Presenters

- ***Kevin Pape**, Over-the-Rhine Foundation, Gray & Pape*
- ***Sanyog Rathod**, Over-the-Rhine Foundation, Sol Developments*
- ***Ed Lee**, Habitat for Humanity*

Project partners

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Over-the-Rhine Community Housing

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Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

Presentation Outline

- Presentation compares the eco-profile of renovating existing vacant historic homes to that of newly constructed homes.
- The purpose of this effort is to evaluate the environmental benefit of reusing existing vacant buildings in our historic neighborhoods.
- The presentation is based on an ongoing project of renovating two existing homes in the historic neighborhood of Over-the-Rhine, Cincinnati, Ohio.

Learning Objectives

- LCA - measure building performance over its life-cycle
- Evaluate environmental impact of construction assemblies over its manufacturing, operational and post-use life cycle.
- Historic buildings can be a better environmental choice for green developments.

Presenters

- ***Ed Lee***, *Habitat for Humanity*
- ***Kevin Pape***, *Over-the-Rhine Foundation, Gray & Pape*
- ***Sanyog Rathod***, *Over-the-Rhine Foundation, Sol Developments*

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Cincinnati Habitat for Humanity®

Over-the-Rhine Community Housing

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Acknowledgements

- ***Sol Developments*** *Team –*
  - *Erica Stauffer, Nate Steeber , Chris Dwyer*
- ***Gray & Pape, GBBN, Messer***

Ed Lee, *Cincinnati Habitat for Humanity*

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Habitat for Humanity Historic, LEED, Affordable Rehab

- 1000's of homes that need love
- Social Equity
  - Need for Green
  - Neighborhood Diversity
  - Home Ownership
- Model for others to follow

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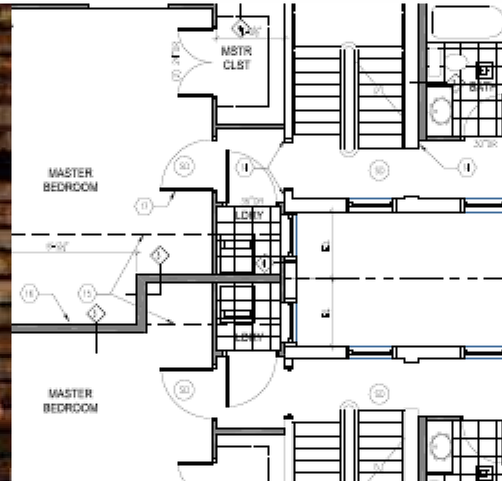
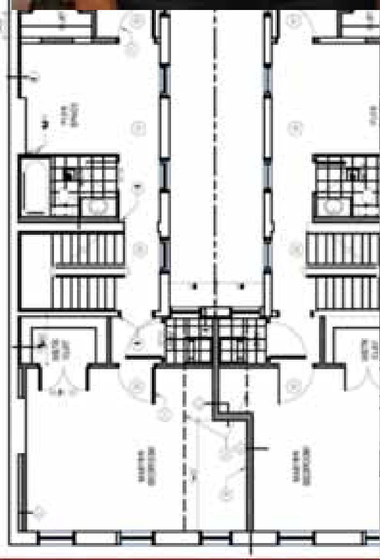
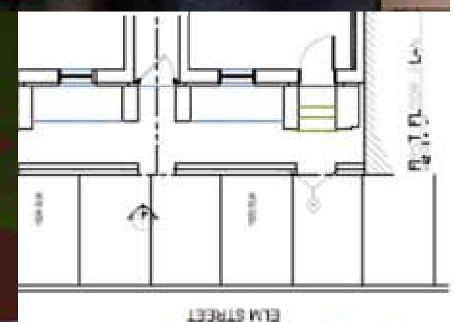
JaQuanna Moses Family



Nicole Holloway Family





Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Kevin Pape, *OTR Foundation, Gray & Pape*

Life Cycle Comparison

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Over-the-Rhine

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Over-the-Rhine's Italianate Architecture

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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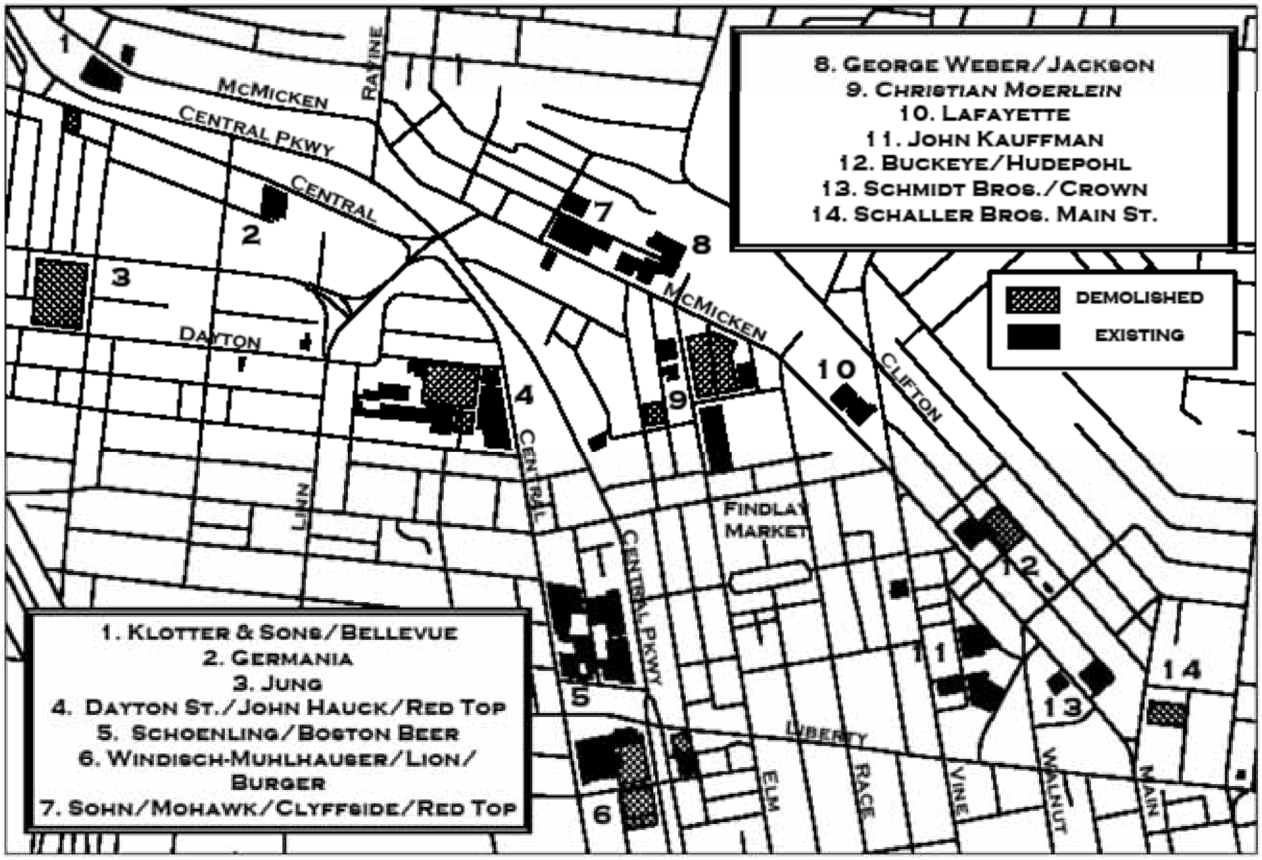
OTR Churches

Phillippus Kirche: Constructed in 1891 is most famous for its "hand to God" steeple top and its pipe organ donated by the famed Moerlein brewing family.

