



The Integral Role of Fire Protection in Sustainability

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Sustainability Defined



“Meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

*Report of the World Commission on Environment and Development:
Our Common Future, Chapter 2: Towards Sustainable Development.
Document A/42/427, United Nations. 1987*

Risk and Sustainability



Critical objectives for environmental and developmental policies include:

“reorienting technology and managing risk”

Loss prevention and property conservation are integral components to sustainability.

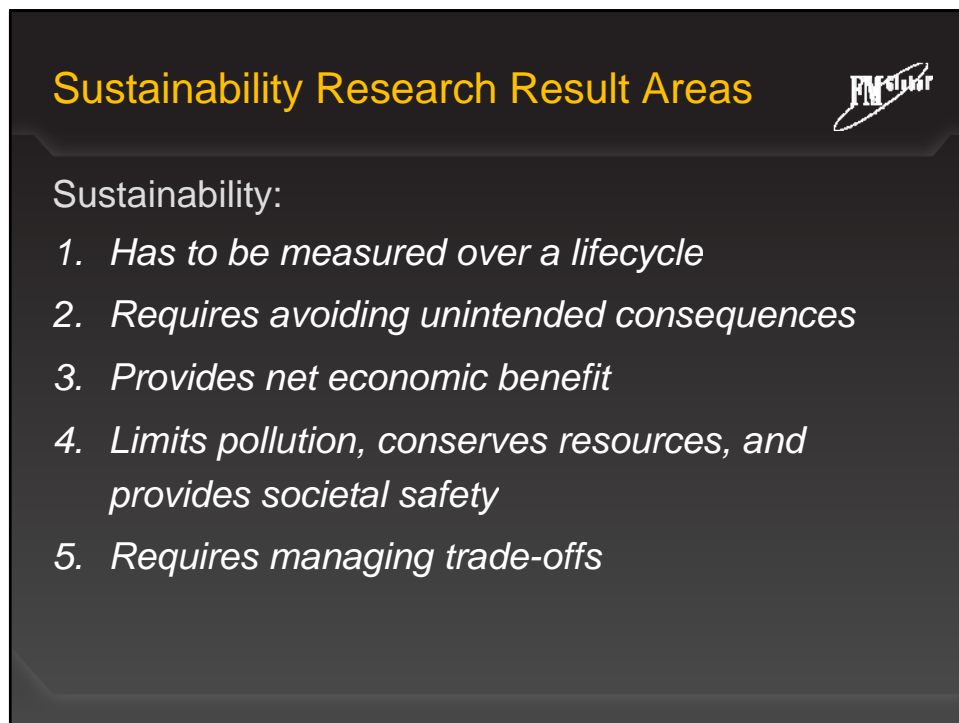
*Report of the World Commission on Environment and Development:
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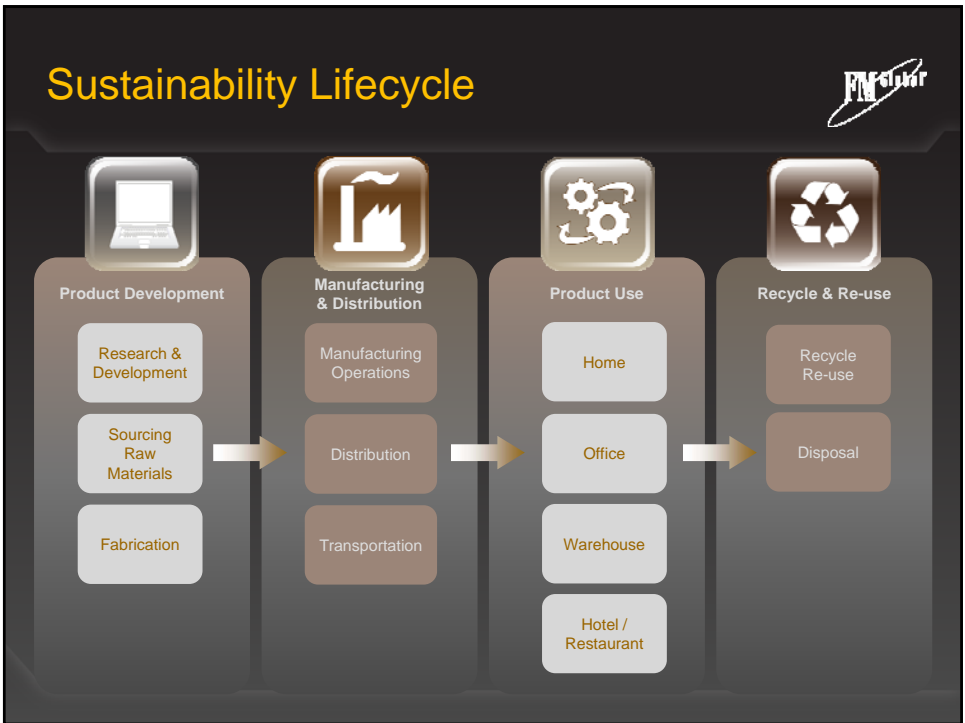
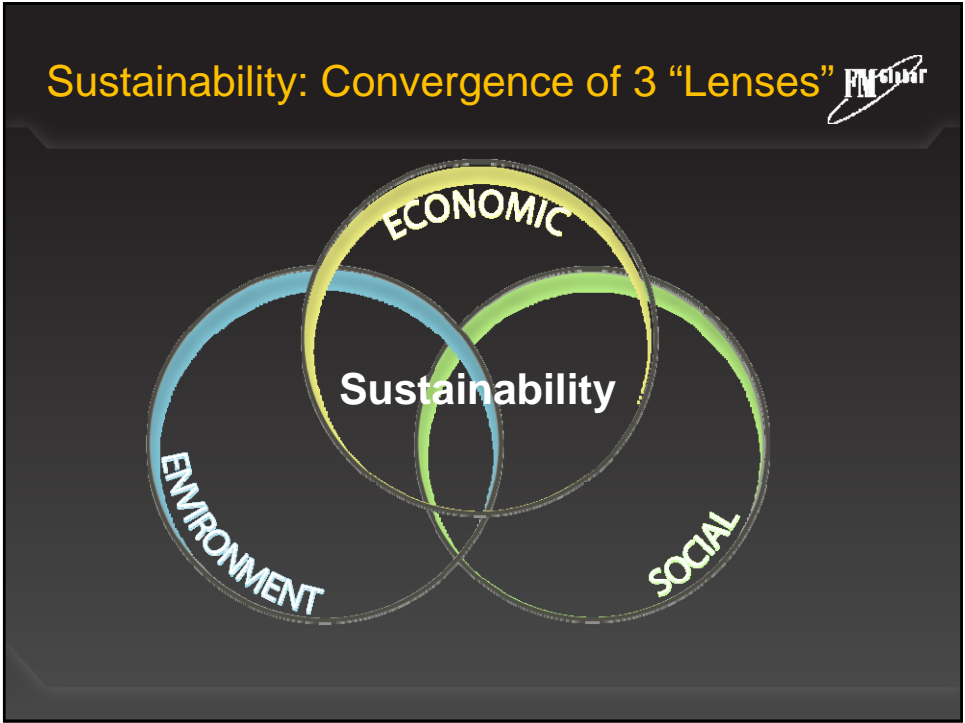
FM Global – The Company



