Standards to facilitate the HCFC phase-out

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Suriname

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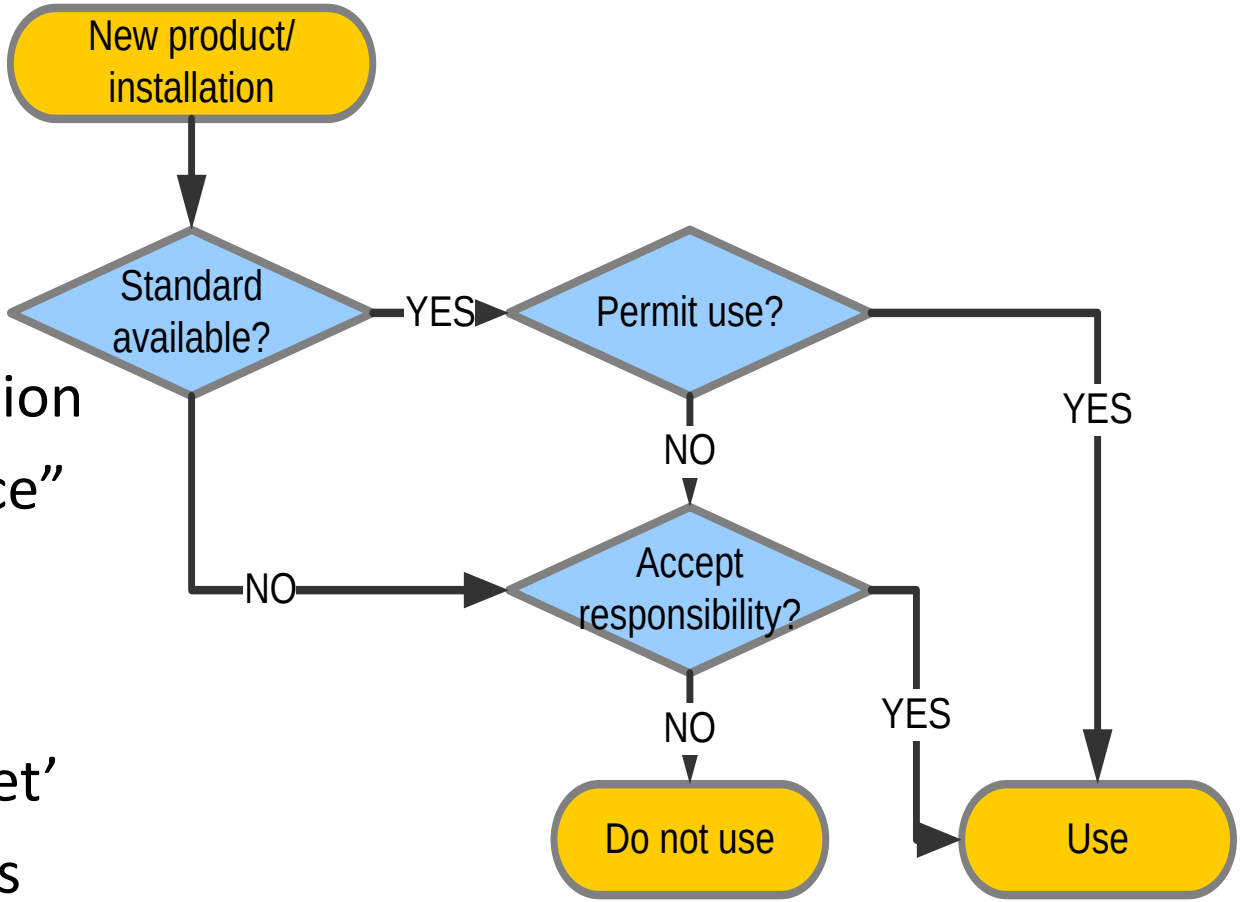
Usefulness of safety standards

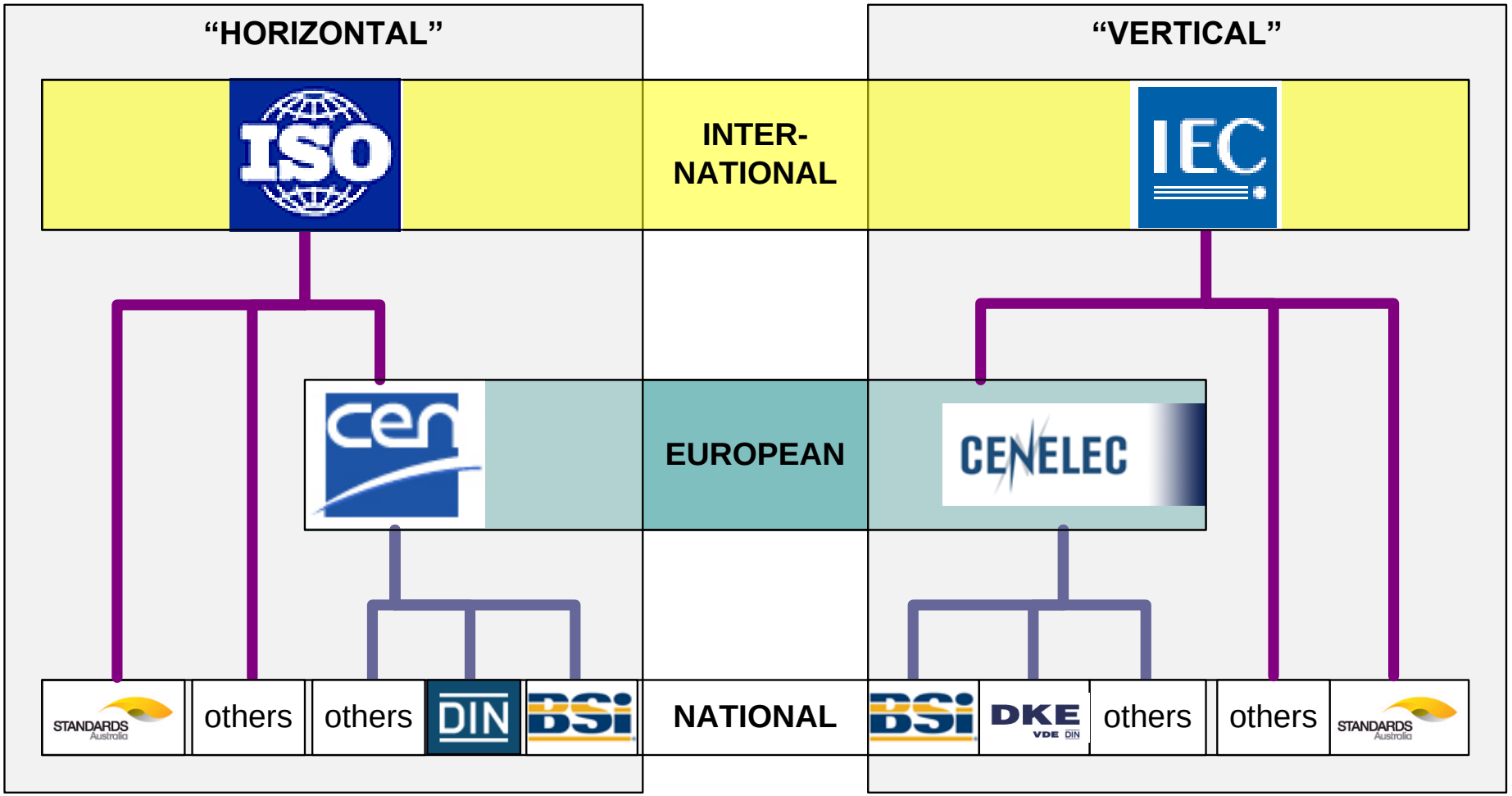
- Important to apply safety standards
  - —Provide indication of “best practice” for technology application
  - —Gives ‘safety net’ for new options



