

Switch



December 6, 2019



Overview

- **Some definitions and current products used**
 - Fire classes
 - Foams versus Gels
 - Retardants
 - PFAS problem
- **Our Product as a Fire Suppressant**
 - Product Development and Refinement
 - Existing Certifications
- **Impacts on the environment and GHG emissions**
 - Municipal fires – environmental impacts
 - Forest fires – environmental impacts
 - Forest fires – GHG impacts
- **Conclusions**

A black and white photograph of a firefighter in full protective gear, including a helmet and a jacket with 'AUCON PROTECTION' visible on the sleeve. The firefighter is holding a hose and spraying water, with steam or smoke in the background.

Some Terminology

- **Classes of Fires**
 - Class A – ordinary combustibles, e.g. standard house fire
 - Class B – flammable liquids (gasoline, diesel, aviation fuel...)
 - Class C – electrical fires
 - Class K – kitchen fires

A black and white photograph of a firefighter in full protective gear, including a helmet and a jacket with 'AQUON PROTECTION' visible on the sleeve. The firefighter is positioned in front of a fire, with smoke or steam visible in the background.

Some Definitions:

Suppressant: Chemical used directly on an active fire

Water:

- When it converts into steam, has a great capacity to absorb and carry away heat. It also has a strong surface tension that causes it to bead up and roll on most fuels before it can absorb its full heat capacity.

USE: Direct Attack



Some Definitions:

Suppressant: Chemical used directly on an active fire

Foams:

- Combinations of wetting and foaming agents added to water to stretch out the water droplet into bubbles.
- The bubbles help cool and smother fires, and increase the heat absorbing surface.
- Foams on flammable liquids have limited duration and must be re-applied periodically.

> 99% water

1% = surfactants (wetting agents), foaming agents, corrosion inhibitors, dispersants

USE: Direct Attack



Some Definitions:

Suppressant: Chemical used directly on an active fire

Gels: (aka Water Enhancers)

- Water enhancers are products added to water to improve one or more of the physical properties of water.
- Gels are currently made from super absorbent polymers and surfactant.
- Water is held in gel by a three-dimensional network of cross-linked polymers designed to absorb many times their weight of water.
- The gel absorbs heat and sticks to most every surface that would need fire protection including vertical surfaces and structures.

95% - 99.5% = Water

0.5% - 5% Gel components

USE: Direct Attack & Structure Protection

IMPORTANT NOTE: FOAMS and GELS are not retardants



Some Definitions:

Retardant: Chemicals put in place to prevent fire from starting

- Long term retardants contain fertilizer salts that change the way fuel burns.
- Retardant reacts to heat causing a different chemical reaction in fuel other than normal combustible gases and tars.
- This reaction is independent of the water content of the retardant, so they are still effective after the water has evaporated.
- Long-term retardant will remain effective as long as the salts cling to the grass or woody material.
- 85% water
- 10% fertilizer
- 5% minor ingredients: Colorant (iron oxide, or fugitive) thickener (natural gum or clay), corrosion inhibitors, stabilizers, bactericides.

USE: Direct or Indirect Attack



The PFAS Problem

PFAS – per- and polyfluoroalkyl substances

Firefighting foams had relied on PFOS and PFOA (specific PFAS compounds) as active ingredients for decades.

- largely phased out of use in most industries, under a 2006 voluntary agreement brokered by the EPA.

PFOS and PFOA have been shown to be associated with high cholesterol, increased liver enzymes, decreased vaccination response, thyroid disorders, pregnancy induced hypertension and preeclampsia, and cancer.*

EPA Health Advisory level is **70 ppt**.

*<https://iaspub.epa.gov/tdb/pages/contaminant/contaminantOverview.do?contaminantId=11020>



The PFAS Problem

PFAS – per- and polyfluoroalkyl substances

The wide use of chemical fire foams containing fluorinated compounds have contaminated aquifers and wells, leading to extraordinary remediation costs.

The drinking water of about 16 million Americans **is contaminated**, including 126 military bases, where PFAS-rich firefighting foam is used for training exercises.

As a result of major litigation and punitive awards the fire protection industry is demanding alternatives and are wary of the next PFOS/PFOA additives.

PFAS – The level of Contamination

- The Current EPA Limit is **70ppt** in drinking water

Highest Levels of PFAS Contamination in Groundwater at U.S. Military Installations

Facility	State	Maximum Detection of PFAS (parts per trillion)	Type of PFAS In Maximum Detection	Other PFAS Detected	Latest Test
England Air Force Base	Louisiana	20,700,000	PFHxS	PFOS PFOA PFBS PFHpA PFNA	2016
Naval Air Weapons Station China Lake	California	8,000,000	PFOS+PFOA		2017
Patrick Air Force Base	Florida	4,338,000	PFOS+PFOA	PFBS	2017
Myrtle Beach Air Force Base	South Carolina	2,640,000	PFOS+PFOA	PFHxS PFHpA PFBS PFNA	2019
Langley Air Force Base	Virginia	2,225,000	PFOS+PFOA	PFBS	2018
Naval Air Station Jacksonville	Florida	1,397,120	PFOS+PFOA		2018
Niagara Falls Air Reserve Station	New York	1,310,000	PFOS+PFOA	PFBS	2018
Grand Prairie Armed Forces Reserve Complex	Texas	1,247,000	PFOS+PFOA		2018
Altus Air Force Base	Oklahoma	1,150,000	PFOS+PFOA	PFHxS 6:2 FTS PFHxA PFBS 8:2 FTS PFDA PFTrDA PFNA PFDoA DFI In A	2017

The fallout from PFAS use

News

Tyco and 3M Ask for MDL Treatment in Dozens of Firefighting Foam Lawsuits

The lawsuits come on the heels of a \$670.7 million settlement with DuPont and Chemours Co. last year involving an MDL over a related chemical that has been linked to cancer and hypertension in pregnant women and other illnesses.

By Amanda Bronstad | October 02, 2018 at 02:50 PM

NEWS / REGION/STATE

NY suing firefighting foam companies for \$38M

The state alleges that harmful chemicals in the foams have been detected at several sites, including Gabreski Air National Guard Base.

BUSINESS

NY files 2nd lawsuit over firefighting foam; could be combined with Westfield water contamination litigation

Posted Feb 27, 2019

Fire College Employees Sue AFFF Manufacturers For \$35 Million

Posted by: Curt Varone | December 25, 2018 | 0 Comments

Your Military

DoD: At least 126 bases report water contaminants linked to cancer, birth defects

By: Tara Copp

The Pentagon does know it can't afford to clean everything up right now. The foam cleanup adds \$2 billion to the more than \$27 billion in environmental cleanup the

adds \$2 billion to the more than \$27 billion in environmental cleanup

and-stack the foam cleanup based on risk to the populace compared to its other environmental responsibilities, Sullivan previously told Military Times.

