IL PROGETTO “QUADERNI CODICE”

Una sinergia fra Corpo Nazionale VV.F., INAIL, Sapienza e CNI per la diffusione della sicurezza antincendio

8 luglio 2021 - Istituto Superiore Antincendi

La Direzione Centrale per la Prevenzione e la Sicurezza Tecnica e il progetto Quaderni Codice

Stefano Marsella - Direttore Centrale DCPST

COMPARTIMENTAZIONE ANTINCENDIO

INAIL

Focus sulla misura S.3 del Codice di prevenzione incendi

- COMPARTIMENTAZIONE

2020

COLLANA RICERCHE

PROGETTAZIONE DELLA MISURA ESODO

INAIL

Focus sulla misura S.4 del Codice di prevenzione incendi

- ESODO

2020

COLLANA RICERCHE

GESTIONE DELLA SICUREZZA E OPERATIVITÀ ANTINCENDIO

INAIL

Focus sulle misure S.5 e S.9 del Codice di prevenzione incendi

- GESTIONE DELLA SICUREZZA ANTINCENDIO
- OPERATIVITÀ ANTINCENDIO

2020

COLLANA RICERCHE

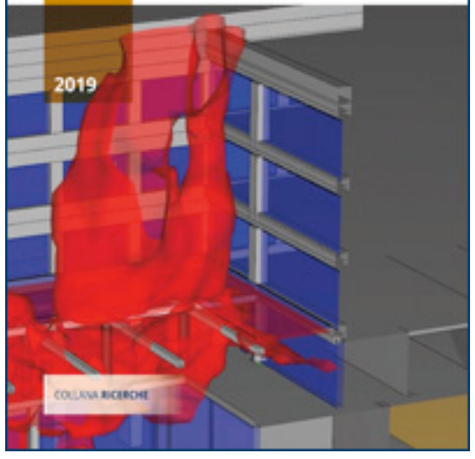
METODI PER L'INGEGNERIA DELLA SICUREZZA ANTINCENDIO

INAIL

Focus sui Metodi del Codice di prevenzione incendi

- M.1 Metodologia per l'ingegneria della sicurezza antincendio
- M.2 Scenari d'incendio per la progettazione prestazionale
- M.3 Salvaguardia della vita con la progettazione prestazionale

2019



COLLANA RICERCHE

LA PROTEZIONE ATTIVA ANTINCENDIO

INAIL

Focus sulle misure S.6, S.7 e S.8 del Codice di prevenzione incendi

- CONTROLLO DELL'INCENDIO
- RIVELAZIONE ED ALLARME
- CONTROLLO DI FUMI E CALORE

2019

COLLANA RICERCHE

LA RESISTENZA AL FUOCO DEGLI ELEMENTI STRUTTURALI

INAIL

Focus sulla misura S.2 del Codice di prevenzione incendi

- RESISTENZA AL FUOCO

2019

COLLANA RICERCHE

IL CODICE DI PREVENZIONE INCENDI

INAIL

La progettazione antincendio Applicazioni pratiche nell'ambito del d.m. 3 agosto 2015 e s.m.i.

2018

COLLANA RICERCHE

REAZIONE AL FUOCO

INAIL

Focus sulla misura S.1 del Codice di prevenzione incendi

- REAZIONE AL FUOCO

2021

COLLANA RICERCHE

RISCHIO INCENDIO ED ESPLOSIONE IN AGRICOLTURA

INAIL

Prevenzione e procedure di emergenza

2020

COLLANA RICERCHE

RISCHIO INCENDIO ED ESPLOSIONE IN EDILIZIA

INAIL

Prevenzione e procedure di emergenza

2020

COLLANA RICERCHE

il PNRR e gli investimenti nell’efficientamento energetico degli edifici

- adeguare la vigilanza sul mercato dei prodotti da costruzione, degli estintori e di altri prodotti

uno studio recente della Fire Protection Research Foundation della NFPA individua almeno 100 prodotti, sistemi e caratteristiche che riguardano gli attributi degli edifici verdi

