High Performance Multifamily

Energy Efficiency Strategies for Multifamily Building

Presented by Sean Denniston

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National Grid Professional Network

Meet your clients’ energy needs. Watch your business grow.
That’s business on the grid.

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- Email alerts on program updates, e-newsletters, webinars, and case studies.
- Educational content and industry expertise tailored to your business, clients, and projects.
- No-cost* training and education on new technologies, building codes, and National Grid incentive programs.
- Technical support and project review.
- One-on-one consultations for larger projects.

Why work with us?

National Grid is a leader in energy efficiency. Our goal is to help professionals like you adopt better energy efficiency practices.

When you work with us, you’ll have access to:

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- Information and incentives that make high-performance equipment more affordable for your clients.
- Education on how energy saving solutions can reduce utility and maintenance costs, improve employee productivity and occupant comfort, increase asset value, and bring additional non-energy benefits.

*Depending on your location for in-person education and training workshops, there may be a nominal cost to meet regulatory requirements.

It’s easy to get started.
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That’s business on the grid.
Safety Minute: Dig Safe

National Grid is reminding the public to call Dig Safe at 811 before undertaking any digging projects or excavations. A call to Dig Safe to mark underground utilities is not only the safe thing to do – it’s the law!
For more information visit Dig Safe.

For more information visit Dig Safe:
http://call811.com/before-you-dig
New Buildings Institute
Provider # 50111235

Greater Energy Efficiency for Multifamily Buildings
NG201701

Sean Denniston
May 18, 2017

Multifamily Energy Code
Multifamily Energy Codes

High-Rise Multifamily:
- 4 or more stories
- Regulated in Commercial Chapter

Ramona Apartments, Portland, OR
Twin Canal Village, Virginia Beach, VA
Multifamily Energy Codes

High-Rise Multifamily:
- 4 or more stories
- Regulated in Commercial Chapter

Low-Rise Multifamily:
- 3 or fewer stories (up to 5 in some cases in MA)
- Regulated in Residential Chapter

Low-Rise Multifamily Regulation
Low-Rise Multifamily Regulation

Requirements Crafted for:
- Single Family usage patterns
- Single Family loads
- Single Family occupancy densities
- Single Family hot water use
High-Rise Multifamily Regulation

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High-Rise Multifamily Regulation

18

IECC—COMMERCIAL PROVISIONS . . . . . . . . . . C-1
CHAPTER 1 SCOPE AND ADMINISTRATION . . . . . . C-3
CHAPTER 2 DEFINITIONS . . . . . . . . . . . . . . . . C-7
CHAPTER 3 GENERAL REQUIREMENTS . . . . . . C-13
CHAPTER 4 COMMERCIAL ENERGY EFFICIENCY . . . . . C-31
CHAPTER 5 EXISTING BUILDINGS . . . . . . . . . . C-95
CHAPTER 6 REFERENCED STANDARDS . . . . . . C-99
High-Rise Multifamily Regulation

Requirements Crafted for:
- Commercial usage patterns
- Commercial loads
- Commercial occupancy densities
- Commercial hot water use

Poll Questions

1. Where does your company primarily offer its products / services?
   a) Metro NYC
   b) Long Island
   c) Upstate NY
   d) MA
   e) RI

2. What kind of products / services does your company offer?
   a) Architecture/Engineering
   b) Equipment Sales / Distribution
   c) Energy Consulting
   d) Lighting Design and Consulting
   e) HVACR
   f) Other
Major Differences

