage is subject to variability and uncertainty. Geological studies suggest that the San Andreas, Hayward, and Calaveras faults have equally destructive potential.

An earthquake could increase emergency fuel demand while disrupting the fuel supply. Refineries could be damaged and become inoperable, pipelines could rupture, roads and bridges could become impassable, and the power grid infrastructure could face several types of widespread damage. This report focuses on how that possible combination of effects can create severe, long-lasting fuel shortages and explores how the City can reduce the likelihood of such shortages.

Other types of disasters can also cause widespread, long-lasting power outages and increased demand for backup power, further depleting the limited fuel supply. These include:

- Wildfires. The last several years of megafires have necessitated Public Safety Power Shutoffs in many parts of the Bay Area and across California.[3] None of these have affected the City so far, but that could change in the future, especially if climate change makes fires larger and more frequent.
- Cyberattacks. Control systems for refineries and pipelines, or even the pipelines themselves are subject to cyberattacks.[4] Such attacks might also affect fuel supply directly if the attackers targeted control systems for pipelines and/or refineries.

---

2 The Lifelines Council, *Lifelines Interdependency Study | Report*. PDF file. https://sfgov.org/ccsfgsa/sites/default/files/ORR/documents/Lifelines%20Council%20Interdependency%20Study.pdf

3 In a Public Power Safety Shutoff, power is turned off in specific areas in an effort to reduce the risk of fires caused by electric infrastructure.

4 The May 2021 Colonial Pipeline cyberattack is a notorious and severe recent example.

- Power shortages. Heatwaves and other climate-related changes impact the demand for power.

Prior Work on Fuel Resilience: the 2018 Fleet Week Exercise

The City's Department of Emergency Management (DEM) holds exercises periodically during a Fleet Week event that tests various aspects of emergency preparedness, with a focus on coordinating with other levels of government. The 2018 exercises used seminars, tabletop exercises, and real-world scenarios to focus on supply chain logistics for fuel delivery. The scenarios included delivering fuel to Pier 96 by emergency watercraft, organized by the Federal Emergency Management Agency (FEMA), and delivering a truck by barge to Treasure Island. Communications and resource request systems were also tested.

These Fleet Week exercises produced an After Action Report that described the conduct of the exercises in detail. It also included extensive background information on fuel and recommended multiple follow-up steps to improve fuel preparedness.

Methodology

The Jury interviewed more than 30 officials in various city and state agencies with knowledge of the City's disaster preparedness programs and plans as well as private consultants and business leaders performing relevant work for the City. Interviewed agencies include:

- San Francisco Public Utilities Commission Water, Power, and Sewer divisions
- Department of Emergency Management
- Office of Resilience and Capital Planning
- Office of the City Administrator
- General Services Administration
- Office of Contract Administration
- Department of the Environment
- Port of San Francisco
- San Francisco International Airport
- California Energy Commission

The Jury attended public meetings of the Capital Planning Committee to learn how the capital planning process incorporated disaster preparedness needs. The Jury also read and analyzed publicly available documents from agency websites. Contracts, policies, best-practices presentations, and idea discussions from the various agencies were also reviewed.

Discussion

Why Fuel Resilience is Important

Shortages Could Last Much More than 72 Hours After a Disaster

A 72-hour assumption is embedded in many existing City disaster preparedness practices, from the size of backup generators' fuel tanks to the title of the City's citizen information website on disaster preparedness, sf72.org. However, both spikes in demand and limitations in the supply of fuel are likely to last well beyond 72 hours. Planners should not assume, even unconsciously, that "after 72 hours everything will be fine again."

Reasons for longer-lasting spikes in demand include:

- Pacific Gas & Electric (PG&E) will likely achieve only moderate restoration within two weeks of a major earthquake,[5] and the same is true of power provided by the San Francisco Public Utilities Commission (SFPUC) Power Enterprise.
- San Francisco International Airport (SFO) and Treasure Island will likely be without grid power beyond 72 hours. The Lifelines Project report notes that "Depending on fuel availability, they may continue to have power from backup generators, provided there is enough fuel."[6]
- There is widespread skepticism, among both interviewees and the general public, regarding PG&E's ability to follow through on its commitments to restore power given its performance over the past few years with Public Safety Power Shutoffs.
- The 2014 Bay Area Catastrophic Earthquake Regional Logistics Response Plan gives detailed estimates on power restoration timelines. The plan estimates that 161,300 San Francisco households will be without power 72 hours after a major earthquake and 73,100 still without power after seven days.[7] Restoration steps envisaged for the 72-hour to 14-day timeframe imply that power disruptions will continue to affect critical facilities and ordinary households for more than 72 hours.[8]

---

5 City and County of San Francisco, *Lifelines Restoration Performance Project*. PDF file. https://onesanfrancisco.org/sites/default/files/inline-files/Lifelines%20Restoration%20Performance%20Project%20Report_Oct%202020.pdf.

6 *Lifelines Restoration Performance Project*

7 California Office of Emergency Services and Bay Area Urban Areas Security Initiative, *Bay Area Regional Catastrophic Earthquake Logistics Response Plan*. PDF file. http://www.bayareauasi.org/sites/default/files/resources/Regional%20Logistics%20Response_February%202014.pdf.

8 U.S. Department of Homeland Security, *Bay Area Regional Catastrophic Earthquake Logistics Response Plan*. PDF file. http://bayareauasi.org/sites/default/files/resources/Regional%20Logistics%20Response_February%202014.pdf

Likewise, reasons for longer-lasting limitations in supply include:

- The Lifelines Project report noted severe uncertainty in the restoration of fuel supply, to the point of not committing to an estimated restoration timeframe.[9] Sufficient information on the vulnerability of region-wide fuel production and delivery infrastructure was not available.
- The California Energy Commission (CEC) recommends counties plan for a 10–14 day period of fuel self-sufficiency after a major earthquake.[10]
- The 2018 Fleet Week exercises assumed that fuel supplies would not arrive for 9–10 days following an earthquake.[11]
- The Regional Logistics Response Plan's restoration objectives for fuel in the 72-hour timeframe do not include restoring fuel supply.[12] Identifying resources and implementing fuel distribution plans are objectives for the period from 72 hours to 14 days after a disaster.
- A disaster large enough to disrupt the City's fuel and power supply will likely cause similar disruptions throughout the Bay Area. Emergency demand for fuel will most likely be a regional problem, and mutual aid opportunities could be limited. The City might be on its own and might have to "get in line" behind other Bay Area municipalities facing worse problems.

While emergency aid coordinated by state and federal authorities will eventually relieve fuel shortages, that aid is not expected to arrive until much later than 72 hours. The City needs the capability to manage scarce supplies until outside help arrives, and that management task could be difficult.

