XPRIZE WILDFIRE

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INNOVATION LANDSCAPE REPORT

AUG 2026

FOREWORD

Wildfire is no longer a seasonal challenge—it is a constant, growing threat across California and around the world. For utilities, communities, and customers, the risks are immediate: to lives, to infrastructure, and to the reliability of the energy systems we depend on every day.

As this report makes clear, today's wildfire environment is outpacing the tools built to manage it. Detection can be slow. Response can be fragmented. And under extreme conditions, even the most experienced teams face limits in how quickly and safely they can act.

At Pacific Gas and Electric Company (PG&E), we see this reality up close. Strengthening wildfire resilience is at the core of how we serve our customers and protect the communities we call home. Meeting that responsibility requires more than operational excellence—it demands a step change in how we detect, understand, and respond to emerging threats.

That is why the innovations emerging through XPRIZE Wildfire matter.

What stands out in this Innovation Landscape is not just the pace of progress, but the shift toward integrated, end-to-end systems. Across space-based monitoring, AI-powered detection, and autonomous response, teams are building solutions designed to work together—closing the critical gap between ignition and suppression. This is not incremental progress; it is a new operating model for wildfire management.

The goal is clear: detect fires earlier, respond faster, and operate effectively in the conditions where traditional approaches may fall short. Achieving that goal has the potential to fundamentally change outcomes—for first responders, for utilities managing infrastructure risk, and for the customers and communities we all serve.

This report provides a valuable snapshot of that progress—highlighting both the breakthroughs underway and the barriers that remain, particularly around response time, detection accuracy, accessibility, and performance in extreme conditions.

What gives me confidence is the convergence we are seeing across sectors and disciplines. **Innovators are aligning around a shared objective: building scalable, resilient systems that can protect communities everywhere—from high-risk regions in California to remote areas around the globe.**

The opportunity ahead is significant. By pairing innovation with deep collaboration across utilities, technology providers, policymakers, and first responders, we can accelerate the deployment of solutions that improve safety, strengthen grid resilience, and better serve our customers.

We are entering a new era of wildfire management—one defined by speed, intelligence, and autonomy. The work captured in this report shows that, with the right focus and partnership, a more resilient future is within reach.

Mark Quinlan
Senior Vice President of Wildfire, Emergency & Operations at PG&E

TABLE OF CONTENTS

1. Overview 05

1.1 Methodology 07

2. Competition Outlook 08

2.1 Commercial Progress 10
2.2 Key Client Industries 11
2.3 Team Readiness 12
2.3.1 Technology readiness 12
2.3.2 Track A Semifinals (April 2025) 13
2.3.3 Track B Semifinals (July - October 2025) 14

3. Innovation Landscape 16

3.1 Core Barriers 17
Barrier 1: Response Time 17
Barrier 2: Detection Accuracy and Precision 17
Barrier 3: Accessibility 18
Barrier 4: Operability in Extreme Conditions 18
3.2 Wildfire Technology Innovation 19
3.2.1 Space-Based Detection 19
3.2.2 Sensors/Cameras/Towers 20
3.2.3 ML/AI Detection 21
3.2.4 Unmanned Aerial System (UAS) Detection 23
3.2.5 Autonomous Response and Suppression 23

4. Conclusion 25

4.1 Appendix 27
4.1.1 XPRIZE Wildfire Semifinalist Teams 28
4.1.2 XPRIZE Wildfire Qualified Teams 28
Special Thanks 30

"We are at an inflection point. Wildfires are outpacing the systems we built to fight them — but the next generation of technology like those emerging from XPRIZE Wildfire show us a future where rapid, autonomous detection and response is within reach for every community, regardless of geography or resources."

- Dr. Lori Moore-Merrell | Former U.S. Fire Administrator

We are entering a new era where large, high severity wildfires are not inevitable- they are a solvable problem. The convergence of advanced detection, AI, and autonomous response systems has created an unprecedented opportunity to fundamentally change outcomes and create a wildfire resilient future, and XPRIZE is helping catalyze the kind of audacious, cross-sector innovation required to get there. Our opportunity now is to bring these capabilities together into a unified, scalable approach that changes what's possible and ends destructive wildfire."

- Chris Anthony | Founder and CEO - FireWERX

OVERVIEW

Around the world, wildfires are increasing in intensity, frequency, and destruction, and innovation to detect and manage wildfire events has not kept pace with the mounting challenges. Often, wildfires start in hard-to-reach areas and are fueled by extreme weather conditions like drought, high winds, and heat waves. As the risk of wildfires increases, the cost to human life and infrastructure increases exponentially. Current detection and response times are too slow, insufficiently coordinated, and not precise enough to respond to the changing wildfire paradigm.

IMAGINE A WORLD where the most effective technology is deployed to detect and respond to high-risk wildfires before they become destructive.

XPRIZE Wildfire is a 4-year, $11 million competition incentivizing the innovation of firefighting technologies that will end destructive wildfires so that humanity and beneficial wildfire can safely co-exist. Over these years, the XPRIZE Wildfire competition has produced more than incremental improvements to existing technology; it has generated systems integration breakthroughs that did not exist before the competition began. These innovations emerged not from any single team's technical capability, but from the rigid structural constraints imposed by the prize: the requirement to detect and respond, the need to discriminate target fires from decoys, the requirement to identify fires at their smallest size, and the challenge of operating fully autonomously in live field environments.[1]

Across two complementary tracks, the prize is moving the needle to transform current wildfire management approaches through the development of new technologies that can rapidly and accurately detect, characterize, and respond to wildfires before they become destructive. Built to withstand high winds, heavy smoke, cloud cover, day and night operations, and other extreme fire conditions, these technologies are designed for resilience when it matters most. By uniting detection and response into a single system, streamlining across firefighting networks, and reducing costs, teams are creating life-saving tools that can be deployed globally and not just in well-resourced regions. The result: a future where humanity coexists safely with natural fire, preserving its ecological role while preventing destructive wildfires that impact lives, ecosystems, and economies.

This innovation landscape report provides an in-depth analysis of the technology being developed by teams competing in the XPRIZE Wildfire competition. The scope of the report encompasses the two complementary tracks: Space-based Wildfire Detection and Intelligence (Track A) and Autonomous Wildfire Response (Track B). While Track A focuses on real-time space-based wildfire detection and intelligence, Track B tackles autonomous response and suppression system development, addressing together the fundamental wildfire challenges of early detection and accurate suppression.

