



DIGITAL DAYS

POWERED BY

THE **BAT**TERY SHOW



electric & hybrid
vehicle technology expo

Electromobility and Fire Safety- Challenges and Trends

Presenter: Margaret Baumann- Pinfa North America/FRX
Polymers

Outline of Presentation

- Who is Pinfa (Phosphorus, Inorganic and Nitrogen Flame retardant Manufacturers Association)
- EV and HEV vehicles- Market and Trends
- E-Mobility Trends and Challenges
- Role of Flame Retardant Additives- Why do you need them?
- E-Mobility and Fire Safety



- Since 2009
- 3 continents
EU, NA & China

Pinfa is the voice of PIN Flame retardants Users & Manufacturers

Vision

Continuous improving the environmental and health profile of the PIN flame retardant products.

Mission

To maintain high fire safety standards across the world, standards which minimize the risk of fire to the general public.

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Member
Companies

lyondellbasell
Advancing Possible

ADEKA
CORPORATION

BASF
We create chemistry

Budenheim

BYK
Additives & Instruments

CLARIANT

CTF 2000
flame retardants & chemical specialties

**AVAKIAN
POLYCHEM**

where
skin
meets
fabric
dartex

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

GTFI

DU PONT

FR Adviser LLC

EAPFP

EK EVERKEM

FRX
POLYMERS

GREENCHEMICALS

HUBER
NON-HALOGEN
FIRE RETARDANT ADDITIVES

ICL

INEMI

Italmatch Chemicals

LANXESS
Energizing Chemistry

meta dynea

Nabaltec

OKVA

Perstorp
WINNING FORMULAS

AVIENT

PRESAFER

**سابك
sabic**

**Schneider
Electric**

SI Group
The Substance Inside

**JLS
Chemical**

SCOTT BADER

SOLVAY

tfp

TOLSA

THOR

TOTAL

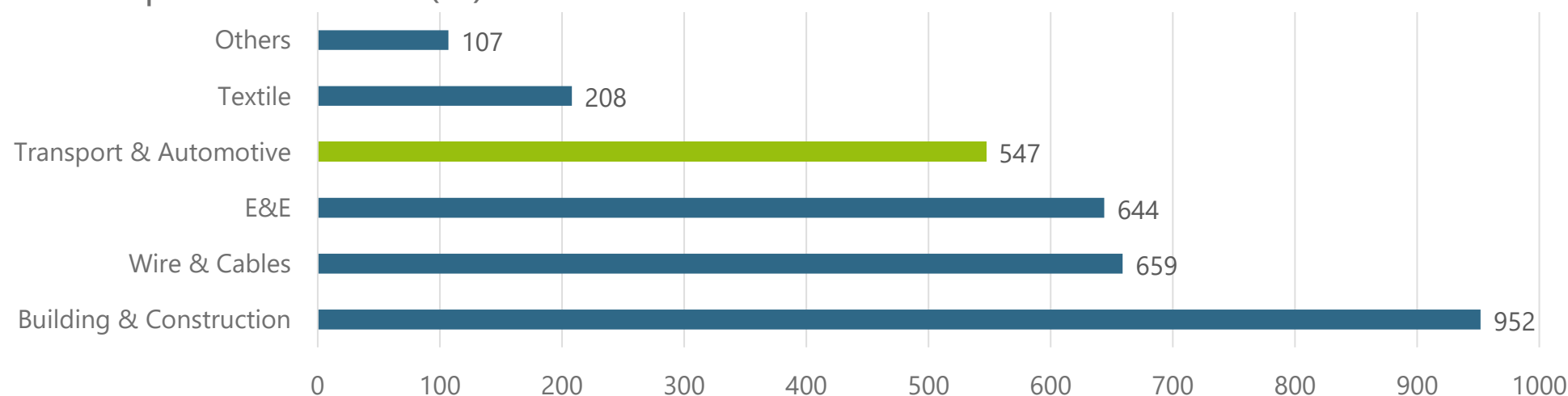
williamblythe
Excellence in chemistry

As of May 2020

Flame Retardant Markets

Automotive & Transport is the **4th Largest Market**

2021 expected FR sales (kt)