Shortages Could Cause Consequential Cascading Failures

Figure 1 illustrated that *all lifelines depend on fuel,* especially in a power outage. In particular, lifeline failures that could occur with power and fuel disruptions include:

- Communication outages due to failures in cell towers and/or switching equipment could imperil the ability of other lifeline services to coordinate restoration efforts and imperil life safety if first responders are unable to communicate.
- Traffic signal outages could cause traffic snarls.

---

9 City and County of San Francisco, *Lifelines Restoration Performance Project*. PDF file. https://onesanfrancisco.org/sites/default/files/inline-files/Lifelines%20Restoration%20Performance%20Project%20Report_Oct%202020.pdf.

10 California Energy Commission, "California Fuel Overview & Emergency Fuels Set-Aside Program" (PowerPoint presentation, University of California at San Francisco, November 4, 2020).

11 San Francisco Department of Emergency Management, *2018 San Francisco Fleet Week Exercise After Action Report*. PDF file.

12 U.S. Department of Homeland Security, *Bay Area Regional Catastrophic Earthquake Logistics Response Plan*. PDF file. http://bayareauasi.org/sites/default/files/resources/Regional%20Logistics%20Response_February%202014.pdf

- Fuel shortages could affect not only vehicles using local roads but also the equipment required to repair those roads. Notably, such shortages could cause difficulties reaching and evacuating injured people.
- Water shortages could imperil public health. The Lifelines Project states that SFPUC Water has enough backup generator fuel for only 72 hours of operation.
- Bay Area Rapid Transit and the San Francisco Municipal Transportation Agency (SFMTA) could fail as power and fuel for transit vehicles run out.
- Natural gas service could fail due to loss of power to shut-off valves.
- Wastewater pump stations could lose power, causing diminished capacity to handle wastewater treatment.
- Garbage service could be disrupted if Recology facilities lose power and/or garbage trucks cannot get fuel. This is a potential public health issue.
- Transportation via the Port and SFO could be disrupted if sea and air vehicles cannot get fuel.

Moreover, fuel shortages could cause or exacerbate grid power outages *and vice versa*. The Regional Logistics Response Plan lists several types of power-fuel interdependencies: for example, power maintenance vehicles require fuel to run, and fuel pumps and pipeline monitoring equipment require power to operate.[13]

How the City has Approached Resilience of Other Lifelines

Fuel resilience is of *at least* comparable importance to the resilience of other lifelines since other lifelines depend on fuel. The investments the City has made in securing other lifelines, and the success of these investments, can help determine what is reasonable to invest in fuel resilience.

Water and wastewater provide a particularly useful comparison since both involve complex infrastructures for transporting fluids over wide areas with multiple points of seismic vulnerability. Numerous redundancy and backup measures mitigate these vulnerabilities. For example, if some water reservoirs fail in an earthquake, they can be valved off without disrupting the water supply. Similarly, wastewater can be buffered in "storage boxes" if treatment plants are temporarily unavailable.

The City has invested in program upgrades to improve the resilience of both water and wastewater systems: the Water System Improvement Program (WSIP) and Sewer System Improvement Program (SSIP), respectively. These programs deploy billions of dollars of bond funding over decades to install state-of-the-art seismic upgrades to key pieces of lifeline infrastructure, including reservoirs, pipes, and treatment plants.

[13] *Bay Area Regional Catastrophic Earthquake Logistics Response Plan.*

The WSIP and SSIP have made steady progress in the face of logistical and budgetary constraints, including the COVID pandemic.

The City needs to approach fuel resilience similarly. Two key features of the water and sewer improvement programs are:

1. Each has a clear organizational owner
2. Each has dedicated funding streams for both capital and personnel

The City should provide similar organizational and budgetary foundations to fuel resilience.

Why Fuel Resilience Needs a Clear Owner

Recognizing the importance of fuel resilience to the safety of San Franciscans, the City Administrator's Office and DEM endorsed the creation of a Fuel Working Group in 2019. This working group made important progress in its first year but was paused in 2020 at the start of the COVID pandemic. The fact that work on other lifeline services continued while this fuel group was paused is indicative of the lack of organizational support for fuel resilience.

The Fuel Working Group was composed of emergency managers from many city agencies and co-led by logisticians from the City Administrator's Office and DEM. The group determined work priorities based on team members' knowledge and concerns, and they met monthly for approximately eight hours. Group projects included designing a small, easy-to-make, battery-powered pump to withdraw fuel from storage tanks, drafting a San Francisco Fuel Plan, and developing theoretical best practices for fuel resilience.

At the onset of COVID in 2020, however, most emergency managers in the group were reassigned to the COVID Command Center or emergency management responsibilities within their own departments; this caused the group's efforts to pause.

Members of the Fuel Working Group worked together successfully and collegially and were personally committed to improving fuel resilience in the City. But the deliverables and expectations of the Fuel Working Group were not defined, prioritized, or funded by the Mayor, Board of Supervisors, City Administrator, or DEM. The Fuel Working Group operated on an ad-hoc basis with a group of committed City employees who defined their own deliverables and had no funding.

The Fuel Working Group needs to be sponsored formally and funded adequately. The DEM logistician is grant-funded which limits the work that can be performed. Effective planning for the acquisition of consumable supplies (e.g., vaccines, personal protective equipment, cleaning supplies) requires dedicated staff with supply chain experience and logistics skills. By comparison, most other lifelines have clear organizational owners with aligned incentives for appropriate planning and resilience.

For example, SFPUC is the clear organizational owner of water and wastewater. SFPUC and PG&E collectively manage electric power, the Department of Technology oversees emergency communications, Recology manages waste disposal, San Francisco Public Works (SFPW) maintains local roads, and the Port and SFO manage their facilities. These organizations have both the authority and the resources to focus on the resilience of their respective lifelines.

There is no such owner for fuel. Since fuel demand and supply are not managed centrally, the City has a patchwork approach to fuel resilience with multiple departments and agencies focusing on small segments. As a result, there are no consistent citywide policies, and departments vary in their level of preparedness at even the most basic levels, such as keeping fleet vehicles' fuel tanks full in case of emergency.

Agency sponsorship of the Fuel Working Group would help empower the group to address fuel resilience in a more overarching and coordinated manner. Possible agency sponsors include The Office of Resilience and Capital Planning (ORCP), which oversees the Lifelines Council, and DEM. ORCP has been studying lifeline interdependencies since at least 2014, and DEM has institutional expertise around fuel as a result of the 2018 Fleet Week exercise.

Additionally, lifeline programs with clear owners, such as water and wastewater, continued their resilience work during the COVID pandemic while the work on fuel resilience was paused. Unfortunately, due to the lifeline interdependencies, this created a priority inversion since fuel resilience is a prerequisite for the resilience of the other lifelines. While the redeployment of resources is understandable, the presence of one emergency did not lessen the risk of others occurring. Other state and local governments have faced overlapping disasters during the pandemic, from megafires in California to winter storms in Texas.

