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KNOWLEDGE PLATFORM  
FOR THE WORLDWIDE  
BUS & COACH SECTOR

## Building and design of buses and coaches, keeping fire safety in mind

Fredrik Rosen, SP Technical Research Institute  
of Sweden



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- Fredrik Rosen  
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Fire Research  
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## SP's Mission



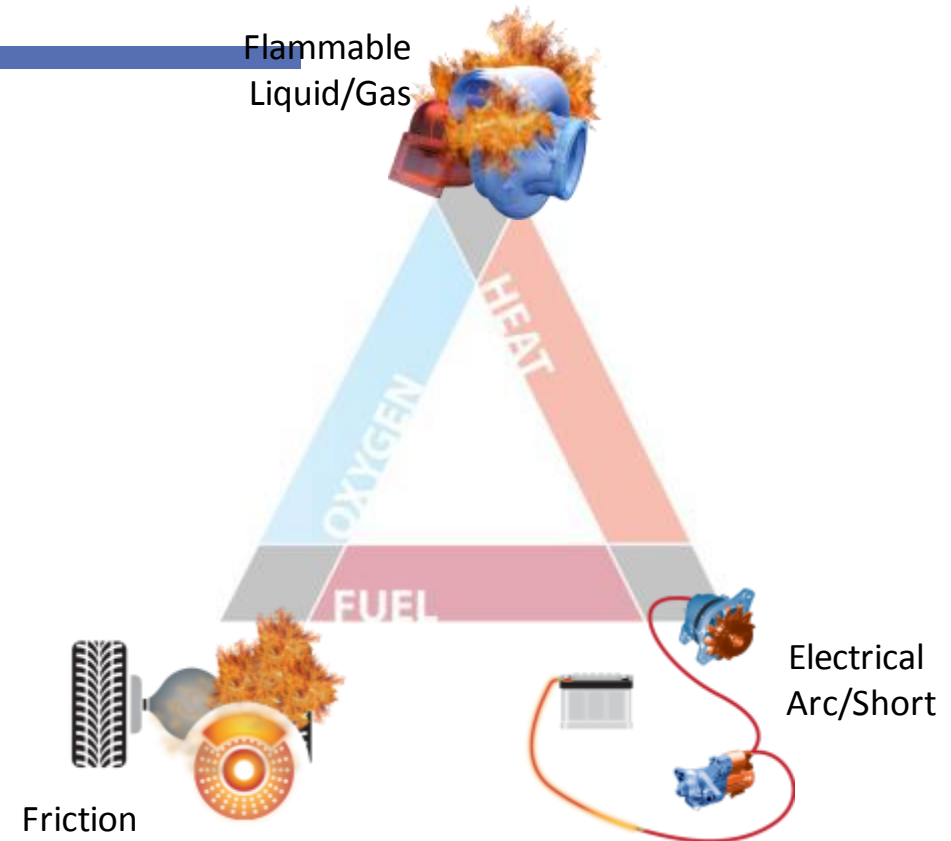
## Bus fires – a common issue world wide

- 350 - 400 bus fires is reported every year in Germany
- Bus fires has almost doubled in Finland over the last 10 years
- An average of six bus or school bus fire reported every day in USA



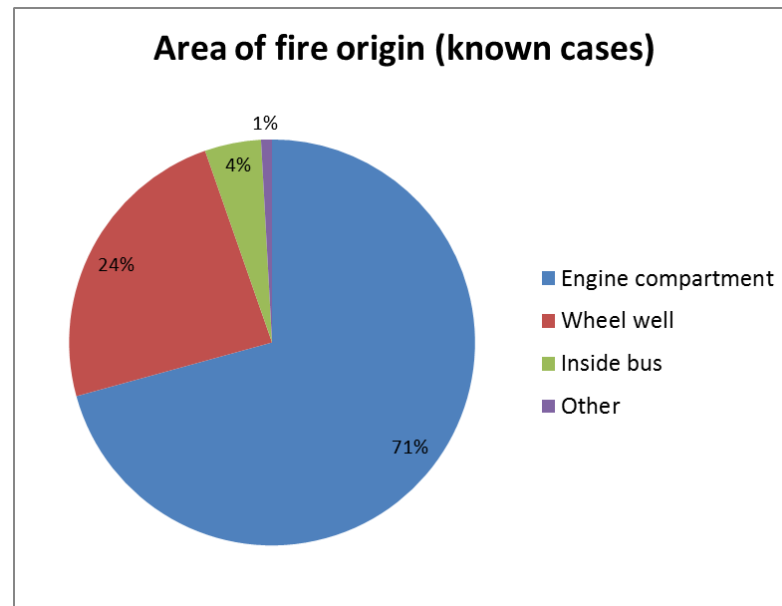
# How bus fires occur

-  Age of Bus
-  Maintenance Issues
-  Equipment Failure
-  Design
-  Vehicle Accident/Collision
-  Arson



