

ET Summit 2022

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Low GWP Refrigerants in Commercial Air Conditioning & Refrigeration

Examples of Projects

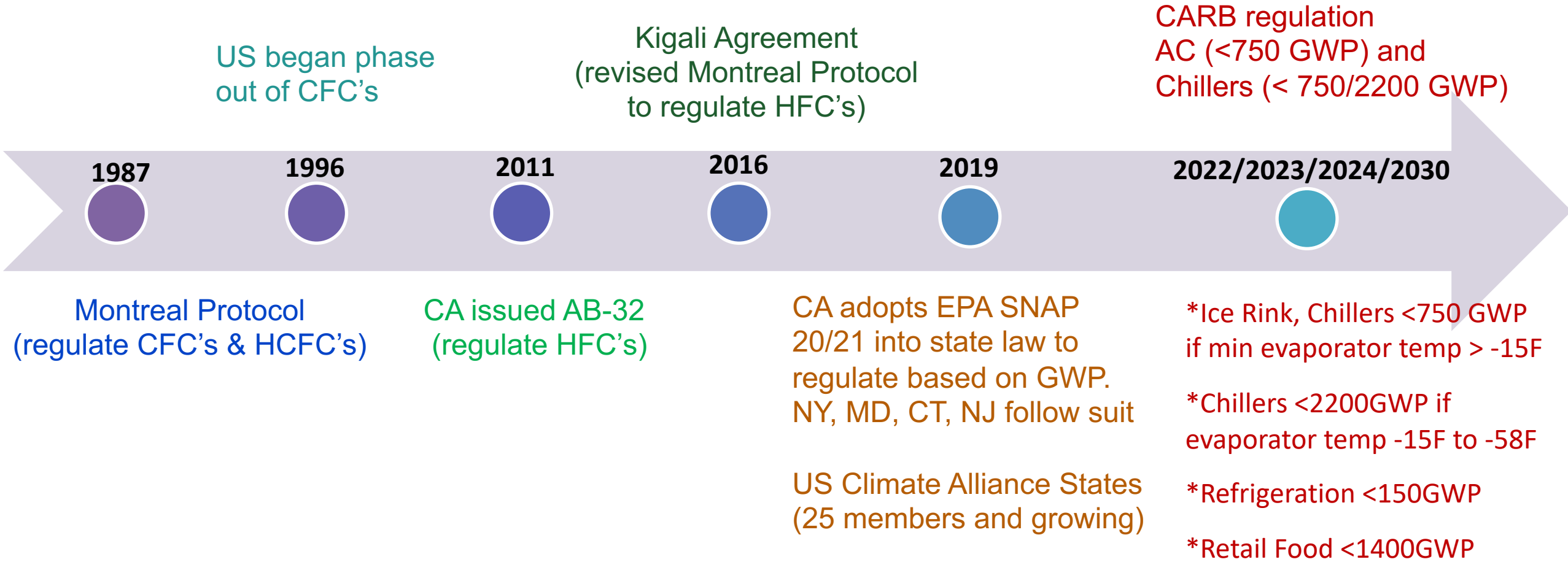


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Refrigerants Regulation in the Making Globally & Locally



Legislation driving *efficient* technology advancements with lower GWP refrigerants

How Does Refrigerant Regulation Affect End Users?

- Commercial/Industrial Chillers and Heat Pumps
- Residential AC and Heat Pumps

Refrigerants	GWP	
R-12 (CFC-12)	10900	
R-507A (Large Refrigeration)	3985	
R-410a (Homes)	2100	
R-22 (Freon)	1810	
R-134a (Auto)	1430	
R-32 (HVAC)	675	
Low GWP Blends (HFOs)	<10	
Natural Refrigerants	R-290 (propane)	4
	R-744 (CO2)	1
	R-707 (ammonia)	0