Sustainability has always been an interwoven part of the core values of our company since our inception in 1835.

Our belief that the **majority of loss is preventable** supports our clients' ability to sustain their businesses and the broader communities in which they operate from an economic, societal and environmental point of view.





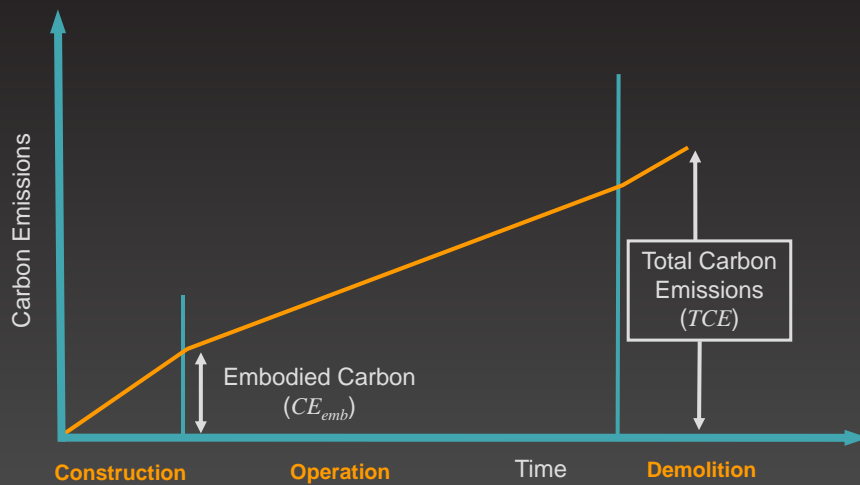
Research Result Area 1: Risk Factor Lifecycle Analysis



