



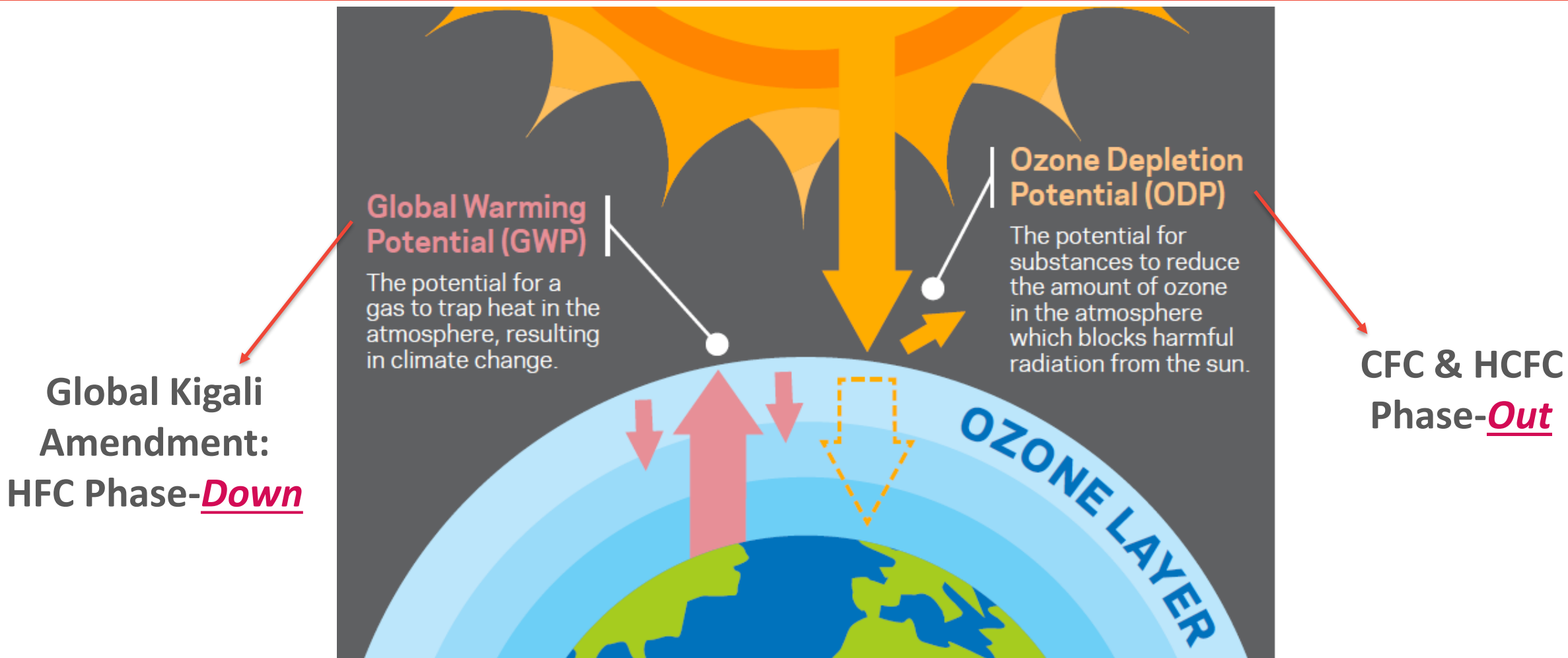
# Low GWP (<750) HFO Refrigerants Update

