

Wildfire Risk Modeling Evaluation Findings and Community Perspectives

Defining a Roadmap for Next-Generation Wildfire Risk Intelligence

Rebecca Harned, David Sapsis, Anjana Manjunath, Hossein Lotfi, Claire Stirm
with Genevieve Biggs, J. Kevin Hiers, Rod Linn, Ilkay Altintas, Melissa Floca, Christopher Anthony



Columbia, MD | October 22, 2026

This publication is available free of charge from:
<https://doi.org/10.60752/102376.33312069>

UL Research Institutes

James J. Hudgens, President and CEO

Christopher J. Cramer, Executive Vice President and Chief Research Officer

Fire Safety Research Institute

Steve Kerber, Vice President and Executive Director



Research
Institutes

Fire
Safety

TABLE OF CONTENTS

Acknowledgments	5
Executive Summary	8
1. Introduction.....	10
1.1 Need for Wildfire Risk Intelligence	10
1.2 Purpose of the Wildfire Risk Modeling Exercise.....	10
1.3 Scope of the Report.....	11
2. Exercise Design and Methodology	14
2.1 Goals and Objectives	14
2.2 Exercise Design	15
2.3 Evaluation Methodology	19
3. Current State of Wildfire Risk Modeling	22
3.1 Modeling Landscape Overview	24
3.2 Science Findings	25
3.3 Practitioner Findings	29
3.4 Key Takeaway.....	33
4. Summary of Findings	36
4.1 Diversity of Modeling Approaches Is a Strength.....	37
4.2 Hazard Modeling Dominates Current Capabilities	37
4.3 Risk Is Not Consistently Defined.....	37
4.4 Science-To-Operations Translation Remains Challenging.....	38
4.5 Data Inconsistencies Limit Comparability	38
5. Priority Needs, Gaps, and Opportunities for Advancement.....	39
5.1 Actionable Risk Intelligence.....	39
5.2 Integrating Fire Behavior and Community Impacts	39
5.3 Strengthening Support for Mitigation Planning	40
5.4 Enhancing Operational Planning and Response Support	41
5.5 Improving Wildland-Urban Interface Exposure Modeling.....	41
5.6 Expanding Consequence and Economic Risk Analysis.....	42
5.7 Advancing Visualization, Communication, and Explainability.....	42

5.8 Opportunity for Ensemble Modeling and Integrated Risk Intelligence.....	43
5.9 Key Takeaways.....	44
6. Technical Gaps Identified	45
6.1 Lack of a Standardized Wildfire Risk Lexicon and Definition Framework	45
6.2 Inconsistent Treatment and Communication of Uncertainty.....	45
6.3 Absence of an End-To-End Shared Risk Assessment Framework.....	45
6.4 Data Gaps	46
6.5 Interoperability Gaps	47
6.6 Model Validation Gaps	48
6.7 Consequence Gaps.....	49
6.8 Decision Support Gaps.....	50
7. Recommendations	51
8. Conclusion: Future of Wildfire Risk Intelligence.....	57
9. List of References	58
Appendix A – Participating Organizations and Models	59
Appendix B – Glossary of Terms.....	60
Appendix C – Semi-Synthetic Core Dataset Features.....	62
Appendix D – Semi-Synthetic Parcel and Building Characteristic Data Schema.....	64
Appendix E – Science/Technical Rubric and Schema	67
Appendix F – Practitioner Rubric and Schema.....	72

LIST OF FIGURES

Figure 1	Illustration of the Exercise Output Evaluation Workstreams, Activities, and Results Analysis
Figure 2	Full Wildfire Risk Pathway: Illustrating the Initial End-to-End Wildfire Risk Framework
Figure 3	Model Methodology Landscape: Chart depicts the trends in model method used by category.
Figure 4	Core Capabilities of Wildfire Models: Chart depicts the trends in capabilities confirmed by category across all models.
Figure 5	Model Capabilities with High Rates of Coverage: Chart depicts the trends in functional capabilities presented by participating models.
Figure 6	Prevalence of Models Capable of Accounting for Specific Building Characteristics by Percentage of Models.
Figure 7	Quantitative Value Typologies Generated as Part of Model Outputs by Percentage of Models.
Figure 8	Primary use Case Alignment: Chart depicts the trends in the primary use case identified for each model by the practitioners/users.
Figure 9	Scale of Actionable Resolution Across Existing Models. Chart depicts the scale that practitioners/users identified the modeling outputs provided being most actionable for.
Figure 10	Percentage of Models Reported as “Easy to Understand”
Figure 11	Capability Ensemble Archetypes as a Preliminary Framework for Model Coupling and Ensembles
Figure 12	Illustrates the Current State of Modeling Capabilities, Translation Gap, and an Initial Target Architecture for Model Ensembles

ACKNOWLEDGMENTS

The Wildfire Risk Modeling Exercise was made possible through the collective efforts of a diverse community of researchers, practitioners, government agencies, private-sector innovators, and nonprofit organizations committed to advancing the science and practice of wildfire risk assessment. The Exercise Planning & Conduct Team extends its sincere appreciation to all individuals and organizations who contributed their time, expertise, resources, and leadership throughout the planning, conduct, evaluation, and analysis phases of this effort.

Special recognition is provided to the Exercise Planning & Conduct Team, whose vision, coordination, technical leadership, stakeholder engagement, data development, workshop facilitation, and after-action analysis enabled the successful execution of this unprecedented collaborative initiative. The team developed the common exercise and testbed framework, semi-synthetic datasets, evaluation methodologies, and post-exercise workshop process that provided a neutral and constructive environment for collaboration and learning across the wildfire risk modeling community.

UL Research Institutes' Fire Safety Research Institute gratefully acknowledges the following individuals for their leadership in designing and conducting the exercise:

Exercise Planning & Conduct Team

Name	Primary Organization Affiliation
Ilkay Altintas	University of California, San Diego
Christopher Anthony	FireWERX
Genevieve Biggs	Gordon and Betty Moore Foundation
Melissa Floca	University of California, San Diego
Rebecca Harned	UL Research Institutes' Fire Safety Research Institute
J. Kevin Hiers	U.S. Department of Defense, Strategic Environmental Research and Development Program
Brian Juhyuk Lee	Google.org
Rod Linn	Los Alamos National Lab
Hossein Lotfi	UL Research Institutes' Fire Safety Research Institute
Anjana Manjunath	California Department of Forestry and Fire Protection (CAL FIRE)
David Sapsis	California Department of Forestry and Fire Protection (CAL FIRE)
Claire Stirm	University of California, San Diego

Participant Model Organizations & Companies

The Planning & Conduct Team also extends its sincere appreciation to the participating organizations and companies that voluntarily contributed their wildfire risk models, analytical capabilities, technical expertise, and constructive feedback throughout the exercise. Collectively, participating teams worked with an estimated 28 models as 20 integrated risk solutions and represented approximately 21 organizations spanning academia, research institutions, government agencies, national laboratories, nonprofit organizations, and the private sector. Their willingness to openly share insights, test their models within a common test environment, and engage in collaborative discussion significantly advanced the community's understanding of the strengths, limitations, and future opportunities for wildfire risk modeling.

CloudFire, Inc	FireSafe Analytics	FiSci
FlameMapper	French National Center for Science	IMAGECAT
Minerva University	OroraTech	Pinepeak
Planet Labs	San Jose State University	SkyTL
Spatial Informatics Group	Tenax AI	University of California, Berkeley
University of California, Irvine	University of Maryland	University of Nevada, Reno
Vanderbilt University	Vibrant Planet	XyloPlan
	Zesty AI	

ACKNOWLEDGMENTS

The exercise culminated with an in-person Wildfire Risk Modeling Workshop and Summit on June 8-9, 2026, in Palo Alto, California. Many of the exercise participants, evaluators, and the Exercise Planning & Conduct Team convened for two (2) days to conduct a hot-wash and develop a roadmap to advance wildfire risk modeling. Below is a photo of the group that convened on Stanford University's campus as part of the workshop and summit.



In no event shall UL Research Institutes (ULRI) be responsible to anyone for whatever use or non-use is made of the information contained in this report and in no event shall ULRI, its employees, or its agents incur any obligation or liability for damages including, but not limited to, consequential damage arising out of or in connection with the use or inability to use the information contained in this report.

Destructive wildfires increasingly threaten lives, homes, critical infrastructure, natural resources, and the long-term resilience of communities.¹ Effective mitigation, preparedness, response, and recovery depend on the ability to understand not only where wildfire may occur and how it may spread, but also who and what may be exposed, how vulnerable those assets are, what consequences may result, and which interventions can most effectively reduce risk. Although wildfire modeling science has advanced significantly, the current landscape includes a complex array of models, methods, assumptions, datasets, and outputs. No single model fully represents the wildfire risk pathway across natural landscapes, low-density wildland-urban intermix, wildland-urban interface, rural communities, and the urban built environment.

The 2026 Wildfire Risk Modeling Exercise was established as an open, collaborative, and non-competitive effort to understand this evolving modeling landscape. Participating organizations applied their models to common semi-synthetic scenarios representing wildland, wildland-urban interface, and urban conditions. The exercise used standardized test environments, shared datasets, common infrastructure, structured documentation, and complementary science and practitioner evaluation streams to examine technical rigor, operational utility, interpretability, transparency, and applicability to real-world decisions. Its purpose was not to rank models or identify a single “best” solution, but to understand the unique capabilities and appropriate applications of different modeling approaches, identify scientific and technical gaps, and explore opportunities for interoperability, integration, and ensemble modeling.

The exercise demonstrated that the diversity of wildfire modeling approaches is a significant strength. Participating models applied empirical, statistical, reduced-physics, semi-physics, physics-based, machine learning, and other computational methods with different approaches, contributing to distinct and often complementary capabilities. The strongest and most mature capabilities were associated with wildfire spread, hazard characterization, ignition likelihood, fire arrival, burn probability, ember pathways, structure exposure, and selected parcel-level vulnerability assessments. Practitioners placed the greatest value on outputs that translated these capabilities into clear maps, timelines, exposure forecasts, and scenario comparisons that could support preparedness planning, evacuation decisions, resource positioning, home hardening, defensible space, fuels reduction, and mitigation prioritization.

At the same time, the exercise identified a persistent gap between technically credible modeling outputs and complete, actionable wildfire risk intelligence. Many models address only selected portions of the hazard > exposure > vulnerability > consequence pathway.

Current capabilities generally become less mature as analysis moves from wildfire behavior and structure exposure toward community consequences, economic loss, social vulnerability, critical infrastructure disruption, evacuation feasibility, suppression effectiveness, and recovery. Few models provide integrated support for operational resource allocation, mitigation trade-off analysis, or dynamic decision making during incidents. As a result, practitioners often found model outputs informative but incomplete, requiring additional models, datasets, or technical interpretation before the information could directly support decisions.

Several cross-cutting barriers limit scientific comparability and adoption of models by the user community. Risk terminology is not consistently defined across models, creating confusion among users and complicating the integration of outputs. There is a concrete need for common terminology and lexicon such that varying model approaches can be consistently understood and represented, establishing the foundation for model interoperability. Uncertainty is also treated and communicated inconsistently, limiting users' ability to distinguish confidence, scenario variability, sensitivity, and unknowns. Differences in the quality, completeness, and availability of building, mitigation, exposure, vulnerability, and post-fire damage data can reduce model fidelity and hinder model scalability. In addition, the lack of common data schemas, metadata, exchange protocols, benchmark datasets, and repeatable testing and evaluation frameworks limits model validation, interoperability, scaling, and ensemble development. Finally, some models focus on process understanding while others are designed exclusively for fire propagation or prediction tools. How these varying approaches influence one another needs further exploration in an open environment where the broad goals of models are understood.

The central finding is that future progress should not depend on developing a single universal wildfire model. Instead, we need to **advance toward a modular and interoperable ecosystem in which complementary models, datasets, and analytical methods work together across the full wildfire risk assessment process**. Ensemble-based workflows offer a promising mechanism for combining these capabilities, quantifying uncertainty, improving geographic transferability, and producing more complete and scientifically defensible risk intelligence. Success requires fostering an open community of practice to develop social, technical, and inter-organizational capabilities to create solutions that are higher value than the sum of their individual parts.

1.1 NEED FOR WILDFIRE RISK INTELLIGENCE

Wildfire is a natural and essential ecological process that supports the health and regeneration of many ecosystems.² However, the frequency, scale, and consequences of destructive wildfires are increasing across many regions. Each year, wildfire destroys thousands of homes and businesses, claims lives, impacts human health, disrupts critical infrastructure, and imposes substantial economic consequences. As communities continue to expand into fire-prone landscapes and severe fire behavior becomes more common, the need for accurate, actionable wildfire risk intelligence has never been greater.³

Effective mitigation, preparedness, and resilience efforts depend on a clear understanding of wildfire risk. Yet despite significant scientific advances, the wildfire community continues to face challenges in consistently measuring, characterizing, and predicting risk across diverse environments and scales. In response, a rapidly growing body of research, modeling approaches, and technological innovations has emerged to better quantify wildfire hazards, exposures, vulnerabilities, and consequences.

While these advancements have expanded the capabilities of wildfire risk assessment, they have also created a complex landscape of models, methods, and assumptions. No single model can fully characterize the breadth of wildfire risk across natural landscapes, communities, and the built environment. Consequently, there is a growing need to understand the unique strengths, limitations, and appropriate applications of existing wildfire risk models, as well as the potential for combining complementary approaches through ensemble modeling. Such efforts offer the opportunity to deliver more accurate, robust, and actionable intelligence for decision makers responsible for reducing wildfire impacts and protecting communities.

1.2 PURPOSE OF THE WILDFIRE RISK MODELING EXERCISE

To advance this objective, a coalition of leading research and technical organizations collaboratively designed and executed the first-ever **Wildfire Risk Modeling Exercise**. The exercise was established as a cooperative, no-fault environment where organizations could apply their wildfire risk models to a common set of scenarios spanning wildland, wildland-urban interface (WUI), and urban environments. The scope of the exercise encompassed risk to natural ecosystems, built communities, critical infrastructure, and the pathways through which fire spreads from wildland fuels into communities, and between structures.

1. INTRODUCTION

The primary purpose of the exercise was to advance the science of wildfire risk modeling while fostering collaboration among organizations working at the forefront of wildfire research and risk assessment. By evaluating multiple models under a common framework, participants sought to better understand the unique capabilities of existing approaches, identify opportunities for integration and interoperability, and evaluate how ensemble modeling techniques may improve overall accuracy and decision support value.

The findings from this exercise provide important insights into the current state of wildfire risk modeling, opportunities for advancement through collaboration and model integration, and priorities for strengthening the scientific foundation of wildfire risk assessment and intelligence.

1.3 SCOPE OF THE REPORT

The exercise, and subsequently this report, are intended to inform both operational decision making and future scientific advancement. The audiences for this effort and report span fire service practitioners, policy makers, industry stakeholders, and the research community, each with distinct needs and decision contexts.

Intended Audiences of This Report

The findings of the Wildfire Risk Modeling Exercise are intended to support a broad community of stakeholders involved in assessing, managing, researching, and communicating wildfire risk. While the report may be valuable to many organizations, three (3) primary audience groups were considered in its development.

Public Safety and Community Risk Reduction Practitioners

The primary audience includes local fire departments, state fire agencies, emergency management organizations, and community leaders responsible for understanding and reducing wildfire risk. These stakeholders rely on wildfire risk assessments to support community wildfire protection planning, standards of cover analyses, mitigation investments, evacuation planning, and resilience initiatives.

1. INTRODUCTION

The findings are also intended to support wildfire response operations by improving the use of risk intelligence in incident action planning, strategic incident planning, and situational awareness. By providing insights into the strengths, limitations, and appropriate applications of wildfire risk models, this report helps practitioners make more informed decisions about model selection and interpretation in both pre-incident and operational environments.

Industry and Infrastructure Decision Makers

A secondary audience includes organizations that use wildfire risk information to inform business, operational, and investment decisions. This includes the insurance and risk transfer industry, the financial industry, and critical infrastructure owners and operators such as electric, gas, water, and telecommunications utilities.

For these stakeholders, understanding the capabilities and limitations of current wildfire risk models is essential for risk evaluation, asset protection, infrastructure resilience, investment prioritization, and long-term planning. The report provides context on model uncertainties, data limitations, and areas where additional scientific advancement is needed to improve confidence in risk-informed decision making.

Research, Academic, and Model Development Communities

The third audience includes researchers, academic institutions, government laboratories, and private-sector organizations that develop wildfire risk models and analytical tools. This audience encompasses developers of both open-source and proprietary models, including those advancing foundational wildfire science as well as organizations creating specialized models tailored to specific industries or operational needs.

For this community, the report serves as a reference on the current state of wildfire risk modeling, opportunities for model interoperability and ensemble approaches, shared data requirements, and priority scientific gaps. The findings are intended to inform future research, guide investment in model development, and encourage greater collaboration, transparency, and innovation across the wildfire risk modeling ecosystem.

Intended Use of the Report

This report is intended to serve as a resource for understanding the current capabilities, limitations, and future opportunities of wildfire risk modeling. It is designed to help stakeholders:

- Select and apply wildfire risk models appropriately based on their intended use case.
- Better understand the strengths and limitations of existing modeling approaches.
- Identify opportunities for combining models to improve accuracy, precision, and decision support value.
- Inform community, infrastructure, and operational risk management decisions.
- Guide future research, development, and investment priorities.
- Advance collaboration, interoperability, and open-science approaches across the wildfire risk modeling community.

The report intentionally does not identify a single “best” model. Rather, it seeks to improve understanding of where different models provide value, where gaps remain, and how the collective wildfire risk modeling community can work together to produce more actionable and scientifically defensible wildfire risk intelligence.

2.1 GOALS AND OBJECTIVES

Goal

- Advance wildfire risk modeling science through an interactive exercise and workshop, while fostering collaboration among leading research organizations.

Scope

- The scope of this exercise is inclusive of fire risk models that support natural environments, built communities, and infrastructure.
- Emphasis on fire originating from the wildland, carried by vegetation into the WUI, and propensity for structure-to-structure fire spread.
- Designed as a no-fault forum for all organizations to apply their models in a common simulated environment that encompasses wildland, WUI, and urban environments. This format enables all participating organizations to learn how their models respond to different parameterized variables within natural and built environments and inform future model development.

Objectives

- Identify the unique strengths and most appropriate applications of existing wildfire risk models.
- Evaluate opportunities to combine models into ensemble approaches that improve risk intelligence.
- Identify common data requirements that could enhance model reliability, accuracy, and precision.
- Assess challenges and requirements associated with scaling wildfire risk models to larger geographic extents.
- Explore the feasibility of a shared modeling framework that supports standardization and interoperability.

2. EXERCISE DESIGN AND METHODOLOGY

- Identify opportunities for open science, shared methodologies, and collaborative innovation.
- Document key scientific and technical gaps that can guide future research, development, and investment priorities.

