Multifamily Buildings Sector: The Year Behind and the Year Ahead

Monday
1:30-5:00pm
114
Multifamily Sector Partners
700,000
Housing Units
575 Million
Square Feet
Headquartered in 36 States
40 Units
Cion Housing
New Mexico

178,000 Units
New York City Housing Authority
New York
Homes for America

Showcase Project

Leonard Apartments

66 Housing Units

57% & $23,200

Annual Water Savings
Hempstead Village
Housing Authority
Showcase Project
Gladys Gardens

30 Housing Units
40% & $19,100 Annual Energy Savings
Corcoran Management Company

Implementation Model
Sustainability Training for O&M Staff

Sustainability Training
Corcoran Management Company
Infrared Image of Air Leakage into Attic

Courtesy Turner Building Science & Design, LLC
Chris Jedd

Denver Housing Authority
Integrating Solar Into Your Portfolio

Prepared by
The Housing Authority of the City and County of Denver
The Denver Housing Authority (DHA) is a quasi-municipal corporation with a portfolio of over 11,000 units and housing choice vouchers, providing affordable housing to more than 26,000 very low, low and middle income individuals representing over 10,000 families throughout the City and County of Denver. DHA has transformed public housing in Denver creating vibrant, revitalized, sustainable, transit oriented, and mixed-income communities of choice.
DHA’s Existing Solar Portfolio

2.5 Megawatt Power Purchase Agreement

• 665 existing homes received solar arrays
• $10 million of investment
• Utility savings for DHA and HUD

Low Income Community Solar Program

• 5% of Lowry community solar garden
• Provides bill credits to DHA residents

New Construction/ Major Rehabs

• DHA continues to add solar to new construction and rehab projects across the portfolio

The DHA launched a cross-departmental initiative to expand its portfolio of renewable energy sources and reduce its energy costs.
DHA’s Solar Appetite

Solar Challenges

- Available suitable space
- Various property types and ownership structures
- Various subsidies
- Various lease and utility allowances scenarios
- Financing
- Utility policies

Proposed CSG (2 Megawatts)

Existing PPA (2.5 Megawatts)

Other Roof Top Solar (Aprox. 1 Megawatt)

Remaining Demand for Solar (10 Megawatts)

1 Megawatt =
Community Solar Overview

“A community solar project—sometimes referred to as a solar garden or shared renewable energy plant—is a solar power plant whose electricity is shared by more than one household.”

Source: Energy Sage
Community Solar Facts

- Policies vary state by state
- Various models & approaches
- Various metering & virtual metering scenarios
- Various ways to participate
  - Buy in
  - Power purchase agreement
  - Develop your own
- Benefits
  - Renewable energy
  - Predictable energy costs
  - Energy savings?
- Challenges
  - Long term contracts
  - Contract terms
The Next Step – Proposed DHA Community Solar Garden

Goals Statement: DHA is seeking to be the developer, owner, operator, and part subscriber of a 2 megawatt 100% low income community solar garden

Program Facts*:

• 2.0 megawatts
• $4 million of investment
• 10 to 12 Acres of land
• Providing clean renewable energy to over 500 + low income families
• Includes subscribership from other mission driven organizations
• Offset of over 57,000 tons of CO2 emissions

* estimated

2017
Proposed DHA 100% Low Income Community Solar Garden

Program Benefits
- 100% low-income
- Clean energy
- Energy savings
- Predictable energy costs
- Flexibility

Next Steps
- Project financing
- Construction
- Subscriber optimization
- Interconnection

DOE Better Building Challenge Summit
Questions?

Chris Jedd
CEM, LEED AP BD+C
Portfolio Energy Manager
Denver Housing Authority
cjedd@denverhousing.org
BETTER BUILDINGS...

- Are Measured and Managed.
Theme: Utility Benchmarking

- Saves money
- Elimates waste of natural resources and money
- Combats climate change
- Protects human health and the natural environment
- Promotes energy independence
- Improves government policies and programs
- Generates data for research
- Creates opportunities for recognition
- Increases return on investment
- Stabilizes assets
- Tracks progress towards goals
- Makes properties more marketable
- Preserves affordable housing
- Improves tenant comfort
EPA research has shown that properties involved in utility benchmarking reduce energy consumption by an average of 7% after just 3 years.
Provides critical insight so that you can make decisions about:

A. Direct Cost Reduction  ex. billing error
B. Operational Improvements  ex. water leaks
C. Capital Improvements  ex. fixture upgrade
Year of Data