Ozone2Climate Roadshow  
Beijing, China

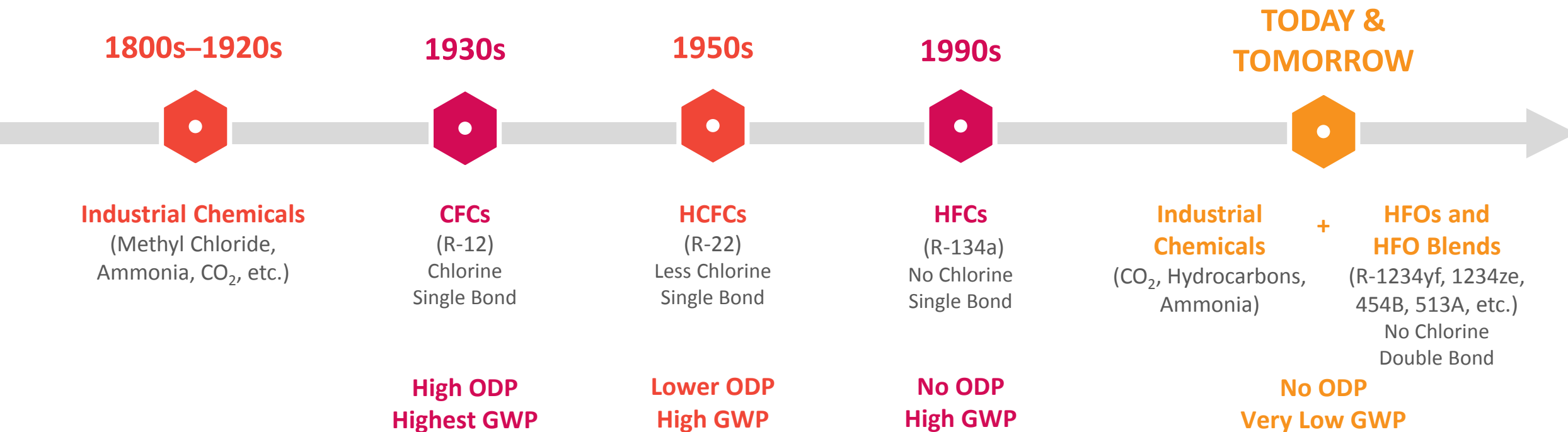
Stefanie M. Kopchick  
Global Market Manager  
The Chemours Company  
April 2018



# Environmental Challenges Driving Industry Transitions



# Evolution of Refrigerant Technology









*Selection of Refrigerants for the Future Will Need to Balance Performance (Capacity and Efficiency), Safety and Sustainability, and Total Cost of System Ownership*

# Opteon™ Offers the Optimal Balance of Properties



# Chemours Refrigerant Roadmap



			Non-flammable (XP Series) Class 1		Mildly Flammable (XL Series) Class 2L	
Current	GWP	Application	Product	GWP	Product	GWP
HFC-134a	1300 (1430)		XP10 (R-513A)	573 (631)	XL10 (R-1234yf)	< 1 (4)
HFC-404A	3943 (3922)	 	XP40 (R-449A)	1282 (1397)	XL40 (R-454A)	238 (239)
			XP44 (R-452A)	1945 (2140)	XL20 (R-454C)	146 (148)
HFC-410A	1924 (2088)	 	XP41 (R-463A)	1377 (1494)	XL41 (R-454B)	467 (466)
					XL55 (R-452B)	676 (698)
HCFC-22	1760 (1810)		XP20 (R-449C)	1146 (1251)	XL20 (R-454C)	146 (148)
HCFC-123	79 (77)		XP30 (R-514A)	2 (7)		
			MZ (R-1336mzz(Z))	2 (9)		



# Retrofit or New Installation: Why Opteon™ XP10 (R-513A)?

— *Replaces R-134a* —



**ASHRAE #:** R-513A

**Blend Components:** R-1234yf/134a

**Blend Composition:** 56/44

## Optimal Balance of Properties



Meets regulatory requirements

Non-ozone depleting  
56% lower GWP vs. R-134a



Azeotropic Blend

No temperature glide



Extends life of existing equipment

Compatible with installed base  
Improved capacity w/ comparable energy efficiency



ASHRAE Classification = A1

Low Toxicity (Class A), Non-flammable (Class 1)



Commercially available & OEM Approved

- Emerson (Copeland), Bitzer, & Tecumseh Approved
- Selected by Major Chiller OEMs Trane, JCI, Carrier, Smardt

# R-134a to Opteon™ XP10 Performance Considerations

	Medium Temperature Refrigeration <sup>1</sup>		A/C Chiller Conditions <sup>2</sup>	
ASHRAE #	R-134a	XP10 (R-513A)	R-134a	XP10 (R-513A)
Relative Capacity	1.00	1.04	1.00	1.02
Relative COP	1.00	1.00	1.00	0.98
Relative Mass Flow	1.00	1.15	1.00	0.94
Suction Pressure (kPa)	99	122	343	374
Discharge Pressure (kPa)	917	965	957	1010
Discharge Temp (°C)	80	73	48	44

<sup>1</sup>MT Conditions: -10°C Evap/40°C Cond/4K Subcool/10K Superheat, 70% Compressor Efficiency

