

Making Sense

Webinar Series

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



Staying Ahead of Rulemaking Proposals on Acceptable Refrigerants

August 26, 2014

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What Is SNAP? What Are NOPRs?

- **SNAP stands for Significant New Alternatives Policy**
 - Environmental Protection Agency's (EPA) program to approve alternative refrigerants to ozone-depleting potential CFCs, HCFCs
 - Approval specific to refrigerant and application
 - Website: <http://www.epa.gov/ozone/snap/index.html>
- **When EPA approves a refrigerant, a Notice of Public Rulemaking (NOPR) is issued in Federal Register**
 - Public has 60 days to review and comment
 - All details on how to submit comments are provided in the NOPR

EPA's First NOPR This Summer

- **Published on July 9; comments due Sept. 8**
- **Listed new flammable A2 and A3 refrigerants and revised venting prohibitions**
 - Stand-alone commercial refrigerators and freezers: R600a, R441A (150 g)
 - Household refrigerators and freezers: R290 (57 g)
 - Vending machines: R600a, R290 (150 g)
 - Self-contained room AC, PTACs, PTHPs, window AC and single-room portable AC: R290, R32, R441A (subject to UL 484 limits)
- <https://www.federalregister.gov/articles/2014/07/09/2014-15889/protection-of-stratospheric-ozone-listing-of-substitutes-for-refrigeration-and-air-conditioning-and>

Second NOPR for Delisting Certain HFCs by Application

- In 2013 and early 2014, EPA held stakeholder meetings to get input on which HFCs, if any, could be delisted
- The NOPR to delist was published on August 6
 - Comments due on October 6
- Links to documents on the EPA website:

Rule: http://www.epa.gov/ozone/downloads/SAN_5750_SNAP_Status_Change_Rule_NPRM_signature_version-signed_7-9-2014.pdf

Fact sheet: http://www.epa.gov/ozone/downloads/SAN_5750_SNAP_Status_Change_Rule-Fact_Sheet_070714.pdf

NOPR:
<http://www.gpo.gov/fdsys/pkg/FR-2014-08-06/pdf/2014-18494.pdf>

Second NOPR Refrigeration and Air Conditioning End Uses Impacted

- **Currently Included**

- **Retail Food Refrigeration** includes all cold storage cases designed to chill food for commercial sale. In addition to grocery cases, the end use includes convenience store reach-in cases and restaurant walk-in refrigerators
- **Vending machines** are self-contained units which dispense goods that must be kept cold or frozen
- **Motor vehicle air conditioning systems**, or MVACS, provide comfort cooling for passengers in cars, buses, planes, trains, and other forms of transportation

- **Not Included, but Seeking Comment**

- **Industrial process refrigeration systems** cool process streams in industrial applications
- **Cold storage warehouses** are used to store meat, produce, dairy products, and other perishable goods
- **Commercial ice machines** are used in commercial establishments to produce ice for consumer use, e.g., in hotels, restaurants and convenience stores
- **Refrigerated transport** moves products from one place to another while maintaining necessary temperatures, and include refrigerated ship holds, truck trailers, railway freight cars, and other shipping containers

- **(Foam and Aerosol Also Impacted)**

<http://www.epa.gov/ozone/snap/refrigerants/index.html>

EPA's Proposed Rule on Delisting HFCs by Application

Refrigerant	Supermarket*		Condensing Units* <i>(field charged)</i>	Standalone Self Contained Comm. Ref. Eqpt* <i>(factory charged sealed systems)</i>	Vending Machines*	Foam	Auto AC
	Direct	Sec.					
R404A/507A	Jan 2016	Jan 2016	Jan 2016	Jan 2016	Jan 2016		
HFC-227ea, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A	Jan 2016	Jan 2016					
R407A, R407F				Jan 2016 (New)			
R134a				Jan 2016 (New)	Jan 2016 (New)	Jan 2017	2021 Model (New)
Various Blends, GWP 600-3990**				Jan 2016 (New)			
Various Foam Refs**						Jan 2017	
Various Auto Blends**							2017 Model (New)

