



FIEP WEBINAR 2025  
On line event

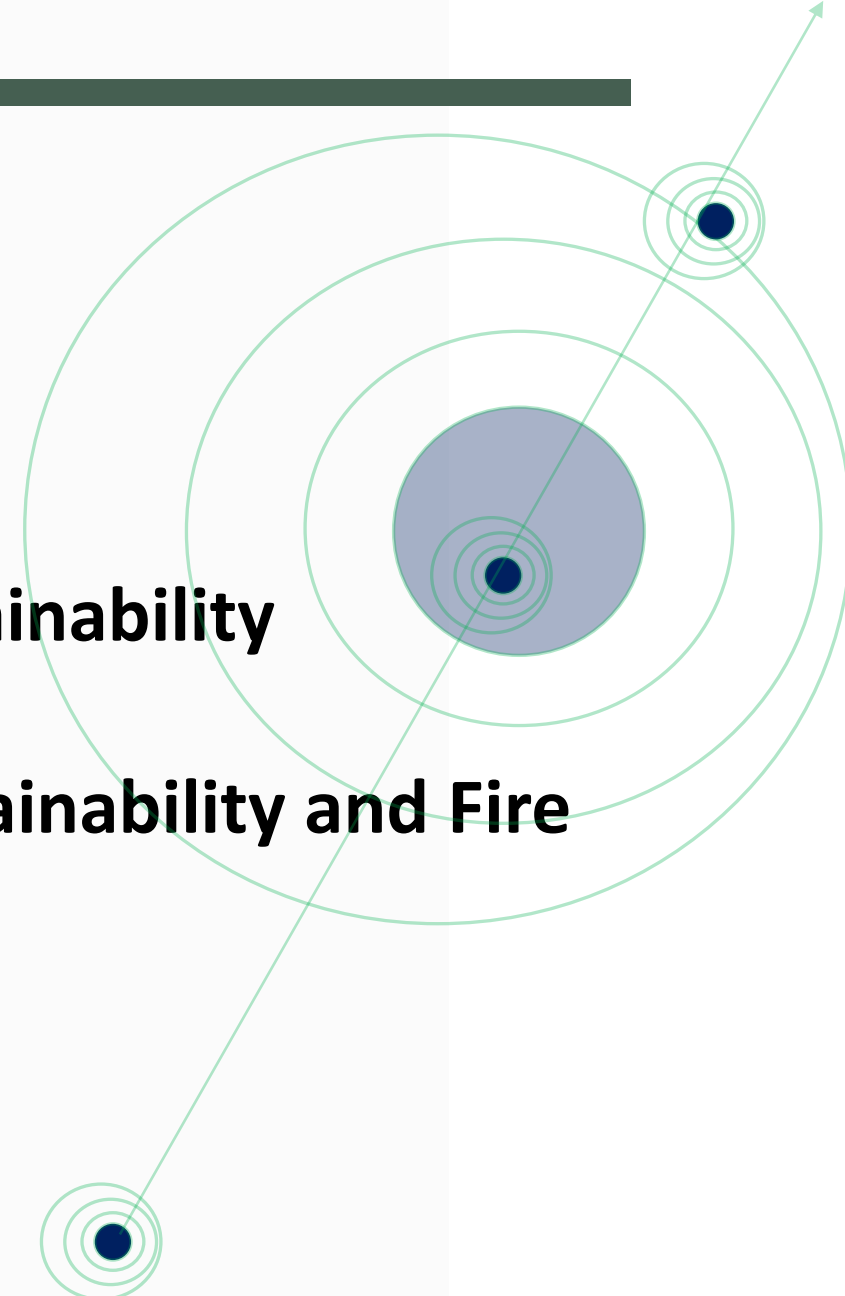
# PVC, Fire Performance, and Sustainability

ROUTE TOWARDS NEW FORMULATIONS

Gianluca Sarti

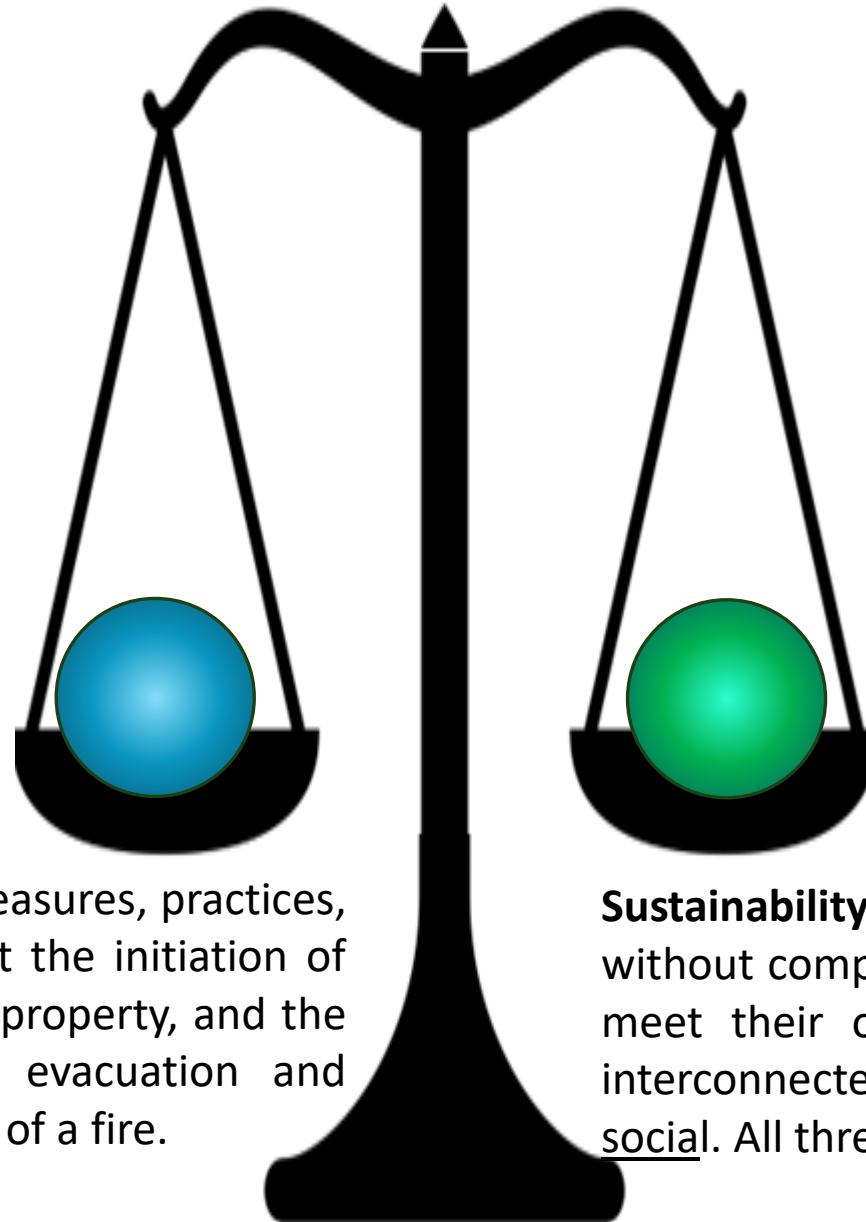
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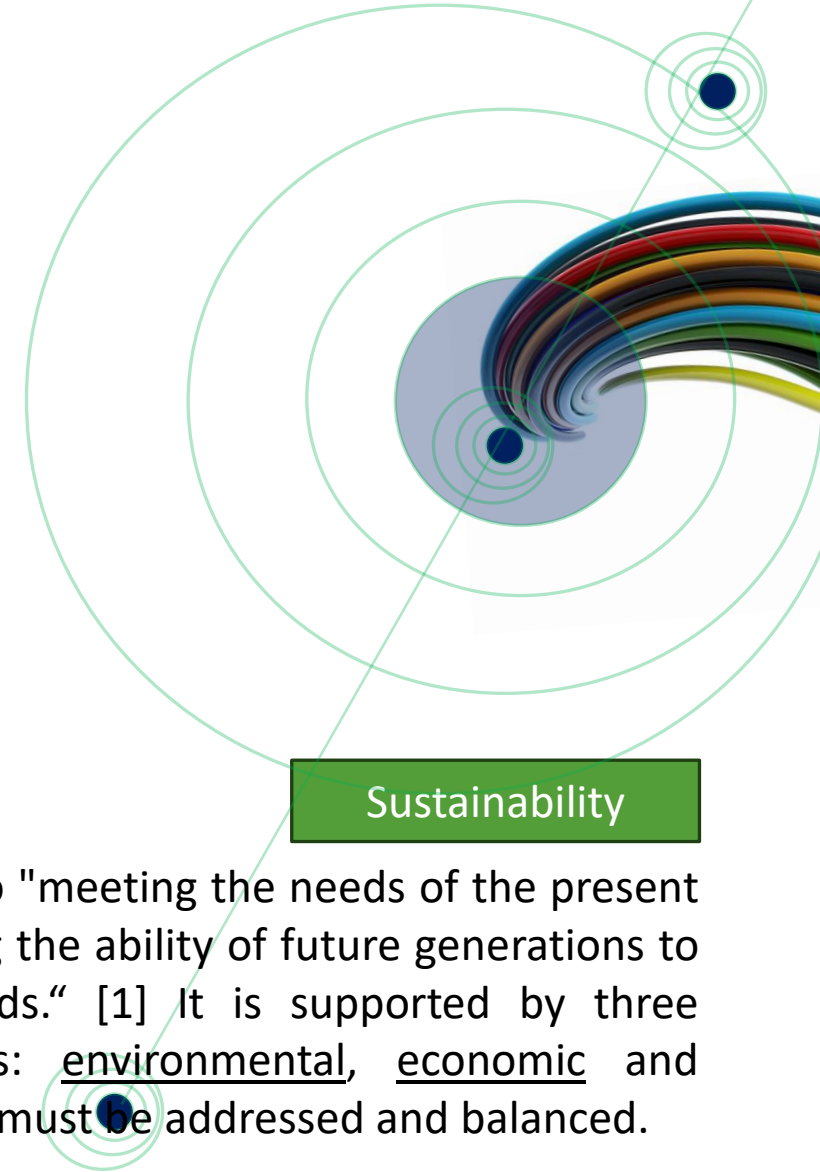
## Fire Safety

**Fire Safety** refers to the set of measures, practices, and systems designed to prevent the initiation of fire, limit its spread, protect life, property, and the environment, and ensure safe evacuation and emergency response in the event of a fire.



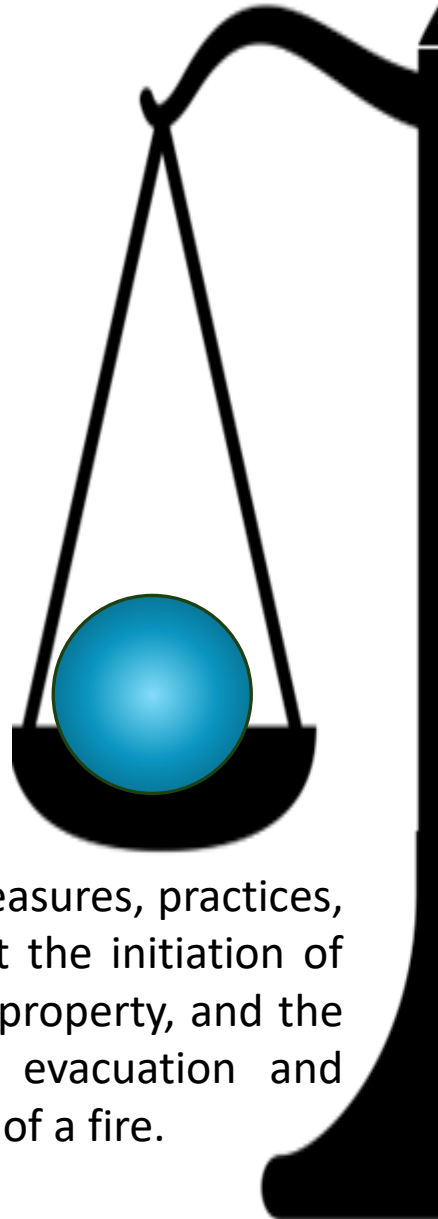
## Sustainability

**Sustainability** refers to "meeting the needs of the present without compromising the ability of future generations to meet their own needs." [1] It is supported by three interconnected pillars: environmental, economic and social. All three pillars must be addressed and balanced.



## Fire Safety

**Fire Safety** refers to the set of measures, practices, and systems designed to prevent the initiation of fire, limit its spread, protect life, property, and the environment, and ensure safe evacuation and emergency response in the event of a fire.



Fire safety objectives

**Active Protections:**

Sprinklers, alarms, smoke control systems

-  
-

**Passive Protections:**

Fire-resistant materials,  
compartmentation, fire doors, increase the  
reaction to fire of materials etc.

