

特別講演

火災と サステナビリティ

SFPEなど
最近の海外動向に学ぶ

2024/02/01
大成建設(株) 小林裕



Sustainability と Fire Resilience

- はじめに
 - Brian Meacham / Margaret McNameeの共著の紹介を少々
 - Sustainabilityの語義、3つのディメンションについて
- SFPE主催ウェビナーの概要: Sustainability and Fire Resilience
 - 第一回: 舞台設定
 - Brian Meacham, Benjamin Ralph, Nelly Martinez, Nathan Millar
 - 第二回: 三つの柱: 環境, 社会, 経済
 - Margaret McNamee, Birgitte Messerschmidt, Finn Nilson, Richard Walls
 - 第三回: 研究開発の課題
 - Greg Baker, Xinyan Huang, Zahra Jandaghian, Grunde Jomaas

はじめに

SFPEにおける火災とサステナビリティ

- 米国ではNFPA / FPRF基金が研究を主導
- 2022年からSFPEで活動が活発化
 - SFPE基金による研究
 - ウェビナー、シンポジウムの開催、等
- Brian Meacham / Margaret McNameeは共著多数
 - Conceptual Basis for a Sustainable and Fire Resilient Built Environmentがお勧め
 - 当該分野をSA-FRと略す場合がしばしば
 - Green buildingsの火災調査:改訂版は共著

SFPE Foundation News Release

SFPE Foundation Announces New Research into Assessment of Sustainable and Fire-Resilient Buildings



sfpe.org/foundation



SFPE and SFPE Foundation Advance Sustainability Objectives Through Numerous Initiatives

SFPE SFPE
Engineering A Fire Safe World® Foundation®

Fire Technology
© 2023 The Author(s)
Manufactured in The United States
<https://doi.org/10.1007/s10694-023-01490-9>

Conceptual Basis for a Sustainable and Fire Resilient Built Environment

Margaret McNamee , Lund University, 221 00 Lund, Sweden
Brian J. Meacham, Meacham Associates, Shrewsbury, MA 01545, USA*

Received: 12 October 2022/**Accepted:** 7 September 2023



Fire Safety Challenges of Green Buildings

Final Report

Prepared by:

Brian Meacham

Brandon Poole

Juan Echeverria

Raymond Cheng

Worcester Polytechnic Institute



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FIRE RESEARCH

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<http://www.nfpa.org/foundation>

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RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

Fire Safety Challenges of 'Green' Buildings and Attributes

Final Report by:

Brian Meacham
Meacham Associates
Shrewsbury, MA, USA

Margaret McNamee
Lund University
Lund, Sweden

October 2020

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サステナビリティの語義について

■ 言葉の定義・派生

- 他動詞 : to **sustain**
- 形容詞 : **sustainable**
- 名詞 : **sustainability**

■ 関連分野の古典をPDFで入手、キーワード検索が可能

- The Limits to Growth, 1972
- Our Common Future, 1987
- Agenda 21, 1992

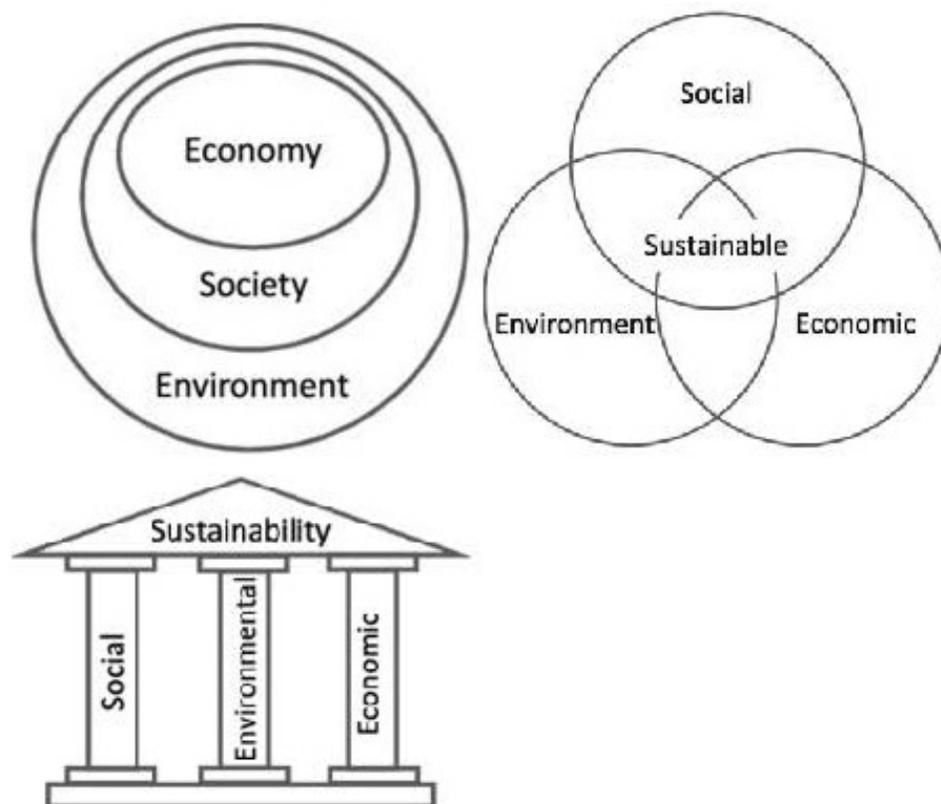
- Sustainされてきたもの : (stability of) model, level of population, human progress, growth, development, etc.

- Sustainableが修飾する名詞 : developmentが大半を占める

- Sustainabilityは : 第一義には持続的な「開発」を意味した

3つの「柱(pillars)」か、3つの「次元(dimensions)」か？

- サステナビリティの文脈で3者が語られる
 - 環境(environment)
 - 社会(society)
 - 経済(economy)
- 3者は「発展(development)」の評価軸
 - 「サステナビリティ」を3本柱が「支え」てはいない
 - 原義は「柱」よりは「次元/評価軸」
- 3重の集合のイメージが妥当であろう
 - すべてを包含する地球「環境」
 - その部分集合たる人間「社会」
 - その評価軸の一つたる「経済」



SFPEのウェビナーについて

SFPEウェビナーのあらまし

- 対象：世界の全ての防火（Fire Protection）技術者
- 登場人物：各回ともモデレータ1名、各国より講師3名
- 主目的：微細な各論よりは大きな総論を語りFP技術者と共有
- 時期：2023年の夏に開催
- 時間：一回あたり1.5時間、都合4.5時間に
- 記録：サイト登録さえすれば動画を無償で配信
- SFPEサイトにsign upして、ぜひとも視聴してみてください

ウェビナーの所在：当会HPより

- 第一回：英国の建築設計者の視点から：ノーマン・フォスター事務所に所属する火災・環境・設備系の技術者が考える建築環境のサステナビリティと火災安全について
(<https://www.pathlms.com/sfpe/courses/54496>)。
- 第二回：サステナビリティの三つの柱：環境のみならず社会と経済の視点でのサステナビリティ，地球規模で見た経済・技術・教育・民意の格差と火災リスクなど (<https://www.pathlms.com/sfpe/courses/54497>)。
- 第三回：現在・そして将来の調査研究の方向性：エネルギーを創る・送る・蓄える，雨水を溜める，緑を育てるなど，各種サステナビリティ関連システムの現状，火災ハザード調整のための技術開発など
(<https://www.pathlms.com/sfpe/courses/57328>)。

Webinar 1: Setting the scene = 舞台設定



- Brian Meacham, Meacham Associates, USA: モデレーター
- Benjamin Ralph, Foster and Partners, UK: 防火技術担当
- Nelly Martinez, Foster and Partners, UK: サステナビリティ設計
- Nathan Millar, Foster and Partners, UK: 環境設計

Foster + Partners : Sustainability and Fire Resilience: Setting the scene

- Where are we?: 現状認識
 - Benjamin: 火災関連の部門長: 総論、火災安全との融合
 - Nelly: サステナビリティ設計担当: 温暖化、Carbon footprintについて
- Story of a project: 建築プロジェクトの流れに即して
 - Nathan: 環境設計担当: 教育・規制、設計目標・フェーズごとの話題



Dr Benjamin Ralph
Head of Fire Safety



Nelly Martinez
Senior Sustainability
Designer



Nathan Millar
Senior Environmental
Designer

Foster + Partners : Sustainability and Fire Resilience : Setting the scene

- Where are we?
 - Highrise buildings, Informal settlements, WUI, etc.
 - **Global warming**, drought, wildfires, nature impact, food security
 - Carbon footprints: embodied carbon vs operational carbon
 - **Design Objectives**
- Story of a project
 - Education / Policy and Regulations
 - Certifications / Extra-regulatory initiatives
 - Green attributes : passive measures, materials, timber construction
 - Retrofit, upgrade, etc.