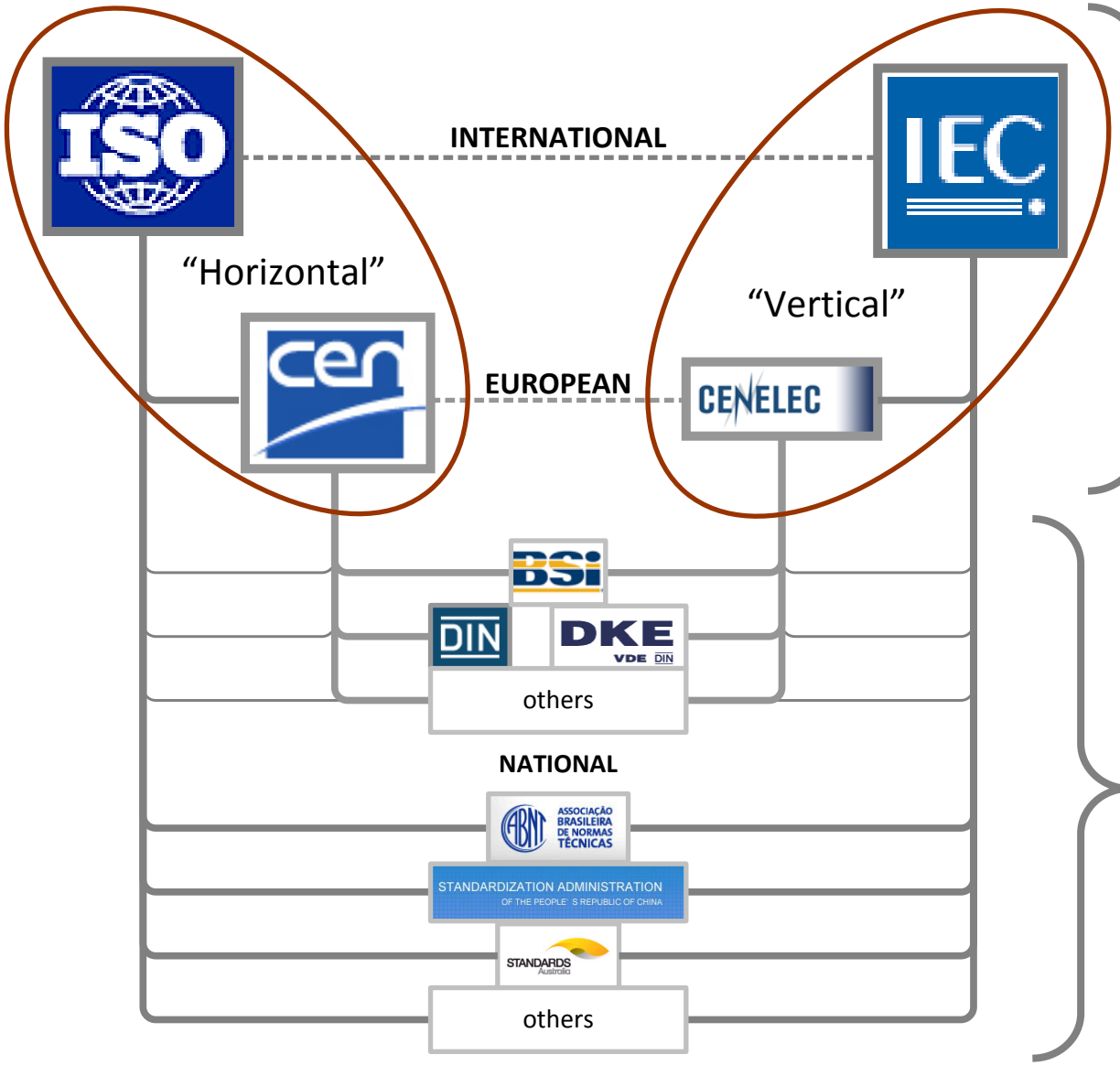
- Most alternatives refrigerants have significantly different safety characteristics to R-22, i.e. flammability

International overview

- Safety standards developed by many different bodies
  - —National, European, International



