The Helix Innovation Center, providing infrastructure to enable natural refrigerants adoption

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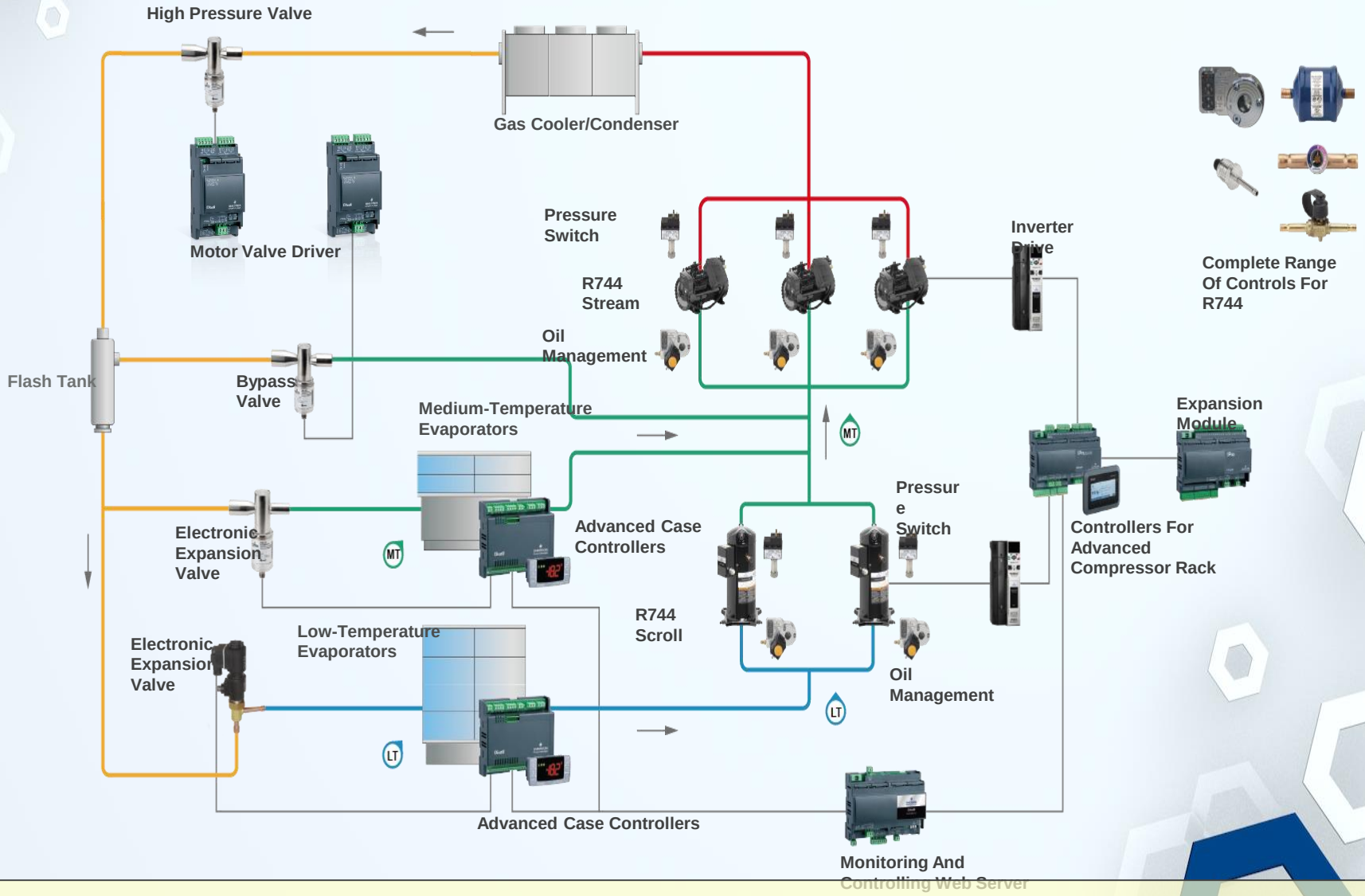
EMERSON

Solutions For Refrigeration With CO_2 (R744)



300+ Sites With Emerson Solutions Globally

Refrigeration Industry Is Going Through Major Transitions

Refrigerants

- Natural – CO2, Propane, NH3
- Low GWP Alternatives
- Self Contained Systems
- Secondary Fluid Systems
- Leak Detection

Emerging markets

- Scroll, Screw Transitions
- HCFC Transition
- Multiple Compressor Racks
- Expanding Large Refrigeration
- Transport Refrigeration