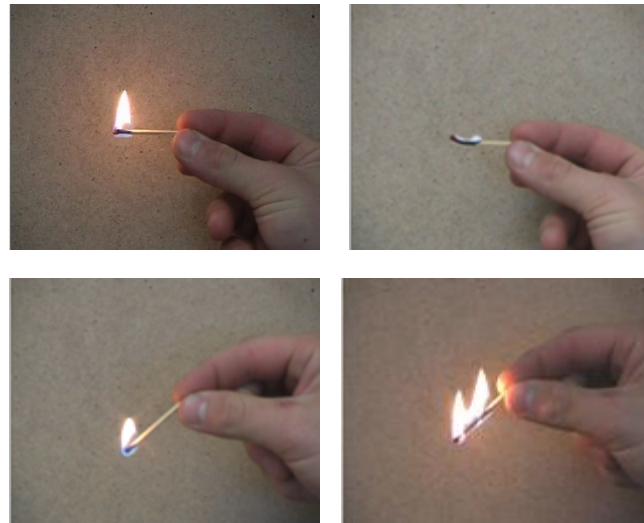
## Bus fires in Sweden – 2005-2013

- 71 % of all bus fires originate from the engine compartment



## Poor fire safety regulations for buses

- UNECE Regulation No. 118 - Burning behaviour of interior materials
- UNECE Regulation No. 107 – Fire Detection





## Forthcoming improvement of regulations



- UN ECE - United Nations Economic Commission for Europe
- Proposal for amendment of **UN ECE Regulation 107** ECE/TRANS/WP.29/GRSG/2014/6 (Fire suppression systems)
- Fire suppression systems in engine compartment will be mandatory for all single-deck, double-deck, rigid or articulated vehicle of category M2 or M3.
- Member state is one of the Contracting Parties that have signed and agreed to the UNECE Vehicle Regulations - 1958 Agreement.

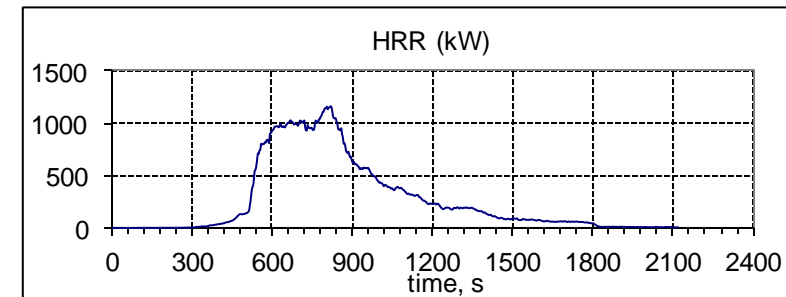




# Fire safety of vehicles

Includes several aspects

- Fire initiation
- Fire growth
- Fire resistance



# Implementing safety features into new bus designs

- OEMs tend to put new safety features on based on demand from their customers - operators/transit authorities
- How do we get operators/transit authorities to adopt a new safety feature with a “we don’t need it” attitude if they can’t measure the benefits in their metrics
- Short of legislation or regulations that mandate a new safety feature – new ways have to be found to make operators/transit authorities metrics look better



# What controls the decisions on cost?

## Funding and Revenue Sources

Public (city buses)

- Government funding to provide a service to the public
- Bus fares
- Grants

Coaches (tour buses)

- Ticket sales

## Metrics – how do they measure success

Public (city buses)

- On-time service
- % of vehicles available for revenue service
- Customer surveys

Coaches (tour buses)