* New And Retrofit Only; Service Is Allowed

** Check EPA Documents For Details

Aerosol Application Not Shown In Above Table

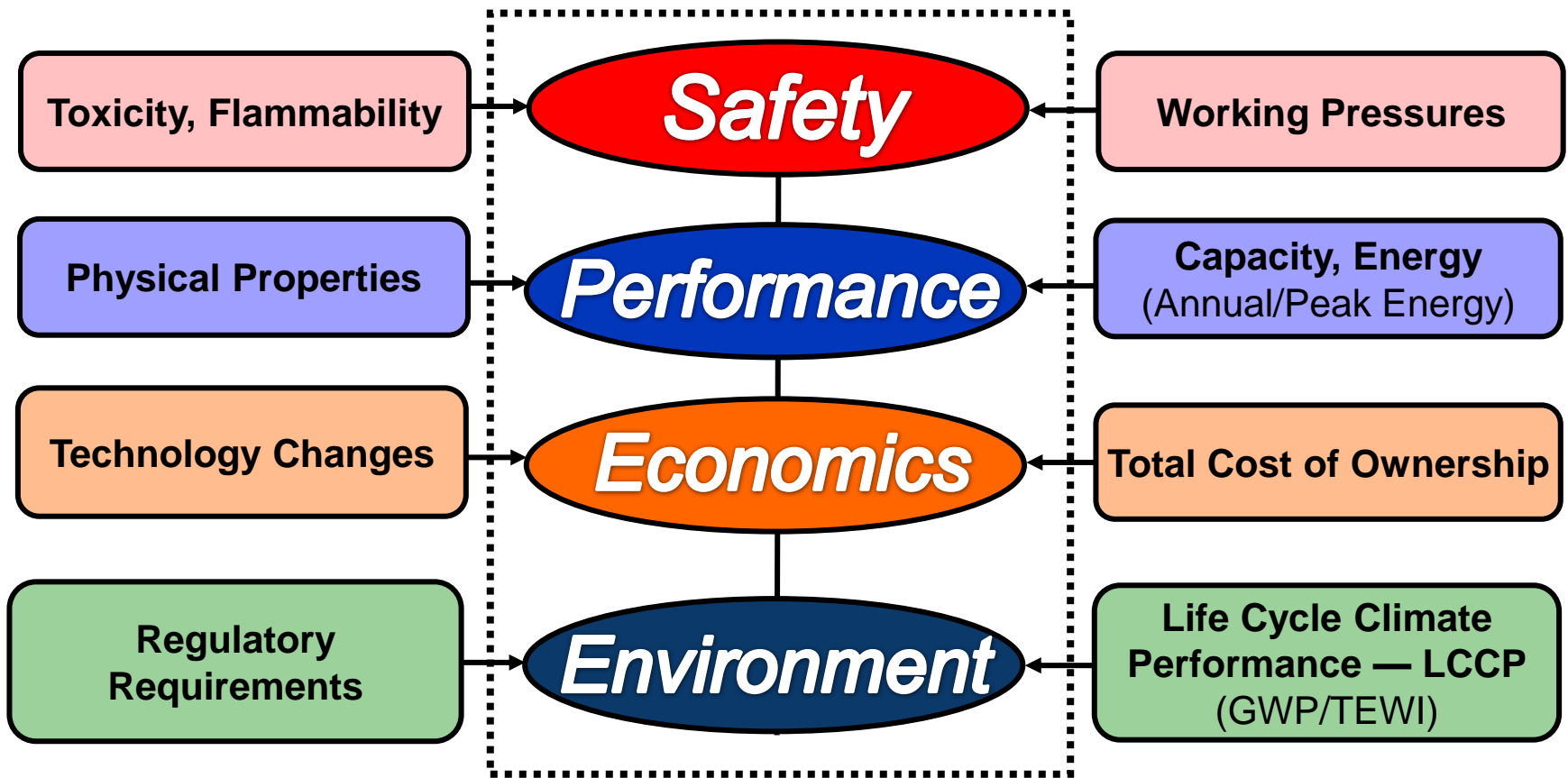
Industrial, Ice Making Heads, Warehouses and Transport Applications Are Not Included In This NOPR But Comments Have Been Requested