Expected trickle-down



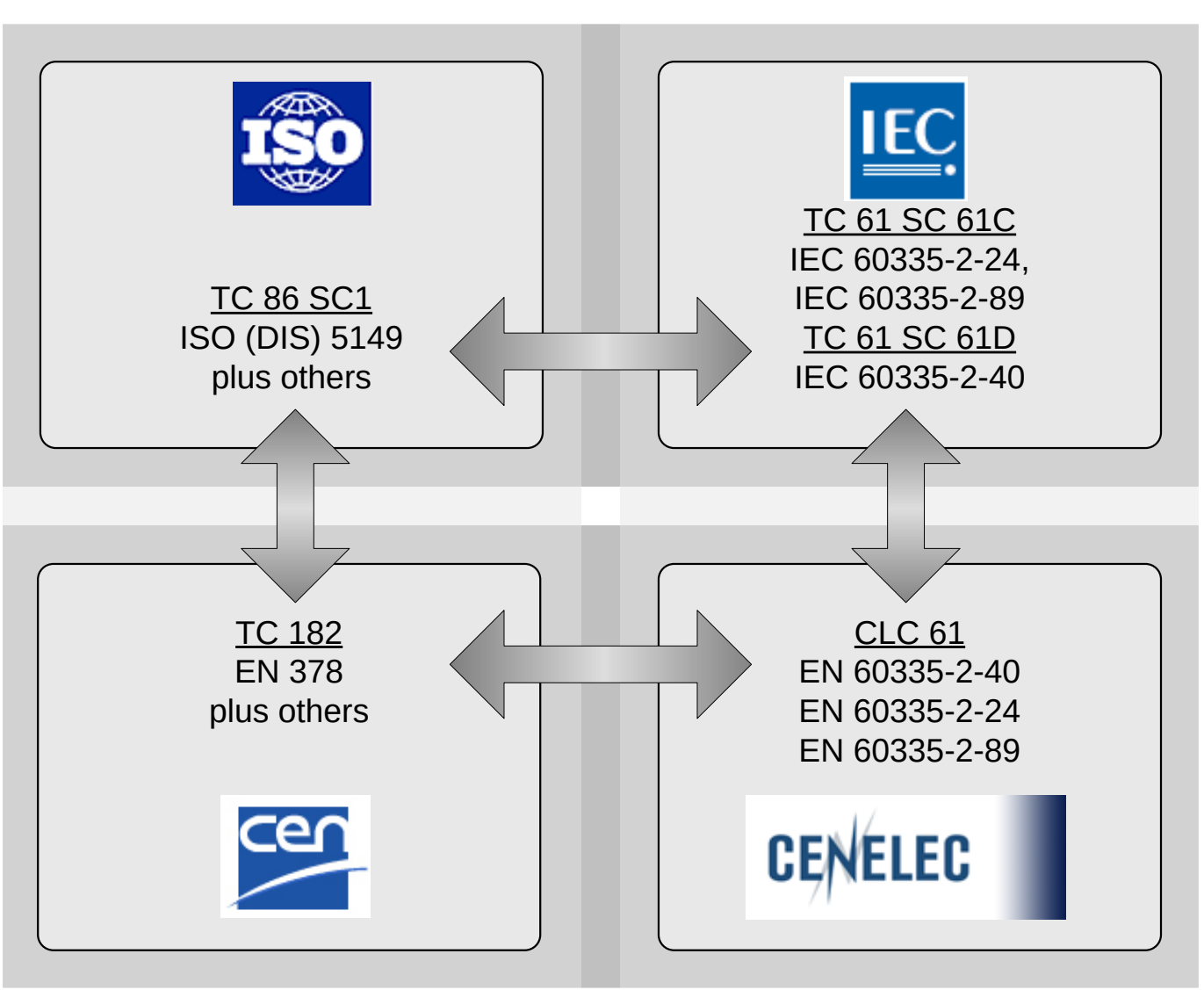
Independent of each other, of government

Some collaboration between organisations

National standards bodies (sometimes independent, sometimes not) – expected to adopt regional/international

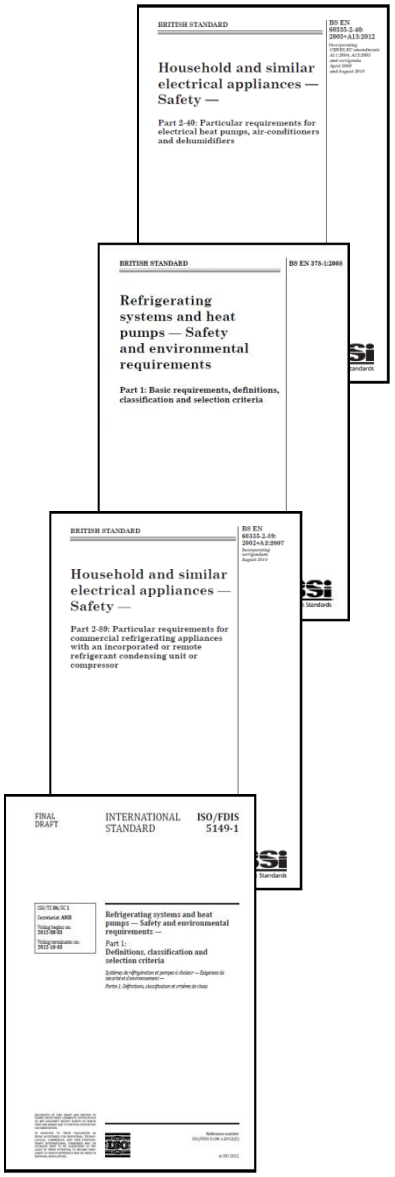
Interaction between International bodies

Key committees responsible for safety standards development



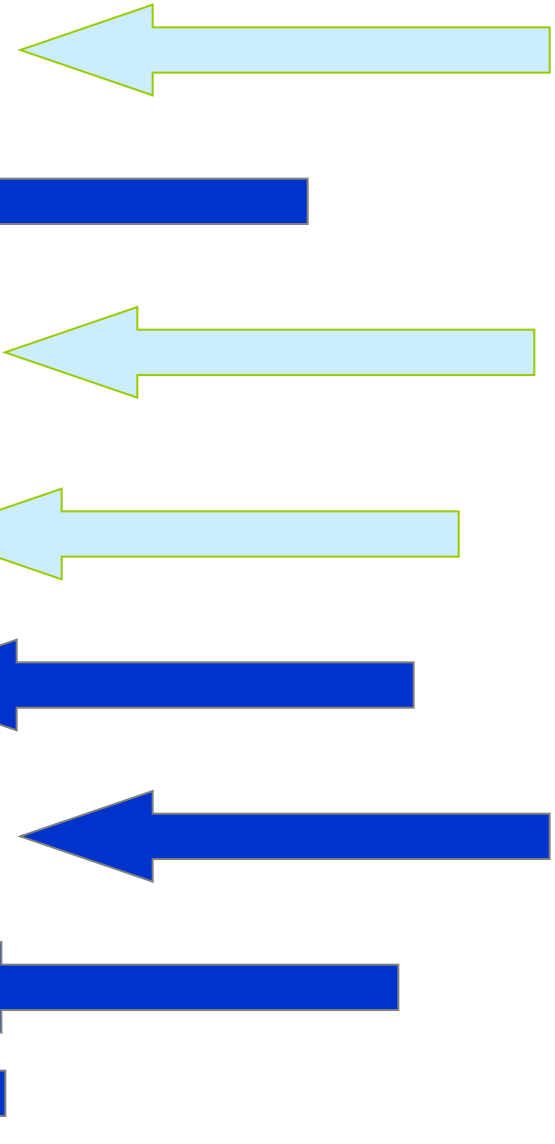
Main relevant standards applicable to AC&R