Global



NEW YORK

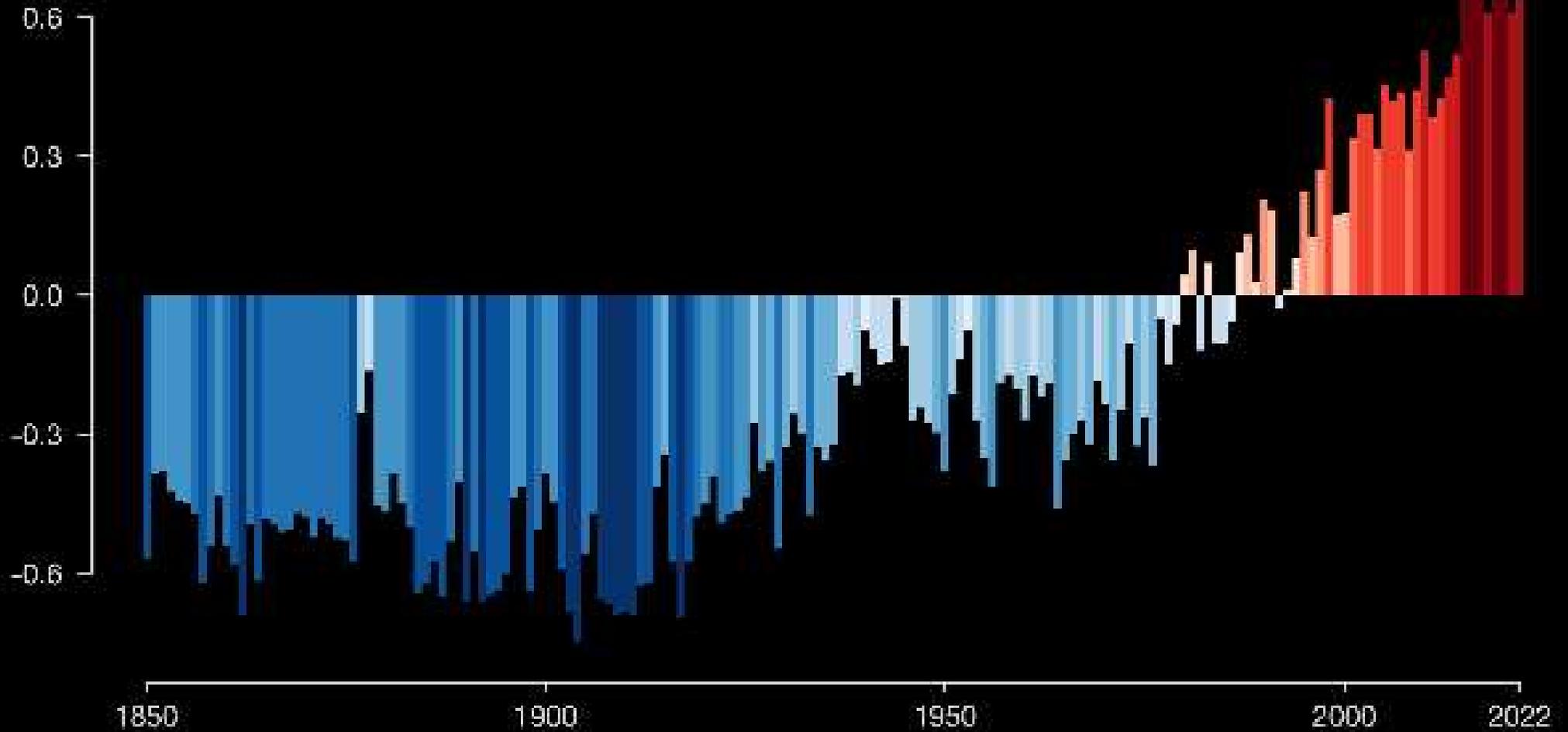
SEATTLE

LONDON

Warming Stripes / Climate Stripes created by Ed Hawkins

Global temperature change

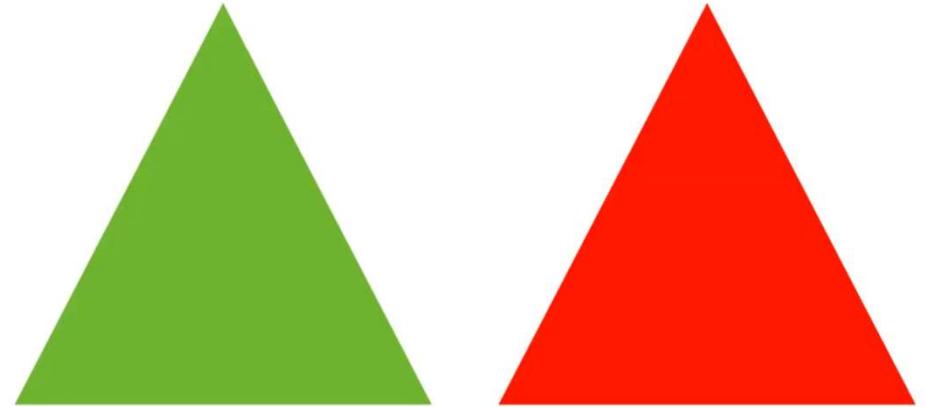
Relative to average of 1971-2000 [°C]



From **Different Silos** to Holistic/Integrated Design Objectives

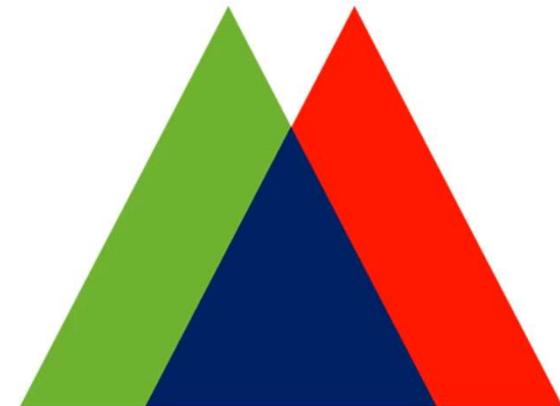
■ 従来：別個のパフォーマンスとして追及

- Sustainability
- Fire



■ 今後：相互のバランスを最適化

- Sustainability/Fireを融合





- 垣根で仕切られた部門のことを英語ではsilosという
 - 個々のsilos内: 上から下まで一体感
 - 横のsilosとは分離: 連携が遮断
- 「火災」と「サステナビリティ」は、これまで別のsilosに生息してきた
- 今こそ互いが共通言語で対話を開始することが求められているという

Webinar 2: Fire Safety Perspectives Relative to 3 Pillars of Sustainability



- Margaret McNamee, Lund University, Sweden: モデレーター
- Birgitte Messerschmidt, NFPA, USA
- Finn Nilson, Karlstadt University, Sweden
- Richard Walls, Stellenbosch University, South Africa

Birgitte : The impact of fire seen through the lens of sustainability

- NFPAの研究担当の部長
- 防火技術者が議論に加わるために
 - Sustainabilityの3つの柱の理解が不可欠
 - Social, economic, and environmental dimensions
- 火災からsustainabilityへの影響
 - Economic impact of fire
 - Environmental impact of fire