Polling Question #1

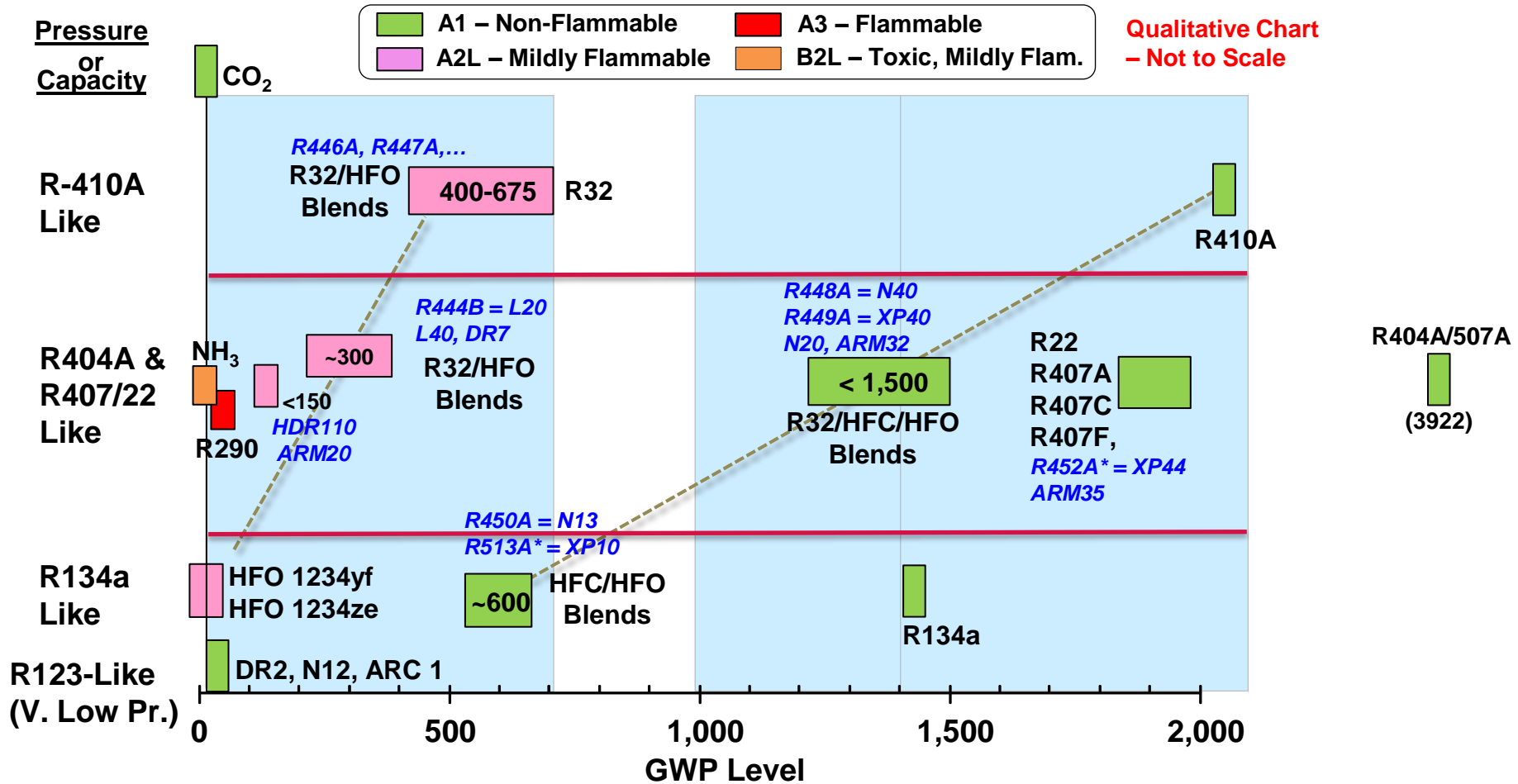
Before seeing the last several slides, how clear were you on the EPA's 1st and 2nd Notice's of Public Rule on refrigerants?