OTR Was Once Home to Almost 50 Breweries



Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Our Farmers' Market

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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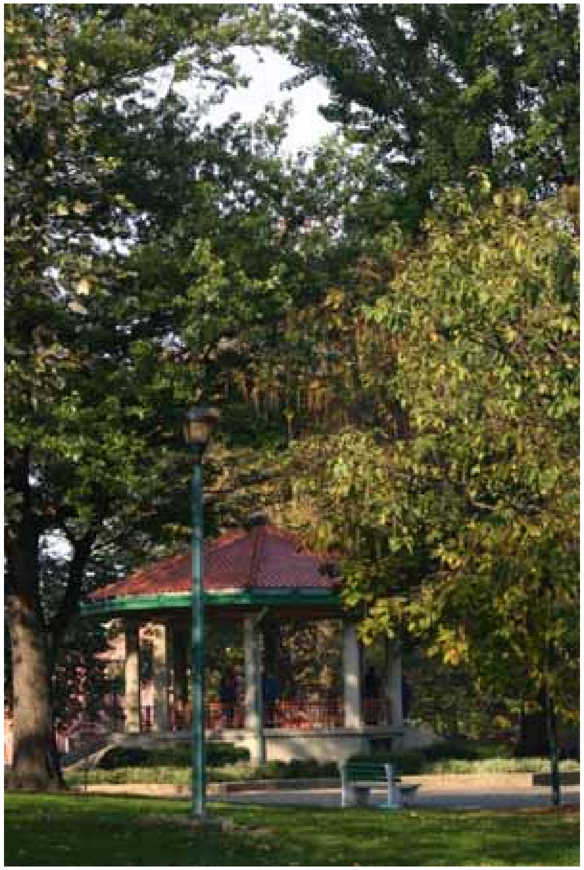
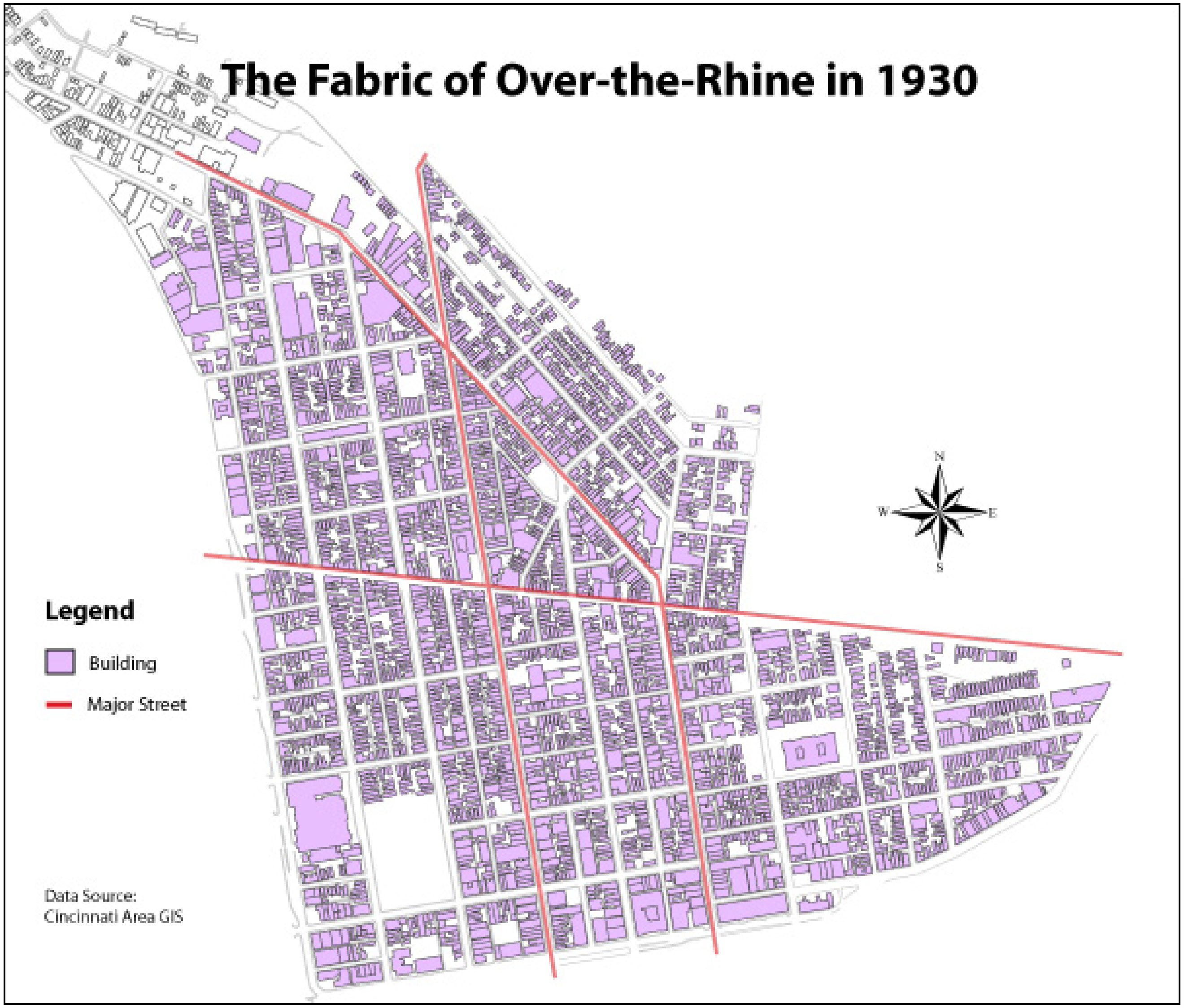
OTR Institutions

Music Hall: America's oldest, large-scale music hall, and home to one of America's oldest symphonies and opera companies. Site of presidential debates and numerous historic events.



Washington Park: Cincinnati's second oldest public park



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Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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24 W. Elder

1737 Elm

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Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

2008 Over-the-Rhine Green Historic Study

The project began with a common assumption:

- Historic preservation and green design have conflicting goals.

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

OVER THE RHINE FOUNDATION

Goal of the 2008 Study

Explore potential conflicts and commonalities between the goals of historic preservation and those of environmental preservation and determine:

- What genuine conflicts exist?
- Can we identify ways to overcome them?
- In what areas do “green” and historic share common values, design elements, and technique?
- Can green-historic be accomplished in a cost-effective manner?

Properties

Properties were chosen for more than prototypical reasons. They were also selected for containing both elements that we recognized as challenges and opportunities from the beginning.

The Properties

- 1313 Clay St., originally a stable for Brauer Dairy.
- 1420 Pleasant St., originally small tenement apartments.

The Properties

- 1700 Vine St., originally a storefront with residential units above it.
- 1202-1204 Main St., the Belmain Building, originally constructed as a hotel for vaudeville performers.

Relevant Findings

- Secretary of Interior Standards for Rehabilitation and LEED Green Building Certification can be achieved simultaneously in a cost-effective manner.
- OTR's inherent environmental benefits such as urban density, walkability reuse of existing buildings and infrastructure make it easier to attain higher levels of green certifications.
- Several character defining features of a historic buildings had a sustainable function. (Day-lit spaces, Operable windows, light wells, prismatic glass, door transoms, durable materials, natural ventilation)
- Current building codes need to adapt to facilitate both green practices and reuse of historic buildings.
- Proper communication can reduce project costs. Most "conflict" between meeting green certification and historic preservation result from mis-understanding or an inadequate understanding of options.

Visit www.otrfoundation.org for the complete 2008 OTR Green-Historic study.

Sanyog Rathod

OTR Foundation, Sol Developments

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Green Historic Study – Energy Modeling Objectives

- Determine if historic buildings can obtain the minimum energy performance necessary to attain LEED certification, without compromising its historic character.
- Assess if contributing historic characteristics of the exterior envelope such as single-pane windows, storefronts, exterior brick walls, and skylights can be preserved while pursuing LEED certification.

Life Cycle Comparison
HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Green Historic Study –
Energy Modeling Methodology

- **Belmain**

  OTR's prototypical mixed use buildings with single-pane wood windows, wood store fronts, brick exterior walls with plaster finish on the interior.

  Belmain also represents most OTR buildings with **shared party-walls**.

- **Clay Street**

  Unique in terms of its historic interior finish. Given its historic use as a stable the exterior brick walls were always exposed on the interior.




PARAMETERS

BELMAIN

	Historic Baseline	Model #1 Balanced	Model #2 Efficient
Target HERS Score		**85 Maximum**	**85 Maximum**
Perimeter walls	As is: Combination of Exposed brick and empty stud framed bump-outs.	Where exposed to ambient conditions - rigid foam R10 + open cell spray foam in stud cavities	Where exposed to ambient conditions - open cell foam R-15 + open cell spray foam in stud cavities
Windows	Double hung wood single paneU.9; SHGC.65	Storm windows over existing windows - U.58 ; SHGC .50; retail glazing U.40 SHGC.40	High end window replacements U.19; SHGC .27; retail glazing U.3 SHGC .3
Basement Clg.	Un-insulated	R10 continuous rigid foam on ceiling	R13 open cell foam to basement ceiling
Air Leakage	.35 air changes per hour	20% improvement - tighter windows	20% improvement - tighter windows
Ceiling	R30	Same	Same
Parti Walls	Building DOES abut other buildings	Same	Same

Minimum LEED requirements were used for following elements: HVAC System (SEER 13), Lighting, Appliances, Water Heater

Following elements of the building remained unchanged: Doors, Skylights

RESULTS	Historic Baseline	Model #1 Balanced	Model #2 Efficient
HERS Score Energy Performance	**102**	**85**	**79**
End-Use Annual Costs	**$17,965**	**$15,105**	**$14,526**
End-Use Energy Savings Annual	**-**	**$2,860**	**$3,439**
Installed Cost of Improvements	-	$41,265	$102,375
Annual Cash Flow	**-**	**($299)**	**($4,400)**

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Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

CLAY STREET

PARAMETERS

	Historic Baseline	Model #1 Balanced	Model #2 Efficient
Target HERS Score		**85 Maximum**	**85 Maximum**
Perimeter walls	Exposed brick	Exposed brick	Open cell foam R-15 behind drywall and on interior of brick
Windows	Double hung wood single paneU.9; SHGC.65	High end windows replacements U.19; SHGC .27	High end windows replacements U.19; SHGC .27
Floor above basement	Un-insulated slab	R25 continuous spray foam to ceiling	R13 open cell foam beneath slab
Air Leakage	.35 air changes per hour	20% improvement - tighter windows	20% improvement - tighter windows
HVAC	14 SEER heat pumps	Dual fuel heat pumps, 16 SEER	Same as historic
Ceiling	R30	R49	Same as historic
Water heaters	40 gal electric units	Tankless natural gas	Same as historic
Parti Walls	Building does NOT abut any other buildings	Same	Same

Minimum LEED requirements were used for following elements: Lighting, Appliances,

RESULTS	Historic Baseline	Model #1 Balanced	Model #2 Efficient
HERS Score Energy Performance	159	85	85
End-Use Annual Costs	**$12,899**	**$5,962**	**$6,409**
End-Use Energy Savings Annual	-	**$6,940**	**$6,492**
Installed Cost of Improvements	-	**$80,344**	**$90,117**
Annual Cash Flow	-	**$787**	**($409)**

Relevant Findings

- Energy simulation tools can help make balanced decision to preserve historic character while attaining overall energy efficiency.
- Conflicts primarily related to un-insulated walls and historic windows.
- Party walls contribute tremendously to energy efficiency due to minimized heat loss.
- Future areas of study – Quantify intrinsic sustainable value of OTR – urban density, community connectivity, walkability, public transportation, and reuse of infrastructure & existing buildings.

