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Research in support of fire resilient societies

Background

The global impact of fire is staggering. The World Health Organisation (WHO) estimates global burn deaths at 180,000 annually, the vast majority of these in low and middle-income countries, with few fire safety regulations or provisions.¹ The situation in developed countries is troubling as well. Within Europe, more than 3,500 people are killed annually in fires based on a five-year average². The number of injuries is approximately 20 times the number of fatalities, resulting in at least 70 000 injuries per year in the EU alone! The losses in the USA are similar.³ In most developed countries the cost of fire is estimated to at least 1% of the Gross Domestic Product (GDP), a number which has been largely unchanged for decades. The total cost of fire in the USA has been estimated at USD 328.5 billion, which was 1.9% of the U.S. GDP.⁴ Global loss due to wild and fire is presently greater than at any time in the past. SwissRe has reported that the combined insurance losses from all wildfires worldwide in 2017 were USD 14 billion, the highest ever in a single year.⁵ According to Allianz, fires and explosions in the built environment accounted for 59% of 1,807 business interruption claims globally, according to data analysed over a five-year period, with losses in 2015 in the billions of US dollars.⁶

What we know – and more importantly – what we don't know

Fires have threatened society throughout recorded history and beyond. Increased regulation and standardisation of building or product fire performance requirements has been the standard response to lessons learned from historic fires, creating solutions to existing problems but not effectively preventing emerging threats. In recent years, the adoption of performance-based building regulations in numerous countries has supported the adoption of novel construction solutions without compromising on fire safety through application of performance-based design methods. However, data on performance of materials, people and more are lacking.

We know that new building materials and technologies are being developed at a rapid pace to satisfy demands for sustainability and/or energy efficiency. However, a full understanding of the fire performance of these new materials and technologies is lacking. Research is needed to better understand fire performance of materials, products and systems. More holistic fire test methods are needed to help assure new materials and systems meet societal expectations. More integrated fire engineering analysis methods are needed to support design.

We know that Global demographics are changing. For the first time ever, more than half the global population lives in urban environments, and this number will continue to rise. In rapidly growing cities, particularly in low- and middle-income countries, the urban poor are at increased risk. In Europe and North America, the population is rapidly aging due to lower birth rates and longer life expectancy. We increasingly live in tall buildings. Yet, we do not understand in detail the vulnerabilities associated with changing demographics and urban landscapes. Research is needed to understand the evolving fire risks and how they can be mitigated.

¹ WHO Burns Facts sheet: <http://www.who.int/en/news-room/fact-sheets/detail/burns> (accessed June 2018).

² N.N Brushlinsky, M. Ahrens, S.V. Sokolov, P. Wagner, "World Fire Statistics", nr 23-2018, Centre of Fire Statistics of the International Association of Fire and Rescue Services (CTIF). <https://www.ctif.org/world-fire-statistics> (accessed June 2018).

³ <https://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/fires-in-the-us/overall-fire-problem/fire-loss-in-the-united-states> (accessed June 2018).

⁴ <https://www.nfpa.org/-/media/Files/News-and-Research/Resources/Research-Foundation/Research-Foundation-reports/Other-research-topics/RFTotalCost.pdf> (accessed June 2018).

⁵ http://www.swissre.com/media/news_releases/nr20180410_sigma_global_insured_losses_highest_ever.html (accessed June 2018).

⁶ <https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS-Global-Claims-Review-2015.pdf> (accessed June 2018).

We know that the success of fire suppression tactics in buildings depends highly on the type and arrangement of fuels burning, and the geometry and ventilation conditions within the spaces and buildings where the fire is burning. However, the interactions and influences between spaces, contents and tactics have not been quantified for use in fire safety design for the modern built environment. We know that energy storage systems and energy producing systems are potential fire hazards. Yet we do not understand the implications of these risks when integrated into the built environment to create buildings that are energy self-sufficient.

Knowledge and data are needed in all of these areas – and more – to better understand and characterise the totality of the fire problem, and to fully incorporate the potential of emerging technologies, such as innovative materials, Artificial Intelligence, real-time predictive modelling and decision-support systems, and application of multidisciplinary research findings, into reducing the global impact to society of unwanted fire.

What needs to be done

Fire safety science and engineering research needs to be integrated into societally-transformative risk mitigation and resiliency initiatives. Grand Challenges such as changing demographics (specifically an aging society), urbanisation, energy efficiency and climate change all have fire safety implications. Yet fire safety is rarely thought of as part of the solution to these challenges.

In 2016, the United Nations adopted their Sustainable Development Goals (SDGs) as part of *The 2030 Agenda for Sustainable Development* (A/Res/70/1). The Agenda is a plan of action which seeks to strengthen collaboration through a common understanding of what needs to be done. The resolution and presentation of the 17 SDGs and their 169 individual targets was called to action in the field of sustainability which has repercussions, both for fire safety and in other areas, that are yet to be fully understood. The rapid adoption of this framework is almost certainly due to the almost universal recognition of the need for common views and definitions of sustainability. We need an **Agenda 2030 for a Fire Safe World**.