*Sustainability of building construction has to be measured over the lifetime of its use
- including all risks along the way.*



Research Result Area 1 : Risk Factor Lifecycle Analysis



Research Result Area 1 : Risk Factor Lifecycle Analysis



Risk Fraction (RF) = Fraction of Total Lifecycle Carbon Emissions due to Risk

$$RF_{fire} = f_f * LT * \left(\underbrace{\frac{F_b * m_f * e_{CO_2}}{TCE}}_{\text{Fire}} + \underbrace{\frac{F_r * CE_{emb}}{TCE}}_{\text{Rebuild}} \right)$$

- f_f = Fire Frequency
- LT = Building Lifetime
- F_b = Fraction Burned
- F_r = Fraction Replaced
- m_f = Fuel Loading
- e_{CO_2} = emission fraction
- CE_{emb} = Embodied Carbon
- TCE = Total Carbon Emissions

$$RF_{AFS} = RF_{fire} / F_{AFS}$$

F_{AFS} = Reduction in Risk
with Automatic Fire
Sprinklers

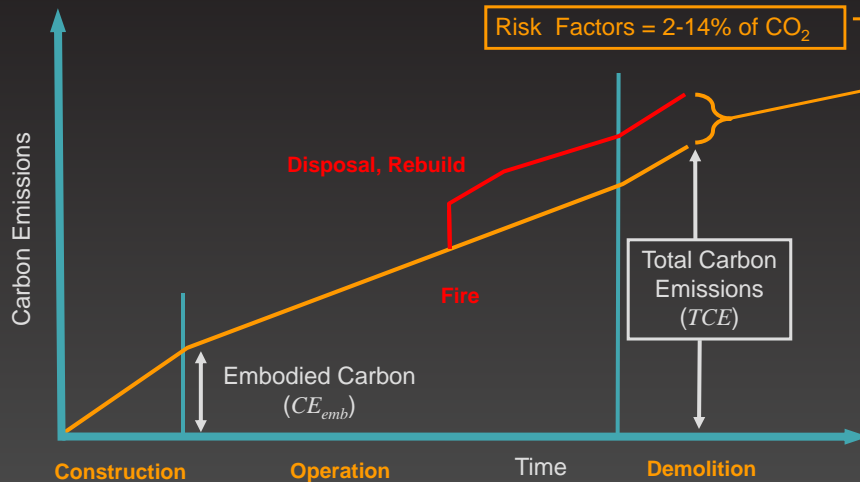
Analysis Values from Literature/FM Data



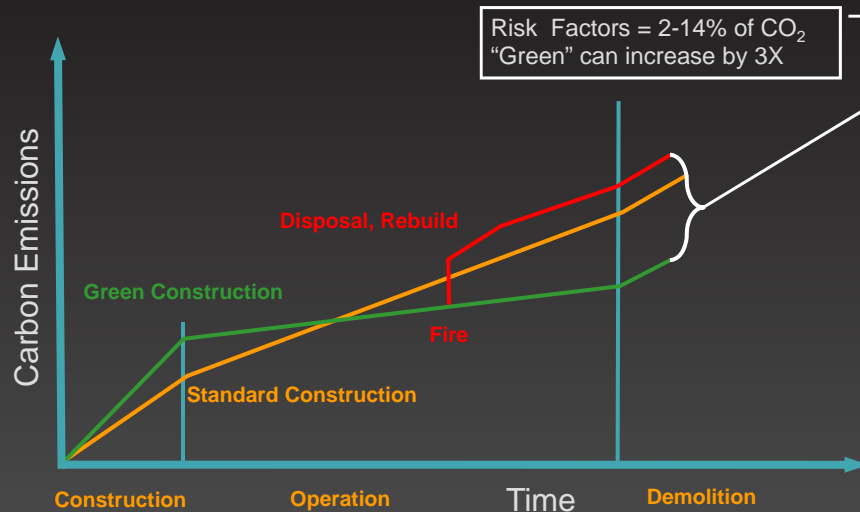
Symbol	Parameter, units	1: Current Std. Office Building	2: Office Building, Reduced Operating Emissions	3: High Hazard Facility	Reference
f_f	Frequency of large* fires, fires/yr	0.001	0.001	0.016	FM Data
LT	Lifetime, yrs	40-60	50	40	Archival Literature
m_f	Fuel density, kg/m ²	38-115	110 (est)	40 (est)	NFPA
e_{CO_2}	CO ₂ per unit mass burned	3.0	3.0	3.0	Archival Literature
TCE	Total lifecycle carbon emissions, kg CO ₂ /m ²	3300-4500	2000	4000 (est)	Archival Literature
F_{emb}	Embodied fraction of total carbon emissions	0.15-0.2	0.6	0.2	Archival Literature
