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Energy Retrofit of Older Homes in San Antonio

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Historic Homeowner Fair
Office of Historic Preservation
City of San Antonio
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2012 – 13:

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Acknowledgements

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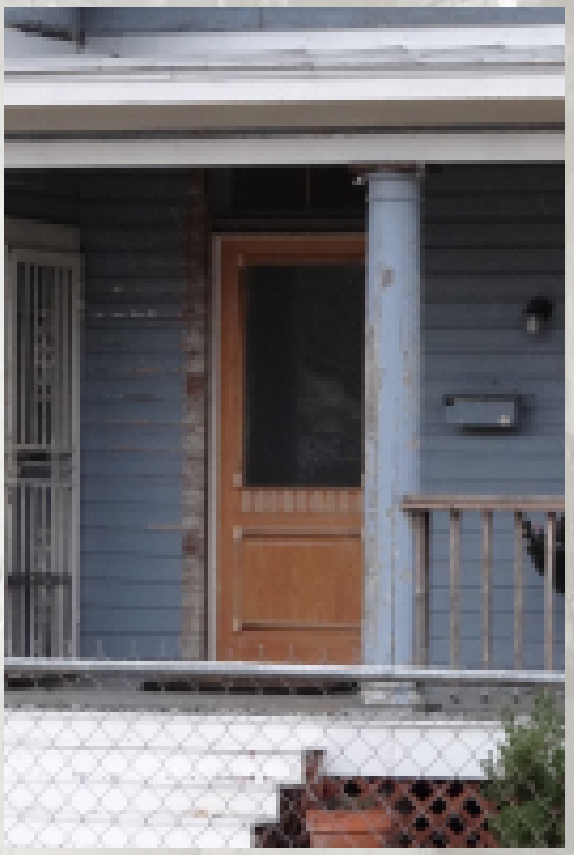
- 1/3 of all residential housing units in US (about 40 million) were built before 1960 *(American Housing Survey, 2008)*

- Potential energy savings from retrofit of older homes are substantial and undisputed

- Historic homes need thoughtful attention to the details and features that give them cultural heritage value.

- Where to find good information?



Front porch of case study

Research Background

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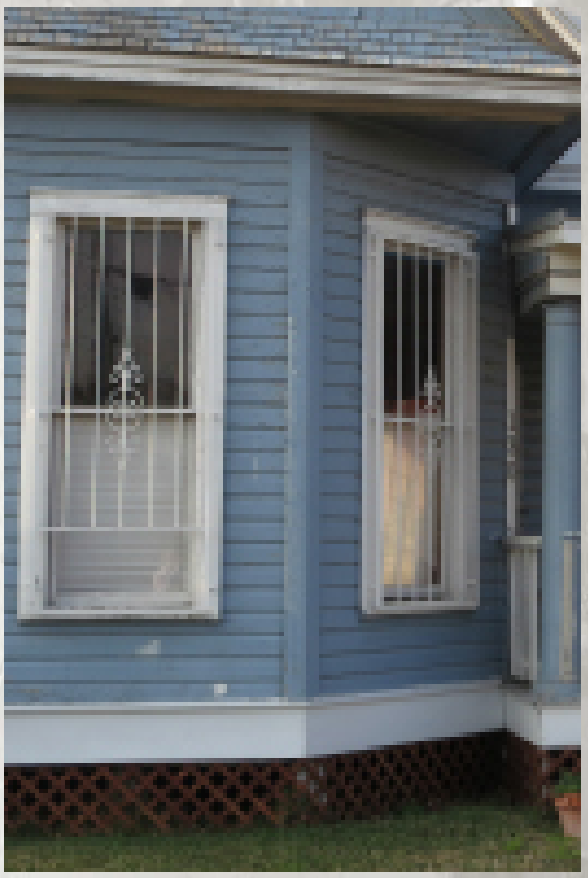
- An energy efficient home can reduce costs, conserve energy, and improve occupant health.
- Re-use of existing buildings:
  - retains the embodied energy of the construction, and
  - promotes healthy and strong communities due to continuity of cultural identity.
- Maintenance extends life of building materials, reducing the need for future replacement.



