ENERGY SAVINGS
WHITEPAPER

An analysis of the unique 75F® IoT-based Building Management System in U.S. large hotels, 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. large hotels, both retrofit and new construction. Studied 75F applications include Dynamic Chill Water Balancing (DCWB) and 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 **26%** in retrofit large hotels
- **Total building** energy savings of up to **20%** for new construction large hotels
- Savings potential is **even across the country**, with highest savings on the west coast and southern U.S.

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 hotels 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.

LARGE HOTELS

Large hotel HVAC energy consumption is based on a 122,132 square-foot building with six floors above ground and a basement. It includes one gas-fired boiler for heating and one air-cooled chiller for cooling. Distribution and terminal units include VAV with hot water reheating coils for public spaces on the ground and top floors, and a dedicated outside air system (DOAS) and four-pipe fan coil units for the guest rooms.

RESULTS | **Large Hotels, Retrofit**

RESULTS | **Large Hotels, New Construction**

75F® Dynamic Chill Water Balancing™

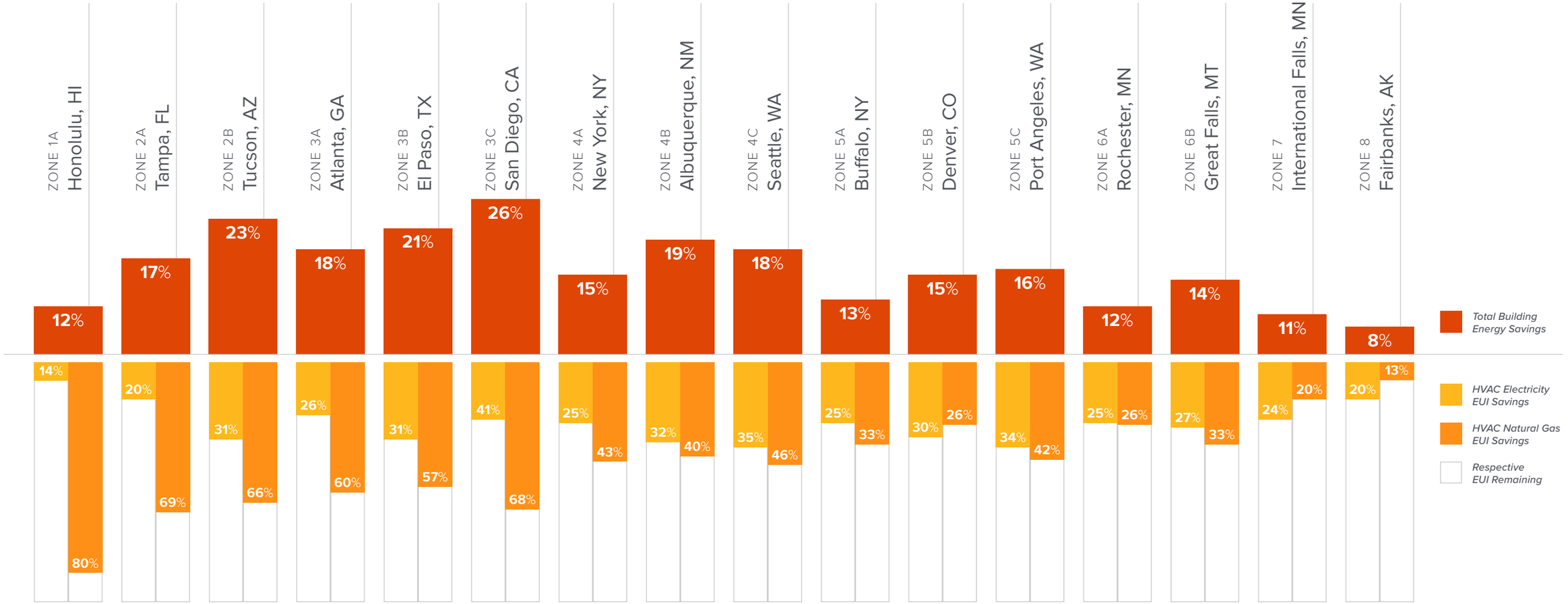
75F Dynamic Chilled Water Balancing is an end-to-end solution for chilled water systems. 75F sensors in each zone gather millions of data points daily and communicate these points via a 900 MHz wireless mesh network to the 75F® Central Control Unit™ — giving users the ability to monitor the inlet and outlet temperatures, chilled water flow rates, and BTU energy consumption across the line. 75F's system understands, analyzes, and optimizes the overall performance of the HVAC system under various conditions, thereby driving significant energy savings at an AHU level and at the chiller plant.