Finally, a dedicated agency sponsor for fuel preparedness would enable region-wide coordination of fuel demand and supply. Other lifeline services have regional coordination bodies that address common challenges, such as Bay Area Clean Water Agencies for water. Coordination of fuel needs will be necessary but difficult to achieve without a dedicated owner.

Assessing Fuel Demand and Supply in Advance

Proactively Assessing Demand

If a disaster happens tomorrow and results in fuel shortages, understanding the fuel demand of critical infrastructures, including essential vehicles and backup generators, and the available fuel supply will be critical. However, both fuel demand and supply could vary widely based on the type and severity of the disaster. Therefore, proactive planning for a wide range of demand and supply constraints is essential.

The 2018 Fleet Week After Action Report included baseline data on potential fuel demand and supply. These data are summarized in Figure 2 below:

Figure 2: Fuel Demand and Supply Estimates from the 2018 Fleet Week After Action Report

Gasoline		Diesel	
Gasoline demand from vehicles, gallons per day	1,649	Diesel demand from vehicles, gallons per day	905
Gasoline demand from generators, gallons per day	350	Diesel demand from generators, gallons per day	425,865
Total gasoline demand	1,999	Total diesel demand	426,770
Total gasoline storage capacity, all City fueling stations	132,000	Total diesel storage capacity, all City fueling stations	255,400

These amounts are reported as baseline estimates only because it is unclear how they were determined or whether they are reliable; this is, in itself, disturbing. Nevertheless, the figures do provide a starting point for considering the kind of demand and supply sources that should be assessed.

Assuming there is any relative accuracy to these figures, the gap between diesel demand and supply is the most concerning problem. If, hypothetically, every storage tank at the City's fueling stations was full, the gasoline supply would last for two months at this level of demand, but the diesel supply, primarily used for backup generators, would last less than a single day.

Due to the likelihood that the demand for diesel fuel could far exceed the supply, the City needs to prioritize estimating backup generator demand in advance. This is a sizable challenge because of the widely distributed nature and ownership of critical backup generators throughout the City. Multiple types of facilities—some City-owned, some not—have generators. This includes operations buildings, hospitals, fire and police stations, water and wastewater pumping stations, and communications towers. These generators typically have storage tanks on premises sufficient for 24–72 hours of operation without refueling, at most; this is likely not enough to keep these facilities operational until power is restored. The City-owned generators are typically managed by the particular City agencies that own the facilities for which they provide backup power, and there is no centralized management.

Backup generator usage is especially difficult to estimate for several reasons:

- Backup generators are rarely used under normal operating conditions. They are tested periodically to ensure they work, but these tests do not provide sufficient information to assess the load capacity of the generators in a disaster or how the generators would behave over an extended period.
- The backup generators needed would vary based on the type and severity of the disaster. Power could be disrupted in some parts of the City and not others. It is highly unlikely that all available generators would be needed at the same time and for an extended period, but it is impossible to predict which generators will be needed and for how long.

- The range of potential use patterns for backup generators could change over time as progress on power resilience in other areas is made. For example, some critical facilities are provided with dual redundant power feeds from PG&E such that a single substation failure will not cause loss of power, and there are projects underway such as the Bay Corridor project that will expand the usage of dual feeds.[14]

There have been ad hoc efforts to catalog critical backup generators citywide, but a formal central inventory that catalogs the location and capacity of these generators does not appear to exist. It also does not appear that the City has performed any exercises to test how much fuel could be used realistically in a range of plausible disasters.

Preparing and maintaining an inventory of generators would not only help estimate fuel demand but would also be logistically useful during the actual disaster. Knowledge of which generators need to be checked on and/or refueled and when, and how to deliver fuel to them if needed, is key strategic information for emergency responders. Gathering that information centrally and keeping it updated regularly is a logical first step toward better fuel resilience.

Building New Storage Capacity

The next logical question is how to expand diesel storage capacity. There are a few reasons that local fuel storage capacity in the City is difficult to increase:

- The City's density and geographical constraints leave few suitable spaces for building large fuel tanks.
- Permitting for new tanks is time-consuming and expensive due to the risk of leakage or fire.
- Gas stations will likely become smaller and more sparse over time as gas-powered vehicles are replaced by electric vehicles.

There is a rare opportunity, however, to build new fuel storage capacity locally. The SFPUC wastewater enterprise plans to free up significant space at the Southeast Treatment Plant within the next 6–8 years by replacing the old digester equipment at the plant. A second fueling station for City vehicles is one proposed use of the space. As of now, no decision as to how this space will be used has been made. The original motivation for the fueling station proposal was improved convenience for refueling SFPUC vehicles.

But the second station could also serve as a very useful backup fuel supply source in an emergency, and the City should capitalize on this opportunity.

[14] The Bay Corridor Transmission and Distribution Project aims to better serve large SFPUC Power customers in the southeast portion of the City.

Making Private Fuel Reserves Accessible

Most existing fuel storage within the City's limits is owned privately (and thereby not included in Figure 2). There are eighty-five retail gas stations in the City whose storage tanks can hold a total of two million gallons of gasoline and 293 thousand gallons of diesel. In particular, these stations hold more diesel than all of the City-owned fueling stations combined. This is enough for an additional 16 hours of backup generator refueling.[15]

But even if the stations were not damaged in an earthquake, and if the reserve tanks were mostly full, their use is unpredictable due to the following:

- Heightened citizen demand (i.e., panic buying) could exhaust the supply quickly.
- Most retail gas stations have limited storage capacity and are on smaller, less accessible streets.
- Retail gas stations are not typically equipped to operate without power.

The City could mitigate these difficulties but has not. For example, the City has not signed any Memoranda of Understanding (MOUs), contracts, or other agreements with station owners to ensure that fuel from these stations could be used to meet critical infrastructure needs. The CEC recommends that counties undertake such agreements.

Some stations will be more useful in an emergency than others. Stations with one or more of the following characteristics would be preferred partners:

- Large onsite fuel storage capacity
- Proximity to priority travel routes
- 24/7 operations with onsite staff
- Ability to operate without power, through backup generators or transfer switches

There are eight Shell and three Chevron stations that have relatively large capacities for both gasoline and diesel (at least 30 thousand gallons gasoline and 10 thousand gallons diesel storage). Agreements with these providers would improve the City's fuel resilience. This is limited information, and a more thorough analysis of existing gas stations is warranted.

The City should also consider agreements with nearby hypermarket stations outside of the City limits.[16] These stations often have the largest amounts of onsite storage capacity, and two of them are located near SFO.

---

[15] San Francisco Department of Emergency Management, *2018 San Francisco Fleet Week Exercise After Action Report*. PDF file.

[16] A hypermarket is a large retail supplier of general merchandise or grocery items that also sells gasoline.

