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### Energy Efficiency in U.S. Residential Rental Housing: Adoption Rates and Impact on Rent

#### OBJECTIVES:

The goal of this research is to determine for a diversity of cities in the U.S.:

- (i): What are the **adoption rates of energy efficiency** features in rental properties?
- (ii): Does having energy efficiency features in rental properties **demand rental premiums** in rental asking prices?
- (iii): Is there a relationship between energy efficiency premiums and *location-specific* environmental conditions?

This is accomplished through collection and analysis of approximately **169,000 rental property listing 10 cities** in the U.S.

#### BACKGROUND:

There are *118 million residential housing units* in the U.S.; **43.7 million rental homes (37%)**

The **“energy efficiency gap”** between possible savings and actual realized savings in buildings is particularly significant in the rental sector, due to the **“split-incentive”** phenomenon

Rental property owners need **additional motivation and tangible benefits** to invest in energy efficiency to reduce the energy efficiency gap

There have been a number of studies in European countries on the impact of energy efficiency on rent, but none in the U.S.



Types of rental housing studied

#### METHODOLOGY:

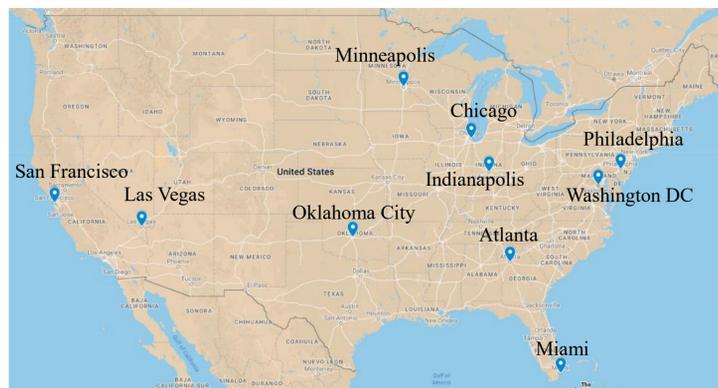
- 1) **Data collection** via online data scraping of Craigslist in 10 cities on select days over a 2 month period (Dec '16-Jan '17)
- 2) **Data cleaning and quality control**: removed posting with missing pricing, or other key variables, or values that were unreasonable, resulting in 36,827 postings in 10 cities

City	Population estimate (million) <sup>1</sup>	Geographic Region <sup>2</sup>	ASHRAE Climate Region <sup>3</sup>	Median Rent One Bedroom (dollars) <sup>4</sup>	Avg. Monthly Residential Site Consumption (all fuels, kWh) <sup>5</sup>	Avg. Electricity Rate (\$/kWh) <sup>6</sup>
Atlanta	5.79	South Atlantic	3A	1,387	2,185	10.86
Chicago	9.51	East North Central	5A	1,595	2,808	11.27
Washington DC	6.10	South Atlantic	4A	2,172	2,171	12.37
Indianapolis	2.00	East North Central	5A	732	2,564	11.28
Las Vegas	2.16	Mountain	3B	875	2,080	11.55
Miami	6.07	South Atlantic	1A	2,000	1,360	11.54
Minneapolis	3.55	West North Central	6A	1,435	2,759	12.13
Oklahoma City	1.37	West South Central	3A	650	2,017	9.09
Philadelphia	6.07	Middle Atlantic	4A	1,295	2,354	13.97
San Francisco	4.66	Pacific	3B	3,600	1,502	18.44

- 3) **Identification of key energy efficiency terms & adoption rates in listings**: five categories of energy efficiency terms and phrases identified through manual and automated searching method, percentages of total listings calculated

- General energy efficiency terms**: energy efficient, energy saving, energy star, energystar, high efficiency, LEED, high efficiency, eco friendly, eco-friendly
- HVAC**: programmable thermostat, smart thermostat, electronic thermostat, nest learning thermostat, efficient heating, energy efficient HVAC, efficient air conditioning
- Appliances**: energy star appliances, energystar appliances, efficient appliances, energy star stainless steel appliances, new appliances
- Lighting**: LED, CFL, natural light, big windows, large windows
- Windows/Building Envelope**: low-e windows, energy efficient windows, dual pane windows, double pane windows, thermal windows, no drafty windows