2.2 EXERCISE DESIGN

Key Design Principles

Seven (7) core principles guided the exercise design process, as are as follows:

1. **Open Participation:** Broad participation was encouraged to capture the diversity of capabilities across the wildfire risk modeling community.
2. **Standardized Scenarios:** Common study areas served as standardized test environments and ensured that all participants evaluated equivalent conditions.
3. **Shared Data Foundation:** Semi-synthetic datasets provided a consistent basis for model application and evaluation of results.
4. **Shared Infrastructure:** All participants were provided with access to a shared infrastructure through Wildfire Commons, which provided a platform for participating entities and teams to collaborate on their workflows, cloud-based computational resources, and submission of technical and executable outputs.
5. **Independent Execution:** Participants retained flexibility to apply their models according to their normal workflows and analytical approaches.
6. **Structured Expert Evaluation:** Results were reviewed by both technical experts and operational practitioners to assess scientific rigor and practical utility.
7. **Non-Competitive Assessment:** The exercise focused on understanding strengths, limitations, and opportunities across modeling approaches rather than identifying a single “best” model.

The Wildfire Risk Modeling Exercise was designed as an open, collaborative benchmarking effort intended to assess the current state of wildfire risk modeling science and technology. Participation was open to all organizations, including government agencies, academic institutions, nonprofit organizations, and private-sector industry entities. This inclusive

2. EXERCISE DESIGN AND METHODOLOGY

approach ensured broad representation of modeling methodologies, technical perspectives, and operational use cases.

The exercise design process involved developing two (2) semi-synthetic 5 km × 5 km test environments representing different landscapes, urban communities, and conditions. These test environments were standardized and allowed participants to apply their models under comparable conditions while still reflecting realistic wildfire risk scenarios.

All participants received standardized and consistent semi-synthetic data packages for each study area. The consistent data foundation allowed the exercise to focus on differences in model assumptions, methodologies, outputs, and interpretations rather than differences in data availability.

Each team applied the exercise data, ran their models, and submitted standardized outputs and documentation. This approach accommodated the diversity of participating organizations while ensuring consistency in the materials available for evaluation. As part of the final submission, participants were required to document the data inputs they used, both from the provided data packages and any supplemental data added.

A multidisciplinary cadre of evaluators was assembled to review submitted results. Evaluators represented both scientific and practitioner perspectives and assessed model outputs using a structured evaluation framework focused on technical merit, utility, interpretability, transparency, and applicability to real-world decision making.

Models were evaluated on their individual strengths, limitations, and contributions to wildfire risk assessment, rather than being compared against one another or ranked. The objective was to better understand the current landscape of wildfire risk modeling capabilities, identify strengths across approaches, and uncover opportunities for future collaboration, interoperability, and model integration.

Enabling Infrastructure

The Wildfire Science & Technology Commons (Wildfire Commons)⁴ served as the shared digital infrastructure that enabled the successful execution of the Wildfire Risk Modeling Exercise. The Wildfire Commons functioned as the central hub for exercise activities, providing participants with access to semi-synthetic data packages, technical guidance and documentation, model submission resources, and exercise communications. In addition, the platform provided



2. EXERCISE DESIGN AND METHODOLOGY

collaborative workspaces that allowed participating organizations to engage with exercise materials and share information throughout the exercise process.

To further support broad participation, Wildfire Commons also offered cloud-based computing resources that participants could leverage to run models, conduct analyses, and process exercise datasets. By providing a common environment for data access, collaboration, technical support, and computational resources, the Wildfire Commons established the foundational infrastructure necessary to support a diverse community of wildfire risk modelers and create a consistent framework for model evaluation, comparison, and scientific advancement.

Semi-Synthetic Landscapes and Datasets

A foundational element of the exercise methodology was the development and use of standardized semi-synthetic landscapes and datasets that provided all participants with a common foundation. The semi-synthetic data was produced through a collaboration with Los Alamos National Laboratory and strategic partners. The use of semi-synthetic data ensured community anonymity while establishing a consistent baseline for evaluating model sensitivities, assumptions, outputs, and capabilities. The semi-synthetic approach served three (3) design and methodology objectives:

1. Standardized test environments,
2. Standardized core data inputs that served as a shared data foundation,
3. Protecting the identity of real communities while preserving realistic conditions.

Together, the semi-synthetic Town of Forests and Town of Prairies functioned as complementary testing environments that exposed models to distinctly different variables, wildfire risk challenges, and established a common framework for assessing the current state of wildfire risk modeling science.

The exercise utilized two (2) distinct 5 km × 5 km test environments, each designed to represent wildfire propagation from natural landscapes into developed (suburban and urban) communities. Both locations included vegetation, residential neighborhoods, commercial properties, building characteristics, transportation networks, and sample weather data, while incorporating realistic spatial geometries and topographies.

2. EXERCISE DESIGN AND METHODOLOGY

- **Town of Forests:** Represents a mountainous, densely vegetated environment characterized by significant elevation changes, complex terrain, and diverse forest conditions. Residential developments are embedded within vegetated areas, providing examples of wildland-urban interface. This landscape was designed to evaluate a model's ability to perform in environments where topography, fuel continuity, and dense vegetation may strongly influence fire behavior, ember exposure, and community risk.
- **Town of Prairies:** Represents a relatively flat landscape with limited elevation variability and lower tree density. Residential development occurs primarily at the interface between developed areas and surrounding vegetation, creating typical WUI conditions. This environment was designed to examine model performance under different fuel distributions, exposure pathways, and fire spread dynamics than in heavily forested landscapes.

Each study area was supported by a comprehensive suite of synthetic geospatial and environmental datasets that could be used across a broad spectrum of wildfire modeling approaches. Core semi-synthetic datasets included the following and are detailed in Appendices C and D:

- Building footprints and structure attributes
- Parcel boundaries
- Elevation and topographic information
- Surface fuel and fuel loading characteristics
- Detailed tree inventory data
- Road networks
- Ignition locations and timing
- Synoptic weather observations
- Fuel moisture and vegetation characteristics

2. EXERCISE DESIGN AND METHODOLOGY

Participants were encouraged to use the synthetic datasets provided as the common analytical foundation for the exercise. If a participant had a model that used data systems other than that provided, they were encouraged to emulate the data provided to maintain comparability. Additionally, if a model required additional data, participants were encouraged to provide that data as well as a description of its source and usage within the model. Supplemental public datasets could be incorporated where relevant to a participant's model, but the core synthetic data remained the standardized basis for all submissions. Human population demographic data was not provided, as US Census American Community Survey (ACS) data is publicly available and readily accessible for inclusion in models.

The semi-synthetic exercise data packages are publicly available on Wildfire Commons at the link below and will remain publicly available to support modeling science and innovation.⁵ Link: <https://www.wildfirecommons.org/educationhub/datachallenge/learner/4da8e5b0-6d81-4aa9-9482-309194cfb975?from=explore&subtab=past>

2.3 EVALUATION METHODOLOGY

Participating organizations submitted their model outputs and supporting documentation at the conclusion of each exercise module. Submissions were then reviewed through a structured evaluation process designed to assess both scientific and operational criteria that accounted for the diversity of modeling approaches.

Each model submission was evaluated by multiple reviewers and through two (2) complementary evaluation streams:

- **Science and Technical Evaluation:** Focused on assessing scientific rigor, technical methodologies, model assumptions, and analytical capabilities.
- **User and Practitioner Evaluation:** Focused on assessing usability, relevance, interpretability, and potential value for real-world decision making and operations.

Provided below is a graphic that illustrates the exercise evaluation methodology and general approach. The detailed evaluation rubrics for both evaluation streams are available in Appendices E and F.

2. EXERCISE DESIGN AND METHODOLOGY

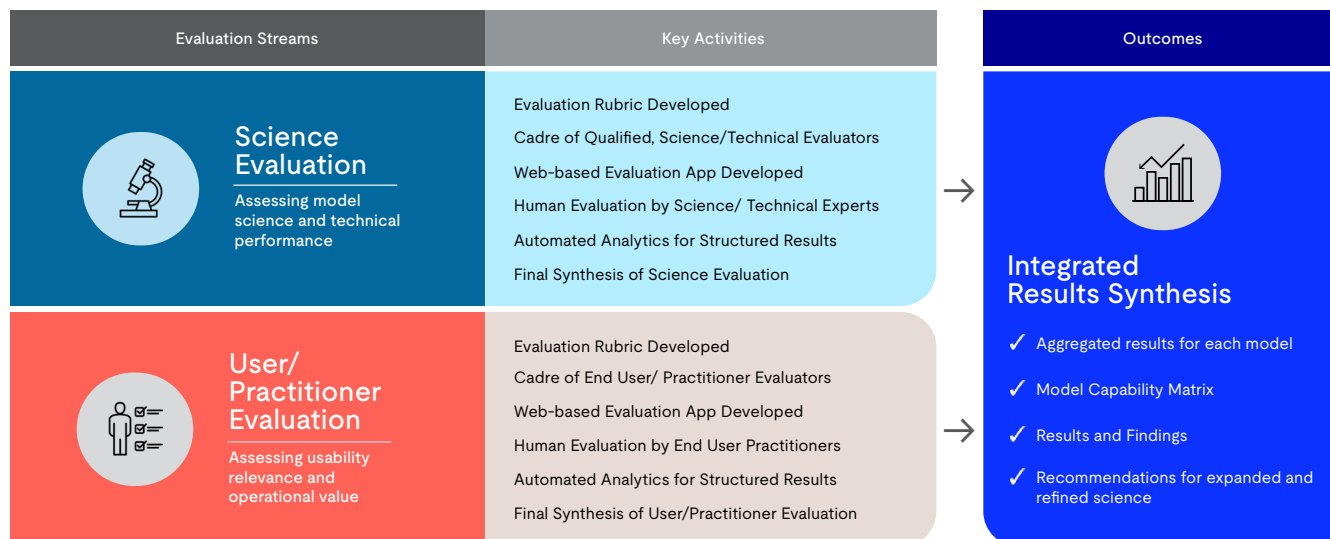


Figure 1: Illustration of the Exercise Output Evaluation Workstreams, Activities, and Results Analysis

Evaluation Criteria

Recognizing the diversity of wildfire risk modeling methodologies, the evaluation framework and rubrics were designed to account for fundamental differences among model types. Not all exercise objectives, variables, datasets, or data attributes were expected to be relevant to every model, and evaluators were instructed to assess submissions within the context of their intended purpose and operational design.

This flexibility was particularly important when evaluating static and dynamic modeling approaches. Static models are generally statistical, actuarial, or probabilistic in nature and do not rely on time-specific scenario inputs such as weather conditions at a particular date, time, and/or location. Dynamic models, by contrast, use scenario-specific inputs to simulate evolving wildfire conditions and generate time-dependent outputs. The evaluation process accounted for these inherent differences, ensuring that models were assessed appropriately according to their design, intended use, and analytical objectives.

Evaluation Rubrics and Analysis

To ensure consistency across reviews, evaluators documented their assessments using a web-based evaluation platform aligned with standardized evaluation rubrics developed specifically for the exercise. The rubrics were designed around the exercise objectives, scenario characteristics, and the information available within the semi-synthetic datasets, including factors such as topography, fuels and vegetation, weather conditions, building characteristics, mitigation measures, and community attributes.

2. EXERCISE DESIGN AND METHODOLOGY

Importantly, the exercise was not designed as a competition, benchmark challenge, or model ranking effort. There were no “right” or “wrong” answers, no performance scores assigned to participants, and no attempt to identify a single best model. Instead, the evaluation process sought to understand the strengths, limitations, applicability, and unique contributions of different modeling approaches and to identify opportunities for future scientific advancement and interoperability.

A minimum of four (4) evaluators reviewed each model, two (2) Science/Technical Evaluators and two (2) Practitioner/User Evaluators. Following completion of individual reviews, results from both evaluation streams were synthesized to identify common themes, model capabilities, gaps, and opportunities for advancement. This integrated assessment provided a balanced understanding of both the scientific performance and practical utility of participating models, forming the foundation for the findings, recommendations, and future research priorities presented in this report. The detailed Evaluation Rubrics are available in Appendix E of this report.

3. CURRENT STATE OF WILDFIRE RISK MODELING

Provided below is a high-level summary of the current state of wildfire risk modeling based on the models that participated in and were evaluated as part of the Wildfire Risk Modeling Exercise.

1. No single model consistently represented the full wildfire-risk pathway.
2. Existing modeling capabilities are more suited for risk assessment and mitigation prioritization than for real-time response.
3. Parcel-level resolution is necessary, but not sufficiently supported by, existing models, potentially due to the lack of parcel-level data at scale.
4. WUI transition and urban conflagration should be treated as distinct capabilities and are not adequately supported by existing models.
5. Human population and community consequences are nearly absent in all model methodologies.
6. Economic loss is an emerging capability, and measures of return on investment from mitigation remains immature.
7. Target ensemble architectures are both modular and interoperable for full integration, rather than monolithic.
8. Common interfaces and definitions are as important as model accuracy.

To establish a shared perspective of the full wildfire-risk pathway, provided below is an initial framework. This is expected to evolve over time, but serves as a starting point and frame of reference for end-to-end wildfire risk assessment throughout this report.

3. CURRENT STATE OF WILDFIRE RISK MODELING

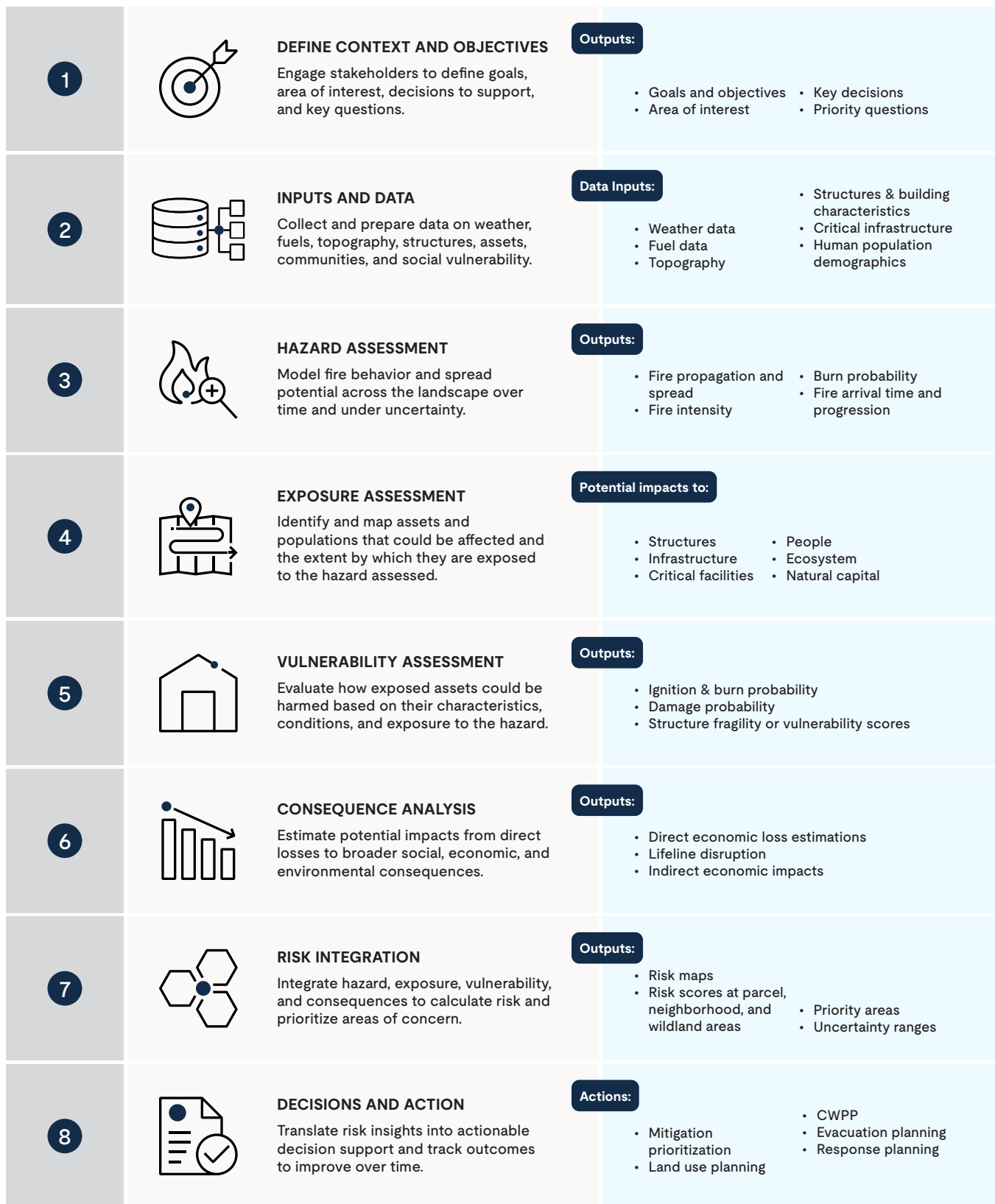


Figure 2: Full Wildfire Risk Pathway: Illustrating the Initial End-to-End Wildfire Risk Framework

3. CURRENT STATE OF WILDFIRE RISK MODELING

3.1 MODELING LANDSCAPE OVERVIEW

The models used during the exercise were methodologically hybrid rather than divided into discrete model classes. Empirical, statistical, reduced-physics, and semi-physics methods form the dominant foundation, particularly for rate-of-spread calculations and landscape fire propagation. Physics-based components were less frequently used and were generally concentrated in WUI transition, heat-transfer, structure ignition, ember transport, or coupled atmospheric applications. Machine learning is increasingly used for structure vulnerability, damage probability, structure fragility, and loss estimation. Most frequently, empirical/statistical methods were combined with semi-physics or machine learning (ML) methods. More advanced Artificial Intelligence-based (AI) methods such as agentic AI, Retrieval-Augmented Generation (RAG), and related emerging AI approaches were very limited.