75F designs and manufactures the world's leading IoT-based Building Management System, an out-of-the-box, vertically integrated solution that is more affordable and easier to deploy than anything on the market today. The company leverages IoT, Cloud Computing and Machine Learning for data-driven, proactive building intelligence and controls for HVAC and lighting optimization. Investors include some of the biggest names in energy and technology. 75F's mission is to improve occupant productivity through enhanced comfort and indoor air quality — all while saving energy.

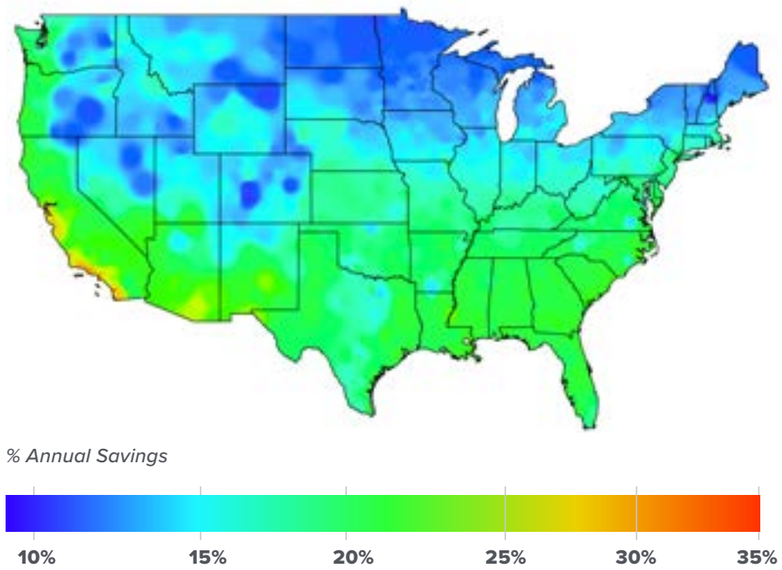
75F® Outside Air Optimization™

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 the required ventilation of outdoor air leveraging additional sensors and optimized setpoints.
- **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.


ZONE 1A Honolulu, HI
12%
14%
80%
ZONE 2A Tampa, FL
17%
20%
69%
ZONE 2B Tucson, AZ
23%
31%
66%
ZONE 3A Atlanta, GA
18%
26%
60%
ZONE 3B El Paso, TX
21%
31%
57%
ZONE 3C San Diego, CA
26%
41%
68%
ZONE 4A New York, NY
15%
25%
43%
ZONE 4B Albuquerque, NM
19%
32%
40%
ZONE 4C Seattle, WA
18%
35%
46%
ZONE 5A Buffalo, NY
13%
25%
33%
ZONE 5B Denver, CO
15%
30%
26%
ZONE 5C Port Angeles, WA
16%
34%
42%
ZONE 6A Rochester, MN
12%
25%
26%
ZONE 6B Great Falls, MT
14%
27%
33%
ZONE 7 International Falls, MN
11%
24%
20%
ZONE 8 Fairbanks, AK
8%
20%
13%
Total Building Energy Savings
HVAC Electricity EUI Savings
HVAC Natural Gas EUI Savings
Respective EUI Remaining