[1] For a more comprehensive look into how XPRIZE Wildfire is contributing to the wildfire innovation landscape, please read XPRIZE Wildfire: A Case Study of Global Innovation, featured in the Responsible FireTech Innovation Playbook, Wonder Labs (2026, forthcoming)

In the Autonomous Wildfire Response Track, teams will develop cutting-edge, integrated autonomous technologies to swiftly detect and suppress wildfires before they grow out of control. This track provides the critical next step: rapid, localized detection and suppression via integrated systems deployed at ground level. A $1M Bonus Prize from Lockheed Martin seeks to advance rapid detection of fires at ignition.

In the Space-Based Wildfire Detection and Intelligence Track, presented by the Minderoo Foundation, teams will address the greatest barrier to how we currently fight fires by rapidly and accurately detecting all fires across a vast and remote area, and transmitting data to ground stations. Teams may use space-based sensors, AI, machine learning, and other technologies to expedite space-based detection of incipient wildfires across landscapes larger than states. The winning team will accurately detect and precisely characterize all fires $10m^2$ in size and smaller, toward $1m^2$, and report with the least false positives to decision makers on the ground within ten minutes.

The competing teams showcase an impressive diversity of technical approaches, from AI-powered satellite observation networks to autonomous drone swarms capable of coordinated suppression. This report examines in detail how the teams' technological innovations directly address the core problems plaguing current wildfire management systems, with specific analysis of detection capabilities, response mechanisms, integration architectures, and scalability pathways.

1.1 Methodology

This technology landscape analysis draws on multiple sources of data collected throughout the XPRIZE Wildfire competition. The report incorporates data from:

- Team surveys administered during the competition, including both closed and open-ended questions on technical capabilities, commercialization progress, and market focus
- Milestone development check-ins submitted by teams as part of competition reporting requirements
- Technical verification data collected during the Track A and Track B Semifinal evaluations
- Technical documentation and submissions provided by teams during qualification and Semifinal rounds

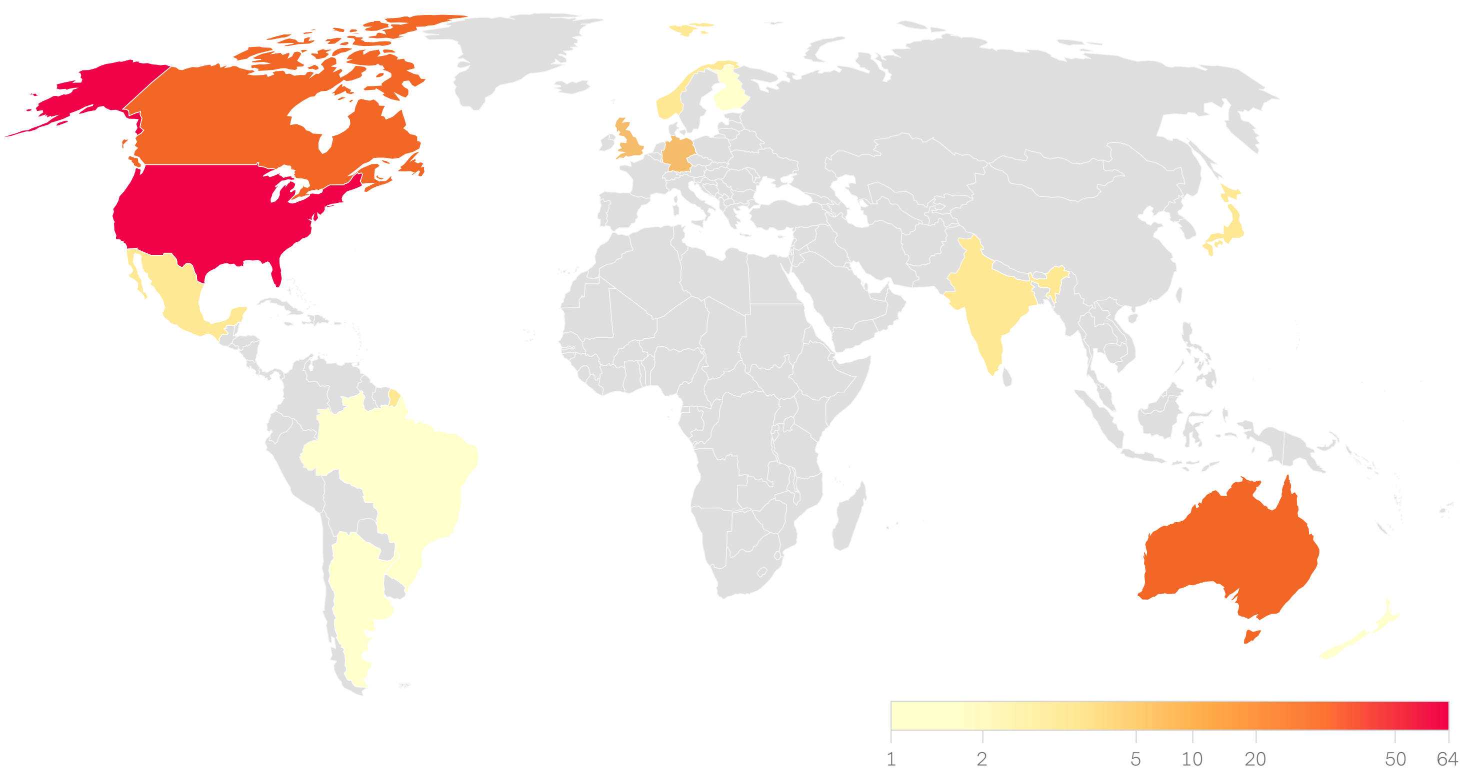
Initial data points were pulled from 120 qualifying technical submissions, and data primarily sourced from teams that advanced to Semifinals. The report summarizes data collected from 24 teams who competed as Semifinalists in the XPRIZE Wildfire competition between January and December 2025, including the Semifinals in April 2025 for teams competing in Track A, and the Semifinal rounds between July and November 2025 for teams competing in Track B. Teams advancing to Finals on both tracks participated in milestone-based check-ins to track their progress and solution development, through self-reported Technology Readiness Level (TRL), one-to-one check-ins, and impact surveys with a mix of standardized and open-ended questions to gather both quantitative and qualitative insight, accounting for the progress of their solutions development in the lead up to the Final rounds. Participation in surveys and reporting activities is a required component of the XPRIZE Wildfire competition, enabling consistent data collection across teams and over time.

COMPETITION OUTLOOK

Launched in 2023, XPRIZE Wildfire recruited teams from around the world and from across a variety of scientific and/or technical disciplines, including but not limited to engineering, space systems, remote sensing, robotics, artificial intelligence, machine learning, data science, fire science, and more. In total, XPRIZE Wildfire registered 370 interested teams. By 2024, at the first technical milestone, XPRIZE Wildfire received Qualified Technical Submissions from 120 teams across 23 different countries spanning both tracks.

