

A photograph of an industrial facility, likely a water treatment plant, featuring large green pipes, white machinery, and a blue and white overhead crane. The scene is brightly lit with overhead industrial lights.

Refrigerant, eh?

Viet Le, LEED AP BD+C | Jacobs Engineering Group Inc.

June 13th, 2018

JACOBS[®]

Why? **What's in it for me?**

“

Change is the only constant.

Heraclitus

”



A grayscale photograph of a large industrial robotic arm in a factory setting. The arm is white with black joints and is positioned vertically. In the background, there are various industrial structures, including pipes, beams, and other machinery. The lighting is bright, and the overall scene is industrial and modern.

1. A brief history

2. Where are we headed?

3. Decision



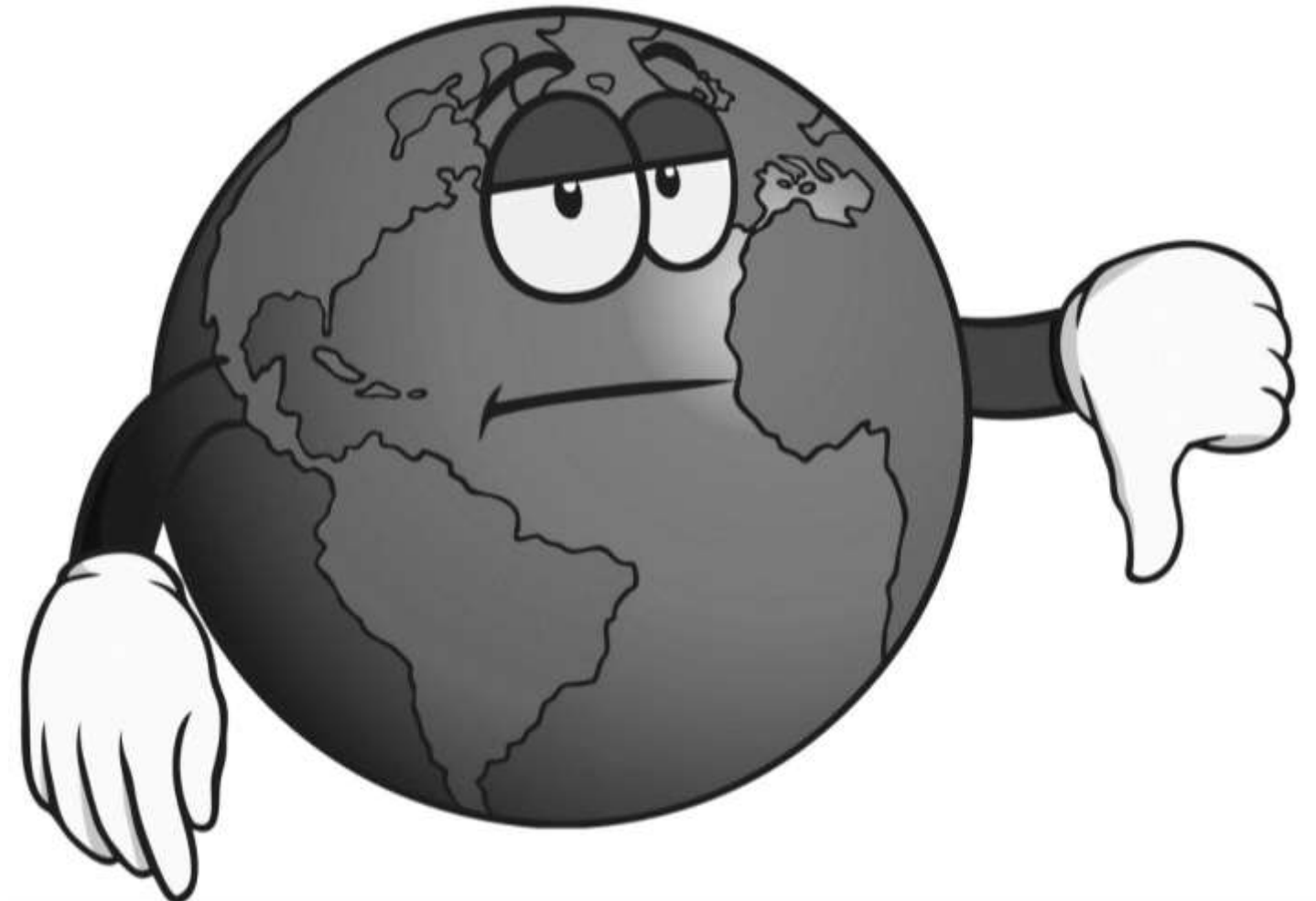
A BRIEF HISTORY

Past CFCs: R-11 & R-12

Human Friendly?