Fire incident (Name and Year)	Description	Reference
Exterior Wall Systems		
Las Vegas (MGM Monte Carlo Hotel), USA, 2008	Object: Exterior wall systems Source: Welding on catwalk on the roof parapet ‘Green’ element (burned): Exterior wall and cladding systems	Beitel and Evans (2011)
Dubai (Tamweel Tower), 2012	Object: Exterior wall systems Source: Unstated – started on top floors ‘Green’ element (burned): Exterior wall and cladding systems	Shabandri and Agarib (2012)
Sharjah's Al Nahda area, Dubai (Al Tayer Tower), 2012	Object: Exterior wall systems Source: Unstated – started on ground floor ‘Green’ element (burned): Exterior wall and cladding systems	Kakande (2012)
Roubaix (Mermoz Tower), France, 2012	Object: Exterior wall systems Source: Balcony fire ‘Green’ element (burned): Exterior wall and cladding systems	Youde (2017)
Istanbul (Polat Tower), Turkey, 2012	Object: Exterior wall systems Source: Unstated ‘Green’ element (burned): Exterior wall and cladding systems	BBC (2012)
Chechnya (Grozny-City Towers), 2013	Object: Exterior wall systems Source: Reported as short cricuit ‘Green’ element (burned): Exterior wall and cladding systems	Taylor (2013)
Melbourne (Lacrosse Building), Australia, 2014	Object: E Source: B ‘Green’ el systems	

Fire incident (Name and Year)	Description	Reference
Dubai (Address Downtown Hotel), UAE, 2015	Object: Exterior wall systems Source: Short-circuit in spotlight between 14th and 15th floor ‘Green’ element (burned): Exterior wall and cladding systems	Moukhallati (2016)
Dubai (Torch Tower), UAE, 2015/2017	Object: Exterior wall systems Source: unknown, start 50th floor ‘Green’ element (burned): Exterior wall and cladding systems	Greenberg (2015)
Baku, Azerbaijan, 2015	Object: Exterior wall systems Source: Unstated ‘Green’ element (burned): Exterior wall and cladding systems	Nazarli (2015)
Various	Object: Exterior wall systems Source: Various – report contains statistics and case studies of several events ‘Green’ element (burned): Exterior wall and cladding systems	White and Delichatsios (2014) Evans (2016) Spearpoint et al. (2019)
London, UK, 2017	Object: Grenfell Tower Source: Combined refridgerator/freezer unit on 4th floor ‘Green’ element (burned): Exterior wall and cladding systems	GOV.UK (2019) McKenna et al. (2019)
England, 2019	‘Green’ element (burned): Exterior wall and cladding systems	
Sharjah (Abbco Tower), UAE, 2020	Object: Exterior wall systems Source: Unstated ‘Green’ element (burned): Exterior wall and cladding systems	BBC (2020)

Fire incident (Name and Year)	Description	Reference
Energy Storage Systems		
Hawaii, USA, 2012	Object: Battery Storage System Source: Battery Storage System, 10-megawatt battery system, Kahuku wind farm ‘Green’ element (burned): Battery Storage System	Irfan (2015) Blum and Long Jr (2016)
Michigan, USA, 2012	Object: Battery System Source: General Motors Battery Laboratory ‘Green’ element (burned): Battery System	Hill et al. (2017)
USA, 2013	Object: EV Battery System Source: Cited – several Tesla vehicles ‘Green’ element (burned): EVs / EV Battery System	Bullis (2013)
Brisbane, Australia, 2018	Object: Solar Home Battery System Source: ‘Green’ element (burned): Battery System	Crockford (2018)
South Korea, 2018	Object: Battery Storage System Source: Battery Storage System ‘Green’ element (burned): Battery Storage System “At least 21 fires had already occurred at battery projects in South Korea, according to BloombergNEF” (Bloomberg) “in nearly every case the issue appears to have been poor management of batteries” (Energy Storage News)	Eckhouse and Chediak (2019) Colthorpe (2019)
Arizona, USA, 2019	Object: Battery Storage System : System d): Battery Storage System	Eckhouse and Chediak (2019) Blum and Long Jr (2016) McKinnon et al. (2020)
Electric Vehicle Battery Fires		
Various	Object: EV / EV Battery Source: B EV / EV Battery ‘Green’ element (burned): EV Battery Storage System	Sun et al. (2020b) Wikipedia (2020)