Historic single-glazed windows, case study home

Background Facts

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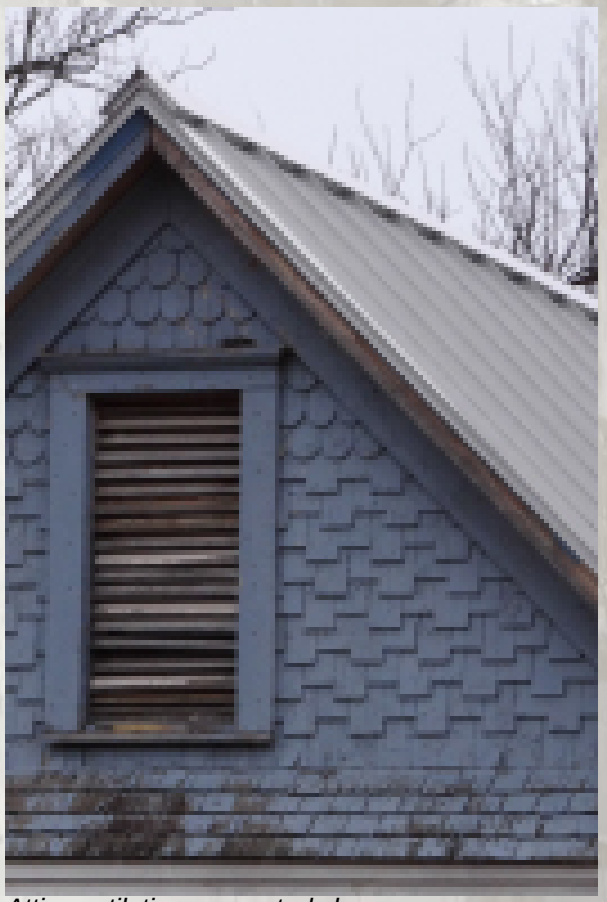
- Objectives:
  - Help people make good choices on maintenance and improvements
  - Retain integrity and identity of the historic district
  - Identify new (and traditional) methods of reducing energy consumption
  - Promote future research.



Attic ventilation, case study home

Project Objectives

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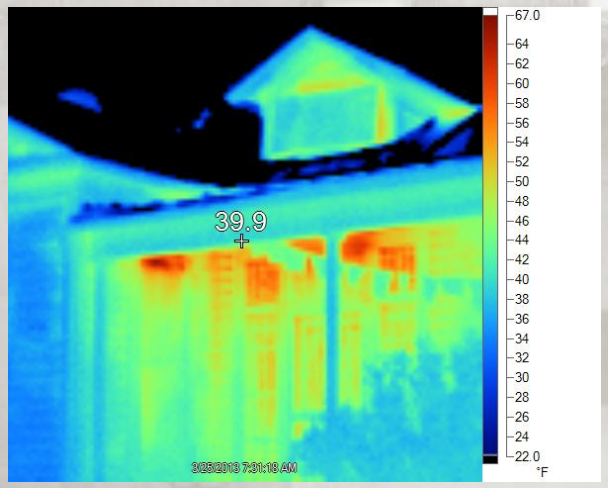
- Condition assessment,
- Modeling of case study homes,
- Simulation of proposed retrofits,
- Economic analysis,
- Develop recommendations,

Blower door test, case study home



Infiltration losses, case study home

Study Design and Methodology

- Four case studies included in 2012-13 study:

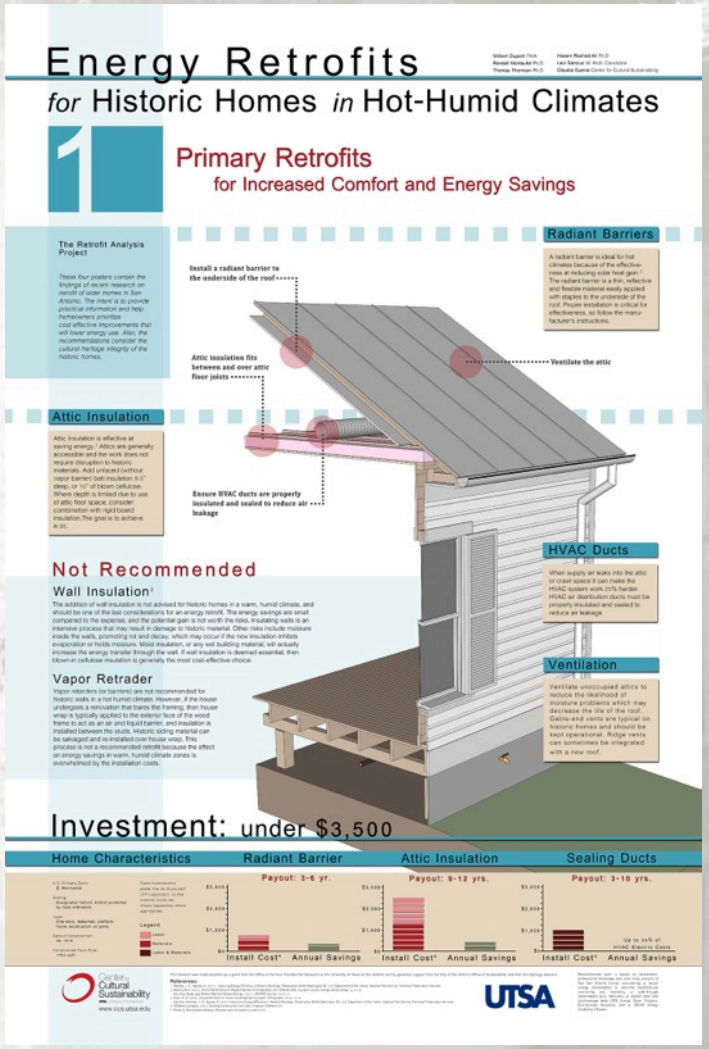
	Home 1	Home 2	Home 3	Home 4
Construction date	1904	1883 (?)	1919	1910
Size (CFA)	1,465 ft^2	1,567 ft^2	1713 ft^2	2099 ft^2
Number of stories	1	1	1.5	1
Number of users	1	4	2	4
Construction	Wood frame on wood piers, raised floor, sheet metal roof.	Wood frame on concrete piers, raised floor, sheet metal roof.	Wood frame on wood piers, raised floor, sheet metal roof.	Wood frame on concrete piers, raised floor, asphalt shingles.
Insulation status	No floor, some parts of walls and roof.	Wall and roof insulation added.	No walls or floor, insulated roof.	No wall or floor, some roof.
Glazing	Single glazing, wood frame, poor condition.	Single glazing, wood frame, poor condition.	Single glazing, wood frame, poor condition.	Single glazing, restored and new.
Cooling system	Central air, 12SEER	Central air, 14SEER	Central air, 10SEER	Central air, 16SEER
Heating system	Electric resistance	Gas furnace, 80 AFUE	Gas furnace, 80 AFUE	Electric resistance
Electric lighting	Incandescent	All CFL	75% CFL	Incandescent
Prior retrofits	Modern kitchen	HVAC; some insulation around openings; roof;	Insulation and radiant barrier in attic.	Window replacement and restoration.

