UNIVERSITÀ POLITECNICA DELLE MARCHE

Montreal Protocol - MOP31 - Rome 2019

SIDE EVENT

Latest developments on refrigeration standards at international and European level

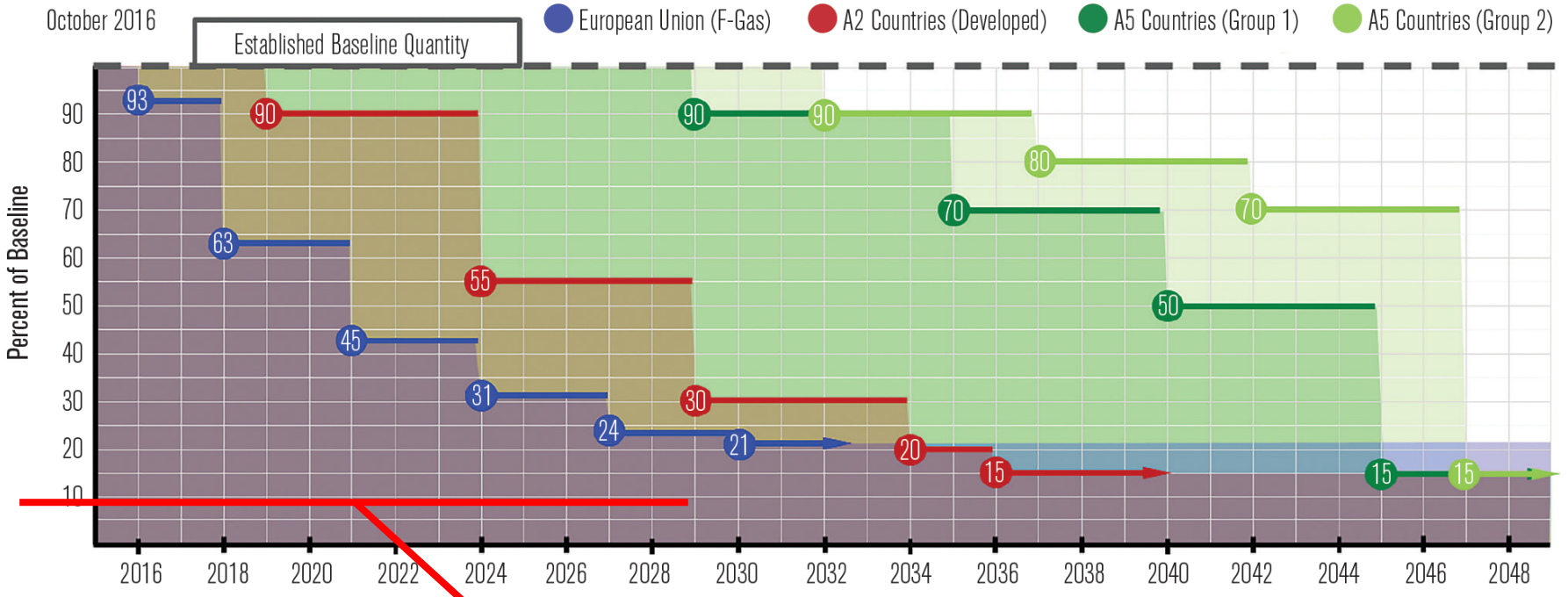
Wednesday, November 6, 2019

"Context of RACHP safety standards under Montreal Protocol and Kigali Amendment"

Prof. Fabio Polonara

TEAP/RTOC

(The views presented here are the views of the author and do not necessarily represent the views of the TEAP and/or RTOC)



Group 1: Kigali Amendment Article 5 parties not part of Group 2
Group 2: Bahrain, India, the Islamic Republic of Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, and the United Arab Emirates

average GWP ≈300

a) compliance with Kigali Amendment (and local regulations) requires that average refrigerants GWP be around 300, at least in the medium term

source: UNEP-RTOC 2018 Assessment Report

	ODP	GWP	
1st generation (1940 to 1990)	**very high**	**very high**	**CFCs**
2nd generation (1990 to 2010)	**low**	**high**	**HCFCs and HFCs**
3rd generation (1995 to 2020)	**zero**	**high**	**HFCs**
4th generation (2010 onwards)	**zero**	**medium/low**	**low-GWP HFCs HFOs**

