

Refrigerant Selection Considerations in Industrial Process Refrigeration

Industrial Processes Emissions Reduction (IPER) Technology Workshop April 5-6, 2022

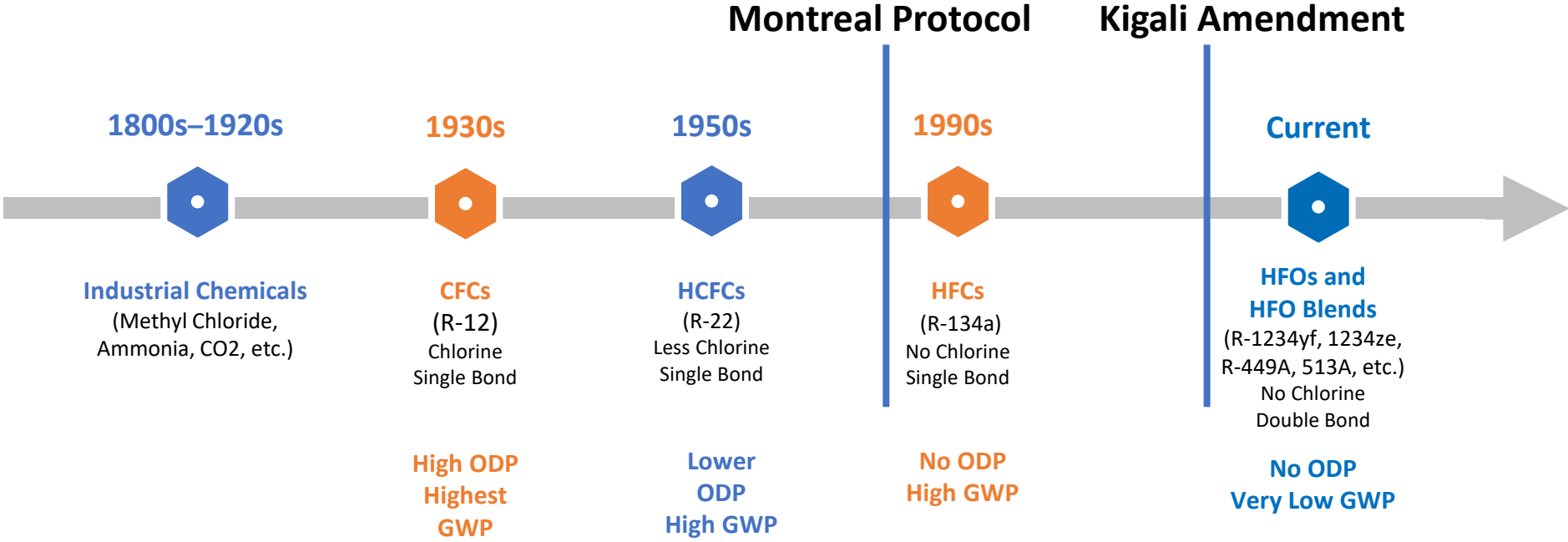