Flame Retardants and Smoke Suppressants

1

The safe evacuation of occupants

2

The preservation of material properties and  
structural integrity

3

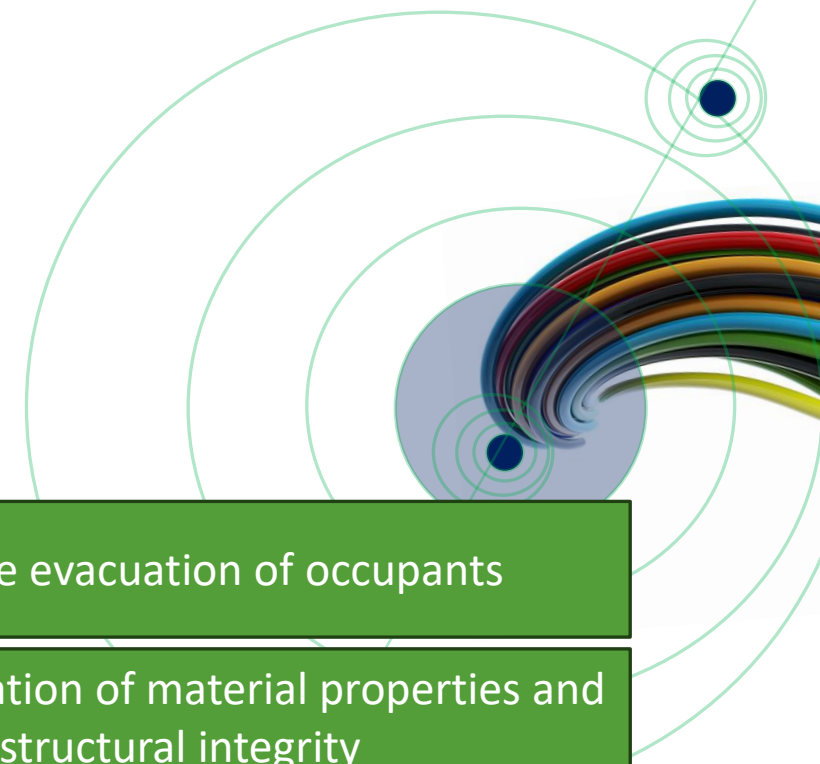
The continuity of operational functionality

4

The protection of the environment from  
fire-related damage

5

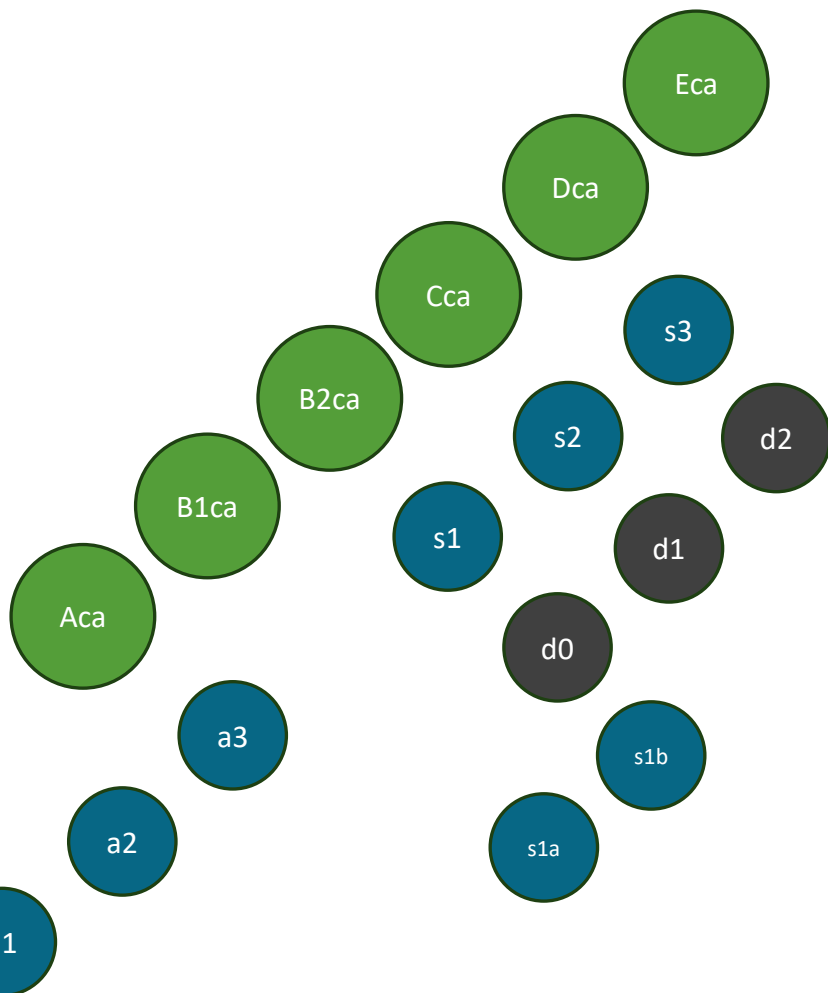
The safeguarding of cultural heritage and  
assets



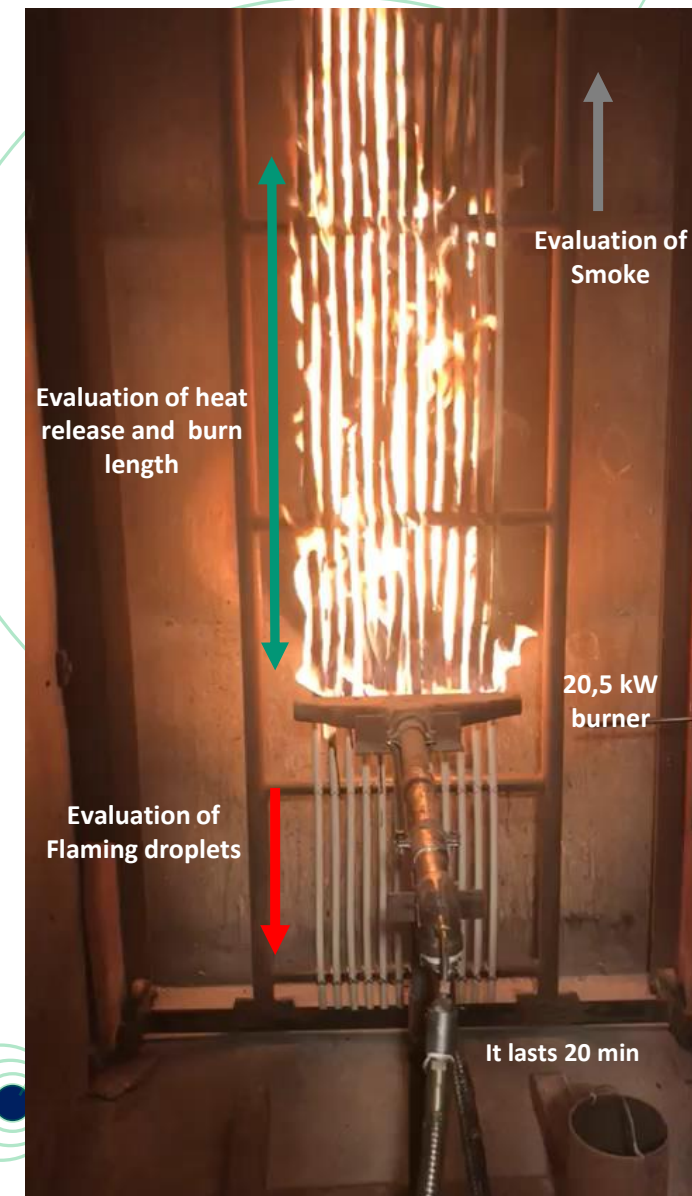
# 2 Fire Safety: reaction to fire

- In the EU CPR made the test more severe in terms of standards and requirements
- Increase of consumption of flame retardants and smoke suppressants
- EN 13501-1; EN 13501-6

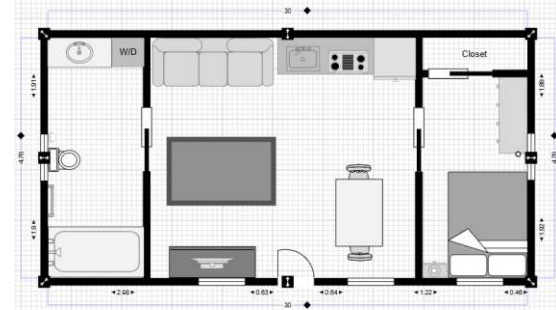
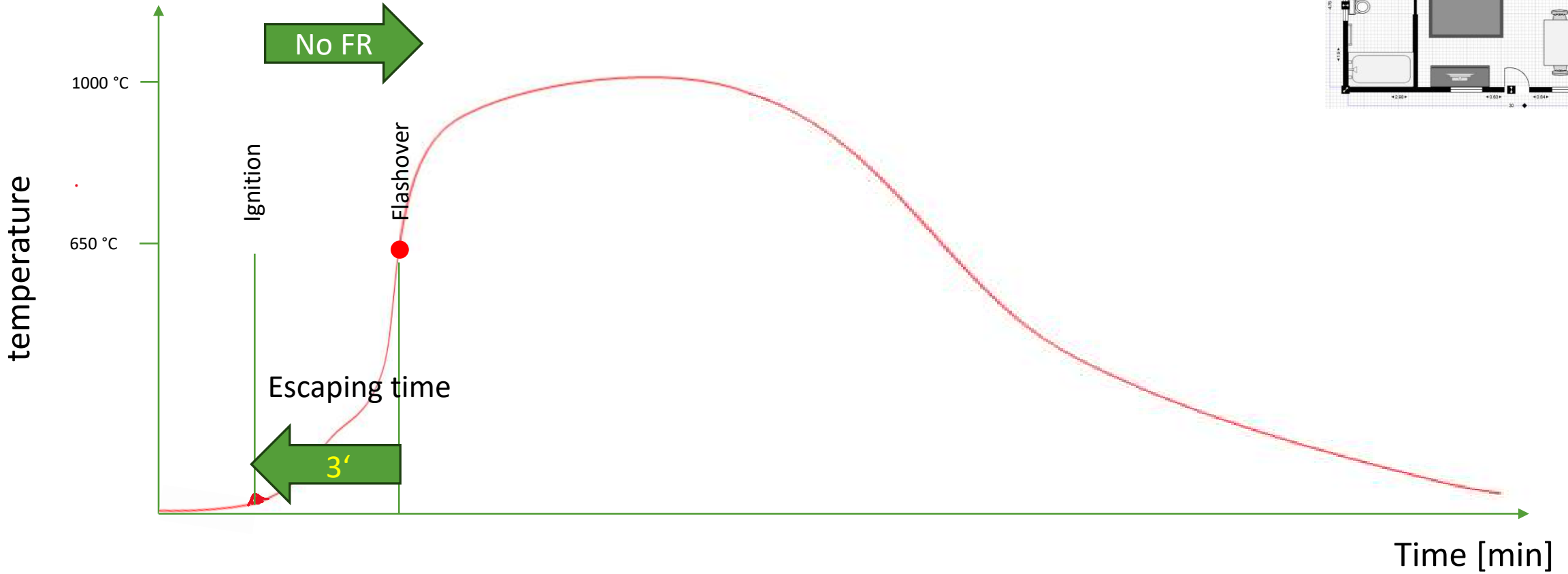
Fca