F_b	Fraction burned, no AFS	0.5-0.8	0.7-1.0	0.7(est)	FM Data
F_r	Fraction replaced, no AFS	0.8-1.0	1.0	1.0 (est)	FM data
F_{AFS}	Reduction in Property Loss achieved by AFS	30-40	30-40	30-40	Munich Re, FM

* Over 1\$M USD Property Damage

Research Result Area 1 : Risk Factor Lifecycle Analysis



Research Result Area 1 : Risk Factor Lifecycle Analysis



Sprinkler Effectiveness



- Comprehensive review of reported reliabilities
 - more than 50 years (1959 to present)
 - many countries (USA, Europe, Japan, Australia, New Zealand...)
 - Data compilation and analysis
- 98% or more systems operate and are effective.**
- NFPA, 2011, Bhimavirapu, et al.*

F_{AFS}	Reduction in Property Loss achieved by AFS	30-40	30-40	30-40	Munich Re, FM
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** Over 1\$M USD Property Damage*

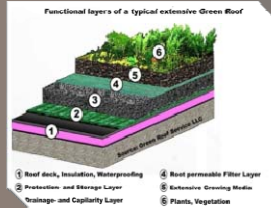
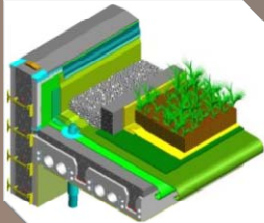
Research Result Area 2: The Risks of Going Green



Sustainability requires avoiding unintended consequences.



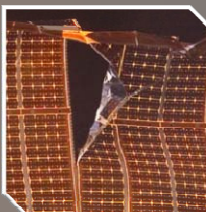
Green Roof Standards



Wind Turbine Standards



Photo Voltaic Standards



Alternative Fuel Standards



Hydrogen Fuel Cells

Ethanol/Bio-Diesel

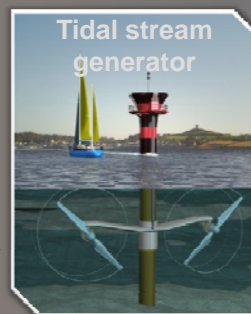
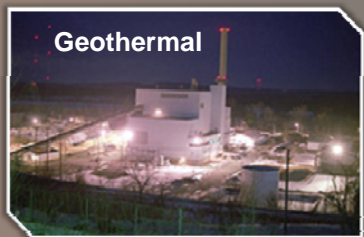
Bio-Mass



Hydrogen Fueled Forklifts



More to Come... Renewable Energy Technologies



Research Result Area 3: The Economic Impact of Loss



Sustainability provides net economic benefit.



