

Making Sense

Webinar Series

$$D = \frac{1.86 \cdot 10^{-3} T^{3/2} \sqrt{1/M_1 + 1/M_2}}{p \sigma_{12}^2 \Omega}$$

Making Sense Webinars

664028-1: Emerson Climate Technologies - Implementation of Low Condensing Refrigeration Webinar - Google Chrome
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Implementation of Low Condensing Refrigeration

EMERSON Climate Technologies

Slides

$COP \equiv \frac{T_m}{T_m - T_c}$

Making Sense Webinar Series

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EMERSON Climate Technologies

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PowerPoint File

Q & A



Making Sense Webinars

Emerson and Our Partners Giving Insight on the **Three Most Important Issues** in Refrigeration

We're Making Sense of the promising role of **new refrigerants**.

We're Making Sense of **energy reduction** technologies.

We're Making Sense of the application of electronics to improve **operational visibility**.



The widespread deployment of sustainable, energy efficient refrigeration solutions using natural refrigerants is fast approaching.

Emerson Climate Technologies invites you to interact with some of the refrigeration industry's most trusted and respected thought leaders on the emerging role of new refrigerants, the benefits of natural refrigerants, and the challenges of transitioning from existing refrigerants to natural refrigerants. Don't miss out through overlooking this important opportunity.

At AHR 2013, we're helping attendees MAKE SENSE of the issues that matter most. Check our website at www.emersonclimate.com/makingsense for presentation schedules and topics. Bring this card with you to one of our presentations and you'll be entered for a chance to win an Apple iPad!

> See what makes sense at the AHR Expo, booth #1605.

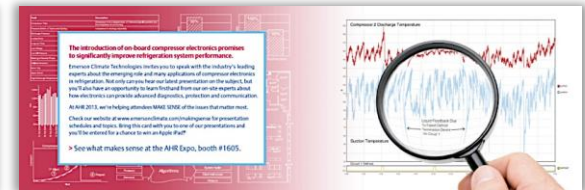


Advanced energy reduction technologies are enabling us to create a new era of system and equipment optimization.

Emerson Climate Technologies continues to interact with the refrigeration industry's foremost innovators in energy reduction technologies. We will be having a presentation about how the improvements in equipment and system technologies are being utilized in today's refrigeration applications. The experts will be speaking through their words to answer any questions you have about these innovations — from the utilization of digital modulation and electronic expansion valves to the application of scroll and variable speed technologies.

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The introduction of on-board compressor electronics promises to significantly improve refrigeration system performance.

Emerson Climate Technologies invites you to spend with the industry's leading experts about the strategic and practical implications of compressor electronics in refrigeration. Don't miss out through overlooking this important opportunity. You'll also have an opportunity to hear firsthand from our on-site experts about how Emerson's comprehensive advanced diagnostics, protection and commissioning solutions can help you optimize your system's performance.

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Making
Sense of the promising role of
new refrigerants.
Webinar Series



A Conversation on Refrigerants

January 21, 2014

Presented By:

Rajan Rajendran

Vice President of Engineering
Services and Sustainability
Emerson Climate Technologies

Guest Panelists:

Barbara Minor

Senior Technical Fellow
DuPont Fluoroproducts

Mark W. Spatz

Global Refrigerant Technology Leader
Honeywell's Fluorine Products

Brett Van Horn, PhD

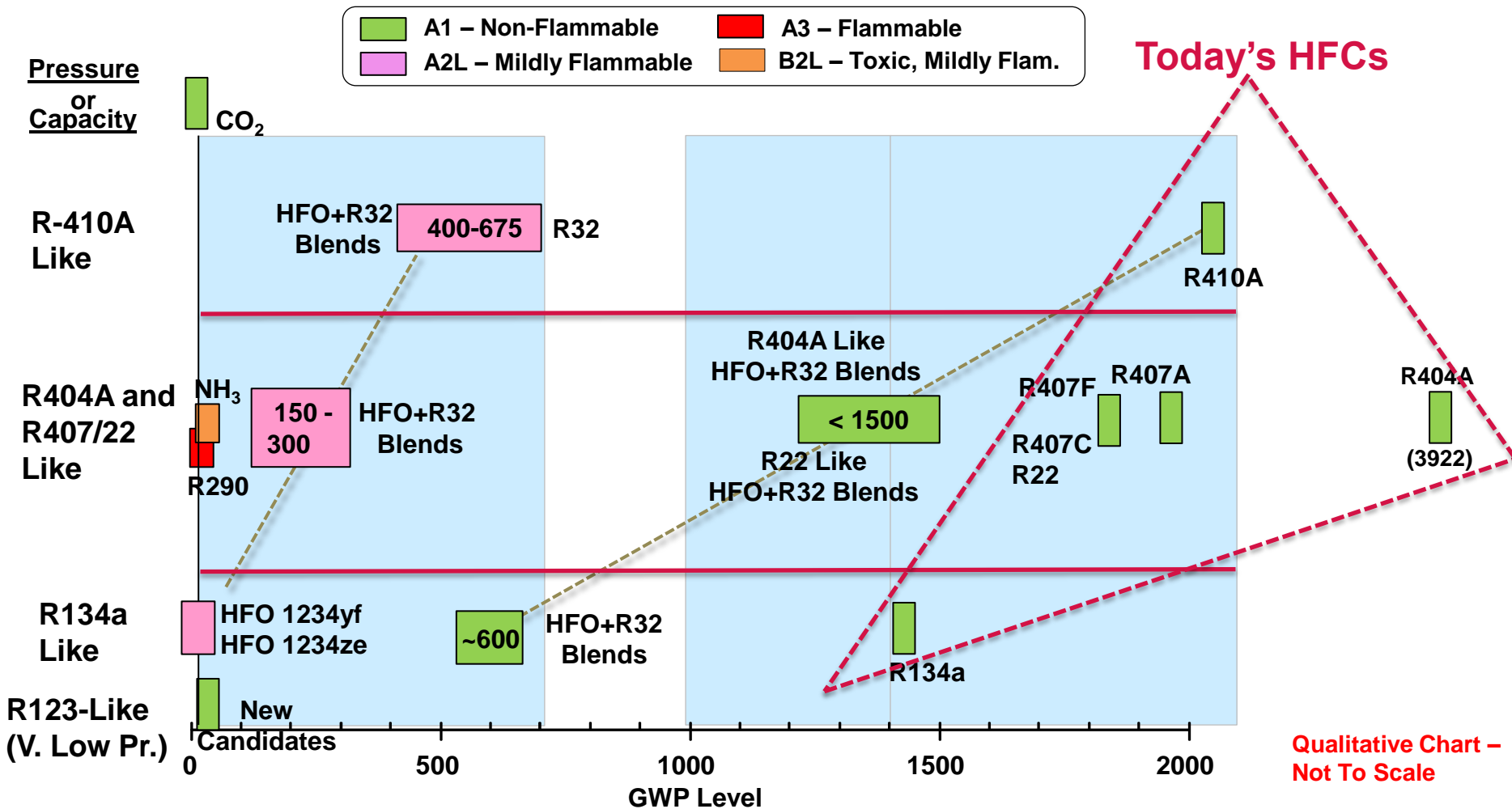
Global Project Leader, R&D
Arkema Inc.

Why Talk About HFCs?

Sample Regulatory and Voluntary HFC Actions

- **Montreal Protocol and HCFC phase-out in developing countries**
 - China, India, Brazil, etc.
- **Montreal Protocol and move to amend and include an HFC phase-down (North American Proposal)**
- **F-Gas revision developments in Europe**
 - HFC phase-down and application-specific bans
- **HFC Taxes**
 - Denmark, Spain, Australia, etc.
- **U.S. Environmental Protection Agency's SNAP**
 - President's Climate Action Plan from 2013
 - Recent stakeholder meetings on listing lower GWP candidates and delisting high GWP HFCs
- **Climate and Clean Air Coalition (CCAC)**
- **Voluntary actions by groups like Consumer Goods Forum (CGF)**