EXCLUSIVE POLITICS FEDERAL HEALTH

NSW Environment Minister calls on PM to ban toxic firefighting foam

Mississippi Mills residents sue NRC for \$40M over water contamination

TOM SPEARS, OTTAWA CITIZEN Updated: December 6, 2016

FireRein Eco-Gel™

Eco-Gel™ Advantages

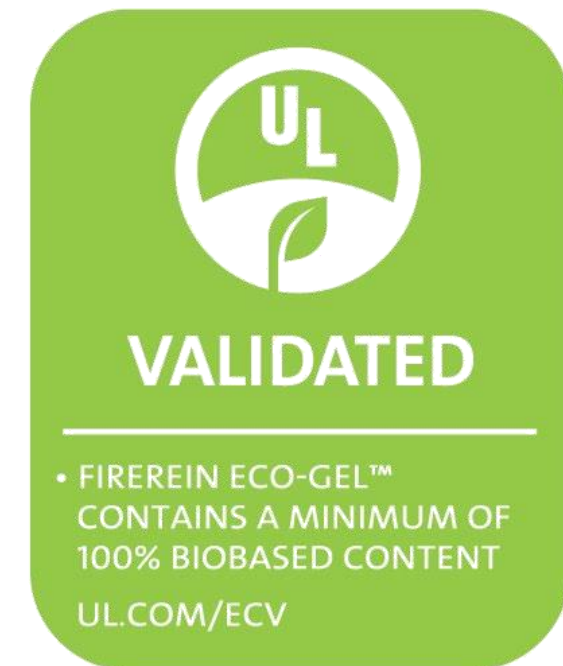
A Gel Fire Suppressant

Eco-Gel™ is a patented water additive that when added to water makes a highly effective **firefighting hydrogel**.

Eco-Gel™ **overcomes the performance and environmental limitations of all foams and other hydrogels!**

Environmental Leadership

Eco-Gel™ is the **only firefighting water additive certified by UL and the US Department of Agriculture (USDA) to be 100% bio-based**. Additionally, Eco-Gel™'s performance means **less water is used**.



FireRein Eco-Gel™

Eco-Gel™ Advantages (continued)

Eco-Gel™ sticks and stays where applied

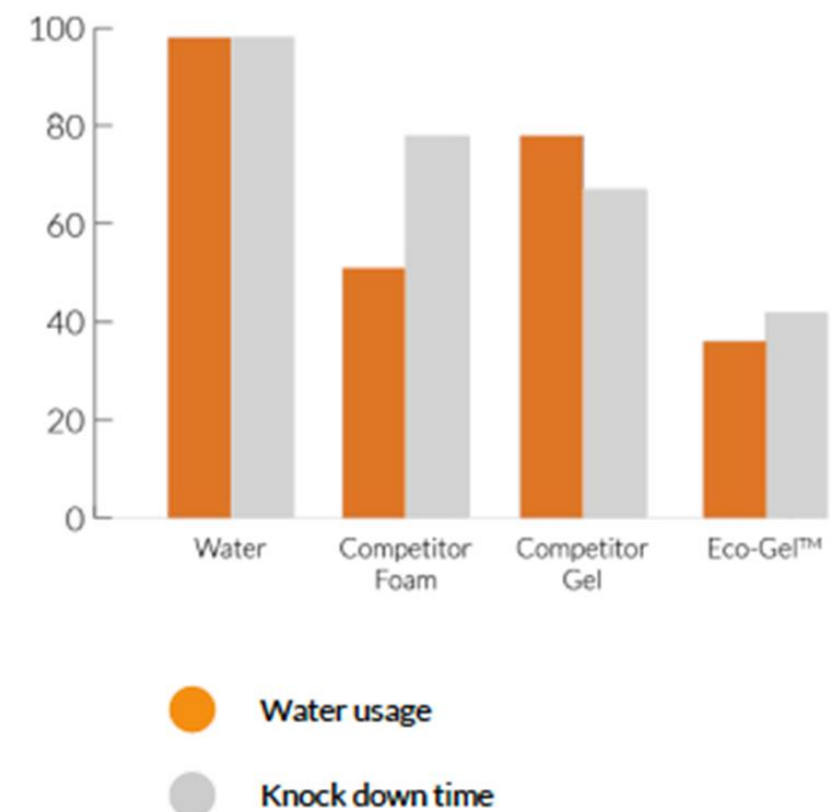
Eco-Gel™ controls the spread of the toxins that are burning in the fire. It contains them to the area sprayed allowing for easier/complete clean up by environmental clean up services. The chemicals are not running off and leaching into the environment. Spill containment would be required to accomplish this with foam.

Faster knock down

Eco-Gel™ addresses two sides of the fire triangle (heat and oxygen). It smothers AND cools the fire.

Third-Party Efficacy Testing to NFPA Standards
April 2015

St Lawrence College, Kingston, Ontario



Environmental Commitments

Eco-Gel™ versus competitors

Daphnia magna – aquatic hazard assessment evaluation



Fire Suppression Gel	Acute LC50 (%)	Farm pool (15 cm)	Farm ditch (30 cm)	Farm pond- Europe (100 cm)	Farm pond- N. America (200 cm)
Eco-Gel®	0.59	0.17	0.09	0.03	0.01
Competitor A	0.097	1.24*	0.62	0.19	0.09
Competitor B	0.0034	5.89*	2.94*	0.88	0.44
Competitor C	0.00172	4.65*	2.33*	0.70	0.35
Competitor D	0.00159	25.16*	12.58*	3.77*	1.89*
Competitor E	0.000063	952.38*	476.19*	142.86*	71.43*

Gel Foam

Independent study performed at University of Guelph

A black and white photograph of a firefighter in full protective gear, including a helmet and a jacket with 'AUCON PROTECTION' visible on the sleeve. The firefighter is holding a hose and spraying water, with steam or smoke in the background.

Application areas

- **Municipal Fires versus Wildland Fires**
 - Jurisdictional separation
 - Municipal priorities
 - Pumper trucks and portable units (Eductors)
 - Wild Land Fires
 - Areal drops versus on the ground

FireRein Eco-Gel™

Eco-Gel™ Performance – Class A Structure Fire



Link: <https://www.youtube.com/watch?v=gbPBBbuPNoc>

Municipal Fires



December 2019

FireRein

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Fire Fighting in the Forest Sector

Most Commonly used Fire Retardant product

- Red Retardant
 - A mixture of Ammonium Phosphate (fertilizer) and Iron Oxide clay
 - Reviews confirm that exposure to this product under certain conditions is **toxic to aquatic species**
 - Laws have been passed **prohibiting fire retardant drops within 100 metres of any waterway**



Meanwhile: In California

INSURANCE · Published 3 days ago

Insurers drop fire coverage for 350,000 California residents

By Kyle Beck | FOXBusiness



Markets

Quote Lookup

Insurance has become a serious problem in California as wildfires -- past and present -- wreak havoc on the state.

After last year's devastating wildfires, insurance companies are balking at fire coverage policy renewals for more than 350,000 residents in high-risk areas.

"We are seeing an increasing trend across California where people at risk of wildfires are being non-renewed by their insurer," state Insurance Commissioner Ricardo Lara said in a statement.

Blanketing California in Fire Retardant Is Potentially Very Harmful



Renee Lewis

12/11/17 11:41AM · Filed to: WEIRD THINGS FALLING FROM THE SKY

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Ocean water turns pink near Malibu amid efforts to battle wildfires



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The ocean water in Malibu looked pink on Monday afternoon amid efforts to battle wildfires.

Indonesia, Chile, Lebanon...

