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*Features*

**FIREFIGHTERS AND FLAME RETARDANT ACTIVISM**

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**ABSTRACT**

In the past decade, exposure to flame retardant chemicals has become a pressing health concern and widely discussed topic of public safety for firefighters in the United States. Working through local, state, and national unions and independent health and advocacy organizations, firefighters have made important contributions to efforts to restrict the use of certain flame retardants. Firefighters are key members in advocacy coalitions dedicated to developing new environmental health regulations and reforming flammability standards to reflect the best available fire science. Their involvement has been motivated by substantiated health concerns and critiques of deceptive lobbying practices by the chemical industry. Drawing on observations and interviews with firefighters, fire safety experts, and other involved stakeholders, this article describes why firefighters are increasingly concerned about their exposure to flame retardant chemicals in consumer products, and analyzes their involvement in state and national environmental health coalitions.

**Keywords:** firefighters; flame retardant chemicals; environmental health; labor-environment coalition

The doctor that I saw . . . told me that the type of cancer I had was normally found in people that work in the chemical industry. When I told him I was a firefighter he sort of laughed and said, “Well you do work in the chemical industry, whether you know it or not.”

—Firefighter and advocate for chemicals regulation  
(interview with authors)

With experiences like the above epigraph in mind, firefighters across the United States took part in a day of action on March 26, 2014. “Give Toxics the Boot” was coordinated by the International Association of Fire Fighters, an environmental organization called Safer Chemicals/Healthy Families, and the filmmakers of *Toxic Hot Seat*, an acclaimed documentary about the controversies surrounding flame retardant chemicals [1]. Rallies, demonstrations, and press conferences took place in 15 cities, and organizers screened *Toxic Hot Seat* at separate events. In San Francisco, local leaders placed 200 pairs of boots on the steps of San Francisco City Hall to memorialize the city’s firefighters who had died of cancer [2]. The scope of this activism, which will be described in more detail below, signals the maturity of the social movement around flame retardant chemicals, and especially firefighters’ central involvement in that movement.

Firefighters have high rates of cancer and other occupationally linked illnesses, in no small part because of the toxic chemicals released during combustion [3-9]. In the past decade, a unique partnership between the professional firefighter community and environmental health activists has developed and grown. This coalition has come together to support science-based flammability standards and improved regulation of chemicals used in consumer products, and has been noticeably successful at passing regulations at the state level against certain widely used toxic chemicals. In this article, we examine this unique “blue-green” coalition, an alliance between occupational and environmental groups, which as far as we are aware is the first policy alliance between firefighters, including their union leadership, and environmentalists. What has motivated members of the firefighting community to care about this issue? What are the key features of advocacy alliances and projects that involve firefighters along with environmental and health advocates and researchers? What are the strengths of these coalitions, and where do weaknesses emerge?

This article describes firefighters’ involvement in campaigns to call attention to the risks of flame retardants. We find that firefighters become involved with flame retardant campaigns because of health concerns, personal experiences, and concerns about “foul play” by the chemical industry. Building on this description, we make three primary arguments. First, the issue of chemical exposure is framed by activists as a health issue, and is compelling to firefighters for this same reason. Second, firefighters describe their support for flame retardant restrictions in terms of the availability of safer alternatives, the lack of fire protection provided by these chemicals in some fire scenarios, and a need for other, proven fire safety technologies. Third, firefighters have played a crucial role in

successful campaigns to restrict flame retardants, and are seen as essential members of safer chemicals coalitions. These findings highlight the relevance of state-level activism and regulation of chemicals, the difficult risk trade-offs involved in balancing fire safety with chemical exposure, and the need for chemical alternatives assessment to support chemical regulation. We conclude the article by providing insight into the potential for future blue-green alliances between these groups and the green-building community in the general area of fire prevention.

## BACKGROUND

### Flame Retardant Chemicals

Chemical flame retardants are widely used as additives to consumer and household products, including furniture, electronics, car and airplane interiors, insulating foams, and carpet padding, to slow combustion. Flame retardants are used to meet flammability standards propagated by states (e.g., California's Technical Bulletin 117 [TB117] for upholstered furniture), the federal government (e.g., the Consumer Product Safety Commission's Standard for the Flammability of Mattresses and Mattress Pads), and industries (e.g., the Upholstered Furniture Action Council's smolder ignition standard).

The manufacture of modern flame retardants began in the 1960s [10]. In 2011, at least 740 million pounds of flame retardants were produced in the United States, and global revenues were at least \$4.8 billion, with an estimated annual growth of 6.9 percent [11, 12]. The widespread use of these chemicals has coincided with state and national policies, educational campaigns, and behavioral changes (especially declining smoking rates) that have decreased fire incidence, injuries, and mortality in the United States. Civilian fire deaths have declined from approximately 7,500 per year in 1977 to 2,855 in 2012 [13, 14]. Thus, in spite of flame retardants' effectiveness in laboratory settings, it is difficult to ascertain whether flame retardants provide a public safety benefit, and some experts have argued that they actually increase risks from fires by increasing smoke toxicity [15].