Equipping the City for Real-Time Emergency Fuel Management

The best-laid plans for managing fuel demand and supply will surely require adjustments when an actual disaster occurs. On the demand side, some backup generators will be required to run at full capacity for an extended period, and others will not. The vehicles that need to be deployed for disaster response will depend on the nature of the disaster. On the supply side, some storage tanks might be damaged while others are not. For those that are available, some will be full when the disaster strikes while others will be empty. The specifics cannot be predicted perfectly in advance.

To ensure the greatest resilience and ability to manage fuel needs in the aftermath of a disaster, emergency responders will need to do two key things:

1. Assess fuel demand and supply as quickly as possible
2. Transport fuel from available supply sources to where it is needed the most

The City needs better equipment to accomplish these two tasks.

Real-Time Supply and Demand Assessment

In an emergency, it is important for responders to know how much fuel is available and where to find it. A real-time monitoring system that tracks fuel availability would result in emergency responders being directed to the available resources more quickly. Knowing where the fuel is stored is not enough—the amount of fuel at a given location is also critical. Real-time data on fuel demand would also result in more efficient delivery to the areas where it is needed most.

The City does not have a centralized system for monitoring fuel availability in the fuel tanks owned by City agencies. The estimated time to create an inventory in an emergency is 4–8 hours and would require technicians that could themselves be affected adversely by the disaster or could be deployed elsewhere. The City's ability to create this inventory is only hypothetical since it has never been tested. Similarly, the City has not performed any exercise to predict fuel demand. The level of preparedness on the demand side is even less since, as discussed previously, an inventory of critical backup generators does not exist. The City lacks knowledge of where generators are and the amount of fuel they might consume.

One option for creating a real-time inventory of fuel supply is automated sensors that monitor fuel levels. The use of such sensors in vehicle fleets is common; for example, many car-sharing companies use them. While it is unclear whether these sensors are suitable for emergency use (e.g., whether they depend on power or Internet service), the City would benefit from investigating the use of fuel sensors or some other comparable technology.

Equipment for Local Fuel Transportation

Tanker trucks deliver fuel to both public and retail gas stations in the City. Either large tractor-trailer trucks (18 wheels and 11,000-gallon capacity) or smaller bobcat-style trucks (10 wheels and 6,000-gallon capacity) carry fuel across bridges and through City streets every day. Many of these trucks are compartmentalized and capable of carrying more than one type of fuel, and they can pump fuel both into and out of storage tanks.

In a disaster, however, bridges could possibly be damaged and impassable, leaving the City with fewer delivery options. To move fuel quickly within the City limits, equipment needed to do that, i.e., tanker trucks, must already be located within the City limits. Trucks should be purchased or retrofitted for this purpose.

The City has taken two steps in this direction. First, it converted a former fire engine (10 wheels and 3,500-gallon capacity) into a fuel tanker with compartments for both gasoline and diesel fuels. The truck has already proven to be useful in refueling multiple fire engines while they are engaged with a fire. In the event of a broader emergency, however, this one truck will not be enough. It will likely be used to resupply the fire engines as it is now.

Second, the City Administrator's Office received a grant in 2020 from the Bay Area Urban Areas Security Initiative to purchase another tanker truck for general use with the City, one with large capacity and multiple compartments for both types of fuel. The grant award of $200,000, however, is much less than the $600,000 bid received for this type of truck. Because of this sizable price gap, the capabilities of the truck will likely be scaled down.

The City has explored alternative technologies for disaster-resilient fuel transport, such as the prototype battery-powered fuel pump developed by the Fuel Working Group mentioned above, and other types of tank and pump equipment that could be retrofitted onto existing trucks. Whether these are the most feasible options or not, it is clear that the City needs to invest in upgrades or other equipment solutions to enhance its ability to refuel both backup generators and critical response vehicles in the aftermath of a disaster.

Securing The Fuel Supply Chain

The ability to resupply fuel to the City after a disaster depends on a complex set of systems with multiple points of vulnerability. A large portion of the supply chain is outside of the City's control and, as mentioned above, resupply could take up to 14 days after a major disaster. This makes the importance of managing the scarce local resources all the more critical. The more the City can do to reduce the time to resupply fuel from outside the City limits, the more quickly the stress on the scarce local resources can be reduced. The following are three ways the City can improve the fuel supply chain:

1. Improve the reliability of contracted fuel vendors and consider adding an out-of-region backup vendor
2. Secure reliable mooring sites for emergency fuel delivery by fuel barge, tanker ship, or similar vessel

3. Correlate priority routes within the City to critical fuel supply and demand sources

Background on San Francisco's Fuel Supply Chain

The City's fuel infrastructure is relatively compact and robust compared to other major urban areas. Within a distance of forty-five miles, for example, there are five crude oil refineries, forty miles of direct delivery pipeline (eight of which are under the bay), a multi-grade fuel terminal just one mile from the City limits, and more than 80 retail gas stations. However, the City's seismic situation and geographical limitations creates unusual vulnerabilities at each link in the supply chain.

Five refineries along the northern edge of Contra Costa County supply most of the Bay Area's gasoline and diesel fuels. The Bay Area, like California in general, imports relatively few refined fuel products. Fuel gets to the City from the refineries directly by truck or by a private pipeline owned and operated by Kinder Morgan, a large and publicly-held corporation based in Texas. The pipeline runs beneath the bay to the Kinder Morgan distribution terminal in Brisbane. From here, fuel is loaded onto trucks for delivery to the City.

Each route has vulnerabilities. Direct truck transport from the refineries is typically across the Bay Bridge, which is known to be at risk of damage in a major earthquake. The Kinder Morgan pipeline, on the other hand, runs close and nearly parallel to the Hayward fault, which is active and dangerous. If that fault gave way and damaged the pipeline and the Bay Bridge, a serious, perhaps long-term disruption to fuel supply to the City would result.

Kinder Morgan has been less forthcoming than other lifeline service operators (public or private) with information on the degree of vulnerability of its infrastructure and any mitigation measures it has taken. Because of this lack of information, the Lifelines Project report gave no estimated restoration timeline for the pipeline in the event of a disaster. The pipeline might survive a large earthquake—the Loma Prieta quake did not cause pipeline failures in the Bay Area, and the general seismic record of large steel pipes is good—but this does not mean it is not vulnerable. Moreover, there is a commercial as well as a physical risk. In an emergency, the Kinder Morgan terminal could face shortages resulting from unusual demand from both new and existing customers. The May 2021 cyberattack on Colonial Pipeline disrupted fuel supply to the southeastern United States for six days.

Improving Vendor Reliability

The City maintains fuel contracts with two vendors, Golden Gate Petroleum and Western States Oil. Each of these vendors acts as a backup for the other: the primary vendor for gasoline can serve as a secondary vendor for diesel and vice versa. But since both vendors' distribution and storage sites are located in the Bay Area, even though outside of the City, there is a significant risk that both vendors could become temporarily unable to supply the City after a major region-wide disaster.

