400 RETROFITTED BUNGALOWS: AN ENERGY USE ANALYSIS

Affordable Comfort Inc. (ACI) Conference
May 2, 2013
Denver, CO
Intro

- Emily Bailey Burns – Grants Manager, HCBA
- Rachel Scheu—Director of Research, CNT Energy

CNT/HCBA Collaboration
- Energy$avers Program
- Utility Bill Analysis
- Findings and Case Studies
- Next Steps
Intro

- Sneak Peek
  - Bungalows are inefficient
  - Energy savings lower than anticipated
  - Highest savings found in 2-4 person households
HCBA Overview

- Who we are, what we do
- Bungalow characteristics (size, age, construction, systems, etc)
- Why bungalows are important
HCBA Overview

- Bungalow Development
Bungalow Characteristics

- Built between 1910 - 1940
- One and one half stories
- Face brick with stone trim
- Low-pitched roof with overhang
- Rectangular shape: narrow at the front and rear ends, longer on the sides
- Generous windows
- Full basement
- Offset front entrance, or side entrance
Why are bungalows important?

- 1/3 of single family housing stock
- 80,000 Constructed
- How do we reach them?
## Bungalow Tracking & Identification

<table>
<thead>
<tr>
<th>Township</th>
<th>PIN</th>
<th>NhId Tax Code</th>
<th>Land Assessed Value</th>
<th>Bldg Assessed Value</th>
<th>Prior Bldg Assessed Value</th>
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<th>Use</th>
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<th># of Apts</th>
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<th># of Full Baths</th>
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Bungalow Tracking & Identification
Bungalow Tracking & Identification
Energy$avers Grant

Did you know that you live in a Historic Chicago Bungalow?

BE COMFORTABLE & SAVE MONEY
FREE energy efficiency programs and other benefits may be available to you!

www.chicagobungalow.org

HISTORIC CHICAGO BUNGALOW ASSOCIATION
Energy$avers Grant

- History of Grant and Funding
  - Established in 2008
  - Subsidized Retrofits
  - Leverage funding sources
    - Peoples Energy Settlement Funds
    - IL Department of Commerce Economic and Opportunity (DCEO)
    - Energy Impact Illinois
    - Peoples Energy Rebate
Energy$avers Grant

- Homeowner Eligibility

<table>
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<tr>
<th>Household Size</th>
<th>Area Median Income 2013 (Effective December 11, 2012)</th>
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<tbody>
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<td>50%</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>4</td>
<td>$38,800</td>
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<td>$39,750</td>
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<td>6</td>
<td>$42,700</td>
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<tr>
<td>7</td>
<td>$45,650</td>
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<tr>
<td>8</td>
<td>$49,800</td>
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</table>

Please a copy of income verification documents for each member of the household age 19 and above:

3 months or 90 days of pay stubs, W-2 forms, Social Security/Pension/Disability payment statements, unemployment documents or letter/statement of unemployment, etc.
Typical Retrofit Recipients

Number of Energy$avers Recipients by Age

- 20-29: 1%
- 30-39: 10%
- 40-49: 17%
- 50-59: 23%
- 60-69: 23%
- 70-79: 17%
- 80+: 9%

*Information based on the 307 Energy$avers Recipients 2010-2013
Typical Retrofit Recipients

Ethnic Make Up of Energy$avers Recipients

- African American: 74%
- Caucasian: 11%
- Hispanic: 6%
- Asian/Pacific Islander: 1%
- American Indian: 0%
- No Information: 8%

*Information based on the 307 Energy$avers Recipients 2010-2013
Energy$avers Grant

- **Typical Retrofit Recipients**

  **Number of Energy$avers Recipients By Household Size**

  - 1 Person Household: 33%
  - 2 Person Household: 28%
  - 3 Person Household: 16%
  - 4 Person Household: 12%
  - 5 Person Household: 6%
  - 6+ Person Household: 5%

*Information based on the 307 Energy$avers Recipients 2010-2013*
Energy$avers Grant

□ Typical Retrofit Recipients

Number of Recipients by Household Size and Age of Applicant (Head of Household)