Refrigerant Options for New and Existing Equipment

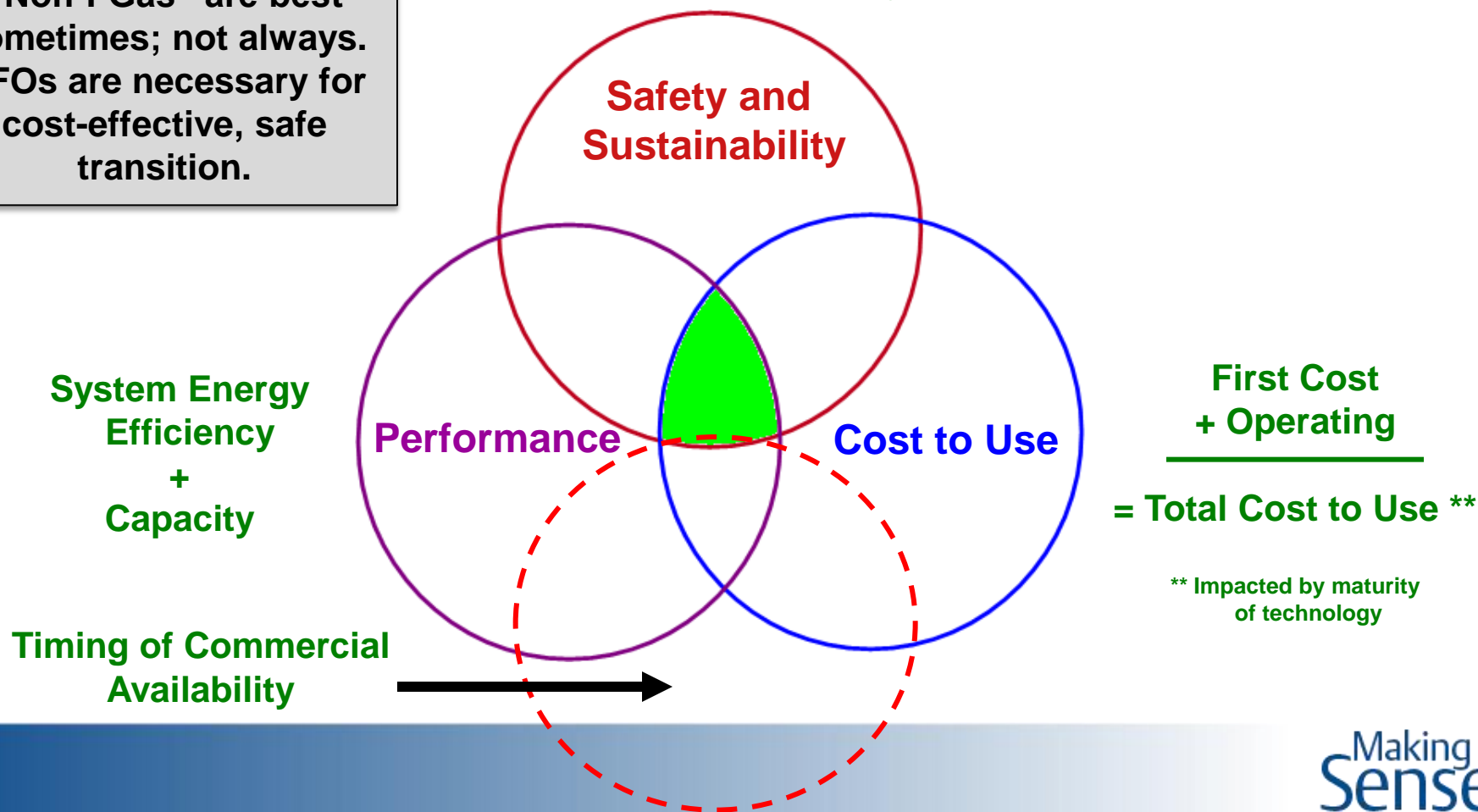


Refrigerant Selection

Best Balance of Properties for Each Application

Zero-ODP, Low-GWP, Favorable LCCP
Favorable Toxicity
No or Low Flammability

“Non-FGAs” are best sometimes; not always. HFOs are necessary for cost-effective, safe transition.