The extent to which the two vendors' supply chains are interdependent or the risks of events that might cause them to become unable to deliver fuel at the same time is unclear. Although the contracts both specify provision of "Priority 1" emergency service, the meaning of "Priority 1" is not well-defined and does not provide any specific quantifiable level of risk reduction in emergency supply. Additionally, there is no evidence of participation by these vendors in fuel preparedness exercises, and they have not practiced emergency fuel delivery with the City.

The CEC recommends a backup vendor in a different region of the state as an available fuel supplier if in-region suppliers are unable to deliver fuel.[17] The City does not currently have any agreement with such a backup vendor and has not tested how delivery of fuel from an out-of-area emergency backup vendor would work. The City should rectify these vulnerabilities and ensure that truly independent, out-of-area fuel supplies are available in an emergency.

Preparing for Emergency Delivery by Water

There are three alternatives for delivering fuel to a distribution point: by truck, by water, or by air. Fuel delivery by air is too risky, and the capacity too low, for this to be a useful option. So delivery by truck or by water are the most viable options.

Unfortunately, a disaster that disrupts the normal fuel supply chain could disrupt infrastructure vital to truck delivery, including:

- Major routes, such as the Golden Gate Bridge, Bay Bridge, 101, and 280
- Loading and unloading facilities
- Truck and truck driver availability

These risks motivated the 2018 Fleet Week exercises to test fuel delivery by water. Fuel providers in an emergency water delivery situation could include private vendors or emergency government suppliers such as FEMA and the Department of Transportation's Maritime Administration. Delivery vehicles could be ships, barges, or other specialized watercraft for petroleum transport. Once the fuel has arrived dockside at a staging area, it can be transferred to trucks for intra-city delivery.

Several City piers, including Piers 50, 80, and 96, have supported heavy traffic between trucks and the ships moored there in the past. However, these piers have not been reinforced in many years and might not be seismically sound enough to receive fuel trucks after a disaster. Pier 96, for example, is a sand dike with unknown seismic vulnerability. Full assessment of its level of vulnerability does not appear to have been performed because of limited soil quality data. Experts estimate that improved geotechnical data to assess the vulnerabilities around this site would require an appropriation of several million dollars.

---

[17] California Energy Commission, "California Fuel Overview & Emergency Fuels Set-Aside Program" (PowerPoint presentation, University of California at San Francisco, November 4, 2020).

A study of the southern portion of the Port is expected to occur in 2022 in cooperation with FEMA and the Army Corps of Engineers. In the meantime, even if Pier 96 ultimately proves to be a seismically suitable and reliable site, the City should explore other sites to ensure that a reliable over-water fuel delivery and truck staging area will be available when needed.

Securing Intra-City Fuel Delivery Routes

Whether the fuel is delivered to the staging area by land or by water, trucks must then transport it to where it is needed. This requires careful planning. The City completed a foundational piece of this planning in 2019 with an analysis of priority routes for critical supply delivery and first responder operations.[18] These routes are prioritized by SFPW to be restored to usability first in the aftermath of a disaster.

The City has not, however, taken the next step to correlate priority routes with fuel demand and supply specifically. There is not a map or other document that links priority routes with key fuel storage sites such as fueling stations for fleet vehicles or critical infrastructure facilities with backup generators.

Such a map could assist in refining the priority routes. The City needs to determine whether there are roadways that need additional seismic improvements to secure the reliability of fuel supply lines after a major earthquake. Additionally, a digital map could be updated in real-time after a disaster to inform emergency responders and fuel suppliers of the current condition of priority routes.

Planning for a Resilient Future

Thorough planning, ideally with comprehensive written plans and playbooks that are reviewed and publicly available, is a key reliability driver for any complex system. The City can plan better to ensure fuel resilience on several timescales.

Short Term: Publishing a Comprehensive Plan

City agencies have discussed and known about the need for a fuel plan for many years. The 2018 Fleet Week After Action Report mentions a fuel plan as a resource for guiding follow-up actions and lists the publication of such a plan as one of its top recommendations. The Fuel Plan was intended to be published formally as part of the City's overall emergency response plan.[19]

But this "plan to make a plan" was never done. The formal Fuel Plan referred to in the After Action Report was neither fully vetted nor approved, and it remained a concept rather than a plan. As mentioned previously, the Fuel Working Group's work on the plan was interrupted in 2020 by the onset of COVID.

---

18 San Francisco Public Works, *Emergency Priority Routes Project*. PDF file. https://www.onesanfrancisco.org/sites/default/files/2019-06/DPW%20Priority%20Route%20Program.pdf

19 The plan was intended to be an attachment to the *Logistics Annex* (ESF #7).

Many recommendations from the 2018 Fleet Week After Action Report illustrate the benefits that a Fuel Plan could provide. Notably, these recommendations include:

- Establishing regional and City logistics task forces and workgroups that meet regularly to vet and enhance the logistical capabilities outlined in the Bay Area Earthquake Plan
- Establishing and exercising a thorough fuel handling, storage, and supply chain plan for disasters
- Establishing a statewide vendor contract database for disaster response agencies
- Expanding outreach to communication and resource supply chain private sector partners
- Incorporating resource request mechanisms and coordination paths information into plans

A Fuel Plan will also be an appropriate place to incorporate lessons learned from the COVID pandemic, with which many Fuel Working Group members now have experience. Supply chain management for the personal protective equipment needed during COVID is analogous to emergency fuel management in that both are scarce resources, both are supplied by outside vendors, both have high regional demand, and both need to be directed to the most life-critical uses. Emergency fuel management raises similar concerns to COVID regarding equity in that fuel supplies must be prioritized to sustain the infrastructure needs of underserved populations, just as medical supplies had to be prioritized for that purpose in the pandemic.

Publishing the Fuel Plan is a critical step in anticipating the actions, drills, and investments required to protect the City from fuel shortages in the weeks after a disaster. The City's leaders should take action to make this plan a reality.

Medium Term: Capital Planning for Fuel Resilience

The City allocates funding for long-term public projects through a regular capital planning process. Every two years the ORCP creates a Capital Plan (the Plan) detailing planned, budgeted, in-progress, and deferred projects that the City expects to work on over the ten years following the Plan's publication. The Plan typically includes budget estimates and funding sources for major projects along with planning for future general obligation bond issues.

Disaster preparedness is a major priority in the Plan. The City's stated prioritization principles for capital planning make this explicit by listing "protecting life safety and enhancing resilience" as the second-highest priority after legal mandates. For example, facility seismic upgrades are often in the Plan.

