

Konsekvensen af de nye krav og regler

24/5-2018 DTI, Aarhus

Introduktion af Asbjørn



Asbjørn Vonsild
Vonsild Consulting ApS
E-mail: Vonsild@Vonsild-consulting.com
Telefon: +45 2372 5559

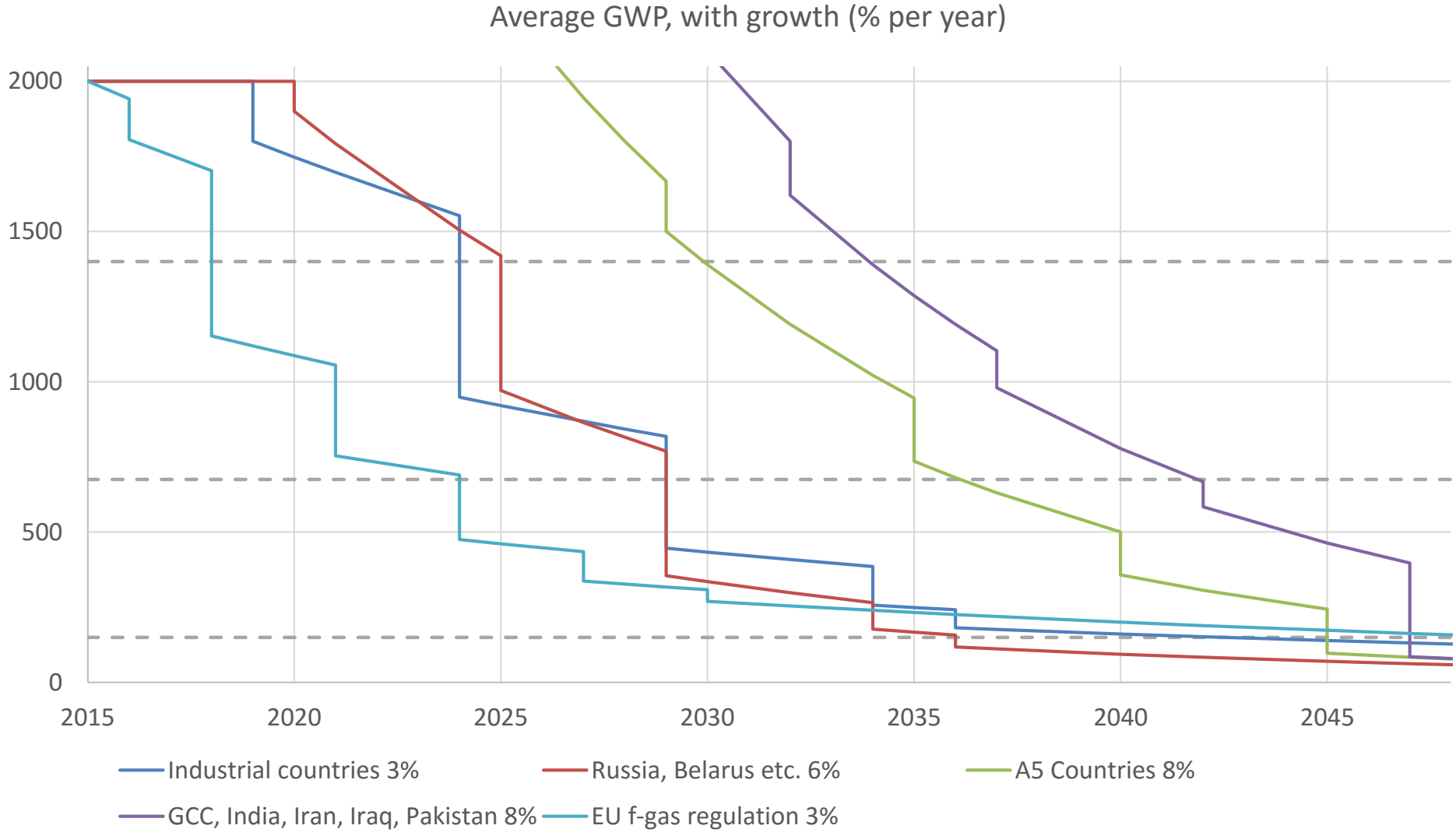
Speciale:

- Standarder og lovgivning indenfor køle-, klima- og varmepumpeanlæg.
- Brandbare kølemidler.