System Energy Efficiency
+
Capacity

Timing of Commercial Availability

First Cost
+ Operating

= Total Cost to Use **

** Impacted by maturity of technology

DuPont™ Opteon® Refrigerants

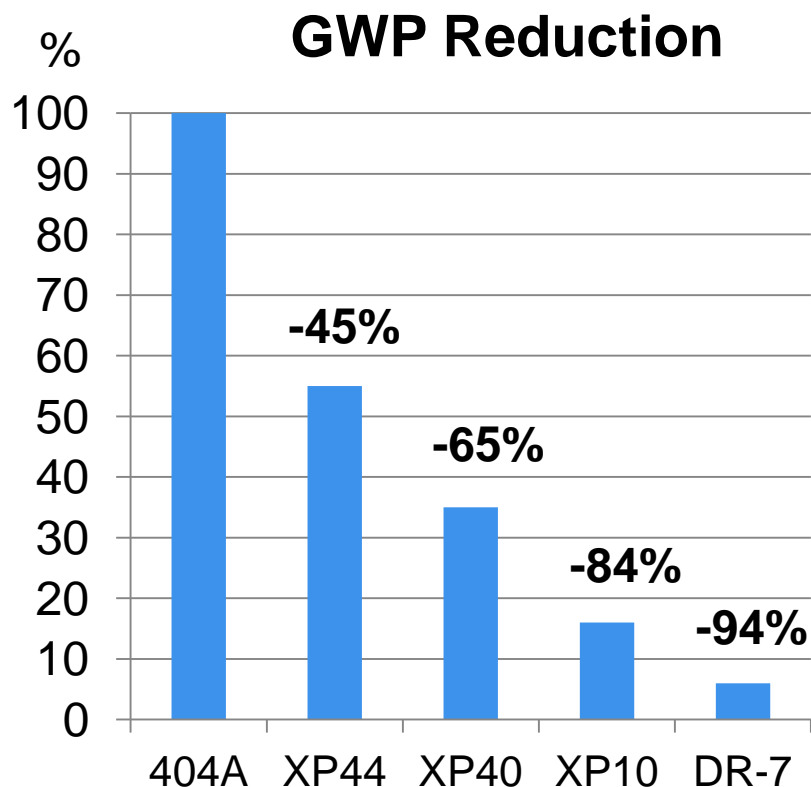
Optimal Balance of Properties; Many Promising Candidates

Leading Lower GWP Candidates — HFO Based

		Non-flammable		Mildly Flammable	
<u>Current</u>	<u>GWP</u>	<u>Name</u>	<u>GWP</u>	<u>Name</u>	<u>GWP</u>
HFC-134a	1430	XP10	630	YF	4
		DR-14	389		
HFC-404A	3902	XP40	1397	DR-7	246
		XP44	2140		
HFC-410A	2088			DR-5A	460
HCFC-22	1810	DR-91	988		
HCFC-123	77	DR-2	9		

Notes: GWP values AR4, “DR” designates under development

Opteon® Low GWP Replacements for R-404A Leading Candidates



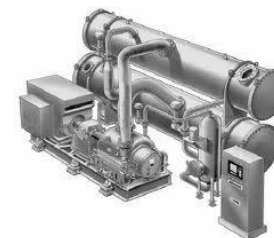
- **XP44**
 - ❑ Close performance match to R-404A
 - ❑ Formulated for lowest discharge temperature; ideal for transport refrigeration
 - ❑ Non-flammable; for retrofit and new systems
- **XP40**
 - ❑ Close performance match to R-404A
 - ❑ Non-flammable; for retrofit and new systems
- **XP10**
 - ❑ Close performance match to R-134a; for retrofit and new systems
 - ❑ Non-flammable; preferred for hybrid CO₂ cascade systems
- **DR-7**
 - ❑ Close performance match to R-404A
 - ❑ Mildly flammable (ASHRAE Class 2L expected)
 - ❑ For smaller charge size equipment (condensing units, self-contained)

Honeywell's Solstice™ Low GWP Refrigerants



Solstice™ HFO's for Low and Medium Pressure Applications

Solstice™ HFO's			
Current Product	Non-Flammable	Mildly Flammable (ASHRAE A2L)	Examples of Possible Applications
HFC-134a GWP = 1300		Solstice yf GWP = 0	Auto A/C, Vending, Refrigerators
		Solstice ze GWP = 1	Chillers, CO ₂ Cascades, Refrigerators
R-123 GWP = 79	Solstice zd GWP = 1		Centrifugal Chillers