Earth Friendly?



Ozone Depletion Potential

R-11

1
ODP

HCFCs

R-22, R-123

0.02
ODP

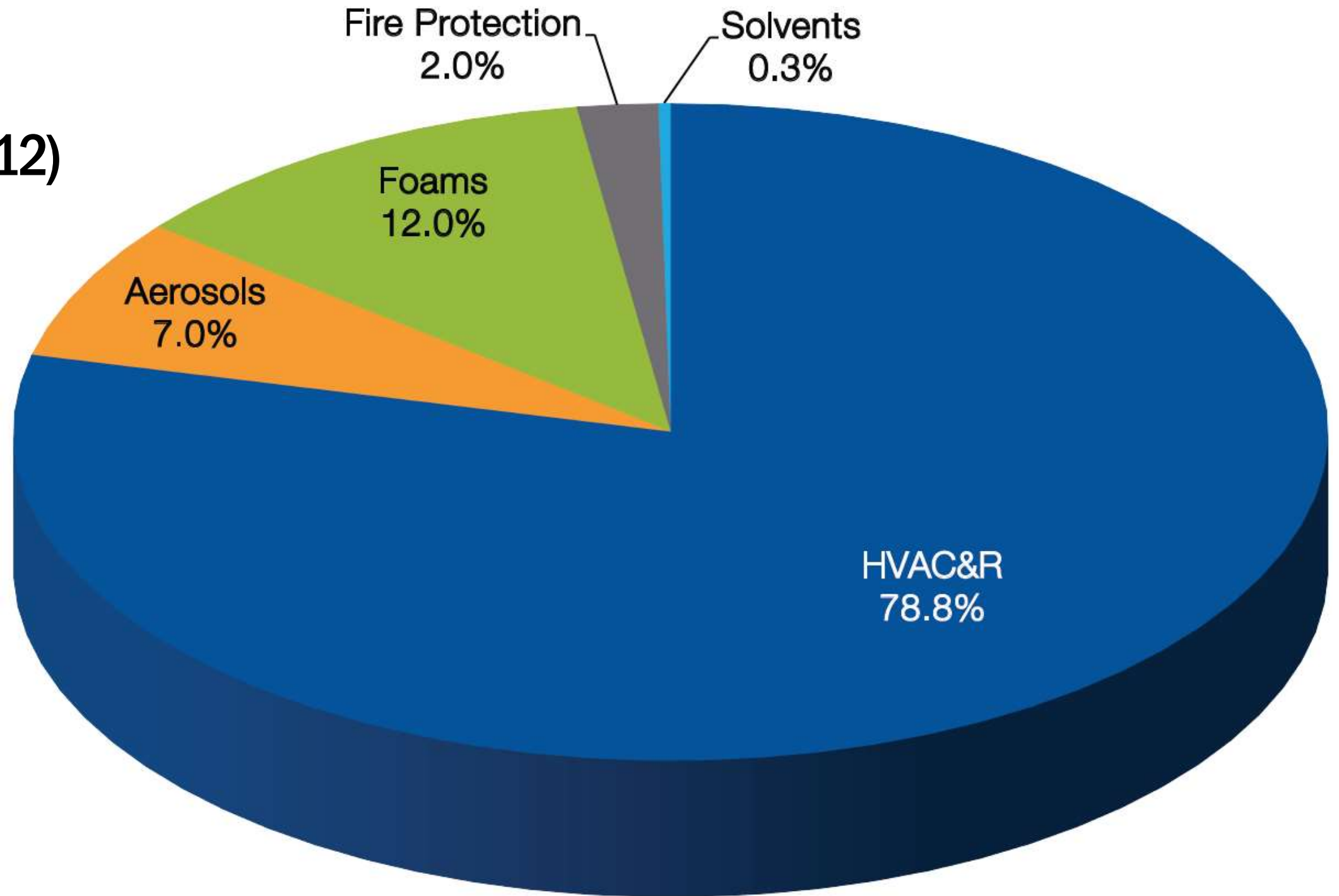
HFCs

R-134a, R-410a

0
ODP

Market Shares of HFCs

(% of Metric Tonnes, 2012)