TRACK A	TRACK B
45 Qualifying Technical Submissions received from teams in 13 countries	75 Qualifying Technical Submissions received from teams in 20 countries

Teams Geographic Representation



At each round of the competition, teams' submissions are reviewed by a judging panel, consisting of subject matter and technical experts who serve as an impartial and independent evaluation team for all aspects of this prize. Judges score the team submissions and make the final determinations as to which teams advance to the next round, resulting in the advancement of those teams most aligned and ready to meet the goals of the competition.

Qualifying teams advanced to Semifinals testing. The Semifinal rounds for both tracks served as validation to prove that these high-tech concepts could function in real-world or high-fidelity simulated environments. Following a series of system technical verifications to validate the qualified teams' technological solution, in early 2025, XPRIZE advanced 50 teams to compete in Semifinals across both tracks—20 in the space-based detection and intelligence and 30 teams in the autonomous wildfire response (comprising detection, monitoring and suppression). For Track B, teams were required to submit detailed evidence of their system development, including video footage and technical documentation to verify their progress. This phase ensured that only teams with a solution performing at minimum technology readiness level 6 (TRL 6) advanced to the in-situ Semifinal testing, which led the judges to select 15 out of the initial pool of 30 teams to proceed to a live-field demonstration.

2.1 Commercial Progress

XPRIZE seeks to spur innovation by bringing together a diverse and varied cohort of individuals, technology experts, students and researchers, start ups, practitioners, and established companies to develop solutions. By the nature of XPRIZE's inclusive approach, teams sit across a spectrum of commercial readiness and have unique business approaches and target customers.

Teams' commercialization stages are reported as follows:

21%
Bootstrapped

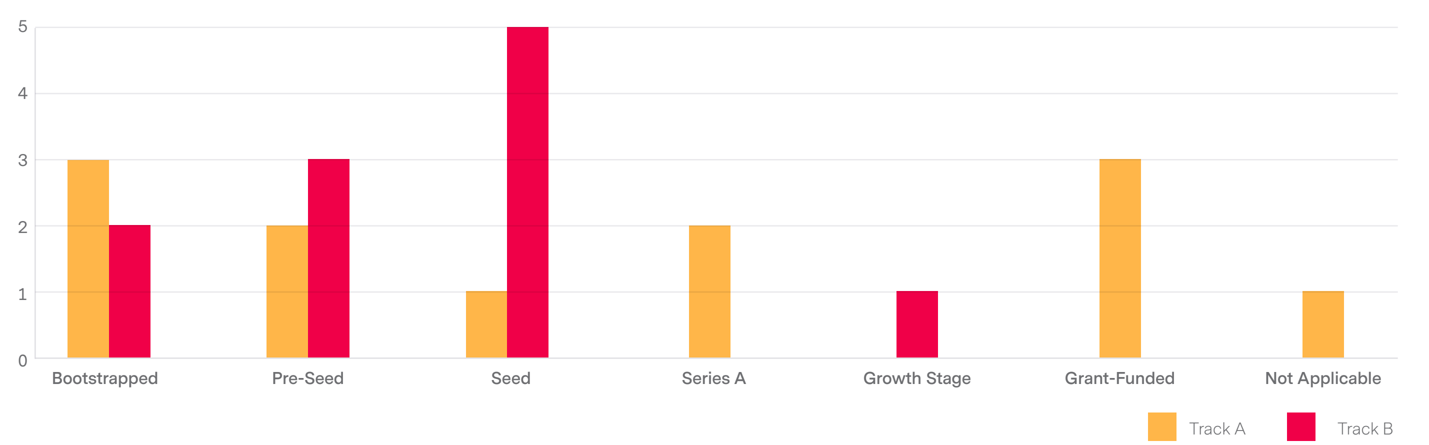
21%
Pre-seed

26%
Seed

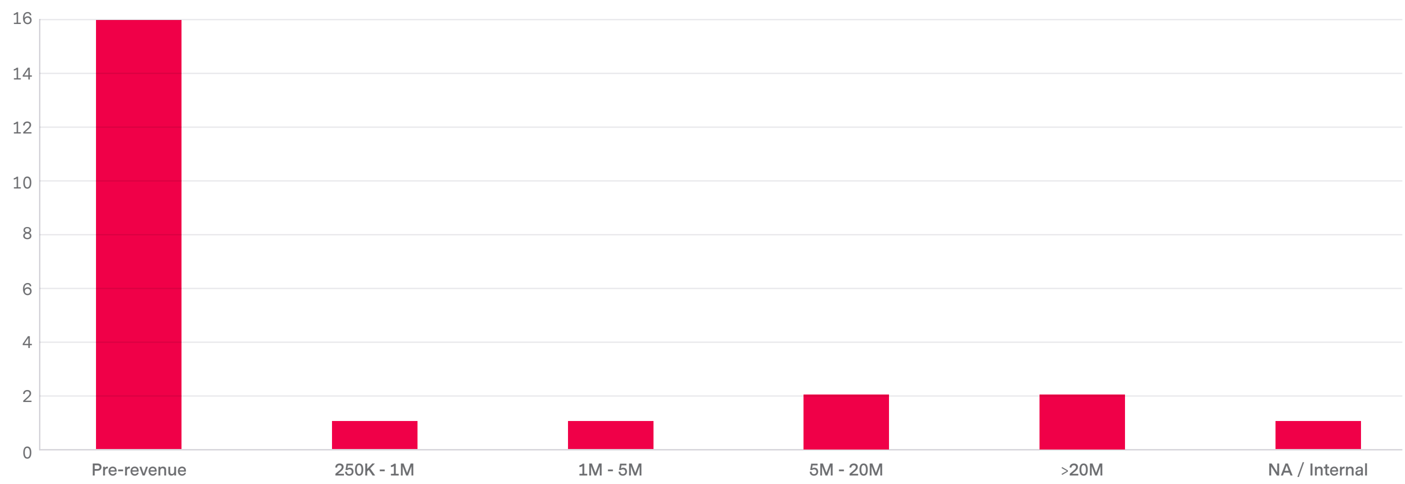
17%
Revenue-generating (> $5M)

While about 26% of teams in both tracks are in the Seed stage, over 47% of the teams are early-stage innovators looking for their first major venture rounds. This distribution demonstrates that the competition attracts both venture-backed startups and established technology firms.

