ENERGY SAVINGS
WHITEPAPER

An analysis of the unique 75F IoT Building Management System in U.S. medium offices, both new construction and retrofit.

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

75F

INTRODUCTION

This report comprehensively quantifies the potential energy savings of the 75F IoT Building Management System (BMS) in U.S. medium offices, both retrofit and new construction. Studied 75F applications include Outside Air Optimization (OAO), and Smart VAV With Reheat.

The National Renewable Energy Lab (NREL) cultivated the data in this report by leveraging U.S. Department of Energy (DOE) building benchmarks and characteristics across multiple cities, annualized to capture total building energy savings as well as heating, ventilating, and air conditioning (HVAC) electricity and natural gas energy use intensity (EUI) reductions.

- **Total building** energy savings of up to **28%** in retrofit mid-size offices
- **Total building** energy savings of up to **31%** for new construction mid-size offices
- Energy savings potential is **consistent** across the United States

METHODOLOGY

The U.S. Department of Energy (DOE) is responsible for conducting research about commercial building systems and energy efficiency in coordination with national laboratories, private industry, and universities, with a stated goal of developing more energy efficient buildings and eventually reaching zero energy buildings. This research relies heavily on standardized benchmarks developed and shared by Lawrence Berkeley National Laboratory (LBNL), Pacific Northwest National Laboratory (PNNL), and the National Renewable Energy Laboratory (NREL), the nation's primary laboratory for renewable energy and energy efficiency research and development.

CLIMATE ZONES

The offices analyzed in this report are in 16 cities representing all U.S. climate zones: Honolulu, HI; Tampa, FL; Tucson, AZ; Atlanta, GA; El Paso, TX; San Diego, CA; New York, NY; Albuquerque, NM; Seattle, WA; Buffalo, NY; Denver, CO; Port Angeles, WA; Rochester, MN; Great Falls, MT; International Falls, MN; and Fairbanks, AK. Efficiencies are based on the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 90.1-2016 for new construction buildings, and Standard 90.1-2004 for retrofit buildings. All buildings have varying schedules, occupancy, component efficiency, locations and orientation, lighting loads, plug loads, HVAC sequences and varying ventilation requirements based on zone use.

MEDIUM OFFICES

Medium office building energy consumption is based on a three-story building with 53,600 square feet, a packaged air conditioning unit for cooling and a gas furnace inside the packaged air conditioning unit for heating. Distribution and terminal units include a VAV terminal box with damper and electric reheating coil.