Global Warming Potential

CO₂

1

GWP

R-134a

1324

GWP



**“GLOBAL
WARMING ISN'T
REAL BECAUSE I
WAS COLD
TODAY! ALSO
GREAT NEWS:
WORLD
HUNGER IS
OVER BECAUSE
I JUST ATE.”**

.....
- STEPHEN COLBERT





A Global Outlook

EU F-gas regulations



R-134a phase-down on cars



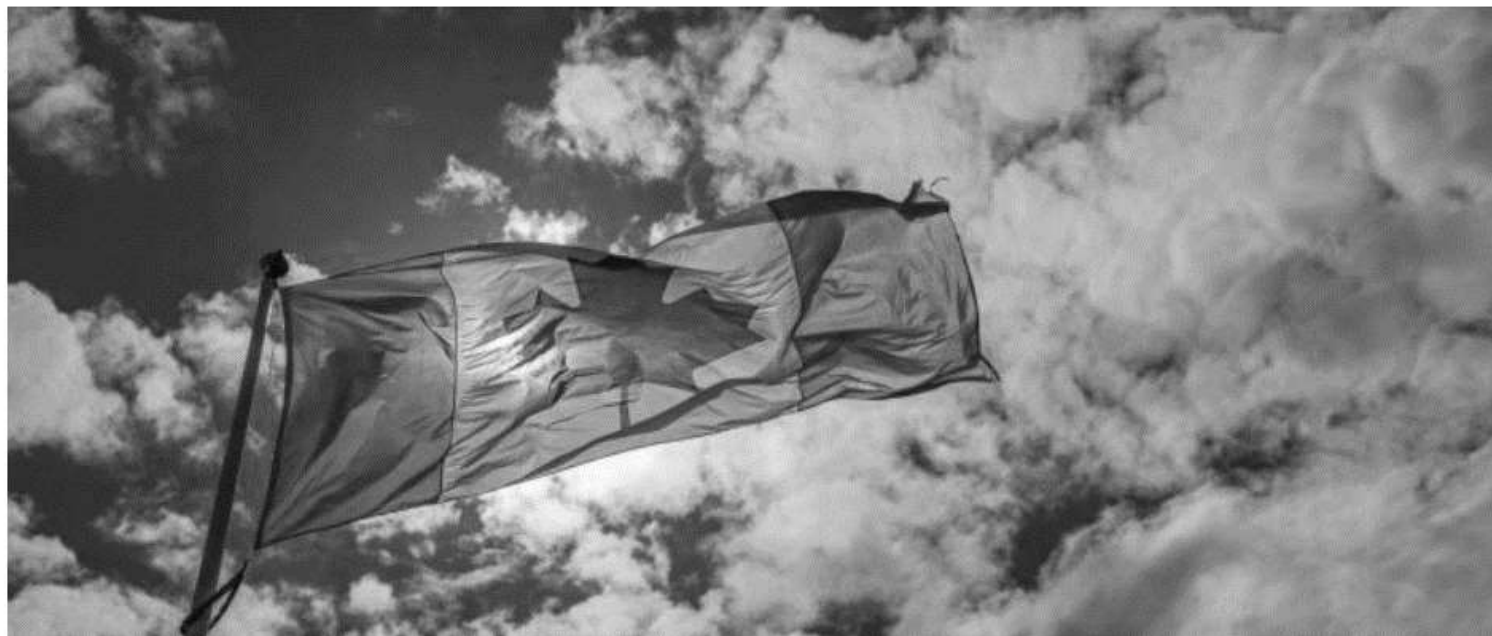
Canada puts HFC phase-down plan in force