Concerns about possible health risks from exposure to flame retardants first emerged with several cases in the 1970s. Flame retardants were accidentally mixed with animal feed, resulting in the poisoning of over a million livestock and leading to high levels of exposure for Michigan residents [16-18]. Later that decade, several organophosphate chemicals commonly referred to as "Tris" were found to be used in children's pajamas [19-21]. In 2007, chemist and scientist-advocate Arlene Blum learned that furniture manufacturers complied with California's TB117 flammability standard for upholstered furniture by adding flame retardant chemicals to polyurethane foam, including the mutagenic TDCPP (Tris[1,3-dichloro-2-propyl]phosphate) she had studied in the 1970s [22].

Since the early scientific and public awareness of certain flame retardants in the 1970s, two general groups of flame retardant chemicals have received the most attention: polybrominated diphenyl ethers (PBDEs) and the Tris chemicals. PBDEs received much scientific and regulatory attention in the United States starting in the 2000s. Biomonitoring research showing the presence and rapid accumulation of PBDEs in women's breast milk in Europe and the United States [23-25] prompted the first measurements in U.S. households in the Silent Spring Institute Household Exposure Study [26], which in turn catalyzed additional research on human exposure to flame retardants. This study identified house dust as the major source of human exposure. The expanded Household Exposure Study in California homes found that PBDE levels in household dust were 10 times higher than levels in other parts of the United States, and 200 times higher than levels in the European Union, and the PBDE blood levels of Californians were twice as high as the national average [27]. Silent Spring attributed these findings to the state's unique furniture flammability standard, TB117, which was met through the use of flame retardants.

Many flame retardants disrupt the endocrine system, interfering with hormones and potentially harming reproduction and development [28]. In animal studies, PBDEs have been shown to be toxic to neurological and reproductive development and potentially carcinogenic [29]. Epidemiological studies have connected PBDE exposure to developmental and reproductive effects in people, ranging from reduced fecundity to decreased IQ in children [30-32]. Some scientists have recently turned their attention to alternative flame retardants, including other brominated and non-brominated flame retardants, some of which are of concern because of toxicity and exposure [33-37].

In the United States, flame retardants are subject to regulation by the Environmental Protection Agency's (EPA's) Toxic Substances Control Act (TSCA) [38]. First passed in 1976, TSCA is now widely critiqued by environmental activists and chemical industry trade groups alike, and reform efforts are underway, though stakeholders certainly have different opinions about what reforms should look like [39]. Among other problems, TSCA grandfathered in existing chemicals, requires little or no screening on the health and environmental hazards of most new chemicals, has strict protections for companies' trade secrets, and requires an almost impossibly high standard of proof for chemical restrictions.

Because of the weaknesses of federal regulations, state governments have raised the bar through state-level restrictions and regulatory reform [40]. Beginning in 2003, 11 states banned PBDE formulations, and the chemical manufacturers announced a voluntary phaseout of the chemicals at the end of 2003, to take effect in 2004 [41]. In 2009, the chemical industry announced the phaseout of the third PBDE formulation, deca-BDE [42], and the EPA followed with regulations preventing future uses in the United States [43]. These phaseouts have been successful at reducing exposure to PBDEs [44], though recent research has documented a transition from phased-out chemicals to other

carcinogenic and untested compounds [34]. Several types of Tris chemicals have recently faced state regulation [45]—one was listed as a carcinogen in 2012 under California’s Proposition 65 law, and included as a candidate product in the state’s inaugural 2014 Safer Consumer Products listing [46, 47]—and a flame retardant manufacturer recently announced it would discontinue production of TDCPP by 2015 [48].

State bans on flame retardant formulations and more extensive regulatory programs on priority chemicals and alternative assessments have provided a focus for activist attention, pressuring the supply chain to shift away PBDEs and other flame retardants on a much quicker timeline than could be achieved through federal regulatory reform. However, activists see flame retardants as a “poster child” for more comprehensive chemical regulation, because often manufacturers replace banned or harmful chemicals with compounds that are inadequately tested, but potentially even more harmful [34].

### **The Flame Retardant Advocacy Coalition**

There is a long history in the social movement literature of looking at how coalitions form, examples of unexpected coalitions, and how such coalitions impact movements and movements’ success. So-called blue-green coalitions bridge gaps between labor and environmental activists [49-51]. Labor and environmental groups are often assumed to have contradictory ways of approaching industrial decision making and to reflect differing class interests, and, indeed, often end up on opposite sides of proposed regulatory reform. However, labor unions and environmental organizations have come together on issues ranging from the environment to globalization [52]. In some blue-green coalitions, successful coalition-building can occur because health concerns provide opportunities for bridging, through a shared collective identity [50]. In others, environmental conditions provide a focus for workers’ protests. For example, unionized workers at a Maine paper mill criticized the company’s environmental practices and toxic releases as part of a broader effort to improve working conditions, “turn[ing] the environment into a strike issue” [53]. A New Jersey coalition supported the movement of a right-to-know bill through the state legislature [51]. In Boston, occupational health activists, school janitors, and teachers collaborated to test environmentally safe cleaning products in public schools [54]. Moving forward, the “green economy” focused on renewable energy and sustainability is seen as a promising avenue for blue-green coalitions [55], and this area has been identified as an emerging area of social science inquiry [56].