Fire Losses



55X

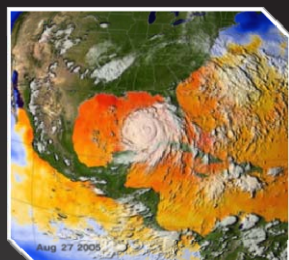
Average risk of fire loss is 55 times less with strong risk management (i.e. upper quartile RiskMark Score)*

\$4.4 Million

*Average Severity of a fire loss exceeds \$4.4 million with weak risk management (lower RiskMark quartile)
\$0.73 million with strong risk management (upper RiskMark quartile)*

*risk = average frequency X average severity

Natural Hazards



28X

Average risk of natural hazards losses are 28 times less with strong risk management (i.e. upper quartile RiskMark Score)*

\$3.4 Million

*Average Severity of a natural hazard loss exceeds \$3.4 million with weak risk management (lower RiskMark quartile)
\$0.48 million with strong risk management (upper RiskMark quartile)*

**risk = average frequency X average severity*

Research Result Area 4: Environmental and Societal Impact of Loss



Sustainability risk management includes limiting damage and pollution, conserving resources, and providing societal safety.



Two Living Room Fires

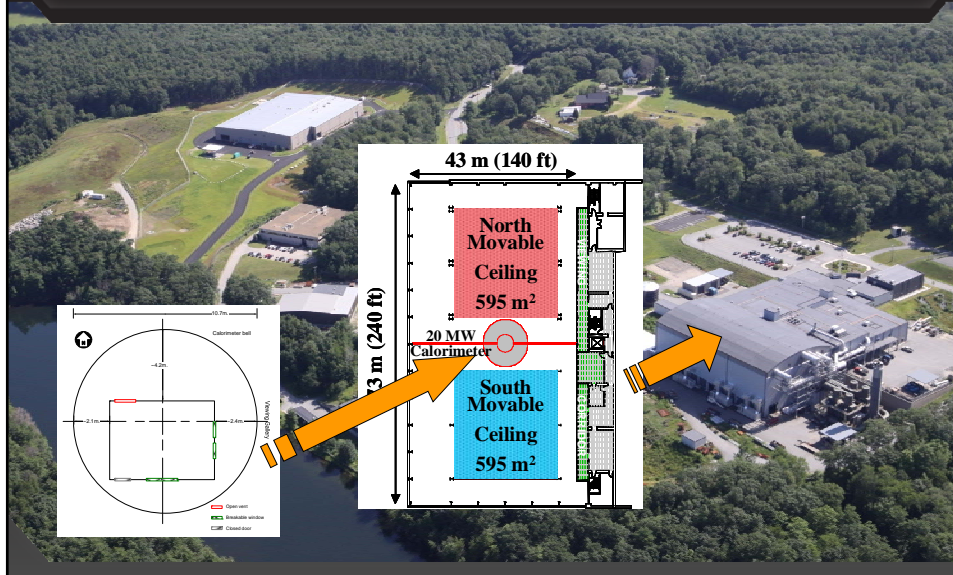


Fire Service
Response
Only

vs.