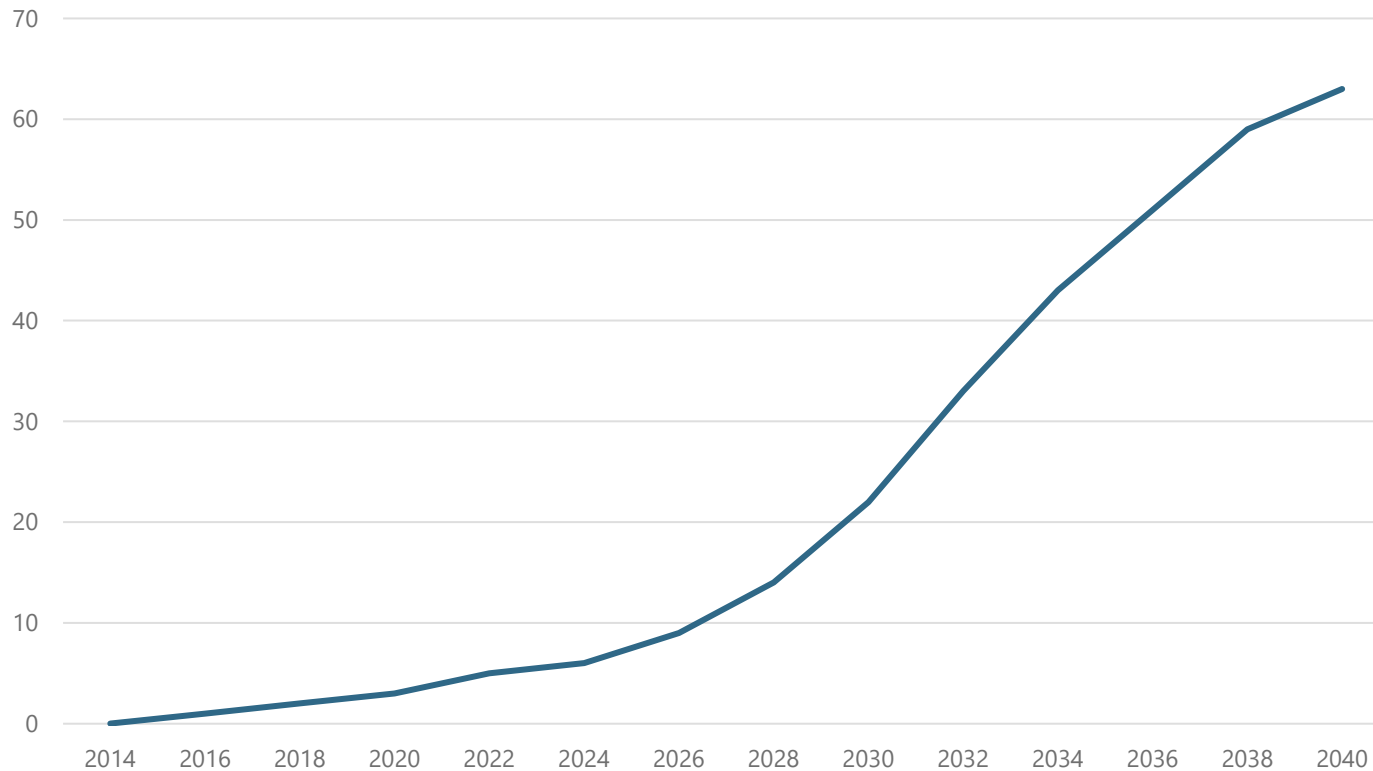


Automotive growth forecasts:

Strong global CAGR > 6%

APAC as the leader: China producing 55% of BEV passenger cars (2019)

Million electric cars per year - World







Graph based on estimates at <https://www.vpsolar.com/en/electric-cars-market-statistics/>

Global Electric Vehicle (EV) is estimated at 160 US \$Billion in 2019
Expected growth 800 \$B by 2027

Resisted the Covid downturn-in first half of 2020-up 57% in EU while overall market -37%

Very dynamic BEV sector

	China 	EU 	USA 	Global 
Market share	4.7%	1.9%	1.3%	1.7%
%growth	+70%	+84%	+50%	+66%

A 100% Electric market in 2050?



Source: Joeri Van Mierlo, MOBI-VUB

Purpose

Bridge the gap between automotive stakeholders of the Emobility value chain

Stakeholders

Pinfa members, automotive industry, OEMs, tier-1 suppliers, academia, etc.

Joint activities



3 workshops organized in the past two years



China – pinfa Emobility & Fire Safety Challenges
Shanghai, 22 November 2018



Japan – pinfa Emobility & Fire Safety Challenges
Tokyo, 01 July 2019



Germany – Joint pinfa/Fraunhofer LBF/FGK Emobility & Fire safety challenges
Darmstadt, November 12 2019