- **there is no 5th generation**

b) in the recent past refrigerants have evolved towards increased sustainability, but we are running out of alternatives

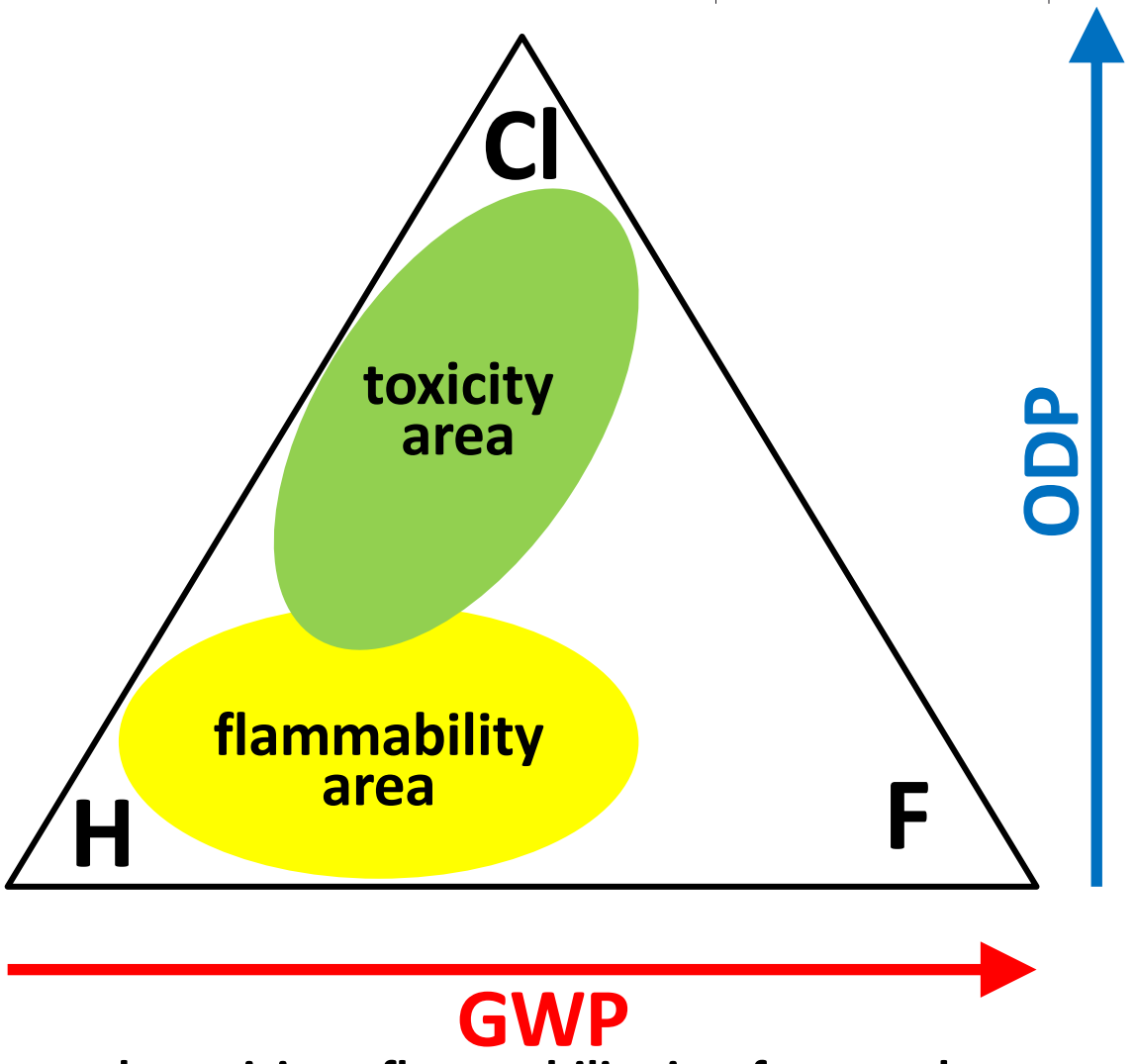
source: McLinden et al., Nature Communications, 8:14776, 2017

