

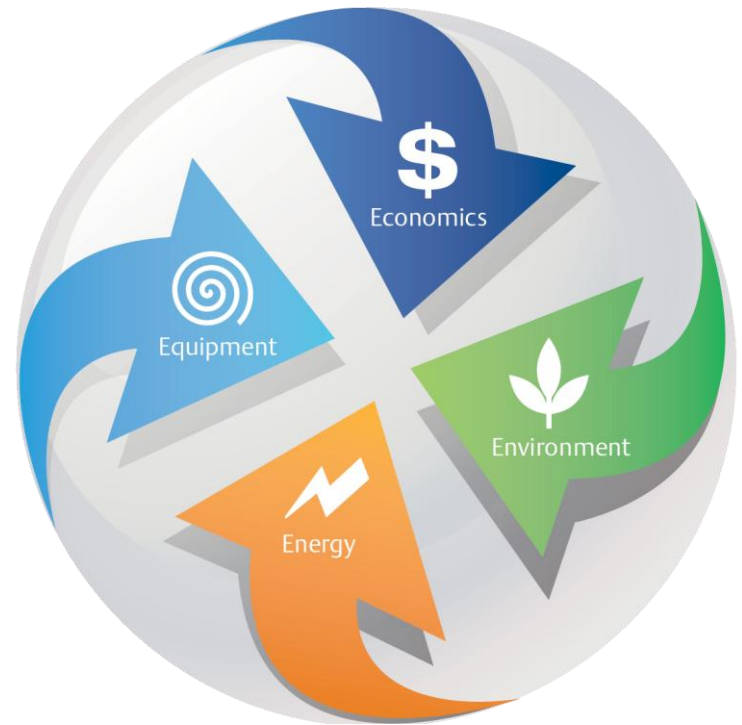


Innovation in Refrigeration

Dr. Rajan Rajendran
Emerson Climate Technologies

Agenda

- Why do we need to do things differently? What has changed?
- The new approach to innovation in refrigeration and the new Helix Innovation Center
- Questions



Refrigeration Industry Economics Remain Staggering

\$990BILLION



ANNUAL GLOBAL
FOOD LOSS/WASTE

\$32BILLION



ANNUAL ENERGY SPEND
IN GLOBAL MARKETS

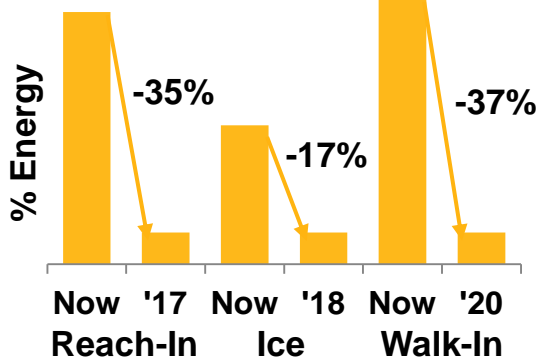
\$18.2BILLION



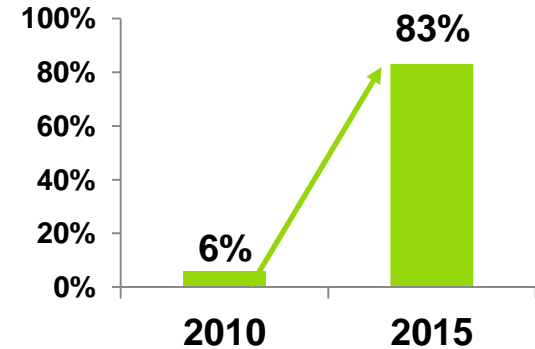
ANNUAL FACILITY
MAINTENANCE COST

We're Now Trying to Balance Four Variables

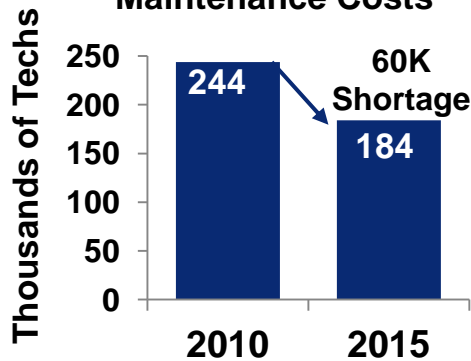
DOE Regulations Require New System Designs



