Innovations in Cal/OSHA Rulemaking: Protecting Firefighters During Wildland and WUI Operations

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The views expressed in this presentation do not necessarily reflect those of Cal/OSHA, DIR or the Labor and Workforce Development Agency.

DIR Division of Occupational Safety and Health (Cal/OSHA)

- Enforcement: Inspections, violations, abatement of hazards
- Consultation: Outreach, education, consultation for employers
- Research and Standards: Drafts new and revised standards
- CA OSH Standards Board: Appointed by Governor, adopts new and revised standards.

Shockey Fire, San Diego. Wildland Urban Interface (WUI) operations result in exposures to structure fire smoke, without the protection of an SCBA.

Photo: DHS Science and Technology Directorate

AB 2146 (Skinner) (2014): DIR must assess whether Cal/OSHA's firefighter safety regulations reflect current NFPA standards. NFPA 1984 pertains to wildland/WUI respiratory protection.

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- Firefighter inhalation hazards during W/WUI deployments.
- Cal/OSHA's rulemaking on W/WUI inhalation exposures
- Cal/OSHA's Collaboration with LA County Fire, Cal/FIRE and USFS

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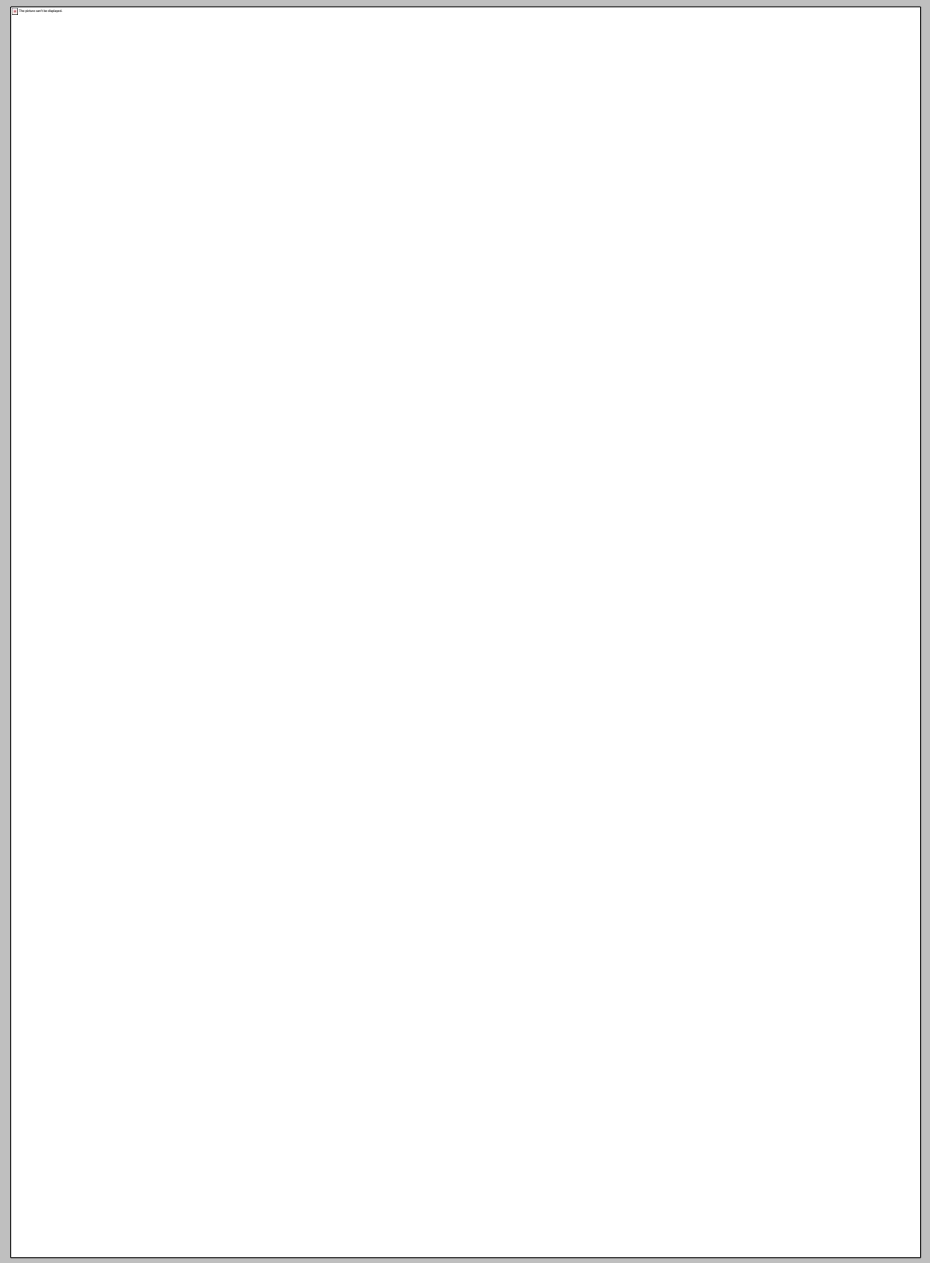
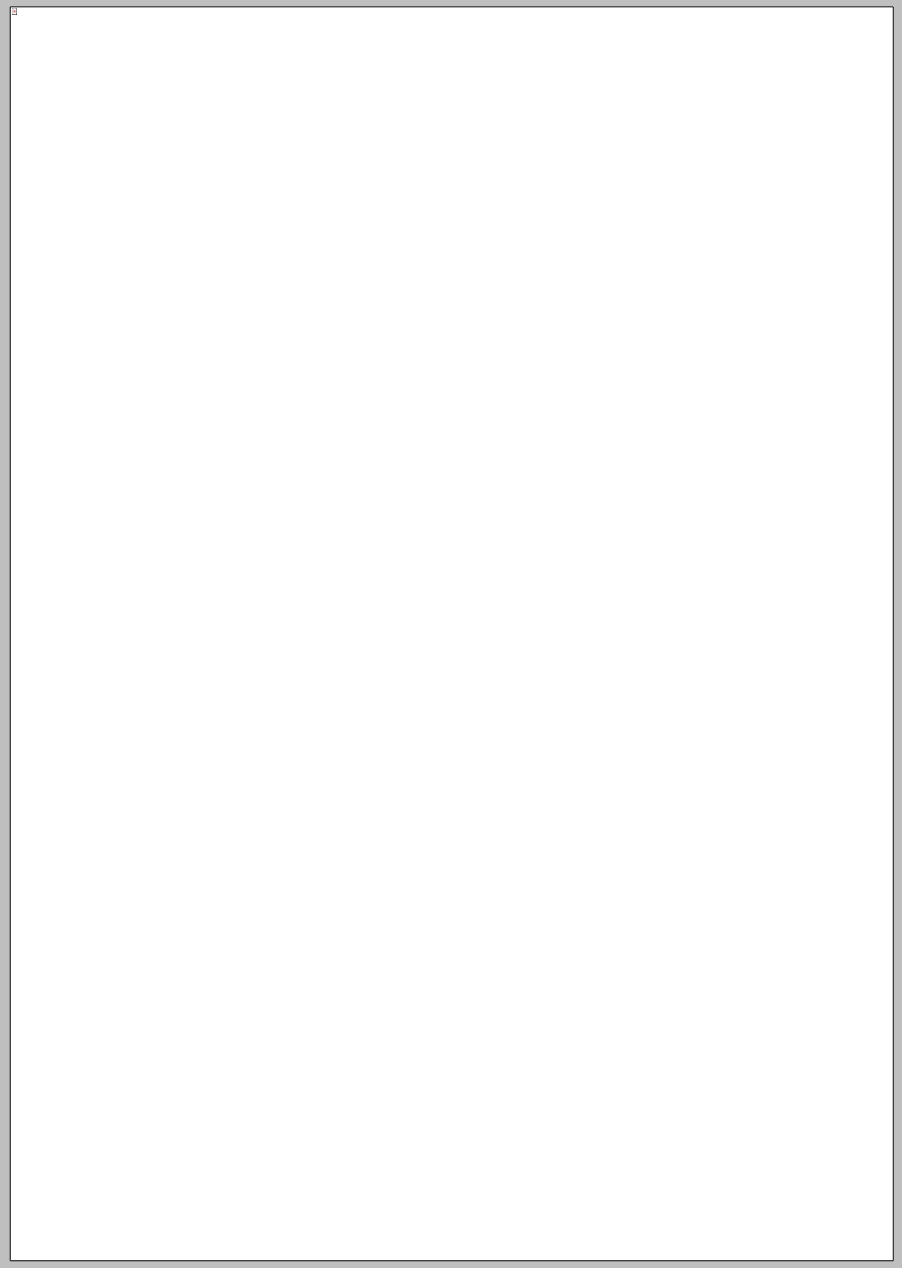
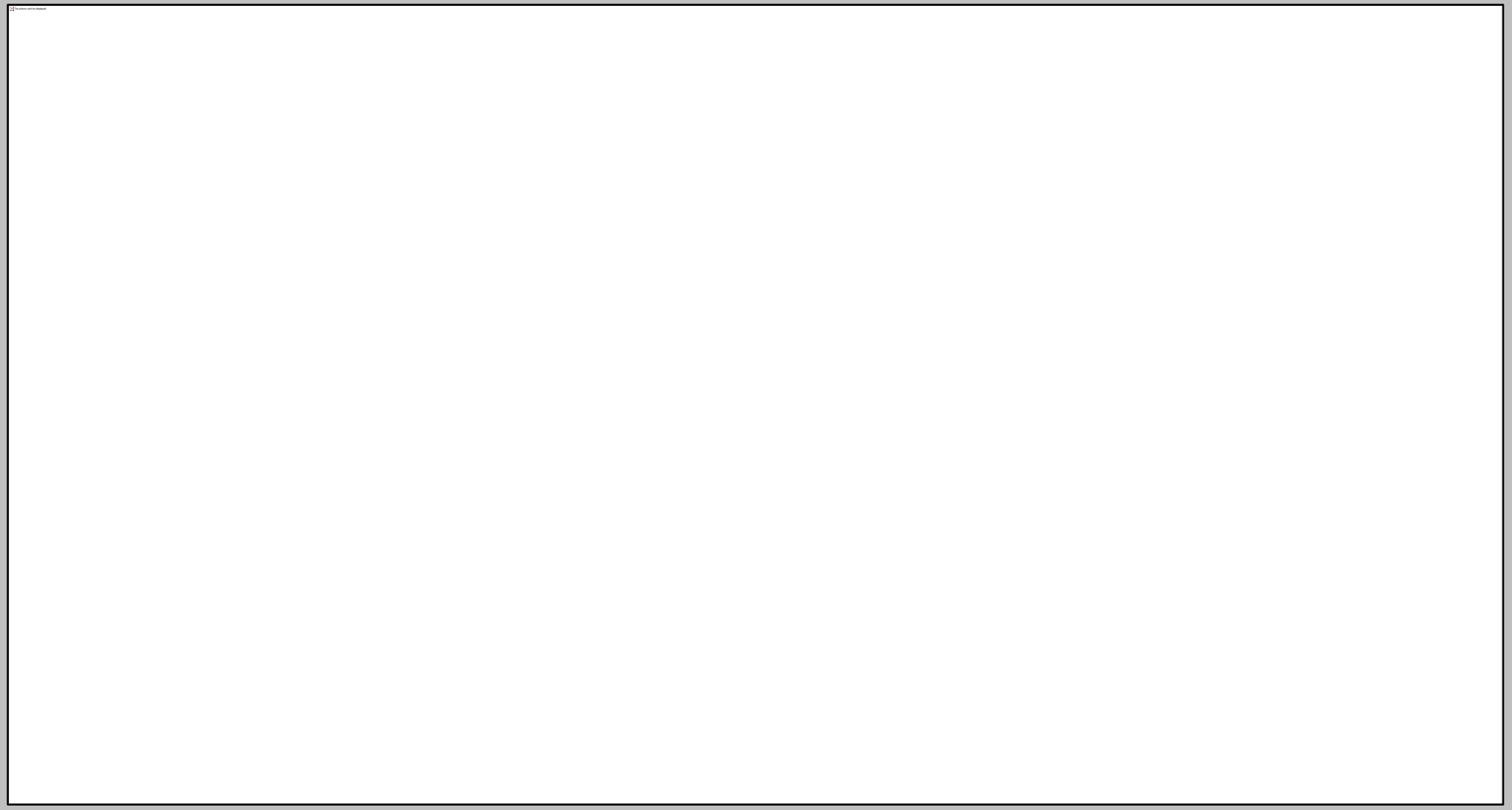