Note: All GWP values use the latest assessment from the ICCP, "AR5"

Honeywell's Solstice™ Low GWP Refrigerant Blends



Solstice™ HFO Blends for Medium & High-Pressure Applications

Solstice™ HFO Blends			
Current Product	<i>Solstice™ N Series</i> Reduced GWP Option Non-Flammable (ASHRAE A1)	<i>Solstice™ L Series</i> Lowest GWP Option Mildly Flammable (ASHRAE A2L)	Examples of Possible Applications
HFC-134a GWP = 1300	N-13 — GWP = 547		Chillers, Med.-temp Refrigeration
HCFC-22 GWP = 1760	N-20 — GWP = 891	L-20 — GWP = 295	Stationary A/C, CO ₂ Cascades, Refrigeration
R-404A GWP = 3943	N-40 — GWP = 1273	L-40 — GWP = 285	Low-Temp Refrigeration
R-410A GWP = 1924		L-41 — GWP = 461 GWP = 572	Stationary A/C Applications



Note: All GWP values use the latest assessment from the ICCP, "AR5"

Current Refrigerant Options to Replace R-22



R-407F

- **For Refrigeration Applications:**
 - R-407F offers the best capacity match to R-22 in medium and low-temperature applications
 - An efficient R-22 retrofit option
 - Lowest GWP (1674) among R-22 replacements for commercial refrigeration
 - Requires POE
 - No TXV change or adjustments