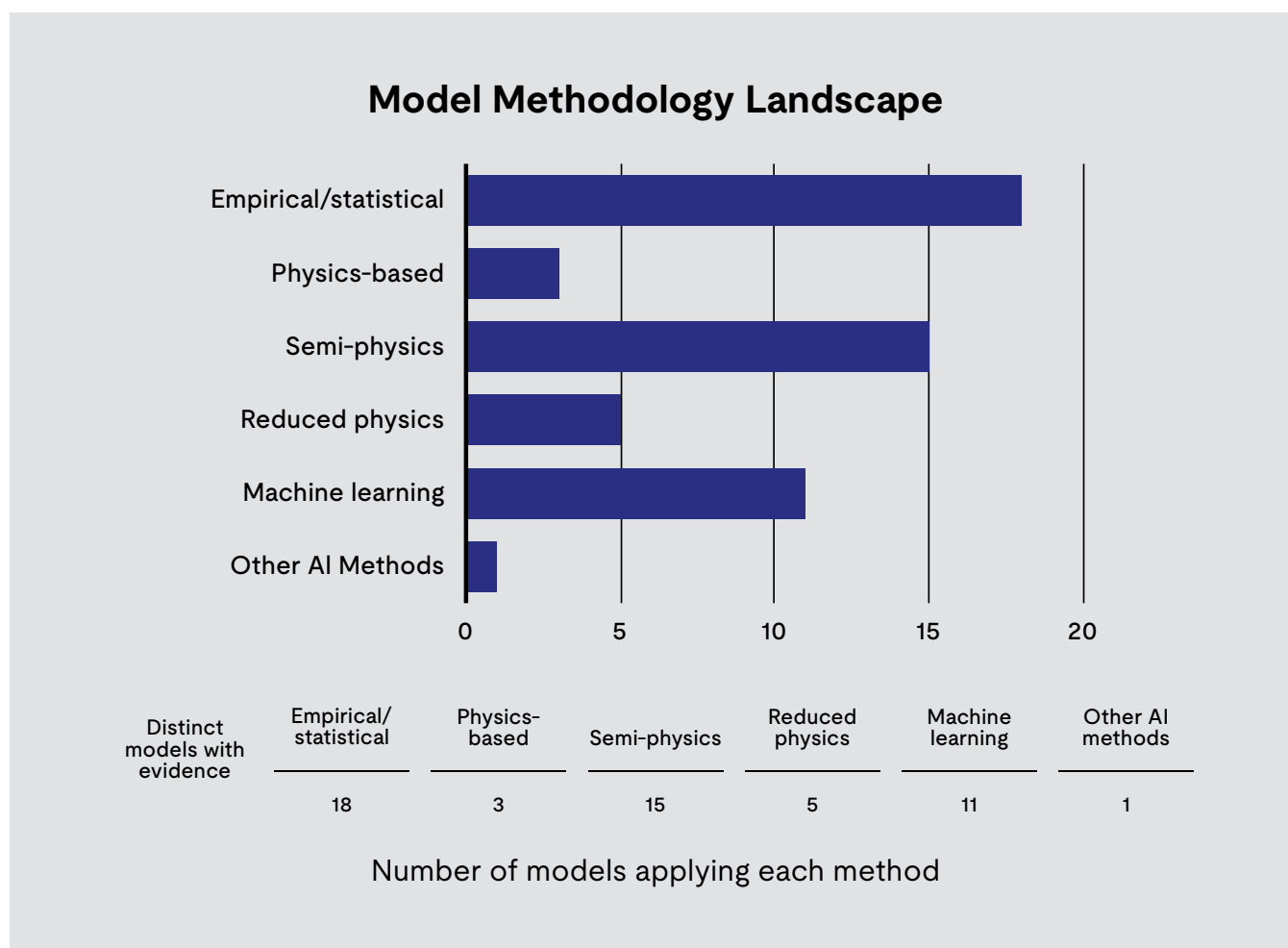


Figure 3: Model Methodology Landscape: Chart depicts the trends in model method used by category.

3. CURRENT STATE OF WILDFIRE RISK MODELING

3.2 SCIENCE FINDINGS

Of the models that participated, the dominant maturity is in fire-spread propagation and hazard characterization. Many models generate fire perimeters, arrival-time surfaces, burn extents, flame-length estimates, and ember pathways. Some models include measures of structure exposure or related hazard outputs. A meaningful subset extends these capabilities to ignition likelihood, structure-damage probability, burn probability, or probabilistic scenario analysis. However, it should be noted that the performance of these models was not assessed, as there is uncertainty in all models and no existing source of truth to evaluate model performance against. The evaluations also identify strong ensemble potential because landscape spread, WUI propagation, structural vulnerability, loss, and decision-support functions are often modular and complementary, and can't be fulfilled by any single model. Provided below is a chart that illustrates the core capabilities of existing models across the four (4) primary capability categories, as well as a roll-up of the number of models that account for all four (4).

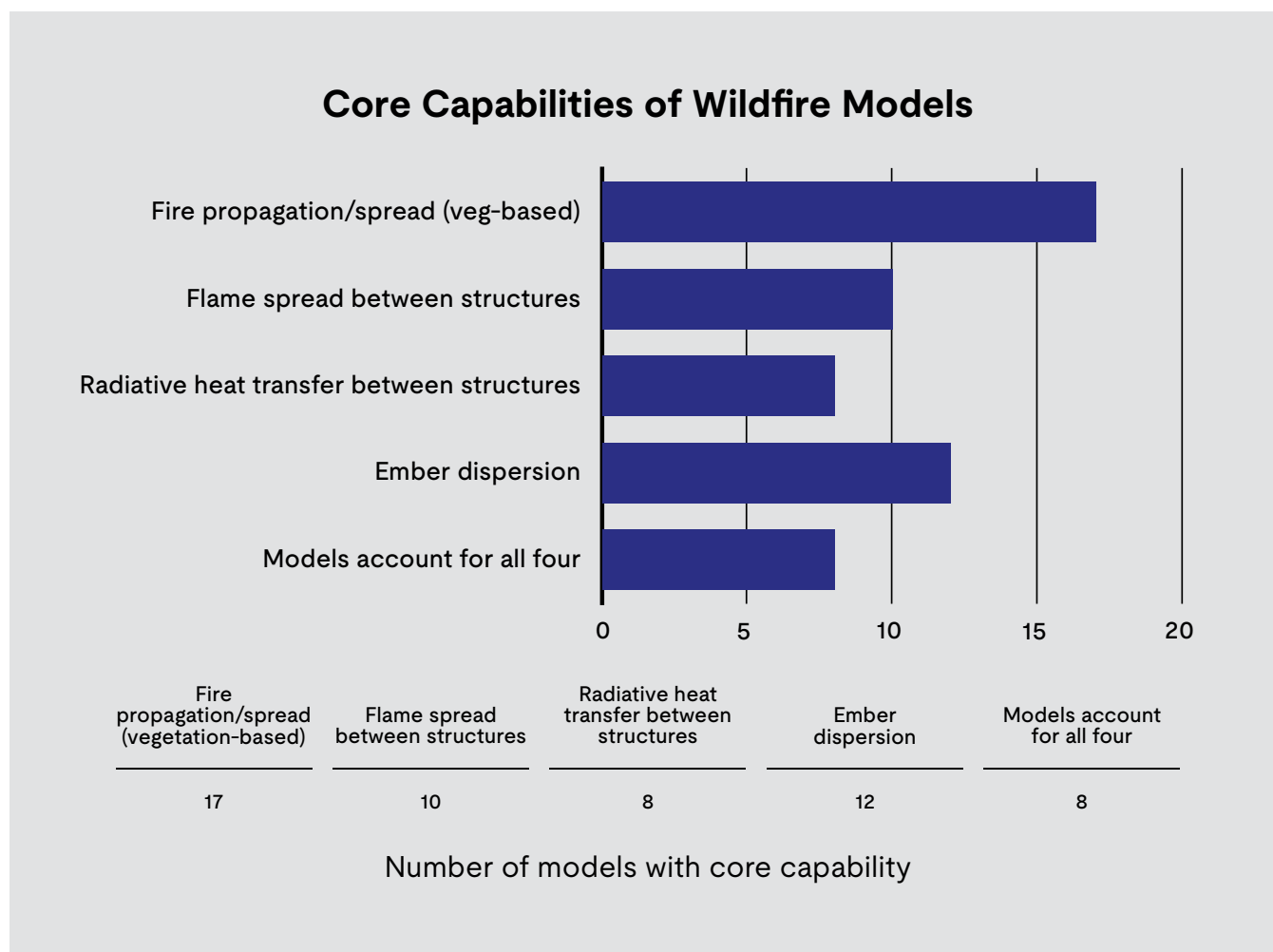


Figure 4: Core Capabilities of Wildfire Models: Chart depicts the trends in capabilities confirmed by category across all models.

3. CURRENT STATE OF WILDFIRE RISK MODELING

Analysis of results revealed that only 40% of models account for all four (4) types of fire model core capabilities. This indicates the importance of ensuring that a wildfire risk assessment incorporates multiple models, whether individually or ensembled, to account for all fire transmission modes when assessing a community's fire risk.

Further, Rothermel's surface fire spread model⁶ is the predominant underlying fire propagation or spread model used across 85% of participating models. It exclusively uses a vegetative fuel model, since a structure fuel model (urban or built environment fuel model) was not available. Application of Rothermel surface fire models is widespread and should be coupled with other model methods to account for other fire transmission models. This ensures a more comprehensive approach to accounting for potential hazard exposure as part of a wildfire risk assessment.

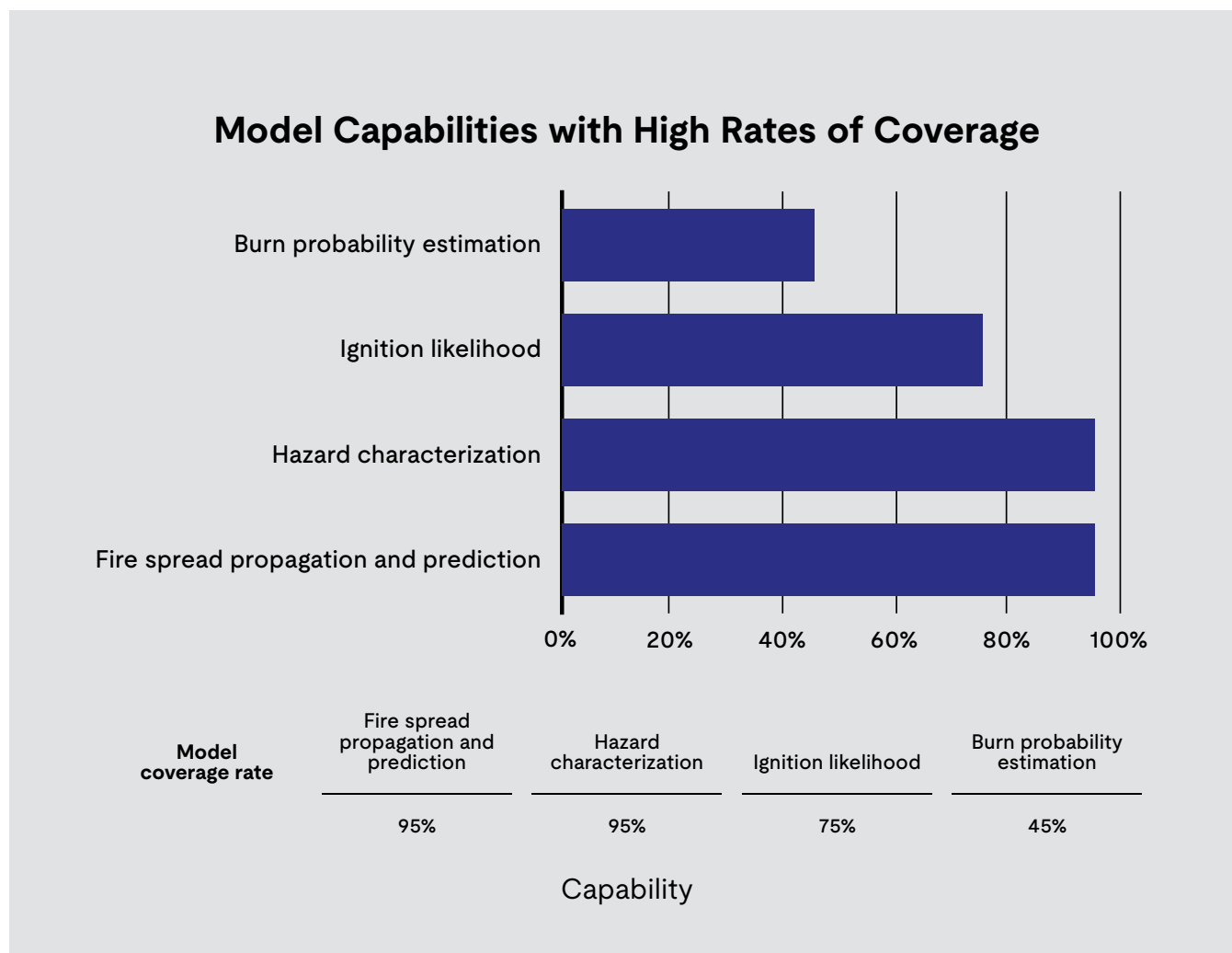


Figure 5: Model Capabilities with High Rates of Coverage:
Chart depicts the trends in functional capabilities presented by participating models.

3. CURRENT STATE OF WILDFIRE RISK MODELING

In exploring the scientific potential to account for structure fuels and associated structure fragility variables, the prevalence by which existing models demonstrated the ability to incorporate specific building characteristics is promising. The chart below illustrates that 65% of the models evaluated incorporated unique building characteristics. Additional analysis revealed that of those models, 50% applied building characteristic inputs as part of the resulting calculation and/or insight on wildfire risk. Additional discussion about the availability of data for building characteristics is available in Section 2 of this report and is detailed in Appendices D.

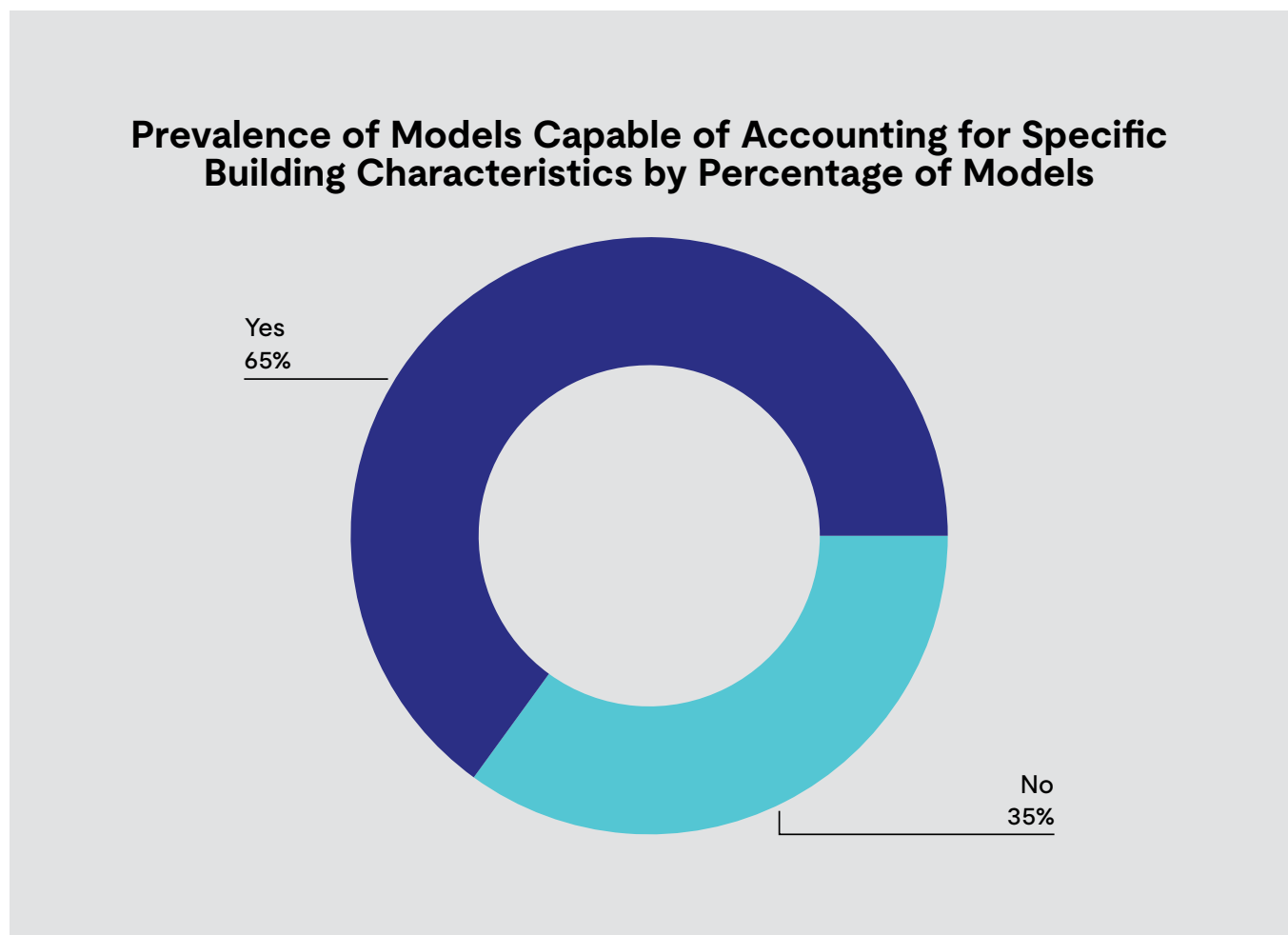


Figure 6: Prevalence of Models Capable of Accounting for Specific Building Characteristics by Percentage of Models.

3. CURRENT STATE OF WILDFIRE RISK MODELING

Another advantage of existing modeling capabilities is that nearly all models generate a quantitative value as part of their output. While this is expected, it is also important to understand the value typologies that models generate as an indicator for how the model information may be able to be incorporated into decision support tools and solutions. The chart below illustrates the composition of value types demonstrated by the models, with the majority (80%) generating as a basic numerical value and significantly fewer as binary (10%) and categorical (5%). This is an important consideration in optimizing existing and future models and assessing the most usable value typologies to inform decisionmaking.