Indonesian forest fires putting 10 million children at risk, says Unicef

Millions aged under five are particularly at risk from the slash and burn fires due to undeveloped immune systems



▲ Fire fighters try to extinguish fire at a peatland in Kampar, Riau province, Indonesia. Smoke haze is putting 10 million children at risk, says Unicef. Photograph: Antara Foto/Reuters



The fires scorched trees in various areas in the mountains overlooking Beirut. WAEL HAMZE/VEPA

Wildfires destroy 41,200 hectares of forest land in Chile

Source: Xinhua | 2019-02-12 12:44:54 | Editor: Yang Yi



SANTIAGO, Feb. 11 (Xinhua) -- Wildfires have destroyed 41,200 hectares of forest land in southern and central Chile, the country's National Forestry Corporation (CONAF) said on Monday.

The figure represents an increase of 45 percent from last year in the area of forest land razed in the fire season, it said, adding it estimated a total loss of 70,000 hectares this season.

Singapore

Indonesia forest fires have 'major impact' on climate, 360m tonnes of CO2 released since August: Masagos

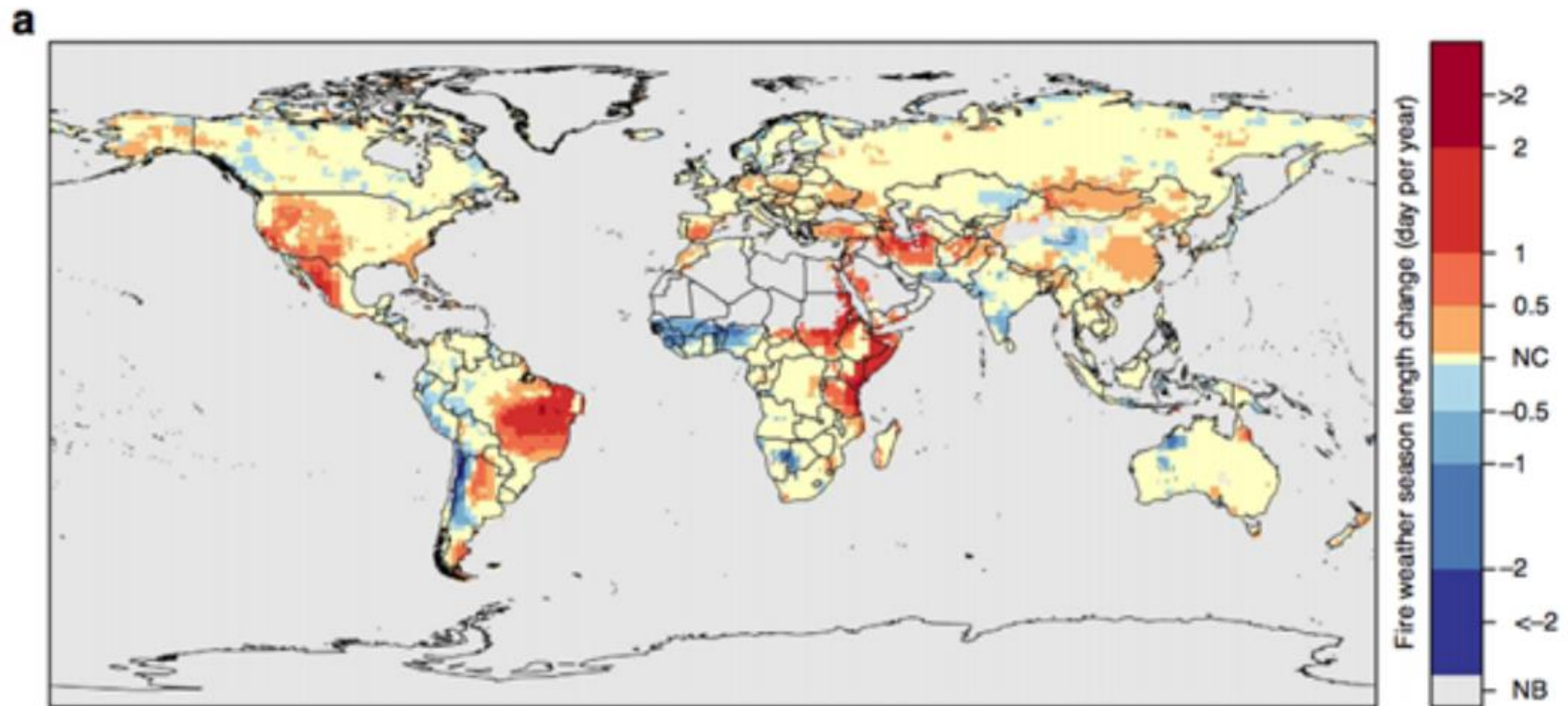


An Indonesian firefighter takes a rest after battling a forest fire in Kampar, Riau on Sep 9, 2019. (File photo: AFP/Wahyudi)

SINGAPORE: Forest and land fires burning in Indonesia have released 360 million tonnes of carbon dioxide since August, said Singapore's Minister for the Environment and Water Resources Masagos Zulkifli on Thursday (Sep 26).

Wildland fires – Current Trends

Global patterns of fire weather season length changes from 1979 to 2013



Increase in days

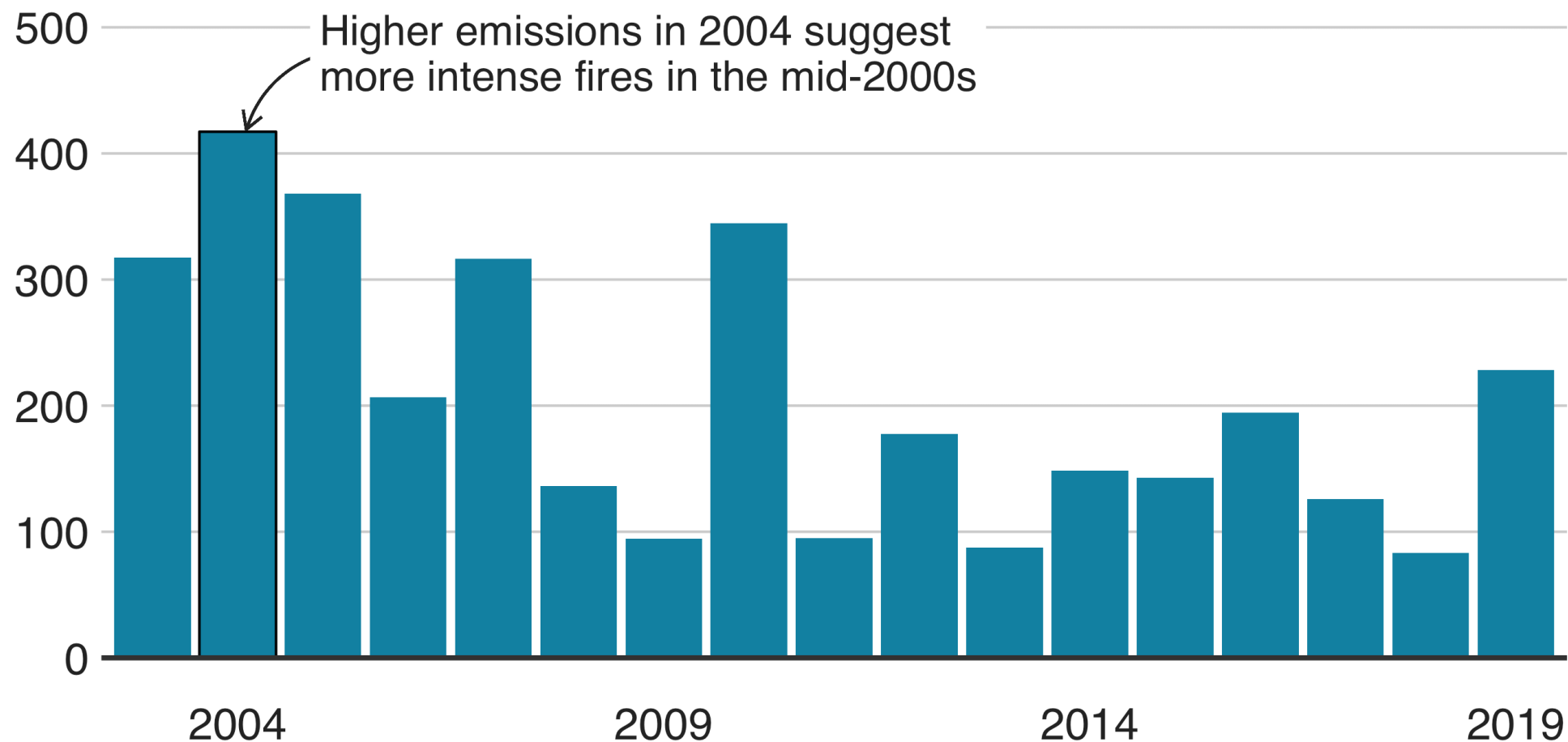
<https://www.carbonbrief.org/global-risk-of-wildfires-on-the-rise-as-the-climate-warms-study-says>