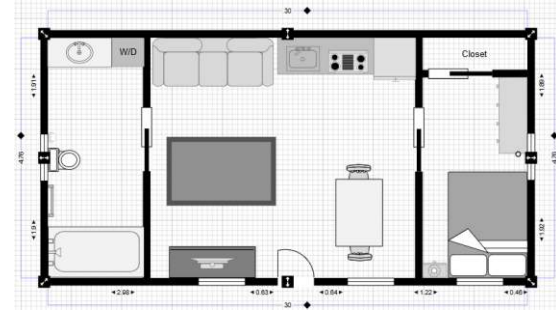
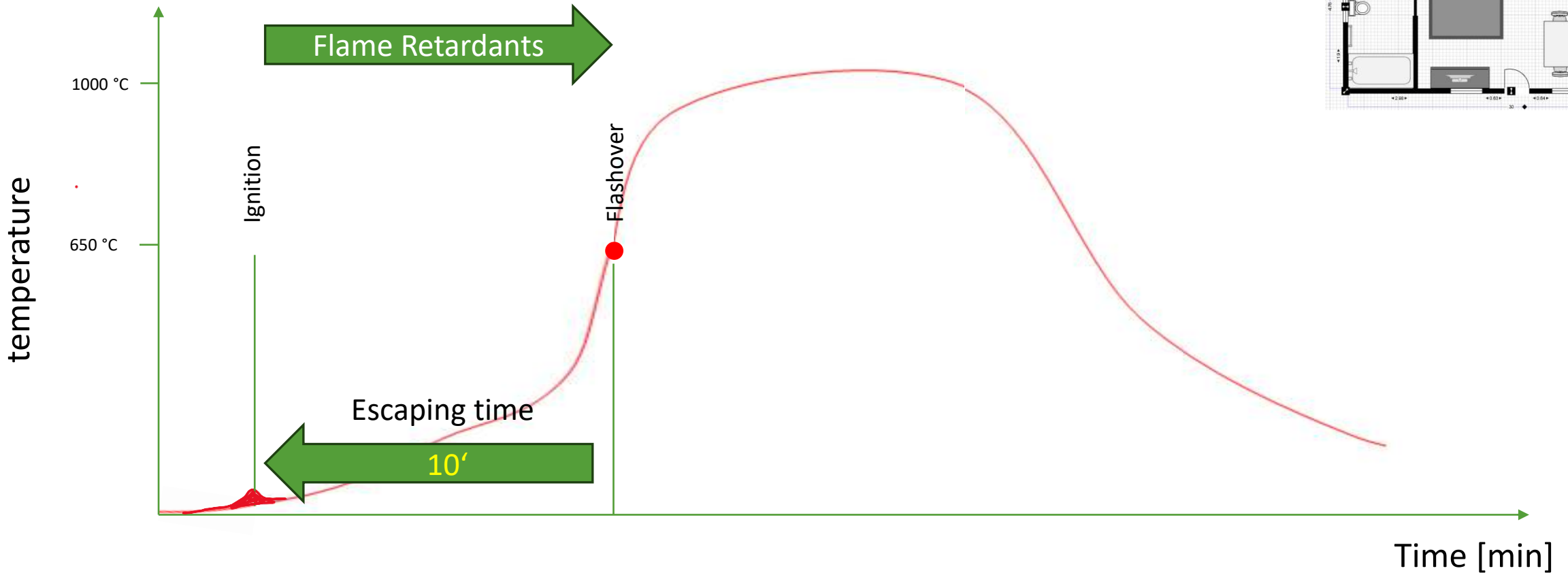
<b>EN 60332-1-2</b>	<b>Aim</b>
H [m]	If Class is > E <sub>ca</sub>
<b>EN 50399</b>	<b>Aim</b>
FS [m]	Main class
THR1200S [MJ]	Main class
Peak HRR [kW]	Main class
FIGRA, [W/s]	Main class
Peak SPR [m <sup>2</sup> /s]	s1, s2, s3
TSP1200s [m <sup>2</sup> ]	s1, s2, s3
Flaming droplets (Y/N)	d0, d1 d2
<b>EN 61034-2</b>	<b>Aim</b>
Transmittance	s1a, s1b
<b>EN 60754-2</b>	<b>Aim</b>
pH / Conductivity	a1, a2, a3



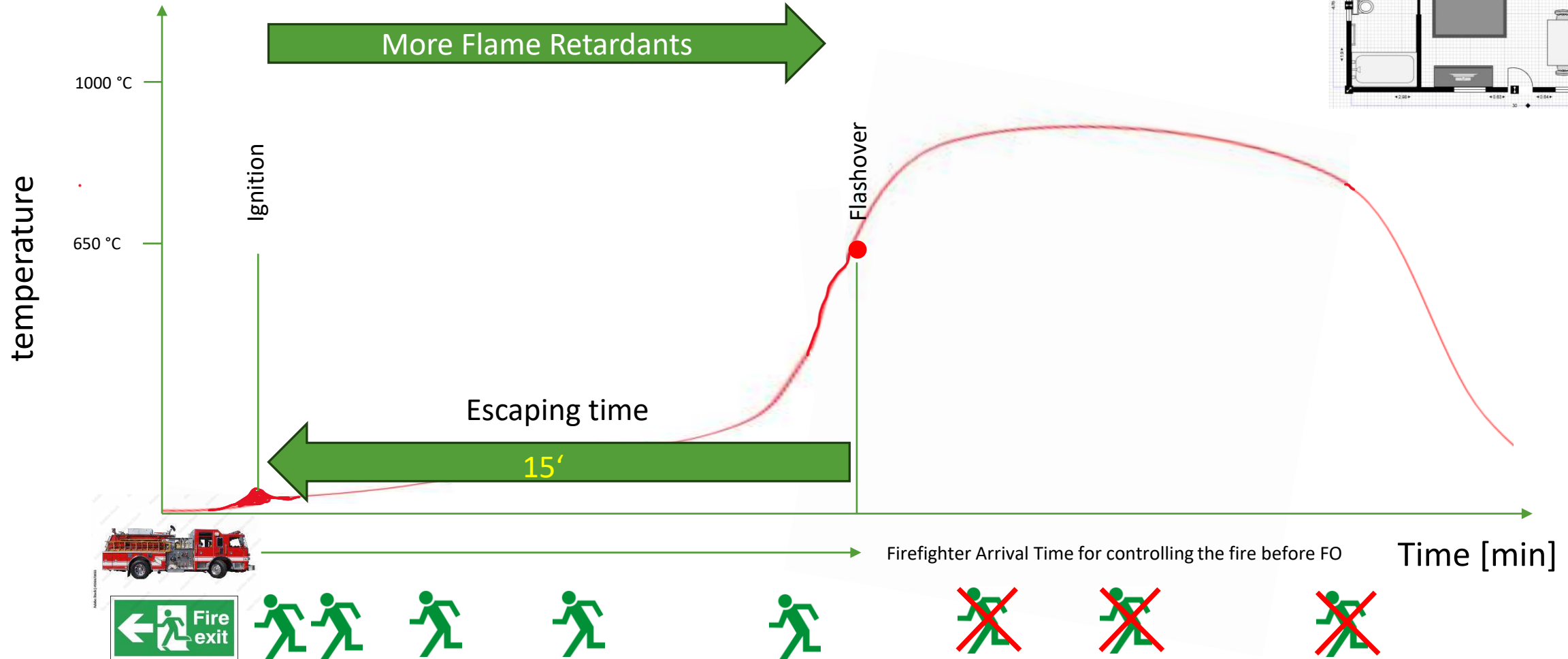
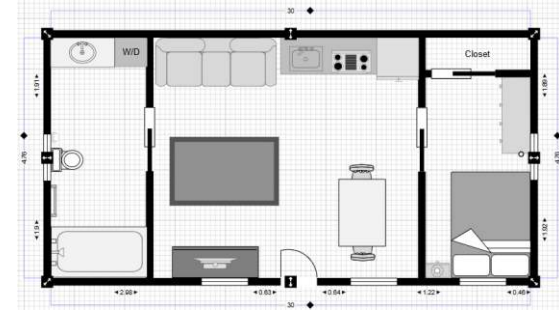
Fire Scenario number 1: 3 minutes between ignition and flashover



Fire Scenario number 2: 10 minutes between ignition and flashover



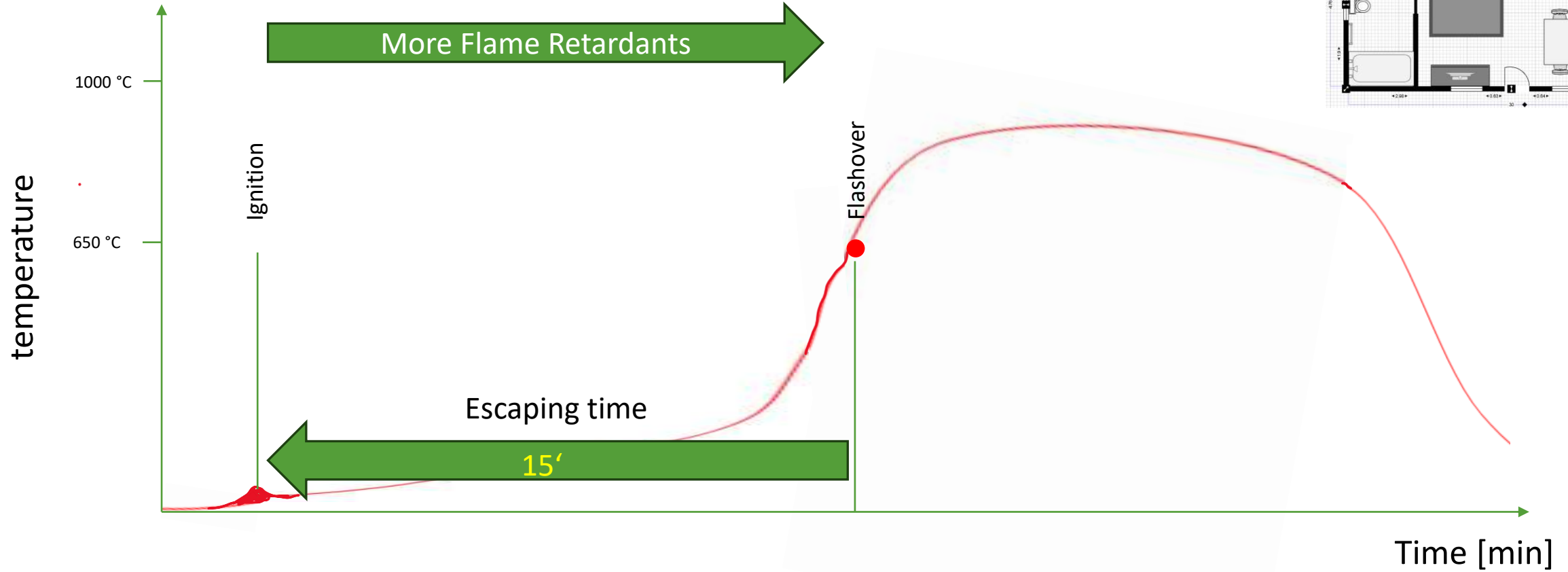
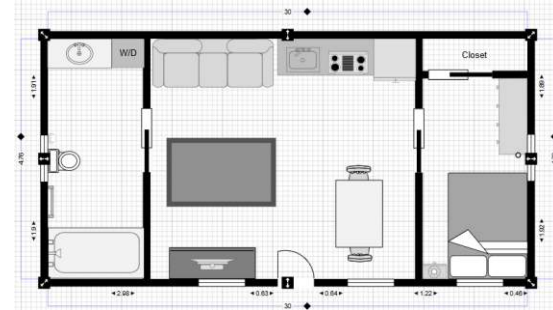
Fire Scenario number 3: 15 minutes between ignition and flashover  
heat release is the “single most important variable in fire safety”



Fire Scenario number 4: 15 minutes between ignition and flashover (the point of non-return), dense smoke

No Smoke Suppressants [28]

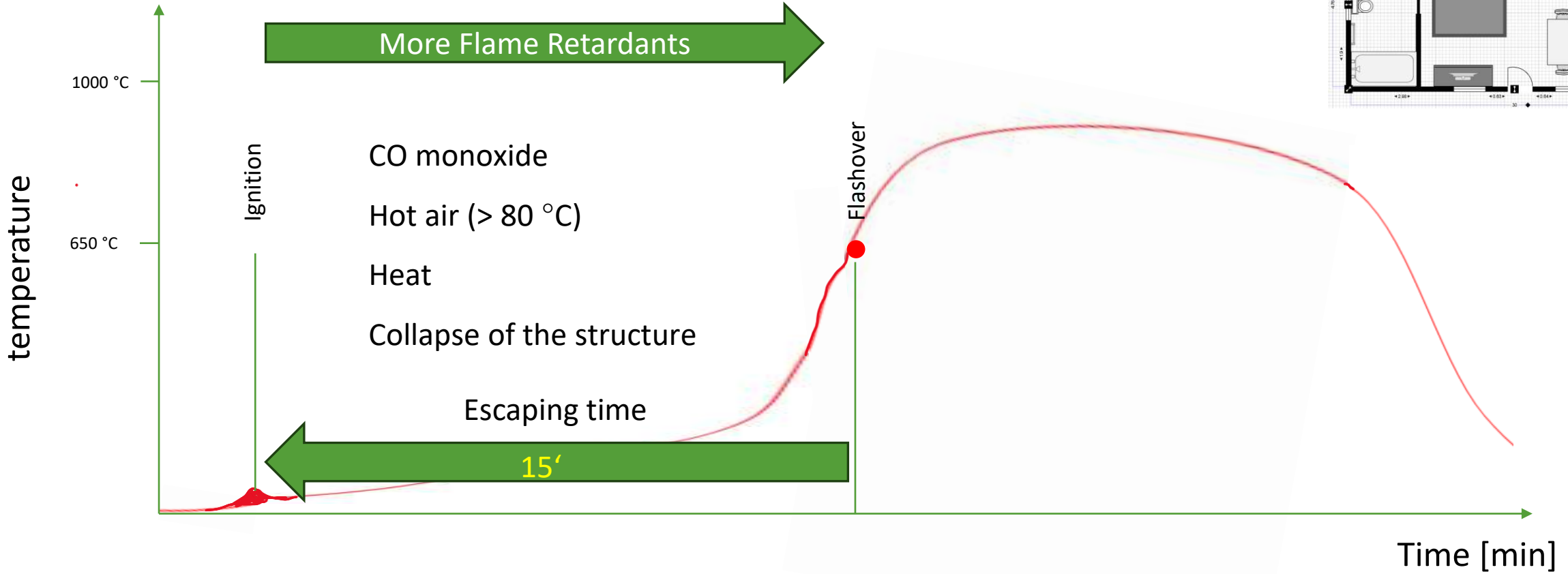
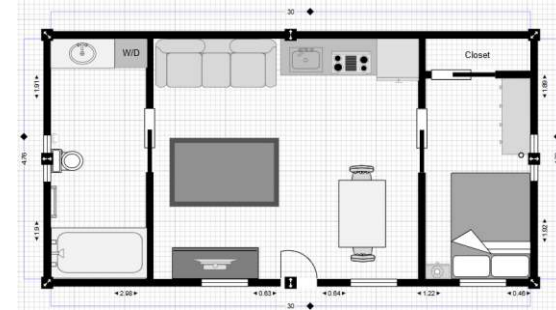
More Flame Retardants