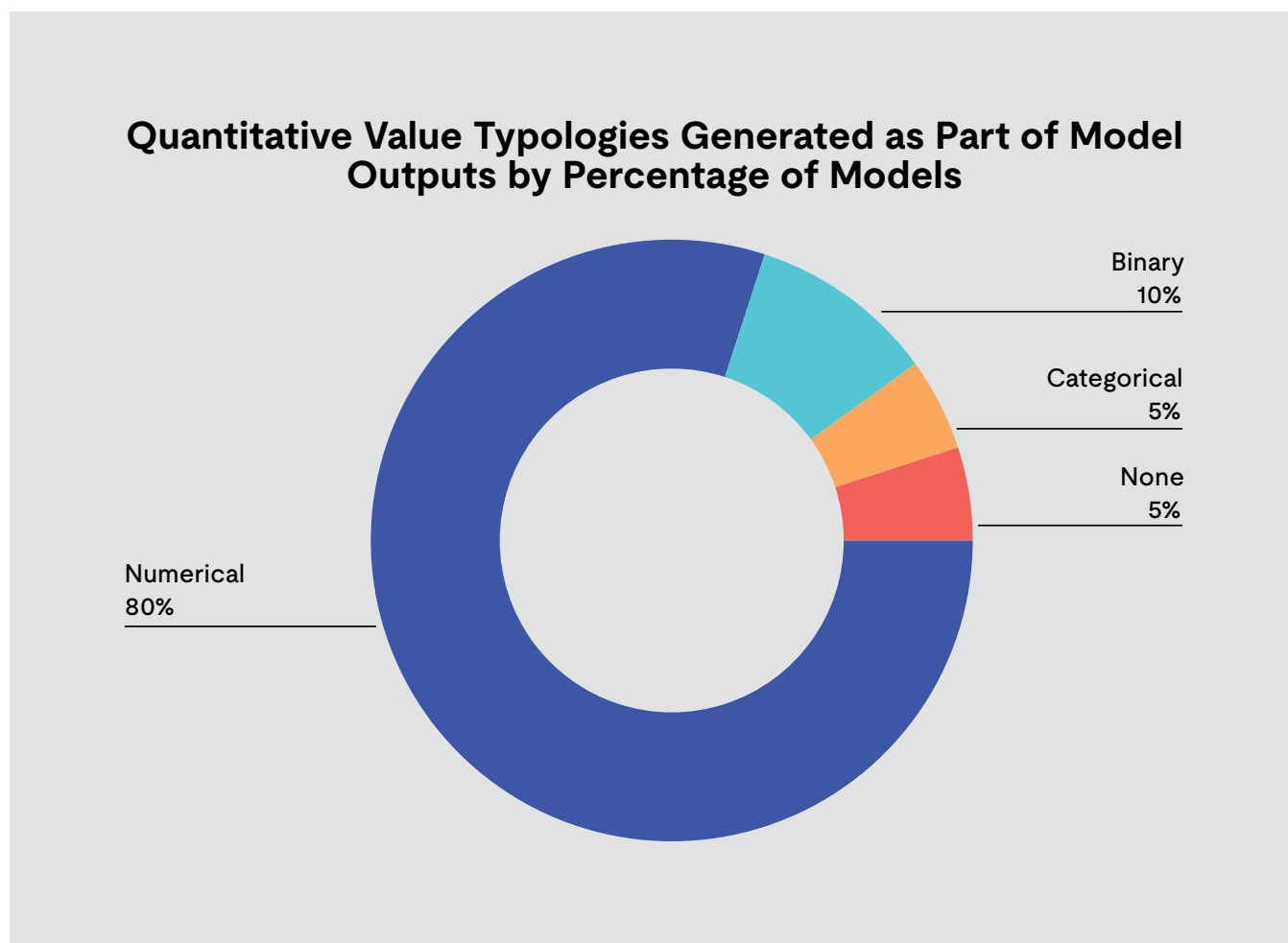


Figure 7: Quantitative Value Typologies Generated as Part of Model Outputs by Percentage of Models.

3. CURRENT STATE OF WILDFIRE RISK MODELING

The primary limitation across existing modeling capabilities is that many methods stop at fire behavior, hazard, exposure, or conditional damage rather than completing the full end-to-end risk assessment from ignition likelihood through to structural fragility, population vulnerability, and come together through consequence estimation and expected loss. Approximately 65% of the models included a consequence or severity estimation and value as part of the output.

Consequence analysis was predominantly limited to direct structure impacts, with much less evidence concerning population effects, critical infrastructure disruption, natural capital asset impacts, service interruption, social vulnerability, cascading consequences, or response-system performance. More specifically, zero (0) models accounted for the human population or socio-economic demographics as a component of their wildfire risk models. The inclusion of human population and demographics is a significant gap that should be explored as part of follow-on model development. Other areas for future development are the representation of output values as community or neighborhood-scale scores and prioritization for mitigation actions.

3.3 PRACTITIONER FINDINGS

Practitioner evaluators consistently identified fire spread propagation, hazard characterization, and ignition likelihood assessment as the strongest and most operationally useful, which is consistent with the existing predominant model core capabilities described in Section 3.2 of this report. Models that clearly communicated projected fire growth, arrival time, spread corridors, ember exposure, and probable community entry points were repeatedly viewed as valuable for preparedness planning, resource positioning, and situational awareness. Provided below is a chart that illustrates the primary use cases (or applications) that practitioner evaluators identified for each of the models, with pre-fire risk assessment (55%) as the predominant use case across all models. Additionally, the most frequently identified secondary use by practitioners was mitigation planning, further indicating the strength of existing models supporting pre-fire preparedness and mitigation actions.

3. CURRENT STATE OF WILDFIRE RISK MODELING

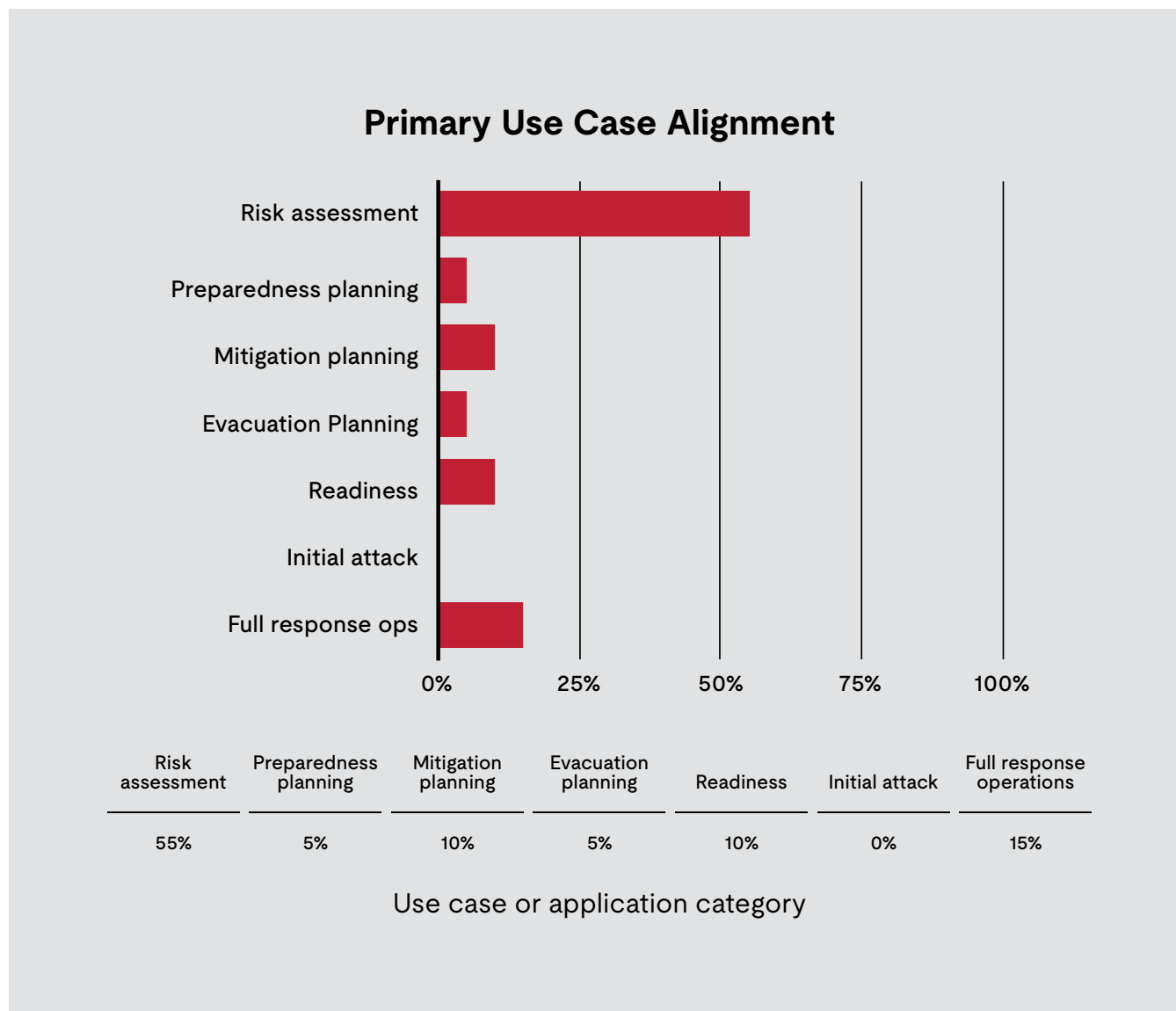


Figure 8: Primary Use Case Alignment:
Chart depicts the trends in the primary use case identified for each model by the practitioners/users.

Practitioners valued outputs that translated complex fire behavior into easily understood maps, timelines, and exposure forecasts, particularly when they identified specific structures, neighborhoods, or pathways likely to experience wildfire impacts. Further, practitioners also indicated the scale or levels of actionability that each of the models supported. This is illustrated in the chart below, with community or neighborhood level ranking the most prevalent (at 95%) followed by structure or parcel level second (at 80%). Practitioners attributed a high value for models that support the structure or parcel level,

3. CURRENT STATE OF WILDFIRE RISK MODELING

particularly for use in risk assessment and other preparedness use cases. It should also be noted that only five (5) of the 20 models were reported to adequately support all three (3) levels of risk information.

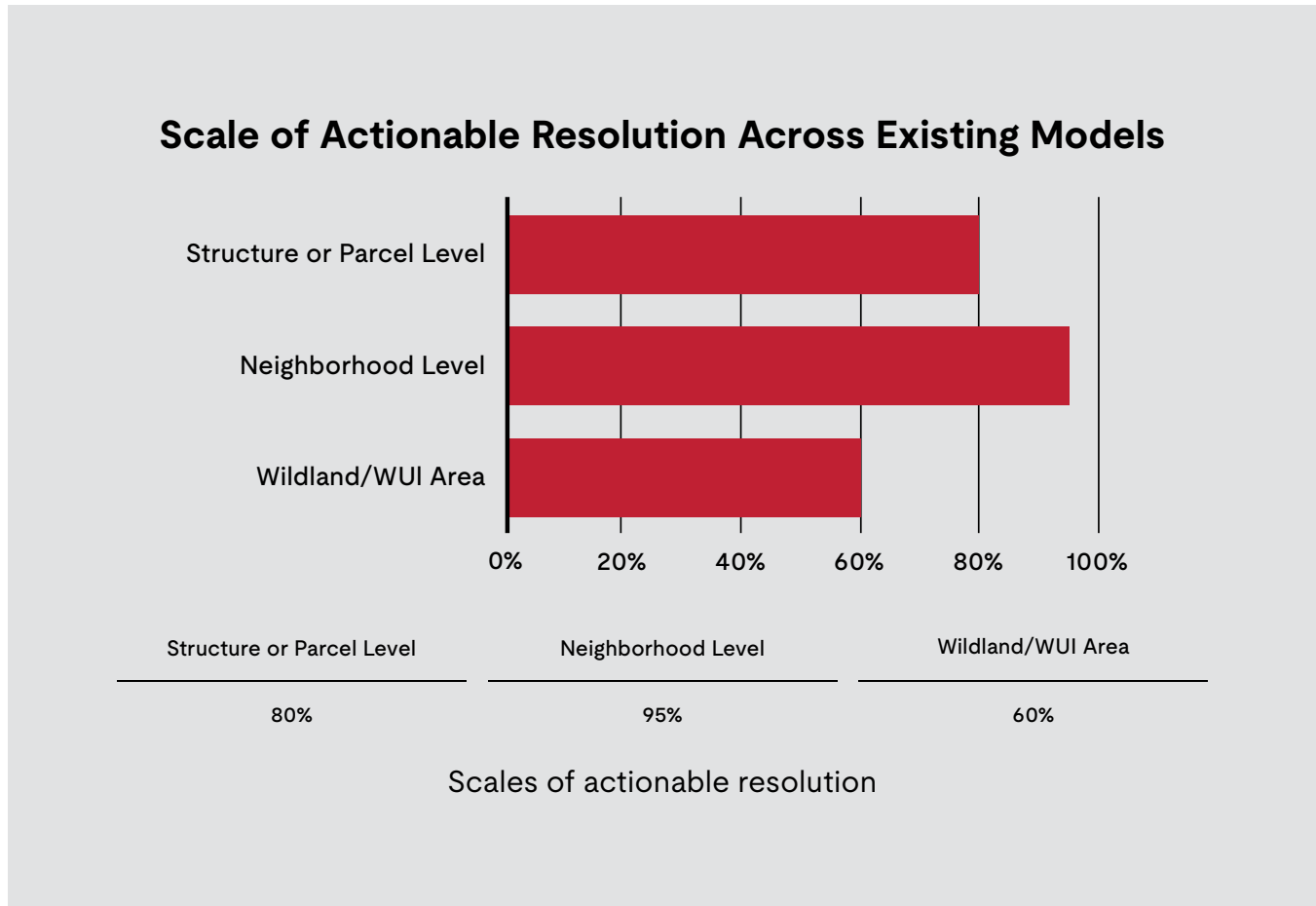


Figure 9: Scale of Actionable Resolution Across Existing Models. Chart depicts the scale that practitioners/users identified the modeling outputs provided being most actionable for.

Across all models, practitioner feedback suggests that the greatest value is achieved when fire behavior, structure vulnerability, and mitigation outcomes are integrated into actionable planning information. Despite strong capabilities in hazard and vulnerability modeling, practitioners consistently identified limitations in end-to-end risk assessment and consequence analysis. Many models effectively predict fire spread, exposure, or ignition likelihood but stop short of quantifying the broader consequences of those outcomes. Evaluators frequently noted the absence of structure-loss estimation, infrastructure disruption, economic consequences, service interruptions, and recovery impacts.

3. CURRENT STATE OF WILDFIRE RISK MODELING

Generally, most models produced outputs that when displayed as a spatial or map-based output were reported as “easy to understand.” This is a positive finding regarding existing models however, outputs were often described as informative but incomplete, requiring additional tools or datasets to translate predicted fire behavior into meaningful assessments of community impact and loss. Several evaluations also emphasized the need for clearer integration between hazard exposure, structure or neighborhood vulnerability, and consequence estimation to support more comprehensive end-to-end risk assessment and related decision making.

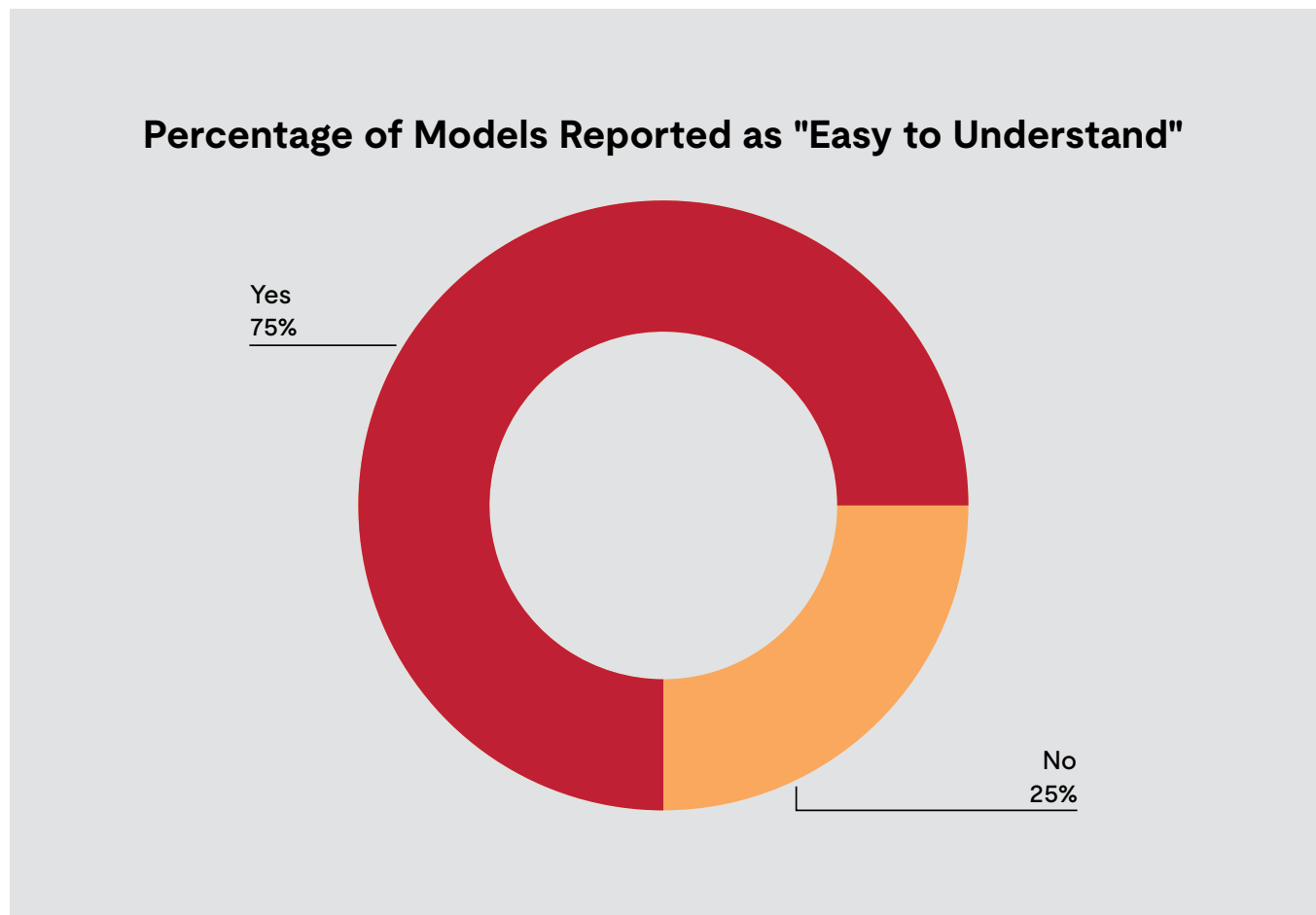


Figure 10: Percentage of Models Reported as “Easy to Understand”

3. CURRENT STATE OF WILDFIRE RISK MODELING

While many models successfully identified structure vulnerability or neighborhood risk, comparatively few, if any, incorporated other inputs such as demographics, vulnerable populations, evacuation planning assumptions and constraints, capacity of transportation systems, suppression capacity, and critical infrastructure dependencies. It would be valuable to modify the scenario to specifically call out these capabilities in future exercises to more directly test and evaluate existing modeling capabilities. Practitioners consistently requested stronger support from models to inform suppression operations, resource optimization, evacuation planning, and mitigation return-on-investment analysis. Dynamic representation of real-world response actions, including retardant application, dozer lines, firing operations, and suppression effectiveness, was a common enhancement request across the evaluations. Collectively, these findings suggest that the largest remaining gap is not in understanding where wildfire risk exists, but in translating risk information into clear, operationally actionable decision support for key use cases beyond a standard risk assessment.

3.4 KEY TAKEAWAY

The evaluation process concluded that the current wildfire modeling ecosystem is strongest in understanding hazard, spread, exposure, and structure vulnerability, but becomes progressively less mature as the analysis moves toward consequences, community impacts, and operational decision making.

Practitioners consistently value models that help answer questions such as where a fire will spread, which structures are most vulnerable, what mitigations are most effective, and how risk changes when actions are taken. The highest-rated solutions generally combined technical rigor with outputs that were intuitive, actionable, and directly connected to real-world decisions.

