



U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



## Current U.S. Efforts for Improving Cooling Efficiency and Opportunities for International Collaboration

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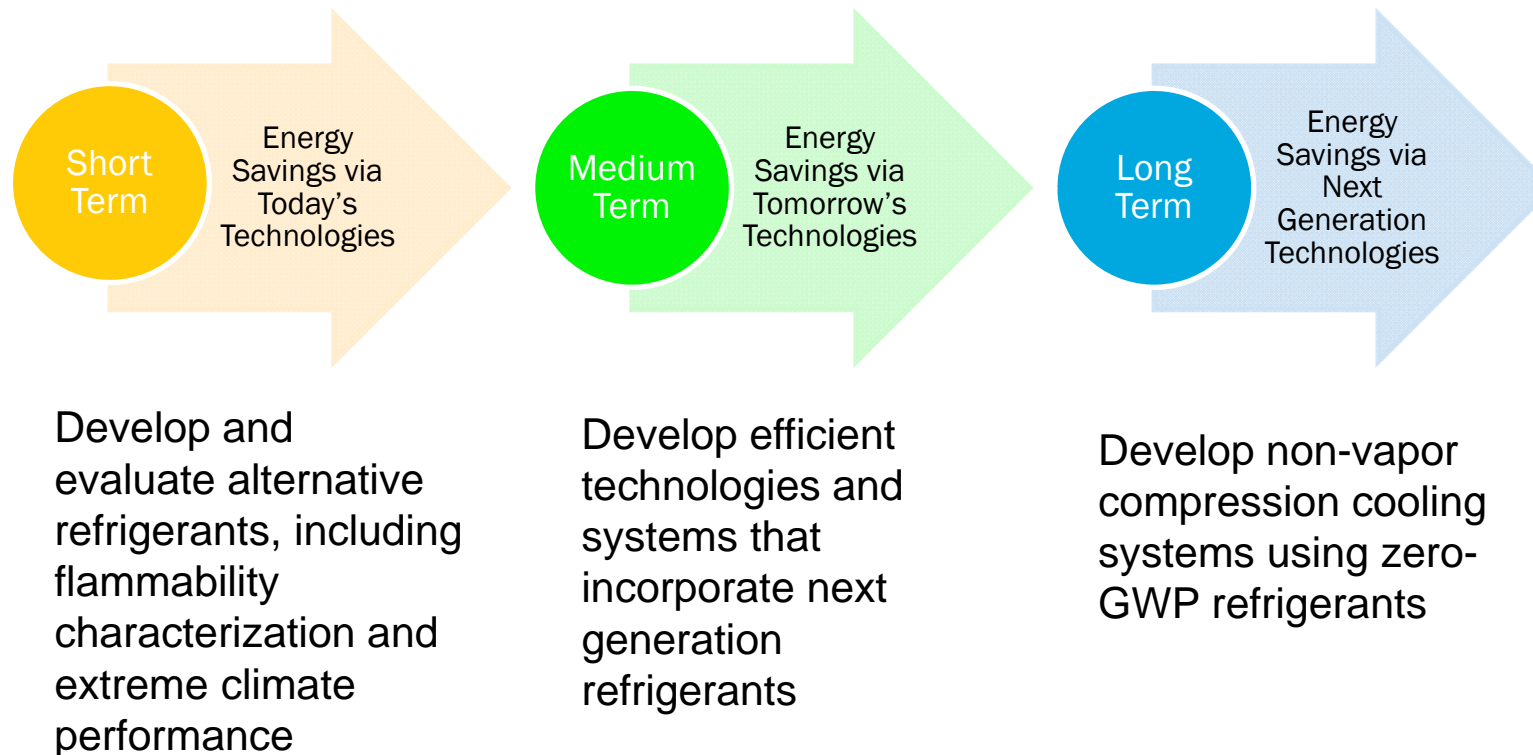
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# U.S. DOE HVAC&R Research Strategy, *Efficiency first*

DOE research aims to develop cost-effective next-generation technologies that “leapfrog” existing technologies and dramatically improve energy efficiency.