AHRI Safe Refrigerant Transition Task Force preparing HVACR industry transition

Many Emerging Alternatives to HFCs

Natural Refrigerants – Examples of Projects



NH3 Chiller/ Pumped CO2

Air Cooled



Ultra-low charge NH3 Chiller

Air Cooled



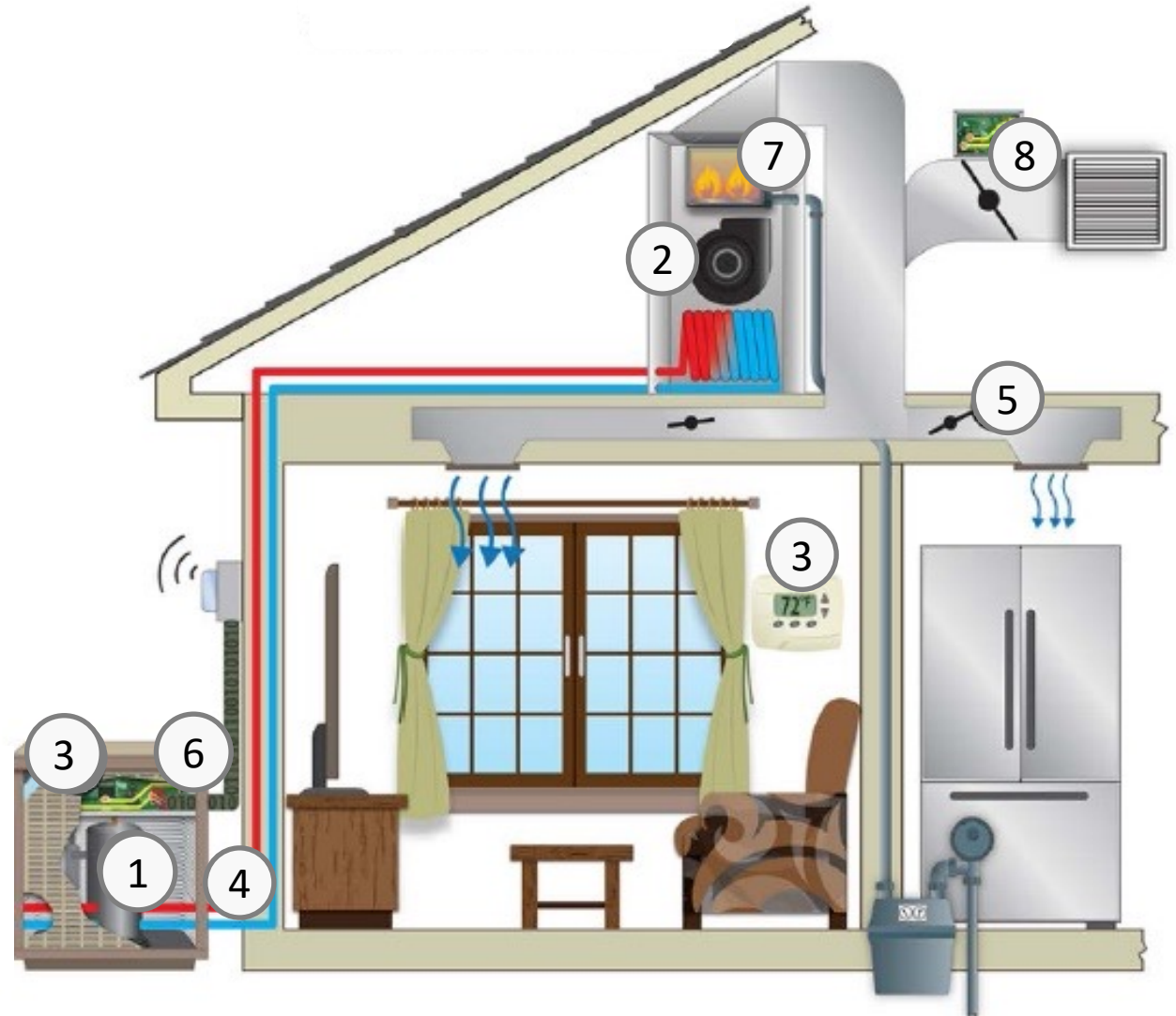
VRF Using R-32 Refrigerant

Very low GWP and air cooled systems offer GHG and water savings

CEC EPIC Project - Next-Generation Variable Capacity Heat Pump System

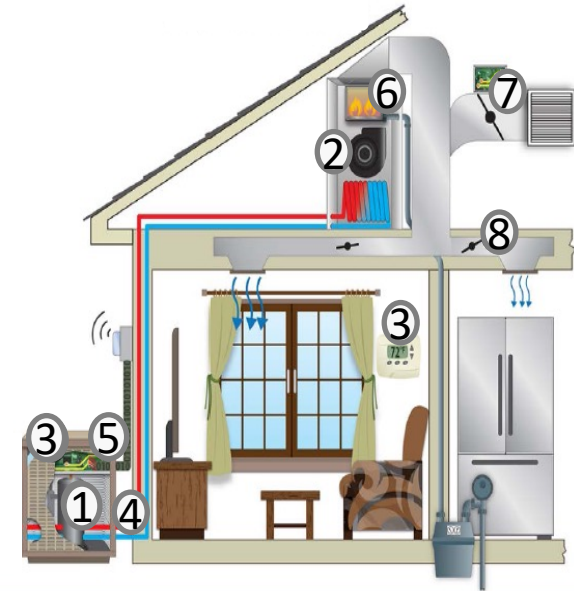
multiple energy efficiency features integrated into single residential system

1. Variable Capacity Compressor
2. Variable Speed Indoor Blower
3. Auto Demand Response
4. **Alternative Refrigerant (R-32)**
5. Zonal Control
6. Fault Detection & Diagnostics
7. Dual Fuel (Intelligent Heating)
8. Integrated Ventilation Control



Next-Gen Variable Capacity Heat Pump - Summary Results

- **Variable Capacity Compressor and Variable Speed Indoor Blower**
 - Next-Gen RSCS provides 22-32% cooling energy savings and over 90% of annual heating load without backup for CA.