NFPA Research Foundation - Fire Safety Challenges for ‘Green Buildings’ and Attributes - 2020

Table 5.1 'Green' (Sustainable) Attributes

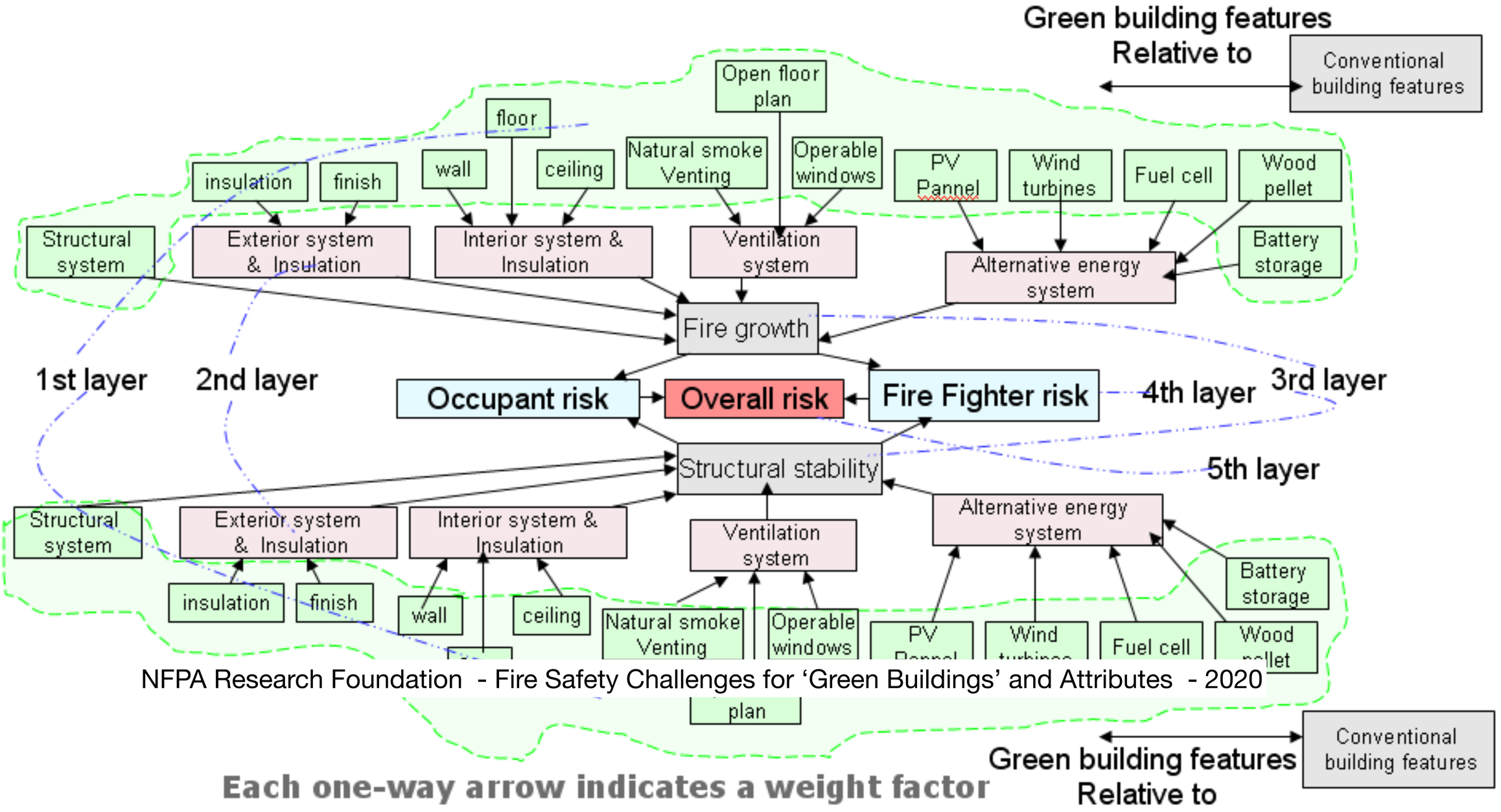
Material / System / Feature	Material / System / Feature	Material / System / Feature
Structural Materials and Systems	**Exterior Materials and Systems**	**Alternative Energy Systems**
- Lightweight engineered lumber	- Structural integrated panel (SIP)	- PV roof panels
- Lightweight concrete	- Exterior insulation & finish (EFIS)	- Oil-filled PV panels
- FRP elements	- Rigid foam insulation	- Wind turbines
- Plastic lumber	- Spray-applied foam insulation	- Hydrogen fuel cells
- Bio-polymer lumber	- Foil insulation systems	*- Battery / energy storage systems*
- Bamboo	- High-performance glazing	- Cogeneration systems
- Phase-change materials	- Low-emissivity & reflective coating	- Wood pellet systems
- Nano materials	- Double-skin façade	*- Building integrated photovoltaics*
- Vegetative roof systems	- Bamboo, other cellulosic	*- Solar radiance concentration*
- Extended solar roof panels	- Bio-polymers, FRPs	**Façade Features**
- Mass timber (e.g., CLT)	- Vegetative roof systems	- Area of glazing
- Additive manufacturing / 3-D printing	- PVC rainwater catchment	- Area of combustible material
- Inflated steel structure	- Exterior cable / cable trays	- Exterior solar shades & awnings
- Hempcrete	- Exterior solar shades / awning	- Exterior vegetative covering
- Ultra-High Performance Concrete	- Exterior vegetative covering	*- Out of plane geometries*
- Carbon fiber composites	*- Alusion Panels*	*- Solar radiance concentration*