Eksterne roller:

- Formand (convenor) for WG16 der arbejder med reglerne for A2 og A3 kølemidler (kulbrinter og lignende) for **IEC 60335-2-40**.
- Medlem af IEC/TC61D/SC61D, styregruppen for **IEC 60335-2-40**.
- Medlem af CEN/TC182/WG6 og CEN/TC182, arbejdsgruppen og styregruppen for **EN 378**.
- Medlem af ISO/TC86/SC1/WG1 og ISO/TC86/SC1, arbejdsgruppen og styregruppen for **ISO 5149**.
- Formand for den danske spejlkomite for standarder til store kølesystemer (s251).
- Medlem af den danske spejlkomite for standarder til elektrisk apparater herunder mindre kølesystemer (s561).
- Medlem af den danske spejlkomite for standarder til kølecontainer (s170).
- Medlem af RTOC (Refrigerant Technical Options Committee), teknisk rådgivningsgruppe for Montreal Protokollen, og hovedforfatter på kapitlet om kølemiddelegenskaber.

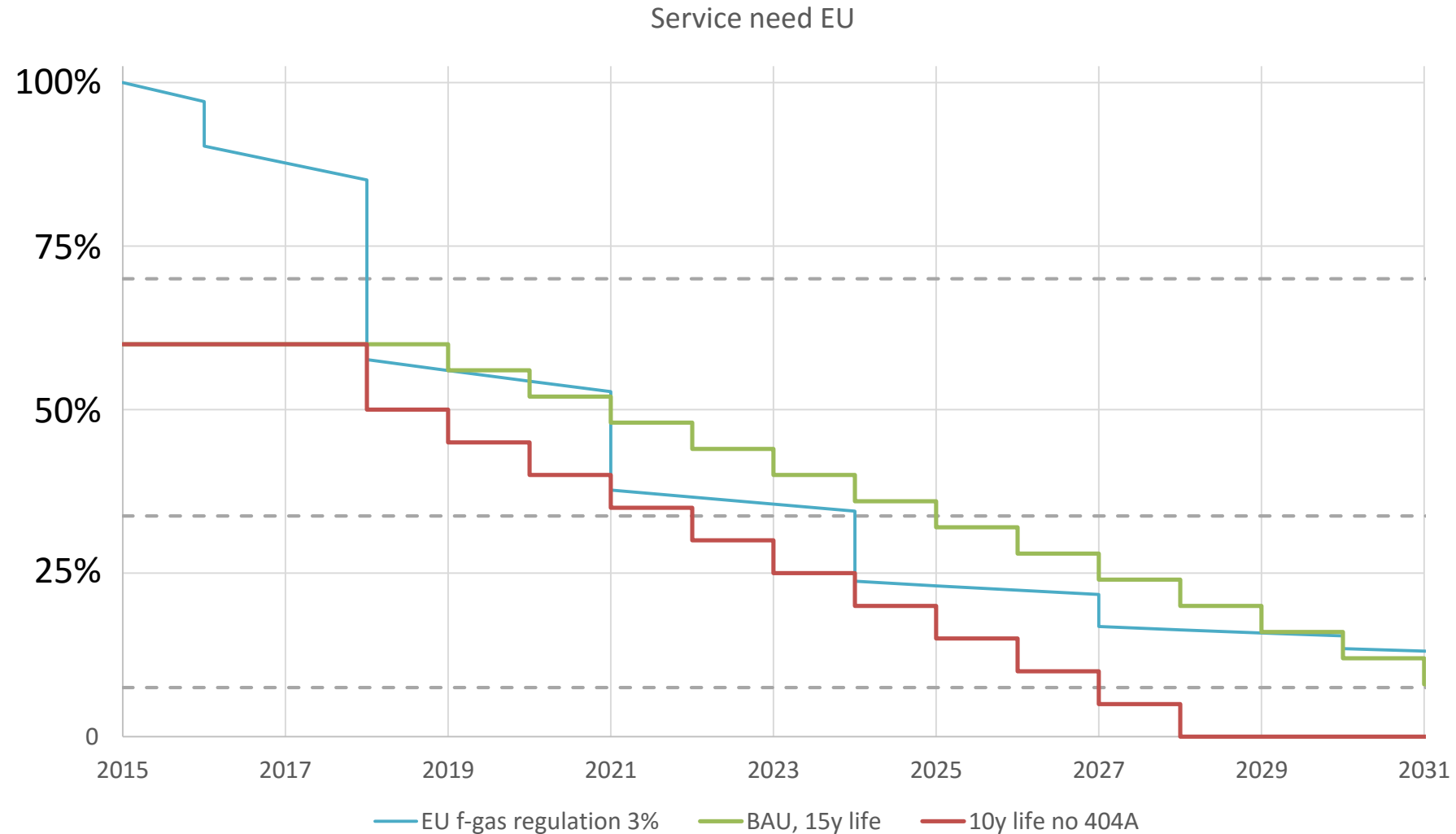
Average GWP values - Globally



EU Service need

– if all new systems use HFO or naturals

- If systems have 15 years lifetime, and service continues as usual, then there are not enough quota today!
- If 404A is replaced with non-flammable alternatives, and system lifetime is shortened to 10 years, then service will be possible... just

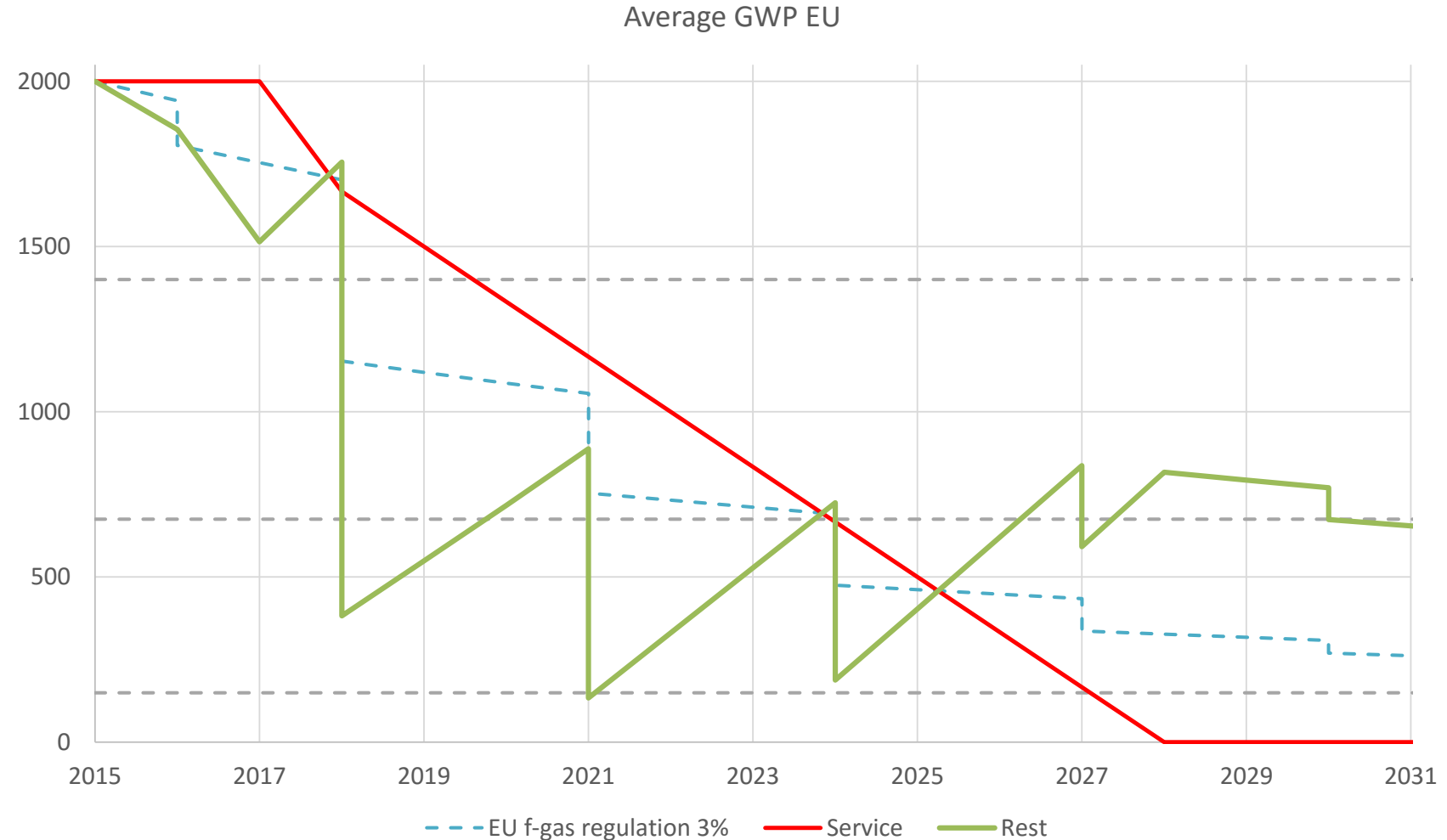


EU Average GWP

– if all new systems use HFO or naturals


- Average GWP for service will fall steadily
- What is left will oscillate!
- It is clear that there will be a refrigerant crisis every 3 years