The City has engaged in long-term capital planning for several multi-decade, multi-billion-dollar projects to upgrade other aspects of lifelines resilience substantially, including the WSIP, SSIP, and the Waterfront Resilience Program (WRP) which funds seismic improvements to the seawall. The most recent 2021 draft Capital Plan discusses all of these extensively and references multiple line item subprojects for each one. These projects have substantial sources of dedicated ongoing funding, ranging from general obligation bonds to SFPUC revenue bonds to grants from several levels of government.

The 2021 draft Capital Plan demonstrates that work on all three of these programs has continued and new milestones have been reached, even during the COVID pandemic. The City has advanced these long-term lifeline resilience goals despite the budgetary uncertainty that arose from drastic changes to tax revenue and redeployment of personnel to COVID emergency response.

The lack of similar planned funding for fuel resilience is likely why this work was paused during COVID. It is also why projects like the purchase of another fuel transport truck have relied on grant funding. While fuel resilience initiatives do not generally require the same level of expenditures as the complex physical infrastructure upgrades required by the WSIP, SSIP, and WRP, they do need and deserve the same organizational support to succeed, and that requires consideration and inclusion in the Plan.

In particular, the Plan envisages a 2027 general obligation bond issue focused on earthquake safety and emergency response. Fuel resilience should be added to this bond issue to ensure long-term sustained progress on this lifeline. The specific studies, exercises, and Fuel Working Group meetings will likely turn up other high-priority resilience projects. Looking even further down the road, a decarbonized future, discussed below, will demand new types of capital investments for energy resilience over several decades. Establishing a dedicated bond revenue stream for fuel resilience will ensure that the City continues to support fuel resilience commensurate with its life-safety impact, now and into the future.

Long Term: Energy Resilience in a Decarbonized Future

Discussion to this point has been centered on fossil fuels (gasoline and diesel) and ensuring the appropriate management of both their demand and supply after a disaster. But if the San Francisco Climate Action Plan proceeds as intended, the focus will need to shift away from fossil fuel within the next generation, and possibly sooner. The Climate Action Plan aims to achieve net-zero emissions by 2050, and at the state level, an executive order from Governor Newsom directs the California Air Resources Board to develop regulations banning the sale of new fossil fuel-powered vehicles by 2035 and requiring heavy-duty vehicles to operate emission-free by 2045.

To ensure that the City's critical infrastructure remains resilient in 2050, the City should begin planning now. Some emergency vehicles and backup generators may initially be exempted from the zero-emissions requirements.

But even if they are exempted, it will be more difficult to supply those vehicles and generators with fuel when there is less overall demand for that fuel and thus a less robust supply chain to meet that demand. For example, gas stations will become less common as gas-powered vehicles are replaced with electric vehicles. The City will need an alternative.

The primary foreseeable alternative is battery-stored electricity, including onboard backup batteries in electric vehicles and stationary batteries installed near critical facilities. Bidirectional charging capability could allow electric vehicles to charge each other or act as backup power supplies for buildings. But the City has not planned for how electric fleet vehicles will be used and recharged in the aftermath of a disaster.

Multiple authoritative sources endorse the use of "solar plus storage" installations for disaster resilience. These are stationary batteries coupled to solar panels that can recharge them even during a grid power outage. The Lifelines Project report recommends installing solar plus storage at critical facilities whenever feasible to mitigate the impact of grid outages.[20] It also recommends electrifying fleet vehicles to reduce dependence on the fuel supply chain. Likewise, the Climate Action Plan lists installation of solar plus storage at key facilities as a strategic action.

Despite commitments in the 2019 and 2021 Capital Plans to pursue solar plus storage installations, the City has made minimal progress. SFPUC has installed a few pilot solar plus storage projects, but they are not designed to provide backup power in an emergency and are not located at critical facilities. A study commissioned by the San Francisco Department of the Environment identifying possible sites for solar plus storage did not include critical infrastructure facilities among the sites considered and did not discuss how solar plus storage might be used for disaster resilience.

Power experts agree that battery backup could work in principle but caution that battery technology is not yet ready for this sort of critical use. Indeed, there are concerns still to be worked out around the cost, complexity, safety, and reliability of battery installations. But the time to start resolving those concerns is now because the service life of generators, fleet vehicles, fuel storage facilities, and other components of critical energy infrastructure is typically measured in decades. If the next generation of such components is still all fossil fuel-based, it will be much more difficult to get to a resilient, electrified infrastructure by 2050. And if that next generation of components is *not* to be fossil fuel-based, the City needs to start planning for that future.

This planning process should begin in the next few years. There is much that the City still does not know about how a transition to electrified disaster response infrastructure will work, what the costs and risks will be, and on what timescale it can be accomplished. Studying those questions in light of the changing technological landscape is the crucial first step toward enabling lifeline services to remain reliable without fossil fuels.

---

[20] City and County of San Francisco, *Lifelines Restoration Performance Project*. PDF file. https://onesanfrancisco.org/sites/default/files/inline-files/Lifelines%20Restoration%20Performance%20Project%20Report_Oct%202020.pdf.

Findings

F1. In the aftermath of a major earthquake (magnitude 7.0 or greater), there will likely be severe citywide fuel and power shortages lasting *more* than 72 hours.

F2. If these shortages resulted in lack of power to lifeline infrastructure facilities and/or lack of fuel for critical lifeline vehicles, the resulting cascading failures of other lifelines could have life safety and quality-of-life impacts greater than the fuel and power shortages themselves.

F3. The City's lack of agency sponsorship and dedicated staffing and budgeting for fuel resilience efforts weakens its ability to ensure fuel resilience in an emergency.

F4. The cessation of fuel resilience progress during COVID indicates that the City is not prioritizing fuel resilience comparably to other aspects of lifeline resilience.

F5. In the aftermath of a major disaster, it will be difficult for emergency responders to catalog the citywide fuel needs of backup generators.

F6. It is impossible to determine how much fuel storage is needed to meet emergency demands after a disaster because the City has not prepared proper estimates of fuel needs in a range of disaster scenarios.

F7. Compiling inventories of available fuel in a disaster will likely take at least half a day and will rely partly on manual assessment of sites by personnel who might themselves be unavailable under disaster conditions.

F8. The City will have a severely limited and unreliable ability in a disaster to get fuel from available reserves to sites such as generator tanks that need fuel urgently.

F9. The City has not invested in technological solutions to augment the ability to refuel critical vehicles and generators in a disaster.

F10. The usability of privately-held local fuel reserves in a disaster is uncertain due to the lack of partnerships between the City and private gas station operators and incomplete data about which private stations could best augment critical supplies.

F11. Opportunities to expand fuel reserves within the City are very rare due to geographic constraints but very valuable for fuel resilience.

F12. In the aftermath of a region-wide disaster such as a major earthquake, the ability of the City's two contracted suppliers to deliver fuel might be compromised temporarily because they would both be susceptible to the same infrastructure failures.