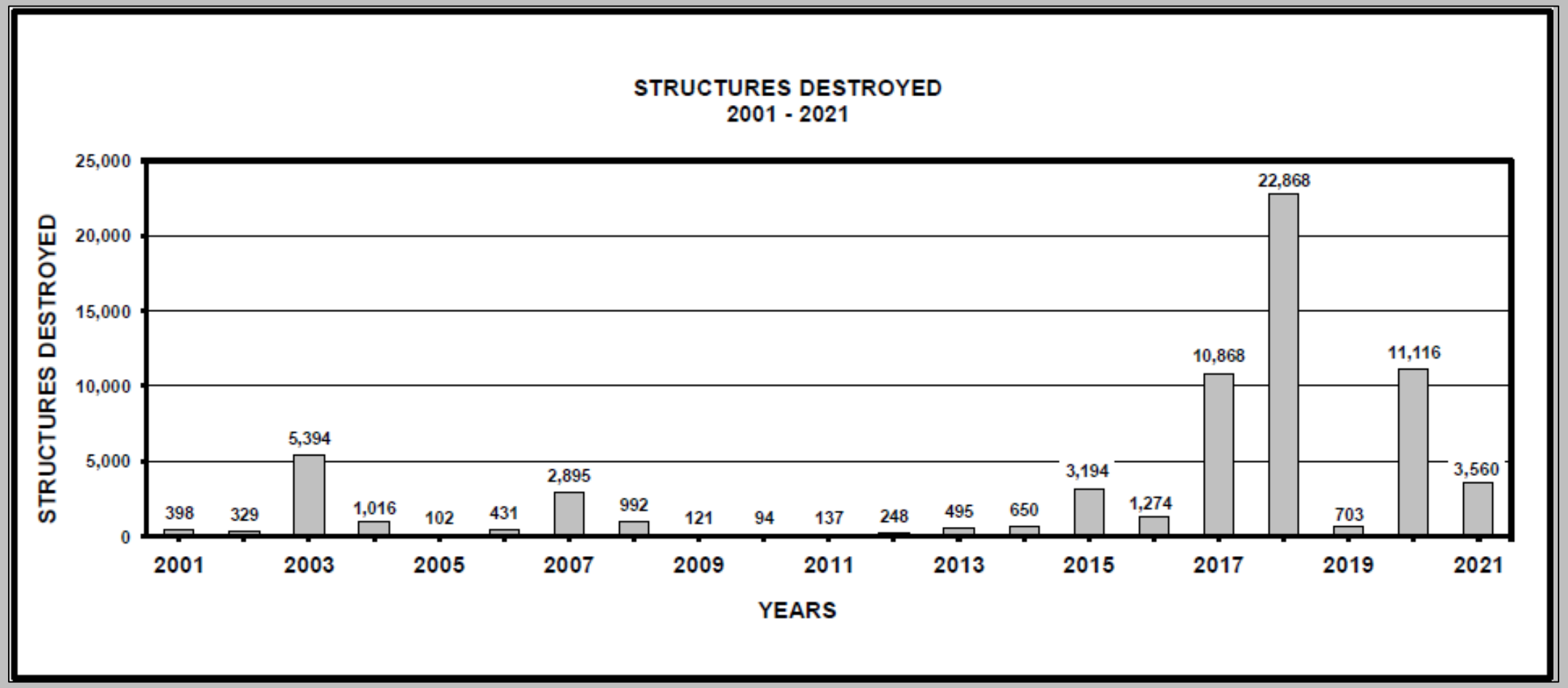
Source: NASA data and Stanford Environmental Change and Human Outcomes Lab, reported in Alison Saldanha, Dangerous Air: As California Burns, America Breathes Toxic Smoke. Sept 28, 2021. https://www.kvpr.org/news/2021-09-28/dangerous-air-as-california-burns-america-breathes-toxic-smoke

Annual smoke days in major U.S. cities, 2009-2013 compared to 2016-2020.

Source: Alison Saldanha, Dangerous Air: As California Burns, America Breathes Toxic Smoke. Sept 28, 2021. https://www.kvpr.org/news/2021-09-28/dangerous-air-as-california-burns-america-breathes-toxic-smoke



Source: Cal/FIRE. Wildfire Activity Statistics, 2021 (Red Book)



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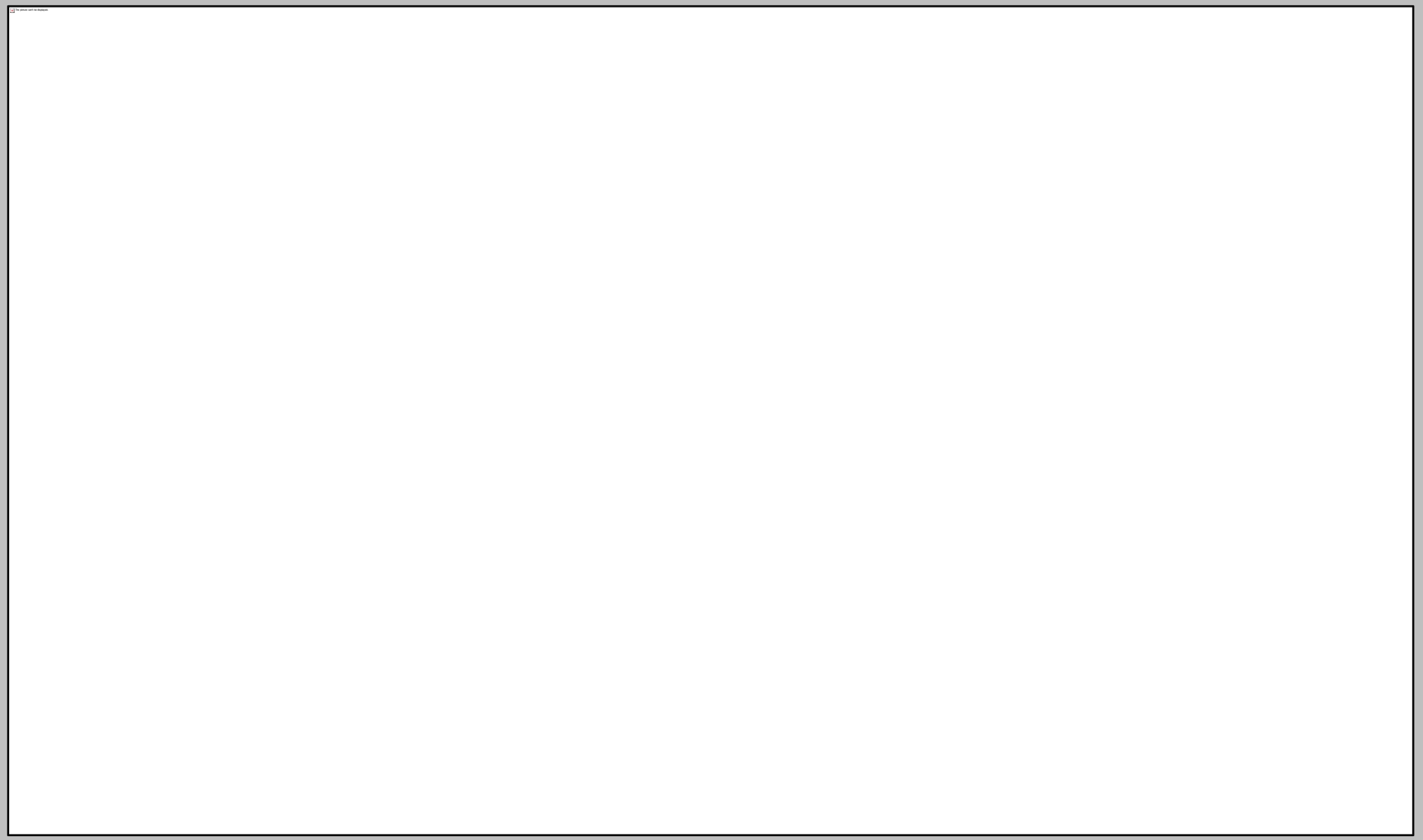

Area Burned by Wildfires in the United States, 1983-2021

Source: NIOSH (Dec 2024) *Wildfire Smoke Exposure Among Farmworkers and Other Outdoor Workers.* External Review Draft

Each year, thousands of Cal/FIRE and municipal firefighters are deployed in strike teams to fight large wildland and wildland-urban interface (WUI) fires.

Source: Wikimedia Commons.
https://commons.wikimedia.org/wiki/File:2020_California_wildfires.png

Photo: LA County Fire Dept.