- Modular construction	*- PET for façade system*	**Site**
Interior Materials and Finishes	*- Interactive printed graphene*	- Permeable concrete systems
- FRP walls / finishes	*- Novel biological materials*	- Permeable asphalt paving / pavers
- Bio-polymer wall / finishes	*- Building integrated carbon capture*	- Extent (area) of lawn
- Bamboo walls / finishes	*- Organic insulation*	- Water catchment / features
- Wood panel walls / finishes	*- Composite window framing material*	- Vegetation for shading
- Bio-filtration walls	*- Mass timber & timber façade systems*	- Building orientation
- Glass walls	*- Ultra-High Performance Concrete*	- Increased building density
- FRP flooring	*- Additive manufacturing / 3-D printing*	- Localized energy production
- Bio-polymer flooring	*- Hempcrete*	- Localized water treatment
- Bamboo flooring	**Building Systems**	- Localized waste treatment
- Interior vegetation	- Natural ventilation	- Reduced water supply
- Skylights	- High volume low speed fans	- Hydrogen infrastructure
- Increased acoustic insulation	- Refrigerant materials	- Community charging stations
- Reflecting panels / solar tubes	- Grey-water for suppression	*- EES fuel loads / hazards*
- Mass timber (e.g., CLT)	- Rain-water for suppression	*- EV fuel load / hazards / chargers*
Interior Space		
- Tighter construction		
- Higher insulation values	- On-site cogeneration	*- Bicycle storage impact exits*
- More enclosed spaces	- High reliance on natural lighting	*- Reduced FD apparatus access*
- More open space (horizontal)	*- Heat pumps*	*- Densification / fire spread*
- More open space (vertical)	*- Interior EV charger*	*- EV chargers on building exterior*