RESEARCH FOUNDATION

RESEARCH FOR THE NFPA MISSION

Economic Impact of Fire: Cost and Impact of Fire Protection in Buildings

Final Report by:

Dr. Ruben Van Coile, Dr. Andrea Lucherini, Ranjit

Kuman Chaudhary

Ghent University

Ghent, Belgium

Dr. Shuna Ni and Dr. David Unobe

Utah State University

Logan, Utah, United States

Dr. Thomas Gernay

Johns Hopkins University

Baltimore, Maryland, United States

February 2023



A
Kindling

Publication

The Invisible US Fire Problem

This report is sponsored by:





RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

February 2020

Research Roadmap: Environmental Impact of Fires in the Built Environment

Final Report by:

Margaret McNamee*, Guy Marlair**, Benjamin Truchot**, and Brian Meacham†

*Division of Fire Safety Engineering, Lund University, Lund, Sweden

†NERIS, Verneuil-en-Halatte, France

Environmental Impact of Fires in the Built Environment: Emission Factors

Final Report by:

Margaret McNamee and Joakim Åström
Division of Fire Safety Engineering, Lund University, Sweden

Benjamin Truchot and Guy Marlair
INERIS, France

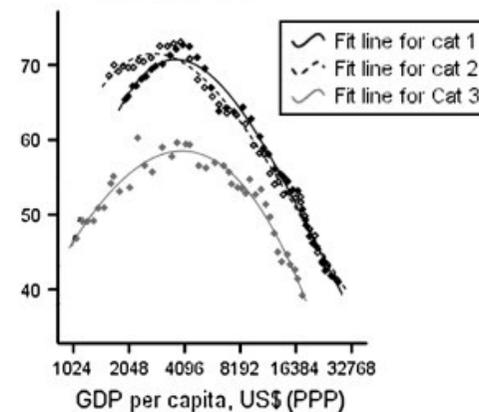
Brian Meacham
Meacham Associates, USA

April 2022

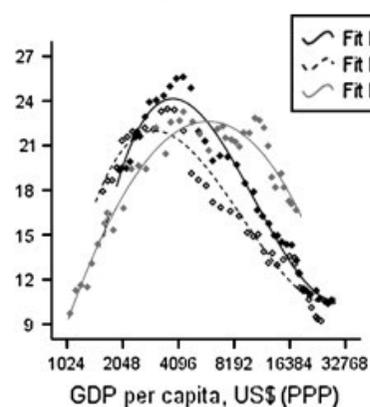
Finn: Economic Sustainability in Relation to Fire Safety

- スウェーデンのリスク研究者
 - 火災の専門ではない
 - 人的リスク全般を研究
 - 高齢者施設の転倒リスクも研究
- GDPと傷害リスクの相関を分析
 - 高所得国が高い安全性を誇る
 - 低所得国は高い傷害／死亡危険

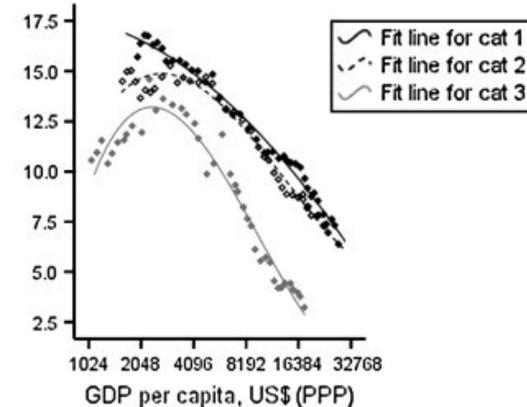
Injury (all causes) mortality rates/100 000



RTA mortality rates/100 000



Fall injury mortality rates/100 000



Finn: Economic Sustainability in Relation to Fire Safety

- 高齢者の転倒リスクでは：
 - 自動応答システムはpassive safety
 - 日常的、場所を選ばぬ危険に有効
- 自動で作動するスプリンクラーも passive
- 自動passive システムの経済：
 - 導入には工事が必要
 - 適用は一部のマーケットに限定
 - 高所得の経済圏
 - ハイエンドの建物

Passive safety is preferable to active safety

- ☹ Behavior change is very difficult
- ☹ Risk/fear-generating communication/information has very low effect
- ⚖ Standards/legislation works well (if they are designed properly)
- 💧 Built-in systems (sprinklers, etc.) are highly effective

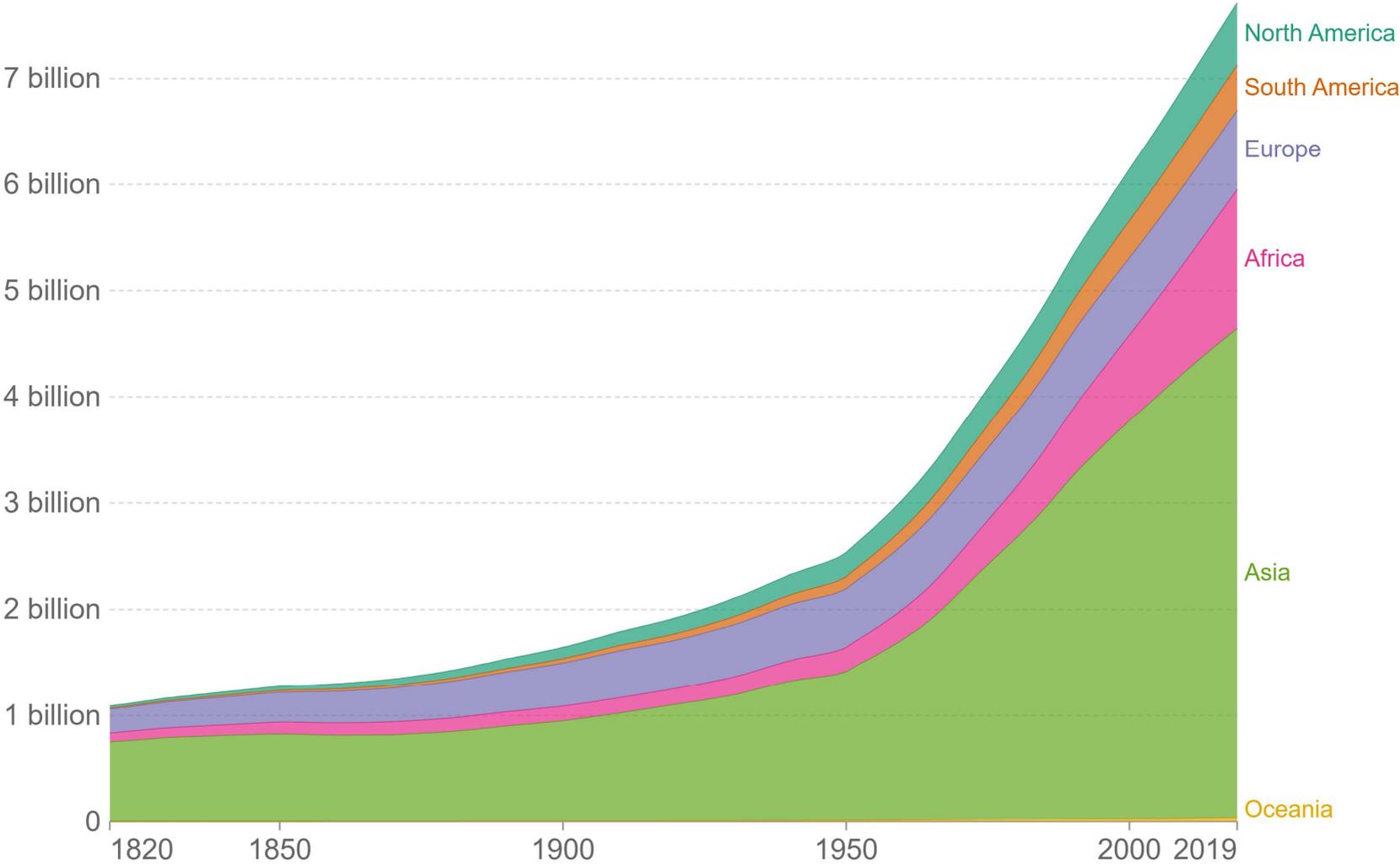
However, passive safety is less economically sustainable than active safety