1. Envelope Requirements
   - Insulation
   - Windows
   - Infiltration

2. Common Area Lighting
Major Differences

1. Envelope Requirements
   - Insulation
   - Windows
   - Infiltration

2. Common Area Lighting

3. Section 406: Additional Efficiency Options

---

### Major Differences: Insulation

#### Climate Zone 5

<table>
<thead>
<tr>
<th></th>
<th>High-Rise</th>
<th>Low-Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roofs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation entirely above roof deck</td>
<td>U-0.032</td>
<td>U-0.026</td>
</tr>
<tr>
<td>Metal buildings</td>
<td>U-0.035</td>
<td>U-0.026</td>
</tr>
<tr>
<td>Attic and other</td>
<td>U-0.021</td>
<td>U-0.026</td>
</tr>
<tr>
<td><strong>Walls, Above Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>U-0.080</td>
<td>U-0.082</td>
</tr>
<tr>
<td>Metal building</td>
<td>U-0.052</td>
<td>U-0.060</td>
</tr>
<tr>
<td>Metal framed</td>
<td>U-0.064</td>
<td>U-0.060</td>
</tr>
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<td>Wood framed and other</td>
<td>U-0.064</td>
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</table>

#### Climate Zone 5

<table>
<thead>
<tr>
<th></th>
<th>High-Rise</th>
<th>Low-Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Walls, Below Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below-grade wall d</td>
<td>R-7.5ci</td>
<td>15/19</td>
</tr>
<tr>
<td><strong>Floors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>U-0.064</td>
<td>U-0.033</td>
</tr>
<tr>
<td>Joist/framing</td>
<td>U-0.033</td>
<td>U-0.033</td>
</tr>
<tr>
<td><strong>Slab-on-grade floors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unheated slabs</td>
<td>R-10 for 24&quot; below</td>
<td>R-10 for 24&quot; below</td>
</tr>
<tr>
<td>Heated slabs</td>
<td>R-15 for 36&quot; below</td>
<td>R-15 for 24&quot; below</td>
</tr>
<tr>
<td><strong>Opaque doors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swinging</td>
<td>U-0.37</td>
<td>U-0.32</td>
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</tbody>
</table>
### Major Differences: Windows

<table>
<thead>
<tr>
<th>Climate Zone 5</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>High-Rise</td>
<td></td>
</tr>
<tr>
<td>Low-Rise</td>
<td></td>
</tr>
</tbody>
</table>

#### Vertical Fenestration

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<tr>
<th></th>
<th>High-Rise</th>
<th>Low-Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U-factor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed fenestration</td>
<td>0.38</td>
<td>0.32</td>
</tr>
<tr>
<td>Operable fenestration</td>
<td>0.45</td>
<td>0.32</td>
</tr>
<tr>
<td>Entrance doors</td>
<td>0.77</td>
<td>0.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orientation</th>
<th>SEW</th>
<th>N</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>PF &lt; 0.2</td>
<td>0.40</td>
<td>0.53</td>
<td>NR</td>
</tr>
<tr>
<td>0.2 ≤ PF &lt; 0.5</td>
<td>0.48</td>
<td>0.58</td>
<td>NR</td>
</tr>
<tr>
<td>PF ≥ 0.5</td>
<td>0.64</td>
<td>0.64</td>
<td>NR</td>
</tr>
</tbody>
</table>

#### Skylights

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U-factor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHGC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.50</td>
<td>0.55</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.40</td>
<td>NR</td>
</tr>
</tbody>
</table>
Major Differences: Infiltration

0.40 CFM/sf:
- Area metric
- 75 Pa Pressure
- Testing Not Required
Major Differences: Infiltration

3 ACH:
- Volume metric
- 50 Pa Pressure
- Testing Required

Low-Rise Apartment
- Native Code: Residential

Mid-Rise Apartment
- Native Code: Commercial

High-Rise Apartment
- Native Code: Commercial
**Major Differences: Infiltration**

**Low-Rise Apartment**
- Native Code: Residential
- Commercial Requirement **0.8-1.5% more** efficient

**Mid-Rise Apartment**
- Native Code: Commercial
- Residential Requirement **1.2-1.9% less** efficient

**High-Rise Apartment**
- Native Code: Commercial
- Residential Requirement **3.5-5.0% less** efficient

---

**Major Differences: Common Area Lighting**
Major Differences: Common Area Lighting
Major Differences: Common Area Lighting