- Head-of-household Age Range
  - 34-44
  - 45-54
  - 55-64
  - 65+ Years

*Information based on the 307 Energy$avers Recipients 2010-2013

HISTORIC CHICAGO BUNGALOW ASSOCIATION
Energy$avers Grant

Typical Retrofit Recipients

Number of Recipients with 50% AMI or Less by Household Size and Age

- Head-of-household Age Range
  - 65+
  - 55-64
  - 45-54
  - 34-44

*Information based on the 307 Energy$avers Recipients 2010-2013 at or below 50% AMI
Energy$avers Grant

- Measures Installed
Energy$avers Grant

- Measures Installed: Air sealing
  - Outer-rim plate gap

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Air sealing
  - Outer-rim plate gap

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Air sealing
  - Plumbing, Chimney & Mechanical Penetrations

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Air sealing
  - Plumbing, Chimney & Mechanical Penetrations

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Air sealing
- Weatherstrip and sweep

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Insulation (unfinished attic)

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Insulation (finished attic)

Photo credit: DNR Construction
Energy$avers Grant

- Measures Installed: Insulation
Energy$avers Grant

- Measures Installed: Infiltration Reduction
• We help reduce energy usage and costs in **households, buildings, and communities**

• **Areas of expertise include:**
  – Dynamic pricing and smart grid
  – Energy-efficient, green, and healthy buildings
  – Regional energy planning

• **We manage programs in Illinois and consult nationally and internationally**
• An affiliate of the Center for Neighborhood Technology

• Other CNT affiliates include IGO CarSharing
Project Scope – HCBA Energy$avers

• Characteristics of the homes pre-retrofit
  – Energy use (gas + electricity)
• How this population of homes compares to other energy + housing data sets
• Program trends and patterns:
  – Savings
  – Measures
  – $ Spent
  – CFM50 reduction
  – HH Income
  – HH size
  – HVAC systems
  – Contractors
  – Geospatial distribution
1. Bungalows are energy intensive, especially gas intensive.

2. Sample is representative of larger CNT Energy & local databases. But different than national databases.

3. Pre-retrofit Gas usage distributed across city except for highest users.

4. Bungalows saved ~9% total energy use (kBtu) after retrofit.

5. Savers and non-savers are distributed across the city.

6. Weak correlation between energy savings & blower door reduction. (median CFM50 reduction = 41%)

7. Highest savers had highest pre-retrofit gas use.

8. 2-4 member households saved the most, while households with 5+ members saved the least.
Findings 1. Bungalows are energy intensive

Bungalows are ~10% more energy intensive per square foot than single family homes in Chicago

<table>
<thead>
<tr>
<th>Energy Use Intensity (kBtu/sf/yr)</th>
<th>Source: CNT Energy &amp; HCBA</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>HCBA Pre-retrofit n=307</td>
</tr>
<tr>
<td>Median</td>
<td>154</td>
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<tr>
<td>25th %</td>
<td>132</td>
</tr>
<tr>
<td>75th %</td>
<td>188</td>
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There are ~437,000 single family home in Chicago (2010)

Energy use intensity of Bungalows (pre-retrofit)

Electricity
Gas
Median

Homes (n=307)
Bungalows use a lot of gas (primarily for space heating)

Therms use in Bungalows (pre-retrofit)

- **Mean**: 1653.317226
- **StDev**: 199.41178464
- **N**: 370

**Median**: 1624 Therms (annual)

Homes (n=370)
Electricity Use in Bungalows

These Households Use Less Electricity than Typical US Household

Median = 7646 kWh

Homes (n=325)
Findings 2. This sample is representative of large local databases but...