- REQUIRES CONSTRUCTION/DECONSTRUCTION /RENOVATION
- REQUIRES ENERGY
- COSTS MORE
- IS OFTEN ONLY INTRODUCED IN HIGH-END BUILDS

Richard: Social Aspects of Fire and Sustainability

- 南アの耐火構造研究者 : Global Southの代表選手として登場
- 世界人口の推移・今後の予測
 - 20世紀の半ばに激増を開始
 - アフリカのインパクトが拡大中
- Global South固有の火災リスク紹介
 - 大都市にある高層建物は欧米に引けを取らない
 - Informal settlementsの抱える問題
 - たちまちに蔓延るスラム街
 - 高密度の密集市街地で消防のアクセスは困難を極める

World population by region



Source: Gapminder (v6), HYDE (v3.2), UN (2019)

A new “Great Fire of London”?



https://en.wikipedia.org/wiki/File:Great_Fire_London.jpg



2017/03/11: Imizamo Yethu, Hout Bay, South Africa



Webinar 3: **Research Directions** in Sustainability and Fire



- Greg Baker, University of Canterbury, New Zealand: モデレーター
- Xinyan Huang, The Hong Kong Polytechnic University, China
- Zahra Jandaghian, National Research Council Canada, Canada
- Grunde Jomaas, University of Primorska, Slovenia

Xinyan : Fire Challenges of Buildings w/ Emerging Energy Systems

- 香港の建築環境・エネルギーの研究者
- 「歴史は繰り返される」
 - 中国内陸の都市の思い出: 集合住宅と工場や発電所が混在する都市
 - 現代: 中小規模の発電施設・変電所・電池・充電施設が遍在するスマートシティ
- 充電塔 + 駐車場の具体例の紹介あり
 - 映像から深センの施設と推定される



Charging tower + Parking:
10-storey structure
charging 400 EVs (15 MW)
71 power distribution cabinets
9 sets of 2-MW transformers



螺旋式の空中充電塔

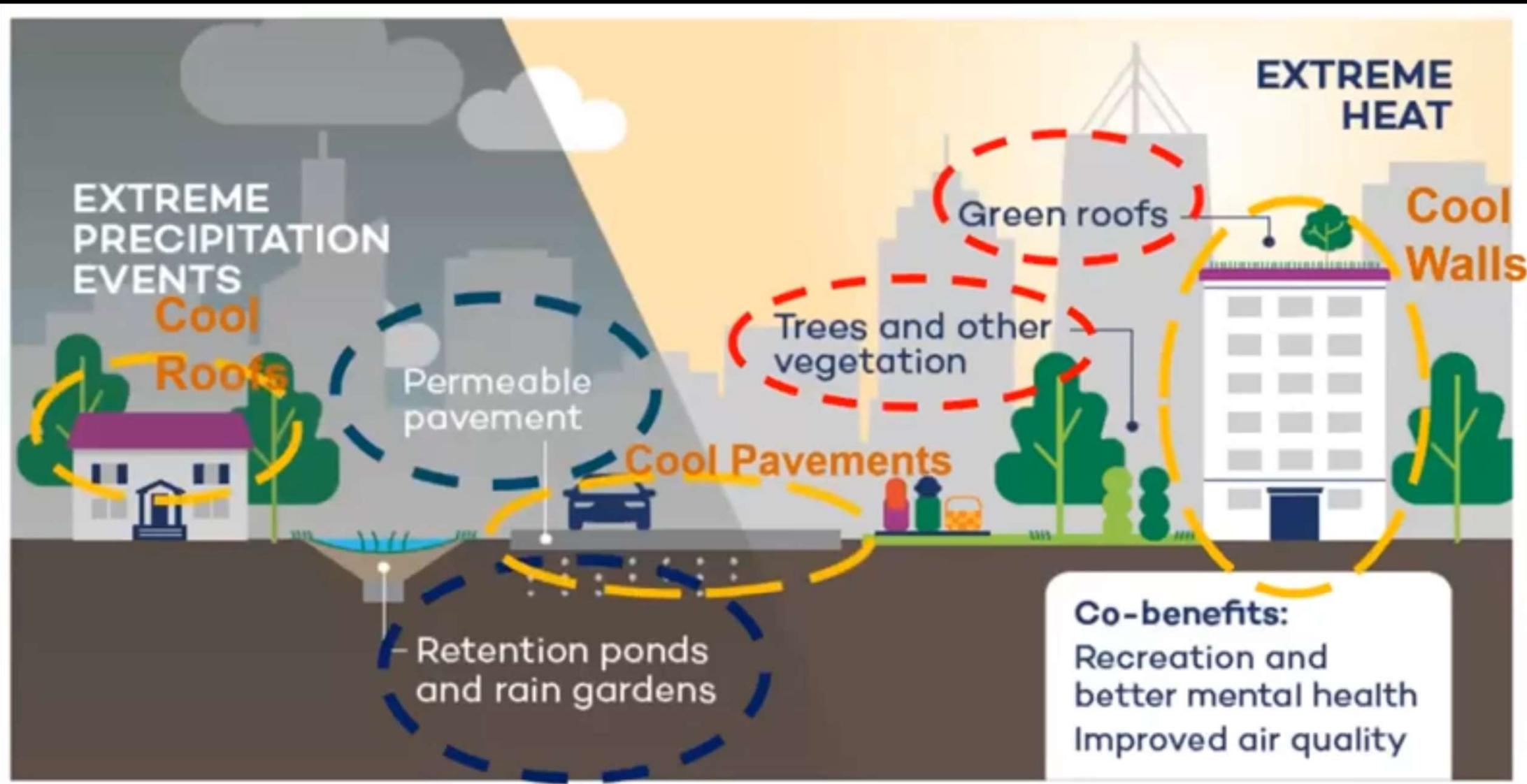
BYD “Build Your Dream” / 比亞迪 / ビーワイディー, 深セン



Zahra: Nature-based solutions for climate resiliency / sustainability

- カナダでNature-based solutionsの研究
- Nature-based は植栽の応用
 - 晴れた日: ヒートアイランドの抑制
 - 雨の日: 都市の水害の抑制
- 他の土木構造と連携する
 - 地下の貯水池
 - 保水性の道路: 夏の冷却効果も兼ねる