Robust Food Safety

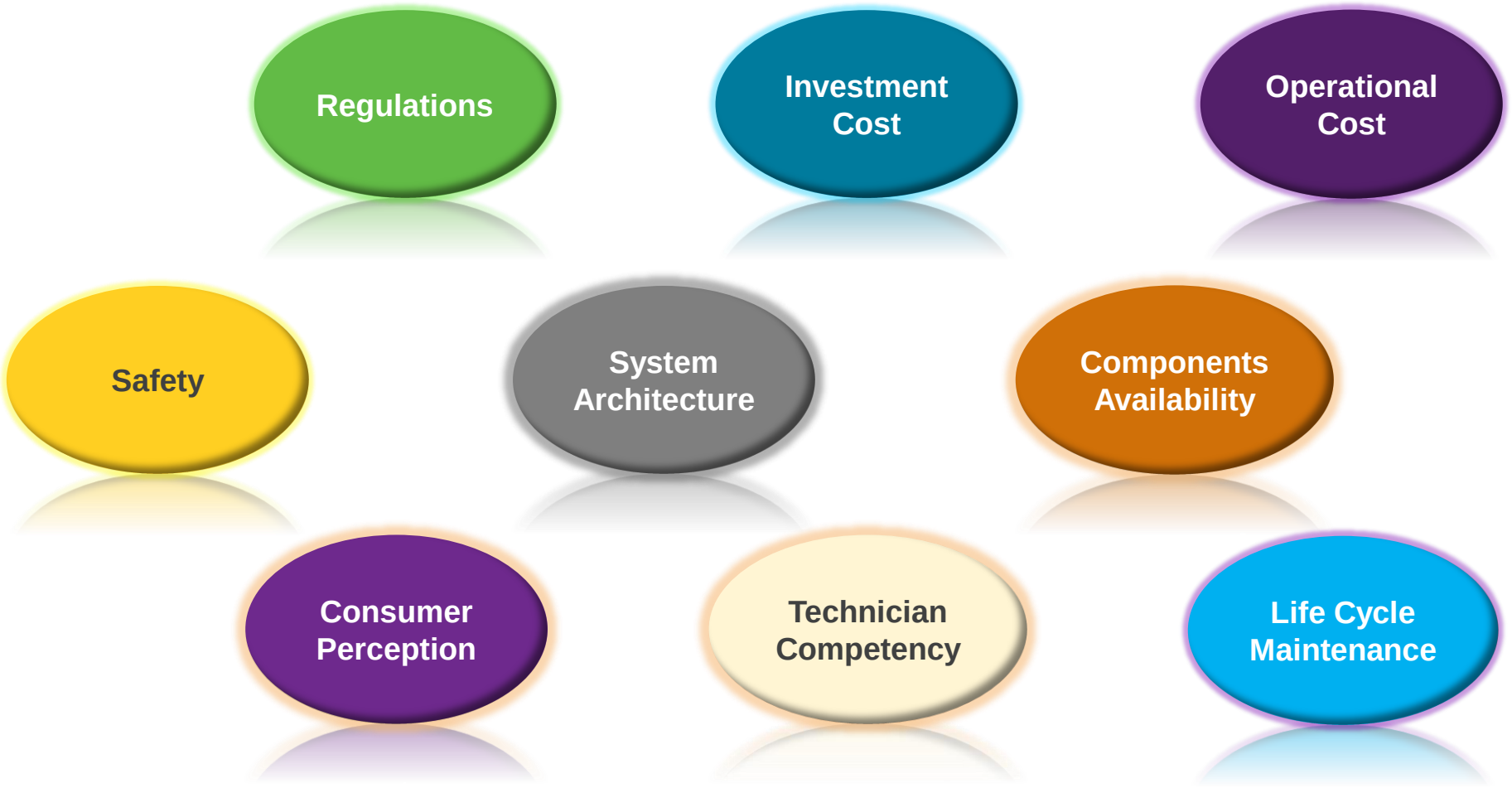
- Predictive Diagnostics
- Supervisory System
- Wireless
- Big Data
- Food Safety Transparency

Efficiency

- Modulation, EC Fan
- Parallel Compression
- Ejector System
- Scheduling & Floating Suction
- Glass Door

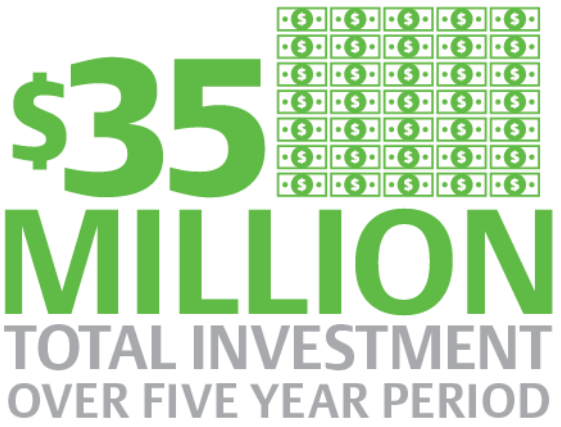
Lot Of Changes Are Happening

Just In Refrigerants There Are Multiple Factors Influencing The Choice



Can We Provide A Infrastructure To Better Support These Transitions?