Visit www.otrfoundation.org for the complete 2008 OTR Green-Historic study.

Life Cycle Comparison

Approach

- Habitat's green historic renovation in OTR – a perfect canvas to conduct a Life-cycle comparison of historic versus new.

Objectives

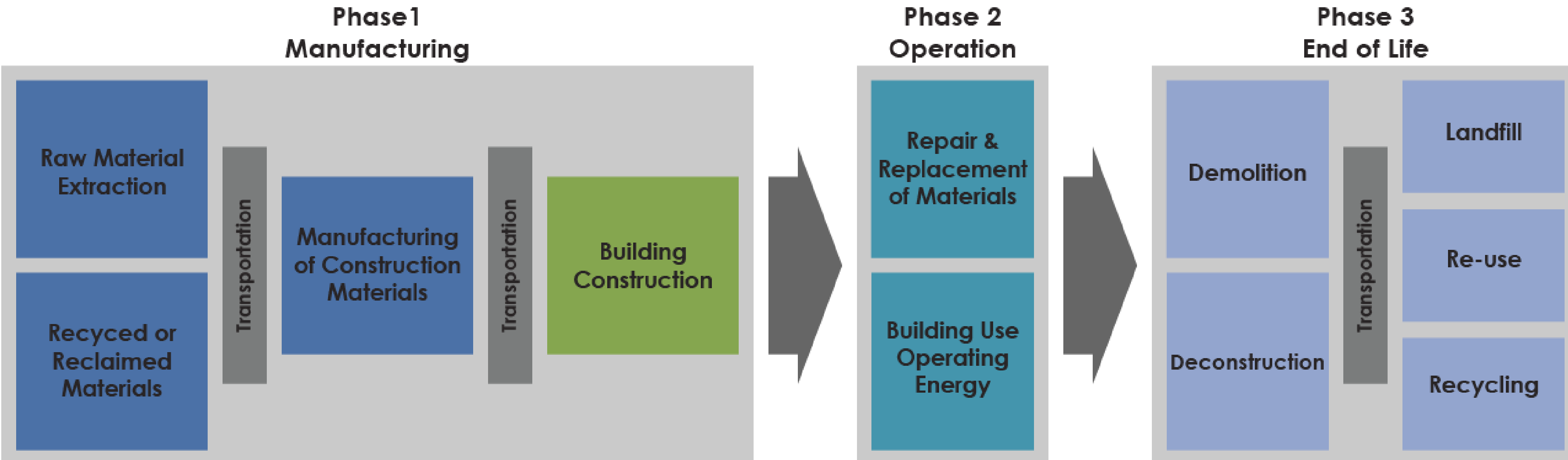
- Quantify the **head-start** historic buildings in OTR offer for sustainable developments in terms of building reuse and urban lifestyle.
- Quantify the amount of embodied energy saved by reusing an existing building.
- Compare the environmental benefits of historic renovation versus constructing new over all phases of the lifecycle.

Why Embodied Energy?




- Production of Building Materials involve an extensive network of extraction, processing and transportation steps. These steps pollute the air and water, destroy natural habitat and deplete natural resources.
- Construction and demolition waste comprise about 40% of the total solid waste stream in U.S (136 million tons per year). 43% of which is generated from residential sources. *2008 USGBC*
- People can live in a house for 10 years before the energy they use in it exceeds what went in to its components – steel, concrete, windows, flooring, drywall, wood – and its construction. *2006 worldchanging*

Building Life Cycle Phases



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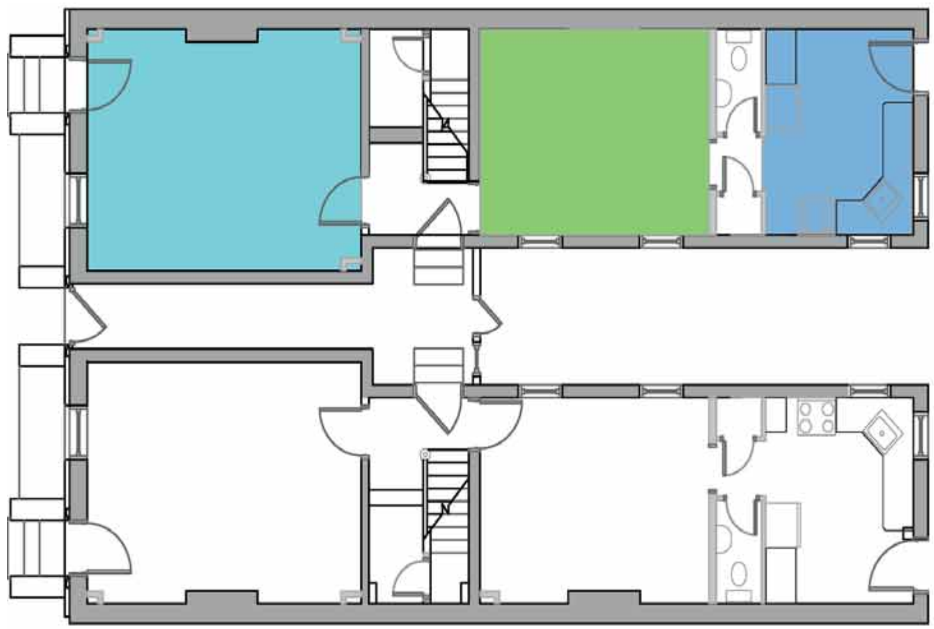
Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION



Elm Street
Historic Baseline

Habitat New Construction
Model 1

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Elm Street Historic-Green Considerations