<sup>2</sup>A/C Chiller Conditions: 4.44°C Evap/37.78°C Cond/ No Subcool/No Superheat, 75% Compressor Efficiency

# Successful Installation of CO<sub>2</sub> Cascade with Opteon™ XP10 (R-513A) at Aldi's in Spain



## Case Study – Aldi's Store in Dos Hermanas, Spain

**“We chose Opteon™ XP10, because it offered the optimal balance of properties when compared to other [134a] options.”**

- Javier Atencia, Technical Manager, Tewis Smart Solutions  
(Energy Consultant for Aldi)

**“The ease of installation was similar to any other previous refrigerant technology, which allowed for us to set up the system without inconveniencing the customer.”**

- Juan Carlos Izqueirido, Technical Manager FRIEX  
(Mechanical Contractor)



# Opteon™ XP10 (R-513A) – Excellent Compatibility & Endorsement from Chiller Manufacturers



## Ingersoll Rand Introduces the EcoWise™ Portfolio of Products as Step to Achieve its Global Climate Commitment

**Davidson, N.C., January 26, 2015** – Ingersoll Rand (NYSE:IR), a world leader in creating comfortable, sustainable and efficient environments, is pleased to announce another milestone in achieving its climate commitment, a roadmap to significantly reduce the environmental impact from its operations and product portfolio by 2030.

Trane Sintes™ air-cooled chiller is energy efficient and quiet, and offers customers the choice of operating with a next generation, low GWP refrigerant – **Opteon™ XP10 (R-513A)** or with R-134a. Product will be available in North America and Latin America with next generation refrigerant option in June 2015.



## Carrier AquaEdge® 19XR, 23XR and AquaForce® 30XV and XA Chillers are Available With Lower Global Warming Refrigerant Solutions

**CHARLOTTE, N.C. - Feb. 9, 2018** - Legacy R-134a as well as the newer R-513A refrigerants are both supported in Carrier chillers. As part of Carrier's commitment to delivering a comprehensive commercial product line that supports the drive for lower global warming refrigerant solutions, **Carrier AquaEdge® 19XR water-cooled centrifugal chillers, 23XR water-cooled screw chillers and AquaForce® 30XV/XA air-cooled screw chillers are compatible with both R-134a as well as lower global warming potential (GWP) option R-513A.**



## Johnson Controls Advances Environmental Sustainability with Chiller Platforms Compatible with Low GWP Refrigerants

**MILWAUKEE – (Jan. 20, 2016)** – [Johnson Controls](#) is advancing its [White House Council on Environmental Quality commitment](#) by enhancing HFC product lines to be fully compatible with the non-flammable, low-GWP refrigerant – Opteon™ XP10 (R-513A), manufactured by The Chemours Company. York centrifugal and screw chillers ranging from 125 to 6,000 tons (440 to 21,100 kW) are compatible with R-513A.



## Chemours™ Opteon™ XP10 Refrigerant Specified by Dunham-Bush for DCLCG Series Of High-Efficiency Direct-Driven VFD Water Cooled Centrifugal Chiller

**WILMINGTON, Del., April. 11, 2017** – Chemours Fluorochemicals (Chemours) today announced the selection of **Opteon™ XP10 (R-513A)** low global warming potential (GWP) refrigerant by **Dunham-Bush for use in its DCLCG Series Of High-Efficiency Direct-Driven VFD Water Cooled Centrifugal Chiller for the Asia Pacific market.**

# <750 GWP R-410A Replacement Comparisons

Air Conditioning	R-410A	XL55 (R-452B)	XL41 (R-454B)	XL40 (R-454A)	R-22	XL20 (R-454C)
GWP AR4 (AR5)	2088 (1924)	698 (676)	466 (467)	239 (238)	1810 (1760)	148 (146)
Capacity vs. R-410A	-	-3%	-4%	-23%	-32%	-33%
COP vs. R-410A	-	+1%	+1%	+3%	+6%	+5%
Evap Glide [K]	0.1	1	1	5	0	6
T Discharge [°C]	82	86	87	77.4	85	73.2
P Discharge [kPa]	2802	2663	2631	2131	1775	1842