3. CURRENT STATE OF WILDFIRE RISK MODELING

A dominant theme across the evaluations was that future progress will come less from development of a single comprehensive model and more from integrating complementary capabilities into interoperable decision-support ecosystems. It is important to note that this evaluation assessed only the modeling capabilities and components submitted by participating teams. In some cases, submissions may represent only a subset of a team's broader modeling ecosystem. It is anticipated that continued open evaluation, benchmarking, and community-based testing and evaluation will build confidence and encourage more comprehensive participation in future efforts.

Practitioners repeatedly described opportunities to combine fire spread forecasting, ember transport, structure vulnerability, consequence assessment, economic loss estimation, social vulnerability, evacuation modeling, and suppression effectiveness into unified workflows. These findings suggest that future wildfire risk assessment solutions should be designed around capability integration, enabling communities to move from understanding wildfire hazards toward informed mitigation, preparedness, response, and recovery decisions.

The existing wildfire modeling ecosystem contains numerous complementary capabilities, but few integrated approaches capable of generating complete wildfire risk intelligence. Provided below is a synthesis of the capability ensemble archetypes that exist across the models that participated in the exercise. This is not all-inclusive but serves as a starting point in exploring options to ensemble multiple models.

3. CURRENT STATE OF WILDFIRE RISK MODELING

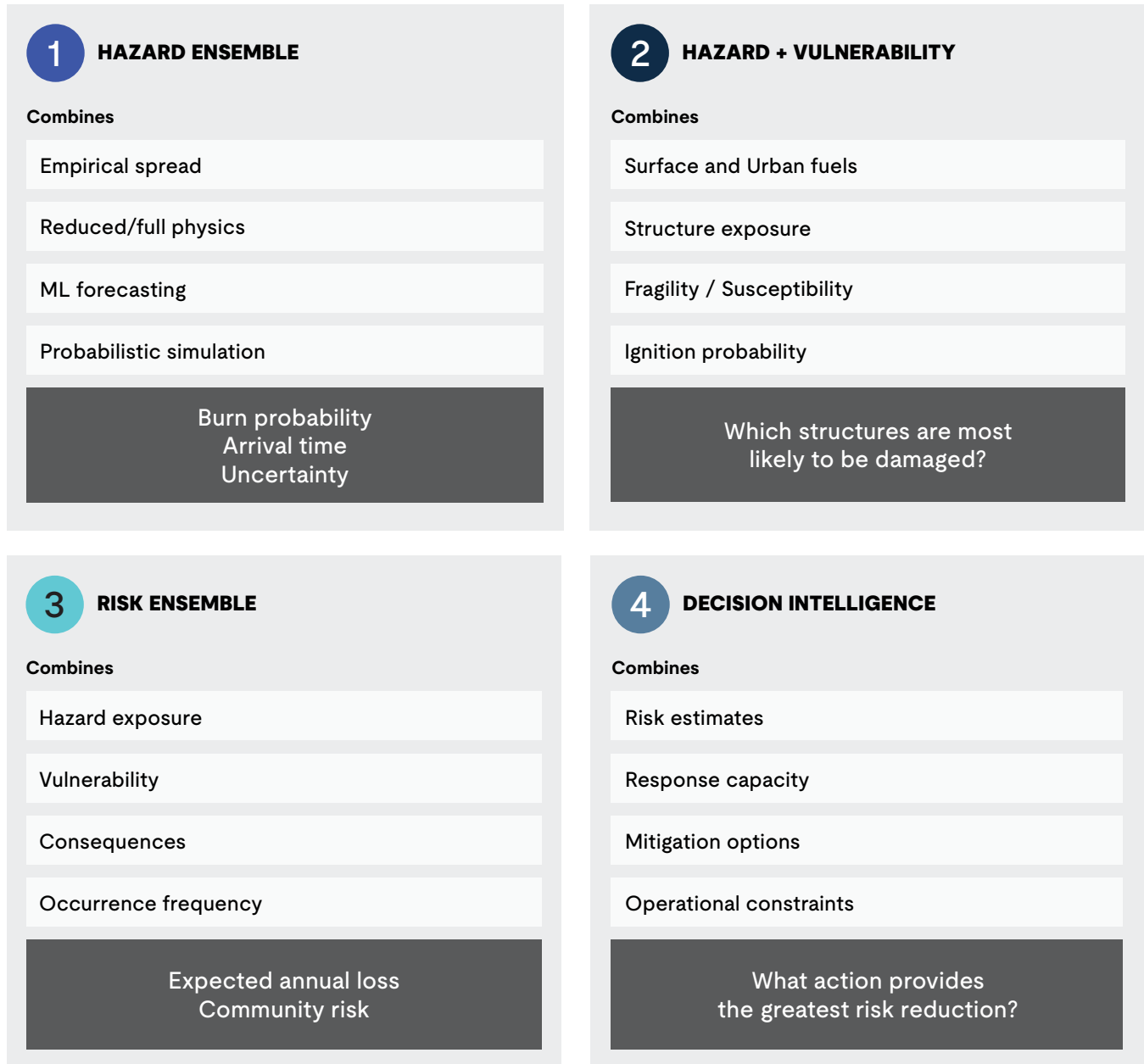


Figure 11: Capability Ensemble Archetypes as a Preliminary Framework for Model Coupling and Ensembles

Despite providing useful hazard or risk information, many models stop short of delivering actionable decision support. Practitioners repeatedly identified the lack of dynamic suppression modeling, mitigation optimization, evacuation optimization, trigger points for action, and operational resource prioritization as significant gaps. Numerous evaluations specifically recommended incorporation of suppression activities such as retardant application, dozer line construction, handline development, firing operations, and real-time response effectiveness. This indicates that the largest remaining capability gap may not be understanding wildfire behavior itself, but translating predictions into operational decisions.

4. SUMMARY OF FINDINGS

Collectively, the findings indicate that wildfire risk modeling is both diverse and rapidly advancing, but significant opportunities remain to improve consistency, integration, and usability.

The most pressing needs include establishing a common risk modeling lexicon, strengthening data foundations, expanding capabilities beyond hazard modeling, improving science-to-operations translation, and creating interoperable frameworks that enable multiple modeling approaches to work together. These advances are foundational to developing the next generation of wildfire risk intelligence and decision-support capabilities.

Diversity of Modeling Approaches Is a Strength

No single model performed better than another; rather, different models demonstrated strengths in addressing different aspects of wildfire risk.

Hazard Modeling Dominates Current Capabilities

Many assessments provide valuable hazard information but fall short of delivering the comprehensive risk intelligence needed to support decision making.

Risk Is Not Consistently Defined

Establishing common terminology, definitions, and a shared conceptual framework will be essential for improving interoperability and advancing wildfire risk science.

Science-to-Operations Translation Remains Challenging

Many models generated technically sophisticated results that required significant expertise to interpret, limiting their utility for practitioners, emergency managers, and community stakeholders.

Data Inconsistencies Limit Comparability

Differences in underlying datasets frequently contributed to variation in model outputs and reduced comparability among modeling approaches.

4. SUMMARY OF FINDINGS

4.1 DIVERSITY OF MODELING APPROACHES IS A STRENGTH

The Wildfire Risk Modeling Exercise demonstrated that multiple valid approaches exist for assessing wildfire risk. Participating models utilized a wide range of scientific and computational methodologies, each offering unique strengths and insights. No single model performed better than another; rather, different models demonstrated strengths in addressing different aspects of wildfire risk. This finding suggests that future advancement should focus on interoperability and integration of complementary capabilities rather than pursuing a singular modeling approach.

4.2 HAZARD MODELING DOMINATES CURRENT CAPABILITIES

Most participating models focus primarily on wildfire hazard characterization, including ignition probability, burn probability, fire spread, and fire behavior prediction. While these capabilities are critical, fewer models addressed exposure, vulnerability, consequences, resilience, or mitigation effectiveness. As a result, many assessments provide valuable hazard information but fall short of delivering the comprehensive risk intelligence needed to support decision making.

4.3 RISK IS NOT CONSISTENTLY DEFINED

The exercise revealed significant variation in how participants define and quantify hazard, exposure, vulnerability, consequence, resilience, and, ultimately, risk. These inconsistencies limit comparability across models and complicate efforts to integrate outputs into a unified assessment framework. Establishing common terminology, definitions, and a shared conceptual framework will be essential for improving interoperability and advancing wildfire risk science.

4.4 SCIENCE-TO-OPERATIONS TRANSLATION REMAINS CHALLENGING

A recurring theme across evaluator feedback was the difficulty of translating scientific outputs into actionable information. Many models generated technically sophisticated results that required significant expertise to interpret, limiting their utility for practitioners, emergency managers, and community stakeholders. Participants emphasized the need for plain-language outputs, end-to-end risk assessment workflows, and decision-support capabilities that connect wildfire science directly to mitigation, preparedness, response, and resilience actions.

4.5 DATA INCONSISTENCIES LIMIT COMPARABILITY

Differences in underlying datasets frequently contributed to variation in model outputs and reduced comparability among modeling approaches. Key challenges included inconsistencies in building attribute data, exposure datasets, vulnerability information, and historical and observational wildfire records. Further, models handled weather inputs differently which further adds to difficulties in comparing model performance. This included a range of approaches for handling weather information, such as excluding weather information altogether, using it for their own reanalysis, basic classification of conditions, and incorporating full synthetic atmospheric profiles resembling the weather data provided. These findings underscore the need for standardized data schemas, common exposure and vulnerability datasets, and improved data collection and sharing practices to support model validation, interoperability, and future integration efforts.

5. PRIORITY NEEDS, GAPS, AND OPPORTUNITIES FOR ADVANCEMENT

The Wildfire Risk Modeling Exercise revealed broad consensus among scientific experts, practitioners, and end users regarding both the capabilities most needed from wildfire risk modeling solutions and the gaps that currently limit their use in practice. While participating models represented diverse scientific approaches and technical capabilities, evaluators consistently emphasized that **future advances should focus less on improving individual model components in isolation and more on creating integrated risk intelligence solutions** capable of supporting decision making across mitigation, preparedness, response, and recovery.

5.1 ACTIONABLE RISK INTELLIGENCE

The most consistent finding across all evaluation groups was the need for models that identify which structures, parcels, neighborhoods, and community assets are most at risk. Stakeholders consistently prioritized outputs that support resource allocation and risk reduction decisions rather than simply describing fire behavior or hazard conditions. Parcel-level risk assessments, vulnerability scores, and relative risk rankings were viewed as particularly valuable because they help decision makers prioritize mitigation investments where they are likely to produce the greatest reduction in risk. In some cases, this is analogous to “understanding risk” or “describing risk” vs. acting on that risk. The need is to better develop the former, but ultimately models should be in service to risk reduction and better system harmony.

This finding highlights a persistent gap in current modeling approaches. Many existing systems excel at characterizing wildfire hazards but struggle to translate those hazards into actionable assessments of risk. **Future development efforts should therefore focus on building end-to-end risk workflows that integrate fire occurrence, spread probability, vulnerability, and consequence modeling into unified decision-support products.** Combining fire spread and burn probability models with structure vulnerability and loss models represents a significant opportunity to create more actionable assessments of community wildfire risk.

5.2 INTEGRATING FIRE BEHAVIOR AND COMMUNITY IMPACTS

A second major priority identified through the exercise was the ability to connect wildfire behavior directly to its impacts on people, structures, and communities. Evaluators consistently favored modeling approaches that integrated fire progression with building

5. PRIORITY NEEDS, GAPS, AND OPPORTUNITIES FOR ADVANCEMENT

characteristics, defensible space, home hardening measures, and structure vulnerability. Current wildfire risk assessments often treat wildfire behavior and community impacts as separate analytical domains. This fragmentation prevents users from understanding how wildfire dynamics translate into actual losses and consequences.

Participants also identified the need to bridge traditionally separate modeling domains.

Future systems should connect landscape-scale wildfire spread models with community-scale fire propagation and structure-to-structure spread models. This would enable a more complete representation of wildfire progression from ignition through wildfire spread, structure ignition, and urban conflagration, particularly within the wildland-urban interface.

5.3 STRENGTHENING SUPPORT FOR MITIGATION PLANNING

The exercise demonstrated strong demand for models that directly support mitigation planning and investment decisions. Evaluators consistently valued capabilities that identify high-risk structures, evaluate vulnerabilities at the parcel level, prioritize mitigation activities, assess mitigation effectiveness, and dynamically update risk estimates as projects are completed.

Although many models can identify areas of elevated hazard, fewer models explicitly estimate the effects of mitigation measures on future risk. Future risks should be considered in multiple domains of time:

1. Immediate, based on current or annualized conditions of vegetation, weather patterns, and urban/community development.
2. In the future at five- to ten-year intervals, based on projected vegetation and weather conditions, and urban/community planned development.
3. Long-term planning at 20- to 30-year intervals, to account for projected climate and weather conditions.

This indicates a gap in the capacity of models to support longer-range planning. Practitioners also expressed a need for risk-based tools that help evaluate the effectiveness of fuel treatments, defensible space programs, home hardening initiatives, and other resilience interventions – and their estimated returns on investment.

5. PRIORITY NEEDS, GAPS, AND OPPORTUNITIES FOR ADVANCEMENT

Future advancement should focus on linking wildfire risk models with mitigation planning and structural resilience tools. Such integration would enable communities to compare alternative investments and quantify expected reductions in risk, thereby supporting more evidence-based mitigation strategies.

5.4 ENHANCING OPERATIONAL PLANNING AND RESPONSE SUPPORT

Operational users emphasized the importance of models that provide time-based forecasts and actionable situational awareness. Highly valued outputs included fire arrival estimates, spread projections, likely fire travel pathways, evacuation triggers, and resource deployment information.

These capabilities are increasingly important as emergency managers and incident commanders seek to incorporate predictive analytics into operational decision making. However, evaluators noted that many existing models generate complex scientific outputs that require substantial technical expertise to interpret.

A significant opportunity exists to expand wildfire risk models into operational decision-support ecosystems. This includes linking fire behavior models with evacuation planning tools, suppression resource allocation frameworks, public warning systems, and consequence models capable of estimating potential impacts under different operational scenarios.

5.5 IMPROVING WILDLAND-URBAN INTERFACE EXPOSURE MODELING

One of the most significant technical gaps identified through the exercise involved the representation of wildfire exposure pathways within the wildland-urban interface. Evaluators repeatedly highlighted the importance of accurately modeling wildfire-to-structure ignition, structure-to-structure fire spread, ember transport, fire spotting behavior, and interactions between vegetation and constructed environments.

Many models continue to focus primarily on direct flame contact while insufficiently representing ember-driven ignition pathways and radiative heat transfer between structures. This is largely due to the reliance on Rothermel-based models as a common foundational methodology across most existing models. At this time, there is a lack of scientific evidence from historic wildfires to confirm which mode of fire transmission (flame spread, radiative heat transfer, and ember dispersion and deposition) is a leading cause of

5. PRIORITY NEEDS, GAPS, AND OPPORTUNITIES FOR ADVANCEMENT

structure ignition. Modelers should continue to advance their research to account for all modes of fire transmission to mitigate for bias where real-world incident validation is not available. Practitioners and users of models should ensure they account for all modes of fire transmission in their risk assessment process.

Future development should therefore strengthen exposure modeling through improved integration of ember transport and spotting models with wildfire spread and vulnerability assessments. Additional emphasis should be placed on representing multiple ignition pathways and understanding how these pathways contribute to structure and community losses.

5.6 EXPANDING CONSEQUENCE AND ECONOMIC RISK ANALYSIS

The exercise also revealed growing demand for consequence-oriented risk assessments. Participants consistently indicated that decision makers need more than predictions of fire behavior; they need information regarding potential outcomes and impacts.

Models capable of estimating structure damage probabilities, expected losses, economic consequences, and community-scale impacts were viewed as especially valuable. Such capabilities support prioritization of investments, budgeting decisions, resilience planning, and grant allocation.

A major opportunity exists to expand wildfire risk assessments beyond hazard characterization by incorporating economic, social, infrastructure, and resilience consequences. Integrating consequence models with hazard and exposure models would enable more complete assessments of community risk and support development of metrics such as expected annual loss and resilience-adjusted risk.

5.7 ADVANCING VISUALIZATION, COMMUNICATION, AND EXPLAINABILITY

Across all stakeholder groups, there was strong agreement that wildfire risk information must be transparent, explainable, and easily understood by both technical and non-technical users. Evaluators consistently favored models that clearly communicated why particular structures or communities were vulnerable and which factors contributed most to risk.

5. PRIORITY NEEDS, GAPS, AND OPPORTUNITIES FOR ADVANCEMENT

Desired capabilities included exposure maps, progression maps, fire travel pathways, structure vulnerability diagnostics, ignition pathway analyses, consequence visualizations, and explicit documentation of assumptions and uncertainties.

Improving explainability represents both a scientific and operational opportunity. Transparent diagnostic information increases confidence in model outputs, supports stakeholder engagement, and helps users identify practical mitigation actions. **Future systems should therefore place greater emphasis on model transparency, uncertainty characterization, and intuitive communication products designed for diverse audiences.**

5.8 OPPORTUNITY FOR ENSEMBLE MODELING AND INTEGRATED RISK INTELLIGENCE

One of the most prominent findings emerging from the exercise is that no single wildfire risk model currently provides all capabilities practitioners/users need. Rather than converging on a single modeling framework, the exercise demonstrated that different models possess complementary strengths that can be combined to provide more comprehensive risk intelligence.

Participants identified significant opportunities to develop ensemble approaches that integrate physics-based models, machine learning systems, empirical methods, and computationally efficient operational models. Such ensembles could better quantify uncertainty, improve transferability across geographies, and produce probabilistic estimates of wildfire risk.

The exercise suggests that the future of wildfire risk science lies not in creating a single “best” wildfire model, but in developing an interoperable ecosystem of models capable of working together across hazard, exposure, vulnerability, consequence, mitigation, and operational domains. By integrating complementary models into ensemble-based workflows, the wildfire community can produce more complete, transparent, and actionable intelligence to support decision making before, during, and after wildfire events.

5.9 KEY TAKEAWAY

The overarching conclusion of the Wildfire Risk Modeling Exercise is that users require integrated wildfire risk intelligence rather than isolated hazard models. Future advancement should focus on interoperable, ensemble-based workflows that connect wildfire behavior,

5. PRIORITY NEEDS, GAPS, AND OPPORTUNITIES FOR ADVANCEMENT

exposure, vulnerability, consequences, mitigation options, and operational decision making into a unified framework for assessing and reducing wildfire risk. Provided below is a graphic that illustrates the current state, translation gap, and a conceptual ensemble framework.