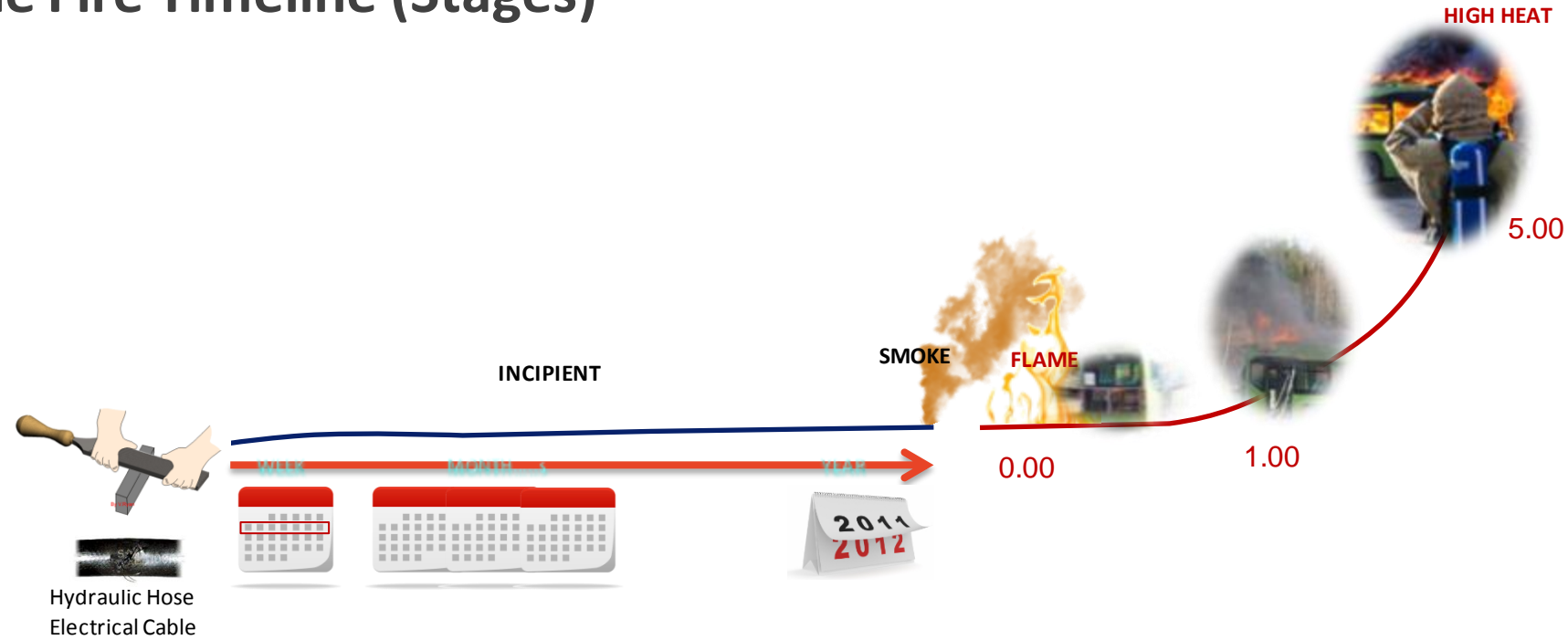
- Ticket Sales
- Customer Surveys



## The cost of improvement



# The Fire Timeline (Stages)



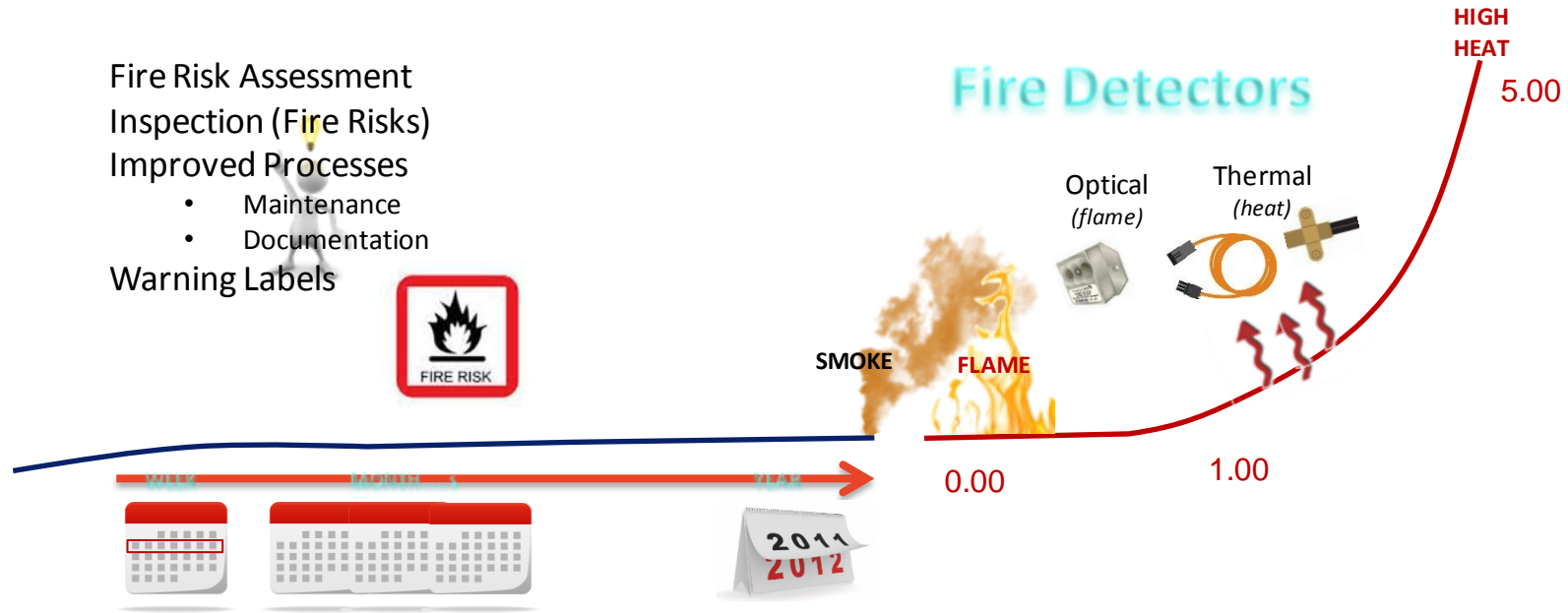
May  
4,  
2015

## Detection methods

Fire Risk Assessment  