Pinfa EU sponsored an E-Mobility and Fire Safety
webinar October 28, 2020

**North America organized a program in 2018
(Michigan) on Fire safety in Automotive which
included Electromobility...**

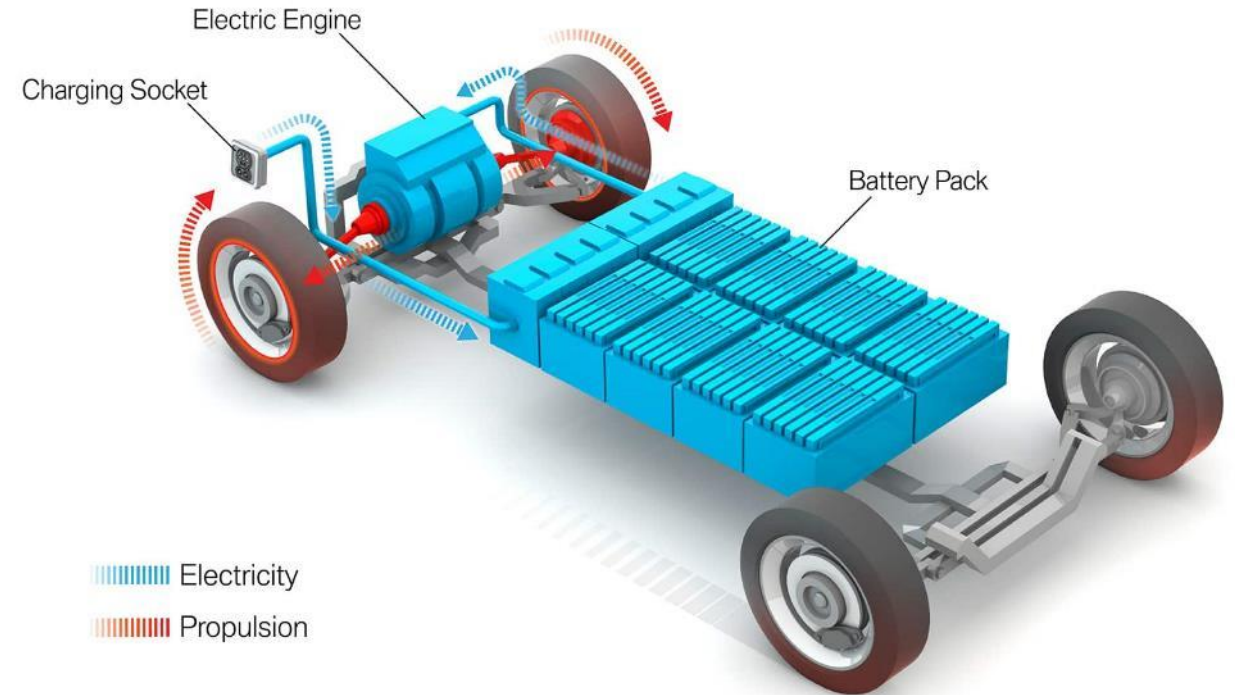
Batteries

- Longer range (>300km)
- Heavier >400kg
- Higher energy density & 800V
 - Today: 145% of 2005
 - Li Solid-State: 230% of 2005
- Fast charging time
- Long-term durability