International Impacts of Forest Fires

Amazon Forest Fire and Deforestation GHG Impacts

Brazil experienced more intense fires in the previous decade

Megatonnes of CO₂ equivalent emissions, 1 January - 21 August

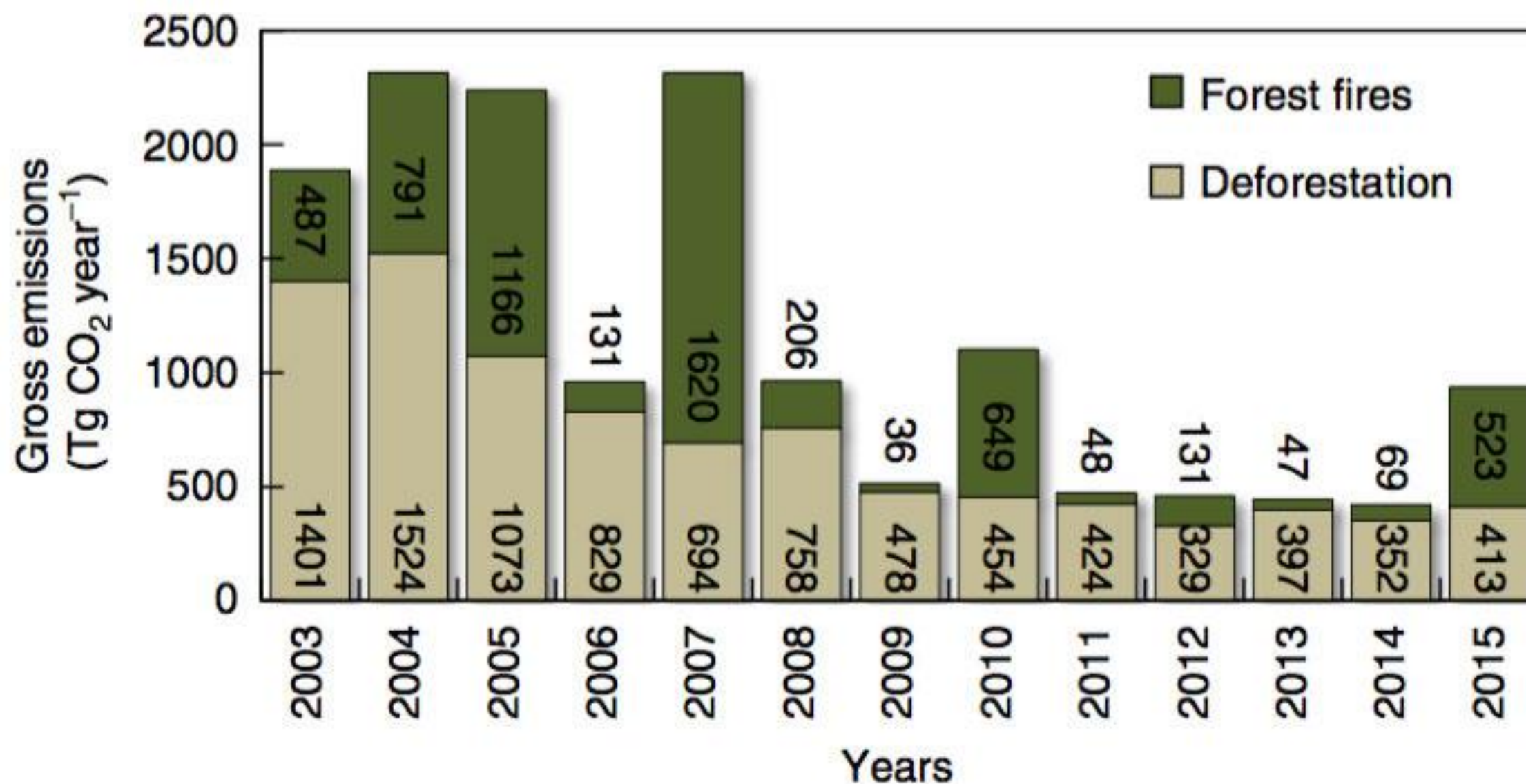


Source: Copernicus Atmosphere Monitoring Service

BBC

International Impacts of Forest Fires

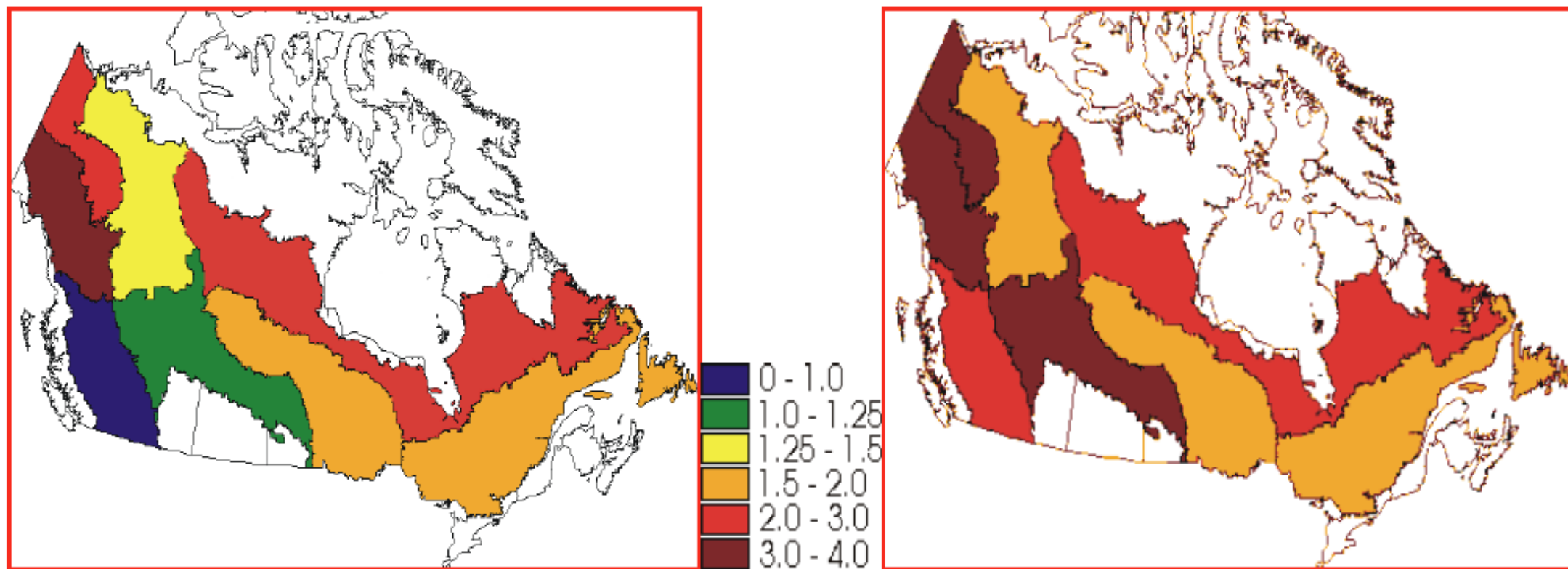
Amazon Forest Fire and Deforestation GHG Impacts



<https://www.carbonbrief.org/carbon-emissions-from-amazon-wildfires-could-counteract-deforestation>

Wildland fires – Trends in Canada

**Two scenarios for increased wildfire intensity (area burned)
with a 3X increase in CO₂ levels**

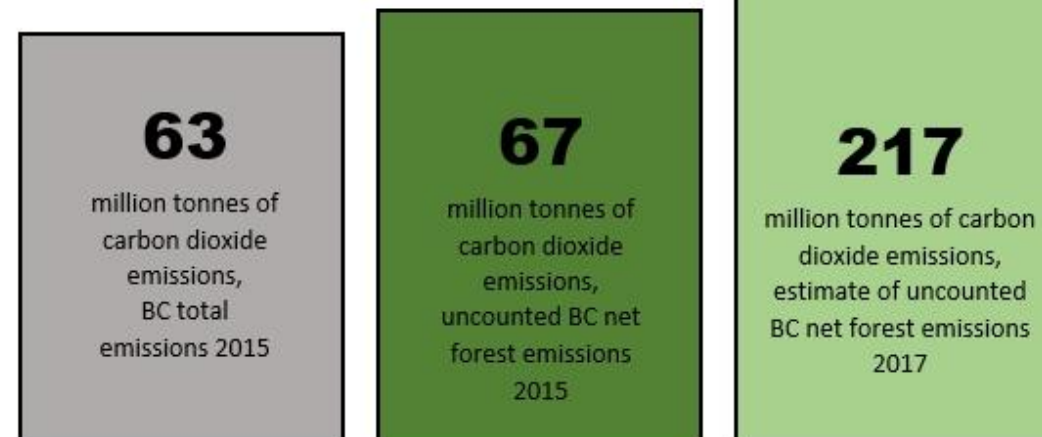