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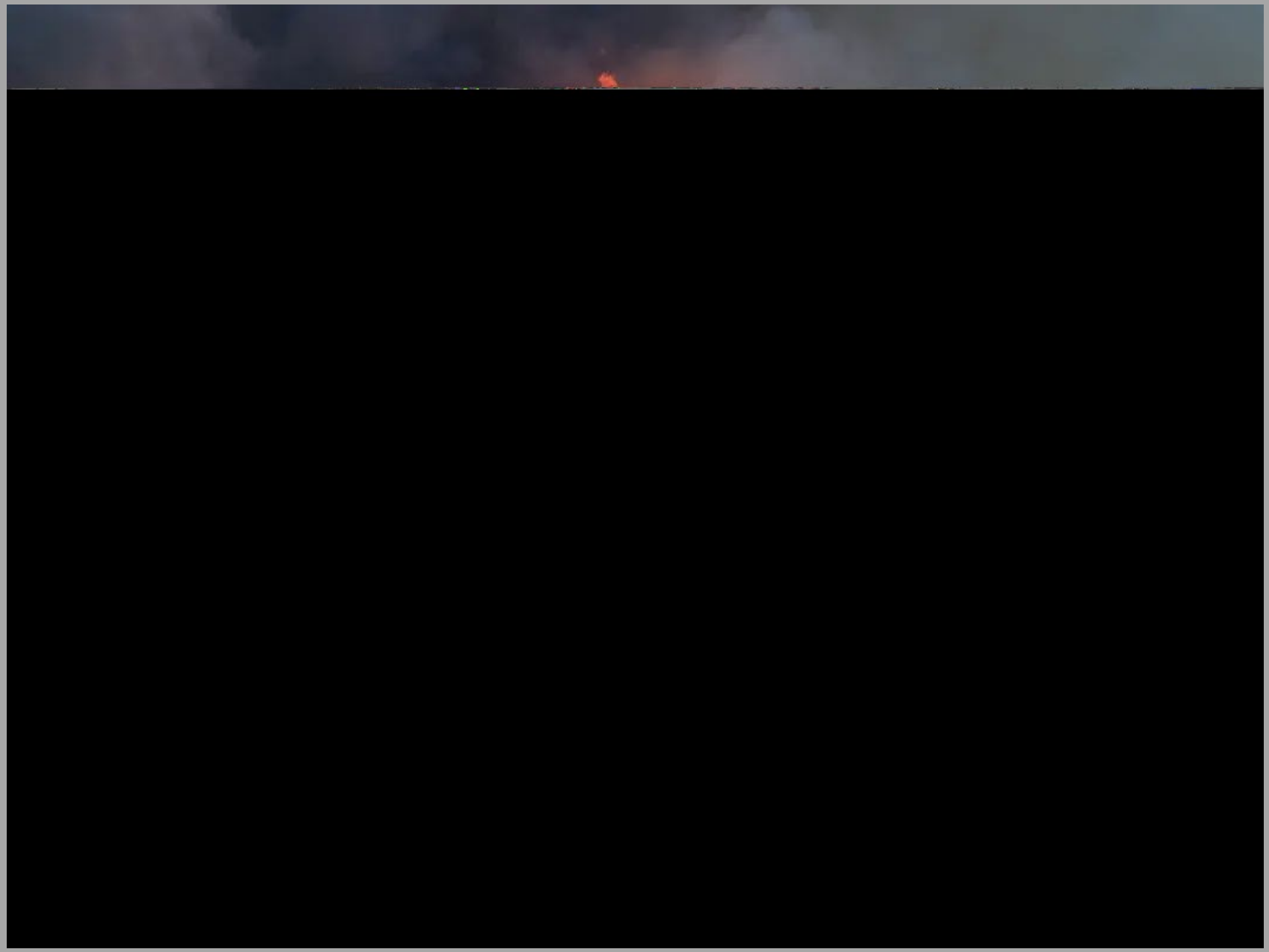
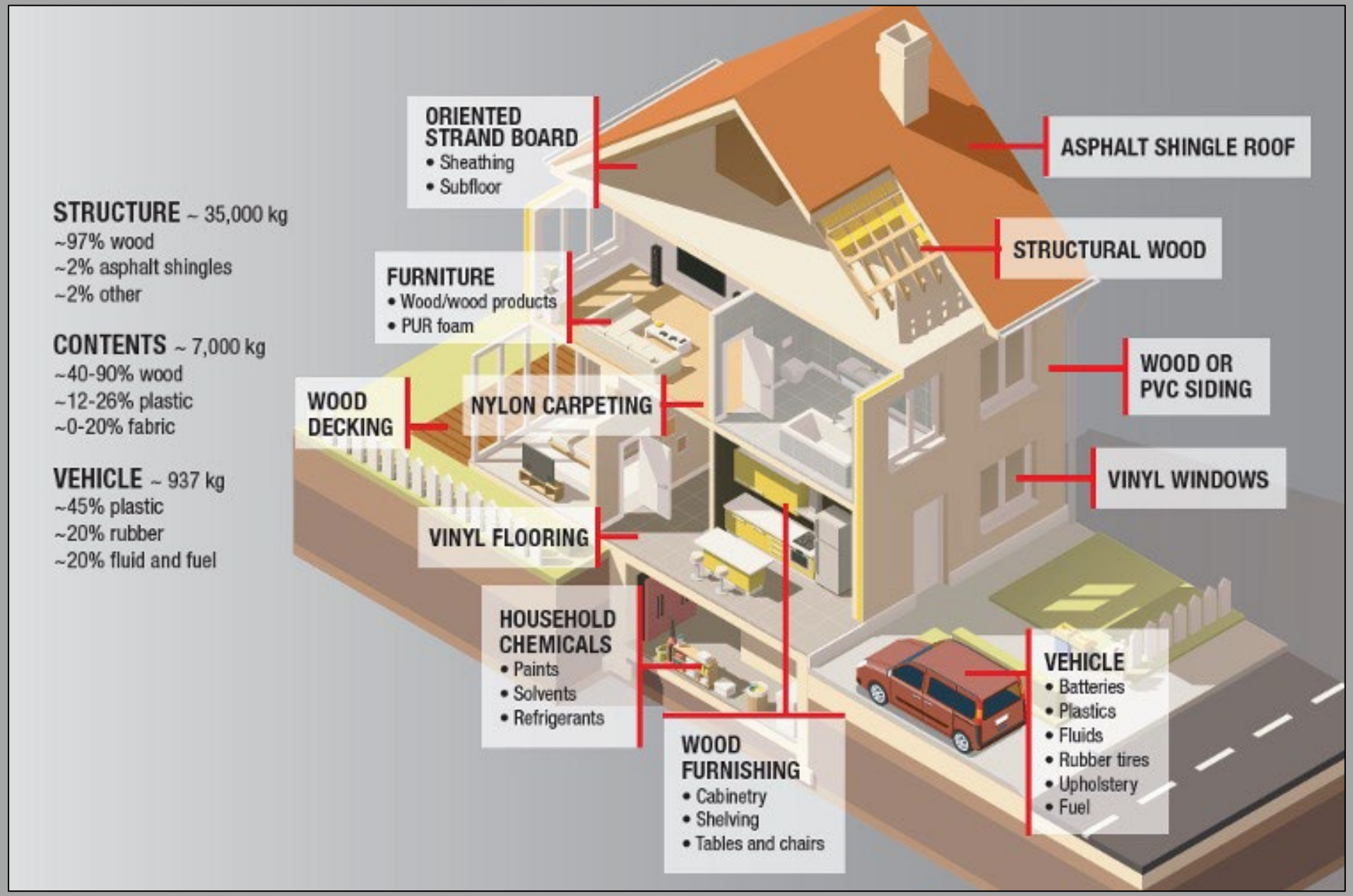


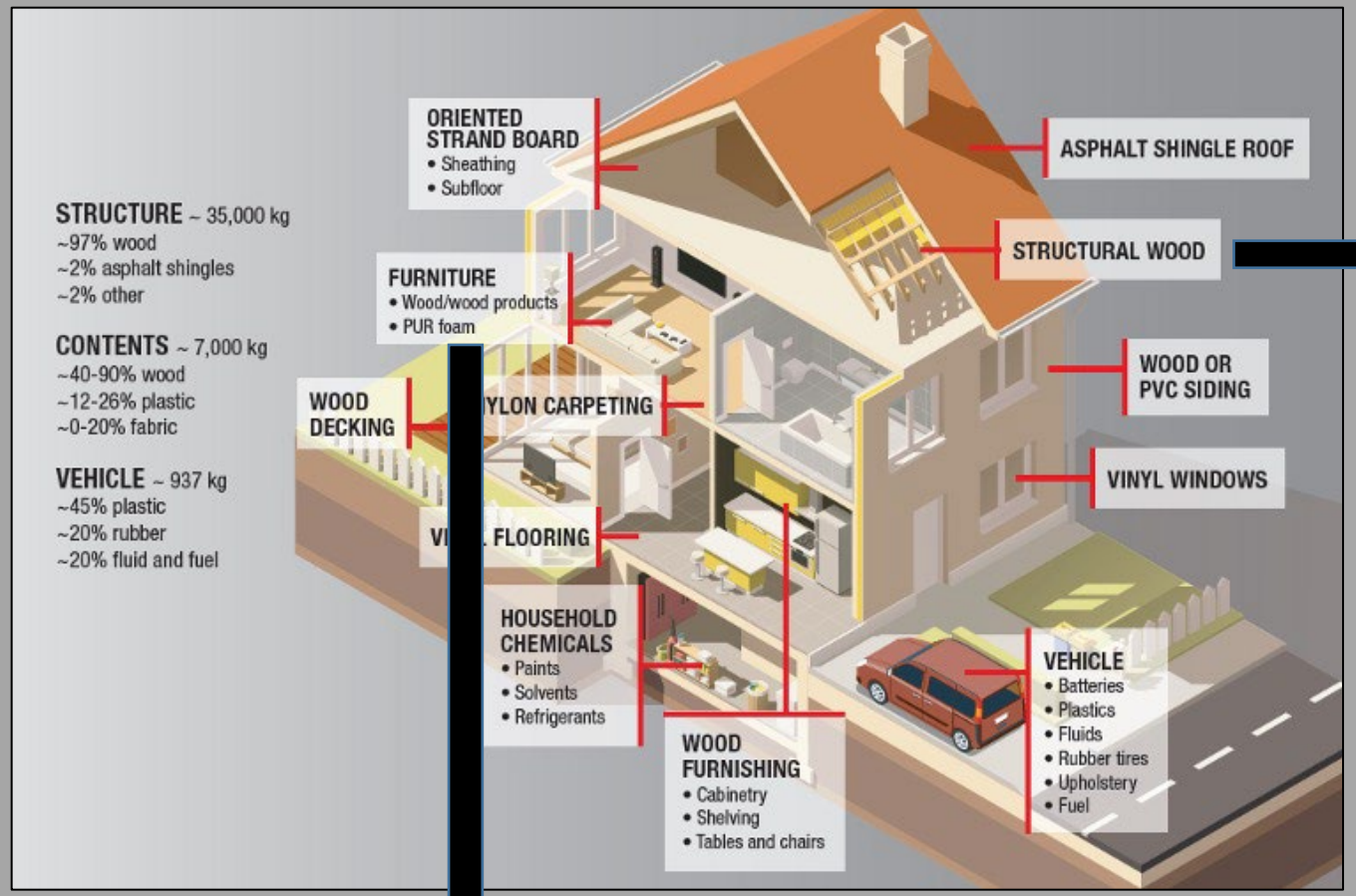
Wildfire approaches community of Chino, CA (Oct 27, 2020)

Photo: David McNew, Getty Images.