High Safety Standards

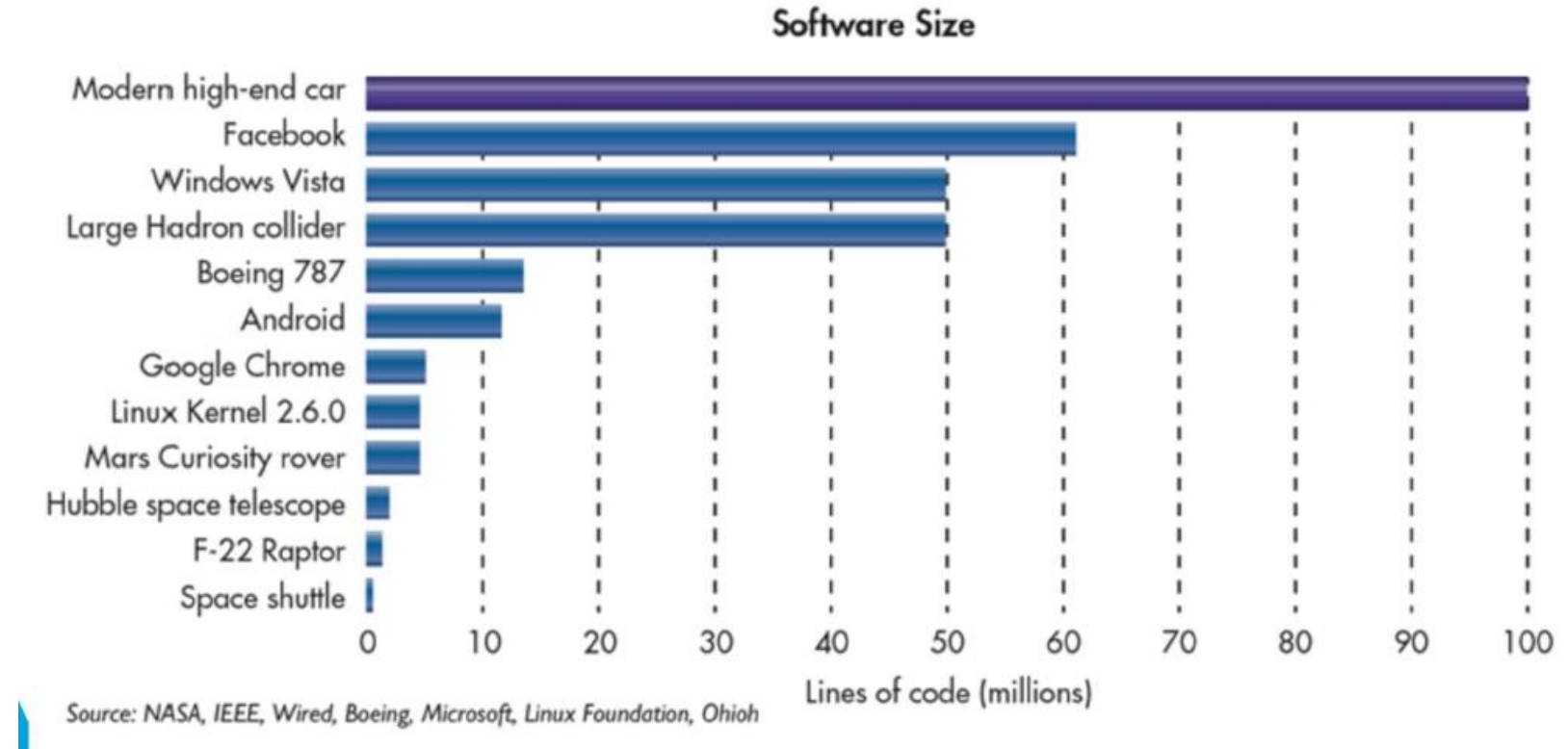
Needs for Mass Market Acceptance

- Reduced Cost (1st criterion)
- Increased Stamina (2nd criterion)
- Increased safety



Sensors and Entertainment systems

Several miles of wires in an xEV
Loads of data produced by xEV



Existing Road Vehicles already represent a fire risk:

- Over 202,000 vehicle fires, causing 560 deaths, 1500 injuries and nearly 2 Billion US\$ property damage in the US alone in 2018.

Electric and Hybrid vehicles bring new and increased safety risks:

- Specific fire risks of batteries, related to energy concentration when fully charged ("Stranded energy") to possible mechanical faults and to risk of runaway