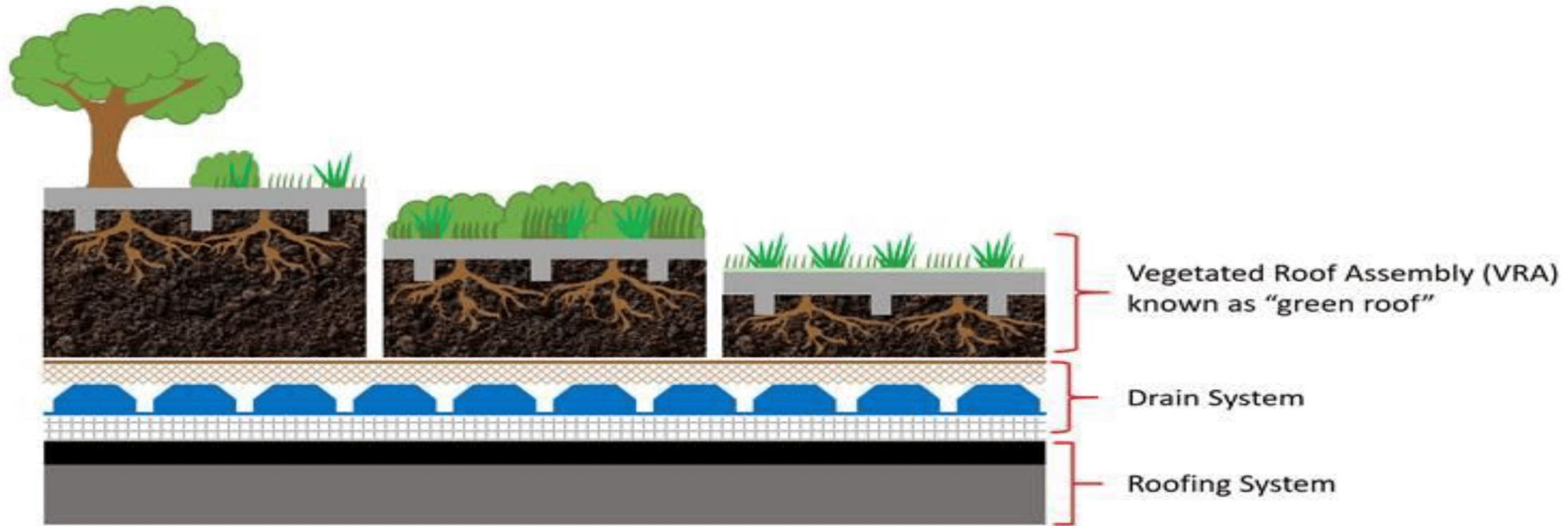




Intensive VRA

Semi-intensive VRA

Extensive VRA





Test Lab, University of Toronto



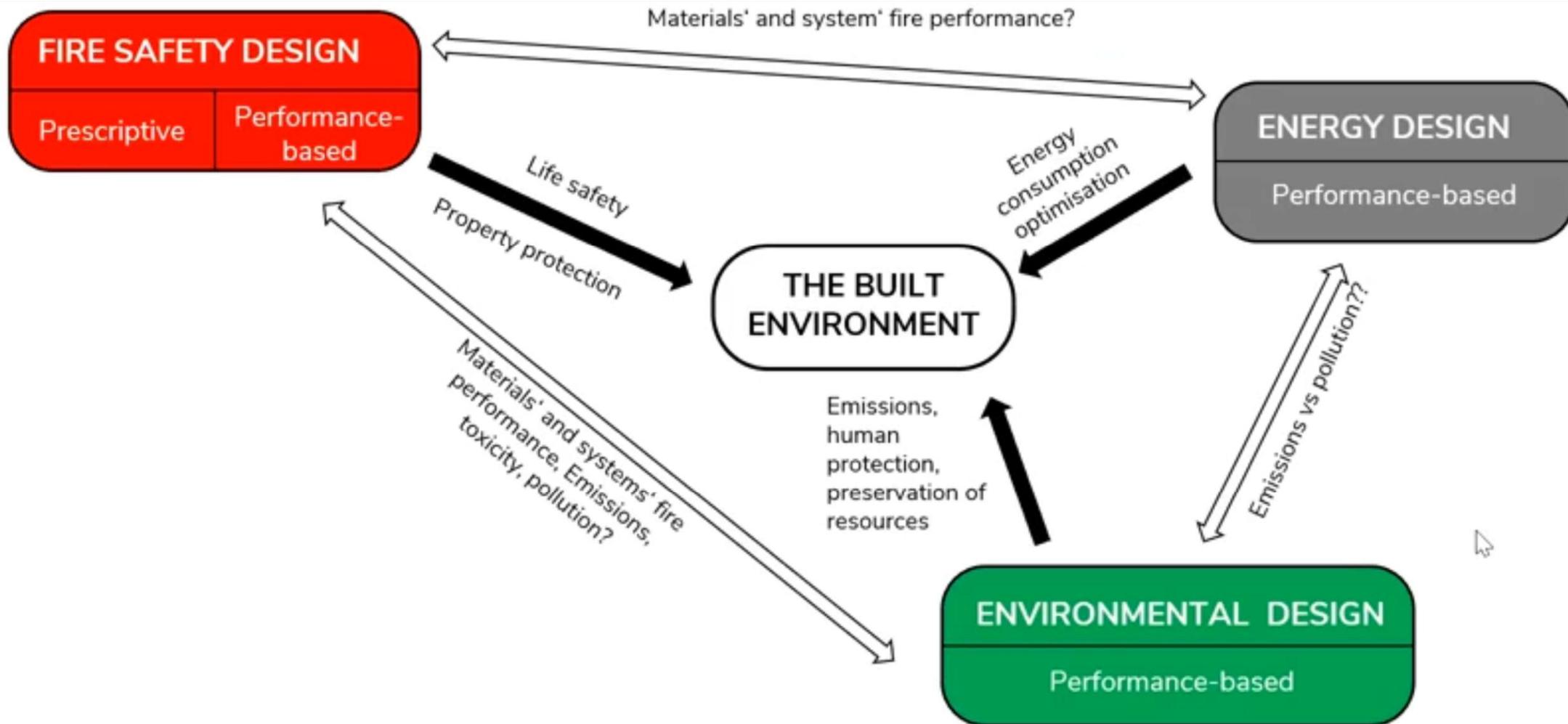
Rooftop Farm, Metropolitan University

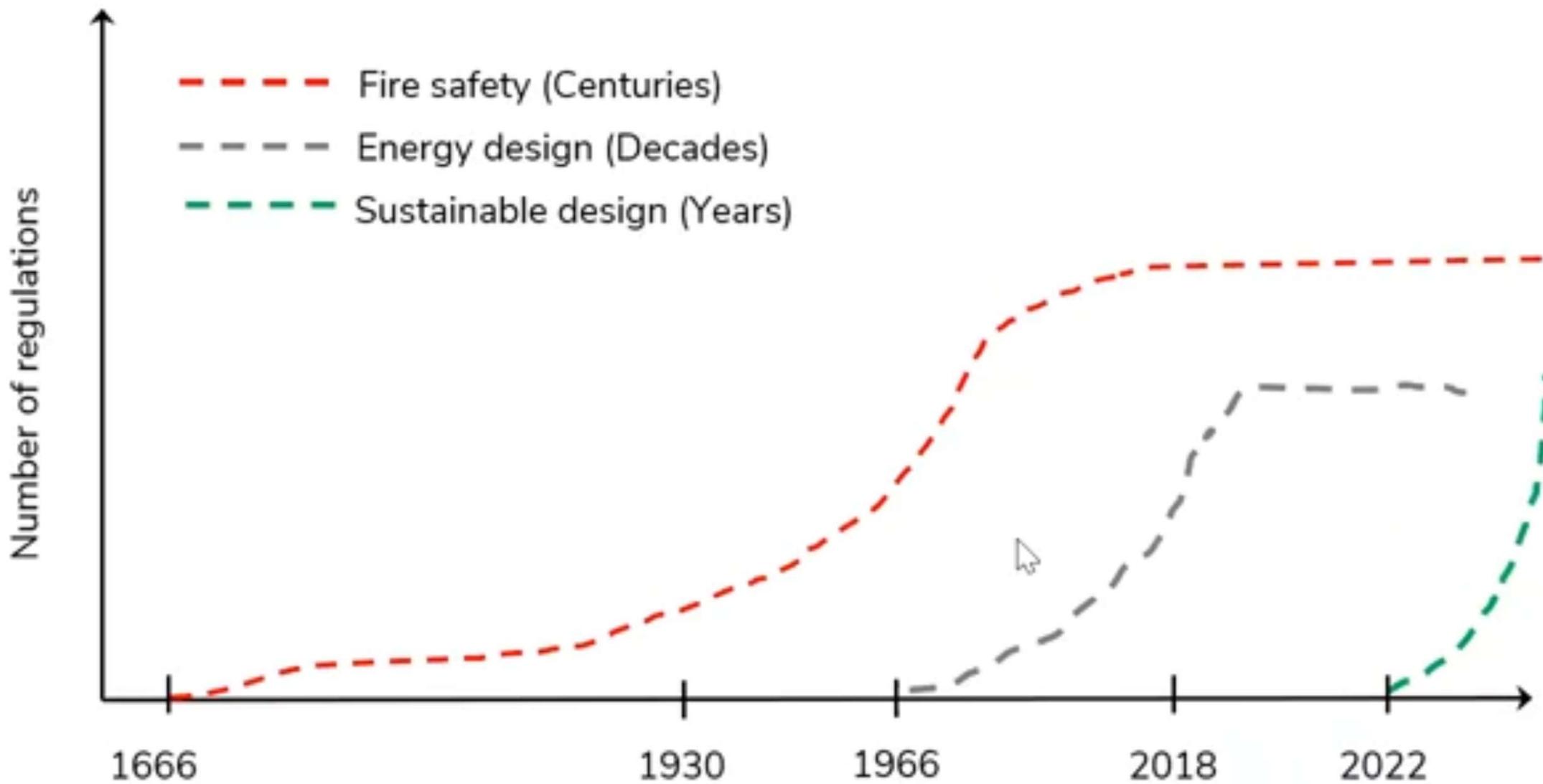


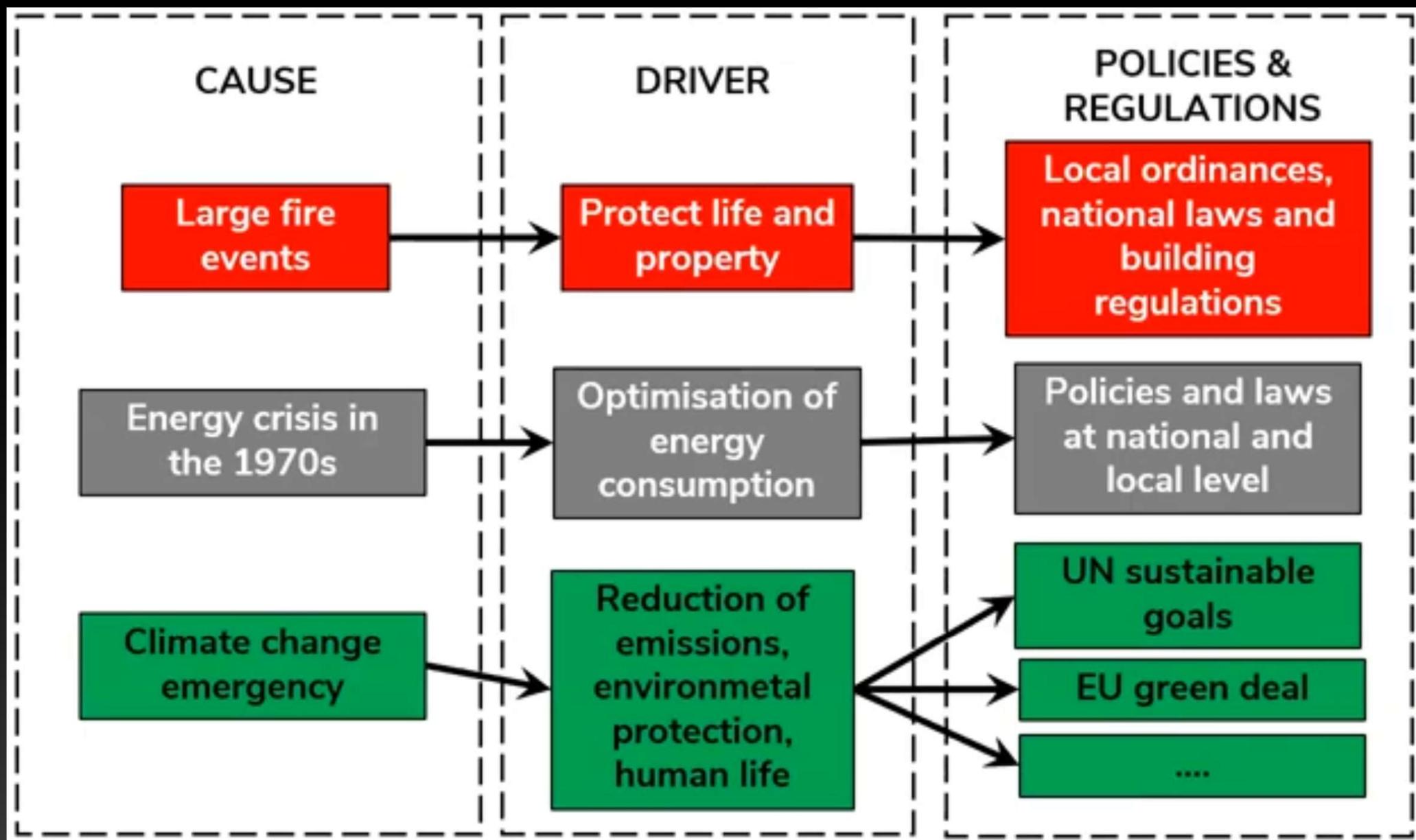
Green Roof, Humber College

Grunde: Emerging fire research to support long-term sustainability

- スロヴェニアの研究機関: FRISSBE, ERA Chair holder
- 欧米大学を歴任: Maryland, Paris, DTU, Edinburgh, ...
- 3つの設計目標の比較: **防火** / **エネルギー** / **サステナビリティ**
 - 歴史: 昔から / 石油危機より / 地球温暖化より
 - 目標: 火災被害の緩和 / エネルギー効率向上 / 温暖化ガスの削減
 - 規制数の推移







まとめ

「火災」と「サステナビリティ」から学んだこと

- サステナビリティの第一義は「**発展**」の「持続可能性」である
 - 「持続可能性」に三つの切り口：環境、社会、経済
 - **発展**を経験した「北」、**発展**を期待する「南」の対話の重要性
 - 「欧米亜」各地域の社会からの講師が対話、情報を共有した
 - 火災の専門外の講師も多数、貴重な情報を提供してくれた
- 「火災」と「サステナビリティ」の対話の重要性：双方向の関わり
 - Green buildings / attributesの火災安全への影響
 - 火災の結果としての環境・社会・経済的側面への影響

以上

以下は補足資料

Agenda 21の用例 : Social, economic, and environmental ...

Assess the resulting **social, economic and environmental impacts**;

Ecosystemic interactions and interactions between land resources and **social, economic and environmental systems**;

Projects should take advantage of opportunities to link **social, economic and environmental gains** for women and their families.

Strengthen regional interdisciplinary projects and establish integrated pest management (IPM) networks to demonstrate the **social, economic and environmental benefits** of IPM for food and cash crops in agriculture;

As sustainable development encompasses **social, economic and environmental dimensions**, it is also important that national accounting procedures are not restricted to measuring the production of goods and services that are conventionally remunerated.

The overall human settlement objective is to improve the **social, economic and environmental quality of human settlements** and the living and working environments of all people, in particular the urban and rural poor.

Governments, in collaboration with the national and international scientific community and in cooperation with international organizations, as appropriate, should intensify efforts to clarify the interactions between and within **social, economic and environmental considerations**.

Governments, in collaboration, where appropriate, with national and international organizations, should review the status of the planning and management system and, where necessary, modify and strengthen procedures so as to facilitate the integrated consideration of **social, economic and environmental issues**.

Providing enhanced training and technical assistance to institutions providing training for technicians, professionals and administrators, and appointed, elected and professional members of local governments and strengthening their capacity to address priority training needs, particularly in regard to **social, economic and environmental aspects of human settlements development**;