AB 2146 (Skinner) (2014): DIR must assess whether Cal/OSHA's firefighter safety regulations reflect current NFPA standards. NFPA 1984 pertains to wildland/WUI respiratory protection.



Source: National Academy of Sciences (2022) *The Chemistry of Fires at the Wildland-Urban Interface.*



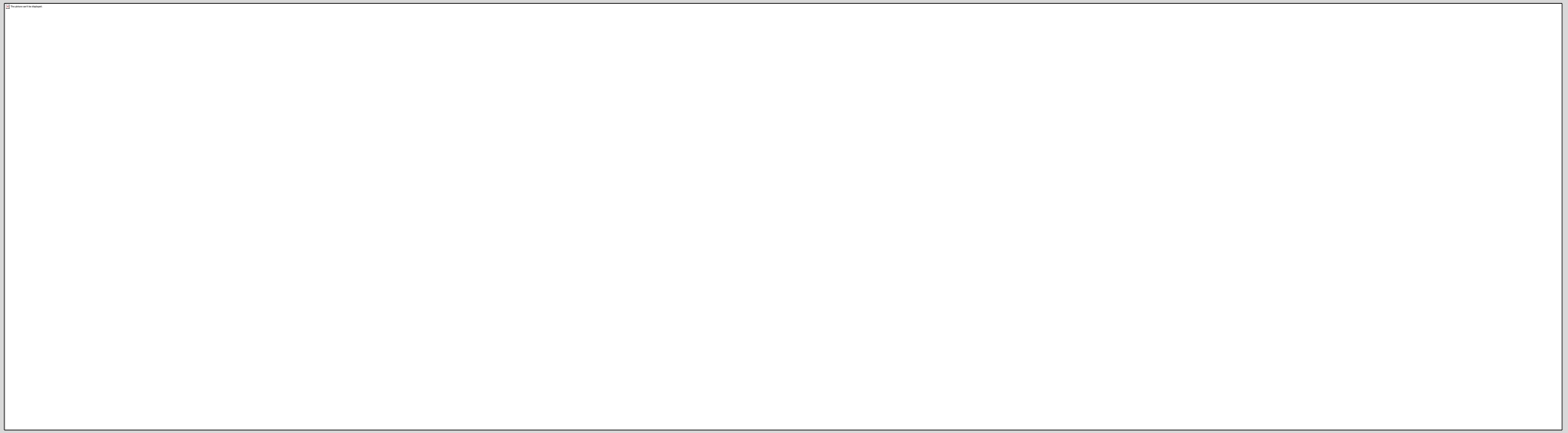
Oriented strand board (OSB)

HCN, CO, NO_2, HCl, acrolein, formaldehyde, PM, PAHs, VOCs, SVOCs, isocyanates

- Acrylic clothing
- Residential furniture

HCN, CO, NO, NO_2, NH_3, PM, PAHs, VOCs, SVOCs, isocyanates, benzene, toluene, formaldehyde, organophosphate flame retardants

Source: National Academy of Sciences (2022) *The Chemistry of Fires at the Wildland-Urban Interface.*



In general, products of combustion are carcinogenic. Meta-analyses of epidemiological studies consistently find a greater risk of various cancers among firefighters.

Horn et al. (2022) Hierarchy of Contamination Control in the First Service: Review of Exposure Control Options to Reduce Cancer Risk. *J Occ Env Hyg.* Vol 19. No 9, 538-557.

International Agency for Research on Cancer

World Health Organization

In 2022, IARC classified occupational exposure as a firefighter as *carcinogenic to humans* (Group 1), on the basis of *sufficient evidence* for cancer in humans.

Evidence for cancer in humans

"Occupational exposure as a firefighter causes cancer. There was *sufficient evidence* for cancer in humans for the following cancer types: mesothelioma and bladder cancer.

There was *limited evidence* for cancer in humans for the following cancer types: colon cancer, prostate cancer, testicular cancer, melanoma of the skin, and non-Hodgkin lymphoma."

Strong mechanistic evidence

"There was *strong* mechanistic evidence in exposed humans that occupational exposure as a firefighter exhibits 5 of the 10 key characteristics (KCs) of carcinogens: "is genotoxic" (KC2), "induces epigenetic alterations"(KC4), "induces oxidative stress" (KC5), "induces chronic inflammation" (KC6), and "modulates receptor mediated effects" (KC8)."

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Source: IARC Monographs (July 1, 2022) https://www.iarc.who.int/news-events/iarc-monographs-evaluate-the-carcinogenicity-of-occupational-exposure-as-a-firefighter/

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National Institute for Occupational Safety and Health NIOSH®

"Based on information provided by manufacturers, the primary reason for not developing a NFPA 1984 Standard-Rev compliant respirator is the lack of demand or negligible purchasing commitment from the federal wildland fire fighting community."

"To move forward in developing a compliant prototype respirator, manufacturers would need sufficient demand or a commitment from federal, state, and local wildland fire management agencies to purchase respirators."

Problem: No suitable respirator exists. A 2014 NIOSH report concluded that lack of demand has been the key barrier.

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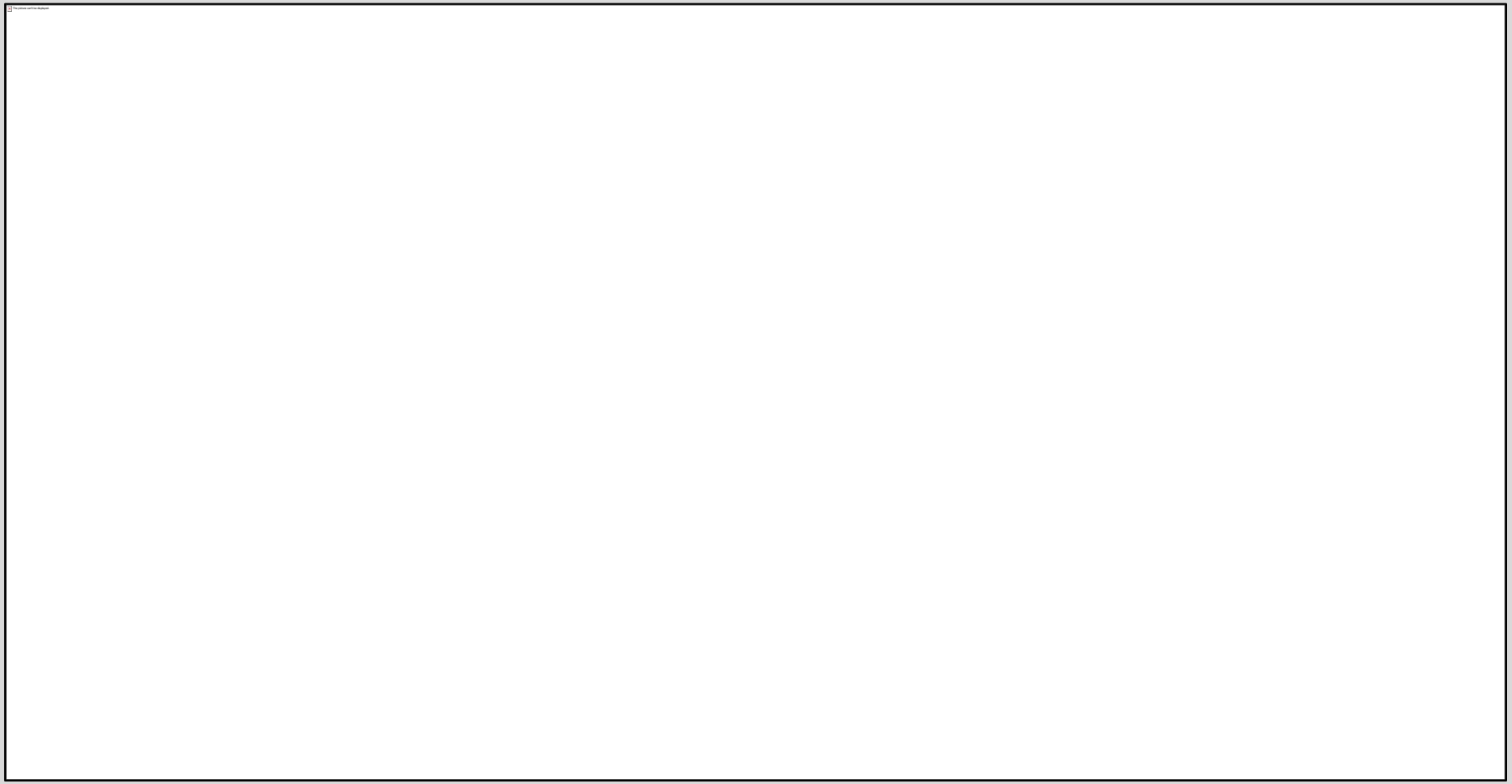
NIOSH (2014): Analysis of Barriers Affecting Implementation of the NFPA 1984 Standard on Respirators for Wildland Fire-fighting Operations 2011 Edition. Unpublished report.



Solution: Technology-forcing regulation. U.S. patents for SO_2 control technology, related to the Clean Air Act of 1970.

"A relatively high degree of [regulatory] stringency appears to be a necessary condition" for inducing higher degrees of innovative activities."

Taylor et al. (2001) The Effect of Government Actions on Technological Innovation for SO_2 Control. EPA/DOE/EPRI

CCR Title 8, § 5194.
Bloodborne Pathogens.

(d) Methods of Compliance.

(A) Needleless Systems, Needle Devices and non-Needle Sharps.