NFPA Research Foundation - Fire Safety Challenges for 'Green Buildings' and Attributes - 2020

Table 5.2 Hazard, Risk and Performance Attributes

Poses potential ignition hazard
Poses potential shock hazard
Poses potential explosion hazard
Poses potential toxicity hazard
Readily ignitable
Burns readily once ignited
Contributes more fuel / increased heat release rate (HRR)
Material affects burning characteristics
Fast(er) fire growth rate
Significant smoke production/hazard
Potential for shorter time to failure
Failure affects burning characteristics
Failure presents smoke spread concern
Failure presents flame spread concern
Material presents flame spread concern
May impact smoke/heat venting
May impact occupant evacuation
May impact fire-fighter (FF) water availability
[illegible]
[illegible]
May impact fire apparatus access
May impact fire-fighter (FF) access and operations
May impact containment of runoff

NFPA Research Foundation - Fire Safety Challenges for ‘Green Buildings’ and Attributes - 2020



NFPA Research Foundation - Fire Safety Challenges for 'Green Buildings' and Attributes - 2020

il PNRR e gli investimenti nell’efficientamento energetico degli edifici

- adeguare la vigilanza sul mercato dei prodotti da costruzione, degli estintori e di altri prodotti
- migliorare la consapevolezza delle responsabilità dei professionisti in materia di sicurezza dei prodotti
- contribuire a definire gli standard di prova mancanti
- continuare ad adeguare le norme alle nuove esigenze (edifici con maggiore tenuta e coibentazione, elementi più leggeri ecc.)

- la mobilità elettrica

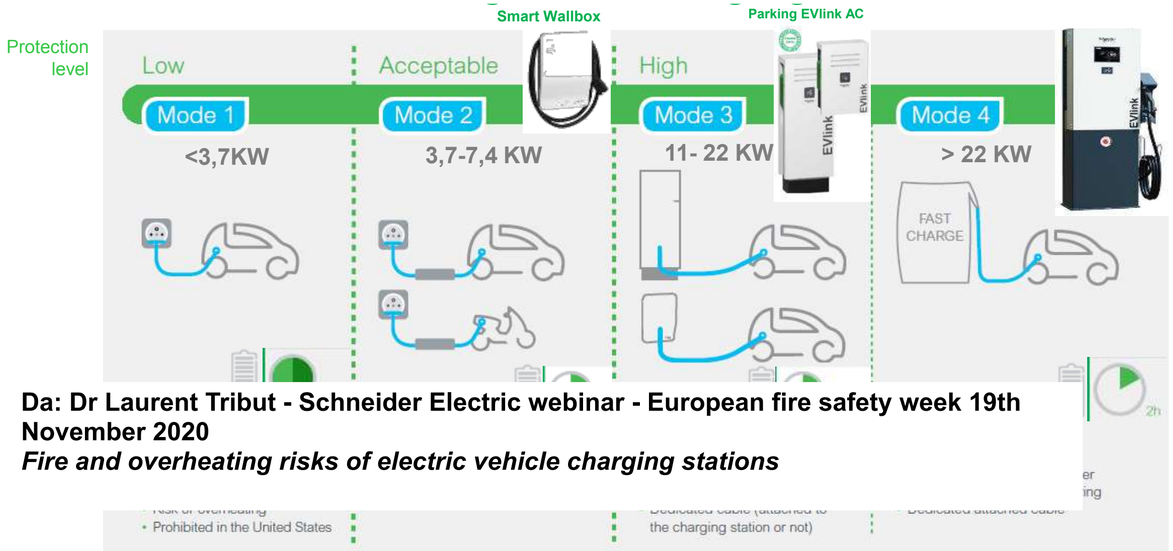
  (dalla tossicità dei fumi fino al pretrattamento delle acque di spegnimento)

Table 41 *Specific comparison of pollutants present in a BEV fire and an ICEV fire*