**DOE's Cooling Research is conducted under our HVAC, Water Heating and Appliance subprogram:**

**<http://energy.gov/eere/buildings/hvac-water-heating-and-appliances>**

# Ongoing U.S. Involvement in IEA Cooling Initiatives

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The U.S. is the operating agent for two new Annexes that launched in 2019 under the auspices of the IEA Heat Pump Program.

Annex	Description
Annex 53: Advanced Cooling/ Refrigeration Technologies Development	Annex aims to develop technological solutions for higher efficiency air-conditioning/refrigeration systems to help minimize/reduce projected energy consumption. Main technology focus areas are traditional vapor compression, alternative vapor compression approaches, and non-traditional cycle approaches for AC and/or refrigeration applications.
Annex 54: Heat Pump Systems with Low-GWP Refrigerants	Annex aims to promote the application of low-GWP refrigerants to accelerate phase down of high-GWP HFCs. Goals include developing design guidelines of optimized heat pump components and systems for low-GWP refrigerants through the review of available low-GWP refrigerants, their properties, and applicable standards, safety and flammability of refrigerants, and safe use of flammable refrigerants.

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# Appliance and Equipment Standards Program

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- **Establishes test procedures for measuring the energy efficiency or energy use of covered products.**
  - *Energy efficiency requires different metrics for different products.*
  - *Test procedures must be carefully developed, so they can't be gamed.*
- **Establishes the mandatory standard levels for the energy efficiency of covered products.**
  - *The standard is defined in terms of the test procedures established by the Program.*
  - *Manufacturers (foreign or domestic) must test their products using the DOE test procedure, and must certify to DOE that their products meet the standard level to be sold in the U.S.*
- **Enforces the standards.**
  - *DOE can order manufacturers to take corrective action if their products do not meet the standard levels.*
  - *This can include ordering them not to sell the products in the United States and the imposition of civil penalties. ~\$30 million in penalties have been assessed since 2010.*
  - *DOE and US Customs and Border Control published a joint proposed rule to better monitor non-compliant imported products.*
- **Works with other Federal Agencies.**
  - *Environmental Protection Agency ENERGY STAR test methods and verification.*
  - *Federal Trade Commission Energy Guide Label.*

# U.S. DOE Rulemaking Summary – Cooling Products

## Active DOE Energy Conservation Standards Rulemakings

Product Name	Last Final Rule	Current Standard Compliance Date	Current Stage	Driver	Most Recent Action
Computer Room ACs*	May 2012	October 2012/2013	In Development	ASHRAE 90.1 Trigger	May 2012 energy conservation standards final rule
Dedicated Outdoor Air Systems*	N/A	N/A	In Development		N/A
Commercial Package AC - Variable Refrigerant Flow*	May 2012 (water-cooled)	October 2012/2013 (water-cooled)	In Development		Ongoing VRF working group meetings
Portable ACs	N/A	N/A	Final Rule	Discretionary	Final rule issued December 2016
Room ACs	April/August 2011	June 2014	Preliminary Analysis	6-year Review	Request for information published June 2015
Evap-cooled and Water-cooled CUAC and CUHP*	May 2012 (≥65k Btu/h)	June 2013/2014 (≥65k Btu/h)	In Development	6-year Review	May 2012 energy conservation standards final rule

\*ASHRAE Equipment

# U.S. DOE Rulemaking Summary – Cooling Products

## Active DOE Test Procedure Rulemakings

Product Name	Current Stage	Driver	Last Action
Computer Room ACs*	NOPR	ASHRAE 90.1 Trigger	Request for information published July 2017  Ongoing VRF working group meetings
Dedicated Outdoor Air Systems*			
Commercial Package AC - Variable Refrigerant Flow*			
Air-cooled CUAC and CUHP*			
Evap-cooled and Water-cooled CUAC and CUHP*	NOPR	7-year Review	Request for information published October 2018
3-Phase Air-cooled CUAC and CUHP < 65,000 Btu/h*			
Room ACs			
Single Package Vertical AC and HP*			
Water-source Heat Pumps*	NOPR	7-year Review	Request for information published June 2018