 Inspection (Fire Risks)  
 Improved Processes

- Maintenance
- Documentation

Warning Labels



May  
 4,  
 2015

# Fire Risk Assessment





# Fire Risk Assessment

OPERATIONAL CHARACTERISTICS

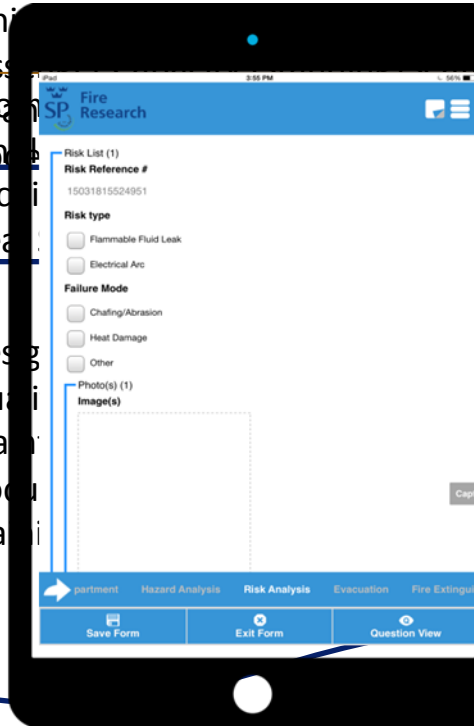
HAZARD ANALYSIS

RISK ASSESSMENT

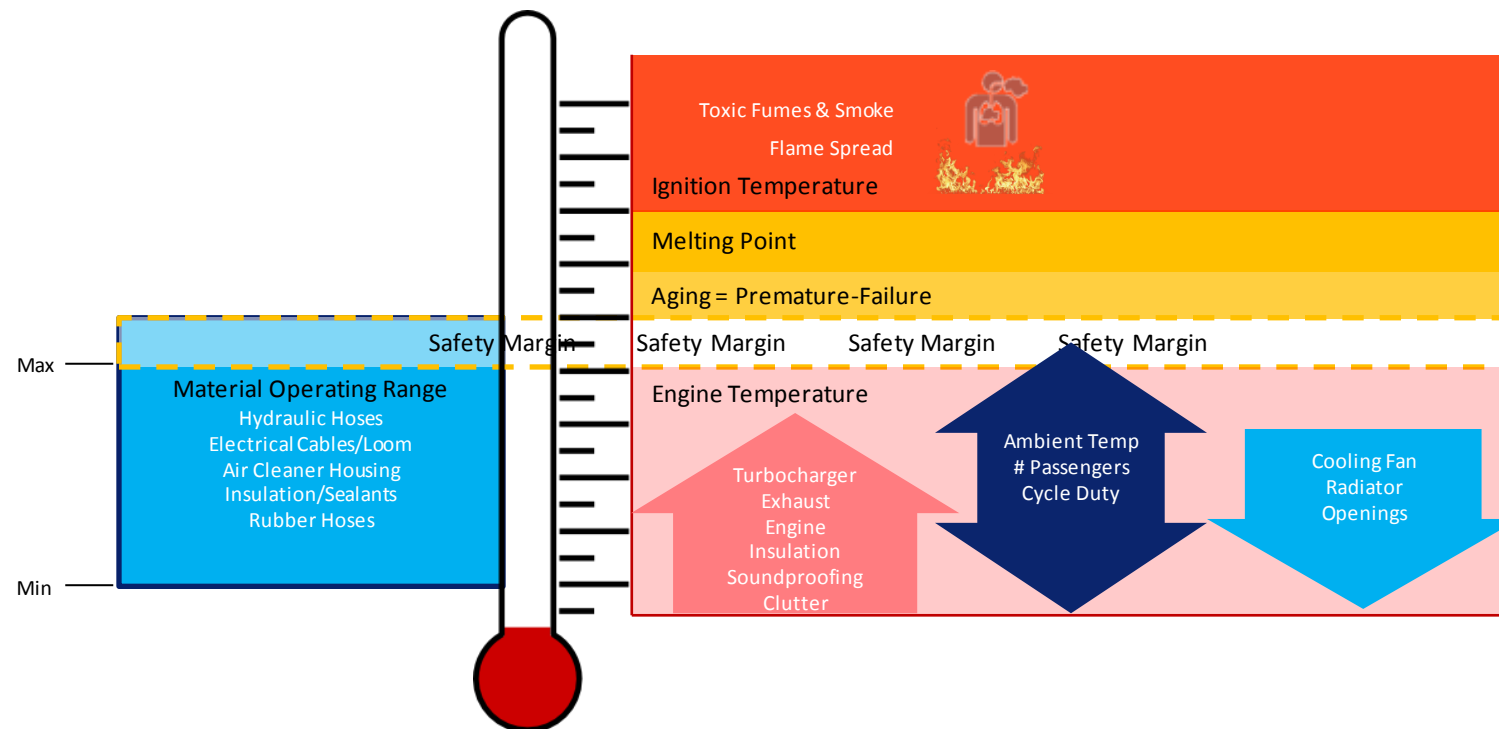
BEST PRACTICES



- Vehicle
- Passenger
- Green
- Motor
- Archi
- Heat
- Desig
- Quali
- Man
- Docu
- Trai