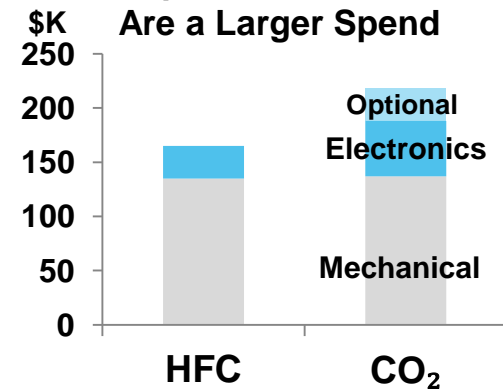
% of Top 50 Retailers Testing Refrigerant Alternatives



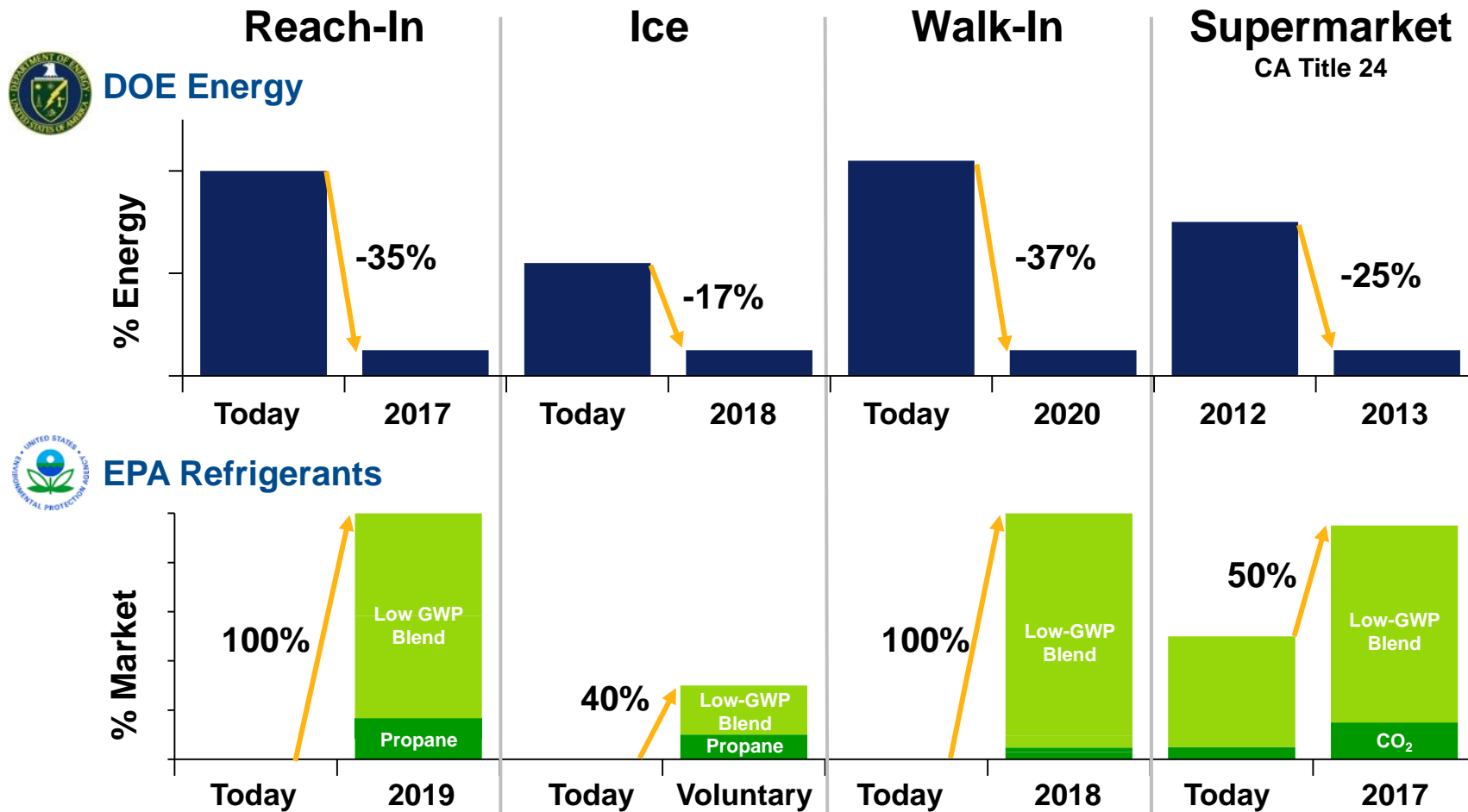
Dwindling Workforce Impacting Maintenance Costs



