BRE Global

Protecting People, Property and the Planet

Construction trends – impacts, challenges and opportunities through research

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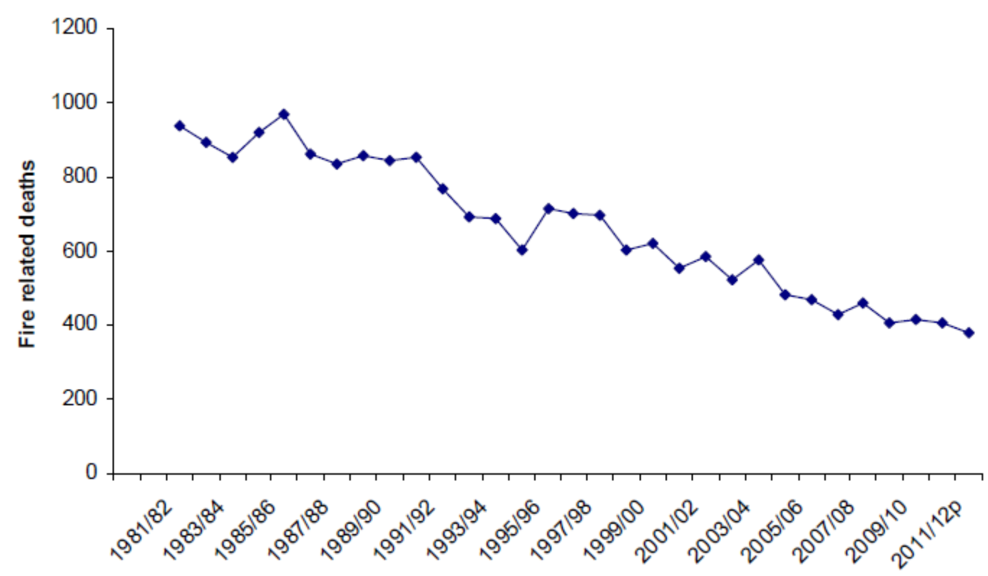
Part of the BRE Trust

Trend in fire deaths in the UK since 1981

Department for Communities and Local Government

Figure 1.4: Fatalities from fires, Great Britain, 2000/01 – 2011/12



p= provisional

Some regulatory changes

- Smoke alarms (1992)
  - 8% in 1988
  - 74% in 1994
  - 86% in 2008

- Furniture and furnishings fire safety regulations introduced in 1988
  - Match resistance
  - Cigarette resistance

- Reduced ignition propensity cigarettes
  - Mandatory in EU countries from November 2011
  - Impact not yet clear

- Construction Products Regulation
  - Mandatory CE marking for all construction products placed on the market in EU countries from 1st July 2013

Our world is continuing to change

– Most significant changes in building technology have been occurring over the last 20 years

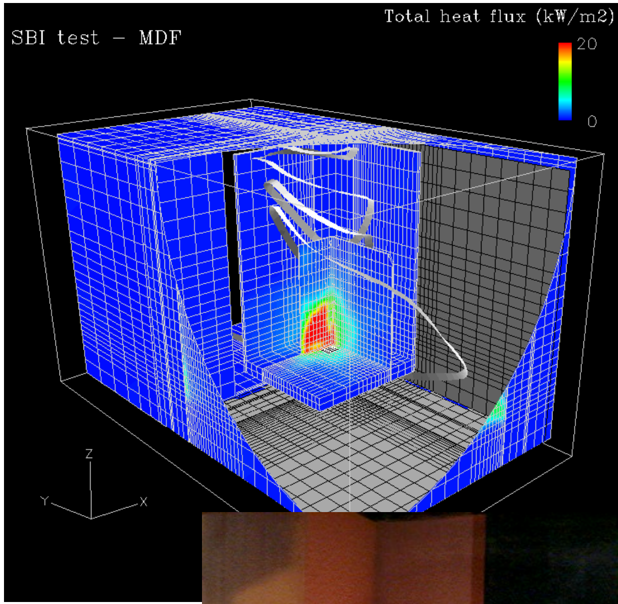
– Moved from traditional construction (e.g. masonry, heavy) to more lightweight, easier and faster to construct