BTW: If the extra refrigerant is used for new systems, then there will not be enough refrigerant to service all systems!



Refrigerant safety class

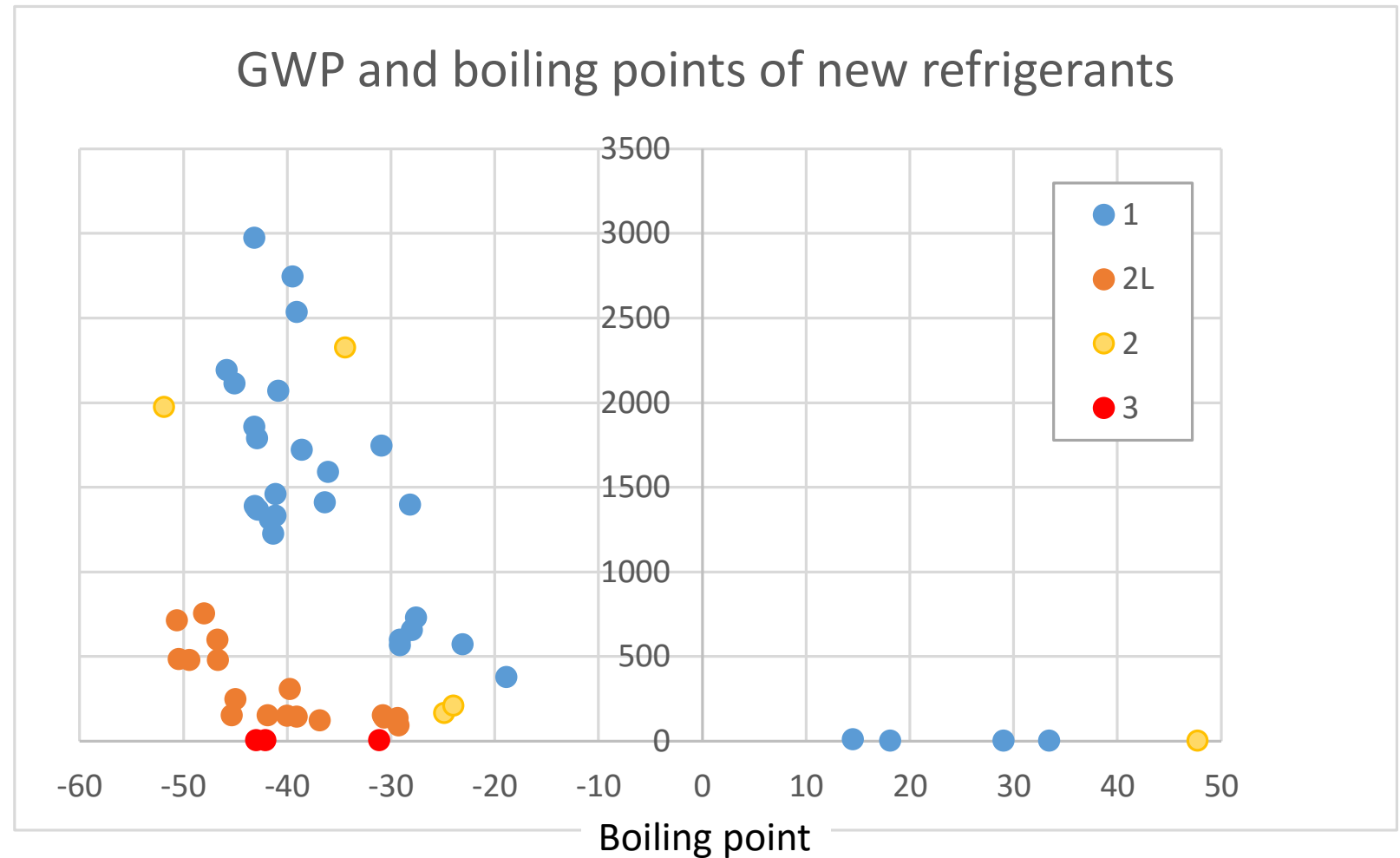
- This presentation focusses on flammability:



| | | |
|-----------------------------|----------------------------------|----------------------------|
| Higher flammability | A3: Hydrocarbons | B3: No refrigerants |
| Flammable | A2: R152 | B2: Seldomly used |
| Lower flammability | A2L: Most HFO's, R32 | B2L: Ammonia |
| No flame propagation | A1: CFC, HCFC, most HFC's | B1: R123 |
| | Lower toxicity | Higher toxicity |

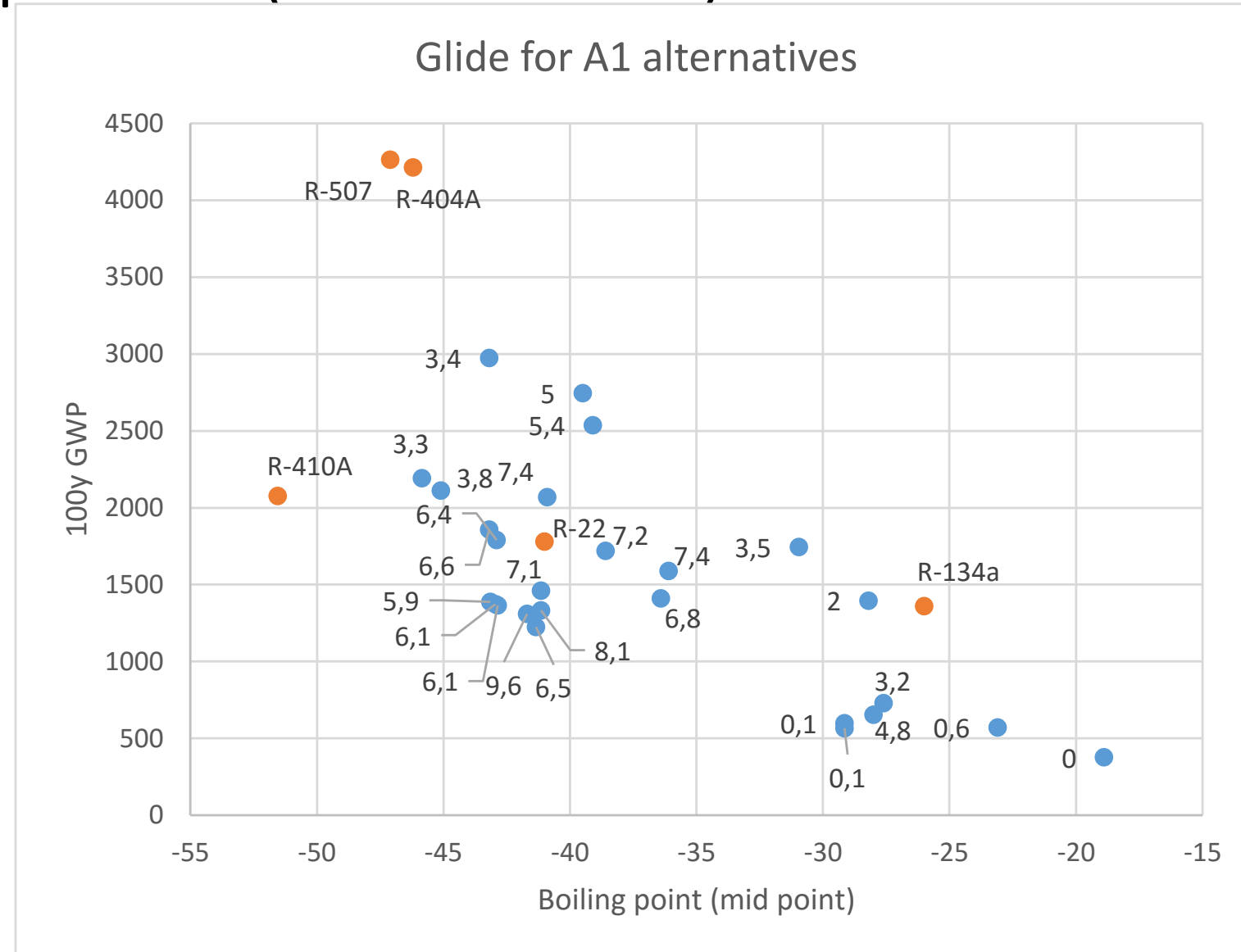
Flammability class and GWP

- Refrigerants with ASHRAE numbers given since 2010 are shown