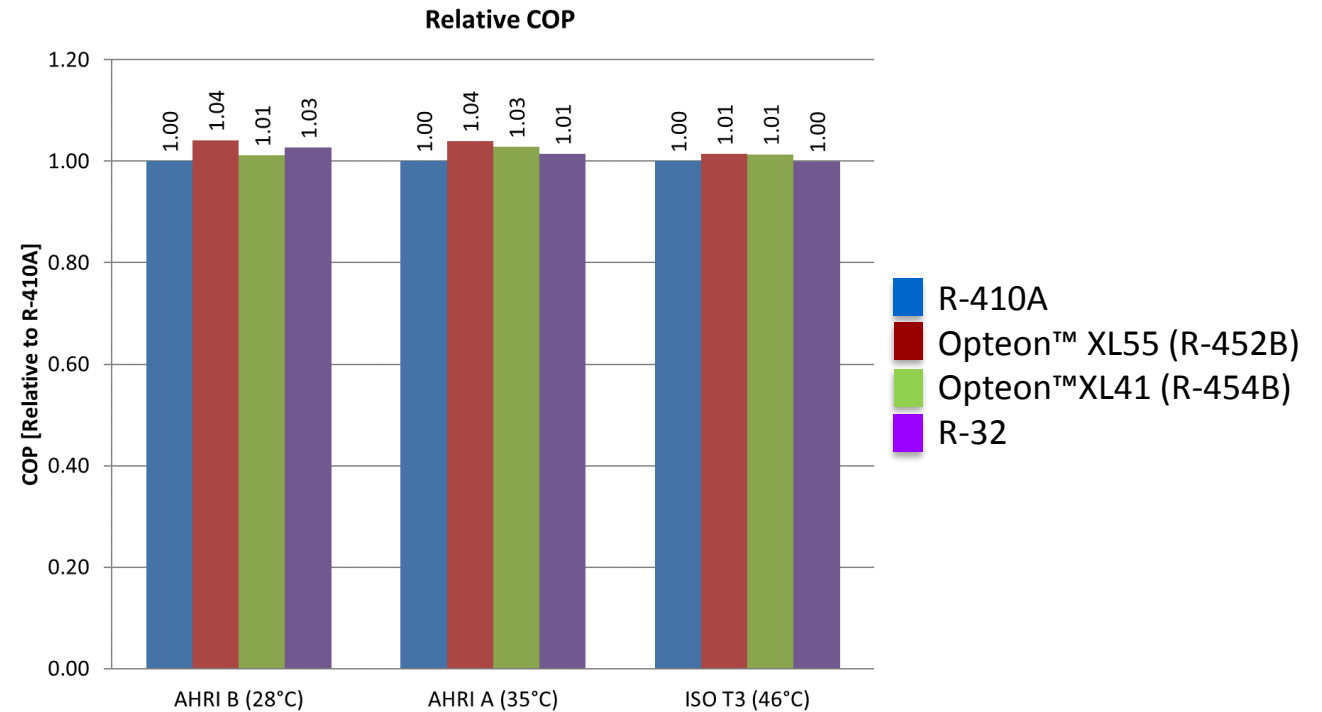
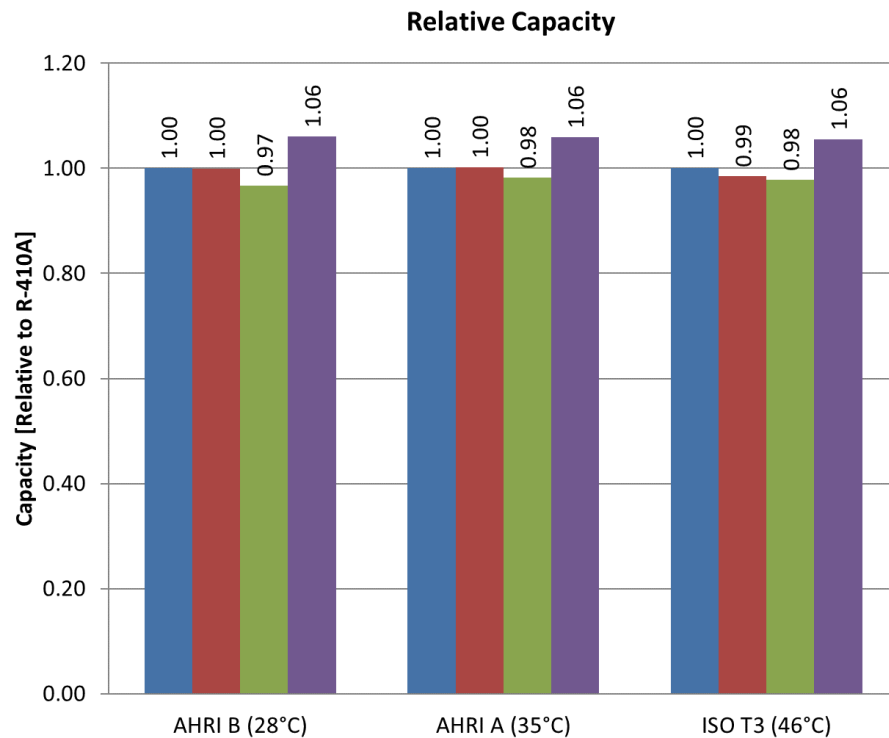
Thermodynamic cycle model results for A/C Conditions:  
10.0°C Avg Evap/ 46.1°C Avg Cond/ 8.3 K Subcool/11.1K Superheat, 70% Compressor Efficiency