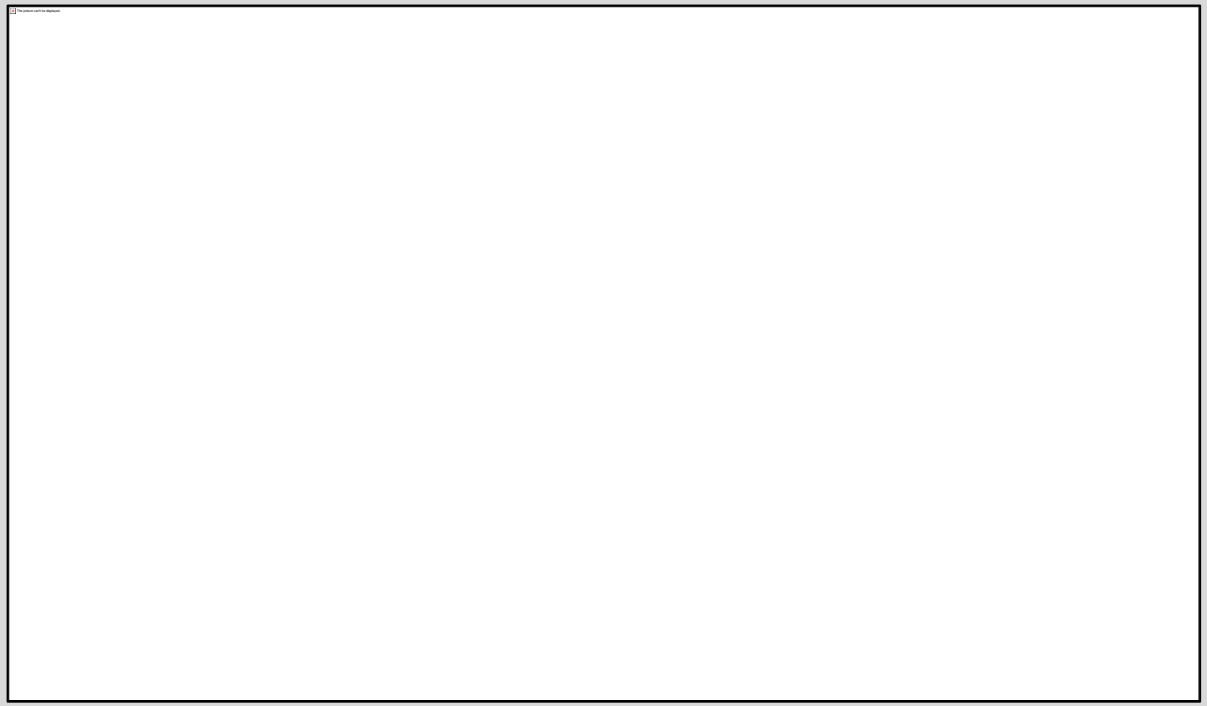
a. Market Availability. <u>The engineering control is not required if it is not available in the marketplace.</u>

Technology-forcing regulation: Cal/OSHA's Bloodborne Pathogens standard required safety engineered injection devices, *when they became available on the market.*

Structure protection is likely a good application for a PAPR with CBRN filtration.

Line crews need something lighter, most likely PM only.

Photo: National Interagency Fire Center. Government Accountability Office GAO-23-105517



“Within two (2) years of the effective date of this section, or within two (2) years after they are made available on the market, the employer shall ensure that each employee deployed to incidents that may involve wildland firefighting or WUI operations is provided with a fully functional, full-face, NIOSH-certified, Class 3, powered air purifying respirator (PAPR) that meets the requirements of NFPA 1984, Standard on Respirators for Wildland Fire-Fighting and Wildland Urban Interface Operations (2022 version).”

Cal/OSHA issues draft regulation on May 25, 2022

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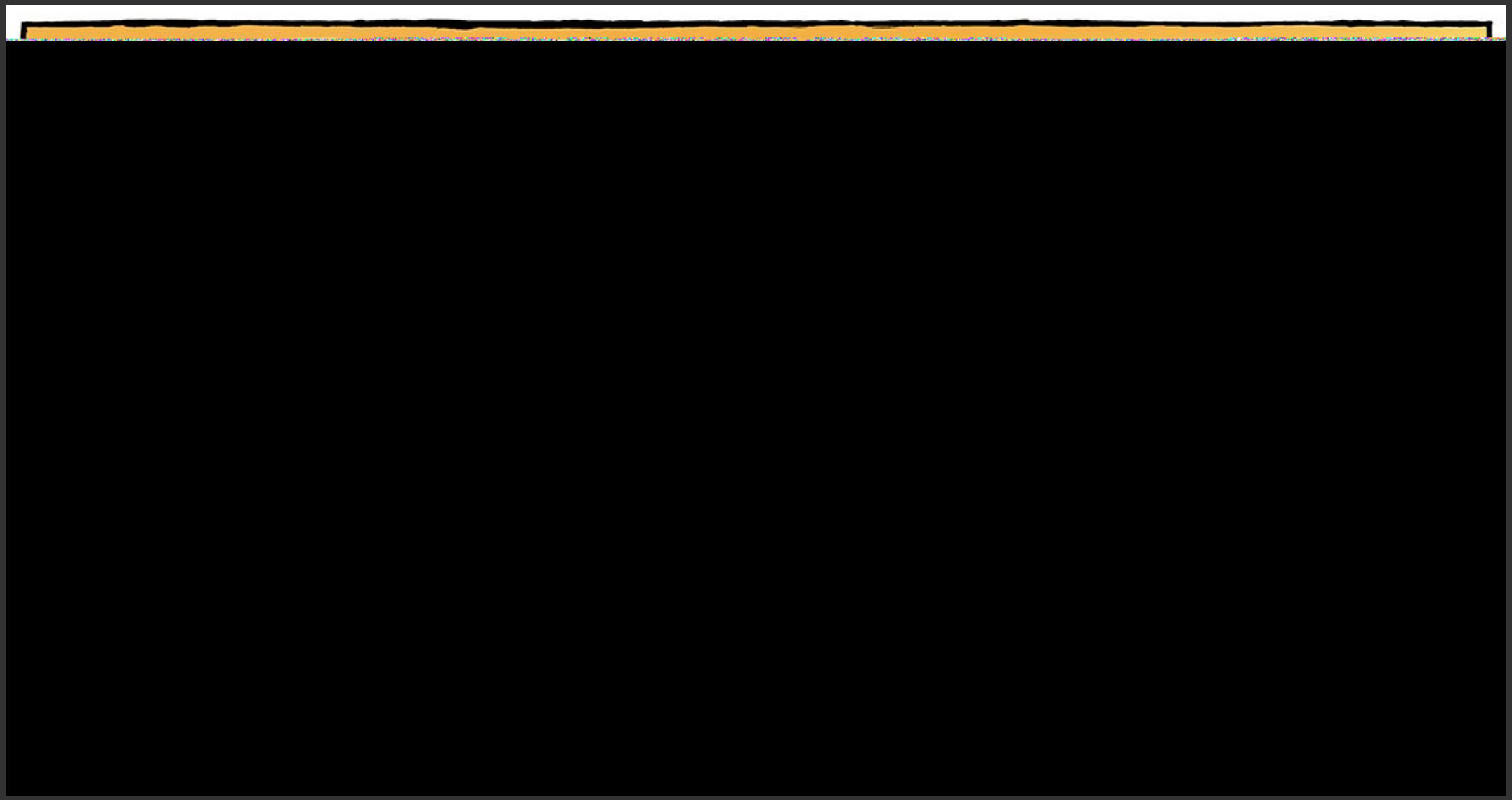

Thanks to Dan Piraro, creator of the Bizarro comic

Goal: Rules that require practical and effective respiratory protection.

Rulemaking Based on the Model of Community-based Participatory Research

A partnership of firefighters, department and union leadership, researchers, fire service organizations, and regulators.

Partners contribute expertise and share decision-making.

Firefighters are collaborators (co-designers, co-producers) from start to finish, in recognition of their expertise and lived experience.

Adapted from National Cancer Institute (Sept 2018). April Oh, Design Thinking and Community-Based Participatory Research for Implementation Science
https://cancercontrol.cancer.gov/is/blog/dispatches-from-is-at-nci-blog-september-2018

Adopted Resolution No. 17 of the IAFF 2024 Convention: *Bill of Rights for Firefighters Participating in Research as Human Subjects*

Photo by Mike Wilson, Cal/OSHA

"CBPR is a collaborative approach to research where scientists and firefighters collaborate as equal partners on all aspects of a research project…"

Principles are "founded on respect for persons, beneficence, and justice."


In 2022-23, Cal/OSHA collaborated with LA County FD, Cal/FIRE and the U.S. Forest Service to conduct Operational Field Assessments of five wildland/WUI respirators.
LOS ANGELES COUNTY
FIRE DEPT.
117
130
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Photos: Mike Wilson, Cal/OSHA

LA County Fire, Cal/FIRE, USFS, Cal/OSHA Operational Field Assessment, Castaic, Aug 30, 2023:
3M PAPR, MSA PAPR, Sundstrom PAPR and APR, TDA/Drager PAPR, Ventus APR

Weight and cardiovascular workload are key considerations. The TDA/Drager PAPR responds to increases in tidal volume by increasing the air flow rate.

Photo: Mike Wilson, Cal/OSHA

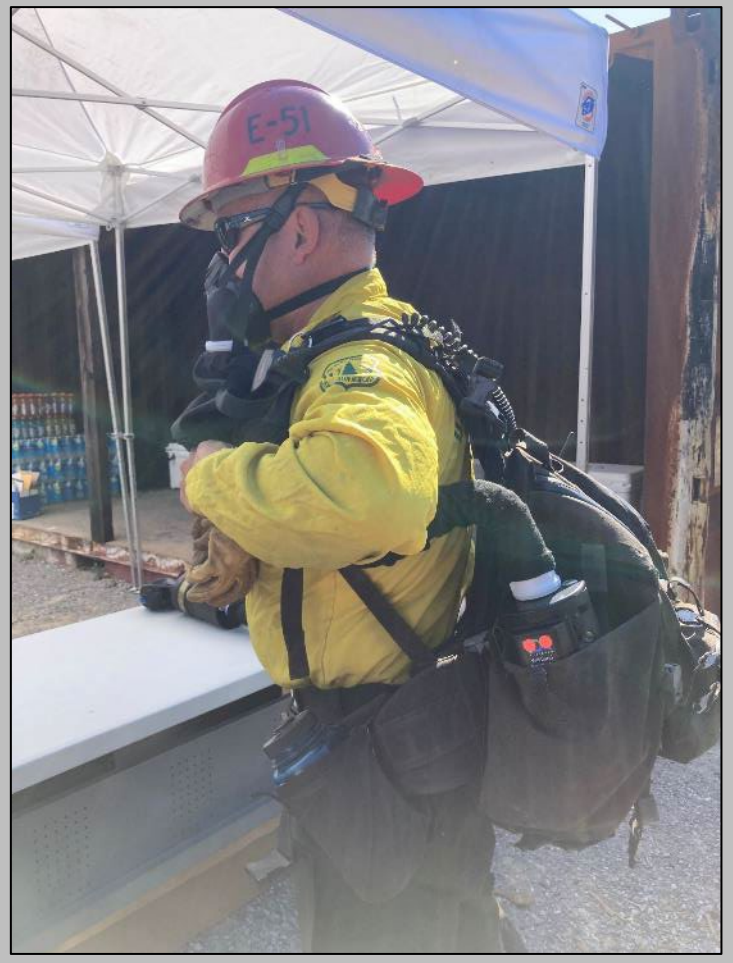
Cutting line while wearing respiratory protection (PAPR and APR) at the OFA, LA County Training Center, Castaic, CA Aug 30, 2023.