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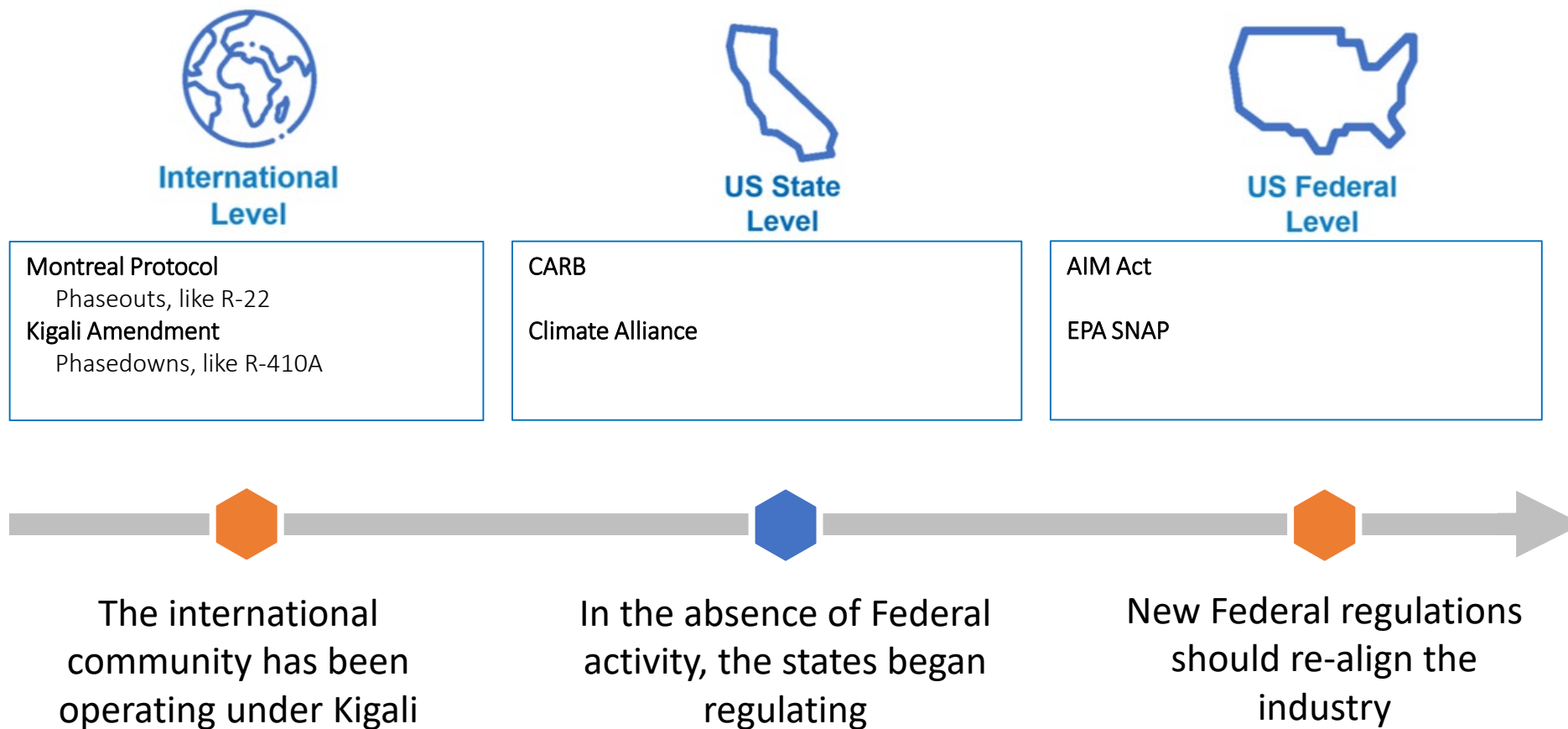
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Evolution of Refrigerants