- Opteon™ XL41 provides the lowest GWP alternative to R-410A with comparable performance, minimizing need to re-design 410A equipment platform!
- Ultra-low GWP (<150) could be reached, with performance comparable to R-22, but higher glide.
- All products shown are ASHRAE Class A2L: Low Toxicity, Mildly Flammable.

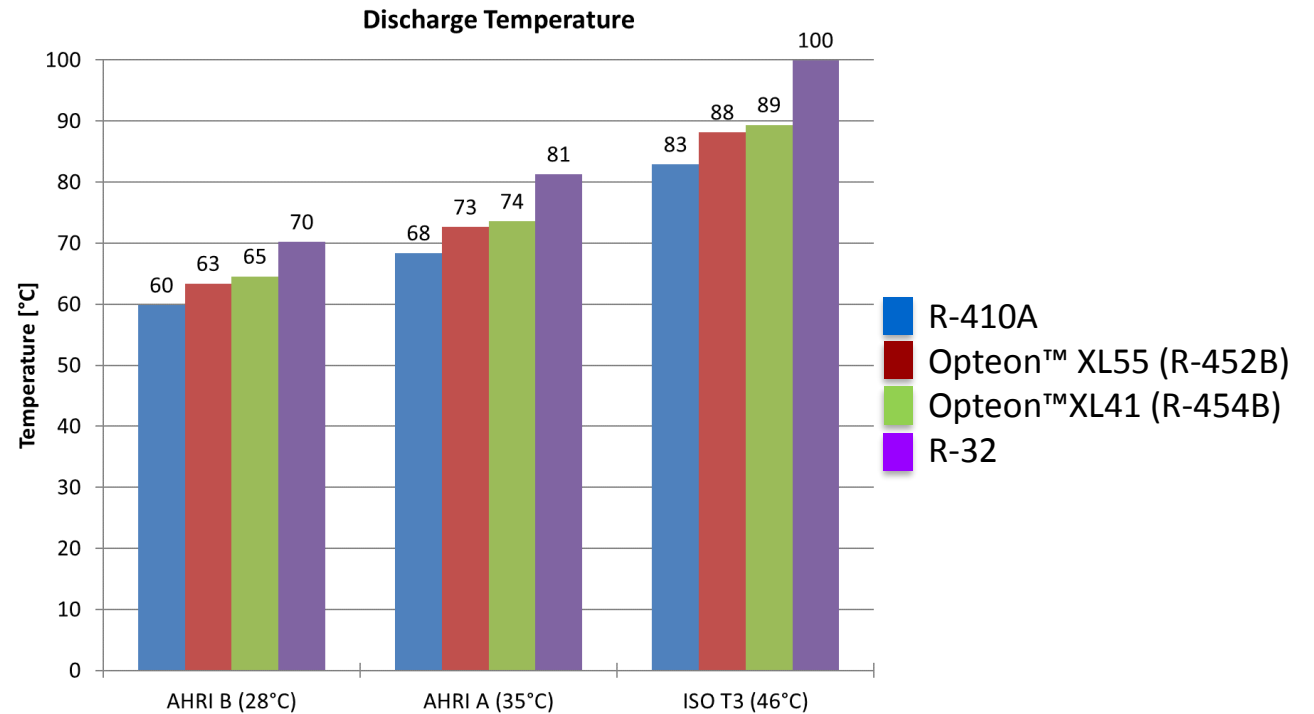
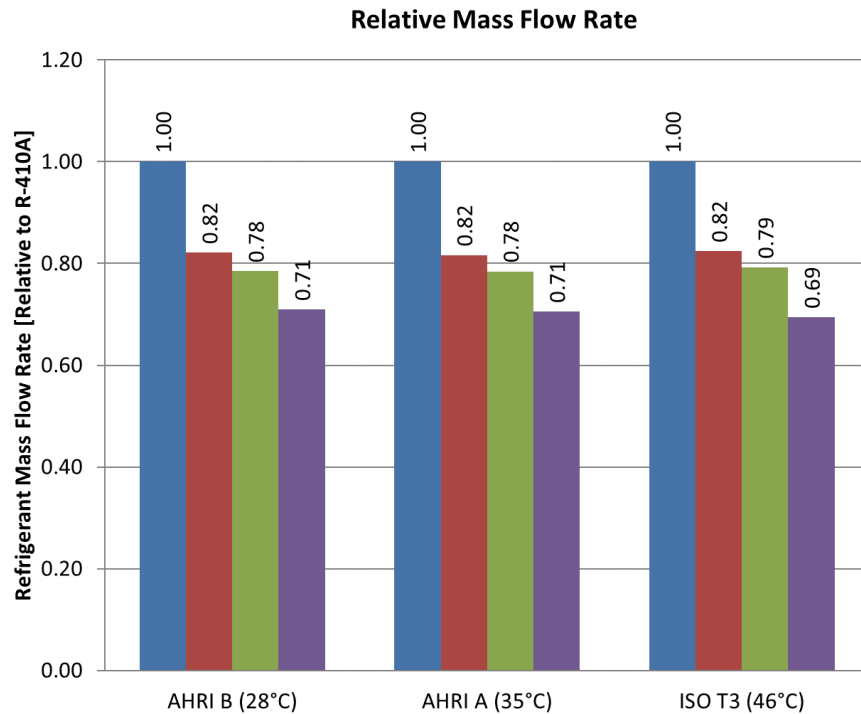
# Soft-Optimized Performance Test Results