- "Horizontal" standards
  - —EN 378: Refrigerating systems and heat pumps - Safety and environmental requirements
  - —ISO 5149: Refrigerating systems and heat pumps - Safety and environmental requirements
- "Vertical" (or product) standards
  - —IEC 60335-2-24: Particular requirements for refrigerators, freezers and ice makers
  - —IEC 60335-2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers
  - —IEC 60335-2-89: Particular requirements for commercial refrigerating appliances with or without remote condensing units



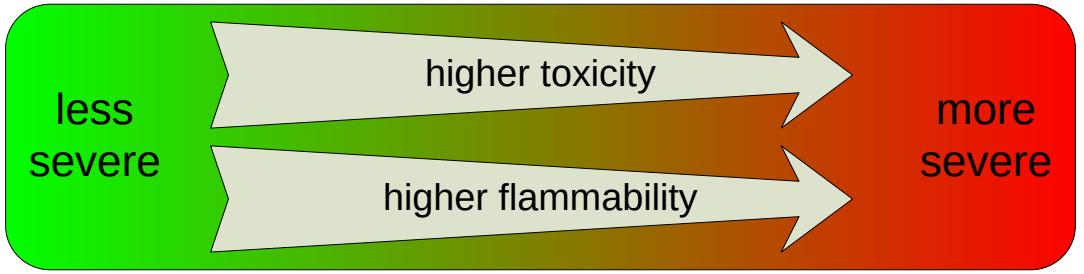
Main topics within RAC safety standards

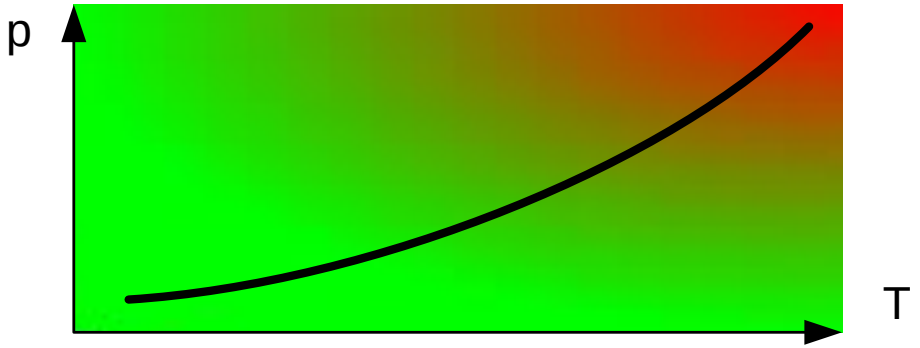
- Classification of refrigerants, occupancy, systems
- Refrigerant charge size – limits
- Safe design and testing of components and pipes
- Safe design and testing of assemblies (systems)
- Electrical safety, sources of ignition
- Installation areas, positioning, pipework, mechanical ventilation, gas detection
- Instructions, manuals, data-plates
- Refrigerant handling

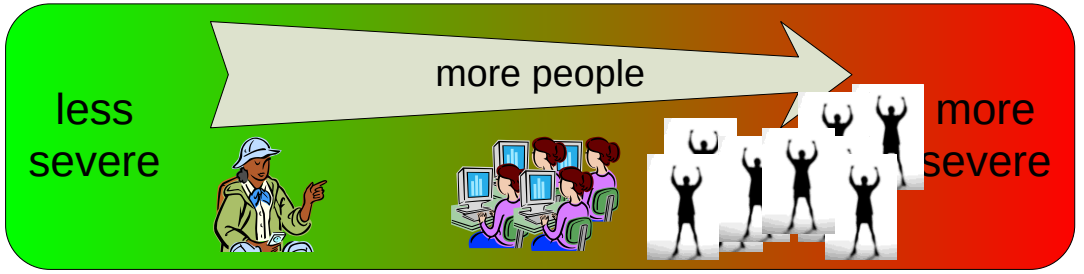


Principle approach of AC&R safety standards

- The criteria for these are a function of certain characteristics
  - —Refrigerant flammability and refrigerant toxicity
  - —Refrigerant pressure under anticipated ambient (temperature) conditions
  - —Type of occupancy that (refrigerant) system is located