- High amperage drive cables and connectors charging connection, move from 12V to 24 V, with risks of overheating and arcing
- Proximity and interconnection of electronics battery management, power and communications
- More cables and connectors than in traditional vehicles

Fire Causes

- Vehicle fault
- Vehicle Crash (drop)
- Charger fault
- Internal Cell fault

Risks can be classified in 4 categories

- Release of thermal energy
- High voltage or loss of function
- Release of kinetic energy
- Release of chemicals (electrolyte and gases)



Faster charging
up to 7min (350kW)

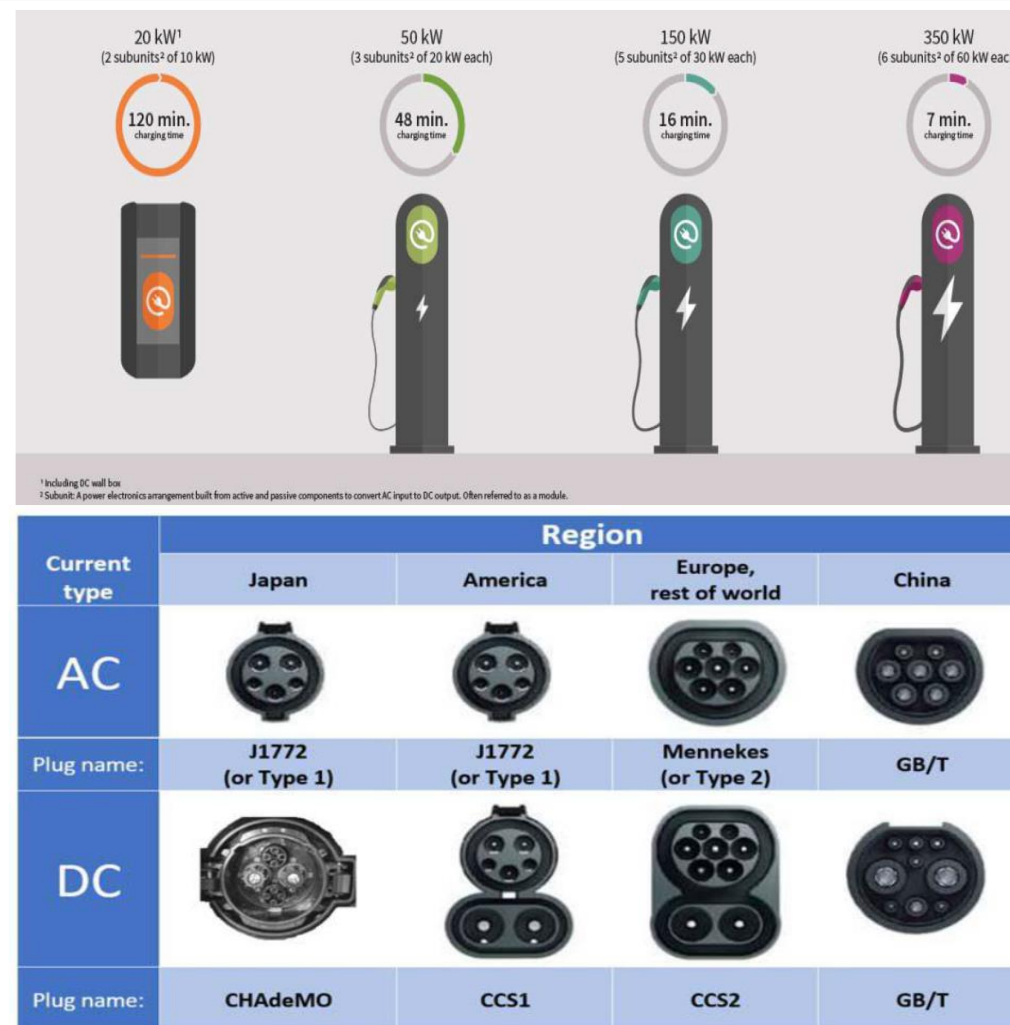
Outgrowing gas stations
150,000 eV C.P. VS 92,000 gas stations
in EU+NA