AMERICA

POLICY

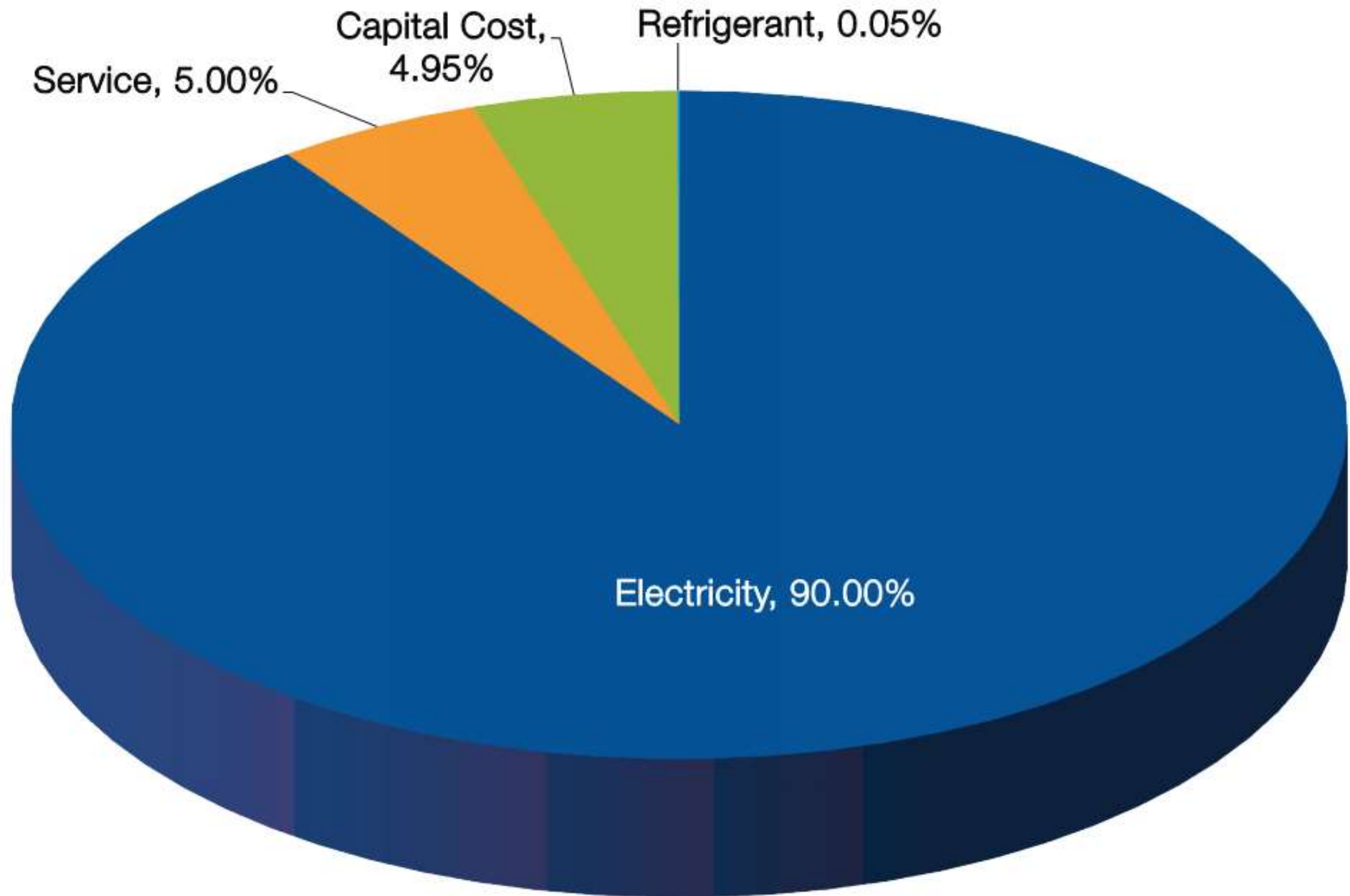
By [Charlotte McLaughlin](#), May 07, 2018, 08:39 GMT-5 • 2 minute read

In line with Kigali, HFC imports will be reduced, and caps will be placed on GWPs in specific end uses.