Fire Scenario number 5: 15 minutes between ignition and flashover (the point of non-return), no dense smoke

Smoke Suppressants [28]

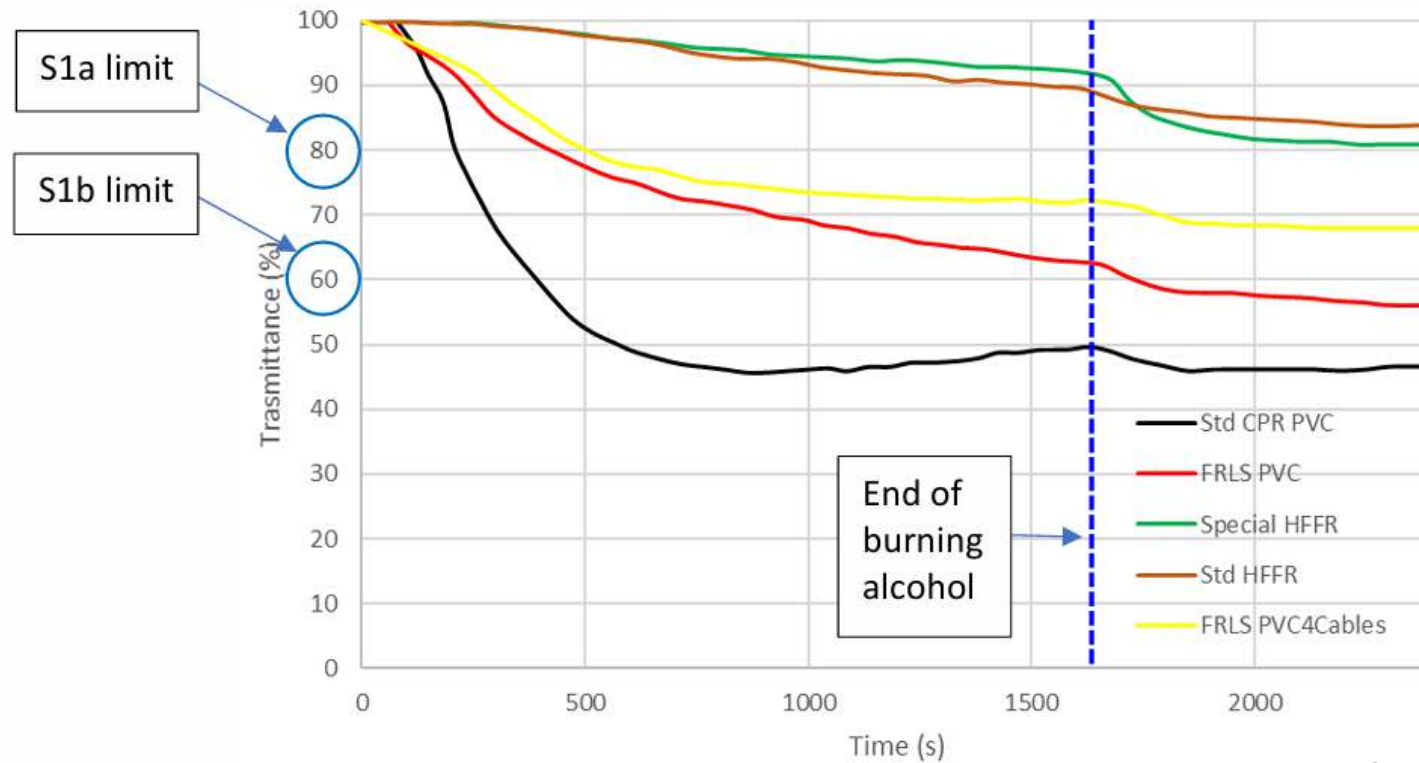
More Flame Retardants



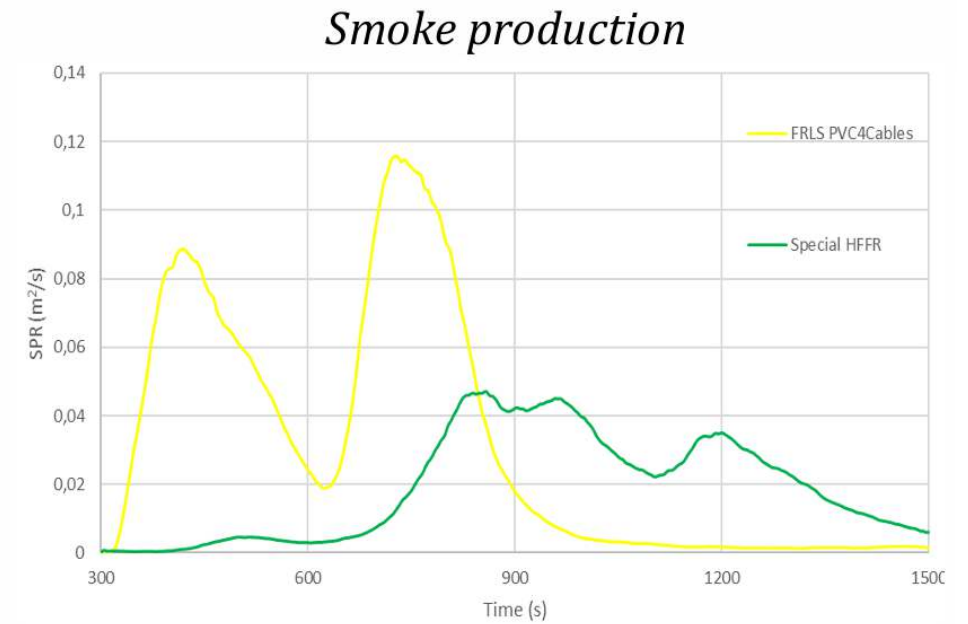
EN 61034-2 (figure a) and EN 50399 (Figure b): transmittance [%] of several kinds of cable. Standard CPR cable in class Cca s3 d1 a3 on the market is

Actually, B2ca s2 d0 a3. (black) FRLS (red) has almost a s1b class, low smoke acidity cable (yellow) a s1b class.

Comments on Ref. 26

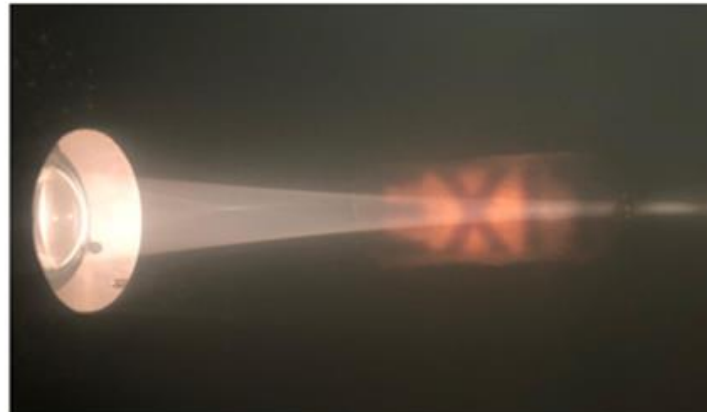
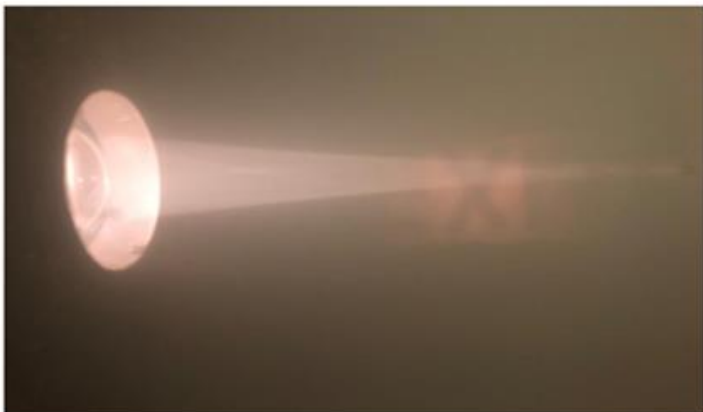
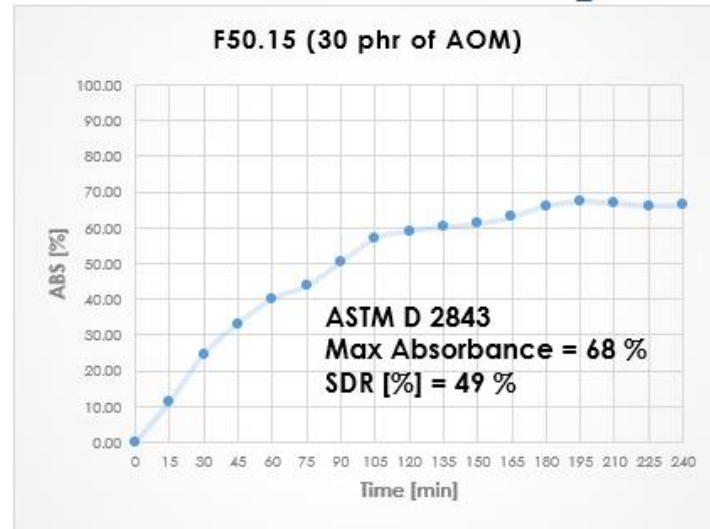
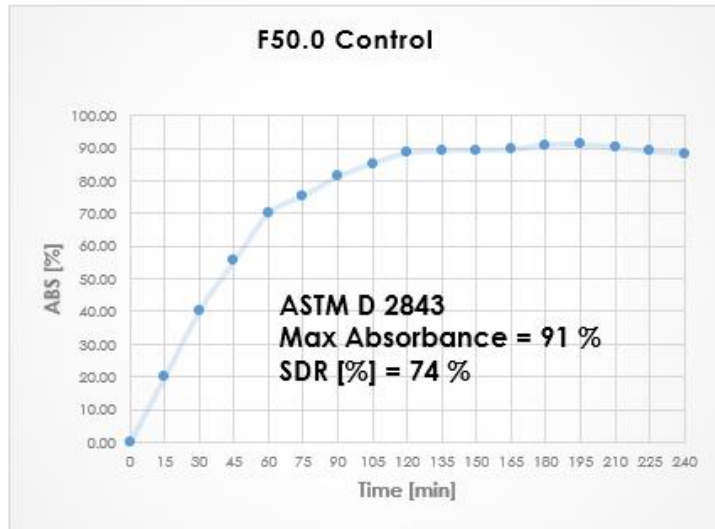


a

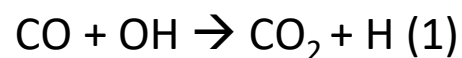


b

NFPA 262: Plenum compounds vs. standard PVC compound for cable without smoke suppressants  
Some Density Rating [%] a.t. ASTM D 2843. Plenum compound is much more below 60 %



Performing EN 50399 the measure of smoke production and CO from low smoke acidity cable decays in time (yellow curve, Figure a), while CO HFFR increases (green curve, Figure a)[28]. CO particularly drops because it is linked to HCl concentration in the gas phase. (equation 1) [25,27]



In presence of HCl this reaction is impeded. When HCl decays [XX] CO decays. The cumulative production of CO from low smoke acidity is therefore much less comparing to standard PVC compound for cables and inhibited and it is even better than the best HFFR. (Figure b)