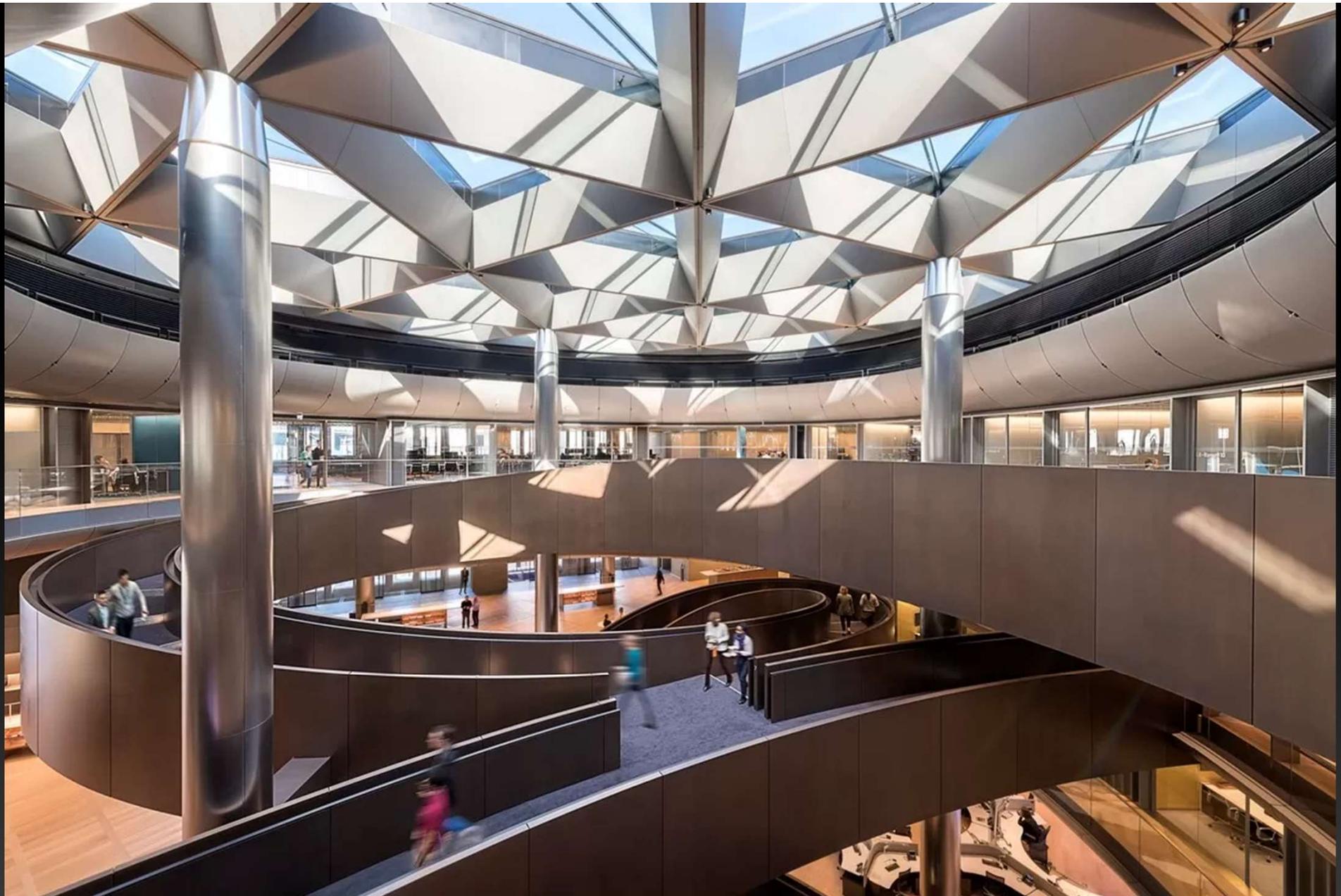
Norman and Bucky, the mentor

Galerie 1

NORMAN FOSTER

10 mai – 7 août 2023





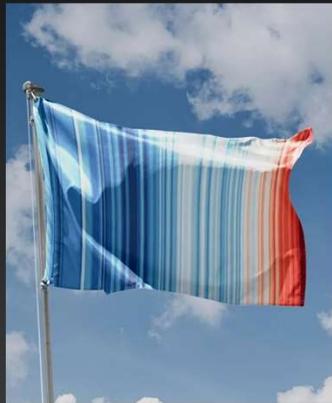
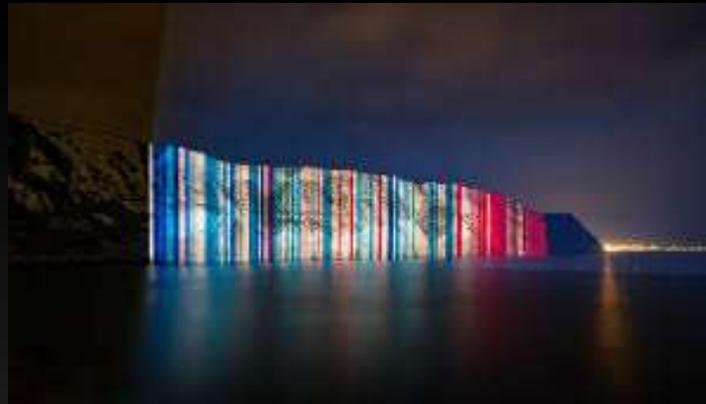
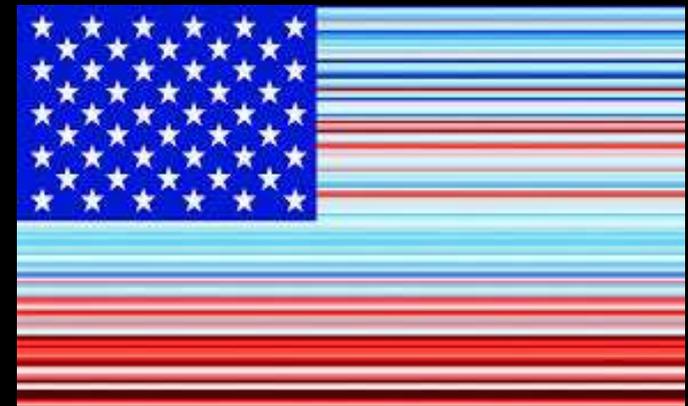


Foster + Partners

Sustainability and Fire

Setting the scene

SFPE
Engineering a Fire Safe World



Fire is a black elephant



"A cross between a black swan (rare, hard-to-predict events with a large impact) and the proverbial elephant in the room. The black elephant is a problem that is actually visible to everyone, but no one wants to deal with it, and so they pretend it is not there. When it blows up as a problem, they all feign surprise and shock, behaving as if it were a black swan."

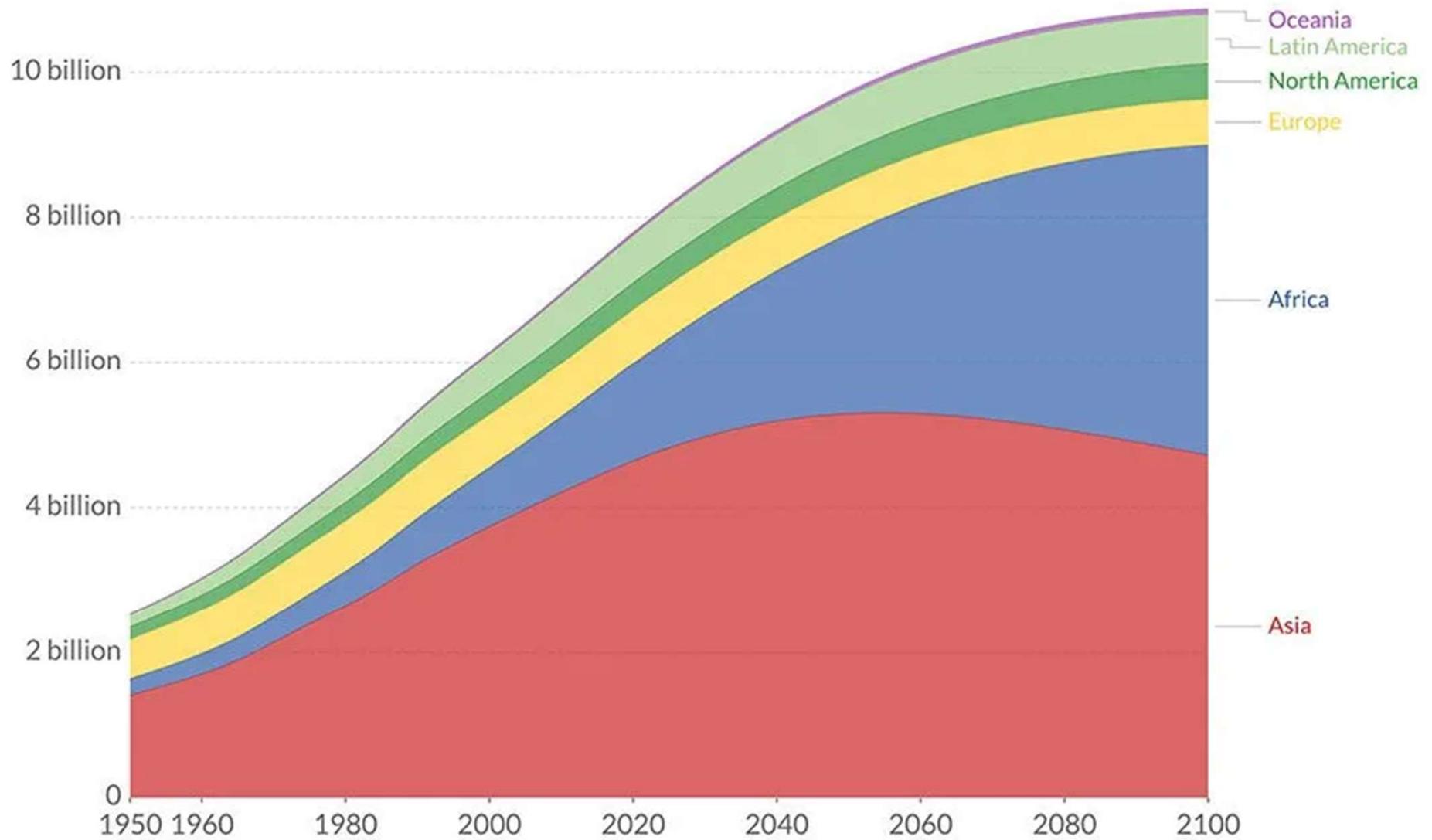
Elephant in the room = 部屋にいる「象」:
誰にも見える厄介者だが、
できれば話題にしたくない