from

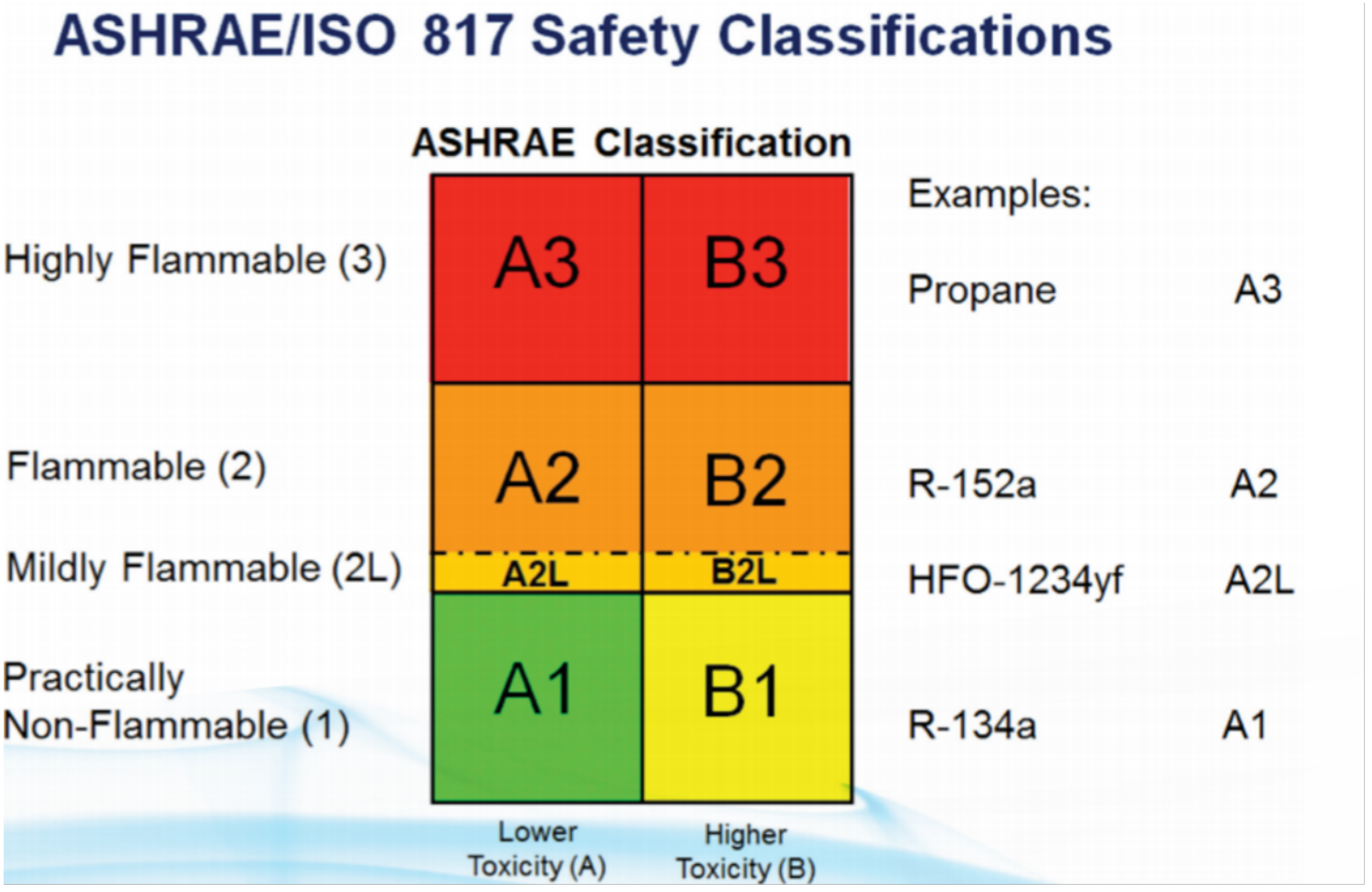
- C_nH_{2n+2}

to

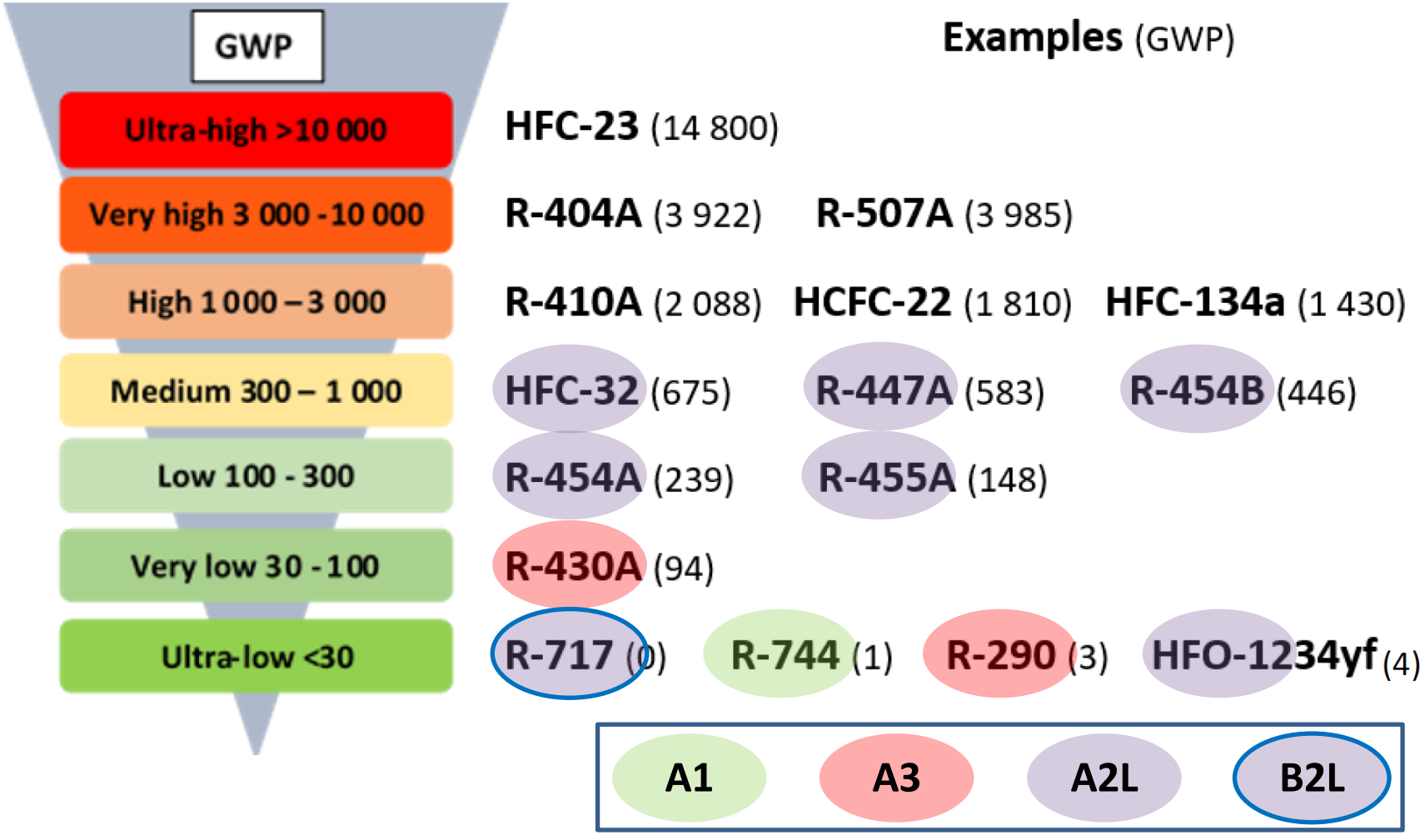
- **CFC**
- **HCFC**
- **HFC**
- **HFO**



c) to cope with environmental requisites, flammability is a feature that must be accepted;



d) the use of A2, A2L and A3 refrigerants may become necessary for specific applications

