The FUNDamental Point Missing from the Wildfire Tech Conversation

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The rise in technology over the last three decades has made life significantly easier for most Americans. It would be hard to argue this point. The potential seems limitless for emergency management challenges, such as wildfire.

Recently, there has been a lot of financial investment and conversations surrounding early detection and AI sensing. According to the Los Angeles Times, "Amid an outbreak of recent wildfires in California, Google announced a commitment to spend $13 million to improve satellite imaging to help track and detect wildfires."[1] This announcement came in the early fall of 2024, and the first satellite was officially launched on March 14, 2025 as part of SpaceX's Transporter-13 mission.

Many wildfire-related tech start-ups are excited about this new opportunity, as it signals a continued investment in platforms that rely on Artificial Intelligence (AI) and other technological advances to help prevent wildfires. AI is also becoming an increasingly popular tool for planning and fire behavior modeling. However, it is worth noting models have yet to accurately predict the devastation that occurred from the Camp, Palisade and Eaton Fires.

Technology is great in theory, and even better in California. Considering it is the state with the biggest wildfire problem; it has spent the last several decades building an infrastructure that can integrate and implement these more sophisticated and complex systems. However, the wildfire problem has become a global issue and many communities are starting from scratch. Therefore, it feels as if an inequitable amount of time, energy and resources are being focused on a solution that is still years and years down the road for the majority of fire departments in America.

What does the research say?

Definitions of the wildfire problem, and subsequent recommendations, have become increasingly subjective. For example, one company claims, "By capturing high-resolution images of the Earth every 20 minutes, the satellite aims to solve the three main challenges of global wildfire mitigation: early fire detection, real-time tracking of the fire movement and understanding fire intensity." There has yet to be one official study that claims early detection is the biggest obstacle to wildfire mitigation.

In August 2024, the National Fire Protection Association's (NFPA's) Fire Protection Research Foundation released the results of a survey administered to "wildfire mitigation stakeholder groups, including government officials, local fire departments, and residents in California and

1 Gomez, Melissa. "Google to invest in satellites and AI to better detect wildfires." Los Angeles Times. 17 September 2023. Access: <https://www.latimes.com/california/story/2024-09-17/google-to-invest-in-satellites-and-ai-to-better-detect-wildfires>.

Oregon."[2] Some of the most notable findings from fire departments in the Stakeholder Perceptions of Wildfire Mitigations for Homes: Multi-Audience Survey Research report include,

- "Lack of funding and resources were reported as the biggest obstacles to achieving wildfire mitigation goals.
- The lack of dedicated staff assigned to outreach and education on wildfire risk and mitigation stems from the funding and resource shortages.
- A majority of firefighters surveyed believe that wildfire protection should be a shared responsibility between property owners and firefighters.
- A majority of departments now have a division dedicated to wildfire issues, and just over half of departments surveyed have allocated personnel specifically for wildfire mitigation or wildfire hazard assessments." [2]

This heavily aligns with internal data collected on all grant requests from the 2019 to 2024 fiscal year. **Figure 1** shows a comprehensive breakdown of requests. Out of 73 total grants, 40 have been dedicated to wildfire prevention.