F13. The City has not contracted with an emergency out-of-region backup vendor in case the two regular vendors cannot deliver fuel, as recommended by the California Energy Commission, despite the risk of region-wide disruptions compromising both.

F14. Although the City's two fuel suppliers are contractually responsible for providing technical support on products and offering assistance required by City personnel, they do not participate actively in the planning, simulation exercises, or ongoing work of the Fuel Working Group.

F15. If an emergency fuel delivery by water is needed, the City has not planned adequately for the risk that landing sites might be damaged, thereby compromising their ability to receive fuel delivery vessels or support tanker trucks for city transport.

F16. The City has insufficient knowledge about whether restoration of routes on the Priority Routes map will allow effective refueling of critical backup generators and fleet vehicles in the event of a disaster.

F17. The lack of a published San Francisco Fuel Plan makes it harder to coordinate on consistent fuel resilience best practices citywide.

F18. The lack of fuel resilience-related line items in the 2019 and 2021 Capital Plans indicates that the City is not prioritizing fuel resilience comparably to other aspects of lifelines resilience.

F19. Progress on fuel resilience has been impeded by the lack of a dedicated, reliable funding source.

F20. The City will likely need to replace some critical backup generators with batteries by 2050 but has not initiated planning for this.

F21. The City will likely need to rely at least partially on electric vehicles for critical infrastructure functions by 2050 but has not initiated planning for how this can be done in a disaster-resilient manner.

Recommendations

R1. The Mayor's Office should determine an appropriate agency sponsor for the Fuel Working Group by December 2021.

R2. The Fuel Working Group should be reconvened by its agency sponsor by February 2022. The working group should meet at least quarterly thereafter.

R3. The agency sponsor of the Fuel Working Group should select members with strong experience in supply chain logistics and emergency management. The Department of Emergency Management, the Office of Contract Administration, the City Administrator's Office, and other City departments who are significant users of fuel, including SFPUC, SFMTA, and DPW should dedicate staff time each month through December 2024, or until the subsequent recommendations in this report are implemented.

R4. By December 2022, the Department of Emergency Management should compile an inventory of generators critical to life safety in the City and their locations, portability, fuel needs, tank storage capacities, and burn rates. This inventory should be updated at least annually thereafter. The inventory should include information including generator location, fuel type, connection type, and any access codes needed for emergency delivery.

R5. By June 2023, the Department of Emergency Management should perform a team exercise to estimate likely ranges of fuel usage for critical generators in the City's inventory in the aftermath of a plausible disaster in which those usage needs would have to be met from local sources. The exercise should give lower and upper bounds stemming from possible variations in which generators would have to run and for how long.

R6. By December 2023, the Department of Emergency Management should develop and test a plan for the quick assessment of local fuel reserves available to City agencies in a disaster, including protocols that ensure incident commanders can assess emergency fuel supply and demand in real-time citywide.

R7. By December 2023, the City should build, retrofit, or purchase a minimum of two additional tanker trucks that can each extract up to 2,500 gallons of fuel from a tank, even in the absence of grid power, and transport it to where it is needed. These vehicles should have the ability to transport both gasoline and diesel fuel.

R8. By December 2022, the City should enter into Memoranda of Understanding or contracts with a minimum of two local private gas station operators to ensure that emergency vehicles can access fuel stored at their stations, including making that fuel technically accessible even in the event of a grid power outage. The operators chosen should be prioritized based on criteria relevant for usefulness in a disaster, such as:

- Amount of fuel stored at the station
- Availability of both gas and diesel
- 24/7 staffed operation
- Ability to dispense fuel without relying on grid power
- Proximity to priority routes
- Geographical distribution of stations (i.e., not all in the same place)

R9. In the 2023 Capital Plan, the City should commit to building an additional fueling station with five-ten thousand gallon storage capacity for both gasoline and diesel fuels in the space to be freed up at the Southeast Treatment Plant when the digester replacement work is done, or to identify an alternate site for an additional fueling station if the Southeast plant is not available.

R10. By December 2022, the Office of Contract Administration should prepare a supply chain vulnerability assessment of the City's two contracted fuel suppliers.

R11. If the two contracted fuel suppliers are found to have joint vulnerabilities that cannot be mitigated adequately, the Office of Contract Administration should enter into a Memorandum of Understanding by December 2023 for emergency backup delivery with a vendor whose facilities and equipment are based outside of the Bay Area.

R12. By December 2021, the Fuel Working Group should ask each City-contracted fuel supplier to send a qualified representative to the Group's planning meetings, field simulations, and other events where the technical advice and operational experience of fuel distributors are needed to help secure disaster readiness.

R13. By December 2023, as part of a Fleet Week live exercise, the Department of Emergency Management and the Office of Resilience and Capital Planning should test a scenario in which the City's normal supply line is damaged and delivery by water is necessary. This exercise should include a full demonstration of marine cargo delivery, readiness of the staging area, performance of the transfer-storage-filling equipment, and performance of the tanker trucks.

R14. By December 2023, the Department of Emergency Management, the Office of Resilience and Capital Planning, and the Port should prepare a seismic vulnerability assessment of likely delivery sites for emergency fuel delivery by water, including Pier 96, Pier 80, Pier 50, and at least one alternative delivery site.

R15. By December 2022, the Department of Emergency Management should publish an analysis of the priority routes determining whether they will allow sufficiently reliable refueling of critical backup generators and fleet vehicles.

R16. By June 2022, the City Administrator's Office should publish a San Francisco Fuel Plan developed in collaboration with the Fuel Working Group. The Fuel Plan should cover key resilience measures such as:

- Processes and timescales for identifying fuel on hand in City-accessible storage
- Citywide policies for maintaining fuel reserves in available tanks (e.g., keeping fleet vehicles topped up at the end of each day, reserve requirements for generator tanks)
- Keeping track of burn rates in normal and plausible emergency scenarios
- Information centralization for key sources and users of fuel, (e.g., types of hose connections used by fuel tanks)
- Scheduling drills around emergency fuel deliveries including surrounding counties
- Functional evaluation of city assets needed for emergency fuel delivery (e.g., piers, roadways, and equipment)
- Reviewing city contracts with fuel vendors
- Developing specifications for equipment that needs to be purchased

The Fuel Plan should also incorporate logistical lessons learned from the COVID pandemic.

R17. In the 2023 Capital Plan, the City should commit to funding capital projects that are identified in the Fuel Plan as a high priority to improve fuel resilience in the City over the subsequent ten years.

R18. In the 2023 Capital Plan, the City should specify how it will provide at least $10 million in dedicated funding for fuel resilience capital projects within the next ten years using general obligation bond revenue.