- Tested off-the-shelf 8.8 kW, 16 SEER ducted split AC/HP system in environmental chamber
- Scroll compressor with POE lubricant
- Replaced OEM TXV with EEV to match R-410A superheat

*Close capacity match to R-410A with improved COP with both Opteon™ XL41 and Opteon™ XL55*



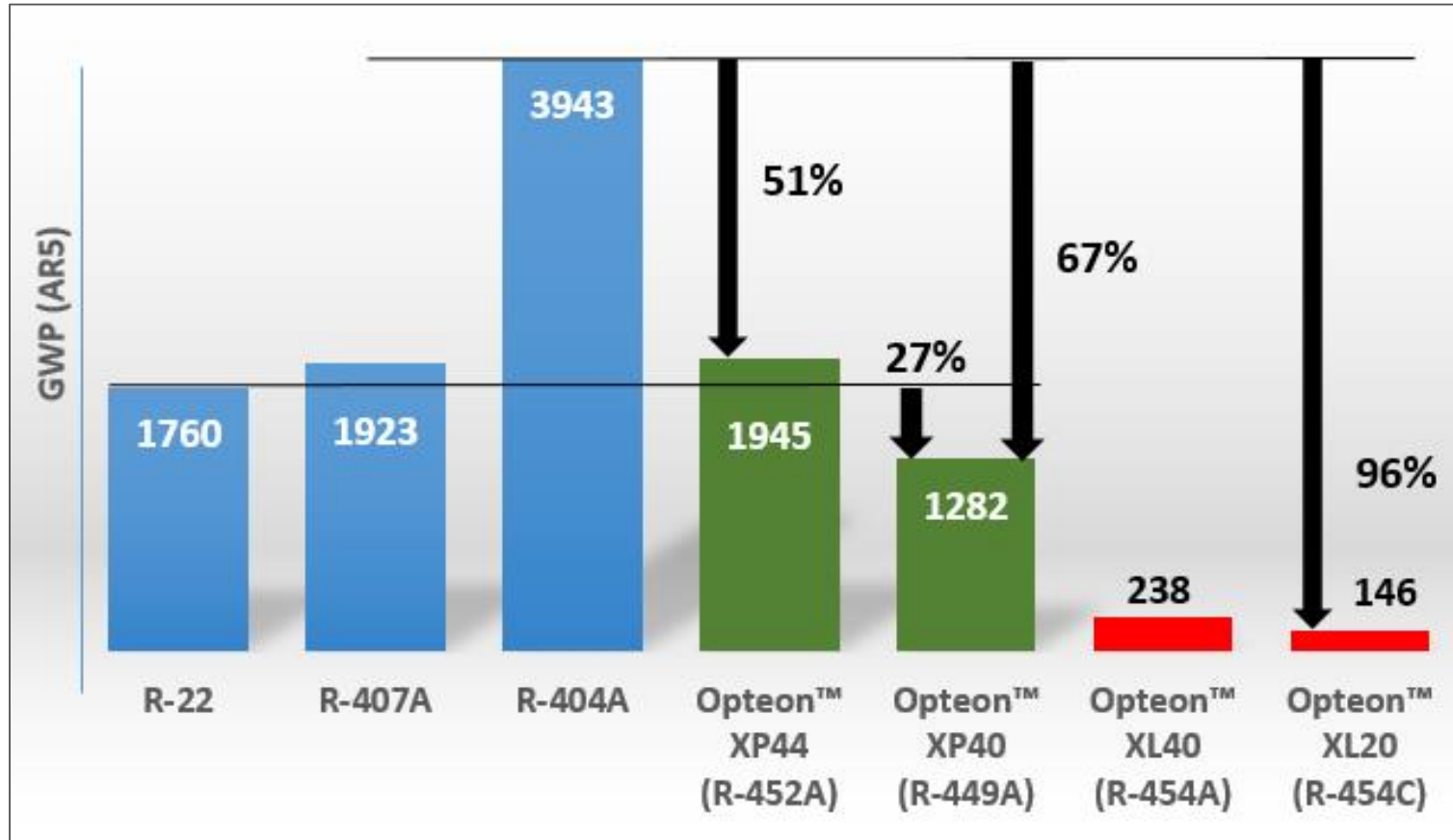
# Soft-Optimized Performance Test Results (continued)