Component Electronics Are a Larger Spend



Where We Are: Regulations & Refrigerants



Redesigns Are Widespread.
Results Require System-Wide Optimization.

Electronics and Data Analytics Growing in the Cold Chain

Remote Monitoring



Global Ops Center



IT Systems



User Dashboards

Supervisory Controls



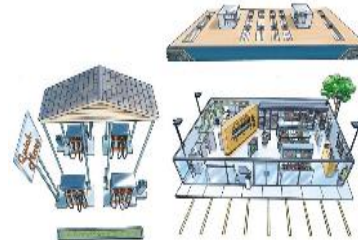
- Building Management
- Refrigeration
- HVAC
- Lighting

Customer Sites

Supermarkets



Convenience Stores



Restaurants



Assets and Systems



Cases and Coolers



Refrigeration Racks



A/C Equipment



Kitchen Equipment

International, National and Regional Regulations and Changes on the Horizon



PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

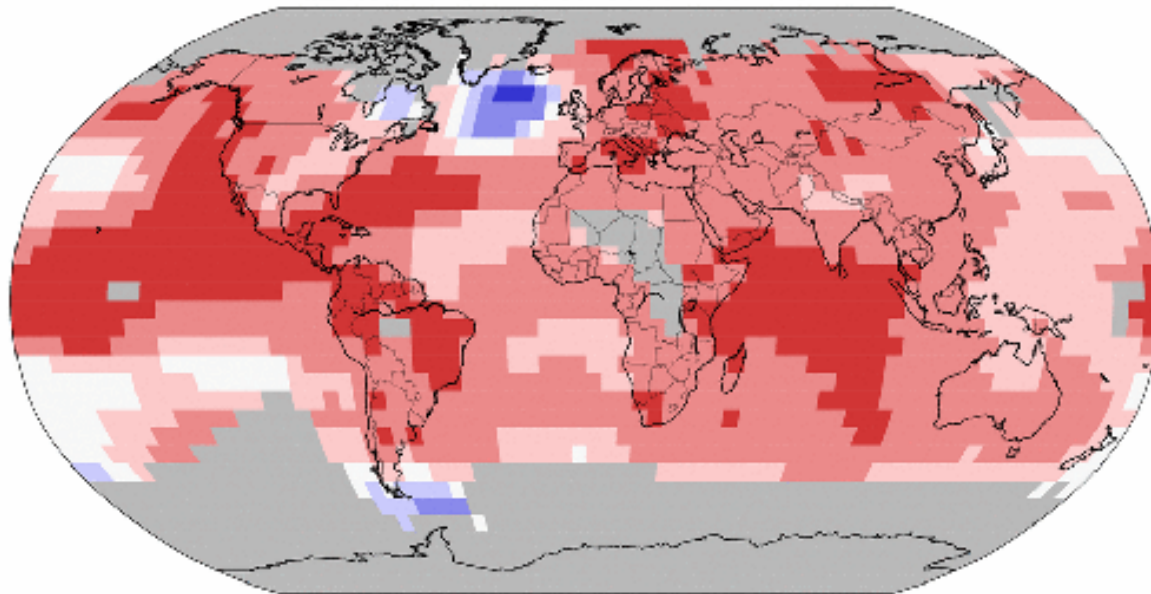


2015 Was Warmest Year Since 1880 – USA Today Article, 1/20/16

Land & Ocean Temperature Percentiles Jan–Dec 2015

NOAA's National Centers for Environmental Information

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0



Record Coldest

Much Cooler than Average

Cooler than Average

Near Average

Warmer than Average

Much Warmer than Average

Record Warmest




Wed Jan 13 12:15:02 EST 2016

- COP21 Meeting in Paris, 12/2015
- Nations agreed to limit global temperature increase to 2 C
- Countries to update pollution reduction pledges by 2020