<table>
<thead>
<tr>
<th>Energy Use Intensity (kBtu/sf/yr) Source: CNT Energy &amp; HCBA Datasets</th>
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<tr>
<td>HCBA Pre-retrofit n=307</td>
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<tr>
<td>75th %</td>
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<tr>
<td>IQR</td>
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Findings 2. ...but not represented well in national samples

- Bungalows consume 17.5% more natural gas than the Chicago median; 77% more than the five state region, 85% more than others in the climate region

<table>
<thead>
<tr>
<th></th>
<th>Therms/yr</th>
<th>Source: CNT Energy &amp; HCBA, RECS Datasets</th>
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<td>HCBA Pre-retrofit n=370</td>
<td>Chicago Single Family n= 200,037</td>
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<td>Mean</td>
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<td>1,437</td>
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<td>IQR</td>
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<td>555</td>
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Findings 3. Gas Usage Distributed Across City
Except for Highest Users (>2154 therms/yr)

Chicago single family = 1382 therms annual (median)
Findings 4. Bungalows reduced energy use 9% after retrofit

- 83% of homes reduced total energy use. (Range -25% to 46%; median = 8.97%)
  - 12% of savers saved >20% (31)
Gas Savings

- 83% of homes reduced gas use. (range -36% to 48%; median = 8.9%)
- 18% of savers saved >20% (55)
Findings 5. Savers and non-savers are distributed across city

Annual Therm Savings per bungalow (%)

- negative savings
- 0 - 5%
- 5 - 10%
- 10 - 15%
- 15 - 20%
- 20 - 25%
- 25 - 30%
Findings 6. Weak Savings correlation to CFM50 reduction

HH with CFM50 readings above the median pre-retrofit had higher gas savings

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<td><strong>N</strong></td>
<td>184</td>
<td>183</td>
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<tr>
<td><strong>Mean</strong></td>
<td>7.72%</td>
<td>10.86%</td>
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<tr>
<td><strong>Median</strong></td>
<td>7.31%</td>
<td>10.44%</td>
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Findings 7. Households that used more natural gas before the retrofit saved more

- Consider targeting highest gas use homes

Gas Savings% by pre-retrofit therms quartiles

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<th>Quartile</th>
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<tr>
<td>All</td>
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<tr>
<td>&lt;1389.46</td>
<td>6.64%</td>
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<tr>
<td>1389.46 to 1624.05</td>
<td>7.18%</td>
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<td>1624.05 to 1888.65</td>
<td>10.58%</td>
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<td>&gt;1888.65</td>
<td>10.80%</td>
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Median
Findings 8. 2 - 4 person households saved most, while households with 5+ members saved least.

Gas Savings (%) by Household Size

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<th>Household Size</th>
<th>Gas Savings (%)</th>
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<td>1</td>
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<td>2</td>
<td>10%</td>
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<td>3</td>
<td>13%</td>
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<tr>
<td>4</td>
<td>27%</td>
</tr>
<tr>
<td>5</td>
<td>16%</td>
</tr>
<tr>
<td>6+</td>
<td>7%</td>
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HCBA Participant household size

- 1: 32%
- 2: 27%
- 3: 16%
- 4: 13%
- 5: 7%
- 6+: 5%

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Case Studies

- Post Analysis Site Visits
  - Looked at high savers and negative savers
  - 7 site visits in May
  - Trends: changes in occupancy, time-at-home
    - Second Site Visit in June
    - Visited homes less likely to have:
      - Changes in occupancy
      - Changes in time-at-home
Case Studies

- Bobby F.
  - Blower door reduction 50%
  - High user= 1732 therms
  - Reduction of 29.3%
  - 80.4% Efficient Boiler
  - Temp. 73 always
  - Homeowner stated feeling more comfortable

Photo Source: Cook County Assessor
Case Studies

- Bettye P.
  - 45% reduction
  - 1781
  - 9.6% Therms savings
  - Boiler 83% eff.
    - Serviced every year
  - Temp. 73 always
  - Lower utility bills, but not necessarily more comfortable

Photo Source: Cook County Assessor
Case Studies

- Robert & Ida H.
  - 41% Reduction
  - 1242 Therms pre-retrofit
  - 13.2% Therm savings
  - Furnace at 90% efficiency; serviced every year
  - Consistent temp 66
  - Lower bills

Photo Source: Cook County Assessor
Conclusion & Next Steps

- Comprehensive Occupant Survey
- Continue to monitor post-retrofit utility results
- Look at potential program components:
  - Mechanical systems
  - Increased attention to measures that effect electricity usage
  - Potential advanced air sealing and insulation measures
Thank You!

Rachel Scheu
773-269-4032
rscheu@cntenergy.org

Emily Bailey Burns
312.675.0300 x16
eburns@chicagobungalow.org