Black swan = 「黒い」白鳥: 稀で予期不能な破局的事象

Black elephant = 誰もが知らないわけじゃない、
稀に生起する破局的な災害など、
普段は忘れていたいけれど、
いざ発生すれば皆は驚愕する

World population by region projected to 2100, 1950 to 2100

Projected population to 2100 is based on the UN's medium population scenario.



BYD/比亞迪/ビ・ヤ・ディ : Build Your Dreamの頭文字 !

BYD, 2023年純利益速報値は前年比で最大87%増

—市場予想は下回る

Evelyn Yu 2024年1月29日 22:11 JST

中国の電気自動車(EV)メーカー最大手, 比亞迪(BYD)の2023年通期純利益は速報値で290億—310億元(約5980億—6400億円)となり, アナリストの予想平均である315億元を下回った。同社が29日に深圳証券取引所に提出した文書で明らかになった。

BYDは同年中にドイツのフォルクスワーゲンを抜き, 中国で販売台数首位のブランドに躍り出た。

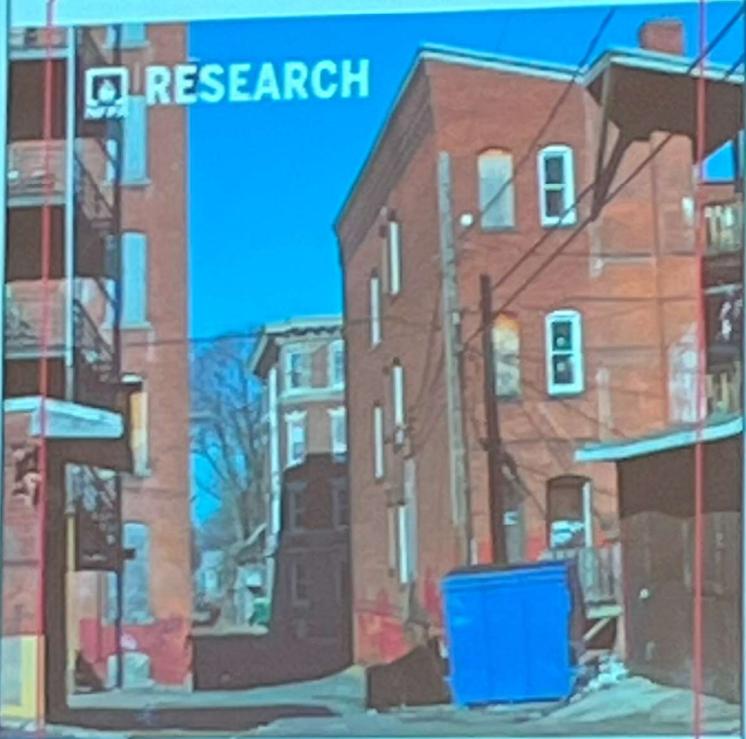
23年の業績についてBYDは, 国外販売の増加とコスト管理により利益が伸びたと説明。速報値は前年比で74.5%から86.5%の増益となる。

<https://www.bloomberg.co.jp/news/articles/2024-01-29/S80WQ2T0AFB400>



Poverty and the Risk of Fire

Invisible US Fire Problem

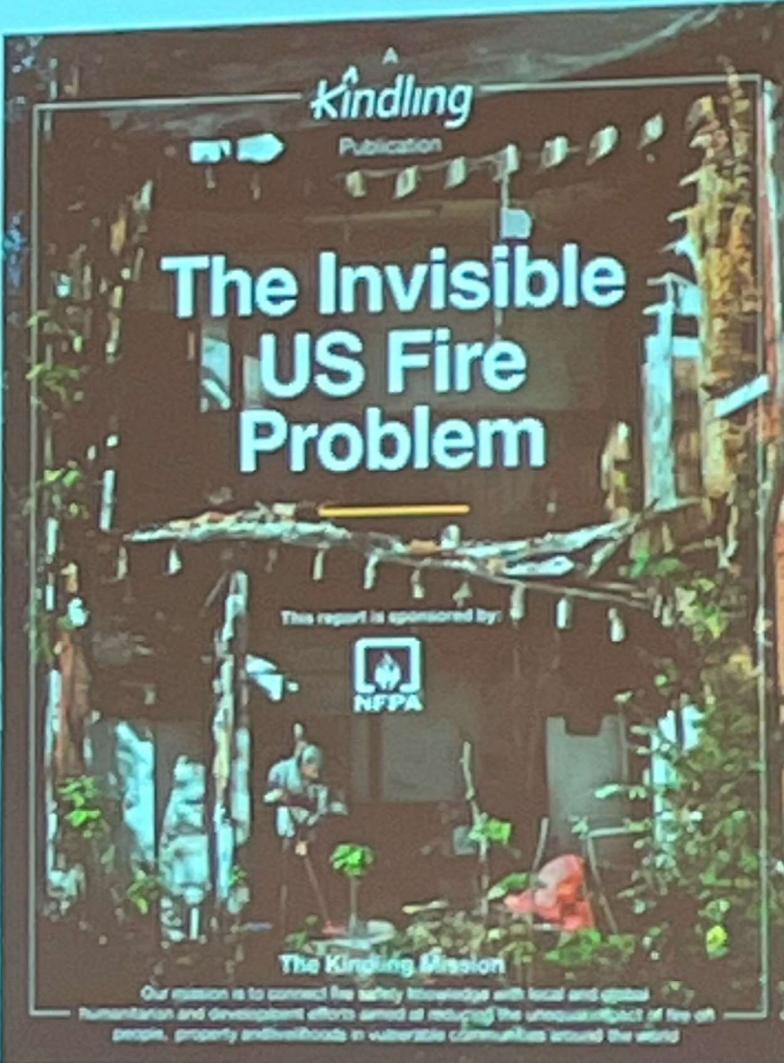


RESEARCH

Poverty and the Risk of Fire
Rita Fahy, Ph.D. and Radhika Maheshwari
July 2021

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[ospoverty.pdf \(nfpa.org\)](#)



A
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Publication

**The Invisible
US Fire
Problem**

This report is sponsored by:
NFPA

The Kindling Mission
Our mission is to connect fire safety knowledge with local and global humanitarian and development efforts aimed at reducing the unequal impact of fire on people, property and livelihoods in vulnerable communities around the world.

[oainvisibleUSFireProblem.pdf \(nfpa.org\)](#)

Building Vulnerability & Fire Risk