# Materials

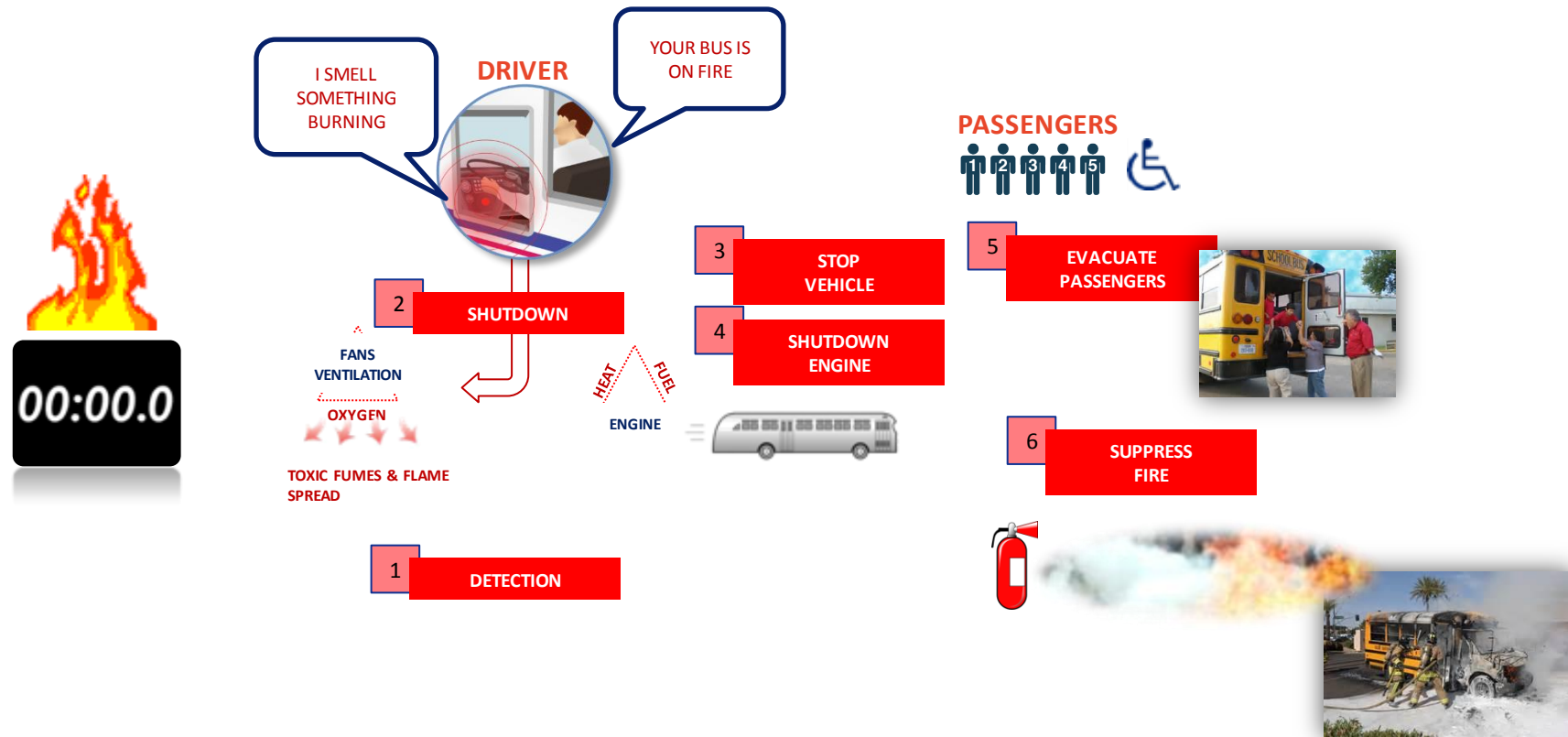


## Savings by implementing innovative new approaches

- Majority of the fires are related to a component failure
- Component failure is a cost driver and measured by the metrics
- Show savings by implementing innovative new approaches to prevent or have better indication of pre-mature failures



# THE FIRE EVENT



# AUTOMATIC FIRE SYSTEM



**AUTOMATIC FIRE SUPPRESSION SYSTEMS  
REMOVE THE HUMAN FACTOR AND ALLOW THE DRIVER TO FOCUS ON THE  
SAFETY OF THE PASSENGERS**



TOXIC FUMES & FLAME  
SPREAD






## Voluntary certification - Fire suppression systems

- Common platform for securing minimum level of safety and security
- Tested in a well-defined and objective way with realistic fire hazards that can occur on a bus based on sound science
- Components tested for harsh environments to secure survivability
- Ensures good distribution and amount of suppression
- Re-ignition protection
- Repeatable and reproducible



## P-mark certificate holders

### Holder of certificate

Marking	Certificateno	Holder	Product/Productname	Product information
	<a href="#">SC0098-14</a>	Amerex Corporation	V25 ABC + ICE-1 V50 ABC	Fire suppression system
	<a href="#">SC0596-13</a>	CEODEUX-Extinguisher Valves Tech. S.A	Compact Line	Fire suppression system
	<a href="#">SC1061-13</a>	Dafo Brand AB	Dafo Forrex Fire Suppression System	Fire suppression system
	<a href="#">SC1263-13</a>	Firetrace USA LLC	Firetrace 360 psi ILP with 20 lbs ABC Dry Chemical Firetrace 360 psi ILP with 10 lbs Black Widow BC Dry Chemical	Fire suppression system
	<a href="#">SC1273-13</a>	Fogmaker International AB	Fogmaker	Fire suppression system

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# FIRE RISK REDUCTION



## Gas bus fire in Holland





Thank you for your attention!