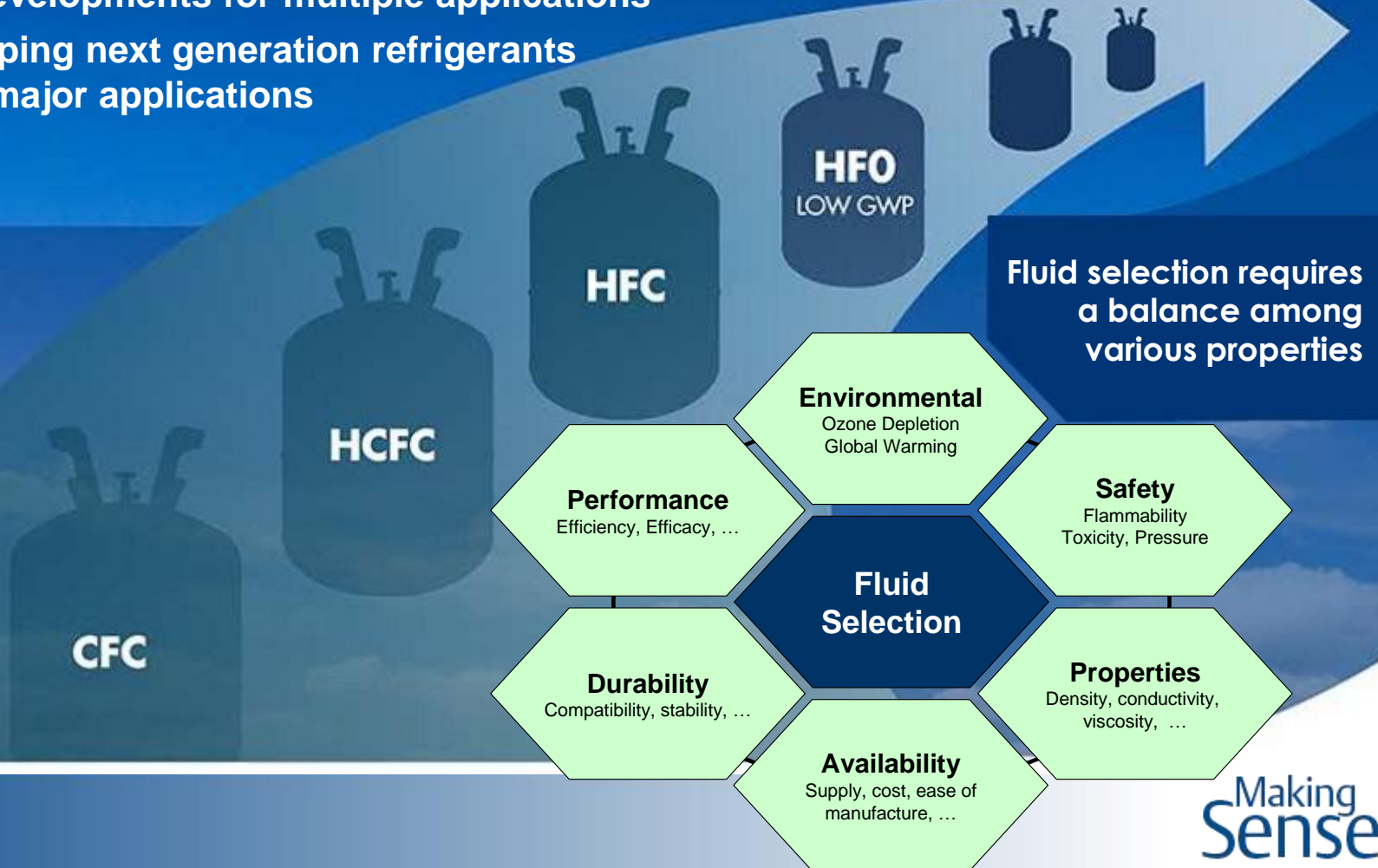
R-422D

- **For Unitary Air Conditioning Applications:**
 - No oil change* or TXV change in most installations
 - Satisfies customers looking for a “drop-in” option

* System designs vary, and the addition of POE may be required to assure proper oil return

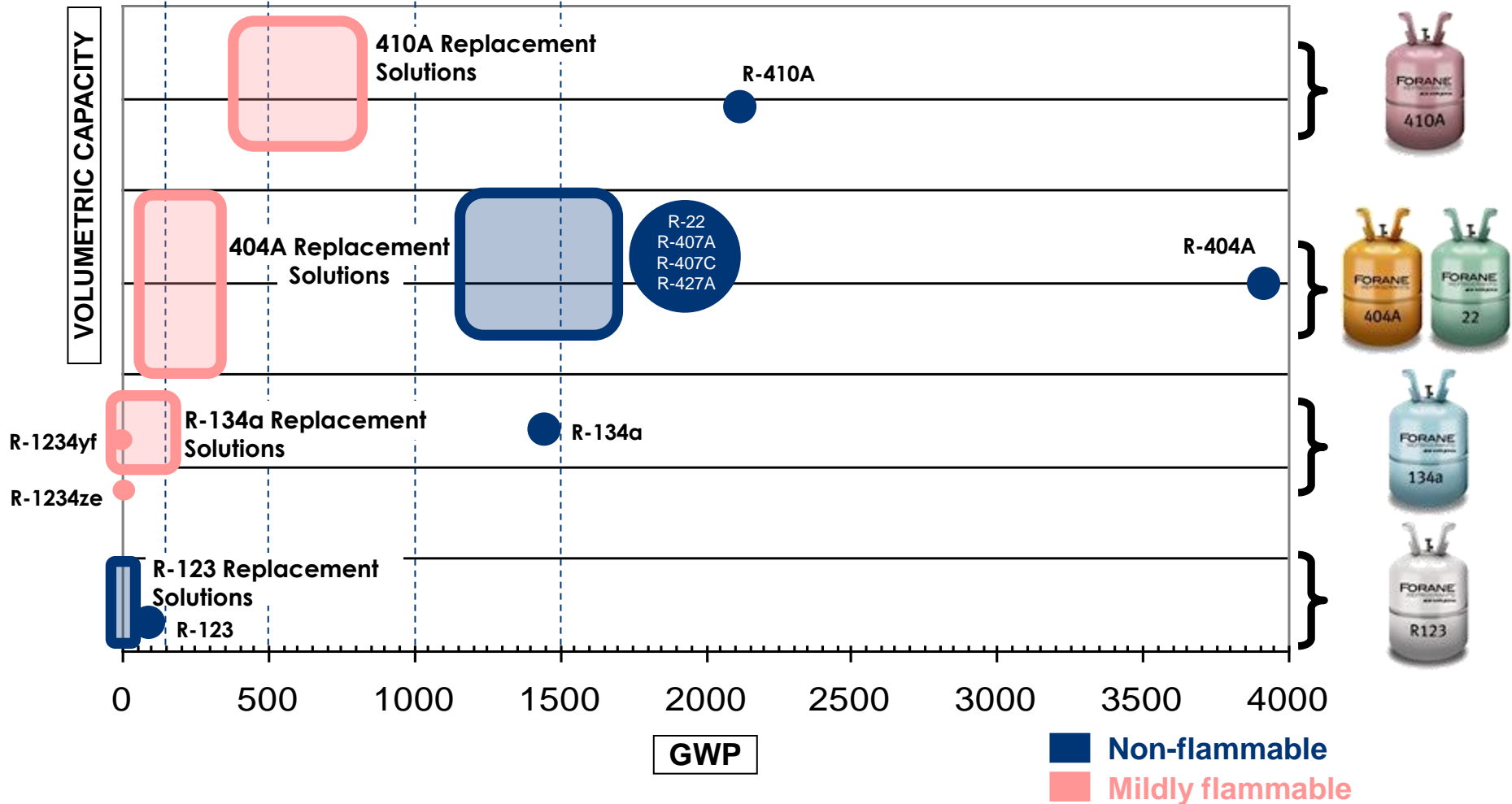
Arkema Moving Toward Sustainable Refrigeration Technology