ANNUAL SAVINGS BY CLIMATE ZONE



ZONE 1A
Honolulu, HI
14% | 80%
12.0% *Total Building Energy Savings*

ZONE 2A
Tampa, FL
20% | 69%
16.8% *Total Building Energy Savings*

ZONE 2B
Tucson, AZ
31% | 66%
23.2% *Total Building Energy Savings*

ZONE 3A
Atlanta, GA
26% | 60%
18.1% *Total Building Energy Savings*

ZONE 3B
El Paso, TX
31% | 57%
21.2% *Total Building Energy Savings*

ZONE 3C
San Diego, CA
41% | 68%
26.1% *Total Building Energy Savings*

ZONE 4A
New York, NY
25% | 43%
15.1% *Total Building Energy Savings*

ZONE 4B
Albuquerque, NM
32% | 40%
18.5% *Total Building Energy Savings*

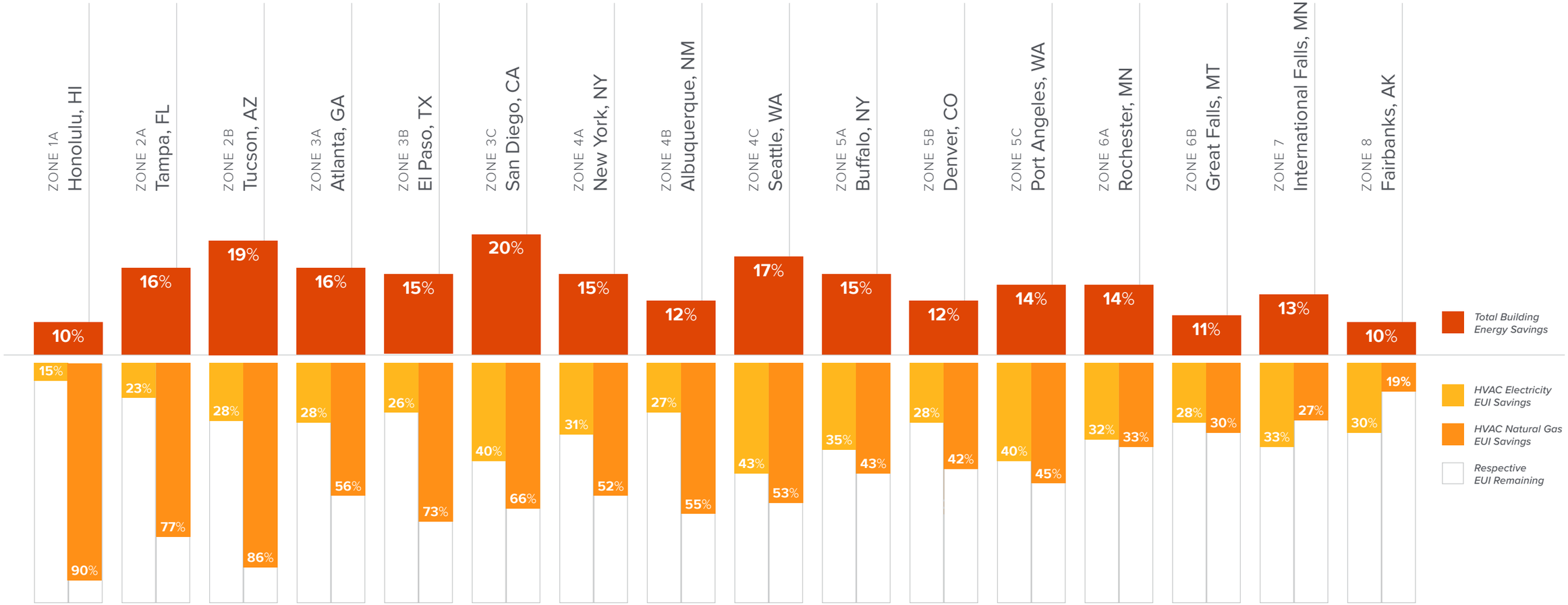
ZONE 4C
Seatlle, WA
35% | 46%
18.0% *Total Building Energy Savings*