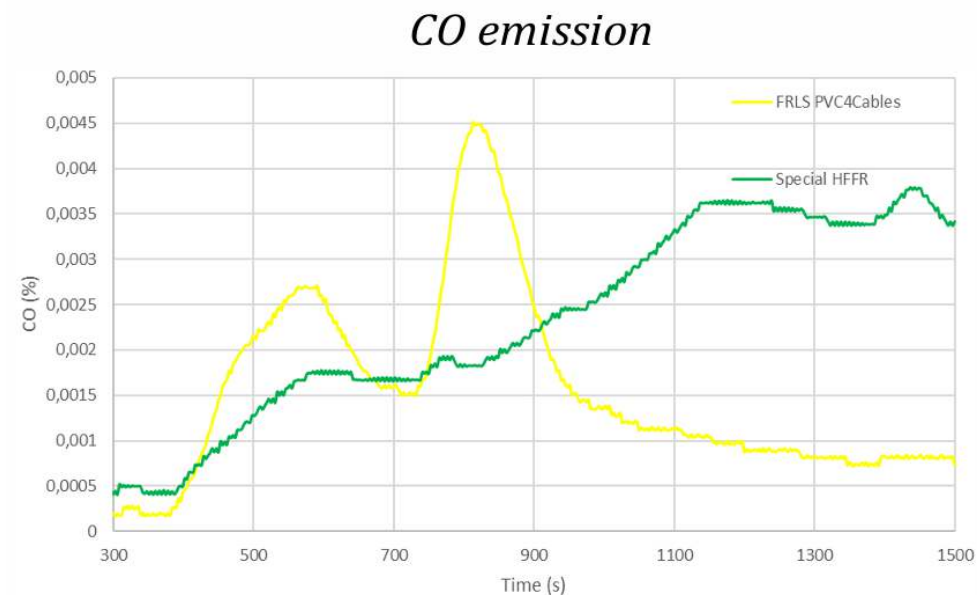
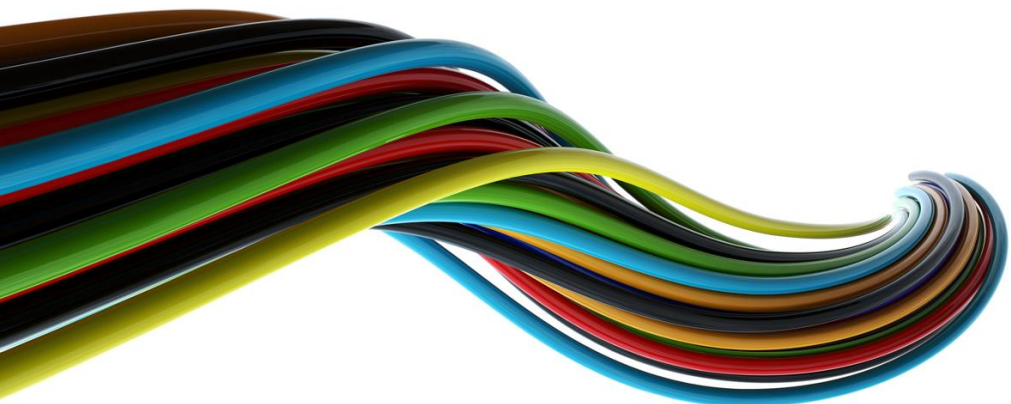


Figure a

**FR(LS) PVC vs HFFR compounds: total CO Production evolution**

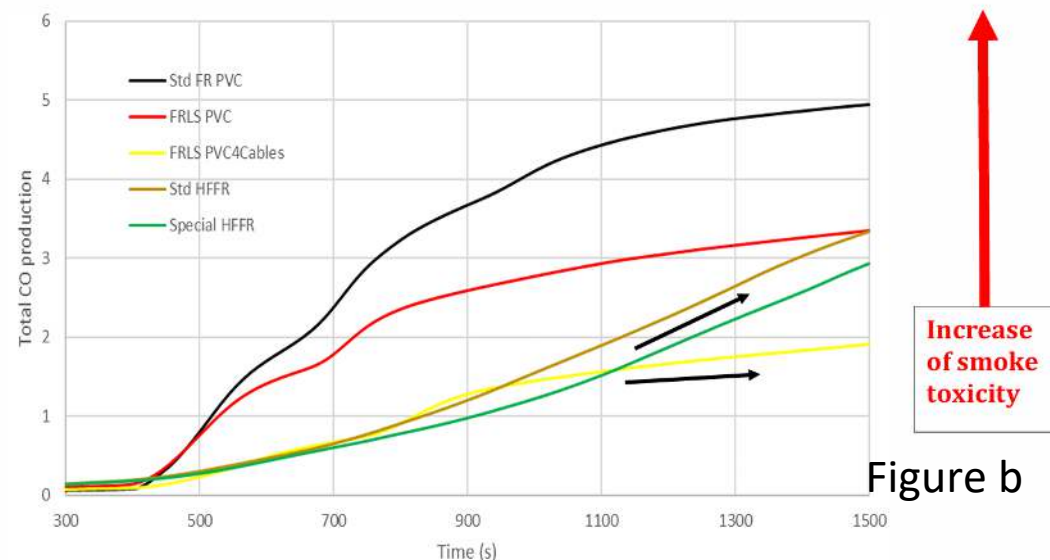
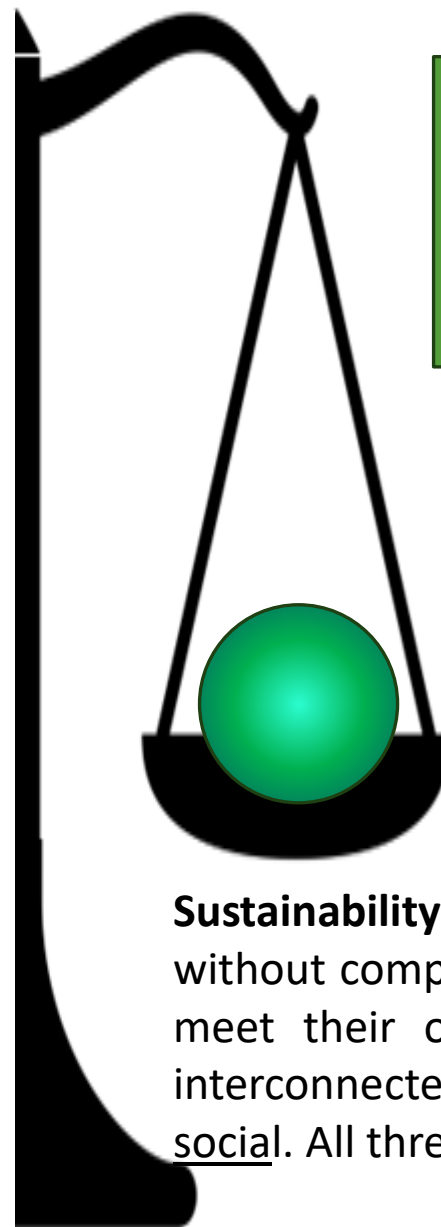


Figure b

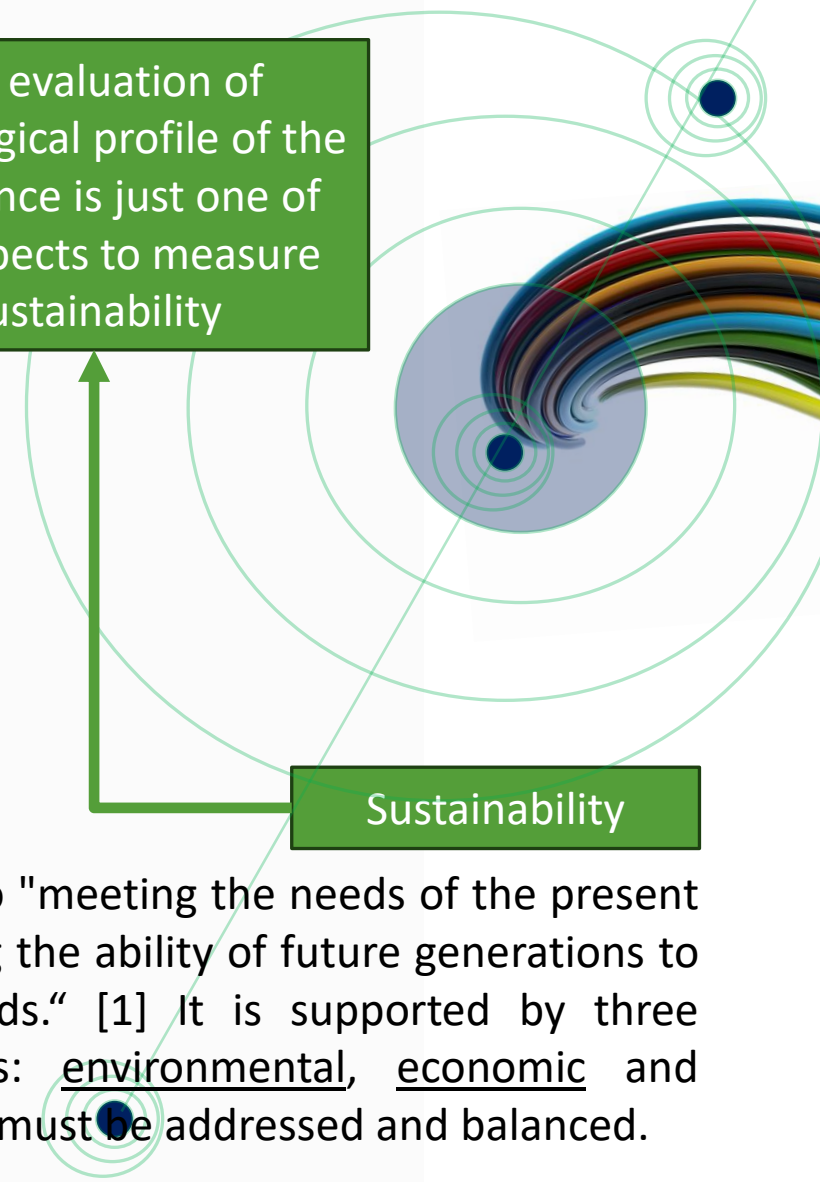
# 2 Route to Sustainability



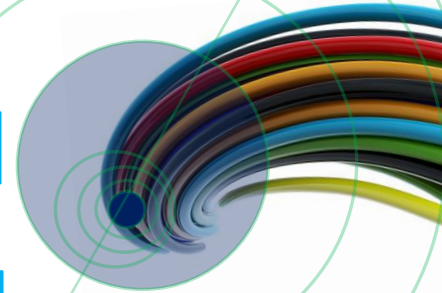
The evaluation of toxicological profile of the substance is just one of the aspects to measure sustainability

Sustainability

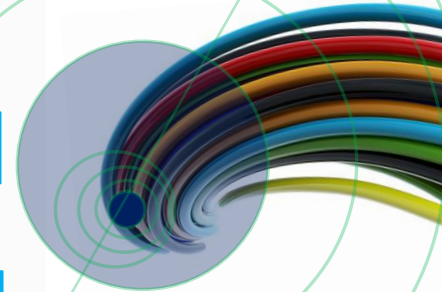
**Sustainability** refers to "meeting the needs of the present without compromising the ability of future generations to meet their own needs." [1] It is supported by three interconnected pillars: environmental, economic and social. All three pillars must be addressed and balanced.