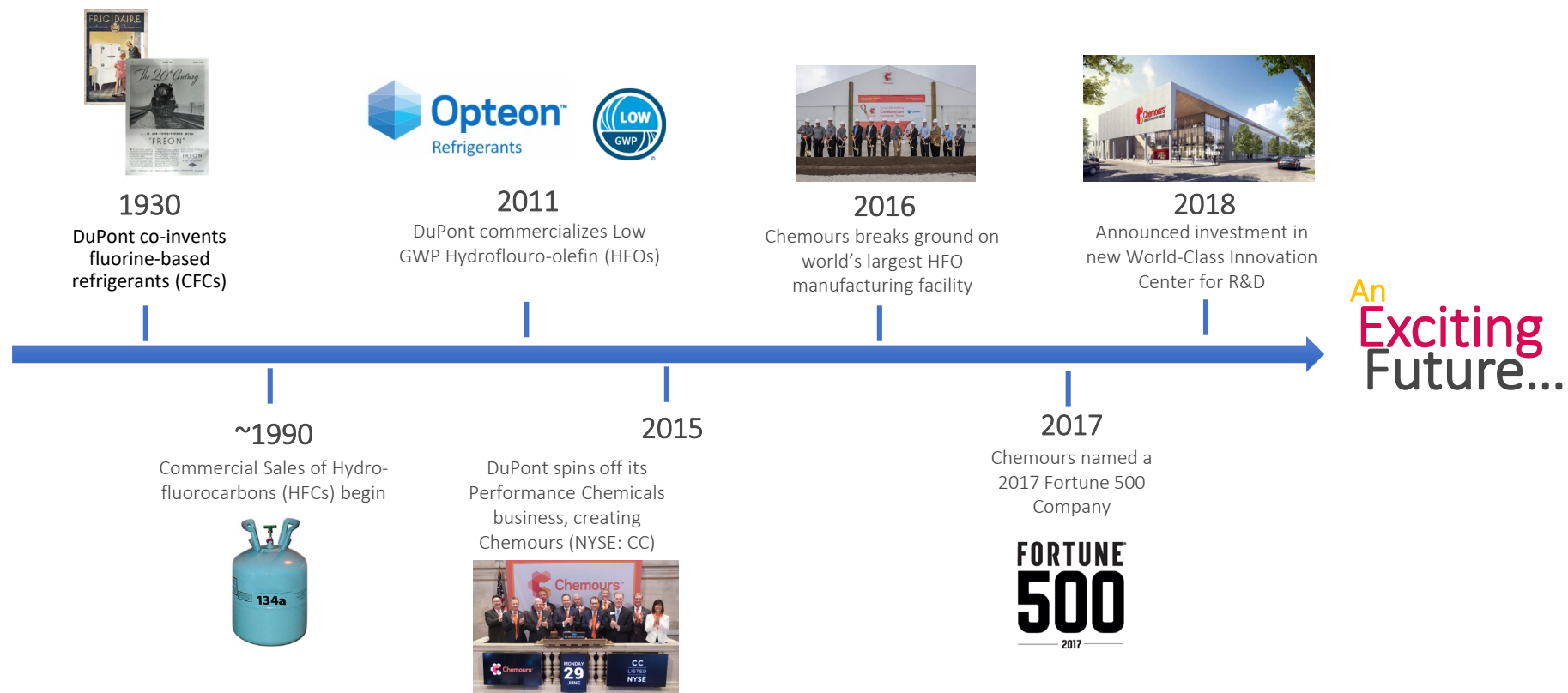


Regulations Drive Industry Transitions

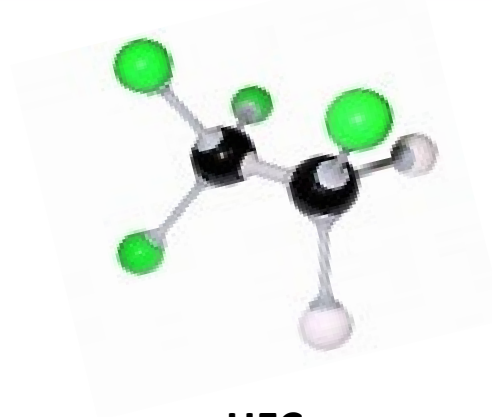
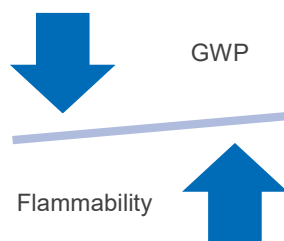
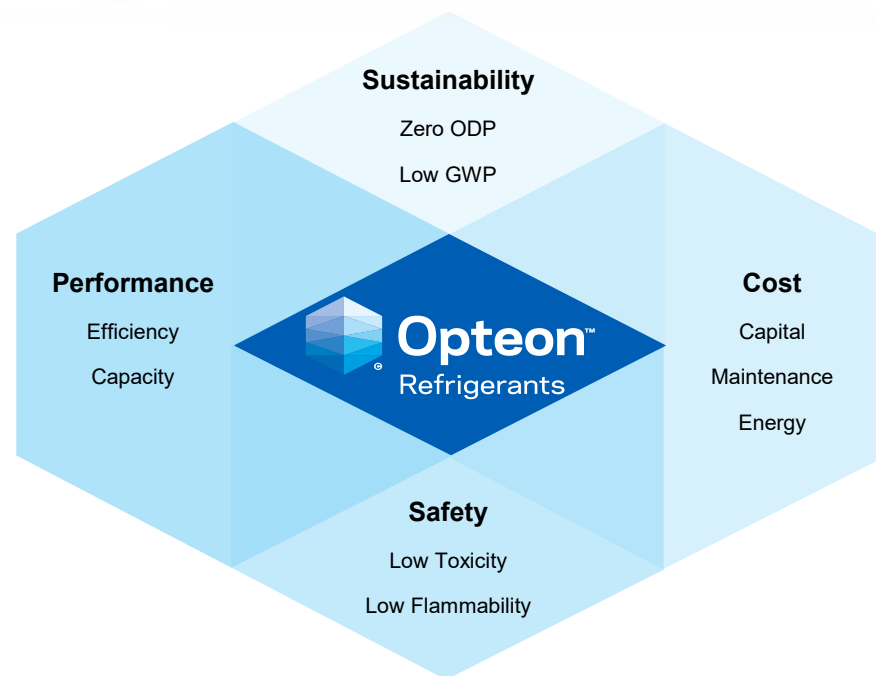
Regulatory Landscape