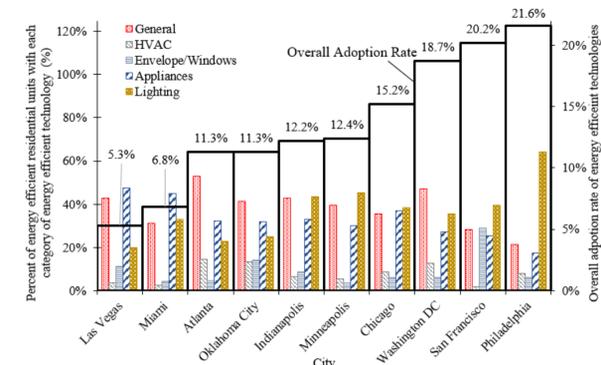
- 4) **Determination of rental premiums for energy efficient features**: Propensity score matching method was used to compare the rental prices of properties with energy efficient features and those without
- 5) **Determination of sub-category trends**:
  - *Housing type*: apartments, multi-family, single family
  - *Energy efficiency categories*: HVAC, appliances, lighting, windows/building envelope



Locations of 10 cities of study

#### RESULTS

##### Adoption Rates:



Adoption rates ranged from **5.3%-21.6%**

**Lighting and appliances (lower cost) are more common**; HVAC and envelope are less

Features that **double as energy efficient** and improved appearance, convenience, comfort (e.g. energy efficient stainless steel appliances) are more common

**Higher adoption rates** in cities with:

- Higher rental prices
- Higher average utility rates
- Comparably liberal-leaning cities

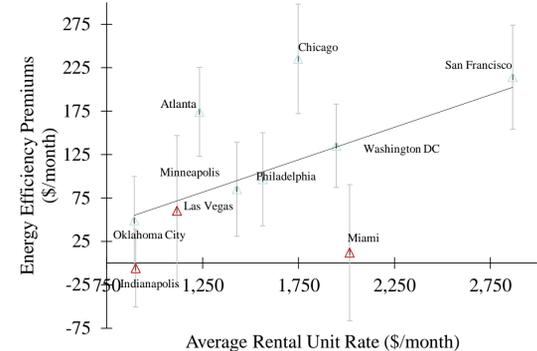
##### Energy Efficiency Premiums:

Energy efficient features general demand a premium of **6%-14%** (statically significant)

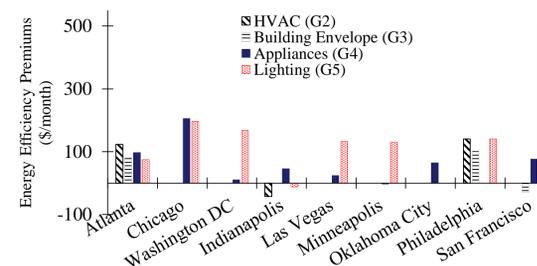
San Francisco & Chicago: highest % increase

Atlanta & Chicago: highest \$ increase

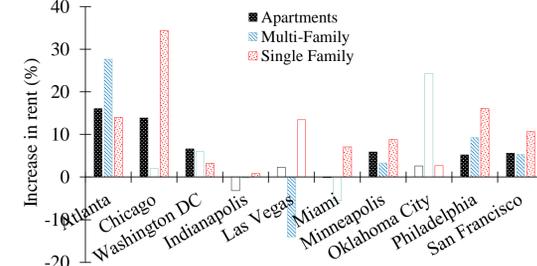
Individual efficient features are demand premiums  
**Single family homes demand higher premiums** compared to multi-family or apartments



##### Premiums by Energy Efficiency Type



##### Premiums by Housing Type



#### CONCLUSIONS & FUTURE WORK

Results provide motivation to both private and company-type landlords to invest in residential rental properties energy efficiency due to non-energy benefits (monetary)

The energy savings associated with the energy efficiency investments should be studied to determine the overall impact on the renters; the willingness to pay for such features should be studied further