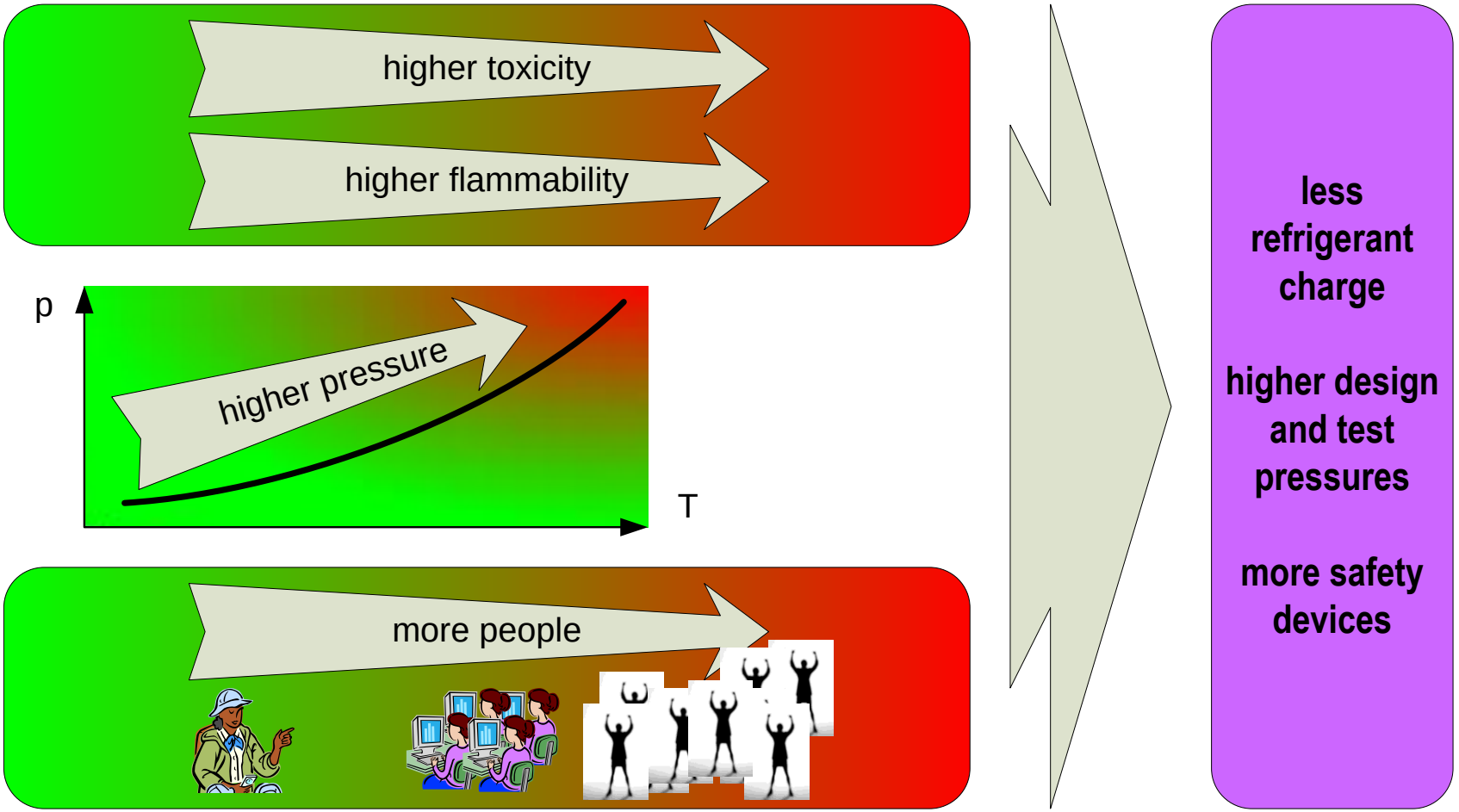




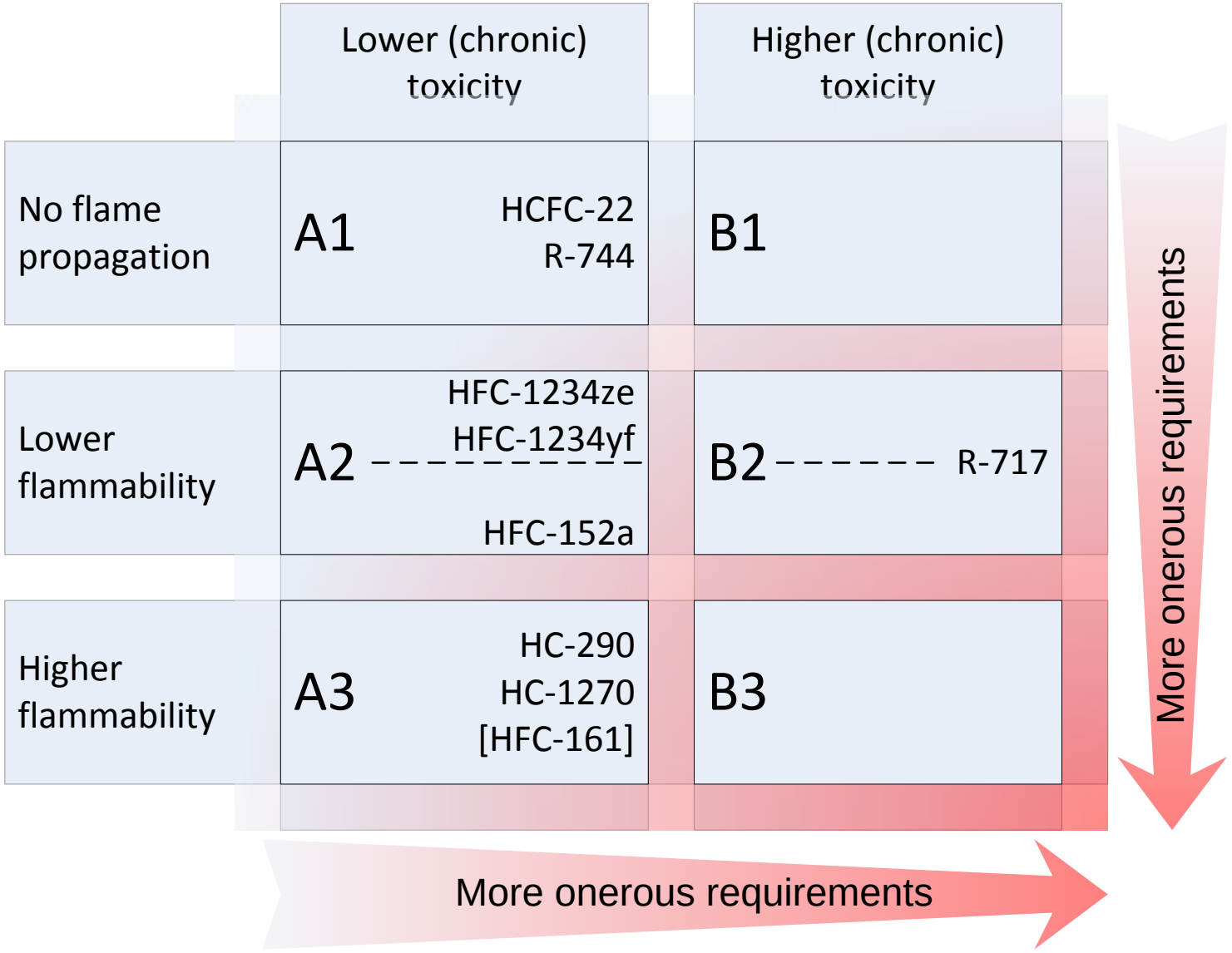


Principle approach of AC&R safety standards

- These result in certain requirements



Refrigerant safety classification

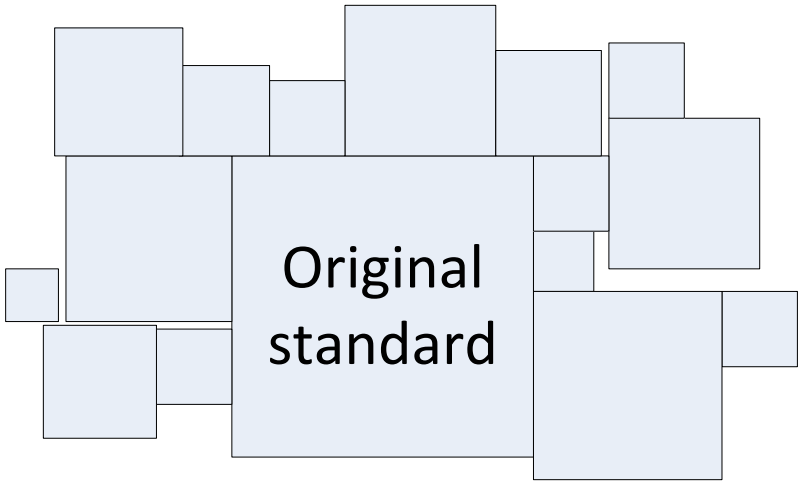


Current key requirements

	Max charge (occupied)	PL (g/m^3)	Max charge - outside	Safe electrics
HCFC-22	**No limit**	**300**	**No limit**	**No**
R-744	No limit	100	No limit	No
HFC-1234ze	3.1 – 25 kg	[40]	No limit	Yes [Some]
HFC-1234yf	2.3 – 25 kg	60	No limit	Yes [Some]
HFC-152a	5 – 25 kg	27	No limit	Yes
HC-290 HC-1270	1 – 2.5 kg	8	25 kg/no limit	Yes
LGHMs	*→ 25 kg*	*[var]*	*No limit*	*Yes*
R-717	2.5 – 25 kg	0.4	No limit	Some

There are some problems

- Several safety standards which are often conflicting
- Historical versions based on principled approach, but have lost their way
  - —Product of jostling of vested interests
  - —Become too convoluted
- Not originally intended for flammable refrigerants
- Current requirements for HCs based on ignorance, lack of experience or for purposes of oppression



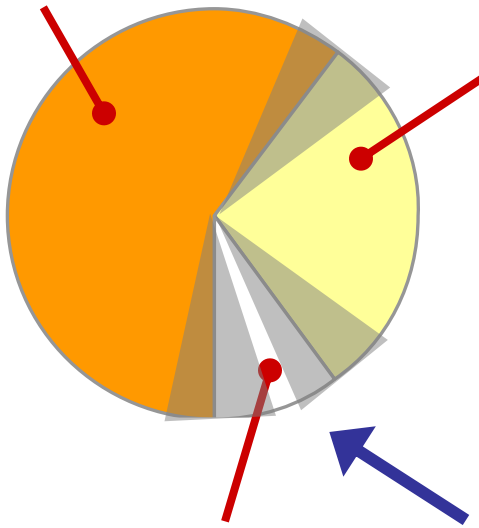
E.g., how to determine charge size limits???

Refrigerant safety group — A3		
Location of the refrigerating system	**Occupancy**	
	General occupancy — Class A	
	Direct systems	Indirect systems
Human occupied space which is not a machinery room	*1* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Only sealed systems with Max. charge = practical limit x room volume and not exceeding 1,5 kg	*2* Considered as direct system; see box nr. *1*
Compressor and liquid receiver in an unoccupied machinery room or in the open air	*3* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Only sealed systems with Max. charge = practical limit x room volume and not exceeding 1,5 kg;	*4* AIC Systems and heat pumps for human comfort: see C.3 Max. charge = practical limit x room volume and not exceeding 1,5 kg;
All refrigerant containing parts in an unoccupied machinery room or in the open air	*5* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Only sealed systems with max. charge = practical limit x room volume and not exceeding 1 kg below or 5 kg above ground floor level	*6* AIC Systems and heat pumps for human comfort: see C.3 Max. charge = practical limit x room volume and not exceeding 1 kg Below ground floor level or 5 kg above ground floor level