Funding Stage Comparison: Track A vs. Track B



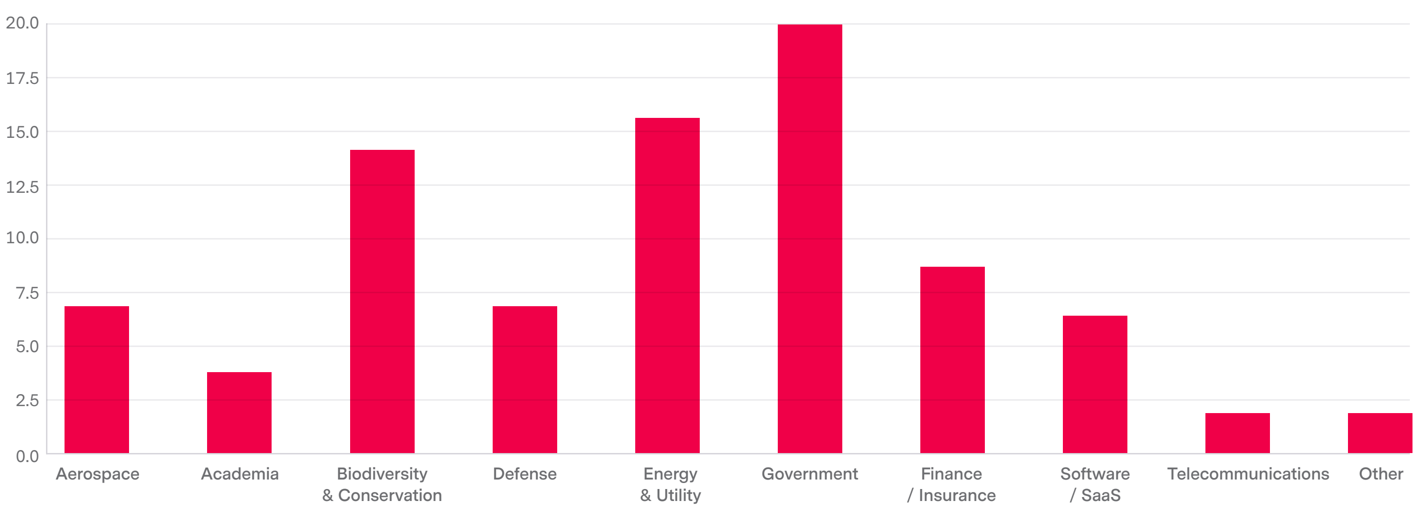
Distribution of Teams by Annual Revenue Range (n=23)



2.2 Key Client Industries

Since teams could select multiple industries, the percentages represent the portion of the total responding teams that identified each sector listed below as a key client.

Distribution of Targeted Industries Across Teams (n=23)



Public sector engagement is the strongest, with nearly 87% of teams identifying Government as a key client, followed closely by the Energy and Utility sector (61%), likely due to the critical need for wildfire protection around power lines and infrastructure.

Over 60% of teams are addressing Biodiversity and Conservation, emphasizing the growing importance of wildfire mitigation strategies and indicating a diverse range of applications for their wildfire detection and intelligence technologies. Approximately 30% see Defense as a viable commercial market, and include teams developing dual-use technologies focused on autonomous flight and network sensors.

2.3 Team Readiness

Teams have demonstrated system readiness during the Semifinals on both Track A and Track B through tangible commercial milestones, technical adoption, and strategic partnerships. The survey data shows that teams have not just competed for the prize purse, but are actively integrating their XPRIZE developments into the real-world wildfire ecosystem. Teams identified three main ways in which the competition advanced their readiness:

- Catalyzed product development: 42% of teams reported that the competition accelerated their timelines, moving solutions from the R&D phase to standard product offerings
- Intellectual property: 21% of teams filed for patents and invention disclosures specifically for algorithms (e.g., 3D geolocating) and hardware (modular aircraft payloads) developed for the XPRIZE.
- Market focus: for about 15% of the teams, XPRIZE Semifinals facilitated a strategic shift to more global markets, leveraging their performance to provide proof-of-concept during capital-raising efforts.

2.3.1 Technology Readiness

Technology Readiness Level (TRL) is a widely used NASA-derived framework used to measure technology maturity from basic research to operational deployment. The TRL scale (typically ranging from 1 to 9) is a useful scoring tool primarily used for de-risking. As a technology moves from TRL 1 (basic principles) to TRL 9 (proven in flight/operations), the technical risk decreases.

For a competition like XPRIZE Wildfire, understanding TRL helps to understand which teams are still in the concept phase and which have systems ready to be deployed in a real forest fire. Based on the teams' self-assessment, the technical maturity based on TRL seems consistent across the competition tracks, with Track A teams averaging a TRL score of 6, while the average TRL score amongst Track B teams is reported at a slightly higher TRL 7.

TRL Phase	Team %	Status
Research (TRL 1-3)	7.69	Early Concept
Prototype/Valley of Death (TRL 4-6)	42.31	High-Risk / Scaling
Demonstration (TRL 7-8)	42.31	Pre-Commercial
Deployment (TRL 9)	7.69	Mission Proven

By mapping the teams to their respective TRL development phases, a significant portion of the competition is currently navigating the most difficult stage of technology commercialization. Approximately 42% of the teams reported a TRL 4-6, also called the Valley of Death. These are teams that have moved beyond basic research but are still refining and demonstrating their prototypes in relevant environments. Success in the XPRIZE Wildfire Finals will likely depend on which of these teams can successfully bridge this gap and prove their system's reliability in operational environments.

2.3.2 Track A Semifinals (April 2025)

The focus of Track A Semifinals was on overcoming the detection lag and low resolution of current satellite systems. Semifinals involved remote technical verification where teams used historical fire data to prove their AI and satellite pipelines could:

- Detect: accurately identify fires across a large extended area within one minute and a reporting lag of ≤10 minutes, with relevant updates every 15 minutes over 12 hours.
- Characterize: Provide precise data (location, size, intensity) within 10 minutes,
- Minimize false positives while seeing through obstacles like cloud cover or smoke—addressing the detection accuracy barrier.

The focus of Track A Semifinals was on the analytic portion of teams' solutions. Semifinals involved the use of historical fire data to challenge the analytical capabilities. In a simulated, remote environment over a 12-hour window, teams were asked to demonstrate their systems could, Detect: accurately identify fires across a large extended area within one minute; Characterize: Provide precise data (location, size, intensity) within ≤10 minutes, with relevant updates every 15 minutes over 12 hours; Minimize false positives while overcoming obstacles like cloud cover or smoke—addressing the detection accuracy barrier. Many teams built their systems to operate on live earth observation data, and consequently faced technical and financial hurdles related to data acquisition, storage, integration, and fusion. Overall, there was a low ability of teams to gather accurate intelligence from historical data, lacking abilities to integrate data across different satellite assets for continuous monitoring.

This round served as a useful benchmarking of teams' solutions, highlighting a critical gap in the current innovation landscape, namely a heavy reliance on publicly available satellite datasets. While the Semifinals highlighted the brilliance of software-driven solutions, it also proved that algorithms alone cannot entirely overcome the limitations of accessing satellite data.