Credit: R. John Anderson

Different Outcomes

**High-Rise Apartment**
- Native Code: Commercial
- Residential Code **1.5% less** efficient

**Mid-Rise Apartment**
- Native Code: Commercial
- Residential Code **2.0% less** efficient

**Low-Rise Apartment**
- Native Code: Residential
- Commercial Code **0.1% less** efficient
The Consequences

1. Confusion in the market & compliance/enforcement

2. Neither code is tuned for multifamily
The Consequences

1. Confusion in the market & compliance/enforcement
2. Neither code is tuned for multifamily
3. Efficiency strategies don’t always deliver consistent savings in high-rise vs low-rise projects
Energy Efficiency Opportunities

- Heating & Cooling Efficiency
- HVAC System Selection
- Thermal Envelope
- Lighting
- Infiltration
Energy Efficiency Opportunities

- Heating & Cooling Efficiency
- HVAC System Selection
- Thermal Envelope
- Lighting
- Infiltration

- Water Heating Efficiency
- Hot water distribution
- Ventilation
- Appliances
- Controls
- Thermal Bridging

Poll Questions

3. How many commercial or industrial energy saving projects have you worked with National Grid in the past?
   a) Zero
   b) 1-4
   c) 5-9
   d) 10+

4. Would you like to speak with a National Grid expert on a current multifamily opportunity that you are pursuing?
   Yes / No
### Water Heating Efficiency

<table>
<thead>
<tr>
<th></th>
<th>Individual Electric</th>
<th>Individual Gas</th>
<th>Central Electric</th>
<th>Central Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric</td>
<td>0.95 EF</td>
<td>0.63 EF</td>
<td>1.97 EF</td>
<td>0.74 EF</td>
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<tr>
<td>Individual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>2.0 EF</td>
<td>0.67 EF / 0.90 EF</td>
<td>2.2 EF</td>
<td>0.77 EF</td>
</tr>
</tbody>
</table>

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**Source:**
- [nbi new buildings institute](https://www.nbi.org)
- [nationalgrid](https://www.nationalgrid.com)

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**Notes:**
- EF stands for Efficiency Factor.
### Water Heating Efficiency

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<thead>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Gas</strong></td>
<td>0.95 EF</td>
<td>0.63 EF</td>
<td>1.97 EF</td>
<td>0.74 EF</td>
</tr>
<tr>
<td><strong>Central Gas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electric</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Energy STAR</strong></td>
<td>2.0 EF</td>
<td>0.67 EF / 0.90 EF</td>
<td>2.2 EF</td>
<td>0.77 EF</td>
</tr>
<tr>
<td><strong>Central Electric</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas</strong></td>
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</table>

**Best in Class**

<table>
<thead>
<tr>
<th></th>
<th>3.5 EF</th>
<th>0.83 EF / 1.0 EF</th>
<th>3.5 EF</th>
<th>0.95 EF / 1.0 EF</th>
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</thead>
<tbody>
<tr>
<td><strong>Central Gas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Electric</strong></td>
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<tr>
<td><strong>Energy STAR</strong></td>
<td></td>
<td></td>
<td>3.5 EF</td>
<td>0.95 EF / 1.0 EF</td>
</tr>
<tr>
<td><strong>Central Electric</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas</strong></td>
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<td></td>
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</table>

**Best in Class 3.5 EF**

<table>
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<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DHW Efficiency: Condensing Gas Storage

Considerations
- Taller
- Venting
- Condensate
DHW Efficiency: Condensing Gas Instantaneous

Considerations

- Capacity
- Venting
- Condensate
DHW Efficiency: Condensing Gas Instantaneous

Opportunities

- Retrofit for tight spaces
- Eliminate recirculation loop

http://www.rinnai.com

DHW Efficiency: Heat Pump Water Heaters

http://www.geappliances.com
DHW Efficiency: Heat Pump Water Heaters

Considerations
• Taller & Wider
• Noise
• Higher Capacity
• Heat Load Impact
• Central System Complexity