Evaluating Past, Current and Future Forest Fire Load Trends in Canada, 2013

Wildland fires – Impacts on GHG emissions

On the left, BC's total emissions in 2015, without uncounted forest emissions (*as reported by the BC government 2017*).
Centre: BC's uncounted forest emissions 2015 (*as reported by the BC government 2017*).
Right: Sierra Club BC projection of 2017 uncounted forest emissions, using federal estimate of BC's 2017 wildfire emissions, combined with BC forest emissions data that were relatively stable in previous years (non-wildfire forest emissions). Chart by Jens Wieting

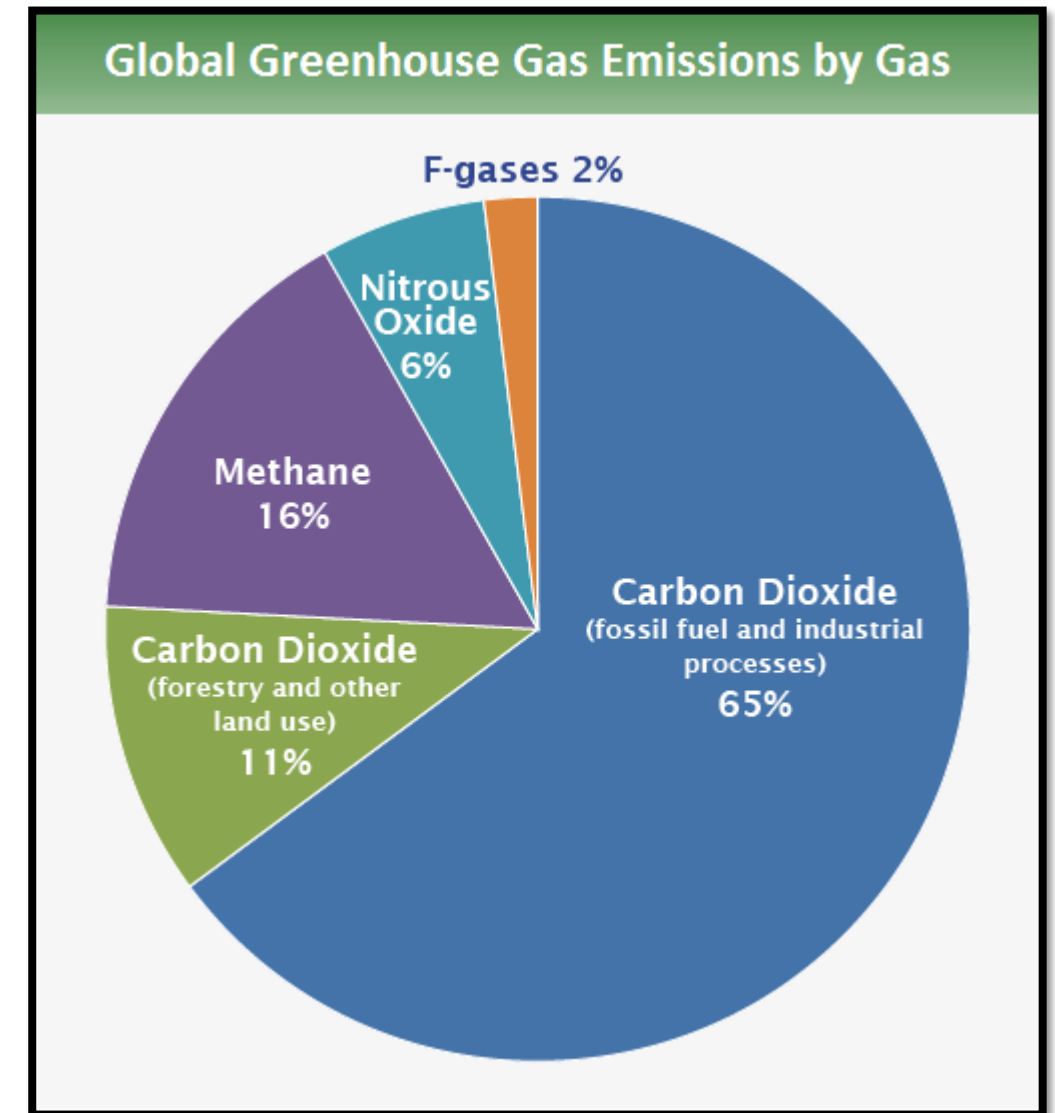
<https://www.nationalobserver.com/2018/11/30/opinion/bc-must-stop-ignoring-surging-forest-carbon-emissions>