Photos: Mike Wilson, Cal/OSHA

Cal/FIRE firefighters wearing TDA/Drager PAPR, MSA PAPR and Sundstrom APR.

Cal/FIRE, USFS, Cal/OSHA OFA, Redding CA. Sept 12, 2023

Photos: Mike Wilson, Cal/OSHA



Photos: Mike Wilson, Cal/OSHA

TDA/Drager PAPR with USFS webgear
Cal/FIRE Operatonal Field Assessment, Redding, Sept 12, 2023.

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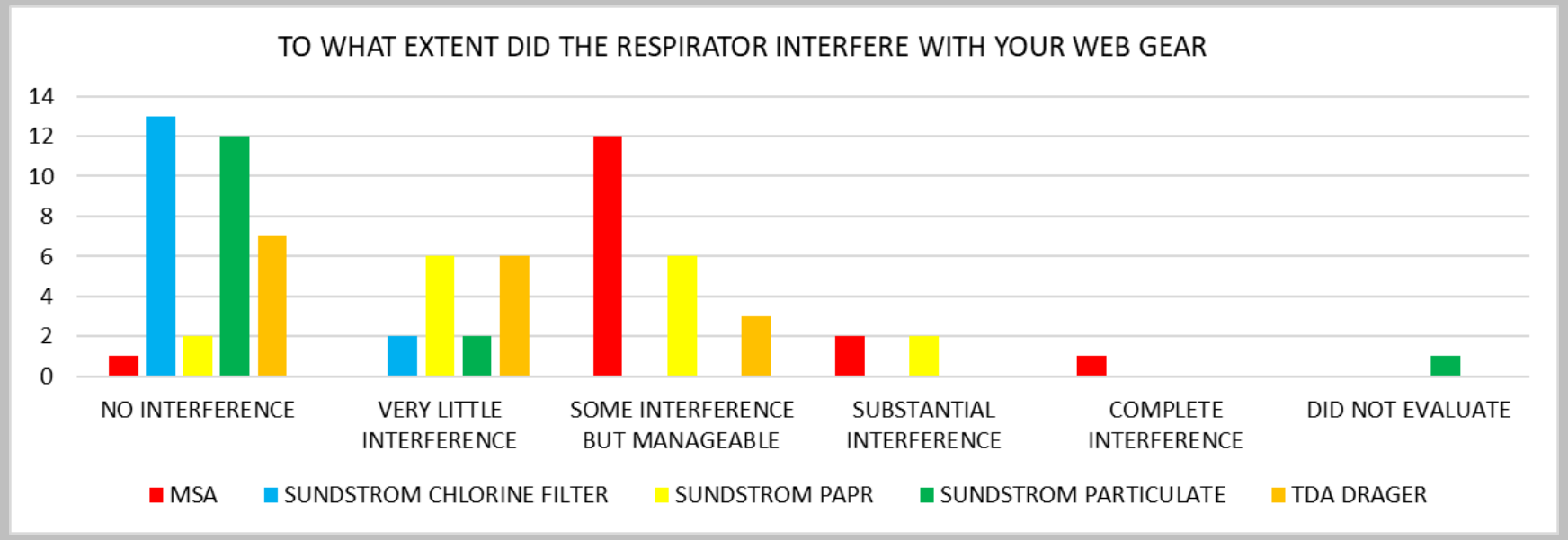
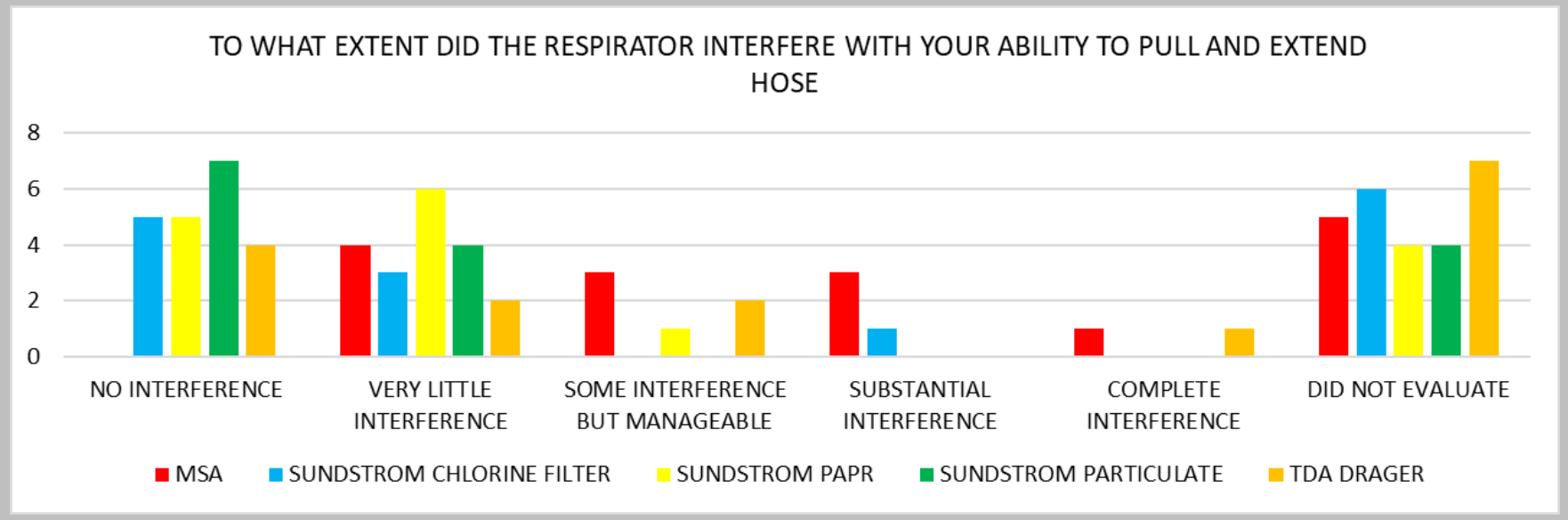
Cal/FIRE firefighters wearing respiratory protection while conducting an extended wildland hoselay.

OFA, Redding CA.
Sept 12, 2023

Photos: Mike Wilson, Cal/OSHA





20 Firefighter participants in the Redding OFA.

MSA: PAPR with G-1 full facepiece

Sundstrom: PAPR with full facepiece

Sundstrom: APR with PM filter

Sundstrom: APR with PM and chlorine filter

TDA Drager: PAPR with half-face mask

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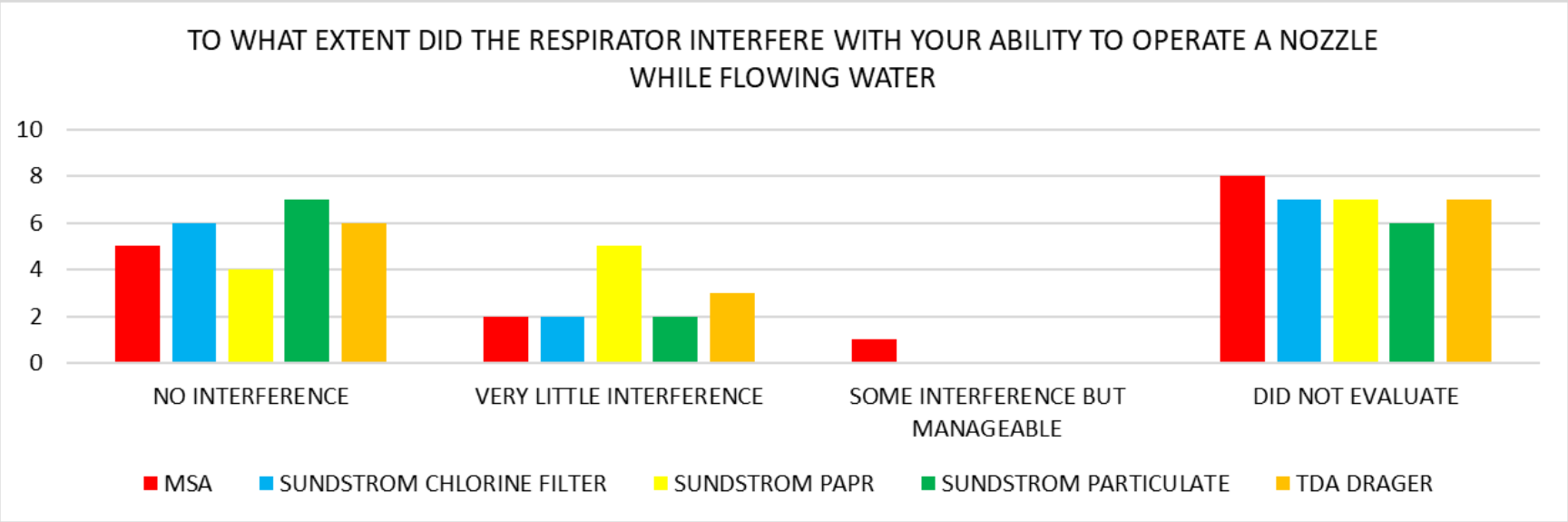