\*ASHRAE Equipment

# U.S. DOE Rulemaking Summary – Cooling Products

## Inactive DOE Energy Conservation Standards Rulemakings (subject to 6-year review)

Product Name	Last Action	Compliance Date of Standard
Central AC (includes mini/multi splits)	Final rule published January 2017	January 2023
3-Phase Air-cooled CUAC and CUHP < 65,000 Btu/h*	Final rule published July 2015	January 2017
Water-source Heat Pumps*	Final rule published July 2015	October 2015
Air-cooled CUAC and CUHP*	Final rule published January 2016	January 2018/2023
Packaged Terminal AC and HP*	Final rule published July 2015	January 2017
Single Package Vertical AC and HP*	Final rule published September 2015	October 2015/2016, September 2019

## Inactive DOE Test Procedure Rulemakings (subject to 7-year review)

Product Name	Last Action
Central AC (includes mini/multi splits)	Final rule published January 2017
Portable ACs	Final rule published June 2016
Packaged Terminal AC and HP*	Final rule published June 2015

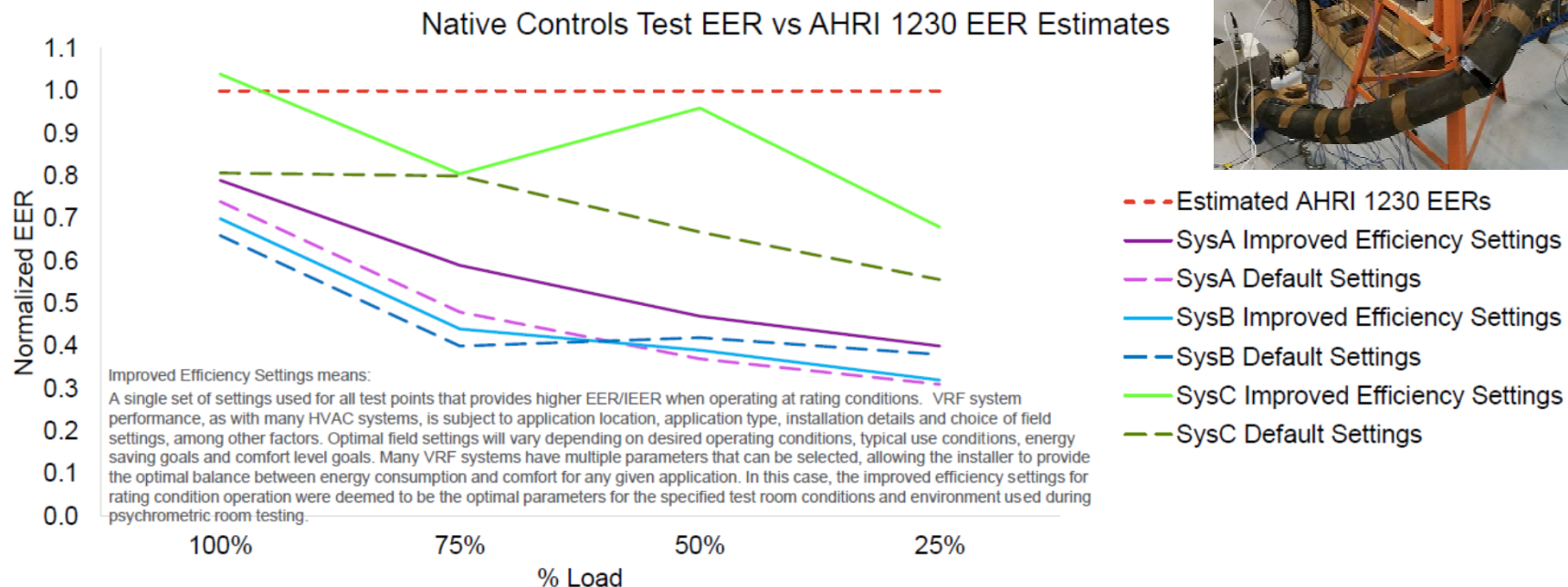
\*ASHRAE Equipment