**This means
reducing emissions
by 40–70% by 2050
compared to 2010!**

Montreal Protocol Amendment to Phase Down HFCs Closer to Reality Now

 United States Environmental Protection Agency

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News Releases By Date

Statement from EPA Administrator Gina McCarthy on Decision Reached at the 27th Meeting of the Parties to the Montreal Protocol / Decision Puts World on Path to 2016 Amendment to Phase Down HFCs

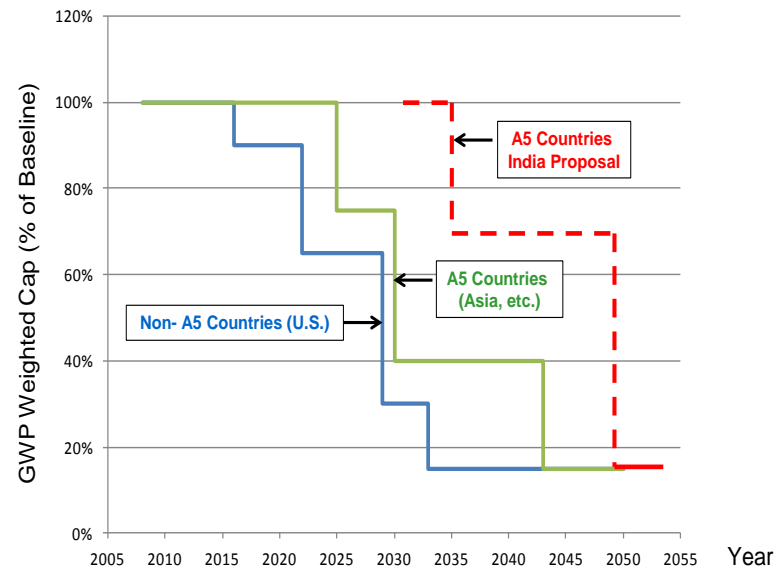
Release Date: 11/05/2015

Contact Information: Enesta Jones U.S. EPA, Office of Media Relations Desk: 202.564.7873 Cell: 202.236.2426; Información de contacto en español: Lina Younes, 202-564-9924, 202-564-4355

DUBAI - Today, countries across the world took the historic step to work together on a 2016 Amendment to the Montreal Protocol to reduce the production and consumption of harmful hydrofluorocarbons (HFCs), greenhouse gases that can be up to 10,000 times more potent than carbon dioxide in contributing to climate change. A 2016 amendment to the Montreal Protocol to phase down HFCs will achieve substantial greenhouse gas reductions and could avoid up to 0.5 degrees Celsius of warming by 2100.

Reaching agreement on this decision by the Parties will pave the way to help all countries transition to alternatives and away from HFCs. It is a significant accomplishment for climate action on the road to the Paris Climate Conference later this month and sends a strong signal that the international community can come together to confront some of the world's greatest environmental challenges and continue progress toward cutting global greenhouse gas emissions.