- Announced construction of a 1234yf production plant in Asia
- HFO developments for multiple applications
- Developing next generation refrigerants for all major applications



Arkema's Next Generation Refrigerants

For Low, Medium and High-Pressure Applications



Arkema's Next Generation Refrigerants

For Low, Medium and High-Pressure Applications

Current Refrigerant	 <p>R-123 GWP = 77</p>	 <p>R-134a GWP = 1430</p>	 <p>R-410A GWP = 2100</p>	 <p>R-404A GWP = 3900</p>	 <p>R-22 GWP = 1810</p>
Non-Flammable	<p>ARC-1 (GWP < 15)</p>			<p>ARM-35 (GWP ~ 2150)</p> <p>ARM-32b (GWP ~ 1400)</p>	<p>ARM-32c (GWP < 1400)</p>
Mildly Flammable		<p>R-1234yf (GWP = 4)</p> <p>ARM-42 (GWP < 150)</p>	<p>ARM-71a (GWP < 500)</p>	<p>ARM-20a (GWP < 150)</p> <p>ARM-20b (GWP ~ 250)</p>	
Flammable				<p>ARM-25 (GWP < 150)</p>	

Thank You!

Questions and Answers

DISCLAIMER

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What Is a Refrigerant User Faced With?

- **Regulatory climate is uncertain/forming to nonexistent. How does one plan in this environment?**
- **Confusing choices:**
 - Short term vs. long term
 - Energy efficiency or global warming potential?
 - Synthetic or natural?
 - Flammable or non-flammable?
- **What do UL standards and building codes allow?**
- **Large base of R22 systems — what alternatives are acceptable with all the new criteria of lower GWP, etc.?**
- **There will be a large base of HFC systems for this next change. Should we be concerned about converting out of these in the future?**
- **How to account for long cycles for: refrigerant development and commercialization; safety standards; building code changes; component and equipment design; and release for production?**

Refrigerant Options: Further Questions

- Will development of lower GWP refrigerants vary for: Europe? U.S.? Asia? Latin America?
- Your thoughts on recent developments in Europe on the F-Gas regulation?
- Your thoughts on the recent EPA stakeholder meetings for SNAP?
- What is the viability of R404A as a refrigerant for the long term?
- Why is R410A a good refrigerant in AC for the long term? Or is it?
- How can we be confident that the lower GWP candidates are not “interims” given the HFC phase-down discussions? What is the minimum GWP needed to meet long-term, phase-down goals?
- What is the user’s responsibility — maintain a right-charged, leak-free system?
- What is the service technician’s responsibility — recover and recycle/reclaim? Be aware of changes and train for new?

HFC Phase-Down Proposals

Updated 1/12/14