Additionally, it is limiting to rely solely on legacy systems such as Sentinel-2, MODIS, Landsat, VIIRS, and GOES, which generally lack the spatial or temporal resolution necessary to meet the competition's audacious goal of detecting fires of $10m^2$ or smaller within one minute of ignition. To solve this issue, some teams are assessing a "virtual constellation" approach, fusing geostationary (GEO) data with low-earth orbit (LEO) data to close the spatial and temporal gaps inherent in public satellites.

In spring 2025, eleven teams were selected to advance to Finals, based on their ability to process massive space-intelligence data into actionable intelligence. In spring 2026, these Finalist teams will compete to accurately detect and precisely characterize all fires 10m^2 in size and smaller, across the entire landscape of New South Wales, Australia, and report with the least false positives to decision-makers on the ground within 10 minutes, to be assessed on speed and accuracy of detection.

2.3.3 Track B Semifinals (July - October 2025)

Semifinals testing for Track B focused on autonomous end-to-end detection and suppression. Teams had to demonstrate their systems were on a path to a fully scalable autonomous end-to-end system from detection to navigation and suppression.

Between the summer and autumn of 2025, XPRIZE Operations staff traveled to the teams' home locations (in situ) for live field trials, with the support of the Alaska Center for Unmanned Aircraft Systems Integration (ACUASI), the University of Alaska's unmanned aircraft system (UAS) research program and one of the seven FAA-designated test sites in the United States established to develop and test UAS technology.

Moving beyond theoretical models and self-reported assessments, the Track B Semifinals phase demanded that teams subject their innovations to rigorous, multi-day field trials conducted at a teams' preferred location across the globe. Between July and October 2025, teams spanning from Tasmania to Sweden to the United States were granted three consecutive days each to physically demonstrate their progress in integrating autonomous detection, navigation, and suppression within their technological solutions. This decentralized testing methodology allowed teams to operate within the specific locations where their systems were developed and tested. Teams had to prove that their solutions worked beyond a proof of concept, testing systems for:

- Autonomous integration. Test the ability of the integrated solution to operate autonomously from detection to response and suppression.
- Smart detection. Test the ability of the solutions to distinguish between fire and decoy fire.
- Connectivity. Ensure the solutions maintain connectivity during operations.
- Functionality in complex terrain. The solutions should be able to operate efficiently on hills, slopes, dense vegetation and dense vegetation.
- Functionality in extreme weather conditions. Solutions were tested on performance against wind speeds of 30 km/h (weather permitting).

The need for proof of system integration has highlighted the stark contrasts among the competitors and the broader technology ecosystem, spanning from seamlessly integrated drone-in-a-box architecture, fusing 5G/Wi-Fi mesh networks with AI-powered computer vision to Scout UAVs equipped with thermal and optical sensors, to more unique system-of-system designs combining autonomous VTOL drones, IoT ground smoke sensors, and risk mapping. This unique testing approach also allowed for the evaluation of diverse engineering philosophies, establishing a robust scoring criteria to measure the effectiveness of future autonomous wildfire technology.

Following the observation and assessment of 13 different Semifinalist solutions, the XPRIZE independent panel of judges ultimately selected five teams to advance to Finals, after demonstrating the most promising solutions that could scale to deploy a fully autonomous end-to-end system capable of monitoring a 1,000 km^2 area in the Alaska wilderness. During Finals, teams' solutions must accurately detect an incipient-stage wildfire within one minute, achieve full suppression of the target, and spot any live moving fires within 10 minutes of ignition. This mission must be performed without any human input, navigating complex terrain and extreme weather while utilizing smart detection to ensure that various decoy fires and false positives remain untouched.

INNOVATION LANDSCAPE

3.1 Core Barriers

Progress in fire management suffers from a critical detection-to-response lag, where the inability to identify small ignitions with high precision allows fires to escape the initial attack window. This window is not just a time measure, but a biological and physical threshold, since once crossed, a fire's energy may blow out of proportions quickly and exponentially, by then rendering traditional suppression methods ineffective.

This delay is further exacerbated by geographic and environmental friction: rugged, roadless terrain physically isolates ground crews, while dead network zones in communication infrastructure prevent real-time data flow. When extreme conditions like high winds or dense smoke effectively ground aerial support, the tactical blind spot becomes absolute. Ultimately, these barriers create a compounding failure loop: the more intense the fire becomes due to delayed response times, the more it limits operational effectiveness and the likelihood of successful containment.

The XPRIZE Wildfire competing teams are designing the breakthrough solution and autonomous systems necessary to end this destructive loop. By integrating high-resolution satellite monitoring, autonomous rapid-response drones, and AI-driven predictive modeling, these technologies strive to close the detection gap and operate in conditions that currently hinder human responders. For a deeper dive into these core challenges, please download the State of Prize Report: The Grand Challenge and Rationale behind XPRIZE Wildfire.

Barrier 1: Response Time

Present-day best-case average time from detection to suppression is 60 minutes (15 minutes to detect, 15 minutes to arrive, 30 minutes to suppress). However, under extreme fire weather conditions, wildfires can transition from controllable to uncontrollable in mere minutes. The 2018 Camp Fire in California, for example, spread at a rate of one football field per second during peak conditions, overwhelming response capabilities. Citizens calling emergency lines remain the primary detection method when flames become visible—meaning hours of combustion may have already occurred.

Barrier 2: Detection Accuracy and Precision

Current satellite detection systems face two critical problems: poor spatial resolution and high false positive rates. Geostationary satellites (GEO) orbit at about 36,000 km, staying fixed over the same spot on Earth. These satellites offer a powerful vantage point for wildfire management, primarily due to their high temporal resolution; by scanning over Europe, Asia and the Americas every 5-15 minutes (and specific areas every 60 seconds), they can pinpoint ignitions and track rapid changes in fire behavior or smoke direction in real-time.

However, these benefits are tempered by a coarse spatial resolution of roughly 2 km per pixel. While sensors can detect sub-pixel heat anomalies as small as a few hundred square meters under ideal conditions, they often require a larger or more intense fire to reliably distinguish the signal from background noise, and prevent false alarms.

GEO examples: Eumetsat; Fengyun-4; NOAA GOES-R Series (GOES-16, 17, 18); Himawari-8/9 (for large wildfires)

LEO satellites provide a critical high-resolution counterpart to GEO data. Because they orbit at a much lower altitude than GEOs (roughly 100 to 1,000 km compared to 36,000 km), they offer significantly higher spatial resolution, with instruments like VIIRS capturing data at 375 meters per pixel. This precision allows for the detection of much smaller, lower-intensity fires that geostationary sensors might miss; however, while LEO can offer the spatial precision needed to map a fire's edge accurately, their quick overpass time means they lack the temporal continuity required for true real-time detection and tracking of a fast-moving front.