North American Proposal and India Proposal For HFC Phase-down

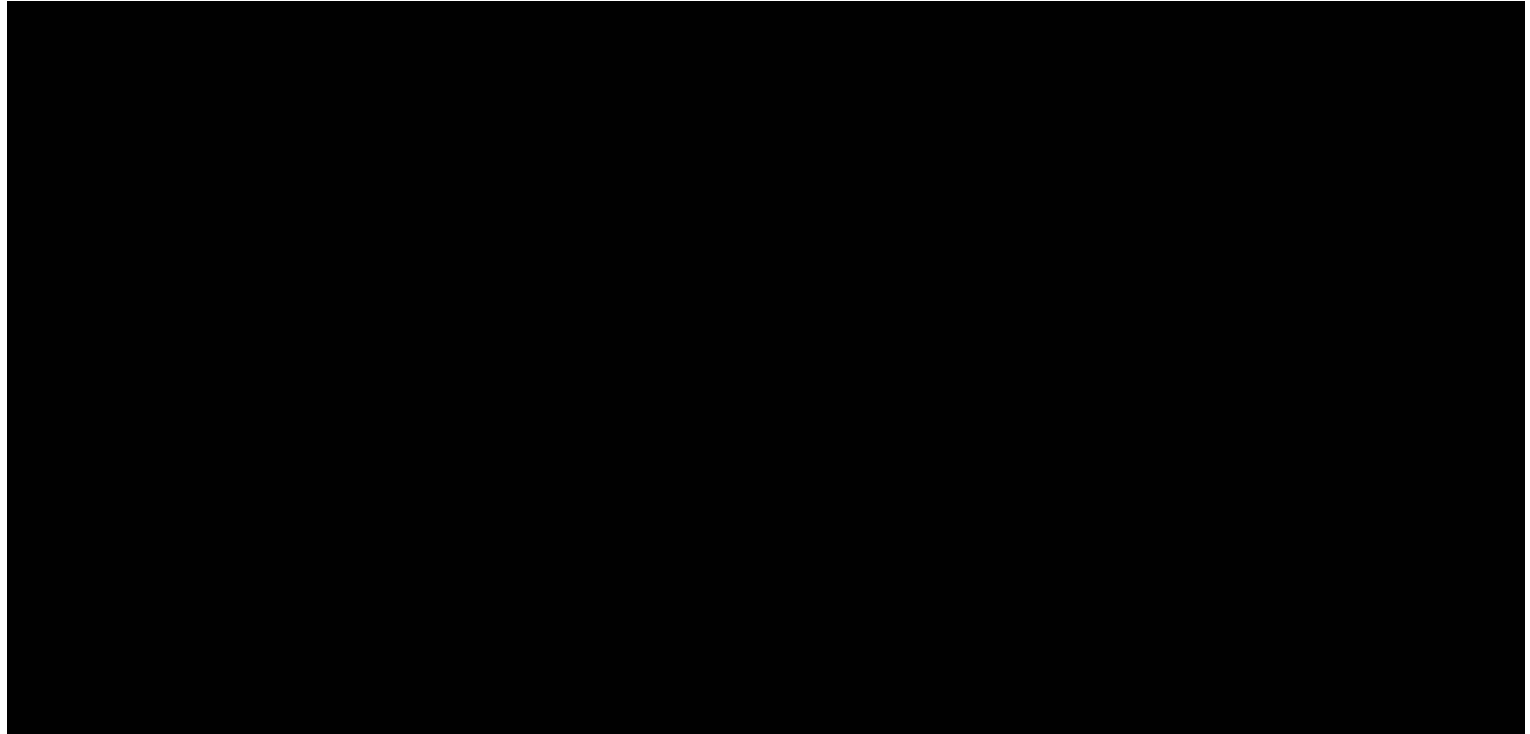


Baseline year, steps, final percent will be negotiated over next year

Emerson Confidential

4

Reason for Starting E360 Is Reason for Innovation as Well



Other Industries Have Solved Major Challenges



Consumer &
Competitive
Landscape



at&t

Data,
Not Talk

Steelcase®

Workspace,
Not Furniture

Johnson & Johnson

Changing
Health Care
Environment

intuit®

Extending the
Startup Culture

These Companies and Many Others Had to Reinvent How They Collaborate and Innovate