(YoDa)
Utility Benchmarking Pipeline

Not Sharing Data

82p

5p

9p

3p

15p

08/16

Either / Both:
>80%
Owner-Paid
Data
or
>30%
Whole-Property
Data

Started

Partial Data Display

Full Data Display

19p

29p

33p

11p

22p

05/17
Year of Data Campaign

25 out of 85 (30%) SENIOR PARTNERS published data displays

10 out of 16 (63%) JUNIOR PARTNERS submitted owner-paid utility data

13 FRESHMAN PARTNERS
2017 Better Buildings Summit

BBC Year One

@ New York City Housing Authority

Bomee Jung, VP Energy & Sustainability

May 15, 2017
77,000
Seniors
62 years old or older

110,000
Children
Under 18 years old

$23,000
Average household income

61%
Are employed (of non-disabled, working age adults)

41%
On fixed income (SOC. SEC., SSI, PENSION, OTHER)

25%
Of NYCHA employees are residents of public housing

12%
Receive public assistance
NextGeneration NYCHA
Comprehensive Sustainability Agenda

NYCHA’s **commitment** as a landlord to create healthy and comfortable homes that will withstand the challenge of climate change

An **invitation** to residents and surrounding communities to work with NYCHA to realize a shared long-term vision of equity, sustainability, and resiliency
Priority Outcome
Healthy Indoor Environments

43% of NYCHA developments are located in the areas of New York City that see the most asthma hospitalizations.¹

They house 151,000 residents and 38,000 children under 15.

New York City plans to have the best air quality among all large US cities by 2030.

NYCHA can’t control outdoor air pollution, but its sustainability strategies can improve indoor air quality.

Data Sources: NYC Department of Health and Mental Hygiene - Environment and Health Data Portal / United Hospital Fund Boundaries; NYCHA Department of Research and Management Analysis

Highest rate of asthma hospitalizations in NYC
NYCHA development
Priority Outcome
Comfortable & Reliable Heat

92% of apartments are heated with steam, the most inefficient way to heat buildings.

1,379 boilers provide NYCHA’s heat. Each has a life expectancy of 30 years. 45% are already 25+ years old.

Apartments are overheated because outdoor temperature sensors can’t tell when it’s hot inside—only that it’s cold outside.

Winter-time indoor temperature

65°F 68°F 75°F 80°F 90°F

That’s like keeping the lights on inside because it’s dark outside—even when you’re sleeping or not home.
Priority Outcome

Get on the path to 80 X 50 GHG goals

Pathway for Reductions in Greenhouse Gas Emissions from NYCHA Portfolio

Source: Mayor’s Office of Sustainability and NYCHA Dept. of Energy and Sustainability
Next Generation NYCHA
Energy Commitments

Reduce energy intensity by 20% by 2025

- Large-scale retrofits via HUD EPC
- Scattered-site retrofits: non-HUD funding

Install 25 MW of renewable generation capacity

- Solar & DG PPAs
- Resiliency
2025 Goals
Improving heating/hot water efficiency is critical.

GHG emissions reduction through 2025 by energy conservation measure

- Lighting Efficiency Measures: 8,000
- Domestic Hot Water Efficiency Measures: 38,700
- Heating Efficiency Measures: 229,900
- Scattered Sites Strategies: 21,500
- Renew300 Solar/ Distributed Generation: 32,100

Total: 330,200

More than 80% of total reduction

Source: NYCHA Dept. of Energy and Sustainability
2025 Goals
Various starting points

Energy Intensity Varies by Development Type

Master planned developments use more energy on average than single buildings or scattered site developments. Master-planned sites use campus-scale steam systems; scattered site buildings tend to use hot water heat.
Context

By 2025, 92% of NYCHA buildings will be 50+ years old

Data Source: NYCHA Department of Research and Management Analysis
Context
State of the Art in 1939
Context
Still with us in 2017
Progress Report
Year 1 of the Better Buildings Challenge
Energy Performance Contracts
Designing Impactful Scopes of Work

Percent avoided CO2 emissions by NYCHA EPC

- 56 M EPC A: 8.2%
- BQDM EPC: 17.4%
- Sandy EPC: 18.5%
Energy Performance Contracts
Cost Savings by Intervention (ECM)

- Ventilation modernization: 0.03%
- Conversion to Instant DHW: 0.43%
- Exterior lighting: 1%
- Water conservation: 16%
- Interior lighting: 31%
- Heating distribution repair/controls: 52%
Energy Performance Contracts
Vacuum Steam Conversion Pilot

- Pilot to convert vacuum steam to atmospheric 2-pipe steam
- TRVs control steam at individual radiators for local control
  ➤ Improve comfort & control – minimizes opening windows to control heat
  ➤ Improves steam balancing
  ➤ Eliminate vari-vac vacuum pump
- Inlet orifice plates restrict steam flow to the radiators
  ➤ Sized to allow 80%-90% of radiator steam capacity
  ➤ Eliminates need for steam trap on radiator
  ➤ Prevents steam from entering the condensate return system
- Whitman Building # 6 Selected
  ➤ 60 Apartments
In-apartment Electric Consumption
Window Air Conditioning Pilot Project
In-apartment Electric Consumption