California: GHGs from Wildland fires versus fossil fuel consumption

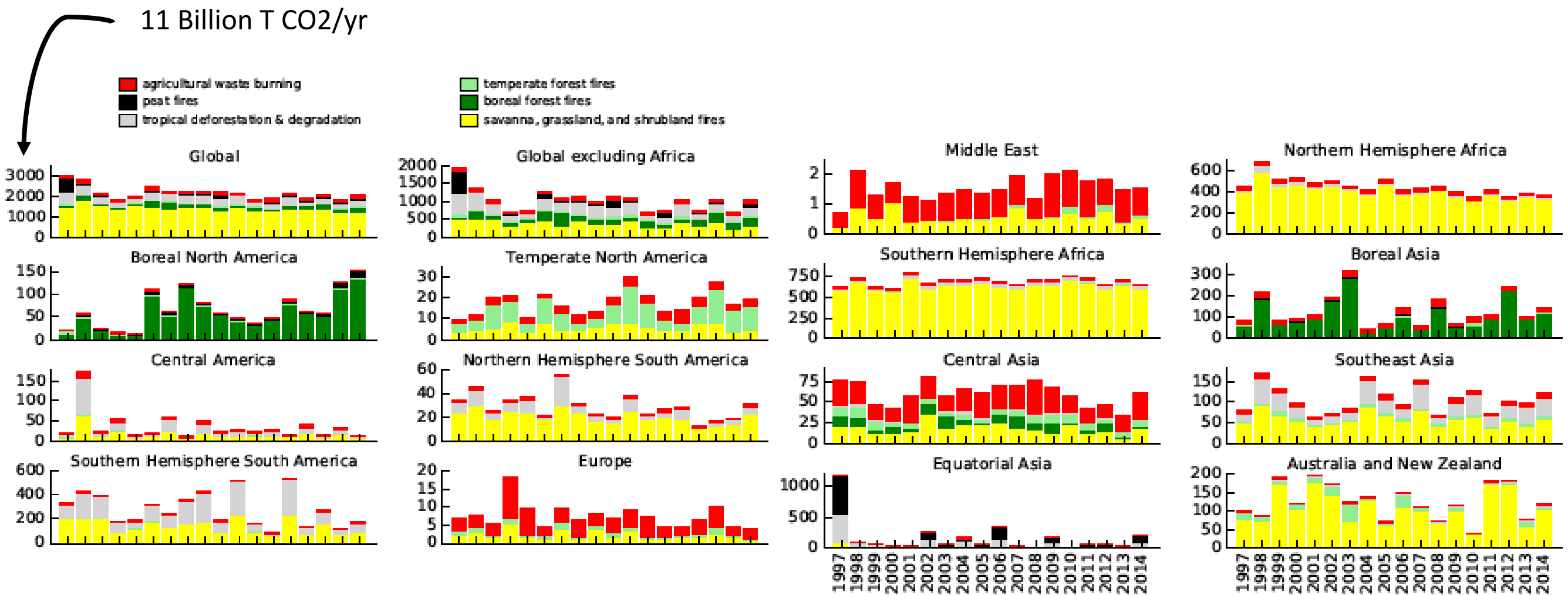
In the **past 15** years in California:

- forest fires released **250 million** tons of carbon
- Compare this to **4.8 billion** tons released by burning fossil fuels
- **Mini-conclusion**
 - Forest fire management is important, but the primary driver should not be for GHG reductions
 - Forest fire impact is context dependant (human, economic, environmental)



<https://www.spokesman.com/stories/2019/jun/07/forest-fires-release-less-co2-than-previously-thou/>
<https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