The Chemours Story

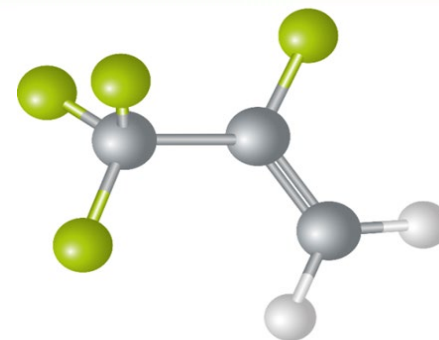


Balancing Performance with Sustainability

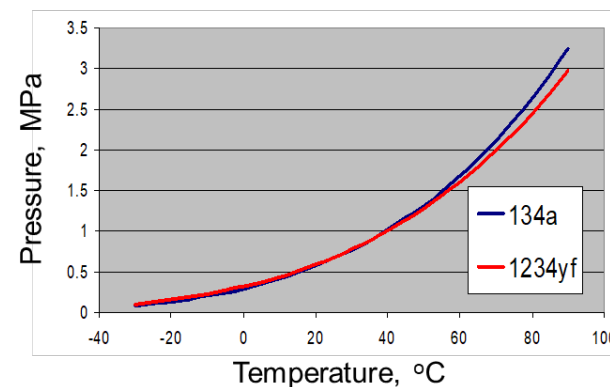


HFC
Hydrofluorocarbon

	<u>R-134a</u>	<u>HFO-1234yf</u>
Formula	CH_2FCF_3	$\text{CF}_3\text{CF}=\text{CH}_2$
Molecular Weight	102	114
ODP	0	0
GWP _{100 (AR5)}	1300	< 1
T Critical Point	102 °C	95°C
Boiling Point	-26°C	-29°C