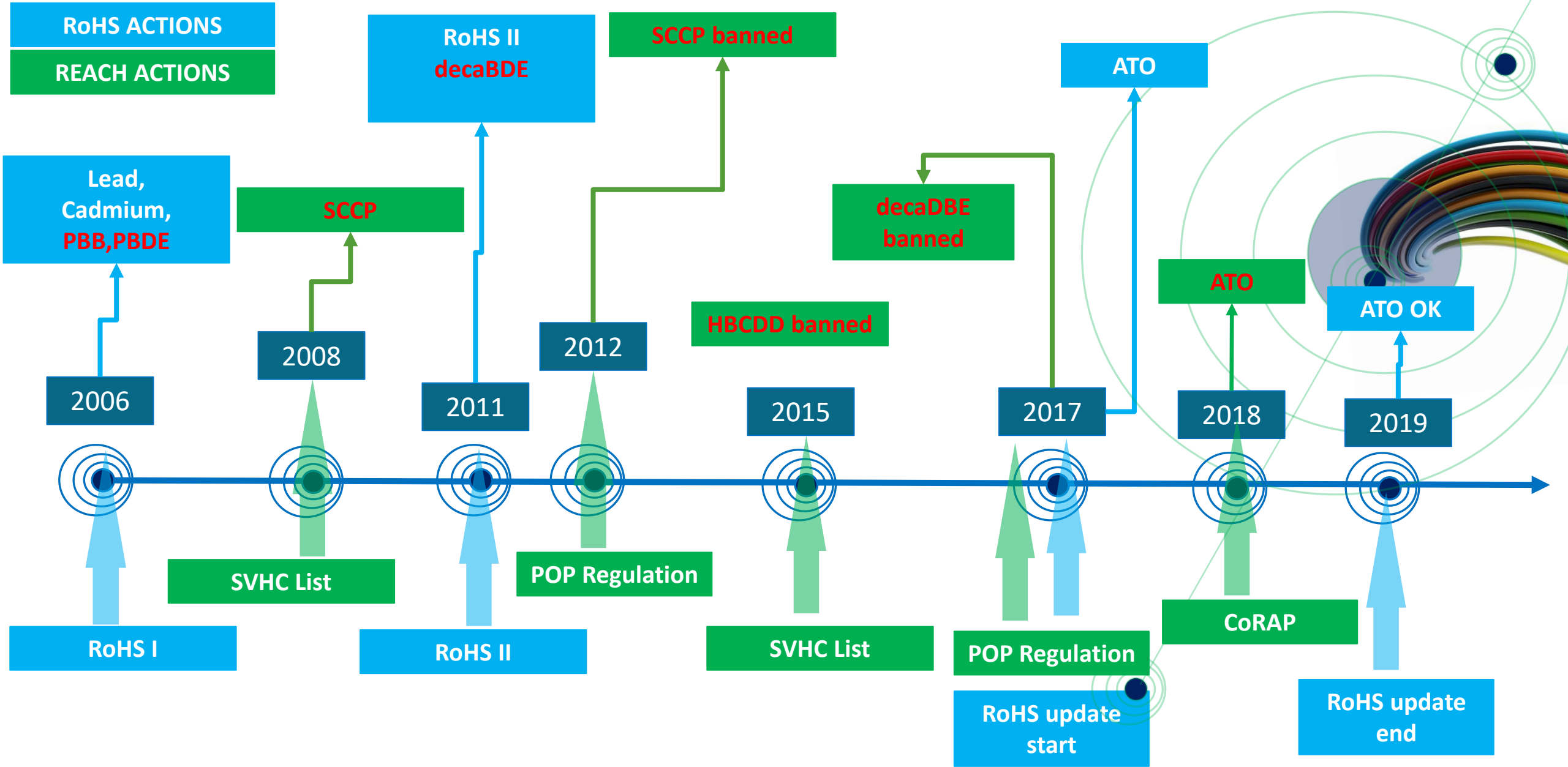


	PVC	Other polymers
Antimony Trioxide	~ 12000 tpa in PVC	~ 12000 tpa in other polymers
Zinc Borates	~ 12000 tpa in PVC	Marginal
Organobromines	Marginal	Significant
Organophosphorus	Significant	Significant
Chlorinated compounds	Significant	Marginal
Incipient Lewis Acids	Growing	Absent
MDH	Significant	Marginal
ATH	Growing	Significant
Other FR Fillers	Marginal	Marginal
Nitrogen based	Absent	Significant



	PVC	Other polymers
Antimony Trioxide	Everywhere	In combination with OB or CCP
Zinc Borates	Everywhere	To reduce ATH
Organobromines	Only DBDPE in coated fabrics	Everywhere
Organophosphorus	Aryl phosphates	PhN, HPP, PhO, RPh, Phosphates
Chlorinated compounds	MCCP, LCCP, CL esters	Cyclic Chlorinated compounds
Incipient Lewis Acids	ZnO, Zn Molybdate, AOM	
MDH	Especially in cables	Synergistic with ATH
ATH	Especially in cables	Especially in cables
Other FR Fillers	MGC, HHM,	Marginal
Nitrogen based		Intumescent systems





RoHS ACTIONS

REACH ACTIONS

2019

2020

2021

ATO

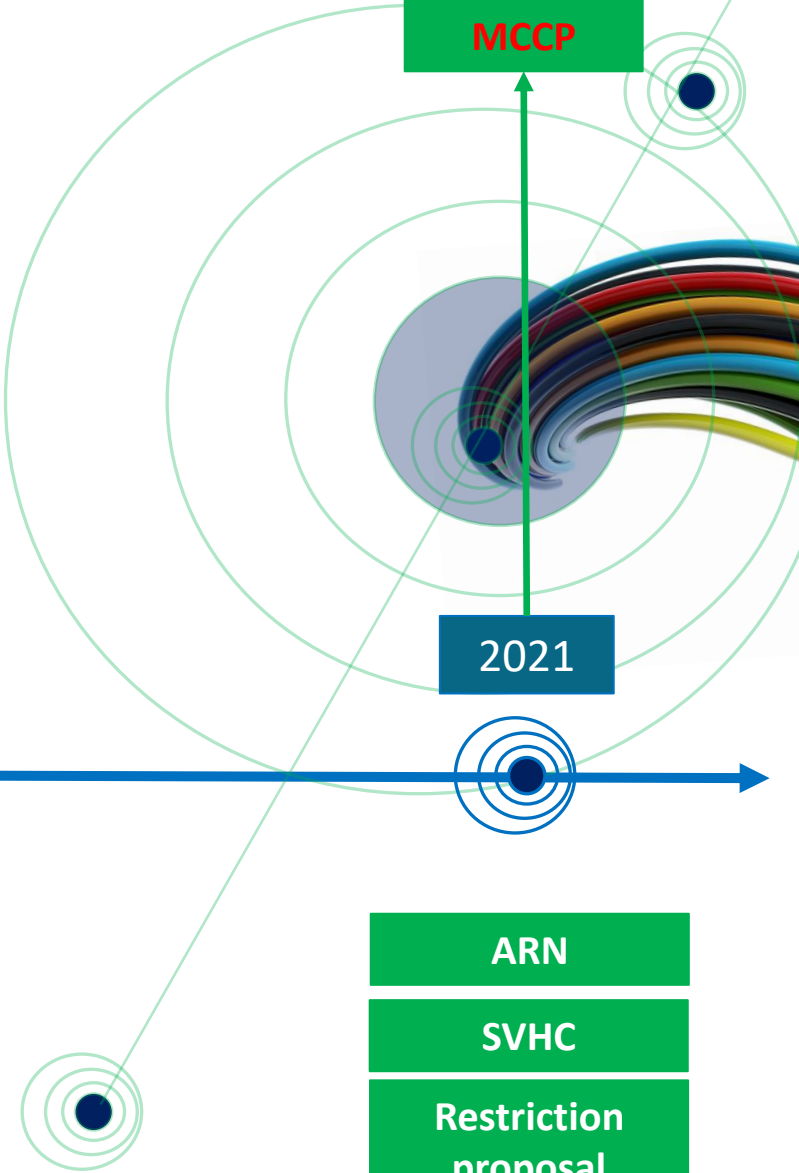
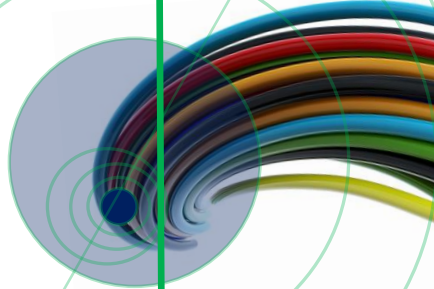
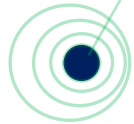
MCCP