Historical Wild Fire Emissions

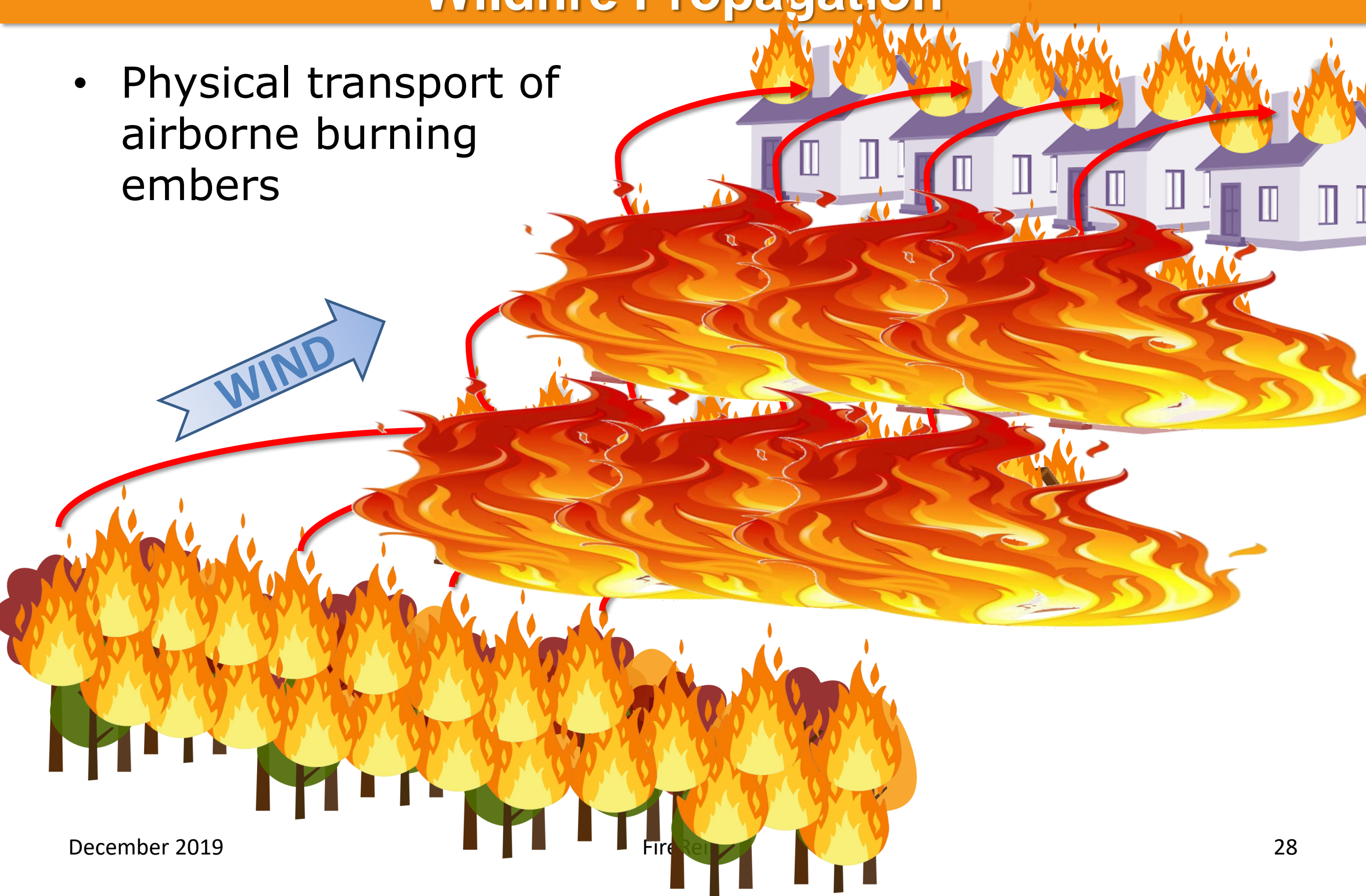


Scale: Tg carbon/yr = 0.0037 Billion Tonnes CO₂/yr

<http://www.globalfiredata.org/>

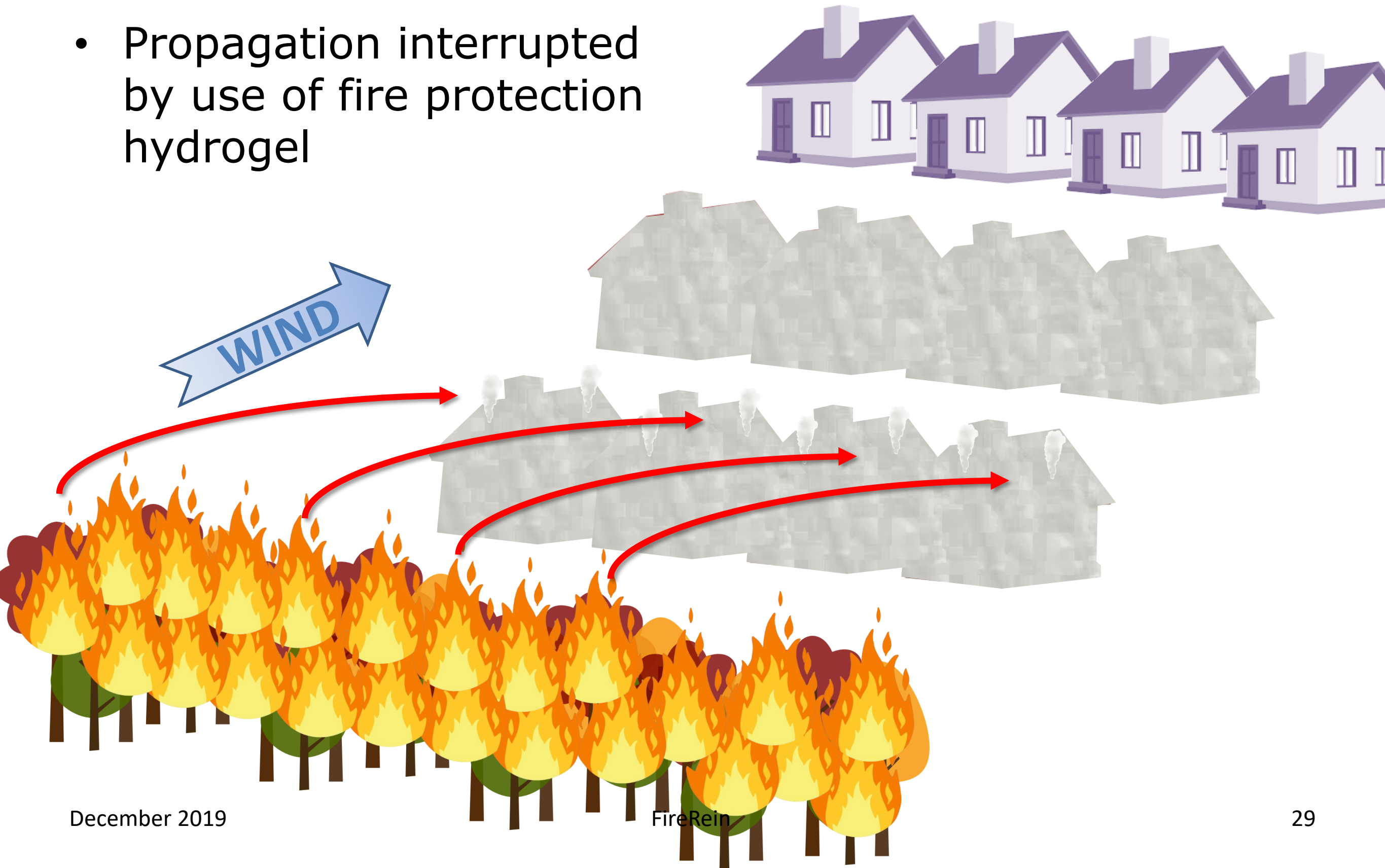
Wildfire Propagation

- Physical transport of airborne burning embers

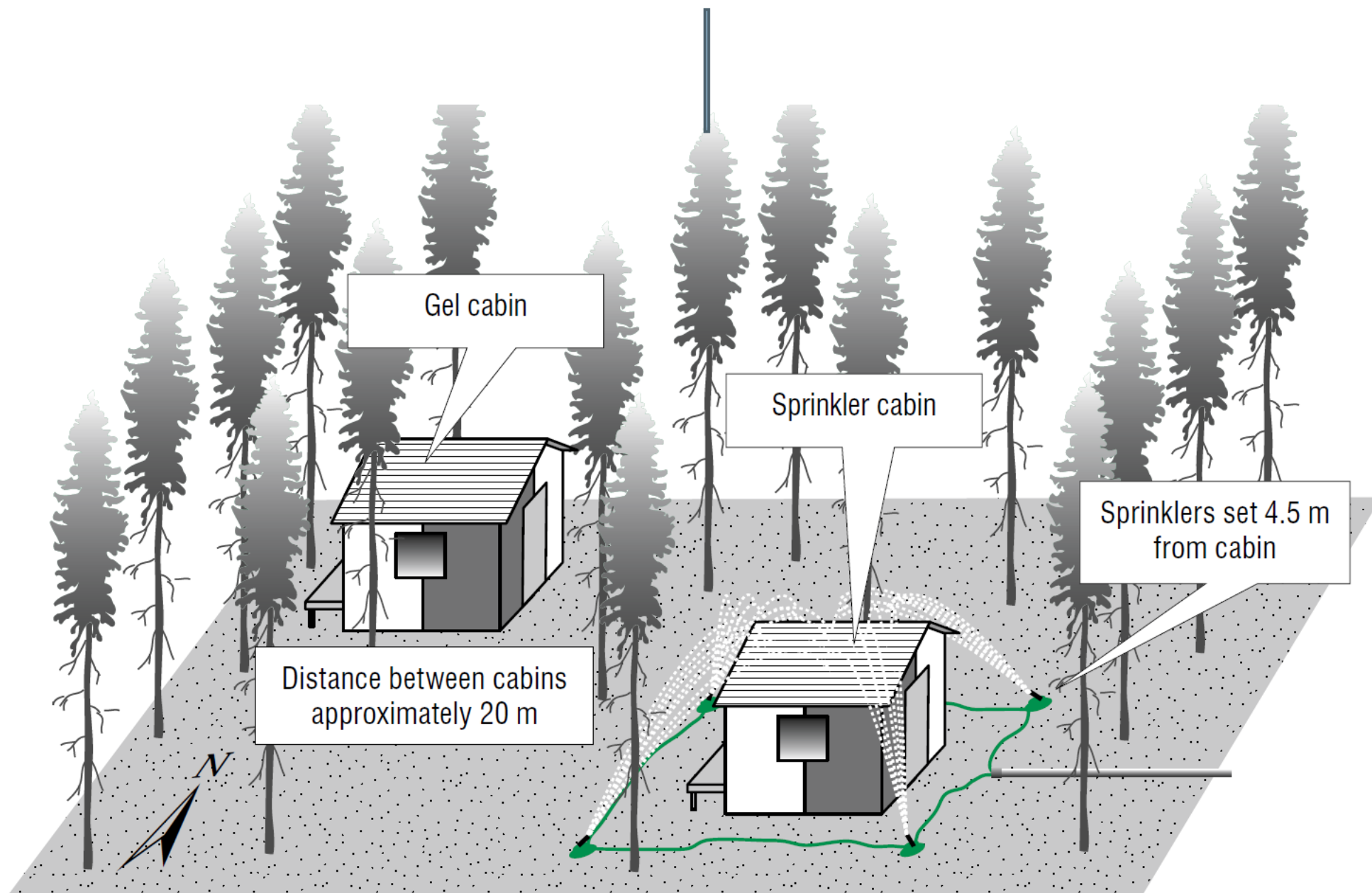


Wildfire Propagation

- Propagation interrupted by use of fire protection hydrogel



Gel testing in wild fire structure protection



FPInnovations: Use of sprinklers and aqueous gel for structure protection from wildfire – case study 2, 2009

Gel testing in wild fire structure protection

Table 3. Structure damage from wildfire passage

Feature	Sprinkler cabin	Gel cabin
Roofing	Undamaged	Undamaged
Siding	Vinyl slightly melted on N and E sides	Vinyl moderately melted on N, S, and W sides and slightly melted on E side Cedar scorched N and W sides
Windows	Undamaged	Outside panes cracked on both N and S sides
Door	Undamaged	Undamaged
Soffit/fascia	Undamaged	Undamaged
Deck	Undamaged	Undamaged

Water use

1465 litres