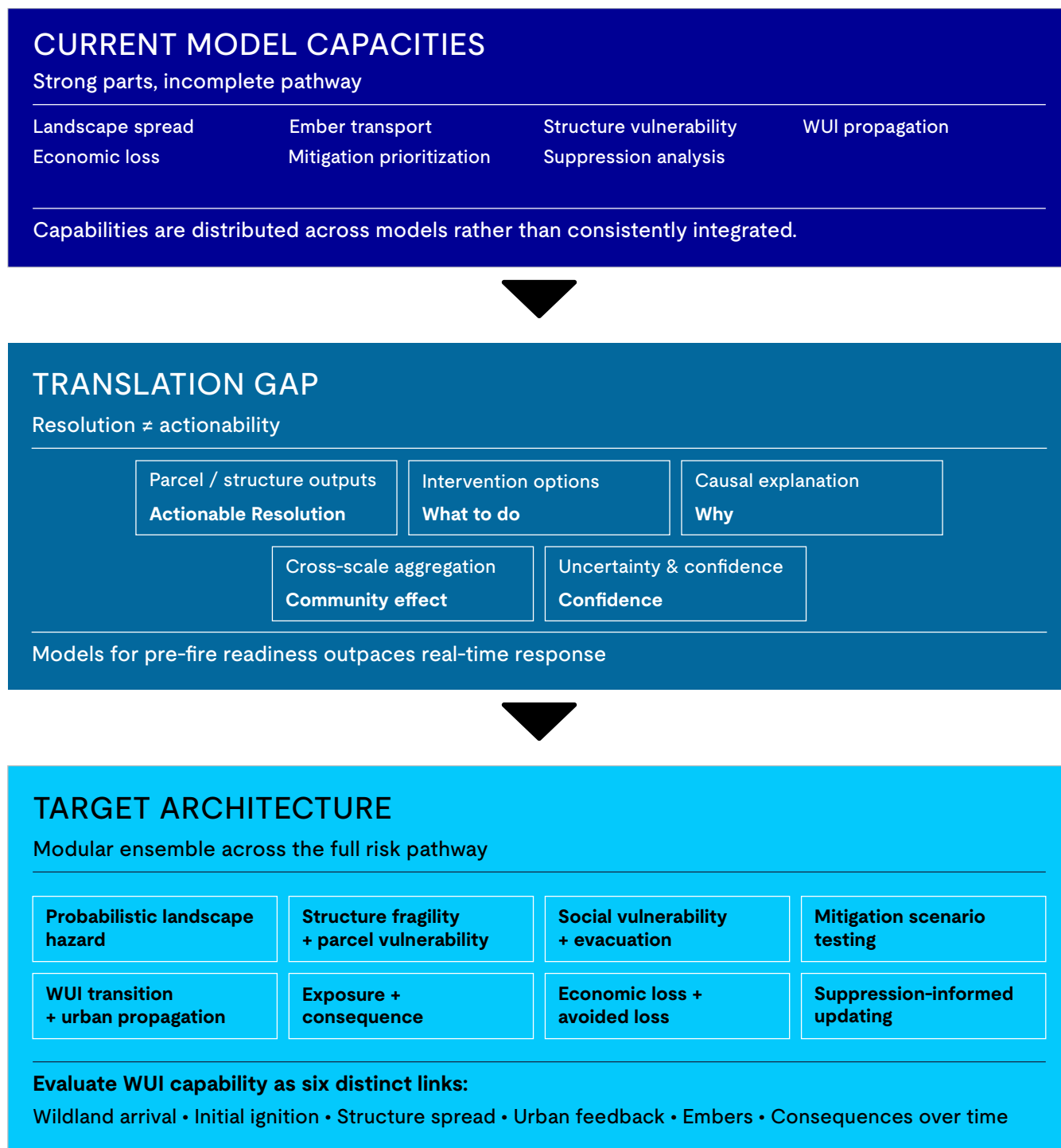


Figure 12: Illustrates the Current State of Modeling Capabilities, Translation Gap, and an Initial Target Architecture for Model Ensembles

6. TECHNICAL GAPS IDENTIFIED

6.1 LACK OF A STANDARDIZED WILDFIRE RISK LEXICON AND DEFINITION FRAMEWORK

The exercise revealed significant inconsistency in how participating models defined and expressed hazard, exposure, vulnerability, consequence, resilience, and risk. Many models used the term “risk” to describe outputs that were more appropriately characterized as fire spread, burn probability, structure vulnerability, ignition likelihood, exposure, or damage probability. This is not surprising, given that the common-use word “risk” is often a synonym for “chance” but conflates processes and a structured approach to modeling. As a result, functionally different model outputs were often presented as equivalent measures of risk despite representing different portions of the risk assessment workflow. This inconsistency complicated model comparison, limited interoperability, and created confusion among practitioners attempting to translate outputs into decisions. A standardized wildfire risk lexicon and formal ontology are needed to define common concepts, output categories, and relationships between risk components.

6.2 INCONSISTENT TREATMENT AND COMMUNICATION OF UNCERTAINTY

Although uncertainty is fundamental to wildfire risk assessment, participating models varied substantially in how uncertainty was represented, quantified, and communicated. Some models incorporated ensemble simulation, Monte Carlo analysis, stochastic ignition scenarios, or probabilistic outputs, while others produced deterministic results with limited discussion of uncertainty. Even among probabilistic models, practitioners often reported difficulty understanding confidence levels, uncertainty bounds, input sensitivity, and the relative influence of assumptions on modeled outcomes. The evaluation identified a need for consistent approaches to uncertainty characterization, documentation, and visualization that allow decision makers to distinguish between model certainty, scenario variability, and unknowns. While probability is important in both understanding mechanisms endemic to the wildfire issue, when used for forecasting or prediction, models must be explicit in their treatment of uncertainty.

6.3 ABSENCE OF AN END-TO-END SHARED RISK ASSESSMENT FRAMEWORK

Most submissions addressed individual portions of the wildfire risk continuum rather than representing the full fire risk assessment pathway or workflow. While fire propagation and

6. TECHNICAL GAPS IDENTIFIED

spread modeling were prevalent across the majority of models, there was less consistency in models accounting for other capabilities — only in a couple of model approaches were they integrated into a common framework. Consequently, results often stopped at exposure, vulnerability, or consequence without connecting all elements required to assess risk comprehensively. The exercise demonstrated the **need for a shared framework into a transparent and interoperable workflow** that integrates ignition probability, fire behavior, exposure, vulnerability, consequence, and resilience for true decision support.

6.4 DATA GAPS

Parcel and Building Characteristic Data Remain Inconsistent and Incomplete

Building characteristics were repeatedly identified as one of the strongest determinants of modeled structure impacts. Yet, evaluators consistently noted that available structure-level data are incomplete, inconsistent, or unavailable for many jurisdictions much less at a national scale. Building construction features, defensible space conditions, roof characteristics, vents, windows, vegetation adjacency, occupancy information, and parcel configuration are often unavailable at scale or not maintained in standardized formats. Further, these factors are often dynamic and require frequent and timely updates to make them current and accurate. These limitations constrain model fidelity and reduce confidence in parcel-level risk estimates.

Lack of Standardized Mitigation and Pre-Incident Inspection Data

Many models sought to evaluate mitigation effectiveness but lacked reliable datasets describing completed mitigation actions. Information on home hardening, defensible space treatments, community fuel projects, prescribed fire, fuel breaks, code adoption, code compliance, and recurring maintenance activities remain fragmented and difficult to access. Without standardized mitigation inventories, models cannot consistently quantify avoided loss, resilience gains, or investment effectiveness across communities.

Several models demonstrated the value of parcel-level vulnerability assessments. Still, evaluators repeatedly noted that many jurisdictions do not possess comprehensive records of home hardening measures, defensible space conditions, maintenance activities, or wildfire inspections. The lack of standardized pre-incident inspection data limits the ability to calibrate, validate, and update vulnerability and structure fragility models while also reducing confidence in mitigation prioritization outputs.

6. TECHNICAL GAPS IDENTIFIED

Need for National Post-Fire Damage Datasets

A substantial number of vulnerability and damage models relied on post-fire inspection datasets such as California DINS records. Evaluators generally viewed these datasets as extremely valuable but highlighted concerns regarding transferability, geographic applicability, and representativeness. The exercise demonstrated the need for broader national post-fire damage inspection datasets and standardized collection methodologies capable of supporting model development, validation, and benchmarking across multiple fuel types, geographies, and construction practices.

6.5 INTEROPERABILITY GAPS

Need for Standard Baseline Methodology Transparency

Practitioners consistently reported that they were more likely to trust, interpret, and utilize outputs when assumptions, data sources, model limitations, and uncertainty were clearly documented. Several technically sophisticated models lost decision-support value because key methodologies were not transparent, adequately documented, or easily understood. The evaluation identified transparency as a foundational requirement for both scientific credibility and operational adoption.

Lack of Common Standards and Data Schemas

A recurring finding across both evaluator groups was the need for common standards governing wildfire risk data. Building characteristics, damage classifications, mitigation actions, fire behavior metrics, uncertainty measures, consequence types, and risk outputs were represented differently across submissions. The absence of standard schemas limits comparability, interoperability, benchmarking, and scaling of risk intelligence efforts. More specifically, computational interoperability, when attempting to achieve fully integrated ensembles for instance, is a fundamental challenge that may only be resolved through co-development among multiple model development groups.

Limited Ability to Exchange Inputs and Outputs Across Models

The exercise demonstrated that most models were developed independently with unique data requirements, assumptions, formats, and output structures. While many evaluators identified strong ensemble opportunities, significant effort would be required to move information between systems. This limits the ability to combine complementary capabilities

6. TECHNICAL GAPS IDENTIFIED

and constrains the development of modular workflows where outputs from one model can serve as inputs into another. In solving for wildfire model interoperability, proven approaches from flood modeling may be adapted and applied. For example, a similar concept for “interoperability” for guiding transition from local multifunctionality to city-scale multisystem flood management⁷ can be borrowed to scale parcel or structure level models to neighborhood, community, and city, county level risk model workflows.

6.6 MODEL VALIDATION GAPS

ASTM E1355 Standard Guide for Evaluating the Predictive Capability of Deterministic Fire Models (2018)⁸ defines model validation as “the process of determining the degree to which a calculation method is an accurate representation of the real-world from the perspective of the intended uses of the calculation method.” Currently, model validation is assessed by comparing modeled fire perimeters to real, observed, or historic fire perimeters and impacts. Accurate and reliable historical fire data is limited and inconsistent, with the majority limited to California-based fires. Some models even use historical fire data to perform model optimization and parameterization as “validation” and then use the outputs to prove that the model has the capability of producing accurate results. This makes actual validation of wildfire models and comparison between them almost impossible. This exercise was intentionally designed to control this issue by establishing semi-synthetic scenes and data, without historical fire data, to mitigate any models from calibrating and backing into those parameterized sensitivities.

Limited Availability of Benchmark and Reference Datasets

Comparing model performance is challenging because no common benchmark datasets currently exist for evaluating wildfire risk models across hazard, vulnerability, consequence, and resilience dimensions. Further, since there is no single source of truth, there is no single basis to validate model performance against. While some submissions referenced historical validation datasets, many lacked common reference conditions against which accuracy, skill, uncertainty, and applicability could be consistently measured. A shared benchmark dataset library would significantly improve model comparison, validation, and technology advancement.

6. TECHNICAL GAPS IDENTIFIED

Need for Repeatable and Standardized Testing Methods

The exercise itself demonstrated the value of common semi-synthetic datasets, scenarios, and evaluation criteria to support replicable and repeatable testing. Standardized inputs can provide for better control in model testing and evaluation. Evaluators repeatedly emphasized that one-time assessments are insufficient for measuring progress or understanding model performance under varying conditions. A standardized testing framework capable of recurring evaluation cycles is needed to measure improvement, identify gaps, and support evidence-based model development.

6.7 CONSEQUENCE GAPS

Human Impacts Remain Underrepresented

Most models focused primarily on physical wildfire behavior and structure impacts while providing limited treatment of life safety, evacuation complexity, vulnerable populations, public health implications, displacement, or recovery impacts. Human-centered outcomes remained among the least represented components of wildfire risk despite their importance to decision makers.

Direct Property-Level Impact Is Advancing but Still Limited

Several models successfully estimated structure loss probability, structure damage, expected annual loss, or economic consequences. However, approaches varied significantly across submissions, leading to inconsistent treatment of vulnerability, damage severity, and loss estimation. Standardized methodologies and supporting datasets remain necessary before these outputs can be compared consistently across systems.

Other Direct Economic Consequences Are Rarely Represented

Most consequence analyses focused on building damage and replacement costs. Few models attempted to quantify impacts to infrastructure, utilities, transportation systems, public services, commercial activity, business interruption, or critical facilities. Consequently, many estimates underrepresent the full magnitude of wildfire impacts experienced by communities.

6. TECHNICAL GAPS IDENTIFIED

Indirect and Long-Term Recovery Impacts Are Largely Absent

The exercise revealed an industry-wide focus on immediate physical damage while largely omitting long-term economic and recovery impacts. Housing displacement, workforce disruption, insurance availability, municipal fiscal impacts, recovery timelines, tax-base effects, and broader community resilience were generally outside the scope of participating models. Incorporating these dimensions will be necessary to transition from wildfire hazard assessment to comprehensive community resilience and risk intelligence.

6.8 DECISION SUPPORT GAPS

Model Outputs Fall Short of Supporting Decision Making

One of the most consistent practitioner findings was that models often produce technically credible outputs but do not explicitly connect those outputs to actionable decisions. Many models provided fire behavior, burn probability, structure vulnerability, or consequence estimates without clearly identifying what the decision maker should do differently as a result. Practitioners consistently favored models that translated outputs into specific mitigation actions, preparedness decisions, evacuation triggers, resource allocation recommendations, prioritization strategies, or investment options. The exercise highlighted a significant opportunity to improve science-to-operations translation by focusing on decision-support products rather than solely analytical outputs.

7. RECOMMENDATIONS

Based on the results and findings from the exercise process, below is a set of recommendations that point toward a common vision:

Develop a national interoperable wildfire risk intelligence ecosystem that integrates hazard, exposure, vulnerability, consequence, mitigation, and operational decision-support capabilities through standardized data frameworks, interoperability, and ensemble-based analytics.

This recommendation serves as the overarching strategic conclusion of the Wildfire Risk Modeling Exercise and serves as a shared roadmap for advancing the next generation of wildfire risk science and technology. Provided below is a table that summarizes the recommendations laid out in this report.

Prioritized Summary of Recommendations

Priority	Recommendation	Rationale	Key Actions	Expected Outcome
1	Establish End-to-End Wildfire Risk Intelligence Frameworks	The strongest finding from the exercise was the need for actionable risk identification rather than standalone hazard characterization.	Develop a standardized risk framework linking hazard, exposure, vulnerability, consequences, and resilience. Establish common risk terminology and performance measures.	Consistent structure-, parcel-, neighborhood-, and community-level risk assessments.
2	Establish Interoperability Standards and Shared Data Frameworks	Nearly all advancement opportunities depend on improved model interoperability and standardized data exchange.	Develop common schemas, APIs, metadata standards, risk taxonomies, and model exchange protocols. Establish governance mechanisms.	A federated ecosystem capable of integrating data and outputs across modeling platforms.
3	Advance Exposure and Vulnerability Modeling	Significant gaps remain in representing structure vulnerability, ember exposure, and building characteristics.	Develop standardized building datasets, ember transport integration, vulnerability models, and ignition pathway analysis methods.	Improved estimation of structure ignition probability and damage potential.
4	Create an Integrated Landscape-to-Community Fire Modeling Ecosystem	WUI fire progression represents one of the most important unresolved scientific challenges identified by evaluators.	Couple landscape spread models with wildfire-to-structure, ember exposure, and structure-to-structure spread models.	Comprehensive representation of wildfire progression from ignition through community impacts.

7. RECOMMENDATIONS

5	Improve Visualization, Communication, and Explainability	Stakeholders consistently emphasized the need for understandable and transparent model outputs.	Develop common visualization standards, explainability frameworks, uncertainty communication methods, and practitioner-oriented products.	Greater user trust, adoption, and science-to-operations translation.
6	Expand Wildfire Risk Modeling into Decision Support Systems	Communities and emergency managers require actionable decision support rather than technical outputs alone.	Link risk models with mitigation planning, structural hardening assessments, resource allocation tools, warning systems, and evacuation models.	Decision-centered risk intelligence supporting mitigation, preparedness, and incident management.
7	Develop Comprehensive Consequence and Economic Risk Modeling Capabilities	Current models inadequately characterize economic, social, and resilience impacts.	Integrate damage models with economic loss, infrastructure disruption, community impacts, and resilience metrics.	Comprehensive consequence assessments supporting investment and policy decisions.
8	Advance Ensemble Modeling as the Future State of Wildfire Risk Assessment	The exercise demonstrated that no single model is sufficient to address all stakeholder needs.	Develop ensemble architectures combining physics-based, empirical, machine learning, and operational forecasting approaches. Incorporate uncertainty quantification and probabilistic outputs.	Robust, scalable, and scientifically defensible wildfire risk intelligence capabilities.

Recommendation 1: Establish End-to-End Wildfire Risk Intelligence Frameworks

The highest priority identified through the exercise is the need to move beyond isolated hazard assessments toward complete risk intelligence workflows. Existing modeling approaches often characterize wildfire occurrence, burn probability, or fire spread independently. Still, decision makers require integrated assessments that connect wildfire hazards to structure fragility, potential damage, neighborhood-level risk, and societal consequences.

Future investment should focus on developing end-to-end workflows that combine wildfire behavior models with vulnerability, damage, and consequence models to produce actionable assessments of wildfire risk at the structure, parcel, neighborhood, and community scales. Such frameworks would allow stakeholders to prioritize risk reduction activities and better understand the implications of wildfire threats.

Desired Outcome: Decision-centered risk assessments capable of identifying who and what is most at risk, why risk exists, and how risk can be reduced.

7. RECOMMENDATIONS

Recommendation 2: Establish Interoperability Standards and Shared Data Frameworks

Many of the gaps identified during the exercise stem from the inability of different modeling approaches to exchange information seamlessly. Participants consistently noted challenges related to inconsistent data schemas, incompatible model outputs, and the lack of standardized terminology for risk-related concepts.

A coordinated effort should be undertaken to establish common data standards, interoperability frameworks, metadata requirements, and risk taxonomies. These standards should support information exchange across models while preserving flexibility for diverse scientific approaches.

Additionally, there is a resounding need to curate and provide open foundational data from authoritative sources to address the common data requirements for improved wildfire risk modeling solutions.

Desired Outcome: A federated modeling ecosystem that enables collaboration, model integration, and workflow automation.

Recommendation 3: Advance Exposure and Vulnerability Modeling

The exercise identified significant limitations in how many models represent exposure pathways and structural vulnerability. In particular, evaluators emphasized the importance of better accounting for ember transport, spotting behavior, building characteristics, defensible space conditions, and mitigation measures.

