Chiller Options and Energy Efficiency

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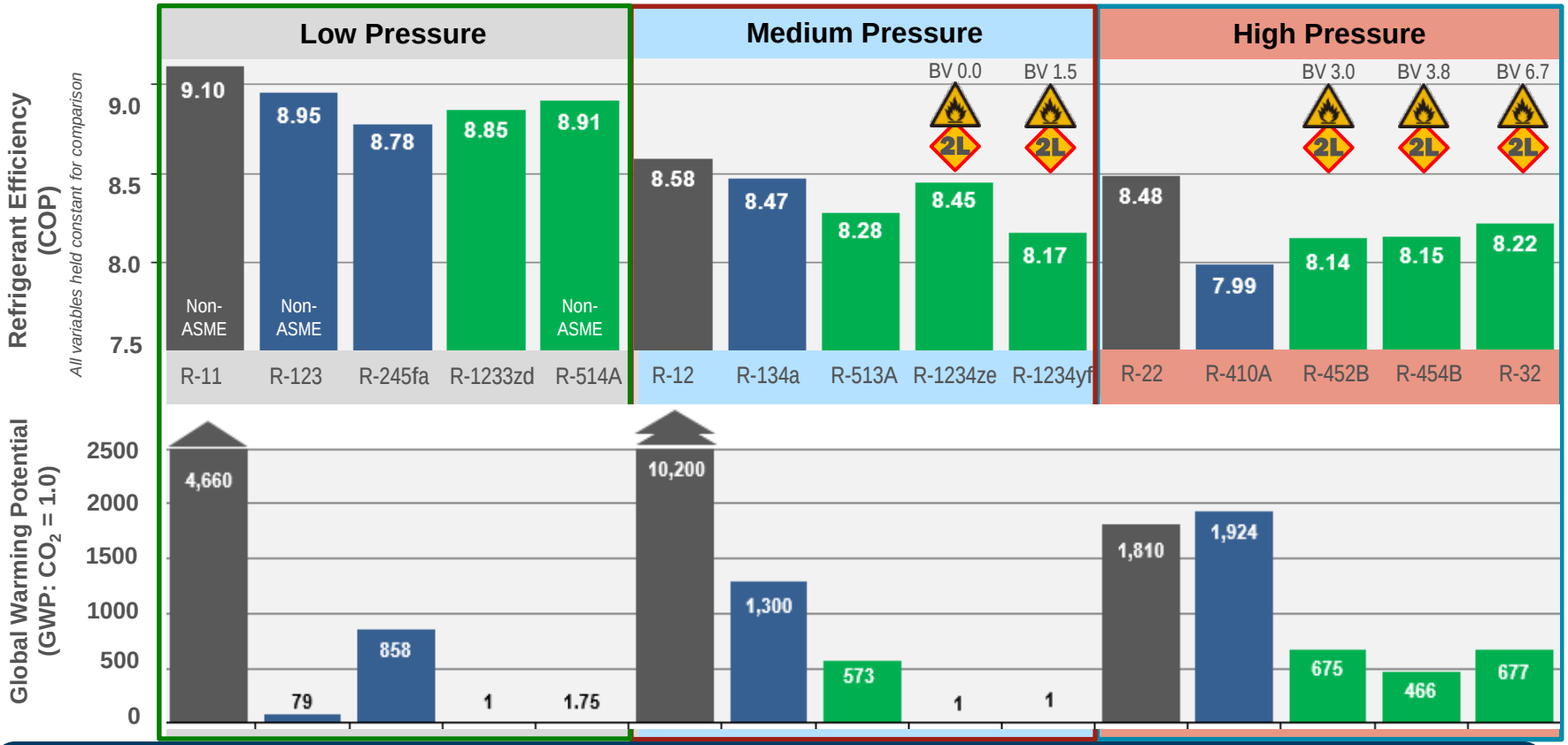
What Has Happened Since Kigali?

- Kigali was the market signal for significant investment in next generation solutions
- Solutions for chiller applications have been identified, and are available in many markets
- Opportunities exist to improve energy efficiencies in chiller applications
- Local government approval of next generation refrigerants is critical for wide success

The Industry Is Moving……..Fast

Next Generation Refrigerant Comparative

Past | Transitional | Future



Industry choices offer options & trade-offs; New options being investigated

Opportunities for Improving Energy Efficiency

- Chiller industry moving to more efficient, low pressure solutions
- Could improve large tonnage chillers as much as 10%
- Medium tonnage chillers move to equivalent efficiency HFOs

Refrigerant Choices & Comparison

Screw & Centrifugal Technology Options

	Low Pressure			Medium Pressure			
	R-123	**R-1233zd**	**R-514A**	**R-134a**	**R-513A**	**R-1234yf**	**R-1234ze**
Flammability	Non **(1)**	Non **(1)**	Non **(1)**	Non **(1)**	Non **(1)**	Slight **(2L)**	Slight **(2L)**
Toxicity	Higher **(B)**	Lower **(A)**	Higher **(B)**	Lower **(A)**	Lower **(A)**	Lower **(A)**	Lower **(A)**
Fluid Efficiency	8.95 COP	8.85 COP	8.91 COP	8.47 COP	8.28 COP	8.17 COP	8.45 COP
Capacity Change	1	~35% Gain	~5% Loss	1	Similar	~5% Loss	~25% Loss
GWP	79	1	2	1300	573	1	1

Chiller efficiency impacted by refrigerant choice – growing customer options

What is Available in Your Country?

- New refrigerant approval is critical for success
- Each country has their own approval process
- Some approval processes are very old- we have not had to approve new refrigerants in a long time
- Make sure your approval process is fair, timely, and helpful
- Consistent approval around the world leads to better, safer, and more cost effective solutions