Flame retardant activism involves diverse coalitions of groups and individuals, including environmental groups, consumer advocacy groups, physicians and public health professionals, firefighters and fire safety experts, women’s health care providers, scientists in public interest organizations and academia,

politicians, and manufacturers required by regulations and flammability standards to include flame retardants in their products. Activists have also worked closely with some flame retardants users, including the product and component manufacturers and retail operations that make up the supply chain (e.g., foam manufacturers and furniture assemblers).

Several different firefighter organizations in the United States have been involved with chemical regulation in different ways. The International Association of Fire Fighters (IAFF) is a union representing more than 300,000 professional firefighters and emergency medicine personnel from 3,200 fire departments around the country [57]. The IAFF has frequently come out in support of PBDE restrictions, and has position statements supporting the bans of PBDEs in the presence of safer alternatives [58]. The National Association of State Fire Marshals (NASFM) is a professional group made up of one fire marshal from each state and other senior fire officials. The group's stated mission is "to protect life, property and the environment from fire" [59]. NASFM has only occasionally supported restrictions on flame retardant chemicals, and often opposed them. Activists and journalists have argued that this was because flame retardant manufacturing companies provided funding to NASFM and at times had the same lobbyists [60]. States also have their own firefighters' unions, and localities down to the local level can have decision-making or educational organizations. Several demographic groups have dedicated firefighting organizations, such as the International Association of Women in Fire and Emergency Services and the International Association of Black Professional Fire Fighters. Also influential in the fire safety world are organizations like the Phoenix Society that represent burn survivors and burn doctors.

Studies in multiple countries have documented that firefighters and other first responders have elevated risks of certain cancers, such as thyroid, bladder, kidney, prostate, testicular, breast, brain, and digestive cancers, multiple myeloma, and non-Hodgkin's lymphoma [3-9]. A recent study by the San Francisco fire department found that rates of breast cancer among female firefighters aged 40-50 were six times the national average. This evidence that firefighters suffer from high rates of many types of cancer has compelled 33 states to pass "presumptive" cancer laws, under which a firefighter's cancer is automatically judged to be service-related [62].

Data from the Centers for Disease Control and Prevention National Health and Nutrition Examination Survey and the California Biomonitoring Program indicate higher firefighter exposure to several PBDE congeners used in furniture foam compared to the general population [63, 64]. Additionally, halogenated flame retardants can release dioxins and furans, which are known carcinogens, when they burn [15]. A recent study of 12 San Francisco firefighters found levels of PBDE flame retardants and their dioxin and furan combustion products that were higher than population averages and reflected "occupational exposure to all three PBDE formulations," suggesting that firefighting increases exposure

to these dangerous chemicals [65]. During combustion, materials containing halogenated flame retardants release smoke that is more toxic because it contains more carbon monoxide, hydrogen chloride or bromide, brominated and chlorinated dioxins and furans, and partially burned hydrocarbons [15]. Because most fire deaths result from inhaling carbon monoxide and other toxic gases, not directly from fire itself, flame retardants may increase risks from fires in other ways, although they may slow point-source ignition from small flames or smolder ignition from cigarettes.

## METHODS

This article draws on observations and interviews with firefighters, fire safety experts, and other involved stakeholders to analyze why firefighters are increasingly concerned about their exposure to flame retardant chemicals in consumer products, and how they have been involved in state and national environmental health coalitions. This study is part of a larger project on the social implications of flame retardant chemicals [40]. In previous publications, we have discussed flame retardants regulation in the United States and the lessons provided by their use and restriction [40]; the implications of scientific uncertainty around emerging contaminants like flame retardants for ethical research practices [66]; and the impact of environmental health advocacy and investigative journalism on flame retardant regulation [67]. We conducted in-depth interviews with over 125 respondents, including firefighters, fire safety experts, activists from environmental and health social movement organizations, scientists, state and federal regulators and legislators, and industry representatives. Interviews were semi-structured to allow for qualitative investigation, and included questions organized around seven themes: respondents' professional trajectories, their work on flame retardant chemicals, the relationship between activism and science, industry and production, biomonitoring and other exposure research, risk and hazard assessment, and the regulation of environmental hazards. This article focuses on responses to these questions by members of the fire safety and firefighting communities, as well as responses by other stakeholders who worked with firefighters in their own work. The research received Institutional Review Board approval from Brown University and Whitman College. We spoke with many respondents more than once. Respondents were identified through publications on flame retardant topics, references in the media, or their organizations' involvement in flame retardant campaigns. Interviews were conducted in person when possible, with 22 interviews conducted over the phone. Interview recordings were transcribed and then coded in NVivo, a software program that manages qualitative data.