- Built in 1857, vacant for over two decades.
- Exterior Restoration

Photo – Adam Nelson, Habitat

Elm Street Historic-Green Considerations

- Interior Historic characteristics preserved

Photos – Adam Nelson, Habitat

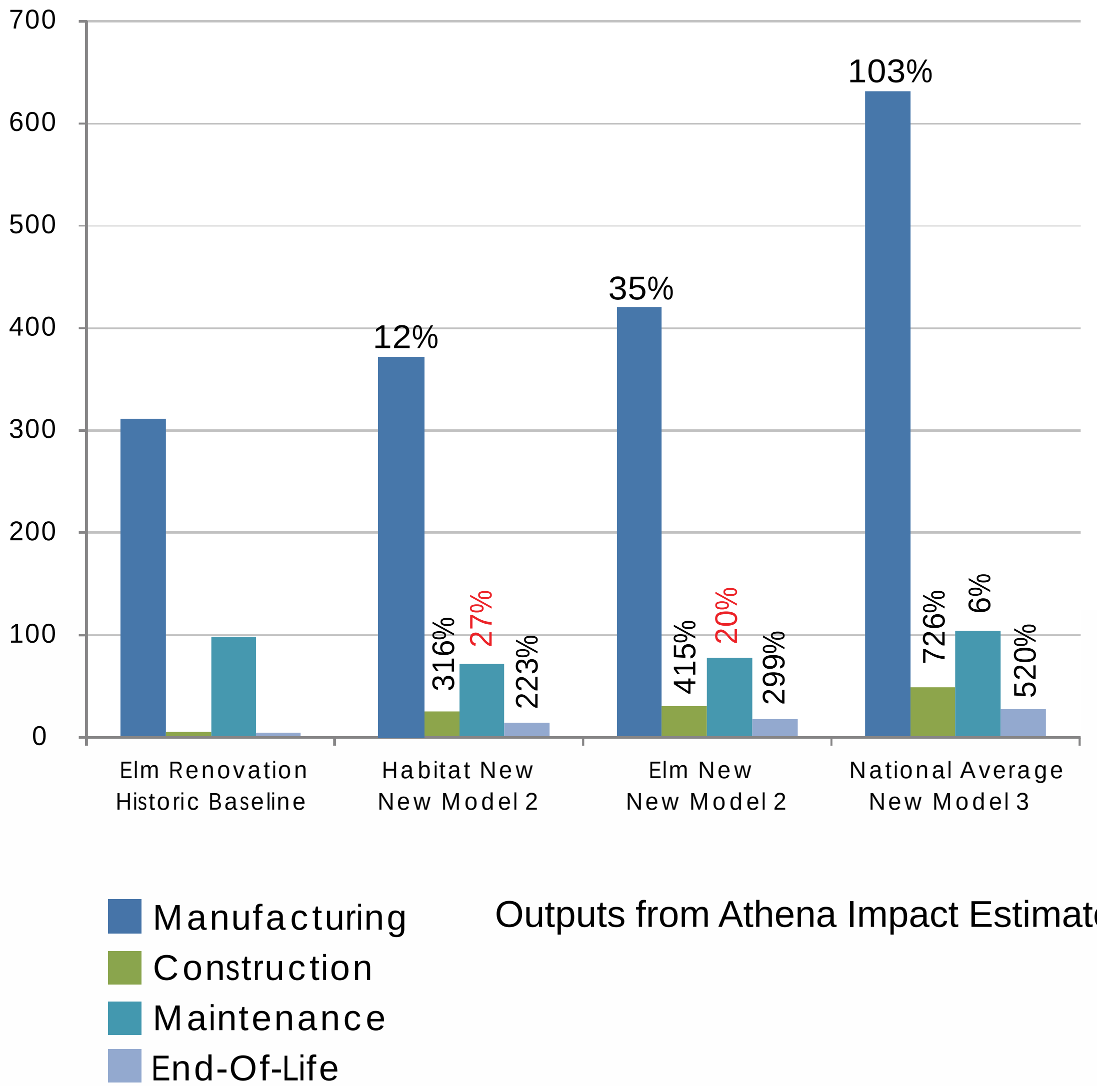
Construction Assembly Parameters

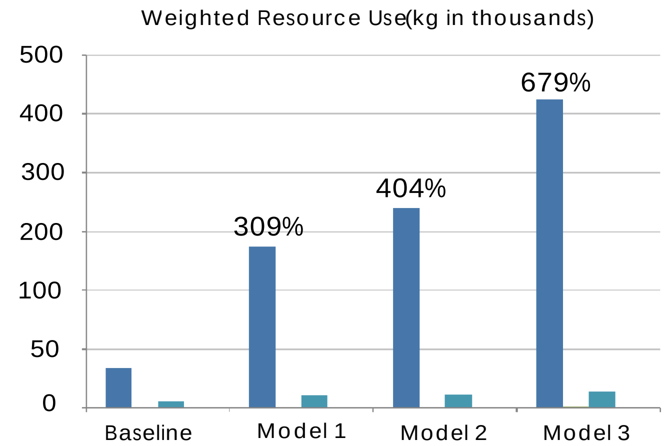
	Elm Renovation Historic Baseline	Habitat New New Model 1	Elm New New Model 2	National Average New Model 3
Home Conditioned Area	**1,827 SF**	**1,320 SF SF**	**1,827 SF**	**2,600 SF**
Basement	814 SF	660 SF	814 SF	1300 SF
Roof	New EPDM and sheathing over existing wood framing	Wood truss, Sheathing , Shingles over Roof felt.	Same	Same
Walls - Exterior	Existing Brick	Wood studs 2x4, Sheathing, Vinyl siding	Same	Same
Walls - Interior	Wood 2x4, GWB	Wood 2x4, GWB	Same	Same
Floors	Existing wood framing	Wood Joist 2x10 @ 16"OC	Same	Same
Slab	Existing slab	Poured Concrete 4" thk.	Same	Same
Foundation	Existing stone	Concrete Footing	Same	Same

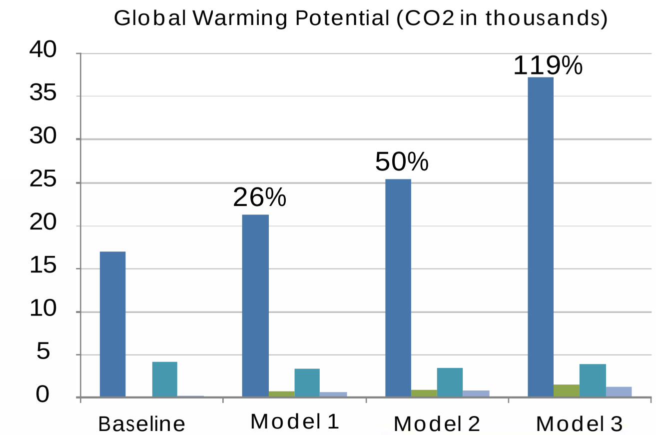
Operating Energy Simulation Parameters

	Elm Renovation Historic Baseline	Habitat New New Model 2	Elm New New Model 2	National Average New Model 3
HERS Score	**76**	**63**	**66**	**65**
LEED Certification	**YES**	**YES**	**YES**	**YES**
Home Conditioned Area	1,827 SF	1,320 SF SF	1,827 SF	2,600 SF
Basement	814 SF	660 SF	814 SF	1300 SF
Walls Above Grade	~R-6, 50% Existing brick & plaster; 50% new rigid over existing	R-16, 2x4 wood framed, batt insulation, with 3/4" **continuous rigid insulation sheathing**	Same as model 2	R-13, 2x4 wood framed, batt insulation
Basement Wall	Stone – no insulation	R-16 Batt	R-16 Batt	R-16 Batt
Floor above Basement	R30 Batt	none	none	none
Foundation Wall	none	R14 Rigid	R14 Rigid	R14 Rigid
Roof / Ceiling	R-56 Spray Foam	R-38 Batt	R-38 Batt	
Windows	New high performance, U-value 0.30; SHGC 0.30	Vinyl Clad, U-value 0.35; SHGC 0.35	Vinyl Clad, U-value 0.35; SHGC 0.35	Vinyl Clad, U-value 0.35; SHGC 0.35
Air Leakage	0.35 air changes per hour	Same	Same	Same
HVAC	Natural Gas Furnace 93 AFUE. AC SEER 13	Same	Same	Same
Water heaters	40 gal gas 0.58	Same	Same	Same
Lighting and Appliances	Energy Star Appliances and 100% of lighting is CFL; default U.S. statistics plug loads	Same	Same	Same

Results







Outputs from Athena Impact Estimator

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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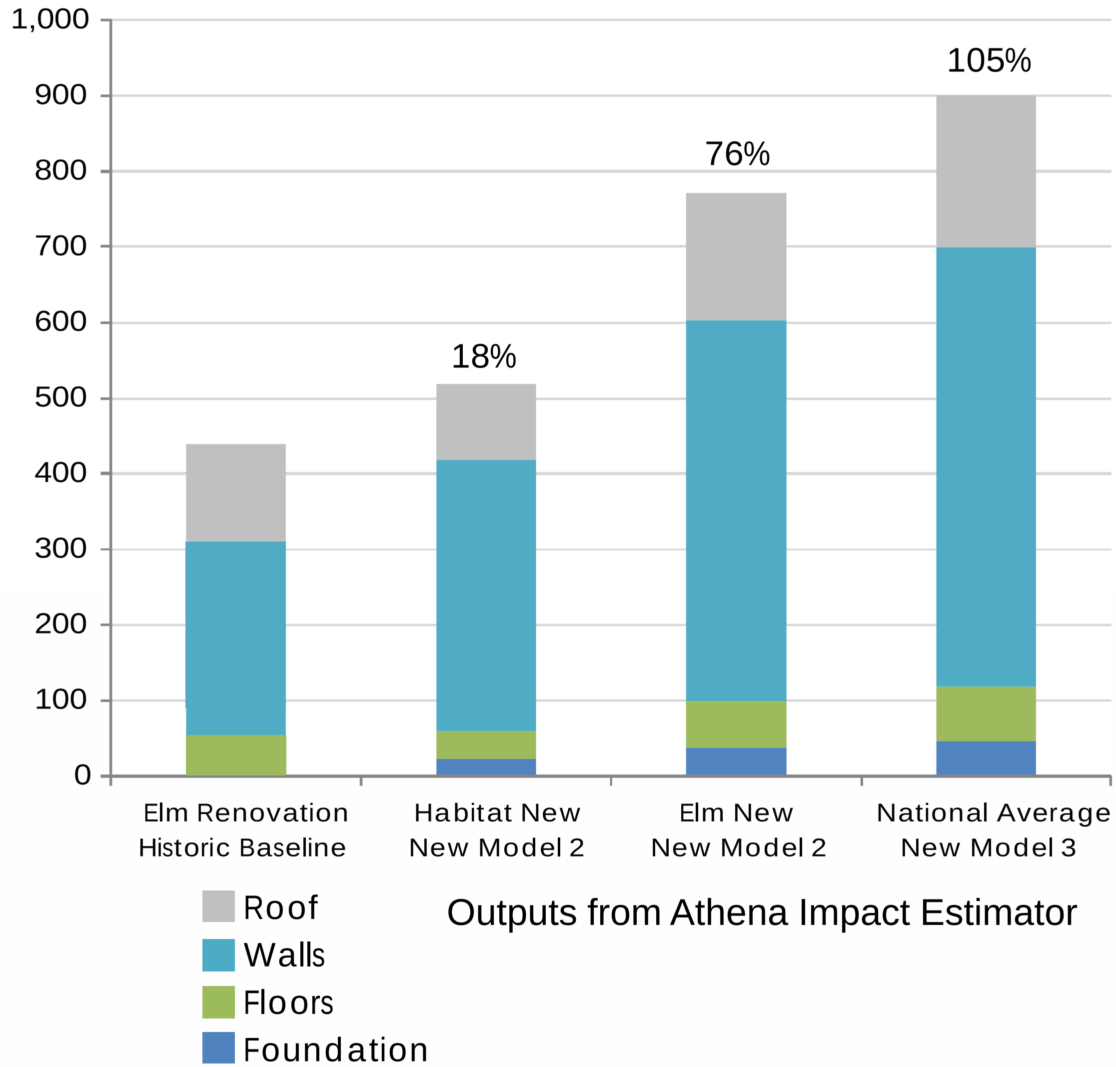
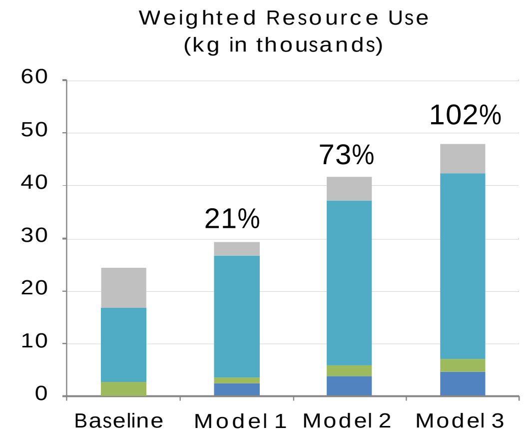
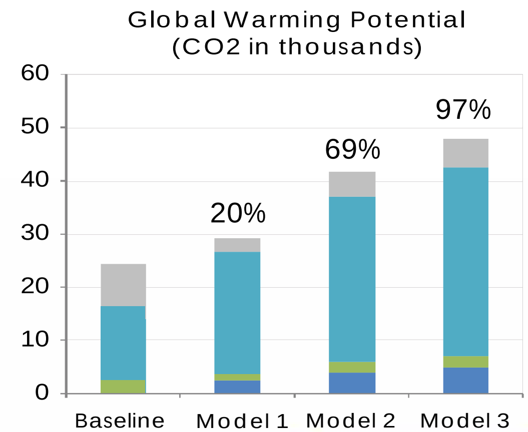
Results Primay Energy Consumption (MJ in thousands)