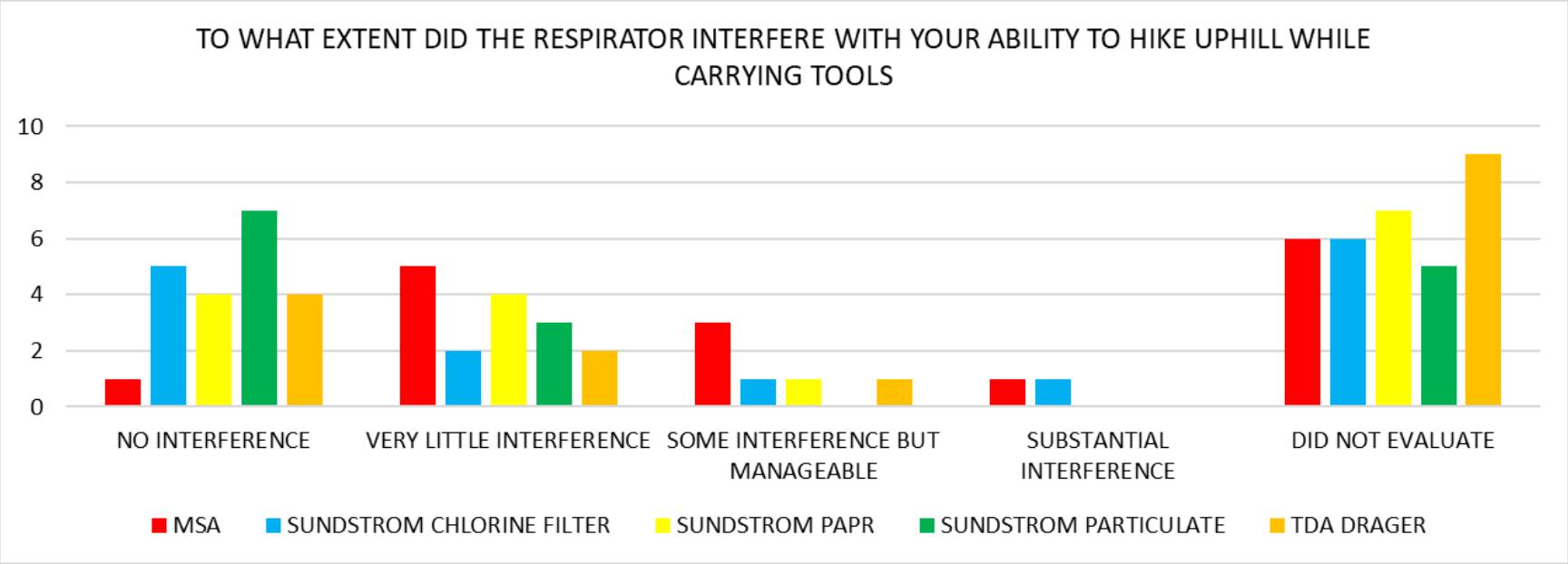

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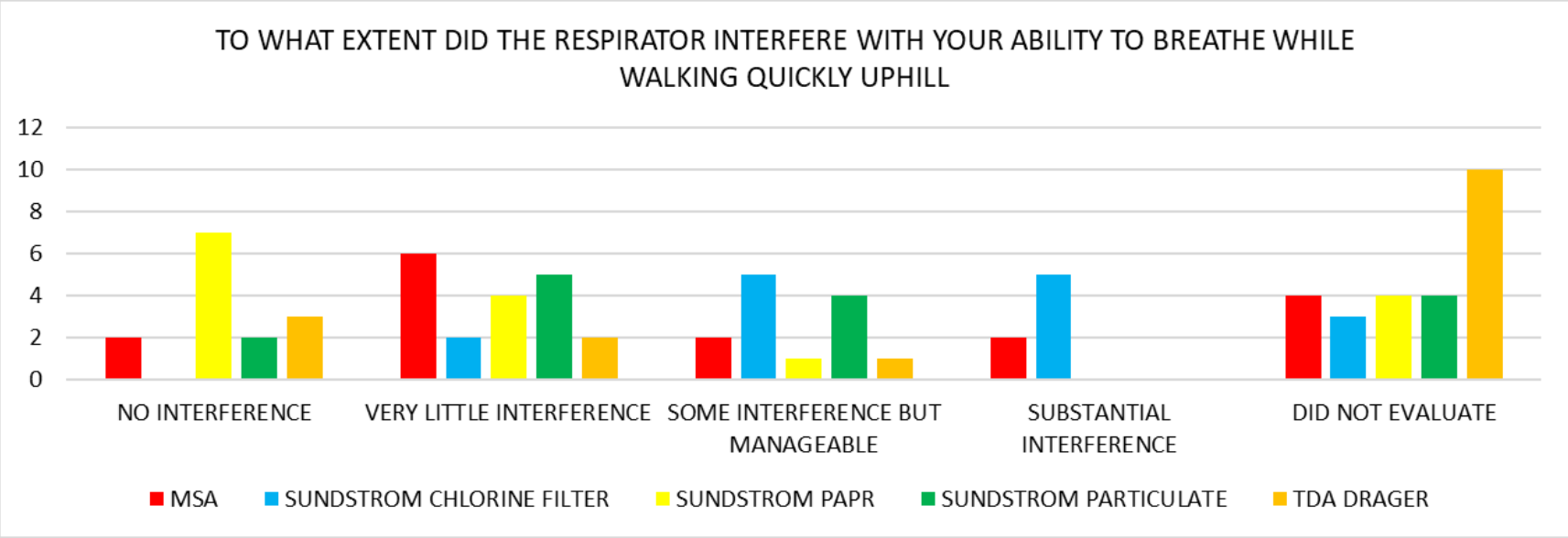

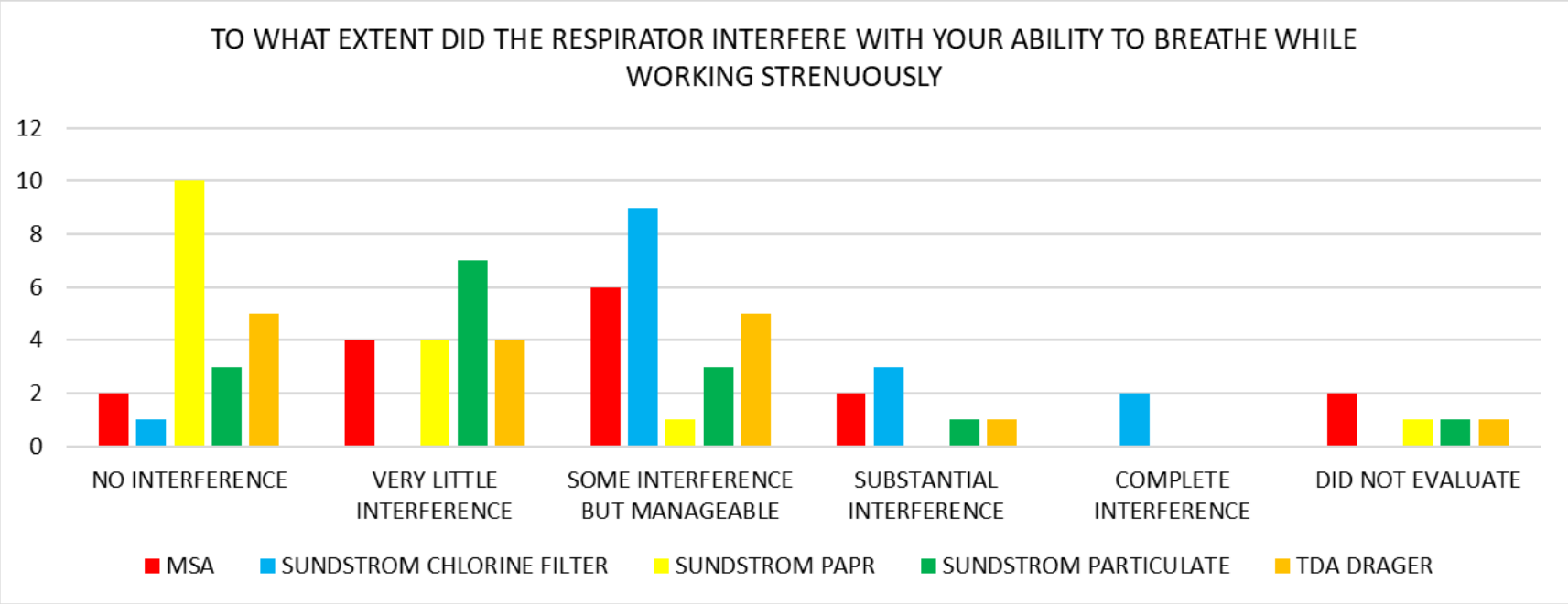

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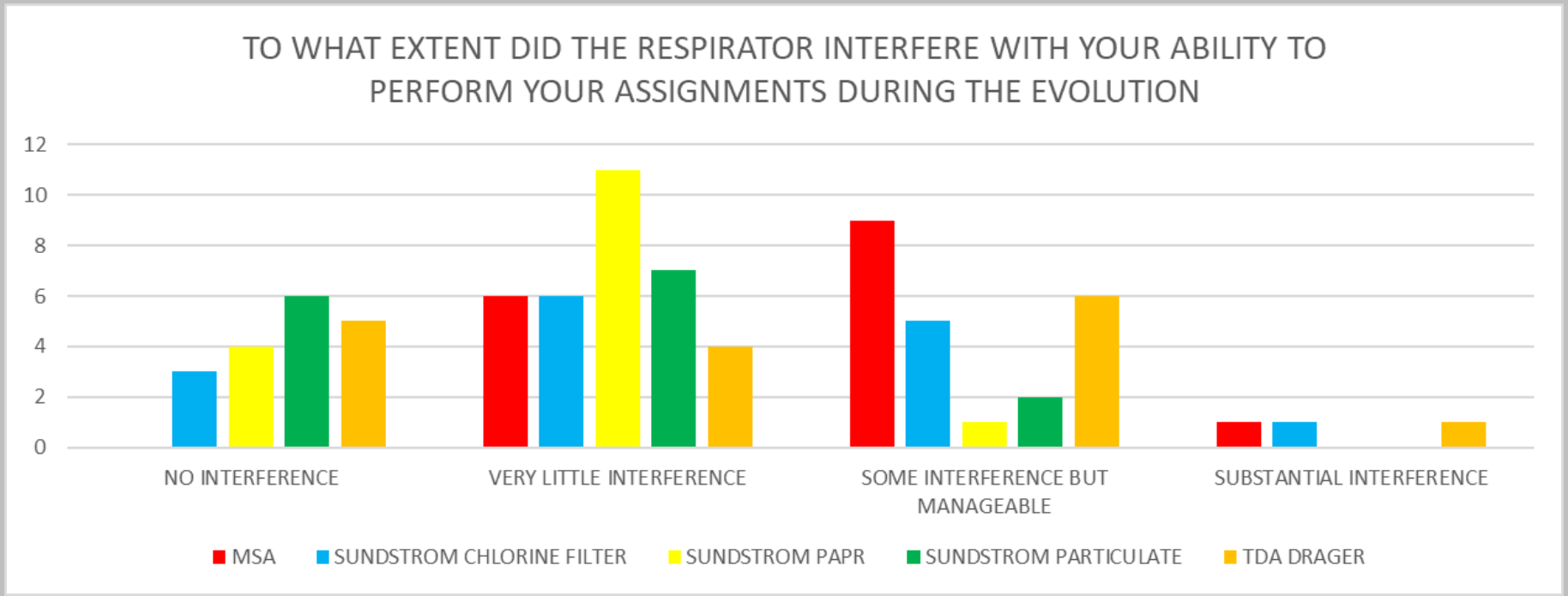

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Photos: Mike Wilson, Cal/OSHA

Type I Engine

- Structure protection
- Powered Air-purifying Respirator (PAPR)
- CBRN or similar cartridge (particulate, acid gas, organic vapor)