- a. Very Clear
- b. Clear
- c. Somewhat Clear
- d. I Did Not Know About Them

Only a Holistic Evaluation Process Can Minimize “Unintended Consequences”



Refrigerant Options for Air Conditioning and Refrigeration Applications



* Pending ASHRAE Final Approval

What Are Available Alternatives?

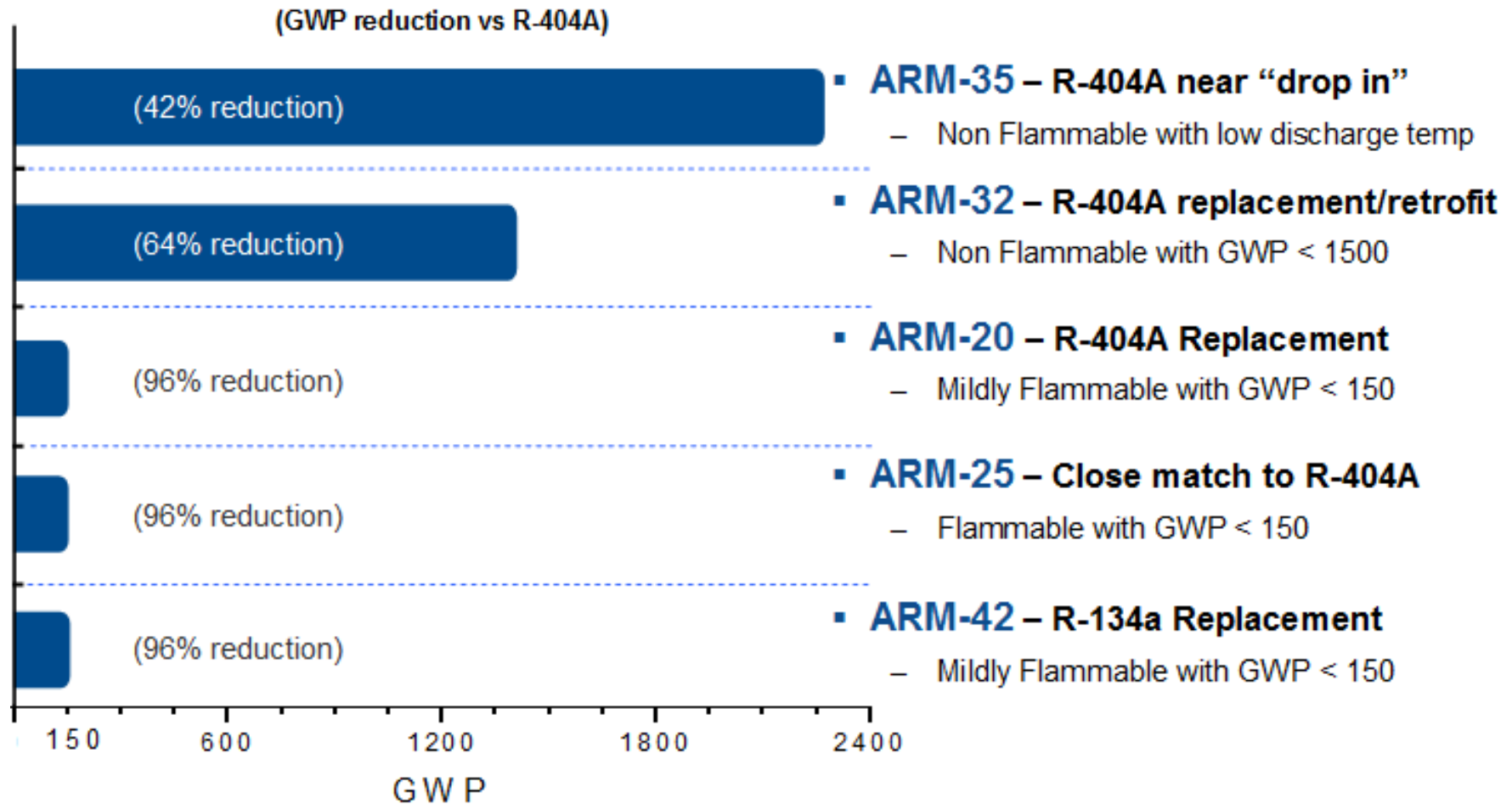
Retail Food Refrigeration	Today	Alternates Today	Future Alternative(s)
Supermarket	R404A/R507A	?	?
Condensing Unit <i>(field charged)</i>	R404A/R507A	?	?
Standalone Self Contained Comm. Ref. Equipment <i>(factory charged sealed systems)</i>	R404A/R507A	?	?
	R134a	?	?