	Pollutant concentrations following a	
Substance	**BEV fire in µg/cm² (experiment)**	**ICEV fire in µg/cm² (real fire)**
Cobalt	155 – 400	0.2
Nickel	156 – 400	0.3
Manganese	148 – 380	3
		1.2
		0.5

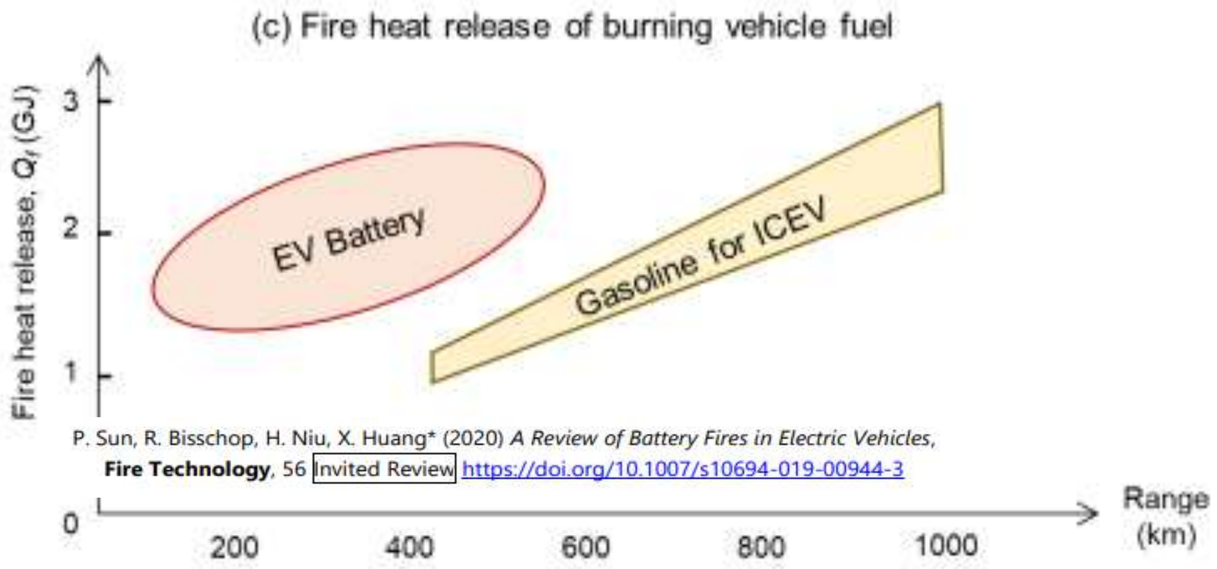
da: Lars Derek Mellert - The Future Lies Underground - and What the Risks of Electric Vehicles Fires? Fire Safety Week 2020 - WEBINAR #4, 19.11.2020

Definitely atypical emissions!



Da: Dr Laurent Tribut - Schneider Electric webinar - European fire safety week 19th November 2020
Fire and overheating risks of electric vehicle charging stations

*According to IEC 61851 definition



P. Sun, R. Bisschop, H. Niu, X. Huang* (2020) *A Review of Battery Fires in Electric Vehicles*, **Fire Technology**, 56 Invited Review https://doi.org/10.1007/s10694-019-00944-3

- vettori di energia alternativi: idrogeno, CNG

da: FIREFIGHTER NEAR MISS - Auto Fire with Compressed Natural Gas (CNG) Fuel Tank Explosion - Seattle Fire Department

Fire and Explosion hazard: The main risk when handling hydrogen is of explosion when mixed with air. In addition, leaks are hard to identify without dedicated detectors since hydrogen is colorless and odorless. A hydrogen flame is almost invisible in daylight.
Loss investigation statistics show that many hydrogen fires result from the self-ignition of sudden hydrogen release through rupture of disks and pressure relief valves. About 25% of the losses were attributed to leaks. Of these leaks, 40% were undetected before the loss.6 Contributing factors were inadequate ventilation and inadequate purging. The data shows the advantage of locating hydrogen equipment outdoors. Hydrogen has been accidentally released outdoors many times without ignition. Almost all indoor releases have ignited. Indoor releases resulted in more than three times as many explosions than fires, whereas outdoor releases have resulted in approximately equal number of fires and explosions.