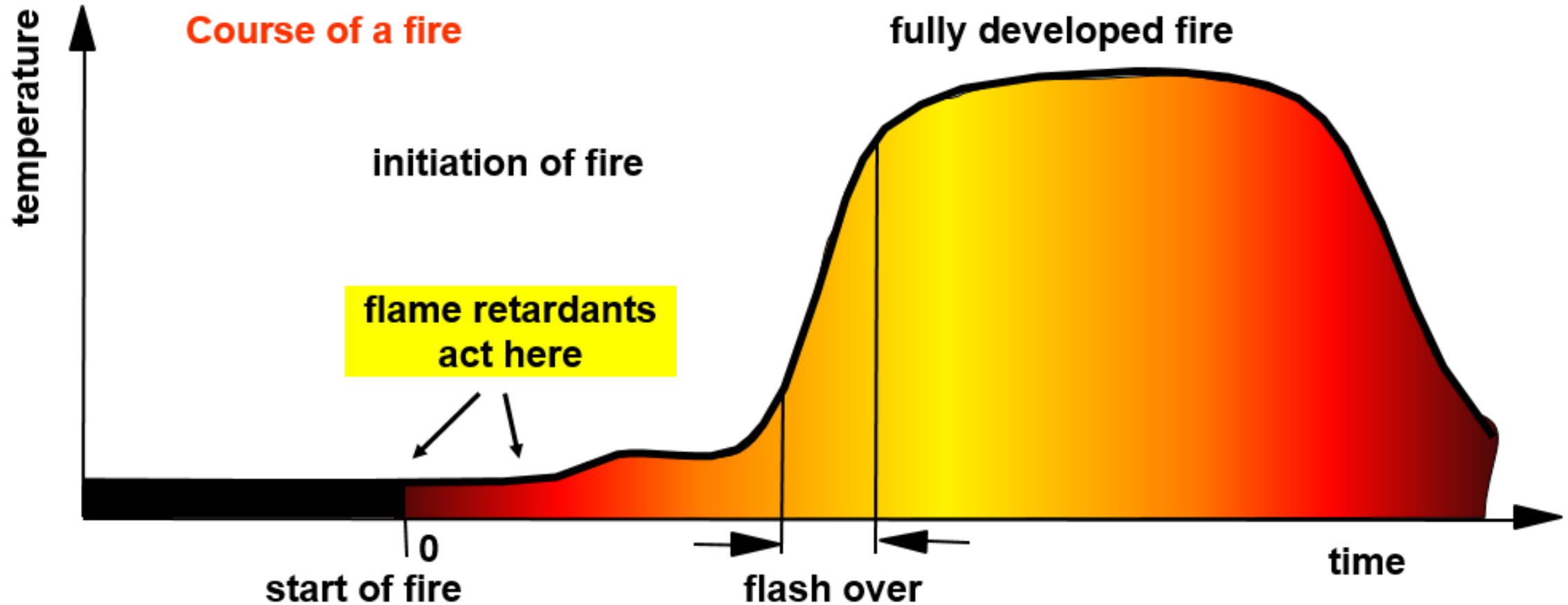
Challenge: Standardization

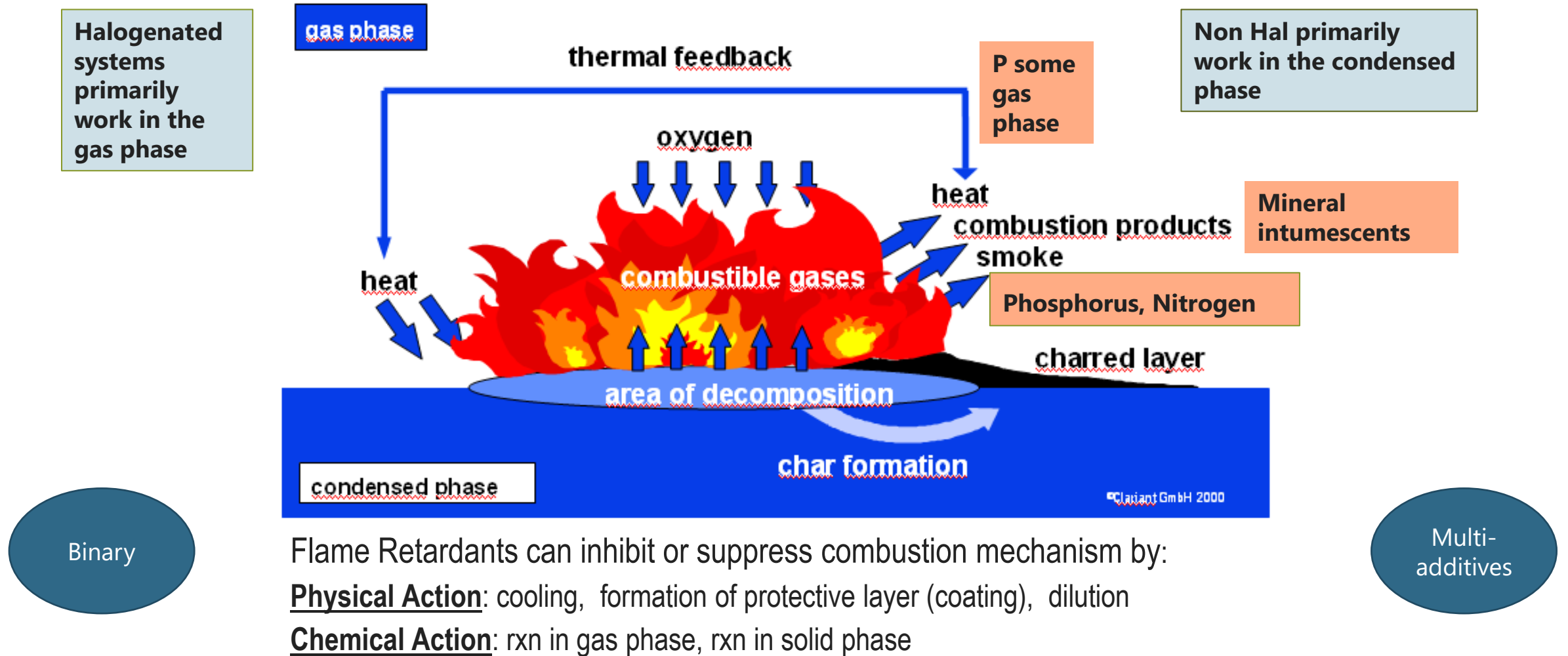
Up to 4 different connectors per charger
3 cables groups (EU standard, EU HPC, US-
no HPC)

Challenge: Fire Safety

Cables: Halogen Free materials (EN50620)
Connectors







More plastics, less metal

- Epoxy & Polyurethane are the most used polymers but also
- Engineering polymers are commonly used.

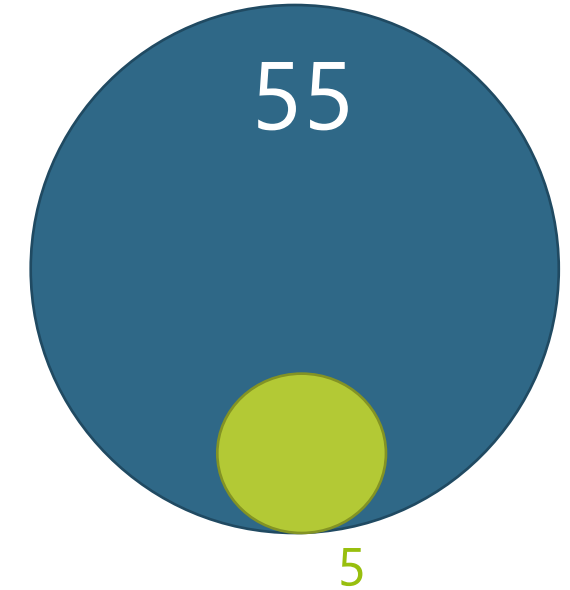
Thinner & lighter casings

- Weight reduction

Concentration Parking & Charging

Very safe: Low occurrence of fire events

- 300,000 Tesla driving 7.5 billion mi suffered 40 fires
 - BEV: 5 fires per billion mi travelled
 - ICE: 55 fires per billion mi travelled