Opportunities
• Load shifting
• Reduce cooling loads
• Integrate with HVAC
DHW Efficiency: Conservation

DHW Efficiency: Conservation

www.delta.com

www.pioneerind.com
**DHW Efficiency: Distribution**

**INDIVIDUAL DHW**
- Water Consumption: 45%
- Equipment Losses: 35%
- Distribution Losses: 20%

**CENTRAL DHW**
- Water Consumption: 35%
- Equipment Losses: 25%
- Distribution Losses: 20%

---

**DHW Efficiency: Distribution**

**INDIVIDUAL DHW**
- Water Consumption: 40%
- Equipment Losses: 30%
- Distribution Losses: 30%

**CENTRAL DHW**
- Water Consumption: 30%
- Equipment Losses: 20%
- Distribution Losses: 50%
DHW Efficiency: Distribution

INDIVIDUAL DHW

Water Consumption 40%

Distribution Losses 30%

Equipment Losses 30%

CENTRAL DHW

Water Consumption 30%

Distribution Losses 50%

Equipment Losses 20%

DHW Efficiency: Distribution

Kitchen  Shower  Bathtub

Cold Supply  Clothes Washer

Circulator Pump  Drain

www.plumbingsupply.com

http://www.weil-mcclain.com/
DHW Efficiency: Distribution

Strategies

CENTRAL DHW

- Water Consumption 30%
- Distribution Losses 50%
- Equipment Losses 20%

Strategies

- Individual DHW
DHW Efficiency: Distribution

Strategies

• Individual DHW
• Pipe Insulation
• Centrally Locate Equipment
DHW Efficiency: Distribution

Strategies
- Individual DHW
- Pipe Insulation
- Centrally Locate Equipment
- Reduce Distribution Volume
DHW Efficiency: Distribution

Strategies

• Individual DHW
• Pipe Insulation
• Centrally Locate Equipment
• Reduce Distribution Volume
DHW Efficiency: Distribution
Ventilation Efficiency

https://basc.pnnl.gov

Ventilation Efficiency

http://www.energyvanguard.com

Ventilation Efficiency

https://foursevenfive.com
Ventilation Efficiency

Exhaust-Only Ventilation

Energy In

Energy Loss

Ventilation Efficiency

Exhaust-Only Ventilation

Energy In

Energy Loss

Fan Affinity Laws
Wheel Diameter Constant, Wheel Velocity Changing

Pressure, Flow, Power

Relative Wheel Velocity

http://www.engineeringtoolbox.com

https://foursevenfive.com

https://www.finehomebuilding.com

nbi new buildings institute

national grid
Ventilation Efficiency

Ventilation Efficiency: HRV & ERV
Poll Questions

5. What information on National Grid’s ProNet website https://www.nationalgridus.com/ProNet/ is most valuable to your business
   a) Never visited
   b) Easily download all incentive applications in one place
   c) Access to a key contact from National Grid who specializes in your industry or vertical
   d) Ability to schedule a one-on-one technical and design consultation via phone, in person, or at your project site.
   e) Other

6. How can you improve your business with energy efficiency incentives?
   a) Engage with National Grid on energy saving projects and upgrades.
   b) Work with other firms that provide energy products and services that are not part of your core business
   c) Complete and submit incentive applications for customers
   d) Other