– Driven by needs to;
  – Reduce energy consumption during use
  – Reduce waste during construction and use
  – Reduce end of building life environmental impact by consideration and focus reduction of hazardous materials, recycling and re-use

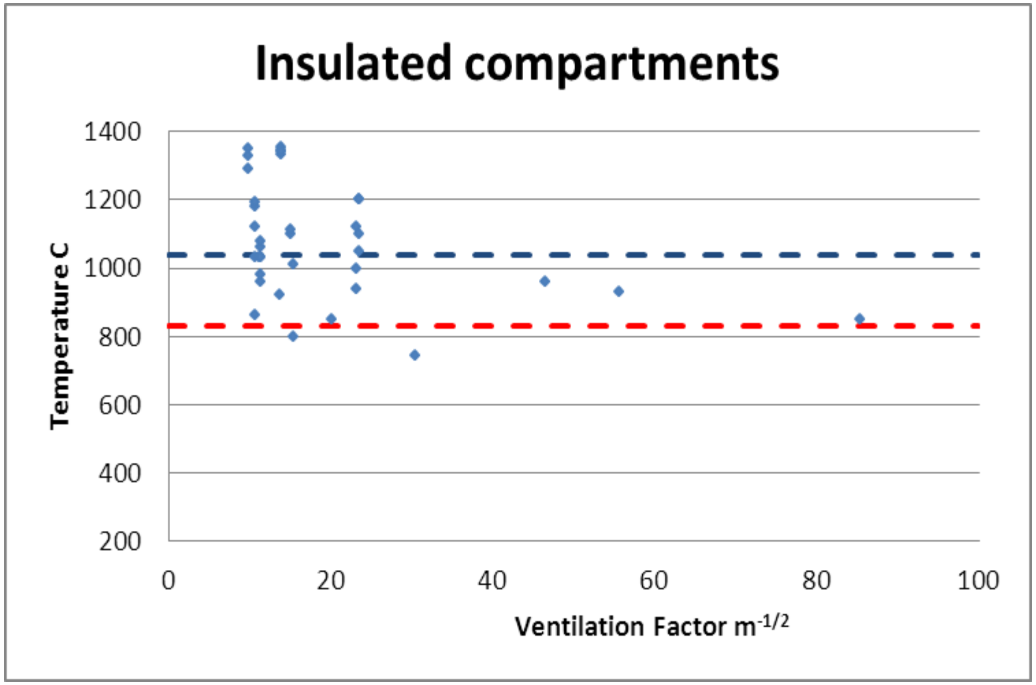
New construction technologies

Some issues we face

- No historical database available to assess performance of new systems, construction methods
- Possibility of systematic faults/poor quality of installation
- Use of new materials (in particular increasing use of highly insulating combustible materials to reduce energy demand)
- New methods for testing and benchmarking fire performance of products and systems
- New requirements for air tightness in buildings
- Levels of safety and property protection unknown
- Possibility of disproportionate damage



Impact of insulation on compartment temperatures
(U values 0.8 to 3 W/m2/ ºC)



Current Building regulations
U values between
0.16 and 0.28 W/m2/ ºC

$m^{-1/2}$

Moore, D and Lennon, T. ‘The natural fire safety concept - full scale tests at Cardington’ Vol. 38, pp. 603-643. *Fire Safety Journal.* 2003,