Arkema's Next-Generation Refrigerants

Retail Food Refrigeration	Today	Alternates Today	Future Alternative(s)
Supermarket	R404A/R507A	R407A	ARM-35 ARM-32
Condensing Unit <i>(field charged)</i>	R404A/R507A	R407A	ARM-35 ARM-32
Standalone Self Contained Comm. Ref. Equipment <i>(factory charged sealed systems)</i>	R404A/R507A		ARM-20** ARM-25**
	R134a		ARM-42**

** A2L – Mildly Flammable

Arkema's Next-Generation Refrigerants

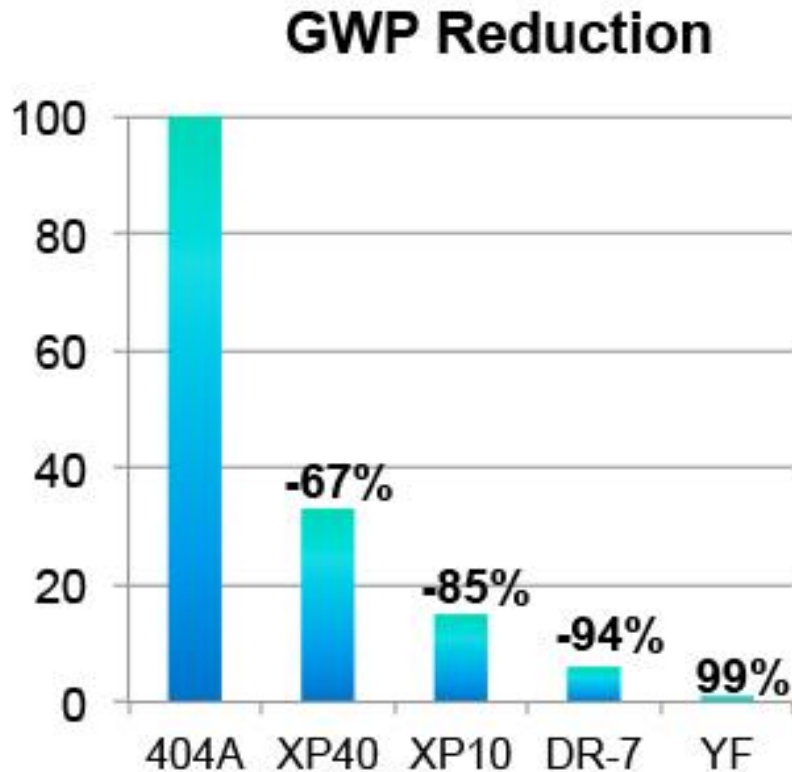


DuPont's Next-Generation Refrigerants

Retail Food Refrigeration	Today	Alternates Today	Future Alternative(s)
Supermarket	R404A/R507A	R407A	XP40 (R449A)
Condensing Unit <i>(field charged)</i>	R404A/R507A	R407A	XP40 (R449A) DR-7**
Standalone Self Contained Comm. Ref. Equipment <i>(factory charged sealed systems)</i>	R404A/R507A	R407A	XP40 (R449A) DR-7**
	R134a		XP10 (R513A) HFO-1234yf**