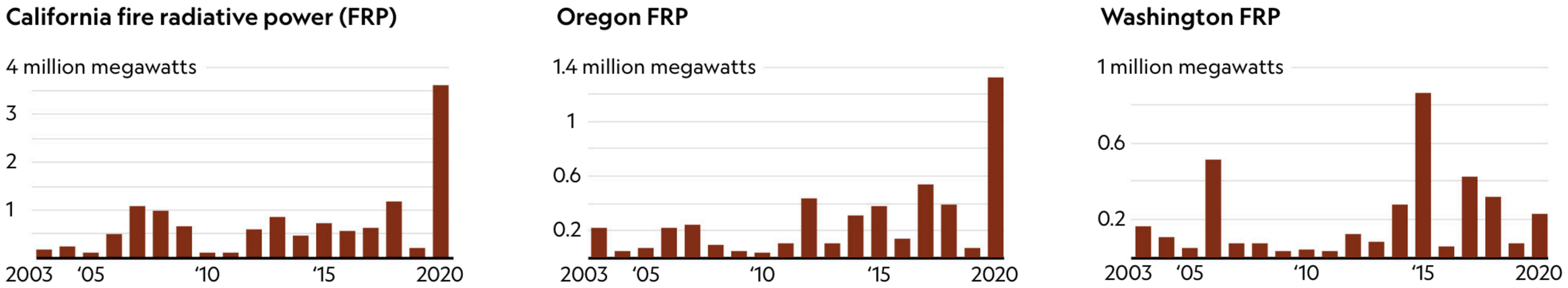
Da: ALLIANZ GLOBAL CORPORATE & SPECIALTY® THE HYDROGEN ECONOMY: OPPORTUNITIES AND RISKS IN THE ENERGY TRANSITION

rischi in caso di rilascio in ambienti confinati

- incendi di interfaccia ed esodo

Climate change intensifies wildfires in the West.

Fire radiative power (FRP) is the rate of radiant heat emitted by a fire. California and Oregon's 2020 fire season has the highest fire intensity of the past 18 years.



CHRISTINA SHINTANI, NG STAFF
SOURCE: NOAA/NESDIS FIRE MAPPING SYSTEM

Da: ALEJANDRA BORUNDA - The science connecting wildfires to climate change - https://www.nationalgeographic.com/science/article/climate-change-increases-risk-fires-western-us

- **necessità di definire i metodi per l'esodo negli incendi di interfaccia**
- **criteri di protezione delle abitazioni dagli incendi di vegetazione**

Abruzzo - Pescara

THE SACRAMENTO BEE

FIRES

Many of the dead in Camp Fire were disabled, elderly. Could they have been saved?