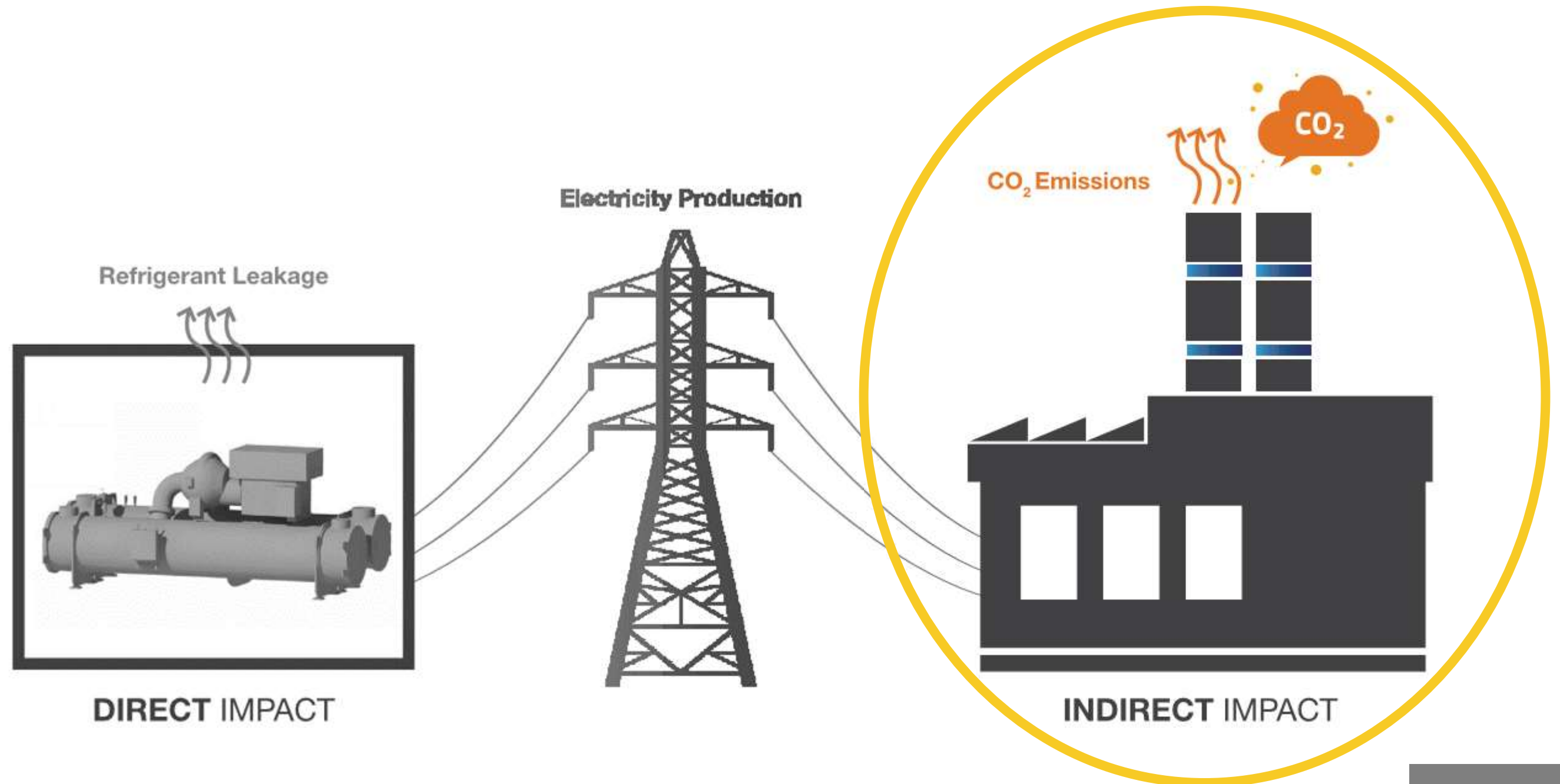


Product	GWP of refrigerant in product	Date
Stand-alone medium-temperature refrigeration system	1,400	Jan. 1, 2020
Stand-alone low-temperature refrigeration system	1,500	Jan. 1, 2020
Centralized refrigeration system	2,200	Jan. 1, 2020
Condensing unit	2,200	Jan. 1, 2020
Chillers	750	Jan. 1, 2025
Mobile refrigeration system	2,200	Jan. 1, 2025
Motor vehicle air-conditioning (MVAC)	150	Jan. 1, 2021 model year of vehicles
Domestic refrigeration	150	Jan. 1, 2025