Master-metered residents use a lot of electricity

Master-metered developments use 4 times the electricity of direct-metered developments

Comparison of electricity consumption at 62 developments in Brooklyn from August 2013 to July 2014

Source: Enterprise Community Partners with NYCHA data
In-apartment Electric Consumption
Air conditioning drives peak demand

Summer cumulative peak demand, 66 Brooklyn developments 2013-2014

Cooling: 23MW
Baseload: 29MW
In-apartment Electric Consumption

Increased need for cooling over time

90°F days per year in New York City\(^1\)

1970–2000: 18

By the 2050s: (As many as Birmingham, AL) 39–57

---

1. Average per year, New York City Panel on Climate Change
In-apartment Electric Consumption

Tenant-owned window ACs provide cooling

1.5 – 2 AC units per apartment

Registered ACs subject to $8-10 monthly surcharge

Up to 85% AC units go unregistered to avoid fee

25% of apartments had more than the allowed number of ACs
In-apartment Electric Consumption
Smart AC Pilot Concept

Install a network of internet-enabled window ACs and implement peak shaving by controlled cycling.

• Professionally installed with safe mounting hardware
• Tenant controls temperature
• Utility can offer additional demand response incentives
In-apartment Electric Consumption

Smart AC Pilot: Key Questions

- Is NYCHA allowed to own window air conditioners?
- Can NYCHA require a trade-in of the old AC?
- Is NYCHA allowed to prohibit installation of additional ACs?
- Can NYCHA suspend the AC fee?
- Does it “pay for itself” through savings?
In-apartment Electric Consumption
Smart AC Pilot: Project Economics

- Estimated project cost of $2 million (1595 apartments in 30 buildings)
- Estimated annual savings of $46,000 => PV of $500K at 4% over 15 years
- Oops! Math doesn’t work! Has to be subsidized by lighting, grant, or other funds
- And by the way, can’t include in EPC 😞
In-apartment Electric Consumption

Smart AC Pilot: Next Steps

- Smaller (much smaller) pilot project via on-bill financing
- Can we reduce costs?
- Need to address project risks:
  - Administrative burden
  - Induced demand for ACs
  - Enforcement of prohibition on “dumb” AC units
call for innovations:
Reducing the Electrical Load in NYCHA Buildings

The New York City Housing Authority (NYCHA) seeks solutions that will reduce electrical demand in developments that are master-metered for electricity.
Resilient Design

Stormwater Management
Resilient Design
Green Infrastructure for CSO

Hope Gardens Before

Hope Gardens After

GI for **Combined Sewer Overflow**: 39 developments in assessment/design, 3 complete and 1 site in construction
Resilient Design

Green Infrastructure for Cloudburst

GI for High Intensity Rains: DEP Cloudburst Pilot at South Jamaica 1 & 2, supported by NYSERDA grant
NextGeneration NYCHA
Sustainability Agenda

Bomee Jung
Vice President, Energy & Sustainability
bomee.jung@nycha.nyc.gov

Full agenda is available for download:
http://j.mp/green-nycha
Multifamily Sector Recognition
2017 Better Buildings Summit
New Multifamily BBC Partners

- Cleveland Housing Authority
- CommonBond Communities
- Elderly Housing Development and Operations Corporation (EHDOC)
- Foundation for Affordable Housing
- Housing Trust of Rutland County
- King County Housing Authority
- Michigan City Housing Authority
- Wesley Housing Corporation

Total = 8 new partners in the past year
BBC Multifamily Partners with Published Showcase Project

- ACTION-Housing, Inc.
- Aeon
- Balfour Beatty Communities
- Capitol Hill Housing
- Cascap, Inc.
- Columbia Residential
- Community Housing Partners
- Corcoran Management
- Cuyahoga Metropolitan Housing Authority
- Forest City Realty Trust
- Gateway Management Services, LLC
- Green Coast Enterprises
- Homes for America
- Housing Authority of Baltimore City
- Housing Authority of City of San Buenaventura, CA
- Houston Housing Authority
- Jersey City Housing Authority
- Jewish Community Housing for the Elderly
- Keene Housing
- LINC Housing Corporation
- Mercy Housing

- New York City Housing Authority
- NHT/Enterprise Preservation Corporation
- Peabody Properties, Inc.
- Preservation of Affordable Housing
- Rockford Housing Authority
- Rural Ulster Preservation Company
- San Antonio Housing Authority
- Tenderloin Neighborhood Development Corporation
- TH Real Estate
- The Community Builders
- The Economic Development Authority of the City of Mankato, MN
- The Housing Authority of the City and County of Denver
- The Silver Street Group and Housing Management Resources
- The Tower Companies
- Trinity Management
- Village of Hempstead Housing Authority
- WinnCompanies