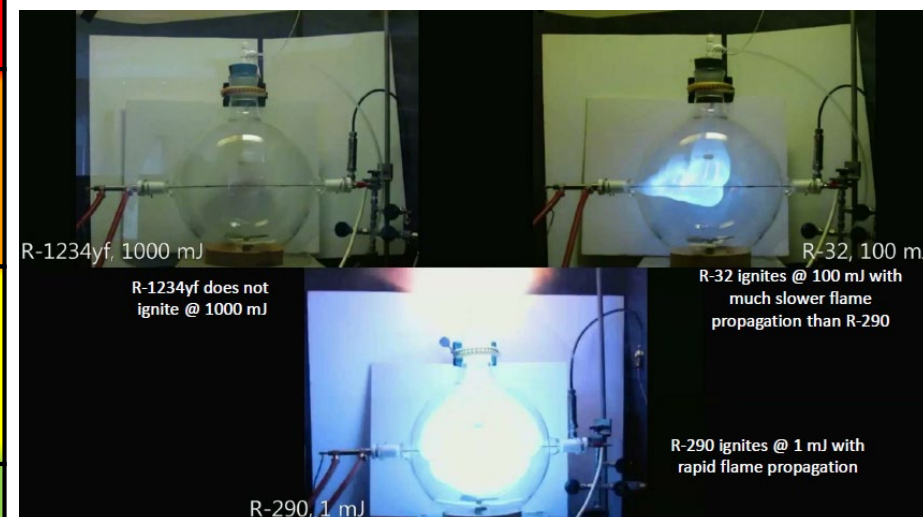
HFO
Hydrofluoroolefin



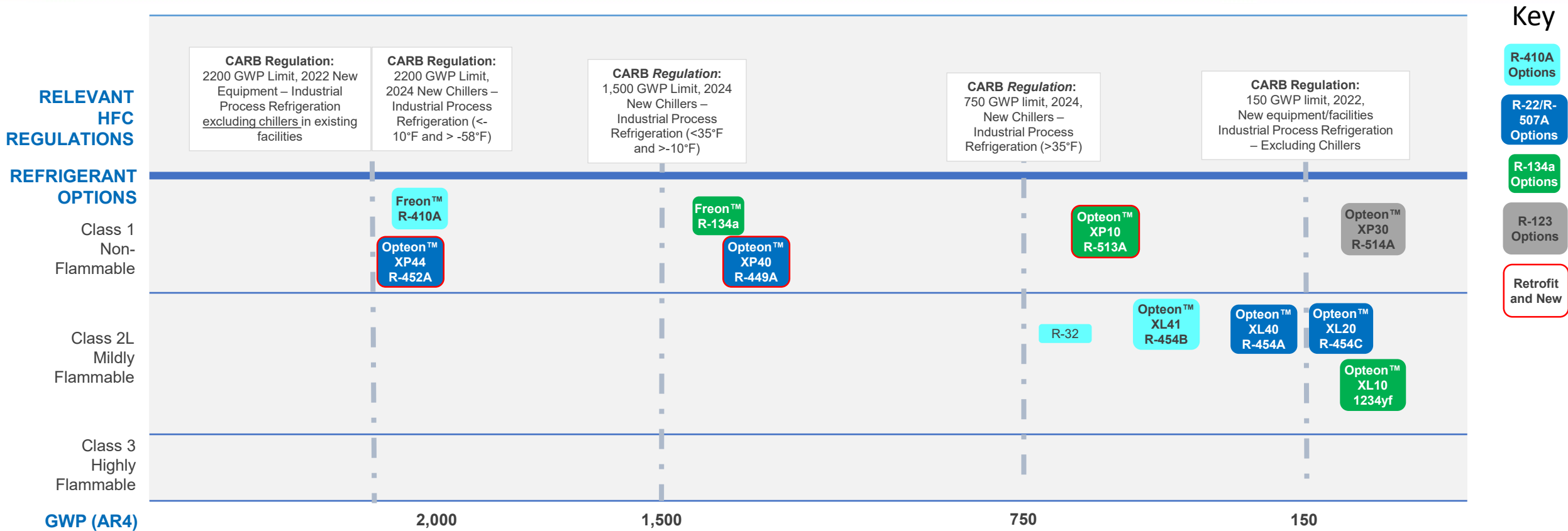
ASHRAE Standard 34 Refrigerant Safety Group Classifications

Increasing Flammability ↑	Higher Flammability	A3	B3
	Flammable	A2	B2
	Lower Flammability	A2L	B2L
	No Flame Propagation	A1	B1
		Lower Toxicity	Higher Toxicity
		Increasing Toxicity →	

Class 3 Requirements <ol style="list-style-type: none"> Exhibit flame propagation @ 60°C & 101.3 kPa $LFL \leq 0.10 \text{ kg/m}^3$ or $HOC \geq 19,000 \text{ kJ/kg}$
Class 2 Requirements <ol style="list-style-type: none"> Exhibit flame propagation @ 60°C & 101.3 kPa $LFL > 0.10 \text{ kg/m}^3$ $HOC < 19,000 \text{ kJ/kg}$
Class 2L Requirements <ol style="list-style-type: none"> Exhibit flame propagation @ 60°C & 101.3 kPa $LFL > 0.10 \text{ kg/m}^3$ $HOC < 19,000 \text{ kJ/kg}$ $S_u \leq 10 \text{ cm/s}$
Class 1 Requirements <ol style="list-style-type: none"> No flame propagation @ 60°C & 101.3 kPa



