



ENERGY SAVINGS

WHITEPAPER

An analysis of the unique 75F IoT Building Management System in U.S. mid-rise apartments, both new construction and retrofit.



INTRODUCTION

This report comprehensively quantifies the potential energy savings of the 75F IoT Building Management System (BMS) in U.S. mid-rise apartments, both retrofit and new construction. The studied 75F application is Outside Air Optimization (OAO).

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 **17%** in retrofit mid-rise apartments
- ▶ **Total building** energy savings of up to **15%** for new construction mid-rise apartments
- ▶ Energy savings potential is **even across the U.S.**, with the **northern and western** portions of the country seeing the highest savings

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 apartments 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.

MID-RISE APARTMENTS

Mid-rise apartment building energy consumption is based on a four-story building with 33,700 square feet, a gas furnace for heating, and one split system DX per apartment for cooling. Distribution and terminal units are constant volume.

RESULTS | [Mid-rise Apartments, Retrofit](#)

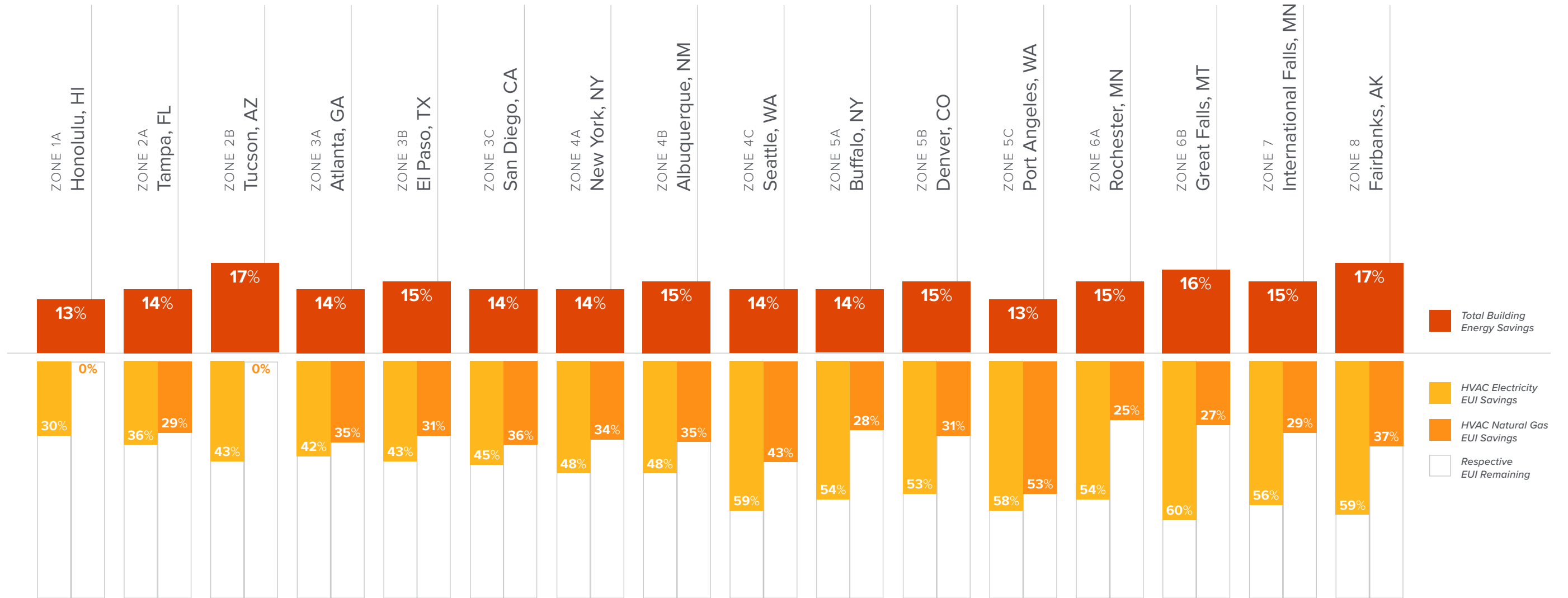
RESULTS | [Mid-rise Apartments, New Construction](#)

APPLICATIONS

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 IM data, though specific control strategy descriptions are available for all three.