RESULTS | **Medium Offices, Retrofit**

RESULTS | **Medium Offices, New Construction**

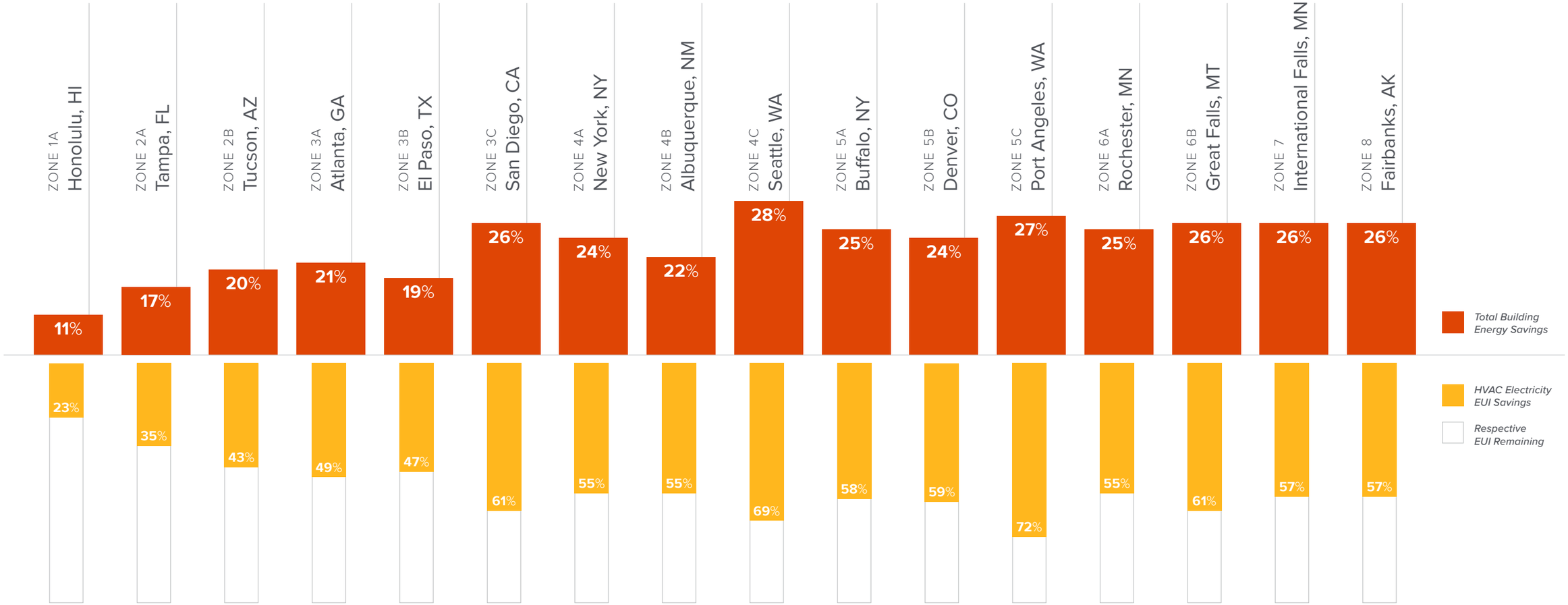
75F® Outside Air Optimization™

75F® Outside Air Optimization™ (OAO) is an application that combines hardware, software, and real-time weather data providing advanced sequences of operation from rooftop economizers to built-up air handlers in a wide range of commercial buildings. While OAO's three primary benefits are improved efficiency, comfort and indoor air quality, this report will focus on OAO's efficiency potential. NREL's study includes three OAO control strategies: OAO, OAO Interval Modulation (IM), and OAO Smart Demand Control Ventilation (DCV). This report focuses exclusively on OAO data, though specific control strategy descriptions are available for all three.

- **OAO** reduces required ventilation of outdoor air leveraging additional sensors and optimized setpoints, and provides comparative enthalpy free cooling.
- **OAO IM** cycles the fan to maintain minimum outdoor air ventilation. Applied in any building with constant-speed fans in the HVAC equipment that provides ventilation to occupants.
- **OAO Smart DCV** uses CO2 sensors to detect occupancy & adjusts ventilation by room in VAV systems. Applied in buildings with central HVAC systems serving multiple zones leveraging traditional VAV terminal units.