Refrigeration Options



Options for Existing R-22 Flooded Systems

1. Do Nothing

- Continue to operate/service with R-22
- **Supply and pricing uncertainty**
- **Ozone depletion potential (ODP)**

2. Complete System Replacement

- **\$\$\$**
- + Efficient & Sustainable Systems

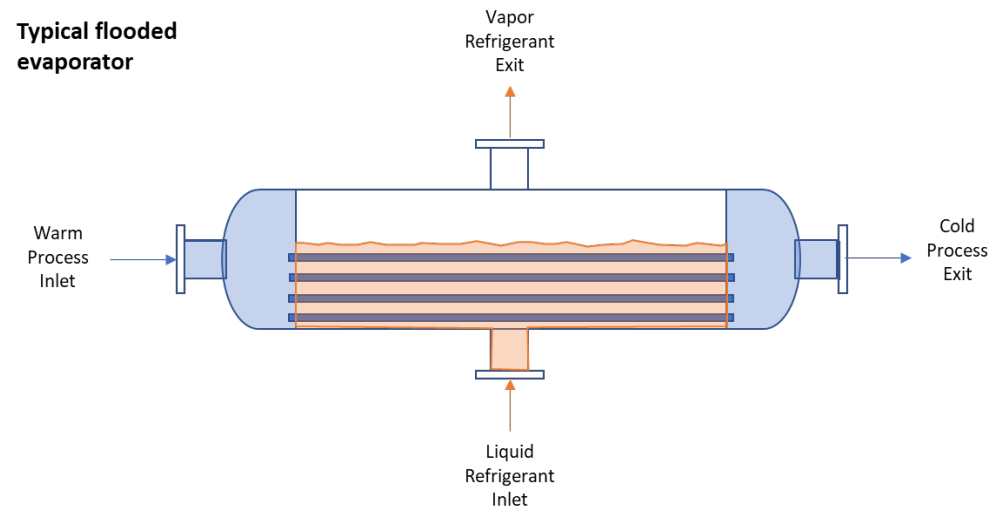
3. Partial System Replacement (Evaporator only)

- **\$\$, custom solution**
- + Demonstrated success w/ Opteon™

4. Refrigerant Only Conversion to Opteon™*

- + Lowest cost to non-ODP, low global warming potential (GWP)
- + Several successful customer projects

*This is an engineered solution. Chemours can assist in viability assessments.



Resources

Product Information

- Product information bulletin
- PUSH Bulletin

Engineering Properties

- PH Diagrams
- PT Data
- Thermodynamic Properties
- Transport Properties

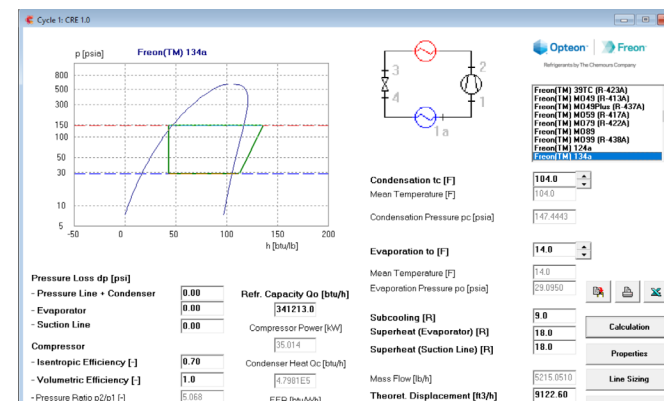
Applications

- Retrofit Guidelines
- Case Studies



Additional Resources

- Refrigeration Replacement Guide
- Line Sizing Tables
- Chemours Refrigeration Expert
- PT Calc mobile app
- Tech service direct contact



<https://www.opteon.com/en/support/understanding-a2l-refrigerants>

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Thank You