The Helix Overview



Designed for Collaboration and Teaming

To foster an environment for academia & industry Stakeholders collaboration. Is dedicated to advancing research and education in heating, ventilation, air conditioning, and refrigeration technologies





Facility Grand Opening	April 2016
Organization In Place	✓
Facilities Up & Running	✓
Natural Refrigerant Events	Over 20

EMERSON

Residential Connected Home

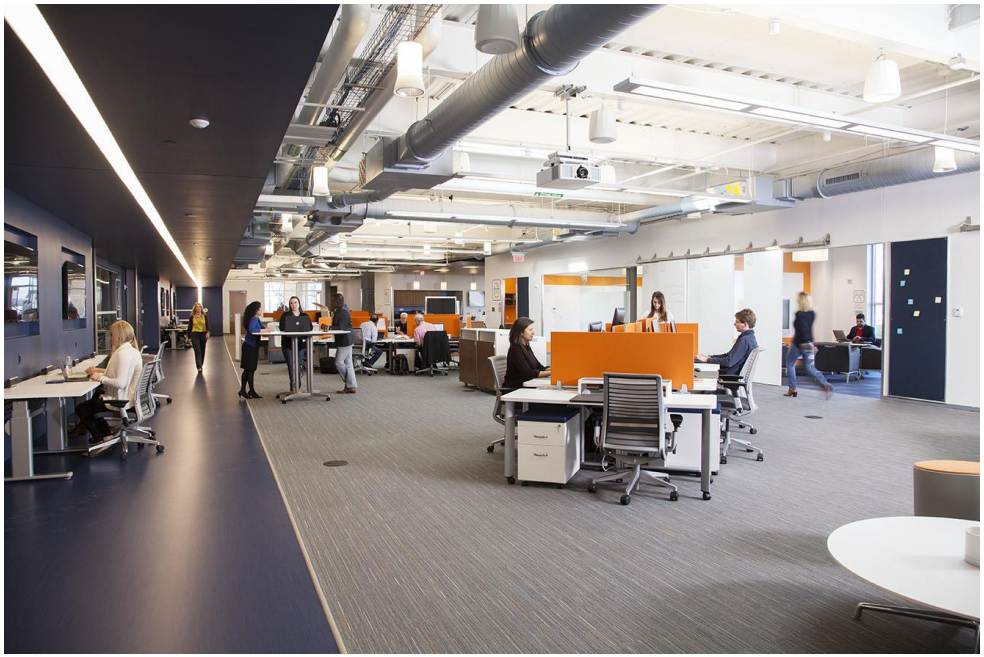
Module 1

Features

- 2,00 sq. m. home
- Fully operational kitchen & bathrooms
- Two complete air conditioning systems
- Environmentally controlled chamber

Temperature: -32 *to* 52 °C
Humidity: 20 *to* 90%

Light Commercial Building



Features

- 3,100 sq. m. commercial building
- Low flow fixtures enable reduction in water usage
- Energy monitoring
- Reflective roofing materials which negate surrounding temperature impact
- 211 tons of construction waste diverted from landfills
- Environmentally controlled chamber

  Temperature: -30°C to 50°C

  Humidity: 20 to 90%

Food Service Operations

Module 3

Features

- 140 sq. m., fully functional, high-density kitchen
- Capacity to serve 150 meals
- Independent temperature and humidity control
- Remote condensing equipment can be located in environment chamber
- Environmentally controlled chamber
  Temperature: -30 to 52 °C
  Humidity: 20 *to* 90%

Supermarket Refrigeration

Features

- CO_2 Transcritical refrigeration system
- 230 sq.m. Supermarket / C-store
- Independent humidity and temperature control
- Remote Gas Cooler located in environment chamber
- Environmentally controlled chamber

  Temperature: -30 to 52 °C
  Humidity: 20 *to* 90%
- Full System Integration; Refrigeration & HVAC

Training

R-744 & R-717 Training

- End Users, Contractors, Colleges, Consultants, Wholesalers, Utilities, Energy Managers, Internal Staff
- Types: (R744, R717, R290)
  - In Class Theory
  - Hands On