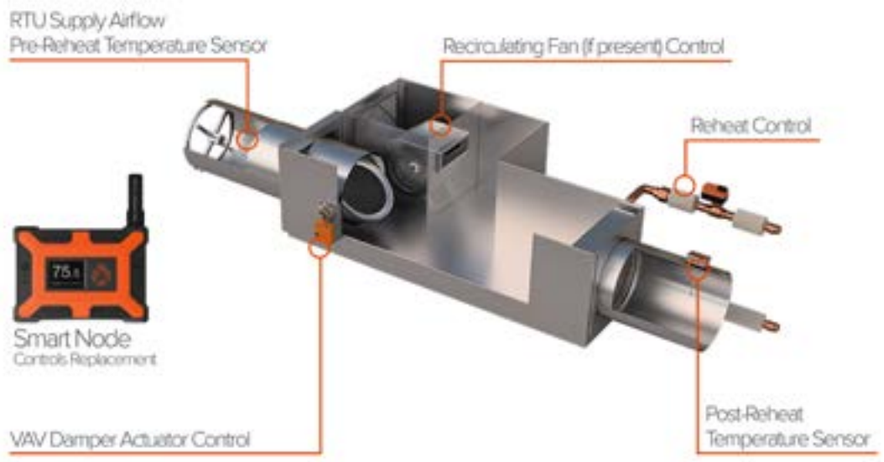
75F® Smart VAV With Reheat™

75F® Smart VAV with Reheat™ is a full-stack solution with components that include sensors connecting to 75F's AI for cloud analysis, a 75F® Central Control Unit™ (CCU) as a supervisor with built-in wall interface, 75F® Smart Node™ as terminal equipment controllers, third-party units with actuators or 75F Smart Dampers, and Facilisight, 75F's building intelligence suite of web and mobile apps for secure remote monitoring and control. VAV is an advantageous application for commercial buildings larger than 40,000 square feet with diverse loads or those that require simultaneous exterior heating and interior cooling during winter months. Where common air handling equipment may serve these zones today, VAV with Reheat allows a central RTU or AHU to serve multiple zones. This way, one duct run can provide air for ventilation and cooling while reheat can be used for zones that need heating. Where traditional VAV systems can be costly and inefficient, 75F has encapsulated newer ASHRAE-recommended advanced VAV control sequences. This application modernizes and acknowledges today's fully modulating RTUs and AHUs.



*In this application, natural gas EUI increases due to cost efficiency over electricity.

75F SMART VAV WITH REHEAT ILLUSTRATION



ZONE 1A
Honolulu, HI
23%
11.0%
Total Building Energy Savings

ZONE 2A
Tampa, FL
35%
17.3%
Total Building Energy Savings

43%
20.1%
Total Building Energy Savings

HVAC Electricity EUI Savings

ZONE 3A
Atlanta, GA
49%
20.8%
Total Building Energy Savings

ZONE 3B
El Paso, TX
47%
18.8%
Total Building Energy Savings

ZONE 3C
San Diego, CA
61%
26.0%
Total Building Energy Savings

ZONE 4A
New York, NY
55%
24.2%
Total Building Energy Savings

ZONE 4B
Albuquerque, NM
55%
22.5%
Total Building Energy Savings

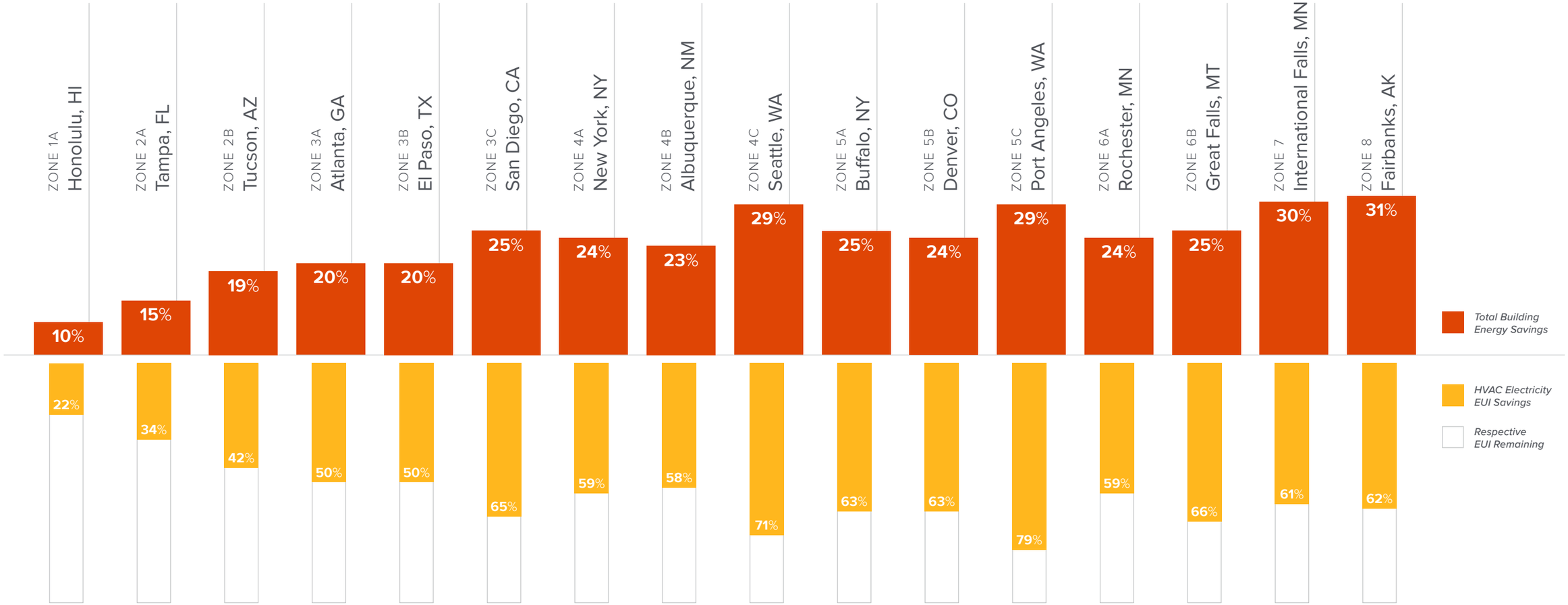
ZONE 4C
Seatlle, WA
69%
28.5%
Total Building Energy Savings