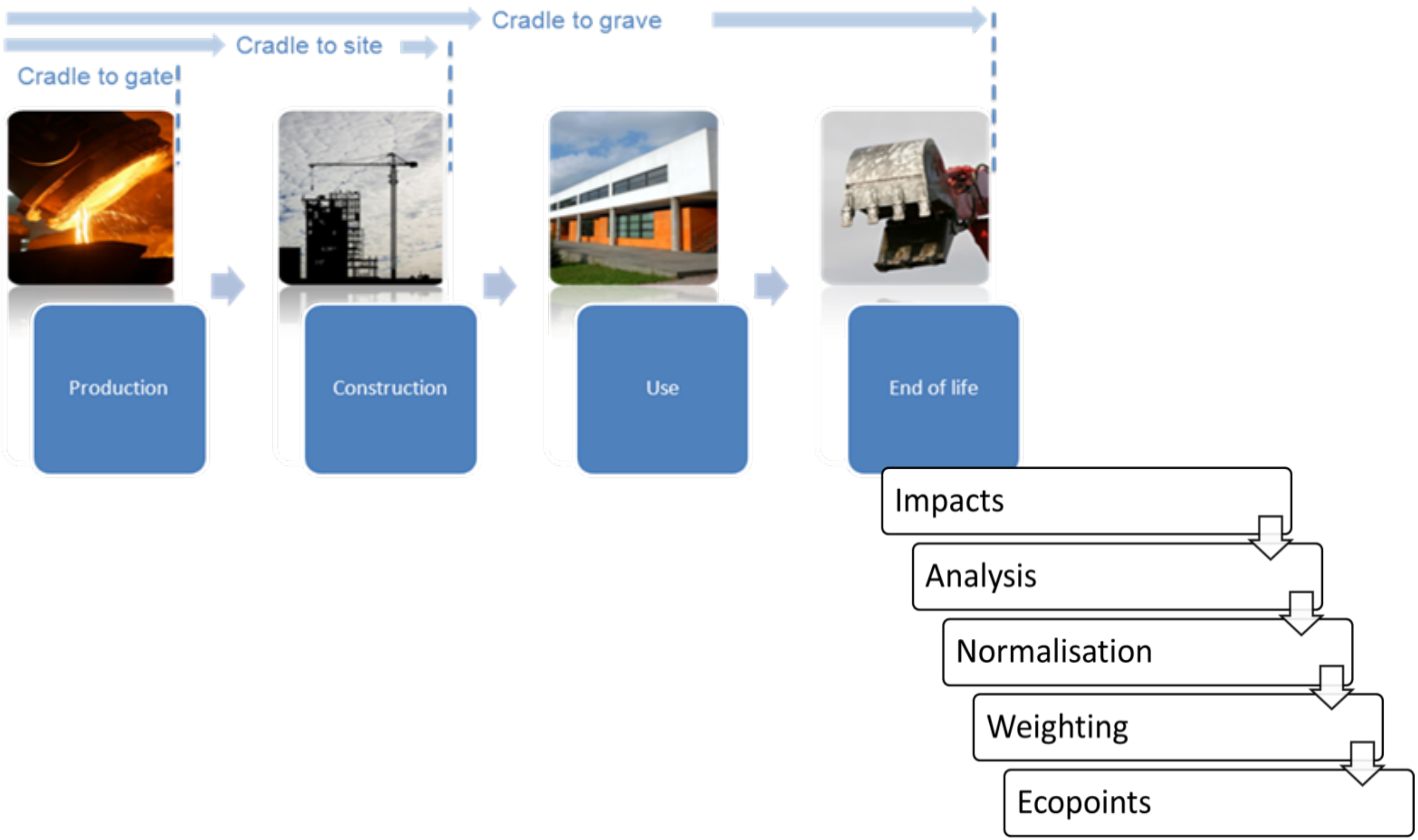
Research opportunities

- To assess impacts, support innovation and resolve challenges
- Maintain or improve safety levels
- Reduce fire losses from property damage and business interruption
- The following is an example of a recent research study that we have undertaken to determine whether it is cost effective to install and maintain fire sprinklers in warehouses in England and Wales
  - First detailed study that considers the sustainability aspects within the analysis i.e. environmental, societal and economic impacts

Sprinklers in warehouses

- The first part of the project was a “cradle to site” assessment of an ‘average’ warehouse fire, considering both the environmental impacts and the monetary costs.
- The second, larger phase of our research, which was the primary focus of the study, looked at a whole-life cost benefit analysis for the installation of sprinklers, for three ranges of warehouse sizes.