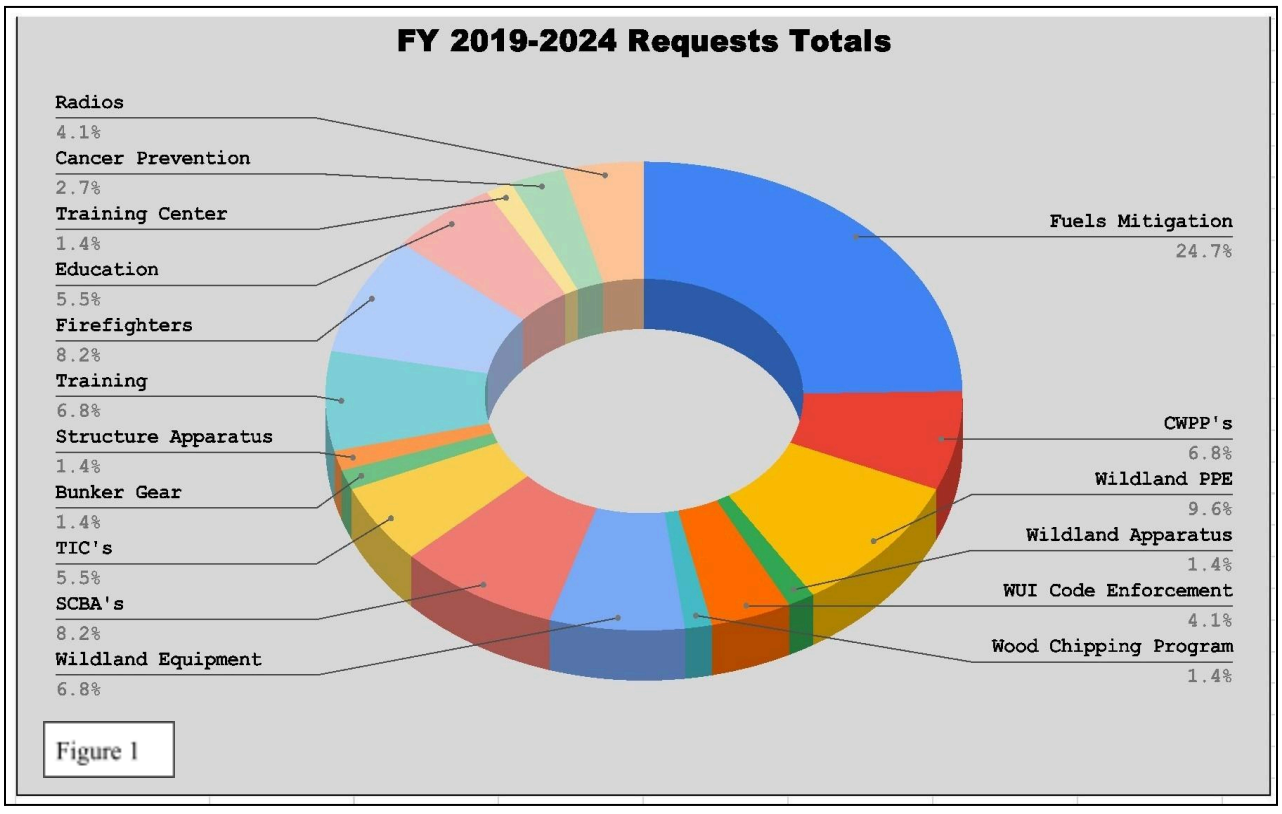

Figure 1

2 "How Stakeholders View Wildfire Mitigation Efforts for Homes." United States Fire Administration. 22 August 2024. Access: <https://www.usfa.fema.gov/blog/ how-stakeholders-view-wildfire-mitigation-efforts-for-homes/>.

Further, the LA Times article also states, “FireSat, a constellation of more than 50 satellites, will be able to detect wildfires as small as the size of a classroom, about 16 by 16 feet, and the first satellite will launch in early 2025, the media giant announced Monday. Firefighting authorities currently rely on satellite imagery that detects wildfires, but only when they reach about the size of a football field, or more than an acre.”[3] Realistically speaking, only a handful of states have early detection technology. It is safe to assume that most fire departments in America do not have access to satellite detection unless a utility provider has a sensor nearby, so they still have to rely on smoke reports from look-outs, first responders and/or residents.

Fire Department Breakdown

According to the United States Fire Administration, out of the 27,089 fire departments registered in the National Fire Department Registry, 85.2% rely primarily on volunteers.

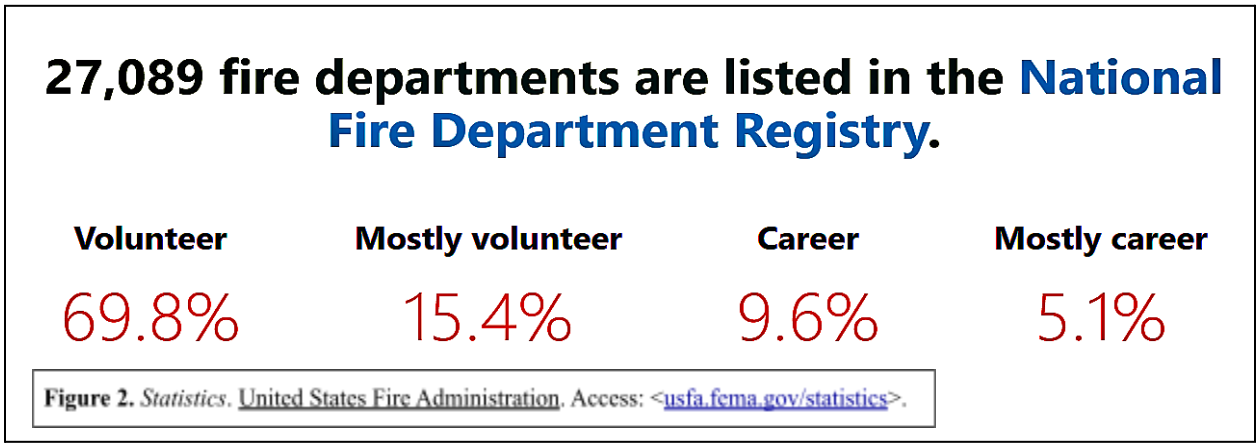

Figure 2. *Statistics*. United States Fire Administration. Access: <usfa.fema.gov/statistics>.