LEO examples: polar-orbiting satellites; NASA Terra/Aqua (MODIS) - 12 hour revisit; NOAA JPSS (VIIRS) (with 12-hour revisit time); Landsat 8 (OLI/TIRS) (with 8 to 16 days revisit time); Sentinel-3

Barrier 3: Accessibility

Wildfires frequently ignite in terrain inaccessible to current firefighting assets. Ground vehicles cannot safely operate on slopes exceeding 40% (22 degrees). Manned aircraft cannot fly below 150 meter altitude, must maintain visual flight conditions, and have limited operability at nighttime.

Barrier 4: Operability in Extreme Conditions

Extreme fire weather creates a paradox: conditions that create the most dangerous fires are the same conditions that can ground firefighting aircraft. High winds (60+ mph), dense smoke, and severe turbulence make manned aircraft operations unsafe. The 2018 Camp Fire saw frequent grounding of aerial assets due to 50-70 mph winds and zero-visibility smoke conditions. This was echoed during the 2025 Los Angeles disaster, where the Palisades and Eaton fires saw critical suppression windows lost as 80-mph Santa Ana wind gusts and extreme turbulence kept water-dropping tankers and helicopters grounded. During Australia's 2019-2020 Black Summer, aircraft were grounded for days at a time. Yet these are precisely the conditions when fires spread most rapidly and aerial suppression is most needed.

3.2 Wildfire Technology Innovation

The four core problems identified above represent systemic barriers that have prevented effective wildfire management for decades. The XPRIZE Wildfire competing teams have developed specific technological solutions targeting each challenge. This section provides detailed analysis of how their innovations address these fundamental issues.

3.2.1 Space-Based Detection

To improve on detection times, Track A teams are striving to compress the detection and data transmission phases to 11 minutes total (1 minute detection + 10 minutes for analysis and transmission). This represents an 82% reduction from the current 60-minute average response time.

Case Study 1: Deepfire

DeepFire's AI system generates predictive risk maps in real-time based on 20 environmental features, including wind speed, lightning, humidity, temperature, fuel moisture. When a fire is detected, the system immediately references its risk predictions to forecast danger levels, fire speed, and likely spread patterns.

By integrating prediction with detection, DeepFire reduces the time emergency managers need to assess fire behavior and mobilize appropriate resources. The feedback loop between detection and prediction continuously refines accuracy.

Case Study 2: Ember Guard

Ember Guard's proven infrastructure processes multiple data streams simultaneously: satellites, social media, ground sensors, and weather data. The multi-cloud GPU inferencing architecture ensures sub-second processing times even with massive data volumes.

Rather than sequential analysis of different data sources, Ember Guard's parallel processing enables immediate cross-validation of fire detections, reducing false positives while accelerating confirmation.

Traditional systems check satellite data, then ground sensors, then weather, a multi-step process that can take 5-8 minutes. Ember Guard has the capability to analyze all sources simultaneously, confirming detections in under 60 seconds.

Case Study 3: Mayday.AI (Guardian Space)

Mayday AI's physics-of-light algorithms understand how fires emit electromagnetic radiation across the spectrum. This enables the system to distinguish fire signatures from false positives (solar panels, water glare, hot vehicles) without time-consuming secondary verification.

Most detection systems require human operators to verify alerts. Mayday.AI's physics-based approach achieves over 95% accuracy automatically, streamlining the human verification bottleneck.

Case Study 4: Redback Fire

A joint partnership between RMIT University and Cedaryn, Redback Fire developed BRIGHT detection algorithm, an advanced physics-based model that avoids the brittleness of pure machine learning by utilizing geostationary sensors adapted for distinct biogeographical regions and diurnal variations. With processing data of under 45 seconds, this solution offers very low latency for fire management agencies. Fire behavior over the subsequent six hours from detection is predicted in seconds using the Inferno wildfire simulator developed by Cedaryn.

3.2.2 Sensors/Cameras/Towers

While space-based systems offer global coverage, ground-based detection systems (e.g., sensor towers, ground cameras, and IoT sensors) provide the front-line defense necessary for immediate, localized action. Ground systems can include networks linked together as a sensor mesh capable of using triangulation to determine the exact GPS coordinates of a fire.

Case Study: Anduril Industries

Anduril's Standard Range Sentry Tower (SRST) is a key component of its wildfire detection system, offering persistent 360-degree monitoring with long-range thermal and optical sensors. Designed for autonomous operation, the Sentry Tower provides 24/7 coverage, enabling early detection of wildfires even in remote and challenging environments.

The towers are highly versatile, with options for both pole-mounted and trailer-based configurations, allowing for rapid deployment and flexibility in high-risk areas. Equipped with advanced AI-powered analytics, the Sentry Tower can detect fire-related events with precision, minimizing false alarms and enabling faster response times. Built with a rugged, defense-grade design, the towers ensure reliable performance even in the harshest environmental conditions.

Anduril's Lattice platform revolutionizes wildfire detection by serving as a centralized common operating picture, seamlessly integrating data from third-party sensors, effectors and Anduril systems into a single, real-time interface. By providing a unified view, Lattice enhances situational awareness, allowing users to monitor fire threats with accuracy and confidence.

By consolidating diverse sensor inputs into a cohesive operational picture, Lattice transforms raw data into actionable insights. This empowers users to effectively coordinate response efforts, optimize resource allocation, and proactively manage wildfire risks. With its advanced capabilities, Lattice enables faster decision-making and improved operational efficiency, ensuring better protection for vulnerable regions.

3.2.3 ML/AI Detection

Detecting wildfires using cutting-edge Machine Learning (ML) and Artificial Intelligence (AI) has transformed wildfire response from a reactive approach into a proactive, high-speed operation. The primary advantage of AI over traditional methods (like fire lookouts or thermal triggers) is its ability to process massive amounts of visual data with human-like intuition at computer-like speeds.

Early detection and reduced latency: AI systems can identify the first signs of smoke or heat anomalies within 60 seconds of ignition. Detecting a fire at the smoldering stage is considered a crucial aspect of early detection. If AI can detect the chemical signature or thermal anomaly of a smoldering fire, it can be extinguished with a few gallons of water or a single hand crew. Once it transitions to the flaming stage, it can require millions of dollars in aerial tankers and thousands of firefighters.