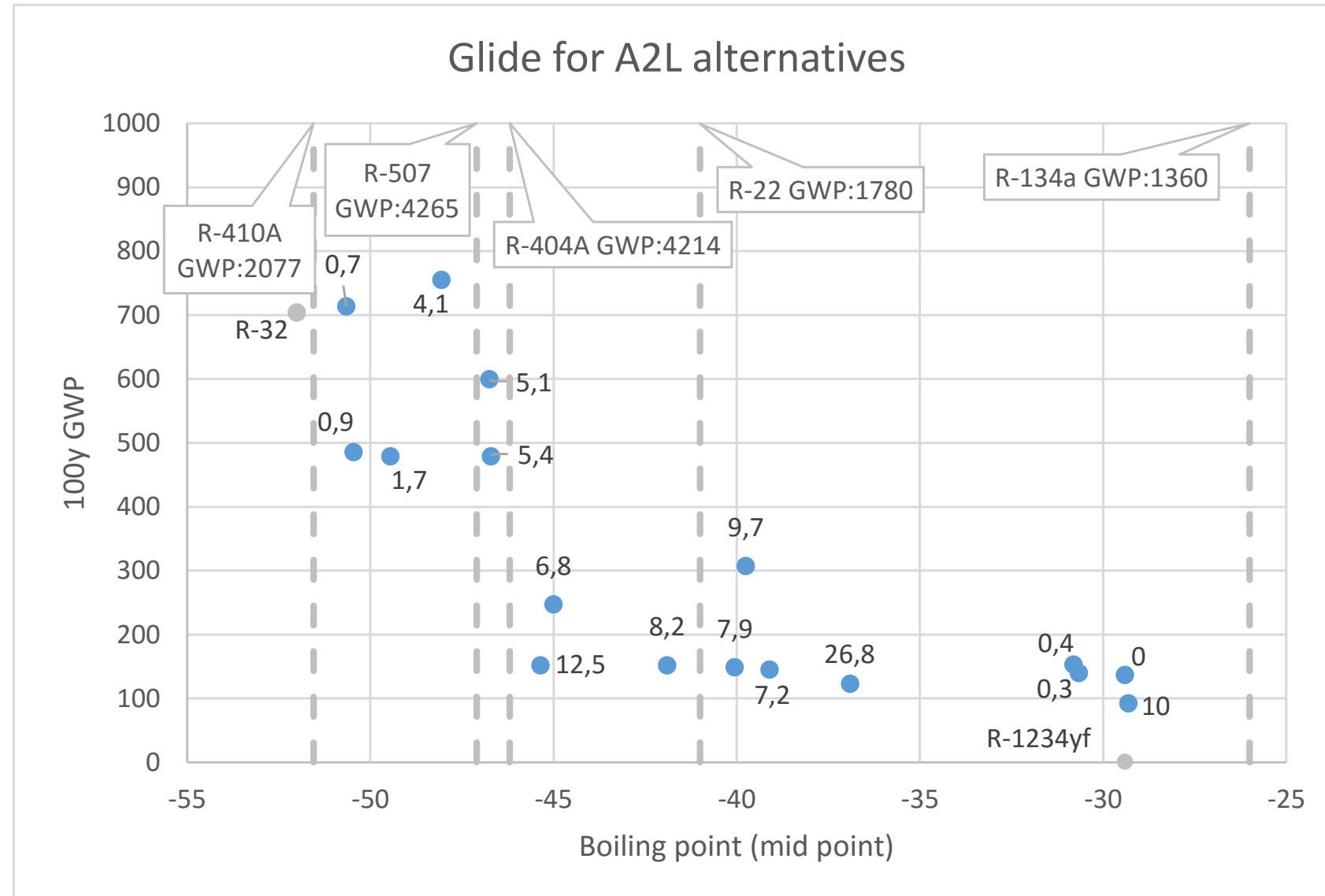
Non-flammable options (since 2010)

- In principle you can go as low GWP as you like, if you accept a high glide...
- Just mix your favorite HFO or HCFO with CO₂!
- Note
 - No non-flammable R410A options have been suggested... maybe except R463A (gwp 1479), not yet public, but may not matter



A2L flammable options (since 2010)

- Same pattern, but much lower GWP...
- Note:
 - 404A options have glide
 - 410A options have GWP from just below 500 to just above 700.