All data gathered from interviews and observations are anonymized. Individuals are identified by name only when we describe their public actions (e.g., speaking at conferences or hearings). Data also come from an extensive review



of the scientific literature on flame retardants from 1995 through 2013. Further data come from extended observations at a company producing flame retardants, two EPA offices, an environmental health nonprofit organization, a university science lab conducting well-regarded flame retardant research, and scientific and advocacy conferences devoted to flame retardants and chemical risk.

## FINDINGS

### Firefighter Involvement in Flame Retardant Advocacy

In the words of a career firefighter, those in the profession are motivated by one overarching goal: “to make it safer for firefighters and to make it safer for the public we serve.” Firefighters have been involved in flame retardant activism in different ways. Some firefighting organizations, like the IAFF, have formed blue-green alliances with environmental organizations, writing letters of support or sending individual firefighters to testify at public hearings. For example, a firefighter testified at a California hearing wearing his uniform, and said he was representing thousands of firefighters around the country exposed to flame retardant chemicals. Others have used their leadership roles within firefighter health groups to advance various preventive health strategies, including chemicals regulation. There are also examples of firefighters collaborating with environmental health activists and researchers. We describe one of these collaborations in greater detail below.

In interviews and at meetings, firefighters said they usually got involved in flame retardant campaigns for personal reasons. One was diagnosed with cancer, and after receiving incredible support from his department, wanted to give back by working to prevent cancer more broadly. Another became concerned after learning that flame retardants can be found in women’s breast milk. As she explained, “I had breast-fed my first child while on active duty. . . . I thought I had been really safe by offering my child the best thing I could for him. . . . But maybe I didn’t realize what was in my breast milk due to the job I do.” This woman became concerned not just for her own health as a result of her job, but for her family’s health as well. Others noted that exposures were so widespread that they were impossible to ignore. As one firefighter said on a conference call, you come back from a fire and “you’re blowing soot out of your mouth, your nose,” and that if the flame retardants are in the dust, they must also be in the soot. Another told us that, although he had retired from active duty three years ago, “I can still take a super-hot shower, or work out and sweat and get really hot, and to this day I still—and I don’t know if it’s brain memory or whatever—but I can still smell smoke.”

Still another firefighter traced his desire to engage in preventive work to a fire he attended with over 20 fatalities:

I realized that all those people were dead before we left the station. So all the, we have the big red truck, and the hoses and the gear and everything that we do, these heroic efforts, they were all dead already. So then I said, well is there some way I can get into the other part of this and start to do more prevention? . . . That was my genesis to get into prevention.

And many firefighters talked about the number of colleagues who have suffered or died from cancer. One recounted the story of losing a friend to bladder cancer, and then fighting on behalf of her family to prove that her cancer was work-related. “It really left a big impact on me,” this firefighter told us, and the experience motivated her later work on flame retardant regulations. Another counted a high number of cases among her co-workers: “in the last two years I’ve had eight friends and colleagues of mine get diagnosed with breast cancer.”

In other instances, firefighters were recruited into the campaigns by existing political allies. One talked about how a legislative ally had sponsored pro-firefighter legislation in the past, and then became interested in PBDEs, indicating that their prior “health and safety-related legislation . . . dove-tailed into, you know, our work on flame retardants very well.” He then connected this back to health concerns: “there is a direct correlation between . . . the chemicals and the carcinogens and exposures that firefighters have over the course of their career, and the occupation risks and cancers that they might have come down with. So we worked pretty hard on that.”

Tony Stefani is a retired San Francisco firefighter who formed the San Francisco Firefighters Cancer Prevention Fund (SFFCPF) after his own battle with cancer. The SFFCPF funds health and exposure research on firefighters and advocates on behalf of firefighters seeking workers’ compensation benefits when they are diagnosed with cancer. Stefani has testified at numerous public hearings and participated in conferences that support flame retardant restrictions. As a result he has emerged as a leader among firefighters concerned about their occupational exposure to toxicants, and played a key role in the HBO documentary *Toxic Hot Seat*, which we discuss in greater detail below. In interviews, several firefighters specifically mentioned that Stefani had inspired them to get involved in flame retardant campaigns, raised their awareness about this issue, or connected them with other like-minded activists.

### Responses to Industry “Foul Play”

The flame retardant industry has an active and well-funded lobbying arm, and multiple firefighters were critical of their tactics. As one firefighter told us, flame retardants:

. . . are big moneymakers for the chemical industry, and the chemical industry has a major lobby. I saw it in action in [city] two years ago when I wanted to help one of our state senators [on state regulations]. . . . And we were fully

aware that some of the people that sat on the committee, the state committee, were taking contributions from the chemical industry.