Major characteristics of case study homes

Selection of Case Studies

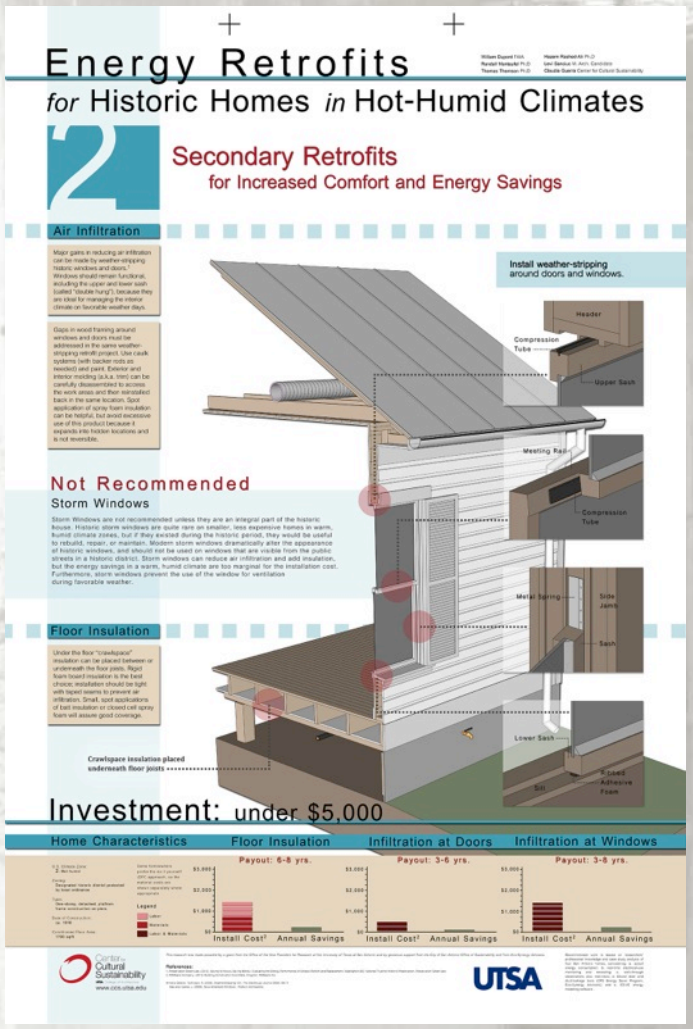
- Recommended Primary Retrofits:
  - Sealing ducts:
    - Initial cost approximately $1,000
    - Simple payback 3 -10 years
  - Attic insulation:
    - Initial cost approximately $2,500
    - Simple payback 9 – 12 years.
  - Radiant barrier:
    - Initial cost approximately $800
    - Simple payback 3 - 6 years.
- Not recommended
  - Wall insulation
  - Vapor retarder

* *Estimates based on 1700 square foot historic home (ca. 1910)*



Study Findings

- Recommended Secondary Retrofits:
  - Weather-stripping doors and windows:
    - Initial cost approximately $2,000
    - Simple payback 3 - 8 years
  - Floor insulation:
    - Initial cost approximately $1,500
    - Simply payback 6 – 8 years.
- Not recommended
  - Storm Windows