There is a pressing need to expand our present understanding of fire safety and what it means for sustainability and resiliency: to resolve potential conflicts and exploit the clear benefit of supporting both sustainability and societal safety objectives. Large scale fire disasters, such as the Grenfell Towers tragedy and large-scale forest fires with record numbers of fatalities, are clear indicators that we must do better to ensure the safety of citizens around the globe. Arguably, the Grenfell Tower fire was in part related to policy objectives for increasing energy performance and sustainability, where the fire safety implications fell through the cracks. Research has already demonstrated that climate change is driving the increasing wildland fire losses.⁷

What is being done so far

While we face daunting challenges, it should not be forgotten that research to date in the field of fire safety has led to the improvement of buildings and products across the board. There are few city-wide conflagrations in high-income countries since the introduction of building and fire regulations based on sound science. The vast majority of fires remain small, avoiding large scale catastrophes. The introduction of new materials, new applications, new building techniques and new designs, and changing demographics, however, means that there is a continued need for research and innovation to ensure the safety of citizens. The task is complex and defies a single hazard approach, as solving one hazard may lead to the realisation of another. Only through a multi-hazard approach can we hope to create solutions that will foster true safety and resilience.

The International Association of Fire Safety Science (IAFSS) has played a significant role in advancing fire safety science and engineering for more than 30 years. The mission of the IAFSS is to promote research, education, dialog and cooperation in fire safety science globally. Our vision is to be a global leader in advancing fire safety through science by fostering dialogue and exchange between fire safety scientists around the world. To this end, the core values of the association are: Excellence, Integrity, Diversity, Inclusion and Transparency. Fire scientists from some 40 countries are members and conduct research nationally or internationally sourcing national and international public and industrial research funding.

A new initiative was launched by the European Commission in October 2017 to foster exchange of information and experience of fire incidents in Europe, *The Fire Information Exchange Platform* (FIEP), with the aim to establish collaboration on:

⁷ <https://nca2014.globalchange.gov/report/sectors/forests#statement-16387> (Last accessed June 2018)

- A common terminology and fire statistics,
- The application of fire prevention principles,
- Dealing with new products (e.g. integrated photovoltaic panels) and high-rise buildings,
- The exchange of experience from fire accidents,
- The use of a fire engineering approach in building regulations.

This important initiative represents an opportunity to influence coming research programmes in Europe. However, moving forward, in order to realise the promise of reducing the global impacts of fire, there is a need to create a roadmap of global fire safety research needs: an **Agenda 2030 for a Fire Safe World**.

Research funding internationally – a start in Europe

The European Framework Programs represent the third largest annual investment in research funding globally and is the largest trans-national source of research funding in the world according to the OECD (see Figure 1). In the present Framework Program, Horizon 2020, almost €80 billion is channelled to investigate and define solutions to some of society’s grand challenges, to support the development of research excellence and to support industrial leadership. Horizon 2020, however, pays scant attention to fire safety and related areas and provides relatively little research funding to the fire science community. Important fire research projects have taken place under Horizon 2020, investigating for example fire safety in tunnels, improved resilience in cities, forest fire response and the fire performance of new energy carriers. Much, however, remains to be done if fire safety is to keep pace with the changing needs of modern society. In a recent open letter to the European Commission, it was noted that “Without a better understanding of fire safety technologies needed to protect our citizens we cannot provide a safer life to our citizens and to those who live among us or just visit Europe.”⁸ This open letter has been supported by more than 200 scientists, many of these members in the IAFSS.

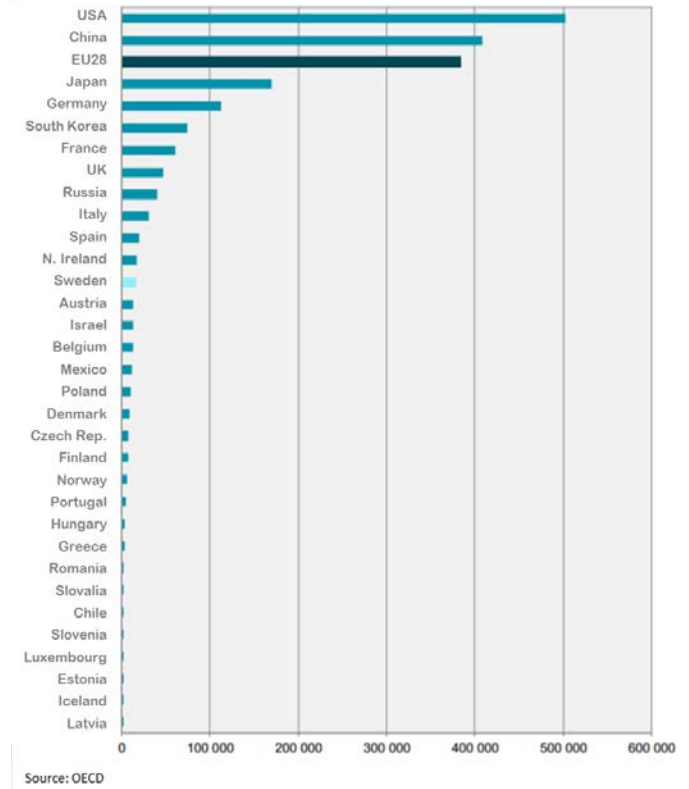


Figure 1: Research expenditure per year in M\$.