Another firefighter said that flame retardants were the “golden egg” of the chemical companies: “they were making money for no apparent reason.”

Multiple firefighters directly stated that they had been inspired to get involved or had their resolve strengthened by dirty or strong-arm lobbying tactics used by the flame retardant manufacturing companies. In particular, firefighters were angered—and motivated—by industry’s claims that the fire service supported the use of flame retardants. A New England firefighter talked about how Citizens for Fire Safety, a now-defunct lobbying organization funded by the flame retardant industry, came into his state and “didn’t understand the players. They tried to disrupt the firefighter community.” He continued, talking about how the lobbying group paid the State Fire Marshal to do “robo-calls” that contained inaccurate information and challenged the credibility of the fire safety community. Another firefighter from the west coast talked about how that same lobbying group mailed misleading brochures:

They have a firefighter with a hose line and a montage with a fire truck and they used our, and maybe even used the California Fire Chief’s emblem. I don’t know. But they certainly used our image and our reputation. . . . To be honest with you, I was OK with flame retardants being all jacked up and being stupid and hurting the environment and people, but then when they used our reputation and our name, that’s when it pissed me off [laughing]. Well, it really wasn’t that cut and dry, but that seemed to be the kicker for me to get involved and say, wait a minute, what’s going on here?

Firefighters were angered by this type of political pressure. One firefighter accused the industry of relying on “scare tactics” and taking advantage of the reputation of the fire service, but also told us, “their tactics backfired on them.” The experience left him so skeptical of flame retardants that, he told us, “I find it hard to believe . . . if someone gets before a microphone and they say they’re there to support the company . . . I find it hard to believe that they’re not bought and paid for.” This skepticism motivated him to participate in the coalition to restrict flame retardants and change flammability standards.

### **Expansion of the Alliance**

Firefighters have become more central to an expanded flame retardant alliance in recent years. Here we talk about several unique activities: biomonitoring studies of firefighters, the *Chicago Tribune’s* award-winning series on flame retardants, the documentary film *Toxic Hot Seat*, and the “Give Toxics the Boot” day of action.

Biomonitoring measures exposure to chemicals or their breakdown products in biological tissues such as blood, urine, or hair. It provides personal measurements that reflect all sources of exposure. Because firefighters are exposed to

many chemicals on the job, biomonitoring results can show the mixture of chemicals they may be exposed to, including diesel, flame retardants, perfluorinated chemicals, and other toxicants linked to cancer.

For example, in response to reports about an alarming number of premenopausal breast cancer cases among San Francisco's women firefighters [61], the San Francisco Cancer Prevention Foundation approached the United Fire Service Women and environmental health advocates in 2012 to better understand breast cancer risk factors among women firefighters, particularly with regard to occupational chemical exposures. This evolved into the Women Firefighters Biomonitoring Collaborative (WFBC), a study led by these two firefighter groups, researchers at University of California-Berkeley and San Francisco, Silent Spring Institute, and environmental health organizations, including the Breast Cancer Fund and Commonweal. The WFBC is funded by the California Breast Cancer Research Program, San Francisco Firefighter Cancer Prevention Foundation and Local 798 of the International Association of Firefighters.

As the first study to measure exposure to chemicals linked to breast cancer among women firefighters, the WFBC is recruiting 80 women firefighters and 80 women from other civil services. They will interview and collect blood and urine samples to measure exposures to certain chemicals with potential links to breast cancer, including current-use and banned flame retardants. Moreover, this is the first study of firefighters to apply an innovative non-targeted biomonitoring method called "Time of Flight" to measure chemicals that might not otherwise be expected in this population. This approach may reveal chemical exposures that have never before been measured. Finally, this study will measure early indicators of adverse health outcomes, including changes in thyroid hormones, melatonin levels, and altered telomere length, which may be related to chemical exposure or chronic night shift work. Combined results will be made available to all participants, firefighters, and civil employees. Individual results will be reported to those study participants who want them.

Two media events also have played key roles in the flame retardant coalition. First, in 2012 the *Chicago Tribune* published a four-part investigative series on industry activities, regulation, and scientific research on flame retardants [68]. This award-winning series contributed to policy developments on flame retardants, including legislative hearings and regulatory activity at the Environmental Protection Agency and Consumer Products Safety Commission [67]. Firefighters were featured in this series and in follow-up stories, and were aware of its impacts. As one firefighter told us, the *Tribune* series "was awesome," and recounted several stories of how the flame retardant industry used lobbyists and paid experts in legislative hearings: "money controls people. It really does. . . . It just blows me away that money can make the worst come out of people." Following the publication of the *Tribune* series, the flame retardant industry disbanded Citizens for Fire Safety, the lobbying group associated with many of

the questionable tactics described in the newspaper stories. The series prompted major Senate hearings and led to increased national interest in reforming the Toxic Substances Control Act.