** A2L – Mildly Flammable

DuPont's Next-Generation Refrigerants



- **Opteon® XP40 (R-449A)**
 - ❑ Close performance, with 67% lower GWP than 404A
 - ❑ New and retrofit with no equipment or oil change
 - ❑ Potential energy efficiency benefit based on system tests
- **Opteon XP10 (R-513A)**
 - ❑ Close performance, with 55% lower GWP than 134a
 - ❑ No-glide azeotrope; new and field retrofit
 - ❑ For self-contained and hybrid CO₂ cascade systems
- **DR-7**
 - ❑ Close performance, with 94% lower GWP than 404A
 - ❑ Mildly flammable (ASHRAE 2L expected)
 - ❑ For smaller charge equipment (e.g., condensing units, self-contained)
- **Opteon YF**
 - ❑ Close performance, with >99% lower GWP than 134a
 - ❑ ASHRAE 2L flammable
 - ❑ For self-contained systems — larger charge than A3

Honeywell's Next-Generation Refrigerants

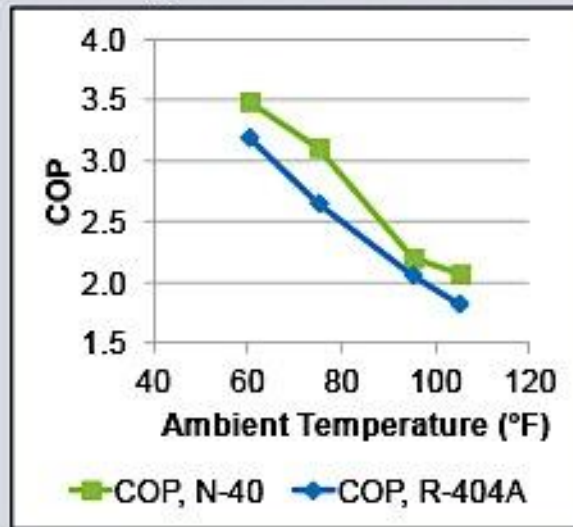
Retail Food Refrigeration	Today	Alternates Today	Future Alternative(s)
Supermarket	R404A/R507A	R407F	N-40 (R448A)
Condensing Unit <i>(field charged)</i>	R404A/R507A	R407F	N-40 (R448A)
Standalone Self Contained Comm. Ref. Equipment <i>(factory charged sealed systems)</i>	R404A/R507A	R407F	N-40 (R448A) L4F (HDR-110)**
	R134a	HFO-1234ze** HFO-1234yf**	N-13 (R450A)

** A2L – Mildly Flammable

Honeywell's Next-Generation Refrigerants Candidates to replace R404A (GWP=3943)

**Non-Flammable — Retrofit
N-40 (R448A) — GWP=1273**

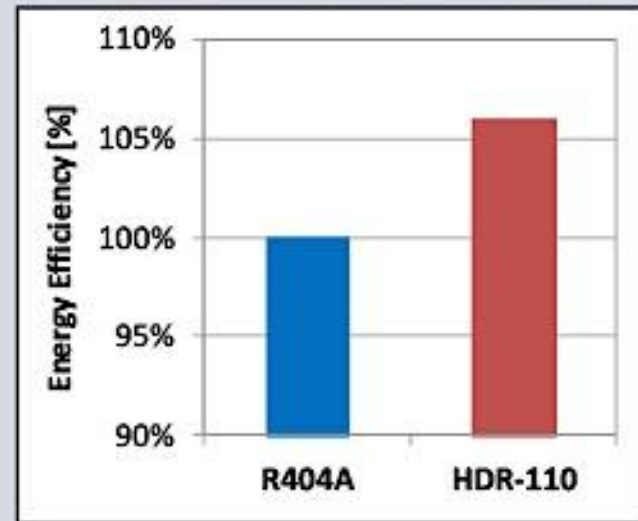
**Testing at DOE-sponsored Lab
(Oak Ridge National Laboratory)**