Chiller Total Cost of Ownership



Total Equivalent Warming Impact

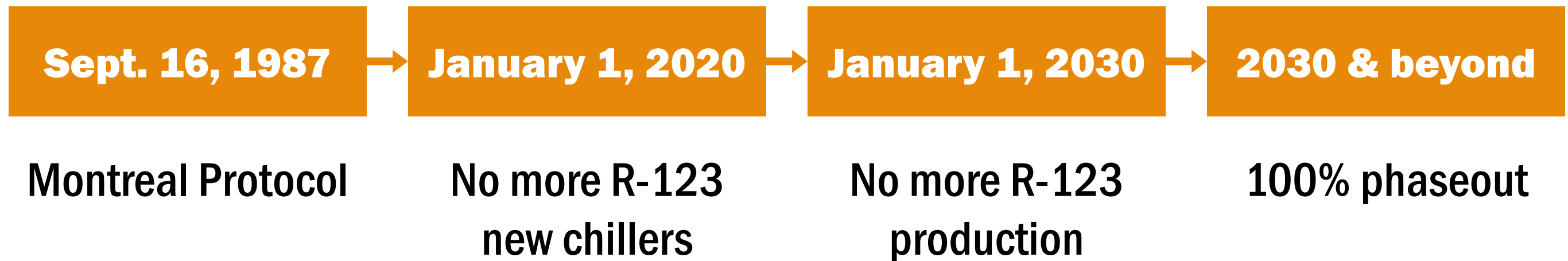




**WHERE ARE WE
HEADED?**

R-123 Timeline

Fact: R-123 is being phased out



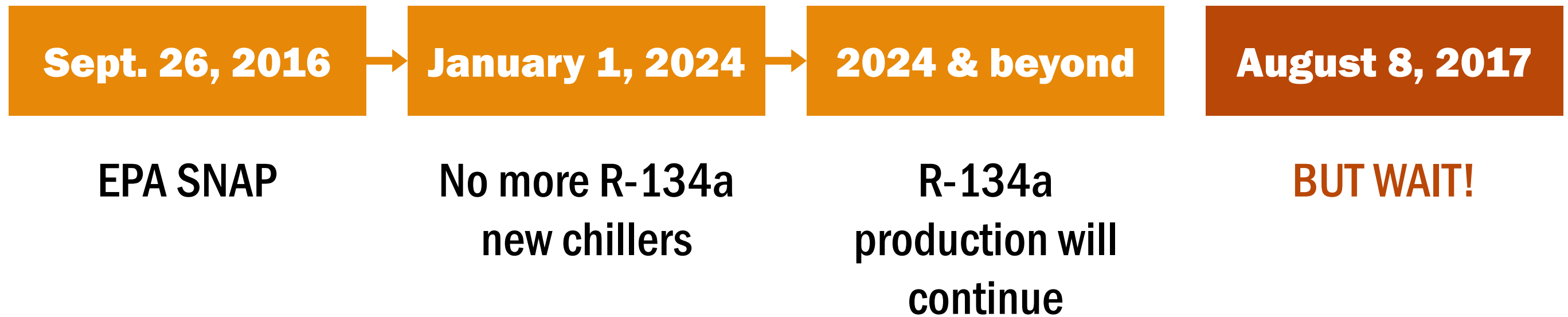
R-123

	R-123
ODP	0.02
GWP	76
COP	8.95
Atm. Lifetime	1.3 years

R-134a

	R-123	R-134a
ODP	0.02	0
GWP	76	1324
COP	8.95	8.47
Atm. Lifetime	1.3 years	14 years

R-134a Timeline





Mexichem.