Outputs from Athena Impact Estimator

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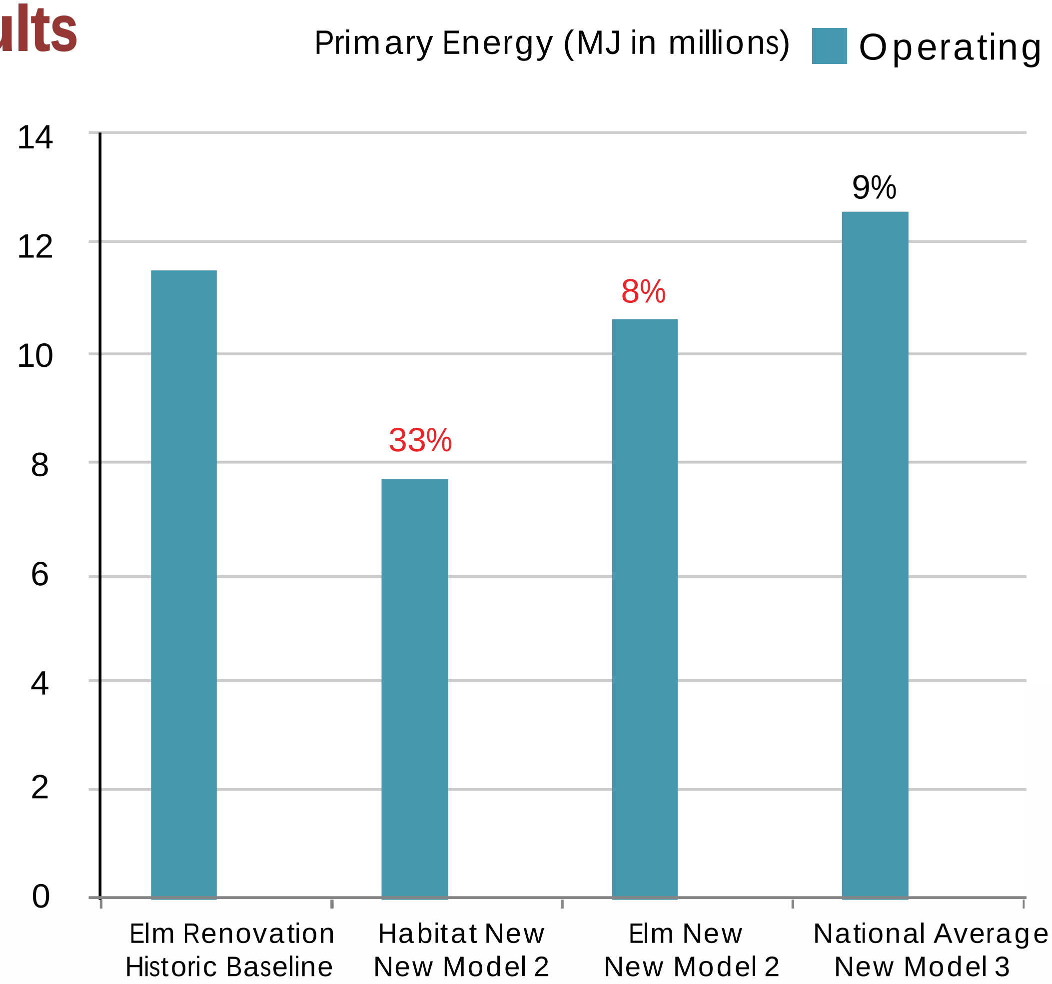
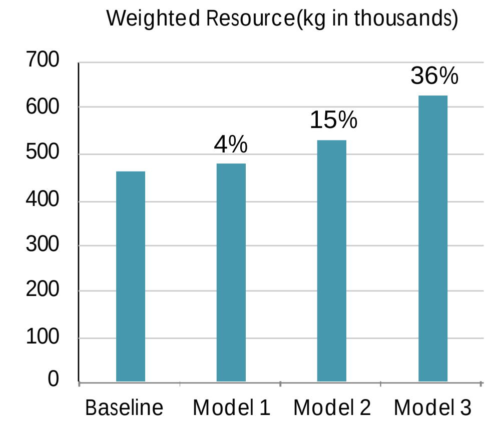
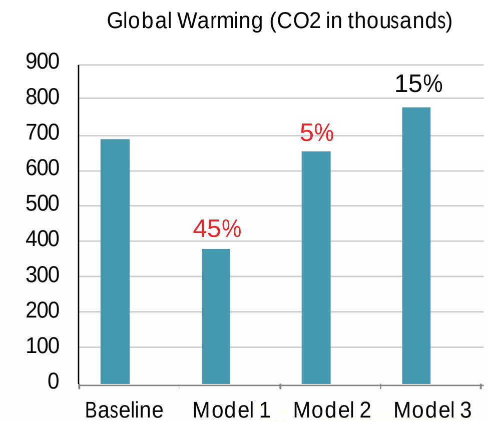
Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

Results







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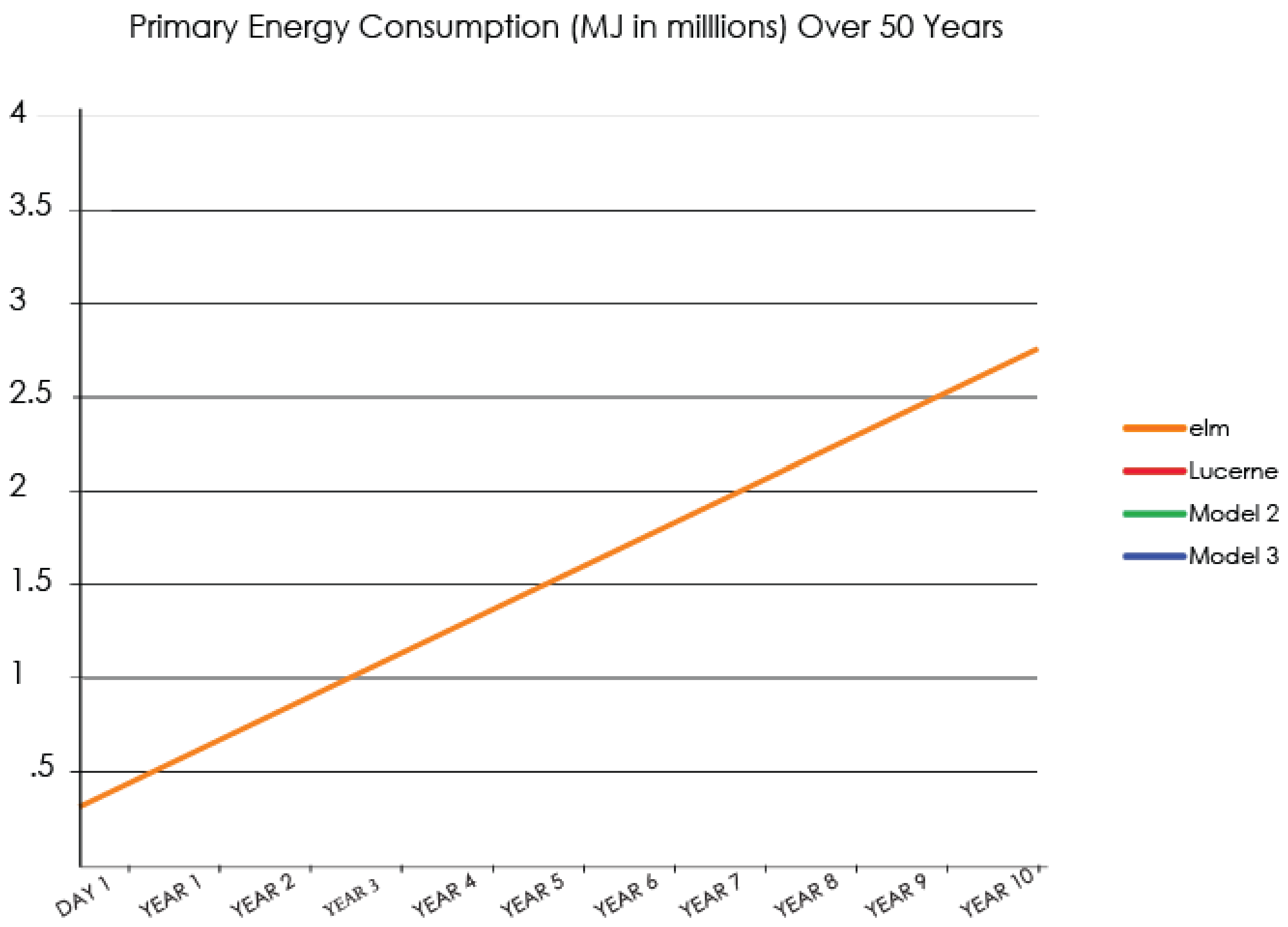
Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION