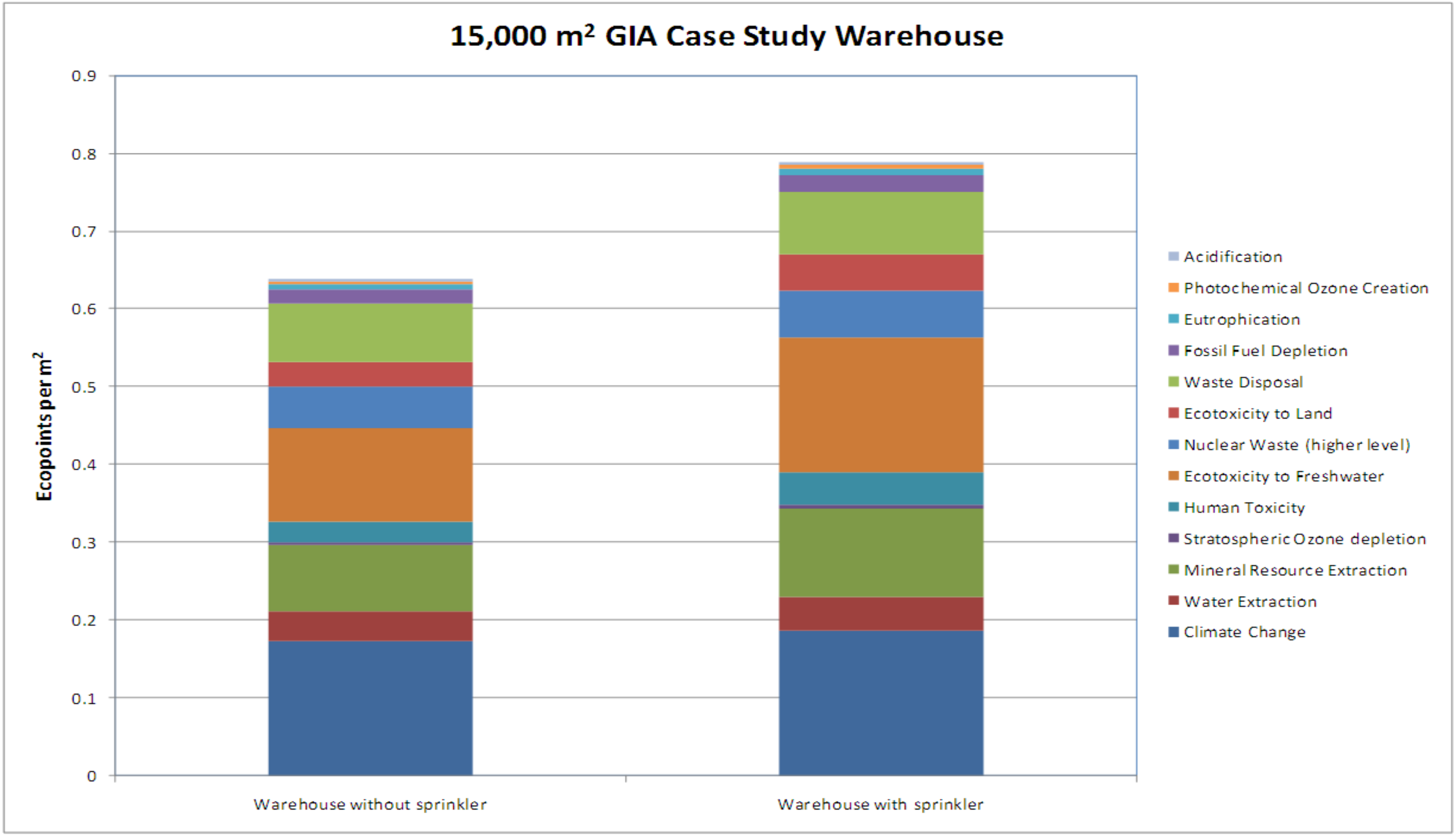
Life cycle stages using BRE Methodology to calculate Ecopoints



Contents specification for the case study warehouse

50% class II commodity (non-combustible contents in heavy carton) and 50% standard plastic (combustible plastic contents). The content loading was assumed to be 75% of the total warehouse capacity

Ecopoints results



Whole life cost benefit analysis

- Generic warehouse buildings were categorised in three size ranges:
  - small, 0 to 2,000m^2,
  - medium, 2,000m^2 to 10, 000m^2 and
  - large, greater than 10, 000 m^2.
- The frequency of fires per (building.year) were estimated from the statistics for the number of buildings of a given type, the estimated proportion with sprinklers, and the number of fires observed.
- Consequences expressed in terms of;
  - Fire and smoke damage
  - Deaths and injuries
  - Carbon dioxide emissions or embodied carbon dioxide
  - Water usage
  - Unemployment
- Monte Carlo calculation method was developed and applied to this problem