- *Opteon™ XL41 and XL55 mass flow rates ~20% lower than R-410A*
- *Discharge temperatures only slightly higher than R-410A*
- *No discharge temperature management needed (required for R-32)*

# Very Low GWP Options to Replace R-22/R-404A in Refrigeration

R-22 / R-404A-like Refrigerants



- HCFC or HFCs
- Non-Flammable HFO Blends
- Mildly Flammable HFO Blends

# Performance of Opteon™ XL40 and XL20 in Refrigeration

## Low Temperature Refrigeration

	R-404A	XL40 (R-454A)	XL20 (R-454C)
GWP AR4 (AR5)	3922 (3943)	239 (238)	148 (146)
Capacity vs. R-404A	-	+8%	-11%
COP vs. R-404A	-	+6%	+6%
Evap Glide [K]	0.4	4.4	5.1
T Discharge [°C]	65.7	86.9	76.6
P Discharge [kPa]	1612	1625	1404

Thermodynamic cycle model results for Low Temperature Refrigeration:  
-32°C Avg Evap/ 35°C Avg Cond/ 5.6 K Subcool/ 5.6K Superheat, 70% Comp. Efficiency

## Medium Temperature Refrigeration

	R-404A	XL40 (R-454A)	XL20 (R-454C)
GWP AR4 (AR5)	3922 (3943)	239 (238)	148 (146)
Capacity vs. R-404A	-	+6%	-9%
COP vs. R-404A	-	+3%	+4%
Evap Glide [K]	0.8	4.8	6.0
T Discharge [°C]	53.8	66.4	61.1
P Discharge [kPa]	1612	1625	1404

Thermodynamic cycle model results for Medium Temperature Refrigeration:  
-6.7°C Avg Evap/ 35°C Avg Cond/ 5.6 K Subcool/ 5.6K Superheat, 70% Comp. Efficiency



# Field Case Study of Opteon™ XL40 (R-454A) Success in the UK!

## Background

- Chemours worked with Dawson Group for several years.
- Sampled Opteon™ XL20 and XL40 for testing in controlled conditions
- XL40 chosen as long term R-404A replacement due to performance improvement over R-404A.
- Implemented in a -18C cold store at Park Cakes using new equipment but existing design



# ***Thank you!***

*The information set forth herein is furnished free of charge and based on technical data that Chemours believes to be reliable. It is intended for use by persons having technical skill, at their own risk. Since conditions of use are outside our control, we make no warranties, expressed or implied and assume no liability in connection with any use of this information. Nothing herein is to be taken as a license to operate under, or a recommendation to infringe any patents or patent applications.*