The Helix Innovation Center at the University of Dayton, Ohio



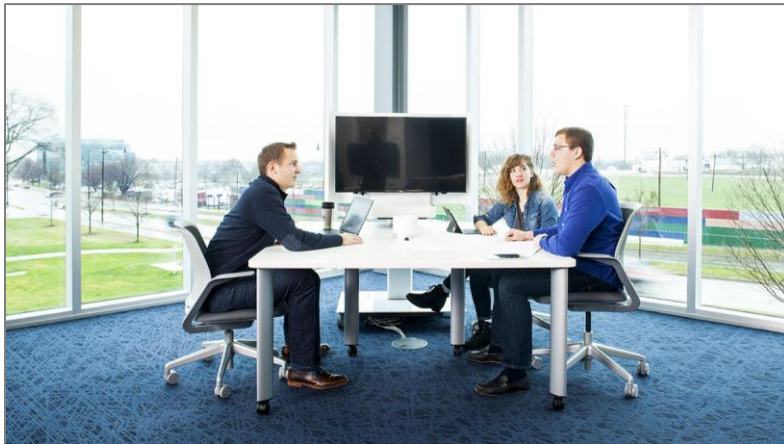
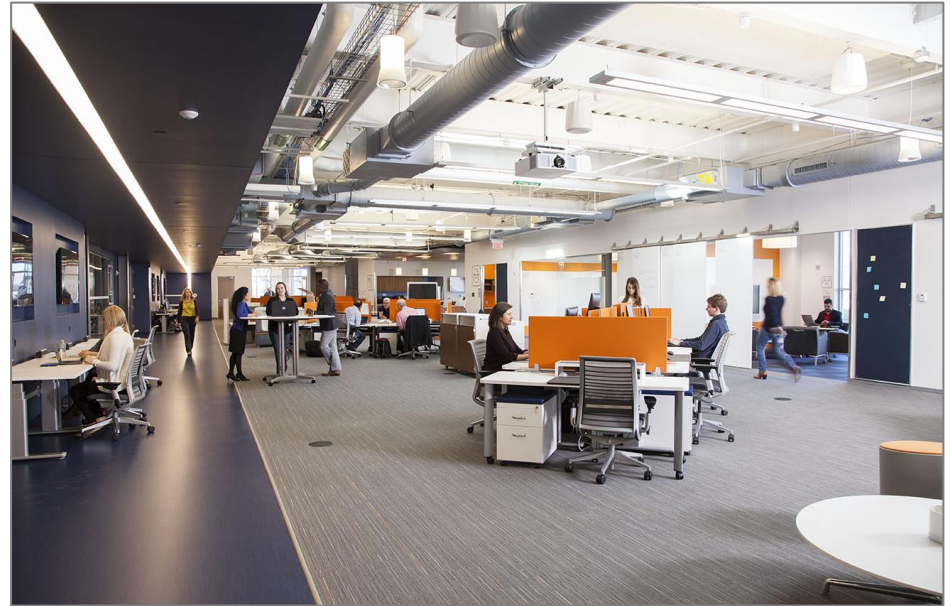
The Helix: A Different Way of Thinking and a New Way to Collaborate

THE **HELIX** represents the
coming **TOGETHER** of
TECHNOLOGY AND **ENGINEERING**
to **create** solutions.

THE **name** represents
the **blue-sky** and the **practical**, of **academics** and
real-world practitioners,
of tomorrow's needs AND today's applications...

All to **CREATE** solutions **REAL** THAT WILL MAKE A
difference **IN THE** **WORLD.**