**Bold** = Shared in the past year  **Total = 38 partners**
BBC Multifamily Partners with Published Implementation Model

- Aeon
- Balfour Beatty Communities
- **Corcoran Management**
- **Cuyahoga Metropolitan Housing Authority**
- Forest City Realty Trust
- Jersey City Housing Authority
- LINC Housing Corporation
- Mercy Housing
- NHT/Enterprise Preservation Corporation
- **Preservation of Affordable Housing**
- REACH CDC
- Rockford Housing Authority
- **Tampa Housing Authority**
- Tenderloin Neighborhood Development Corporation
- TH Real Estate
- **The Economic Development Authority of the City of Mankato, MN**
- The Housing Authority of the City and County of Denver
- The Tower Companies

**Bold** = Shared in the past year
Total = 18 partners
BBC Multifamily Partners with Published Showcase Project AND Implementation Model

- Aeon
- Balfour Beatty Communities
- **Corcoran Management**
- Cuyahoga Metropolitan Housing Authority
- Forest City Realty Trust
- Jersey City Housing Authority
- LINC Housing Corporation
- Mercy Housing
- NHT/Enterprise Preservation Corporation

- **Preservation of Affordable Housing**
- Rockford Housing Authority
- Tenderloin Neighborhood Development Corporation
- TH Real Estate
- **The Economic Development Authority of the City of Mankato, MN**
- The Housing Authority of the City and County of Denver
- The Tower Companies

**Bold** = Accomplished for first time in past year

Total = 16 partners
BBC Multifamily partners who began benchmarking data in the past year

- ACTION-Housing Inc.
- AHEAD, Inc.
- Angola Housing Authority
- Avon Park Housing Authority
- Beacon Communities
- Cambridge, MA Housing Authority
- Caritas Communities, Inc.
- Cascap, Inc.
- Century Housing
- Cion Housing Services
- Codman Square Neighborhood Development Corporation
- CommonBond Communities
- Community Housing Partners
- Corcoran Management
- Danville Development
- EAH Housing, Inc.
- East Bay Asian Local Development Corporation
- East Hartford, CT Housing Authority
- Eden Housing
- Fort Wayne Housing Authority
- Foundation for Affordable Housing
- Gary, IN Housing Authority
- Gateway Management Services, LLC
- Gragg Cardona Partners
- Housing Authority of Baltimore City
- Housing Authority of City of Bristol, CT
- Housing Authority of City of Freeport, IL
- Housing Authority of City of Palatka, FL
- Housing Authority of Knox County, IN
- Housing Authority of McDonough County
- Housing Authority of the Birmingham District
- Housing Authority of the City of Los Angeles
BBC Multifamily partners who began benchmarking data in the past year (cont.)

- Housing Trust of Rutland County
- Houston Housing Authority
- Jamaica Plain Neighborhood Development Corporation
- Jonathan Rose Companies
- King County Housing Authority
- Korman Residential Properties, Inc
- Lucas Metropolitan Housing Authority
- Manhattan Housing Authority
- Minneapolis Public Housing Authority
- Multi-Family Mission Ministries
- New York City Housing Authority
- Newark Housing Authority
- Peabody Properties, Inc.
- Retirement Housing Foundation
- Rockford Housing Authority
- Rural Ulster Preservation Company
- San Antonio Housing Authority

- Schochet Companies
- Tampa Housing Authority
- The City of Hickory Public Housing Authority
- The Community Builders, Inc.
- The Evangelical Lutheran Good Samaritan Society
- The Renaissance Collaborative
- The Silver Street Group and Housing Management Resources, Inc
- Trinity Management
- Utica Municipal Housing Authority
- Vistula Management Company
- VLV Development
- Volunteers of America
- Washington, DC Housing Authority
- Windsor Locks Housing Authority
- WinnCompanies
- Yolo County, CA Housing Authority

Total = 65 partners
BBC Multifamily partners who shared ≥ 80% of their owner-paid receipts this year

- Aeon
- AHEAD, Inc.
- Angola Housing Authority *
- Atlanta Housing Authority
- Avon Park Housing Authority *
- Balfour Beatty Communities
- Beacon Communities
- Cambridge, MA Housing Authority
- Capitol Hill Housing
- Caritas Communities, Inc.
- Cascap, Inc. *
- Codman Square Neighborhood Development Corporation *
- CommonBond Communities
- Cuyahoga Metropolitan Housing Authority
- EAH Housing, Inc.
- East Hartford, CT Housing Authority
- Eden Housing
- Forest City Realty Trust
- Fort Wayne Housing Authority
- FS Energy
- Gary Housing Authority *
- Gateway Management Services, LLC
- Housing Authority of City of Bristol, CT
- Housing Authority of City of Freeport, IL
- Housing Authority of City of Helena, MT
- Housing Authority of City of Palatka, FL
- Housing Authority of McDonough County
- Housing Authority of the Birmingham District
- Jamaica Plain Neighborhood Development Corporation
- Jersey City, NJ Housing Authority
- Jewish Community Housing for the Elderly
- Jonathan Rose Companies
- Keene Housing *
- King County Housing Authority
BBC Multifamily partners who shared ≥ 80% of their owner-paid receipts this year (cont.)