Future advancement should focus on integrating ember transport and spotting models with fire spread and vulnerability assessments while expanding the representation of multiple ignition pathways. Standardized building characteristic datasets and vulnerability assessment methodologies should also be prioritized to improve consistency across modeling efforts.

Desired Outcome: Improved accuracy in estimating structure ignition probability, damage likelihood, and community impacts.

7. RECOMMENDATIONS

Recommendation 4: Create an Integrated Landscape-to-Community Fire Modeling Ecosystem

A major gap identified through the exercise is the disconnect between landscape-scale wildfire behavior models and community-scale fire spread processes. Most existing modeling systems are optimized either for wildfire spread across landscapes or for structure vulnerability, but few adequately represent the progression of fire from wildlands into developed communities.

Future research and development should focus on coupling landscape fire spread models with community fire dynamics models, including wildfire-to-structure ignition, ember exposure, and structure-to-structure spread. Better representation of these interactions is essential for accurately assessing wildfire risk in the wildland-urban interface.

Desired Outcome: Comprehensive modeling of fire progression from ignition through community impacts and urban conflagration.

Recommendation 5: Improve Visualization, Communication, and Explainability

A consistent finding across both practitioners and technical reviewers was the importance of clear, intuitive, and transparent communication of risk. Many existing models produce highly technical outputs that are difficult to interpret or translate into action.

Future efforts should prioritize the development of user-centered visualization frameworks that clearly communicate exposure, vulnerability, consequences, uncertainty, and mitigation opportunities. Explainable outputs that show why particular properties are vulnerable and how risk can be reduced are critical for building stakeholder trust and supporting effective decision making.

Desired Outcome: Increased usability, transparency, and adoption of wildfire risk intelligence products by technical and non-technical stakeholders.

7. RECOMMENDATIONS

Recommendation 6: Expand Wildfire Risk Modeling into Decision Support Systems

Participants consistently indicated that wildfire risk assessments should support decisions, not simply produce scientific outputs. Models that informed mitigation planning, evacuation decisions, resource deployment, and resilience investments were more valued.

Future systems should integrate wildfire risk models with mitigation planning tools, structural hardening assessments, suppression resource allocation models, evacuation planning systems, and consequence models. By linking risk assessment directly to available actions, communities can make more informed and effective investments in risk reduction.

Desired Outcome: Operationally relevant decision-support tools that inform mitigation, preparedness, response, and recovery activities.

Recommendation 7: Develop Comprehensive Consequence and Economic Risk Modeling Capabilities

Current wildfire modeling efforts remain heavily focused on hazard characterization. The exercise highlighted a growing need to quantify the broader consequences of wildfire events, including structure losses, economic impacts, infrastructure disruptions, and community-level outcomes.

Future research should prioritize the development of integrated consequence models that connect fire behavior, exposure, and vulnerability with economic loss, social impacts, and resilience metrics. These capabilities are particularly important for supporting investment prioritization, grant funding decisions, resilience planning, and public policy development.

Desired Outcome: Comprehensive assessments of wildfire consequences that support risk-informed investments and policy decisions.

7. RECOMMENDATIONS

Recommendation 8: Advance Ensemble Modeling as the Future State of Wildfire Risk Assessment

Perhaps the most important strategic conclusion from the exercise is that no single model possesses all capabilities required to support wildfire risk decision making. Instead, different models exhibit complementary strengths that can be leveraged through ensemble approaches.

Future investment should prioritize the development of ensemble modeling frameworks that combine physics-based models, machine learning approaches, empirical models, and operational forecasting systems. Ensemble approaches offer the potential to quantify better uncertainty, improve transferability across geographies, and generate probabilistic estimates of wildfire risk and expected losses.

Desired Outcome: More robust, transparent, and scientifically defensible predictions that leverage the strengths of multiple modeling approaches.

8. CONCLUSION: FUTURE OF WILDFIRE RISK INTELLIGENCE

The synthesis of evaluation data demonstrated a diverse and rapidly advancing wildfire-modeling field with clear maturity in spatial fire propagation/spread analysis and the ability to produce outputs at the parcel, structure, and neighborhood levels, despite the foundational gap in source data at a national scale. The evaluations also reveal persistent gaps between technically credible outputs and complete, actionable risk intelligence. Most models address only selected portions of the hazard-exposure-vulnerability-consequence chain, and comparatively few quantify mitigation benefits, incorporate social vulnerability, or support dynamic operational decision making.

The findings support investment in a modular ensemble framework rather than selection of a single universal model. Such a framework should combine probabilistic landscape fire behavior, explicit WUI and urban propagation, parcel-level vulnerability, community consequences, mitigation scenario testing, economic loss, social vulnerability, evacuation, and suppression effectiveness. Standardized definitions, interoperable data structures, transparent assumptions, and explicit uncertainty characterization will be essential to ensure that combined outputs remain scientifically defensible, operationally interpretable, and actionable for local decision makers.

The principal finding of the Wildfire Risk Modeling Exercise is not that a single model outperforms all others, but that the **future of wildfire risk intelligence lies in an interoperable ecosystem where multiple models, datasets, and scientific approaches work together to quantify uncertainty, characterize risk, and support better decisions.**

9. LIST OF REFERENCES

- 1 Wildland Fire Mitigation and Management Commission. (2023). On Fire: The report of the Wildland Fire Mitigation and Management Commission. U.S. Department of Agriculture.
- 2 U.S. Forest Service. (2024, January 10). Wildfire: A modern-day paradox. U.S. Department of Agriculture. Retrieved October 1, 2026, < <https://www.fs.usda.gov/about-agency/features/wildfire> >
- 3 U.S. Forest Service. (2024). Wildland-urban interface growth in the United States. U.S. Department of Agriculture. Retrieved October 1, 2026, < <https://research.fs.usda.gov/nrs/projects/wuigrowth> >
- 4 Wildfire Science & Technology Commons. (n.d.). Wildfire Science & Technology Commons. Retrieved October 1, 2026, < <https://www.wildfirecommons.org/> >
- 5 Wildfire Science & Technology Commons. (n.d.). Wildfire Risk Modeling Exercise. Retrieved October 2, 2026, from Wildfire Science & Technology Commons resource
- 6 Rothermel, R. C. (1972). A mathematical model for predicting fire spread in wildland fuels (Research Paper INT-115). U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. <https://doi.org/10.2737/INT-RP-115>
- 7 Vercruysse, K., Dawson, D. A., & Wright, N. (2019). Interoperability: A conceptual framework to bridge the gap between multifunctional and multisystem urban flood management. *Journal of Flood Risk Management*, 12(S2), e12535. <https://doi.org/10.1111/jfr3.12535>
- 8 ASTM International. (2018). ASTM E1355-12(2018), Standard guide for evaluating the predictive capability of deterministic fire models. ASTM International. <https://doi.org/10.1520/E1355-12R18>
- 9 United Nations Office of Disaster Risk Reduction. “Sendai Framework Terminology on Disaster Risk Reduction” < <https://www.undrr.org/understanding-disaster-risk/terminology/hips/en0205> >
- 10 National Wildland Fire Coordinating Group. “PMS 205: Wildland Fire Glossary of Terms”. < <https://www.nwcg.gov/publications/pms205/nwcg-glossary-of-wildland-fire-pms-205> >
- 11 National Institute of Standards & Technology. “WUI Definitions”. < <https://www.nist.gov/el/fire-research-division-73300/wildland-urban-interface-fire-73305/hazard-mitigation-methodology-9> >

Appendix A – Participating Organizations and Models

Organization / Company	Model or Ensemble Name
FireSafe Analytics	ConvGRU (Convolution Gated Recurrent Unit)
FiSci	Mitigate platform
FlameMapper	EmberCast
French National Center for Science	FireCaster Ensemble
IMAGECAT	FireImpact
Minerva University	Cell2Fire W
OroraTech	Wildfire Property Risk
Spatial Informatics Group	Ensemble: Pyretechnics, Pyregence
Pinepeak	FlameSight
San Jose State University	WIRC/SJSU
SkyTL	Ensemble: WindTL, AGNI-NAR
Spatial Informatics Group	Ensemble: Pyretechnics, Pyregence
Tenax AI	Tenex.ai Resilience Score Tenex.ai Structural Vulnerability Score
University of California, Berkeley (team) - CloudFire, Inc - Planet Labs - University of Maryland	ElmFire WUI-E
University of California, Irvine	Wildfire Intelligence System
University of Nevada, Reno	Ensemble Risk Assessment
Vanderbilt University	Artificial Neural Network Model AGNI-NAR
Vibrant Planet	WildEST / Structure Risk Score
XyloPlan	Urban Fire Model (XFM)
Zesty AI	Z-Fire L2 Model

Appendix B - Glossary of Terms

Provided below is the glossary of terms that were established specifically to support the Wildfire Risk Modeling Exercise. This set of terms and definitions does not establish a standard lexicon for wildfire risk modeling at large.

Term	Definition
Agentic AI	Autonomous system that perceives its environment, makes independent decisions, plans, and takes actions to achieve complex, goal-oriented tasks with minimal human intervention.
AI Agent	Autonomous system that perceives its environment, reasons, plans, and takes actions to achieve complex goals with minimal human oversight, often using LLMs and other AI tools to learn, adapt, and interact with users and systems to solve problems, automate tasks, and even collaborate with other agents.
Binary	Binary models classify areas as either “high risk” or not. The risk score indicates whether an area exceeds a threshold.
Burn Probability	Probability of any location burning due to a wildfire within a defined time frame.
Categorical	Categorical models assign discrete risk categories to areas. The risk score is a numeric identifier that maps to a category.
Consequence (or Severity Factor)	Degree of negative impact or seriousness of the outcomes from an event involving one or more hazards.
Dynamic	Often physics, reduced-physics, or semi-physics based and are time-resolved fire progressions that are run for scenario-specific outcomes.
Empirical (or Statistical)	Mathematical model based on empirical data or approximations (i.e. actuarial stats).
Hazard Exposure	Degree to which people, natural capital, buildings, and infrastructure are subjected to potential hazards.
Likelihood of Occurrence	Probability that a given hazard is capable of exploiting a given vulnerability or a set of vulnerabilities.
ML / LLM	Trained algorithm that learns patterns from data to make predictions, classifications, or decisions on new, unseen data.
Numerical	Numerical models provide continuous risk scores that can be visualized in various ways such as quantized buckets, even buckets, custom buckets.
Reduced Physics	Simplifies a complex physical system’s high-fidelity description into a computationally efficient, lower-dimensional approximation that captures essential behavior (i.e. reduced order model).
Retrieval Augmented Model	Framework that enhances LLMs by giving them access to external, authoritative knowledge bases (like databases or documents) to retrieve relevant, up-to-date information before generating a response.
Risk	Potential consequences which could occur to a system, society or a community, determined probabilistically as a function of hazard, exposure, vulnerability, severity of consequence, and capacity to withstand impact.

Semi Physics	Mathematical model based partly on theoretical principles and partly on empirical data or approximations.
Static	Typically, statistical/empirical-based models that provide a snapshot of relative risk. May (or may not) have been developed using dynamic methods and simulation repetitions.
Urban Conflagration	Building-to-building fire involving multiple structures and/or spreading flame over a large area within a community, typically observed in high density communities.
Vulnerability	Extent of conditions which increase susceptibility to the impact of a potential hazard.
Wildfire	Any unplanned and uncontrolled vegetation fire that, regardless of ignition source, may negatively affect social, economic or environmental values, and require suppression response or other action. ¹
Wildland Fire	Any non-structure fire that occurs in vegetation or natural fuels. Includes wildfires and prescribed fires. ²
Wildland-Urban Interface	An area where fire may occur in high-density development adjacent to undeveloped wildland vegetation. ³
Wildland Urban Intermix	An area where fire may occur in lower-density housing mingled with undeveloped wildland vegetation. ⁴

Appendix C – Semi-Synthetic Core Dataset Features

Data Source Links:

<https://scil-data.sdsc.edu/data/ul-risk-modeling-2026/Forest/>

<https://scil-data.sdsc.edu/data/ul-risk-modeling-2026/Prairie/>

Key Information:

All rasters and geojsons are in WGS84 (EPSG:4326) unless otherwise stated.

All rasters have no data values defined as 9999.

<city name>_depth.tif : 1 band raster file of surface fuel depth [meters]

<city name>_elevation.tif : 1 band raster file of elevation from USGS DEM products

<city name>_generated_buildings_fireprops.geojson : geojson containing synthetic building polygons

<city name>_ignition.geojson: geojson containing the ignition location and start time.

<city name>_moist1.tif : 1 band raster file of 1 hour surface fuel moisture [dec]

<city name>_moist10.tif : 1 band raster file of 10 hour surface fuel moisture [dec]

<city name>_moist100.tif : 1 band raster file of 100 hour surface fuel moisture [dec]

<city name>_roads.geojson : geojson containing road network

<city name>_rhof1.tif : 1 band raster file of 1 hour surface fuel loading [kg/m²]

<city name>_rhof10.tif : 1 band raster file of 10 hour surface fuel loading [kg/m²]

<city name>_rhof100.tif : 1 band raster file of 100 hour surface fuel loading [kg/m²]

<city name>_SAV.tif : 1 band raster file of fuel surface area to volume [1/m]

<city name>_SB40.tif : 1 band raster file of Scott & Bugran 40 fuel model [int]

<city name>_Synoptic_Weather_Data.csv : CSV containing weather observations including:

timestamp

air temperature (F)

relative humidity (%)

wind speed (mph)

wind direction (deg)

<city name>_Treelist.geojson : geojson containing tree data including:

lat/lon, height (HT) [m],

canopy base height (CBH) [m],

maximum canopy diameter (DIA) [m],

height to maximum canopy diameter (HT_TO_DIA) [m],

canopy bulk density (CBD) [kg/m³],

canopy moisture (MOIST) [dec],

fine fuel size scale (SS)

<city name>_Treelist.txt : text file containing the same data as <city name>_Treelist.geojson in txt format

Voxelized tree data in “voxels” folder:

<city name>_ReadDatFiles.py : python script to read and plot the dat files

treesfueldepth.dat : depth

treesmoist.dat : moistures

treesrhof.dat : density

treesss.dat : size and scale

<city name>_voxels.zip : a zip file containing all the dat files

Known Issues

Forest_SB40.tif: any values that are not between 0-200 are no data values.

Forest_elevation.tif: the value -32768 is no data instead of 9999.

Buildings Data: certain fields in the data are null or of no value, these include:

Structural_sep_dist

Neighborhood_count

Wildland_area

WUI Zone

Parcel_median_size

Appendix D – Semi-Synthetic Parcel and Building Characteristic Data Schema

Field Name	Recommended Data Type	Category	Basic Description
index	Integer	Building/record attributes	Index
bldgID	Integer	Building/record attributes	Bldgid
usage	Text	Building/record attributes	Usage
info	Text	Building/record attributes	Info
windowType	Text	Building vulnerability	Window Type
combustableDeck	Binary integer (0/1)	Building vulnerability	Combustible Deck
ventScreens_in	Decimal	Building vulnerability	Ventscreens
eaves	Text	Building vulnerability	Eaves
woodSiding	Binary integer (0/1)	Building vulnerability	Wood Exterior Siding
woodRoof	Binary integer (0/1)	Building vulnerability	Wood Roof
Built Between	Text	Building age	Year the building was constructed
garage type	Text	Building/record attributes	Garage type
building width [m]	Number	Building dimensions	Building width [m]
building height [m]	Number	Building dimensions	Building height [m]
nominal lot length [m]	Number	Building dimensions	Nominal lot length [m]
nominal lot width [m]	Number	Building dimensions	Nominal lot width [m]
building length [m]	Number	Building dimensions	Building length [m]
roof height [m]	Number	Building vulnerability	Roof height [m]
eave height [m] (height below roof)	Number	Building vulnerability	Eave height [m] (height below roof)
strip_mall_1970	Binary integer (0/1)	Building/record attributes	Strip mall built before 1970
big_box_2010	Binary integer (0/1)	Building/record attributes	Big box built after 2010
med_home_1800	Binary integer (0/1)	Building/record attributes	Medium sized residential home at 1,800 square feet

APPENDIX

small_home_1100	Binary integer (0/1)	Building/record attributes	Small sized residential home at 1,100 square feet
condo_townhome_20	Binary integer (0/1)	Building/record attributes	Condominium or Townhome
small_apartment	Binary integer (0/1)	Building/record attributes	Small apartment
building_sqft	Number	Building dimensions	Building square feet
stories_above_ground	Integer	Building dimensions	Number of stories above ground
sqft_below_ground	Number	Building dimensions	Square feet below ground
effective_year_built	Integer	Building age	Effective year built
year_built_2000_2025	Binary integer (0/1)	Building age	Year built 2000-2025
year_built_1970_1999	Binary integer (0/1)	Building age	Year built 1970-1999
year_built_1940_1969	Binary integer (0/1)	Building age	Year built 1940-1969
attached_garage	Binary integer (0/1)	Building/record attributes	Attached garage
detached_garage	Binary integer (0/1)	Building/record attributes	Detached garage
roof_wood	Binary integer (0/1)	Building vulnerability	Roof wood
roof_non_combust	Binary integer (0/1)	Building vulnerability	Non-Combustible Roof
siding_wood	Binary integer (0/1)	Building vulnerability	Wood Exterior Siding
siding_non_combust	Binary integer (0/1)	Building vulnerability	Non-Combustible Siding
siding_fire_resist	Binary integer (0/1)	Building vulnerability	Fire Resistant Siding
eaves_open	Binary integer (0/1)	Building vulnerability	Open Eaves
eaves_enclosed	Binary integer (0/1)	Building vulnerability	Enclosed Eaves
window_multi_tempered	Binary integer (0/1)	Building vulnerability	Windows multi-pane, tempered glass
window_single_untempered	Binary integer (0/1)	Building vulnerability	Window single pane, untempered glass
window_multi_untempered	Binary integer (0/1)	Building vulnerability	Window multi untempered
window_single_tempered	Binary integer (0/1)	Building vulnerability	Window single-pane, tempered glass
ventScreens_1_4	Binary integer (0/1)	Building vulnerability	Ventscreens .25 inch