ECHA FURTHER TESTS

ARN

SVHC

Restriction proposal



RoHS ACTIONS

REACH ACTIONS

Antimony trioxide  
and ZnBO

DBDPE

ECHA Report NOV/23

ECHA Report on DEC/24

Others ongoing

TBBPA

2022

2023

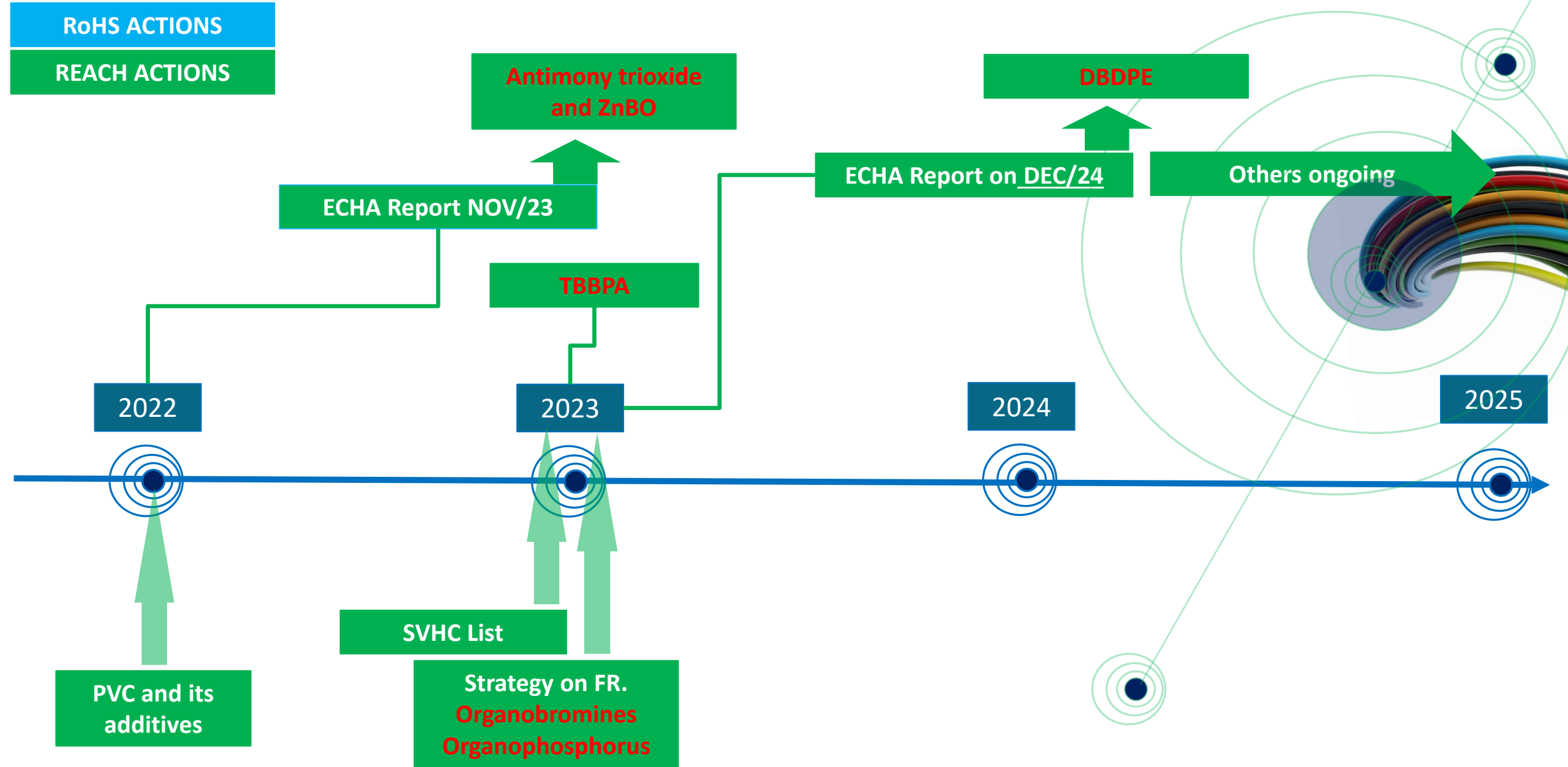
2024

2025

PVC and its  
additives

SVHC List

Strategy on FR.  
Organobromines  
Organophosphorus



MDH

Synthetic

brucite

Dolomite roasting

Brines

Localities for Brucite

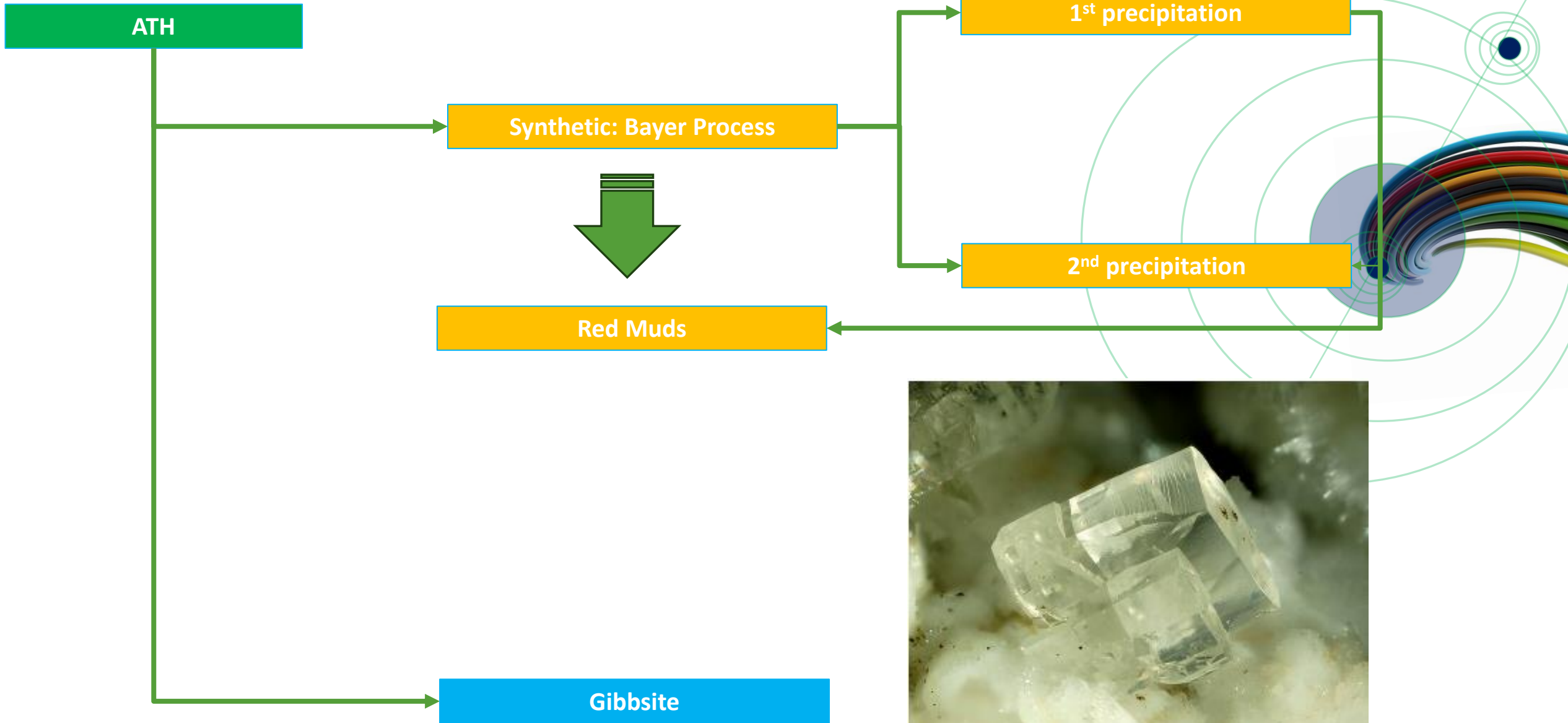
Hide

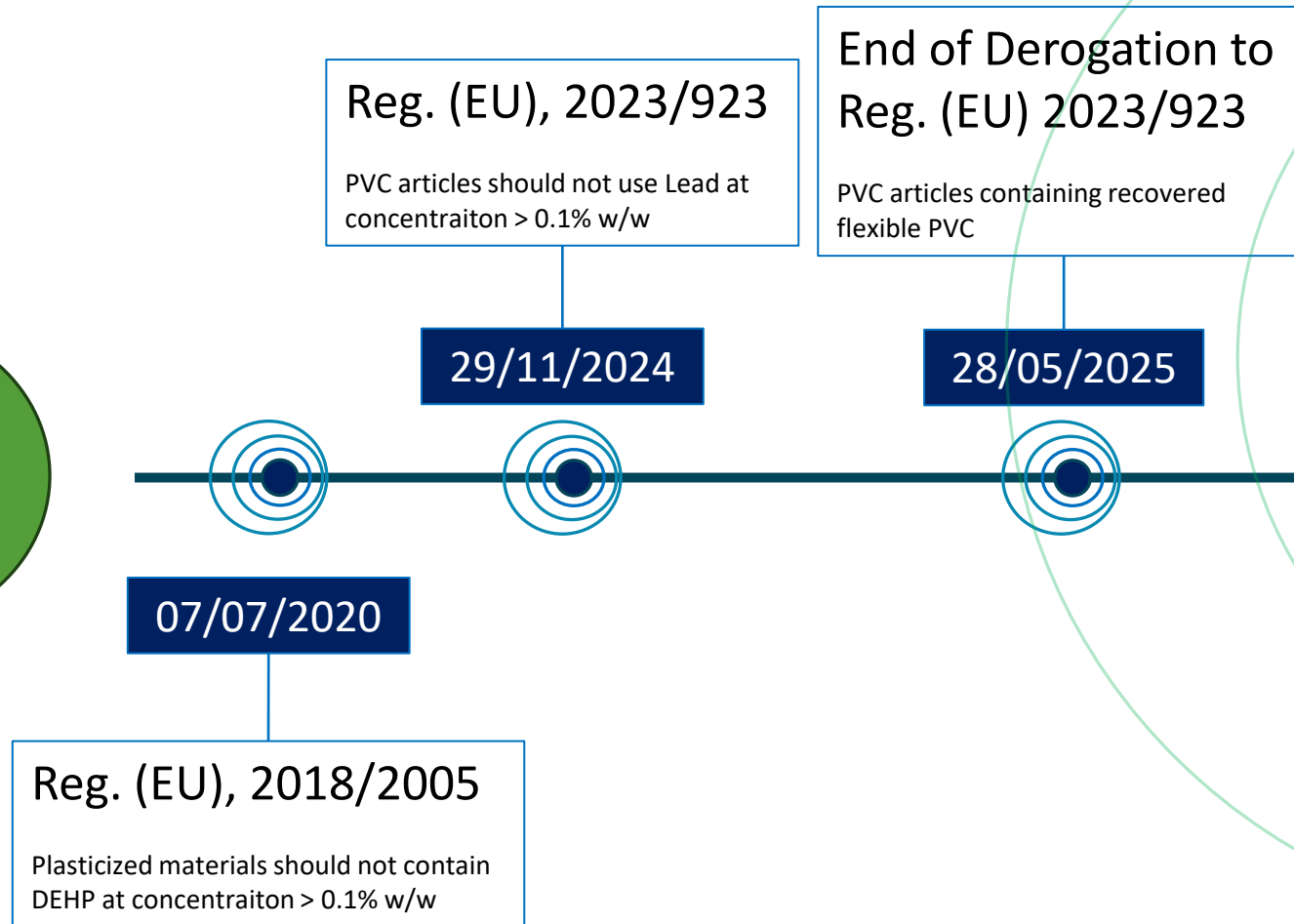


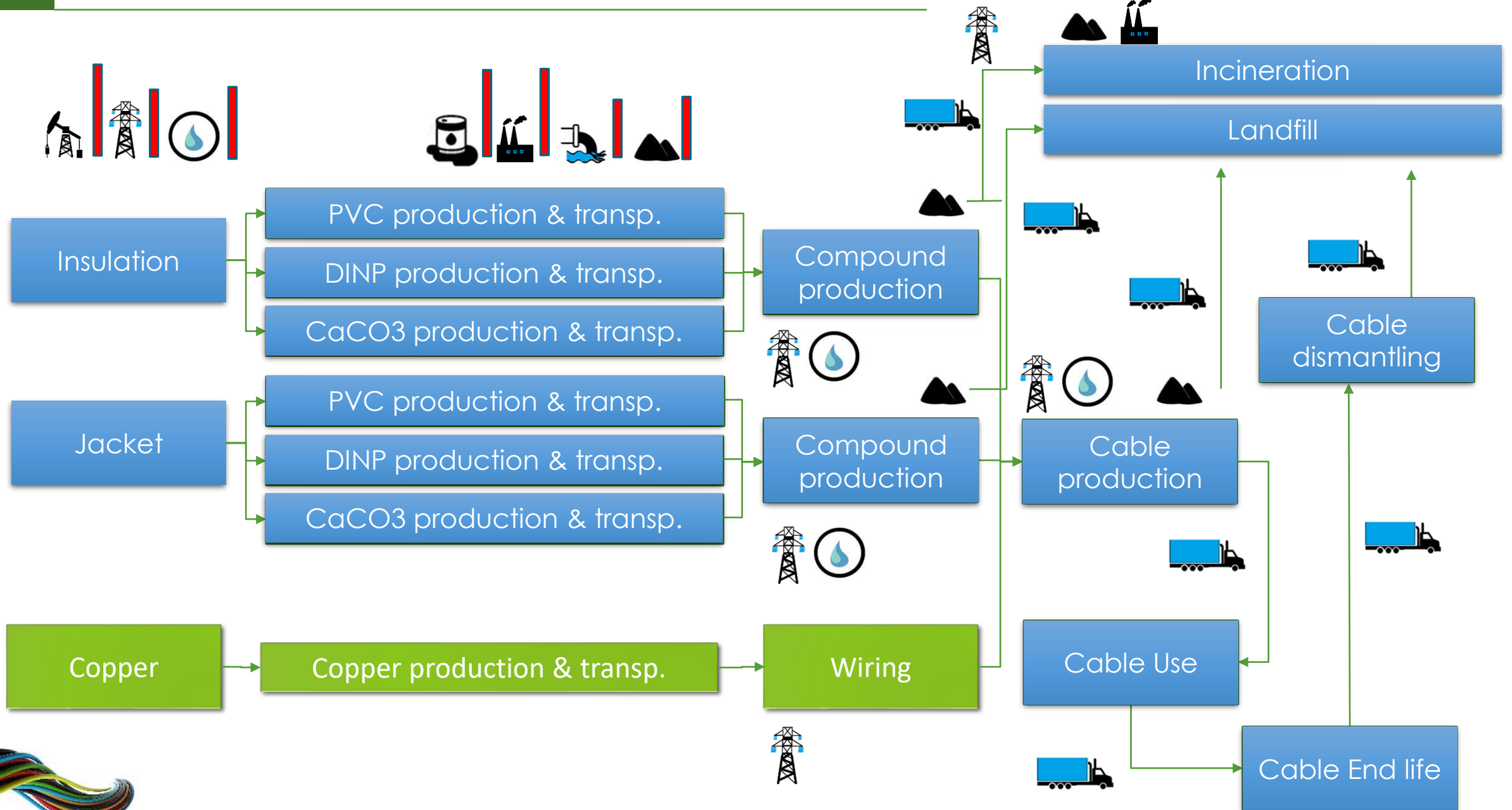
This map shows a selection of localities that have latitude and longitude coordinates recorded. Click on the  symbol to view information about a locality. The  symbol next to localities in the list can be used to jump to that position on the map.