196 litres

Practicality

Installed

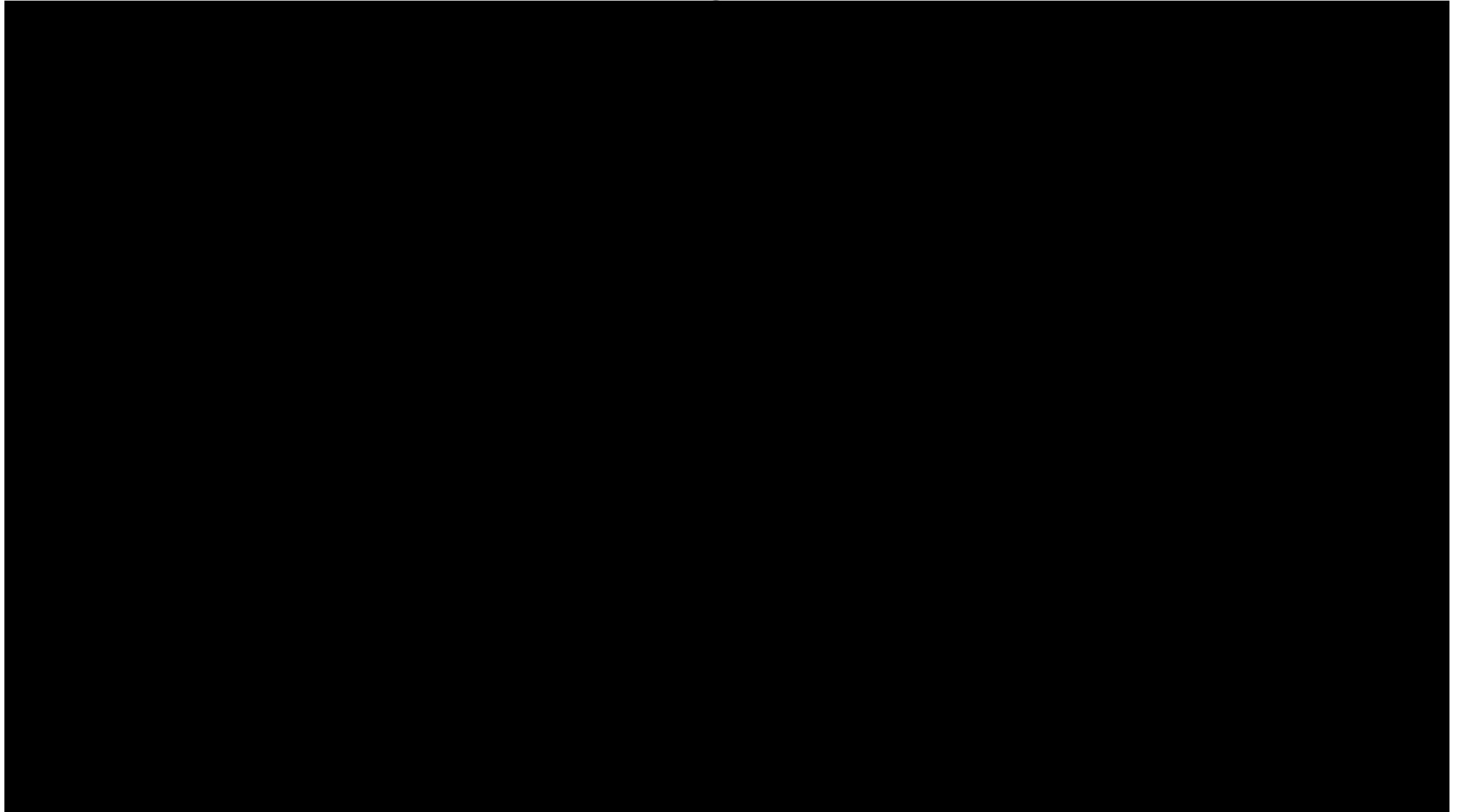
Applied

FPIInnovations: Use of sprinklers and aqueous gel for structure protection from wildfire – case study 2, 2009



FireRein Eco-Gel™

Eco-Gel™ Performance – Exposure Protection



Link: <https://www.youtube.com/watch?v=2oCcsssarEA&t=2s>



Conclusions

- Increasing forest loss to wildfire will contribute to GHG impact, but is minor compared to fossil fuel use.
- Current fire suppressants and retardants create additional concerns regarding toxicity, water contamination and bioaccumulation.
- Fire Suppression Hydrogels represent the future of the fire protection industry.
- FireRein Eco-Gel™ is a 100% bio-based alternative which will efficiently suppress fires with a completely environmentally benign formulation.

A close-up, black and white photograph of a firefighter's arm wearing protective gear, including a sleeve with 'AUVON PROTECTION' branding and a wristwatch.

Questions



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