APPENDIX

ventScreens_1_2	Binary integer (0/1)	Building vulnerability	Ventscreens .50 inch
ventScreens_1_8	Binary integer (0/1)	Building vulnerability	Ventscreens .125 inch
deck_above_grade_wood	Binary integer (0/1)	Building vulnerability	Deck Above Grade - Wood
fence_combustible	Binary integer (0/1)	Building vulnerability	Fence Combustible Material
zone_0_compliant	Binary integer (0/1)	Environmental/WUI context	Zone 0 compliant
zone_1_defensible	Binary integer (0/1)	Environmental/WUI context	Zone 1 defensible
zone_2_defensible	Binary integer (0/1)	Environmental/WUI context	Zone 2 defensible
wildland_veg_type	Numeric code	Environmental/WUI context	Wildland Vegetation Type
wui_veg_type	Numeric code	Environmental/WUI context	WUI Vegetation Type
urban_veg_type	Numeric code	Environmental/WUI context	Urban Vegetation Type
veg_density	Numeric code	Environmental/WUI context	Vegetation Density
topography	Numeric code	Environmental/WUI context	Topography
elevation	Number	Environmental/WUI context	Elevation
avg_slope	Number	Environmental/WUI context	Average Slope
wildland_area	Numeric code	Environmental/WUI context	Wildland area
wui_zone	Decimal	Environmental/WUI context	WUI Zone
acres_treated_wui	Number	Building/record attributes	Acres treated in the WUI
total_land_area	Number	Building/record attributes	Total land area
subdivision_median_size	Number	Building/record attributes	Subdivision median size
parcel_median_size	Number	Parcel	Parcel median size
neighborhood_count	Integer	Building/record attributes	Neighborhood count
structural_sep_dist	Numeric code	Building/record attributes	Structural Separation Distance
total tax assessed value	Number	Parcel	Total tax assessed property value
tax assessed value of improved area	Number	Parcel	Tax assessed value of improved area
geometry.type	Text	Geometry	Geometry.type
geometry.coordinates	Nested numeric array	Geometry	Geometry.coordinates

Appendix E – Science/Technical Rubric and Schema

Category	Field Name	Description	Data Type	Allowed Values / Notes
Model Identification	Model Organization	Organization responsible for the model	Categorical	A-T-S; Envitel; FireSafe Analytics; FiSci; FlameMapper; French National Center for Scientific Research; IMAGECAT; Minerva University; Opal AI; OroraTech; Pinepeak; San Jose State University; SkyTL; Spatial Informatics Group; Tenax AI; UC Berkley / ElmFire; UC Irvine; UC Los Angeles; Univ of Santiago, Chile; Univ of Nevada; Vanderbilt University; Vibrant Planet; XyloPlan; Zesty AI; Other
Model Identification	Other Organization	User-specified organization name when Other is selected	Text	Free text; maximum 255 characters
Model Identification	Model Name	Name of the evaluated model	Text	Free text; maximum 1,000 characters
Model Identification	Evaluator ID	Survey evaluator identifier	Categorical	Science Evaluator 1 through Science Evaluator 12
Review Verification	Outputs Reviewed	Confirms review of outputs for both Town of Forests and Town of Prairies	Yes/No	Yes; No
Review Verification	Output Type	Classifies the model output as static or dynamic	Categorical	Static; Dynamic
Weather Inputs	Synoptic Weather Data Applied	Indicates whether the model applied the provided synoptic weather data	Yes/No	Yes; No
Weather Inputs	Weather Variables Used	Identifies weather variables incorporated by the model	Text	Free text; maximum 1,000 characters
Weather Inputs	Other Weather Variables	Identifies additional weather variables	Text	Free text; maximum 255 characters
Weather Inputs	Supplemental Weather Data Used	Indicates whether additional weather information was incorporated	Yes/No	Yes; No
Weather Inputs	Weather Integration Description	Describes how weather variables were incorporated	Narrative	Free text; maximum 1,000 characters
Weather Inputs	Weather Assumptions Applied	Indicates whether weather conditions or assumptions were applied	Categorical	Yes; No; Somewhat

Weather Inputs	Weather Assumptions Description	Describes weather conditions or assumptions and how they were factored in	Narrative	Free text; maximum 1,000 characters
Fire Behavior	Ember Dispersion Included	Indicates whether the model accounts for ember dispersion or transport	Categorical	Yes; No; Unclear
Fire Behavior	Weather Influence on Ember Transport	Indicates whether ember dispersion incorporates weather variables or conditions	Categorical	Yes; No; Unclear
Historical Data	Historical Occurrence Data Used	Indicates whether historical occurrence data were used	Yes/No	Yes; No
Historical Data	Historical Data Sources	Identifies historical data sources and describes their use	Narrative	Free text; maximum 1,000 characters
Demographics	Population Data Used	Indicates whether population demographic data were used	Yes/No	Yes; No
Demographics	Population Data Sources	Identifies population data sources and describes their use	Narrative	Free text; maximum 1,000 characters
Fire Protection	Fire Protection Capacity Included	Indicates whether local fire service response or suppression capacity is included	Yes/No	Yes; No
Fire Protection	Fire Protection Variables	Describes fire protection capacity variables and how they affect the model	Narrative	Free text; maximum 1,000 characters
Spatial Resolution	Output Resolution	Spatial scale at which model output is provided	Categorical	Less than 1 Meter / Sub-Meter; 10s of Meters; 100 of Meters; 1 Kilometer; Several Kilometers; 10s of Kilometers; Unclear
Environmental Inputs	Synthetic Exercise Data Used	Identifies provided synthetic exercise data used by the model	Text	Free text; maximum 1,000 characters
Environmental Inputs	Vegetation and Fuel Inputs	Identifies tree or vegetative fuel data and describes how they were used	Narrative	Free text; maximum 1,000 characters
Environmental Inputs	Topography Included	Indicates whether topography or other surface features were incorporated	Categorical	Yes; No; Unclear

Environmental Inputs	Topographic Influence Description	Describes how surface features affect model results	Narrative	Free text; maximum 1,000 characters
Building Characteristics	Building Attributes Included	Indicates whether building characteristics were considered	Yes/No	Yes; No
Building Characteristics	Building Characteristics Used	Identifies building characteristics used	Text	Free text; maximum 1,000 characters
Building Characteristics	Other Building Characteristics	Identifies additional building characteristics	Text	Free text; maximum 255 characters
Exposure Modeling	Building Exposure Types Considered	Identifies wildfire exposure pathways modeled for buildings	Text	Free text; maximum 1,000 characters
Exposure Modeling	Other Building Exposure Types	Identifies additional building exposure pathways	Text	Free text; maximum 255 characters
Building Characteristics	Building Influence Description	Describes how building characteristics affect model results	Narrative	Free text; maximum 1,000 characters
Fire Behavior	Wildfire Spread Model Included	Indicates whether a wildfire propagation or spread model is included	Categorical	Yes; No; Unclear
Fire Behavior	Structure-to-Structure Fire Spread	Indicates or describes treatment of flame spread or radiative heat transfer between structures	Text	Free text; maximum 1,000 characters
Fire Behavior	Other Structure-to-Structure Mechanism	Identifies other inter-structure fire spread mechanisms	Text	Free text; maximum 255 characters
Mitigation	Mitigation Actions Included	Indicates whether mitigation actions affect risk quantification	Categorical	Yes; No; Unclear
Mitigation	Mitigation Types Considered	Identifies mitigation actions and how they affect results	Text	Free text; maximum 1,000 characters
Mitigation	Other Mitigation Types	Identifies additional mitigation actions	Text	Free text; maximum 255 characters
Supplemental Data	Supplemental Data Used	Indicates whether additional supplemental data were incorporated	Yes/No	Yes; No
Supplemental Data	Supplemental Data Description	Identifies supplemental data types, sources, and use	Narrative	Free text; maximum 1,000 characters

Risk Outputs	Risk Spatial Distribution Type	Describes the quantitative spatial distribution of risk produced	Text	Free text; maximum 1,000 characters
Risk Outputs	Other Risk Spatial Distribution	Identifies another spatial risk output type	Text	Free text; maximum 255 characters
Risk Outputs	Provides Risk Score or Rank	Indicates whether the output provides a risk rank, score, or value	Categorical	Yes; No; Somewhat
Risk Outputs	Alternative Output Metrics	Identifies measures provided when explicit risk is not produced	Text	Free text; maximum 1,000 characters
Risk Outputs	Other Alternative Output Metric	Identifies another alternative output measure	Text	Free text; maximum 255 characters
Risk Outputs	Risk Score Type	Type of risk ranking or score provided	Categorical	Binary; Numerical; Categorical; None; Other
Risk Outputs	Other Risk Score Type	User-specified risk score type	Text	Free text; maximum 255 characters
Risk Outputs	Economic Loss Representation	Indicates whether risk is expressed in economic or financial terms	Yes/No	Yes; No
Risk Outputs	Economic Risk Methodology	Describes how risk is expressed in economic or financial terms	Narrative	Free text; maximum 1,000 characters
Risk Validation	Results Misaligned with Area Conditions	Indicates whether results appeared inconsistent with area characteristics	Categorical	Yes; No; Unclear
Risk Validation	Gaps and Anomalies	Describes gaps or results that did not align with the area	Narrative	Free text; maximum 1,000 characters
Environment Classification	Environment Differentiation	Indicates whether the model distinguishes among environment types	Categorical	Yes; No; Somewhat
Environment Classification	Classification Methodology	Describes how environment types are defined, measured, and distinguished	Narrative	Free text; maximum 1,000 characters
Environment Classification	Best-Supported Environment Type	Environment type the model appears to model most effectively	Categorical	Wildland; Wildland-Urban Interface (WUI); Wildland Urban Intermix; Urban/Suburban; Other
Environment Classification	Other Environment Type	User-specified environment type	Text	Free text; maximum 255 characters

Technical Approach	Modeling Approaches Used	Identifies analytical approaches applied by the model	Text	Free text; maximum 1,000 characters
Technical Approach	Other Modeling Approach	Identifies an additional modeling approach	Text	Free text; maximum 255 characters
Technical Approach	Technical Notes	Evaluator notes and observations on the technical approach	Narrative	Free text; maximum 1,000 characters
Technical Approach	AI Methods Incorporated	Describes use of ML, LLM, RAG, AI agent, agentic, or other AI methods	Narrative	Free text; maximum 1,000 characters
Operational Use	Primary Intended Application	Primary appropriate use for the model	Categorical	Risk Assessment; Preparedness Planning (i.e. CWPP); Mitigation Planning/Prioritization; Evacuation Planning; Readiness for Incident Response; Initial Attack Phase; Full Response Operations; Post-Fire Recovery; Other
Operational Use	Other Primary Application	User-defined primary application	Text	Free text; maximum 255 characters
Operational Use	Secondary Intended Application	Secondary appropriate use for the model	Categorical	Same values as Primary Intended Application
Operational Use	Other Secondary Application	User-defined secondary application	Text	Free text; maximum 255 characters
Model Assessment	Greatest Strengths	Describes the model's greatest strengths	Narrative	Free text; maximum 1,000 characters
Model Assessment	Ensemble Opportunity	Describes opportunities to combine the model with other models	Narrative	Free text; maximum 1,000 characters
Evaluation Rating	Building Characteristics Effectiveness	Rates whether building characteristics provide insight on urban or suburban wildfire risk	Likert Scale	Strongly disagree; Disagree; Neutral; Agree; Strongly agree
Evaluation Rating	Risk Output Effectiveness	Rates effectiveness of the resulting risk rank, score, or value	Likert Scale	Strongly disagree; Disagree; Neutral; Agree; Strongly agree

Appendix F – Practitioner Rubric and Schema

Category	Field Name	Description	Data Type	Allowed Values / Notes
Model Information	Model Organization	Organization responsible for the model	Categorical	25 predefined organizations; Other
Model Information	Other Organization	User-defined organization name	Text	Free text; maximum 255 characters
Model Information	Model Name	Name of evaluated model	Text	Free text; maximum 1,000 characters
Model Information	Evaluator ID	Practitioner evaluator identifier	Categorical	Practitioner Evaluator 1 through Practitioner Evaluator 18
Review Verification	Model Outputs Reviewed	Confirms review of outputs for both Town of Forests and Town of Prairies	Yes/No	Yes; No
Operational Application	Primary Intended Use	Primary appropriate use for the model	Categorical	Risk Assessment; Preparedness Planning (i.e. CWPP); Mitigation Planning/ Prioritization; Evacuation Planning; Readiness for Incident Response; Initial Attack Phase; Full Response Operations; Post-Fire Recovery; Other
Operational Application	Other Primary Intended Use	User-defined primary use	Text	Free text; maximum 255 characters
Operational Application	Secondary Intended Use	Secondary appropriate use for the model	Categorical	Same options as Primary Intended Use
Operational Application	Other Secondary Intended Use	User-defined secondary use	Text	Free text; maximum 255 characters
Operational Application	Third Intended Use	Third appropriate use for the model	Categorical	Same options as Primary Intended Use; None
Operational Application	Other Third Intended Use	User-defined third use	Text	Free text; maximum 255 characters
Decision Support	Supports Pre-Fire Risk Reduction Decisions	Indicates whether the model clearly informs pre-fire risk reduction decisions	Yes/No	Yes; No
Decision Support	Supports Response Operations Decisions	Indicates whether the model clearly informs response operations decisions	Yes/No	Yes; No
Decision Support	Primary Decision Point Supported	Identifies one primary decision point clearly informed by the model	Narrative	Free text; maximum 1,000 characters
Decision Support	Secondary Decision Point Supported	Identifies a second decision point clearly informed by the model	Narrative	Free text; maximum 1,000 characters

Environment Classification	Differentiates Environment Types	Indicates whether the model distinguishes among environment types or classifications	Categorical	Yes; No; Somewhat
Environment Classification	Classification Methodology	Describes how environment types are defined, measured, and distinguished	Narrative	Free text; maximum 1,000 characters
Environment Classification	Best-Supported Environment Type	Environment type the model appears to model most effectively	Categorical	Wildland; Wildland-Urban Interface (WUI); Wildland Urban Intermix; Urban/Suburban; Other
Environment Classification	Other Environment Type	User-defined environment type	Text	Free text; maximum 255 characters
Fire Behavior	Fire Behavior Information Provided	Identifies fire behavior information provided or included	Text	Free text; maximum 1,000 characters
Fire Behavior	Other Fire Behavior Information	Identifies additional fire behavior information	Text	Free text; maximum 255 characters
Fire Behavior	Distinguishes Fire Behavior Variables	Indicates whether different fire behavior variables are applied to vegetation and buildings	Yes/No	Yes; No
Fire Behavior	Fire Spread Modes Included	Identifies modes of fire spread represented	Text	Free text; maximum 1,000 characters
Fire Behavior	Other Fire Spread Modes	Identifies additional fire spread modes	Text	Free text; maximum 255 characters
Fire Behavior	Beyond-Wildfire Capabilities	Identifies additional factors incorporated beyond wildfire spread	Text	Free text; maximum 1,000 characters
Fire Behavior	Other Beyond-Wildfire Capability	Identifies an additional capability	Text	Free text; maximum 255 characters
Information Products	Information Types Generated	Identifies information types provided or estimated	Text	Free text; maximum 1,000 characters
Information Products	Other Information Type	Identifies an additional information type	Text	Free text; maximum 255 characters
Information Products	Most Effective Information Type	Identifies the information the model provides most effectively	Text	Free text; maximum 1,000 characters
Mitigation Support	Parcel, Neighborhood, or Community Insights	Indicates whether outputs are detailed enough to inform mitigation actions and investments	Yes/No	Yes; No
Mitigation Support	Mitigation Actions Supported	Identifies mitigation actions and investments informed by the model	Text	Free text; maximum 1,000 characters

Mitigation Support	Other Mitigation Actions	Identifies additional mitigation actions	Text	Free text; maximum 255 characters
Insights	Variables Most Clearly Represented	Identifies variables most clearly included and represented	Text	Free text; maximum 1,000 characters
Insights	Other Key Variables	Identifies additional variables	Text	Free text; maximum 255 characters
Insights	Insights Provided	Identifies types of insights provided by the model	Text	Free text; maximum 1,000 characters
Insights	Other Insights	Identifies additional insights	Text	Free text; maximum 255 characters
Dynamic Modeling	Scenario Testing Capability	Indicates whether users can test mitigation strategies and compare outcomes	Categorical	Yes; No; Unclear
Usability	Assumptions and Limitations Clearly Communicated	Indicates whether assumptions, limitations, and confidence are conveyed clearly	Categorical	Yes; No; Somewhat
Usability	Easy to Interpret	Indicates whether the model is easy to interpret and understand	Categorical	Yes; No; Somewhat
Usability	User Experience Narrative	Describes the evaluator's experience reviewing and understanding results	Narrative	Free text; maximum 1,000 characters
Consistency	Consistent Across Jurisdictions	Indicates consistent application across locations while adapting to local conditions	Categorical	Yes; No; Somewhat
Equity and Resilience	Supports Vulnerable Population Analysis	Indicates whether the model identifies disproportionately at-risk or vulnerable populations	Categorical	Yes; No; Somewhat
Equity and Resilience	Quantifies Avoided Losses	Indicates whether the model quantifies avoided losses, mitigation return, or resilience benefits	Categorical	Yes; No; Somewhat
Equity and Resilience	Description of Insights	Describes how the model provides equity or resilience insights	Narrative	Free text; maximum 1,000 characters
Risk Outputs	Risk Surface Type	Describes the quantitative spatial distribution of risk produced	Text	Free text; maximum 1,000 characters
Risk Outputs	Other Risk Surface Type	Identifies an additional risk representation	Text	Free text; maximum 255 characters
Risk Outputs	Provides Risk Score or Rank	Indicates whether an explicit risk rank, score, or value is provided	Categorical	Yes; No; Somewhat
Risk Outputs	Risk Score Type	Type of risk ranking or score provided	Categorical	Binary; Numerical; Categorical; None; Other

Risk Outputs	Other Risk Score Type	User-defined risk metric	Text	Free text; maximum 255 characters
Risk Outputs	Economic Loss Representation	Indicates whether risk is expressed in economic or financial terms	Yes/No	Yes; No
Risk Outputs	Economic Risk Methodology	Describes how economic or financial risk is expressed	Narrative	Free text; maximum 1,000 characters
Evaluation	Risk Output Effectiveness	Rates the effectiveness of the resulting risk rank, score, or value	Likert Scale	Strongly disagree; Disagree; Neutral; Agree; Strongly agree
Evaluation	Misaligned Results Identified	Indicates whether results appeared inconsistent with area characteristics	Categorical	Yes; No; Unclear
Evaluation	Gaps and Anomalies	Describes gaps or results that did not align with the area	Narrative	Free text; maximum 1,000 characters
Evaluation	Model Notes and Observations	Provides additional notes and observations on model results	Narrative	Free text; maximum 1,000 characters
Model Assessment	Top Three (3) Strengths	Describes the model's top three (3) strengths	Narrative	Free text; maximum 1,000 characters
Model Assessment	Greatest Strength	Describes the model's greatest strengths	Narrative	Free text; maximum 1,000 characters
Model Assessment	Ensemble Opportunity	Describes opportunities to combine or ensemble the model with others	Narrative	Free text; maximum 1,000 characters
Model Assessment	Additional Ensemble Benefits	Describes additional insights or decisions supported by combining models	Narrative	Free text; maximum 1,000 characters
Response Operations	Supported Response Functions	Identifies response functions clearly supported by the model	Text	Free text; maximum 1,000 characters
Response Operations	Other Supported Response Functions	Identifies additional response functions	Text	Free text; maximum 255 characters