Nature limits the options available

- Thomas Midgley identified 8 elements which are light enough to use for refrigeration (1937):

| | | | |
|-------------------|-------------------|--------------------|---------------------|
| 4 | 3 | 2 | 1 |
| | | | ¹ H |
| ⁶ C | ⁷ N | ⁸ O | ⁹ F |
| | | ¹⁶ S | ¹⁷ Cl |
| | | | ³⁵ Br |

- McLinden and colleagues have run a multi-year study to investigate all combinations of these molecules, so don't expect any new molecules!
- Iodine has also been suggested... but usually gives problems with ODP and toxicity, and gives a higher boiling point. I assume the refrigerant manufacturers have already reviewed the few options.

- Science has investigated almost all possible molecules for refrigeration, and you know them all...

- The only white fields that I see on the map are:

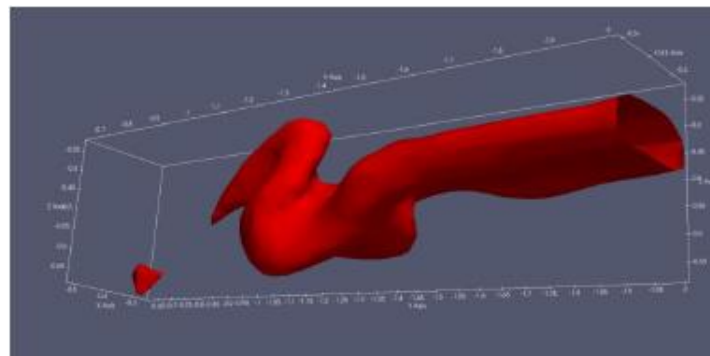
- High boiling point fluids
- Blends with high fraction of CO₂ (high glide)
- Compounds with high toxicity
- Synthetic compounds with flammability higher than 2L (similar to R-1132a and R-161)
- Unstable compounds with Iodine? Toxicity and ODP?

Safety standards in EU - developments

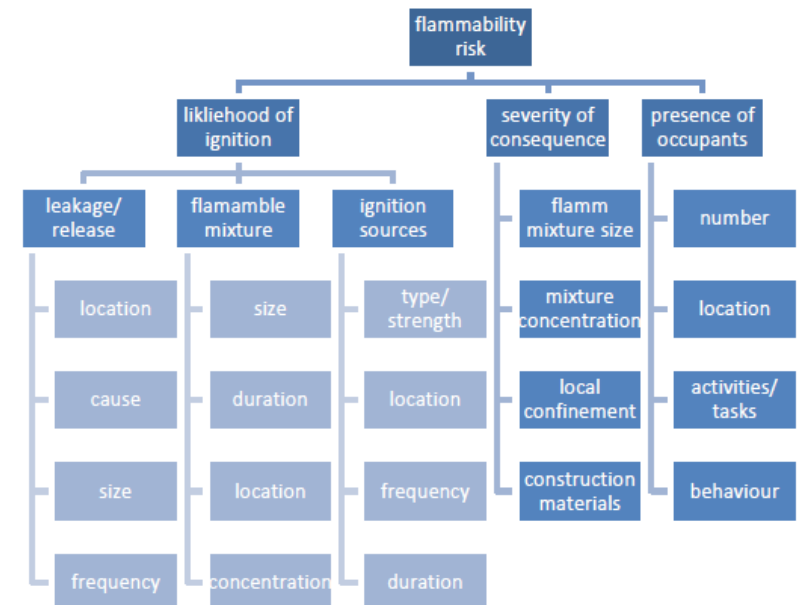
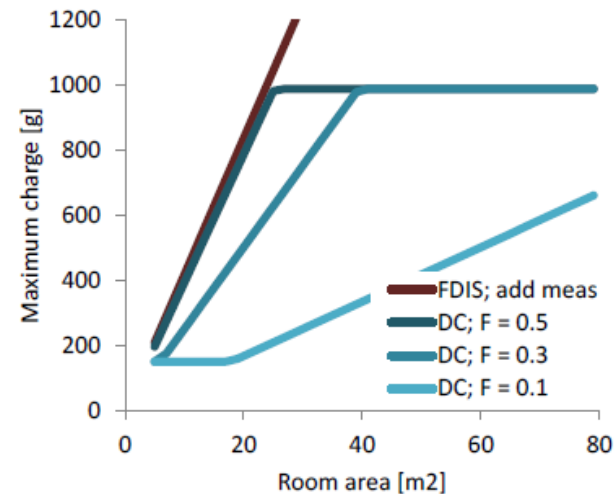
| Standard | | Sector | Current version | Comments |
|--------------------------|---------------|--------------------------------------|-----------------|--|
| Product safety standards | EN 60335-2-11 | Heat pump tumble driers | 2016 | Limit for flammable refrigerants 150g. No proposals have been made to change this limit. |
| | EN 60335-2-24 | Domestic refrigeration | 2010 | Limit for flammable refrigerants 150g. No proposals have been made to change this limit. |
| | EN 60335-2-40 | Air conditioners & heat pumps | 2013 | IEC have increased charge sizes for A2L in 2018. IEC proposal for increasing charge sizes for hydrocarbons for small rooms, max. 1 kg. Expected IEC publication early 2021. Copying from IEC to EN has been very slow. |
| | EN 60335-2-89 | Commercial refrigeration | 2017 | Limit for flammable refrigerants 150g. IEC proposal for increasing charge size fro A2L to 1,2 kg and for hydrocarbons to 500 g. Could be published end of 2019. Copying from IEC to EN has been very slow. |
| | ISO 13043 | Vehicle air conditioning | 2011 | |
| | ISO 20854 | Refrigerated containers | None | Under development |
| group safety standard | EN 378 | Refrigerating systems and heat pumps | 2016 | Proposals for increasing charge sizes (but not cap limits) for flammable refrigerants. Date is not yet fixed, but likely to be 2020. |