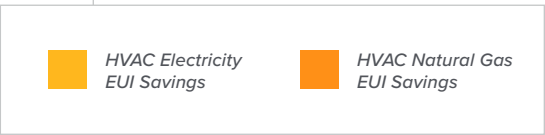
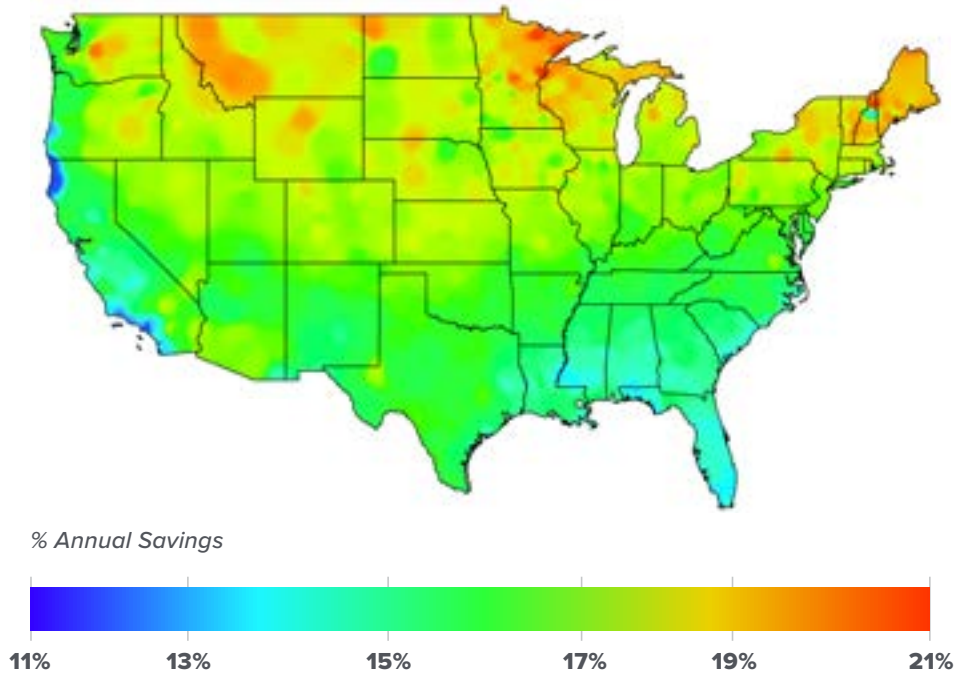
- ▶ **OAO** reduces required ventilation of outdoor air leveraging additional sensors and optimized setpoints, and provides comparative enthalpy free cooling.
- ▶ **OAO IM** cycles the fan to maintain minimum outdoor air ventilation. Applied in any building with constant-speed fans in the HVAC equipment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