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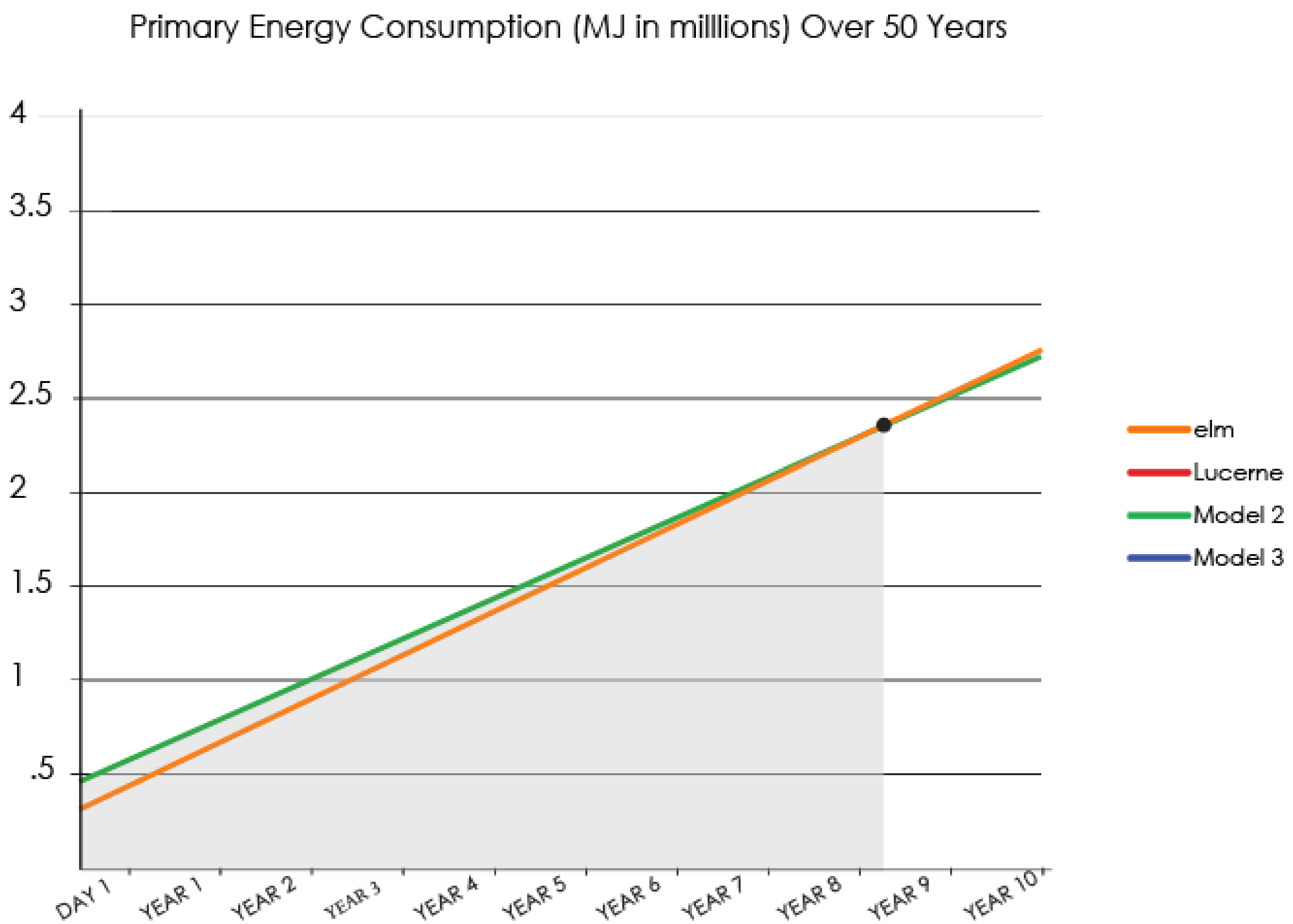
Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION



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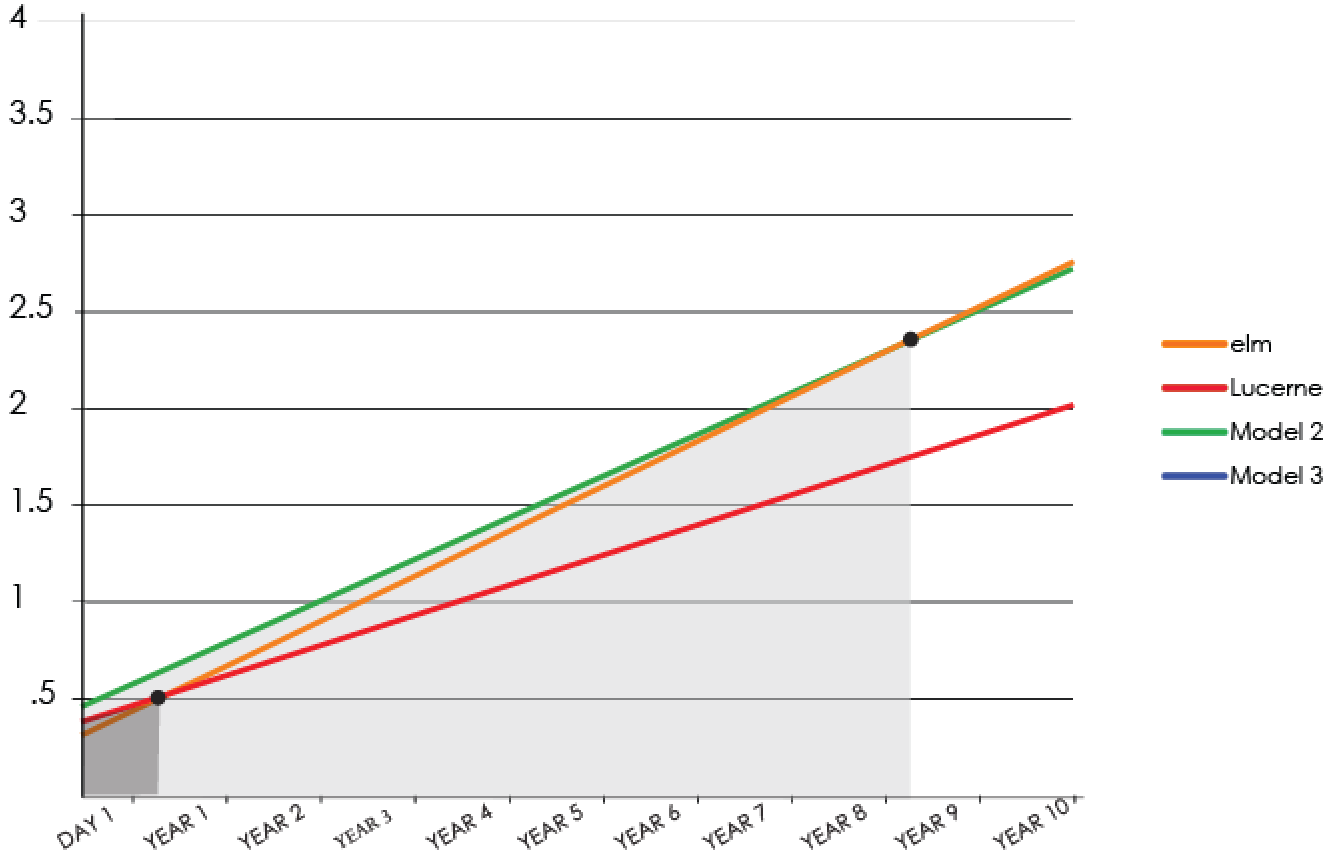
Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