	Supervised occupancy — Class B	
	Direct systems	Indirect systems
Human occupied space which is not a machinery room	7 A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Max charge = practical limit x room volume and not exceeding 1 kg Below ground floor level and 2,5 kg above ground floor level	*8* Considered as direct system; see box nr. *7*
Compressor and liquid receiver in an unoccupied machinery room or in the open air	*9* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Max charge = practical limit x room volume and not exceeding 1 kg Below ground floor level and 2,5 kg above ground floor level	*10* AIC Systems and heat pumps for human comfort: see C.3 max charge = practical limit x room volume and not exceeding 1 kg Belowground floor level and 2,5 kg above ground floor level
All refrigerant containing parts in an unoccupied machinery room or in the open air	*11* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Max charge = practical limit x room volume and not exceeding 1 kg below or 10 kg above ground floor level	*12* AIC Systems and heat pumps for human comfort: see C.3 max Charge = 1 kg Below ground floor or 10 kg above ground floor level
	Occupancy with authorised access only — Class C	
	Direct systems	Indirect systems
Human occupied space which is not a machinery room	*13* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Max charge = 1 kg below ground floor and 10 kg above ground floor level	*14* Considered as direct system; see box nr. *13*
Compressor and liquid receiver in an unoccupied machinery room or in the open air	*15* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Max charge = 1 kg below ground floor and 25 kg above ground floor level	*16* AIC Systems and heat pumps for human comfort: see C.3 max charge = 1 kg Below ground floor and 25 kg above ground floor level
All refrigerant containing parts in an unoccupied machinery room or in the open air	*17* A/C systems and heat pumps for human comfort: see C.3 All other refrigerating systems: Max charge = 1 kg below ground floor level. No restriction above ground floor level	*18* AIC Systems and heat pumps for human comfort: see C.3 Max. charge = 1 kg Below ground floor and no restriction above ground floor level