- Superior performance (+11% compared to 404A)
- Going through extensive testing in supermarkets

**Mildly Flammable — New Product
L4F (HDR-110) — GWP<150**

**Testing at Buffalo Research Lab
Self-Contained: Reach-in Freezer**



- Capacity within 5% of R404A
- 6% better energy efficiency (ASHRAE Std 72)

Emerson View on Available Options (Not a Comprehensive List)

Retail Food Refrigeration	Today	Alternates Today	Future Alternative(s)
Supermarket	R404A/R507A	R407A/F* CO ₂	R448A*, R449A* ARM32*
Condensing Unit <i>(field charged)</i>	R404A/R507A	R407A/F*	R448A*, R449A* ARM32*
Standalone Self Contained Comm. Ref. Equipment <i>(factory charged sealed systems)</i>	R404A/R507A	R290***	R448A(?), L40** R449A(?), DR7** HDR-110**, ARM20**
	R134a	R290 ¹	R450A(?) R513A(?) HFO-1234yf** HFO-1234ze**

* May Have Disch. Temp Issues For Compressor

** A2L – Mildly Flammable

*** A3 – Highly Flammable

? – Some Clarifications Required From EPA

1 – Total System Redesign Required

Polling Question #2

What is your plan for refrigerants?

- a. I plan to go with new synthetic (A1 non-flammable), lower GWP refrigerants like R-448A, R-449A or ARM32.
- b. I plan to go straight to A2L (mildly flammable) refrigerants like R-444B or HFO-1234ze or even A3 (flammable) refrigerants like R-290.
- c. I will use a combination of both a. and b.
- d. I'm looking for only A1, <150 GWP solutions like CO₂, DR2, N12 or ARC1.

EPA's Proposed Rule on Delisting HFCs by Application

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Early Thoughts on NOPR

- **Supermarket industry transition from R404A/R507A in new systems**
 - No comment
- **Condensing unit applications will be extremely difficult to convert from R404A/R507A by January 2016**
 - Numerous model approvals, discharge temperature, DOE efficiency
- **Self-contained applications will be nearly impossible to convert from R404A/507A and R134a**
 - R290 and CO₂ are not efficient and economical options for all sizes
 - Need to maintain refrigerants under 2,500 GWP as acceptable alternates in these small, critically charged, low-leak systems
 - Implementation timing must allow for breadth of components, units and systems to be redesigned, tested, approved and qualified
- **Blends With Glide Won't Work for Flooded Evaporators — An Often Forgotten Issue!**

What Are the Next Steps?

- **Attend the EPA meeting tomorrow, Aug. 27**
- **Review NOPR in detail, formulate position, and submit your comments on your own and through industry organizations (we are)**
- **Comment Period Ends October 6**
- **Encourage others in the industry to do the same; not commenting may be interpreted as agreement**
- **For our part, Emerson will continue to evaluate alternatives and work with customers to find the best acceptable solution for each application**

Suggested Topics to Comment on/Quantify by October 6

- **Scope/Refrigerant Options**

- Pieces of Equipment Impacted/Discontinued
- Refrigerant Options/Compliance Plans
- Design and Operational Considerations
- Service Replacement

- **Investment/Timeline**

- Equipment Design and Qualification
- Manufacturing
- Engineering Resources
- In-House and Third Party Test Lab Availability and Costs
- Regulatory Burden (DOE) and Cost to Comply

- **Safety and Liability Risk**

- Manufacturing Operations
- Qualified Technicians
- Legal/Insurance Impact
- Building Codes

Polling Question #3

Are you planning to provide commentary to the EPA concerning either of the NOPRs that were discussed today?

- a. Yes
- b. No
- c. Undecided

Thank You!

Questions?

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