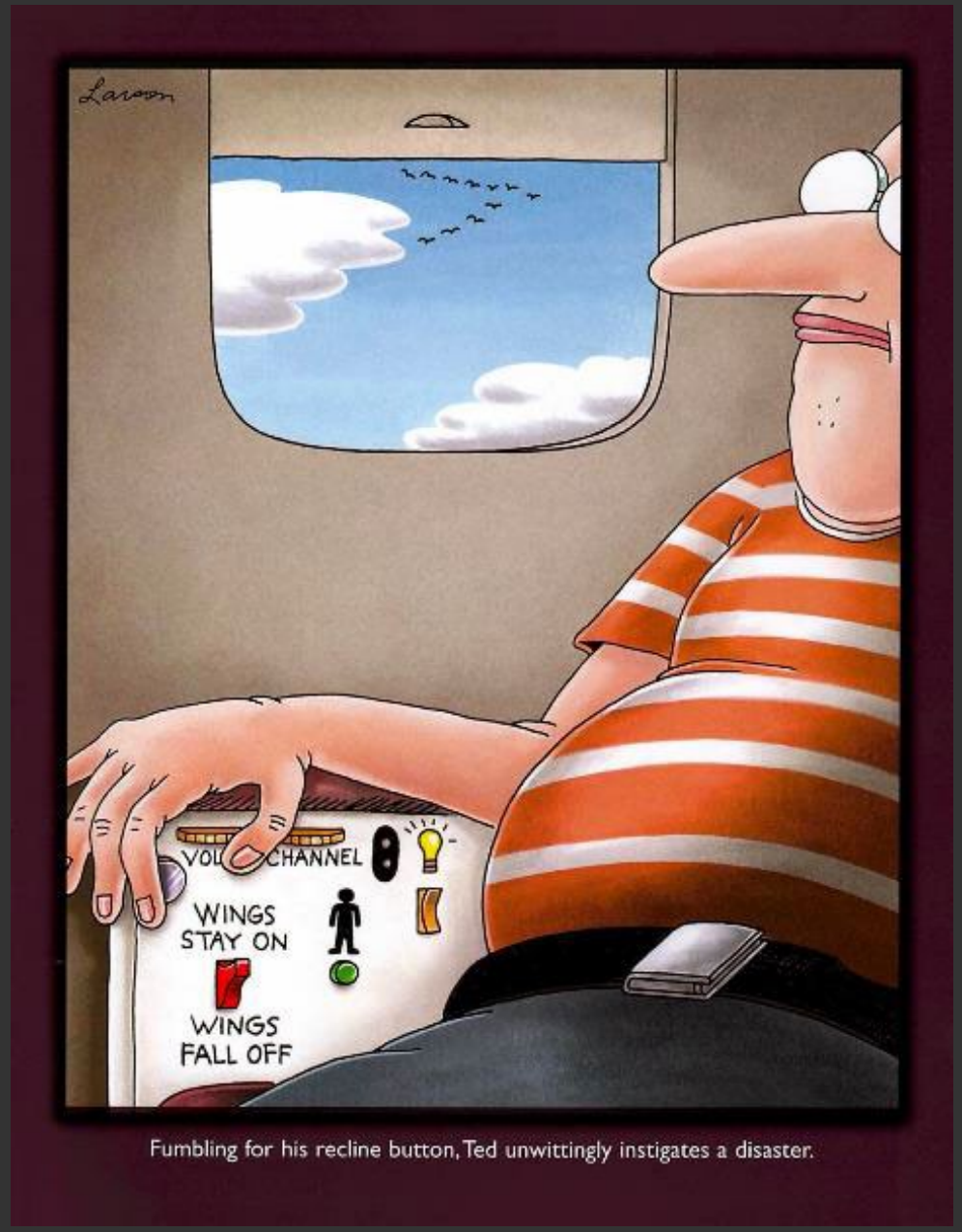
Type III Engine

- Progressive hoselays, perimeter control
- Powered Air-purifying Respirator (PAPR) or Air-purifying respirator (APR)
- CBRN or similar cartridge

Hand Crews

- Working from personnel carriers, handline work
- Air-purifying respirator (APR) or PAPR
- CBRN or particulate filter only

Photos: Alvin Jornada, SF Chronicle
Arcata Fire District
Government Accountability Office GAO-23-105517



Thanks to Gary Larson, creator of the Far Side.

“Fumbling for his recline button, Ted unwittingly instigates a disaster.”

Goals:

- Avoid impractical requirements.
- Avoid inappropriate designs.
- Avoid false starts.
- Build trust and cultural acceptance.
- Motivate design innovation.

Strategies:

- Engage labor and management.
- Collaborate from the beginning.
- Draw on the lived experience of firefighters.
- Build a scientific foundation, but do not await exhaustive evidence of harm before acting.
- Advance new rules based on a reasonable body of evidence.

Technical Question #1

§5144(d)(1)(C)
"Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

(d)(2) Respirators for IDLH atmospheres

(A) The employer shall provide the following respirators for employee use in IDLH atmospheres:

1. A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

2. A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply."

Can we reasonably estimate exposures at a WUI fire? What product of combustion should be evaluated? Does a wildland or WUI fire constitute an IDLH condition?

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Technical Question #2

NFPA 1984
Filter cartridges are tested using individual chemical challenges:

- Organic vapors (C_6H_{12})
- Sulfur dioxide
- Nitrogen dioxide
- Formaldehyde
- Acrolein
- Hydrogen fluoride
- Hydrogen cyanide

- A test is not required to assess cartridge performance under smoke conditions.
- Combustion products are highly variable, depending on conditions.
- How does smoke affect breakthrough and the life of the cartridge?
- We must understand how cartridges perform under actual smoke conditions.

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Technical Question #3

- Does wearing a PAPR or APR increase cardiovascular stress while performing typical tasks at a WUI or wildland incident?
- Does wearing a PAPR or APR worsen heat stress?
- Does wearing a PAPR or APR affect situational awareness?

Definitive evidence of cause-and-effect

Balance of the evidence

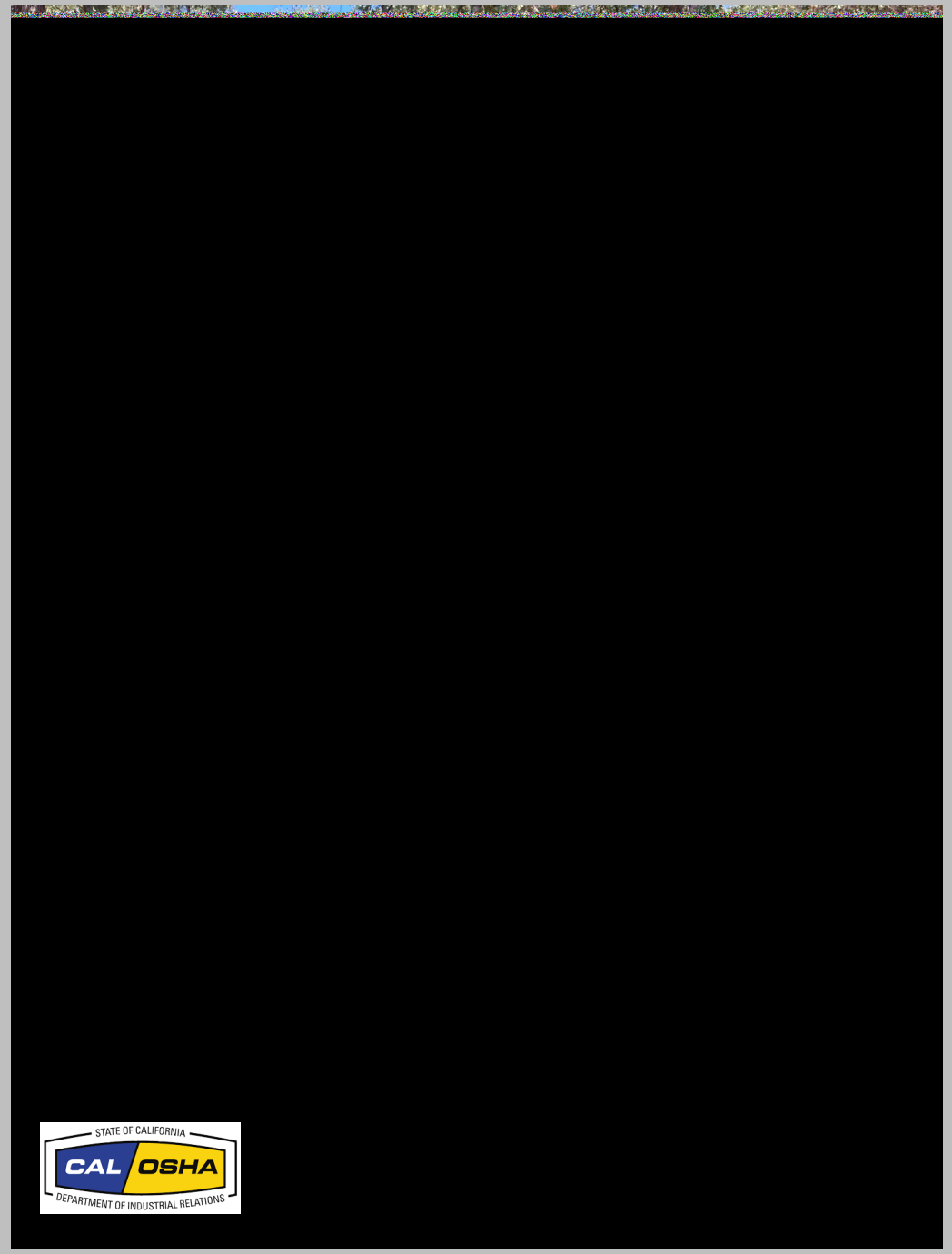
Reasonable grounds for concern

Scientific suspicion of risk

In answering these questions, we need to understand the objective (firefighter protection) and apply an appropriate standard of evidence as the trigger for action (regulation).

- In establishing a scientific fact, requiring clear evidence of cause-and-effect is appropriate (statistical significance, or 90-99% association).
- In establishing firefighter safety protections, however, the balance of evidence is sufficient for taking action (66-90% association between smoke exposure and harm).
- In general, as the likelihood and severity of harm increase, the standard of evidence for taking protective action should decrease.

David Yee. Late Lessons from Early Warnings. *EHP* Vol. 114 (April 2006. https://ehp.niehs.nih.gov/doi/epdf/10.1289/ehp.8134



Next Steps:

- Redesign PAPRs and APRs based on input from firefighters;
- Conduct lab and field-based smoke challenges of PAPR and APR cartridges;
- Conduct physiological workload studies;
- Convene Technical Advisory Commitee.
- Draft Cal/OSHA rulemaking documents.

Photo: Mike Wilson, Cal/OSHA

Goal: Practical and effective respiratory protection.

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