BY TONY BIZJAK, ALEXANDRA YOON-HENDRICKS, PHILLIP REESE, AND MOLLY SULLIVAN

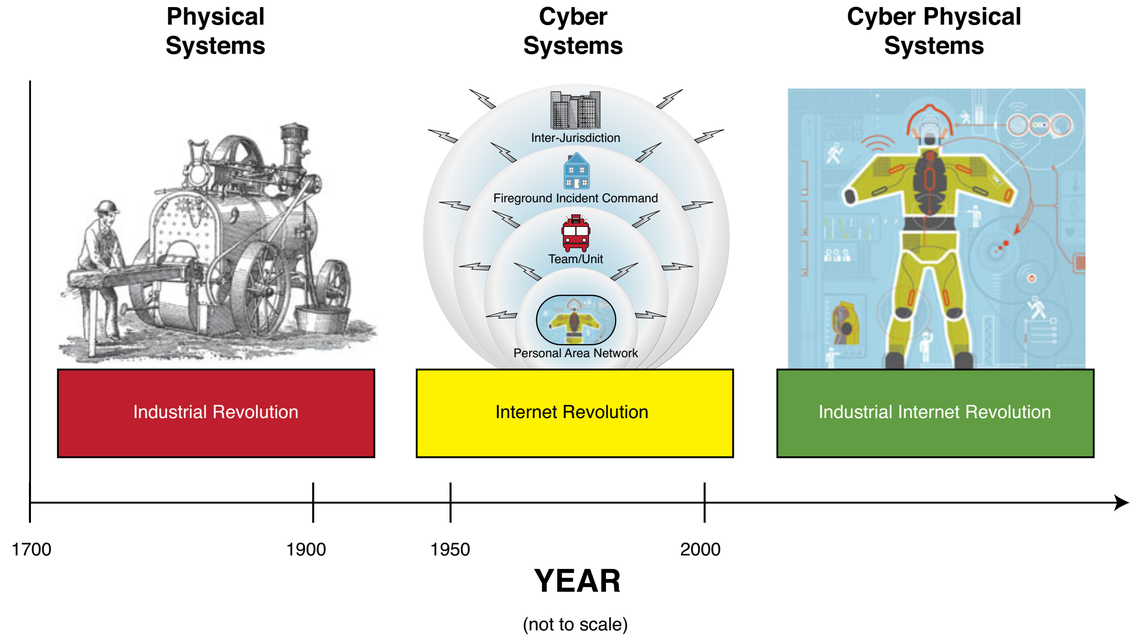
DECEMBER 04, 2018 12:00 AM, UPDATED AUGUST 16, 2019 08:06 AM

California - Sacramento

NIST Special Publication 1191 - Research Roadmap for Smart Fire Fighting - Summary Report

Figure 1.1 Example of the Smart Fire Fighting process.

Figure 1.2 Historical perspective on technology development. (Source, far left: Shutterstock, Kuznetsov Alexey)



The following enabling technologies are emerging or are already available:

- **Autonomous vehicles and collision avoidance**, addressing the 10 percent of fire fatalities associated with vehicle fires
- **Mobile robots** such as those in the most recent DARPA (Defense Advanced Research Projects Agency) Robotics Challenge, which in 2014, for the first time, focused on fire-fighting activities, including identifying a standpipe, transporting a bulky nonrigid fire hose, attaching the hose to the standpipe, and opening the spigot
- **Smart clothing**: shirts that measure heart rate, breathing rate, skin surface temperature, and triaxial accelerometry; boots that measure speed, distance, steps, and stride rates, with data wirelessly sent to a smartphone for analysis; and socks infused with textile sensors and paired with an electronic anklet that tracks steps, speed, altitude, and distance and that can detect jumping
- **Augmented reality glasses** that display enriched information over and above visible operations
- **Mobile computing** with millions of smartphone applications
- Global Positioning System (GPS) and **enhanced mapping capabilities**
- **Big data**, representing a new frontier in fire protection and emergency response, including data from real-time distributed sensors and databases distributed over the cloud
- The rise of **multimedia, social media, and the Internet of Things**, leading to the exponential growth of information with a large fraction of the population linked by cell phones
- BACnet®, the ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) data communication protocol for **building automation** and control networks, which will encourage technology integration, thereby increasing effectiveness and efficiency of individual equipment items such as building sensors [8]
- **Smart Home fire alarm systems**, which provide enhanced control over key building functions, including safety, security, entertainment, energy, and ambient environment
- FirstNet, the nationwide, interoperable, broadband network that will provide police, fire fighters, and emergency medical service professionals the ability to transmit and receive voice communications in seven ways, including push-to-talk functionality, group-call (one-to-many) capability, direct-mode (i.e., peer-to-peer or talk-around), full- duplex voice (like a traditional phone call), and with caller identification (ID)

Fine