R19. By December 2024, the Office of Resilience and Capital Planning should publish a feasibility study on replacing current City backup generators with battery backup installations or other zero-emission technology by 2050. The study should examine costs, risks, and alternatives, including mobile and stationary battery sources, taking into account not only the present state of battery technology but likely future developments in upcoming decades.

R20. By December 2024, the Office of Resilience and Capital Planning should publish a plan for achieving disaster resilience with a zero-emissions City vehicle fleet. This plan should analyze the stationary backup power sources that might be needed to recharge critical response vehicles in the event of a disaster and how bidirectional charging technology might be used to enable the batteries in City fleet vehicles to serve as mobile backup power sources analogous to mobile backup generators but also likely future developments.

Request for Responses

Pursuant to Penal Code sections 933 and 933.05, the Jury requests responses as follows:

From the following City agencies within 60 days:

- From the Office of the Mayor:

Findings	1,2,3,4,5,6,7,15,16,17,18,19,20,21
Recommendations	1,2,3,4,5,6,9,12,13,14,15,16,17,18

- From the City Administrator's Office:

Findings	3,4,8,9,10,11,12,13,14,17,18,19,20,21
Recommendations	1,2,3,7,8,9,10,11,12,13,14,16,17,18,19,20

- From the Department of Emergency Management:

Findings	1,2,4,5,6,7,8,9,14,15,16,17,20,21
Recommendations	4,5,6,13,14,15

- From the Office of Resilience and Capital Planning:

Findings	8,9,18,19
Recommendations	9,13,14,17,18,19,20

- From the Office of Contract Administration:

Findings	10,12,13,14
Recommendations	7,8,10,11

- From the San Francisco Public Utilities Commission:

Findings	11,20
Recommendations	3,9

From the following governing body within 90 days:

- From the Board of Supervisors:

Findings	3,4,18,19
Recommendations	9,17,18

Bibliography

Alameda County Civil Grand Jury. *Disaster Preparedness: How Ready is Alameda County?* PDF file. http://grandjury.acgov.org/grandjury-assets/docs/2019-2020/DisasterPrep.2020-3.pdf

Association of Bay Area Governments. *Cascading Failures: Earthquake Threats to Transportation and Utilities*. PDF File. December 2014. https://abag.ca.gov/sites/default/files/infrastructurereport_2014.pdf

California Energy Commission. "California Fuel Overview & Emergency Fuels Set-Aside Program" (PowerPoint presentation, University of California at San Francisco, November 4, 2020).

California Office of Emergency Services and Bay Area Urban Areas Security Initiative. *Bay Area Regional Catastrophic Earthquake Logistics Response Plan*. PDF file. February 2014. http://www.bayareauasi.org/sites/default/files/resources/Regional%20Logistics%20Response_February%202014.pdf.

City and County of San Francisco. *Capital Plan*. PDF File. Fiscal Years 2020-2029. https://onesanfrancisco.org/sites/default/files/2019-06/19CapPlan-Doc_FINAL_Web_190517.pdf

City and County of San Francisco. "Draft Capital Plan for Fiscal Years 2022-2031." One SF. https://www.onesanfrancisco.org/Draft-Plan-2022

City and County of San Francisco. *ESF #7: Logistics Annex*. PDF File. https://sfdem.org/sites/default/files/FileCenter/Documents/65-CCSF%20ERP%20ESF%207%20-%20Logistics%20Annex.pdf

City and County of San Francisco. "Hazards and Climate Resilience Plan." One SF. https://onesanfrancisco.org/hazard/overview

City and County of San Francisco. *Lifelines Restoration Performance Project*. PDF file. October 2020. https://onesanfrancisco.org/sites/default/files/inline-files/Lifelines%20Restoration%20Performance%20Project%20Report_Oct%202020.pdf

City and County of San Francisco. "Plans." Department of Emergency Management. https://sfdem.org/plans-0

City and County of San Francisco Civil Grand Jury. *Act Now Before it's Too Late: Aggressively Expand and Enhance Our High-Pressure Emergency Firefighting Water System*. PDF file. June 13, 2019. https://civilgrandjury.sfgov.org/2018_2019/AWSS_Final_Report_with_Appendices_6_13_2019.pdf

City and County of San Francisco Civil Grand Jury. *Disaster Planning: The Realities of Emergency/Disaster Medical Preparedness in San Francisco*. PDF file. May 2006. https://civilgrandjury.sfgov.org/2005_2006/Disaster_Planning.pdf

City and County of San Francisco Civil Grand Jury. *It's a Catastrophe: The State of Emergency Planning in San Francisco*. PDF file. June 19,2003. https://civilgrandjury.sfgov.org/2002_2003/Its_A_Catastrophe_The_State_of_Emergency.pdf

City and County of San Francisco Civil Grand Jury. *Keeping the Faucets Flowing: Water Emergency Preparedness in San Francisco*. PDF file. June 19, 20013. https://civilgrandjury.sfgov.org/2002_2003/Keeping_the_Faucets_Flowing_Water_Emergency.pdf

City and County of San Francisco Civil Grand Jury. *Preparing for a Disaster: Administrative Commitment and Appropriate Funding in the Department of Emergency Management and the Department of Public Health*. PDF file. July 9, 2007. https://civilgrandjury.sfgov.org/2006_2007/Preparing_for_Diaster.pdf

City and County of San Francisco. *Rising Sea Levels … At Our Doorstep*. PDF file. June 2014. https://civilgrandjury.sfgov.org/2013_2014/2014_CGJ_Report_Rising_Sea_Levels_w_correction.pdf

Port of San Francisco. "Waterfront Resilience Program." San Francisco Port Resilience. https://www.sfportresilience.com/

San Francisco Department of Emergency Management. *2018 San Francisco Fleet Week Exercise After Action Report*. PDF file.

San Francisco Department of the Environment. "San Francisco Climate Action Plan." SF Environment. https://sfenvironment.org/climateplan

San Francisco Public Utilities Commission. "Sewer System Improvement Program." San Francisco Water Power Sewer. https://www.sfwater.org/index.aspx?page=116

San Francisco Public Utilities Commission. "WSIP Overview." San Francisco Water Power Sewer. https://sfwater.org/index.aspx?page=115

San Francisco Public Works. *Emergency Priority Routes Project*. PDF file. https://www.onesanfrancisco.org/sites/default/files/2019-06/DPW%20Priority%20Route%20Program.pdf

State of California. "Governor Newsom Announces California Will Phase Out Gasoline-Powered Cars & Drastically Reduce Demand for Fossil Fuel in California's Fight Against Climate Change." CA.GOV. https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/

The Lifelines Council. *Lifelines Interdependency Study|Report*. PDF file. April 17, 2014. https://sfgov.org/ccsfgsa/sites/default/files/ORR/documents/Lifelines%20Council%20Interdependency%20Study.pdf

Disclaimer

Two members of the Civil Grand Jury recused themselves from involvement with the investigation and preparation of this report.