All-Volunteer Fire Departments - Consist of all volunteers. There are no paid positions.

Mostly Volunteer: These departments have a mixture of volunteer and paid firefighters. However, the majority of the full-time staff employed at these departments are assigned a lot of administrative and operational planning duties.

Mostly Career: These departments have a higher volume of paid administrative and officer positions, but supplement emergency response and overhead time with volunteers.

All Paid/All Career: These departments are all-paid and career-type departments. Typically these are found in major metropolitan areas, which have the tax base and economy to support multi-million dollar budgets. That is the infrastructure needed for comprehensive technology integration. Yet these are not the areas that have the biggest wildfire risk or early detection problems. These communities often lack the large timber trees that can hide smoke columns.

[3] Gomez, Melissa. “Google to invest in satellites and AI to better detect wildfires.” Los Angeles Times. 17 September 2023. Access: <https://www. latimes.com/california/story/2024-09-17/google-to-invest-in-satellites-and-ai-to-better-detect-wildfires>.

In California, 28.4% of all fire departments are all-volunteer, a stark comparison from the national average. Conversely, it is worth noting that California only represented 3% of total award selection for the 2023 Fiscal Year Assistance to Firefighters Grant, according to internal data. The federal grant programs are still a vital component to ensuring fire departments have access to funding that can help them make high-value purchases such as Self-Contained Breathing Apparatus (SCBA's) and replacing outdated engines.

The Ugly Truth about Funding Fire Departments

As priorly stated, the state of California has the infrastructure and the economy in place to not have to rely on federal funding assistance. That economy includes a voter base that approved the $10 billion dollar Climate Change initiative. Moreover, CAL FIRE has a comprehensive grant funding program, along with various private stakeholders that support mitigation efforts. Governor Newsom's "Make America Rake Again" legislation is a huge step towards putting good fire on the ground. It is indisputable that California is doing some amazing things in the wildfire prevention realm. However, if we want to truly reduce the risk of wildfire everywhere, we have to start analyzing the wildfire problem everywhere. That includes understanding how the current funding infrastructure and pathways cannot withstand the new level of occurrence and severity. If the technology was truly made to benefit first responders, then it is essential to understand how fragile and cumbersome the market is for fire departments.

Volunteer fire departments try to provide their firefighters with on-call and/or per-call stipends, but that is not always plausible because they are primarily funded through tax revenue. It is also harder to get local tax incentives to pass because there are so many competing interests for these underserved communities. With cuts in federal spending for wildfire prevention, this could make it increasingly harder for rural volunteer fire departments to prepare for a growing wildfire risk. As history has repeatedly demonstrated, risk is not often mitigated until after the threat bursts through the front door. It's a gamble every community living in a fire-prone area takes.

Volunteer fire departments also encounter a lot of obstacles when it comes to submitting grants, including but not limited to:

- They don't have funds for a professional grant writer and may not know of local resources that can support this activity.
- Applying for and managing grants can be a very complicated process. Without the proper support and/or administrative staff, it is harder for departments to write a competitive application. Moreover, the chances of selection decrease without personnel that can support it. Therefore, even when grants are catered to rural volunteer fire departments, they don't always have the strongest competitive edge.
- Lack of knowledge about grants entirely.
    - **Tip for departments**: My entire wildfire planning profession began because my fire chief told me, "You can put a sentence together, you're our new grant writer." When I gave a presentation at the Indianapolis Fire Tech Summit in February

2025, I told fire departments to go to their local public education partners. A grant application for the local fire department would make a great cross-curricular project for high school students.