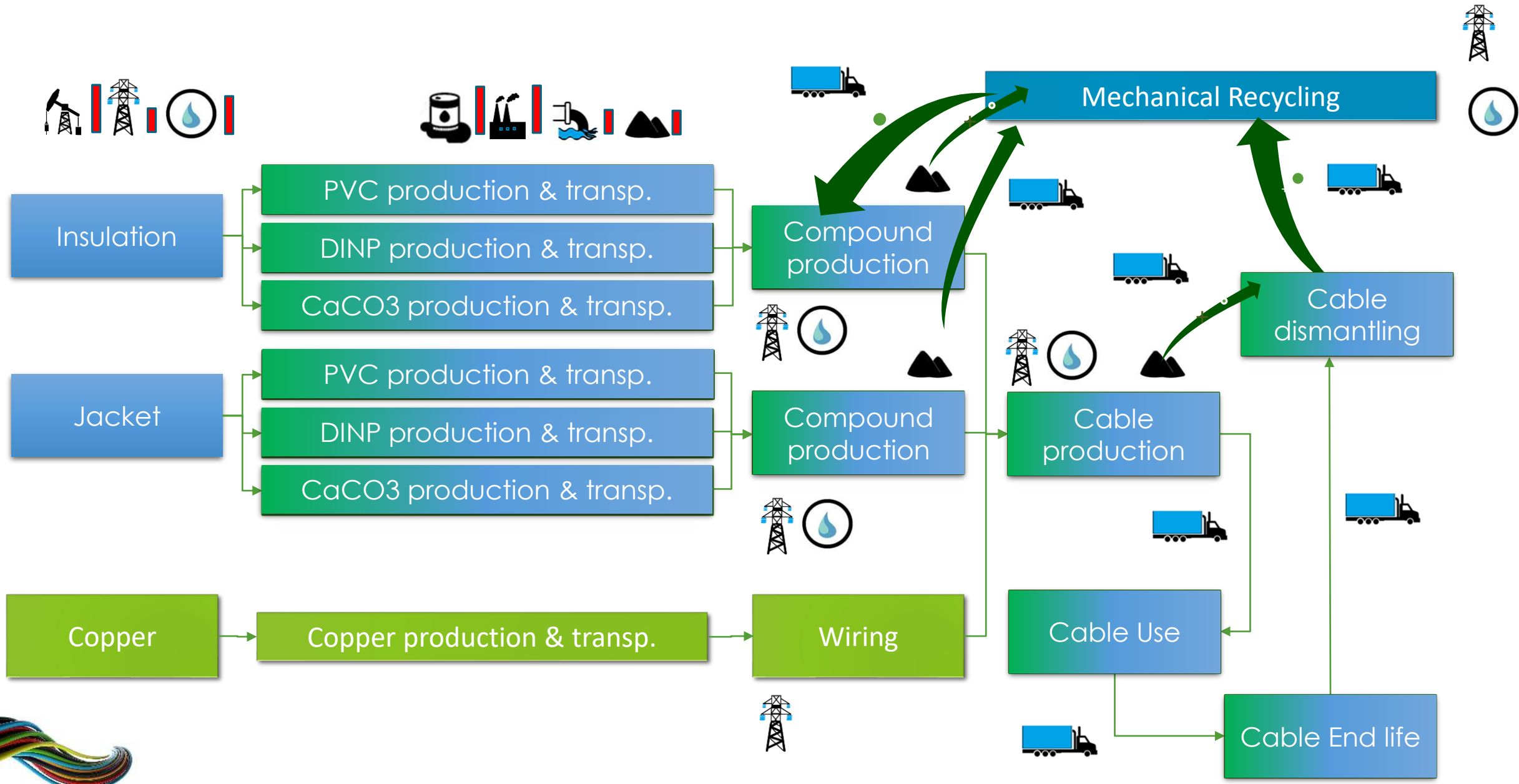
From: <https://www.mindat.org/>

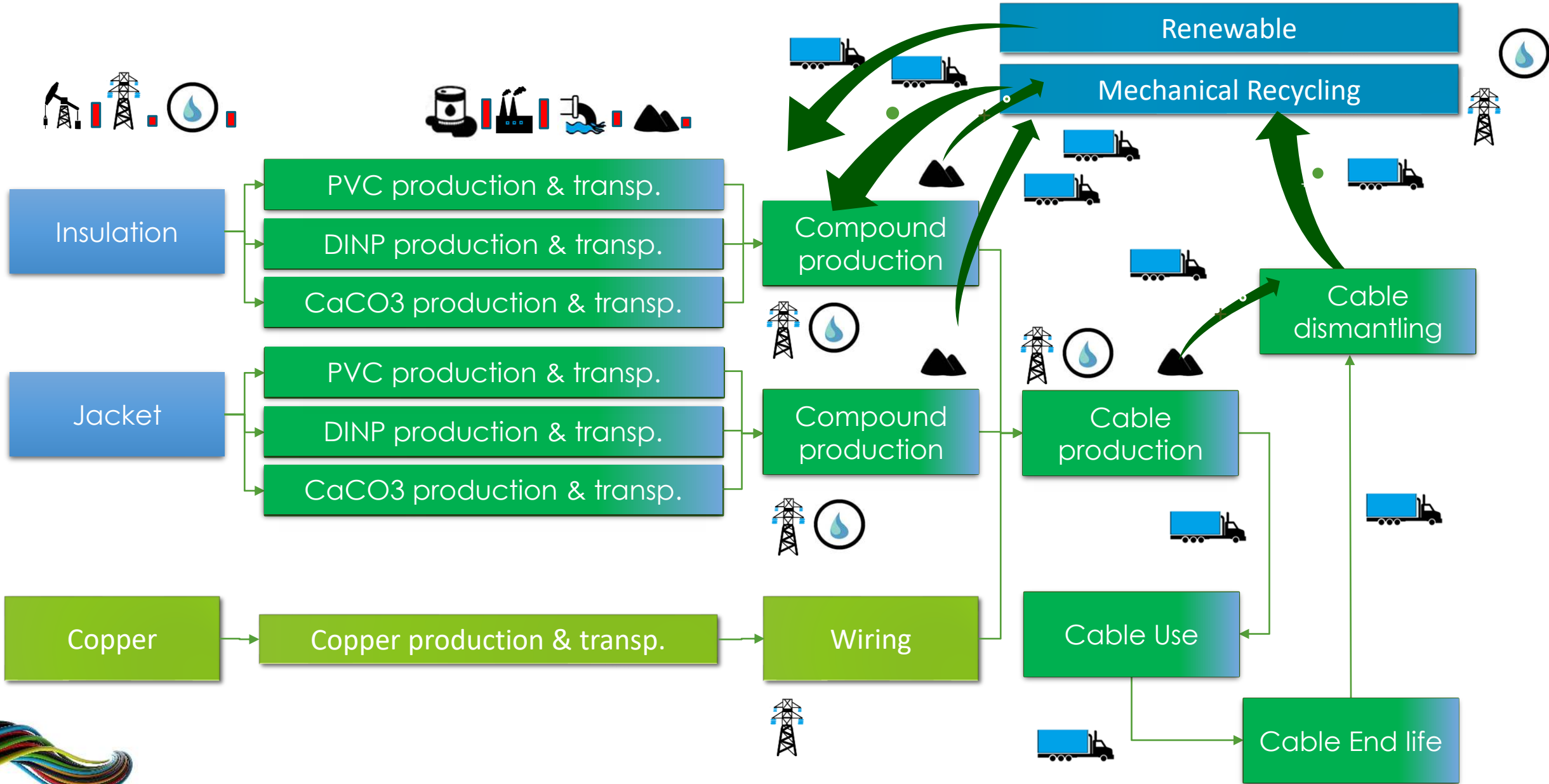


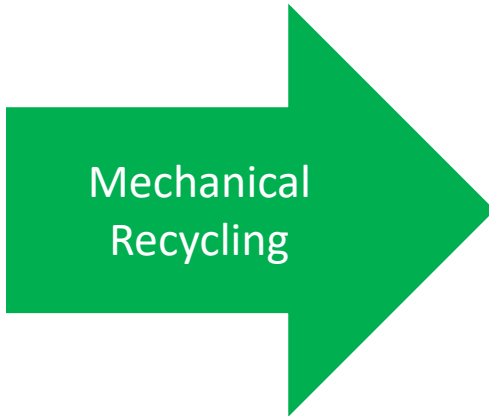












Floreale: scraps from cables

Post industrial is completely recyclable

Post consume

Less 0,1 % of Lead

Less 0,1 % of DEHP

Essential Conditions after 2020/2025

Recyclate

Less demanding cable compounds

Undercoat layer in hoses

Bottom layer in roofing membranes

.....  
Many other articles

Detecting and sorting



TM1 Jacket a.t. EN 50363-4-1 and R16 a.t. EN 50363-0 Annex 1 (ITA)	Original	New one A MCCP free	New one B MCCP free
S PVC K 70	100,0	100,0	100,0
DINP	49,0	54,0	49,0
<b>MCCP</b>	<b>10,0</b>	<b>0,0</b>	<b>0,0</b>
<b>Chlorinated Esters</b>	<b>0,0</b>	<b>0,0</b>	<b>10,0</b>
CaCO <sub>3</sub>	26,0	20,0	26,0
Brucite	50,0	56,0	50,0
<b>ATO</b>	<b>5,0</b>	<b>6,0</b>	<b>5,0</b>
<b>Zinc Borate</b>	<b>5,0</b>	<b>5,0</b>	<b>5,0</b>
IX 1010	0,2	0,2	0,2
Stabilizer CZ	5,0	5,0	5,0
FT Wax	0,5	0,1	0,5
TOT	250,7	246,3	250,7

TM1 Jacket a.t. EN 50363-4-1 and R16 a.t. EN 50363-0 Annex 1 (ITA)	Original	New one A MCCP free	New one B MCCP free
Density [g/CC]	1,509	1,529	1,509
Hardness [Shore A]	86	86	86
Tensile Strength [MPa]	13,0	12,4	13,0
Elongation at break [%]	258	245	258
<b>LOI [%O<sub>2</sub>]</b>	<b>34</b>	<b>34</b>	<b>34</b>
Lead [% w/w]	0,0	0,0	0,0
<b>ATO [% w/w]</b>	<b>1,99</b>	<b>2,44</b>	<b>1,99</b>
<b>Zinc Borate [% w/w]</b>	<b>1,99</b>	<b>2,03</b>	<b>1,99</b>
Brucite [% w/w]	19,94	22,74	19,94
BPA [% w/w]	0,00	0,00	0,00
<b>MCCP [% w/w]</b>	<b>3,99</b>	<b>0,00</b>	<b>0,00</b>
DEHP [% w/w]	0,00	0,00	0,00

TM1 Jacket a.t. EN 50363-4-1 and R16 a.t. EN 50363-0 Annex 1 (ITA)	Original	New one ATO free
S PVC K 70	100,0	100,0
DINP	49,0	49,0
MCCP	0,0	0,0
Chlorinated Esters	10,0	10,0
CaCO <sub>3</sub>	26,0	20,0
Brucite	50,0	70,0
<b>ATO free FR</b>	<b>0,0</b>	<b>10</b>
<b>ATO</b>	<b>5,0</b>	<b>0,0</b>
<b>Zinc Borate</b>	<b>5,0</b>	<b>0,0</b>
IX 1010	0,2	0,2
Stabilizer CZ	5,0	5,0
FT Wax	0,5	0,5

TM1 Jacket a.t. EN 50363-4-1 and R16 a.t. EN 50363-0 Annex 1 (ITA)	New one ATO free	New one ATO free
Density [g/CC]	1,509	1,529
Hardness [Shore A]	86	87
Tensile Strength [MPa]	13,0	12,8
Elongation at break [%]	258	259
<b>LOI [%O<sub>2</sub>]</b>	<b>34</b>	<b>33</b>
Lead [% w/w]	0,00	0,00
<b>ATO [% w/w]</b>	<b>1,99</b>	<b>0,00</b>
<b>Zinc Borate [% w/w]</b>	<b>1,99</b>	<b>0,00</b>
Brucite [% w/w]	19,94	28,42
BPA [% w/w]	0,00	0,00
MCCP [% w/w]	0,00	0,00
DEHP [% w/w]	0,00	0,00

TM1 Jacket a.t. EN 50363-4-1 and R16 a.t. EN 50363-0 Annex 1 (ITA)	Original	New one
S PVC K 70	100,0	100,0
DINP	49,0	49,0
MCCP	10,0	10,0
Chlorinated Esters	0,0	0,0
CaCO <sub>3</sub>	76,0	26,0
<b>Brucite</b>	<b>0,0</b>	<b>50,0</b>
<b>ATO</b>	<b>4,0</b>	<b>5,0</b>
<b>Zinc Borate</b>	<b>0,0</b>	<b>5,0</b>
IX 1010	0,2	0,2
Stabilizer CZ	5,0	5,0
FT Wax	0,3	0,5
TOT	244,5	250,7

TM1 Jacket a.t. EN 50363-4-1 and R16 a.t. EN 50363-0 Annex (ITA)	Original	New one
Density [g/CC]	1,511	1,509
Hardness [Shore A]	85	86
Tensile Strength [MPa]	13,3	13,0
Elongation at break [%]	260	258
<b>LOI [%O<sub>2</sub>]</b>	<b>31</b>	<b>34</b>
Lead [% w/w]	0,00	0,00
ATO [% w/w]	1,64	1,99
Zinc Borate [% w/w]	0,00	1,99
Brucite [% w/w]	0,00	19,94
BPA [% w/w]	0,00	0,00
MCCP [% w/w]	4,09	3,99
DEHP [% w/w]	0,00	0,00

- **Fire safety objectives obviously** must be **preserved** when replacing traditional flame retardants **with new substances**.
- **New flame retardants** must achieve **performance** levels comparable **to older ones**.
- Achieving **equivalent fire protection** at the **same cost** can be **challenging, often resulting in higher compound costs**.
- **Traditional flame retardants, despite their lower sustainability profiles, have saved millions of lives during the "plastic age."**
- **A careful balance must be maintained** between **sustainability** and **fire safety** to ensure that **environmental advancements** do not **compromise safety standards** or effectiveness.



PVC Forum Italia ([www.pvcforum.it](http://www.pvcforum.it)) is the Italian association that brings together the leading companies in the production, compounding, and processing of PVC, as well as manufacturers of additives and processing machinery. Based in Milan, PVC Forum is part of the European network of PVC forums connected to ECVM (European Council of Vinyl Manufacturers), the European association of PVC producers, which is a division of the association of European plastics producers (PlasticsEurope).

[www.pvcforum.it](http://www.pvcforum.it)



VinylPlus® is the Voluntary Commitment to the sustainable development of the European PVC industry. The program was developed through an open dialogue with stakeholders, involving industry, NGOs, legislators, representatives of civil society, and end-users of PVC. VinylPlus® operates in the 27 European Union countries plus Norway, Switzerland, and the UK. VinylPlus® is registered as a SMART partnership on the UN's Partnerships for the SDGs platform.

[vinylplus.eu](http://vinylplus.eu)



PVC4Cables is the ECVM platform dedicated to the PVC cable supply chain. It brings together PVC resin producers, stabilizer and plasticizer manufacturers, and PVC compounders. It is open to the participation of PVC cable manufacturers, recyclers, and industry associations. PVC4Cables aims to be a driver for environmentally compatible innovations in the PVC cable sector and to serve as a point of reference for dialogue and communication with all stakeholders: cable manufacturers, legislators, designers, installers, electricians, media, and the general public.

[www.pvc4cables.org](http://www.pvc4cables.org)



# Thank you for your attention



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