Fires per billion mi travelled



Fire retardant additives are used to help delay the combustability of materials

- It is not the only criteria for material choice
 - Maximum continuous utilization temperature in dry or humid conditions
 - For high Voltage components dielectric strength is key, so some traditional polymers like Nylon 6 may be problematic
 - Retention of mechanicals and HDT
 - Selection of additives in Plastics is critical
 - Some halogenated FR additives can cause electrochemical corrosion
 - High pH leads to dissolution of the passive surface layer of oxides and aluminum
 - Non Hal is better here
 - Processing cost
 - Lower density is preferred

Becoming mandatory in many parts of the world

e.g. China – mandatory by 2021

- UL 94 V-0 for electrical/electronic components
- EN62368 Communication systems for all vehicles

Batteries facing more severe endurance tests:
Example: Japan

Standard No.			
	Current standard		In future ?
Standard No.	UN R100-03	GB/T 31467.3	GTR(Global Technical Regulations) 5.4.12
Flame retardancy to external flame	Y	Y	Y
Flame retardancy for internal hot gas	N	N	Y

Increasing FR requirements in an EV

Seat, seat belt, ceiling cloth, convertible top, arm rest, door trim, front trim, rear trim, side trim, rear package tray, head back tilt control device, carpet, mat, sun visor, sunshade, wheel cover etc.



Source: Solvay

More & More Plastic

Example: increased composite adoption for Battery Upper Case

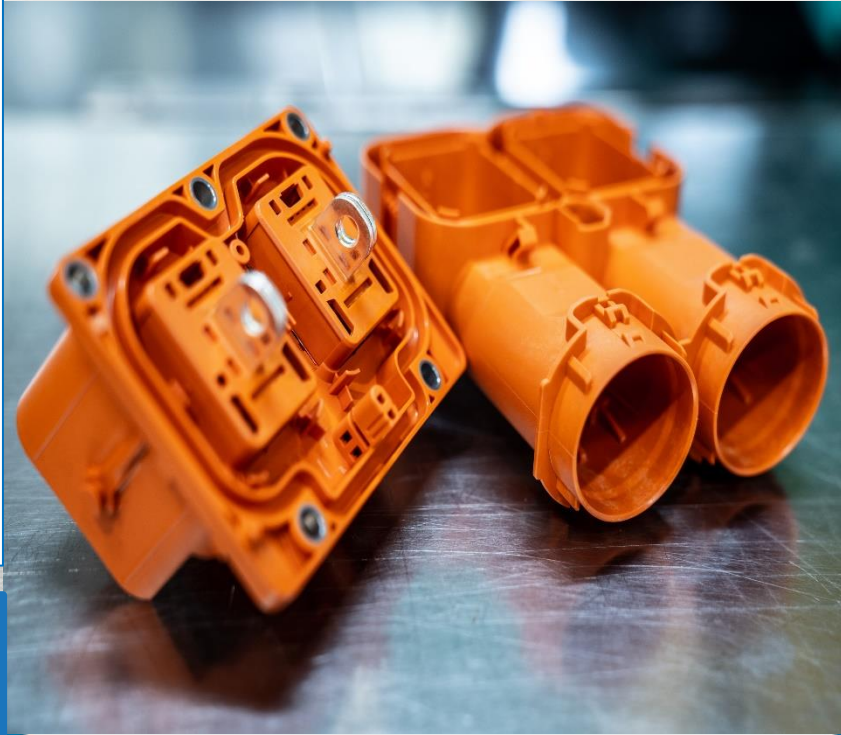
OEM	Vehicle	EV/PHEV	LWR CASE	UPR CASE
Nissan	リーフ	EV	Steel	Steel
BMW	i3	EV	Aluminum	Steel
TESLA	S	EV	Aluminum	Steel
Mitsubishi	i-Miev	EV	Steel	Plastic (PP)
Renault	ZOE ZE	EV	Aluminum	Steel
FIAT	500e	EV	Steel	Composite
VW	e-up	EV	Steel	Composite (GF-SMC)
	e-Golf	EV	Steel	Composite (GF-SMC)
BYD	E6	EV	Steel	Composite
	Denza EV	EV	Aluminum	Steel
Chevrolet	Spark	EV	Steel	Composite
Toyota	RAV4	EV	Aluminum	Steel
Chevrolet	BOLT	EV	Steel	Composite (GF-SMC)
FORD	Focus EV	EV	Steel	Steel
SMART	SMART	EV	Steel	Steel



APPLICATION REQUIREMENTS

The color orange is used to identify live, plastic sheathed components in electric vehicles, - the challenge is to develop orange compounds that exhibit high color stability over the long term.