Going back to **Figure 1**, SCBA's and Thermal Imaging Cameras (TIC's) represented the item most requested, outside of wildfire mitigation and prevention. While the argument can be made that mapping from the new satellites can assist firefighters on the ground, that is only dependent on the fact that they have, and are trained, on the technology needed to support ground operations. TIC's take away a lot of the middle-man and extra expenses that come along with mapping programs because firefighters can carry them during ground operations. More importantly, TIC's do not rely on cell service or connectivity to be operational, which is another big obstacle to suppression in rural communities.

Another problem that delays early and aggressive initial attack on wildfire ignitions is response times. When a lot of volunteer fire stations were originally built, their purpose was to house fire engines and equipment, not firefighters. However, as the wildfire problem has increased in rural areas, the additional time it takes firefighters to get to their actual equipment can delay response time from 15-30 minutes. Unfortunately, it is extremely hard to find funding pathways that support fire station construction. An argument can be made that if stations were expanded it could help reduce delays in response time. Still, that would be dependent on having the funds for personnel to be staffed at the station 24/7.

Training, along with access to wildland personal protective equipment (PPE) and wildland tools, is another challenge for volunteer departments facing an increase in wildland and/or vegetation fire. They usually struggle to keep their bunker gear and SCBA's updated, which puts these items at the bottom of the priority until wildland calls outnumber structure calls. Bunker gear is significantly bulkier, making it harder for firefighters to move quickly in rough terrain. Having wildfire suppression training and the proper equipment to carry out those objectives also increases the efficacy in initial attack operations.

Those are the difficulties volunteer fire departments have accessing funding to critical resources. Unfortunately, all paid/career fire departments face different challenges that also restrict their access to funding and resources. Their budgets are still heavily reliant on tax revenue, which increases operational capacity. However, funds and budgets are still determined by boards or city officials, and they have to compete with every other municipal department. Further, the chances of funds being misappropriated increase if financial decisions are being made by those who don't have a comprehensive understanding of the wildfire crisis.

Public outreach and community engagement is arguably the biggest challenge to developing and updating Community Wildfire Protection Plans. It can consume a project budget and kill a timeline. However, without community participation and buy-in, the chances of residents reducing their personal risk decreases significantly. Organizations and nonprofits are working

tirelessly trying to troubleshoot this problem. There are technologies and applications that have been created to help assist with this problem. However, an argument can be made that one of the biggest things humanity is missing in a post-pandemic world is genuine human connection. Firefighters are one of the biggest untapped resources for public engagement. Generally speaking, firefighters are a staple of their community and are often well-received by the public. This is not always the case, but as Snoop Dog once said, "No one ever wrote a song called 'F**k the Fire Department."

Unfortunately, both volunteer and all paid/all career fire departments struggle to find the time to plan and implement public engagement events outside of annual fundraisers. This is not meant to be a generalization, because they make it happen. For volunteer departments, a lack of funding and back-up support in case a call comes during the event makes it increasingly difficult to plan and pull off. For all-paid/career departments in cities and suburbs that have a high cost of living, a lot of firefighters can't afford to live in the communities they protect. An article published by *The Guardian* in 2023 reports on a California firefighter who moved his family to Nashville because the cost of living in Los Angeles was too high, and flew back to Los Angeles for his shifts.[4] This seems to be a common trend for many all paid/all career fire departments across California.

Firefighters aren't the only ones leaving, though. Homeowners in fire-prone areas are facing a lot of uncertainty right now. Insurance companies and mortgage companies are pulling out of cities and states at an alarming pace. Climate-driven migration is starting to happen, and industries are picking up on the trend. According to a study completed by Engineered Vision, $560 billion dollars are currently being invested in Manufacturing Megaprojects across the United States. Arizona, Idaho, Nevada and New Mexico are the only "traditionally" fire-prone states that are receiving funding from these projects. An alarming majority of these investments are being made throughout the Midwest and along the East Coast.

The point is the current national infrastructure does not support the growing wildfire crisis. Future funding opportunities are unknown at this time, which makes our rural communities more vulnerable to disasters they won't be able to recover from. It's not that the technology conversation doesn't matter, it's just not practical for everyone at this time. We have to acknowledge the funding limitations and re-imagine the antiquated volunteer infrastructure. When almost 70% of fire suppression is done by free labor, there isn't a huge financial incentive to change. Moreover, budget constraints can prevent the change from occurring, and recruitment and retention continues to be an obstacle across the country.

[4] Montali, Stefano. "Meet the California firefighter 'super commuters' traveling 2,000 miles for work." The Guardian. 23 August 2023. Access: <https://www.theguardian.com/us-news/2023/aug/23/california-firefighter-super-commuters-traveling-work>.