Limited penetration of some alternatives

Viable currently/in short-term

Viable if obstructive standards are remedied



Not viable due to cost, safety or performance limitations

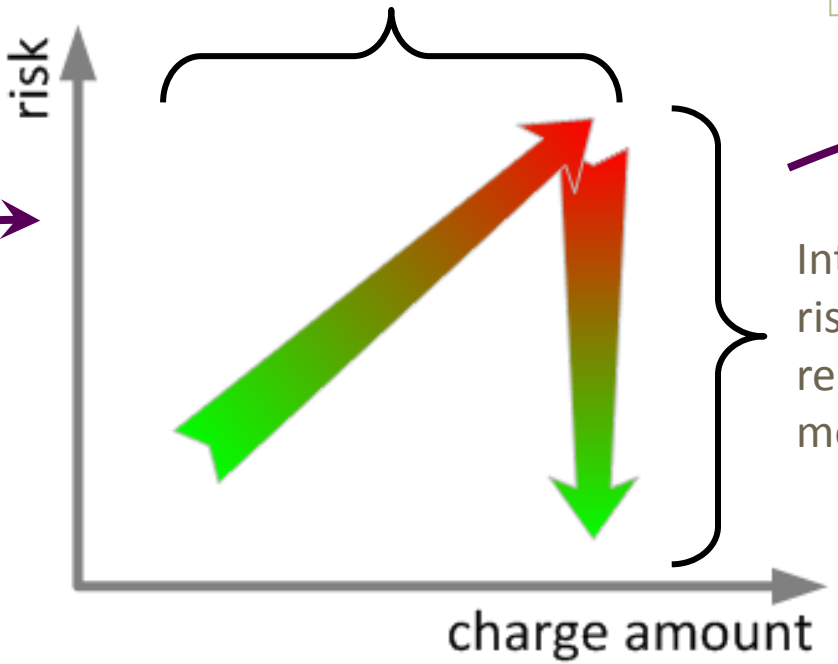
(Often, gap can be closed if alternatives system concepts are used, e.g., chiller instead of piped refrigerant)

Specific problems for HCs

Main topics	Impact for HCs
Classification of refrigerants, occupancy, systems	+
Refrigerant charge size – limits	+++
Safe design and testing of components and pipes	+
Safe design and testing of assemblies (systems)	+
Electrical safety, sources of ignition	+++
Installation areas, positioning, pipework, mechanical ventilation, gas detection	++
Instructions, manuals, data-plates	+
Refrigerant handling	++

Can resolve with alternative safety measures

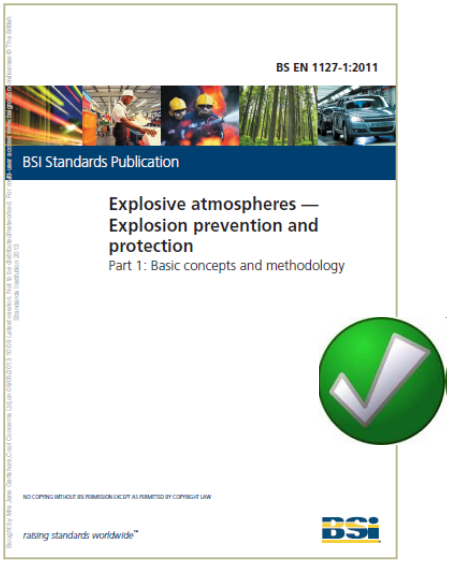
Increase refrigerant charge (greater capacity)



Introduce risk-reducing measures


FINAL DRAFT
INTERNATIONAL STANDARD
ISO/FDIS 5149-1

Refrigerating systems and heat pumps — Safety and environmental requirements —
Part 1: Definitions, classification and selection criteria


BS EN 1127-1:2011
BSI Standards Publication
Explosive atmospheres — Explosion prevention and protection
Part 1: Basic concepts and methodology

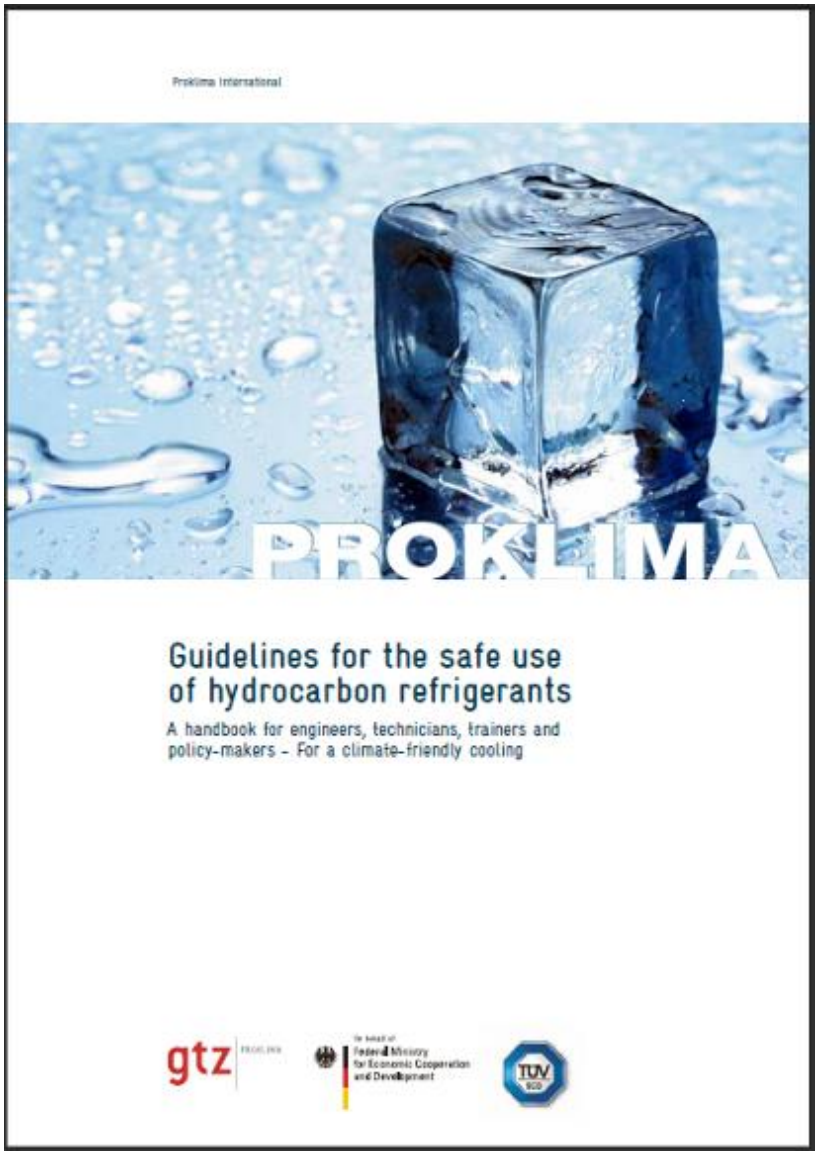
New standards for wider application and improved safety