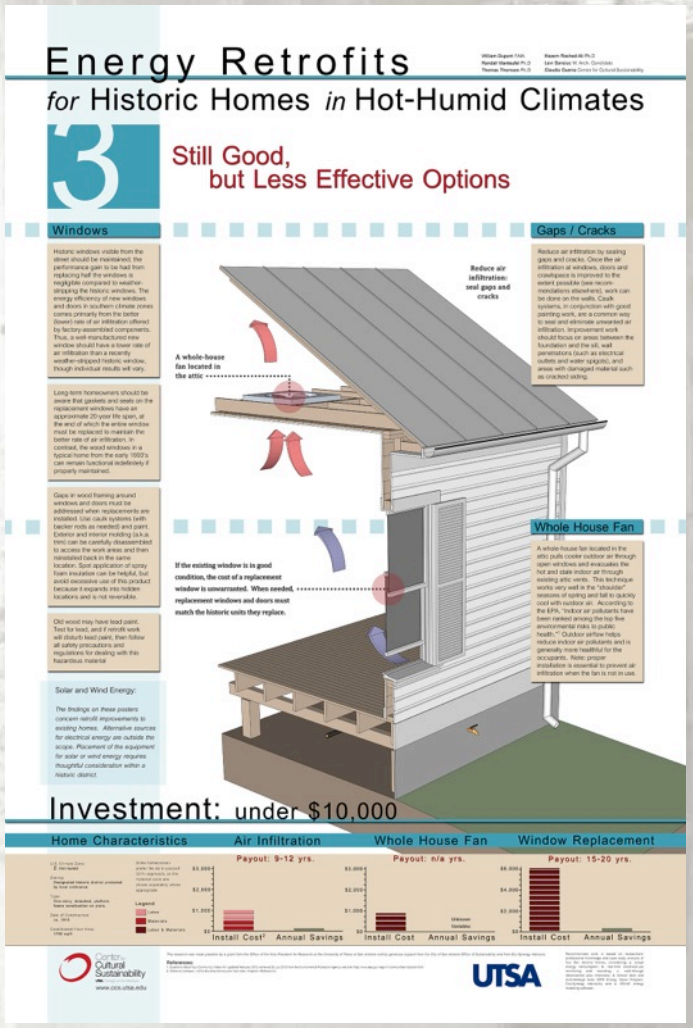


* *Estimates based on 1700 square foot historic home (ca. 1910)*

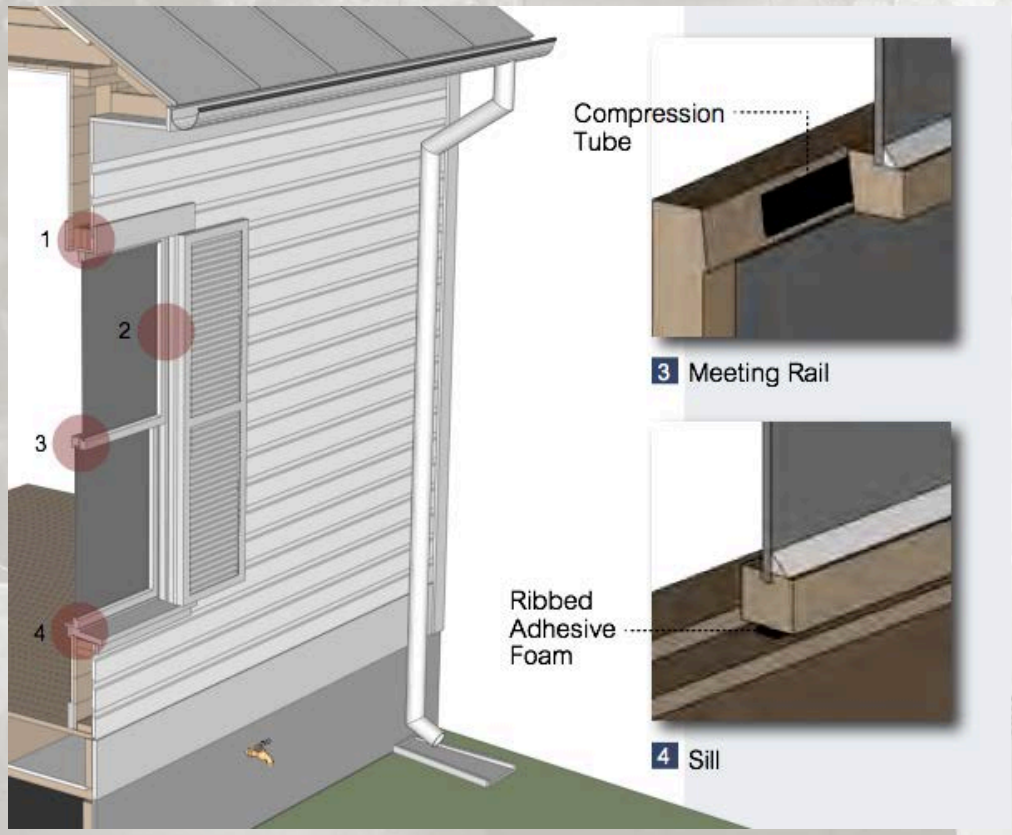
Study Findings

- Additional Possible Retrofits:
  - Whole house fans:
    - Initial cost approximately $1,000
  - Window replacement:
    - Initial cost approximately $5,000
    - Simple payback 15 – 20 years.
  - Reducing air infiltration:
    - Cost approximately $1,000