In addition to print media coverage, a documentary film directed by James Redford and Kirby Walker called *Toxic Hot Seat* was released in 2013 [1]. The film details how firefighters, environmental activists, and scientists came to work together around reducing exposure to toxic flame retardants, both from a residential home furnishings standpoint and for firefighters' occupational health. The movie showcases the coalition's efforts to collaborate with lawmakers on the state and federal levels. It also demonstrates the importance of investigative journalism, which uncovered the tactics used by the chemical industry to undermine the efforts of environmental activists.

In 2014, the makers of the film partnered with IAFF and Safer Chemicals, Healthy Families, an environmental health coalition, to sponsor a national day of action called "Give Toxics the Boot." Firefighters and public health professionals in 15 cities took part in events held across the nation at city halls and state capitols where local legislators were educated on the hazards of flame retardant exposures among the firefighting community and the general population. The day was also coupled with showings of *Toxic Hot Seat*. From the fire service arena, union leaders, fire chiefs, and medical examiners for fire departments got together to speak about the occupational hazards posed by flame retardants. The involvement of the firefighting community was particularly important in making this day of action a success.

### Health Frames

The issue of chemical exposure is framed by activists as a health issue, and is compelling to firefighters for this same reason. As one firefighter explained, his colleagues "understand it" because "we see too many firefighters at a young age coming down with different forms of cancer, strange cancers. . . . They understand that we're trying to make it healthier for this generation and for the next generation in this profession." This represents what sociologists term a "frame alignment" between different groups' interpretations and explanations of an issue [69].

Firefighters who work on chemicals regulation have a very high level of awareness that their profession suffers high rates of illness, as described above, and they attribute this to their exposures while fighting fires. In the powerful words of a career firefighter, "we are the canaries. I think we are the ones that are being put into the mine shaft with this stuff and hopefully come out alive." One firefighter talked about how firefighters' protective equipment doesn't fully measure or prevent exposures, because of limitations to the equipment and its cumbersome nature:

The problem is the combustionable [sic] gas indicators or CGI monitors that are used don't pick up all the carcinogens that are in the air, they pick up a few, but not enough. And so the SCBAs [self-contained breathing apparatuses] are cumbersome, they weigh 30 to 40 pounds, they are on the back and you've got a mask over your face, it's hot and you can't understand each other when you're talking. So the big thing is everyone takes them off their back and goes to work.

Another explained that, in spite of the "tough exterior" of firefighters and advances in their protective equipment, "we're actually at a much higher risk than the general population because all the stuff when it's burned or partially burned, it goes right in, we can't get protective gear that stops this from happening."

The firefighters who participate in flame retardant campaigns tend to be from the union leadership or to be retired firefighters who now are active in foundations or firefighter support organizations. We heard inconsistent opinions about how aware rank-and-file firefighters were of potential dangers from chemical exposure. Some said awareness was growing: "Firefighters are starting to see the problem that we are having as far as the active and retired firefighters contracting various forms of cancer at higher rates than they have in the past. So, they are becoming more aware." Another noted that "the fire service has done a lot of good work in terms of just taking care of ourselves," through advances in gear like wearing air pumps and washing coats and pants between fires. However, active firefighters also talked about how it can be an uphill battle to get their colleagues to be concerned about their exposures, because of the firefighter identity: "the majority of firefighters go in there and do a job and that's the bottom line. It's usually an aggressive person that wants to be in this profession and they don't really think too much about what the outcome could be 20 or 30 years down the line." Additionally, it remains to be seen whether advances in personal protective equipment will be fully embraced and utilized. For example, only seven of the 12 San Francisco firefighters who participated in a recent biomonitoring study said they wore their SCBA gear in fires [65].

Firefighters and environmental activists alike talked about a health frame as being key in uniting the different organizations to work on pieces of legislation, a finding that aligns with past scholarship on blue-green coalitions where the health frame allowed for the development of new partnerships [51]. An environmental activist said, "you need to put a human face on it. . . . Part of the whole strategy was to change the frame from an environmental frame to a health frame." This focus on health protection aligns with both the firefighters' goal of preventing fires and illness, and environmentalists' goals of preventing chemical exposures to protect consumers. It also parallels the model of bringing groups whose health has been affected, such as breast cancer survivors turned activists, to environmental issues, as in the work of Silent Spring Institute [70].

### Safer Alternatives

State-level bans of flame retardants have not banned *all* flame retardant chemicals, nor have they (for the most part) touched flammability standards more generally. Instead, the bans have restricted the use of individual chemicals with the understanding that safer alternatives are available.

Typically, firefighters have supported the phaseout of certain chemicals only when safer alternatives are identified. As the IAFF said in a 2009 press release, “We will demand that the next generation of flame retardants be effective, environmentally friendly and safe for both citizens and firefighters.” For the firefighting community, this is obviously a trade-off that is carefully considered: when it comes to personal and professional safety, anything that decreases fire safety is seen as harmful. This is similar to another blue-green coalition between environmentalists and janitors, in that janitors do not want to sacrifice product efficacy for product safety [54].