Case Study: Dryad Networks

Dryad Networks' Silvanet gas sensors detect wildfires during the smoldering phase—before visible flames develop. The sensors measure combustion gases (CO, CO_2, VOCs) released when organic matter begins pyrolysis. Traditional detection requires visible smoke or thermal signatures, while Dryad detects the chemical precursors to combustion, identifying fires that are literally invisible to cameras and thermal sensors. A fire detected at the smoldering phase might be $1m^2$ in size, while the same fire detected by optical systems 20 minutes later could be $100m^2$ or larger, requiring more suppressant and time to extinguish. The detection at the smoldering stage is what sets Dryad systems apart.

Edge computing: modern AI can run directly on drones or satellites. This allows the device to classify a fire locally and only transmit a small alert packet, rather than wasting time and bandwidth downloading high-resolution images to the ground for analysis.

Predictive nowcasting and forecasting: beyond just detection, the fusion of AI and cutting-edge physics-based simulation can analyze fire behavior and surrounding conditions to predict where the fire will move over timescales ranging from the next minutes to hours and even days ahead, enabling far more strategic and safer resource allocation.

Case Study: SIRIUS Wildfire Alliance

SIRIUS aims to bridge detection with a cutting-edge, physics-based wildfire spread model to provide nowcasting and forecasting capabilities across any terrain and with any combination of suppression actions. By predicting the likely spread of the fire, they help commanders decide where to send air tankers or crews before fires even become visible to the human eye on the ground.

A fully dynamic digital twin also lets commanders explore what-if scenarios, receive ranked suppression recommendations within seconds of detection, and filter probable false positives by cross-validating alerts against simulated fire physics. When multiple fires compete for limited assets, the system ranks them by growth rate, threatened infrastructure, and suppression difficulty. The same framework extends to risk mapping, prevention, and firefighter training through FLAMESIGHT, the operational platform built by Pinepeak as a core partner within SIRIUS.

Looking ahead, SIRIUS aims to bring detection time down to one minute or less by leveraging space-edge computing, where detection and forecasting algorithms run directly on the satellite. Instead of sending gigabytes of raw data, the satellite identifies a fire locally and only sends a tiny alert (coordinates and intensity) via efficient telemetry. This turns a 90-minute delay into a sub-60-second alert.

RGB/IR/multispectral: the combination of RGB, infrared (IR), and multispectral sensors creates a layered defense. Each sensor sees a different part of the electromagnetic spectrum, thus overcoming environmental challenges that would blind a single-sensor system. Multispectral data may be used to identify a high-risk dry forest, while RGB can be used to spot the first puff of smoke, and finally IR to track the fire's movement through the smoke once it begins to spread. This multi-layered approach can help attain the under 60-second detection targets expected by the XPRIZE Wildfire competition.

Case Study: MyRadar

MyRadar's solution uses a wildfire and smoke analysis layer that fuses traditional weather data with high-resolution IR to provide a comprehensive view of both the fire's heat core and its smoke plume. MyRadar employs Robust Satellite Techniques (RST) to analyze time-series data, mathematically synthesizing rapid, high-frequency feeds from GEO satellites with the higher spatial resolution of LEO systems. Crucially, the organization democratizes this environmental intelligence by routing orbital anomaly data directly into the hands of the public and first responders via an application with over 15 million annual users, thereby accelerating the information delivered to a mobile device in a human hand.

3.2.4 Unmanned Aerial System (UAS) Detection

Commonly referred to as drones, UAS play a critical role in the XPRIZE Wildfire competition, particularly in the Autonomous Wildfire Response track. Unlike satellites or fixed towers, UAS offer a mobile and adaptable aerial perspective that bridges the gap between high-altitude surveillance and ground-level action. They can be launched almost instantly from the back of a truck or a localized drone-in-a-box station, reducing field deployment times. These systems often use scout drones to identify the hottest part of the fire and then guide suppression drones to drop the payloads exactly where they will have the most impact.

3.2.5 Autonomous Response and Suppression

Autonomous response and suppression represent the initial attack phase of the XPRIZE Wildfire competition. By removing humans from the high-risk flight environment and utilizing high-capacity, coordinated machines, these technologies aim to extinguish fires before they reach a catastrophic size.

Ultra-heavy lift UAS: High-risk fires often occur in rugged, inaccessible terrain where traditional ground crews cannot reach quickly. Ultra-heavy lift UAS are designed to bridge the gap between small surveillance drones and massive, expensive piloted tankers.

Case Study: FireSwarm Solutions & ACC Innovation

ACC Innovation's Thunder Wasp GT is an ultra-heavy-lift, jet fueled UAS that serves as the suppression backbone for Team FireSwarm Solutions.

Thunder Wasp can transform into an effective suppression Fire Wasp by integrating FireSwarm's proprietary Fire Mission Kit and drone agnostic autonomous swarm software designed to integrate with existing systems. The solution is designed to carry up to 400 kg of liquid or equipment via a long line. A swarm of 3-5 Fire Wasps can support crews at night and in low visibility and is designed for comparable mission profiles to a medium-sized manned helicopter, but without the risk to human pilots. It is widely considered one of the most effective tools for autonomous suppression due to its combination of massive lift capacity and 24/7 operational readiness.

Case Study: Wildfire Quest & Kaizen Aerospace

Wildfire Quest (led by Valley Christian Schools) utilizes a proprietary drone-mounted platform developed with partner Kaizen Aerospace. Fadron, a Bulgarian company specializing in advanced UAV software and AI, engineers Wildfire Quest's end-to-end mission automation—from the central command and control center to the sophisticated AI algorithms driving precise fire localization and autonomous suppression.

Kaizen Aerospace empowers Wildfire Quest with high-capacity autonomous transport, bridging the logistical

> gap between inaccessible wilderness and mission-critical supplies. With a payload threshold of up to 400kg, Kaizen's heavy-lift platforms eliminate the bottlenecks of rugged terrain while drastically reducing personnel risk by removing manned aircraft from hazardous environments. To ensure maximum operational safety and flight-path integrity, Altitude R&D, based in Switzerland, provides bespoke customization of the autopilot algorithms—delivering the world-class precision required for heavy-lift maneuvers in the most demanding climates.

Coordinated UAS swarm response: The swarm approach is also applicable for suppression, allowing for broader land coverage and more aptly scalable across an entire landscape. Drones can also rotate into a cycle: as one drops its payload and returns to base for a rapid refill, another is already arriving well recharged at the fire line, ensuring a continuous stream of suppression. Combined with appropriate suppression payload delivery mechanisms equipped with modern stabilization technology that can ensure the suppressant can actually be delivered to the fire, rather than being blown away by the wind or fire-generated thermals.

Drone swarms can also be equipped with different suppression systems (e.g., water, foam, or chemical retardants) depending on the fire type and terrain.