Focus of charge limit discussions

- In most of the last decade the focus has been on allowing higher charges of A2L refrigerant
- Currently working groups are discussing how to allow higher sizes of A3 (and A2) refrigerants
- This is also (indirectly) requested by the EU commission in standardisation mandate M/555.



Release with airflow



Charge limits of EN 378

- Toxicity menu has 3 options
 - Normally not the limiting factor for flammable substances of toxicity Class A.
 - For future (and some existing) Class A refrigerants this may not be the case.
- Flammability menu has 4 options, but the first actually covers at least 4 options (depends on how you count)

Expect that future revisions will add more options on the menu!

The following method shall be applied to determine the charge limit of a refrigerating system:

- a) determine the appropriate access category a, b or c according to Table 4 and location I, II, III, or IV according to 5.3 for the system;
- b) determine the toxicity class of the refrigerant used in the refrigerating system which will be A or B, being the first character in the safety class specified in Annex E. The toxicity limit equals ATEL/ODL values (see Annex E) or the practical limit (see Annex E) whichever is higher;
- c) determine the charge limit for the refrigerating system based on toxicity as the greater of:
 - 1) Charge limit from Table C.1;
 - 2) 20 m³ multiplied by the toxicity limit for sealed refrigerating systems;
 - 3) 150 g for sealed refrigerating system using toxicity class A refrigerant;
- d) determine the flammability class of the refrigerant used in the refrigerating system which will be 1, 2L, 2 or 3, being the characters following A or B in the safety class specified in Annex E. Determine the corresponding LFL according to Annex E;
- e) determine the charge limit for the refrigerating system based on flammability as the greater of:
 - 1) Charge limit from Table C.2; ← For flammability
 - 2) $m_1 \times 1,5$ for sealed refrigerating systems using flammability class 2L;
 - 3) m_1 for sealed refrigerating systems using flammability class 2 or 3;
 - 4) 150 g for sealed refrigerating systems;
- f) apply the lowest refrigerant charge obtained according to c) and e). For determination of charge limits for refrigerants of flammability class 1, e) is not applicable.

Konklusion

- Der vil komme kølemiddelkrise igen i 2021 og 2024
- Der vil blive problemer med at servicere systemer i fremtiden, selv dem med HFO-blends der bliver solgt i dag
- Brandbarhed er kommet for at blive!
- Brandbarhed er på agendaen i de fleste standardiseringsarbejdsgrupper
- Der vil komme mulighed for større fyldninger af HC kølemidler i standarderne
- Husk at checke giftigheden næste gang du bliver præsenteret for et nyt vidunderkølemiddel!