Primary Energy Consumption (MJ in milllions) Over 50 Years



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Life Cycle Comparison

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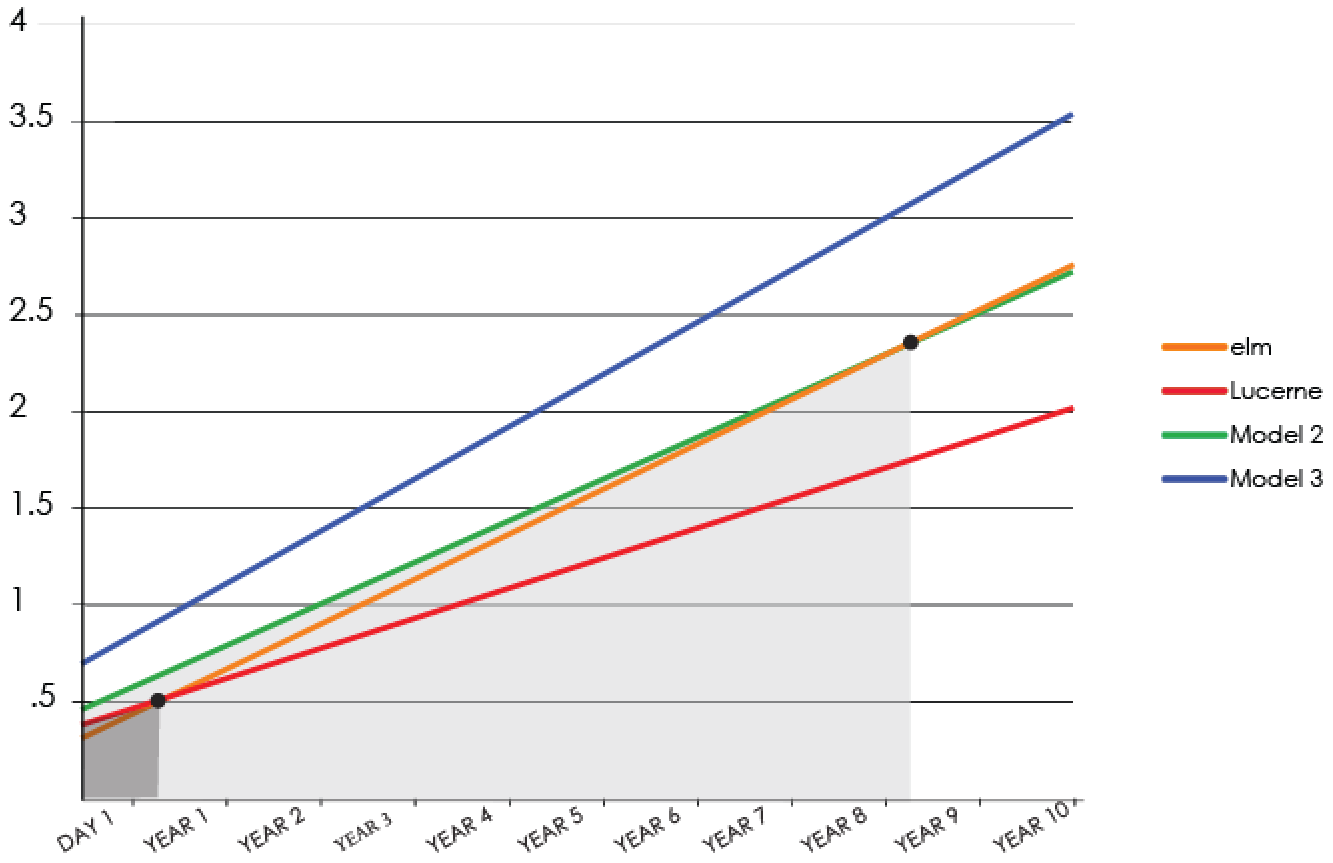

Graph representation method derived from MIT study created by Agbonkhese, Hughes, Tucker & Yu

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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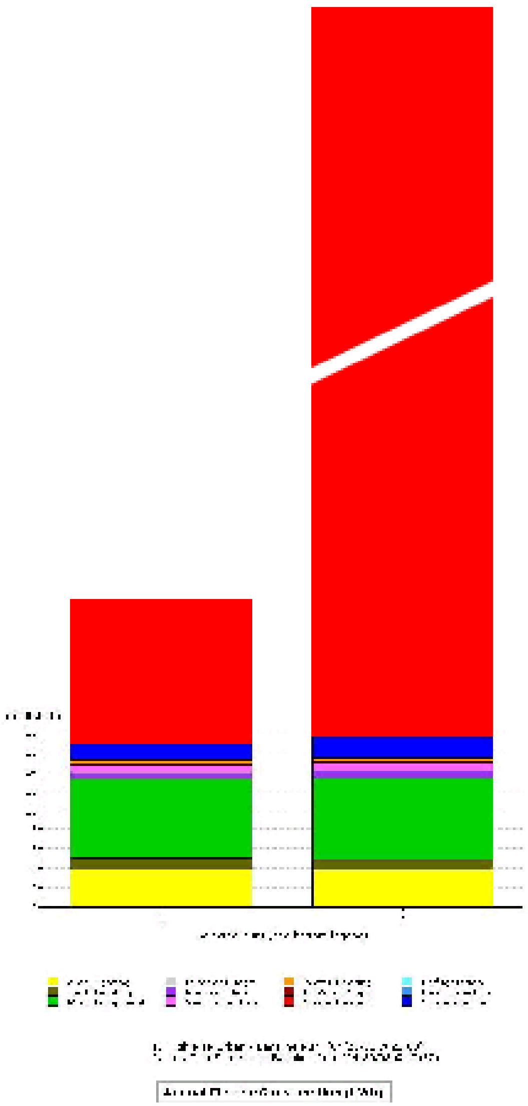

Projjal Dutta, New York MTA

Over-the-Rhine Urban Lifestyle

- Quantify intrinsic sustainable value of OTR in terms of urban density, community connectivity, and walkability.
- The carbon footprint of car commutes by home users is significant when compared to the energy used to run a home.
- Compare the environmental impact of commuting in Over-the-Rhine, Hyde park and Liberty Township.

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Selected community resources and their frequency per year

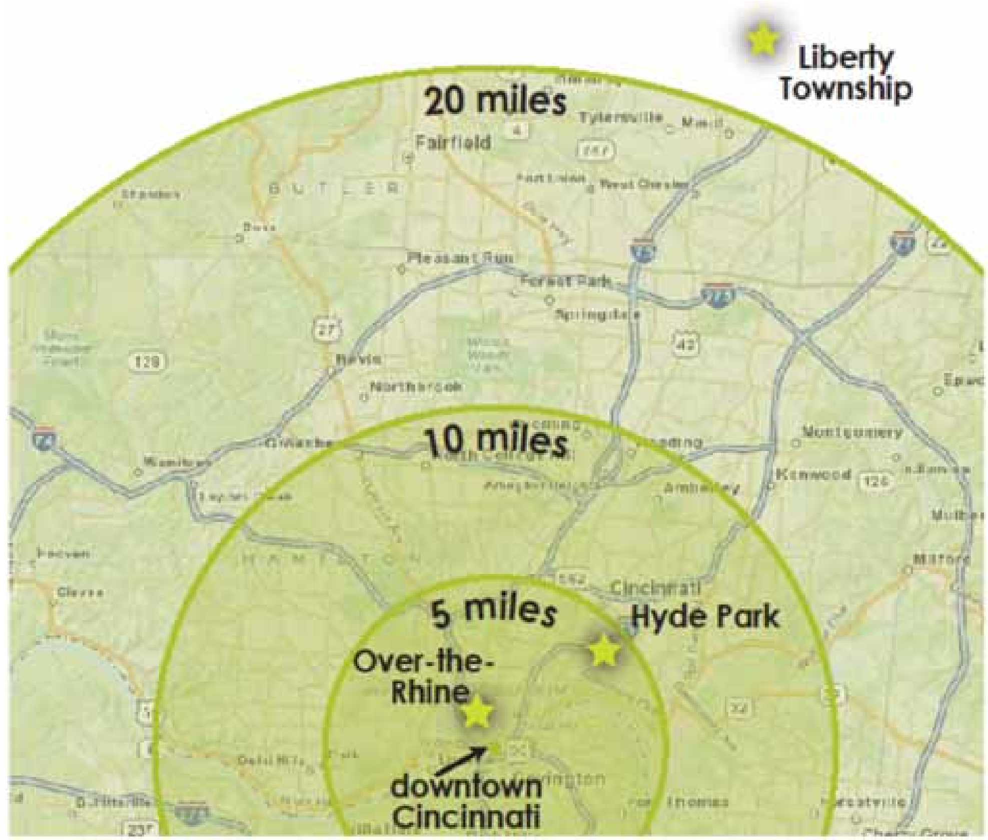
Leisure

Zoo	Park	Restaurant	Theater
(closest)	(closest)	(average of 5 closest)	(closest)
3	24	104	24

Nessecity

Gas	Conveince Store	School
(closest)	(closest)	(average distance over 12 years)
52	52	400

Shopping	Bank	Library	Grocery
(average of closest shopping center & 3 malls)	(average of 3 closest)	(closest)	(closest)
24	26	36	52