Residential Sprinkler
+
Fire Service Response

Living Room Fire Tests

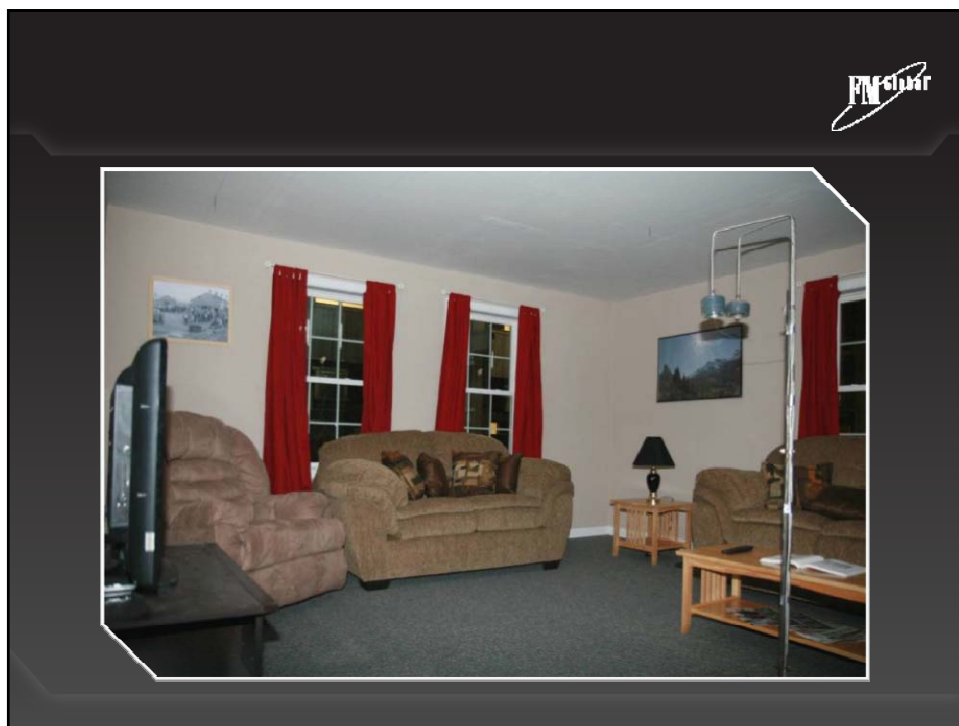


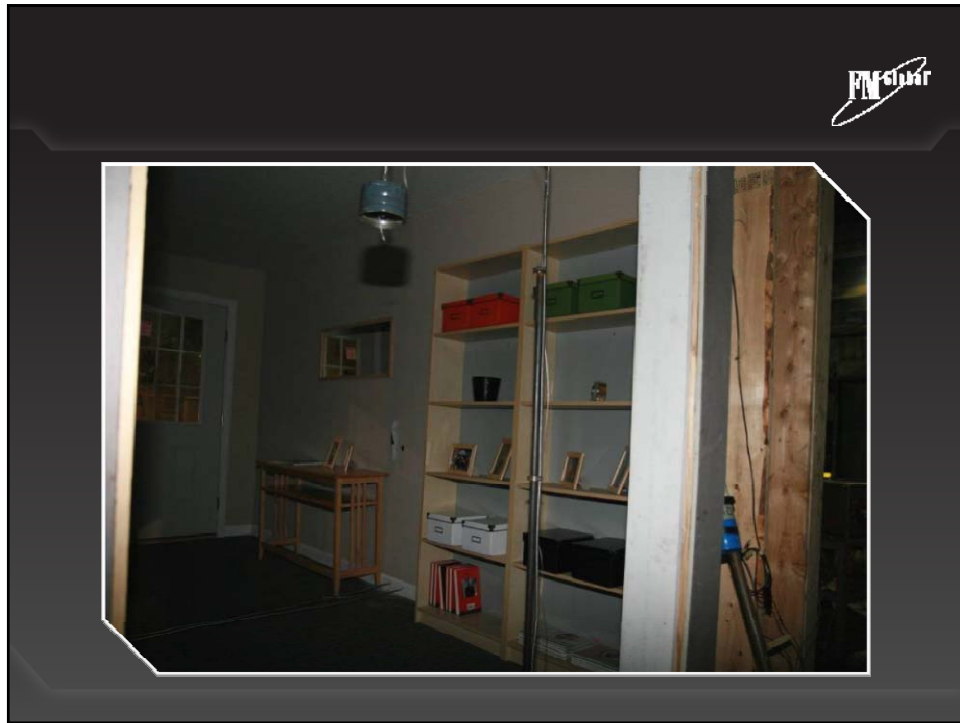
Exterior walls



Interior walls







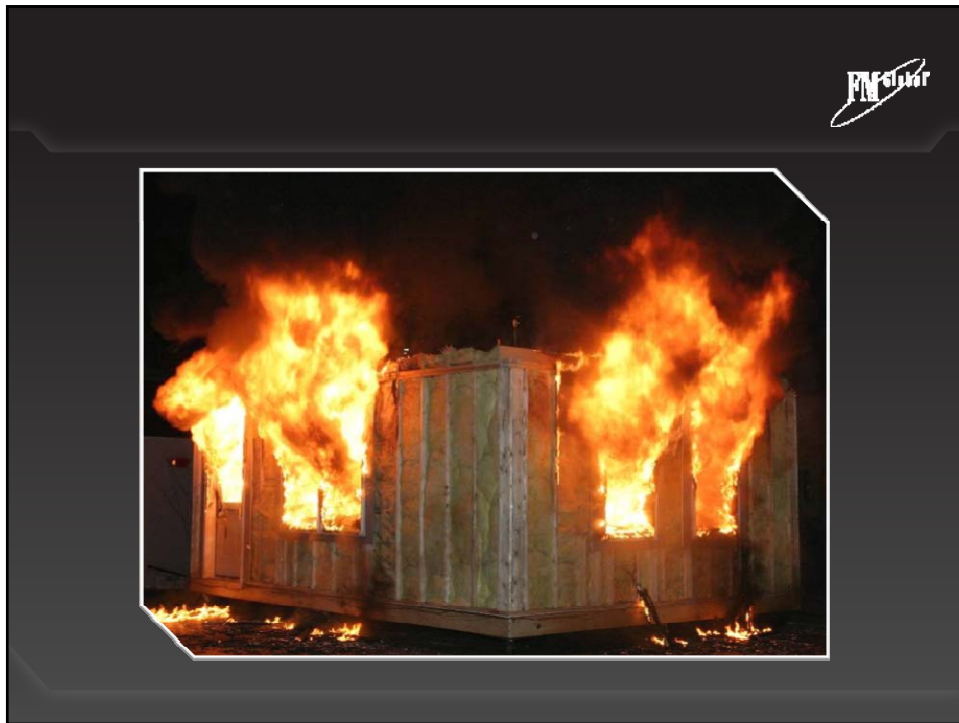
Sprinkler System



FM Approved
Residential Sprinkler

Installed per FM Global
Engineering Standards





Reduced Greenhouse Gases



98%

U.S. Data:

- 2.9 million fires in homes (98-08)