Because of the desire to maintain fire prevention standards, combined with concerns about the efficacy of flame retardants themselves, firefighters have embraced alternatives assessment to identify safer, functional alternatives. Alternatives assessment involves identifying all possible functional substitutes for a product that is to be replaced, evaluating the hazard characteristics of possible substitutes, and using this hazard information to make informed choices about which chemical to use next. As a retired firefighter explained it, “we don’t want to exchange apples for apples.” And as another firefighter said in a public hearing, “one toxic chemical replacing another toxic chemical is not going to benefit anybody.” These comments reflect concerns over regrettable substitution, a concern when any widely used chemical is removed from a market [71]. Firefighters have actively participated in alternatives assessment processes like the Environmental Protection Agency’s Design for the Environment (DfE) program, which conducts alternatives assessments to identify safer replacements for chemicals of concern [72]. Firefighters have participated in five DfE assessments related to flame retardants since 2005.

Firefighters also emphasize that flame retardants are not the only tool used to achieve fire safety. For example, many highlight the need for more sprinklers in homes. One noted, “fires are down because of sprinklers, because of fire prevention.” He said flame retardants were “overrated” as a fire prevention tool. As an advocate for burn survivors said at a public hearing, “if there’s a way to make furniture relatively fire-safe, inherently . . . then we should do it without toxic poisonous chemicals. We should also have this legislature look towards other laws to have residential sprinkler ordinances promoted throughout the state.” Thus the fire safety community notes that flame retardants are only part of the story when it comes to improving fire safety.

Some firefighters are also aware of research from fire scientists disputing the efficacy of flame retardants in consumer products such as furniture and building

insulation [73, 74]. As one career firefighter described, “there should be a real, honest discussion about the efficacy of flame retardants. I mean, they’re showing that it doesn’t actually do any good.” Another echoed this perspective: “now you hear [questions about] whether this stuff actually works, and whether you really need these flame retardants in chairs and in other stuff, other applications, or, if there are safer alternatives.” These perspectives in particular align with recently successful efforts to revise flammability standards like California’s TB 117, which is now leading to reform in other states. As one burn advocate told us, fire safety concerns in house fires did not come from inside furniture: “I’ve never been in a fire where the fire somehow started inside the foam. It starts on the outside.” This individual argued that because the original TB117 did not offer a significant fire safety protection, the use of flame retardants was not justified:

Obviously we want anything to prevent fires and what goes so wrong with fires and sometimes that’s the horrors of being burned and we want that, we don’t want people being burned. But at what cost? I haven’t seen anything personally, that flame retardants do to prevent fires. I think they make them worse. The conditions are smokier, people can’t survive inside a room as long as they probably used to because the smoke and the heat are so bad.

This advocate for burn survivors supported the revisions to TB117 because he believed they would actually improve fire safety [75].

### **Firefighters are a Necessary Ally**

Activists and legislators give significant credit to firefighters for the success of chemicals reform. In the words of a firefighter, “there isn’t a government or legislative body that’s going to pass a ban on flame retardants unless the fire service weighs in and has some significant involvement.” From our analysis, the fire service contributed in the passage of nearly every piece of state legislation to restrict flame retardants, in ways ranging from sending a letter of support to testifying in favor of the legislation. This is similar to previous findings that alliances between labor and environment improve the odds that occupational or health regulations can be passed and implemented [51]. The firefighting community is held in high esteem by the public, and also by environmental activists, who develop strategies to reach out to the fire service.

However, this is a fragile coalition, for several reasons. First, it typically involves some but not all firefighters or professional organizations, and this has been an issue at times that pits parts of the fire service against each other. Additionally, those active in flame retardant bans tend to be union leadership or retired firefighters, not rank and file. Leaders have sometimes advised environmental activists that going to fire houses and talking to practicing firefighters would not necessarily be a good use of time and resources. Second, both firefighters and environmental health activists work on a wide variety of issues, but beyond flame retardants, it is unclear what overlap exists between their two



agendas. The potential is there, as one firefighter told us, because “I think chemicals and how they impact our membership is [an area where] we are going to continue to be part of the discussion.” But the concern is that, as another career firefighter explained, “you can get too broad and at least in our state it needs to be specific to our profession.” This firefighter talked about his organization’s concerns about cuts in pensions, limited funds for equipment, and a move away from professional full-time fire departments to part-time or volunteer-run departments. While many environmental groups will likely be sympathetic to these concerns, they may not rise to the top. As this firefighter insightfully commented, “. . . there’s only so much legislative capital out there at a time, you know?”

Finally, environmental groups recognize that this is a fragile coalition and talk a lot about how to maintain these alliances. They bend over backwards to involve the fire service, even when it means downplaying their own short-term goals, because they know the involvement of the fire service is crucial. As an example, environmental advocates and scientists who collaborated with firefighters on a biomonitoring study deferred to the firefighters’ desires not to publicize results, even though the study could have gained more public attention if the results had been broadly disseminated.