RESULTS | MID-RISE APARTMENT, RETROFIT



HIGHLIGHTS | MID-RISE APARTMENT, RETROFIT

ANNUAL SAVINGS BY CLIMATE ZONE



ZONE 1A
Honolulu, HI

30%
0%
12.6%
Total Building Energy Savings

ZONE 2A
Tampa, FL

36%
29%
14.3%
Total Building Energy Savings

ZONE 2B
Tucson, AZ

43%
0%
17.4%
Total Building Energy Savings

ZONE 3A
Atlanta, GA

42%
35%
14.0%
Total Building Energy Savings

ZONE 3B
El Paso, TX

43%
31%
14.9%
Total Building Energy Savings

ZONE 3C
San Diego, CA

45%
36%
13.7%
Total Building Energy Savings

ZONE 4A
New York, NY

48%
34%
14.4%
Total Building Energy Savings

ZONE 4B
Albuquerque, NM

48%
35%
14.7%
Total Building Energy Savings

ZONE 4C
Seattle, WA

59%
43%
14.0%
Total Building Energy Savings

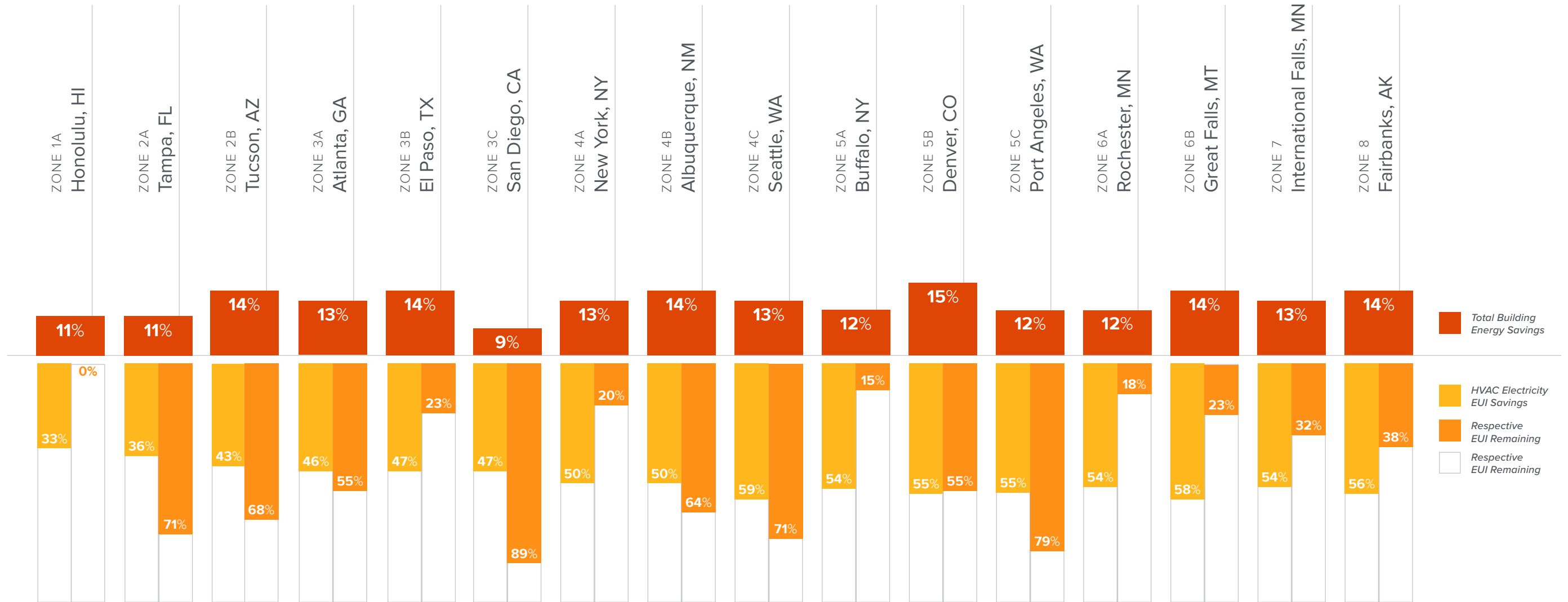
ZONE 5A
Buffalo, NY

54%
28%
14.1%
Total Building Energy Savings

ZONE 5B
Denver, CO

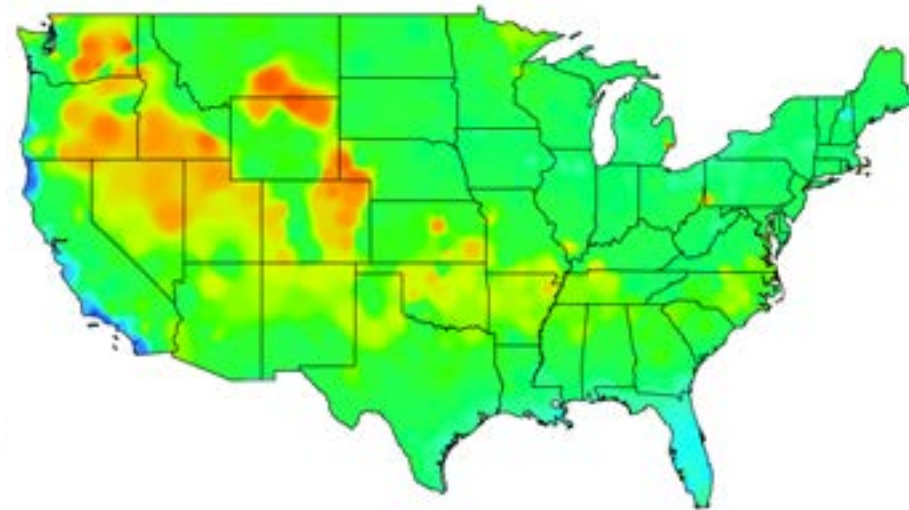
53%
31%
15.3%
Total Building Energy Savings

RESULTS | MID-RISE APARTMENT, NEW CONSTRUCTION



HIGHLIGHTS | MID-RISE APARTMENT, NEW CONSTRUCTION

ANNUAL SAVINGS BY CLIMATE ZONE



% Annual Savings

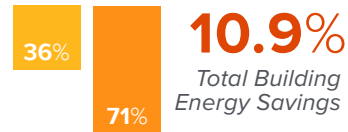


 HVAC Electricity
EUI Savings

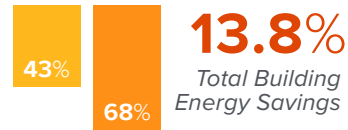
ZONE 1A
Honolulu, HI



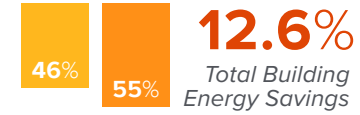