- Potential reduction from sprinklers of 979mil kg CO₂

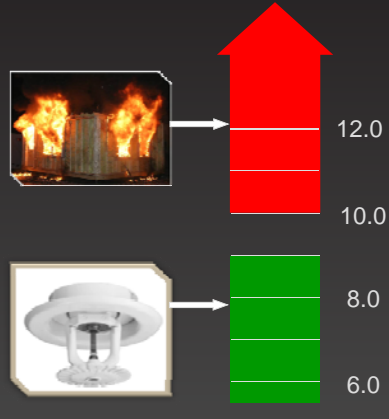
Reduced Water Pollution



- Water captured and Analyzed per EPA Standards



Measured Ph



Reduced Water Pollution



- Total cyanide
- Nitrogen (ammonia)
- Phosphorous
- Benzene

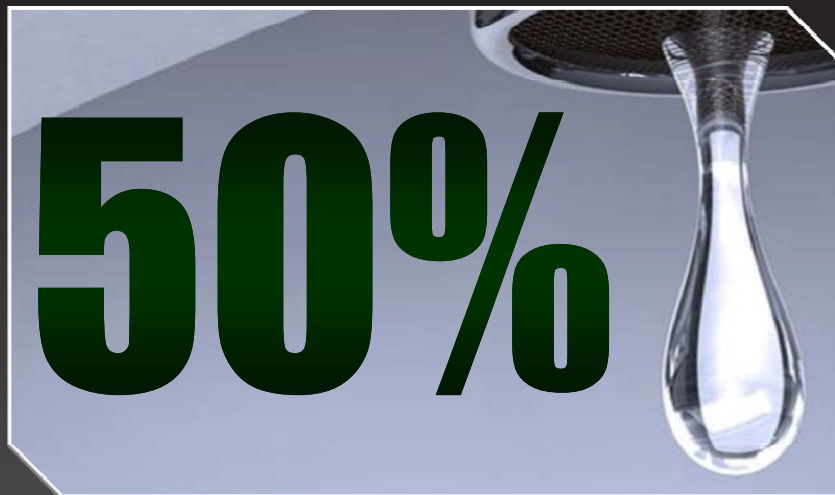


- Total dissolved solids
- Total cyanide
- Nitrogen (ammonia)
- Phosphorous
- Antimony
- Arsenic