The Helix Is Designed for Collaboration and Teaming



Commercial Kitchen at The Helix



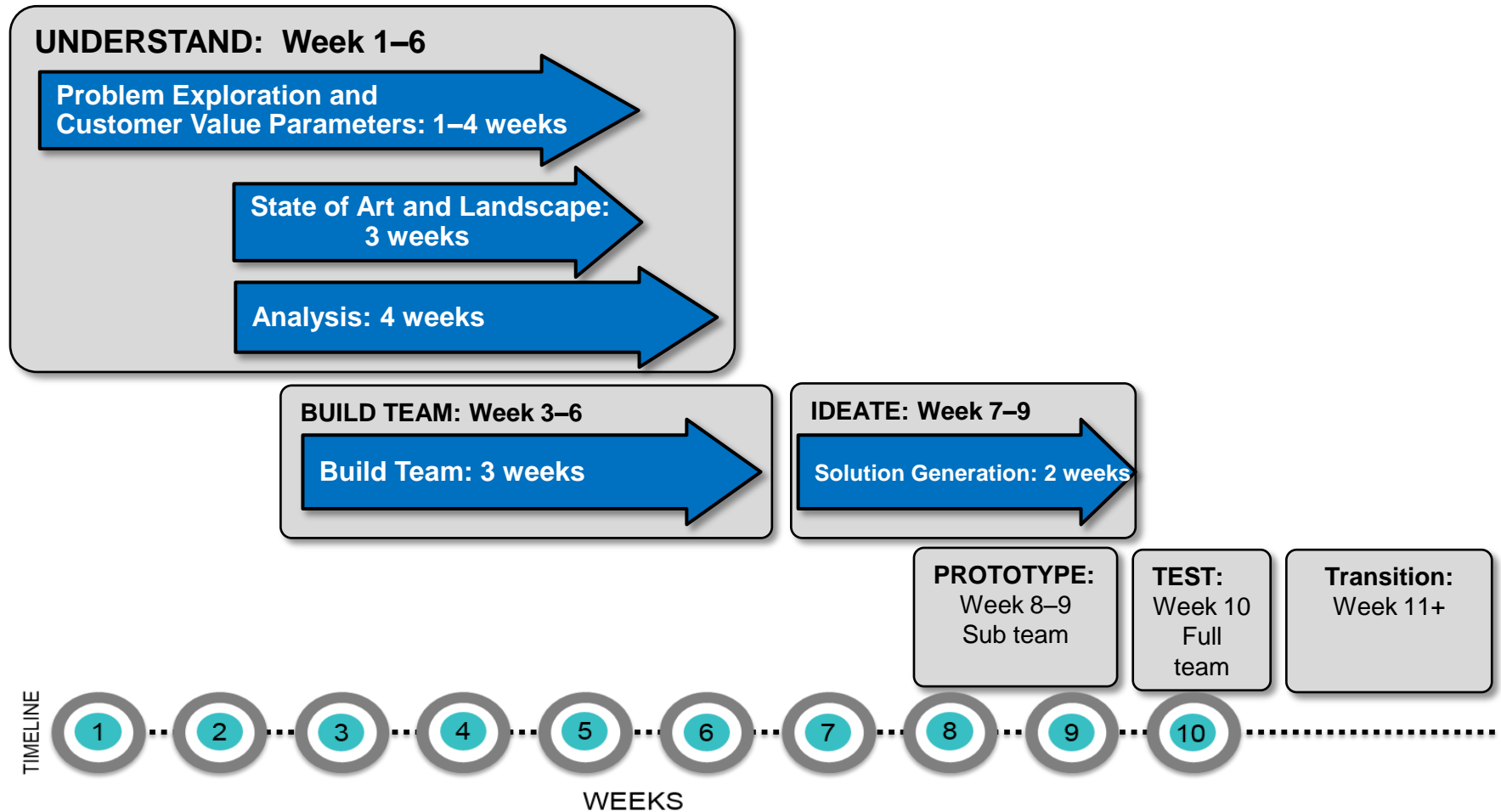
- 1,500 sq. ft., fully functional, high-density kitchen
- Designed for modern American cuisine
- Capacity to serve 150 meals
- Independent temperature and humidity control
- Remote condensing equipment can be located in environment chamber
- Environment chamber temperature control from -25 °F to 125 °F; humidity control from 20–90%

Supermarket/C-Store at The Helix



- 2,500 sq. ft. supermarket and C-store module
- Independent humidity and temperature control
- Remote condensing equipment can be located in environment chamber
- Environment chamber temperature control from -25 °F to 125 °F; humidity control from 20–90%
- Currently configured for CO₂ transcritical refrigeration system
- Refrigeration rack can be used for HVAC, hot water, snow melt features

Innovation Is More Than a Building — The Helix Innovation Process



Thank You!

Questions?

**For Further Details, Contact
Rajan.Rajendran@Emerson.com**

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