- Lucas Metropolitan Housing Authority *
- Manhattan Housing Authority *
- Mercy Housing, Inc.
- Minneapolis Public Housing Authority
- New Bedford Housing Authority
- New York City Housing Authority *
- Newark Housing Authority
- NHT/Enterprise Preservation Corporation
- Peabody Properties, Inc.
- Preservation of Affordable Housing
- Retirement Housing Foundation
- Rural Ulster Preservation Company
- Schochet Companies
- Tampa Housing Authority
- Tenderloin Neighborhood Development Corporation
- TH Real Estate
- The City of Hickory Public Housing Authority *
- The Economic Development Authority of the City of Mankato, MN
- The Evangelical Lutheran Good Samaritan Society
- The Housing Authority of the City and County of Denver
- The Renaissance Collaborative *
- The Tower Companies
- Trinity Housing Corporation of Greeley, Colorado
- Trinity Management
- Village of Hempstead Housing Authority
- Vistula Management Company *
- VLV Development
- Washington, DC Housing Authority
- Windsor Locks Housing Authority
- Wishrock Investment Group

* Junior partners that have met their Year of Data goal
Total = 64 partners
BBC Multifamily partners who have shared a partial data display

- Balfour Beatty Communities
- Fort Wayne Housing Authority *
- FS Energy *
- Jersey City Housing Authority *
- Mercy Housing *
- Peabody Properties, Inc.*
- Preservation of Affordable Housing *
- REACH CDC
- Retirement Housing Foundation *
- The Evangelical Lutheran Good Samaritan Society *
- Trinity Management*
- Wishrock Investment Group *

* Senior BBC partners that have met their Year of Data goal

Bold = published in past year
Total = 12 partners
BBC Multifamily partners who have shared a full data display

- Angola Housing Authority
- Atlanta Housing Authority *
- Cambridge, MA Housing Authority
- Capitol Hill Housing *
- Cascap, Inc.
- Forest City Realty Trust
- Gateway Management Services, LLC
- Jewish Community Housing for the Elderly *
- Keene Housing
- King County Housing Authority
- LINC Housing Corporation
- New Bedford Housing Authority *
- New York City Housing Authority
- The Schochet Companies *
- Tenderloin Neighborhood Development Corporation *
- TH Real Estate *
- The Economic Development Authority of the City of Mankato, MN *
- The Housing Authority of the City and County of Denver *
- The Renaissance Collaborative
- The Tower Companies *
- Trinity Housing Corporation of Greeley, Colorado *
- Village of Hempstead Housing Authority *

* Senior BBC partners that have met their Year of Data goal
**Bold** = published in past year

Total = 22 partners
BBC Multifamily Goal Achiever

Has met the BBC goal of 20% reduction in portfolio-wide energy consumption, achieving 24% savings within six years.
BBC Multifamily Goal Achiever

Has met the BBC goal of 20% reduction in portfolio-wide energy consumption, achieving 21% savings.
Sustainability Department

- Triple Bottom Line
- Commitment to Enterprise Green Communities & Better Buildings Challenge
- Health Benefits, Economic and Utility Savings
- Identifying New Partners
Goal: Invest in Renewables

• Generate 2 MW of Renewable Energy On-Site
  • Partnerships with Utilities, Green Banks, Solar Developers

• 5 Affordable Housing Solar Projects
  • Rooftop
  • Solar Carports
  • Community Solar

• Stabilizing Electricity Costs & Offsetting Carbon Footprint
  • Track Performance
Goal: Seek New Opportunities

• Connecticut Green Bank
  • Linking Solar Developers and MF Owners with low-cost financing

• Combined Proposal: Solar Rooftop and Solar Carport
  • Reduce Electricity Rates by 17%
  • Projected Savings Increase Annually

• Challenges
  • Consents, Permitting, Rate Uncertainty, SRECs
New Opportunity: Community Solar

- Market has Grown 56% since 2006
- Allows Multiple Customers to Invest in a Single Project
  - Virtual Net Metering
  - Allocated a Share of Generation
- Community Solar can Lower the Soft Cost Portion of Solar Investments
  - 57% of Commercial System is Non-Hardware
  - 64% of Residential System is Non-Hardware
Input
• Utility Data
• Building Information

Assess
• Property Performance
• Comparable Properties

Review
• Determine Appropriate Changes
• On-site Processes

Address
• Implementation Changes
• Refine Controls

Save
• Energy, Water, and Money

Portfolio-Wide Retrofits
Northwood – Jackson, MS
• Our 1st Enterprise Green Communities Certified Project
Upcoming Opportunity:

- Madonna Manor, Jackson, MS
  - HUD Better Buildings TA
    - EZ Retro-fit
Madonna Manor

Sustainable Operations

- Lighting Efficiency (Retrofit)
- Building Upgrades (Mechanical)
- Water Efficiency (Fixtures)
Upcoming Opportunity:

- The Village Apartments, Jackson, MS
Partnership for Improving Resident Health

• Reduce Households with Tobacco Smoke
• Elimination of Irritating Cleaning Products
• Improved Asthma Trigger Control
• Fewer Medical Interventions
• Improved Family Outcomes

Green & Healthy Homes Initiative®
The Year Ahead

Multifamily Sector 2017
BETTER BUILDINGS…

- Save Money.
- Create Jobs.
- Improve Health.
Our nation wastes more energy than it uses –

- Capital Improvements
  - Retrofitting for Efficiency
  - Upgrading at Replacement
- Operational Improvements
  - Utility Benchmarking
  - Regular Maintenance
  - Systems Controls
  - Addressing Malfunctions
  - Tenant Behavior

“[O]ur nation wastes more energy than it uses –

  yes, 57% of the energy flowing into our economy…
  is simply wasted as heat, noise, and leaks.”

- Tom King, National Grid
- Alex Laskey, OPower
Theme: Cost Savings

- Direct Cost Reductions
  - Rate Discounts
  - Fine Avoidance
  - Bill Correction
  - Off-Peak Rates
  - Whole-Sale Purchasing
  - Utility Futures
  - Green Power
  - Renewable Energy

- Increased Property Value
  - Higher Appraisals
  - Higher Rent
  - Decreased Vacancies

$3.4 BILLION PER YEAR COST-EFFECTIVE ENERGY SAVINGS U.S. MULTIFAMILY SECTOR + $? WATER

- American Council for an Energy Efficient Economy
“Solar and wind... are each creating jobs at a rate 12 times faster than that of the rest of the U.S. economy.

- Environmental Defense Fund
“[E]nergy efficiency investments create more jobs than those in fossil fuel industries, estimated at approximately 8 jobs (direct and indirect) per $1M invested compared to about 3 jobs in fossil fuels.”

- Environmental Defense Fund
**Theme: Healthy Homes**

- **Health Hazards in Homes**
  - Asbestos
  - Carbon monoxide
  - Crowding
  - Environmental Tobacco Smoke
  - Excessive noise
  - Fire
  - Heat, cold, dampness, dryness
  - Inaccessibility / physical danger to elderly, children, and disabled persons
  - Inadequate lights, views & ventilation
  - Insufficient / polluted water
  - Lead paint, pipes & soil
  - Mold & mildew
  - Pests
  - Radon
  - Trip, slip & fall hazards
  - Volatile Organic Compounds

  “Traditional building practices often overlook the interrelationships between a building, its components, its surrounding, and its occupants. ‘Typical’ buildings consume more of our resources than necessary, negatively impact the environment, and generate a large amount of waste….

  [T]hese buildings are costly to operate in terms of energy and water consumption. And they can… lead to health problems.”

  - Smart Community Network
Theme: Healthy Homes

- Health Problems in Homes
  - Allergies
  - Asthma & respiratory illnesses
  - Behavioral problems
  - Birth defects
  - Brain & nervous system damage
  - Cancer
  - Cardiovascular disease
  - Death
  - Depression & anxiety
  - Injuries
  - Tuberculosis
  - Learning disabilities & low IQ
  - Low productivity
  - Psychological distress

“Utility costs for low-income families can be up to 25 percent of expenses after rent or mortgage payments – more than what is spent on education or health care – as compared to approximately 5 percent of net income for middle class families.

Energy and water savings enable low-income residents to shift financial resources to higher-priority items such as more nutritious food, health care, and education....”

- Global Green U.S.A.
Energy Plus Health: Recent Findings

Home R\textsubscript{X}: The Health Benefits of Home Performance
A Review of the Current Evidence

Jonathan Wilson, National Center for Healthy Housing (NCHH)
David Jacobs, NCHH
Amanda Reddy, NCHH
Ellen Tohn, Tohn Environmental Strategies
Jonathan Cohen, U.S. Department of Energy (DOE)
Ely Jacobsohn, DOE

December 2016
Home R Study Reviewed Five Categories of Upgrades

1. **Base energy efficiency**: energy efficiency programs that included at least two of the following three activities: insulation, air sealing, and heating improvements.

2. **Enhanced energy efficiency**: energy efficiency measures included air sealing, insulation, and heating upgrades and enhanced work to address moisture, ventilation, or other issues.
Enhanced and Base Upgrades

Enhanced upgrades
◦ reduce indoor air contaminants linked to chronic illnesses, control environmental contaminants (dust mites, mold/moisture) that can trigger respiratory symptoms
◦ improve symptoms of asthma and other respiratory health conditions.