- **Auto Demand Response (DR)**
 - Variable capacity heat pump maintains customer comfort during DR event.
- **Alternative Refrigerant**
 - **R-32 improves cooling efficiency by 2-3% and peak demand reduction by 7-8% compared to R-410A across CA climate zones.**
- **Zonal Control**
 - Zoning should be required for variable capacity heat pumps *with ducts in unconditioned space*.
- **Fault Detection and Diagnostics (FDD)**
 - FDD improves performance with potential, up to 55% efficiency savings (literature).
- **Integrated Ventilation**
 - Additional 1-4% cooling energy savings and 1% for heating using VCHP with heat recovery ventilator (HRV).
- **Dual Fuel (Intelligent Heating)**
 - Dual fuel functionality adds system versatility for future intelligent heating capability.



1. Variable Capacity Compressor
2. Variable Speed Indoor Blower
3. Auto Demand Response
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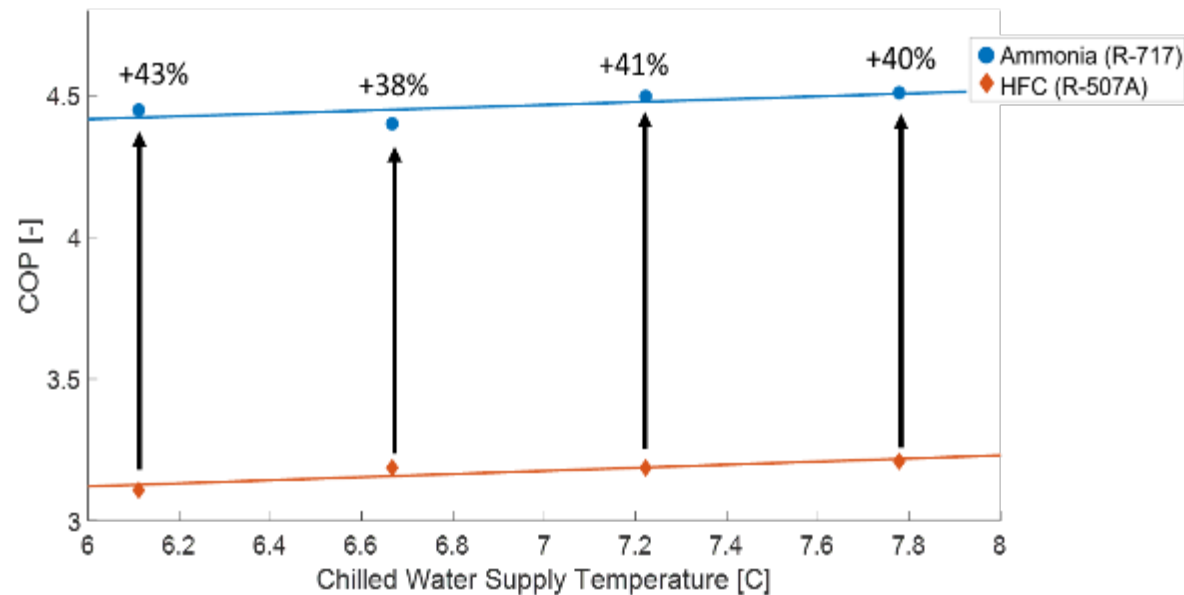
Ultra-Low Charge Ammonia Chiller Project