* *Estimates based on 1700 square foot historic home (ca. 1910)*



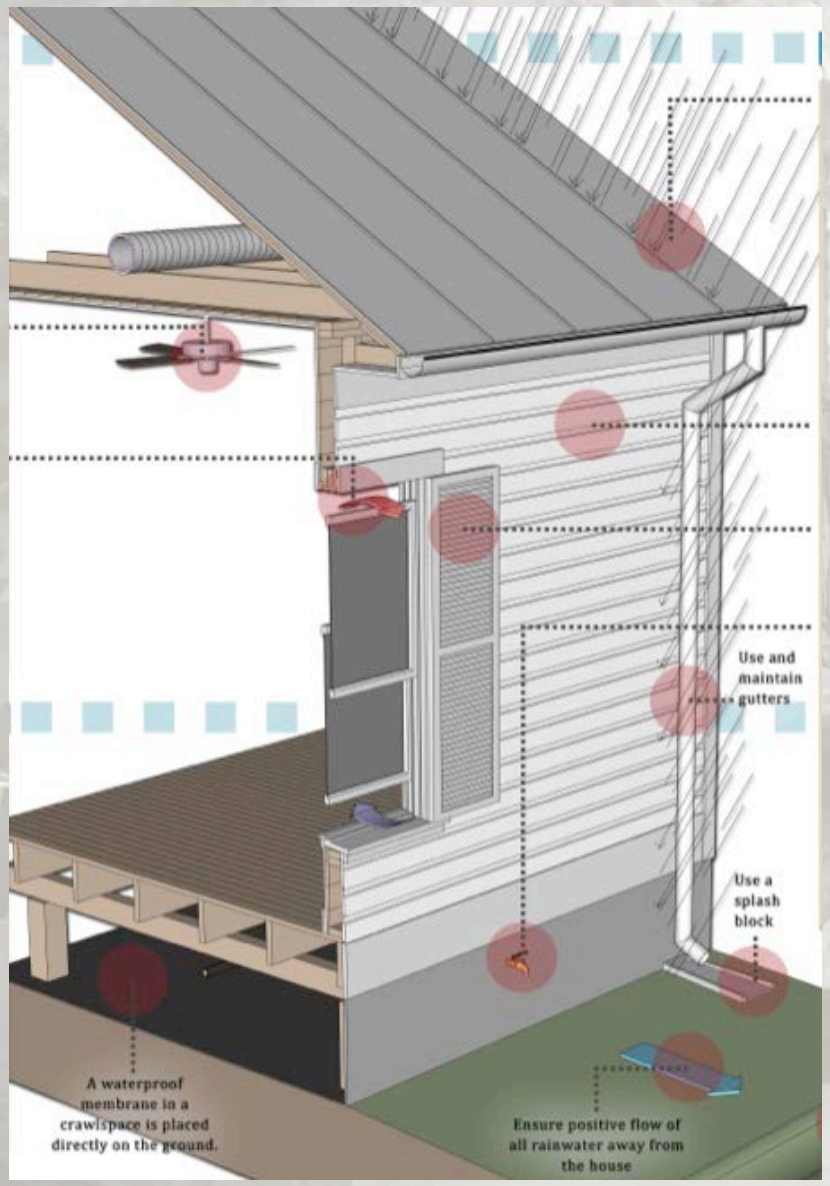
Study Findings



In a historic district, always maintain the historic windows that are visible from the street.

- Payback on a new window is almost equal to its lifespan.
- The performance gain of a new window versus weather-stripping of old is negligible.

Study Findings



INTERIOR:
- Program thermostat
- SEER 15, or better, HVAC
- Ceiling fans
- Natural ventilation
- Energy Star appliances
- CFL light bulbs

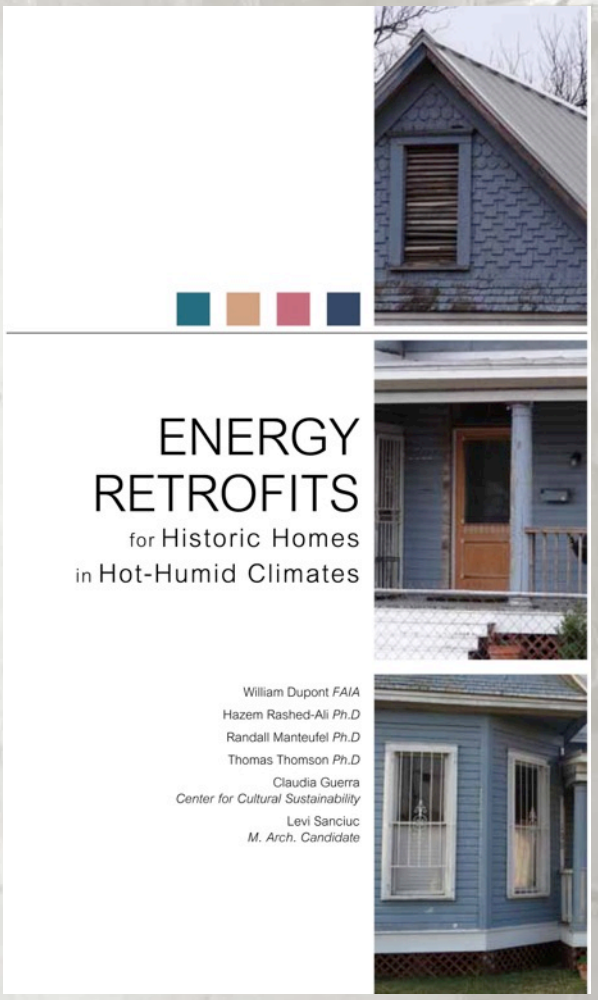
EXTERIOR:
- Shed water
- Use historic shade devices
- Repair leaks