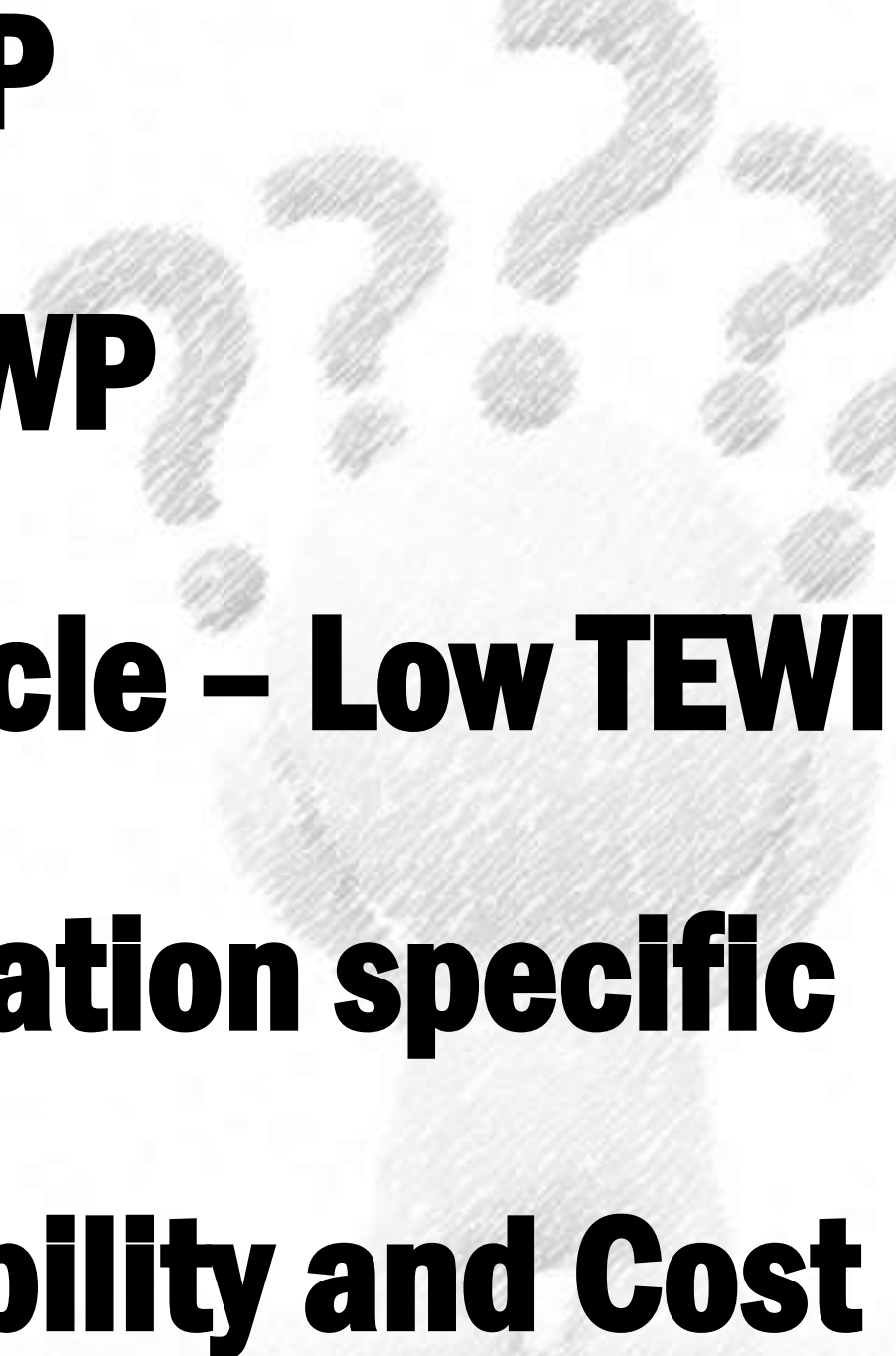
ARKEMA
INNOVATIVE CHEMISTRY



SNAP
SIGNIFICANT • NEW • ALTERNATIVES • POLICY

R-134a Timeline



- 
- 1. No ODP**
 - 2. Low GWP**
 - 3. Life cycle – Low TEWI**
 - 4. Application specific**
 - 5. Availability and Cost**

The Future HFOs

Efficiency ↓ 2%

Chiller Cost ↑ 3%

The Future HFOs

HFC Replacement	Current	HFO Alternatives		
	R-134a	R-513a	R-1234yf	R-1234ze
ODP	0	0	0	0
GWP	1324	513	1	1
COP	8.47	8.28	8.17	8.45
Flammability	None (1)	None (1)	Slight (2L)	Slight (2L)
Atmospheric Lifetime	14 years	5.9 years	11 days	18 days



Another Alternative... **WATER**





**DECISIONS,
DECISIONS...**

R-123

HFOs

R-134a

Water



Questions?

**Think long term.
Think TEWI.**

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