Suggestions

General observations about existing standards	Needs for local standard
In several parts	Should be one (compact) part
Only for new systems	Has to cover (a) new systems and (b) conversion of existing systems
Covers lots of issues that are not specifically HCs; general for all refrigerants and refrigeration systems	Keep focus on HCs; avoid unnecessary deviation and confusion
Many of the requirements are very convoluted, complex and ambiguous	Must be comprehensible for technicians so simplify and normalise rules

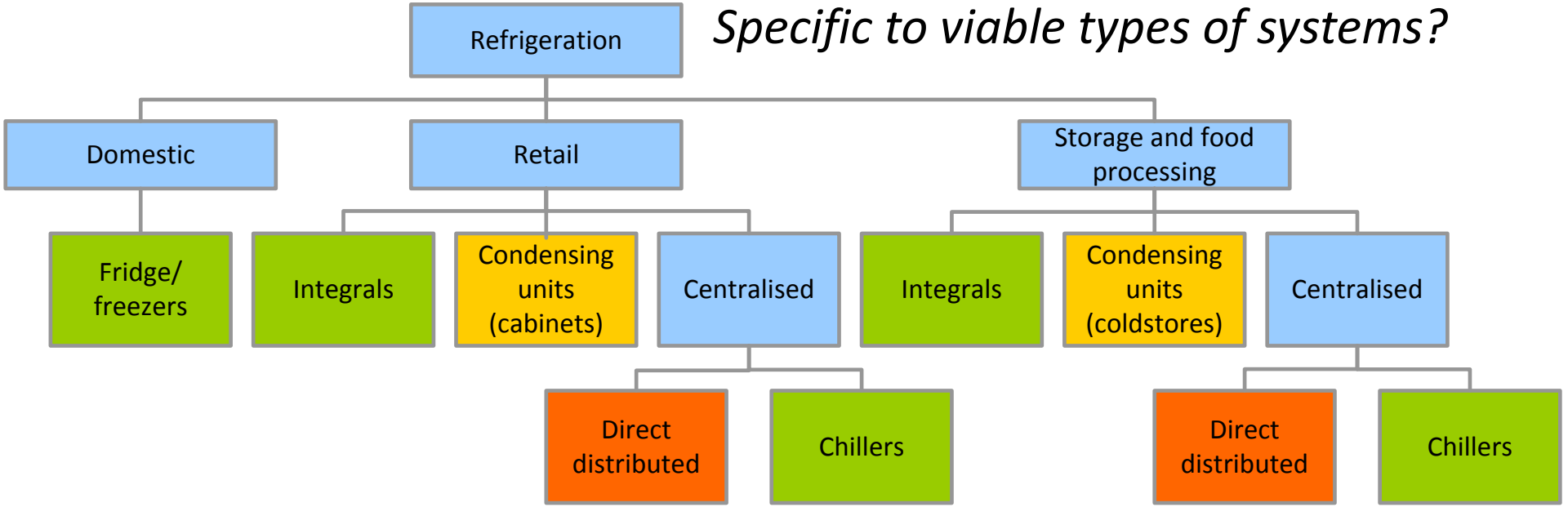
Suggestions

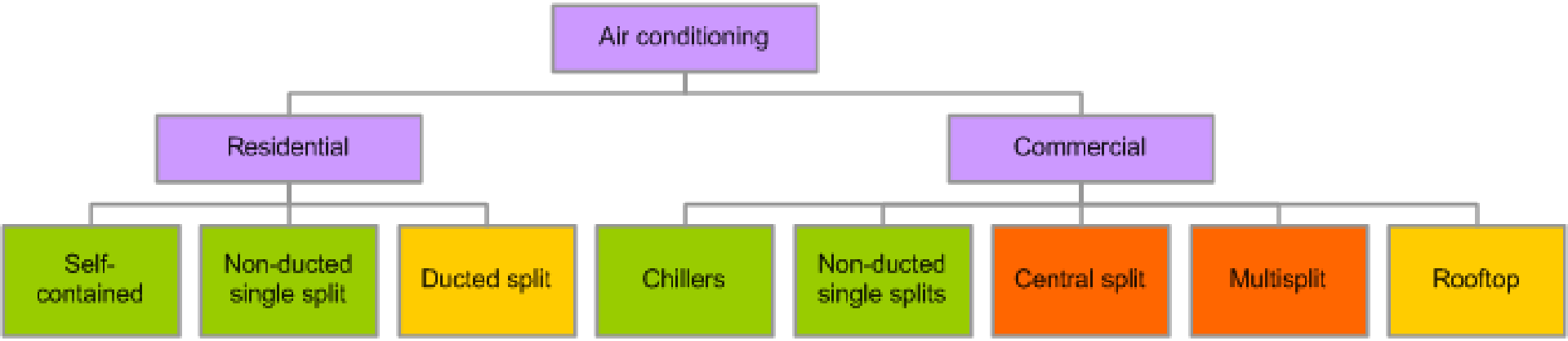
- Text should be short and simple
  - —Avoid lengthy passages
  - —Make use of diagrams, pictures, etc
- Apply additional approaches not in current EN 378
  - —E.g., use of shut-off valves to reduce refrigerant leak amount
- Lots of useful material in GIZ HC safety handbook
  - —But it needs to be summarised!



Suggestions

Specific to viable types of systems?





Suggestions

- *Topics to cover…*
- Design of systems
  - —Charge sizes (in relation to location)
  - —Ventilation (minimum airflow rate)
  - —Avoidance/protection of potential sources of ignition
  - —Machinery rooms, alarms, controls, etc
  - —Marking, signs, etc
- Installation of systems
  - —Positioning of equipment parts indoors
  - —Positioning of outdoor equipment
  - —Considerations for piping (joints, routing, etc)

Suggestions

- *Topics to cover…*
- Equipment for servicing and refrigerant handling
- Working procedures
  - —Working area checks, equipment checks, risk assessment
  - —Installation of units, piping, etc
  - —Refrigerant recovery and/or venting, evacuation
  - —Charging
  - —Brazing/hot-work, repairs
  - —Handling electrical items, potential sources of ignition
  - —Cylinder handling/transport/storage
  - —Tightness (leak) test, strength (pressure) test
  - —Commissioning, record keeping

Thank you for your attention!