# DOE Test Procedure Development Example

## Variable-refrigerant flow system testing.

- Investigating performance of VRF systems in native-control load-based testing.
- Collaboration with manufacturers, utility groups, efficiency advocates, and test laboratory.





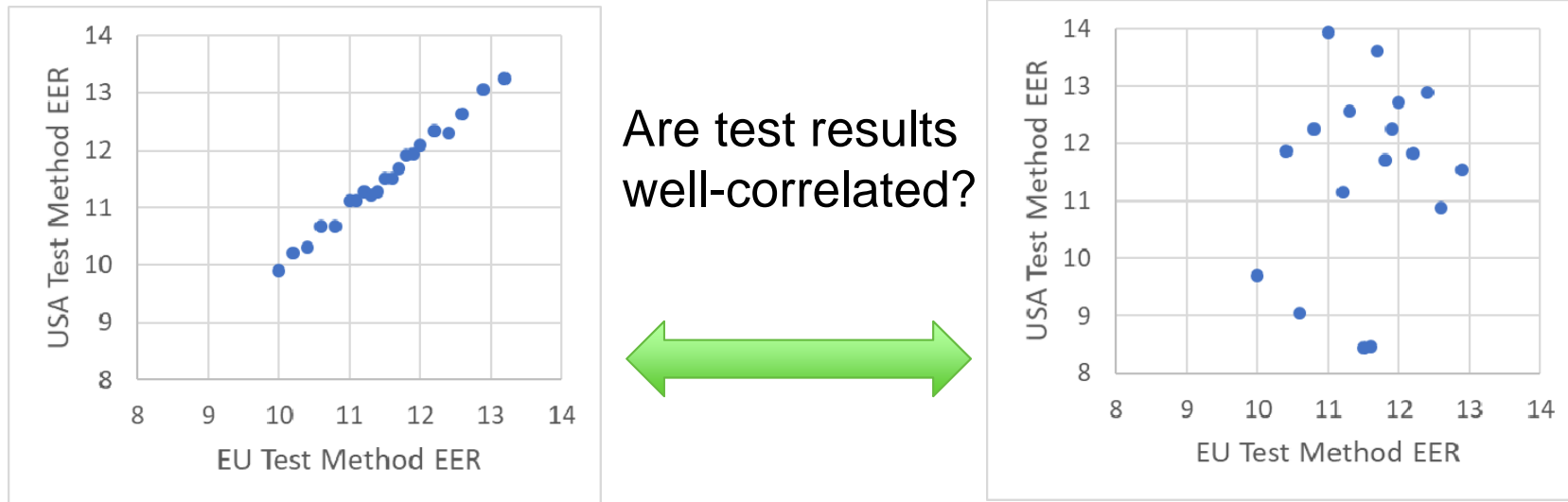
# Energy Star Cold Climate Heat Pump Testing

- Evaluation of heat pump test conditions in draft revision to standard CSA C656 for potential ENERGY STAR inclusion.
- Confirm repeatable testing at the coldest outdoor temperatures for heat pump operation—down to -26 °C.
- Preliminary investigation of load-based testing.
- Compare results with extrapolations of current test.



# Potential AC Round Robin Test in 4E

Comparative test procedure evaluation would evaluate and address test method differences.



- Do different test methods provide consistent predictions of air-conditioner efficiency?
- What test method differences cause different results?
  - Lab facility differences
  - Product test set-up
  - Test conditions: temperature, humidity
  - Calculations to determine efficiency
- Plans: Initial investigation of potential differences in ratings, key test standard differences.