UL94 V-0 down to
0.4mm



**With
Flame retardant**

**RAL 2003
RAL 2008**

CTI \geq 600 V

**High
Stiffness**

Source: Lanxess AG HPM

APPLICATION REQUIREMENTS

**EMI
Shielding**

**Electrical
Insulation**

**Leakage
Proof**

**UL 94
V0 at 2/3 mm**



**Temperature
Resistance**

**High
Stiffness**

**Dimensional
Stability**

**Space
Constraints**

APPLICATION REQUIREMENTS

**Vibration ageing
Performance**

UL 94 V0 at 2 mm

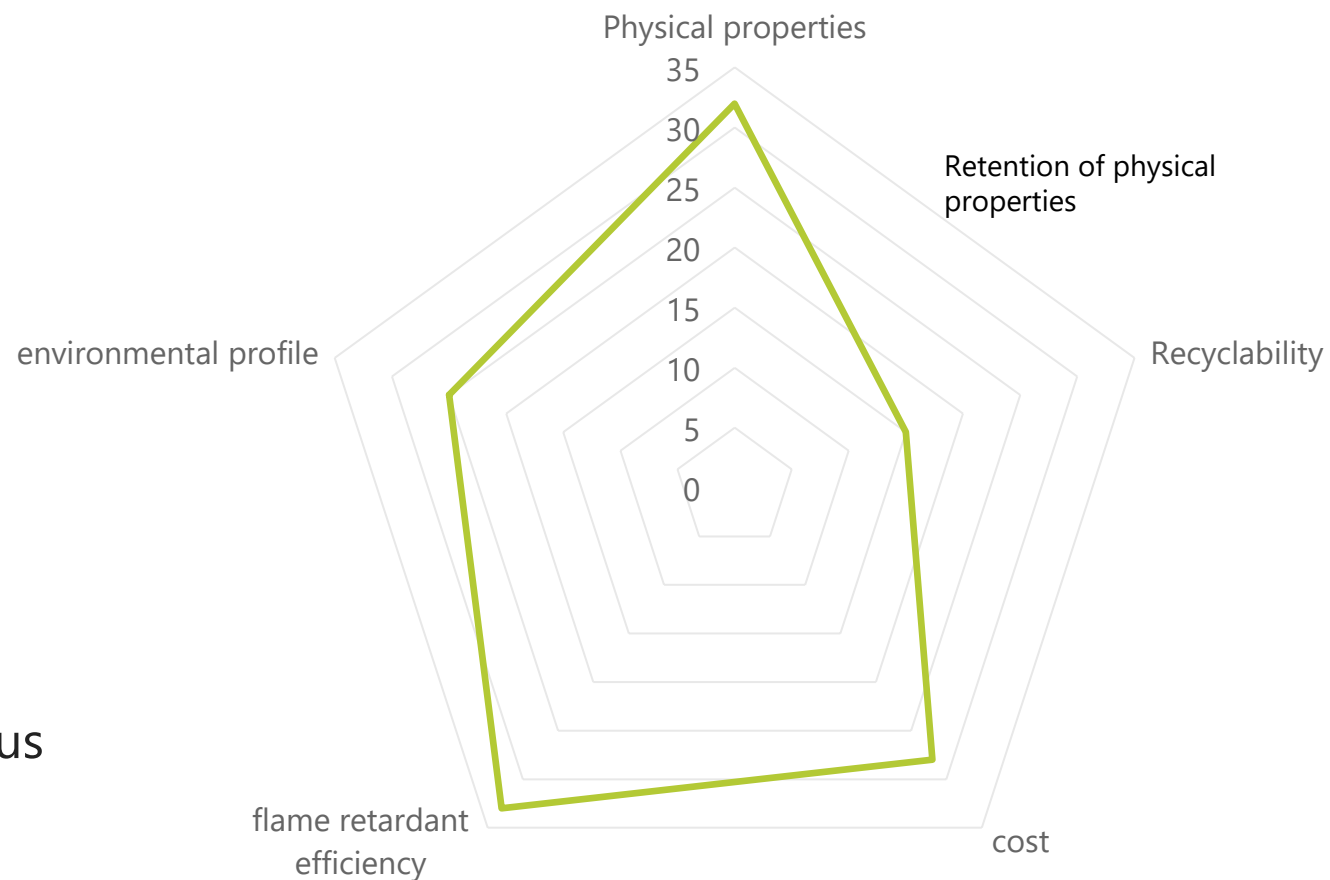
High Stiffness



**Impact
resistance**

**Leakage
Proof**

EMI Shielding



Need for continuous Improvement...

Search for perfect FR

Compliance with more and more stringent regulations

- REACH
- RoHs
- WEEE
- POP / Stockholm convention
- Ecodesign Regulation for screens & displays

Recycling challenges

- Migration/Leakage of flame retardants
- Physical alterations of recycled polymer
- Ensuring feedstock for the recycler: durable supply of recyclable material
- Sorting of FR formulation : marker the future of sorting

Goal of pinfa- Bring stakeholders and supply chain together to meet material fire safety needs and challenges

Mobility as a Service

Connected
Autonomous
Shared
Electric





THANK YOU FOR YOUR ATTENTION!

Thanks to Pinfa EU Executive Committee

Thanks to Pinfa NA Executive Committee

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