Planning for the next Framework Programme, Horizon Europe, is underway and the first calls are expected in 2020 for funding 2021. Horizon Europe has a proposed budget of €100 billion and will be based on three pillars of research with the central pillar hinged a Grand Challenges. To date five overarching clusters of Grand Challenges have been identified:

- Health
- Inclusive and Secure Society
- Digital and Industry
- Climate, Energy and Mobility
- Food and Natural Resources

These clusters have a number of pre-identified “interventions” summarised in their preliminary line-up in Table 1. Neither Fire nor Safety are mentioned by name but numerous interventions have both fire and safety implications. As in the case of Horizon 2020, Horizon Europe promises to provide openings for important fire science research but with little by way of dedicated topics unless the fire community can be rallied to provide specific, detailed and well-motivated input!

⁸ G. Boustras, G. Rein, B. Marci, D.X. Viegas, P. van Hees, E. Planas, P-A. Santoni, O. Vilalta, V. Molkov, S. Dembele and E. Ronchi, “Open Letter to the European Commission”. <http://www.paucostafoundation.org/ing/open-letter.php>

Agenda 2030 for a Fire Safe World

In addition to the clusters and areas of intervention, Horizon Europe aims to take a Missions-orientated approach to generating results with the potential to have a significant impact on identified Grand Challenges. Missions that have been illustrated in the recent Mazzucato report⁹.

These Missions should:

- Be ambitious but realistic research & innovation actions
- Be bold, inspirational with wide societal relevance
- Have a clear direction: should be targeted, measurable and time-bound
- Foster multiple, bottom-up solutions
- Be cross-disciplinary, cross-sectoral and cross-actor

Table 1: Clusters and areas of intervention, preliminary proposal for Pillar 2 in Horizon Europe.

Health	Inclusive and Secure Society	Digital and Industry	Climate, Energy and Mobility	Food and Natural Resources
<ul style="list-style-type: none"> - Health throughout the life course - Environmental and social health determinants - Non-communicable and rare diseases - Infectious diseases - Tools, technologies and digital solutions for health - Health care systems 	<ul style="list-style-type: none"> - Democracy - Cultural heritage - Social and economic transformations - Disaster-resilient societies - Protection and Security - Cybersecurity 	<ul style="list-style-type: none"> - Manufacturing technologies - Digital technologies - Advanced materials - Artificial intelligence and robotics - Next generation internet - High performance computing and Big Data - Zero carbon circular industries - Space 	<ul style="list-style-type: none"> - Climate science and solutions - Energy supply - Energy systems and grids - Zero carbon industry - Buildings and housing - Communities and cities - Industrial competitiveness in transport - Clean transport and mobility - Smart mobility - Energy storage 	<ul style="list-style-type: none"> - Environmental observation - Biodiversity and natural capital - Agriculture, forestry and rural areas - Sea and oceans - Food systems - Bio-based innovation systems - Circular systems

Fire science is well-suited to a Missions-based approach similar to that proposed for Horizon Europe, and the fire community should therefore come together to provide input to the European Commission, both on a dedicated Fire Safety Mission and with input to the current proposal for Clusters and Interventions shown in Table 1. In the same vein, there are both national and other international programs funding excellent science and innovation that would profit from an understanding of fire safety missions and related research needs, e.g. international programs such as the 100 Resilient Cities Initiatives, World Bank Funded projects and state aid programmes for emerging economies. An Agenda 2030 for a Fire Safe World will provide much needed input to all relevant funding agencies and initiatives.

Workshop to start developing Agenda 2030 for a Fire Safe World

The 3rd European Symposium on Fire Safety Science, scheduled for September 12-14, 2018, in Nancy, France, offers a perfect opportunity for the fire science community to meet and discuss the definition of a Fire Safety Mission and the identification of specific topics for fire science research as input to such a mission.

We would therefore like to invite you to this Workshop on the afternoon of **Tuesday, September 11** to participate in refinement of ideas and drafting of text that can be used with key research funding entities, governmental agencies, and NGOs worldwide. While our initial focus will be input to the European Commission, we aim to develop strategies and documents for approaching key funding and partner organizations globally.

We seek participants who want to actively help develop a research roadmap and potentially white papers, to facilitate the generation of directed funding towards fire safety science research to address emerging societal and environmental challenges. Your participation will not require you to sign a joint statement on research needs although this will be encouraged as one possible outcome of the Workshop. Registration for the workshop will be possible on the conference website.

⁹ Mazzucato Report EU Publications web link <https://publications.europa.eu/s/gnwm>