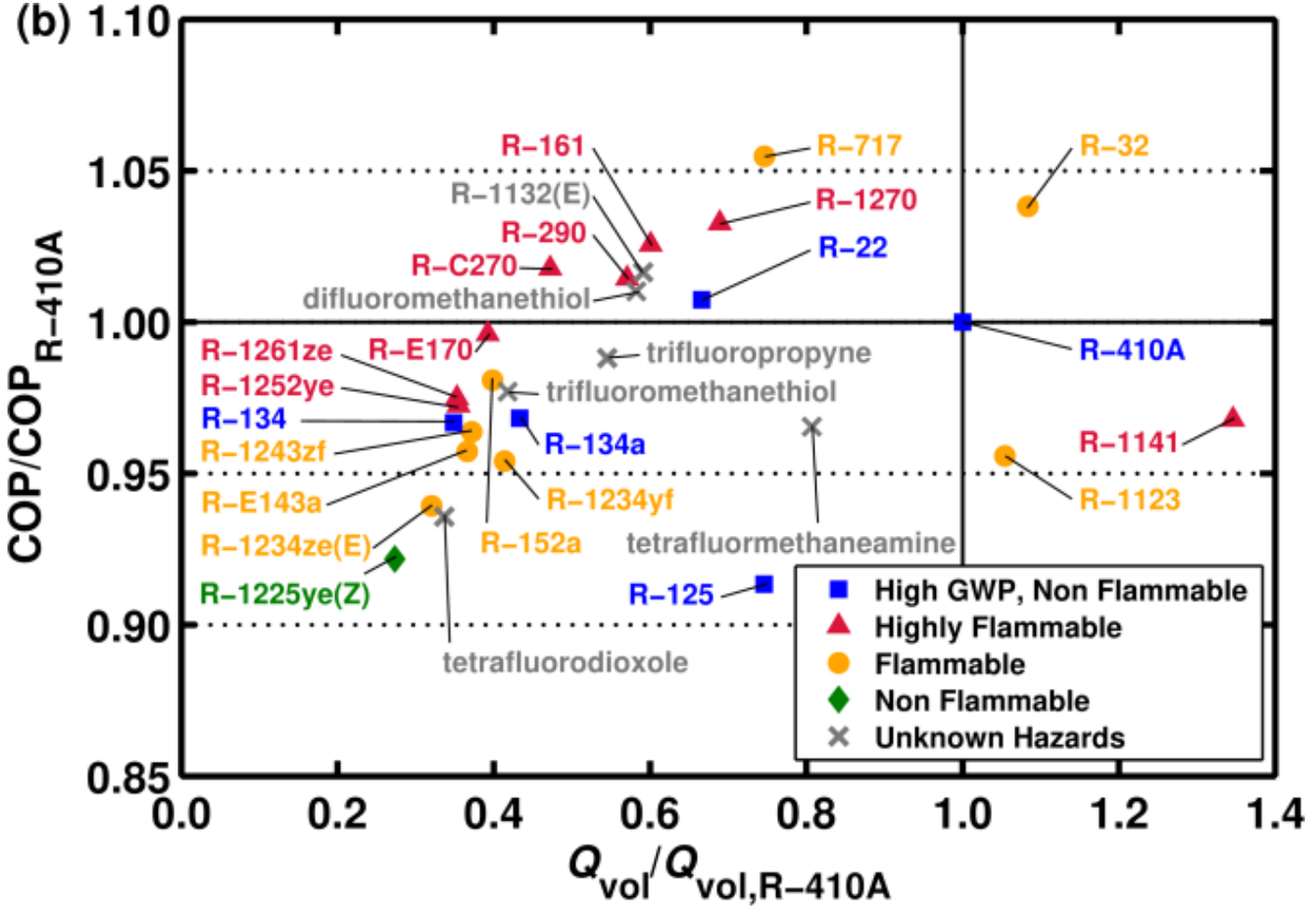


e) available alternatives are often in the "flammable" domain

sources: OzoneAction, Kigali FactSheets #3 - UNEP-RTOC 2018 Assessment Report

Air Conditioning basic cycle

Simulation with optimized Heat Exchangers



f) also in terms of Energy Efficiency feasible alternatives reside in the "flammable" domain

source: Brown et al., NIST Technical Note, 2017

In conclusion, acknowledging the fact that available alternatives are limited and most often flammable, it is necessary:

- **to select the most adequate refrigerant for each application, recognizing environmental and safety considerations,**
- **to use high efficiency and leak-free equipment,**
- **to improve refrigerant handling practices (equiment commissioning, servicing and decommissioning).**

Most of all,

- **SAFETY STANDARDS have to be adequately updated and improved in order to take into account technology innovation and extended applications;**

Thank you for your attention