ZONE 2A
Tampa, FL



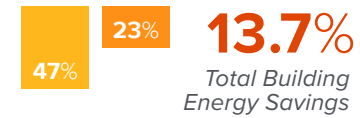
ZONE 2B
Tucson, AZ



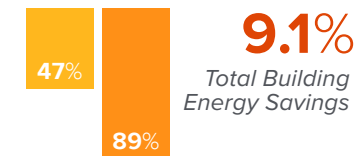
ZONE 3A
Atlanta, GA



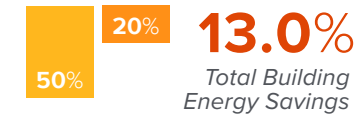
ZONE 3B
El Paso, TX



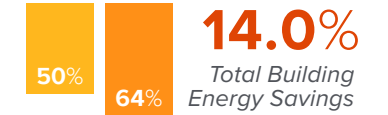
ZONE 3C
San Diego, CA



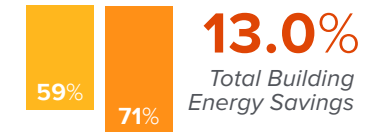
ZONE 4A
New York, NY



ZONE 4B
Albuquerque, NM



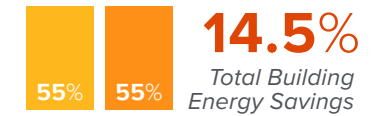
ZONE 4C
Seattle, WA



ZONE 5A
Buffalo, NY



ZONE 5B
Denver, CO



CONCLUSION

This analysis shows significant savings from Outside Air Optimization sequences in mid-rise apartment buildings, particularly in the northern portions of the U.S. for retrofit projects and the western and northwestern areas for new construction. Retrofit mid-rise apartments have the potential for greatest efficiency improvements in this report with savings of up to 17% total building energy use in representative cities,

though retrofit buildings are a close second at 15%. While the highest savings are typically located in the midwest and western portions of the U.S., no particular climate zone demonstrates total building savings below an 8% range in new build scenarios and a 11% range for retrofits. Most circumstances lead to overall savings between 13% and 15%.