> **Case Study: Data Blanket**
>
> Data Blanket's prepositioned drone-in-a-box provides instant response to inaccessible terrain during nighttime or poor weather.
>
> The Direct Incident Commander deployment eliminates agency coordination delays while being affordable enough for communities and local fire agencies to purchase directly. Data Blanket is demonstrating that readiness isn't just about the aircraft, but must consider the intelligence layer that connects orbital sensors, autonomous suppression drones, and the first responders on the ground.
>
> By attacking a fire from multiple angles simultaneously, a swarm can "blanket" a fire line or create a continuous cycle where drones rotate between the fire and a refill station.

Precision payload delivery mechanisms: A significant challenge in wildfire suppression is delivering water or retardant directly to the base of the fire amidst high winds and intense thermals. Anduril Industries has developed advanced stabilization and precision hover technology for its autonomous vehicles, enabling payloads to be delivered with exceptional accuracy, even in the turbulent conditions caused by large fires. Building on the surveillance capabilities of its Sentry Towers, Anduril is advancing its technology to include active intervention systems that precisely deploy suppression materials to target high-risk ignitions.

Integrated software and data links: The proposed suppression systems are being designed to work within existing fire-agency ecosystems to ensure safety and coordination. For example, Data Blanket's integrations with ATAK (Android Team Awareness Kit) and Tablet Command allow autonomous suppression drones to communicate directly with fire managers and allow them to be the ultimate decision-maker.

CONCLUSION

The transition from detection (Track A) to autonomous response (Track B) is fundamentally a quest for scale. One of the most profound benefits of scaling is that it democratizes fire safety. Whether it is a scaled space-based intelligence and detection or a portable drone-in-a-box network, this technology can prove its capacity to protect a remote village in the Amazon or a small town in the Australian Outback just as effectively as it protects a fire-ready community in California.

Maintaining a fleet of manned firefighting aircraft is financially impossible for most regions. Scaling autonomous technology changes the economics of fire response. By combining incentive competition with real-world testing, XPRIZE Wildfire is accelerating the development and validation of technologies capable of transforming wildfire response systems globally.

4.1 Appendix

4.1.1 XPRIZE Wildfire Semifinalist Teams

Team Name	Track	Location
DeepFire	A	Baton Rouge, LA, USA
Ember Guard	A	Palo Alto, CA, USA
Fire Eye	A	Hillsboro, OR, USA
Generative Intelligence	A	Andalusia, Spain
Mayday AI (Guardian Space)	A	Darmstadt, Germany
MyRadar	A	Orlando, FL, USA
Orbital Sidekick	A	San Francisco, CA, USA
Redback Fire	A	Melbourne, Australia
SIRIUS Wildfire Alliance	A	London, UK
Snuffed	A	Flagstaff, AZ, USA
AeroWatch	B	Barcelona, Spain
Agni	B	Dresden, Germany
Anduril	B	Costa Mesa, CA, USA
Aura	B	Southampton, UK
Crossfire	B	College Park, MD, USA
Data Blanket	B	Bellevue, WA, USA
Dryad Networks	B	Eberswalde, Germany
Ember Flash Aerospace	B	Santa Cruz, CA, USA
Fire Foresight	B	Hobart, Tasmania, Australia
FireSwarm Solutions	B	Squamish, BC, Canada
Flamejackets	B	Atlanta, GA, USA
FLARE-X (University of Texas at Austin)	B	Austin, TX, USA
Pyr-Stop	B	Bristol, UK
Wildfire Quest	B	San Jose, CA, USA

4.1.2 XPRIZE Wildfire Qualified Teams

Team Name	Track	Location
Akula Tech	A	Melbourne, Australia
Blackshark AI	A	Graz, Austria
Chooch	A	San Mateo, CA, USA
DeepFire	A	Baton Rouge, LA, USA
Ember Guard	A	Palo Alto, CA, USA
Fire Eye	A	Hillsboro, OR, USA
Generative Intelligence	A	Mijas, Spain
International Space Wildfire Institute (ISWI)	A	South Lake Tahoe, CA, USA
Loft Orbital	A	Toulouse, France
Mayday AI (Guardian Space)	A	Darmstadt, Germany
Muon Space	A	Mountain View, CA, USA
MyRadar	A	Orlando, FL, USA
Orbital Sidekick	A	San Francisco, CA, USA
OroraTech	A	Munich, Germany
Redback Fire Team	A	Melbourne, Australia
SIRIUS Wildfire Alliance	A	London, United Kingdom
Snuffed	A	Flagstaff, AZ, USA
SpectraCan	A	Vancouver, BC, Canada
Team FUEGO (EarthSight International, Fireball Information Technologies, EarthDaily Analytics, UC Berkeley)	A	Santa Fe, NM, USA
Woolpert DI Cloud Geo	A	Ladera Ranch, CA, USA
Data Blanket	B	Bellevue, WA, USA
Green Tech Innovation	B	Monterrey, Mexico
N5SHIELD	B	Rockville, MD, USA
AeroWatch	B	Barcelona, Spain
Agni	B	Dresden, Germany
Anduril	B	Costa Mesa, CA, USA
Aura	B	Southampton, United Kingdom
BAMF Drones	B	Newport News, VA, USA
BlackBee Robotics	B	Blacksburg, VA, USA
Crossfire (University of Maryland)	B	College Park, MD, USA
Dryad Networks	B	Berlin, Germany
Ember Flash Aerospace	B	Santa Cruz, CA, USA
FireDrone	B	Tel Aviv, Israel

4.1.2 XPRIZE Wildfire Qualified Teams (Continued)

Team Name	Track	Location
Fire Foresight	B	Hobart, Tasmania, Australia
FireSwarm Solutions	B	Squamish, BC, Canada
FlameJackets (Georgia Tech)	B	Atlanta, GA, USA
FLARE-X (UT Austin)	B	Austin, TX, USA
GatorX (FNN)	B	Gainesville, FL, USA
MetaPhotonix	B	Orinda, CA, USA
N5 Sensors	B	Rockville, MD, USA
Optect - Optical Detection	B	Bath, United Kingdom
Pyr-Stop	B	Bristol, United Kingdom
Rain	B	Alameda, CA, USA
RAINDROPS (Norwegian University of Science and Technology + Brigham Young University)	B	Trondheim, Norway & Provo, UT, USA
Rangair	B	Beaverton, OR, USA
SWIFT (Penn State University)	B	State College, PA, USA
Skyspec	B	Tokyo, Japan
Think Circuits	B	Oakland, CA, USA
Wildfire Quest	B	San Jose, CA, USA
Wild-Flyer	B	Huntsville, AL, USA

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Thank you to all of the teams for your contributions and for taking on the challenge of competing in XPRIZE Wildfire.

XPRIZE WILDFIRE

INNOVATION LANDSCAPE REPORT

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