Base energy efficiency work can also create healthier living environments.
◦ improved general health
◦ reductions in some asthma symptoms
◦ fewer cases of hypertension and upper respiratory risks
◦ some improvements in indoor air quality contaminants.
3. Green new construction:

Research includes four studies that have documented observed reductions in healthcare utilization.

Multiple studies of green renovation and new construction also found reductions in indoor air pollutants, other asthma triggers such as pests and mold, and, ultimately, asthma symptoms.
4. Enhanced ventilation:
   ◦ Reduced indoor air quality contaminants that have been linked with chronic illnesses or respiratory risks
   ◦ fewer respiratory risks among people with asthma
   ◦ and reduced allergens.
Stand-alone home services/upgrades:

- Improve occupant health Could be incorporated into home performance work specifications.
- These include:
  - in-room HEPA (high-efficiency particulate air) air cleaners
  - replacement of gas stoves with electric stoves
  - upgrades from older wood stoves to cleaner burning models.
- These upgrades help to reduce respiratory risks by reducing air contaminants (e.g., Nitrogen dioxide; fine particulate matter).
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of measures evaluated within studies</td>
<td>• Air Sealing Insulation • Heating Improvements</td>
<td>• Air Sealing • Insulation • HVAC Upgrades • Moisture Control • Ventilation • Basic Pest Exclusion • Other</td>
<td>EE Measures plus combo of the following: • Enhanced ventilation • Low-VOC product • Carpet Removal • Smoke Free Policies</td>
<td>Alternative Ventilation Strategies • Exhaust Only • Heat/ Energy Recovery Ventilators</td>
<td>• In-room Air Cleaners Replacement of stoves: • Gas to Electric • Old Wood Burning to Cleaner Wood Burning</td>
</tr>
<tr>
<td>Health or Indoor Environment Impact</td>
<td>• More stable temperatures • Less humidity • Less dust • Reduced hypertension • Reduced triggers of allergies and asthma</td>
<td>Same as “Base” plus • Reduced indoor pollutants and biologic contaminants • Fewer respiratory symptoms • Fewer colds • Indications of lower healthcare utilization</td>
<td>• Less presence of formaldehyde, VOCs, particulate matter, and NO2 • Improvement in mental health</td>
<td>• Reduced indoor air pollutants and biologic contaminants • Reduced respiratory symptoms • Possible reductions in radon</td>
<td>• Lower particulate levels in the air • Reduction in asthma and healthcare utilization</td>
</tr>
<tr>
<td>Strength of Evidence</td>
<td>7 Studies</td>
<td>7 Studies</td>
<td>9 Studies</td>
<td>8 Studies</td>
<td>9 Studies</td>
</tr>
</tbody>
</table>
Weatherization and Green Rehabilitation—Improving Health through a Combination of Energy and Housing Interventions

Lessons From Studies of Green Public Housing in Boston
Why Public/Multifamily Housing?

- Motivated by asthma concerns
- Healthy Public Housing Initiative
- Indoor exposures and risk factors
  - Allergens (Peters et al. 2008)
  - Combustion by-products (Zota et al. 2005)
  - Pesticides (Julien et al. 2007)
  - Smoking (Kraev et al. 2009)
  - Ventilation (Zota et al. 2005)
  - Multiple exposures (Brugge et al. 2003)
- Disease burden / vulnerability
- Opportunities for intervention
  - Single landlord
  - Initiatives / policies / construction / re-hab
Where to intervene?

people
- education
- case management
- clinical intervention

places
- maintenance
- renovation
- construction
- systems

policies
- maintenance
- purchasing
- tenant policies
- regulatory
Why does place matter?

How can we eliminate health disparities?

Energy

Green

Health

How can we reduce energy consumption?
Where to intervene?

- smoke-free policies
- chemical exposures
- resident education
- ‘green’ transitions
- better pest control policies
The BRIGHT Study

Boston Residential Investigation on Green and Healthy Transitions

Boston Housing Authority
HARVARD School of Public Health
CBPH Committee for Boston Public Housing
BEACON communities
TRINITY FINANCIAL
MASSART Massachusetts College of Art and Design
Green Housing

Old Colony
Green Housing – BRIGHT Study

How do these transitions affect:
- Comfort?
- Satisfaction?
- Environmental exposures?
- Health?
- Energy usage?
## Green Attributes