Helix Collaboration Methodology, 9 Steps

Problem Discovery

1. Objective:

   CONVERGE ON A CHALLENGE OR CHALLENGES

2. Participants

   GOVT. POLICY MAKERS

   ACADEMIA

   END USERS

   CONSULTANTS

   INSTALLATION & SERVICE PERSONAL

3. Type Of Collaboration

   ON SITE, DAYTON OHIO

Ideas Convergence

4. Understand

   ECO SYSTEM, OPPURTUNITY, JOBS, OUTCOMES, CONSTRAINTS

5. Participants

   FORM A CORE TEAM BASED ON STEP 3 & 4

6. Type Of Collaboration

   JOINT REVIEWS & FEEDBACK

Realization

7. Create & Partner

   PARTNER WITH A PROVEN IDEA

8. Participants

   GOVT. POLICY MAKERS

   ACADEMIA

   END USERS

   CONSULTANTS

   INSTALLATION & SERVICE PERSONAL

9. Type Of Collaboration

   ON SITE, AUSTRALIA

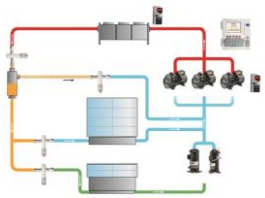
CO2 Project In Plan; Advances in Basic Booster Architectures

Scope of Project: To Understand the Net Benefit of Each Individual Strategy With a Repeatable Set of Conditions

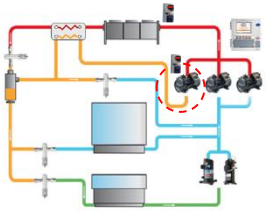
Phase 1

Testing Period
June 2017 through September 2017

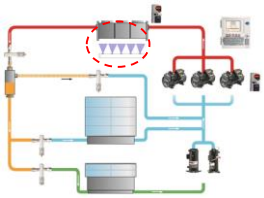
1. Basic Entry Level



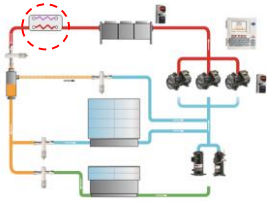
2. Parallel Compression



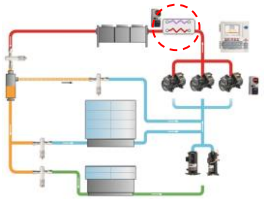
3. Adiabatic Gas Cooler



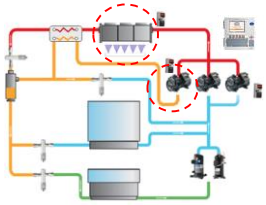
4. Mechanical Sub Cooling



5. Heat Reclaim



6. Adiabatic Gas Cooler & Parallel



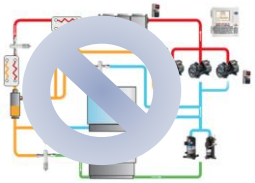
Weather Normalize Energy Data will be Collected at the Following Ambient Temperatures:
-30°C (Min 10°C SCT), 10°C, 15°C, 20°C, 25°C, 30°C, 35°C, 40°C, 46°C

Advances in Basic Booster Architectures

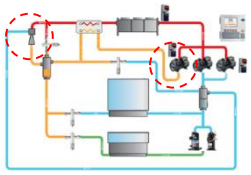
Scope of Project: To Understand the Net Benefit of Each Individual Strategy With a Repeatable Set of Conditions

Phase 2

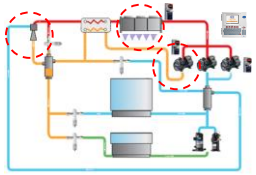
7 Total Condensing with Parallel



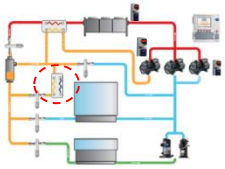
8 Vapor Ejectors & Parallel



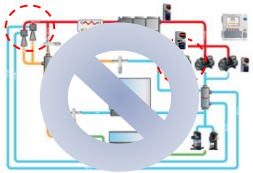
9 Vapor Ejectors, Parallel & Adiabatic



10 A/C & Parallel Compression



11 Vapor, Liquid Ejectors & Parallel,



12 Integrated System

Test # 11 & 12 may not be required

1. Will Help Industry To Have One More Data Point On A Controlled Store Environment
2. Runs At Real Store Environment with Back To Back Test For Higher Confidence On Results
3. Will Help To Clearly Identify Change on Each System Strategy

Opportunity To collaborate