ZONE 5A
Buffalo, NY
25% | 33%
13.2% *Total Building Energy Savings*

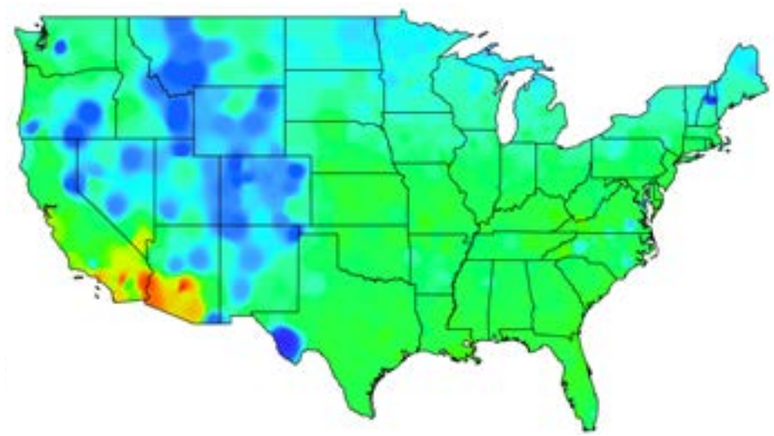
ZONE 5B
Denver, CO
30% | 26%
14.6% *Total Building Energy Savings*

HVAC Electricity EUI Savings

HVAC Natural Gas EUI Savings


ZONE 1A Honolulu, HI
10%
15%
90%
ZONE 2A Tampa, FL
16%
23%
77%
ZONE 2B Tucson, AZ
19%
28%
86%
ZONE 3A Atlanta, GA
16%
28%
56%
ZONE 3B El Paso, TX
15%
26%
73%
ZONE 3C San Diego, CA
20%
40%
66%
ZONE 4A New York, NY
15%
31%
52%
ZONE 4B Albuquerque, NM
12%
27%
55%
ZONE 4C Seattle, WA
17%
43%
53%
ZONE 5A Buffalo, NY
15%
35%
43%
ZONE 5B Denver, CO
12%
28%
42%
ZONE 5C Port Angeles, WA
14%
40%
45%
ZONE 6A Rochester, MN
14%
32%
33%
ZONE 6B Great Falls, MT
11%
28%
30%
ZONE 7 International Falls, MN
13%
33%
27%
ZONE 8 Fairbanks, AK
10%
30%
19%
Total Building Energy Savings
HVAC Electricity EUI Savings
HVAC Natural Gas EUI Savings
Respective EUI Remaining

ANNUAL SAVINGS BY CLIMATE ZONE



% Annual Savings

10% 15% 20% 25%

ZONE 1A
Honolulu, HI
15% 90%
10.3% *Total Building Energy Savings*

ZONE 2A
Tampa, FL
23% 77%
16.0% *Total Building Energy Savings*

ZONE 2B
Tucson, AZ
28% 86%
19.4% *Total Building Energy Savings*

ZONE 3A
Atlanta, GA
28% 56%
15.7% *Total Building Energy Savings*

ZONE 3B
El Paso, TX
26% 73%
15.1% *Total Building Energy Savings*

ZONE 3C
San Diego, CA
40% 66%
20.2% *Total Building Energy Savings*

ZONE 4A
New York, NY
31% 52%
15.3% *Total Building Energy Savings*

ZONE 4B
Albuquerque, NM
27% 55%
12.3% *Total Building Energy Savings*

ZONE 4C
Seatlle, WA
43% 53%
17.0% *Total Building Energy Savings*

ZONE 5A
Buffalo, NY
35% 43%
14.8% *Total Building Energy Savings*

ZONE 5B
Denver, CO
28% 42%
11.7% *Total Building Energy Savings*

HVAC Electricity EUI Savings

HVAC Natural Gas EUI Savings

CONCLUSION

This analysis shows significant savings from 75F® Outside Air Optimization™ and 75F® Dynamic Chill Water Balancing™ sequences in large hotels, particularly on the west coast and the southern half of the country. Retrofit large hotels have the potential for greatest efficiency improvements in this report with savings of up to 26% total building energy use in representative cities compared to 20% in new build use cases. These higher numbers are typically found in the aforementioned areas, though new construction buildings also see strong energy savings in the northeast comparatively. Where energy savings are lowest in the Rocky Mountains area for new builds and the Midwest for retrofits, total building energy savings still tend to be in the 10% range.

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