ZONE 5A
Buffalo, NY
58%
24.5%
Total Building Energy Savings

ZONE 5B
Denver, CO
59%
23.8%
Total Building Energy Savings

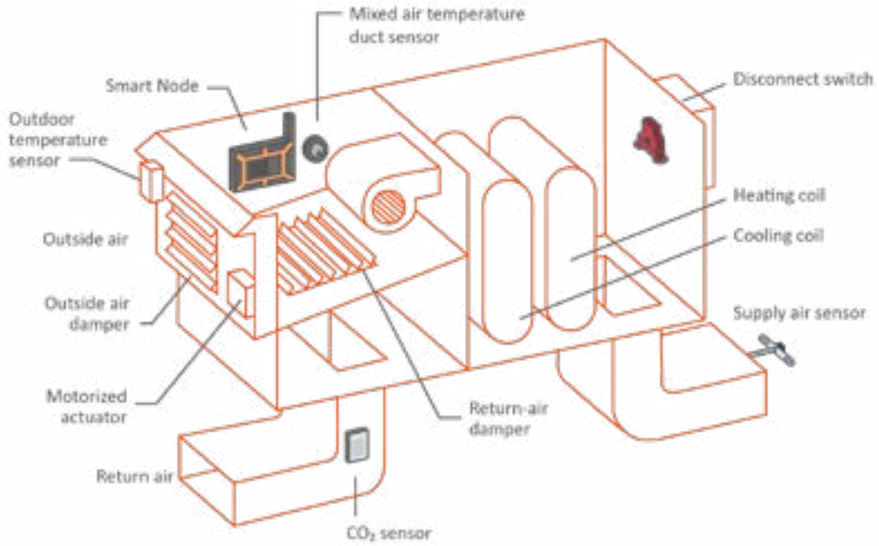
RESULTS | MEDIUM OFFICES, NEW CONSTRUCTION

◀ Methodology



*In this application, natural gas EUI increases due to cost efficiency over electricity.

75F OUTSIDE AIR OPTIMIZATION ILLUSTRATION



ZONE 1A
Honolulu, HI

22%

9.9%
Total Building Energy Savings

ZONE 2A
Tampa, FL

34%

15.4%
Total Building Energy Savings

ZONE 2B
Tucson, AZ

42%

18.9%
Total Building Energy Savings

HVAC Electricity EUI Savings

ZONE 3A
Atlanta, GA

50%

20.4%
Total Building Energy Savings

ZONE 3B
El Paso, TX

50%

20.0%
Total Building Energy Savings

ZONE 3C
San Diego, CA

65%

24.7%
Total Building Energy Savings

ZONE 4A
New York, NY

59%

23.6%
Total Building Energy Savings

ZONE 4B
Albuquerque, NM

58%

22.5%
Total Building Energy Savings

ZONE 4C
Seatlle, WA

71%

29.5%
Total Building Energy Savings

ZONE 5A
Buffalo, NY

63%

24.5%
Total Building Energy Savings

ZONE 5B
Denver, CO

63%

23.5%
Total Building Energy Savings

CONCLUSION

This analysis shows significant savings from combined applications 75F® Smart VAV With Reheat and 75F® Outside Air Optimization sequences in medium-sized offices, with energy reduction potential across the United States. New construction medium offices have the potential for greatest efficiency improvements in this report with savings of up to 31% total building energy use in representative cities, though retrofit buildings are a close second at 28%. While these high savings are typically located in colder climates such as Minnesota and Alaska, data in warmer climates such as California and Arizona range between 17% and 26% for both retrofits and new construction. In this application, savings stem from reductions in electricity EUI and an increase in natural gas EUI where cost efficiency makes sense.

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