

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
ENERGY EFFICIENCY &  
RENEWABLE ENERGY

# High-efficiency Low Global-Warming Potential (GWP) Packaged Rooftop System

United Technologies Research Center

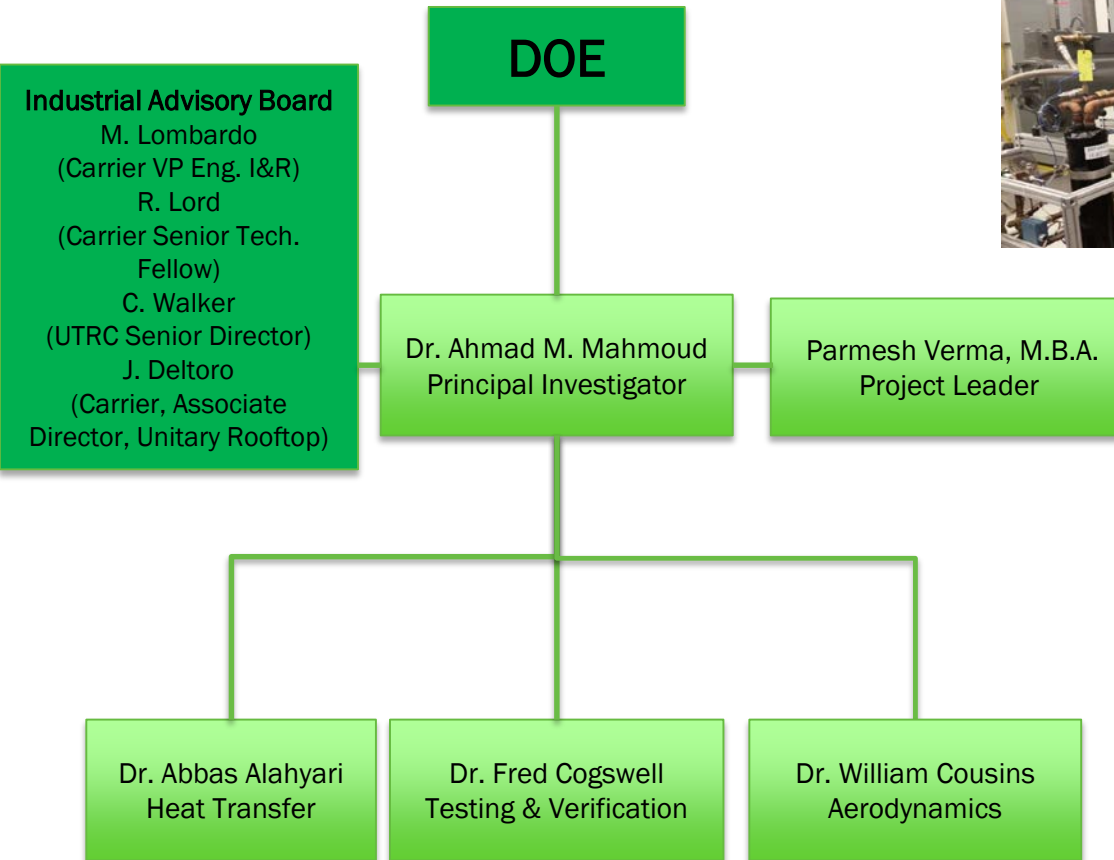
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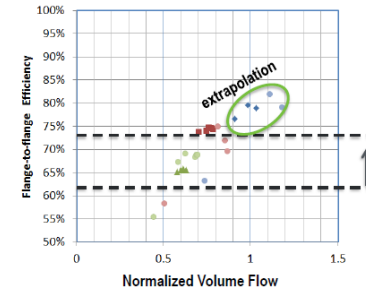


# High-efficiency Low GWP Packaged RTU System

## Team



## Compressor Development



## System Test Facilities



## Unique Qualifications

- Completed compressor development project
- Market analysis & cost (Carrier BU)
- High-fidelity modeling & experimental facilities

# High-efficiency Low GWP Packaged RTU System

## Problem Definition:

- Current small commercial building HVAC systems use R410A with GWP=2088\*.
- Potential regulations and market drivers are pushing the HVAC&R industry to lower direct GWP and higher efficiency systems (indirect GWP).
- New low-GWP refrigerants require new approaches for compressor and system design in order to achieve high efficiency and safe/reliable operation.

Solution must be cost-effective and have favorable value proposition (e.g. <2 year payback in new and retrofit construction)

## Target Market and Audience:

### Packaged Systems:

- Primary: Commercial rooftop cooling systems
- Secondary: Residential cooling systems



# High-efficiency Low GWP Packaged RTU System

## The Solution

### State-of-the-Art

- Radical departure in compressor, heat exchanger and system balance of plant and integration requires significant R&D
- Current technology is short-term stop gap for future efficiency and environmental mandates

Develop and demonstrate (TRL6) a high-efficiency 5TR packaged roof-top system:

- Cost-effective
- Sustainable, non-flammable, non-toxic and high-efficiency refrigerant
- High cycle efficiency (>+10% vs. R410A).
- Technology shall be matured from Technology Readiness Level (TRL) 4 to 6\* in 26 months (a fully functional prototype tested at relevant conditions in a relevant environment)

Metric	State of the Art	Proposed
Use of Low GWP A1 refrigerants	R410A; Not possible to meet capacity and efficiency targets	Integrated system with low GWP refrigerant: <ul style="list-style-type: none"><li>• High-efficiency compressor</li><li>• Highly effective and low pressure drop evaporator</li><li>• High-effectiveness compact condenser</li></ul>
Primary COP	15.6 SEER Rooftop systems (5– 20 Ton)	>20SEER (i.e. >2.1 primary seasonal COP) leading to 30% primary energy reduction
Payback	<5 years	< 2 years (new construction & retrofits)

\*[https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt\\_accordion1.html](https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html)

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## Approach

Phase 1: Component and system design and optimization and supplier engagement.

Phase 2: Two prototypes will be built, and commissioned and tested at UTRC Psychrometric Facility to demonstrate:

- 1) targeted system performance i.e. Seasonal Energy Efficiency Ratio (SEER)
- 2) system operability over a wide range of conditions dictated by market needs
- 3) validate value proposition.

## Advantage, Differentiation, and Impact

UTRC's detailed system analysis shows that the proposed high-efficiency low GWP system has the potential to provide **primary seasonal COP > 2.1** (vs. 2.0 BTO goal) at a cost premium that meets market needs.

Other “desirable characteristics” include:

- Demonstration of long-term safe low-GWP refrigerant solution
- High part-load performance
- Significant energy consumption potential upon full (new and retrofit) commercialization

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# Thank You

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