## CONCLUSION

Firefighters’ concerns about flame retardants have lent much public credence to the chemical reform activists who have been working for years on this issue. Lending their authority as the front line of protecting the public from fires, firefighters have been prominent players in a large coalition focused on state-level regulation of certain types of flame retardant chemicals.

Firefighter leaders get involved in these campaigns because of their general awareness that firefighters have high levels of cancer and other occupational illness, concerns about foul play by the chemical industry, and personal experiences that motivate them toward preventing fires and preventing illness. This coalition is facilitated through the use of health frames that align the perspectives and goals of these otherwise dissimilar groups. Firefighters have maintained that fire safety should not be sacrificed in order to achieve chemical safety, often supporting flame retardant bans only after safer alternatives are identified. Finally, we argue that firefighter support is a necessary condition for successful flame retardant restrictions.

This coalition has been successful at restricting the use of certain flame retardants, but it remains fragile. Campaigns to reduce the use of flame retardants appeal to environmentalists and the fire safety community alike, because of compatible concerns over health, toxic exposures, and industry misconduct. The potential for future scientific collaborations like the WFBC may also be strong, serving the interests of the fire service by improving the knowledge base about exposure and disease pathways, and deepening the base of environmental and

occupational health science. One firefighter said that biomonitoring research in particular could help address firefighters' "belief that we are invincible" by demonstrating, "this is what's in your blood right now. You can't deny that." Others noted that scientific research on firefighters' exposures had the potential to contribute to policy in a concrete way. Thus we suggest that continued scientific and educational collaborations among firefighters, environmental advocates, and researchers have significant potential to deepen such alliances, especially when framed primarily around health protection and the reduction of chemical exposures. Emphasizing the combination of health effects, toxic exposures, and industry misconduct that galvanized firefighter-environmentalist collaboration can offer lessons for other labor-environmental coalitions. For example, environmental health activists, scientists, and automotive plastic workers have come together to address high rates of breast cancer that are potentially associated with occupational exposures [76]. This alliance is strengthened by a clear commitment from the environmental health colleagues to engage the union in designing a research study, jointly authoring research articles, and publicizing the results to diverse audiences. Going forward, these health-oriented blue-green alliances should also be the subject of ongoing social science observation and analysis.

The issue of flame retardants has not appealed to all parts of the fire service equally, with union leadership and retirees taking the most active roles. This demonstrates that identifiable occupational groups are not monolithic. Future studies of similar blue-green alliances should be attentive to whether elite involvement represents the occupation as a whole, and how compelling different health, environmental, and policy frames are to different sectors of an occupational group. Moreover, both environmental health and fire service advocates face an ever-growing list of needs, ranging from broad regulatory reform to shrinking public budgets and pensions. It remains to be seen whether this coalition can extend beyond the issue of flame retardants to other topics of mutual interest.

What does this suggest about the future of this blue-green alliance? In the short term, this alliance is expected to continue, as environmental activists move from banning PBDEs to other toxic flame retardants. The environmental community aims to bolster this relationship by supporting the fire service more broadly, as the fire service faces budget cuts and is attacked for its pensions. More generally, some are optimistic about alliances between firefighters and environmentalists. One firefighter suggested that the groups could continue to collaborate on issues related to "the public we serve" and "the health and safety of our membership." Another retired firefighter was more specific about his hopes for a strengthened collaboration between environmentalists and firefighters, remarking "How un-green is a fire? . . . At the end of the day if you go to all this effort to recycle on site and reuse materials and all this stuff, if the building burns and then, have you seen all the smoke and all the crap that

goes up into the sky? It's the most disgusting thing you could ever imagine. And so I think fires are very un-green." This suggests that perhaps the environmental community could support fire prevention more broadly, because fires destroy goods which have to be replaced and are incredibly polluting. The connections between the green building community and environmental advocates are an additional understudied blue-green alliance. In the health care sector, the nonprofit organization Health Care Without Harm works extensively with hospital unions to create safer workplaces, including concerted efforts to reduce chemical exposures in hospitals through changes in product purchasing decisions. For example, Kaiser Permanente, the largest U.S. nonprofit health management organization, which owns 32 hospitals in three states, announced on June 3, 2014 that it will stop buying furniture treated with flame retardants [77].

However, the ability of this coalition to endure may depend on whether all parties share an interest in the same concrete issue. For example, environmentalists may not be excited about requiring home sprinkler systems, a top priority for firefighters. In the case of flame retardants, the coalition was driven and cultivated by the environmental community, but in future work on fire safety more generally, firefighters would have to be the main drivers, with environmentalists playing a supportive role. Environmentalists also cultivate other blue-green alliances with different labor groups, including the health care community, transportation workers' unions, day care workers, and those in the aviation industry—all these groups may have higher than normal exposure to flame retardants because their work spaces (hospitals, buses, and airplanes) are governed by strict flammability standards. Thus future work on blue-green alliances could identify similarities and differences across these multiple labor groups.

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