Without Sprinklers

24 species > 10:1, 11 species > 50:1, 6 species > 100:1

Reduced Water Usage

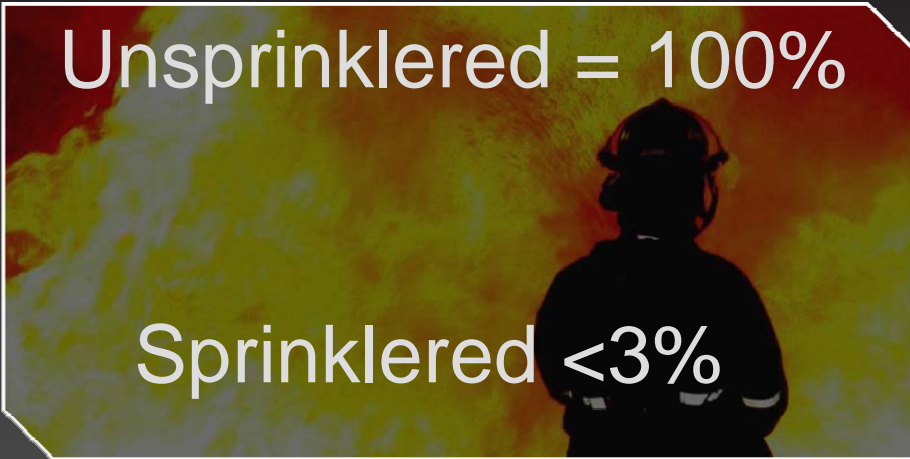


Reduced Fire Damage To Room



Unsprinklered = 100%

Sprinklered <3%



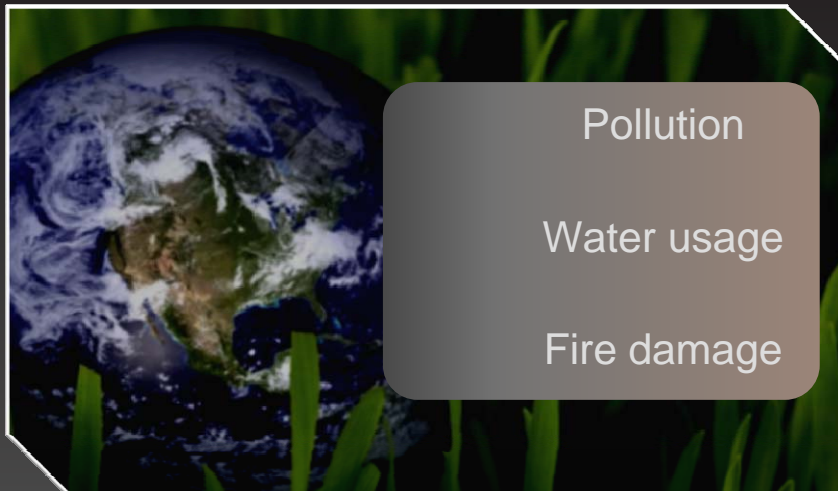
Sprinklers Proven To Reduce...



Pollution

Water usage

Fire damage



Research Result Area 5: Sustainable Building Materials



Sustainability requires managing trade-offs and demands a broader and deeper knowledge of material attributes and performance.



Global Certification Systems



LEED	BREEAM	Green Star	CASBEE	Green Globes	Three Star
	Management	Management	Quality of Service	Project and Environmental Management	Operations and Management
Energy & Atmosphere	Energy	Energy	Energy	Energy	Energy Savings
	Waste				
Sustainable Sites	Land Use	Land Use and Ecology	Outdoor Environment on Site, Offsite Environment	Site	Land Savings
	Transport	Transport			
	Ecology				
Water Efficiency	Water	Water		Water	Water Savings
	Pollution	Emissions		Emissions & Effluents	
Indoor Environmental Quality	Health and Well-Being	Indoor Environmental Quality	Indoor Environment	Indoor Environment	Indoor Environmental Quality
Materials and Resources	Materials	Materials	Resources and Materials	Resources	Material Savings
Innovation		Innovation			

"The Relationship of Sustainability to Flammability of Construction Materials", Bill, et al., INTERFLAM, 2010.

Building Materials - Fire



Latest Loss Prevention Research Fire Modeling - Testing



www.fmglobal.com/modeling

Sustainable Construction Products



- Looking Deeper
- How to know products meet their specific level of performance?



What's Next?



- More Renewable Energy Standards
- New Metrics for Certification of Materials
- Emerging Technologies Research
- Collaborations
 - Clients
 - Industry Leaders
 - Certification Organizations

Sustainability Research Result Areas



Sustainability:

1. *Has to be measured over a lifecycle*
2. *Requires avoiding unintended consequences*
3. *Provides net economic benefit*
4. *Limits pollution, conserves resources, and provides societal safety*
5. *Requires managing trade-offs*

More Research to Come...



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Sustainability Lifecycle