<table>
<thead>
<tr>
<th>Washington Beech</th>
<th>Old Colony</th>
<th>Ruth Lillian Barkley (Cathedral)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Low / No VOC paints, primers, adhesives and sealants</td>
<td>- Low / No VOC paints, primers, adhesives and sealants</td>
<td>- Low / No VOC paints, primers, adhesives and sealants</td>
</tr>
<tr>
<td>- Green label certified floor coverings</td>
<td>- Energy Star appliances and exhaust fans</td>
<td>- Energy Star appliances and exhaust fans</td>
</tr>
<tr>
<td>- Energy Star exhaust fans</td>
<td>- Sustainable materials for finishes and coverings</td>
<td>- Sustainable materials for fixtures, finishes and coverings</td>
</tr>
<tr>
<td>- Ventilation system compliant with ASHRAE 62.1-2007 and ASHRAE 62.2</td>
<td>- Energy-efficient windows</td>
<td>- Energy-efficient windows and entry doors</td>
</tr>
<tr>
<td></td>
<td>- Closed-cell foam insulation at sidewalls</td>
<td>- Closed-cell foam insulation at sidewalls</td>
</tr>
<tr>
<td></td>
<td>- High-efficiency, gas-fired hydronic heat and hot water</td>
<td>- High efficiency hot water heating system</td>
</tr>
<tr>
<td></td>
<td>- PV, co-generation and “green” electricity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- ERV units in roof plenums to re-use vertical heat loss</td>
<td>- Individual shut-off valves</td>
</tr>
</tbody>
</table>
Green Housing – BRIGHT Study

Conventional

Green

NO SMOKING!
Green Housing – BRIGHT Study

- PM2.5: ↓ 41.1%*
- NO2: ↓ 66.1%*

Other findings: 47% fewer symptoms


*p < 0.05
Green Housing – BRIGHT Study

**Other findings: 47% fewer symptoms**


* p < 0.05
Housing, exposures and health

- Reduced indoor air pollution sources
- Reduced infiltration of outdoor air pollution

= Reduced exposure to air pollution
Green Housing – BRIGHT Study

Within a small geographic area, we have seen:

- Significant between-household variability
- Indoor > Outdoor concentrations
- Exposures strongly influenced by:
  - Sources
  - Building design/age
  - Occupant activity
Symptoms at home in last 30 days

YEAR 1 and 2
Symptoms at home in last 30 days

2012 – 218
Summer/Winter

Conventional

Green

2013 – 195
Summer/Winter

Conventional

Green

change in symptom score

+ 0.0

- 2.3*

+ 0.2

*p < 0.05
Results: Asthma Morbidity

Odds ratios (OR) for control children experiencing:

- Asthma symptoms: 2.9 (1.0, 8.3)
- Asthma attack: 3.2 (1.1, 9.1)
- Hospital visit: 4.2 (1.1, 16.6)
- Missed school for asthma: 4.8 (1.4, 16.6)
Old Colony – Work Orders

- Baseline 2006-2009
- Test Period January 2012 to July 2014
- Decreases in six of nine categories examined
- Increases in Appliances, Heating, and Lighting

preliminary data
## Old Colony – Cost Savings

**Δ utilities?**

<table>
<thead>
<tr>
<th></th>
<th>BHA</th>
<th>Phase I</th>
<th>Difference (Savings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>$232,400</td>
<td>$124,500</td>
<td>$107,900</td>
</tr>
<tr>
<td>Gas</td>
<td>$372,100</td>
<td>$74,700</td>
<td>$297,400</td>
</tr>
<tr>
<td>Water</td>
<td>$289,100</td>
<td>$110,700</td>
<td>$178,500</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$893,600</strong></td>
<td><strong>$309,900</strong></td>
<td><strong>$583,900</strong></td>
</tr>
</tbody>
</table>

Preliminary data
Comparison of Median Temperature at Green and Control Apartments

- **Year 1 Control**: n = 27
- **Year 2 Control**: n = 11
- **Year 2 Green**: n = 14

Temperature (°F)
What do you do when the apartment gets too cold?

YEAR 1

YEAR 2

preliminary data

How do you adapt to cold?
people

places

policies

NO₂ ↓ 41.1%
PM₂.₅ ↓ 66.1%
utilities ↓ $500K/yr

Symptoms ↓ 47%
Asthma hospital visits ↓ 67%
Asthma symptoms ↓ 52%
Missed school ↓ 71%
Conclusions

- ‘Green’ as a ‘bundled’ intervention can improve IAQ and improve resident health and reduce energy costs
- Similar opportunities via weatherization / rehab
- Structural vs. behavioral factors
  - buildings v. people → BOTH matter
  - some significant sources can only be controlled with attention to BOTH
- Multifamily housing has significant ‘system’ effects
- Lack of research on behavior side of the equation
- Use of systems is critical
  - e.g., windows, heating, cooling, ventilation
- Need more research on weatherization / rehab, but many lessons to draw from related interventions
Thank You

Provide feedback on this session in the new Summit App!

Download the app to your mobile device or go to bbsummit.pathable.com