Results – Breakdown of average costs considered

Quantity	"Small" warehouse (< 2,000 m²)		"Medium" warehouse (2-10,000 m²)		"Large" warehouse (> 10,000 m²)	
	No sprinkler	*Sprinkler*	*No sprinkler*	*Sprinkler*	*No sprinkler*	*Sprinkler*
Cost of total area damaged	£116,427	£37,540	£1,511,289	£36,663	£1,861,284	£37,907
Cost of injuries	£658	£1,692	£2,217	£1,674	£2,448	£1,634
Cost of fatalities	£6,602	£17,665	£23,228	£17,808	£25,551	£17,686
Cost of CO_2 released in fire	£202	£20	£2,661	£20	£2,659	£20
Cost of CO_2 embodied in replacement	£537	£52	£7,081	£52	£7,077	£53
Cost of water used in firefighting	£5,017	£3,609	£8,376	£3,579	£5,666	£3,599
Cost of CO_2 embodied in rebuild	£106	£13	£866	£8	£649	£10
Cost of unemployment	£15,818	£1,822	£196,268	£1,655	£192,518	£2,706
Total costs	**£145,364**	**£62,410**	**£1,751,983**	**£61,457**	**£2,097,849**	**£63,612**

(Values quoted in 2010 prices, and based on best estimates of fire and smoke damage costs)

Results – Average whole life costs (warehouse buildings)

(Values quoted in 2010 prices, and based on best estimates of fire and smoke damage costs)

Quantity	"Small" warehouse (< 2,000 m^2)		"Medium" warehouse (2000-10,000 m^2)		"Large" warehouse (> 10,000 m^2)	
	No sprinkler	Sprinkler	No sprinkler	Sprinkler	No sprinkler	Sprinkler
Total cost of fire	£21,895	£16,059	£845,065	£22,093	£3,824,157	£14,695
Cost of insurance over lifetime	£32,630	£16,315	£139,604	£69,804	£723,504	£361,731
Total cost of sprinklers		£66,349		£184,551		£848,029
Total Whole Life Costs	£54,525	£98,722	£984,669	£276,448	£4,547,661	£1,224,454

Conclusions 1

- For warehouses larger than 10,000m^2, the average whole life costs for buildings with sprinklers are between 2 and 5 times smaller than the corresponding average costs for buildings without sprinklers. A similar level of cost-effectiveness was found for warehouses between 2,000 and 10,000m^2 in area.
- Sprinklers were, on average, not cost-effective in warehouses with an area below 2,000 m^2. The lifetime referred to is that of the sprinkler system, which is on average, 45 years.

Conclusions 2

- There is an overall net environmental benefit to installing sprinklers including a reduction in CO_2 emissions from fire, reduced size of fire, reduced quantities of water used to fight fire and resultant embodied CO_2 savings from contents replacement and warehouse rebuild
- It is estimated that 20% of warehouses between 2,000 and 10,000m^2 in area are fitted with sprinklers. For warehouses above 10,000m^2 in area, the estimated fraction with sprinklers is 67%. In a hypothetical scenario where all warehouses above 2,000m^2 in area are fitted with sprinklers, the study indicates that the annual saving in the UK could be between £60m and £210m.
- Full version of final report available at;

  http://www.business-sprinkler-alliance.org/wp-content/uploads/downloads/2014/01/BRE-Report.pdf

Finally….

- Investing in solving fire protection problems through research and collaboration
  - In 2003, the first BRE University Centre of Excellence was set up here at Edinburgh – BRE Centre for Fire Safety Engineering
  - Through education and research, the BRE Trust (a charity) promotes and supports excellence and innovation in the built environment for the benefit of all
    - Funding has been provided to support
      - Chair of Fire Safety Engineering(Prof.Jose Torero and now Prof. Albert Simeoni)
      - 12 PhDs – the next generation of leaders in the field

Thank you for listening

– Any questions ?

– Ackowledgements to colleagues at BRE;
  – Richard Chitty
  – Jeremy Fraser-Mitchell
  – Owen Abbe
  – Corinne Williams