Proximity of each case study to downtown Cincinnati

Community Resource Commuting Study

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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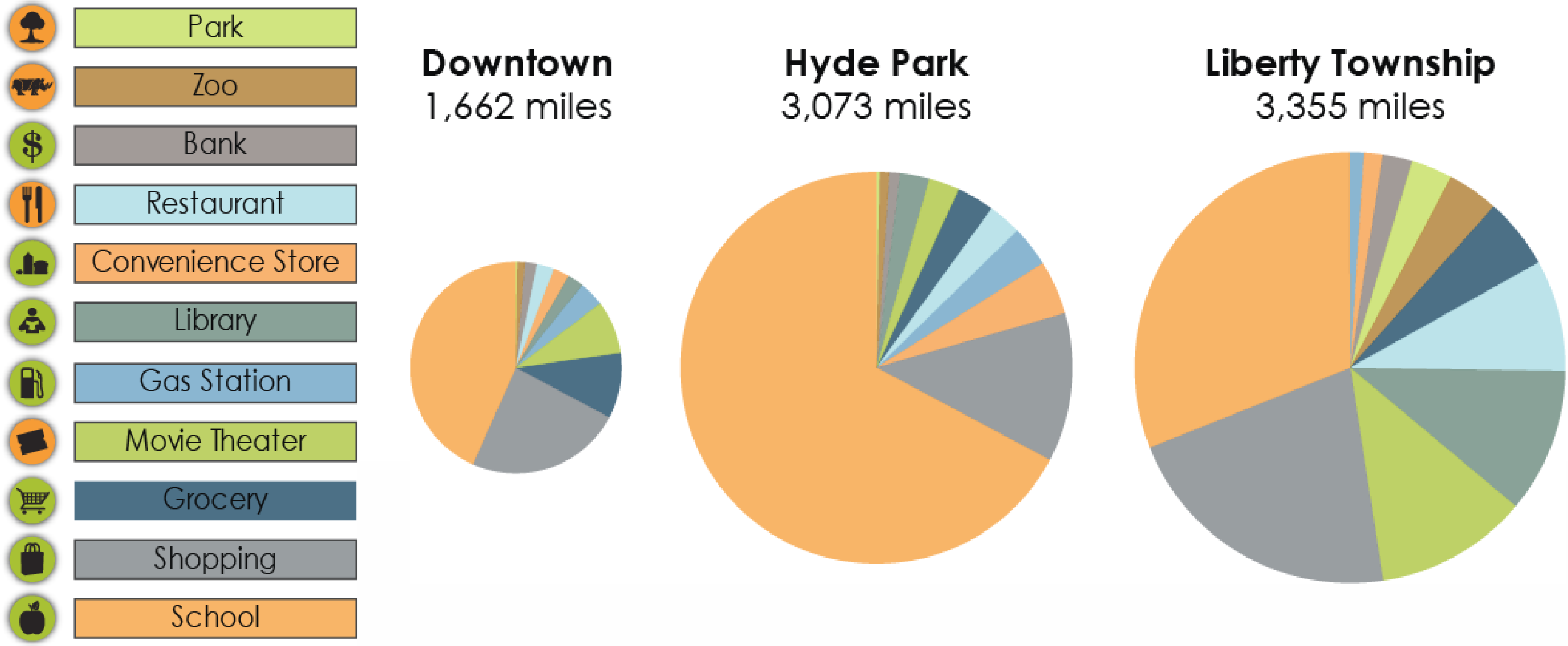

Community Resource Commuting Study

Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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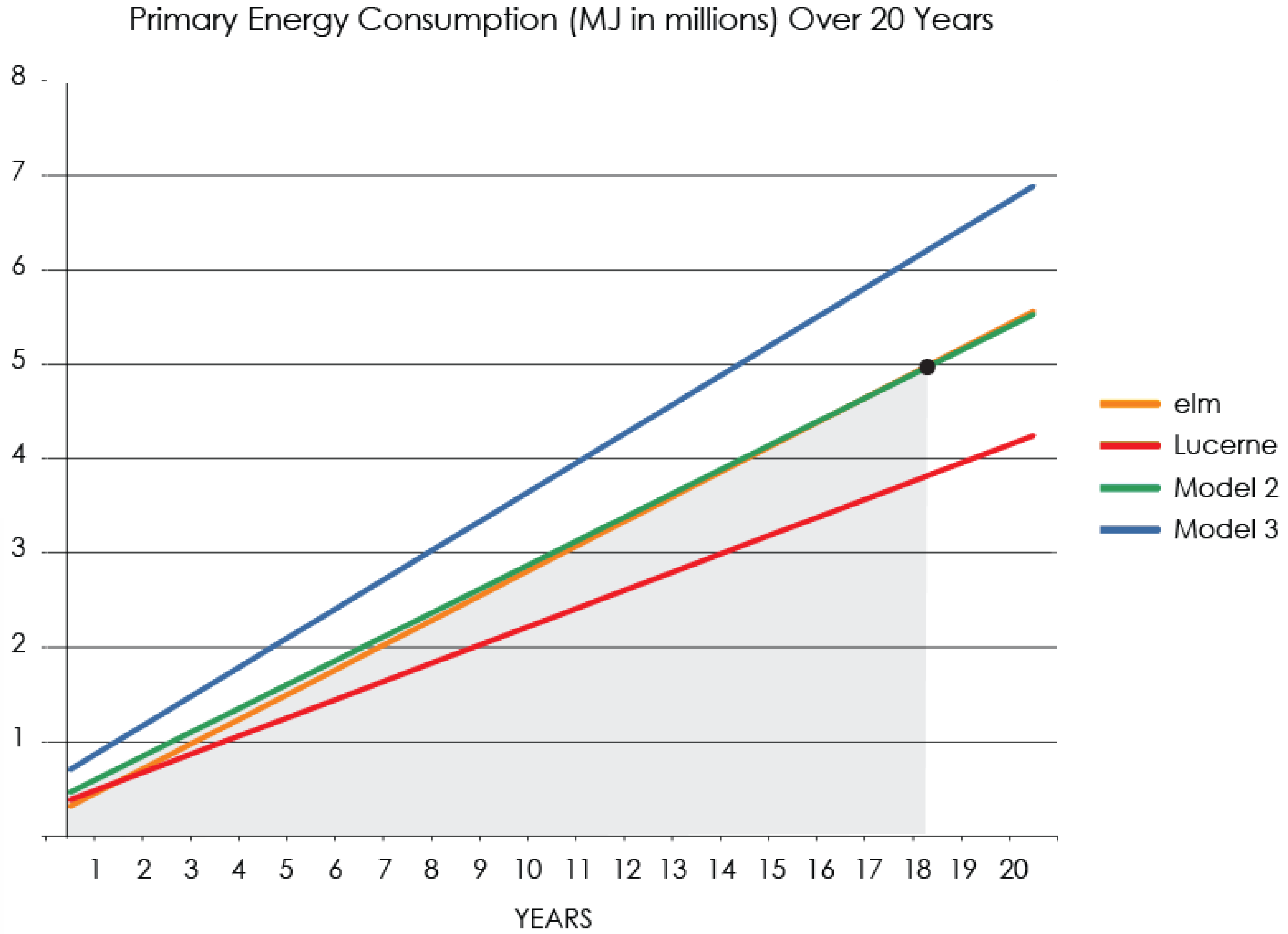
Results

	Over-the-Rhine	Hyde Park	Liberty Township
Total miles driven for resources per year	1,661.88	3,073.24	3,355.16
Total miles driven for work per year			
Total megajoules used for driving per year	29,469.11	37,217.48	38,765.22
Total CO_2 emissions from driving per year	2.17 tons	2.74 tons	2.85 tons
Walkscore	85	55	28
LEED Score (Location & Linkages)	10	6-10	3-7

Community Resource Commuting Study



Life Cycle Comparison

HISTORIC RENOVATION VERSUS NEW CONSTRUCTION

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Conclusions

- Renovating an existing historic home can save up to 50% of embodied energy when compared to a national average home.
- Regardless of new or existing, a small size home can have the least amount of operating energy as well as environmental impact.
- Operating energy contributes to the largest portion of the total life cycle energy hence reduction of energy use by occupants should be a primary consideration.
- Reduced automobile dependence through urban density and walkability can have also have a significant reduction in environmental impact.
- This study is a framework to conduct more LCA on historic buildings

Limitations

- Continue to quantify energy used in restoring historic building materials.
- Site work and Landscaping to be added to the Eco Footprint.
- Work commute to be included in lifestyle footprint.

Closing Remarks

Cincinnati Habitat for Humanity®

Challenges

- Historic
  - Windows
  - Soffit
  - Brick
- Urban
  - Flat roof
  - Electric and Sewer
- LEED – nothing significant!!!!

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Challenges

- Collaboration

- "OTR Green-Historic Study" disputes the assumption that "green" and historic exist in inherent conflict. Historic buildings can go green without compromising historic character.
- We already possess the tools that we need to put people back into historic buildings and make our historic urban neighborhoods centerpieces of environmentally responsible development.
- Demonstrating that neglected buildings in the urban core can be revitalized to historic and green standards, and that renovations can be done in an affordable manner, creates a benchmark for other housing developers to reference when considering green building projects.

Over-the-Rhine Foundation Vision

Over-the-Rhine has roughly 500 vacant buildings, and hundreds more in need of significant restoration. This liability can become one of Cincinnati's greatest strengths.

We have a vision of making Over-the-Rhine America's greenest historic neighborhood.

Q&A

- **This Study and the 2008 OTR Green Historic Study can be viewed at www.otrfoundation.org**

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