Cost-Benefit Analysis - Where is your market?

Wildfires are exacerbating the cost-of-living challenges for every American. The supposition that residents who live in mountainous areas are automatically rich is extremely inaccurate. According to the American Forest Foundation 39% of American forests are family-owned, representing the largest portion of forested private landownership.[5] This represents the same percentage of U.S. farmland ownership, according to the USDA's 2014 Tenure, Ownership, and Transition of Agricultural Land (TOTAL) Survey.[6] When these residents lose their homes, they cannot afford to rebuild at the inflated costs. These are also the populations that struggle the most to reduce the fuel load on their property.

Homeowners are an attractive market for autonomous suppression technology. Yet, given the percentage of generational landowners, and increased financial pressures that plausible market is cut by at least 40%.

If volunteer departments and homeowners are ruled out, that leaves all paid/combined career departments, private corporations and entities, military and state agencies. In order to beat out competition, the autonomous technology needs to be capable of multiple operational tasks to be considered cost-effective.

Currently, autonomous technology, drones and robots are able to perform 1-2 tasks, and at a much slower pace than a human. Aerial assistance is extremely helpful, but it is limited to 30-35 mph wind speeds, and RAWs data from historic fires reveal 50-80 mph wind gusts.

While the cost of suppression seems high now, it is relatively misunderstood and significantly lower than what it would cost with additional technological intervention. This again demonstrates a need for autonomous suppression systems be multi-faceted. Once it inevitably runs out of water, can it go dig line?

There is no concrete data on what percentage of rural areas are covered by hydrants. However, based on common trends in grant applications, it's safe to assume it's under 5%.

It's also hard to get exact numbers for what some of the autonomous drones and robots will cost, but it is also safe to assume that it will cost more than $69.24/hr, which is the hourly rate for a top-level AD-M emergency response worker.[7]

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[5] "The Link to Family Forest Owners." American Forest Foundation. Access: <https://www.forestfoundation.org /why-we-do-it/the-link-to-family-forest-owners/>.
[6] 2014 Tenure, Ownership and Transition of Agricultural Land (TOTAL). United States Department of Agriculture. Access: <https://agcensus.library.cornell.edu/census_parts/2012-2014-tenure-ownership-and-transition-of-agricultural- land-total/>.
[7] 2025 Administratively Determined Pay Plan for Emergency Workers. United States Department of the Interior. Page 4. Access: <https://gacc.nifc.gov/sacc/resources/inc_bus_mgmt/DOI_AD_ Pay_Plan.pdf>

Figure 3 shows the 2025 Administratively Determined Pay Plan for Emergency Workers. Entry-level firefighters (AD-A) start at $18.44/hr. Wildland firefighters are significantly cheaper than autonomous suppression technology. Their range of movement and ability to complete multiple tasks outperform any current known robotic system.

Classification	Pay rate (per hour)
AD-A	18.44
AD-B	20.24
AD-C	22.60
AD-D	24.84
AD-E	27.32
AD-F	29.76
AD-G	32.48
AD-H	36.40
AD-I	40.20
AD-J	44.32
AD-K	48.64
AD-L	58.24
AD-M	69.24

Figure 3

In a 2015 article, Brian Y. Lattimer, Associate Professor of Mechanical Engineering at Virginia Tech acknowledges,

> "Future use of robots in firefighting will depend on the robot durability, sufficient sensors for environment monitoring and perception, task capabilities, cost, level of autonomy, and movement speed. Many of the robots being designed for firefighting applications are lacking in some or all of these areas. For firefighters, cost is a significant consideration and is currently restricting the more broad use of robotics in firefighting. However, as these robots become more effective at conducting firefighting tasks while firefighters monitor their performance at safe locations, robots will be used more routinely to support firefighters."[8]

The new normal with fire has caused a lot of knee-jerk reactions from industries and communities that don't understand the various complexities and nuances that come with funding and suppressing wildfire. It is tied to the national infrastructure that has existed for more than a century. Refusing to acknowledge that infrastructure, and its inevitable collapse means that effective response, planning and prevention efforts will continue to be delayed. The time to act is now, but we need to be acting with intention and acknowledging that no one is certain what the future holds for funding these disasters.

[8] Lattimer, Brian Y., Ph.D. "Robotics in Firefighting." Society of Fire Protection Engineers. Copyright 2015. Access: <https://www.sfpe.org/publications/fpemagazine/fpeextra/etarchives3/fpeetissue100>.