SITE:
- Healthy shade trees
- Use porches, decks
- Good surface drainage

Best Practices and Basics

- Pamphlet developed for dissemination of results to historic home owners, Available at: www.ccs.utsa.edu/research

- Presentations by CCS research faculty and staff



Dissemination to Homeowners

- Analysis of Radiant Barrier retrofit
  - 10 case study homes,
  - Analysis before and after the retrofit
  - Volunteers needed
- Study Expansion:
  - Increase number of case studies,
  - Funds for improvements
  - Study other retrofit methods

Radiant barrier installed in attic

Current and Future Research

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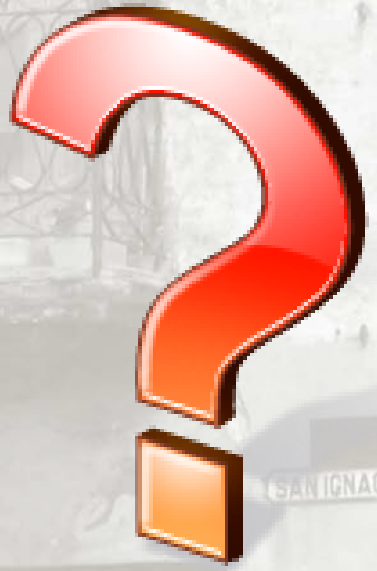

Questions

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- Regression analysis of San Antonio home sales prices show that older houses with green features **sell at a 9% premium** (when all other variables are constant).
  - Analysis based on period between October 2009 and December 2012,
  - House ages are 50 years and higher,
  - Analysis based on houses including at least one of the following:
    - green features,
    - energy efficiency features,
    - green certification.

Real Estate Data Analysis

- Sample description:

agec1	age		Green Certification	Green Features	EE Features	dsomegreen
	N	Mean				
1	3272	55.6	3	84	498	522
2	1563	64.4	3	42	245	256
3	666	75.0	2	23	99	105
4	730	85.0	2	23	118	120
5	361	99.4	3	21	58	64

- Regression Results/Parameter Estimates:

Variable	DF	Parameter Estimates	Standard Error	t Value	Pr > | t |
dsomegreen	1	0.09354	0.02968	3.15	0.0016
age	1	0.00078215	0.00051221	1.53	0.1268
SqFt	1	0.52847	0.01332	39.66	< 0.0001

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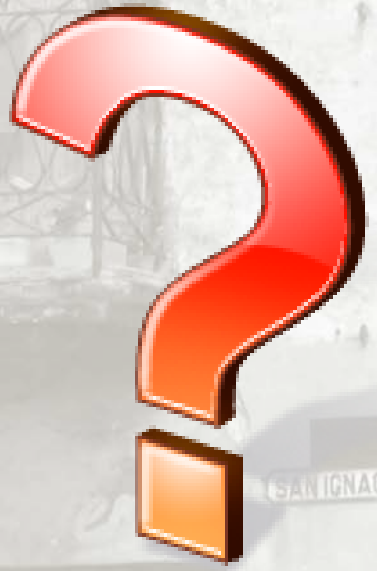

Questions

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