Appliance Efficiency

LEARN MORE

Dishwashers
FIND PRODUCTS MOST EFFICIENT

Clothes Dryers
FIND PRODUCTS MOST EFFICIENT

Dehumidifiers
FIND PRODUCTS

Freezers
FIND PRODUCTS

Clothes Washers
FIND PRODUCTS MOST EFFICIENT

Refrigerators
FIND PRODUCTS MOST EFFICIENT
Appliance Efficiency

LEARN MORE

Dishwashers
FIND PRODUCTS
MOST EFFICIENT

Clothes Dryers
FIND PRODUCTS
MOST EFFICIENT

Dehumidifiers
FIND PRODUCTS

Freezers
FIND PRODUCTS

Clothes Washers
FIND PRODUCTS
MOST EFFICIENT

Refrigerators
FIND PRODUCTS
MOST EFFICIENT

Appliance Efficiency

LEARN MORE

KitchenAid
KA 19.8 CU FT CD KFIS20XVMS

Specific Dimensions Located Inside Model
• 70 1/2-in H X 35 5/8-in W X 32 1/2-in D - Excluding handles to 28 13/16-in
• Order this product using S05 item number 178972
• Counter-depth design offers a built-in look
• Four adjustable SpillClean™ glass shelves
• One year manufacturer warranty

$3199

This appliance is rated:
• Efficient (CEE Tier I)
• More Efficient (CEE Tier II)
• Most Efficient (CEE Tier III)
Based on information from Consortium Energy Efficiency Agency

Item # 296130 Model # KFIS20XVMS

CEE
Consortium for Energy Efficiency

nationalgrid
Appliance Efficiency

Controls Efficiency
Controls Efficiency

![Image of a Honeywell thermostat and a smartphone with a Honeywell Home app interface.](www.honeywell.com)

Lighting Efficiency

**HIGH-EFFICACY LAMPS.** Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts;
2. 50 lumens per watt for lamps over 15 watts to 40 watts; and
3. 40 lumens per watt for lamps 15 watts or less.

![Image of a compact fluorescent lamp.](www.feit.com)
Lighting Efficiency

HIGH-EFFICACY LAMPS. Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts;
2. 50 lumens per watt for lamps over 15 watts to 40 watts; and
3. 40 lumens per watt for lamps 15 watts or less.
Lighting Efficiency

For smaller diameter linear fluorescent bulbs: and

Envelope Efficiency: Thermal Bridging

http://www.schock-us.com

https://sustainabilityworkshop.autodesk.com/
### Envelope Efficiency: Thermal Bridging

<table>
<thead>
<tr>
<th>Location</th>
<th>Code U-Factor</th>
<th>Effective U-Factor</th>
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</thead>
<tbody>
<tr>
<td>1A - Miami</td>
<td>U-0.077</td>
<td>U-0.199</td>
</tr>
<tr>
<td>2B - Phoenix</td>
<td>U-0.064</td>
<td>U-0.186</td>
</tr>
<tr>
<td>4C - Portland</td>
<td>U-0.064</td>
<td>U-0.145</td>
</tr>
<tr>
<td>5A - Boston</td>
<td>U-0.064</td>
<td>U-0.145</td>
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</tbody>
</table>
### Envelope Efficiency: Thermal Bridging

<table>
<thead>
<tr>
<th>Location</th>
<th>Low-Rise</th>
<th>Mid-Rise</th>
<th>High-Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A - Miami</td>
<td>-0.5%</td>
<td>-0.3%</td>
<td>-2.3%</td>
</tr>
<tr>
<td>2B - Phoenix</td>
<td>-1.4%</td>
<td>-0.8%</td>
<td>-4.0%</td>
</tr>
<tr>
<td>4C - Portland</td>
<td>-2.9%</td>
<td>-0.4%</td>
<td>-2.5%</td>
</tr>
<tr>
<td>5A - Boston</td>
<td>-2.7%</td>
<td>-0.5%</td>
<td>-3.5%</td>
</tr>
</tbody>
</table>

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**Envelope Efficiency: Thermal Bridging**

[Image of thermal bridging analysis]
Poll Question

7. How valuable has this webinar been to you?

a) Not valuable at all. The content was too technical and detailed for me to understand.
b) Slightly valuable. It was worth attending, but I would not recommend it to anyone.
c) Moderately valuable. Content was interesting and informative, but only increased my knowledge or comfort level a little.
d) Very valuable. This was time well spent and I learned a lot.
e) Extremely valuable. My knowledge of National Grid VSD offerings and opportunity has increased considerably.