- Demonstration site is Takara Sake USA Inc. at Berkeley, CA
- Pilot test of AURA (R-717) chiller by Mayekawa
 - Ultra low charge (1.5 lb/RT) and air cooled
 - Packaged system for easy on-site installation
 - Rated at 50 RT (175 kW)
- A water-cooled R-507A chiller on site is used as a baseline HFC system
 - Rated at 82.5 RT (290 kW)



Chiller Project Results – Energy Consumption

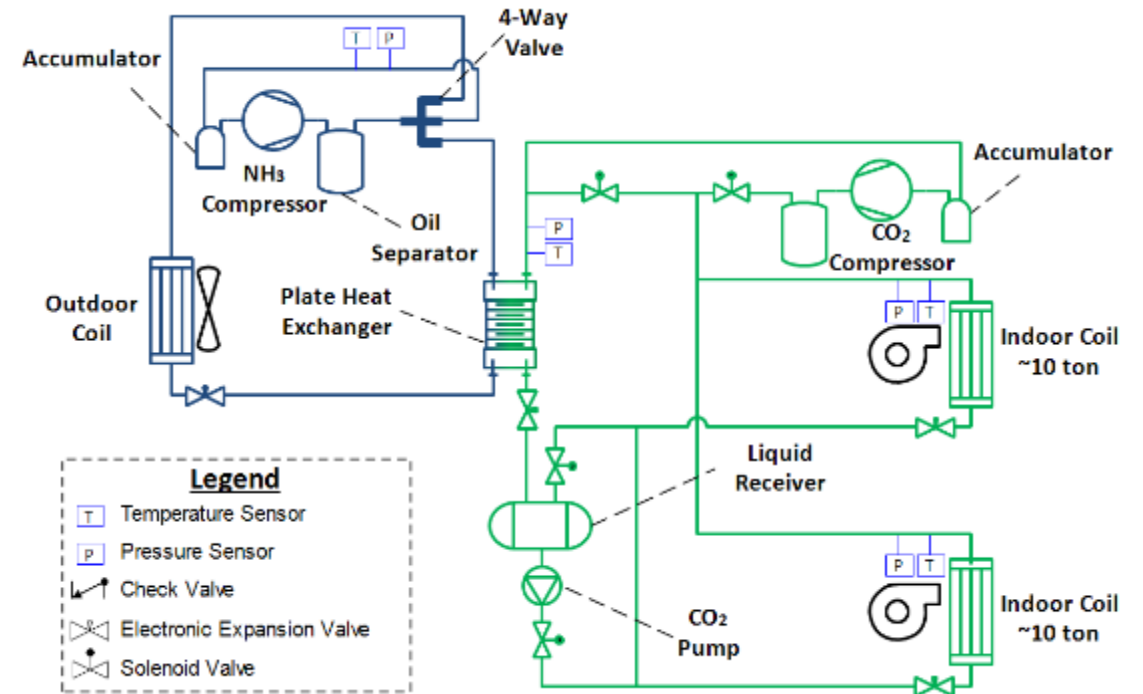
- Evaluate chiller performance under specific operating conditions
 - Chiller efficiency at 70% - 80% capacity
 - Ambient temperature at 65°F – 70°F (18°C – 21°C)
 - Chilled water supply temperature 65°F – 70°F (6.1°C – 7.8°C)



R-717 chiller shows ~40% higher efficiency at noted operating conditions
Same could apply to commercial buildings

New CEC Project - An NH₃ / CO₂ Heat Pump System

- Goal
 - Demonstrate the performance and cost effectiveness of a novel NH₃ / CO₂ reversible heat pump for small commercial and multi-family applications
- Objectives
 - Design, optimize and evaluate a prototype of the heat pump in the lab
 - Deploy production units in **3** distinct California climate zones
 - Conduct measurement and verification of the field units for at least **9** months of operation



1. Low GWP refrigerants can be more efficient than current ones
2. Some are mildly flammable – issue needs to be resolved
3. Good future for low GWP refrigerants



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